Management of frozen shoulder: a systematic review and cost-effectiveness analysis

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The research reported in this issue of the journal was commissioned by the HTA programme as project number 09/13/02. The contractual start date was in March 2010. The draft report began editorial review in March 2011 and was accepted for publication in September 2011. As the funder, by devising a commissioning brief, the HTA programme specified the research question and study design. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HTA editors and publisher have tried to ensure the accuracy of the authors' report and would like to thank the referees for their constructive comments on the draft document. However, they do not accept liability for damages or losses arising from material published in this report.

The views expressed in this publication are those of the authors and not necessarily those of the HTA programme or the Department of Health.

Abstract

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Background: Frozen shoulder is condition in which movement of the shoulder becomes restricted. It can be described as either primary (idiopathic) whereby the aetiology is unknown, or secondary, when it can be attributed to another cause. It is commonly a self-limiting condition, of approximately 1 to 3 years' duration, though incomplete resolution can occur.

Objectives: To evaluate the clinical effectiveness and cost-effectiveness of treatments for primary frozen shoulder, identify the most appropriate intervention by stage of condition and highlight any gaps in the evidence.

Data sources: A systematic review was conducted. Nineteen databases and other sources including the Cumulative Index to Nursing and Allied Health (CINAHL), Science Citation Index, BIOSIS Previews and Database of Abstracts of Reviews of Effects (DARE) were searched up to March 2010 and EMBASE and MEDLINE up to January 2011, without language restrictions. MEDLINE, CINAHL and PsycINFO were searched in June 2010 for studies of patients' views about treatment.

Review methods: Randomised controlled trials (RCTs) evaluating physical therapies, arthrographic distension, steroid injection, sodium hyaluronate injection, manipulation under anaesthesia, capsular release or watchful waiting, alone or in combination were eligible for inclusion. Patients with primary frozen shoulder (with or without diabetes) were included. Quasi-experimental studies were included in the absence of RCTs and case series for manipulation under anaesthesia (MUA) and capsular release only. Full economic evaluations meeting the intervention and population inclusion criteria of the clinical review were included. Two researchers independently screened studies for relevance based on the inclusion criteria. One reviewer extracted data and assessed study quality; this was checked by a second reviewer. The main outcomes of interest were pain, range of movement, function and disability, quality of life and adverse events. The analysis comprised a narrative synthesis and pair-wise meta-analysis. A mixed-treatment comparison (MTC) was also undertaken. An economic decision model was intended, but

was found to be implausible because of a lack of available evidence. Resource use was estimated from clinical advisors and combined with quality-adjusted life-years obtained through mapping to present tentative cost-effectiveness results.

Results: Thirty-one clinical effectiveness studies and one economic evaluation were included. The clinical effectiveness studies evaluated steroid injection, sodium hyaluronate, supervised neglect, physical therapy (mainly physiotherapy), acupuncture, MUA, distension and capsular release. Many of the studies identified were at high risk of bias. Because of variation in the interventions and comparators few studies could be pooled in a meta-analysis. Based on single RCTs, and for some outcomes only, short-wave diathermy may be more effective than home exercise. High-grade mobilisation may be more effective than low-grade mobilisation in a population in which most patients have already had treatment. Data from two RCTs showed that there may be benefit from adding a single intra-articular steroid injection to home exercise in patients with frozen shoulder of < 6 months' duration. The same two trials showed that there may be benefit from adding physiotherapy (including mobilisation) to a single steroid injection. Based on a network of nine studies the MTC found that steroid combined with physiotherapy was the only treatment showing a statistically and clinically significant beneficial treatment effect compared with placebo for short-term pain (standardised mean difference –1.58, 95% credible interval –2.96 to –0.42). This analysis was based on only a subset of the evidence, which may explain why the findings are only partly supportive of the main analysis. No studies of patients' views about the treatments were identified. Average costs ranged from £36.16 for unguided steroid injections to £2204 for capsular release. The findings of the mapping suggest a positive relationship between outcome and European Quality of Life-5 Dimensions (EQ-5D) score: a decreasing visual analogue scale score (less pain) was accompanied by an increasing (better) EQ-5D score. The one published economic evaluation suggested that low-grade mobilisation may be more cost-effective than high-grade mobilisation. Our tentative cost-effectiveness analysis suggested that steroid alone may be more cost-effective than steroid plus physiotherapy or physiotherapy alone. These results are very uncertain.

Limitations: The key limitation was the lack of data available. It was not possible to undertake the planned synthesis exploring the influence of stage of frozen shoulder or the presence of diabetes on treatment effect. As a result of study diversity and poor reporting of outcome data there were few instances where the planned quantitative synthesis was possible or appropriate. Most of the included studies had a small number of participants and may have been underpowered. The lack of available data made the development of a decision-analytic model implausible. We found little evidence on treatment related to stage of condition, treatment pathways, the impact on quality of life, associated resource use and no information on utilities. Without making a number of questionable assumptions modelling was not possible.

Conclusions: There was limited clinical evidence on the effectiveness of treatments for primary frozen shoulder. The economic evidence was so limited that no conclusions can be made about the cost-effectiveness of the different treatments. High-quality primary research is required.

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Contents

Glossary

Case series A group of case reports of patients who were given similar treatments. There is no control group involved.

Cost-effectiveness analysis An economic analysis that expresses the effects or consequences of interventions on a single dimension. This would normally be expressed in 'natural' units (e.g. cases cured, life-years gained, additional strokes prevented). The difference between interventions in terms of costs and effects is typically expressed as an incremental cost-effectiveness ratio (e.g. the incremental cost per life-year gained).

Cost–utility analysis The same as a cost-effectiveness analysis but the effects or consequences of interventions are expressed in generic units of health gain, usually quality-adjusted life-years.

Exercise therapy Gentle rhythmic active exercises, function-based exercises [to maintain/restore the range or quality (co-ordination and/or control) of movement] or both.

Incremental cost-effectiveness ratio An expression of the additional cost of health gain associated with an intervention relative to an appropriate comparator. Expressed as the difference in mean costs (relative to the comparator) divided by the difference in mean health gain.

Intention-to-treat analysis Analysis that compares participants in the groups to which they were originally assigned.

Mixed-treatment comparison This is an extension of a traditional meta-analysis. Whereas a traditional meta-analysis includes only trials making direct comparisons between an intervention and a comparator, a mixed-treatment comparison also includes indirect evidence. This approach overcomes the limitations of the traditional approach in cases in which there are no or limited trials making the relevant head-to-head comparison.

Mobilisations Therapist-applied passive movements of joints or other structures performed in such a way that they are always within the control of the patient. They may be performed by various techniques and may be combined with active movement on the part of the patient.

Physical therapy This term is used to refer to the broad range of physical interventions such as physiotherapy (including mobilisation or other modalities such as electrotherapy) and chiropractic and osteopathic interventions.

Quality-adjusted life-year An index of health gain in which survival duration is weighted or adjusted by the patient's quality of life during the survival period. Quality-adjusted life-years have the advantage of incorporating changes in both quantity (mortality) and quality (morbidity) of life.

Randomised controlled trial A trial in which the participants are randomly allocated to the control or treatment groups.

WinBUGS Statistical software for Bayesian analysis using Markov chain Monte Carlo methods.

List of abbreviations

15D	15-dimension utility measure
ASES	American Shoulder and Elbow Surgeons
CI	confidence interval
CLAD	censored least absolute deviations
CRD	Centre for Reviews and Dissemination
CrI	credible interval
DASH	Disabilities of the Arm, Shoulder and Hand
EPPI	Evidence for Policy and Practice Information
EQ-5D	European Quality of Life-5 Dimensions
ERM	end-range mobilisation
FLEX-SF	Flexilevel Scale of Shoulder Function
GP	general practitioner
HAQ	Health Assessment Questionnaire
HGMT	high-grade mobilisation technique
HRQoL	health-related quality of life
HUI	Health Utilities Index
ICER	incremental cost-effectiveness ratio
IQR	interquartile range
ITT	intention to treat
LGMT	low-grade mobilisation technique
MAE	mean absolute error
MCID	minimum clinically important difference
MCMC	Markov chain Monte Carlo
MCS	mental component summary
MD	mean difference
ME	mean error
MRM	mid-range mobilisation
MTC	mixed-treatment comparison
MUA	manipulation under anaesthesia
MWM	mobilisation with movement
NICE	National Institute for Health and Clinical Excellence
NSAID	non-steroidal anti-inflammatory drug
NTIS	National Technical Information Service
OLS	ordinary least squares
PCS	physical component summary
PSWD	pulsed short-wave diathermy
QALY	quality-adjusted life-year
QoL	quality of life
RCT	randomised controlled trial
RMSE	root-mean-square error
SD	standard deviation
SDQ	Shoulder Disability Questionnaire
SE	standard error
SF-6D	Short Form questionnaire-6 Dimensions
SF-36	Short Form questionnaire-36 items

SMD	standardised mean difference
SPADI	Shoulder Pain and Disability Index
SRQ	Shoulder Rating Questionnaire
SWD	short-wave diathermy
TENS	transcutaneous electrical nerve stimulation
UCLA	University of California Los Angeles
VAS	visual analogue scale

All abbreviations that have been used in this report are listed here unless the abbreviation is well known (e.g. NHS), or it has been used only once, or it is a non-standard abbreviation used only in figures/tables/appendices, in which case the abbreviation is defined in the figure legend or in the notes at the end of the table.

Executive summary

Background

Frozen shoulder is a condition in which movement of the shoulder becomes restricted. The condition can vary in severity from mild pain and/or less significant restriction of movement to severe pain and/or severely restricted movement. Key characteristics are gradual onset of shoulder stiffness, severe pain, especially at night, and restriction in active and passive range of movement of the shoulder. Frozen shoulder can be described as either primary (idiopathic), if the aetiology is unknown, or secondary, when it can be attributed to another cause. It is commonly a self-limiting condition, of approximately 1–3 years' duration, although incomplete resolution can occur.

Objectives

To (1) evaluate the clinical effectiveness of strategies currently used in the NHS for the management of primary frozen shoulder and identify the most appropriate intervention by stage of condition; (2) collate patients' views and experiences of the interventions by way of a systematic review; (3) assess the cost-effectiveness of the different interventions in order to inform the development of a decision model; (4) develop a decision-analytic model to estimate the cost-effectiveness of alternative treatment options for frozen shoulder; (5) make recommendations for clinical practice; and (6) identify any gaps in the evidence, undertake value of information analysis to assess the potential value of future research on interventions for frozen shoulder and make specific recommendations for further research.

Methods

Clinical effectiveness

A systematic review was undertaken. Nineteen databases, including MEDLINE, EMBASE and the Cochrane Central Register of Controlled Trials (CENTRAL), were searched up to March 2010 for published and unpublished studies and without language restrictions. The websites of relevant organisations were scanned. The reference lists of systematic reviews were also checked to identify studies. Updated searches of MEDLINE and EMBASE were undertaken in January 2011.

Randomised controlled trials (RCTs) evaluating physical therapies, arthrographic distension, steroid injection, sodium hyaluronate injection, manipulation under anaesthesia (MUA), capsular release or watchful waiting, alone or in combination, were eligible for inclusion. Patients with primary frozen shoulder (with or without diabetes) were included. Relevant comparators were any of the treatments, no treatment or placebo. Quasi-experimental studies were included in the absence of randomised trials. For MUA and capsular release, case series of at least 50 participants with primary frozen shoulder were also eligible in the absence of controlled study designs. The main outcomes of interest were pain, range of movement, function and disability, quality of life, time to recovery, return to work and recreation, and adverse events.

Two researchers independently screened studies for relevance based on the inclusion criteria. One reviewer extracted data and assessed study quality; this was checked by a second reviewer.

Final value data were extracted where available and if not change from baseline was extracted. Disagreements were resolved by consensus and, if necessary, a third researcher was consulted.

A narrative and tabular summary of key study characteristics, quality assessment and results was undertaken. Outcomes were reported as the mean difference (MD) and 95% confidence interval (CI), except for pain, for which the standardised mean difference (SMD) was calculated. Length of follow-up was classified as short term (4 weeks to 3 months), medium term (> 3 months and ≤ 6 months) and long term (> 6 months). Where appropriate, individual study results were combined in a pair-wise meta-analysis grouped by type of intervention and comparator. A mixed-treatment comparison (MTC) evaluating the effectiveness of the interventions compared with placebo was undertaken as an exploratory analysis. The MTC was performed for the outcome of pain up to 3 months only because this was the only outcome and time point for which a network was available. Comparisons were described as statistically significant (at the 5% level) when the credibility interval (CrI) did not cross 0 for the SMD.

Patients' views

MEDLINE, the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PsycINFO were searched in June 2010 to identify qualitative studies of patients' views of treatments, with searches being restricted to English-language papers published from 1980 onwards. The review processes followed those of the effectiveness review.

Economic analysis

A systematic review of full economic evaluations meeting the intervention and population inclusion criteria of the clinical review was performed. The intention was to develop a decision-analytical model; however, because of the paucity of evidence for key components of the modelling (including the structure) the development of a model was not possible. To provide some useful information for the decision-maker, we undertook a number of investigatory exercises. First, we elicited details on resource use from clinicians for the interventions of interest and produced cost estimates based on national sources. Second, we mapped two important clinical outcomes, pain [using visual analogue scale (VAS) 0–100 mm] and quality of life [using the Short Form questionnaire-36 items (SF-36) mental and physical component score], to the European Quality of Life-5 Dimensions (EQ-5D). This allowed us to estimate quality-adjusted life-years (QALYs) for some of the interventions included in the clinical effectiveness review. Finally, having these two components allowed us to present a tentative cost-effectiveness analysis for some of the included interventions.

Results

Clinical effectiveness

The searches yielded 8883 citations. Thirty-two relevant studies were identified, one of which was a cost–utility analysis conducted alongside a separately published study of effectiveness.

Data from studies with a low risk of bias were sparse, in particular for the more invasive treatments (MUA, distension and capsular release). Twenty-eight RCTs, one quasi-experimental study (for 'supervised neglect') and two case series (for capsular release) were included. A total of 18 studies did not report an adequate method of randomisation (therefore these studies described as RCTs may have been quasi-experimental studies); 24 did not report an adequate method of allocation concealment; and 13 did not have blinded outcome assessment. For most of the studies it was unclear whether they were adequately powered to detect a statistically significant difference between groups. Across most trials there did not appear to be systematic methods for recording of adverse events.

For most comparisons there were insufficient studies with a similar intervention and comparator to allow quantitative pooling. Primarily a narrative synthesis was undertaken. Because of the lack of data on stage of frozen shoulder and outcomes of patients with and without diabetes, it was not possible to undertake planned subgroup analyses.

Conservative interventions

A single quasi-experimental study, with a high risk of bias, reported significant short-, medium- and long-term benefit for function and disability with supervised neglect compared with physical therapy.

A further 11 studies investigated a physical therapy. The majority of these were various forms of physiotherapy. The comparators were an alternative physiotherapy modality or a control group. Most of the studies had a high risk of bias. Only single studies were available for specific modalities. The majority of studies comparing two active interventions reported no significant difference in outcome between therapies. For studies that did report a benefit with an intervention, this tended to be evident for some outcomes only within the study. This may reflect the effect of the intervention or may be related to poor study quality. There was evidence from one study of a statistically significant short-term benefit with short-wave diathermy (SWD) plus stretching compared with home exercise only. There was evidence from the same study for a benefit with SWD compared with a heat pack for range of movement; however, in the same study there was no evidence of benefit for function and disability. There was also evidence from a single study that laser therapy had benefit over placebo laser in the short and medium term for pain and function and disability. Both studies had some risk of bias. The content, intensity and quality of the background home exercise that all groups received was also unclear. A further study, also at some risk of bias, found marginally significant improvement for function and disability and range of movement with high-grade mobilisation techniques compared with low-grade mobilisation techniques; however, there was no evidence of benefit for pain or quality of life in this study.

Three RCTs compared acupuncture with another treatment and they all had a high risk of bias. It was possible to calculate the MD and 95% CI for only one of the studies, which compared electroacupuncture and inferential electrotherapy. There was no significant difference between the two groups in pain or function and disability at short-, medium- and long-term follow-up.

Six studies evaluated steroid injection. The majority of the available data were from two multi-arm studies that were of satisfactory quality, although one had some risk of bias. Both studies evaluated a single intra-articular steroid injection in patients with frozen shoulder of < 6 months' duration. The comparators were home exercise alone, physiotherapy alone (both with placebo injection) and steroid injection followed by physiotherapy. For pain there was a short-term statistically significant benefit with steroid injection compared with placebo (SMD –1.15, 95% CI –1.62 to –0.67; two RCTs). There was no difference compared with physiotherapy (SMD –0.22, 95% CI –0.65 to 0.20; two RCTs). When steroid injection was provided in conjunction with physiotherapy, there was an added benefit for pain over physical therapy alone (SMD –0.98, 95% CI –1.43 to –0.52; two RCTs). There was also benefit with the combined intervention over steroid injection alone (SMD –0.75, 95% CI –1.20 to –0.29; two RCTs), although there was substantial heterogeneity. The results for function and disability and range of movement were broadly consistent with the results for pain. Based on a single study, there was no statistically significant benefit for quality of life with a steroid injection alone compared with placebo or physiotherapy alone. However, there was a benefit for quality of life when physiotherapy was added to steroid injection compared with placebo and physiotherapy alone. There was no evidence of benefit for the combined intervention over steroid injection alone.

Invasive interventions

The data from high-quality RCTs of invasive interventions were even more limited than for conservative interventions. In addition, there was considerable variability between the studies in how the procedures were delivered, making comparability between studies difficult.

Four RCTs assessed MUA. A single, satisfactory-quality study compared MUA with home exercise alone. There was no significant difference between groups in pain, function and disability, range of movement or working ability at short-, medium- or long-term follow-up. A study with some risk of bias compared MUA with arthrographic distension. There was greater improvement in pain and function and disability at 6 months with arthrographic distension than with MUA in participants with adhesive-stage primary frozen shoulder. The remaining two studies had a high risk of bias.

Three RCTs investigated distension with steroid injection, two of which used arthrographic distension. A single satisfactory study reported a significant improvement in one of two function and disability measures with arthrographic distension including steroid compared with home exercise (plus placebo arthrography). There was no evidence of benefit for range of movement or pain. A second study, with some risk of bias, compared arthrographic distension including steroid with steroid alone. There was benefit with distension for a single range of movement measure at 6 weeks. There was no evidence of benefit for other outcomes.

Two case series of more than 50 participants were identified that investigated capsular release. The best-quality case series had an average length of follow-up of 10 months (range 3 to 29 months). There was a significant improvement in function and disability, working ability and a measure of range of movement amongst participants in this study.

Three RCTS, all at high risk of bias, investigated sodium hyaluronate. The best-quality study reported a benefit with two injections of sodium hyaluronate compared with home exercise. However, there was no consistent evidence across outcomes of a benefit compared with 10 daily sessions of physical therapy or a single steroid injection.

Mixed-treatment comparison

Nine interventions formed part of a connected network with placebo. Steroid combined with physiotherapy was the only treatment that showed a statistically and clinically significant beneficial treatment effect compared with placebo (SMD −1.58, 95% CrI −2.96 to −0.42). Overall, there was no clear difference in the treatment effects of any of the interventions, that is, the CrIs overlapped. This analysis was based on only a subset of the evidence, which may explain why the findings are only partly supportive of the main analysis. Given the possible heterogeneity of placebos and study populations, and the inclusion of poor-quality studies, there is some uncertainty regarding the results of the MTC.

Patients' views

No studies were identified from the searches that explored patients' views or experiences of treatments for frozen shoulder.

Cost-effectiveness

The review identified one economic evaluation, conducted in the Netherlands. High-grade mobilisation was compared with low-grade mobilisation, from a societal perspective. The evaluation failed to deal with parameter uncertainty and dismissed differences in QALYs based on statistical inference. The evaluation was of reasonable quality, with a risk of bias, but failed to provide an answer to the broader question being posed.

Based on resource-use estimates obtained from clinical experts, average costs were estimated for the interventions included in the review. The costs for an unguided steroid injection varied from £36.16 to £138.51 depending on the practitioner delivering the injection, the type of steroid used and where the practitioner is based (i.e. the setting). These costs suggest that a physiotherapist delivering treatment in a community setting is the cheapest option and a rheumatologist delivering treatment in a hospital setting is the most expensive. A guided steroid injection (considered less popular in the NHS than unguided) produced estimated costs ranging from £299.68 to £475.56. These costs were mainly influenced by who delivered the injection. Physiotherapy was estimated to cost between £98.75 and £126.75 dependent on setting. The addition of a steroid injection to physiotherapy presents a plethora of scenarios dependent on practitioner, steroid choice and setting; these costs range between £121.43 and £607.31.

Manipulation under anaesthesia was estimated to cost £1446 and capsular release £2204, both of which included rehabilitation physiotherapy. Arthrographic distension was estimated to cost approximately £114.84, depending on the choice of steroid injection. A range of other resource use and costing scenarios is presented.

A mapping analysis explored the relationship between pain measured with a pain VAS and the SF-36 mental and physical components [mental component summary (MCS) and physical component summary (PCS)] and the EQ-5D. Ordinary least squares (OLS) regression was used as the main statistical technique. The fit of all of the models was poor. However, the data suggest that all models (whether they are based on pain VAS or SF-36 PCS and MCS scores) estimate more accurate predictions for less severe health states, but overpredict the value of more severe EQ-5D states. Using the OLS model we mapped the reported mean pain VAS at baseline and at 3 months of follow-up onto the EQ-5D. The same was carried out for SF-36 PCS and MCS. The findings of the mapping suggest that there is a positive relationship between outcomes: a decreasing pain VAS score (less pain) is accompanied by an increasing (better) EQ-5D score; an increasing EQ-5D score (i.e. better health status) appears to be generally accompanied by increasing SF-36 scores (i.e. higher scores = a better quality of life). The estimates were then used to predict EQ-5D scores at baseline and 3 months for a subset of the trials included in the clinical effectiveness review. Subsequently this allowed the tentative estimation of QALYs and calculation of cost-effectiveness ratios. The results suggested that steroid alone may be more cost-effective than steroid plus physiotherapy or physiotherapy alone.

Conclusions

Implications for health care

- There may be short-term benefit from adding a single intra-articular steroid injection to home exercise for patients with primary frozen shoulder of <6 months' duration. In the same population there may also be benefit from adding physiotherapy (including mobilisation in 8–10 sessions over 4 weeks) to a single steroid injection.
- Based on a single study, and for some outcomes only, there may be benefit from adding SWD to passive mobilisation and home exercise. Based on a single study, and for some outcomes only, high-grade mobilisation may be more effective than low-grade mobilisation in a population of patients who have already had physiotherapy and/or steroid injection.

Given the paucity of economic evidence it is not possible to make any conclusions regarding the most cost-effective interventions.

Recommendations for research

There are large gaps in the evidence for the effectiveness and cost-effectiveness of all of the interventions investigated. Taking into account the views of health-care professionals in a recent survey, and the interventions that are most commonly used in the NHS, we suggest that the following should be given priority in future high-quality RCTs assessing effectiveness and cost-effectiveness:

- A 'standard care' package of high-quality conservative management. This should be fully specified in any future trial and we suggest that it should involve a structured protocol of high-quality education, advice, home exercise and monitoring.
- Steroid injection, in particular an investigation of the effectiveness and cost-effectiveness of multiple injections and whether there is any added benefit from providing physiotherapy after steroid injection, over and above steroid injection plus standard care.
- Physical therapies, specifically physiotherapy interventions, which have a component that involves mobilisation or exercises. Research is required to establish whether there is any benefit from having physiotherapy alone, over and above a standard package of care
- Intensive interventions, specifically arthrographic distension, MUA and arthroscopic capsular release.
- Important subgroups in any future RCTs are phase of frozen shoulder and patients with diabetes. These trials should collect data on resource use and use a utility measure to allow assessment of cost-effectiveness. A systematic approach to recording adverse events will also be important.

The large number of treatment options for frozen shoulder and the limited evidence for their effectiveness and cost-effectiveness makes prioritisation of these difficult and they are not listed in order of importance. We suggest that an appropriate starting point would be a multi-arm trial that compares the effectiveness and cost-effectiveness of interventions of differing intensity and costs: high-quality conservative management, steroid injection (possibly in conjunction with arthrographic distension) and surgical management (MUA and capsular release).

Funding

Chapter 1

Background

The decision problem

The commissioning brief requested an evidence synthesis comparing the clinical effectiveness and cost-effectiveness of different treatments for frozen shoulder to determine the most appropriate management strategy. The aims of the project were to:

1. evaluate, by way of a systematic review, the clinical effectiveness (including adverse effects) of strategies currently used in the NHS for the management of frozen shoulder and identify the most appropriate intervention by stage of condition, specifically physical therapies, steroid and other shoulder injections, manipulation under anaesthesia (MUA), arthrographic distension, capsular release, watchful waiting and combinations of these interventions
2. collate, by way of a systematic review, patients' views and experiences of the interventions being assessed in the review
3. identify, by way of a systematic review, the cost-effectiveness of the different interventions in order to inform the development of a decision model
4. develop a decision-analytic model to estimate the cost-effectiveness of alternative treatment options for frozen shoulder
5. make recommendations for clinical practice
6. identify any gaps in the evidence, undertake value of information analysis to assess the potential value of future research on interventions for frozen shoulder and make specific recommendations for further research.

Frozen shoulder

Frozen shoulder is a painful condition in which movement of the shoulder becomes severely restricted. The condition can vary in severity from mild to severe pain and/or from some to severe restriction in movement. It was first described in 1875 by the French pathologist Duplay, who named it *péri-arthrite scapula-humérale*. The most well-known definition and name for the condition was provided in 1934 by an American surgeon EA Codman. He defined it as coming on slowly 'with pain usually felt near the insertion of the deltoid; inability to sleep on the affected side; painful and incomplete elevation and external rotation; restriction of both spasmodic and mildly adherent type; atrophy of the spinati; little local tenderness; [and] X-rays negative except for bone atrophy' and named it 'frozen shoulder'.[1] However, there is an acknowledged absence of a specific definition of the condition[2,3] and of a diagnostic label,[3] with additional names for frozen shoulder including adhesive capsulitis, painful stiff shoulder, retractile capsulitis, Checkrein shoulder, monoarticular arthritis and steroid-sensitive arthritis.[4] Throughout this report the term 'frozen shoulder' will be used.

Frozen shoulder is typically characterised as having three overlapping phases:[5]

1. phase 1, in which there is progressive stiffening and loss of motion in the shoulder with increasing pain on movement, which may be worse at night (months 2–9), usually referred to as the painful phase

2. phase 2, in which there is a gradual decrease in pain but stiffness remains and there is considerable restriction in the range of movement (months 4–12), usually referred to as the stiffening or 'freezing' phase
3. phase 3, in which there is an improvement in range of movement (months 12–42), usually referred to as the resolution phase.

There are different views about the underlying fundamental process: inflammation, scarring and scarring produced in reaction to inflammation.[6] Bunker describes a pathology of fibrous contracture of the rotator interval and coracohumeral ligament of the shoulder joint.[7] In addition to the capsular contracture, there is often a reduced joint volume: 3–4 ml compared with the normal volume of 10–15 ml.[8] The formation of new blood vessels in the synovial membrane, which is most marked in the rotator interval area, is a feature of the early stage of the condition. In the stiff phase this declines and thick white scar tissue can be seen and palpated within the capsule at arthroscopic and open surgery. Histology also shows thickening and contracture of the capsule. A significant increase in fibroblasts, which lay down scar tissue and myofibroblasts, which contract scar tissue, has been identified.[8] In addition, pathological studies have identified the presence of inflammatory cells (mast cells, T cells, B cells and macrophages), suggesting a process of inflammation leading to scarring.[9]

The cumulative incidence of frozen shoulder is estimated at 2.4 per 1000 population per year based on a Dutch general practice sample.[10] A large UK-based primary care study found that frozen shoulder affected 8.2% of men and 10.1% of women of working age.[11] In contrast, frozen shoulder was estimated to affect only 0.75% of the UK population based on a specialist shoulder surgeon's hospital care experience.[8] This discrepancy in estimated prevalence may be explained by the fact that only the most resistant cases of frozen shoulder are seen in a hospital setting.[6] Frozen shoulder most commonly occurs in people in their mid-50s and is thought to be slightly more common in women than in men.

Frozen shoulder can be described as either primary (idiopathic), whereby the aetiology is unknown, or secondary, when it can be attributed to another cause. Secondary frozen shoulder has been defined as that associated with diabetes (although some classify this as primary frozen shoulder), trauma, cardiovascular disease and hemiparesis. The incidence of frozen shoulder is reported to be 10–36% amongst people with diabetes, who tend not to respond as well to treatment as those without diabetes.[5] The proportion of frozen shoulder attributed to trauma varies (9–33%) and the trauma is often not particularly severe. There is also a discrepancy between the extent of trauma and severity of subsequent frozen shoulder.[4] These uncertainties mean that in practice it can be difficult to differentiate between primary and secondary frozen shoulder.

Although for most people frozen shoulder is a self-limiting condition of approximately 1–3 years' duration, it can be extremely painful and debilitating; people with the condition may struggle with basic daily activities and be worn down by sleep disturbance as a result of the pain.[12] As well as interfering with domestic and social activities, it can affect the ability to work. There may not be a complete resolution for all patients and there is variation across case series in the proportion of patients who do not regain full shoulder motion,[5] possibly a reflection of variation in how outcome was assessed. Based on the largest series of patients with a mean follow-up of 4.4 years from onset of symptoms, 59% had normal or near normal shoulders, 35% had mild to moderate symptoms with pain being the most common complaint and 6% had severe symptoms at follow-up.[13] Recurrence is unusual although it is estimated that the other shoulder becomes affected in 6–17% of patients within 5 years.

Diagnosis and management

Diagnosis, in both primary and secondary settings, is based on clinical examination and medical history. A key alerting feature is restriction of shoulder movement in all directions – passive and active range of movement.[14] Blood tests, radiography and ultrasound are usually normal and not routinely required unless history or physical examination suggests the need to rule out other pathologies, for example if rheumatoid arthritis or osteoarthritis is suspected. Frozen shoulder is commonly managed in the primary care setting. In a UK study of patterns of referral and diagnosis of shoulder conditions it was estimated that 22% of patients were referred to secondary care, up to 3 years following initial presentation, although most referrals occurred within 3 months.[15] There is little evidence available on referral patterns in relation to frozen shoulder specifically.[12]

There are a number of management options, both surgical and non-surgical, but there is no consensus about management. For the purpose of the report we have classified the interventions as conservative and invasive (*Table 1*).

The aims of treatment, depending on stage of condition, are pain relief, increasing arm movement, reducing the duration of symptoms and return to normal activities for the patient. Treatment options include:

- Watchful waiting or 'supervised neglect', which involves explaining the condition to the patient, and education and advice about mobilisation within pain limits and use of pain relief.
- Oral medications such as non-steroidal anti-inflammatory drugs (NSAIDs) and oral steroids. Although the use of oral steroids is described in the literature they are not a commonly used intervention in the UK.
- Gentle exercise supervised by a physiotherapist or as part of a home exercise programme.
- Physical therapies to help regain range of movement and prevent further stiffness. These encompass the wide range of techniques used by physiotherapists as well as acupuncture, and chiropractic and osteopathic techniques. Several different regimes have been described in the literature including supervised exercises, mobilisation, physiotherapy and use of electrotherapeutic interventions such as laser therapy and ultrasound. Mobilisation is therapist-applied passive movement of joints or other structures performed in such a way that they are always within the control of the patient. Electrotherapies include transcutaneous nerve stimulation (TENS), interferential therapy, short-wave diathermy (SWD) and pulsed short-wave diathermy (PSWD), and ultrasound. TENS and interferential therapy consist of electric pulses or currents and have an analgesic effect. SWD and PSWD use radio frequency energy to generate heat in tissues, which has an analgesic effect and reduces muscle spasm and joint stiffness. Ultrasound, mechanical vibration at very high speed, also generates heat

TABLE 1 Classification of interventions for frozen shoulder

Conservative treatment	Steroid injections
	Physical therapy
	Acupuncture
Invasive treatment	Sodium hyaluronate
	MUA
	Distension
	Capsular release

and has the same therapeutic effect as SWD and PSWD.[6] Low-level laser therapy is non-thermal and is believed to reduce pain and inflammation, although the exact mechanism of its effect is unknown.[16] Acupuncture is a form of ancient Chinese medicine in which fine needles are inserted into the skin at certain points on the body. Chiropractic uses a range of manual therapies, with an emphasis on manipulation of the spine, whereas osteopathy uses gentle stretching, massage and manipulation of muscles and joints.[17]

- Intra-articular corticosteroid injections to reduce inflammation and provide pain relief. A range of different doses and number of injections is described in the literature. This intervention is usually delivered in the primary care setting but also in the secondary care setting, depending on how services are organised in a particular region.
- Arthrographic distension (also called hydrodilatation), which involves controlled dilatation of the joint capsule with sterile saline or other solution such as local anaesthetic or steroid, guided by radiological imaging (arthrography). The procedure is performed under local anaesthetic.
- MUA, in which the shoulder is freed by rotation while the patient is under short general anaesthesia. This can be undertaken as a day procedure.
- Arthroscopic capsular release, a surgical procedure conducted under general or regional anaesthesia during which the contracted tissue is released. Open capsular release is another surgical option, usually recommended in those resistant to arthroscopic intervention. Both can be undertaken as a day procedure.

These interventions can be used individually or in combination, depending on the disease stage. There is currently not a consensus about the overall management of the condition and the sequence in which treatments should be offered to patients. A recent survey of 303 UK health-care professionals [general practitioner (GPs), including those with a special interest, physiotherapists, advanced scope physiotherapists and orthopaedic surgeons] found that the professional groups had different views on the most appropriate treatment pathway for frozen shoulder.[18] However, there appears to be a fairly consistent view that the treatments used should depend on the phase of the disease and/or that a step-up approach should be adopted in terms of the degree of treatment invasiveness.[5,12,18,19] There is a suggestion that aggressive mobilisation should be avoided in the early, severely painful phase.[12,14,19] Surgical intervention is generally, although not exclusively, used when the condition is resistant to the other interventions,[19] although there is no consensus as to what time point or level of pain should indicate surgical intervention.[18]

The most commonly used or recommended interventions for the painful phase, in the recent UK survey of health-care professionals, were conservative treatment (watchful waiting, education, oral pain relief) and physical therapy (mainly physiotherapy and mobilisation), each recommended in one-third of responses, and intra-articular steroid injection, recommended in 18% of responses. For patients in the resolution phase, surgery was the most preferred option (mainly MUA and arthroscopic capsular release), recommended in almost half of the responses, followed by conservative treatment (12%) and physical therapy (19%).

Previous systematic reviews

Several systematic reviews had previously been undertaken on interventions for frozen shoulder, some of which focused on shoulder pain in general and included a range of conditions. Those interventions evaluated were oral steroids,[20] corticosteroid injections,[21–23] physiotherapy,[24–26] acupuncture,[27] arthrographic distension[28] and multiple interventions[29] (*Table 2*). None of the

TABLE 2 Previous systematic reviews

Study	Intervention	End date for literature search
Alvado 2001[26]	Physical therapy	1999
Arroll 2005[23]	Corticosteroids	2004
Buchbinder 2006[20]	Oral steroids	2005
Buchbinder 2008[28]	Arthrographic distension	2006
Buchbinder 2003[21]	Corticosteroids	2002
Cleland 2002[25]	Physical therapy	2000
Green 1998[29]	Multiple intervention	1995
Green 2003[24]	Physiotherapy	2002
Green 2005[27]	Acupuncture	2003
Shah 2007[22]	Corticosteroid injections	2006

literature searches was recent and the reviews required updating (*Table 2*). In addition, some of the reviews did not report results by type of shoulder complaint. A recent review of systematic reviews on frozen shoulder noted the tendency to focus on a single intervention and that updated reviews were required.[30]

It is apparent from previous reviews that there is variation in how frozen shoulder is defined across studies. A review of 21 randomised controlled trials (RCTs) of interventions for frozen shoulder could not derive a consistent description of the condition from the trials investigating this patient group.[2] Although the RCTs required that participants had restricted shoulder movement, there was inconsistency across trials in the number of degrees of restriction, the type of restriction (active or passive) and the direction of the restriction (abduction or external rotation).[2] This highlights the difficulty of applying a strict definition for frozen shoulder within the context of a systematic review.

Focus of the synthesis

We undertook a systematic review of a range of NHS-relevant interventions for the treatment of primary frozen shoulder with the aim of informing a decision-analytic model. Previous reviews have tended to assess single treatments. The main focus was on comparing the main treatment options for frozen shoulder and identifying the most appropriate treatment by stage of frozen shoulder. Although variations within treatments were included in the synthesis, the main interest was in questions such as whether there is additional benefit from providing physiotherapy following steroid injection. Given the range of interventions being considered and the possibility that all treatment options would not have been compared in head-to-head in trials we planned to undertake a mixed-treatment comparison (MTC) in addition to pair-wise meta-analysis. MTC is an extension of traditional meta-analysis in which trials comparing the same intervention and the same comparator are pooled to estimate an overall treatment effect. A MTC overcomes the limitations of standard meta-analysis when there are no or few head-to-head comparisons or when the decision problem requires the comparison of several interventions.[31,32] A ranking of interventions, based on the probability that each treatment is best,[33] can be produced. This is of particular value when several treatment options are under consideration.

Chapter 2

Methods

Overview

There were four planned components for the assessment: a systematic review of the clinical effectiveness of the interventions, a systematic review of patients' views and experiences of the treatments, a systematic review of studies assessing the cost-effectiveness of the treatments and an assessment of the cost-effectiveness of the alternative treatment options for primary frozen shoulder. At various stages of the assessment the review team consulted with an advisory group including clinicians, an economist, researchers undertaking other research on frozen shoulder, service users and a specialist in dissemination.

Review of clinical effectiveness and cost-effectiveness

The systematic review of studies of clinical effectiveness and cost-effectiveness was undertaken following the general principles outlined in Centre for Reviews and Dissemination (CRD) guidance.[34]

Literature searches

The literature searches sought to identify papers on the use of physical therapies, steroid and other shoulder injections, MUA, arthrographic distension, capsular release, watchful waiting and combinations of these interventions for people with a primary diagnosis of frozen shoulder. A range of study types [systematic reviews, RCTs, economic evaluations, quasi-experimental studies (i.e. with a control group), case series of at least 50 participants] were eligible for inclusion and so the use of a study type filter in the search strategy was not considered appropriate.

The following databases were searched: MEDLINE, MEDLINE In-Process & Other Non-Indexed Citations, Cumulative Index to Nursing and Allied Health (CINAHL), EMBASE, Science Citation Index, BIOSIS Previews, Physiotherapy Evidence Database (PEDro), Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts of Reviews of Effects (DARE), Health Technology Assessment (HTA) database, Cochrane Central Register of Controlled Trials (CENTRAL), PASCAL, Manual, Alternative and Natural Therapy (MANTIS), Latin American and Caribbean Health Sciences Literature (LILACS) and NHS Economic Evaluation Database (NHS EED). In the study protocol the Office of Health Economics Health Economic Evaluations Database (OHE HEED) was listed as one of the databases to be searched but access to this database was not available at the time that the searches were conducted. The searches were not restricted by language. The databases were searched from inception up to March 2010 (22 March for MEDLINE). Update searches were undertaken of MEDLINE and EMBASE on 5 January 2011.

In addition, information on studies in progress, unpublished research or research reported in the grey literature was sought by searching a range of relevant databases including Conference Proceedings Citation Index: Science, Health Management Information Consortium (HMIC),

ClinicalTrials.gov and National Technical Information Service (NTIS). Furthermore, the reference lists of relevant systematic reviews were checked to identify further studies.

The websites of some relevant organisations were also scanned: the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) (www.niams.nih.gov/default.asp), the British Elbow & Shoulder Society (BESS) (www.bess.org.uk/), the National Physiotherapy Research Network (www.csp.org.uk/director/members/research/networkingandsupport/nationalphysiotherapyresearchnetwork.cfm) and the Primary Care Rheumatology Society (www.pcrsociety.org/).

The search strategy was developed using the MEDLINE database as the primary database (*Table 3*). In terms of the PICOS formula (patient, intervention, comparator, outcome, study design), the search strategy focused on population and intervention. The strategy was constructed so that lines 1–18 contain the various terms for frozen shoulder with these being combined at line 19. In the remainder of the strategy potential interventions for this condition are grouped together and then subsequently combined with line 19. For example, lines 28–30 seek to retrieve records for arthroscopy, arthroscopic release or capsular release, all combined in line 31 and subsequently further combined with line 19 so that line 32 potentially identifies records containing terms for both frozen shoulder and arthroscopy. A similar approach has been used throughout the strategy with each of the potential interventions.

One of the particular challenges in constructing this search strategy was that there is no MeSH directly corresponding to 'frozen shoulder' or 'adhesive capsulitis'. The nearest MeSH available, 'bursitis', refers to knee joints and elbow joints as well as the shoulder joint so it is inevitable that redundant records will be identified by the search. The inclusion of free-text terms in the strategy is therefore essential.

During the development of the search strategy a small number of records were identified in which neither the title of the paper nor the abstract contained reference to a potential intervention. As the article titles appeared to indicate that the papers could be potentially useful, lines 1–6 at the beginning of the MEDLINE search strategy focus simply on identifying and retrieving records that have 'frozen shoulder', etc. in the title of the record. This assumes that when the term appears in the title there is a high likelihood that it could be relevant even if no intervention is specifically mentioned.

The strategies from all of the databases are given in full in *Appendix 1*.

Inclusion and exclusion criteria

Studies were included in the review if they met the criteria below, which are also summarised in *Table 4*.

Population

Participants with idiopathic (primary) frozen shoulder were included. We took a pragmatic approach and included studies based on the authors' definition of frozen shoulder to ensure that we identified all of the relevant evidence. Ideally, only patients with loss of active and passive external rotation of the involved shoulder with normal radiographic findings would be included. This would allow for exclusion of patients with arthritis of the shoulder, which can present as a similar clinical picture. However, such information is not always available in reports of trials.

TABLE 3 MEDLINE search strategy

OvidSP interface; Ovid MEDLINE(R), 1950 to March Week 2 2010

3158 records identified, update search (5 January 2011) identified 98 records

1. (frozen adj6 shoulder$).ti. (272)
2. (stiff$adj3 shoulder$).ti. (93)
3. (adhesive adj (capsulitis or capsulitides)).ti. (165)
4. ((bursitis or bursitides) adj6 shoulder$).ti. (27)
5. ((capsulitis or capsulitides) adj6 shoulder$).ti. (89)
6. 1 or 2 or 3 or 4 or 5 (552)
7. (frozen adj6 shoulder$).ab. (466)
8. (stiff$adj3 shoulder$).ab. (307)
9. exp bursitis/ (3095)
10. (adhesive adj (capsulitis or capsulitides)).ab. (298)
11. ((bursitis or bursitides) adj6 shoulder$).ab. (45)
12. ((capsulitis or capsulitides) adj6 shoulder$).ab. (161)
13. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ti,ab. (175)
14. shoulder pain/ (1799)
15. (shoulder$adj3 (pain or pains or painful or complain$)).ti,ab. (3905)
16. Shoulder Impingement Syndrome/ (929)
17. (shoulder$adj6 impinge$).ti,ab. (496)
18. subacromial impingement syndrome.ti,ab. (110)
19. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 (8926)
20. Arthrography/ (3671)
21. (arthrograph$adj6 (distension$or distention$)).ti,ab. (36)
22. (arthrogram$adj6 (distension$or distention$)).ti,ab. (1)
23. (glenohumeral adj6 (distension$or distention$)).ti,ab. (9)
24. Dilatation/ (7623)
25. (dilatation or hydrodilat$).ti,ab. (34,251)
26. or/20–25 (43,572)
27. 19 and 26 (213)
28. Arthroscopy/ (12,449)
29. (arthroscop$adj6 (releas$or decompress$or capsulotom$)).ti,ab. (568)
30. ((capsular adj2 releas$) or interventional microadhesiolysis or capsulotomy).ti,ab. (1953)
31. or/28–30 (14,377)
32. 19 and 31 (778)
33. Injections, Intra-Articular/ (4409)
34. 33 and 19 (259)
35. injections/ (29,104)
36. 35 and 19 (67)
37. ((bursa$or intrabursa$or intra bursa$or periartic$or peri artic$or intraartic$or intra artic$) adj3 inject$).ti,ab. (3026)
38. 37 and 19 (132)
39. ((subacromial or acromioclavicular or glenohumeral) adj3 inject$).ti,ab. (144)
40. ((extra articular or extraarticular or shoulder$) adj3 inject$).ti,ab. (153)
41. 34 or 36 or 38 or 39 or 40 (572)
42. exp Physical Therapy Modalities/ (95,938)
43. (physiotherapy or physiotherapies or physical therap$or manual therap$).ti,ab. (16,547)
44. (passive adj (motion or movement)).ti,ab. (1400)
45. CPM.ti,ab. (3594)

TABLE 3 MEDLINE search strategy (*continued*)

46. muscle stretching exercises/ (333)

47. (stretching or stretches).ti,ab. (15,092)

48. (mobilisation or mobilization).ti,ab. (32,663)

49. (exercise$adj2 (program$or strength$or intervention$or training or prescription$or prescrib$)).ti,ab. (15,121)

50. (exercise$adj2 (therap$or therapeutic)).ti,ab. (2787)

51. ((home or supervis$) adj2 exercis$).ti,ab. (1536)

52. ((pendular or pendulum) adj exercis$).ti,ab. (13)

53. ((isokinetic or resist$) adj2 exercise$).ti,ab. (2412)

54. or/42–53 (165,811)

55. 19 and 54 (1251)

56. exp Musculoskeletal Manipulations/ (9623)

57. chiropractic$.ti,ab. (2520)

58. osteopath$.ti,ab. (3141)

59. (manipulat$adj3 (anesthesia or anaesthesia or anesthetic$or anaesthetic$)).ti,ab. (317)

60. MUA.ti,ab. (752)

61. 56 or 57 or 58 or 59 or 60 (15,100)

62. 19 and 61 (223)

63. (TENS or ALTENS).ti,ab. (4717)

64. ((electric$adj2 stimulat$) or (transcutaneous adj2 stimulat$) or (transdermal adj2 electrostimulat$) or (cutaneous adj2 electrostimulat$) or electroanalgesia or electro analgesia).ti,ab. (43,717)

65. (muscle adj2 stimulat$).ti,ab. (4333)

66. (neuromodulation or neuro modulation or neurostimulation or neuro stimulation).ti,ab. (2177)

67. interferential.ti,ab. (204)

68. or/63–67 (53,102)

69. 19 and 68 (79)

70. biofeedback.ti,ab. (3972)

71. Biofeedback, Psychology/ (5327)

72. or/70–71 (6440)

73. 19 and 72 (18)

74. cryotherapy/ (2779)

75. ice/ (2686)

76. diathermy/ (2482)

77. hyperthermia, induced/ (9561)

78. hot temperature/ (82,248)

79. ((cold or ice or heat or hot) adj (pack$or therap$or treat$)).ti,ab. (10,182)

80. (thermograph$or thermotherap$or thermo therap$or hypertherm$or hyper therm$or diatherm$or cryotherap$or cryo therap$).ti,ab. (33,180)

81. or/74–80 (123,890)

82. 19 and 81 (103)

83. exp Laser Therapy/ (41,566)

84. ultrasonic therapy/ (6801)

85. ultrasound.ti,ab. (105,682)

86. Ultrasonography, Interventional/ (9172)

87. (electrotherapeutic adj (intervention$or treat$)).ti,ab. (7)

88. or/83–87 (153,673)

89. 19 and 88 (375)

90. magnetic field therapy/(279)

91. pulsed electromagnetic field therapy.ti,ab. (22)

92. ((electromagnetic$or magnetic$) adj3 field$).ti,ab. (17,098)

TABLE 3 MEDLINE search strategy (*continued*)

93. (biomagnetic$or bio magnetic$or pulsed signal).ti,ab. (345)

94. PEMF.ti,ab. (264)

95. or/90–94 (17,449)

96. 19 and 95 (16)

97. nerve block/ (10,624)

98. neuromuscular blockade/ (1083)

99. (nerve adj2 block$).ti,ab. (5976)

100. or/97–99 (14,316)

101. 19 and 100 (129)

102. exp Acupuncture Therapy/ (12,086)

103. acupuncture$.ti,ab. (9788)

104. (electroacupuncture$or electro acupuncture$).ti,ab. (1968)

105. (osteopuncture$or osteo puncture$).ti,ab. (1)

106. (perioste$adj3 (stimulat$or therap$or needling)).ti,ab. (134)

107. or/102–106 (13,946)

108. and 107 (110)

109. massage/ (3834)

110. (massag$or acupressure or shiatsu or shiatzu or zhi ya or chih ya).ti,ab. (5864)

111. 09 or 110 (7657)

112. 19 and 111 (61)

113. (rehabilitat$adj2 (program$or protocol$)).ti,ab. (8627)

114. 19 and 113 (125)

115. ((watch$adj2 wait$) or (conservative adj2 treat$)).ti,ab. (20,170)

116. 19 and 115 (243)

117. (management adj2 (decision$or option$or choice$)).ti,ab. (6499)

118. 19 and 117 (6)

119. 114 or 116 or 118 (361)

120. 6 or 27 or 32 or 41 or 55 or 62 or 69 or 73 or 82 or 89 or 96 or 101 or 108 or 112 or 119 (3236)

121. limit 120 to yr="1966 -Current" (3158)

TABLE 4 Inclusion criteria

Population	Participants with idiopathic (primary) frozen shoulder (adhesive capsulitis) as defined by the authors, with or without diabetes
Intervention	Physical therapies, arthrographic distension, steroid injection, sodium hyaluronate injection, MUA, capsular release, watchful waiting
Comparator	Any of the above, no treatment or placebo
Outcomes	Pain; ROM; function and disability; quality of life; time to recovery, return to work and recreation; adverse events
Study design	RCTs; in the absence of randomised trials, quasi-experimental studies (i.e. with a control group). If controlled trials were not available for MUA or capsular release, case series of at least 50 participants
Studies of economic evaluations	Full economic evaluations that also met the population and intervention inclusion criteria

ROM, range of movement.

Studies of general shoulder conditions were included only if outcome data were reported separately for participants with primary frozen shoulder, and studies of mixed populations of primary and secondary frozen shoulder were included only when at least 90% of the participants had primary frozen shoulder or data were reported separately for the two groups. Frozen shoulder in people with diabetes is defined as primary in some classifications and as secondary in others. Patients with diabetes were included as primary frozen shoulder.

Intervention

The following interventions, or combinations of these, were eligible for inclusion:

- physical therapies (including physiotherapy, acupuncture, chiropractic and osteopathy interventions); physiotherapy encompasses a wide range of techniques including mobilisation, biofeedback, ultrasound and laser therapy and all therapies falling under the physiotherapy umbrella were included
- distension
- steroid and other shoulder injections such as sodium hyaluronate
- MUA
- capsular release (arthroscopic and open)
- the approach of 'watchful waiting' (as defined by the authors but including education and advice about mobilisation within pain limits, home exercise and use of pain relief).

There are a number of other treatments that have been researched for frozen shoulder that are not commonly used on the NHS, such as radiotherapy, collagenase injection, salmon calcitonin and antibodies to tumour necrosis factor-α. These interventions were excluded. Sodium hyaluronate is not licensed for use in frozen shoulder but a recent survey reported its use by a few respondents and therefore it was included in the review to establish the evidence base.

Comparator

Studies using any of the above treatments as a comparator (including studies comparing different regimens of the same intervention), no treatment or placebo were included. The two exceptions to this were acupuncture and sodium hyaluronate. Dose-ranging studies of sodium hyaluronate were excluded. Studies of acupuncture were included only when the comparator was one of the other interventions of interest in the review. Therefore, studies comparing more than one type of acupuncture or comparing acupuncture to an alternative therapy such as moxibustion were excluded.

Outcomes

The outcomes of interest were pain (e.g. at rest, on movement, at night); range of movement (e.g. internal and external rotation, elevation); function and disability; quality of life; time to recovery, return to work and recreation; and adverse events.

Study design

Only RCTs were eligible for inclusion where this level of evidence was available on an intervention/management strategy. In the absence of randomised trials, quasi-experimental studies (i.e. with a control group) were included. If controlled trials were not available for MUA or capsular release, case series of at least 50 participants were included. It is unclear what size a good-quality case series should be and therefore this was chosen as an arbitrary cut-off; it was considered an achievable size of case series for this field while maximising the possibility of a representative sample of patients.

The intention was to include and update systematic reviews if (1) they fulfilled all the relevant inclusion criteria, (2) they had no significant sources of error and bias and (3) they were reported

in detail and the raw data are available from the report or authors to allow an update of the synthesis (if searches are more than 12 months out of date). Otherwise they would be screened as an additional source of studies. Previous systematic reviews focused on individual interventions and had variable inclusion criteria and therefore updating of individual reviews was not appropriate. The reference lists of reviews were screened for additional studies.

Full economic evaluations

Full economic evaluations that met the population and intervention inclusion criteria were eligible for inclusion. A full economic evaluation was defined as any study in which a comparison of two or more relevant alternatives was undertaken with costs and outcomes examined separately for each alternative. This included cost-effectiveness analyses (including cost–consequence analysis), in which health outcomes are expressed in natural units; cost–utility analysis, in which benefits are measured in utility units or utility-weighted life-years; and cost–benefit analyses, in which benefits are measured in monetary form using approaches such as 'willingness to pay' or 'human capital approach'.

Screening and study selection

Two researchers independently screened all titles and abstracts identified from the searches to identify potentially relevant studies. Full manuscripts of potentially relevant studies were ordered and two researchers independently assessed the relevance of each study using the criteria above. Disagreements were resolved by consensus and, if necessary, a third researcher was consulted.

Data extraction

Descriptive data extracted included study design, number randomised, loss to follow-up, country, setting, inclusion criteria, population characteristics, description of the intervention including duration and intensity, concomitant treatments and outcome measures used. These data were extracted by one researcher using a pre-piloted standardised data extraction form in Evidence for Policy and Practice Information (EPPI)-Reviewer 3 (EPPI-Centre, Institute of Education, University of London, UK). Number of participants randomised, number included in each analysis, mean and standard deviation (SD) were extracted into a pre-piloted Microsoft Excel 2007 spreadsheet (Microsoft Corporation, Redmond, WA, USA). Descriptive and outcome data were checked by a second reviewer and discrepancies were resolved through discussion and, if necessary, a third opinion was sought.

For continuous outcomes the post-intervention (final value) mean and SD for each group were extracted, where available, as first preference. Otherwise, change scores (the difference between baseline and follow-up) and SD for each group were extracted, and the between-group difference in change and SD where data for the individual groups were not available. Data available only in graph format were not extracted; authors were contacted for the actual data. Where only median and ranges were reported, these were extracted. Unadjusted data were extracted to allow for covariate analyses in the MTC. Where unadjusted data were not available, adjusted data were extracted and the type of adjustment recorded (two studies[35,36]). Standard data imputation methods were used, where necessary, to calculate SDs.[37] If the SD or standard error (SE) was not reported, the variance was calculated from the 95% confidence interval (CI) or *p*-value (three studies[38–40]). Where this information was not available, the SD was imputed based on the average SD across all interventions for that outcome (two studies[35,41]). As a final means of imputing SD, a simulation model written in the R programme was used. The model repeatedly sampled from the possible range of values of the outcome measure being used (e.g. 0–9 in the case of a Likert

0–9 scale used to measure pain) to identify sequences whose mean equalled the mean reported in the trial of interest. Where the two means matched, the model calculated a SD; finally, the mean of these SDs was calculated and used in our analysis (two studies[42,43]). The R code is presented in *Appendix 3*.

Where the number of participants in an analysis was unclear, and the information was not available from the authors, the number randomised minus the number of dropouts was used.

Assessment of risk of bias

Quality assessment was also undertaken by one researcher and checked by a second with discrepancies resolved by consensus or recourse to a third researcher if necessary. Studies were assessed using the checklist in *Appendix 4*. The criteria for assessing randomised and non-randomised trials were based on recent CRD guidance;[34] the criteria for case series are based on those used in a recent systematic review including case series.[44] The quality of economic evaluations was assessed using a modified version of the Drummond checklist.[45]

Synthesis

The synthesis had two main components: (1) a narrative synthesis, including pair-wise comparisons and (2) a MTC. The analysis was based on the protocol and an a priori analysis plan. The primary outcomes of interest were patient-assessed pain intensity, function and disability, quality of life and range of movement. Given that the symptoms of frozen shoulder change over time (with pain being the strongest characteristic of the early stages but not later), it was not appropriate to use a single primary outcome.

Narrative synthesis and pair-wise comparisons

A narrative and tabular summary of key study characteristics, quality assessment and results was undertaken. Studies were grouped by the main intervention of interest in the study and then by comparator. Where appropriate, based on clinical and statistical heterogeneity and the necessary data being available, individual study results were combined in a pair-wise meta-analysis based on type of intervention and comparator using RevMan 5 (The Cochrane Collaboration, The Nordic Cochrane Centre, Copenhagen, Denmark).[46] A random-effects model was used except when there were fewer than three studies when a fixed-effect model was used. Heterogeneity was assessed using the chi-squared test and the I^2 statistic. A chi-squared test with p-values < 0.1, and I^2 values $> 50\%$ were taken to indicate that there was substantial statistical heterogeneity.[34,47] When a quantitative synthesis was not appropriate the results of studies were discussed in a narrative. Studies reporting median rather than mean values were discussed in the narrative synthesis only.

Outcomes

Pain was measured using several different outcome scales; therefore, the standardised mean difference (SMD) was calculated. Final value and change scores were not combined together as SMDs, as the difference in SD reflects differences in measurement. Scales were amended, where necessary, so that an increase in score equated to an increase in pain according to the *Cochrane Handbook*.[48] The SMD measure used was Hedges' *g* as this is considered appropriate for studies with small sample sizes.[49]

The interpretation of the SMD is not as intuitive as the interpretation of the original measures of treatment effect. To address this issue, the pooled SMD was back transformed to an original

measure by multiplying it with a 'typical' SD of one of the pain measures. A visual analogue scale (VAS) 0–100 mm was chosen, as this measure of pain, compared with others used by studies included in the review, had the largest volume of literature regarding minimum clinically important differences (MCIDs) in pain. This included one study performed in a shoulder-specific population.[50] Transformation from SMD to VAS 0–100 mm was made using a representative pooled SD at baseline from one of the included trials.[51] It should be noted that this was only appropriate for pooled rather than individual study SMDs.[52] The reduction in pain recorded as a SMD can be interpreted on a VAS 0–100 mm using *Table 5*. No data could be located on the MCID in pain for individuals with frozen shoulder; however, it is suggested that a difference of 14 mm on a 100-mm VAS scale is the MCID for individuals with rotator cuff disease, a shoulder disorder also characterised by pain and restricted range of movement.[50] Given that the between-group MCID is thought to approximate 40% of that within individuals,[6,53] the MCID between groups for rotator cuff disorder can be estimated to be approximately 5.6 mm. This value is therefore used as a proxy for the between-group MCID for frozen shoulder.

A wide range of function and disability scales were reported in the studies. These outcomes were not converted to a SMD as they were not considered similar enough. This was because there were differences between some scales in the aspects of function and disability assessed and in the weighting given to similar components. In addition, the correlation between some of the included scales was at best moderate.[54–56]

Because of the large number of different range of movement measures used, following discussion with the advisory group these were prioritised for the analyses. The passive range of movement outcomes of interest were passive external rotation, passive internal rotation and passive abduction; and the active range of movement outcomes were active external rotation, active internal rotation and active abduction. When passive and active range of movement was not reported separately, unspecified external rotation, internal rotation and abduction were used in the synthesis. When active internal rotation was not reported but hand behind back was, this was used as a proxy measure, although there is some evidence that the correlation between the two is low to moderate.[57]

Interventions

As stated above, studies were grouped by type of intervention in the narrative synthesis and pair-wise comparisons. In addition, subgroups were created within interventions. These subgroups were specified a priori to identify clinically similar studies for pooling in the pair-wise comparisons and MTC to guide the exploration of similarities and differences within classes of interventions in the narrative synthesis. These subgroups were as follows:

- Active physical therapy and physical therapy without mobilisation. Active physical therapy (or physical therapy with mobilisation) was defined as an intervention in which at least part of the intervention involved the patient's body being wholly or partly in motion, such as exercise, mobilisation and stretching (with or without passive techniques such as heat treatment). Interventions in which there was no such active mobilisation or stretching and

TABLE 5 Standardised mean differences and equivalent reductions on the VAS 0–100 mm scale

	Reduction in pain score				
SMD	−0.3	−0.5	−1.0	−1.5	−2.0
VAS 0–100 mm	−5.6	−9.15	−18.3	−27.45	−36.6

the participant was the passive recipient of a therapy such as laser therapy, TENS, ultrasound, heat treatment or ice packs alone were classified as physical therapy without mobilisation.

■ Steroid injections were grouped by the number of injections – three or fewer injections and more than three injections. This was based on advice from the advisory group that patients in the UK are unlikely to receive more than three injections for frozen shoulder; therefore, this was the cut-off used.

Length of follow-up

Follow-up of ≤ 4 weeks was not included in the analysis as it was not considered to be informative. Where studies did not report the same length of follow-up, outcomes were pooled grouped by short-, medium- and long-term follow-up. For short-term follow-up the data point from each study at 3 months' follow-up or the closest data point before 3 months' follow-up was used. For the outcome of pain, where pair-wise comparisons were possible, the same short-term follow-up data used for the MTC at 3 months were pooled. This was to enable comparison of results from the pair-wise comparisons and the MTC. For medium-term follow-up the data point at 6 months or the closest data point before 6 months was used. For long-term follow-up the data point at 12 months or the closest data point before 12 months was used. Data were also presented (when reported) at multiple times within a follow-up period (e.g. 6 weeks and 3 months). When only a narrative synthesis was possible, data were discussed using the same categories.

Unit of analysis error

Some of the included studies had a unit of analysis error, that is, patients were randomised to the intervention but outcome was reported by shoulder when a participant had two frozen shoulders. In these instances the number of patients was used as the denominator in the analysis as only a few patients had more than one shoulder involved; therefore, the difference between number of shoulders and number of participants was small.[58]

Multi-arm trials

Where pooling of multi-arm trials required the use of a control group more than once in the same meta-analysis, the number of participants in the control group was divided approximately evenly among the comparisons, with the means and SDs left unchanged. Where different arms were assessing minor variations of a class of intervention these were combined before pooling.[37]

Subgroup analyses

Subgroup analyses were planned to explore the influence of the following study characteristics in the MTC and pair-wise comparisons:

■ inclusion of patients with diabetes
■ stage of frozen shoulder
■ study quality (with studies stratified by concealment of allocation and by blinding of outcome assessors).

Because of the small number of studies suitable for pooling it was only possible to explore these factors in the narrative.

Mixed-treatment comparison

A MTC was undertaken. A MTC, also referred to as network meta-analysis, goes beyond the scope of the standard pair-wise meta-analysis in which direct within-trial results are pooled in a weighted manner, and provides a mechanism for bringing together both direct and indirect evidence. The approach allows data networks that include A versus B trials, B versus C trials and A versus C trials to be used to make inferences about the relative efficacy of all treatments.[33] This allows estimation of comparisons not previously considered in a clinical trial to be made. As the

summary treatment effect from each trial is used to inform the MTC, the randomisation of the trial is maintained within the analysis.

As with standard meta-analysis, to facilitate this type of analysis a number of conditions need to hold:

- Homogeneity assumption – that trials are sufficiently homogeneous to be quantitatively combined.
- Consistency assumption – that had treatment C been included in a trial comparing interventions A and B, then the treatment effect dAC would be equivalent to that obtained from a trial of interventions A and C.[33] Assuming consistency, the treatment effect dAC is the sum of the treatment effects dAB and dBC.
- Methodological similarity – that trial methods are similar as relative effects from trials may be associated with the quality of the study, particularly when subjective outcome measures are used.[59]

The MTC analysis was conducted in WinBUGS version 1.4.3 (MRC Biostatistics Unit, Cambridge, UK),[60] which is a Bayesian analysis software that utilises Markov chain Monte Carlo (MCMC) methods. A Bayesian framework involves a formal combination of a prior probability distribution (which reflects our belief about the possible values of the pooled effect) and a likelihood function (which informs the distribution of the pooled effect based on the observed data) to obtain a posterior probability distribution of the pooled effect. As the outcome for this analysis was the treatment effect difference, a normal likelihood distribution was used for the treatment effect data. A random-effects model was specified as it is likely that, although the treatment effects may be drawn from a common distribution, because of clinical and methodological variations, the true effect size is unlikely to be exactly the same.

Mixed-treatment comparison methods can be applied only to a connected network of RCTs. Because of the diversity of outcomes reported in the clinical trials the number of network options was limited. We were unable to standardise function and disability measures and given the variety reported no network was available. Range of movement outcomes were also not reported in a systematic manner in trials, leaving no network available. As previously stated it was possible to standardise the different pain outcome measures using the SMD; therefore, pain was the only outcome available to undertake a MTC.

Some studies reported more than one type of pain outcome; therefore, for the MTC one pain measure was selected from each study using a hierarchy based on the clinical significance of the type of pain. This was established following discussions with the advisory group, including individuals with frozen shoulder, and after exploring the literature. When more than one pain outcome was reported in a study a single measure was chosen for the MTC analysis in the following order: overall pain, pain at night, pain on activity, any other type of pain (excluding pain at rest) and pain at rest.

Only RCTs reporting final values and SDs (or when data were available to calculate final values or to impute SDs) were eligible for inclusion in the MTC. The model fit was assessed using the residual deviance. A value close to the number of data points in the data set reflects a 'good fit'. The MCMC simulation requires initial values to be specified for all parameters that are modelled as distributions. It is anticipated that following a sufficient burn-in period the chain will approach a stationary distribution. Convergence to a stable estimate should take place regardless of initial values. This was assessed using diagnostic tools provided within the WinBUGS package, including graphical time series trace of starting values for the selected parameters, the Brooks–Gelman–Rubin statistic and posterior distributions. The first 10,000 iterations were used as

'burn-in' and discarded; subsequently, a further 100,000 iterations were performed. Uncertainty was presented using the upper and lower limits of 95% credible intervals (CrIs), which describe the bounds within which it is believed there is a 95% chance that the true value lies.

The selection of the prior distributions is extremely important, particularly when there is limited effectiveness data. In a situation in which we have no information and we wish to include non-informative priors, it is important to check that the selections are truly non-informative. Prior distributions are given to those parameters being estimated by the model. The combining of the prior and the data gives us the posterior distributions from which we sample. The prior for the between-study SD was set to be a uniform distribution with a range 0 to 2. This covered the range of treatment effects within a particular comparison. However, when data are sparse, non-informative priors have an unintentionally large influence on the precision of the treatment effect, which can lead to different statistical inferences.[61] For this reason we undertook a number of sensitivity analyses to ensure that our prior was non-informative and allowed the model to reach convergence. For each network, a sensitivity analysis was performed by changing the range of the uniform prior distribution on the SD from 0–2 to 0–0.8, 0–5, 0–10 and, as a final check for stability for network 1, 0–15. An additional sensitivity analysis was also performed by repeating each analysis using a burn-in of 30,000 iterations.

Systematic review of patients' views of interventions for frozen shoulder

Given the range of possible treatment options for frozen shoulder, patient preference is an important factor in the treatments received by people with frozen shoulder as well as the sequence in which they try treatments when more than one type of treatment is necessary. We therefore undertook a systematic review of studies of patients' views of treatments for frozen shoulder. Three databases (CINAHL, MEDLINE and PsycINFO) were searched on 3 June 2010 to identify qualitative studies, with searches being restricted to English-language papers published from 1980 onwards. The search strategies used combined a set of terms for frozen shoulder/ adhesive capsulitis with a qualitative search filter.[62] The search strategies used are given in full in *Appendix 2*.

Studies investigating patients' views or experiences about the treatments included in the main review were eligible for inclusion. Only English-language qualitative studies were included; expert opinion, letters containing no data on patient views, editorials and discussion papers were excluded.

The processes for study selection, data extraction and quality assessment followed those of the main review. Studies were selected independently by two researchers and disagreements were resolved through discussion.

The intention was to extract data on study aim, participant characteristics, methods of collecting data on patient views and experiences, method of analysis, results in the form of a summary of key themes arising from the analysis and authors' conclusions. Study quality was to be assessed using a tool developed by Hawker *et al.*[63] and a narrative synthesis undertaken.

Assessment of cost-effectiveness

The intention was to develop a decision-analytic model, following National Institute for Health and Clinical Excellence (NICE) guidance on methods for technology appraisal,[64] to estimate the cost-effectiveness of the different treatments for frozen shoulder. The specific objectives outlined

in the proposal for the cost-effectiveness analysis were to (1) assess the cost-effectiveness of the named interventions for frozen shoulder to inform clinical practice and (2) identify the key uncertainties relating to the cost-effectiveness analysis and to use these to inform future research priorities. We reviewed the literature to:

- identify any existing modelling in a similar population
- identify treatments for this condition
- identify sequences or order of treatments
- explore whether treatments (or sequences of treatment) were influenced by phase of condition
- identify any potential sources of data to populate the model
- identify studies most relevant to the UK decision-maker.

The economic literature for this clinical area was found to be scant. The development of a full economic model was not possible. We present a full discussion around the issues of modelling treatments for frozen shoulder in *Chapter 3* (see *Decision model*), but, in brief, a lack of clinical evidence and consensus regarding treatment options made the structuring and populating of a model unachievable.

In an attempt to present some information that will be useful to the decision-maker we undertook a number of supplementary investigative exercises. First, we used the advisory group to elicit details of resource use associated with the interventions for which evidence has been identified in the systematic review. In conjunction with the advisory group, cost estimates for these procedures were produced. Second, as our initial aim was to express health benefits in terms of quality-adjusted life-years (QALYs), we investigated the available evidence to identify utility outcomes. A search of the published literature was undertaken to find any published studies that had measured and reported health utility as an outcome. Following the NICE reference case[64] the European Quality of Life-5 Dimensions (EQ-5D) should be used to elicit individuals' preference for health states. The EQ-5D measures health on five attributes: mobility, self-care, usual activity, pain/discomfort and anxiety/depression. These data are then combined with the UK social tariff, which is based on 10-year time trade-off data,[65] and used to weight the time spent in a given health state. Third, we explored the possibility of mapping outcomes presented in the clinical trials from the systematic review to the EQ-5D using established methods. The aim of the mapping was to generate changes in EQ-5D and QALYs for the interventions assessed in the clinical review. We then present some basic exploratory calculations to identify interventions that might be cost-effective and worthy of further investigation, although we acknowledge that these calculations are extremely uncertain.

Chapter 3

Results

Assessment of clinical effectiveness

Study selection

The searches identified 8883 records, 8341 from the original searches undertaken in March 2010, 521 from the update searches undertaken in MEDLINE and EMBASE in January 2011 and 21 from subsequent reference checking (*Figure 1*). On the basis of reviewing title and abstracts 8161 papers were excluded; 722 papers were ordered for a more detailed evaluation. Additionally, an author sent in one paper. Of the 723 papers, 67 were published in languages other than English. These included Chinese (22 papers), Russian (19 papers), Italian (6 papers), Japanese (6 papers), Dutch (5 papers), French (2 papers), Croatian (1 paper), German (1 paper), Hebrew (1 paper), Korean (1 paper), Norwegian (1 paper), Slovak (1 paper) and Turkish (1 paper).

After a detailed evaluation, 691 papers were excluded from the review, including four for which there was no translator available, and five that could not be obtained through the British Library (see *Appendix 5* for a list of excluded studies). The main reasons for excluding studies from the review were that they were not a clinical study (146 studies) or they did not meet the study design criteria (193 studies) or the population criteria (244 studies). Of the studies excluded on the basis
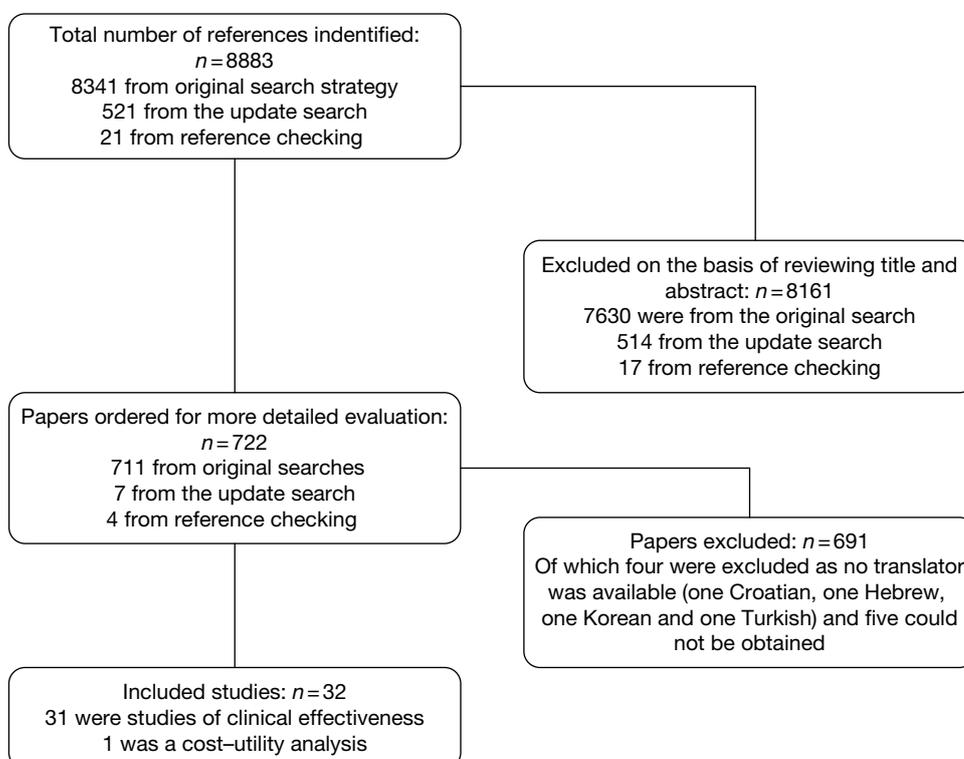
FIGURE 1 Flow chart of study selection.

of population, in 42 studies it was unclear if the patients had primary frozen shoulder, whereas in 17 studies < 90% of patients in each study had primary frozen shoulder.

There were 32 studies included in the review, one of which was a cost–utility analysis conducted alongside a separately published study of effectiveness. Of the 32 studies, 28 were published in English, 2 in Chinese, 1 in Japanese and 1 in Norwegian.

Studies were grouped by the main treatment intervention of interest: six studies were of steroid injection (with and without physical therapy), three of sodium hyaluronate injection, twelve of physical therapy, three of acupuncture, four of MUA, three of distension and two of capsular release. One study, by Calis *et al.*,[66] fell into more than one category and was reported in all relevant sections (steroid injection, sodium hyaluronate injection and physical therapy). In one of the physical therapy studies there was a 'supervised neglect' comparator. The included studies were from a wide range of countries (Turkey, Canada, UK, USA, Italy, Japan, Hong Kong, China, Taiwan, the Netherlands, Singapore, Thailand, Greece, Pakistan, Finland, Australia, Denmark and Norway).

Although a quantitative synthesis was planned this was largely not possible, as few studies could be pooled. The overall quality of the studies was poor and there were few studies of the same comparators. Within the classes of intervention there was considerable variability between studies in various aspects of the intervention such as dose (e.g. of steroid or sodium hyaluronate injection), and duration and intensity of treatment, especially in terms of physical therapy and home exercise programmes. The physical therapy interventions encompassed a range of combinations of 'active' and 'passive' components. There was variability in the outcomes reported, the tools used to measure individual outcomes, time of follow-up and type of data reported. As a result there were few situations in which it was appropriate to pool and undertake the planned subgroup analyses. It was therefore necessary to primarily use narrative synthesis to present the findings of this review. The main analysis was the narrative synthesis with pair-wise comparisons where appropriate. This is presented first with studies grouped by intervention. This is followed by the MTC. This was a secondary, exploratory analysis because of the small number of studies that connected in the network.

Steroid injection
Study characteristics
Six RCTs investigated steroid injections, with or without the addition of physiotherapy, in the treatment of primary frozen shoulder. A summary of the study characteristics is reported in *Table 6*, with further details available in *Appendix 6*. All were full papers of studies conducted in the UK,[41,67] Turkey,[66,68] Canada[35] and the USA[42] between 1981 and 2008. There was one two-armed trial,[68] one three-armed trial[67] and four four-armed trials[35,41,42,66]

The steroids administered were methylprednisolone acetate and triamcinolone hexacetonide. Two studies used a single injection of 20 mg triamcinolone hexacetonide,[41,67] one of which also administered lidocaine,[67] and three studies used a single injection of 40 mg methylprednisolone acetate or triamcinolone hexacetonide.[35,66,68] The remaining study administered three 40-mg injections of methylprednisolone acetate plus lidocaine, one each week for 3 weeks.[42] In one of the studies the injection was guided using fluoroscopy.[35] Five of the studies reported administering an intra-articular injection,[35,41,42,66,68] one of which compared an anterior and a lateral approach,[42] and in one study it was unclear.[67]

The comparators were steroid injection plus physiotherapy,[35,41,67] placebo injection,[35,41,42,68] physiotherapy with[35,41] and without[66,67] placebo injection and home exercise alone.[66]

TABLE 6 Studies of steroid injections

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Bal 2008[68] Two-arm RCT	*n* = 80 (82 shoulders) Steroid injection: 40 (42) Placebo injection: 40 (40)	Steroid: methylprednisolone acetate, 40 mg, 1 ml, one injection Placebo: saline, 0.9% sodium chloride, 1 ml, one injection	Presence of shoulder pain with limitation of both active and passive movements of the glenohumeral joint of ≥ 25% in at least two directions. Symptom duration between 6 weeks and 6 months
Calis 2006[66] Four-arm RCT	*n* = 90 (95 shoulders) Sodium hyaluronate injection: 24 (27) Steroid injection: 25 (26) PT: 21 (22) No intervention (home exercise only): 20 (20)	Sodium hyaluronate: 30 mg, one injection once weekly for 2 weeks. Steroid: triamcinolone acetonide, 40 mg, one injection PT: 10 daily sessions at least 45 minutes	History of pain for at least 1 month; limited active and passive shoulder movement; decreased passive ROM of 20% or more, in at least three movements, according to the American Medical Association guide for the evaluation of permanent impairment
Carette 2003[35] Four-arm RCT	*n* = 93 Steroid injection: 23 Placebo injection: 23 Steroid + PT: 26 PT + placebo: 23	Steroid: triamcinolone hexacetonide, 40 mg, 2 ml, one injection Placebo: saline, 2 ml, one injection PT: 12 × 1-hour sessions, 3 times per week for 4 weeks	Adhesive capsulitis defined as the presence of shoulder pain with limitation of both active and passive movements of the glenohumeral joint of ≥ 25% in at least two directions compared with contralateral shoulder or normal values. Symptomatic for < 1 year
Dacre 1989[67] Three-arm RCT	*n* = 66 (data reported for 62) Steroid injection: 22 Steroid + PT: 20 PT: 20	Steroid: triamcinolone, 20 mg, 1 ml with 2% lidocaine, one injection PT: 4–6 weeks' duration	Painful stiff shoulder for at least 4 weeks; inability to use arm with restriction of movement and loss of full function; pain at night causing sleep disturbance and inability to lie on affected side
Rizk 1991[42] Four-arm RCT	*n* = 48 Steroid, (IA) + PT: 16 Steroid, (IB) + PT: 16 Placebo injection (IA) + PT: 8 Placebo injection (IB) + PT: 8	Steroid: methylprednisolone acetate, 40 mg, 1 ml with 2 ml of 1% lidocaine. Once weekly for 3 weeks IA (using anterior approach) or IB (using lateral approach) PT: 11 weeks Placebo: 1% lidocaine once-weekly for 3 weeks IA or IB	Total ROM < 50% of normal range (i.e. < 320°); shoulder pain for < 6 months, nocturnal accentuation of pain, no effusion in the glenohumeral joint
Ryans 2005[41] Four-arm RCT	*n* = 80 Steroid injection: 20 Steroid + PT: 20 PT + placebo injection: 20 Placebo injection: 20	Steroid: triamcinolone, 20 mg, 1 ml and normal saline, 2 ml; 1.5 ml injected by an anterior approach and 1.5 ml by a lateral approach Placebo: saline (3 ml) administered as per steroid PT: eight sessions over 4 weeks	Painful shoulder in the 5th cervical (C5) dermatome distribution of between 4 weeks' and 6 months' duration. Restriction of active and passive ROM in both external rotation and glenohumeral abduction of > 25% compared with other shoulder

IA, intra-articular; IB, intrabursal; PT, physiotherapy; ROM, range of movement.

Five of the six trials evaluated a physical therapy regimen as part of the intervention.[35,41,42,66,67] These varied between studies but all consisted of physiotherapy modalities. They included combinations of exercises, mobilisation techniques, TENS, ultrasound, ice, heat packs and interferential therapy. All of the studies appeared to include some form of mobilisation as part of the physiotherapy, although details were scant in some studies. The duration of physiotherapy ranged from 4 to 11 weeks, although, with the exception of one study, duration was < 6 weeks. One study tailored the physiotherapy depending on whether participants had acute or chronic-like symptoms.[35]

Five studies reported that participants in all groups were asked to undertake home exercises, although the level of detail reported varied between studies. Bal *et al.*[68] had a substantial home exercise programme: participants were asked to undertake shoulder stretching and stabilising exercises five times per day over 12 weeks, using a heat pack before exercise and a cold pack after. Carette *et al.*[35] asked participants to carry out active and auto-assisted exercises twice daily over 12 weeks. In the study by Calis *et al.*[66] stretching and Codman's exercises were performed. Details of home exercise were not reported in the other two studies.[41,42] The study by Dacre *et al.*[67] did not have a home exercise component.

There was also some variability between studies in concomitant treatments. Four studies reported that paracetamol of varying doses was available to participants: 1500 mg per day when needed in one study,[68] a supply (dose unspecified) in one study,[35] one to two tablets every 4–6 hours (a maximum of eight per day) in another study[41] and paracetamol when needed in the remaining study.[66] Another study stated that all participants were advised to continue NSAIDs.[42] One study did not report whether participants received concomitant treatment.[67]

The inclusion criteria varied between the six studies, although four of the studies used similar criteria for the extent of restriction of movement.[35,41,66,68] Three of the studies included participants with frozen shoulder of < 6 months' duration.[35,41,42] Where reported, frozen shoulder was diagnosed through presence of pain and range of movement, clinical diagnosis, presence of symptoms, laboratory tests and radiography. The method of diagnosis was unclear in two studies.[42,68] Three studies included a small number of participants with diabetes: 6% in the study by Carette *et al.*,[35] 5% in the study by Dacre *et al.*[67] and 6% in the study by Ryans *et al.*[41] None of the studies reported results separately for patients with diabetes. The participants' stage of frozen shoulder at baseline was not reported in any of the studies. Where reported, the mean duration of frozen shoulder amongst the included participants ranged from 13[42] to 21[35] weeks. None of the studies reported whether participants had received any previous treatment for frozen shoulder. The mean age of participants ranged from 54 to 57 years and the proportion of women ranged from 42% to 63%.

Quality assessment

Quality varied between the included studies. Four studies did not report the method of randomisation;[42,66–68] therefore, it was unclear whether these were truly randomised studies as stated by the authors. In addition, in two of these studies it was unclear whether the intervention groups were comparable at baseline.[67,68] These four studies therefore have a potentially high risk of bias even though they met other criteria such as blinding of outcome assessment. Only one of these studies was adequately powered for at least one outcome.[67] Bal *et al.*[68] also reported substantial loss to follow-up (20%, all in the placebo group). Dacre *et al.*[67] and Rizk *et al.*[42] reported considerably less loss to follow-up (6% and 8% respectively), whereas Calis *et al.*[66] reported that there were no dropouts.

The remaining two studies were considered of satisfactory quality although one had some risk of bias.[41] Both reported an adequate method of randomisation and Carette *et al.*[35] also reported an adequate method of allocation concealment; it was unclear whether Ryans *et al.*[41] used an adequate method because, although sealed envelopes were used, it was not stated whether these were opaque or sequentially numbered. Both studies met most of the remaining criteria including reported blinding of outcome assessment. Ryans *et al.*[41] reported that participants were blinded to type of injection. Carette *et al.*[35] attempted to blind the injection; however, the method used (covering the syringe with foil) may not have been reliable. Blinding of the physiotherapy treatment was not possible. Carette *et al.*[35] also reported an intention-to-treat analysis. The main limitation of this study was that it may not have been sufficiently powered; 17% were lost to follow-up and there appears to be an imbalance between treatment groups, with greater loss to

follow-up in the steroid group. Ryans et al.[41] did not report an intention-to-treat analysis and there was also a high proportion lost to follow-up (27%), with a higher number of dropouts in the steroid only and placebo groups. As with the Carette study, the Ryans study may not have been sufficiently powered. Full details of study quality are reported in *Appendix 8*.

Pain

All six studies assessed pain but Calis et al.[66] and Dacre et al.[67] reported data in graphical form only (*Table 7*). Consequently, a SMD could not be calculated and these two studies could not be included in a meta-analysis. Calis et al.[66] reported that there was significantly greater improvement in pain in the steroid group than in the placebo group ($p = 0.02$). Dacre et al.[67] evaluated steroid, steroid and physiotherapy, and physiotherapy alone. This study reported that all three groups showed a significant reduction in pain after 6 weeks ($p < 0.001$) with mean measures improving by 49–66%, and further improvements at 6 months. Improvements were reported to be similar in all three treatment groups.

Of the four remaining studies, three reported final mean values and SDs were reported or could be imputed. Both Carette et al.[35] and Rizk et al.[42] reported pain overall and Ryans et al.[41] reported daytime pain at rest (*Table 7*). Each of the three studies reported pain using a different scale.

The study by Bal et al.[68] reported mean change and SDs at 12 weeks for pain at night measured on the VAS 0–100 mm. Although a SMD could be calculated for this study, it was inappropriate to pool this SMD with those SMDs calculated from final value means, as the difference in SD reflects not differences in measurement scale, but differences in the reliability of the measurements.[48]

Table 8 provides the SMDs and 95% CIs. The outcome data for individual groups in the included trials are available in *Appendix 7*.

Steroid versus placebo

Three studies reported pain at short-term follow-up. Two studies reported final value mean pain for short-term follow-up: Carette et al.[35] reported data at 6 weeks and 3 months and Ryans et al.[41] reported data at 6 weeks (*Table 8*). As stated in the methods section, to allow comparison of the results of the meta-analysis with the MTC for pain, time points closest to 3 months were pooled, that is, 3-month data for Carette et al.[35] were pooled with 6-week data for Ryans et al.[41] There was a significant decrease in pain with steroid injection compared with placebo: pooled SMD –1.15, 95% CI –1.62 to –0.67 (*Figure 2*). When back transformed to a 0–100 mm VAS scale,

TABLE 7 Pain outcomes in studies evaluating steroid injections

Study	Pain outcome assessed[a]	Scale used	Data reported and time of follow-up
Bal 2008[68]	Pain at night	VAS 0–100 mm	Mean change at 2 and 12 weeks (baseline median and IQR reported only)
Calis 2006[66]	Pain severity	VAS[b]	Data reported in graphs only; *p*-value for between-group difference reported at 3 months
Carette 2003[35]	Pain overall	SPADI 5-item pain subscale	Change from baseline at 6 weeks and 3, 6 and 12 months
Dacre 1989[67]	Pain at night	VAS 0–10 cm	Data presented in graphs only
Rizk 1991[42]	Pain overall	Likert (0–5)	Final mean values at 4, 11 and 24 weeks. SD not reported
Ryans 2005[41]	Daytime pain at rest	VAS 0–100 mm	Change from baseline at 6 and 16 weeks

IQR, interquartile range; SPADI, Shoulder Pain and Disability Index.
a   Lower scores indicated better outcome.
b   Unit of measurement (cm or mm) not specified.

this equates to a mean difference (MD) of 21 mm (95% CI –29.7 to –12.3 mm). No data could be located on the MCID in pain for individuals with frozen shoulder. However, it is suggested that a difference of 14 mm on a 100-mm VAS scale is the MCID for individuals with rotator cuff disease, a shoulder disorder also characterised by pain and restricted range of movement.[50] Given that the between-group MCID is thought to approximate 40% of that within individuals,[6,53] the MCID between groups for rotator cuff disorder can be estimated to be approximately 5.6 mm. Using this as a proxy for between-group MCID for frozen shoulder, this suggests that there is a clinically significant decrease in pain with steroid compared with placebo. There was no statistical heterogeneity between the studies ($I^2 = 0\%$). When 6-week data for Carette et al.[35] and Ryans et al.[41] were pooled the results were similar (pooled SMD –1.30, 95% CI –1.78 to –0.81; MD 23.8 mm, 95% CI 32.6 to 14.8 mm).

Bal et al.[68] reported mean change in pain at 12 weeks. There was no significant difference in pain with steroid compared with placebo (*Table 8*).

Steroid versus physiotherapy combined with placebo

Two studies reported data at short-term follow-up: Carette et al.[35] reported data at 6 weeks and 3 months and Ryans et al.[41] reported data at 6 weeks (*Table 8*). In both studies physiotherapy was combined with placebo. When 3-month data from Carette et al.[35] were pooled with 6-week data from Ryans et al.[41] there was no significant difference in pain between steroid and physiotherapy (*Figure 3*). When back transformed to a 0–100 mm VAS scale, this equates to a MD of –4 mm (95% CI –11.9 to 3.7 mm), which suggests that there may be no clinically significant difference between treatments. There was no statistical heterogeneity between studies ($I^2 = 0\%$). When 6-week data for Carette et al.[35] and Ryans et al.[41] were pooled there was a marginally significant decrease in pain with steroid compared with physiotherapy combined with placebo (pooled SMD –0.51, 95% CI –0.94 to –0.07). However, when back transformed to a 0–100 mm VAS scale, this equates to a MD of –9.3 mm (95%–17.2 to –1.2 mm), which, as with the pooled 3-month and 6-week data, suggests that there may be no clinically significant difference between treatments.

Steroid combined with physiotherapy versus placebo

Two studies reported pain at short-term follow-up: Carette et al.[35] reported data at 6 weeks and 3 months and Ryans et al.[41] reported data at 6 weeks (*Table 8*). When 3-month data from Carette et al.[35] were pooled with 6-week data from Ryans et al.[41] there was a statistically significant decrease in pain with steroid combined with physiotherapy compared with placebo: pooled SMD –1.88, 95% CI –2.43 to –1.33 (*Figure 4*). When back transformed to a 0–100 mm VAS scale, this equates to a MD of –34.40 mm (95% CI –44.47 to –24.34 mm). This suggests that there is a clinically significant decrease in pain with steroid combined with physiotherapy compared with placebo. There was no statistical heterogeneity between studies ($I^2 = 3\%$). When 6-week data for Carette et al.[35] and Ryans et al.[41] were pooled the results were similar (pooled SMD –2.31, 95% CI –2.89 to –1.72; MD –42.3 mm, 95% CI –52.9 to –31.5 mm).

Steroid combined with physiotherapy versus physical therapy combined with placebo

Three studies reported pain for short-term follow-up. In all studies physiotherapy was combined with a placebo injection. Carette et al.[35] reported pain at 6 weeks and 3 months, Rizk et al.[42] reported pain at 11 weeks and Ryans et al.[41] reported pain at 6 weeks (*Table 8*).

When 3-month data from Carette et al.[35] were pooled with 11-week data from Rizk et al.[42] and 6-week data from Ryans et al.[41] there was a significant decrease in pain with steroid combined with physiotherapy compared with physiotherapy: pooled SMD –0.57, 95% CI –0.94 to –0.20 (*Figure 5*). However, there was evidence of substantial statistical heterogeneity ($I^2 = 79\%$). When 6-week data for Carette et al.[35] were pooled with 11-week data from Rizk et al.[42] and 6-week data

Study or subgroup	Steroid			Placebo			Weight	Std mean difference IV, Fixed, 95% CI	Std mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	22.1	13.1	23	39	13.1	23	55.8%	−1.27 (−1.91 to −0.63)	
Ryans et al.[41]	28.1	10.392	17	38.7	10.392	17	44.2%	−1.00 (−1.71 to −0.28)	
Total (95% CI)			40			40	100.0%	**−1.15 (−1.62 to −0.67)**	

Heterogeneity: χ^2 = 0.31, df = 1 (p = 0.58); I^2 = 0%
Test for overall effect: z = 4.72 (p < 0.00001)
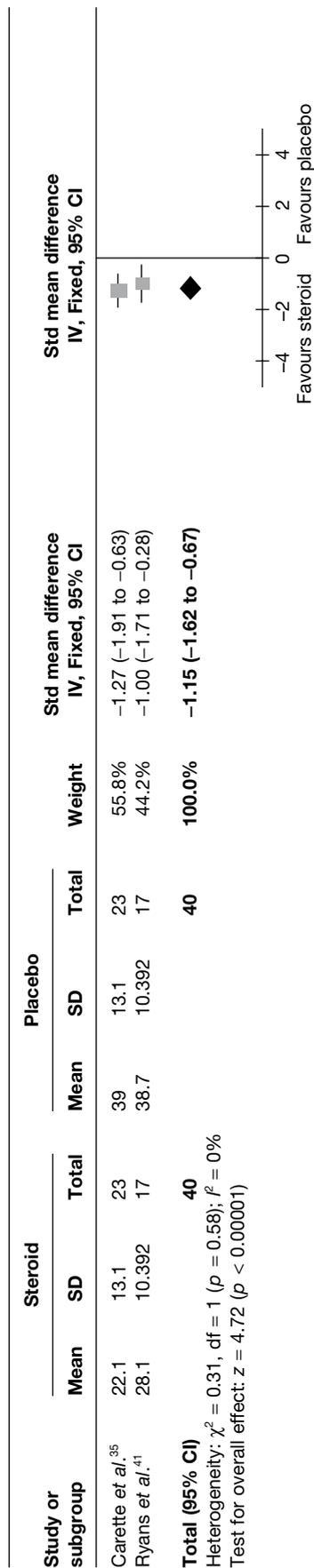
FIGURE 2 Standardised mean difference at up to 3 months: steroid vs placebo.

Study or subgroup	Steroid			PT + placebo			Weight	Std mean difference IV, Fixed, 95% CI	Std mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	22.1	13.1	23	27.3	13.1	26	56.5%	−0.39 (−0.96 to 0.18)	
Ryans et al.[41]	28.1	10.392	17	28.2	10.392	20	43.5%	−0.01 (−0.66 to 0.64)	
Total (95% CI)			40			46	100.0%	**−0.22 (−0.65 to 0.20)**	

Heterogeneity: χ^2 = 0.75, df = 1 (p = 0.38); I^2 = 0%
Test for overall effect: z = 1.03 (p = 0.30)

FIGURE 3 Standardised mean difference at up to 3 months: steroid vs physiotherapy combined with placebo.

Study or subgroup	Steroid + PT			Placebo			Weight	Std mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	16.9	13.1	21	39	13.1	23	61.6%	−1.66 (−2.35 to −0.96)
Ryans et al.[41]	14.9	10.392	17	38.7	10.392	17	38.4%	−2.24 (−3.11 to −1.36)
Total (95% CI)			**38**			**40**	**100.0%**	**−1.88 (−2.42 to −1.33)**

Heterogeneity: $\chi^2 = 1.03$, df = 1 ($p = 0.31$); $I^2 = 3\%$
Test for overall effect: z = 6.77 ($p < 0.00001$)
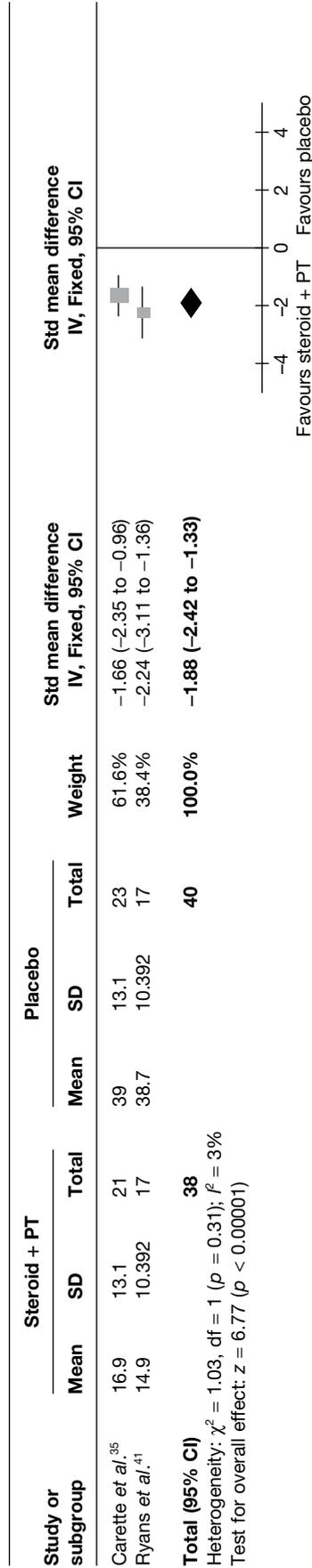
FIGURE 4 Standardised mean difference at up to 3 months: steroid combined with physiotherapy vs placebo.

Study or subgroup	Steroid + PT			PT + placebo			Weight	Std mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	16.9	13.1	21	27.3	13.1	26	38.2%	−0.78 (−1.38 to −0.18)
Rizk et al.[42]	3.417	1.557	29	3.13	1.653	15	35.0%	0.18 (−0.45 to 0.80)
Ryans et al.[41]	14.9	10.392	17	28.2	10.392	20	26.8%	−1.25 (−1.97 to −0.54)
Total (95% CI)			**67**			**61**	**100.0%**	**−0.57 (−0.94 to −0.20)**

Heterogeneity: $\chi^2 = 9.49$, df = 2 ($p = 0.009$); $I^2 = 79\%$
Test for overall effect: z = 3.03 ($p = 0.002$)
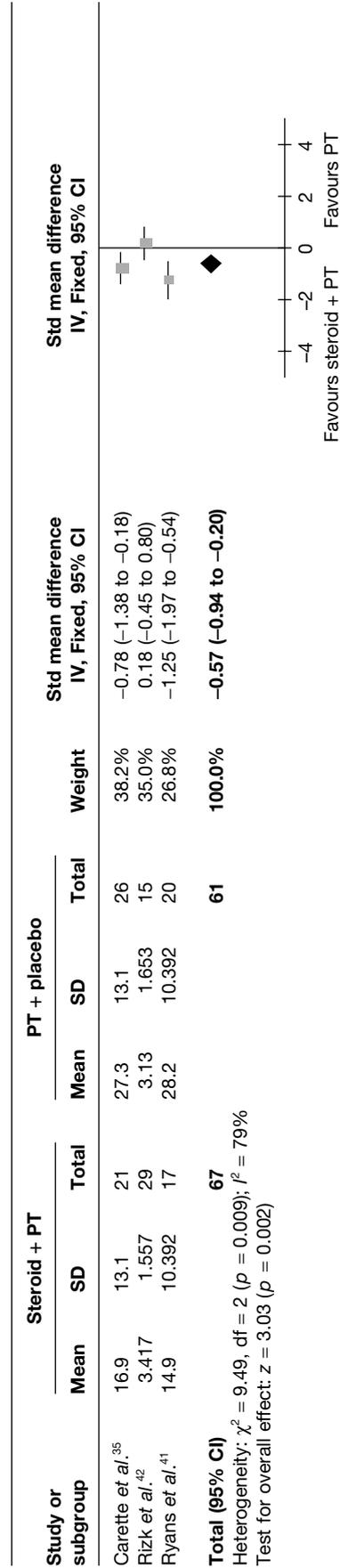
FIGURE 5 Standardised mean difference at up to 3 months: steroid combined with physiotherapy vs physiotherapy combined with placebo.

from Ryans *et al.*,[41] the results were similar (pooled SMD –0.86, 95% CI –1.25 to –0.47, I^2 = 89%). Potential sources of heterogeneity may be the type of steroid used, different lengths of follow-up and proportion of patients with diabetes. Furthermore, the studies by Carette *et al.*[35] and Ryans *et al.*[41] were assessed to have a potentially lower risk of bias than the study by Rizk *et al.*[42]

Given the differences in study quality, a sensitivity analysis was performed by excluding Rizk *et al.*[42] from the meta-analyses (*Figure 6*). Pooling 3-month data from Carette *et al.*[35] and 6-week data from Ryans *et al.*[41] resulted in a significant decrease in pain with steroid combined with physiotherapy compared with physiotherapy: pooled SMD –0.98, 95% CI –1.43 to –0.52. Furthermore, there was no longer evidence of statistical heterogeneity (I^2 = 0%). When back transformed to a 0–100 mm VAS, the pooled SMD equates to a MD of –17.93 mm (95% CI –26.2 to –9.5 mm), which suggests that there is also a clinically significant decrease in pain with steroid combined with physiotherapy compared with physiotherapy. When 6-week data for Carette *et al.*[35] and Ryans *et al.*[41] were pooled the results were similar (pooled SMD –1.51, 95% CI –2.00 to –1.02; MD 27.6 mm, 95% CI 36.6 to 18.7 mm).

The study by Rizk *et al.*[42] also reported pain for medium-term follow-up. At 24 weeks there was no significant difference between steroid combined with physiotherapy and physiotherapy (see *Table 8*).

Steroid combined with physiotherapy versus steroid

Carette *et al.*[35] reported data at 6 weeks and 3 months and Ryans *et al.*[41] reported data at 6 weeks (*Table 8*). When 3-month data from Carette *et al.*[35] were pooled with 6-week data from Ryans *et al.*[41] there was a significant difference in pain with steroid combined with physiotherapy compared with steroid alone: pooled SMD –0.75, 95% CI –1.20 to –0.29 (*Figure 7*). When back transformed to a 0–100 mm VAS, this equates to a MD of –13.7 mm (95% CI –21.96 to –5.3 mm), which suggests that there may be no clinically significant difference between treatments. However, there was evidence of substantial 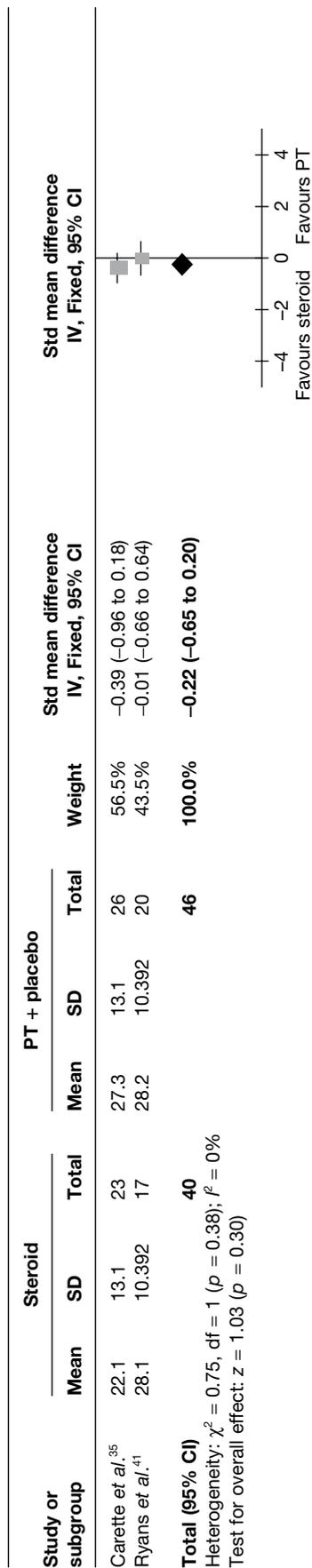statistical heterogeneity (I^2 = 70%); therefore, this result should be interpreted with caution. When 6-week data for Carette *et al.*[35] and Ryans *et al.*[41] were pooled, there was a significant decrease in pain with steroid combined with physiotherapy compared with steroid alone (pooled SMD –1.00, 95% CI –1.47 to –0.53). When back transformed to a 0–100 mm VAS, this equates to a MD of –18 mm (95% CI 26.9 to 9.7 mm). This suggests that there may be a clinically significant reduction in pain with steroid combined with physiotherapy compared with steroid alone. Furthermore, there was no evidence of statistical heterogeneity (I^2 = 0%).

Function and disability

Four of the six studies assessed function and disability; however, only the Shoulder Pain and Disability Index (SPADI) total score and SPADI 8-item disability subscales were common to more than one study and follow-up times varied (*Table 9*). Results were presented as change from baseline data for all but one of the studies.[66] *Table 10* provides the between-group difference in means and 95% CIs. The outcome data for the individual groups in the included trials are available in *Appendix 7*.

Steroid versus placebo

Two studies reported SPADI total score and SPADI 8-item subscale score for steroid versus placebo injection (*Table 10*).[35,68]

Carette *et al.*[35] reported SPADI total score at 6 weeks and found a significant effect in favour of the steroid injection group (MD –17.8, 95% CI –31.96 to –3.64).

Study or subgroup	Steroid + PT			PT + placebo			Weight	Std mean difference IV, Fixed, 95% CI	Std mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	16.9	13.1	21	27.3	13.1	26	58.7%	−0.78 (−1.38 to −0.18)	
Ryans et al.[41]	14.9	10.392	17	28.2	10.392	20	41.3%	−1.25 (−1.97 to −0.54)	
Total (95% CI)			38			46	100.0%	**−0.98 (−1.43 to −0.52)**	

Heterogeneity: $\chi^2 = 0.99$, df = 1 ($p = 0.32$); $I^2 = 0\%$
Test for overall effect: z = 4.17 ($p < 0.0001$)
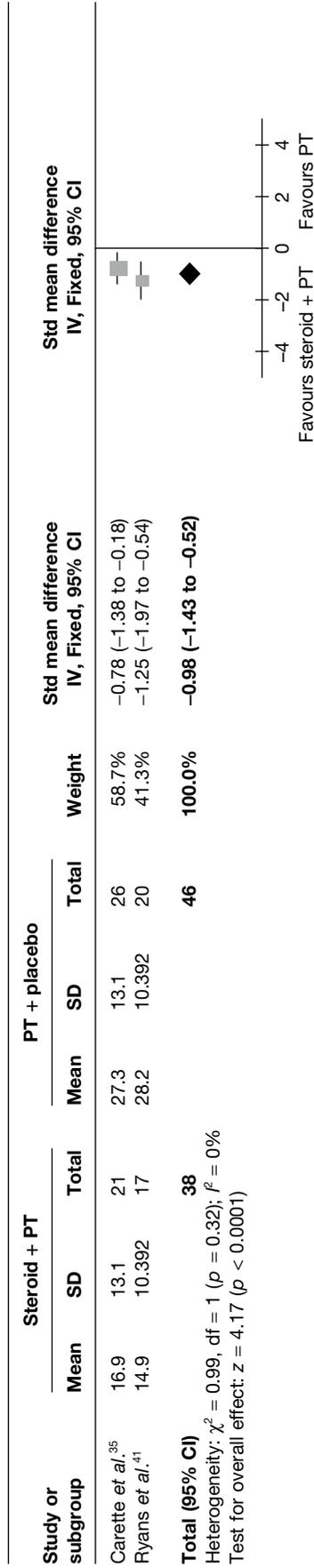
FIGURE 6 Standardised mean difference at up to 3 months (sensitivity analysis): steroid combined with physiotherapy vs physiotherapy combined with placebo.

Study or subgroup	Steroid + PT			Steroid			Weight	Std mean difference IV, Fixed, 95% CI	Std mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	16.9	13.1	21	22.1	13.1	23	58.8%	−0.39 (−0.99 to 0.21)	
Ryans et al.[41]	14.9	10.392	17	28.2	10.392	20	41.2%	−1.25 (−1.97 to −0.54)	
Total (95% CI)			38			43	100.0%	**−0.75 (−1.20 to −0.29)**	

Heterogeneity: $\chi^2 = 3.30$, df = 1 ($p = 0.07$); $I^2 = 70\%$
Test for overall effect: z = 3.19 ($p = 0.001$)
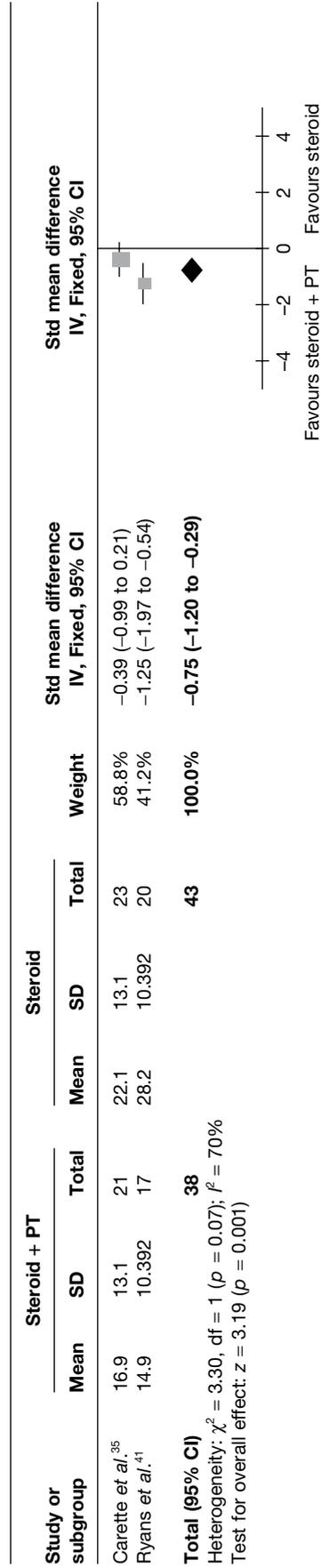
FIGURE 7 Standardised mean difference at up to 3 months: steroid combined with physiotherapy vs steroid.

TABLE 8 Pain results from studies of steroid injections (SMD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months
Steroid vs placebo			
Bal 2008[68]	−0.05 (−0.55 to 0.45)[a]		
Carette 2003[35]	−1.55 (2.22 to −0.89)[b]		
	−1.27 (−1.91 to −0.63)[c,d]		
Ryans 2005[41]	−1.00 (−1.71 to −0.28)[b,d]		
Steroid vs physiotherapy + placebo			
Carette 2003[35]	−0.94 (−1.53 to −0.35)[b]		
	−0.39 (−0.96 to 0.18)[c]		
Ryans 2005[41]	−0.01 (−0.66 to 0.64)[b]		
Steroid + physiotherapy vs placebo			
Carette 2003[35]	−2.36 (−3.15 to −1.58)[b]		
	−1.66 (−2.35 to −0.96)[c,d]		
Ryans 2005[41]	−2.24 (−3.11 to −1.36)[b,d]		
Steroid + physiotherapy vs physiotherapy + placebo			
Carette 2003[35]	−1.75 (−2.43 to −1.07)[b]		
	−0.78 (−1.38 to −0.18)[c,d]		
Rizk 1991[42]	0.18 (−0.45 to 0.80)[e]	0.06 (−0.56 to 0.68)[f]	
Ryans 2005[41]	−1.25 (−1.97 to −0.54)[b,d]		
Steroid + physiotherapy vs steroid			
Carette 2003[35]	−0.81 (−1.43, -0.19)[b]		
	−0.39 (−0.99 to 0.21)[c]		
Ryans 2005[41]	−1.25 (−1.97 to −0.54)[b,d]		

a　Reported at 12 weeks.
b　Reported at 6 weeks.
c　Reported at 3 months.
d　Statistically significant, i.e. the CI did not cross the line of no effect (zero).
e　Reported at 11 weeks.
f　Reported at 24 weeks.

Both studies reported 3-month follow-up and were pooled at this time point, although it should be noted that the study by Bal *et al.*[68] was at high risk of bias. When the two studies were pooled (*Figure 8*) statistical heterogeneity was high ($I^2 = 80\%$); therefore, the treatment effect should be treated with considerable caution. The study by Carette *et al.*[35] reported a significantly greater decrease in SPADI total score in the steroid group than in the placebo and home exercise group (MD −16.10, 95% CI −30.26 to −1.94), whereas in the Bal *et al.* study[68] the treatment effect was in favour of placebo and home exercise, although the CIs crossed the line of no effect. Only Carette *et al.*[35] reported SPADI total score for medium- and long-term follow-up; there was no significant difference between groups for these later follow-up times (*Table 10*).

Carette *et al.*[35] reported SPADI 8-item disability subscale score at 6 weeks and found a significant effect in favour of the steroid injection group (MD −13.80, 95% CI −27.53 to −0.07).

As with SPADI total score, the same two studies reported SPADI 8-item disability subscale score and were available for meta-analysis at 3 months.[35,68] Again, the pooled treatment effect should be treated with considerable caution because of high heterogeneity (*Figure 9*). Carette *et al.*[35]

TABLE 9 Function and disability outcomes in studies evaluating steroid injections

Study	Function and disability outcomes assessed	Data reported and time of follow-up
Bal 2008[68]	UCLA Shoulder score (35-point scale: < 28 poor, 29–33 good, 34–35 excellent as defined by the authors)	Change from baseline at 12 weeks
	SPADI total score (0–100)[a]	
	SPADI 8-item disability subscale (0–100)[a]	
Calis 2006[66]	Constant score	Final value data at 15 days and 3 months (3-month data used in analysis)
Carette 2003[35]	SPADI total score (0–100)[a]	Change from baseline at 6 weeks and 3, 6 and 12 months[b]
	SPADI 8-item disability subscale (0–100)[a]	
Ryans 2005[41]	Shoulder Disability Questionnaire (SDQ) (0–22)[a,c] (score ≥ 5 was defined by authors as significant disability)	Change from baseline at 6 and 16 weeks
	Self-assessed global function (100-mm VAS, 0–100)[a]	

UCLA, University of California Los Angeles, CA, USA.
a   Higher scores indicated worse outcomes.
b   All analyses adjusted for gender.
c   Also known as Crofts score.

reported a significantly greater decrease in SPADI 8-item subscale score in the steroid group than with placebo and home exercise (MD –14.30, 95% CI –28.03 to –0.57), whereas in the Bal *et al.* study[68] the treatment effect was in favour of placebo and home exercise, although the CIs crossed the line of no effect.

Only Carette *et al.*[35] reported SPADI 8-item subscale score for medium- and long-term follow-up; there was no significant difference between groups for this outcome (*Table 10*).

Ryans *et al.*[41] reported results of the Shoulder Disability Questionnaire (SDQ) and global function at 6 and 16 weeks. There was no significant difference between the steroid group and the placebo group at either time point for either outcome (*Table 10*). Bal *et al.*[68] reported University of California Los Angeles (UCLA) Shoulder score with steroid injection versus placebo and both groups were similar at the 3-month follow-up [steroid group median 32.5, interquartile range (IQR) 6.2; placebo group median 31.5, IQR 7.7; no *p*-value reported].

Steroid versus home exercise
Calis *et al.*[66] reported Constant score for short-term follow-up; steroid injection was associated with a significantly better outcome than home exercise alone (MD 9.10, 95% CI 2.98 to 15.22).

Steroid versus physiotherapy
Calis *et al.*[66] compared steroid with physiotherapy (without placebo injection) using the Constant score. At 3 months there was no significant difference between the two treatment groups (MD –5.80, 95% CI –11.80 to 0.20).

Steroid versus physiotherapy combined with placebo
Two studies compared steroid with physiotherapy plus placebo injection.[35,41] One study reported SPADI total score[35] and the other the SDQ and a global function score.[41]

There was a significantly greater improvement in SPADI total score in the steroid group than in the physiotherapy group at 6 weeks in the study by Carette *et al.*[35] (MD –14.50, 95% CI –28.25 to –0.75), but not at 3 months or for medium- and long-term follow-up or in the SPADI 8-item disability subscale score between treatment groups at any follow-up time in the same study

Study or subgroup	Steroid			Placebo			Weight	Mean difference IV, Fixed, 95% CI	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Bal et al.[68]	-44.4	24	40	-48.2	16.3	24	67.2%	3.80 (-6.09 to 13.69)	
Carette et al.[35]	-45.5	24.5	23	-29.4	24.5	23	32.8%	-16.10 (-30.26 to -1.94)	
Total (95% CI)			63			47	100.0%	-2.73 (-10.84 to 5.38)	
Heterogeneity: χ^2 = 5.10, df = 1 (p = 0.02); I^2 = 80%									
Test for overall effect: z = 0.66 (p = 0.51)									
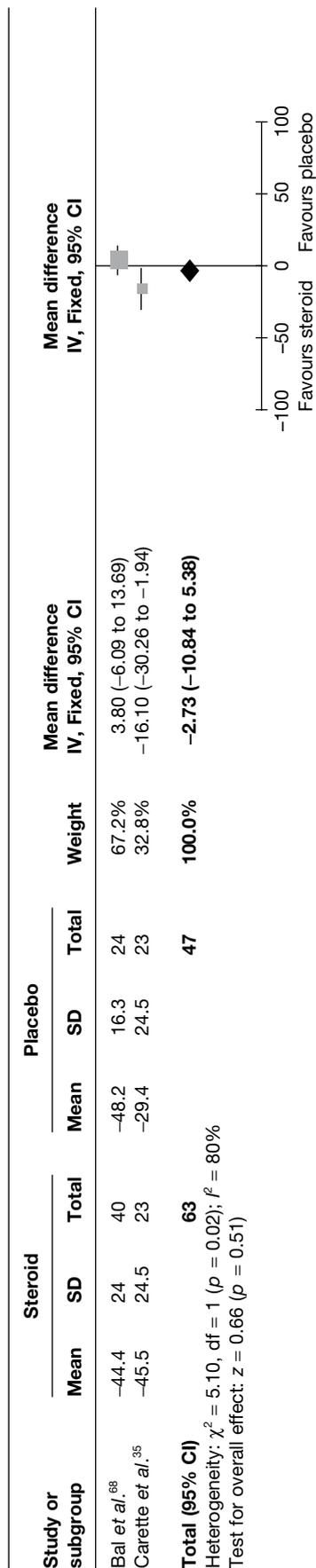
FIGURE 8 Shoulder Pain and Disability Index total score at 3 months: steroid vs placebo.

Study or subgroup	Steroid			Placebo			Weight	Mean difference IV, Fixed, 95% CI	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Bal et al.[68]	-42.2	26.3	40	-49.8	18.8	24	60.5%	7.60 (-3.49 to 18.69)	
Carette et al.[35]	-43	24	23	-28.7	23.5	23	39.5%	-14.30 (-28.03 to -0.57)	
Total (95% CI)			63			47	100.0%	-1.05 (-9.68 to 7.58)	
Heterogeneity: χ^2 = 5.92, df = 1 (p = 0.02); I^2 = 83%									
Test for overall effect: z = 0.24 (p = 0.81)									
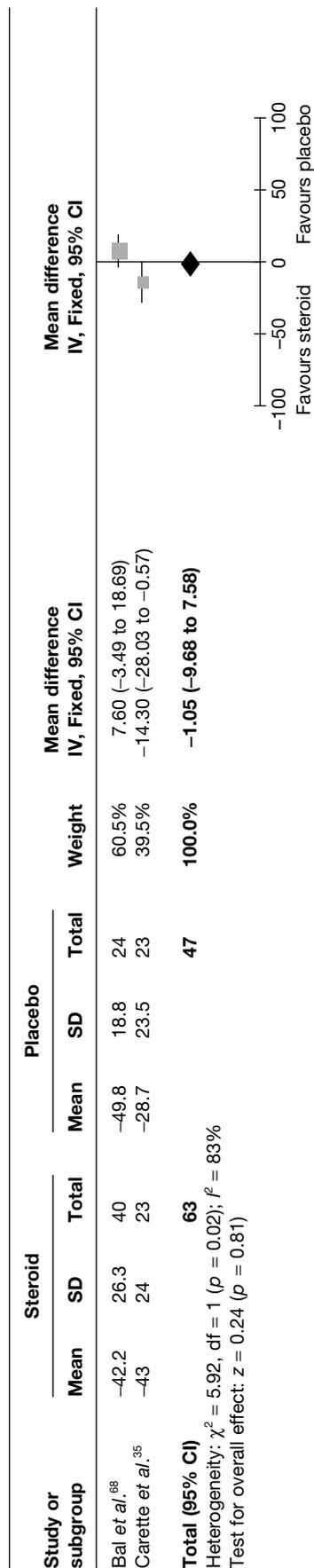
FIGURE 9 Shoulder Pain and Disability Index 8-item subscale score at 3 months: steroid vs placebo.

(*Table 10*).[35] There was also no significant difference between treatment groups in either SDQ or global function score at 6 or 16 weeks in the study by Ryans *et al.*[41]

Steroid combined with physiotherapy versus placebo

Two studies investigated steroid combined with physiotherapy versus placebo.[35,41] One study reported SPADI total score[35] and the other the SDQ and a global function score.[41]

There was a significant improvement in total SPADI score with steroid in combination with physiotherapy compared with placebo in the study by Carette *et al.*[35] at 6 weeks (MD –27.60, 95% CI –42.03 to –13.17) and 3 months (MD –21.00, 95% CI –35.43 to –6.57), although not at medium- (MD –14.10, 95% CI –28.53 to 0.33) or long-term follow-up (MD –1.10, 95% CI –15.53 to 13.33) (*Table 10*).[35] There was also a significant improvement in SPADI 8-item disability subscale score with steroid in combination with physiotherapy compared with placebo in the same study at 6 weeks (MD –23.90, 95% CI –37.89 to –9.91) and 3 months (MD –20.00, 95% CI –33.99 to –6.01) but not at medium- and long-term follow-up.

There was a significant improvement in both SDQ (MD –4.70, 95% CI –7.85 to –1.55) and global function score (MD –21.00, 95% CI –34.54 to –7.46) with steroid in combination with physiotherapy compared with placebo at 6 weeks in the study by Ryans *et al.*[41] At 16 weeks there was no significant difference between groups in this study (*Table 10*).

Steroid combined with physiotherapy versus physiotherapy combined with placebo

Two studies investigated the effect of steroid combined with physiotherapy versus physiotherapy (plus placebo injection) on function and disability using SPADI total score[35] and the SDQ and a global function score.[41]

There was a significant improvement in total SPADI score with steroid in combination with physiotherapy compared with physiotherapy in the study by Carette *et al.*[35] at 6 weeks (MD –24.30, 95% CI –38.33 to –10.27), although not at 3 months (MD –12.50, 95% CI –26.53 to 1.53) or for medium- and long-term follow-up (*Table 10*).[35] Similarly, there was a significant improvement in SPADI 8-item disability subscale score with steroid in combination with physiotherapy compared with physiotherapy in the same study at 6 weeks (MD –21.60, 95% CI –35.34 to –7.86) but not at any of the other follow-up points.[35]

Ryans *et al.*[41] also showed a significant improvement in SDQ score with steroid combined with physiotherapy compared with physiotherapy at 6 weeks (MD –4.30, 95% CI –7.76 to –0.84) but not at 16 weeks, and there was no significant difference in global function score at either follow-up time.

Steroid combined with physiotherapy versus steroid

Two studies compared steroid injection followed by physiotherapy with steroid alone. One study reported a SPADI total score and SPADI 8-item disability subscale score;[35] another study reported SDQ and global function score.[41]

There was no significant difference between treatment groups in SPADI total or SPADI 8-item disability subscale score at short-, medium- or long-term follow-up in the study by Carette *et al.*,[35] or between treatment groups in either SDQ or global function for short- or medium-term follow-up in the study by Ryans *et al.* (*Table 10*).[41]

TABLE 10 Function and disability results of studies of steroid injections (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Steroid vs placebo			
SPADI total score			
Bal 2008[68]	3.80 (–6.09 to 13.69)[a]		
Carette 2003[35]	–17.8 (–31.96 to –3.64)[b,c]	–12.90 (–27.06 to 1.26)[d]	–2.90 (–17.06 to 11.26)[e]
	–16.10 (–30.26 to –1.94)[a,b]		
SPADI 8-item subscale			
Bal 2008[68]	7.60 (–3.49 to 18.69)[a]		
Carette 2003[35]	–13.80 (–27.53 to –0.07)[b,c]	–7.10 (–20.83 to 6.63)[d]	0.80 (–12.93 to 14.53)[e]
	–14.30 (–28.03 to –0.57)[a,b]		
SDQ			
Ryans 2005[41]	–3.00 (–6.44 to 0.44)[c]	–1.20 (–5.63 to 3.23)[f]	
Global function			
Ryans 2005[41]	–11.60 (–27.11 to 3.91)[c]	5.10 (–15.92 to 26.12)[f]	
UCLA Shoulder score			
Bal 2008[68]	Steroid: median 32.5 (IQR 6.2)[a]		
	Placebo: median 31.5 (IQR 7.7)[a]		
	No *p*-value		
Steroid vs home exercise			
Constant score			
Calis 2006[66]	9.10 (2.98 to 15.22)[a,b]		
Steroid vs physiotherapy			
Constant score			
Calis 2006[66]	–5.80 (11.80 to 0.20)[a]		
Steroid vs physiotherapy + placebo			
SPADI total score			
Carette 2003[35]	–14.50 (–28.25 to –0.75)[c]	–8.20 (–21.95 to 5.55)[d]	–4.60 (–18.35 to 9.13)[e]
	–7.60 (–21.35 to 6.15)[a]		
SPADI 8-item subscale			
Carette 2003[35]	–11.50 (–24.97 to 1.97)[c]	–5.30 (–18.77 to 8.17)[d]	–2.60 (–16.07 to 10.87)[e]
	–5.30 (–18.77 to 8.17)[a]		
SDQ			
Ryans 2005[41]	–2.60 (–6.32 to 1.12)[c]	–2.20 (–6.49 to 2.09)[f]	
Global function			
Ryans 2005[41]	–2.30 (–18.68 to 14.08)[c]	7.10 (–13.43 to 27.63)[f]	
Steroid + physiotherapy vs placebo			
SPADI total score			
Carette 2003[35]	–27.60 (–42.03 to –13.17)[b,c]	–14.10 (–28.53 to 0.33)[d]	–1.10 (–15.53 to 13.33)[e]
	–21.00 (–35.43 to –6.57)[a,b]		

TABLE 10 Function and disability results of studies of steroid injections (MD and 95% CI) (*continued*)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
SPADI 8-item subscale			
Carette 2003[35]	−23.90 (−37.89 to −9.91)[b,c] −20.00 (−33.99 to −6.01)[a,b]	−11.60 (−25.59 to 2.39)[d]	0.30 (−13.69 to 14.29)[e]
SDQ			
Ryans 2005[41]	−4.70 (−7.85 to −1.55)[b,c]	−1.00 (−5.12 to 3.12)[f]	
Global function			
Ryans 2005[41]	−21.00 (−34.54 to −7.46)[b,c]	1.50 (−17.96 to 20.96)[f]	
Steroid + physiotherapy vs physiotherapy + placebo			
SPADI total score			
Carette 2003[35]	−24.30 (−38.33 to −10.27)[b,c] −12.50 (−26.53 to 1.53)[a]	−9.40 (−23.43 to 4.63)[d]	−2.80 (−16.83 to 11.23)[e]
SPADI 8-item subscale			
Carette 2003[35]	−21.60 (−35.34 to −7.86)[b,c] −11.00 (−24.74 to 2.74)[a]	−9.80 (−23.54 to 3.94)[d]	−3.10 (−16.84 to 10.64)[e]
SDQ			
Ryans 2005[41]	−4.30 (−7.76 to −0.84)[b,c]	−2.00 (−5.96 to 1.96)[f]	
Global function			
Ryans 2005[41]	−11.70 (−26.22 to 2.82)[c]	3.50 (−15.42 to 22.42)[f]	
Steroid + physiotherapy vs steroid			
SPADI total score			
Carette 2003[35]	9.80 (−4.63 to 24.23)[c] 4.9 (−9.53 to 19.33)[a]	1.20 (−13.23 to 15.63)[d]	−1.8 (−16.23 to 12.63)[e]
SPADI 8-item subscale			
Carette 2003[35]	10.10 (−4.04 to 24.24)[c] 5.70 (−8.44 to 19.84)[a]	4.50 (−9.64 to 18.64)[d]	0.50 (−13.64 to 14.64)[e]
SDQ			
Ryans 2005[41]	1.70 (−2.37 to 5.77)[b]	−0.20 (−4.43 to 4.03)[f]	
Global function			
Ryans 2005[41]	9.40 (−4.93 to 23.73)[c]	3.60 (−15.49 to 22.69)[f]	

a   Reported at 3 months or 12 weeks.
b   Statistically significant, i.e. the CI did not cross the line of no effect (zero).
c   Reported at 6 weeks.
d   Reported at 6 months.
e   Reported at 12 months.
f   Reported at 16 weeks.

Range of movement

The range of movement measurements of interest in the review were external rotation, internal rotation and abduction (both passive and active); if internal rotation was not available but hand behind back was reported, this was used as a proxy measure. Five studies reported at least one of these measures (*Table 11*). Change from baseline data was available from three of these studies[35,41,68] and final value data was available from one study.[66] A fifth study, by Rizk *et al.*,[42] reported only means with no measures of variance or *p*-values with which to impute SDs. *Table 12* provides the between-group differences in means and 95% CIs. The outcome data for the individual groups in the included trials are available in *Appendix 7*.

Steroid versus placebo

One study by Bal *et al.*[68] reported passive internal rotation at 12 weeks. There was a significantly greater improvement in the placebo group compared with steroid injection (MD –28.50°, 95% CI –41.56° to –15.44°). This result contradicts the original analysis in the paper, which reported that there was no statistically significant difference between the two groups, using the Mann–Whitney *U*-test.

Three studies reported passive external rotation at short-term follow-up, two at 6 weeks[35,41] and two at 3 months.[35,68] Improvement in passive external rotation was significantly greater with steroid injection than with placebo injection at 6 weeks (pooled MD 9.48°, 95% CI 2.76° to 16.19°; two RCTs) (*Figure 10*). There was no significant heterogeneity between these studies ($I^2 = 0\%$)

Meta-analysis of the two studies that reported passive external rotation at 3 months showed no significant difference between the steroid and the placebo groups (*Figure 11*)[35,68] This pooled result was associated with substantial heterogeneity ($I^2 = 80\%$) and should therefore be treated with caution. The study by Carette *et al.*[35] showed a significant improvement in passive external rotation in the steroid group compared with placebo whereas the study by Bal *et al.*[68] showed no significant difference between groups (*Table 11*). There were several possible sources of heterogeneity, in particular differences in the risk of bias.

Two RCTs reported passive external rotation for medium-term follow-up: 16 weeks[41] and 6 months.[35,41] There was no significant difference between steroid and placebo groups in passive external rotation (MD 4.67°, 95% CI –2.21° to 11.55°) (*Figure 12*). There was some evidence of

TABLE 11 Range of movement (ROM) outcomes in studies evaluating steroid injections

Study	ROM outcomes assessed[a]	Data reported and time of follow-up
Bal 2008[68]	Passive internal rotation (°), passive external rotation (°), passive abduction (°)	Change from baseline at 12 weeks
Calis 2006[66]	Passive abduction (°), passive external rotation (°)	Final value data at 15 days and 3 months (3-month data used in analysis)
Carette 2003[35]	Passive external rotation (°), passive abduction (°), hand behind back (cm)	Change from baseline at 6 weeks and 3, 6 and 12 months[b]
Rizk 1991[42]	Passive internal rotation (°), passive external rotation (°) and passive abduction (°)	Mean only (no measure of variance) for weeks 1–11, 15 weeks and 6 months (6 weeks, 11 weeks and 6 months used in analysis)[c]
Ryans 2005[41]	Passive external rotation (°)	Change from baseline at 6 and 16 weeks

a   Higher ROM indicates better outcome (appears to be measured in degrees but not specifically stated).
b   All analyses adjusted for gender.
c   Means only reported, SDs calculated if possible.

Study or subgroup	Steroid			Placebo			Weight	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	18.3	16.3	23	7.1	16.3	23	50.8%	11.20 (1.78 to 20.62)
Ryans et al.[41]	14.3	15.2	17	6.6	13.2	17	49.2%	7.70 (−1.87 to 17.27)
Total (95% CI)			40			40	100.0%	9.48 (2.76 to 16.19)
Heterogeneity: χ^2 = 0.26, df = 1 (p = 0.61); I^2 = 0%								
Test for overall effect: z = 2.77 (p = 0.006)								
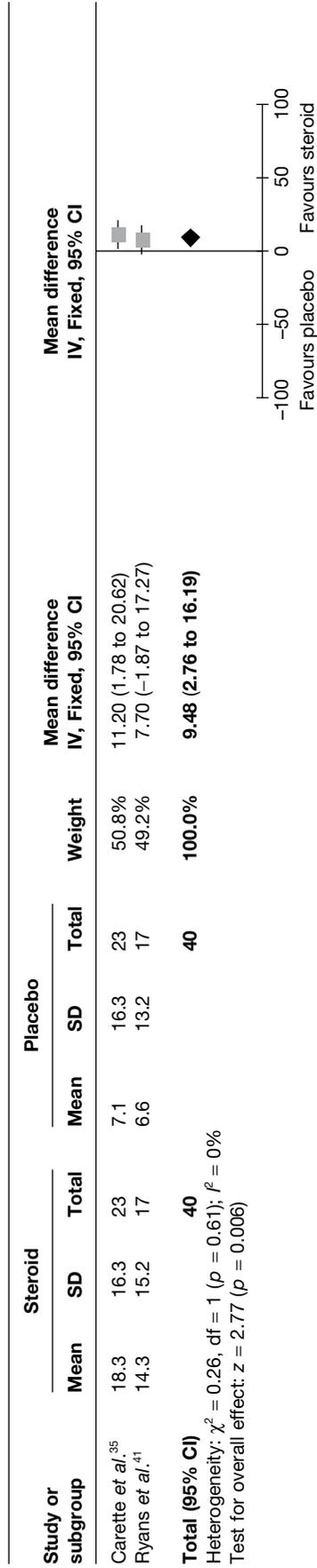
FIGURE 10 Passive external rotation at 6 weeks: steroid vs placebo.

Study or subgroup	Steroid			Placebo			Weight	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Bal et al.[68]	27.4	19.5	40	31.2	20.1	24	46.7%	−3.80 (−13.86 to 6.26)
Carette et al.[35]	25.5	16.3	23	13.4	16.3	23	53.3%	12.10 (2.68 to 21.52)
Total (95% CI)			63			47	100.0%	4.67 (−2.21 to 11.55)
Heterogeneity: χ^2 = 5.11, df = 1 (p = 0.02); I^2 = 80%								
Test for overall effect: z = 1.33 (p = 0.18)								
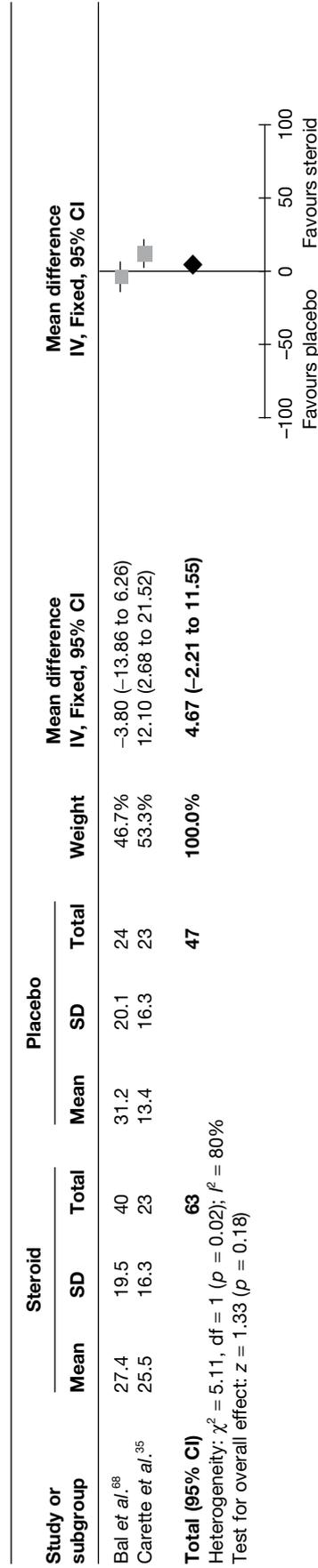
FIGURE 11 Passive external rotation at 3 months: steroid vs placebo.

moderate statistical heterogeneity ($I^2 = 43\%$). Both studies appeared clinically similar although the follow-up time points differed. Carette *et al.*[35] was the only study to examine passive external rotation at long-term follow-up and found no significant difference between steroid and placebo groups (*Table 12*).[35]

Carette *et al*[35] reported passive abduction and hand behind back at 6 weeks and 3, 6 and 12 months. There was no significant difference between groups at any of the time points for either outcome (*Table 11*).

Steroid versus home exercise
Calis *et al.*[66] reported passive abduction and passive external rotation at 3 months. There was a significantly greater improvement in the steroid group compared with home exercise alone in both passive abduction (MD 16.80°, 95% CI 6.60° to 27.00°) and passive external rotation (MD 8.00°, 95% CI 2.48° to 13.52°).

Steroid versus physiotherapy
Calis *et al.*[66] reported passive external rotation and passive abduction at 3 months. There was significantly greater passive external rotation at 3 months with physiotherapy than with steroid (MD –10.80°, 95% CI –16.94° to –4.66°). There was no significant difference between treatment groups for passive abduction (*Table 12*).

Steroid versus physiotherapy combined with placebo
Three studies reported passive external rotation at time points up to 3 months.[35,41,66] Two of the studies involved physiotherapy sessions over 12 weeks and in both physiotherapy groups a placebo injection was also given.[35,41] Both studies reported data at 6 weeks and one[35] reported data at 3 months; 6-week data were pooled. There was no significant difference in passive external rotation between groups at 6 weeks (*Figure 13*). There was substantial statistical heterogeneity between the studies ($I^2 = 64\%$).

Carette *et al.*[35] reported passive external rotation, and passive abduction at 3 months. There was no significant difference between treatment groups for both outcomes (*Table 12*).

Medium-term follow-up data were available for the studies by Carette *et al.*[35] and Ryans *et al.*[41] Carette *et al.*[35] reported passive external rotation at 6 months and Ryans *et al.*[41] at 16 weeks. There was no significant difference between groups (*Figure 14*). There was no significant difference between groups in passive external rotation at 12 months in the Carette *et al.* study.[35] Similarly, the same study showed no significant difference between treatment groups in passive abduction or hand behind back at medium- or long-term follow-up (*Table 12*).

Steroid combined with physiotherapy versus placebo
Two studies reported passive external rotation at time points up to 3 months.[35,41] Both studies reported data at 6 weeks and one[35] reported data at 3 months. Data at 6 weeks were pooled. The meta-analysis (*Figure 15*) indicated that passive external rotation was significantly greater with steroid injection plus physiotherapy than with placebo injection at 6 weeks (pooled MD 16.99°, 95% CI 10.01° to 23.97°).

Passive external rotation was significantly greater with steroid injection plus physiotherapy than with placebo injection at 3 months (MD 17.60°, 95% CI 7.90° to 27.30°) in the study by Carette *et al.*[35]

Medium-term follow-up data were also available up to 6 months: Carette *et al.*[35] reported passive external rotation at 6 months and Ryans *et al.*[41] at 16 weeks. The pooled estimate showed that

Study or subgroup	Steroid			Placebo			Weight	Mean difference IV, Fixed, 95% CI	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	29.5	16.3	23	20.8	16.3	23	70.8%	8.70 (−0.72 to 18.12)	
Ryans et al.[41]	19.1	19.2	13	22.2	18.2	12	29.2%	−3.10 (−17.76 to 11.56)	
Total (95% CI)			**36**			**35**	**100.0%**	**5.25 (−2.67 to 13.18)**	

Heterogeneity: $\chi^2 = 1.76$, df = 1 ($p = 0.18$); $I^2 = 43\%$
Test for overall effect: z = 1.30 ($p = 0.19$)
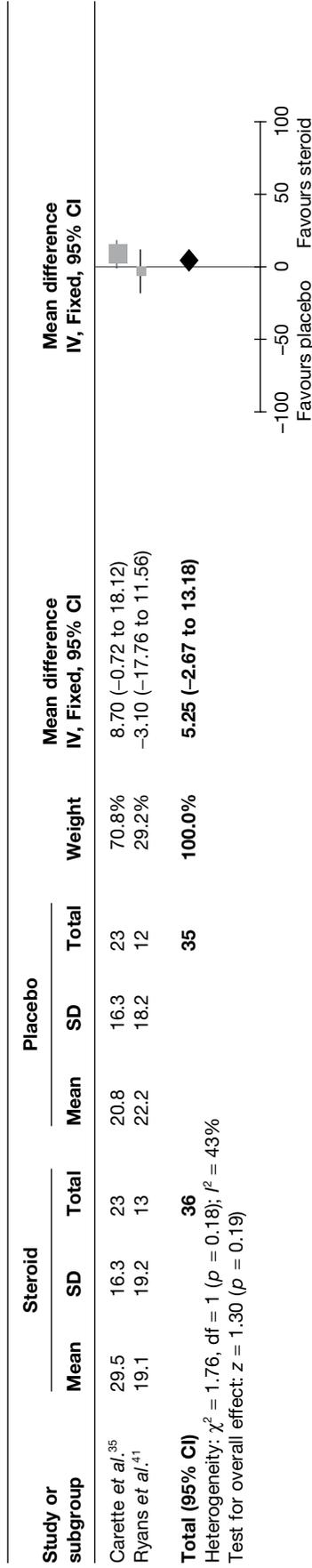
FIGURE 12 Passive external rotation at up to 6 months: steroid vs placebo.

Study or subgroup	Steroid			PT + Placebo			Weight	Mean difference IV, Fixed, 95% CI	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	18.3	16.3	23	9.6	16.3	26	50.6%	8.70 (−0.44 to 17.84)	
Ryans et al.[41]	14.3	15.2	17	16.7	13.2	20	49.4%	−2.40 (−11.66 to 6.86)	
Total (95% CI)			**40**			**46**	**100.0%**	**3.22 (−3.29 to 9.72)**	

Heterogeneity: $\chi^2 = 2.80$, df = 1 ($p = 0.09$); $I^2 = 64\%$
Test for overall effect: z = 0.97 ($p = 0.33$)
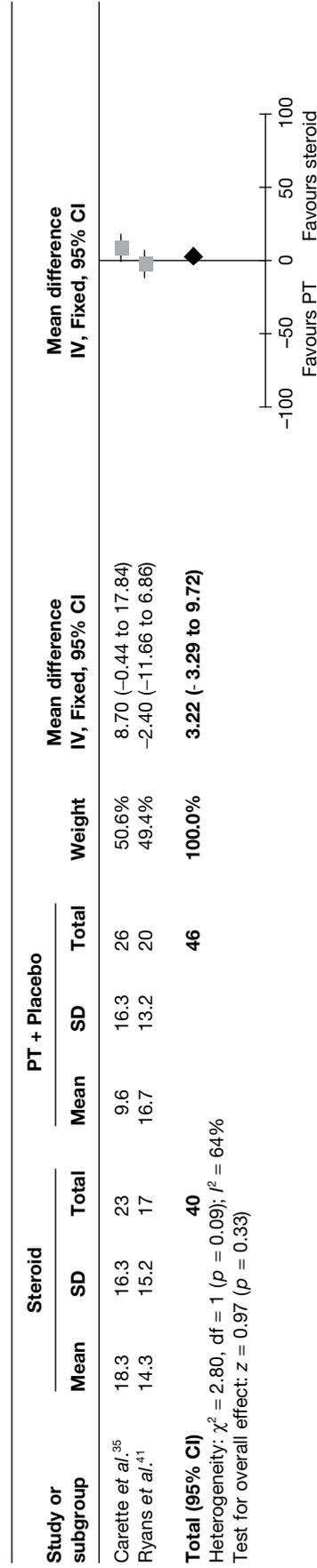
FIGURE 13 Passive external rotation at 6 weeks: steroid vs physiotherapy combined with placebo.

Study or subgroup	Steroid			PT + Placebo			Weight	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	29.5	16.3	23	23	16.3	26	65.1%	6.50 (−2.64 to 15.64)
Ryans et al.[41]	19.1	19.2	13	18	14	16	34.9%	1.10 (−11.39 to 13.59)
Total (95% CI)			36			42	100.0%	4.62 (−2.76 to 11.99)

Heterogeneity: $\chi^2 = 0.47$, df = 1 ($p = 0.49$); $I^2 = 0\%$
Test for overall effect: z = 1.23 ($p = 0.22$)
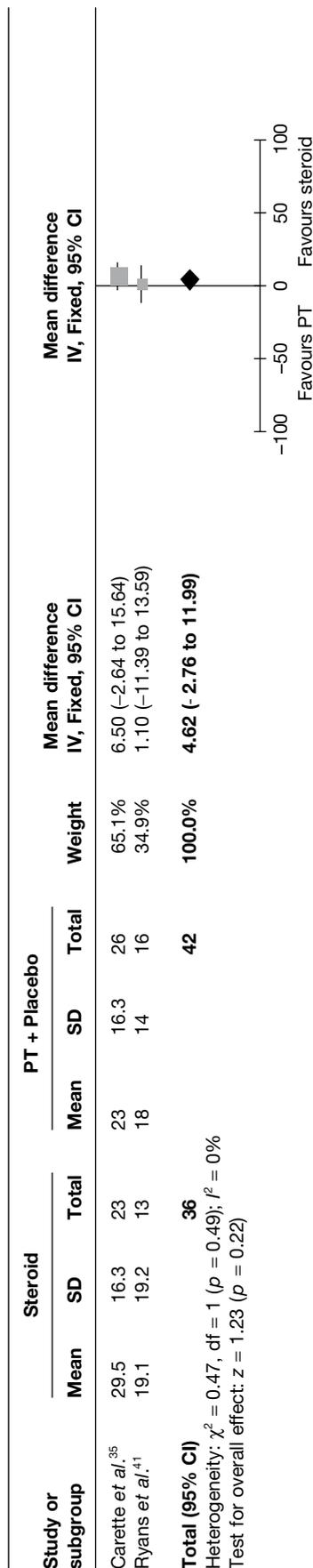
FIGURE 14 Passive external rotation at up to 6 months: steroid vs physiotherapy combined with placebo.

Study or subgroup	Steroid + PT			Placebo			Weight	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	26.5	16.5	21	7.1	16.3	23	51.7%	19.40 (9.70 to 29.10)
Ryans et al.[41]	21	16.5	17	6.6	13.2	17	48.3%	14.40 (4.36 to 24.44)
Total (95% CI)			38			40	100.0%	16.99 (10.01 to 23.97)

Heterogeneity: $\chi^2 = 0.49$, df = 1 ($p = 0.48$); $I^2 = 0\%$
Test for overall effect: z = 4.77 ($p < 0.00001$)
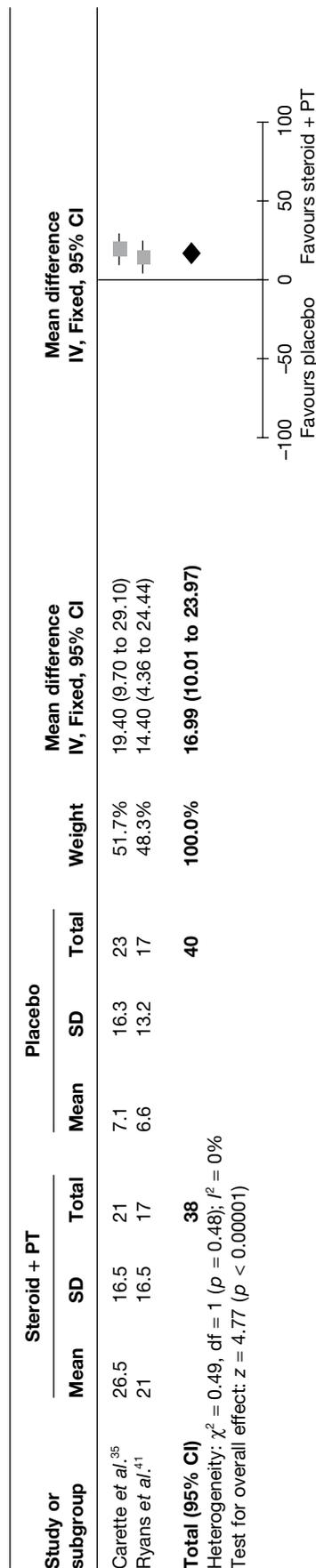
FIGURE 15 Passive external rotation at 6 weeks: steroid combined with physiotherapy vs placebo.

passive external rotation was significantly greater with steroid injection plus physiotherapy than with placebo injection at medium-term follow-up (pooled MD 8.14°, 95% CI 0.18° to 16.09°); however, there was substantial statistical heterogeneity ($I^2 = 70\%$) (*Figure 16*). There were a number of possible sources of heterogeneity including the dose of steroid used, different length of follow-up and the proportion of participants with diabetes. There was no significant difference between groups at 12 months in the single study reporting long-term follow-up (*Table 12*).[35]

Carette *et al.*[35] reported passive abduction at 6 weeks and 3, 6 and 12 months. Improvement of passive abduction was significantly greater in the steroid plus physiotherapy group than with placebo injection at 6 weeks (MD 15.30°, 95% CI 7.14° to 23.46°), 3 months (MD 16.30°, 95% CI 8.14° to 24.46°) and 6 months (MD 13.00°, 95% CI 4.84° to 21.16°). There was no significant difference between treatment groups at 12 months (*Table 12*).

In the same study there was a significantly greater improvement in hand behind back for the steroid with physiotherapy group than with placebo injection at 6 weeks (MD –9.00 cm, 95% CI –15.80 cm to –2.20 cm) and 3 months (MD –7.10 cm, 95% CI –13.90 cm to –0.30 cm), but not at any of the other time points (*Table 12*).

Steroid combined with physiotherapy versus physiotherapy combined with placebo

Three studies reported passive external rotation at time points up to 3 months.[35,41,42] All studies reported data at 6 weeks[35,41,42] and two also reported data at 3 months.[35,42] Because of SDs not being available for one study,[42] data were pooled from two of the studies for 6-week follow-up.[35,41] The increase in passive external rotation was significantly greater with steroid injection plus physiotherapy than with physiotherapy (plus placebo injection) at 6 weeks (pooled MD 10.80°, 95% CI 4.02° to 17.58°) (*Figure 17*). There was moderate to high heterogeneity between the studies ($I^2 = 70\%$); the results of this analysis should therefore be considered with caution.
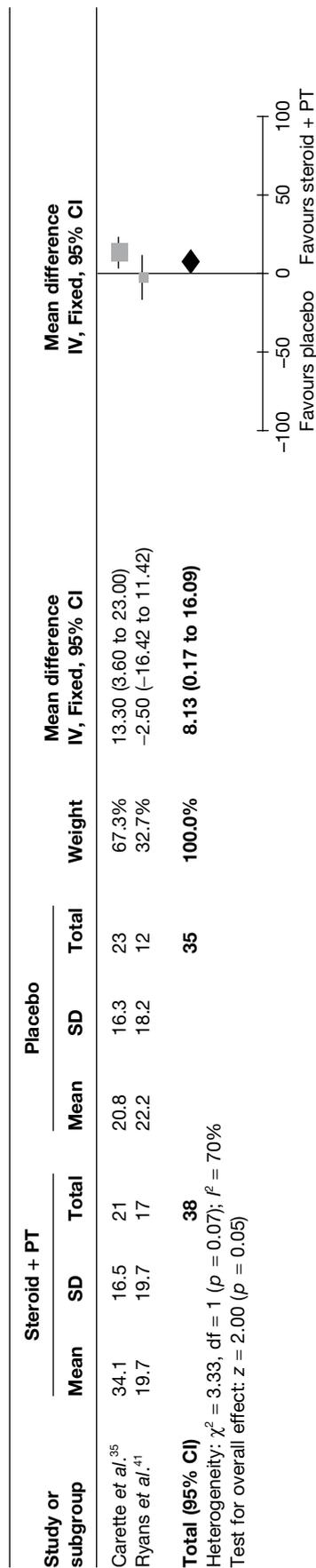
The study by Carette *et al.*[35] also showed that the increase in passive external rotation was significantly greater with steroid injection plus physiotherapy than with physiotherapy at 3 months (MD 13.00°, 95% CI 3.56° to 22.44°).

Medium-term data were also available from Carette *et al.*[35] and Ryans *et al.*[41] The pooled estimate (*Figure 18*) showed that passive external rotation was significantly greater with steroid injection plus physiotherapy than with physiotherapy at up to 6 months (pooled MD 7.36°, 95% CI 0.04° to 14.68°). The study by Carette *et al.*[35] showed no significant difference between groups at 12 months (*Table 12*).

Carette *et al.*[35] reported passive abduction at 6 weeks and 3, 6 and 12 months. Improvement of passive abduction was significantly greater in the steroid plus physiotherapy group than with physiotherapy at 6 weeks (MD 11.30°, 95% CI 3.40° to 19.20°), 3 months (MD 10.40°, 95% CI 2.50° to 18.30°) and 6 months (MD 7.90°, 95% CI –0.00° to 15.80°). There was no significant difference between treatment groups at 12 months (*Table 12*).

Steroid versus steroid and physiotherapy

Two studies reported passive external rotation for short-term follow-up;[35,41] both studies reported data at 6 weeks and one[35] reported data at 3 months; the 6-week data were pooled. Passive external rotation was significantly greater with steroid injection plus physiotherapy than with steroid alone at 6 weeks (pooled MD –7.52°, 95% CI –14.70° to –0.34°). This analysis was not associated with statistical heterogeneity ($I^2 = 0\%$) (*Figure 19*). The study by Carette *et al.*[35] showed no significant difference between treatment groups at 3 months (*Table 12*).

Study or subgroup	Steroid + PT			Placebo			Weight	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	34.1	16.5	21	20.8	16.3	23	67.3%	13.30 (3.60 to 23.00)
Ryans et al.[41]	19.7	19.7	17	22.2	18.2	12	32.7%	−2.50 (−16.42 to 11.42)
Total (95% CI)			38			35	100.0%	8.13 (0.17 to 16.09)

Heterogeneity: $\chi^2 = 3.33$, df = 1 ($p = 0.07$); $I^2 = 70\%$
Test for overall effect: $z = 2.00$ ($p = 0.05$)

FIGURE 16 Passive external rotation at up to 6 months: steroid combined with physiotherapy vs placebo.

Study or subgroup	Steroid + PT			PT + Placebo			Weight	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	26.5	16.5	21	9.6	16.3	26	51.6%	16.90 (7.46 to 26.34)
Ryans et al.[41]	21	16.5	17	16.7	13.2	20	48.4%	4.30 (−5.45 to 14.05)
Total (95% CI)			38			46	100.0%	10.80 (4.02 to 17.58)

Heterogeneity: $\chi^2 = 3.31$, df = 1 ($p = 0.07$); $I^2 = 70\%$
Test for overall effect: $z = 3.12$ ($p = 0.002$)
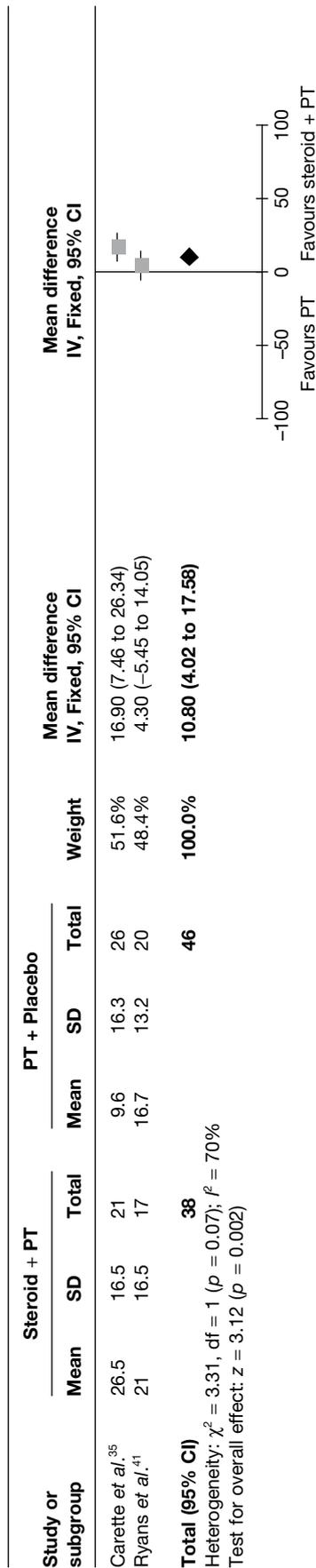
FIGURE 17 Passive external rotation at 6 weeks: steroid combined with physiotherapy vs physiotherapy combined with placebo.

| Study or subgroup | Steroid + PT | | | PT + Placebo | | | Weight | Mean difference IV, Fixed, 95% CI |
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	34.1	16.5	21	23	16.3	26	60.2%	11.10 (1.66 to 20.54)
Ryans et al.[41]	19.7	19.7	17	18	14	16	39.8%	1.70 (−9.91 to 13.31)
Total (95% CI)			**38**			**42**	**100.0%**	**7.36 (0.04 to 14.68)**

Heterogeneity: $\chi^2 = 1.52$, df = 1 ($p = 0.22$); $I^2 = 34\%$
Test for overall effect: z = 1.97 ($p = 0.05$)
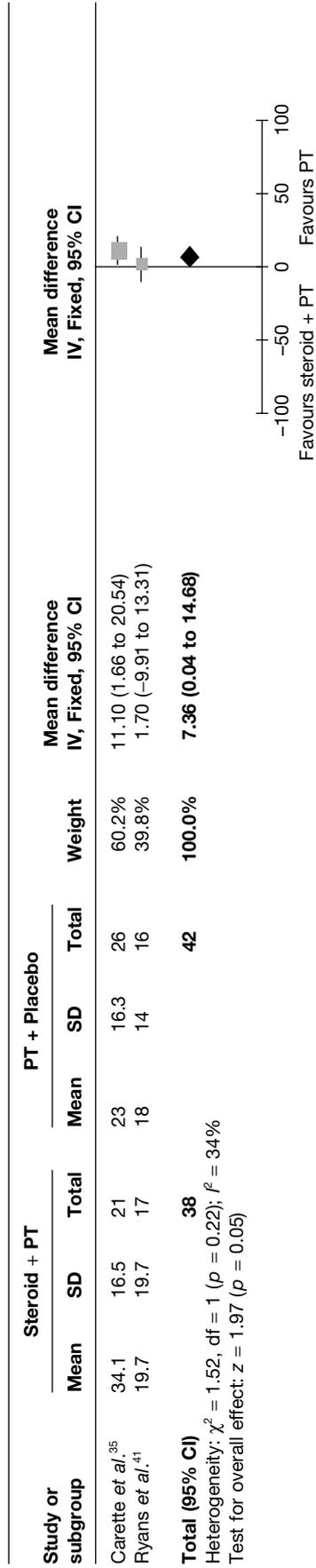
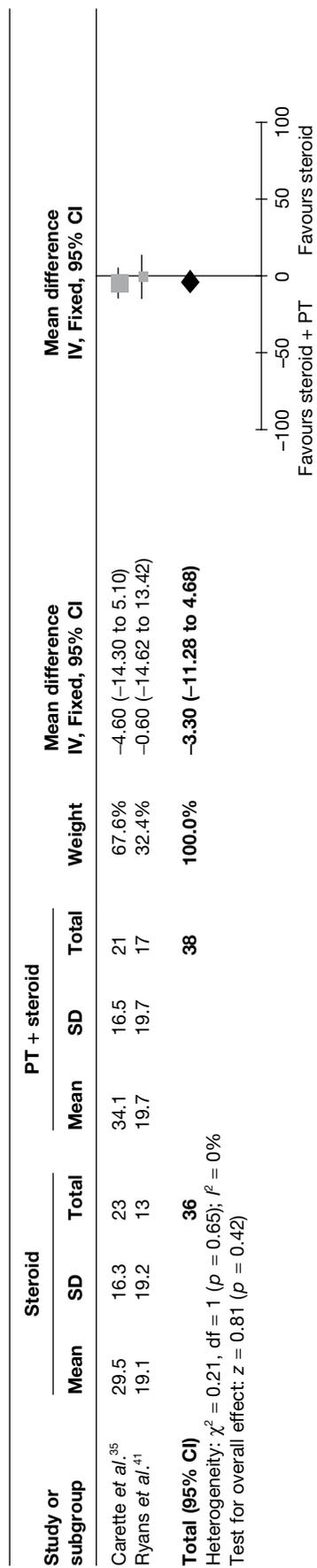

FIGURE 18 Passive external rotation at up to 6 months: steroid combined with physiotherapy versus physical therapy combined with placebo.

| Study or subgroup | Steroid | | | PT + steroid | | | Weight | Mean difference IV, Fixed, 95% CI |
	Mean	SD	Total	Mean	SD	Total		
Carette et al.[35]	18.3	16.3	23	26.5	16.5	21	54.7%	−8.20 (−17.90 to 1.50)
Ryans et al.[41]	14.3	15.2	17	21	16.5	17	45.3%	−6.70 (−17.36 to 3.96)
Total (95% CI)			**40**			**38**	**100.0%**	**− 7.52 (− 14.70 to − 0.34)**

Heterogeneity: $\chi^2 = 0.04$, df = 1 ($p = 0.84$); $I^2 = 0\%$
Test for overall effect: z = 2.05 ($p = 0.04$)
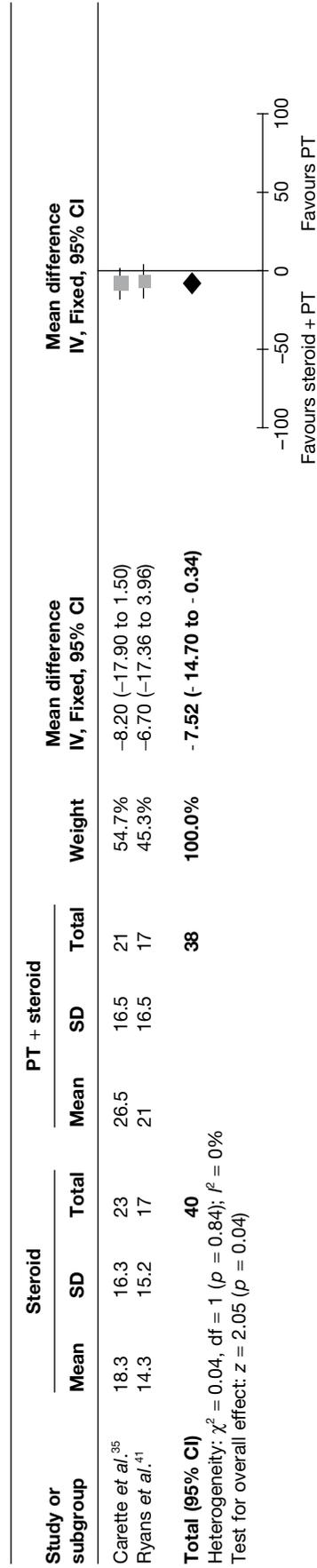
FIGURE 19 Passive external rotation at 6 weeks: steroid versus steroid and physiotherapy.

Study or subgroup	Steroid			PT + steroid			Weight	Mean difference IV, Fixed, 95% CI	Mean difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total			
Carette et al.[35]	29.5	16.3	23	34.1	16.5	21	67.6%	−4.60 (−14.30 to 5.10)	
Ryans et al.[41]	19.1	19.2	13	19.7	19.7	17	32.4%	−0.60 (−14.62 to 13.42)	
Total (95% CI)			**36**			**38**	**100.0%**	**−3.30 (−11.28 to 4.68)**	

Heterogeneity: $\chi^2 = 0.21$, df = 1 ($p = 0.65$); $I^2 = 0\%$
Test for overall effect: $z = 0.81$ ($p = 0.42$)

FIGURE 20 Passive external rotation at up to 6 months: steroid versus steroid and physiotherapy.

TABLE 12 Range of movement results of studies of steroid injections (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Steroid vs placebo			
Passive internal rotation (°)			
Bal 2008[68]	−28.50 (−41.56 to −15.44)[a,b]		
Passive external rotation (°)			
Bal 2008[68]	−3.80 (−13.86 to 6.26)[a]		
Carette 2003[35]	11.20 (1.78 to 20.62)[b,c] 12.10 (2.68 to 21.52)[a,b]	8.70 (−0.72 to 18.12)[d]	0.40 (−9.02 to 9.82)[e]
Ryans 2005[41]	7.70 (−1.87 to 17.27)[c]	−3.10 (−17.76 to 11.56)[f]	
Passive abduction (°)			
Bal 2008[68]	3.60 (−10.90 to 18.10)[a]		
Carette 2003[35]	7.20 (−0.83 to 15.23)[c] 12.30 (4.27 to 20.33)[a]	7.80 (−0.23 to 15.83)[d]	−1.20 (−9.23 to 6.83)[e]
Hand behind back (cm)			
Carette 2003[35]	−0.50 (−7.15 to 6.15)[c] −1.10 (−7.75 to 5.55)[a]	−0.50 (−7.15 to 6.15)[d]	2.80 (−3.85 to 9.4)[e]
Steroid vs home exercise			
Passive external rotation (°)			
Calis 2006[66]	8.00 (2.48 to 13.52)[a,b]		
Passive abduction (°)			
Calis 2006[66]	16.80 (6.60 to 27.00)[a,b]		
Steroid vs physiotherapy			
Passive external rotation (°)			
Calis 2006[66]	−10.80 (−16.94 to −4.66)[a,b]		
Passive abduction (°)			
Calis 2006[66]	−8.10 (−19.07 to 2.87)[a]		
Steroid vs physiotherapy + placebo			
Passive external rotation (°)			
Carette 2003[35]	8.70 (−0.44 to 17.84)[c] 7.50 (−1.64 to 16.64)[a]	6.50 (−2.64 to 15.64)[d]	−0.80 (−9.94 to 8.34)[e]
Ryans 2005[41]	−2.40 (−11.66 to 6.86)[c]	1.10 (−11.39 to 13.59)[f]	
Passive abduction (°)			
Carette 2003[35]	3.20 (−4.57 to 10.97)[c] 6.40 (−1.37 to 14.17)[a]	2.70 (−5.07 to 10.47)[d]	−1.90 (−9.67 to 5.87)[e]
Hand behind back (cm)			
Carette 2003[35]	−0.80 (−7.30 to 5.70)[c] 0.10 (−6.40 to 6.60)[a]	0.70 (−5.80 to 7.20)[d]	2.90 (−3.60 to 9.40)[e]

TABLE 12 Range of movement results of studies of steroid injections (MD and 95% CI) (*continued*)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Steroid + physiotherapy vs placebo			
Passive external rotation (°)			
Carette 2003[35]	19.40 (9.70 to 29.10)[b,c] 17.60 (7.90 to 27.30)[a,b]	13.30 (3.60 to 23.00)[b,d]	7.60 (−2.10 to 17.30)[e]
Ryans 2005[41]	−2.50 (−16.42 to 11.42)[c]	−2.50 (−16.42 to 11.42)[f]	
Passive abduction (°)			
Carette 2003[35]	15.30 (7.14 to 23.46)[b,c] 16.30 (8.14, 24.46)[a,b]	13.00 (4.84 to 21.16)[b,d]	5.70 (−2.46, 13.86)[e]
Hand behind back (cm)			
Carette 2003[35]	−9.00 (−15.80 to −2.20)[b,c] −7.10 (−13.90 to −0.30)[a,b]	−5.90 (−12.70 to 0.90)[d]	−1.50 (−8.30 to 5.30)[e]
Steroid + physiotherapy vs physiotherapy + placebo			
Passive external rotation (°)			
Carette 2003[35]	16.90 (7.46 to 26.34)[b,c] 13.00 (3.56 to 22.44)[a,b]	11.10 (1.66 to 20.54)[b,d]	6.40 (−3.04 to 15.84)[e]
Ryans 2005[41]	4.30 (−5.45 to 14.05)[c]	1.70 (−9.91 to 13.31)[f]	
Passive abduction (°)			
Carette 2003[35]	11.30 (3.40 to 19.20)[b,c] 10.40 (2.50 to 18.30)[a,b]	7.90 (−0.00 to 15.80)[d]	5.00 (−2.90 to 12.90)[e]
Hand behind back (cm)			
Carette 2003[35]	−9.30 (−15.96 to −2.64)[b,c] −5.90 (−12.56 to 0.76)[a,b]	−4.70 (−11.36 to 1.96)[d]	−1.40 (−8.06 to 5.26)[e]
Steroid + physiotherapy vs steroid			
Passive external rotation (°)			
Carette 2003[35]	−8.20 (−17.90 to 1.50)[c] −5.50 (−15.20 to 4.20)[a]	−4.60 (−14.30 to 5.1)[d]	−7.20 (−16.90 to 2.50)[e]
Ryans 2005[41]	−6.70 (−17.36 to 3.96)[b,c]	−0.60 (−14.62 to 13.42)[f]	
Passive abduction (°)			
Carette 2003[35]	−8.10 (−16.26 to 0.06)[c] −4.00 (−12.16 to 4.16)[a]	−5.20 (−13.36 to 2.96)[d]	−6.90 (−15.06 to 1.26)[e]
Hand behind back (cm)			
Carette 2003[35]	8.50 (1.70 to 15.30)[b,c] 6.00 (−0.80 to 12.80)[a]	5.40 (−1.40 to 12.20)[d]	4.30 (−2.50 to 11.10)[e]

a　Reported at 3 months or 12 weeks.
b　Statistically significant, i.e. the CI did not cross the line of no effect (zero).
c　Reported at 6 weeks.
d　Reported at 6 months.
e　Reported at 12 months.
f　Reported at 16 weeks.

Data were also available for medium-term follow-up for the same two studies. The pooled analysis showed no significant difference between groups and the analysis was not associated with statistical heterogeneity ($I^2 = 0\%$) (*Figure 20*). The study by Carette *et al.*[35] showed no significant difference between treatment groups at long-term follow-up (*Table 12*).

Carette *et al.*[35] reported passive abduction at 6 weeks and 3, 6 and 12 months. At 6 weeks improvement of passive abduction was significantly greater in the steroid plus physiotherapy group than with steroid alone (MD –8.10, 95% CI –16.26 to 0.06); there were no significant differences between treatment groups at later follow-up times (*Table 12*).

Similarly, for hand behind back, there was a significantly better improvement in the steroid with physiotherapy group than with steroid alone at 6 weeks (MD 8.50, 95% CI 1.70 to 15.30) but not at later follow-up (*Table 12*).

Quality of life

Only Carette *et al.*[35] reported quality of life data following treatment (*Table 13*).[35] *Table 14* provides between-group differences in means and associated 95% CIs. Further outcome data can be found in *Appendix 7*.

There was a statistically significant improvement in the physical component of the SF-36 with steroid plus physiotherapy compared with placebo at 6 months (MD 7.10, 95% CI 0.86 to 13.34). There was no statistically significant difference between these two groups at any of the other time points evaluated.

There was a statistically significant improvement with steroid plus physiotherapy compared with physiotherapy (plus placebo injection) in the physical component at 6 weeks (MD 5.30, 95% CI 0.03 to 10.57) and in the mental component at 6 months (MD 8.20, 95% CI 1.98 to 14.42) and 12 months (MD 6.90, 95% CI 0.68 to 13.12). There was no statistically significant difference between these two treatments groups at any of the other time points evaluated.

For the comparisons steroid compared with placebo, steroid compared with physiotherapy (plus placebo injection) and steroid compared with physiotherapy plus steroid, the study by Carette *et al.*[35] showed no statistically significant difference between treatment groups at any of the time points evaluated.

TABLE 13 Quality of life outcomes in studies that evaluated steroid injections

Study	QoL outcomes assessed	Data reported and time point before and closest to 3 and 6 months
Carette 2003[35]	SF-36 physical component SF-36 mental component	Change from baseline at 6 weeks and 3, 6 and 12 months[a]
Ryans 2005[41]	SF-36 scores: physical function, role limitation physical, role limitation mental, social functioning, mental health, vitality, bodily pain, health perception, change in health	Baseline data only reported

SF-36, Short Form questionnaire-36 items.
a   All analyses adjusted for gender.

TABLE 14 Quality of life results of studies of steroid injections (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Steroid vs placebo			
SF-36 physical component			
Carette 2003[35]	1.90 (–3.36 to 7.16)[a] 5.10 (–0.16 to 10.36)[b]	3.30 (–1.96 to 8.56)[c]	1.00 (–4.26 to 6.26)[d]
SF-36 mental component			
Carette 2003[35]	–1.10 (–7.23 to 5.03)[a] 1.00 (–5.13 to 7.13)[b]	1.70 (–5.34 to 8.74)[c]	0.30 (–5.83 to 6.43)[d]
Steroid vs physiotherapy			
SF-36 physical component			
Carette 2003[35]	3.30 (–1.97 to 8.57)[a] 3.70 (–1.57 to 8.97)[b]	1.00 (–4.27 to 6.27)[c]	1.70 (–3.57 to 6.97)[d]
SF-36 mental component			
Carette 2003[35]	–0.50 (–6.61 to 5.61)[a] –1.60 (–7.71 to 4.51)[b]	2.80 (–3.31 to 8.91)[c]	1.10 (–5.01 to 7.21)[d]
Steroid combined with physiotherapy vs placebo			
SF-36 physical component			
Carette 2003[35]	3.90 (–1.36 to 9.16)[a] 3.60 (–1.66 to 8.86)[b]	2.00 (–3.26 to 7.26)[c]	1.40 (–3.86 to 6.66)[d]
SF-36 mental component			
Carette 2003[35]	3.10 (–3.14 to 9.34)[a] 5.40 (–0.84 to 11.64)[b]	7.10 (0.86 to 13.34)[c,e]	6.10 (–0.14 to 12.34)[d]
Steroid combined with physiotherapy vs physiotherapy			
SF-36 physical component			
Carette 2003[35]	5.30 (0.03 to 10.57)[a,e] 2.20 (–3.07 to 7.47)[b]	–0.30 (–5.57 to 4.97)[c]	2.10 (–3.17 to 7.37)[d]
SF-36 mental component			
Carette 2003[35]	3.70 (–2.52 to 9.92)[a] 2.80 (–3.42 to 9.02)[b]	8.20 (1.98 to 14.42)[c,e]	6.90 (0.68 to 13.12)[d,e]
Steroid combined with physiotherapy vs steroid			
SF-36 physical component			
Carette 2003[35]	–2.00 (–7.26 to 3.26)[a] 1.50 (–3.76 to 6.76)[b]	1.30 (–3.96 to 6.56)[c]	–0.40 (–5.66 to 4.86)[d]
SF-36 mental component			
Carette 2003[35]	–4.20 (–10.44 to 2.04)[a] –4.40 (–10.64 to 1.84)[b]	–5.40 (–11.64 to 0.84)[c]	–5.80 (–12.04 to 0.44)[d]

a   Reported at 6 weeks.
b   Reported at 3 months or 12 weeks.
c   Reported at 6 months.
d   Reported at 12 months.
e   Statistically significant, i.e. the CI did not cross the line of no effect (zero).

TABLE 15 Adverse events in studies evaluating steroid injections

Study	Adverse events reported
Bal 2008[68]	No side effects were noted during the drug or exercise therapy sessions
Calis 2006[66]	Not reported
Carette 2003[35]	Not reported
Dacre 1989[67]	No patients had adverse reactions
Rizk 1991[42]	No withdrawals due to adverse effects
Ryans 2005[41]	Not reported

Adverse events

Three of the studies that investigated steroids reported adverse events.[42,67,68] There was a limited amount of information reported regarding adverse events in the included studies (*Table 15*). None of the studies reported any details regarding how adverse event data were collected or recorded; therefore, the data should be treated with caution. Two reported that no adverse effects were reported in any of the treatment groups[67,68] and one reported that there were no withdrawals due to adverse effects.[42]

Summary

The six included steroid injection studies were diverse in terms of the intervention: two used a single steroid injection of 20 mg, three a single injection of 40 mg and one used three injections of 40 mg administered over 3 weeks. Five of the studies reported using an intra-articular injection. There was also some variation between studies in the physiotherapy provided, although most of the studies used a programme of < 6 weeks' duration that included mobilisation and home exercise for all groups. Five of the studies were multi-armed trials. Steroid injection was compared with placebo in three studies, home exercise in one study and physiotherapy alone in four studies (with or without placebo). The effect of steroid injection followed by physiotherapy was also assessed. This combined intervention was compared with placebo, steroid alone and physiotherapy (with placebo) alone.

Information about previous treatments that participants had received and stage of frozen shoulder was limited. Outcomes were not reported by stage of frozen shoulder or by whether or not participants had diabetes. As a result, it was not possible to explore in the synthesis the effect of these variables on outcome. It was unclear whether four of the studies were truly randomised and therefore these studies had a potentially high risk of bias.[42,66–68] The fifth study was of adequate quality,[35] whereas the sixth was of reasonable quality but may have a risk of bias.[41]

For most of the comparisons, data were available from only one or two studies, which may have been underpowered to detect an effect. There were sufficient data to pool the two best-quality studies for some of the outcomes, although in some instances statistical heterogeneity was high. In addition, although both studies used a single intra-articular injection, one evaluated a guided injection of 40 mg of steroid[35] and the other used a 20-mg dose and the injection appeared to be unguided.[41] For most outcomes and comparisons it was necessary to undertake a narrative synthesis.

Steroid alone

There was evidence of short-term benefit with steroid injection compared with placebo for pain, function and disability, and range of movement but not quality of life. The evidence on function and disability was mixed and this may reflect differences in study quality and/or clinical differences. There was also evidence of short-term benefit with steroid injection compared with

home exercise alone for function and disability and two measures of range of movement from one study with a potentially high risk of bias. There was no consistent evidence across outcomes for a benefit with steroid injection compared with physical therapy.

Steroid followed by physiotherapy

There was consistent evidence across all outcomes (pain, function and disability, range of movement and quality of life) of a short-term benefit with steroid injection followed by physiotherapy compared with placebo or physiotherapy; however, this was based on a small number of studies. There was also evidence of better quality of life with the combined treatment in the medium term. When steroid injection plus physiotherapy was compared with steroid alone there was a short-term beneficial reduction in pain and a better range of movement at the 6-week follow-up with the combined intervention but not at 3 months or later and there was no benefit for any other outcomes.

In conclusion, a small number of diverse studies were identified, four of which had a potentially high risk of bias. Based on the best available evidence, there was a benefit, mainly short term, with a single steroid. There was an added benefit with providing physiotherapy in addition to steroid injection compared with home exercise alone and physiotherapy alone for several outcomes. There was also benefit with the combined intervention compared with steroid alone for pain and for range of movement at 6 weeks but not the other outcomes. There was insufficient evidence to conclude with reasonable certainty in what clinical situations steroid injection, with or without physiotherapy, is most likely to be effective for primary frozen shoulder.

Sodium hyaluronate

Study characteristics

Three RCTs investigated sodium hyaluronate in the treatment of primary frozen shoulder. A summary of the study characteristics is reported in *Table 16*. All were full papers of studies conducted in Turkey,[66] Italy[69] and Japan[70] between 1996 and 2006. There were two two-armed trials[69,70] and one four-armed trial.[66]

Calis *et al.*[66] used a 30-mg injection once weekly for 2 weeks, Takagishi *et al.*[70] used 2 mg injected once weekly for 5 weeks and Rovetta *et al.*[69] used 20 mg of sodium hyaluronate coadministered with 20 mg of steroid (triamcinolone acetonide) injected at 15-day intervals for the first month then monthly for 6 months and physical therapy (mobilisation or exercises) for 4–12 weeks. The comparators were steroid injection,[66,70] steroid injection and physiotherapy,[69] physiotherapy[66] and no intervention except for home exercise.[66]

Two of the three studies included physiotherapy.[66,69] Both studies differed in the duration and content of the regimen, but each contained some form of active exercise or mobilisation. Calis *et al.*[66] had a regimen of 10 daily sessions consisting of a heat pack applied for 20 minutes, ultrasonic therapy for 5 minutes (1.5 W/cm^2 intensity), TENS for 20 minutes at the patient's level of tolerance, and stretching exercises. In comparison, Rovetta *et al.*[69] had a 4- to 12-week regimen of the most appropriate therapy for the individual (passive mobilisation, active exercises and facilitation exercises), which was chosen by a physiotherapist. Only Calis *et al.*[66] reported that participants had a home exercise programme, which consisted of stretching and Codman exercises, but did not provide any further details.

Two studies reported that patients received concomitant treatments.[69,70] Rovetta *et al.*[69] allowed paracetamol (dose unspecified) to be taken if necessary, whereas Takagishi *et al.*[70] stated that participants who were using topical NSAIDs prior to commencing the study were allowed to continue to do so. Calis *et al.*[66] allowed paracetamol to be taken if necessary.

TABLE 16 Studies of sodium hyaluronate with or without physical therapy

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Calis 2006[66] Four-arm RCT	*n* = 90 (95 shoulders) Sodium hyaluronate injection: 24 (27) Steroid injection: 25 (26) PT: 21 (22) No intervention (home exercise only): 20 (20)	Sodium hyaluronate: 30 mg, one injection once weekly for 2 weeks Steroid: triamcinolone acetonide, 40 mg, one injection PT: 10 daily sessions at least 45 minutes	History of pain for at least 1 month; limited active and passive shoulder movement; decreased passive ROM of ≥ 20%, in at least three movements, according to the American Medical Association guide for the evaluation of permanent impairment
Rovetta 1998[69] Two-arm RCT	*n* = 30 Sodium hyaluronate + steroid injection + PT: 16 Steroid injections + PT: 14	Sodium hyaluronate: 20 mg at 15-day intervals in the first month, then monthly for 6 months Steroid: triamcinolone acetonide at 15-day intervals in the first month, then monthly for 6 months PT: for 4–12 weeks	Clinical history of spontaneous shoulder pain; glenohumeral abduction and forward flexion < 90°, external rotation < 20°; clinical absence of signs of rotator cuff interruption; cervical examination excluding dysfunction in this area; plain radiographs in standard views; sonographic examination showing shrinking of the joint capsule with increased capsular echogenicity
Takagishi 1996[70] Two-arm RCT	*n* = 20 Sodium hyaluronate: 10 Steroid injection: 10	Sodium hyaluronate: 2 mg, one injection once weekly for 5 weeks Steroid: dexamethasone, 2 mg, one injection once weekly for 5 weeks	Patients with frozen shoulder who have < 120° of shoulder joint flexion and those who suffer from pain on exercise of > 4 on the VAS and suffer from pain during night-time and daytime

PT, physiotherapy; ROM range of movement.

The inclusion criteria varied between the three studies. Rovetta *et al.*[69] reported that none of the participants had diabetes, whereas Calis *et al.*[66] and Takagishi *et al.*[69] did not report whether or not any of the participants had diabetes. Frozen shoulder was diagnosed through physical examination, laboratory tests, subacromial impingement test, clinical history, radiography or ultrasound when described. The method of diagnosis was unclear in one study.[70] The participants' stage of frozen shoulder at baseline was not reported in any of the studies and it was unclear whether participants had received any previous treatments. The mean age of participants ranged from 48 years to 65.8 years. The proportion of women ranged from 63% to 75%.

Quality assessment

None of the studies reported the method of randomisation or allocation concealment, and only one stated that blinded outcome assessment was performed; therefore, all three studies have a potentially high risk of bias. The study by Calis *et al.*[66] was of higher quality and fulfilled five criteria: the number of participants randomised, treatment groups that were comparable at baseline, blinded outcome assessors, use of intention-to-treat analysis and no unexpected imbalances in dropouts. Rovetta *et al.*[69] fulfilled two criteria, stating the number of participants randomised and also having treatment groups that were comparable at baseline, whereas Takagishi *et al.*[70] fulfilled only one criterion, which was stating the number of patients randomised. Full details of study quality are reported in *Appendix 8*.

Pain

All three studies evaluating sodium hyaluronate assessed pain; however, the study by Calis *et al.*[66] reported pain in graphical form and therefore could not be included in the analysis. Calis *et al.*[66] did, however, report that there was significant improvement in pain severity at 3 months within each of the treatment groups, including the no intervention group ($p < 0.001$). Rovetta *et al.*[69] and Takagishi *et al.*[70] both used a VAS but assessed different types of pain at different time points (*Table 17*); therefore, it was inappropriate to pool the two studies. *Table 18* provides the SMDs

TABLE 17 Pain outcomes in studies evaluating sodium hyaluronate

Study	Pain outcome assessed	Scale used	Data reported and time of follow-up
Calis 2006[66]	Pain severity	VAS	Data reported graphically only
Rovetta 1998[69]	Pain on passive joint motion	VAS 0–10 cm	Final value at 6 months
Takagishi 1996[70]	Pain on activity	VAS 0–10	Final value at 5 weeks

TABLE 18 Pain results of studies of sodium hyaluronate (SMD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Sodium hyaluronate combined with steroid and physiotherapy vs steroid combined with physiotherapy			
Rovetta 1998[69]		−0.78 (−1.50 to −0.06)[a,b]	
Sodium hyaluronate vs steroid			
Takagishi 1996[70]	−0.21 (−1.09 to 0.67)[c]		

a　Reported at 6 months.
b　Statistically significant, i.e. the CI did not cross the line of no effect (zero).
c　Reported at 5 weeks.

and 95% CIs. The outcome data for the individual groups in the included trials are available in *Appendix 7*.

Sodium hyaluronate versus steroid

Takagishi *et al.*[70] found no significant difference in pain at short-term follow-up with sodium hyaluronate compared with steroid (see *Table 18*).

Sodium hyaluronate combined with steroid and physiotherapy versus steroid combined with physiotherapy

Rovetta *et al.*[69] found a significant decrease in pain at 6 months with sodium hyaluronate combined with steroid and physiotherapy compared with steroid combined with physiotherapy (SMD −0.78, 95% CI −1.50 to −0.06).

Function and disability

Calis *et al.*[66] and Takagishi *et al.*[70] both assessed function and disability. Calis *et al.* assessed function and disability using the Constant score (*Table 19*), whereas Takagishi *et al.*[70] used a Japanese-specific activities of daily living questionnaire. However, Takagishi *et al.* reported baseline values and a *p*-value for the within-group change from baseline only and therefore could not be included in the analysis. *Table 20* provides the MD and 95% CIs. The outcome data for the individual groups in the included trial are available in *Appendix 7*.

At 3 months Calis *et al.*[66] found a significantly greater improvement in the Constant score with sodium hyaluronate compared with no treatment (MD 8.90, 95% CI 2.62 to 15.18), but no significant difference in Constant score between sodium hyaluronate and physiotherapy (MD −6.00, 95% CI −12.16 to 0.16) or between sodium hyaluronate and steroid injection (MD −0.20, 95% CI −5.86 to 5.46).

Range of movement

The range of movement measurements of interest were external rotation, internal rotation and abduction (both passive and active); if internal rotation was not available but hand behind back was reported, this was used as a proxy measure of active internal rotation. All three studies

TABLE 19 Function and disability outcomes in studies evaluating sodium hyaluronate

Study	Function and disability outcomes assessed	Data reported and time of follow-up
Calis 2006[66]	Constant score	Final values at 3 months
Takagishi 1996[70]	Activities of daily living questionnaire (Japanese specific)	Baseline data and *p*-value for within-group change from baseline only reported

TABLE 20 Function and disability results of sodium hyaluronate (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Sodium hyaluronate vs no treatment			
Constant score			
Calis 2006[66]	8.90 (2.62 to 15.18)[a,b]		
Sodium hyaluronate vs physiotherapy			
Constant score			
Calis 2006[66]	−6.00 (−12.16 to 0.16)[a]		
Sodium hyaluronate vs steroid			
Constant score			
Calis 2006[66]	−0.20 (−5.86 to 5.46)[a]		

a   Reported at 3 months.
b   Statistically significant, i.e. the CI did not cross the line of no effect (zero).

that evaluated sodium hyaluronate reported at least one of these measurements (*Table 21*). *Table 22* provides the between-group difference in means and 95% CIs. The outcome data for the individual groups in the included trials are available in *Appendix 7*.

Sodium hyaluronate versus no treatment
Calis *et al.*[66] reported passive external rotation and passive abduction at 3 months. There was a significantly greater improvement in the sodium hyaluronate group than in the no treatment group in both passive external rotation (MD 8.30°, 95% CI 2.52° to 14.08°) and passive abduction (MD 12.40°, 95% CI 0.14° to 24.66°).

Sodium hyaluronate versus physiotherapy
Calis *et al.*[66] reported passive external rotation and passive abduction at 3 months. There was significantly greater improvement in the physiotherapy group than in the sodium hyaluronate group in both passive external rotation (MD −10.50°, 95% CI −16.87° to −4.13°) and passive abduction (MD −12.50°, 95% CI −23.98° to −1.02°).

Sodium hyaluronate versus steroid
Calis *et al.*[66] reported passive external rotation and passive abduction at 3 months. There was no significant difference in passive external rotation or passive abduction between groups (see *Table 22*). Takagishi *et al.*[70] reported external rotation at 5 weeks. There was no significant difference between groups (see *Table 22*).

TABLE 21 Range of movement (ROM) outcomes in studies evaluating sodium hyaluronate injections

Study	ROM outcomes assessed (°)	Data reported at time points up to 3 and 6 months
Calis 2006[66]	Passive external rotation, passive abduction	Final values at 15 days and 3 months
Rovetta 1998[69]	Internal rotation, external rotation, abduction	Final values at 6 months
Takagishi 1996[70]	External rotation	Final values at 5 weeks

TABLE 22 Range of movement results of studies of sodium hyaluronate injections (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Sodium hyaluronate vs no treatment			
Passive external rotation (°)			
Calis 2006[66]	8.30 (2.52 to 14.08)[a,b]		
Passive abduction (°)			
Calis 2006[66]	12.40 (0.14 to 24.66)[a,b]		
Sodium hyaluronate vs physiotherapy			
Passive external rotation (°)			
Calis 2006[66]	−10.50 (−16.87 to −4.13)[a,b]		
Passive abduction (°)			
Calis 2006[66]	−12.50 (−23.98 to −1.02)[a,b]		
Sodium hyaluronate vs steroid			
Passive external rotation (°)			
Calis 2006[66]	0.30 (−5.92 to 6.52)[a]		
Passive abduction (°)			
Calis 2006[66]	−4.40 (−15.78 to 6.98)[a]		
External rotation (°)			
Takagischi 1996[70]	−2.00 (−21.25 to 17.28)[c]		
Sodium hyaluronate + steroid + physiotherapy vs steroid + physiotherapy			
Internal rotation (°)			
Rovetta 1998[69]		23.70 (13.44 to 33.96)[b,d]	
External rotation (°)			
Rovetta 1998[69]		−0.70 (−15.11 to 13.71)[d]	
Abduction (°)			
Rovetta 1998[69]		3.20 (−18.70 to 25.10)[d]	

a　Reported at 3 months.
b　Statistically significant i.e. the CI did not cross the line of no effect (zero).
c　Reported at 5 weeks.
d　Reported at 6 months.

Sodium hyaluronate with steroid and physiotherapy versus steroid with physiotherapy

One study, by Rovetta *et al.*,[69] reported internal rotation, external rotation and abduction at 6 months only. There was a significantly greater improvement in internal rotation with sodium hyaluronate combined with steroid and physiotherapy than with steroid combined with physiotherapy (MD 23.70°, 95% CI 13.44° to 33.96°). There was no significant difference in mean external rotation or mean abduction between groups (see *Table 22*).

Quality of life

None of the three studies that evaluated sodium hyaluronate assessed quality of life.

Adverse events

None of the three studies evaluating sodium hyaluronate reported whether or not participants experienced any adverse events.

Summary

The three included studies investigating sodium hyaluronate used variable doses and in one study sodium hyaluronate was combined with steroid injection and physiotherapy. Because of variations in outcomes reported and comparators used it was not possible to pool data in a meta-analysis. For most outcome measures data were available from a single study only. The studies did not report participants' stage of frozen shoulder or previous treatments received.

All of the studies had a potentially high risk of bias; none reported the method of randomisation and therefore it was unclear whether they were truly randomised. Because it was unclear whether all studies had enough participants to detect a statistically significant treatment effect, it should be kept in mind that where studies did not report a statistically significant benefit (i.e. the CI crossed the line of no difference) this should not be interpreted as evidence of no difference between the groups.

One study reported a medium-term benefit in pain outcome when sodium hyaluronate was added to steroid and physiotherapy. The same study also reported a significant benefit at medium-term follow-up for internal rotation but not for external rotation or abduction. Another study reported a benefit for function and disability with sodium hyaluronate compared with home exercise but not with physiotherapy or steroid. The same study reported significantly better short-term passive external rotation and abduction with sodium hyaluronate than with home exercise and physiotherapy but not steroid injection. A second study reported no evidence of a benefit for external rotation with sodium hyaluronate compared with steroid.

In conclusion, a small number of diverse studies of sodium hyaluronate were identified, all of which may have had a high risk of bias. There was insufficient evidence to make conclusions with any certainty about the effectiveness of sodium hyaluronate for primary frozen shoulder and in what situations it is likely to be effective.

Physical therapy

Study characteristics

Eleven RCTs and one controlled trial investigated various types of physical therapy in the treatment of primary frozen shoulder. A summary of the study characteristics is reported in *Table 23*, with further details available in *Appendix 6*. Eleven were full papers and one[71] was available in abstract form only. One was a Chinese-language paper.[72] The studies were published in the Netherlands,[40,73] Turkey,[51,66,74] Hong Kong,[75] Singapore,[76] Thailand,[77] Greece,[16] Taiwan,[78] China[72] and the UK[71] between 1994 and 2009. There were nine two-armed trials,[16,40,51,72–74,76–78] two three-armed trials[71,75] and one four-armed trial.[66]

TABLE 23 Studies including physical therapies

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Calis 2006[66] Four-arm RCT	*n* = 90 (95 shoulders) Sodium hyaluronate injection: 24 (27) Steroid injection: 25 (26); PT: 21 (22); No intervention (home exercise only): 20 (20)	Sodium hyaluronate: 30 mg, one injection once weekly for 2 weeks Steroid: triamcinolone acetonide, 40 mg, one injection PT: 10 daily sessions: heat pack applied for 20 minutes; ultrasonic therapy for 5 minutes (1.5 W/cm^2 intensity); TENS for 20 minutes; and stretching exercises	History of pain for at least 1 month; limited active and passive shoulder movement; decreased passive ROM of ≥ 20%, in at least three movements, according to the American Medical Association guide for the evaluation of permanent impairment
Diercks 2004[73] Two-arm controlled trial	*n* = 77 PT: 32 Supervised neglect: 45	PT: active PT; duration and frequency not reported Supervised neglect: education and home exercise within painless range	Idiopathic frozen shoulder using Lundberg criteria: > 50% motion restriction of the glenohumeral joint in all directions for at least 3 months
Dogru 2008[51] Two-arm RCT	*n* = 50 Ultrasound + PT: 25 Sham + PT: 25	Ultrasound + PT: active PT; 10 × 50-minute sessions over 2 weeks of superficial heat (heat packs) (20 minutes), ultrasound (10 minutes) and exercise programme (20 minutes) Sham ultrasound + PT: same as above except that the ultrasound machine was not switched to 'on'	Shoulder pain of at least 3 months' duration; at least 25% loss of shoulder motion in all planes; pain on motion of at least 40 mm on VAS
Dundar 2009[74] Two-arm RCT	*n* = 57 Continuous passive motion: 29 PT: 28	Continuous passive motion: 20 × 1-hour sessions over 4 weeks using an external motorised device Conventional PT: active PT, 20 × 1-hour sessions over 4 weeks	Frozen shoulder patients with gradually increasing shoulder pain and stiffness (painful phase and stiff phase)
Leung 2008[75] Three-arm RCT	*n* = 30 SWD + stretching: 10 Heat pack + stretching: 10 No intervention: 10	SWD + stretching: three 20-minute sessions per week for 4 weeks, machine frequency of 27.12 MHz, followed by stretching exercises Heat pack + stretching: superficial heat (63°C) with electrical heat pack; stretching exercises as above No intervention: home exercise only	Idiopathic frozen shoulder with shoulder pain and limited shoulder movement for at least 8 weeks
Maricar 1999[76] Two-arm RCT	*n* = 54 PT + exercise: 16[a] Exercise only: 16[a]	PT + exercise: active PT, eight weekly sessions and from week 5 a 15-minute exercise circuit of nine exercises Exercise only: 15-minute exercise circuit of nine exercises	Major complaint of limitation in shoulder range of motion with secondary complaint of pain; able to place arms behind head and back reaching vertebral column; 90-degree abduction (late stage 2 to stage 3)
Pajareya 2004[77] Two-arm RCT	*n* = 122 PT: 61 No intervention: 61	PT: SWD (20 minutes) + active PT three times a week for 3 weeks No intervention: information only	Shoulder pain and limitation of a passive range of shoulder motion in all directions that interfered with activities of daily living
Stergioulas 2008[16] Two-arm RCT	*n* = 74 Laser therapy: 37 Placebo laser: 37	Laser therapy: 12 sessions over 8 weeks: two per week in the first 4 weeks, then one per week Placebo laser: regimen as above	Painful and limited passive glenohumeral mobility; more restricted lateral rotation (< 8%) relative to abduction and medial rotation
Vermeulen 2006[40] Two-arm RCT	*n* = 100 HGMT: 49 LGMT: 51	HGMT: 30-minute session twice weekly for a maximum of 12 weeks consisting of 5-minute assessment of ROM in order to apply the mobilisation technique into the stiffness zone. Mobilisation techniques were applied with intensities according to Maitland grades III and IV LGMT: 30-minute session twice weekly for a maximum of 12 weeks consisting of 5-minute assessment of ROM in order to apply the mobilisation technique within the pain-free zone. Mobilisation techniques were performed according to Maitland grades I and II	≥ 50% loss of passive movement of shoulder joint relative to non-affected side, in one or more of three movement directions (abduction in frontal plane, forward flexion or external rotation); duration of complaints ≥ 3 months

TABLE 23 Studies including physical therapies (*continued*)

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Wies 2003[71] Three-arm RCT	*n* = 30 Osteopathy: 10 PT: 10 Control: 10	Osteopathy: the Niel-Asher technique, consisting of a progression of deep tissue manipulation, for 9 weeks PT: manual therapy and therapeutic exercise for 9 weeks Control: breathing exercises + massage + ROM exercises for 9 weeks	Patients with primary frozen shoulder
Yang 2007[78] Two-arm RCT	*n* = 30 (28 started) ERM + MRM: 14 MWM + MRM: 14	ERM + MRM: 30 minutes twice per week for 3 weeks each MWM + MRM: 30 minutes twice per week for 3 weeks each	Painful stiff shoulder for at least 3 months; ROM losses of at least 25% compared with the non-involved shoulder in at least two of glenohumeral flexion, abduction or medial or lateral rotation
Yan 2005[72] Two-arm RCT	*n* = 54 Dumb-bell gymnastics: 26 Barehanded exercises: 28	Dumb-bell gymnastics: 5–10 minutes, two to three times a day for 3 months using dumb-bells weighing 2–5 kg Barehanded exercises: performed for 3 months	'Standard shoulder periarthritis diagnostic criteria'

PT, physiotherapy; ROM, range of movement.
a   Number analysed in each group and number randomised not reported by group.

A variety of physical therapy regimens were used, most of which were physiotherapy modalities. These included various combinations of exercises (up to and beyond the pain threshold), stretching, manipulation of the glenohumeral joint, ultrasound, superficial heat, SWD, laser therapy, Codman's exercises, wall-climbing exercises, continuous passive motion, manual therapy, dumb-bell gymnastics and massage. For the purposes of the synthesis, the interventions were grouped based on whether or not at least one component involved mobilisation (of any type) under the supervision of a therapist. Therapies that involved some form of mobilisation (with or without other physical therapies) are described as active therapies. Studies using interventions such as laser therapy or TENS without any supervised mobilisation or exercise were classified as therapy without mobilisation.

Seven compared at least two forms of physical therapy.[40,71,72,74–76,78] One of the studies had what was described as a 'supervised neglect' intervention.[73] This study by Diercks and Stevens was the only study identified that explicitly used a supervised neglect intervention; therefore, this study was included although it was not a RCT.[73] Undertaken in the Netherlands, a physiotherapy intervention of unspecified duration was used that involved a standardised protocol, carried out by a therapist, of active exercises up to and beyond the pain threshold. The supervised neglect comparator involved providing patients with an explanation of the natural course of the disease and instructions not to exercise in excess of their pain threshold, to undertake pendulum exercises and active exercises within the painless range and to resume all activities that were tolerated. In the Calis *et al.* study, physiotherapy was compared with sodium hyaluronate and steroid injection;[66] and in the Pajareya *et al.* study, physiotherapy was compared with no intervention.[77]

A single study did not have an arm with an active mobilisation component. This study by Stergioulas[16] compared laser therapy with placebo laser (with home exercise). The remaining studies compared multiple active physical therapies. One compared ultrasound and physiotherapy with sham ultrasound and physiotherapy;[51] one compared 1-hour sessions of continuous passive motion with physiotherapy;[74] one compared osteopathy with physiotherapy and with breathing exercises, massage and range of movement exercises;[71] one compared

end-range mobilisation (ERM) and mid-range mobilisation (MRM) with mobilisation with movement (MWM) and MRM;[78] one compared passive joint mobilisations and exercises with exercises only;[76] one compared SWD plus stretching with heat pack plus stretching;[75] one compared dumb-bell gymnastics with barehanded exercises;[72] and one compared high-grade mobilisation techniques (HGMT) with low-grade mobilisation techniques (LGMT) (both followed by Codman pendular exercises).[40] All of the physiotherapy arms included an active mobilisation component. The intervention duration ranged from 2 weeks to 3 months.

Six studies reported that home exercise was used as part of the intervention, although details were limited in some studies. Where specified the home exercise routines included daily Codman and stretching exercises,[66] Codman, stretching and active range of movement exercises,[51] daily passive range of movement and pendulum exercises,[74] pendulum and pain-free exercises[16] and daily stretches.[75] Home exercise was discouraged in one study.[78] Analgesic use also differed between studies where reported. NSAIDs or other analgesics were prescribed when necessary in one study,[73] paracetamol was taken when necessary in another,[66] paracetamol was allowed to a maximum of 1000 mg daily in another,[51] 400 mg of ibuprofen was given daily for 3 weeks in one study[77] and prescribed and non-prescribed pain medication was allowed in one study.[40] No NSAIDs or other analgesics were allowed in one RCT, with a week washout period before the study commenced.[74]

The inclusion criteria varied between the studies. All included patients with some limitation of movement, although the extent of this varied where reported. Primary frozen shoulder was diagnosed through range of movement, biochemical analyses, radiography and clinical diagnosis where reported. Four studies did not report how frozen shoulder was diagnosed.[40,71,77,78] Three included participants with diabetes: 37% in the study by Dogru *et al.*,[51] 16% in the study by Vermeulen *et al.*[40] and 33% in the study by Pajareya *et al.*[77] Separate data were not presented for this subgroup. The mean duration of frozen shoulder at baseline ranged from 3 months to 6.8 years. The stage of frozen shoulder included was reported by few studies: stage 1 or 2 in the study by Dundar *et al.*,[74] 'stiff stage' in the studies by Yan[72] and Leung and Cheing[75] and late stage 2 or 3 in the study by Maricar and Chok.[76] Outcome was not reported separately by stage of frozen shoulder. Only one study, Vermeulen *et al.*,[40] reported on whether participants had received any previous treatment for frozen shoulder. In this study 81% of participants had previously received physical therapy, 61% steroid injections and 6% surgery. The proportion of female participants ranged from 20% to 86% and the mean age of participants ranged from 50 to 62.5 years.

Quality assessment
The quality of the studies was generally poor. Only one was of satisfactory quality, reporting the number randomised and both an appropriate method of randomisation and adequate allocation concealment.[78] This study by Yang *et al.* also met most of the remaining criteria including comparability at baseline, blinding of outcome assessors and intention-to-treat analysis; however, the study may not be adequately powered to detect significant differences between groups and there was a large number of dropouts (23%). The main limitation of this study was the study design for the purposes of our review; only limited data were suitable for inclusion in our analysis as different sequences of the three same mobilisations were compared at end of treatment (see *Appendix 6*).[78]

Leung and Cheing,[75] Stergioulas[16] and Vermeulen *et al.*[40] reported an appropriate method of randomisation; Leung and Cheing[75] and Vermeulen *et al.*[40] did not report whether an adequate method of allocation concealment was used; and Stergioulas[16] reported that allocation was performed using opaque envelopes but it was unclear whether the envelopes were numbered sequentially. Although these three studies fulfilled other criteria, such as comparability at baseline

and blinding of outcome assessors, there was still a possible risk of bias. Leung and Cheing[75] reported that there was no loss to follow-up and loss to follow-up was 15% in the Stergioulas study[16] (the majority in the laser group) and 4% in the Vermeulen study[40] (with equal numbers from each group). Vermeulen *et al.*[40] also used intention-to-treat analysis and was adequately powered for one outcome.

Calis *et al.*,[66] Dogru *et al.*,[51] Dundar *et al.*,[74] Pajareya *et al.*[77] and Yan[72] reported the number of participants randomised. It was unclear whether the method of assignment was truly random in any of these studies and allocation concealment was not reported; therefore, they potentially have high risk of bias. These studies also fulfilled few of the remaining criteria. Dogru *et al.*[51] and Calis *et al.*[66] reported blinding of outcome assessment. Dropouts were relatively high in the Pajareya study[77] (12%, the majority in the control group) and the reporting of satisfaction results was also unclear. There were no or very few dropouts in the Calis *et al.*,[66] Dogru *et al.*,[51] Yan[72] and Dundar *et al.*[74] studies. Calis *et al.*[66] also used intention-to-treat analysis.

The number of participants randomised was inconsistently reported in the study by Maricar and Chok.[76] Neither Maricar and Chok[76] or Wies *et al.*[71] reported the method of randomisation or allocation concealment, so were at high risk of bias. Few of the remaining criteria were met. Dropouts were high in the study by Maricar and Chok (41%)[76] and not reported by Wies *et al.*[71]

Allocation to groups was not randomised in the study by Diercks and Stevens[73] and met none of the quality criteria (including blinding of outcome assessment) except comparability at baseline (there were no significant differences in age, sex or duration of disease). This study was quasi-experimental with a successive cohort as the physical therapy group. This study was therefore at a high risk of bias. The paper reported that there was no loss to follow-up.

Pain

Six studies assessed pain (*Table 24*). The study by Pajareya *et al.*[77] reported analgesic use at 3 weeks only and was therefore excluded from the synthesis. Calis *et al.*[66] reported data in graphical form only; consequently, the SMD could not be calculated and this study could not be included in a meta-analysis. Calis *et al.*[66] did, however, report that there was significant improvement in pain severity at 3 months within both the physical therapy group and the no intervention group ($p < 0.001$).

The remaining four studies each evaluated different physical therapies using different comparators; therefore, it was not appropriate to pool the studies in a meta-analysis.[16,40,51,74]

TABLE 24 Pain outcomes in studies evaluating physical therapies

Study	Pain outcome assessed	Scale used	Data reported and time of follow-up
Calis 2006[66]	Pain severity	VAS	Data reported graphically only
Dogru 2008[51]	Pain overall	SPADI 5-item pain subscale	Final mean values at 2 weeks and 3 months
Dundar 2009[74]	Pain overall	SPADI 5-item pain subscale	Final mean values at 4 weeks and 12 weeks
Pajareya 2004[77]	Analgesic use	No. of tablets	Median at 3 weeks
Stergioulas 2008[16]	Pain overall	VAS 0–100 mm	Final mean values at 4, 8 and 12 weeks
Vermeulen 2006[40]	Pain at night	VAS 0–100 mm	Mean change at 3, 6 and 12 months (baseline median and IQR reported only)

Table 25 provides the SMDs and 95% CIs. The outcome data for individual groups in the included trials are available in *Appendix 7*.

Physical therapy versus physical therapy

There was no significant difference in pain between continuous passive motion and conventional physiotherapy at short-term follow-up (12 weeks) (*Table 25*).[74] There was no significant benefit from adding ultrasound to a 20-minute supervised exercise programme of Codman's exercises, wall-climbing and joint stretching for patient's tolerance at short-term follow-up (3 months) (*Table 25*).[51] There was no significant difference in pain between HGMT and LGMT at any time point (*Table 25*).[40]

Physical therapy without mobilisation versus control

There was a significant reduction in pain with laser compared with placebo laser at 8 weeks (SMD –1.71, 95% CI –2.29 to –1.12) and 16 weeks (SMD –1.89, 95% –2.49 to –1.29) (*Table 25*).[16]

Function and disability

Ten of the twelve studies that assessed physical therapies reported function and disability outcomes (*Table 26*). SPADI score[16,51,71,74,77] and Constant score[66,73,74] were common to several studies; however, the data could not be pooled in meta-analysis as the comparisons varied substantially. Short- and medium-term data were available from these studies. Final value data were available from six studies.[16,51,66,73–75] Pajareya *et al.*[77] included only baseline data, so this study was not included in the analysis. Change from baseline data was available from the study by Vermeulen *et al.*[40] Yang *et al.*[78] reported mean percentage of change only. *Table 27* provides between-group differences and 95% CIs. Because of differences between interventions and comparators it was not appropriate to pool these studies. Outcome data for individual studies are available in *Appendix 7*.

Physical therapy versus control

Diercks and Stevens[73] reported a statistically significant improvement in Constant score with supervised neglect compared with physiotherapy at 3 (MD –16.37, 95% CI –21.46 to –11.28), 6 (MD –15.40 95% CI –20.50 to –10.30), 12 (MD –17.74, 95% CI –22.75 to –12.73), 18 (MD –16.13, 95% CI –22.20 to –10.06) and 24 (MD 9.22, 95% CI –15.69 to –2.75) months' follow-up. It is worth noting that there were several factors that could have biased this result. The

TABLE 25 Pain results of studies of physical therapy (SMD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Physical therapy vs physical therapy			
Dundar 2009[74]	–0.31 (–0.83 to 0.21)[a]		
Dogru 2008[51]	0.28 (–0.28 to 0.85)[b]		
Vermeulen 2006[40]	–0.15 (–0.55 to 0.24)[b]	–0.27 (–0.67 to 0.12)[c]	–0.33 (–0.73 to 0.06)[d]
Physical therapy without mobilisation vs control			
Stergioulas 2008[16]	–1.71 (–2.29 to –1.12)[e,f]	–1.89 (–2.49 to –1.29)[f,g]	

a Reported at 12 weeks.
b Reported at 3 months.
c Reported at 6 months.
d Reported at 12 months.
e Reported at 8 weeks.
f Statistically significant, i.e. the CI did not cross the line of no effect (zero).
g Reported at 16 weeks.

TABLE 26 Function and disability outcomes of studies evaluating physical therapy

Study	Outcomes assessed	Data reported and time of follow-up
Calis 2006[66]	Constant score	Final value data at 15 days and 3 months
Diercks 2004[73]	Constant score (≥ 80 points indicates a normal functioning shoulder)	Final value data at 3, 6, 9, 12, 15, 18, 21 and 24 months reported
Dogru 2008[51]	SPADI total score (0–100)[a]	Final value data at 2 weeks and 3 months[b,c]
	SPADI 8-item disability subscale (0–100)[a]	
Dundar 2009[74]	SPADI total score (0–100)[a]	Final value data at 4 weeks and 12 weeks
	Constant score	
Leung 2008[75]	ASES assessment (score out of 100)	Final value data reported at 2, 4 and 8 weeks
Pajareya 2004[77]	SPADI total score (0–100)[a]	3-week data only (not included)
	Global rating of pain and disability	Baseline data only
Stergioulas 2008[16]	SPADI total score (0–100), Croft score (out of 22), DASH (%) and HAQ (two or three items scored 0–3)	Final value data reported at 4, 8 and 16 weeks
Vermeulen 2006[40]	Shoulder rating questionnaire (Dutch-language version) (17–100)	Change from baseline at 3, 6 and 12 months
	SDQ (Dutch-language version) (0–100)[a]	Percentage of participants reporting 'much worse or no change' and 'better or much better' at 3, 6 and 12 months
	5-point Likert scale (1 = much worse; 5 = much better)	
Wies 2003[71]	SPADI (0–100)[a]	Change from baseline at 9 weeks
Yang 2007[78]	FLEX-SF (1–50)	Mean percentage of change from baseline at 6 weeks

DASH, Disabilities of the Arm, Shoulder and Hand; FLEX-SF, Flexilevel Scale of Shoulder Function; HAQ, Health Assessment Questionnaire.
a   Higher scores indicated worse outcomes.

TABLE 27 Function and disability results of studies of physical therapy (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Physical therapy vs control			
Constant score			
Calis 2006[66]	14.90 (8.32 to 21.48)[a,b]		
Diercks 2004[73]	−16.37 (−21.46 to −11.28)[a,b]	−15.40 (−20.50 to −10.30)[b,c]	−17.74 (−22.75 to −12.73)[b,d]
			−16.13 (−22.20 to −10.06)[b,e]
			−9.22 (−15.69 to −2.75)[b,f]
Leung 2008[75]	SWD vs home exercise: 17.50 (1.76 to 33.24)[b,g]		
	HP vs home exercise: 4.00 (−10.38 to 18.38)[g]		
Physical therapy vs physical therapy			
SPADI total score			
Dogru 2008[51]	4.50 (−6.36 to 15.36)[a]		
Dundar 2009[74]	0.17 (−0.73 to 1.07)[a]		
Wies 2003[71]	PT vs osteopathy: −19.90 (−40.11 to 0.31)[h]		
	PT vs control: −4.00 (−22.47 to 14.47)[h]		
	Osteopathy vs control: 15.90 (−2.04 to 33.84)[h]		
SPADI 8-item subscale			
Dogru 2008[51]	3.10 (−8.44 to 14.64)[a]		
Constant score			
Dundar 2009[74]	−3.37 (−8.28 to 1.54)[a]		

TABLE 27 Function and disability results of studies of physical therapy (MD and 95% CI) (*continued*)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
FLEX-SF			
Yang 2007[78]	ERM + MRM: 19.9% (SD 8.1%)[i]		
	MWM + MRM: 17.25% (SD 12.2%)[i]		
ASES			
Leung 2008[75]	HP vs SWD: 13.50 (–2.16 to 29.16)[g]		
Shoulder rating questionnaire			
Vermeulen 2006[40]	2.40 (–4.00 to 8.80)[a]	4.50 (–2.39 to 11.39)[c]	6.60 (–0.63 to 13.83)[d]
SDQ			
Vermeulen 2006[40]	–5.20 (–14.95 to 4.55)[a]	–5.70 (–17.42 to 6.02)[c]	–11.20 (–22.60 to 0.20)[d]
Physical therapy without mobilisation vs control			
SPADI			
Stergioulas 2008[16]	–14.11 (–19.50 to –8.72)[b,g]	–13.83 (–18.88 to –8.78)[b,j]	
Croft score			
Stergioulas 2008[16]	–4.34 (–6.34 to –2.34)[b,g]	–7.13 (–9.18 to –5.08)[b,j]	
DASH score			
Stergioulas 2008[16]	–9.24 (–14.35 to –4.13)[b,g]	–10.51 (–15.37 to –5.65)[b,j]	
HAQ score			
Stergioulas 2008[16]	–0.75 (–1.09 to –0.41)[b,g]	–0.31 (–0.64 to 0.02)[j]	

FLEX-SF, Flexilevel Scale of Shoulder Function; HP, heat pack; PT, physiotherapy.
a   Reported at 3 months or 12 weeks.
b   Statistically significant, i.e. the CI did not cross the line of no effect (zero).
c   Reported at 6 months or 24 weeks.
d   Reported at 12 months.
e   Reported at 18 months.
f   Reported at 24 months.
g   Reported at 8 weeks.
h   Reported at 9 weeks.
i   Reported at 6 weeks.
j   Reported at 16 weeks.

physiotherapy group were prescribed exercises up to and beyond the pain threshold whereas the supervised neglect group were advised to exercise within the painless range. Also, as a successive cohort was recruited after 2 years (the physiotherapy group), treatment protocols may have changed during the time that elapsed (although the authors did report that a standardised treatment protocol was used). Although the baseline characteristics reported were similar between groups it is possible that there may have been unmeasured differences between groups.

Leung and Cheing[75] found significant improvement in American Shoulder and Elbow Surgeons (ASES) score with SWD plus stretching compared with home exercise (MD 17.50, 95% CI 1.76 to 33.24). There was no significant difference between heat pack plus stretching and home exercise (*Table 27*).

Calis *et al.*[66] reported that Constant score was significantly improved with physiotherapy plus home exercise compared with home exercise alone (MD 14.90, 95% CI 8.32 to 21.48).

Physical therapy versus physical therapy

The study by Dogru et al.,[51] which compared ultrasound and physiotherapy with sham ultrasound and physiotherapy, found no significant difference between treatment groups in SPADI total score or the SPADI 8-item disability subscale at 3 months (*Table 27*).

The intention in the study by Yang et al.[78] was to compare two different sequences of three types of mobilisation (each type of mobilisation was delivered over a 3-week period). The two groups received the three types of mobilisation but in a different order over 12 weeks (see *Appendix 6*). Because at the end of the 12 weeks both groups had received the same treatments, only 6-week data were extracted for ERM and MRM versus MWM and MRM. The change in FLEX-SF score was similar at 6 weeks for ERM and MRM (19.9%, SD 8.1%) and MWM and MRM (17.25%, SD12.2%)

The study by Dundar et al.,[74] which compared continuous passive motion with physiotherapy, found no significant difference between treatment groups in SPADI total score or the Constant score (*Table 27*).

Leung and Cheing[75] found no significant difference between SWD and heat pack groups in terms of ASES score (*Table 27*).

In the study by Vermeulen et al.[40] there was no significant difference between HGMT and LGMT in the shoulder rating questionnaire score (*Table 27*). There was also no significant improvement in SDQ score with HGMT compared with LGMT at any time point (*Table 27*); however, it should be noted that the 95% CI marginally crossed the line of no effect at 12 months (MD –11.20, 95% CI –22.60 to 0.20). There was no significant difference in the proportions of patients who reported '(much) worse or no change' at 3 months (13% vs 12%), 6 months (13% vs 10%) or 12 months (9% vs 18%) and 'better or much better' at 3 months (87% vs 88%) 6 months (87% vs 90%) or 12 months (91% vs 82%).

There was no significant difference in SPADI score with physiotherapy compared with osteopathy in the study by Wies et al.;[71] however, it should be noted that the 95% CI marginally crossed the line of no effect (MD –19.90, 95% CI –40.11 to 0.31). There was no significant difference between either the physiotherapy or osteopathy group and the control group (breathing exercises, range of movement exercises and massage) (*Table 27*).

Physical therapy without mobilisation versus control

Stergioulas[16] reported several measures of function and disability. At 8 weeks laser treatment was associated with significantly improved SPADI score (MD –14.11, 95% CI –19.50 to –8.72), Croft score (MD –4.34, 95% CI –6.34 to –2.34) Disabilities of the Arm, Shoulder and Hand (DASH) score (MD –9.24, 95% CI –14.35 to –4.13) and Health Assessment Questionnaire (HAQ) score (MD –0.75, 95% CI –1.09 to –0.41) compared with placebo laser. At 16 weeks laser treatment was associated with significantly improved SPADI score (MD –13.83, 95% CI –18.88 to –8.78), Croft score (MD –7.13, 95% CI –9.18 to –5.08) and DASH score (MD –10.51, 95% CI –15.37 to –5.65). There was no significant difference in HAQ score between groups at 16 weeks (*Table 27*).

Range of movement

Eleven of the included studies that investigated physical therapy reported a range of movement measure of interest (*Table 28*). All of the studies except two reported short- or medium-term follow-up. One presented data at 24 months[73] and one at 12 months.[40] Six studies reported final value data and one[77] presented data that were not included in the analysis as follow-up was l < 4 weeks. One study reported change from baseline data.[40] Maricar and Chok[76] reported only

TABLE 28 Range of movement outcomes in studies evaluating physical therapy

Study	Outcomes assessed	Data reported and time of follow-up
Calis 2006[66]	Passive abduction, passive external rotation (°)	Final value data at 15 days and 3 months
Diercks 2004[73]	External rotation, internal rotation (ROM part of Constant score, number of points out of 10 correspond to extent of movement)	Final value data at 24 months[a]
Dogru 2008[51]	External rotation, internal rotation, passive abduction (°)	Final value data at 2 weeks and 3 months[b]
Dundar 2009[74]	Passive external rotation, passive internal rotation, passive abduction (°)	Final value data at 4 weeks and 12 weeks
Leung 2008[75]	External rotation (arm by side) (°), external rotation (arm at 90 (°)), hand behind back (cm)	Final value data at 2, 4 and 8 weeks
Maricar 1999[76]	External rotation (°), internal rotation (°), hand behind back (cm)	Graphs and *p*-values only reported at 3, 5, 7 and 8 weeks
Pajareya 2004[77]	External rotation, internal rotation	3-week data only (not included in analysis)
Stergioulas 2008[16]	Active abduction, external rotation (in neutral abduction) (°)	Final value data at 4, 8 and 16 weeks
Vermeulen 2006[40]	Active abduction, active external rotation, passive abduction, passive external rotation (°)	Change from baseline at 3, 6 and 12 months
Wies 2003[71]	Active abduction (°)	Change from baseline at 9 weeks
Yang 2007[78]	Humeral lateral rotation (external rotation), humeral medial rotation (internal rotation) (°)	Mean percentage of change from baseline at 6 weeks

ROM, range of movement.
a   Medians only reported.
b   Unclear whether 3 months from commencement of treatment or following treatment.

graphs and *p*-values, presented narratively. Because of the differences between the interventions and comparators meta-analyses were not performed. *Table 29* provides between-group differences and 95% CIs. Outcome data for individual studies are available in *Appendix 7*.

Physical therapy versus control

In the study by Calis *et al.*[66] there was a significant improvement in passive abduction (MD 24.90°, 95% CI 14.59° to 35.21°) and passive external rotation (MD 18.80°, 95% CI 13.11° to 24.49°) in the physiotherapy group compared with home exercise alone.

In the study by Leung and Cheing[75] there was a significant improvement in external rotation with arm by side (MD 21.00°, 95% CI 4.95° to 37.05°) with SWD plus stretching compared with home exercise. Hand behind back was also significantly greater in the SWD plus stretching group compared with the home exercise group (MD –7.00 cm, 95% CI –13.14 cm to –0.86 cm). There was no significant difference between either SWD or heat pack (both with stretching exercises) and home exercise in external rotation with arm at 90°, and no significant difference between heat pack and home exercise in external rotation with arm by side or hand behind back (*Table 29*).

The study by Diercks and Stevens[73] reported that at 24 months the physiotherapy group had a median of 8 points for the Constant score for external rotation, compared with 10 points in the supervised neglect group, although no measure of variance was provided. This corresponds to a greater range of motion in the supervised neglect group in this plane. For internal rotation, both groups reported a median of 8 points, corresponding to the position dorsum of the 12th dorsal vertebra.

Physical therapy versus physical therapy

Dogru *et al.*[51] found no significant difference between ultrasound and sham ultrasound in external rotation, internal rotation and abduction (*Table 29*).

There was also no significant difference in the study by Dundar *et al.*[74] between continuous passive motion and physical therapy in passive external rotation, passive internal rotation and passive abduction (*Table 29*).

The study by Wies *et al.*[71] showed a significantly greater improvement in active abduction in the osteopathy group (MD 45.20°, 95% CI 16.87° to 73.53°) and physiotherapy groups (MD 38.80°, 95% CI 5.76° to 71.84°) compared with control (breathing exercises, massage and exercise). There was no significant difference between the physiotherapy and osteopathy groups (*Table 29*).

Yang *et al.*[78] reported that the mean percentage of change in external rotation was similar between ERM plus MRM (mean 36.4%, SD 24.3%) and MWM plus MRM (mean 34.2%, SD 13.3%). However, there was a greater change in internal rotation with MWM + MRM (45.6%, SD 38.5%) compared with ERM and MRM (20.5%, SD 24.4%) (*Table 29*).

Leung and Cheing[75] found that there was a significant improvement in external rotation both with arm by side (MD 29.50°, 95% CI 14.28° to 44.72°) and with arm at 90° abduction (MD 30.10°, 95% CI 13.51° to 46.69°) with SWD compared with heat pack. There was also a significant improvement in hand behind back with SWD compared with heat pack (MD –12.30 cm, 95% CI –18.79 cm to –5.81 cm) (*Table 29*).

Maricar and Chok[76] compared passive joint mobilisations and exercises with exercises only and found no significant difference in external rotation or internal rotation between treatment groups at weeks five, seven or eight.

The study by Vermeulen *et al.*[40] showed a significant improvement in active abduction at 12 months with HGMT compared with LGMT (MD 12.60°, 95% CI 0.06° to 25.14°). There was also a significant improvement with HGMT in passive abduction at 3 months (MD 13.10°, 95% CI 1.62° to 24.58°) and 12 months (MD 12.50°, 95% CI 1.03° to 23.97°), and in passive external rotation at 12 months (MD 6.50°, 95% CI 0.27° to 12.73°). There was no significant difference between groups in active external rotation at any of the time points, or in passive external rotation, active abduction or passive abduction at the remaining time points (*Table 29*).

Physical therapy without mobilisation versus control
There was no significant difference in external rotation or active abduction at short- or medium-term follow-up between laser and placebo laser (*Table 29*).[16]

Quality of life
Two studies, one by Dogru *et al.*[51] and the other by Vermeulen *et al.*,[40] reported quality of life using the physical and mental components of the SF-36 (*Table 30*). Data at 3 months' follow-up were available (*Table 31*). As the interventions varied substantially these studies were not pooled. Outcome data for the individual groups are available in *Appendix 7*.

Physical therapy versus physical therapy
There was no significant difference between ultrasound and sham ultrasound groups in the SF-36 physical or mental components at 3 months' follow-up in the study by Dogru *et al.* (*Table 31*).[51]

There was no significant difference between HGMT and LGMT groups in the SF-36 physical or mental components at any time point in the study by Vermeulen *et al.* (*Table 31*).[40]

Other
Two studies reported other outcomes of interest (*Table 32*). Pajareya *et al.*[77] reported satisfaction with treatment and percentage of patients reporting treatment success. Yan[72] also reported the

TABLE 29 Range of movement results of studies of physical therapy (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Physical therapy vs control			
External rotation			
Diercks 2004[73]			PT: median = 8 points[a]
			Supervised neglect: median = 10
Leung 2008[75]	SWD vs home exercise, arm by side: 21.00° (4.95° to 37.05°)[b,c]		
	SWD vs home exercise, arm at 90°: 11.60° (−6.58° to 29.78°)[b]		
	HP vs home exercise, arm by side: −8.50° (−28.19° to 11.19°)[b]		
	HP vs home exercise, arm at 90°: −18.50° (−41.15° to 4.15°)[b]		
Internal rotation			
Diercks 2004[73]			PT: median = 8 points[a]
			Supervised neglect: median = 8
Hand behind back			
Leung 2008[75]	SWD + stretching vs home exercise: −7.00 cm (−13.14 cm to −0.86 cm)[b,c]		
	HP + stretching vs home exercise: 5.30 cm (−0.93 cm to 11.53 cm)[b]		
Passive external rotation			
Calis 2006[66]	18.80° (13.11° to 24.49°)[c,d]		
Passive abduction			
Calis 2006[66]	24.90° (14.59° to 35.21°)[c,d]		
Physical therapy vs physical therapy			
External rotation			
Dogru 2008[51]	−9.70° (−19.51° to 0.11°)[d]		
Dundar 2009[74]	0.76° (−7.40° to 8.92°)[d]		
Yang 2007[78]	ERM + MRM: 36.4% (SD 24.3%)[e]		
	MWM + MRM: 34.2% (SD 13.3%)[e]		
Leung 2008[75]	HP vs SWD, arm by side: 29.50° (14.28° to 44.72°)[b,c]		
	HP vs SWD, 90 degree abduction: 30.10° (13.51° to 46.69°)[b,c]		
Internal rotation			
Dogru 2008[51]	−3.50° (−11.67° to 4.67°)[d]		
Yang 2007[78]	ERM + MRM: 20.5% (SD 24.4%)[e]		
	MWM + MRM: 45.6% (SD 38.5%)[e]		
Passive internal rotation			
Dundar 2009[74]	0.92° (−8.34° to 10.18°)[d]		
Passive abduction			
Dogru 2008[51]	−0.20° (−16.06° to 15.66°)[d]		
Dundar 2009[74]	−4.42° (−11.83° to 2.99°)[d]		
Vermeulen 2004[40]	13.10° (1.62° to 24.58°)[c,d]	11.00° (−1.59° to 23.59°)[f]	12.50° (1.03° to 23.97°)[b,g]

TABLE 29 Range of movement results of studies of physical therapy (MD and 95% CI) (*continued*)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Active abduction			
Vermeulen, 2004[40]	10.00° (–2.16° to 22.16°)[d]	8.90° (–4.67° to 22.47°)[f]	12.60° (0.06° to 25.14°)[c,g]
Wies 2003[71]	Physical therapy vs osteopathy: –6.40° (–32.77° to 19.97°)[h]		
	Physical therapy vs control: 38.80° (5.76° to 71.84°)[c,h]		
	Osteopathy vs control: 45.20° (16.87° to 73.53°)[c,h]		
Active external rotation			
Vermeulen 2004[40]	2.30° (–2.81° to 7.41°)[d]	2.70° (–2.36° to 7.76°)[f]	4.90° (–0.67° to 10.47°)[g]
Passive external rotation			
Vermeulen 2004[40]	1.40° (–3.48° to 6.28°)[d]	4.10° (–0.97° to 9.17°)[f]	6.50° (0.27° to 12.73°)[c,g]
Hand behind back			
Leung 2008[75]	Heat pack vs SWD: –12.30 cm (–18.79 cm to –5.81 cm)[b,c]		
Physical therapy without mobilisation vs control			
External rotation			
Stergioulas 2008[16]	2.05° (–2.75° to 6.85°)[b]	4.19° (–0.74° to 9.12°)[i]	
Active abduction			
Stergioulas 2008[16]	5.47° (–0.40° to 11.34°)[b]	5.20° (–1.60° to 12.00°)[i]	

a   Reported at 24 months.
b   Reported at 8 weeks.
c   Statistically significant, i.e. the CI did not cross the line of no effect (zero).
d   Reported at 3 months or 12 weeks.
e   Reported at 6 weeks.
f   Reported at 6 months.
g   Reported at 12 months.
h   Reported at 9 weeks.
i   Reported at 16 weeks.

TABLE 30 Quality of life outcomes in studies evaluating physical therapy

Study	Outcomes assessed	Data reported and time of follow-up
Dogru 2008[51]	SF-36 physical component SF-36 mental component	Final value data at 2 weeks and 3 months[a] (3-month data included in analysis)
Vermeulen 2004[40]	SF-36 physical component SF-36 mental component	Change from baseline at 3, 6 and 12 months

a   Unclear whether 3 months from commencement of treatment or following treatment.

TABLE 31 Quality of life results of studies of physical therapy (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Physical therapy vs physical therapy			
SF-36 physical component			
Dogru 2008[51]	−0.40 (−5.22 to 4.42)[a]		
Vermeulen 2004[40]	0.60 (−6.03 to 7.23)[a]	2.10 (−5.08 to 9.28)[b]	0.40 (−7.78 to 8.58)[c]
SF-36 mental component			
Dogru 2008[51]	1.00 (−5.19 to 7.19)[a]		
Vermeulen 2004[40]	4.10 (−3.91 to 12.11)[a]	0.30 (−7.95 to 8.55)[b]	−2.50 (−8.36 to 3.36)[c]

a Reported at 3 months.
b Reported at 6 months.
c Reported at 12 months.

TABLE 32 Other outcomes in studies evaluating physical therapy

Study	Outcomes assessed	Data reported and time of follow-up
Pajareya 2004[77]	Satisfaction (number of patients reporting that they were 'very satisfied', 'moderately satisfied', 'unsatisfied' or 'very unsatisfied')	Data at 3 weeks
	Treatment success (% success)	Treatment success at 3, 6, 12 and 24 weeks
Yan 2005[72]	Rate of improvement (%)	Rate of improvement (excellent, good, average and bad) at 3 months

percentage of patients describing their rate of improvement as bad, average, good and excellent at 3 months. These data are summarised in *Table 33* and further information for the individual studies is available in *Appendix 7*.

Physical therapy versus control

In the study by Pajareya *et al.*[77] similar proportions of each group reported that they had successful treatment at 6 weeks (61.4% vs 60.8%). At 12 weeks, 76.8% in the physiotherapy compared with 60.8% in the control group reported successful treatment, and at 24 weeks the proportions were 80.4% in the physiotherapy group and 82.4% in the control group.

In the same study the number of patients 'very satisfied' at 3 weeks was five in the physical therapy group versus one in the control group; the numbers 'moderately satisfied', 'unsatisfied' and 'very unsatisfied' were 7 versus 1, 24 versus 13 and 23 versus 45 in the physical therapy group versus the control group respectively.[77]

Physical therapy versus physical therapy

Yan[72] compared dumb-bell exercises with barehanded exercises and found that a greater number of patients performing dumb-bell exercises than those performing barehanded exercises reported an excellent rate of improvement at 3 months (24 vs 0).

Adverse events

Two studies reported adverse events.[74,77] In the study by Pajareya *et al.*[77] patients in the physiotherapy group were asked whether they had pain that persisted for > 2 hours after treatment or more disability the next morning. There were 10 episodes of pain in the physiotherapy group (in four patients) that persisted for > 2 hours after treatment. Patients

TABLE 33 Other outcome results from studies of physical therapy

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Physical therapy vs control			
Treatment success			
Pajareya 2004[77]	% of patients		% of patients[c]
	Physical therapy: 61.4%,[a] control: 60.8%		Physical therapy: 80.4%, control: 82.4%
	Physical therapy: 76.8%,[b] control: 60.8%		
Satisfaction			
Pajareya 2004[77]	No. of patients[d]		
	'very satisfied': physical therapy 5, control 1		
	'moderately satisfied': physical therapy 7, control 1		
	'unsatisfied': physical therapy 24, control 13		
	'very unsatisfied': physical therapy 23, control 45		
Physical therapy vs physical therapy			
Rate of improvement			
Yan 2005[72]	No. of patients[b]		
	Bad: dumb-bell exercises 0, barehanded 7		
	Average: dumb-bell exercises 0, barehanded 16		
	Good: dumb-bell exercises 2, barehanded 5		
	Excellent: dumb-bell exercises 24, barehanded 0		

a   Reported at 6 weeks.
b   Reported at 3 months or 12 weeks.
c   Reported at 6 months or 24 weeks.
d   Reported at 3 weeks.

were also asked whether the trial drugs and/or treatment programme upset them in any way and were examined for signs of echymosis or burn during range of movement evaluation. Side effects of NSAIDs were reported but it was unclear which treatment groups these applied to (see *Appendix 6*). Dundar *et al.*[74] stated that no side effects were observed during the study. No further information regarding how adverse events were measured or assessed was reported. The study by Stergioulas[16] reported that there were no complications. Adverse events did not appear to have been assessed in the remaining nine studies.

Summary

Twelve studies were included that investigated various types of physical therapy, without use of steroid injection. They were very diverse in the physical therapies evaluated, although most evaluated physiotherapy modalities. The comparators were another physical therapy or control. With the exception of one study,[16] at least one component of the intervention involved active mobilisation or exercise. Half the studies reported that participants were advised to undertake home exercise.

One study of satisfactory quality was identified and three studies were of reasonable quality but had some risk of bias. The other studies had a potentially high risk of bias. Because of the considerable variability of the interventions investigated in the studies and different outcomes measures used it was not appropriate to pool any studies in a meta-analysis. The studies did not report outcome by stage of frozen shoulder or the presence of diabetes and information was very limited regarding previous treatments received.

Physical therapy versus control

There was evidence from one study (with some risk of bias) that there was a significant short-term benefit for function and disability with SWD in conjunction with stretching compared with home exercise and for some but not all measures of range of movement. A further study with some risk of bias reported significant short- and medium-term benefit with laser therapy (plus home exercise) compared with home exercise alone for pain and function and disability but not range of movement. Another study with a potentially high risk of bias reported significant short-term benefit with physiotherapy (plus home exercise) compared with home exercise alone for function and disability and two ranges of movement. One study reported significant short-, medium- and long-term benefit for function and disability with supervised neglect compared with physiotherapy; however, this study was at high risk of bias.

Comparing physical therapies

The majority of studies comparing two physical therapies reported no significant difference in outcome between therapies; however, with the exception of three studies,[40,75,78] these all had a potentially high risk of bias. A single study with some risk of bias found a significant benefit of SWD compared with a heat pack (both with stretching) for three ranges of movement; however, in this same study there was no significant difference in benefit for function and disability. Another study with some risk of bias found a significant improvement in one measure of function and disability and in three ranges of movement with HGMT compared with LGMT, but no benefit for pain. A single satisfactory study found no benefit from providing ERM followed by MRM compared with MWM followed by MRM. Based on single studies with a high risk of bias there was no significant difference between continuous passive motion and conventional physical therapy, between mobilisation with and without ultrasound or between joint mobilisation and exercise. A single study with a high risk of bias reported that daily exercises using dumb-bells were significantly more effective than exercises without dumb-bells. One study available only as an abstract and at high risk of bias reported a significant benefit of physiotherapy and osteopathy compared with breathing and range of movement exercises combined with massage in one measure of range of movement. There was no significant difference between physiotherapy and osteopathy techniques.

In conclusion, the studies identified were diverse and mainly of poor quality. With the exception of physiotherapy including SWD, only single studies were identified of any one physical approach. Based on the best available evidence there may be benefit from SWD and stretching and from HGMT in patients who have already had physiotherapy or a steroid injection. There was insufficient evidence to make conclusions with any certainty about the best mode of physical therapy for primary frozen shoulder.

Acupuncture

Study characteristics

Three RCTs investigated acupuncture in the treatment of primary frozen shoulder. A summary of study characteristics is reported in *Table 34*. All were full papers of studies conducted in Hong Kong,[79] China[80] and Taiwan[81] between 2006 and 2008. There was one two-armed trial[80] and two three-armed trials.[79,81] Sample sizes ranged from 74 to 360.

TABLE 34 Studies of acupuncture with or without physical therapy

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Cheing 2008[79] Three-arm RCT	*n* = 74 Electroacupuncture: 25 Interferential electrotherapy: 24 Control: 25	Electroacupuncture: 10 sessions, two to three times per week over a 4-week period. Three points needled (one trigger point, LI15 and ST38) with a needle of 0.30 × 40 mm diameter Interferential electrotherapy: 10 × 20-minute sessions over 4 weeks at 80–120 Hz. Four suction-type electrodes were placed around the shoulder region in a coplanar arrangement Control: no treatment for 4 weeks	Localised pain over one shoulder, night pain and restricted active and passive shoulder motion
Fang 2006[80] Two-arm RCT	*n* = 360 Electroacupuncture: 174 TENS: 186	Electroacupuncture: 10 × 40-minute sessions every other day. Four acupuncture points [Waiguan (SJ5) and Hegu (LI4) and, alternating each session, Jianliao (SJ14) and Jian qian (Ex-UE) or Jianyu (LI15) and Naoshu (SI10)]; 0.30 × 40 mm needles inserted to depth of 20–25 mm TENS: 10 × 40-minute sessions every other day. Electrodes placed at four acupuncture points [Waiguan (SJ5) and Hegu (LI4) and, alternating each session, Jianliao (SJ14) and Jian qian (Ex-UE) or Jianyu (LI15) and Naoshu (SI10)]. High frequency (100 Hz) for 10 minutes and low frequency (2 Hz) for 30 minutes. Intensity of current 10 ± 2 mA	Used 'recognised criteria' (no further details provided
Ma 2006[81] Three-arm RCT	*n* = 75 Acupuncture: 30 Acupuncture + PT: 15 PT: 30	Acupuncture: 15-minute session twice a week for 4 weeks. Each session consisted of therapeutic principles in promoting flow of qi and blood, driving out the wind and cold, removing dampness and activating meridians; therapeutic methods on three yang meridians of the hand; and prescriptions with jianjiao, jianyu (LI15), fengchi (GB20), hegu (LI4) and yanglingquan (GB34) PT: five sessions per week for 4 weeks	Shoulder pain for at least 3 months, could not lift arms more than 135°

PT, physiotherapy.

One study used acupuncture[81] and two studies used electroacupuncture,[79,80] The number of acupuncture points needled ranged from three to five. Although needle point prescriptions varied between studies, two studies both included Hegu (LI4) and Jianyu (LI15) needle points.[80,81] In the acupuncture study, acupuncture was administered in a course of eight sessions. In both studies of electroacupuncture, the intervention was administered in a course of 10 sessions, with acupuncture points needled to a depth of 15–25 mm and electricity administered when 'De qi' sensation was felt. Further details of the electrical stimulation used were reported in one study only[79] and consisted of 2–100-Hz electrical stimulation at a pulse of 100–400 microseconds for 20 minutes. The comparators were interferential electrotherapy,[79] waiting list control,[79] TENS,[80] physiotherapy[81] and acupuncture with physiotherapy.[81]

One study included a physiotherapy regimen.[81] This consisted of a heat pack for 15 minutes, joint mobilisation for 5–10 minutes and active shoulder exercises for 5–10 minutes, five times per week for 4 weeks. One study reported concomitant treatment of a home exercise programme of mobilisation exercises five times a day over 6 months.[79] Two studies did not report whether participants received any concomitant treatment.[80,81]

The inclusion criteria varied between the three studies. It was unclear in all studies whether they included participants with diabetes. Frozen shoulder was diagnosed by an orthopaedic surgeon, through clinical examination and through clinical history. The participants' stage of frozen shoulder was not reported in two studies.[79,81] In the other study participants were reported

to have either stage 1 (described by the authors as pre-adhesive) frozen shoulder, that is, they had shoulder pain that increased at night with range of motion normal or only slightly affected, or stage 2 (described by the authors as adhesive) frozen shoulder, that is, a reduction in pain but severely affected range of motion.[80] None of the studies reported whether participants had received previous treatment for frozen shoulder. Where reported, the mean age of participants ranged from 51.5 to 56.4 years and the proportion of women from 52% to 55%.

Quality assessment

None of the studies reported the method of randomisation or allocation concealment; therefore, these three studies are potentially at high risk of bias. The study by Cheing *et al.*[79] was of the highest quality and fulfilled five criteria: the number randomised, the comparability of treatment groups at baseline, double blinded, blinding of outcome assessors to treatment allocation and no unexpected imbalances in dropouts between groups. This study, however, did not use intention-to-treat analysis. Fang *et al.*[80] fulfilled two criteria: the number of participants randomised and the blinding of participants. Ma *et al.*[81] also fulfilled two criteria: the number of participants randomised and the comparability of treatment groups at baseline for important prognostic factors.

The studies by Fang *et al.*[80] and Ma *et al.*[81] reported outcome measures at ≤ 4 weeks from baseline and are therefore excluded from the subsequent synthesis. Furthermore, the waiting list control arm for the study by Cheing *et al.*[79] reported outcomes at 4 weeks from baseline only. The following synthesis is therefore based on the study by Cheing *et al.*[79] and compares electroacupuncture with interferential therapy only. This study reported on the outcomes of pain and of function and disability only.

Pain

Cheing *et al.*[79] reported results of 'pain at the moment' at approximately 2, 4 and 7 months using a 0–10 cm VAS. There was no significant difference in pain between the electroacupuncture and interferential therapy groups at 2 months (SMD 0.35, 95% CI –0.23 to 0.93), 4 months (SMD 0.21, 95% CI –0.37 to 0.78) or 7 months (SMD 0.21, 95% CI –0.37 to 0.78).

Function and disability

Cheing *et al.*[79] reported results of the Constant score at 2, 4 and 7 months. There was no significant difference in Constant score between the electroacupuncture and interferential therapy groups at 2 months (MD –2.80, 95% CI –5.88 to 0.28), 4 months (MD 3.10, 95% CI –1.53 to 7.73) or 7 months (MD –1.70, 95% CI –4.76 to 1.36).

Adverse events

None of the three studies that evaluated acupuncture or electroacupuncture reported on whether or not participants experienced any adverse events.

Summary

Three studies compared acupuncture with another treatment, although only one provided data beyond 4 weeks' follow-up. This study had a potentially high risk of bias and it was unclear whether it had enough participants to detect a difference between groups. Based on a single study, there was no statistically significant difference between electroacupuncture and inferential electrotherapy in pain or function and disability at short-, medium- or long-term follow-up. There was insufficient evidence to make conclusions with any certainty about the effectiveness of acupuncture for primary frozen shoulder and in what situations it is likely to be effective.

Manipulation under anaesthesia
Study characteristics

Four RCTs investigated MUA in the treatment of primary frozen shoulder. A summary of study characteristics is available in *Table 35* and full details are provided in *Appendix 6*. All were full papers of studies conducted in Pakistan,[82] the UK[38,83] and Finland[39] between 2007 and 2009. All were two-arm trials and sample sizes ranged from 36[38] to 125.[39]

The MUA procedure was described in three of the RCTs[38,39,83] and was performed by a physician[39] or, in the two UK studies, by an orthopaedic surgeon.[38,83] In two studies participants received a steroid injection (triamcinolone) in conjunction with MUA, 30 mg[38] in one of the UK studies and 80 mg[82] in the study from Pakistan.

A single study, by Amir-us-Saqlain *et al.*,[82] reported use of a physiotherapy programme following MUA. The other three studies advised participants in the intervention and control groups to undertake home exercises. Kivimaki *et al.*[39] appeared to have the most intensive home exercise programme, although details were scanty in all the studies; participants in this study received physiotherapy advice in two sessions and written instructions for a daily training programme including pendulum and stretching exercises. Quraishi *et al.*[38] reported a home exercise programme of pendulum exercises and wall-climbing movements; specific details were not provided by Jacobs *et al.*[83]

TABLE 35 Studies of MUA

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Amir-us-Saqlain 2007[82] Two-arm RCT	*n* = 43 MUA + steroid injection + manipulated extremity + PT: 23 MUA + steroid injection + PT: 20	MUA: no further details Steroid: 80 mg Kenacort (triamcinolone) with 2% xylocaine Manipulated extremity: kept in 160° of abduction with 90° of external rotation for 24 hours PT: daily 30-minute sessions for 3 weeks	History of pain and stiffness of the shoulder joint with no identifiable cause, restriction of glenohumeral motion < 50% of abduction and < 50% of external rotation compared with the contralateral shoulder joint and normal radiography. All symptoms had to be of 3 weeks' duration
Jacobs 2009[83] Two-arm RCT	*n* = 53 MUA: 28 Steroid + distension: 25	MUA: manipulation of arm into full adduction and forward flexion, full external rotation, full internal rotation and full abduction Steroid + distension: three steroid and distension treatments at 6-week intervals: triamcinolone, 40 mg, 1 ml; 2% lidocaine, 5 ml; 0.25% bupivacaine, 10 ml; air, 5 ml	Patients with primary frozen shoulder
Kivimaki 2007[39] Two-arm RCT	*n* = 125 MUA: 65 Home exercise: 60	MUA: manipulation of arm into flexion and abduction and rotation into internal and external rotation Home exercise: PT advice in two sessions and written instructions for a daily training programme	Gradually increasing shoulder pain and stiffness, shoulder mobility of ≤ 140° in elevation and 30° in external rotation
Quraishi 2007[38] Two -arm RCT	*n* = 36 MUA + steroid: 17 (18 shoulders) Arthrographic distension: 19 (20)	MUA: a specific protocol was followed to ensure safe breakage of adhesions by using a short lever arm Steroid: triamcinolone acetonide, 30 mg and 2% lidocaine, 2ml Distension: normal saline (10–55 ml) injected to progressively distend capsule rupture	Stage 2 adhesive capsulitis, global loss of active and passive shoulder movement, restriction of rotation < 50% of normal, and normal anteroposterior and axillary lateral radiography of glenohumeral joint

PT, physiotherapy.

Each of the studies had a different comparator. In the study by Amir-us-Saqlain et al.[82] from Pakistan, the intervention being assessed was the effect of keeping the manipulated extremity in abduction and external rotation for 24 hours following MUA. Both groups received MUA, including a steroid injection, followed by physical therapy and the experimental group also had the extremity kept in a fixed position following MUA. In the two UK studies, Jacobs et al.[83] compared MUA with distension in combination with steroid injection; and Quraishi et al.[38] compared MUA, including a steroid injection, with arthrographic distension. Kivimaki et al.[39] compared MUA (plus home exercise) with home exercise alone, which involved physiotherapy advice in two sessions and written instructions for home exercise.

The inclusion criteria varied between studies in terms of extent of restriction of movement.[38,39,82] Jacobs et al.[83] did not specify the symptomatic inclusion criteria other than that patients with primary frozen shoulder were included. Quraishi et al.[38] included only patients with stage 2 frozen shoulder. The stage of frozen shoulder was described as painful and stiff or in the 'freezing' phase in two RCTs,[39,83] and the majority of participants reported pain and stiffness in one RCT (the remainder had either pain or stiffness).[82] At baseline the duration of frozen shoulder ranged from a mean or median of 10 weeks to 40 weeks. Two studies reported on whether participants had received previous treatment for frozen shoulder. Quraishi et al.[38] reported that 44% had previously received physical therapy, 61% a steroid injection and 31% physical therapy combined with steroid injections. Kivimaki et al.[39] alluded to participants having received previous treatment by reporting that in the 3 months prior to randomisation there was no difference between treatment groups in terms of physical therapy, massage or chiropractic manipulations received. The mean or median age of the participants ranged from 53 to 57 years and the proportion of women ranged from 58% to 68%. It was unclear whether participants with diabetes were included in one study,[82] one study reported that there were no participants with diabetes[83] and in the remaining two studies the proportions with diabetes were 14%[39] and 17%.[38]

Quality assessment

The included RCTs generally varied in quality. All of the studies reported the number of participants randomised and comparability at baseline, although one reported only comparability for range of movement.[82] The Amir-us-Saqlain et al.[82] and Jacobs et al.[83] studies did not report the method of randomisation and so it was unclear whether these studies were truly randomised, and they did not report allocation concealment or whether the outcome assessors were blinded, although this would not have been possible in the study by Amir-us-Saqlain et al.[82] These studies therefore had a potentially high risk of bias. Additionally, Jacobs et al.[83] was not adequately powered, loss to follow-up was high (19%) and it was unclear whether imbalances in dropouts were adjusted for. Although the authors stated that intention-to-treat analysis was performed, not all patients were included in the analysis. It was unclear whether the study by Amir-us-Saqlain et al.[82] was adequately powered and loss to follow-up was high (23%).

Both Kivimaki et al.[39] and Quraishi et al.[38] reported appropriate randomisation methods; however, only Kivimaki et al.[39] reported allocation concealment and blinding of outcome assessors and was therefore classified as of adequate quality. Loss to follow-up was high in this study (34% at 6 months) and was greater in the MUA group than in the control group; the analysis did not appear to be intention to treat. The study did not appear to be adequately powered at the 6- and 12-month follow-ups. Although Quraishi et al.[38] reported that the investigator was blinded, it was not clear whether outcome assessment was blinded or whether there was allocation concealment and therefore this study may be at risk of bias. Loss to follow-up was relatively low in this study (8%) although it was unclear whether the study was adequately powered. Full details of study quality are reported in Appendix 8.

Manipulation under anaesthesia versus home exercise

Kivimaki *et al.*[39] compared MUA plus home exercise with home exercise alone. MDs and 95% CIs were reported by the authors for pain, function and disability, passive abduction, passive internal rotation, external rotation and working ability at the follow-up points of 6 weeks and 3, 6 and 12 months from baseline (*Table 36*). The outcome data for the individual groups are available in *Appendix 7*.

Pain

There was no significant difference in pain intensity between MUA and home exercise at 6 weeks or 3, 6 or 12 months (*Table 37*).

Function and disability

There was no significant difference in Constant score between treatment groups at 6 weeks or 3, 6 or 12 months (*Table 37*).

Range of movement

There was no significant difference in passive abduction, passive internal rotation or external rotation between treatment groups at 6 weeks or 3, 6 or 12 months (*Table 37*).

Working ability

There was no significant difference in the change in working ability between treatment groups at 6 weeks or 3, 6 or 12 months (*Table 37*).

Adverse events

The authors reported that there were no major complications during manipulation.

Manipulation under anaesthesia versus distension

Two studies compared MUA with distension;[38,83] however, both MUA and distension differed between studies and so the data for pain and function and disability that were available could not be considered for pooling.

One RCT by Jacobs *et al.*[83] compared MUA with steroid injection in combination with distension treatment. Only limited data were available for pain, function and disability and quality of life, which were presented as mean regression coefficients up to 16 weeks (and 24 months for quality of life) (*Table 38*). The other RCT by Quraishi *et al.*[38] compared MUA plus steroid injection with arthrographic distension. This study reported means and ranges for pain and function and disability at 2 and 6 months. The percentage of patients who were satisfied with treatment was also reported (*Table 38*). The outcome data for the individual groups are available in *Appendix 7*.

TABLE 36 Outcomes assessed in the study of MUA versus home exercise[39]

Outcomes assessed	Data reported and time of follow-up
Pain intensity: Likert scale (0–10)[a]	MD at 6 weeks and 3, 6 and 12 months (converted to SMD)[b]
Function and disability: modified version of SDQ (14 activities of daily living in previous 24 hours, scored out of 28)[a]	MD at 6 weeks and 3, 6 and 12 months
ROM: passive abduction (°), passive internal rotation (cm), external rotation (°) (and flexion, not included in analysis)	MD at 6 weeks and 3, 6 and 12 months
Working ability (0–10)	MD at 6 weeks and 3, 6 and 12 months
Adverse events	Narrative summary

ROM, range of movement.
a   Higher score indicates worse outcome.
b   SMD imputed from 95% CIs.

TABLE 37 Results of the study of MUA versus home exercise (MD and 95% CI)[39]

	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Pain intensity (SMD and 95% CI)			
	0.2 (–0.64 to 1.02)[a]	–0.35 (–0.78 to 0.09)[c]	–0.28 (–0.73 to 0.16)[d]
	0.07 (–0.32 to 0.46)[b]		
Function and disability			
	4 (–3.8 to 11.8)[a]	–1.7 (–5.3 to 1.9)[c]	0 (–3.2 to 3.2)[d]
	0.3 (–2.69 to 2.75)[b]		
ROM			
Passive abduction (°)	10 (–3.2 to 23.2)[a]	9 (–4 to 22)[c]	7 (–5 to 19)[d]
	9 (–6 to 24)[b]		
Passive internal rotation (cm)	4 (–9 to 9)[a]	–2 (–7.4 to 3.4)[c]	–1 (–4.1 to 6.1)[d]
	–3 (–7.4 to 2.4)[b]		
External rotation (°)	5 (–2 to 12)[a]	6 (–2 to 14)[c]	4 (–4.1 to 12.2)[d]
	6 (–3 to 15)[b]		
Working ability			
	0.4 (–4.2 to 1.8)[a]	0.5 (–0.6 to 1.6)[c]	0.1 (–0.8 to 1.0)[d]
	0 (–0.8 to 0.8)[b]		

ROM, range of movement.
a   Reported at 6 weeks.
b   Reported at 3 months.
c   Reported at 6 months.
d   Reported at 12 months.

Pain

The study by Jacobs *et al.*[83] showed no significant difference in pain intensity between treatment groups up to 16 weeks. The mean regression coefficient (SE) was –2.77 (0.33) for MUA and –2.75 (0.42) for distension combined with steroid injection (95% CI –1.11 to 1.15).

In the study by Quraishi *et al.*[38] at 2 months' follow-up the mean VAS score was 4.7 (range 0 to 8.5) in the MUA plus steroid arm and 2.4 (range 0 to 8) in the arthrographic distension arm (*p*-value not reported). At 6 months there was a significantly greater improvement in VAS in the arthrographic distension group than in the MUA group (SMD 1.52, 95% CI 0.75 to 2.30) (*Table 39*).

Function and disability

The study by Jacobs *et al.*[83] found no significant difference between treatment groups in the Constant score up to 16 weeks: mean regression coefficient (SE) 3.13 (0.24) for MUA and 3.23 (0.42) for distension plus steroid injection (95% CI –1.09 to 0.81).

In the study by Quraishi *et al.*[38] at 2 months' follow-up the mean Constant score was 58.5 (range 24 to 90) in the MUA plus steroid arm and 57.4 (range 17 to 80) in the arthrographic distension arm. At 6 months the Constant score was significantly improved in the arthrographic distension group compared with the MUA group (–6.40, 95% CI –6.56 to –6.24) (*Table 39*).

TABLE 38 Outcomes assessed in the studies of MUA vs distension

Study	Outcomes assessed	Data reported and time of follow-up
Jacobs 2009[83]	Pain (not specified): VAS (1–100)[a]	Mean regression coefficient (mean of 2, 6, 12 and 16 weeks)
Quraishi 2007[38]	Pain outcome overall: VAS (0–10)[a]	Mean and range at 2 and 6 months (no SDs reported)[b]
Jacobs 2009[83]	Function and disability: Constant score	Mean regression coefficient (mean of 2, 6, 12 and 16 weeks)
Quraishi 2007[38]	Function and disability: Constant score	Mean and range at 2 and 6 months (no SDs reported)[b]
Quraishi 2007[38]	ROM: external rotation, internal rotation, abduction (and forward elevation, not included in analysis) (°)	Between-group *p*-values at 6 months (mean values available only on graph)
Jacobs 2009[83]	Quality of life: SF-36, all components	Scores at 24 months presented in graphs and summarised narratively in text
Quraishi 2007[38]	Satisfaction	% satisfied at 6 months

ROM, range of movement.
a Higher score indicates worse outcome.
b A between-group *p*-value was reported for 6 months' follow-up and this was used to estimate the SD at 6 months; there was no *p*-value for 2 months' follow-up.

TABLE 39 Results of the studies of MUA vs arthrographic distension (SMD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Pain			
Jacobs 2009[83]		Mean regression coefficient (SE) MUA: –2.77 (0.33)[a] Distension: –2.75 (0.42)[a] SMD (95% CI)	
Quraishi 2007[38]		1.52 (0.75 to 2.30)[b,c]	
Function and disability			
Jacobs 2009[83]		Mean regression coefficient (SE) MUA: 3.13 (0.24)[a] Distension: 3.23 (0.42)[a] SMD (95% CI)	
Quraishi 2007[38]		–6.40 (–11.51 to –1.29)[b,d]	

a Reported at 16 weeks.
b Reported at 6 months.
c Statistically significant, i.e. the CI did not cross the line of no effect (zero).

Range of movement

Quraishi *et al.*[38] reported no statistically significant difference between groups in external rotation (*p* = 0.13), internal rotation (*p* = 0.48) and abduction at 6 months' follow-up (*p* = 0.62) (data available only in a graph).

Quality of life

Jacobs *et al.*[83] reported that all components of the SF-36 improved for all patients during the course of treatment, with the greatest improvements shown in the physical role and bodily pain components. There was no statistically significant difference with respect to change in SF-36 scores between the treatment groups (data available only in graph format, no *p*-values reported).

Satisfaction

Quraishi *et al.*[38] reported that at final follow-up 81% of MUA patients were satisfied or very satisfied compared with 94% of patients who received arthrographic distension. All of the patients with diabetes were satisfied with their outcome (three in both the MUA and arthrographic distension groups).

Adverse events

The study by Jacobs *et al.*[83] reported that no systemic or local complications were noted in either treatment group. Quraishi *et al.*[38] did not report any information on adverse events.

Manipulation under anaesthesia followed by manipulated extremity kept in fixed position

Amir-us-Saqlain *et al.*[82] assessed the effect of keeping the manipulated extremity in abduction and external rotation for 24 hours following MUA compared with MUA not using the fixed position. Both groups also received a steroid injection and physical therapy. Only measures of range of movement were assessed 12 weeks post treatment (*Table 40*). Between-group differences in means and 95% CIs are presented in *Table 41*. Outcome data for the individual groups are presented in *Appendix 7*.

Range of movement

Passive abduction (MD 22.49°, 95% CI 13.14° to 31.84°), passive internal rotation (MD 1.00 cm, 95% CI 0.71 cm to 1.29 cm), active abduction (MD 28.99°, 95% CI 17.07° to 40.91°) and active internal rotation (MD 0.91 cm, 95% CI 0.49 cm to 1.33 cm) were significantly greater at 12 weeks post treatment in the MUA combined with steroid injection plus manipulated extremity and physiotherapy group than in the MUA combined with steroid injection plus physiotherapy group. There was no significant difference in passive or active external rotation between treatment groups.

TABLE 40 Outcomes assessed in the study of MUA followed by fixed extremity[82]

Outcomes assessed	Data reported and time of follow-up
ROM: passive abduction, passive internal rotation, passive external rotation, active abduction, active external rotation, active internal rotation (and active and passive forward flexion, not included in analysis)[a]	ROM 12 weeks post treatment

ROM, range of movement.
a   All measured in degrees except internal rotation, which was measured by spinal level.

TABLE 41 Results of the study of MUA followed by fixed extremity (MD and 95% CI)[82]

	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
ROM			
Passive abduction (°)	22.49 (13.14 to 31.84)[a]		
Passive internal rotation (cm)[b]	1.00 (0.71 to 1.29)[a]		
Passive external rotation (°)	4.84 (–2.26 to 11.94)		
Active abduction (°)	28.99 (17.07 to 40.91)[a]		
Active internal rotation (cm)	0.91 (0.49 to 1.33)[a]		
Active external rotation (°)	6.62 (–3.32 to 16.56)		

ROM, range of movement.
a   Statistically significant, $p < 0.0001$.
b   The paper states that this was measured by spinal level. There is a lack of clarity in the paper, but it appears to be measured in cm.

Summary

The four included studies of MUA were diverse in terms of the intervention and the comparator. Some studies used a steroid injection (triamcinolone) in conjunction with MUA. The studies were not considered clinically similar enough to be pooled in a meta-analysis. Across all of the studies information about previous treatments that participants had received and stage of frozen shoulder was limited. It was not possible to explore variation between those with and without diabetes.

Because it was unclear whether all studies had enough participants to detect a statistically significant treatment effect, it should be kept in mind that where studies did not report a significant benefit (i.e. the CI crossed the line of no difference) this should not be interpreted as evidence of no difference between the groups. A single study of adequate quality reported no statistically significant difference between MUA (and home exercise) and home exercise alone in pain, function and disability, range of movement or working ability at 6 weeks and 3, 6 and 12 months.[39] Follow-up at 6 months and beyond in this study should be treated with some caution because of high loss to follow-up, which was somewhat higher in the MUA group, and also the lack of intention-to-treat analysis. Two studies comparing MUA with distension had mixed findings. One, with a potentially high risk of bias, found no significant difference in pain or function and disability between MUA and distension (which included steroid) up to 16 weeks post treatment.[83] The second, which had some risk of bias, found a significantly greater improvement in pain and function and disability at 6 months with arthrographic distension than with MUA in conjunction with steroid.[38] The fourth study, with a potentially high risk of bias, reported that keeping the manipulated extremity in abduction and external rotation for 24 hours following MUA was superior to MUA without this additional process for passive and active abduction and internal rotation at 12 weeks.[82]

In conclusion, there was very little evidence available for MUA and most of the studies identified had limitations. The single adequate study found no evidence of benefit of MUA over home exercise alone. Generalisability is somewhat unclear because of the limited information about previous interventions that participants had received and stage of frozen shoulder.

Distension

Study characteristics

Three RCTs investigated distension with steroid injection in the treatment of primary frozen shoulder. A summary of study characteristics is reported in *Table 42*, with further details available in *Appendix 6*. All were full papers of studies conducted in Australia,[43] Denmark[84] and Norway[36] and published between 1998 and 2008. All were two-armed trials.

The two most recent studies by Buchbinder *et al.*[43] and Tvetia *et al.*[36] used arthrographic distension. One injected 40 mg of steroid (in 1 ml) and up to 82 ml of saline on a single occasion[43] and the other injected 20 mg of steroid (2 ml), 4 ml of local anaesthetic and 10 ml of saline on three occasions at 2-week intervals,[36] along with contrast medium in the arthrographic distension groups. Both of these studies stated that the procedure continued until rupture occurred. Buchbinder *et al.*[43] had the additional end points of patient termination of the procedure and a maximum of 90 ml having been injected. The older study by Gam *et al.*[84] stated that the injection was confirmed by ultrasound and participants were injected with 20 mg of steroid with 19 ml of lidocaine once per week for up to 6 weeks. Details were not provided in this study as to whether distension occurred or how this was established. The two studies of arthrographic distension used different comparators: Buchbinder *et al.*[43] used a placebo comparator of arthrogram only, whereas Tveita *et al.*[36] used steroid injection (with local anaesthetic).

TABLE 42 Studies including distension with steroid injection

Study details and study design	Participants randomised (total *n* and by group)	Trial treatments	Condition-related inclusion criteria
Buchbinder 2004[43] Two-arm RCT	*n* = 46 Arthrographic distension + steroid: 25 Placebo: 21	Arthrogram: the needle was positioned, connected to the connector tap and tube and 0.5–1 ml of contrast injected and a radiographic image taken. Steroid: methylprednisolone acetate, 40 mg, 1 ml and up to 82 ml of normal saline was then injected (total volume 30–90 ml)	Pain and stiffness in predominantly one shoulder for ≥ 3 months, restriction of passive ROM of > 30° in two or more planes of movements, measured to onset of pain
		Distension: the end point of the procedure was filling of the subscapular bursa, capsular rupture, injection of the total volume of liquid or the participant requesting termination of the procedure	
		Placebo: arthrogram only	
Gam 1998[84] Two-arm RCT	*n* = 22 Distension + steroid: 13 Steroid: 9	Distension + steroid: intra-articular injection, confirmed by ultrasound	Frozen shoulder of more than 6 weeks' duration, nocturnal accentuation of pain, passive range of shoulder external rotation < 50% of opposite shoulder
		Steroid: triamcinolone hexacetonide, 20 mg, once per week for a maximum of 6 weeks or until no symptoms	
		Distension: an additional 19 ml of lidocaine 0.5%	
Tveita 2008[36] Two-arm RCT	*n* = 76 Arthrographic distension + steroid: 37 Steroid: 39	Arthrogram: Kaye–Schneider technique was used	Limitation of passive movement in the glenohumeral joint compared with the unaffected side, > 30° for at least two of forward flexion, abduction or external rotation; pain in predominantly one shoulder lasting > 3 months and < 2 years
		Steroid: triamcinolone acetonide, 20 mg, 2 ml and 3–4 ml of bupivacaine hydrochloride (5 mg/ml). Three injections at 2-week intervals	
		Distension: an additional 10 ml of saline. Three injections at 2-week intervals were given. The capsule would usually rupture in the wall of the subscapular recess or sometimes in the wall of the bicipital or axillary recesses, which was recorded as a loss of resistance, and contrast leakage was identified by fluoroscopy. If rupture had not occurred, more contrast and local anaesthetic was injected until rupture	

ROM, range of movement.

Home exercise of pendular exercises and scapular setting were given in the study by Buchbinder *et al.*[43] and no manual treatment (e.g. physiotherapy, massage) or other medical interventions were allowed. In contrast, in the Tveita *et al.* study[36] patients were allowed to continue with their current physiotherapy programme; no patients were prescribed new physiotherapy programmes during the study. The study of non-arthrographic distension did not report any information regarding home exercise.[84]

There was some variability in concomitant treatments. Buchbinder *et al.*[43] allowed paracetamol and codeine preparations but NSAIDs were not allowed, Tveita *et al.*[36] allowed pain medication organised by the patients' primary care physicians and Gam *et al.*[84] reported that analgesics were permitted.

The inclusion criteria varied between studies; however, the two most recent studies of arthrographic distension required similar extent of restriction in shoulder movement.[36,43] The duration of frozen shoulder at baseline ranged from a median or mean of 114 days (approximately 4 months) to 7 months, although the stage at baseline was not reported by any of the studies. Diagnosis was by measuring passive range of movement to onset of pain,[43] clinical examination, blood samples and radiography or ultrasound,[84] and clinical history and radiography.[36]

A substantial proportion of patients (28%) had diabetes in the Buchbinder study;[43] the remaining two studies had no patients with diabetes. Buchbinder et al.[43] also included a small proportion (2.2%) with secondary frozen shoulder. Buchbinder et al.[43] and Tveita et al.[36] also reported that patients had undergone treatment for frozen shoulder before the study: in the Buchbinder study 28% of patients had received corticosteroid injections whereas in the Tveita study 17% had undergone physiotherapy. The ages of patients ranged from a mean or median of 47 years to 57.3 years and the proportion of women was either 59% or 80%.

Quality assessment

Buchbinder et al.[43] was considered of satisfactory quality as the risk of bias was minimised through computerised randomisation and allocation concealment by a biostatistician who kept the assignment scheme. An intention-to-treat analysis was also performed. Patients were blinded to treatment and outcome assessors were also blinded. The treatment groups were also comparable at baseline. The main limitation of this study is that it was not sufficiently powered after dropouts (9%). The intention-to-treat analysis used in the study was adequately powered based on the authors' power calculation (the sample size to detect a difference in SPADI scores).

Both Gam et al.[84] and Tveita et al.[36] reported a reliable method of randomisation; however, it was not clear whether an adequate method of allocation concealment had been used. Tveita et al.[36] reported that patients were not informed of their actual assignment until the first injection was to be given, and no information regarding allocation concealment was reported by Gam et al.[84] Therefore, these studies are potentially at risk of bias. Gam et al.[84] reported that outcome assessors were blinded and that the groups were comparable at baseline. In the study by Tveita et al.[36] there appeared to be a higher proportion with previous shoulder problems and who were on sick leave in the steroid injection group. Tveita et al.[36] also reported using statistical adjustment to control for baseline differences for the function and disability SPADI outcome but not for range of movement. Tveita et al.[36] used intention-to-treat analysis and both studies reported the same rate of loss to follow-up (9%), with similar numbers in each arm.

Pain

Two studies, one by Buchbinder et al.[43] and one by Gam et al.,[84] assessed pain. Buchbinder et al.[43] reported change from baseline data at 3, 6 and 12 weeks using a 10-point Likert scale (*Table 43*). However, the study by Gam et al.[84] reported data for VAS pain scores at rest and VAS pain scores on function in graphical form only. This study was described narratively.

There was no significant difference in pain between arthrographic distension with steroid and placebo (arthrogram) at 6 weeks (SMD –0.40, 95% CI –0.99 to 0.19) or 12 weeks (SMD –0.15, 95% CI –0.73 to 0.44) in the study by Buchbinder et al.[43]

In the study by Gam et al.[84] there was no significant difference between the steroid and distension groups for VAS pain score on function ($p = 0.1$) or VAS pain score at rest ($p = 0.1$) (time points unclear). The authors reported that there was a tendency toward less pain in the distension group. Additionally, the authors reported that analgesic consumption was significantly lower at week 11 in the distension group than in the steroid group ($p = 0.008$). These results were presented in graphical form only.

Function and disability

Two of the three included studies assessed function and disability.[36,43] Both reported SPADI total score and one[43] reported a problem elicitation technique score, a patient preference disability measure in which patients identify their own problems related to the disease that they would like to see improve as a result of treatment. Change from baseline data were available from Buchbinder et al.[43] and final value data were available from Tveita et al.[36] (*Table 44*). These

TABLE 43 Pain outcomes in studies evaluating distension

Study	Outcomes assessed	Data reported and time of follow-up
Buchbinder 2004[43]	Likert scale, pain overall (0–10)[a]	Change from baseline at 3, 6 and 12 weeks (6 and 12 weeks included in analysis)
Gam 1998[84]	VAS pain score at rest (0–10)[a]	Data presented graphically at 3, 6 and 12 weeks, *p*-values only
	VAS pain score on function (0–10)[a]	
	Analgesic consumption	

a Higher scores indicate worse outcomes.

TABLE 44 Function and disability outcomes in studies evaluating distension

Study	Outcomes assessed	Data reported and time of follow-up
Buchbinder 2004[43]	SPADI total score (0–100)[a]	Change from baseline at 3, 6 and 12 weeks (6 and 12 weeks included in analysis)
	Problem elicitation technique score[a]	
Tveita 2008[36]	SPADI total score (0–100)[a]	Final value at 6 weeks after last injection[b]

a Higher scores indicate worse outcomes.
b Data appeared to be adjusted for baseline differences in groups.

were not pooled as the comparator arms were different between studies: Buchbinder *et al.*[43] compared arthrographic distension with placebo whereas Tveita *et al.*[36] used steroid injection as a comparator. *Table 45* provides the between-group MDs and 95% CIs. The outcome data for individual groups are available in *Appendix 7*.

Distension versus placebo

There was no significant difference between arthrographic distension and placebo in SPADI total score at 6 or 12 weeks in the study by Buchbinder *et al.*[43] (*Table 45*). In contrast, there was a significant improvement in the problem elicitation technique score with distension compared with placebo at 6 weeks (MD –46.00, 95% CI –80.99 to –11.01) and 12 weeks (MD 54.40, 95% CI 12.57 to 96.23) in the same study.

Distension versus steroid

There was no significant difference in SPADI total scores between distension and steroid at 6 weeks in the Tveita *et al.* study[36] (*Table 45*).

Range of movement

The range of movements of interest in this review that were reported by the studies of distension were passive and active abduction, passive and unspecified external rotation, passive internal rotation and hand behind back. Change from baseline data were available from Buchbinder *et al.*[43] and final value data were available from Tveita *et al.*[36] (*Table 46*). It was considered inappropriate to pool the two studies as one had a placebo comparator and one a steroid injection comparator. The study by Gam *et al.*[84] provided limited data for extraction and these were summarised narratively. *Table 47* summarises the between-group MDs and 95% CIs. The outcome data for individual groups are available in *Appendix 7*.

Distension versus placebo

There was no significant difference between groups in the outcomes active abduction, external rotation or hand behind back at 6 or 12 weeks' follow-up in the study by Buchbinder *et al.*[43] (*Table 47*).

TABLE 45 Function and disability results of studies of distension (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Distension vs placebo			
SPADI total score			
Buchbinder 2004[43]	5.00 (–7.85 to 17.85)[a]		
	4.40 (–10.08 to 18.88)[b]		
Problem elicitation technique score			
Buchbinder, 2004[43]	46.00 (–80.99 to –11.01)[a,c]		
	54.40 (12.57 to 96.23)[b,c]		
Distension vs steroid			
SPADI total score			
Tveita 2008[36]	–6.00 (–14.12 to 2.12)[d]		

a   Reported at 6 weeks.
b   Reported at 12 weeks.
c   Statistically significant, i.e. the CI did not cross the line of no effect (zero).
d   Reported at 6 weeks after last injection (12 weeks from baseline).

TABLE 46 Range of movement outcomes in studies evaluating distension

Study	Outcomes assessed	Data reported and time of follow-up
Buchbinder 2004[43]	Active abduction, external rotation in neutral, hand behind back (°)	Change from baseline at 3, 6 and 12 weeks
Gam 1998[84]	Passive abduction, passive external rotation (°)	Data presented graphically (number achieving four levels of improvement) at 3, 6 and 12 weeks, *p*-values only
Tveita 2008[36]	Passive abduction, passive external rotation, passive internal rotation, active abduction, active external rotation, active internal rotation (°)	Final value at 6 weeks after last injection

Distension versus steroid

The study by Tveita *et al.*[36] found that there was a significant improvement in passive abduction with steroid compared with distension at 6 weeks after the last injection (MD –34.00°, 95% CI –40.78° to –27.22°). There was no significant difference between groups for active abduction, external or internal rotation, or passive internal or external rotation (*Table 47*).

The study by Gam *et al.*[84] reported that there was a significant improvement with distension compared with steroid in external rotation (*p* = 0.0007) but no statistically significant difference in abduction (time point unclear).

Adverse events

All of the studies investigating distension reported adverse events. These were reported in detail in the study by Buchbinder *et al.*[43] and to a lesser extent by Gam *et al.*[84] and Tveita.[36] The adverse events reported by all studies are summarised in *Table 48*.

Buchbinder *et al.*[43] reported that open-ended questions were used to assess the extent of adverse events. More patients in the arthrographic distension group than in the placebo group reported pain associated with the procedure (16% vs 5%) and pain lasting up to 48 hours (12% vs 5%). None of the adverse events was reported as serious and a number of additional adverse events were reported (*Table 48*).

TABLE 47 Range of movement results of studies of distension (MD and 95% CI)

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Distension vs placebo			
Active abduction (°)			
Buchbinder 2004[43]	8.90 (–8.55 to 26.35)[a]		
	4.50 (–15.16 to 24.16)[b]		
External rotation (°)			
Buchbinder 2004[43]	–6.50 (–24.62 to 11.62)[a]		
	2.10 (–14.50 to 18.70)[b]		
Hand behind back (°)			
Buchbinder 2004[43]	1.90 (–0.76 to 4.56)[a]		
	0.80 (–1.95 to 3.55)[b]		
Distension vs steroid			
Active abduction (°)			
Tveita 2008[36]	3.00 (–13.00 to 19.00)[c]		
Active external rotation (°)			
Tveita 2008[36]	2.00 (–6.33 to 10.33)[c]		
Active internal rotation (°)			
Tveita 2008[36]	2.00 (–5.88 to 9.88)[c]		
Passive abduction (°)			
Tveita 2008[36]	–34.00 (–40.78 to –27.22)[c,d]		
Passive external rotation (°)			
Tveita 2008[36]	–2.00 (–9.42 to 5.42)[c]		
Passive internal rotation (°)			
Tveita 2008[36]	–3.00 (–9.13 to 3.13)[c]		

a   Reported at 6 weeks.
b   Reported at 12 weeks.
c   Reported at 6 weeks after last injection (time point unclear).
d   Statistically significant, i.e. the CI did not cross the line of no effect (zero).

TABLE 48 Adverse events in studies investigating distension

Study	Adverse events reported
Buchbinder 2004[43]	Total reported adverse events: arthrographic distension (*n* = 25): 9 (36%), placebo (*n* = 21): 1 (5%)
	Pain associated with procedure: arthrographic distension (*n* = 25): 4 (16%), placebo (*n* = 21): 1 (5%)
	Increased pain for up to 48 hours after procedure: arthrographic distension (*n* = 25): 3 (12%), placebo (*n* = 21): 1 (5%)
	Claustrophobia at time of procedure: arthrographic distension (*n* = 25): 1 (4%), placebo (*n* = 21): 1 (5%)
	Unsettled, anxious and hot: arthrographic distension (*n* = 25): 0 (0%), placebo (*n* = 21): 1 (5%)
	Shoulder noisy (i.e. fluid noises): arthrographic distension (*n* = 25): 1 (4%), placebo (*n* = 21): 0 (0%)
Gam 1998[84]	Two cases of unacceptable pain after injection (one in each treatment group)
Tveita 2008[36]	Injections reported as very painful: distension: 5, steroid: 6
	Other possible side effects reported: distension: 14, steroid: 20
	Complaints of flushing or disturbances in heat regulation: distension: 9, steroid: 13
	Minor loss of sensation and motor control loss in affected arm: distension: 2, steroid: 2
	Glenohumeral joint infection: treatment group unspecified: 1

Gam *et al.*[84] reported that the number and type of side effects were recorded. The only adverse events reported in this study were two cases of unacceptable pain after injection (one in each treatment group); these patients dropped out of the study.

In the study by Tveita *et al.*[36] the patients recorded pain intensity related to the injection procedures. Six patients in the steroid group and five in the distension group felt that the injections were very painful. Flushing and disturbances in heat regulation were also common in both groups and a number of other non-serious adverse events were reported (*Table 48*).

Summary

Three studies were included that investigated the effects of distension with steroid injection. Two of these studies investigated arthrographic distension[36,43] and the other investigated non-arthrographic distension.[84] The comparators evaluated were steroid alone[36,84] and placebo (arthrogram only).[43] Only one study was judged to be of satisfactory quality,[43] whereas the remainder were potentially at risk of bias. Because of the variability in the interventions and comparators it was not considered appropriate to pool any of the studies. Stage of frozen shoulder was not reported in any of these studies; however, previous treatments were described in two of the studies.[36,43]

Distension compared with placebo

One study of satisfactory quality compared distension with placebo and reported benefit with distension in the short term in one of two measures of function and disability. There was no difference in three measures of range of movement or in pain at function at short-term follow-up. None of the adverse events reported was considered serious.

Distension compared with steroid

Two studies that were potentially at risk of bias compared distension with steroid. One study that compared arthrographic distension with steroid reported no difference between groups in one measure of function and disability, but reported a benefit in one range of movement in the short term. Some patients in both groups considered the injections as being very painful and one case of glenohumeral joint infection (septic arthritis) was reported. The study that compared non-arthrographic distension with steroid reported no difference between groups in pain at function or at rest, but a significant benefit with distension in one measure of range of movement but not another at short-term follow-up. One patient from each group dropped out as a result of unacceptable pain.

In conclusion, few studies of distension were identified and only single studies of different comparisons were available. Based on one study of satisfactory quality there is a little evidence of potential benefit with distension compared with placebo. There is insufficient evidence to draw conclusions about the efficacy of distension (arthrographic or non-arthrographic) for frozen shoulder.

Capsular release

Two case series of more than 50 participants were identified that investigated capsular release in the treatment of primary frozen shoulder. A summary of the study characteristics is reported in *Table 49*, with further details available in *Appendix 7*. One study was published in Norway in 2007 by Austgulen *et al.*;[85] the other in Taiwan in 2002 by Chen *et al.*[86]

The capsular release procedures varied between the two studies. Only a summary of the procedures are provided here; fuller descriptions are available in the original papers. In the study by Chen *et al.*,[86] the authors stated that the intervention involved distension and debridement, release and manipulation. The degree of joint movement was confirmed arthroscopically

TABLE 49 Studies including capsular release

Study details and study design	Participants	Treatment	Condition-related inclusion criteria
Austgulen 2007[85] Case series	$n = 66$ (70 shoulders)	Arthroscopic capsular and ligament release + PT Surgery was performed under general anaesthesia in beach chair position. Shoulder arthroscopy was performed using normal technique. Access to the shoulder joint was from behind and surgical instruments entered from in front in the rotator interval. The rotator interval was cleaned out and the frontal capsule and glenohumeral ligament and coracohumeral ligament were split from biceps tendon to 6 o'clock. Both capsule and ligaments were split with an Acufex Upbiter Scissor punch. The subacromial space was inspected and adherences were loosened. The space and displacement were evaluated. Where spaces were narrow subacromial decompression was performed until the shoulder could move at maximal outward rotation and to 180° in abduction. All patients received aggressive rehabilitation with a physiotherapist from the first day after surgery	Patients with primary frozen shoulder. Diagnosis of frozen shoulder was confirmed during anaesthesia: limited outward rotation of < 20° and < 45° in abduction with a fixed scapula
Chen 2002[86] Case series	$n = 183$ cases	Arthroscopic brisement (distension, debride, release) followed by gentle manipulation + PT (further details provided), then the arm was kept in abduction–external rotation position for 2 days during which the patient was confined to bed. Passive and active exercise of the shoulder was then allowed, with a rehabilitation programme at the hospital rehabilitation facility	Basic criteria for definition of idiopathic frozen shoulder

PT, physiotherapy.

(after distension by water and the syringe rebound), a synovectomy was performed using an arthroscopic shaver or vaporisation, capsular scar tissue was described by the authors as being debrided and then gentle manipulation was performed. This involved arm elevation in the scapular plane (which was usually associated with audible popping of the contracted capsule) and external rotation followed by internal rotation at varying degrees of abduction. This was done with gradual pressure and stopped if unyielding resistance was met. The authors stated that repetition of these steps led to tearing of the capsular structures. The arm was kept in abduction–external rotation for 2 days following the procedure.

The Austgulen *et al.* study[85] reported that shoulder arthroscopy was performed using normal technique, and the frontal capsule, glenohumeral ligament and coracohumeral ligament were split from the bicep tendon to 6 o'clock. The authors stated that the subacromial space was inspected and adherences loosened. Where the spaces were narrow subacromial decompression was performed until the shoulder could move at maximal outward rotation and at 180° in abduction.

Both studies included a programme of physiotherapy following the procedure. Austgulen *et al.*[85] specifically stated that the patients received aggressive rehabilitation from the first day after surgery (no further details reported). This study also reported that participants were asked to perform home exercises (including stretches) every day. In addition, concomitant NSAIDs were given as needed and postoperative oxycodone was given occasionally.[85] Chen *et al.*[86] did not state whether a home exercise routine was undertaken or whether concomitant medication was given.

The inclusion criteria differed between the studies, with Chen *et al.*[86] reporting limited criteria (i.e. basic criteria for diagnosis of idiopathic frozen shoulder). Additionally, Austgulen *et al.*[85] required that participants had already tried physiotherapy but without a satisfactory result. The nature and intensity of the previous physiotherapy was not reported. The diagnostic criteria

also varied between studies. In the Austgulen study[85] diagnosis was based around limited range of movement and confirmed under anaesthesia. Chen *et al.*[86] used clinical history, physical examination, radiography and arthrography. Neither study reported the stage of frozen shoulder; the average duration of frozen shoulder at baseline was 13 months (range 3 to 60 months) in the Austgulen study[85] and 8 months (range not reported) in the Chen study[86] (it was unclear whether this was mean or median). A total of 17% of the patients in the Austgulen study had diabetes[85] but this information was not reported in the study by Chen *et al.*[86] In both studies participants had received previous treatment for frozen shoulder. Austgulen *et al.*[85] reported that participants had received physical therapy, whereas Chen *et al.*[86] reported that none of the participants had responded to conservative treatment of at least 12 weeks' duration. The average age (mean or median not specified) of participants was 53 years in the Austgulen study,[85] whereas Chen *et al.*[86] reported that ages ranged from 32 years to 79 years. The percentage of women was similar in both studies: 67%[85] and 75%.[86]

Quality assessment

Both studies were case series, which are inherently at high risk of bias because of the lack of a control group. The Bradford Hill criteria (a group of minimal conditions necessary to provide adequate evidence of a causal relationship between an incidence and a consequence) state that there must be a temporal relationship between the incidence of the factor (in this case surgery) and consequence (recovery). For a condition such as frozen shoulder, which for most people will resolve over a 1- to 3-year period, this relationship cannot be ascertained without a control group.[87] Austgulen *et al.*[85] was considered better quality as this study reported inclusion criteria, the population appeared representative of the frozen shoulder population, SDs were reported and patients were recruited prospectively, although the extent of this was unclear. The number of dropouts was unclear. Chen *et al.*[86] met only one criterion (reporting of inclusion criteria); the remainder were unclear or not met. There were no dropouts in this study. Further details of quality assessment are available in *Appendix 8*.

Outcomes available

Data were sparse for all outcomes assessed (*Table 50*). The effect on short-term pain was described narratively in Chen *et al.*[86] Function and disability and relevant measures of range of movement (external rotation, internal rotation and abduction; it was not specified whether these were active or passive) were reported at baseline and follow-up and as average gain in range of movement by Chen *et al.* (no further details available).[85,86] Additionally, Austgulen *et al.*[85] reported data for ability to work, physical activity, sleep at night and satisfaction. Both studies reported adverse events. Numerical results are summarised in *Table 51*. The complete outcome data for these studies are available in *Appendix 7*.

Pain

Only one study reported any data regarding pain. Chen *et al.*[86] reported that two-thirds of patients complained of pain exacerbation after arthroscopic brisement; 5% had pain duration of longer than a few weeks. Half of patients had pain relief within 1 month whether in motion or not. After 3 months all except eight shoulders were pain free in any direction of shoulder movement (data were not reported).

Function and disability

Austgulen *et al.*[85] reported a significant improvement in the Oxford Shoulder score from a baseline mean of 41.0 (SD 7.5) to 18.4 (SD 7.3) postoperatively ($p < 0.001$), a scale for which the best possible outcome is 12 and worst possible outcome is 60 (*Table 51*).

Similarly, Chen *et al.*[86] reported that an improvement in the mean modified ASES score from a baseline score of 41 (SD 13) to 87 (SD 11) was significant ($p < 0.005$) at follow-up (*Table 51*).

TABLE 50 Outcomes assessed in studies evaluating capsular release

Study	Outcomes assessed	Data reported and time of follow-up
Chen 2002[86]	Pain (reduction of pain): pain component of ASES (modified version)[a]	Pain described narratively at 'a few weeks' and 1 and 3 months (3-month data used in analysis)
Austgulen 2007[85]	Function and disability: Oxford Shoulder score (12, best outcome; 60, worst)	Mean and SD postoperatively (average follow-up 10 months, range 3 to 29 months)
	Function and disability: telephone questionnaire assessing ability to work, physical activity, sleep at night (all 0, most complaints; 10, least complaints) and patient satisfaction (0, worst; 10, best)	Mean and SD postoperatively (average follow-up 10 months, range 3 to 29 months)
Chen 2002[86]	Function and disability: modified version of ASES (0–100)[a]	Final value mean and SD[b] at time of follow-up (average follow-up 23 months, range 6 months to 5 years)
Austgulen 2007[85]	ROM: external rotation, abduction (both degrees) (and flexion, not included in analysis)	Mean and SD postoperatively (average follow-up 10 months, range 3 to 29 months)
Chen 2002[86]	ROM: external rotation, internal rotation (both degrees) (and elevation, not included in analysis)	Average gain at latest follow-up (not specified)

ROM, range of movement.
a　Higher score indicates improved outcome.
b　Measure of variance unclear but assumed to be a SD.

Austgulen et al.[85] reported significant improvements from baseline to follow-up ($p < 0.001$) on a 10-point scale in mean working ability (baseline 2.4, SD 2.6; follow-up 7.4, SD 2.5), mean physical activity (baseline 2.3, SD 2.5; follow-up 7.4, SD 2.4) and sleep at night (baseline 1.7, SD 2.5; follow-up 7.2, SD 2.6). This study also reported high satisfaction postoperatively (8.6, SD 1.6 on a 10-point scale) (*Table 51*).

Range of movement

Austgulen et al.[85] reported that there was a significant improvement in mean external rotation from 3° (SD 5°) to 39° (SD 23°) ($p < 0.001$) and in mean abduction from 34° (SD 8°) to 154° (SD 37°) ($p < 0.001$) postoperatively.

Chen et al.[86] reported a similar average gain in external rotation of 35°. The gain in internal rotation was 30°.

Adverse events

Austgulen et al.[85] reported that two patients had frozen shoulder again and had repeat surgery. No deep infections, nerve damage or other complications were reported. Chen et al.[86] found that only one patient experienced complications (superficial wound infection). No further information regarding how adverse events had been assessed was reported in either study.

Summary

Two studies investigated capsular release. Both were case series and therefore inherently at high risk of bias. One of the studies stated that debrisement was a component of the capsular release procedure and both reported that physiotherapy was undertaken post procedure.

One case series reported that the majority of patients were pain free at movement at short-term follow-up. Statistical significance was not reported. There was evidence of benefit for function and disability from both studies. Each study reported a significant improvement in one function and disability scale. Additionally, one study reported significant benefits in working ability, physical activity, sleep at night and satisfaction with capsular release. One study reported

TABLE 51 Results of the studies of capsular release

Study	Short term (≤ 3 months)	Medium term (> 3 and ≤ 6 months)	Long term (> 6 and ≤ 12 months)
Function and disability			
Oxford Shoulder score			
Austgulen 2007[85]			Baseline: mean 41.0 (SD 7.5)
			Postoperatively: mean 18.4 (SD 7.3) ($p < 0.001$)
Modified ASES			
Chen 2002[86]	Baseline: mean 41 (SD 13)		
	Follow-up: mean 87 (SD 11)[a] ($p < 0.005$)		
Range of movement			
Internal rotation (°)			
Chen 2002[86]	Average gain: 35		
External rotation (°)			
Austgulen 2007[85]			Baseline: mean 3 (SD 5)
			Postoperatively: mean 39 (SD 23) ($p < 0.001$)
Chen 2002[86]	Average gain: 30		
Abduction (°)			
Austgulen 2007[85]			Baseline: mean 34 (SD 8)
			Postoperatively: mean 154 (SD 37) ($p < 0.001$)
Other			
Working ability			
Austgulen 2007[85]			Baseline: mean 2.4 (SD 2.6)
			Postoperatively: mean 7.4 (SD 2.5) ($p < 0.001$)
Physical activity			
Austgulen 2007[85]			Baseline: mean 2.3 (SD 2.5)
			Postoperatively: mean 7.4 (SD 2.4) ($p < 0.001$)
Sleep at night			
Austgulen 2007[85]			Baseline: mean 1.7 (SD 2.5)
			Postoperatively: mean 7.2 (SD 2.6) ($p < 0.001$)
Satisfaction			
Austgulen 2007[85]			Mean (SD) 8.6 (1.6)

a   Measure of variance unclear, but assumed to be SD.

evidence of significant benefit in two measures of range of movement with capsular release; the other study reported an improvement in two measures of range of movement, but did not report whether or not these were significant.

In conclusion, although the evidence available suggested potential benefit from capsular release, these studies were at high risk of bias and cannot be used to draw conclusions regarding the efficacy of this treatment for frozen shoulder.

Mixed-treatment comparison results

A MTC was performed for pain only. As previously stated in the report, this was because pain was the only outcome for which a network was available.

Analyses were planned for pain recorded at ≤ 3 months (excluding pain recorded at ≤ 4 weeks from the start of treatment), > 3 months and ≤ 6 months, and > 6 months and ≤ 12 months. However, data were only available for ≤ 3 months.

Four networks were evaluated:

- Network 1: studies of any intervention (i.e. conservative and invasive) and any quality.
- Network 2: studies of any intervention that were at least of satisfactory quality (i.e. method of randomisation was adequate and outcome assessment was blinded). The overall quality of the available trials for the MTC was poor, with most not reporting on the a priori quality criterion of allocation concealment. So that a network of trials could be formed, method of randomisation rather than allocation concealment was used as a quality criterion in the MTC.
- Network 3: studies of non-invasive treatments of any quality, excluding sodium hyaluronate (because it is rarely used in the NHS).[18]
- Network 4: studies of non-invasive treatments that were at least of satisfactory quality (i.e. method of randomisation was adequate and outcome assessment was blinded), excluding sodium hyaluronate.

Interpretation of standardised mean differences

Reduction in pain recorded as a SMD can be transformed back into the units of one or more of the pain measurement instruments. The decision was made to back transform to a VAS 0–100 mm as this measure had more substantial information than other pain measures. This included one study performed in a shoulder-specific population.[50] Transformation from SMD to VAS was made using a representative pooled SD at baseline from one of the included trials.[51] No data could be located on the MCID in pain for individuals with frozen shoulder. However, it is suggested that a difference of 14 mm on a 100-mm VAS scale is the MCID for individuals with rotator cuff disease, a shoulder disorder also characterised by pain and restricted range of movement.[50] Given that the between-group MCID is thought to approximate 40% of that within individuals[6,53] the MCID between groups for rotator cuff disorder can be estimated to be approximately 5.6 mm. This value is therefore used as a proxy for the between-group MCID for frozen shoulder.[6] The reduction in pain recorded as a SMD can be interpreted on a VAS 0–100 mm scale using *Table 52*.

From the 31 included trials, the total number of trials potentially available for analysis was nine. The reasons for trials being excluded from the analysis are presented in *Table 53*.

The nine trials and the 10 interventions they evaluated are shown in *Table 54*. The placebo used varied between studies and included saline injections, lidocaine injection, placebo laser, sham distension and sham ultrasound. The four studies of physical therapy consisted of physiotherapy with an active mobilisation component. Physical therapies without an active component consisted of laser therapy and interferential therapy. Four studies included steroid injections;

TABLE 52 Standardised mean differences and equivalent reductions on a VAS 0–100 mm scale

	Reduction in pain score				
SMD	−0.3	−0.5	−1.0	−1.5	−2.0
VAS 0–100 mm	−5.6	−9.15	−18.3	−27.45	−36.6

TABLE 53 Reasons for trials being excluded from the MTC

Reason for exclusion from the MTC	No. of studies excluded
Trial did not report pain as an outcome	9
Trial did not report pain data	6
Trial reported pain at ≤ 4 weeks	2
Trial reported pain at > 3 months only	1
Trial reported mean change and baseline medians only	2
SDs could not be imputed	1
Trial compared the same class of intervention with each other	1

TABLE 54 Network table

Study	Placebo	Steroid injection	Steroid + active physical therapy	Sodium hyaluronate	Active physical therapy	Active physical therapy + placebo	Electroacupuncture	Physical therapy without mobilisation	Arthrographic distension + steroid	MUA + active physical therapy
Buchbinder 2004[43]	✓a								✓	
Carette 2003[35]	✓b	✓	✓			✓b				
Cheing 2008[79]							✓	✓c		
Dogru 2008[51]					✓	✓d				
Kivimaki 2007[39]					✓					✓
Rizk 1991[42]			✓✓e			✓f				
Ryans 2005[41]	✓b	✓	✓			✓b				
Stergioulas 2008[16]	✓g							✓h		
Takagishi 1996[70]		✓		✓						

a Sham distension.
b Saline injection.
c Interferential therapy.
d Sham ultrasound.
e Two arms with the same intervention, only difference is injection approach (anterior vs lateral).
f Lidocaine injection.
g Placebo laser.
h Laser.

these were triamcinolone hexacetonide (40 mg once, 20 mg once), methylprednisolone (40 mg once for 3 weeks) and dexamethasone (2 mg once weekly for 5 weeks). Steroid injections were either given alone (three studies[35,41,70]) or combined with physiotherapy (three studies[35,41,42]). Seven of the nine studies included in the review had a home exercise component.[16,35,39,41–43,51]

In these nine trials, a variety of pain outcomes and pain scales were reported (*Table 55*). If a trial reported more than one pain outcome or used more than one scale, only the pain outcome/scale prioritised for use in the analysis (see *Chapter 2*, *Mixed-treatment comparison*) is reported.

To check that the non-informative priors used in the analysis were truly non-informative a sensitivity analysis was performed for each network by changing the range of the uniform prior distribution on the SD from 0–2 to 0–0.8, 0–5, 0–10 and, as a final check for stability for network 1, 0–15. An additional sensitivity analysis was also performed by repeating each analysis using a burn-in of 30,000 iterations.

All four networks were evaluated; however, the lack of evidence available to inform networks 2, 3 and 4 led to a lack of stability in the models, particularly a lack of stability in between-study variance. For completeness these analyses have been presented in *Appendix 10* although no conclusions can be drawn from the results presented. Only the results for the network of any intervention and of any quality (network 1) are presented here. The slightly higher number of trials included in this network allows the model to achieve stability.

Network 1: studies of any intervention and of any quality

There were nine trials with data that could be used in the analysis of pain at or close to 3 months. These nine trials formed a connected network of nine interventions compared with placebo. The network is presented in *Figure 21*.

Each line represents one comparison. For example, there were two studies available for the comparison of steroid with placebo. Where there is no line there were no studies available, for example physical therapy without mobilisation versus arthrographic distension and steroid.

The models were run for 100,000 iterations and were not sensitive to the length of burn-in. Stable estimates of treatment effect, CrIs and between-study heterogeneity were produced by the models using a uniform prior of (0, 5), (0, 10) and (0, 15). Convergence, determined by graphical traces and the Brooks–Gelman–Rubin statistic, was achieved. The results of the uniform prior (0, 5) are presented here. Results for uniform priors (0, 10) and (0, 15) are available in *Appendix 10*.

TABLE 55 Type of pain reported, pain scale used and quality of studies available for MTC analysis

Study	Type of pain reported	Type of pain scale used	Time point used	At least satisfactory quality[a]
Buchbinder 2004[43]	Pain overall	Likert scale 0–9	12 weeks	✓
Carette 2003[35]	Pain overall	SPADI 5-item pain subscale	3 months	✓
Cheing 2008[79]	Pain at the moment	VAS 0–10 cm	Approx. 2 months	
Dogru 2008[51]	Pain overall	SPADI 5-item pain subscale	3 months	
Kivimaki 2007[39]	Pain intensity	Likert scale 0–10	3 months	✓
Rizk 1991[42]	Pain overall	Likert scale 0–5	11 weeks	
Ryans 2005[41]	Daytime pain at rest	VAS 0–100 mm	6 weeks	✓
Stergioulas 2008[16]	Pain overall	VAS 0–100 mm	8 weeks	✓
Takagishi 1996[70]	Pain on activity	VAS 0–10	5 weeks	

a Method of randomisation was adequate and outcome assessment was blinded.
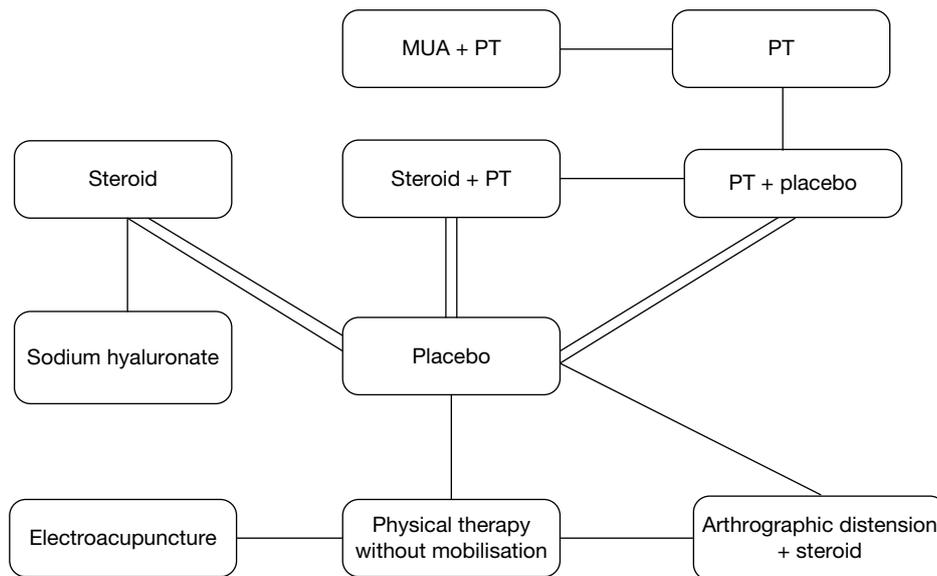
FIGURE 21 Network diagram of studies of any intervention and any quality. PT, physical therapy.

The model was a good fit as the residual deviance was close to the number of data points. *Table 56* presents the treatment effects compared with placebo in order of mean effectiveness. Steroid combined with physiotherapy showed a beneficial treatment effect compared with placebo with 95% CrIs that did not cross the line of no effect. The 95% CrI of the treatment effect of physical therapy without mobilisation and physiotherapy combined with placebo marginally crossed the line of no effect. The remaining interventions (electroacupuncture, steroid injection, physiotherapy, MUA plus physiotherapy, sodium hyaluronate and arthrographic distension) all crossed the line of no effect. There was no clear difference between the interventions in treatment effects, that is, the CrIs overlapped. These results are also displayed graphically in *Figure 22*.

Steroid combined with physiotherapy showed a clinically significant as well as statistically significant reduction in pain, with a 95% CrI that corresponded to a clinically significant reduction in pain only: –28.9 mm (95% CrI –54.1 to –7.7 mm). Although the MD was clinically significant for most of the other comparisons, the 95% CrIs contained values that were clinically insignificant. For example, steroid injection had a MD of –21.0 mm (95% CrI –45.0 to 3.5 mm).

Opportunities for comparison with standard meta-analysis are limited as most of the studies were not pooled in a quantitative synthesis. It was possible to compare with the standard meta-analyses for steroid plus physiotherapy versus placebo and steroid versus placebo. The results of the MTC are consistent with the standard meta-analysis of steroid combined with physical therapy versus placebo presented earlier in this report. This standard meta-analysis contained the same two studies included in the MTC. The results of the meta-analysis also showed that steroid combined with physiotherapy resulted in both a statistically and a clinically significant reduction in pain compared with placebo (pooled SMD –0.98, 95% CI –1.43 to –0.52; back transformed MD 17.93 mm, 95% CI –26.2 to –9.5 mm).
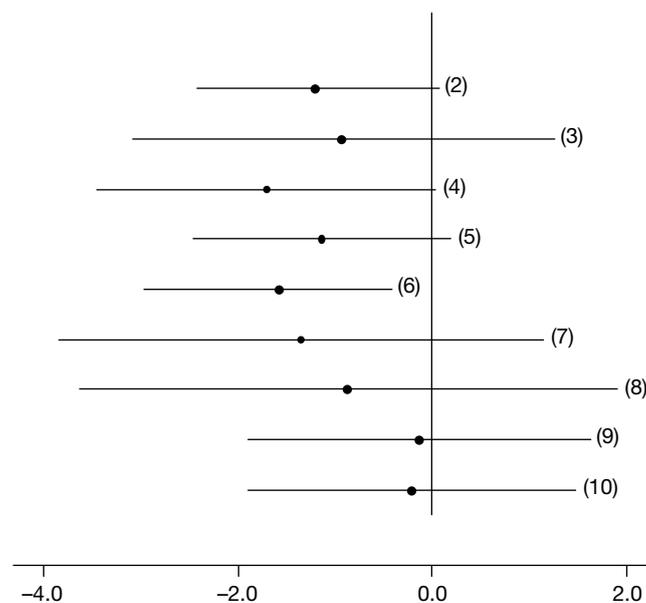
Assumptions

In a MTC there are three key assumptions: homogeneity, consistency and methodological similarity.

TABLE 56 Mean reduction in pain compared with placebo with CrIs in order of mean treatment effectiveness for pain at 3 months, including studies of any quality

Prior: uniform (0, 5)			
Comparator: placebo			
Treatment	**Node number**	**SMD (95% CrI)**	**VAS 0–100 mm, MD (95% CrI)**
Physical therapy without mobilisation	4	−1.71 (−3.46 to 0.04)	−31.3 (−63.3 to 0.7)
Steroid + physiotherapy	6	−1.58 (−2.96 to −0.42)[a]	−28.9 (−54.1 to −7.7)
Electroacupuncture	7	−1.36 (−3.84 to 1.14)	−24.9 (−70.3 to 20.9)
Physiotherapy + placebo	2	−1.22 (−2.42 to 0.07)	−22.3 (−44.3 to 1.2)
Steroid	5	−1.15 (−2.46 to 0.19)	−21.0 (−45.0 to 3.5)
Physiotherapy	3	−0.95 (−3.09 to 1.25)	−17.4 (−56.5 to 22.9)
MUA + physiotherapy	8	−0.88 (−3.60 to 1.90)	−16.1 (−65.9 to 34.8)
Sodium hyaluronate	10	−0.21 (−1.90 to 1.47)	−3.8 (−34.8 to 26.9)
Arthrographic distension + steroid	9	−0.14 (−1.89 to 1.62)	−2.6 (−34.6 to 29.6)

Data points: 13; residual deviance: 12.66; τ^2 (between-study variance): 0.69 (95% CrI 0.0003 to 4.58).
a   Did not cross line of no effect.

FIGURE 22 Caterpillar plot of the SMD estimates and their 95% CrIs compared with placebo. The treatments associated with each number can be identified from *Table 56*.

Homogeneity

The assumption of homogeneity is that trials are sufficiently homogeneous to be quantitatively combined. In the analysis presented, placebo included sham distension, saline injections and placebo laser. Although we believed that it was appropriate to pool different types of placebo, it could be argued that these are not similar enough because of the differing degree of invasiveness. Furthermore, there were differences in the populations of the included studies.

For all studies of conservative treatments, it was not reported whether participants had received any previous treatment for frozen shoulder. However, for both studies of invasive treatments (MUA combined with physical therapy, and arthrographic distension with steroid) it was reported that at least some participants had undergone previous treatments for frozen shoulder including corticosteroid injections or some form of physical therapy. This would suggest that the populations of the invasive studies had a longer duration and possibly more treatment-resistant forms of frozen shoulder than those in the conservative treatment studies.

Consistency

The assumption of consistency is that had treatment C been included in a trial comparing interventions A and B then the treatment effect dAC would be equivalent to that obtained from a trial of interventions A and C.[33] Assuming consistency, the treatment effect dAC is the sum of the treatment effects dAB and dBC. However, this assumption requires that the treatments involved belong to closed loops in the network of evidence, such as that seen in a connected polygonal structure.[88] Given that the structure of the network presented here was of a radiating star, with only one loop of evidence, it was not feasible to assess consistency.

Methodological similarity

Of the nine studies included in the analysis, five were of at least satisfactory quality (method of randomisation was adequate and outcome assessment was blinded)[16,35,39,41,43] and four were not.[42,51,70,79] To assess the effect of quality on the estimates, a network of studies that were at least of satisfactory quality was evaluated (network 2). However, this model was unstable and, although presented in *Appendix 10*, the reliability of the data included in the analysis presented is uncertain and does not allow a robust assessment of the impact of quality.

Summary

Nine interventions formed part of a connected network with placebo and the evidence was informed by all nine trials. Twenty-two studies had to be excluded from the MTC for a range of reasons; therefore, the network was a small subset of the available evidence. Steroid combined with physiotherapy showed a beneficial treatment effect compared with placebo with 95% CrIs that did not cross the line of no effect. Furthermore, this treatment, when back transformed to a VAS 0–100 mm scale, showed a clinically significant reduction in pain with 95% CrIs that excluded clinically insignificant values. The remaining treatments had 95% CrIs that crossed the line of no effect and which contained clinically insignificant values. Overall, there was no clear difference in the treatment effects of any of the interventions, that is, the CrIs overlapped. Although the model was a good fit and gave stable estimates, given the arguable heterogeneity of the placebos and of study populations, and the inclusion of poor-quality studies, the reliability of the results of the MTC is uncertain and they should be interpreted with caution.

Patients' views of interventions for frozen shoulder

Searches of three databases (CINAHL, MEDLINE and PsycINFO) identified 1067 potentially relevant references (*Figure 23*). Nine full papers were ordered on the basis of screening titles and abstracts. Of these, two papers could not be obtained within the time frame required; however, it is unlikely that these would have met the inclusion criteria. One paper appeared to focus on the clinical effectiveness of steroid injections[89] and the remaining paper appeared to examine the quality of life of patients with frozen shoulder but did not appear to address treatments.[90] None of the remaining six papers met the inclusion criteria; therefore, no data were available on patients' views regarding interventions for frozen shoulder.
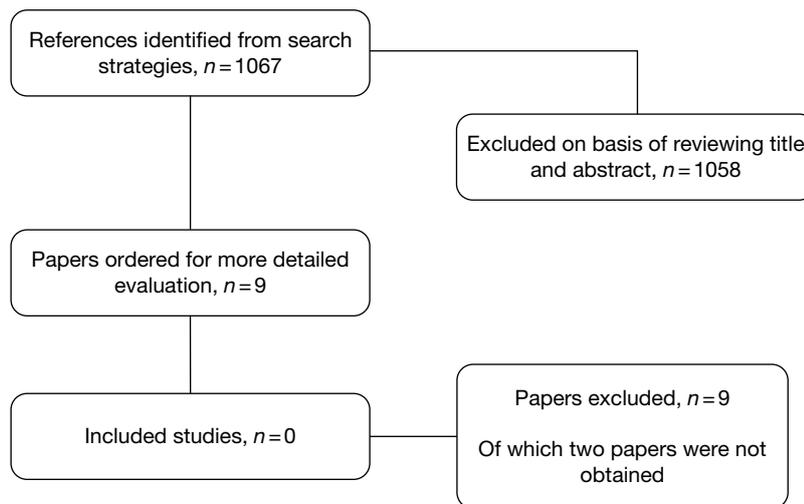
FIGURE 23 Study selection.

Economic analyses

Previous economic evaluations

We identified one full economic evaluation, conducted in the Netherlands, that met our inclusion criteria as outlined in *Chapter 2* (see *Inclusion and exclusion criteria*).[91] The included economic evaluation, a cost–utility analysis, was conducted as part of a clinical study[40] comparing HGMT with LGMT in a Dutch frozen shoulder population. The clinical study, reported in a separate paper, also met the inclusion criteria for the effectiveness review.[40] In summary, the clinical study randomised 100 patients to either HGMT or LGMT. Patients were treated twice weekly for 30 minutes during a period of 12 weeks and were encouraged to attend all treatment sessions. From 6 weeks onward, treatment could be reduced in frequency or stopped if a normal range of movement was noticed by the therapist. The study assessed a number of clinical outcomes including active and passive range of movement, shoulder disability (measured by a shoulder rating questionnaire and the SDQ), pain and quality of life (measured by the SF-36). For a full assessment of the study details and quality see *Physical therapy*. The study was considered to be of reasonable quality, with some risk of bias.

The aim of the economic evaluation component of the study was to compare the two techniques in terms of costs and QALYs from a societal perspective. In addition, the authors also estimated the impact of frozen shoulder on costs and health. Costs were assessed over the 12-month follow-up period and presented as undiscounted annual costs in euros for the price year 2004. All resource-use information was collected from the patients using quarterly cost questionnaires. Wherever possible Dutch standard prices, which were designed to reflect social costs and standardise economic evaluations, were used. Where standard prices were not available, charges were used. Costs included treatment sessions, alternative medicine sessions, hospitalisations (MUA, acromioplasty), home nursing care, medication, travel costs and non-health-care costs (labour and domestic help). All appropriate costs appear to have been included for a societal perspective.

The measure of benefit used in the analysis was QALYS; these were based on the Short Form questionnaire-6 Dimensions (SF-6D) utility index values, which were estimated using SF-36 data collected alongside the study. The SF-6D provides a means for using the SF-36 data to estimate a preference-based single index measure for health using general population values, thereby allowing the authors to obtain QALYs.

Differences in outcome measures (SF-6D and costs) were tested using double-sided non-parametric bootstrapping. The average estimated QALYs were 0.695 for HGMT and 0.702 for LGMT. The difference of 0.007 in favour of LGMT was reported to be not statistically significant ($p = 0.71$, 95% CI –0.32 to 0.049). The total reported average annual societal costs were €8809 for HGMT and €6911 for LGMT (a cost difference of €1898 in favour of LGMT). The difference in costs was also reported to be not statistically significant ($p = 0.37$, 95% CI –€2551 to €5711). The authors concluded that the economic analysis does not allow for evidence-based recommendation regarding the preferred treatment.

A full assessment of the quality of this economic evaluation based on the Drummond checklist and the study data extraction/summary are presented in *Appendices 11* and *12* respectively. There were a number of limitations to the study including the lack of an incremental analysis, which would not have resulted in an incremental cost-effectiveness ratio (ICER) but would have informed us that LGMT dominates HGMT (i.e. has higher effectiveness and lower costs). The authors dismiss the difference in QALYs and costs based on statistical inference, which is inappropriate. Further probabilistic sensitivity analysis would have allowed parameter uncertainty to be fully characterised and the expected value of further research to be considered. Overall, despite the limitations the analysis was of reasonable quality and the results, although uncertain, provide us with an indication that LGMT may be a more cost-effective option than HGMT.

Although this one economic evaluation provides us with some information regarding the cost-effectiveness of these two physiotherapy techniques, it does not fully address the question posed. The study was conducted in the Netherlands, was limited to two active physiotherapy techniques, failed to appropriately deal with uncertainty and presented utilities using SF-6D, which cannot easily be compared with the preferred EQ-5D measure because of differences in the descriptive systems and values applied to health states. EQ-5D has become the instrument of choice for many agencies including NICE.[64] The use of one instrument allows more comparability across projects undertaken by these agencies. The small amount of evidence that we are able to glean from this analysis is useful but, given the lack of economic evaluations for other relevant interventions, to further develop and inform decision-making in the UK it was felt that it was essential for us to undertake some additional work.

Decision model

Based on the preliminary examination of the clinical effectiveness data it was anticipated that any modelling undertaken was likely to be in the form of a simple decision tree. As a tool for modelling decision trees provide an effective method for structuring a problem and combining data from various sources. Possible treatment pathways are laid out in a linear manner and appropriate costs and effects are assigned. The final outcome of interest, in this instance QALYs, is attached to the end of the tree. The proportion of participants achieving particular end points is calculated to give a measure of effect. Costs can be attached to both the end points and the treatments/events within the tree. Total costs for each intervention are calculated by summing the costs associated with each pathway. At each point at which a choice is available there is a chance node; a probability conditional on the previous event is attached to each chance node. This node determines the proportion of individuals who progress down each unique pathway in the tree. A simple example is shown in *Figure 24*.

We reviewed the literature to identify existing models in a similar population and sequences or order of treatments, to explore whether treatments (or sequences of treatments) were influenced by phase of condition and to identify any potential source data (e.g. unit costs, resources or utilities) to help populate the model.
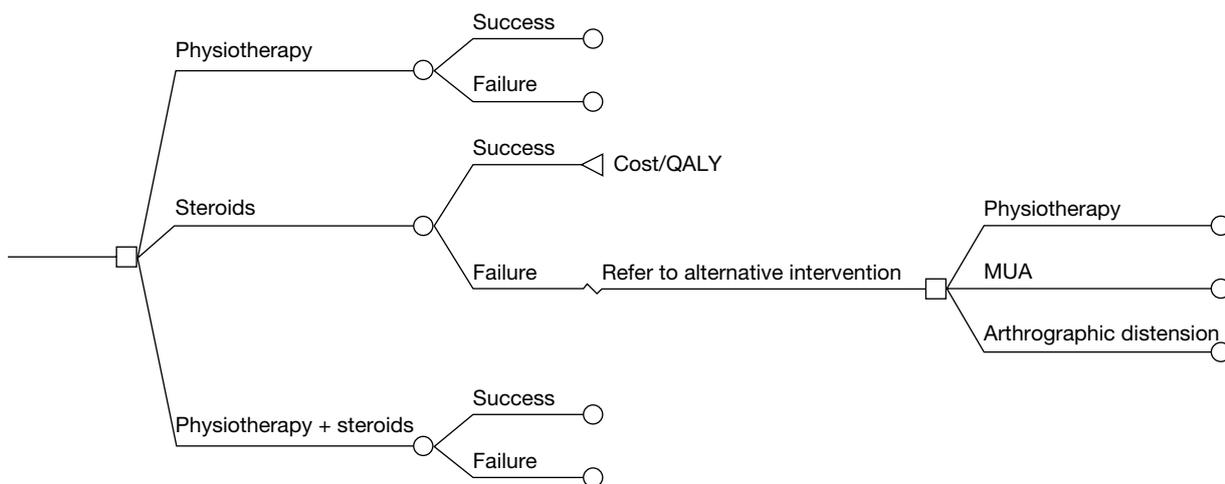
FIGURE 24 Example decision tree.

As outlined earlier, we identified one economic evaluation as part of a clinical study; we did not identify any modelling studies in this area. Further, very few of the trials in the review of effectiveness consider phase of frozen shoulder or previous treatment history of participants. Because of the limited data available, it was not possible in the clinical synthesis to investigate the impact of phase of frozen shoulder on treatment effectiveness. The only potential 'proxy' for phase of condition was duration of frozen shoulder at baseline. The uncertainty associated with such an assumption would need to be carefully considered when drawing conclusions as there is a considerable individual variability in the duration of each phase: it is suggested that the painful freezing stage may last from 2 to 9 months, the adhesive phase from 4 to 12 months and the resolution phase from 12 to 42 months. It was felt that the poor reporting in many of the clinical trials made it difficult to support the assumption that mean duration of frozen shoulder at baseline could be used as a proxy for stage of condition.

Supplementary examination of the available literature failed to provide any clear indication as to potential treatment pathways or treatment sequences. The recent survey of UK health-care professionals suggested that there is a fairly constant view that treatments should depend on the phase of the condition and/or that a step-up approach should be adopted in terms of the degree of treatment invasiveness.[18] With this in mind the clinical advisory group were presented with two alternative modelling scenarios that were thought to be potentially feasible. These were discussed in depth at a group meeting. Option one involved comparing all possible treatments for each phase of the condition (painful, adhesive and resolution) as mutually exclusive options, ignoring any treatment sequencing and phase of condition. This was considered unrepresentative of clinical practice where treatments would often be given simultaneously or in sequence. The results of this type of model would be uninformative and misleading. Option one was rejected as a viable modelling scenario. Option two involved sequencing treatments dependent on their invasiveness. This would potentially allow treatments such as physiotherapy followed by steroid injections followed by MUA to be evaluated. In essence, all treatments, in all possible sequence order, would be considered. This modelling option required an assumption that the clinical effectiveness of each treatment, as obtained from the included clinical trials, would remain the same regardless of where it was placed in a sequence of treatments or what treatments had been received before it. Again, it was the view of the advisory group that this was not a realistic assumption and in fact the effectiveness of treatments is likely to be linked to the position of the treatment in the sequence. The general consensus within the advisory group surrounding this issue was that the assumptions that would be required were, from a clinical perspective, inappropriate.

Given the lack of relevant data from the trials included in the review, the consensus from the advisory group that the required assumptions were clinically inappropriate and the confirmatory position regarding the lack of consensus on recommended treatment pathways in recently published articles,[18] it was decided that it was not feasible or useful in this instance to construct a decision-analytic model. In fact, it was perceived that any attempt to undertake modelling would provide hugely uncertain results, which would not allow any conclusions to be made.

Given the lack of UK data on physiotherapy from the identified economic evaluation[91] and the lack of economic evaluations of the other relevant interventions we opted to elicit from our clinicians on the advisory group details of the resource use associated with the modalities identified in the review for a frozen shoulder population. The available evidence was then used to obtain utility valuations, which we present as exploratory cost-effectiveness analyses. Our intention, had a de novo model been developed, was to undertake the analysis from an NHS perspective. This perspective has been maintained for the investigative costing exercise. Resources estimated have been valued using national average unit costs (pounds sterling) at 2009–10 prices where possible. Resource use, unit costs and total cost are presented separately, where possible, for each individual treatment. The estimation of resource use gives us only part of the evidence requirements for an economic analysis. The presentation of cost data alone should allow some conjecture about the economic implications of alternative treatments, but does not provide the information required to inform a decision on the cost-effectiveness of these alternatives. To help inform such decisions, the cost estimates obtained from this exercise will be combined with our derived health-related quality of life (HRQoL) estimates (see *Mapping from the pain VAS and SF-36 onto the EQ-5D*) and presented as ICERs. An ICER is calculated as the difference in the expected cost of two interventions, divided by the difference in the expected QALYs produced by the two interventions. To inform which therapies are of greatest clinical as well as economic value, cost-effectiveness results are usually compared against an acceptable threshold of cost-effectiveness to determine whether a health-care intervention is cost-effective, and a good use of resources, or one that represents poor value for money. The cost-effectiveness threshold for interventions in the English and Welsh NHS is suggested by NICE to be £30,000 per additional QALY; therefore, we have used this threshold.[92]

The following sections will outline:

1. resource-use estimation and costing
2. mapping from clinical outcomes to EQ-5D
3. estimation of QALYs and ICERs.

Resource-use estimation

Steroid injections

Six RCTs investigated steroid injections in the treatment of primary frozen shoulder, either alone or in combination with physical therapy.[35,41,42,66–68] Steroid injections can be delivered by a number of different practitioners using different approaches. We have broken these down into a guided injection delivered by an orthopaedic surgeon, a rheumatologist or a radiologist in a hospital setting; unguided injection delivered by a physiotherapist or a GP in a non-hospital setting; and unguided injection delivered by a physiotherapist, an orthopaedic surgeon or a rheumatologist in a hospital setting. Given the nature of the condition and the individual nature of treatments, it was not possible to be precise about the number of injections that an average individual may receive. It was also suggested by our advisory group that the number of patients receiving guided injection within the NHS was likely to be low.

Unguided injections

The clinical experts suggested that it would be rare for individuals to receive more than three injections and on average they would receive two injections spread over various durations of time. *Table 57* provides the unit costs of the resources that are used when delivering a steroid injection outside of a hospital setting. We have not included the cost of consumables as these costs are likely to be negligible. The six trials evaluating injections identified in the review of effectiveness assess the use of dexamethasone alone or in conjunction with lidocaine, or triamcinolone alone or in conjunction with lidocaine. We have elected to present costs for both types of steroid although both of the UK trials identified in the review evaluated triamcinolone.[41,67]

Alternative scenarios for the delivery of unguided steroid injections were considered and full details of these are presented in *Appendix 13*. The base case considered three sessions, an initial session of 20 minutes' duration when an assessment would be undertaken plus two injection sessions of 10–20 minutes' duration. Using an average of 15 minutes for the two injection sessions, and assuming a combined injection of triamcinolone and lidocaine, the total cost if delivered by a physiotherapist is £36.18. The total cost if delivered by a GP is £108.68. The choice of steroid injection for the base case was based on the UK trials identified as part of the effectiveness review.[41,67] The use of a premixed ready-to-inject vial of dexamethasone plus lidocaine would increase the total cost to £39.06 if delivered by a physiotherapist and £111.56 if delivered by a GP.

Unguided injections are also delivered within a hospital setting. We further estimated that the costs associated with unguided injections in the hospital setting would be £27.17 if delivered in a hospital physiotherapy unit, £88.01 if delivered in an orthopaedic setting and £138.51 if delivered in a rheumatology setting.

Guided injections

Guided injections were assumed to be delivered in a hospital setting by key personnel including an orthopaedic surgeon, a rheumatologist or a radiologist. We estimated that the same number of sessions would be required, using the same type of steroid. The variation in the cost of the guided injections is driven by who delivers the injection. For the base case we have again used the cost of a combined injection of triamcinolone and lidocaine, but present the cost of the premixed dexamethasone plus lidocaine to allow a range to be expressed. We have also assumed that on average two injections will be given over three visits. Alternative scenarios showing varying resource-use levels (suggested alternative numbers of sessions/injections) are presented in *Appendix 13*. Unit costs for guided injections are presented in *Table 58*.

TABLE 57 Unit costs for unguided steroid injections

Unguided injection	Unit cost	Source
GP	£35 per consultation	Curtis 2009[93]
Physiotherapist	£39 per hour	Curtis 2009[93]
Dexamethasone 40 mg/lidocaine 10 mg	£3.28 per vial	BNF[94]
Dexamethasone 40 mg	£1.00 per vial	BNF[94]
Triamcinolone 20 mg	£1.49 per vial	BNF[94]
Lidocaine 5 ml	35p	BNF[94]

BNF, *British National Formulary*.

Note: Unit costs[93] for key health-care personnel reflect average values. Data were not available by staff grade level, e.g. physiotherapist grade 6 or above.

TABLE 58 Unit costs for guided steroid injections

Guided injection	Unit cost	Source
Orthopaedic outpatient visit, first	£124	Department of Health[95]
Orthopaedic outpatient visit, follow-up	£86	Department of Health[95]
Rheumatology outpatient visit, first	£211	Department of Health[95]
Rheumatology outpatient visit, follow-up	£129	Department of Health[95]
Dexamethasone 40 mg/lidocaine 10 mg	£3.28 per vial	BNF[94]
Dexamethasone 40 mg	£1.00 per vial	BNF[94]
Physiotherapist outpatient attendance, first	£38 per hour	Department of Health[95]
Physiotherapist outpatient attendance, follow-up	£29 per hour	Department of Health[95]
Triamcinolone 20 mg	£1.49 per vial	BNF[94]
Lidocaine 5 ml	35p	BNF[94]

BNF, *British National Formulary*.
Note: Unit costs[95] for key health-care personnel reflect average values. Data were not available by staff grade level.

The total cost of injections delivered within the orthopaedic setting ranges from £299.68 to £302.56 depending on the steroid injected. Injections delivered in the rheumatology setting have a total cost ranging from £472.68 to £475.56. These alternative delivery settings have been presented as it is believed that these are all viable options depending on available NHS services within a local area.

Steroid injection plus physiotherapy

The resource use associated with the combined treatment of steroid injection plus physiotherapy is again related to the setting in which the treatments are given and the method of steroid delivery. A number of scenarios are presented (see *Table 59* for relevant unit costs):

- Scenario one: six physiotherapy sessions with an active mobilisation component and two unguided steroid injections all delivered by a physiotherapist. It has been assumed that no additional time was required and the total cost is equal to the total cost of active physiotherapy plus the steroid injections. The total cost ranges from £130.43 to £133.31 if delivered by a community physiotherapist, or from £121.43 to £126.81 if delivered by a hospital-based physiotherapist, depending on choice of steroid.
- Scenario two: six physiotherapy sessions with an active mobilisation component delivered by a community-based physiotherapist, plus two unguided steroid injections delivered by a GP over three visits. The total cost of this scenario ranges from £235.75 to £238.75, depending on choice of steroid.
- Scenario three: six physiotherapy sessions with a mobilisation component delivered by a hospital-based physiotherapist, plus two unguided steroid injections delivered by a GP over three visits. The total cost of this scenario ranges from £226.75 to £238, depending on choice of steroid.
- Scenario four: six physiotherapy sessions with a mobilisation component delivered by a community-based physiotherapist, plus two guided steroid injections delivered within the orthopaedic setting. The total cost ranges from £420.23 to £423.31, depending on choice of steroid.
- Scenario five: six physiotherapy sessions with a mobilisation component delivered by a community-based physiotherapist, plus two guided steroid injections delivered within the rheumatology setting. The total cost ranges from £605.43 to £607.31, depending on choice of steroid.

■   Scenario six: six physiotherapy sessions with an active mobilisation component, plus two guided steroid injections delivered by a hospital-based physiotherapist. The total cost ranges from £160.43 to 165.81, depending on choice of steroid.

Alternative scenarios could be estimated by varying the number of injections, delivery method and setting. However, the base-case scenarios presented reflect what we believe are current options in the NHS.

Sodium hyaluronate injection

Three trials evaluating sodium hyaluronate were identified in the effectiveness review.[66,69,70] In a recent UK-based survey of treatment recommendations by health-care professionals involved in managing frozen shoulder, sodium hyaluronate injection was recommended by < 1% for treating the early 'painful' phase or 'resolution' phase of frozen shoulder.[18] It was further suggested by the clinical advisory group that one injection would typically be delivered over two sessions in a hospital setting. The injection was likely to be delivered by a consultant. However, the costs were not available for sodium hyaluronate for provision under the NHS. It was felt that this intervention was likely to be delivered in a hospital setting, but we were unable to ascertain any costs associated to its delivery that would be borne by the NHS.

Physical therapy

The broader range of physical therapies are not available through the NHS and therefore have not been costed. Two categories of physiotherapy were costed, physiotherapy with mobilisation (active) and physiotherapy without mobilisation. It was felt by the advisory group that physiotherapy without mobilisation would not be delivered on its own in an NHS setting, but may be used to complement another therapy. Therefore, for the purpose of resource-use estimation, physiotherapy without mobilisation has been considered only as an add-on delivered alongside other therapies.

Active physiotherapy

It was estimated by the advisory group that physiotherapy with a mobilisation component would on average comprise six sessions each of 30 minutes' duration, followed by a final review session of 15 minutes' duration. Full details of all estimates of resource use and any plausible ranges are presented in *Appendix 13*.

As can be seen from *Table 59*, the cost of physiotherapy is dependent on the setting in which the treatment is delivered. We have used all variations in hourly cost to calculate a plausible range of total cost for the delivery of active physical therapy. Within a community setting, active physical therapy is estimated to cost a total of £126.75. Within a hospital setting the same treatment is estimated to have an average total cost of £98.75.

Physiotherapy without mobilisation

The review of effectiveness identified one trial that was classified as 'physiotherapy without mobilisation'.[16] The trial evaluated laser versus placebo laser (plus home exercise). Given that

TABLE 59 Unit costs for active physiotherapy

Staff delivering treatment	Unit cost	Source
Community physiotherapist	£39 per hour	Curtis 2009[93]
Physiotherapist outpatient attendance, first	£38 per hour	Department of Health[95]
Physiotherapist outpatient attendance, follow-up	£29 per hour	Department of Health[95]

Note: Unit costs[93,95] for key health-care personnel reflect average values. Data were not available by staff grade level.

it is unlikely that laser therapy would be delivered without some form of mobilisation (active physiotherapy) within the NHS, we have assumed that laser therapy would be provided in conjunction with an active mobilisation, adding an additional 15 minutes to a 20- to 30-minute session. The additional cost reflects what we believe is current practice, that is, the delivery of both active mobilisation and other passive modalities such as heat treatment in the same treatment session. The additional cost would be either £49.38 or £63.38 depending on the setting.

Acupuncture

Three trials evaluating acupuncture were identified in the effectiveness review.[79–81]

It was felt by the clinical advisory group that acupuncture, like other physiotherapies, would in clinical practice rarely be given in isolation of other treatments. We have therefore assumed that acupuncture would be delivered in physiotherapy sessions, in either a hospital or a community setting, over the same duration as active physiotherapy, that is, six sessions of 20–30 minutes' duration at a total cost ranging from £117.75 to £126.75.

Manipulation under anaesthesia

The review identified four RCTs investigating MUA in the treatment of primary frozen shoulder.[38,39,82,83] The resource implications of MUA were difficult to firmly establish. The actual cost of MUA has been estimated at £424 (range £191–500) based on the HD24C code, which was obtained from the *NHS Reference Costs*.[95] In addition, there is a need for extensive rehabilitation physiotherapy, which was estimated on average to consist of two 30-minute sessions per week for 4 months, plus a final review, which would take place with the orthopaedic surgeon. Therefore, in total, the estimated cost of MUA is £1446. If steroid injections are also used this cost would increase accordingly.

Arthrographic distension

Three trials evaluating arthrographic distension with steroid injection were identitied in the effectiveness review.[36,43,84] Arthrographic distension is assumed to be delivered in the hospital setting by a radiologist or an orthopaedic surgeon and involves the use of radiological imaging (e.g. fluoroscopy) to ensure that the injection is accurately placed. The procedure was assumed to require around 15 minutes based on the clinical literature. Because there are no UK trials in the clinical review it is unclear how many visits for injections might be needed. We have therefore conservatively estimated the cost as involving one hospital outpatient visit with injection. The estimated cost of this procedure has been derived from the *NHS Reference Costs*[95] at £113 (range £78–133) based on code RA16Z, plus the cost of a combined injection of triamcinolone and lidocaine (£1.49 + £0.35), giving a total of £114.845 (range £79.84–134.84).

Capsular release

Two studies evaluating capsular release were identified in the effectiveness review.[85,86] Capsular release is performed in the hospital setting and delivered by a surgical team, which is likely to comprise anaesthetist, orthopaedic surgeon, anaesthetic nurse, scrub nurse and assistant and recovery nurse. The procedure is likely to take 30–45 minutes, followed by a further 15 minutes for recovery from anaesthetic. The estimated cost of this procedure has been derived from the *NHS Reference Costs*[95] at £1182 (range £787–1489) based on code HB62C. Like MUA, capsular release requires a follow-up of intensive physiotherapy. We have estimated that the physiotherapy following capsular release would be the same as that following MUA. On average this would consist of two 30-minute sessions per week for 4 months, plus a final review that would take place with the orthopaedic surgeon. Therefore, in total, the estimated cost of capsular release is £2204 (range £1809–2511).

Summary

Average costs were estimated for the interventions included in the review. These ranged from £36.18 for an unguided steroid injection to £2204 for capsular release. Where possible, these estimated average costs will be used to inform tentative cost-effectiveness ratios, which will be presented later in the report. They will be combined with HRQoL data estimated by means of a mapping exercise, which is presented in the following section. The aim is to estimate HRQoL by mapping from three clinical outcomes to EQ-5D using an available data set. The main focus of the mapping is to explore the nature and direction of the relationship between different clinical and HRQoL outcome measures. We will then use the EQ-5D estimates to obtain HRQoL outcomes for a subset of clinical trials identified in the review that have presented data on the three relevant outcomes.

Mapping from the pain VAS and SF-36 onto the EQ-5D

The clinical trials identified in the effectiveness review report outcomes using a variety of measures including pain (overall, at rest, on movement, at night), range of movement (e.g. internal and external rotation, elevation), function and disability, quality of life, time to recovery and return to work and recreation, and adverse events. Of the selection of measures used in the trials, none was designed to generate health state utility values, which are required to calculate QALYs, which can then be used to assess cost-effectiveness. Outcomes from treatments affect two basic components – the quantity and quality of life – both of which are captured in the QALY. There are a variety of standardised 'off-the-shelf' preference-based measures available to derive estimates of HRQoL, such as the EQ-5D, SF-6D, Health Utilities Index (HUI) and 15-dimension utility measure (15D).[65,96,97,98] These HRQoL values can subsequently be incorporated in economic models for performing cost-effectiveness analyses. They are the preferred benefit measure when undertaking any cost-effectiveness analysis.

An additional search of MEDLINE was conducted to identify health quality of life outcomes that could be used to inform any modelling. The lack of use of generic preference-based measures in existing frozen shoulder clinical studies is a potential current barrier to populating economic models with the best evidence on effectiveness and to thereby allow broader comparisons across different diseases.

The included economic evaluation presented HRQoL in the form of the SF-6D, but it was felt that given the general preference for EQ-5D and the possibility of bias in the clinical study further investigation was warranted. The EQ-5D is the recommended instrument of choice for use in cost-effectiveness analyses by NICE and is the most commonly used instrument.

In the context of this clinical review, it is not clear why HRQoL has not been included in the battery of outcome measures in the clinical trials in frozen shoulder populations to date. Possible reasons why such instruments have not been administered may be because it is not practical or they are too time-consuming for patients to complete in trials in addition to all of the other forms/questionnaires that are used – often across multiple time points – or even because studies were not initially designed to focus on economic questions. It may be that the general perception is that these generic instruments are not sensitive enough.

In a situation such as this, in which such instruments have not been used in clinical studies, a pragmatic alternative is to apply a mapping function to convert non-preference-based health data into one of the generic preference-based measures. Mapping essentially provides a statistical equation that allows the estimation of health utilities and the subsequent calculation of QALYs in clinical studies that do not use any preference-based HRQoL instruments. In the published literature, the EQ-5D was recently reported as being the most popular target measure used for mapping.[96]

On the other side of the mapping equation, the most widely used generic measures/instruments that have been mapped include the SF-36 and SF-12 health surveys, which offer the option of presenting scores across eight dimensions or two summary measures derived from the eight dimensions. These two summary measures are the physical component and the mental component.[99,100] Also, a number of shoulder-specific questionnaires (scores) have been shown to be significantly correlated with the EQ-5D in the literature, in particular the SDQ.[55] Of particular importance in the current clinical effectiveness review were patient-assessed pain intensity, function and disability, quality of life and range of movement. Pain was the most common outcome measure in the included clinical studies and, for instance, in the MTC analysis, pain was analysed based on the following preference hierarchy: overall pain, pain at night, pain on activity, any other type of pain (excluding pain at rest) and pain at rest. Furthermore, and within the context of the current clinical effectiveness review, three of the studies reported the SF-36 as an outcome measure. As mentioned earlier in the clinical sections of the report, two studies meeting the full inclusion criteria reported the mean physical and mental component summary scores.[31,47] One additional study, which did not meet the analysis criteria, reported the means for the eight dimensions of the SF-36.[81] The outcomes were reported over the time horizon of 4 weeks and as a result the study was excluded from further analysis. Therefore, in line with the decision made as part of the clinical review we elected not to map from this evidence base, but rather to utilise the potentially more reliable component summary scores that had been reported in the other two trials.[35,51]

In a recent review of mapping studies, simple additive models that employed a utility index score as the dependent variable and the main effects of either total or instrument dimension scores as independent variables performed almost as well as more complex models comprising many variables.[99] With this in mind, and as the main focus of this analysis was to explore the nature and direction of the relationship between different outcome measures, we chose to follow a simple approach and use mean pain VAS score (as it was a main outcome in the clinical review) and mean SF-36 physical and mental component summary scores (as it is one of the most widely used generic quality-of-life measures in mapping studies). These were important outcomes in the clinical effectiveness review.

To undertake an exploratory mapping analysis of this nature we required a data set in which the two measures being mapped had been administered specifically to a frozen shoulder population. We were unable to obtain a data set of this nature for a frozen shoulder population; however, we obtained a UK data set involving patients with rotator cuff disease from the SAPPHIRE RCT.[101] Both measures chosen for the exploratory mapping analyses were already calculated and readily available in the SAPPHIRE data set.[102]

The selection of outcomes on which to map was a pragmatic decision based on the data available in the SAPPHIRE data set. The relationship is estimated using a range of techniques and statistical specifications. Furthermore, we compare the mapping approaches tested in terms of their predictive performance in the SAPPHIRE trial population. Within the context of the current review, we conducted an analysis to explore whether or not relationships between the pain VAS and SF-36 and the EQ-5D exist and the nature of those relationships. In doing so, we considered that we might be able to demonstrate the need for the collection of utility EQ-5D data in future clinical trials and offer a potential alternative approach for frozen shoulder populations for whom there is currently a lack of HRQoL data.

The SAPPHIRE trial compared the efficacy of corticsosteroid (40 mg/ml triamcinolone acetonide) versus local anaesthetic (1% lidocaine) injection in subjects presenting to GPs with (acute) shoulder pain (in one or both shoulders) persisting no longer than 12 months, and with diagnosis of rotator cuff tendonitis.[102] The trial evaluated the impact of giving GPs

TABLE 60 Patient baseline characteristics and mean reported scores

Study	Treatment arms	Duration of shoulder condition[a]	Patient characteristics		EQ-5D (mean)	SF-36 PCS (mean)	SF-36 MCS (mean)	Pain VAS (mean) (0–100 mm)
			Age (years)	% female				
Dogru (Turkey)[51]	2	Shoulder pain of at least 3 months' duration	53.9–56.8 (55.4 total)	57 (total)	–	36.6–38.9	42–43.5	78–80.8
Stergioulas (Greece)[16]	2	Duration of frozen shoulder at baseline of 26.5–27.1 weeks	55.5–56.8	37	–	–	–	67.03–70.9
Carette (Canada)[35]	4	Adhesive capsulitis of <1 year's duration, mean duration of current episode of shoulder pain 20.3–22.1 weeks	54.2–56.5	46.2–66.7	–	35.2–37.6	43.1–49.8	–
SAPPHIRE trial (UK)[102,104]	2	Shoulder pain persisting for ≤ 12 months, median duration of shoulder pain 6.5–8 weeks	55–59	51–55	0.453–0.512	35.96–38.89	44.64–46.54	68.43[b]

a Based on (study-specific) condition-related inclusion criteria.
b Not reported in the trial publications and thus estimated from the SAPPHIRE data set for the current analyses.

additional training in diagnosing rotator cuff pathologies and in performing shoulder injections, or no training. Trial participants were followed up at 1 and 3 months, with a final follow-up at 6–12 months post randomisation. The outcome measures were the SF-36, EQ-5D, British SDQ[103] and VAS to assess the extent of shoulder pain (at night, in daytime at rest, in daytime on movement).

The population characteristics for the two studies included in the clinical review that reported mean overall pain VAS scores,[16,51] using a 0- to 100-mm scale, and the two studies included in the clinical review that reported mean SF-36 physical and mental component summary scores[35,51] are reported in *Table 60*. The population characteristics of the participants in the SAPPHIRE trial[102,104] are also shown in *Table 60*.

The three studies included in the clinical effectiveness review reporting mean pain VAS scores and/or mean SF-36 physical component summary (PCS) and mental component summary (MCS) scores and the SAPPHIRE trial include populations with broadly similar proportions of men and women and of a similar age and duration of shoulder condition or pain and with similar mean pain VAS and SF-36 PCS and MCS scores.

The mapping presented here is an exploratory exercise, based on a patient population with very similar baseline characteristics as the frozen shoulder population. We examine the relationship between the EQ-5D and pain as measured by a VAS 0–100 mm and the EQ-5D and SF-36 (specifically the SF-36 PCS and MCS) health surveys.

Methods
The following sections present the methods used in estimating HRQoL data to inform our tentative analysis and potentially inform other economic evaluations.

Instruments
Pain visual analogue scale Pain was measured on a scale from 0 to 100 mm in both the studies included in the clinical review (see *Table 60*) and the SAPPHIRE data set. Values anchored on

the VAS at 0 generally represent no pain whereas values anchored at 100 generally represent the worst pain possible. Both studies have data available as mean values. When more than one type of pain was measured in any single study, data were selected for the mapping exercise based on the pain hierarchy as reported earlier in the clinical sections of this report.

SF-36 The SF-36 questionnaire covers different aspects of HRQoL and the items can be pooled in eight different subscales: physical functioning, role – physical, body pain, general health, vitality, social functioning, role – emotional, and mental health.[107] Patient scores are rated on a 0 (worst)–100 (best) scale for each subscale. These eight subscales can be pooled in two different clusters: the PCS and the MCS. The calculation of the SF-36 summary scores (PCS and MCS) is based on a published algorithm which uses a standardised scoring system with mean = 50 and SD = 10. The two component summary scores are used for the current regression analyses.

EQ-5D The EQ-5D is a five-item questionnaire encompassing the domains of mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Respondents are asked to indicate whether they have no problems, some problems or major problems in each domain, with responses scored as 1, 2 and 3 respectively. To produce a combined utility health score, in which 1 is full health and 0 is equivalent to being dead, individuals' answers about the extent of their problems in each of the five health domains are then weighted. The weights, based on a large UK study, are used to take into consideration population preferences for each health domain.[65] The resulting descriptive system defines 243 health states. The worst-valued health state is –0.594 (worse than death), whereas the best-valued health state is 1.0 (perfect health).

Data set

We used the SAPPHIRE trial data set and measurements at 3 months for the primary (base-case) analysis. The number of participants with complete outcomes data at 3 months was (1) 141 for the EQ-5D and pain VAS and (2) 133 for the EQ-5D and SF-36 PCS and MCS. The time point of 3 months was chosen as it represented a clinically relevant time point in the frozen shoulder trials included in this review. The data sets for (1) and (2) were then each divided into two by taking a random sample of 60% of the data and separating that data from the remaining 40% to provide an estimation data set and a validation data set respectively. In the case of (1), the EQ-5D and pain VAS, 85 measurements were available for the estimation data set and 56 measurements for validation. For (2), the EQ-5D and SF-36 PCS and MCS, 80 measurements were available for the estimation data set and 53 measurements for validation.

It should be noted that the collection of new data to validate a model's predictions is the preferred approach.[108] However, in many situations this is neither practical nor possible and an alternative approach is to split the data in hand into two parts. The first part is used to estimate the model coefficients (estimation sample) and the second part is used to assess the prediction accurary of the model (validation sample). Thus, data splitting provides a data set to measure the 'in-use' (or within-sample) prediction accuracy of the model and simulates the complete or partial replication of the data set, in this case the SAPPHIRE trial data set.

Statistical analysis

Econometric estimation methods tested Ordinary least squares (OLS) regression was used as the main statistical technique in the analysis. The target outcome (dependent variable) was the overall EQ-5D index score, and the explanatory (independent) variables were (1) the pain VAS and (2) the SF-36 PCS and MCS scores. Based on the theoretical limitations of OLS modelling approaches reported in the empirical econometric literature,[100,109,110] the current exploratory investigation estimates the EQ-5D index scores also using TOBIT (an ecometric model named after its developer James Tobin,[111] which allows for upper censoring of the dependent variable,

EQ-5D, at 1.0; a caveat is that it produces biased estimates in the presence of heteroscedasticity or non-normality) and CLAD (censored least absolute deviations, which produces consistent estimates in the presence of heteroscedasticity or non-normality, whereas also allowing for censoring at either the upper or the lower bound).

Regression analyses   All regressions were conducted in Stata version 11 (StataCorp LP, College Station, TX, USA) and specifically included the estimation of the following models and included independent variables. The general regression models for (1) the EQ-5D and pain VAS and (2) the EQ-5D and SF-36 PCS and MCS were defined as:

$$\text{EQ-5D}_i = \alpha + \beta_1 \times painVAS_i + \varepsilon_i \qquad \text{[Equation 1]}$$

where EQ-5D represents the EQ-5D health state index value, $i = 1,2,\ldots, n$ represents individual respondents, *painVAS* represents the pain score, α is the intercept and ε is the error term, and

$$\text{EQ-5D}_i = \alpha + \beta_1 \times PCS_i + \beta_2 \times MCS_i + \varepsilon_i \qquad \text{[Equation 2]}$$

where EQ-5D represents the EQ-5D health state index value, $i = 1,2,\ldots, n$ represents individual respondents, *PCS* represents the SF-36 PCS score, *MCS* represents the SF-36 MCS score, α is the intercept and ε is the error term. Variations of the first model were explored by including squared terms. Variations of the second model were explored by including squared and interaction terms.

We conducted three sets of analyses using alternative approaches relating to the choice of estimation and validation samples from the main SAPPHIRE data set:

- Regression models using main effects with and without squared terms and interaction term (using individual-level data at 3 months):
  - for (1), EQ-5D and pain VAS, total $n = 141$, estimation data set = 85 (60%), validation data set = 56 (40%)
  - for (2), EQ-5D and SF-36 PCS and MCS, total $n = 133$, estimation data set = 80 (60%), validation data set = 53 (40%).
- Regression models using main effects with and without squared terms and interaction term (using individual-level data at 1, 3 and 12 months):
  - for (1), EQ-5D and pain VAS, total $n = 491$, estimation data set = 295 (60%), validation data set = 196
  - for (2), EQ-5D and SF-36 PCS and MCS, total $n = 467$, estimation data set = 280 (60%), validation data set = 187.

Data for all time points (1, 3 and 12 months) were pooled to increase the sample size and the statistical precision of the estimates with correction for the clustering of several responses per patient by using the option 'cluster' in the regress command in Stata version 11.[112]

- Prediction models using the main effects with and without squared terms and interaction term (using models estimated from 3-month data and used to predict EQ-5D scores at 12 months):
  - for (1), EQ-5D and pain VAS, validation data set = 171
  - for (2), EQ-5D and SF-36 PCS and MCS, validation data set = 163.

Assessment of models' performance   Model fit (explanatory performance) and predictive/ mapping performance were based on assessments of the adjusted R^2, mean error (ME), mean absolute error (MAE) and root-mean-square error (RMSE), as well as the percentage of individual predictions within 0.10, 0.05 and 0.01 of their actual EQ-5D utility values (arbitrary

cut-off values). Descriptive statistics and plots of actual versus predicted EQ-5D scores were also generated to examine the pattern of errors across EQ-5D scale, for example to assess whether they were evenly distributed across poor/better health states.

Results from the mapping exercise
Pattern of EQ-5D, pain visual analogue scale and SF-36 PCS and MCS scores

EQ-5D and pain visual analogue scale   The mean EQ-5D scores (ordered according to health state severity) in the SAPPHIRE population vary over a wide range (e.g. from negative utility values to 'perfect health' as indicated by utility values of 1.0; *Table 61* and *Figure 25*). In contrast, the SAPPHIRE trial mean pain VAS scores vary over a narrower range (e.g. highest mean VAS score = 60, when a maximum pain VAS of 100 is possible). An increasing EQ-5D score (i.e. better health status) appears to be generally accompanied by decreasing pain VAS scores (i.e. lower scores = less pain).

EQ-5D and SF-36 PCS and MCS   *Figure 26* and *Table 62* show that mean EQ-5D scores (ordered according to health state severity) in the SAPPHIRE population vary over a wide range. In contrast, the SAPPHIRE trial mean SF-36 PCS and MCS scores vary over a relatively narrow range. An increasing EQ-5D score (i.e. better health status) appears to be generally accompanied by increasing SF-36 PCS and MCS scores (i.e. higher scores = a better quality of life).
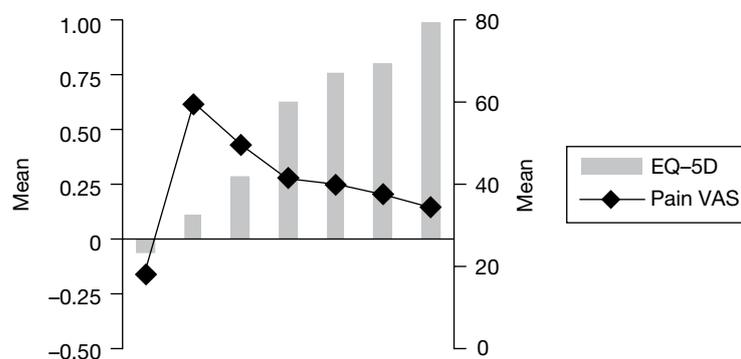
FIGURE 25 Pattern of EQ-5D scores and pain VAS scores within the SAPPHIRE data set (for complete responses) at 3 months' follow-up (base case).

TABLE 61 Pattern of EQ-5D scores and pain VAS scores within the SAPPHIRE data set (with complete responses at 3 months)

| EQ-5D grouping	n	EQ-5D (mean)	Pain VAS (mean)
<0	8	−0.05	18.13
0–0.249	15	0.08	60
0.25–0.499	1	0.26	50
0.5–0.699	52	0.63	41.87
0.7–0.799	24	0.75	40.17
0.8–0.899	26	0.83	38.88
0.9–1.0[a]	15	1.0	34.67
Full index	15	1.0	34.67
Overall	141	0.63	37.63

a   All values were equal to 1.0, i.e. full index.

TABLE 62 Pattern of EQ-5D scores and SF-36 PCS and MCS scores within the SAPPHIRE data set (with complete responses at 3 months)

EQ-5D grouping	n	EQ-5D (mean)	SF-36 PCS (mean)	SF-36 MCS (mean)
<0	10	−0.07	35.96	45.70
0–0.249	18	0.11	39.18	47.35
0.25–0.499	1	0.26	36.64	41.14
0.5–0.699	44	0.63	39.68	42.01
0.7–0.799	21	0.75	44.07	50.23
0.8–0.899	28	0.82	42.91	53.2
0.9–1.0[a]	0	NA	NA	NA
Full index	11	1.0	40.68	48.95
Overall	133	0.59	40.79	47.21

NA, not applicable (no values fell within this grouping).
a   All values were equal to 1.0, i.e. full index.
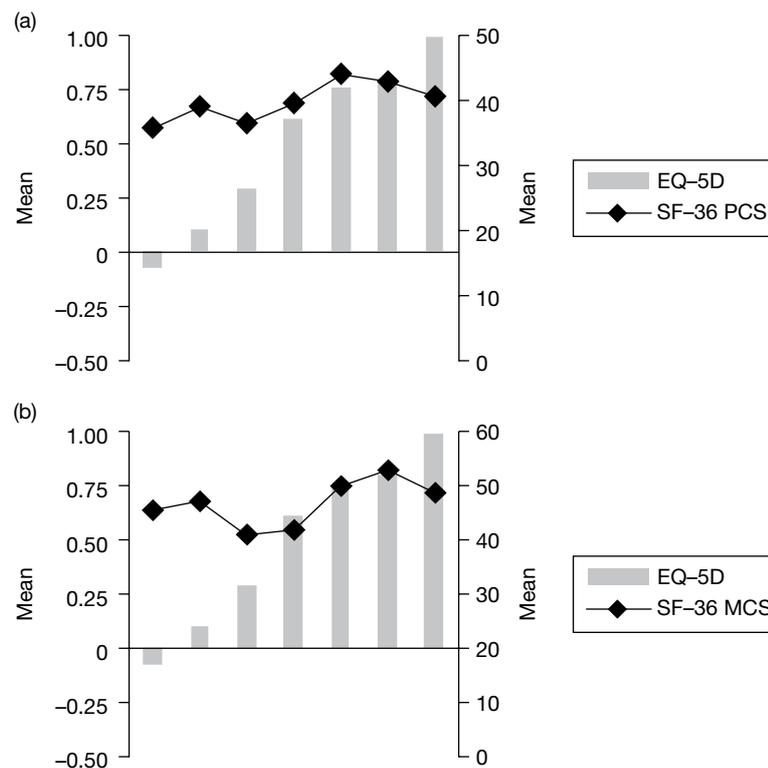
FIGURE 26 Pattern of EQ-5D scores and SF-36 PCS and MCS scores within the SAPPHIRE data set (for complete responses) at 3 months' follow-up (base case).

Regression analyses

EQ-5D and pain visual analogue scale
Table 63 shows the results of the regression of the pain VAS scores onto the EQ-5D using the 3-month data set (base case). The explanatory power and fit of both OLS models was poor, with an adjusted R^2 ranging from −0.0014 to 0.0081. The TOBIT and CLAD models including main effects and squared terms were still relatively poor although they produced the smallest MAEs (0.2158 and 0.1877 respectively) compared with the two OLS models. However, all models predicted only between 16% and 23% of scores to within 0.05 of actual EQ-5D utility values.

TABLE 63 Regression models using pain VAS at night main effects with and without squared terms (using individual-level data at 3 months)

	Model 1		Model 2		Model 3		Model 4	
Econometric estimation method	OLS		OLS		TOBIT		CLAD	
Independent variables	Pain VAS night		Pain VAS night, squared terms		Pain VAS night, squared terms		Pain VAS night, squared terms	
	Coeff.	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*
Intercept	0.5540896	0.0524505	0.5353785	0.0663995	0.5413921	0.0725511	0.6872609	0.0621687
pVASnight	0.0013853	0.0010672	0.0033283	0.0043293	0.0042145	0.0047531	0.0009522	0.0036473
pVASnight*pVASnight			−0.000023	0.0000497	−0.0000312	0.0000546	−0.000013	0.0000385
Adjusted R^2	0.0081		−0.0014		–		–	
ME	0.03958		0.0402		0.0206		−0.0479	
MAE	0.21718		0.2218		0.2158		0.1877	
RMSE	0.276951		0.280038		0.280351		0.279724	
|Difference|[a]								
|Δ|≤0.10	14	25%	14	25%	16	28%	28	49%
|Δ|≤0.05	9	16%	10	18%	9	16%	13	23%
|Δ|≤0.01	3	5%	1	2%	2	4%	8	14%
	Actual		*Predict*		*Predict*		*Predict*	
Mean	0.64429		0.60413		0.62368		0.69218	
SD	0.279102		0.048668		0.057483		0.011428	
Min.	−0.140		0.535		0.541		0.652	
Max.	1.000		0.656		0.684		0.705	
Range	1.140		0.120		0.142		0.69218	

SE, robust standard error.
a   Proportion of predicted values with errors < |0.01|, |0.05| and |0.10|.
b   Range = maximum value − minimum value.
Total n = 141. Estimation data set = 87 (60%), validation data set = 54 (40%). 'Base case'.

Appendix 14 shows the results of the regression of the pain VAS scores onto the the EQ-5D using individual-level data at 1, 3 and 12 months. Compared with using data from 3 months only, the explanatory power and fit improves but only slightly. The two OLS models generated an adjusted R^2 of 0.1009. Errors were generally similar across all models with RMSEs ranging from 0.26403 to 0.26689. Models 1–4 were able to predict between 20% and 26% of the scores to within 0.05 of actual EQ-5D utility values. The predictive performances of all models were generally similar.

Appendix 14 also shows the results of the regression of the pain VAS scores onto the EQ-5D using models estimated from 3-month data and used to predict EQ-5D scores at 12 months. Predicting EQ-5D scores at 12 months based on the mapping functions derived from the 3-month data set did not perform as well as the analyses using data from all time points. Models 1–4 were able to predict between 11% and 21% of the scores to within 0.05 of actual EQ-5D utility values.

EQ-5D and SF-36 PCS and MCS　*Table 64* shows the results of the regression of the SF-36 PCS and MCS scores onto the EQ-5D using the 3-month data set (base case). The explanatory power and fit of the three OLS models was poor, with an adjusted R^2 ranging from 0.0147 to 0.0830. The simplest OLS model including only main effects produced the smallest MAEs (0.21135) compared with the other models. However, models 1–5 were only able to predict between 13% and 25% of the scores to within 0.05 of actual EQ-5D utility values.

Appendix 14 shows the results of the regression of the SF-36 PCS and MCS scores onto the EQ-5D using individual-level data at 1, 3 and 12 months. Compared with using data only from 3 months, the explanatory power and fit of all models improves. The three OLS models generated an adjusted R^2 ranging from 0.3840 to 0.4284. Errors are smaller, with the smallest MAE and RMSE for model 5 (CLAD) of 0.1814 and model 1 (OLS) of 0.1889 respectively. Models 1–5 were able to predict between 70% and 78% of the scores to within 0.05 of actual EQ-5D utility values but only 41–55% to within 0.01 of actual EQ-5D utility values. The predictive performances of all models are generally similar.

Appendix 14 also shows the results of the regression of the SF-36 PCS and MCS scores onto the EQ-5D using models estimated from 3-month data and used to predict EQ-5D scores at 12 months. Predicting EQ-5D scores at 12 months based on the mapping functions derived from the 3-month data set was somewhat less accurate than the analyses using data from all time points. Models 1–5 were able to predict between 31% and 58% of the scores to within 0.05 of actual EQ-5D utility values.

Finally, the data suggest that all models (whether they are based on pain VAS or SF-36 PCS and MCS scores) predict better for less severe health states, but overpredict the value of more severe EQ-5D states.

Potential implications for application to frozen shoulder populations

The population used in mapping studies should cover the range of clinical and demographic characteristics of the population on which the mapping function is ultimately to be applied. The two populations should be sufficiently homogeneous that relationships between outcomes in one population can be used to infer relationships about outcomes in the other population. The current exploratory analyses were undertaken on a UK data set of patients with rotator cuff disease and not on the specific population of interest in the current review, that is, frozen shoulder patients. However, we considered the patients in the SAPPHIRE trial data set to exhibit similar enough characteristics to patients with frozen shoulder (see *Table 60*) to be potentially useful for drawing inferences for this population from the mapping analyses. Our findings indicated that, of the models estimated, the simple OLS model including only the main effects of (1) pain VAS mapped onto the EQ-5D and (2) SF-36 PCS and MCS mapped onto the EQ-5D

TABLE 64 Regression models using SF-36 PCS and MCS main effects with and without squared terms and interaction term (using individual-level data at 3 months)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Econometric estimation method	OLS		OLS		OLS		TOBIT		CLAD	
Independent variables	PCS MCS		PCS MCS, squared terms		PCS MCS, squared terms and interaction term		PCS MCS, squared terms and interaction term		PCS MCS, squared terms and interaction term	
	Coeff.	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*	*Coeff.*	*SE*
Intercept	0.2842682	0.1811317	−0.6233533	0.5770837	−1.552434	0.749881	−1.814838	0.7887539	−0.6770489	1.035821
PCS	0.004559	0.003425	0.0018081	0.0201721	0.0249701	0.0232969	0.0286508	0.0244527	0.0157259	0.0273862
MCS	0.0026323	0.0030736	0.0516204	0.0221907	0.073418	0.0246642	0.0831682	0.0259928	0.0399689	0.0316185
PCS*PCS			0.0000186	0.000258	0.0000464	0.0002541	0.000041	0.0002683	0.0000152	0.0002815
MCS*MCS			−0.0005561	0.0002495	−0.0005877	0.0002459	−0.0006711	0.0002584	−0.0002875	0.0002772
PCS*MCS					−0.00052	0.0002744	−0.0005816	0.0002883	−0.0002641	0.0003168
Adjusted R^2	0.0147		0.0513		0.0830		–		–	
ME	0.00025		−0.00220		0.01147		−0.00645		−0.07296	
MAE	0.21135		0.23023		0.242658		0.24848		0.215912	
RMSE	0.27294		0.301496		0.314054		0.324165		0.300666	
|Difference|[a]	*Actual*	*Predict*		*Predict*		*Predict*		*Predict*		*Predict*
|Δ|≤0.10	17	32%	19	36%	19	36%	18	34%	24	45%
|Δ|≤0.05	7	13%	12	21%	11	21%	9	17%	13	25%
|Δ|≤0.01	2	4%	3	6%	2	4%	2	4%	2	4%
	Actual	*Predict*		*Predict*		*Predict*		*Predict*		*Predict*
Mean	0.59623	0.59598		0.59842		0.58476		0.60267		0.66918
SD	0.274200	0.070105		0.119652		0.150510		0.169153		0.118474
Min.	−0.020	0.444		0.128		0.044		−0.03		0.258
Max.	1.000	0.700		0.734		0.799		0.843		0.799
Range	1.020	0.256		0.607		0.755		0.846		0.541

SE, robust standard error.
a   Proportion of predicted values with errors <|0.01|, |0.05| and |0.10|.
b   Range = maximum value − minimum value.
Total n = 133. Estimation data set = 80 (60%), validation data set = 53 (40%). 'Base case'.

performed just as well as some of the more complex models/approaches. If we apply this mapping function to the two studies in the review that did report data for (1) mean pain VAS[16,51] and (2) mean SF-36 PCS and MCS scores[35,51] then hypothetically it becomes possible to derive utilities based on the EQ-5D, which in principal can then be used in performing assessments of the cost-effectiveness (cost–utility) of two or more treatments in patients with frozen shoulder.

Table 65 illustrates the results of this process using data from the two frozen shoulder trials in the clinical effectiveness review that reported mean pain VAS scores[16,51] (see *Appendix 7* for full details and data extraction tables for these studies). Using the OLS1 model function/equations we mapped the reported mean pain VAS at baseline and after 3 months of follow-up onto the EQ-5D. The corresponding EQ-5D scores can then be predicted at baseline and after 3 months of follow-up.

Table 66 illustrates the same using data from the two frozen shoulder trials in the clinical effectiveness review that reported the SF-36 PCS and MCS[35,51] (see *Appendix 7* for full details and data extraction tables for these studies).

TABLE 65 Cost-effectiveness results from mapping onto EQ-5D (pain VAS scale 0–100 mm)

Study	Intervention	EQ-5D estimated from mapping		Mean QALYs over 3 months	Estimated cost per patient	QALY difference	Cost difference	ICER
		Baseline	3 months					
Dogru (Turkey)[51]	Ultrasound + physiotherapy	0.518	0.695	0.15163	£148.13	−0.00163	0	
	Sham ultrasound + physiotherapy	0.527	0.699	0.15325	£148.13			Benefit favours
Stergioulas (Greece)[16]	Physical therapy (laser)	0.55	0.687	0.15463	£49.38	0.00350	0	Benefit favours
	Control (placebo laser)	0.562	0.647	0.15113	£49.38			

Note: Studies reporting pain VAS data (0–100 mm) as medians rather than means were excluded from the theoretical mapping analysis. Cheapest resource-use scenarios as presented in *Resource-use estimation* have been used to obtain costs.

TABLE 66 Cost-effectiveness results from mapping onto EQ-5D (SF-36 PCS and MCS)

Study	Intervention	EQ-5D estimated from mapping		Mean QALYs over 3 months	Estimated cost per patient	QALY difference	Cost difference	ICER
		Baseline	3 months					
Carette (Canada)[35]	Steroid injection + physiotherapy	0.51	0.673	0.14788	£121.43		Dominated	
	Physiotherapy + placebo injection	0.587	0.702	0.16113	£117.75		Dominated	
	Steroid injection	0.583	0.739	0.16525	£36.18	0.01275	£3.68	£288.63
	Placebo injection	0.571	0.649	0.15250	£32.50			
Dogru (Turkey)[51]	Ultrasound + physiotherapy	0.564	0.647	0.15138	£148.13	0.00537	0	Benefit favours
	Sham ultrasound + physiotherapy	0.522	0.646	0.14600	£148.13			

Note: Cheapest resource use scenarios as presented in *Resource-use estimation* have been used to obtain costs.

Based on these EQ-5D estimates QALYs have been approximated by applying the area under the curve (AUC) method, which is implemented by summing the areas of the geometrical shapes obtained by linearly interpolating between utility scores over the study period. Using the UK estimated costs obtained from our resource-use assessment we have presented tentative cost-effectiveness results, which may allow some inference about the cost-effectiveness of some of these interventions.

These calculations are based on the assumption that no further downstream costs will be incurred by the patient. Also, because of the methods we are using we have only been able to compare interventions within trials, not across trials. Any future evaluation should consider all relevant interventions within the same analysis.

Tables 65 and *66* show the baseline and 3-month EQ-5D scores that have been obtained using the estimates provided by the mapping and the QALYs obtained based on these estimates. The costs presented in these tables represent the cheapest UK scenarios presented in *Resource-use estimation*. In some instances, because of interventions requiring the same resource and therefore costing the same, no ICERs have been presented. For the study evaluating interventions that incur different costs,[35] the incremental results suggest that physiotherapy (with placebo injection) and steroid injection with physiotherapy were both dominated (less effective and more costly) by steroid injection alone. Steroid injection has an ICER of £288.63, which is well below the widely used threshold of £30,000.

These results are tentative. Their purpose is to try to help inform further research, not to directly inform decision-making. Actual QALY gains, and incremental cost per QALY estimates, can differ based on how the utilities were derived: directly from preference-based measures or predicted on the basis of mapping.[113] This is neatly demonstrated by the results of the Dogru study, which, depending on whether mapping from the VAS or SF-36, suggest QALY gains in favour of alternative interventions.[51] Furthermore, the choice of direct measure used in cost–utility analyses matters (e.g. EQ-5D, SF-6D, HUI, 15D) and may, in an economic evaluation, lead to different treatment options being considered more or less cost-effective relative to one another.[114] These are all issues outside the scope of this research.

Summary

There were no studies identified in the clinical review that provided utilities data needed for generating cost per QALY estimates in assessments of the cost-effectiveness of alternative treatment options for frozen shoulder.

- The exploratory analysis presents an alternative approach to deriving utility estimates by mapping from outcomes measured in a trial onto a preference-based measure of QoL.
- For mapping to be of any value, a degree of overlap is required between the descriptive systems of the measures being used. The results of the exploratory analysis suggest that a statistical association between the EQ-5D and pain VAS and the EQ-5D and the SF-36 PCS and MCS measures potentially exists, specifically that a decreasing pain VAS score (less pain) is accompanied by an increasing (better) EQ-5D score and similarly that increasing (better) SF-36 PCS and MCS scores are accompanied by an increasing (better) EQ-5D score.
- There is insufficient evidence available to make conclusions about the effectiveness of treatments for frozen shoulder in terms of QoL outcomes based on patient preference measures.

Chapter 4

Discussion

The aims of the project were to undertake a systematic review of the clinical effectiveness and cost-effectiveness of treatments used for the management of idiopathic frozen shoulder, by stage of condition, in order to make recommendations for clinical practice and identify gaps in the evidence. The project also aimed to develop a decision-analytic model to estimate the cost-effectiveness of the alternative treatment options and undertake value of information analysis to assess the potential value of future research on interventions for frozen shoulder.

Both conservative and more invasive treatment options were included in the review. Conservative treatments are generally considered to be education about the condition with advice for self-management, physiotherapy and corticosteroid injection, either alone or alongside physiotherapy. Physiotherapy and steroid injection are delivered in a range of NHS settings including primary care, delivered mainly by physiotherapists and GPs, secondary tier specialist musculoskeletal clinics and a hospital setting. More invasive treatments that were included in the review were distension, MUA and capsular release, which are delivered in a hospital setting. Sodium hyaluronate does not appear to be commonly used in the NHS but there appeared to be a growing literature on its use and it was therefore included. This was classified with the more invasive treatments, mainly because it would be delivered in a hospital setting.

Principal findings

Clinical effectiveness

Data from studies with a low risk of bias were sparse, in particular for the more invasive treatments. For most comparisons the necessary data were not available or it was inappropriate to statistically pool studies because of their variability. Primarily a narrative synthesis was undertaken. For the majority of studies it was unclear whether they had sufficient power to detect a statistically significant difference between groups; therefore, where there is no evidence of an effect it cannot be assumed that there is no effect. Information on outcome by stage of condition was not available. Based on the duration of frozen shoulder and the inclusion criteria, the trials included mixed populations with idiopathic frozen shoulder, probably mainly people in the first painful phase and the second stiffening stage. In addition, only five of the studies were undertaken in a UK NHS setting. RCTs were available for all of the interventions except capsular release, for which case series only were available, and watchful waiting or 'supervised neglect', for which a quasi-experimental study was available. However, some of the RCTs may in fact have been quasi-experimental. Across most trials there did not appear to be systematic methods for recording of adverse events.

Conservative interventions

Although several of the studies had a home exercise only control group, the information provided was often limited in terms of the extent of educational advice provided. The single study of 'supervised neglect', perhaps more appropriately called watchful waiting, was the only study to formally assess a broader intervention of self-management. However, as with the reporting of many complex interventions, there was insufficient information for replication in a clinical setting.[73] The finding from this study from the Netherlands, that supervised neglect was associated with a better outcome than physiotherapy (of unspecified duration), should be treated

with considerable caution because of limitations in the study design. The lack of high-quality research on watchful waiting was surprising given that in a recent survey of UK professionals it was a commonly used treatment in the painful phase of frozen shoulder.[18]

A further 11 studies evaluated physical therapy, mainly physiotherapy with active mobilisation. The comparators were a control or another form of physical therapy. Because of the diversity of the interventions and comparators only single studies were available for individual therapies and most of the studies had a high risk of bias. Based on a single study there was evidence of a statistically significant short-term benefit of SWD plus stretching (12 sessions over 4 weeks) compared with home exercise only and compared with a heat pack plus stretching for some outcomes.[75] There was also evidence from a single study that laser therapy (12 sessions over 8 weeks) had benefit over home exercise alone in the short and medium term.[16] Both studies had some risk of bias and the content, intensity and quality of the home exercise comparator was unclear. A further study, also at some risk of bias and in a population in which the majority had already received physiotherapy and/or a steroid injection, found marginally significant improvements for function and disability and improvement in range of movement with HGMT compared with LGMT.[40] None of these studies was undertaken in a UK setting.

Only studies comparing acupuncture with another of the treatments of interest were included, not studies comparing different methods of acupuncture. Only three studies were identified, none of which was from the UK, and all had a potentially high risk of bias.[79–81] There was insufficient evidence to make conclusions about the effectiveness of acupuncture for primary frozen shoulder.

Six studies evaluated steroid injections, although the majority of the available data were from two multi-arm studies that were of satisfactory quality, one with some risk of bias.[35,41] Both studies evaluated a single intra-articular steroid injection in patients with frozen shoulder of < 6 months' duration. The comparators were home exercise alone, physiotherapy alone (both with placebo injection) and steroid injection followed by physiotherapy. One used a guided injection and the other appeared to use an unguided approach. The physiotherapy was of 4 weeks' duration in both studies, with one including twelve sessions and the other eight. The actual content of the sessions varied between the studies, although both used mobilisation techniques. All groups in both studies were also given a home exercise programme.

Given that steroid injection is administered to reduce inflammation and provide pain relief, pain outcome is of particular interest for this intervention. For pain there was a short-term statistically significant benefit (up to 3 months) with steroid injection compared with home exercise alone but not compared with 4 weeks of physiotherapy. When steroid injection was provided in conjunction with physiotherapy, there was an added benefit for pain over physical therapy alone and over steroid injection alone. This was broadly consistent with the evidence for function and disability and range of movement. Only one of these studies used a QoL outcome measure (SF-36). There was no statistically significant benefit for QoL with a steroid injection alone compared with home exercise or physiotherapy alone. However, there was a benefit for QoL when physiotherapy was added to steroid injection over either home exercise or physiotherapy alone but not steroid injection alone. Overall, the evidence suggests that there is some evidence of a short-term benefit from adding steroid injection to physiotherapy alone; however, there remains some uncertainty as to whether this adds any substantial clinical benefit over steroid alone (with home exercise).

Invasive interventions

The data from high-quality RCTs of invasive interventions were even more limited than for conservative interventions and only two were undertaken in a UK setting. MUA, distension and capsular release are most commonly used when conservative treatments have failed, although

for most of these studies it was unclear what treatments participants had already received, if any. In addition, there was considerable variability between the studies in how the procedures were delivered, making comparability between studies difficult.

There was insufficient evidence on all three interventions to make any robust recommendations regarding their use. Based on a single, satisfactory quality study, there was no evidence, across several outcomes, that MUA was better than a conservative intervention involving provision of advice in two sessions from a physical therapist plus written instructions for a daily training programme.[39] A study from the UK, with some risk of bias, reported greater improvement across outcomes with arthrographic distension than with MUA in participants with second stage (stiffening or 'freezing' stage) primary frozen shoulder.[38]

There was no consistent evidence that arthrographic distension was associated with a better outcome than home exercise only or steroid injection. A single satisfactory study comparing arthrographic distension including steroid with placebo arthrography (with home exercise) reported a significant improvement with distension in function and disability measured using a patient-defined scale, but not in another function measure, range of movement or pain.[43] A second study with some risk of bias reported a benefit with arthrographic distension including steroid compared with steroid alone but only for a single range of movement measure at 6 weeks and not for other range of movement outcomes or a measure of function and disability.[36]

Only case series were available for capsular release. The lack of a control group presents particular problems in assessing the effectiveness of an intervention in a condition such as frozen shoulder in which the condition normally resolves within a 3-year period. Based on the best-quality case series, undertaken in Norway with the procedure performed by a single surgeon, there was a significant improvement in several outcomes based on an average length of follow-up of 10 months (range 3 to 29 months).[85] All patients had tried physiotherapy previously without a satisfactory result.

Based on three studies of sodium hyaluronate, all at high risk of bias, there was insufficient evidence to recommend use of this treatment in preference to steroid or physical therapy. The best-quality study reported a benefit with two injections of sodium hyaluronate compared with home exercise but there was no consistent evidence across outcomes of a benefit over 10 daily sessions of physical therapy or single steroid injection.[66]

Mixed-treatment comparison

A MTC was undertaken for the outcome of pain with the aim of bringing together both direct and indirect evidence in a connected network, thereby allowing inferences about the relative efficacy of all treatments to be made. Nine interventions formed part of a connected network with placebo and the evidence was informed by nine trials. A total of 22 studies had to be excluded from the MTC for a range of reasons; therefore, the network was a small subset of the available evidence. Of the nine interventions compared with placebo (plus home exercise) in the MTC, only steroid combined with physiotherapy and steroid alone were compared with placebo in the direct evidence synthesis (i.e. standard meta-analysis). The results from the MTC were consistent with the direct evidence synthesis of steroid combined with physiotherapy versus placebo. In both analyses the combined intervention showed a beneficial and clinically significant effect. In contrast, the results of the MTC were inconsistent with the direct evidence synthesis of steroid compared with placebo. In the MTC the 95% CrIs crossed the line of no effect. In the direct evidence synthesis, steroid showed both a statistically and a clinically significant beneficial effect compared with placebo. The remaining interventions included in the MTC (physiotherapy, physiotherapy combined with placebo, physiotherapy without mobilisation, electroacupuncture, sodium hyaluronate, MUA combined with physiotherapy, and arthrographic distension with steroid) had 95% CrIs that crossed the line of no effect.

Gaps in the clinical effectiveness evidence

There were several gaps in the evidence regarding conservative treatment options for primary frozen shoulder. Watchful waiting is the most conservative treatment option. However, it remains unclear what constitutes watchful waiting. It would seem inappropriate to do absolutely nothing and this is unlikely to happen in clinical practice. The intervention of supervised neglect evaluated by Diercks and Stevens[73] included provision of education about the condition. This included an explanation of the natural course of the disease and advice not to exercise in excess of the pain threshold and to carry out pendulum exercises and active exercises within this painless range, with resumption of all activities that were tolerated. In addition, NSAIDs and analgesics were prescribed where necessary. Details were not provided about how the information was delivered and any methods used to maximise compliance with the home exercise programme and the extent of any monitoring, for example in the form of primary care review appointments, were unclear. In our view, education about the condition and guidance for self-management including home exercises are appropriate elements of a standard care package. Methods of maximising compliance with any advice may also be important. Several of the studies used a home exercise control group but it was often unclear what this consisted of and the extent and quality of education provided. Therefore, it was unclear in most studies whether the control group were receiving a high-quality standard care package or whether they were simply provided with a leaflet of exercises. In our view, the former is the most appropriate comparator to use in trials to establish any additional benefit from any more intensive interventions such as a package of physiotherapy treatment or steroid injection. The benefit of a physiotherapy intervention over a structured high-quality conservative intervention of education and home exercise using methods to maximise compliance has not been adequately addressed. Physiotherapy is the most commonly used NHS physical therapy and is therefore of particular interest.

It also remains unclear, based on the research evidence available, what constitutes an optimal physiotherapy intervention in terms of the essential components, number and length of sessions and overall duration and the type of physiotherapy. It also remains unclear at what stage and severity of frozen shoulder such an intervention would be of greatest benefit and whether any effect is similar in people with and without diabetes.

In clinical practice, patients can receive a second or third steroid injection when there has been no benefit from the first injection or when symptoms deteriorate again. There was no evidence available on the effectiveness of a second or third injection provided in a way that reflects NHS clinical practice. One US study evaluated the effect of once-weekly injections for 3 weeks rather than on the basis of the patients' response to the first injection.[42]

The role of the more invasive interventions in the treatment pathway for frozen shoulder remains unclear and further research is required to establish their effectiveness. There was considerable overlap in the duration of symptoms between the participants in the trials of invasive and conservative treatments. This suggests that the populations may have been similar across the more conservative and invasive interventions. In most studies it was unclear whether participants had received conservative treatments first that had not been effective, whether they were presenting for treatment having tried self-management or whether their preference was for an intervention that involved a shorter duration of treatment.

Comparison with other effectiveness research

We are aware of three systematic reviews that have been published since our assessment started: one of corticosteroid injections compared with physiotherapy for frozen shoulder;[115] one of sodium hyaluronate injection for chronic painful shoulder;[116] and one of conservative and surgical interventions for frozen shoulder.[117] A guideline based on a systematic review has also recently been published focusing on diagnosis, assessment and physiotherapy management of

frozen shoulder.[6] Our conclusions regarding steroid injections are similar to those of Blanchard and colleagues[115] who concluded that corticosteroid injections have a greater effect in the short term than physiotherapy but that the results of the review should be interpreted with caution because of the limited data available and variability between the studies. The recent guideline also comes to similar conclusions to the Blanchard review and our review regarding steroids compared with physiotherapy.[6]

The review of conservative and surgical interventions, undertaken by Favejee *et al.*,[117] highlighted similar limitations in the literature to our review. They identified the lack of an unambiguous definition for frozen shoulder and the lack of information on phase of condition as well as a need for further research. However, they made somewhat stronger conclusions about the effectiveness of some interventions than our review has done or those of Blanchard *et al.*[115] and Hanchard *et al.*[6] have done. They concluded that there was strong evidence for the short-term effectiveness of steroid injections and laser therapy and moderate evidence for the effectiveness of mobilisation techniques in the short and long term as well as evidence for the effectiveness of arthrographic distension alone and in addition to active physiotherapy in the short term. The Favejee *et al.*[117] review used a broad definition of frozen shoulder that did not appear to be restricted to primary frozen shoulder. For example, the conclusion about strong evidence for the effectiveness of laser therapy is based on three trials only, one of which was of a primary frozen shoulder population. The other two trials were excluded from our review. The review of sodium hyaluronate is not directly comparable with our review as a range of chronic shoulder conditions were included, as well as dose-ranging studies. The review concluded that sodium hyaluronate injection was modestly more effective than steroid injection for function and there was an improvement in pain and function compared with placebo.[116]

Patient views

We were unable to identify any papers that explored patients' views or experiences of treatments for frozen shoulder. As treatment for frozen shoulder can vary substantially and is often guided by patient preference, this was considered an important area for investigation; however, the lack of available evidence did not allow us to explore this further. Although no papers exploring patients' views were found, there were limitations to this review because of time constraints. Our searches were restricted to searches of three databases for English-language studies and unpublished studies may have been missed. Nonetheless, there does appear to be a clear need for research in this area.

Cost-effectiveness review

A single Dutch cost-effectiveness study met the inclusion criteria for the systematic review.[91] This was conducted as part of a trial that was included in the clinical effectiveness review.[40] The trial reported statistically significant improvement in range of movement with HGMT compared with LGMT in a population in which the majority of patients had already received physiotherapy and/or steroid injection. There was no significant difference in QoL, although the CIs were wide. There was also no significant difference in pain or function and disability, although for one of the function and disability scales the CIs just crossed the line of no effect. The economic analysis was of reasonable quality with some risk of bias and was conducted outside of the UK (the Netherlands), which may limit generalisability. It showed that LGMT may be a cost-effective option compared with HGMT.

Our searches failed to identify any modelling studies conducted in the relevant population or similar populations/conditions. We did identify a limited number of economic evaluations conducted alongside clinical trials in patients with unilateral shoulder pain, chronic shoulder complaints and acute and subacute shoulder complaints.[91,118–121] We considered these populations to be similar enough to allow some comparisons to be made, although these populations were

not the focus of our research and we did not undertake a systematic review in these patient populations. The economic evaluations did not meet our inclusion criteria but we anticipated that they would provide some useful information to inform our research. One of these studies, James *et al.*,[119] was conducted in the UK and allowed some comparison of the cost estimates obtained in the clinical trial and the estimates obtained from our advisory group for the frozen shoulder population. Because of the limited evidence available to us through the review, alternative methods of obtaining evidence were pursued. The clinical advisors on the project were utilised and primary data from a clinical trial in a similar population identified.

Cost estimates

The estimated resource use provided by our clinical advisory group allowed the calculation of average treatment costs from the perspective of the UK NHS for the interventions identified in the systematic review. The estimated average costs for therapies involving administration of steroid injections ranged from £36.18 to £138.51 for unguided injections and from £299.68 to £475.56 for guided injections. Variations in costs were attributable to the type of health-care professionals involved and the delivery setting. The costs of therapies involving active physiotherapy alongside steroids were estimated to vary over a wide range, from £121.43 to £607.31, and reflected practice variations in regard to number of physiotherapy sessions, delivery setting and the steroid used.

Physiotherapy alone, involving some form of mobilisation as a component, was estimated to range from £98.75 to £126.75. Acupuncture was estimated to cost from £117.75 to £126.75. Difference in costs was mainly due to community versus hospital-based setting.

The estimated average costs associated with surgical interventions ranged from £1213 to £1522 for MUA, from £79.84 to £134.84 for arthrographic distension and from £1809 to £2511 for capsular release. The difference in costs was driven by the difference in the hospital resources utilised in performing MUA arthrographic distension and capsular release. This is reflected in the different NHS reference cost codes under which these interventions are reported by hospitals and subsequently costed.

Comparison with costs of other research

The validation of these estimates is difficult given the lack of evidence available. James *et al.*[119] conducted a cost–consequence analysis comparing local corticosteroid injection and physiotherapy for the treatment of new episodes of unilateral shoulder pain in UK primary care. The analysis collected resource-use data from patients enrolled in the trial from entry until 6 months post randomisation. The study reports an average cost of £114.60 for those patients receiving the physiotherapy intervention. This is very similar to our estimate of an average cost of £112.75 for physiotherapy (average based on community/hospital setting). They also report an average cost of £71.28 for the steroid group, which compares favourably with our average estimate of £73.87 for an unguided injection (average based on alternative delivery setting and choice of steroid). Although these costs appear to be close, the uncertainty remains on how closely either set of costings would reflect clinical practice. Patients throughout the James *et al.* study had access to additional treatments that were included in the resource-use figures. So the average cost for the physiotherapy group also included costs for resources such as radiography, non-trial injections, etc. In addition, costs were presented for 2003 and we have not inflated them to match our 2009 price year. This may suggest that our cost estimates are a little on the high side given the difference in price years and the fact that our costs consider only resources for one specific treatment and not the additional resources that a patient may consume by choosing to access alternative treatments or specialists alongside the primary prescribed treatment.

As with the single included economic evaluation for frozen shoulder, the majority of economic evaluations identified were conducted in the Netherlands. Although some provided useful data for the comparability of utility estimates they did not provide us with a clear picture of the resource utilisation of the alternative treatments that we have considered in this review. Van den Hout *et al.*,[91] which met the inclusion criteria, presented societal costs of €8809 for HGMT and €6911 for LGMT. Enough data were presented to allow costs from the perspective of the health-care provider to be estimated and these range from €2552 for HGMT to €2293 for LGMT. Because of differences in health-care systems the cost analysis used charges, which are relevant in the Netherlands, rather than costs, which are relevant for the NHS setting. So even if we convert euros into British pounds a like-for-like comparison would be difficult. In our view, the estimates obtained from our clinical advisory group represent the most reliable resource estimates and, although we acknowledge that there is some uncertainty surrounding the estimates because of the lack of evidence available, it was not possible to investigate this further. The need for a clearer picture of the resources used as patients progress through their treatment pathway is evident and is lacking in the current evidence base.

Quality of life and utility data

To fully evaluate HRQOL it is necessary to consider all of the ways that the condition being treated and the intervention being delivered impact on patient health outcomes. This means measuring the effect of the condition and the treatment on both duration and quality of life. The use of QALYs allows both of these concerns to be captured and reflected in one outcome. The QALY integrates mortality and morbidity to convey health status in terms of equivalent well years of life. A key component of the QALY is the utility values, which can be measured using a variety of methods. The measurement of utilities is an area of ongoing debate and research, which is beyond the scope of this discussion.

The clinical trials identified in the effectiveness review reported a variety of outcomes, mainly pain, range of movement and function and disability, with some measuring QoL, time to recovery and return to work and recreation, and adverse events. There seems little agreement across the trials regarding the tools with which these outcomes should be measured or which is the primary outcome. This may be related to the changing, progressive nature of the condition. In the early painful stages those outcomes that capture pain are likely to be more important; however, as the condition progresses the function and disability outcomes may become more important. When faced with a plethora of outcomes such as this it raises the question of why HRQoL, which may capture all of these outcomes, has not been routinely measured alongside those outcomes more traditionally considered clinical outcomes. We found only one study reporting HRQoL (utility outcomes) in the frozen shoulder population[91] and only scant data on HRQoL in patient populations considered similar.

It is unclear why these data have not been collected in the clinical trials identified in the effectiveness review. Possible reasons may be because it was not practical or was too time-consuming for patients to complete in addition to other measures or possibly because the studies were not designed to focus on economic questions and therefore utilities were not thought to be important. These reasons are only conjecture; further research is required to establish why HRQoL does not appear to be considered a relevant outcome in these types of patients. However, this lack of utility data hinders any decision analysis being undertaken. When outcome measures used in trials are limited to condition-specific outcomes the ability to evaluate the cost-effectiveness of one treatment against another treatment in a different population is lost.

Because of the potential for bias in the one study presenting HRQoL data and the use of the less popular SF-6D tool,[91] we undertook a mapping exercise. Our aim was to try and establish

a link between the outcomes considered in the clinical trials and HRQoL. The EQ-5D is the most popular instrument of choice for the measurement of utilities and is recommended in the NICE reference case.[64] The decision was made to use this instrument in a mapping exercise. The mapping investigated the relationship between QoL, as measured by two components of the SF-36, and HRQoL, as measured by the EQ-5D, and pain, as measured by a VAS 0–100 mm, and EQ-5D. The SF-36 was used as this is a widely used and accepted tool for measuring QoL and was used in two of the included studies in the effectiveness review: one compared ultrasound and placebo;[51] the other compared steroid injection, steroid injection plus physiotherapy, physiotherapy alone and placebo.[35] A VAS 0–100 mm was used as it was readily available in the data set used for mapping and was a scale used in the clinical trials. The mapping was based on data from the SAPPHIRE trial.[40] The complete data set was made available by the authors of the trial. The findings of the mapping suggest that there is a positive relationship between outcomes: a decreasing pain VAS score (less pain) is accompanied by an increasing (better) EQ-5D score; an increasing EQ-5D score (i.e. better health status) appears to be generally accompanied by increasing SF-36 scores (i.e. higher scores = a better quality of life). Two trials included in the review of effectiveness, Dogru *et al.*[51] and Stergioulas,[16] used pain VAS (0–100 mm). Using the prediction equation obtained from mapping pain VAS and the results of the two trials we were able to estimated incremental QALY improvements, which ranged from –0.00163 to 0.00350. Two trials included in the review, Carette *et al.*[35] and Dogru *et al.*,[51] used SF-36 PCS and MCS as an outcome measure. Using the prediction equation obtained from the mapping and the results of the two trials we were able to estimate incremental QALY improvements, which ranged from 0.00537 to 0.01275.

Although the mapping was conducted on data from a similar population, primary collection of utility data would be required to validate that the positive relationship remains in the frozen shoulder population.

Those economic evaluations in similar populations that have reported EQ-5D data[118,120,121] have demonstrated improvements from baseline ranging from 0.06 to 0.16, which are comparable to those in the SAPPHIRE trial. These trials included a variety of interventions including an education and activation programme, manipulative therapy, which comprised specific manipulation and mobilisation techniques, and graded exercise therapy delivered by a physiotherapist. All were compared with usual care, which was variable in its content and the depth of its description. The populations in these trials had a higher baseline EQ-5D value (range 0.51 to 0.587 for pain VAS; 0.518–0.562 for SF-36 PCS/MCS) than the population from the SAPPHIRE trial (range 0.453 to 0.512).[102] This may suggest that the population of the SAPPHIRE trial, each of whom had a confirmed diagnosis of rotator cuff tendonitis, differs from populations with other shoulder complaints. It is likely that this population may be comparable to a population of frozen shoulder patients in the painful phase of the condition; however, we have no evidence to support this other than the comparability of the SF-36 scores across the SAPPHIRE population and the frozen shoulder populations in Carette *et al.*[35] and Dogru *et al.*[51] These data suggest that the populations have very similar QoL scores at baseline. Further investigation of these issues is warranted but is outside the scope of this research.

None of those economic evaluations presenting EQ-5D data presented QALYs. It is not clear why QALYs were not derived. One study provided justification, which was that the minimal changes in clinical effectiveness of the EQ-5D outcome provided no additional information when analysed in a cost-effectiveness analysis.[113] It is not clear that this is valid justification for not deriving QALY outcomes.

Strengths and limitations of the review

To our knowledge this is the first systematic review that has included all NHS-relevant interventions in a single synthesis. A total of 19 electronic databases were searched including potential sources of unpublished data. Unlike several previous reviews there were no language restrictions. Full papers of 67 studies in 12 languages other than English were screened for eligibility, of which four were subsequently included in the review. Risk of bias was assessed and taken into consideration in the synthesis. Whenever possible, the treatment effect for individual studies was reported with a 95% CI, even when quantitative synthesis was not undertaken.

The key limitation of this technology assessment was the lack of data available. This was despite comprehensive searches without language restrictions across a range of sources of studies. There was insufficient evidence to make robust conclusions about the effectiveness of any of the interventions. Because of the lack of evidence on stage of frozen shoulder in the included trials, it was not possible to undertake the planned synthesis exploring the influence of stage of frozen shoulder or the presence of diabetes on the effectiveness of the various interventions. Even where there were several trials of a single intervention, there was such diversity in the intervention and comparators used and such poor reporting of outcome data that there were few instances in which the planned quantitative synthesis was possible or appropriate. Given that most of the included studies had a small number of participants and may have been underpowered, this was unfortunate.

Unlike some other reviews that have looked at shoulder complaints across the board as a single condition, we attempted to reduce variability due to the nature of the shoulder condition by including only patients with primary frozen shoulder. However, despite this, it is likely that the population included is diverse because of variability in how the included studies defined frozen shoulder. Together with the lack of information on impact of stage, this means that even for those interventions for which there is some evidence of effectiveness, there is some uncertainty as to what primary frozen shoulder populations this applies to.

Because the studies were often poorly reported it was difficult in some instances to be certain that the population included those with primary frozen shoulder and not those with secondary frozen shoulder. As a result we may have excluded studies that did in fact include a primary frozen shoulder population. Comparing the results of our review with those of other recent reviews it is unlikely that the inclusion of such studies would have altered our conclusions.

The variability in the outcome measures used was a further limitation of the data available. Pain, and function and disability were the most commonly used end points in clinical trials for frozen shoulder and there was considerably variability in the measures used to assess these three outcomes. Studies included in the review measured pain used the verbal numeric rating scales or VAS scales (including the SPADI 5-item subscale), which have been shown to be highly correlated with one another.[122] The decision to standardise results of these studies using the SMD enabling pooling of studies was therefore appropriate. In direct contrast the outcome of function and disability was measured by a number of different shoulder-specific scales, which have been shown to have low to moderate correlation with one another. This indicates that different shoulder-specific function and disability scales may not be measuring the same thing.[54,55,123,124] On the basis of this we did not use a standardised score for function and disability outcomes, which meant that a quantitative pooling of these data, for the most part, was not possible.

To aid interpretation, pooled SMDs for the outcome of pain were back transformed to a 0–100 mm VAS. As no between-group, or, for that matter, within-group, MCID on the 0–100 mm

VAS was available for frozen shoulder, a proxy was derived from the within-group MCID of a rotator cuff disease population. Although this proxy represents the best available between-group MCID for frozen shoulder at this time and has been used elsewhere,[6] any implied clinical significance should be seen as tentative rather than definitive. In addition, such an approach was appropriate only for pooled estimates.

Several studies that were included in the review were not included in the synthesis because the period of follow-up was ≤ 4 weeks. Such short follow-up periods are unlikely to capture meaningful changes in outcome measures.

Mixed-treatment comparison

A key factor to consider in evaluating the strengths and limitations of the MTC undertaken is whether the assumption that the studies are sufficiently homogeneous to be quantitatively combined has been met. Arguable sources of heterogeneity in the MTC were the fact that the placebos were not identical between studies, given the differing nature of the interventions; and that there was differential reporting of the use of previous treatments for frozen shoulder associated with the invasiveness of treatment, which may indicate that populations between trials varied in the treatment resistance of frozen shoulder. Furthermore, as in the main synthesis, there was a paucity of high-quality studies. However, the model was a good fit and gave stable estimates and it is interesting that there was no clear difference between the interventions in effectiveness and no single intervention was substantially better than the others. Given the possible heterogeneity of placebos and of study populations, and the inclusion of poor-quality studies, there is some uncertainty regarding the results of the MTC, as there is with the main synthesis.

Economic evidence

The lack of available data made the development of a decision-analytic model impossible. We found little evidence on treatment related to stage of condition, treatment pathways, the impact on quality of life and associated resource use and no information on utilities. Without making a number of questionable assumptions, modelling was not possible. Following clinical advice it was decided that insufficient evidence was available to inform the structure of a model or to guide and justify our assumptions. Although it was not possible to build a decision model, the assessment has estimated the costs for the various treatments included in the review and investigated the link between QoL and utilities where possible. We have not been able to quantify the uncertainty in our cost estimates and the use of a small group of clinical experts to derive the estimates is a limitation. Despite this limitation we believe that the estimates obtained may provide useful information as input to (future) cost-effectiveness assessments of treatments in frozen shoulder populations.

The findings of the exploratory mapping analysis suggest that there is likely to be a relationship between the SF-36 and the EQ-5D, and VAS and the EQ-5D in frozen shoulder populations. Caution is needed, however, as further data on QoL outcomes using both non-preference-based and preference-based measures are now needed. This will allow full validation of the nature and direction of the relationship between the instruments and investigation of whether utilities might be a useful outcome measure in frozen shoulder populations. It is clear from the results obtained that the relationship between the two clinical outcomes and EQ-5D is not the same. This is demonstrated in the Dogru *et al.* study[51] by the different direction of QALY benefit, which favours the intervention over the control when VAS is mapped to EQ-5D and the control over the intervention when SF-36 is mapped. The choice of clinical outcome to be included in the mapping is obviously very important and how this choice is made warrants further research. It is also unclear whether the use of more complex statistical methods would alter the predictive performance of the SF-36 PCS and MCS mapping onto the EQ-5D utilities, compared with the models tested in the exploratory analysis, for example whether including all eight dimensions

of the SF-36 profile in mapping onto the EQ-5D changes the nature of the relationship. These methodological investigations are beyond the scope of this report.

Mapping is a substitute for primary measurement of utilities and is subject to a number of potential limitations. In this instance the main limitations are likely to be that it was not performed directly using individual-level patient data drawn from frozen shoulder trials but used a UK data set of patients with rotator cuff disease (the SAPPHIRE trial); and the small study sample ($n = 141$ for pain VAS, and $n = 133$ for SF-36 PCS/MCS in the base case presented). It would be possible to further validate the apparent relationship between the SF-36/VAS and the EQ-5D through the use of an external data set (i.e. an alternative trial). However, to fully measure the apparent relationship between these two outcomes the collection of primary data will be required, which will have greater validity.

Improving the evidence on the effectiveness and cost-effectiveness

This assessment highlighted considerable gaps in the evidence for the effectiveness and cost-effectiveness of all of the interventions investigated for frozen shoulder. Given the range of treatment options a multi-arm trial would be the most appropriate way forward. This raises the question of which interventions should be given priority for future research on treatments for frozen shoulder and where resources would best be spent in undertaking future research. Given the lack of an economic model we were not in a position to characterise the decision uncertainty and present a value of information analysis to support recommendations about where future resources for research should focus.

Given that clinically there is a fairly consistent view that a stepped-up approach should be used in terms of invasiveness of treatment, most patients are likely to receive only the conservative treatments. It could be argued, therefore, that this is the most important area on which to focus the research effort. However, given the lack of consensus across professional groups regarding the most appropriate care pathway and the apparent overlap in patients receiving treatments of varying invasiveness, it may be inappropriate to put research effort into conservative treatments at the expense of the invasive treatments. The costing exercise we undertook found that the invasive treatments may be substantially more expensive than the conservative options. It would therefore be important to establish whether these interventions produce benefits for the patient and are cost-effective choices.

In a recent survey of 303 health-care professionals involved in the management of frozen shoulder, 88% of respondents, including GPs, physiotherapists and orthopaedic surgeons, considered that there was a need for a RCT comparing treatments, particularly in the early painful phase.[18] Several interventions were supported for future research: watchful waiting and education (classified as conservative), physical therapy, injections and surgery (encompassing MUA and capsular release). Overall preferences for interventions requiring further research differed between the professional groups. The interventions that received least support were arthrographic distension, sodium hyaluronate injection, oral painkillers and oral steroids. There was support for research on physiotherapy and mobilisation techniques but much less so for individual therapies such as acupuncture, ultrasound, heat, laser therapy and electroacupuncture. A recently published guideline from the Chartered Society for Physiotherapy has also suggested that there may not be much to be gained from evaluating specific modalities as stand-alone treatments.[6]

Any future trials should give more serious attention to the control group used. Home exercise (with or without a placebo) was the most commonly reported control in the included studies.

However, in general the content of this control intervention was poorly reported. There is a large gap in the evidence about the effectiveness of a high-quality conservative intervention of education, home exercise and self-management of pain with support and monitoring. Any future trial should pay careful attention to the control condition to clearly establish what additional benefit other interventions provide. In addition, the maximum length of follow-up in most studies was 3 months. Future trials should therefore have follow-up periods that are of sufficient length to allow determination of whether interventions are effective in the medium and long term.

There is a view clinically that stage of frozen shoulder is an important aspect to consider when making treatment choices. This is not reflected in how most trials have been undertaken to date, although it is unclear why not. Obviously it makes recruitment to trials easier if the population is not restricted in this way. Stratification within trials may be a more pragmatic approach. Another possible factor explaining the lack of consideration for stage is the wide range of countries in which the trials have been undertaken. It is clear, however, that any future research should not neglect consideration of stage. Because of the lack of evidence on treatment effects in patients with diabetes, this will be an important subgroup. This reflects the recent survey that highlighted those with diabetes as an important subgroup.[18]

Populations included in the review were diverse because of considerable variation in how frozen shoulder was defined in the individual studies. This is unsurprising given that there is a noted absence of a standard definition and classification for frozen shoulder.[2,3] The variations in study populations together with the lack of information on the stage of frozen shoulder mean that, even for those interventions for which there is some evidence of effectiveness, there is some uncertainty as to which frozen shoulder populations these apply to. Although potential classifications for primary and secondary frozen shoulder have been put forward,[3] a consensus on the definition of frozen shoulder is sorely needed to enable the generalisability of further research to be assessed.

Given that studies of clinimetric properties (i.e. validity, reproducibility, responsiveness and ease of scoring) of various shoulder-specific disability scores have conflicting findings, it is difficult to suggest the most appropriate score to use.[125,126] Further research is therefore needed to determine the clinimetric properties of shoulder-specific function and disability scores. This should conclude with a consensus on the most appropriate tools to assess shoulder function, both in research and in clinical practice. For assessing the clinical meaningfulness of between-group differences in future trials, consideration should be given to the recommendations of the Initiative on Methods, Measurement and Pain Assessment in Clinical Trials (IMPACT).[127] This group suggests that the clinical meaningfulness of group differences in trials, in terms of pain, should be established using a multifactorial evaluation of factors such as statistically significant treatment effects, responder analysis, effect size compared with that of other established treatments, safety and tolerability, and results for other end points.

Based on the available evidence we were unable to structure a simple decision tree, but, given the complex nature of the treatment pathways, future decision-analytic modelling undertaken in this area will need to take into account the nature of any sequential decision-making processes and treatments rather than just a single therapy. This will require tangible evidence of current treatment patterns and resource use in frozen shoulder populations. There may be benefit in undertaking an elicitation exercise with a range of health-care professionals to prioritise the interventions to be compared and underpin the design of any future trial.

There is a current lack of studies providing data on HRQoL specific to frozen shoulder populations. This information is required to enable assessments of cost–utility to be undertaken.

The inclusion of preference-based QoL measures alongside clinical trials in frozen shoulder populations is a necessity. Whether the EQ-5D as an instrument is considered to be the most appropriate for use in frozen shoulder populations has yet to be determined and further research is required to address this and other questions on the use of HRQoL measures in clinical studies. Mapping is always a second-best solution to using a preference-based (generic or condition-specific) measure in the first place, but it is often the approach followed for pragmatic reasons and so this remains an important area of research. Primary data collection in frozen shoulder populations is now needed.

Chapter 5

Conclusions

Implications for service provision

- There may be short-term benefit for patients with frozen shoulder of < 6 months' duration of adding a single intra-articular steroid injection to home exercise. There is also short-term benefit for the same population of adding physiotherapy to a single intra-articular steroid injection. This is based on two studies that varied in steroid dose and in whether the injection was guided, making it difficult to determine how the steroid intervention should be delivered. Although neither study explicitly provided information on stage of frozen shoulder, only patients with frozen shoulder of < 6 months' duration were included, suggesting that these patients were likely to be at the initial painful stage. Based on two studies of physiotherapy that included mobilisation in 8–12 sessions over a 4-week period, it is unclear what is the most effective physiotherapy to provide with injection in terms of content and duration.
- Based on a single study, and for some outcomes only, there may be benefit from adding SWD to passive mobilisation and home exercise.
- Based on a single study, HGMT may be more effective for some outcomes, but not others, than LGMT in a population that has already received physiotherapy and/or a steroid injection. In the study, high-grade mobilisation consisted of twice-weekly, 30-minute sessions for a maximum of 12 weeks during which Maitland grade III and IV mobilisation was applied into the stiffness zone. Low-grade mobilisation was delivered according to the same schedule but consisted of Maitland grade I and II mobilisation applied within the pain-free zone. LGMT may be more cost-effective than HGMT.
- Given the paucity of economic evidence no conclusions can be made about the cost-effectiveness of the different interventions.

Suggested research priorities

There are large gaps in the evidence for the effectiveness and cost-effectiveness of all of the interventions investigated. Taking into account the gaps in the evidence, the views of health-care professionals in a recent survey[18] and the interventions that are most commonly used in the NHS, we suggest that the following should be given priority in future high-quality RCTs assessing effectiveness and cost-effectiveness:

- A 'standard care' package of high-quality conservative management. This should be fully specified in any future trial and we suggest that it should involve a structured protocol of high-quality education, advice, home exercise and monitoring/support to encourage completion of the home exercises.
- Steroid injection, in particular an investigation of the effectiveness and cost-effectiveness of multiple injections and whether there is any added benefit from providing physiotherapy after steroid injection over and above that obtained with steroid injection plus high-quality conservative management.

- Physical therapies, specifically physiotherapy interventions that have a component which involves mobilisation or exercises. Research is required to establish whether there is any benefit from having physical therapy alone over and above that of high-quality conservative management.
- Intensive interventions, specifically arthrographic distension, MUA and arthroscopic capsular release. Although there is also a gap in the evidence regarding the effectiveness of distension, in the recent survey of health-care professionals this intervention did not receive as much support as a topic for future research as the other intensive interventions.

The large number of treatment options for frozen shoulder and the limited evidence for their effectiveness and cost-effectiveness makes prioritisation of these difficult and they are not listed in order of importance. We suggest that an appropriate starting point would be a multi-arm trial that compares the effectiveness and cost-effectiveness of interventions of differing intensity and costs: high-quality conservative management, steroid injection (possibly in conjunction with arthrographic distension) and surgical management (MUA and capsular release).

Important subgroups in any future RCTs are phase of frozen shoulder and patients with diabetes. These trials should collect data on resource use and use a utility measure to allow assessment of cost-effectiveness. A systematic approach to recording adverse events will also be important.

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Contribution of authors

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Appendix 1

Search strategies for effectiveness review

BIOSIS Previews

Interface: Web of Science (ISI) on Web of Knowledge
Search date: 30 March 2010
Strategy: as below
Records identified: 800

# 20	800	#19 OR #17 OR #15 OR #13 OR #11 OR #9 OR #5 OR #3
		Databases=PREVIEWS Timespan=All Years
# 19	140	#18 AND #1
		Databases=PREVIEWS Timespan=All Years
# 18	33,082	Topic=("nerve block" or "neuromuscular blockade" or acupuncture or electroacupuncture or "electro acupuncture" or osteopuncture or "osteo puncture" or "perioste* stimulat*" or "perioste* therap*" or "perioste* needling" or massag* or acupressure or shiatsu or shiatzu or "zhi ya" or "chih ya" or "rehabilitat* program*" or "rehabilitat* protocol*" or "watch* wait*" or "conservative treat*" or "management decision*" or "management option*" or "management choice*")
		Databases=PREVIEWS Timespan=All Years
# 17	454	#16 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 16	>100,000	Topic=(physiotherapy or physiotherapies or "physical therap*" or "manual therap*" or "passive motion" or "passive movement" or "muscle stretching" or "muscle stretches" or "muscle stretch" or mobilisation or mobilization or "exercis* program*" or "exercis* intervention*" or "exercis* train*" or "exercis* prescription*" or "exercis* prescrib*" or "exercis* therap*" or "therapeutic exercis*" or "home exercis*" or "supervis* exercis*" or "pendular exercis*" or "pendulum exercis*" or "isokinetic exercis*" or "resist* exercise*")
		Databases=PREVIEWS Timespan=1969-2010
# 15	38	#14 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 14	>100,000	Topic=(biofeedback) OR Topic=(thermograph* or thermotherap* or "thermo therap*" or hypertherm* or "hyper therm*" or diatherm* or cryotherap* or "cryo therap*") OR Topic=("cold pack*" or "cold therap*" or "cold treat*" or "ice pack*" or "ice therap*" or "ice treat*" or "heat pack*" or "heat therap*" or "heat treat*" or "hot pack*" or "heat therap*") OR Topic=("Laser Therapy" or "ultrasonic therapy" or "Interventional ultrasonography") OR Topic=("electrotherapeutic intervention*" or "electrotherapeutic treat*") OR Topic=("magnetic field therapy") OR Topic=("electromagnetic field therapy") OR Topic=("Biomagnetic therapy")
		Databases=PREVIEWS Timespan=1969-2010
# 13	31	#12 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 12	50,394	Topic=(TENS or ALTENS) OR Topic=("electric* stimulat*" or "transcutaneous stimulat*"or "transdermal electrostimulat*"or "cutaneous electrostimulat*"or electroanalgesia or "electro analgesia") OR Topic=("muscle stimulat*") OR Topic=(neuromodulation or "neuro modulation" or neurostimulation or "neuro stimulation") OR Topic=(interferential)
		Databases=PREVIEWS Timespan=1969-2010
# 11	30	#10 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 10	5938	Topic=(chiropractic*) OR Topic=(osteopath*) OR Topic=(manipulat* and (anesthesia or anaesthesia or anesthetic* or anaesthetic*)) OR Topic=(MUA)
		Databases=PREVIEWS Timespan=1969-2010

# 9	112	#8 OR #7
		Databases=PREVIEWS Timespan=1969-2010
# 8	39	Topic=("subacromial inject*" or "acromioclavicular inject*" or "glenohumeral inject*") OR Topic=("extra articular inject*" or "extraarticular inject*") OR Topic=("shoulder* inject*")
		Databases=PREVIEWS Timespan=1969-2010
# 7	81	#6 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 6	85,801	Topic=(injections) OR Topic=("intraarticular injection*" or "intra-articular injection*" or "intra articular injection*") OR Topic=("bursa* inject*" or "intrabursa* inject*" or "intra bursa* inject*" or "periartic* inject*" or "peri artic* inject*")
		Databases=PREVIEWS Timespan=1969-2010
# 5	152	#4 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 4	5743	Topic=(Arthroscopy) OR Topic=("arthroscop* releas*" or "arthroscop* decompress*" or "arthroscop* capsulotom*") OR Topic=("capsular releas*" or "interventional microadhesiolysis" or capsulotomy)
		Databases=PREVIEWS Timespan=1969-2010
# 3	11	#2 AND #1
		Databases=PREVIEWS Timespan=1969-2010
# 2	25,371	Topic=("arthrograph* distension*" or "arthograph* distention*") OR Topic=("arthrogram* distension*" or "arthogram* distention*") OR Topic=("glenohumeral distension*" or "glenohumeral distention*") OR Topic=(dilatation or hydrodilat*) OR Topic=(arthography)
		Databases=PREVIEWS Timespan=1969-2010
# 1	2354	Topic=("frozen shoulder*") OR Topic=("stiff* shoulder*") OR Topic=("adhesive capsulitis") OR Topic=("shoulder bursitis") OR Topic=(periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) OR Topic=("shoulder pain*" or "pain* shoulder" or "shoulder complaint*") OR Topic=("shoulder* impinge*") OR Topic=("subacromial impingement syndrome")
		Databases=PREVIEWS Timespan=1969-2010

Cumulative Index to Nursing and Allied Health Literature (CINAHL)

Interface: EBSCO
Search date: 26 March 2010
Strategy: as below
Records identified: 1757

S73	S18 or S22 or S27 or S33 or S40 or S51 or S56 or S62 or S66 or S70 or S72
S72	s14 and s71
S71	rehabilitat* N2 program* or rehabilitat* N2 protocol* or watch* N2 wait* or conservative N2 treat* or management N2 decision* or management N2 option* or management N2 choice*
S70	S14 AND S69
S69	S67 or S68
S68	(massag* or acupressure) or (shiatsu or shiatzu) or zhi ya or chih ya
S67	(MH "Massage")
S66	S14 and S65
S65	S63 or S64
S64	electroacupuncture* or osteopuncture* or perioste* N3 stimulat* or perioste* N3 therap* or perioste* N3 needling
S63	(MH "Acupuncture+")
S62	S14 AND S61
S61	S57 or S58 or S59 or S60
S60	neuromuscular block*

S59	(MH "Nerve Block")
S58	pulsed electromagnetic field therapy or electromagnetic* N3 field* or biomagnetic* or pulsed signal or PEMF
S57	(MH "Magnetics+")
S56	S14 AND S55
S55	S52 or S53 or S54
S54	electrotherapeutic N2 intervention* or electrotherapeutic N2 treat* or laser N2 therap* or ultrasound N2 therap*
S53	(MH "Ultrasonography+")
S52	(MH "Lasers+")
S51	S14 AND S50
S50	S43 or S44 or S45 or S46 or S47 or S48 or S49
S49	(thermograph*or thermotherap* or hypertherm* or diatherm* or cryotherap*) or thermo therap* or hyper therm* or cryo therap* or thermo graph*
S48	hot N2 pack* or hot N2 therap* or hot N2 treat*
S47	cold N2 pack* or cold N2 therap* or cold N2 treat* or ice N2 pack* or ice N2 therap* or ice N2 treat* or heat N2 pack* or heat N2 therap* or heat N2 treat*
S46	(MH "Hyperthermia, Induced")
S45	(MH "Ice")
S44	(MH "Diathermy")
S43	(MH "Cryotherapy") or (MH "Heat-Cold Application")
S42	S14 AND S41
S41	(MH "Biofeedback")
S40	S14 AND S39
S39	(TENS or ALTENS) or electric* N2 stimulat* or transcutaneous N2 stimulat* or transdermal N2 electrostimulat* or cutaneous N2 electrostimulat* or electroanalgesia or muscle N2 stimulat* or neuromodulation or neurostimulation or interferential
S38	S14 and S37
S37	S34 or S35 or S36
S36	chiropractic* or osteopath* or manipulat* N3 anesthesia or manipulat* N3 anaesthesia or manipulat* N3 anesthetic* or manipulat* N3 anaesthetic* or MUA
S35	(MH "Manual Therapy+")
S34	(MH "Manipulation, Chiropractic") or (MH "Manipulation, Orthopedic") or (MH "Manipulation, Osteopathic")
S33	S14 and S32
S32	S28 or S29 or S30 or S31
S31	exercise* N2 therap* or exercise* N2 therapeutic or home N2 exercis* or supervis*N2 exercis* or pendular exercis* or pendulum exercis* or isokinetic N2 exercise* or resist*N2 exercise*
S30	passive motion or passive movement or CPM or (stretching or stretches) or (mobilisation or mobilization) or exercise* N2 program* or exercise* N2 strength* or exercise* N2 intervention* or exercise* N2 training or exercise* N2 prescription* or exercise* N2 prescrib*
S29	physiotherapy or physiotherapies or physical therap* or manual therap*
S28	(MH "Physical Therapy+")
S27	S24 or S25 or S26
S26	subacromial N3 inject* or acromioclavicular N3 inject* or glenohumeral N3 inject* or extraarticular N3 inject* or shoulder* N3 inject*
S25	bursa*N3 inject* or intrabursa* N3 inject* or intra bursa* N3 inject* or periartic* N3 inject* or peri artic* N3 inject* or intraartic* N3 inject* or intra artic* N3 inject*
S24	S14 and S23
S23	(MH "Injections+")
S22	S14 and S21
S21	S19 or S20
S20	arthroscop* N6 releas* or arthroscop* N6 decompress* or arthroscop* N6 capsulotom* or capsular N2 releas* or interventional microadhesiolysis or capsulotomy
S19	(MH "Arthroscopy")
S18	S14 and S17
S17	S15 or S16

S16	arthrograph* N6 distension* or arthrograph* N6 distention* or arthrogram* N6 distension* or arthrogram* N6 distention* or glenohumeral N6 distension* or glenohumeral N6 distention* or (dilatation or hydrodilat*)
S15	(MH "Arthrography")
S14	S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13
S13	subacromial impingement syndrome
S12	shoulder* N6 impinge*
S11	(MH "Shoulder Impingement Syndrome")
S10	shoulder* N3 pain or shoulder* N3 pains or shoulder* N3 painful or shoulder* N3 complain*
S9	(MH "Shoulder Pain")
S8	periarthritis N6 shoulder* or peri-arthritis N6 shoulder* or periarthritides N6 shoulder* or peri-arthritides N6 shoulder* or pericapsulitis N6 shoulder* or peri-capsulitis N6 shoulder*
S7	capsulitis N6 shoulder*
S6	bursitides N6 shoulder*
S5	bursitis N6 shoulder*
S4	adhesive N3 capsulitis
S3	(MH "Adhesive Capsulitis")
S2	stiff* N3 shoulder*
S1	frozen N6 shoulder*

Cochrane Central Register of Controlled Trials (CENTRAL)

Interface: Cochrane Library Issue 3 2010
Search date: 23 March 2010
Strategy: as below
Records identified: 539

ID	Search	Hits
#1	(frozen NEAR/6 shoulder*):ti,ab,kw	65
#2	(stiff* NEAR/3 shoulder*):ti,ab,kw	63
#3	MeSH descriptor **Bursitis** explode all trees	127
#4	(adhesive NEXT (capsulitis or capsulitides)):ti,ab,kw	44
#5	(bursitis or bursitides) NEAR/6 shoulder*:ti,ab,kw	11
#6	(capsulitis or capsulitides) NEAR/6 shoulder*	39
#7	(periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) NEAR/6 shoulder*:ti,ab,kw	77
#8	MeSH descriptor **Shoulder Pain** explode all trees	240
#9	(shoulder* NEAR/3 (pain or pains or painful or complain*)):ti,ab,kw	682
#10	MeSH descriptor **Shoulder Impingement Syndrome** explode all trees	84
#11	(shoulder* NEAR/6 impinge*):ti,ab,kw	107
#12	"subacromial impingement syndrome":ti,ab,kw	20
#13	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12)	964
#14	MeSH descriptor **Arthrography**, this term only	148
#15	(arthrograph* NEAR/6 (distension* or distention*)):ti,ab,kw	10
#16	(arthrogram* NEAR/6 (distension* or distention*)):ti,ab,kw or (glenohumeral NEAR/6 (distension* or distention*)):ti,ab,kw	3
#17	MeSH descriptor **Dilatation**, this term only	281
#18	(dilatation or hydrodilat*):ti,ab,kw	2541
#19	(#14 OR #15 OR #16 OR #17 OR #18)	2695
#20	(#13 AND #19)	25

#21	MeSH descriptor **Arthroscopy** explode all trees	835
#22	(arthroscop* NEAR/6 (releas* or decompress* or capsulotom*)):ti,ab,kw	64
#23	(capsular NEAR/2 releas*):ti,ab,kw or "interventional microadhesiolysis":ti,ab,kw or (capsulotomy):ti,ab,kw	197
#24	(#21 OR #22 OR #23)	1048
#25	(#13 AND #24)	51
#26	MeSH descriptor **Injections, Intra-Articular** explode all trees	628
#27	(#13 AND #26)	62
#28	MeSH descriptor **Injections** explode all trees	15,394
#29	(#13 AND #28)	115
#30	(bursa* or intrabursa* or intra bursa* or periartic* or peri artic* or intraartic* or intra artic*) NEAR/3 inject*:ti,ab,kw	813
#31	(#13 AND #30)	79
#32	(subacromial or acromioclavicular or glenohumeral) NEAR/3 inject*:ti,ab,kw or (extra articular or extraarticular or shoulder*) NEAR/3 inject*:ti,ab,kw	72
#33	(#27 OR #29 OR #31 OR #32)	169
#34	MeSH descriptor **Physical Therapy Modalities** explode all trees	9583
#35	(physiotherapy or physiotherapies or (physical therap*) or (manual therap*)):ti,ab,kw or (passive NEXT (motion or movement)):ti,ab,kw or (CPM):ti,ab,kw	10,737
#36	MeSH descriptor **Muscle Stretching Exercises** explode all trees	82
#37	(stretching or stretches):ti,ab,kw or (mobilisation or mobilization):ti,ab,kw or (exercise* NEAR/2 (program* or strength* or intervention* or training or prescription* or prescrib*)):ti,ab,kw or (exercise* NEAR/2 (therap* or therapeutic)):ti,ab,kw	10,643
#38	(home or supervis*) NEAR/2 exercis*:ti,ab,kw or (pendular or pendulum) NEXT exercis*:ti,ab,kw or (isokinetic or resist*) NEAR/2 exercise*,:ti,ab,kw	1658
#39	(#34 OR #35 OR #36 OR #37 OR #38)	23,617
#40	(#13 AND #39)	300
#41	MeSH descriptor **Musculoskeletal Manipulations** explode all trees	4745
#42	(chiropractic*):ti,ab,kw or (osteopath*):ti,ab,kw or (manipulat* NEAR/3 (anesthesia or anaesthesia or anesthetic* or anaesthetic*)):ti,ab,kw or (MUA):ti,ab,kw	728
#43	(#41 OR #42)	5242
#44	(#13 AND #43)	119
#45	(TENS or ALTENS):ti,ab,kw or (electric* NEAR/2 stimulat*) or (transcutaneous NEAR/2 stimulat*) or (transdermal NEAR/2 electrostimulat*) or (cutaneous NEAR/2 electrostimulat*) or electroanalgesia or (electro analgesia):ti,ab,kw or (muscle NEAR/2 stimulat*):ti,ab,kw or (neuromodulation or (neuro modulation) or neurostimulation or (neuro stimulation)):ti,ab,kw or (interferential):ti,ab,kw	17,526
#46	(#13 AND #45)	76
#47	MeSH descriptor **Biofeedback (Psychology)** explode all trees	710
#48	(biofeedback):ti,ab,kw	1348
#49	(#47 OR #48)	1348
#50	(#13 AND #49)	6
#51	MeSH descriptor **Cryotherapy** explode all trees	866
#52	MeSH descriptor **Ice** explode all trees	63
#53	MeSH descriptor **Diathermy** explode all trees	620
#54	MeSH descriptor **Hyperthermia, Induced** explode all trees	981
#55	MeSH descriptor **Hot Temperature** explode all trees	1079
#56	(cold or ice or heat or hot) NEXT (pack* or therap* or treat*):ti,ab,kw or (thermograph* or thermotherap* or (thermo therap*) or hypertherm* or (hyper therm*)):ti,ab,kw or (diatherm* or cryotherap* or (cryo therap*)):ti,ab,kw	2278
#57	(#51 OR #52 OR #53 OR #54 OR #55 OR #56)	4273
#58	(#13 AND #57)	51
#59	MeSH descriptor **Laser Therapy** explode all trees	2372
#60	MeSH descriptor **Ultrasonic Therapy** explode all trees	523

#61	MeSH descriptor **Ultrasonography, Interventional** explode all trees	529
#62	(ultrasound):ti,ab,kw or (electrotherapeutic NEAXT (intervention* or treat*)):ti,ab,kw	5557
#63	(#59 OR #60 OR #61 OR #62)	8267
#64	(#13 AND #63)	58
#65	MeSH descriptor **Magnetic Field Therapy** explode all trees	369
#66	"pulsed electromagnetic field therapy":ti,ab,kw or (electromagnetic* or magnetic*) NEAR/3 field*:ti,ab,kw or (biomagnetic* or bio magnetic*) or (pulsed signal)):ti,ab,kw or (PEMF):ti,ab,kw	793
#67	(#65 OR #66)	1121
#68	(#13 AND #67)	12
#69	MeSH descriptor **Nerve Block** explode all trees	1994
#70	MeSH descriptor **Neuromuscular Blockade** explode all trees	266
#71	(nerve NEAR/2 block*):ti,ab,kw	2595
#72	(#69 OR #70 OR #71)	2854
#73	(#13 AND #72)	49
#74	MeSH descriptor **Acupuncture Therapy** explode all trees	1830
#75	(acupuncture*):ti,ab,kw or (electroacupuncture* or (electro acupuncture*)):ti,ab,kw or (osteopuncture* or (osteo puncture*)):ti,ab,kw or (perioste* NEAR/3 (stimulat* or therap* or needling)):ti,ab,kw	4213
#76	(#74 OR #75)	4239
#77	(#13 AND #76)	58
#78	MeSH descriptor **Massage** explode all trees	595
#79	(massag* or acupressure or shiatsu or shiatzu or (zhi ya) or (chih ya)):ti,ab,kw	1277
#80	(#78 OR #79)	1277
#81	(#13 AND #80)	20
#82	(rehabilitat* NEAR/2 (program* or protocol*)):ti,ab,kw or (watch* NEAR/2 wait*) or (conservative NEAR/2 treat*):ti,ab,kw or (management NEAR/2 (decision* or option* or choice*)):ti,ab,kw	2974
#83	(#13 AND #82)	34
#84	(#20 OR #25 OR #33 OR #40 OR #44 OR #46 OR #50 OR #58 OR #64 OR #68 OR #73 OR #77 OR #81 OR #83)	588

Clinicaltrials.gov

Interface: http://clinicaltrials.gov/
Search date: 31 March 2010
Strategy: two separate searches carried out, one for 'frozen shoulder' and a second for 'adhesive capsulitis'
Records identified: 29

Cochrane Database of Systematic Reviews (CDSR)

Interface: Cochrane Library Issue 3 2010
Search date: 23 March 2010
Strategy: as CENTRAL strategy above
Records identified: 17

Conference Proceedings Citation Index: Science

Interface: Web of Science (ISI) via Web of Knowledge
Search date: 30 March 2010
Search strategy: as below

Records identified: 82

# 42	82	#41 OR #40 OR #39 OR #38 OR #37 OR #36 OR #35 OR #34 OR #33 OR #32 OR #31 OR #30 OR #29 OR #28 OR #27 OR #26 OR #25 OR #24 OR #23 OR #22
		Databases=CPCI-S Timespan=1966–2010
# 41	1	#21 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 40	7	#20 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 39	2	#19 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 38	11	#18 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 37	0	#17 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 36	0	#16 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 35	5	#15 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 34	0	#14 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 33	0	#13 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 32	0	#12 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 31	2	#11 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 30	0	#10 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 29	0	#9 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 28	12	#8 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 27	7	#7 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 26	35	#6 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 25	0	#5 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 24	13	#4 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 23	12	#3 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 22	1	#2 AND #1
		Databases=CPCI-S Timespan=1966–2010
# 21	2325	Topic=("management decision*" or "management option*" or "management choice*")
		Databases=CPCI-S Timespan=1966–2010
# 20	1814	Topic=("rehabilitat* program*" or "rehabilitat* protocol*" or "watch* wait*" or "conservative treat*")
		Databases=CPCI-S Timespan=1966–2010
# 19	427	Topic=("perioste* stimulat*" or "perioste* therap*" or "perioste* needling" or massag* or acupressure or shiatsu or shiatzu or "zhi ya" or "chih ya")
		Databases=CPCI-S Timespan=1966–2010

# 18	1345	Topic=("nerve block" or "neuromuscular blockade" or acupuncture or electroacupuncture or "electro acupuncture" or osteopuncture or "osteo puncture")
		Databases=CPCI-S Timespan=1966–2010
# 17	8	Topic=("electromagnetic field therapy" or "Biomagnetic therapy")
		Databases=CPCI-S Timespan=1966–2010
# 16	18	Topic=("Interventional ultrasonography" or "electrotherapeutic intervention*" or "electrotherapeutic treat*" or "magnetic field therapy")
		Databases=CPCI-S Timespan=1966–2010
# 15	16,084	Topic=("heat pack*" or "heat therap*" or "heat treat*" or "hot pack*" or "heat therap*" or "Laser Therapy" or "ultrasonic therapy")
		Databases=CPCI-S Timespan=1966–2010
# 14	895	Topic=(diatherm* or cryotherap* or "cryo therap*" or "cold pack*" or "cold therap*" or "cold treat*" or "ice pack*" or "ice therap*" or "ice treat*")
		Databases=CPCI-S Timespan=1966–2010
# 13	895	Topic=(diatherm* or cryotherap* or "cryo therap*" or "cold pack*" or "cold therap*" or "cold treat*" or "ice pack*" or "ice therap*" or "ice treat*")
		Databases=CPCI-S Timespan=1966–2010
# 12	895	Topic=(diatherm* or cryotherap* or "cryo therap*" or "cold pack*" or "cold therap*" or "cold treat*" or "ice pack*" or "ice therap*" or "ice treat*")
		Databases=CPCI-S Timespan=1966–2010
# 11	6798	Topic=(biofeedback or thermograph* or thermotherap* or "thermo therap*" or hypertherm* or "hyper therm*")
		Databases=CPCI-S Timespan=1966–2010
# 10	360	Topic=(neurostimulation or "neuro stimulation" or interferential)
		Databases=CPCI-S Timespan=1966–2010
# 9	574	Topic=("cutaneous electrostimulat*"or electroanalgesia or "electro analgesia" or "muscle stimulat*" or neuromodulation or "neuro modulation")
		Databases=CPCI-S Timespan=1966–2010
# 8	11,210	Topic=(TENS or ALTENS or "electric* stimulat*" or "transcutaneous stimulat*"or "transdermal electrostimulat*")
		Databases=CPCI-S Timespan=1966–2010
# 7	18,081	Topic=(chiropractic* or osteopath* or manipulation or MUA)
		Databases=CPCI-S Timespan=1966–2010
# 6	7995	Topic=(physiotherapy or physiotherapies or "physical therap*" or "manual therap*" or "passive motion" or "passive movement" or "muscle stretching" or "muscle stretches" or "muscle stretch" or mobilisation or mobilization or "exercis* program*" or "exercis* intervention*" or "exercis* train*" or "exercis* prescription*" or "exercis* prescrib*" or "exercis* therap*" or "therapeutic exercis*" or "home exercis*" or "supervis* exercis*" or "pendular exercis*" or "pendulum exercis*" or "isokinetic exercis*" or "resist* exercise*")
		Databases=CPCI-S Timespan=1966–2010
# 5	2	Topic=("subacromial inject*" or "acromioclavicular inject*" or "glenohumeral inject*" or "extra articular inject*" or "extraarticular inject*" or "shoulder* inject*")
		Databases=CPCI-S Timespan=1966–2010
# 4	5583	Topic=(injections or "intraarticular injection*" or "intra-articular injection*" or "intra articular injection*" or "bursa* inject*" or "intrabursa* inject*" or "intra bursa* inject*" or "periartic* inject*" or "peri artic* inject*")
		Databases=CPCI-S Timespan=1966–2010
# 3	656	Topic=(Arthroscopy or "arthroscop* releas*" or "arthroscop* decompress*" or "arthroscop* capsulotom*" or "capsular releas*" or "interventional microadhesiolysis" or capsulotomy)
		Databases=CPCI-S Timespan=1966–2010
# 2	2	Topic=("arthrograph* distension*" or "arthograph* disten" or "arthrogram* distension*" or "arthogram* distention*" or "glenohumeral distension*" or "glenohumeral distention*" or arthography)
		Databases=CPCI-S Timespan=1966–2010
# 1	275	Topic=("frozen shoulder*" or "stiff* shoulder*" or "adhesive capsulitis" or "shoulder bursitis" or periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis or "shoulder pain*" or "pain* shoulder" or "shoulder complaint*" or "shoulder* impinge*" or "subacromial impingement syndrome")
		Databases=CPCI-S Timespan=1966–2010

Database of Abstracts of Reviews of Effects (DARE)

Interface: Cochrane Library Issue 3 2010
Search date: 23 March 2010
Strategy: as CENTRAL strategy above
Records identified: 17

EMBASE

Interface: OvidSP
Search date: 22 March 2010
Strategy: as below
Records identified: 3785

An update search carried out on 5 January 2011 identified a further 521 records.

Database: EMBASE <1980 to 2010 Week 11>

1. humeroscapular periarthritis/(766)
2. (frozen adj6 shoulder$).ti. (215)
3. (stiff$adj3 shoulder$).ti. (73)
4. (adhesive adj (capsulitis or capsulitides)).ti. (161)
5. ((bursitis or bursitides) adj6 shoulder$).ti. (17)
6. ((capsulitis or capsulitides) adj6 shoulder$).ti. (86)
7. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ti. (70)
8. 1 or 2 or 3 or 4 or 5 or 6 or 7 (1071)
9. (frozen adj6 shoulder$).ab. (440)
10. (stiff$adj3 shoulder$).ab. (313)
11. exp bursitis/(1723)
12. (adhesive adj (capsulitis or capsulitides)).ab. (279)
13. ((bursitis or bursitides) adj6 shoulder$).ab. (51)
14. ((capsulitis or capsulitides) adj6 shoulder$).ti,ab. (183)
15. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ab. (98)
16. shoulder pain/(5140)
17. (shoulder$adj3 (pain or pains or painful or complain$)).ab. (3349)
18. Shoulder Impingement Syndrome/(680)
19. (shoulder$adj6 impinge$).ab. (364)
20. subacromial impingement syndrome.ab. (96)
21. 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 (9277)
22. Arthrography/(2891)
23. (arthrograph$adj6 (distension$or distention$)).ti,ab. (32)
24. (arthrogram$adj6 (distension$or distention$)).ti,ab. (1)
25. (glenohumeral adj6 (distension$or distention$)).ti,ab. (7)
26. Dilatation/(107)
27. (dilatation or hydrodilat$).ti,ab. (28,266)
28. or/22–27 (31,214)
29. 21 and 28 (368)
30. Shoulder arthroscopy/(361)

31. (arthroscop$adj6 (releas$or decompress$or capsulotom$)).ti,ab. (535)
32. ((capsular adj2 releas$) or capsulotomy or interventional microadhesiolysis).ti,ab. (1787)
33. or/30–32 (2581)
34. 21 and 33 (280)
35. injection/(11,806)
36. 35 and 21 (61)
37. ((bursa$or intrabursa$or intra bursa$or periartic$or peri artic$or intraartic$or intra artic$) adj3 inject$).ti,ab. (2681)
38. 37 and 21 (141)
39. ((subacromial or acromioclavicular or glenohumeral) adj3 inject$).ti,ab. (137)
40. ((extra articular or extraarticular or shoulder$) adj3 inject$).ti,ab. (136)
41. 36 or 38 or 39 or 40 (400)
42. exp physiotherapy/(24,873)
43. (physiotherapies or physical therap$or manual therap$).ti,ab. (8968)
44. (passive adj (motion or movement)).ti,ab. (1271)
45. CPM.ti,ab. (3193)
46. muscle stretching/or stretching exercise/(3543)
47. (stretching or stretches).ti,ab. (12,491)
48. (mobilisation or mobilization).ti,ab. (28,856)
49. (exercise$adj2 (program$or strength$or intervention$or training or prescription$or prescrib$)).ti,ab. (14,622)
50. (exercise$adj2 (therap$or therapeutic)).ti,ab. (2185)
51. ((home or supervis$) adj2 exercis$).ti,ab. (1554)
52. ((pendular or pendulum) adj exercis$).ti,ab. (16)
53. ((isokinetic or resist$) adj2 exercise$).ti,ab. (2223)
54. or/42–53 (91,822)
55. 21 and 54 (1248)
56. orthopedic manipulation/(222)
57. chiropractic$.ti,ab. (1998)
58. osteopath$.ti,ab. (2213)
59. (manipulat$adj3 (anesthesia or anaesthesia or anesthetic$or anaesthetic$)).ti,ab. (284)
60. MUA.ti,ab. (3446)
61. 56 or 57 or 58 or 59 or 60 (7965)
62. 21 and 61 (109)
63. (TENS or ALTENS).ti,ab. (4441)
64. ((electric$adj2 stimulat$) or (transcutaneous adj2 stimulat$) or (transdermal adj2 electrostimulat$) or (cutaneous adj2 electrostimulat$) or electroanalgesia or electro analgesia).ti,ab. (36,123)
65. (muscle adj2 stimulat$).ti,ab. (3878)
66. (neuromodulation or neuro modulation or neurostimulation or neuro stimulation).ti,ab. (2484)
67. interferential.ti,ab. (208)
68. or/63–67 (45,043)
69. 21 and 68 (108)
70. biofeedback.ti,ab. (3532)
71. 21 and 70 (7)
72. cryotherapy/(7404)
73. ice/(2468)
74. diathermy/(2178)

75. hyperthermia/(11,961)
76. thermograph$.ti,ab. (2186)
77. ((cold or ice or heat or hot) adj (pack$or therap$or treat$)).ti,ab. (7854)
78. (thermotherap$or thermo therap$or hypertherm$or hyper therm$or diatherm$or cryotherap$or cryo therap$).ti,ab. (24,875)
79. or/72–78 (45,638)
80. 21 and 79 (140)
81. low level laser Therapy/(4456)
82. ultrasound/(42,405)
83. echography/(111,055)
84. (electrotherapeutic adj (intervention$or treat$)).ti,ab. (4)
85. or/81–84 (154,738)
86. 21 and 85 (717)
87. magnetotherapy/(317)
88. pulsed electromagnetic field therapy.ti,ab. (26)
89. ((electromagnetic$or magnetic$) adj3 field$).ti,ab. (14,142)
90. (biomagnetic$or bio magnetic$or pulsed signal).ti,ab. (332)
91. PEMF.ti,ab. (223)
92. or/87–91 (14,579)
93. 21 and 92 (23)
94. nerve block/(9791)
95. neuromuscular blocking/(6800)
96. nerve block$.ti,ab. (4505)
97. or/94–96 (17,905)
98. 21 and 97 (141)
99. exp Acupuncture/(14,373)
100. acupuncture$.ti,ab. (8902)
101. (electroacupuncture$or electro acupuncture$).ti,ab. (1536)
102. (osteopuncture$or osteo puncture$).ti,ab. (2)
103. (perioste$adj3 (stimulat$or therap$or needling)).ti,ab. (114)
104. or/99–103 (15,019)
105. 21 and 104 (166)
106. massage/(4230)
107. (massag$or acupressure or shiatsu or shiatzu or zhi ya or chih ya).ti,ab. (4120)
108. 106 or 107 (6434)
109. 21 and 108 (86)
110. (rehabilitat$adj2 (program$or protocol$)).ti,ab. (8634)
111. 21 and 110 (143)
112. ((watch$adj2 wait$) or (conservative$adj2 treat$)).ti,ab. (20,913)
113. 21 and 112 (267)
114. (management adj2 (decision$or option$or choice$)).ti,ab. (6144)
115. 21 and 114 (10)
116. 111 or 113 or 115 (404)
117. 8 or 29 or 34 or 41 or 55 or 62 or 69 or 71 or 80 or 86 or 93 or 98 or 105 or 109 or 116 (3785)

Health Management Information Consortium (HMIC)

Interface: OvidSP
Search date: 25 March 2010
Strategy: as below
Records identified: 8

Database: HMIC Health Management Information Consortium <January 2010>

1. (frozen adj6 shoulder$).ti,ab. (0)
2. (stiff$adj3 shoulder$).ti,ab. (4)
3. (adhesive adj (capsulitis or capsulitides)).ti,ab. (0)
4. ((bursitis or bursitides) adj6 shoulder$).ti,ab. (0)
5. ((capsulitis or capsulitides) adj6 shoulder$).ti,ab. (0)
6. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ti,ab. (0)
7. (shoulder$adj3 (pain or pains or painful or complain$)).ti,ab. (34)
8. (shoulder$adj6 impinge$).ti,ab. (0)
9. subacromial impingement syndrome.ti,ab. (0)
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 (35)
11. (arthrograph$adj6 (distension$or distention$)).ti,ab. (0)
12. (arthrogram$adj6 (distension$or distention$)).ti,ab. (0)
13. (glenohumeral adj6 (distension$or distention$)).ti,ab. (0)
14. (dilatation or hydrodilat$).ti,ab. (20)
15. (arthroscop$adj6 (releas$or decompress$or capsulotom$)).ti,ab. (0)
16. ((capsular adj2 releas$) or interventional microadhesiolysis or capsulotomy).ti,ab. (0)
17. ((bursa$or intrabursa$or intra bursa$or periartic$or peri artic$or intraartic$or intra artic$) adj3 inject$).ti,ab. (2)
18. ((subacromial or acromioclavicular or glenohumeral) adj3 inject$).ti,ab. (0)
19. ((extra articular or extraarticular or shoulder$) adj3 inject$).ti,ab. (0)
20. (physiotherapy or physiotherapies or physical therap$or manual therap$).ti,ab. (732)
21. (passive adj (motion or movement)).ti,ab. (0)
22. CPM.ti,ab. (6)
23. (stretching or stretches).ti,ab. (42)
24. (mobilisation or mobilization).ti,ab. (97)
25. (exercise$adj2 (program$or strength$or intervention$or training or prescription$or prescrib$)).ti,ab. (229)
26. (exercise$adj2 (therap$or therapeutic)).ti,ab. (27)
27. ((home or supervis$) adj2 exercis$).ti,ab. (40)
28. ((pendular or pendulum) adj exercis$).ti,ab. (0)
29. ((isokinetic or resist$) adj2 exercise$).ti,ab. (11)
30. chiropractic$.ti,ab. (55)
31. osteopath$.ti,ab. (80)
32. (manipulat$adj3 (anesthesia or anaesthesia or anesthetic$or anaesthetic$)).ti,ab. (2)
33. MUA.ti,ab. (0)
34. (TENS or ALTENS).ti,ab. (27)
35. ((electric$adj2 stimulat$) or (transcutaneous adj2 stimulat$) or (transdermal adj2 electrostimulat$) or (cutaneous adj2 electrostimulat$) or electroanalgesia or electro analgesia).ti,ab. (9)
36. (muscle adj2 stimulat$).ti,ab. (5)
37. (neuromodulation or neuro modulation or neurostimulation or neuro stimulation).ti,ab. (1)

38. interferential.ti,ab. (5)
39. biofeedback.ti,ab. (5)
40. ((cold or ice or heat or hot) adj (pack$or therap$or treat$)).ti,ab. (18)
41. (thermograph$or thermotherap$or thermo therap$or hypertherm$or hyper therm$or diatherm$or cryotherap$or cryo therap$).ti,ab. (90)
42. ((laser or ultrasonic) adj2 (therap$or treat$)).ti,ab. (25)
43. ultrasound.ti,ab. (260)
44. (electrotherapeutic adj (intervention$or treat$)).ti,ab. (0)
45. pulsed electromagnetic field therapy.ti,ab. (0)
46. ((electromagnetic$or magnetic$) adj3 field$).ti,ab. (121)
47. (biomagnetic$or bio magnetic$or pulsed signal).ti,ab. (0)
48. PEMF.ti,ab. (0)
49. (nerve adj2 block$).ti,ab. (2)
50. neuromuscular block$.ti,ab. (3)
51. acupuncture$.ti,ab. (118)
52. (electroacupuncture$or electro acupuncture$).ti,ab. (1)
53. (osteopuncture$or osteo puncture$).ti,ab. (0)
54. (perioste$adj3 (stimulat$or therap$or needling)).ti,ab. (0)
55. (massag$or acupressure or shiatsu or shiatzu or zhi ya or chih ya).ti,ab. (67)
56. (rehabilitat$adj2 (program$or protocol$)).ti,ab. (182)
57. ((watch$adj2 wait$) or (conservative adj2 treat$)).ti,ab. (30)
58. (management adj2 (decision$or option$or choice$)).ti,ab. (353)
59. or/11–58 (2475)
60. 10 and 59 (8)
61. limit 60 to yr="1966 -Current" (8)
62. from 61 keep 1–8 (8)

Health Technology Assessment (HTA) database

Interface: Cochrane Library Issue 3 2010
Search date: 23 March 2010
Strategy: as CENTRAL strategy above
Records identified: 3

Latin American and Caribbean Health Sciences Literature (LILACS)

Interface: http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&base=LILACS&lang=i&form=F
Search date: 26 March 2010
Strategy: shoulder joint [Subject descriptor] or adhesive capsulitis [Words] or bursitis or periarthritis [Words]
Records identified: 298

Manual, Alternative and Natural Therapy (MANTIS)

Interface: Dialog Classic
Search date: 30 March 2010
Strategy: as below
Records identified: 189

? s frozen (6W) shoulder?/ti,ab,de
1317 FROZEN/TI,AB,DE
6053 SHOULDER?/TI,AB,DE
S1 172 FROZEN (6W) SHOULDER?/TI,AB,DE

? s stiff? (3W) shoulder?/ti,ab,de
3859 STIFF?/TI,AB,DE
6053 SHOULDER?/TI,AB,DE
S2 33 STIFF? (3W) SHOULDER?/TI,AB,DE

? s adhesive (W) (capsulitis or capsulitides)/ti,ab,de
437 ADHESIVE/TI,AB,DE
149 CAPSULITIS/TI,AB,DE
0 CAPSULITIDES/TI,AB,DE
S3 115 ADHESIVE (W) (CAPSULITIS OR CAPSULITIDES)/TI,AB,DE

? s (bursitis or bursitides) (6W) shoulder?/ti,ab,de
373 BURSITIS/TI,AB,DE
0 BURSITIDES/TI,AB,DE
6053 SHOULDER?/TI,AB,DE
S4 52 (BURSITIS OR BURSITIDES) (6W) SHOULDER?/TI,AB,DE

? s (capsulitis or capsulitides) (6W) shoulder?/ti,ab,de
149 CAPSULITIS/TI,AB,DE
0 CAPSULITIDES/TI,AB,DE
6053 SHOULDER?/TI,AB,DE
S5 41 (CAPSULITIS OR CAPSULITIDES) (6W) SHOULDER?/TI,AB,DE

? s (periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or
pericapsulitis) (6W) shoulder?/ti,ab,de
54 PERIARTHRITIS/TI,AB,DE
0 PERI-ARTHRITIS/TI,AB,DE
0 PERIARTHRITIDES/TI,AB,DE
0 PERI-ARTHRITIDES/TI,AB,DE
0 PERI-CAPSULITIS/TI,AB,DE
3 PERICAPSULITIS/TI,AB,DE
6053 SHOULDER?/TI,AB,DE
S6 29 (PERIARTHRITIS OR PERI-ARTHRITIS OR PERIARTHRITIDES OR

PERI-ARTHRITIDES OR PERI-CAPSULITIS OR PERICAPSULITIS)
(6W) SHOULDER?/TI,AB,DE
? s shoulder? (3W) (pain or pains or painful or complain?)/ti,ab,de
6053 SHOULDER?/TI,AB,DE
40861 PAIN/TI,AB,DE
400 PAINS/TI,AB,DE
3210 PAINFUL/TI,AB,DE
4803 COMPLAIN?/TI,AB,DE
S7 1170 SHOULDER? (3W) (PAIN OR PAINS OR PAINFUL OR

COMPLAIN?)/TI,AB,DE
? s shoulder? (6W) impinge?/ti,ab,de
6053 SHOULDER?/TI,AB,DE

994 IMPINGE?/TI,AB,DE
S8 192 SHOULDER? (6W) IMPINGE?/TI,AB,DE

? s subacromial (W) impingement (W) syndrome/ti,ab,de
235 SUBACROMIAL/TI,AB,DE
934 IMPINGEMENT/TI,AB,DE
15975 SYNDROME/TI,AB,DE
S9 28 SUBACROMIAL (W) IMPINGEMENT (W) SYNDROME/TI,AB,DE

? s s1:s9
S10 1532 S1:S9

? s arthrograph? (6W) (distension? or distention?)/ti,ab,de
365 ARTHROGRAPH?/TI,AB,DE
204 DISTENSION?/TI,AB,DE
107 DISTENTION?/TI,AB,DE
S11 6 ARTHROGRAPH? (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s arthrogram? (6W) (distension? or distention?)/ti,ab,de
126 ARTHROGRAM?/TI,AB,DE
204 DISTENSION?/TI,AB,DE
107 DISTENTION?/TI,AB,DE
S12 0 ARTHROGRAM? (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s glenohumeral (6W) (distension? or distention?)/ti,ab,de
758 GLENOHUMERAL/TI,AB,DE
204 DISTENSION?/TI,AB,DE
107 DISTENTION?/TI,AB,DE
S13 1 GLENOHUMERAL (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s dilatation or hydrodilat?/ti,ab,de
301 DILATATION
4 HYDRODILAT?/TI,AB,DE
S14 304 DILATATION OR HYDRODILAT?/TI,AB,DE

? s s11:s14
S15 310 S11:S14

? s s10 and s15
1532 S10
310 S15
S16 11 S10 AND S15

? s arthroscop? (6W) (releas? or decompress? or capsulotom?)/ti,ab,de
2147 ARTHROSCOP?/TI,AB,DE
7144 RELEAS?/TI,AB,DE
2479 DECOMPRESS?/TI,AB,DE
52 CAPSULOTOM?/TI,AB,DE
S17 96 ARTHROSCOP? (6W) (RELEAS? OR DECOMPRESS? OR

CAPSULOTOM?)/TI,AB,DE
? s capsular (2W) releas? or interventional (W) microadhesiolysis or capsulotomy/ti,ab,de

540 CAPSULAR
7144 RELEAS?
34 CAPSULAR(2W)RELEAS?
352 INTERVENTIONAL
1 MICROADHESIOLYSIS
1 INTERVENTIONAL(W)MICROADHESIOLYSIS
42 CAPSULOTOMY/TI,AB,DE
S18 77 CAPSULAR (2W) RELEAS? OR INTERVENTIONAL (W)

MICROADHESIOLYSIS OR CAPSULOTOMY/TI,AB,DE
? s s17:s18
S19 164 S17:S18

? s s10 and s19
1532 S10
164 S19
S20 32 S10 AND S19

? s injection?/ti,ab,de
>>>Term "DE.." is not defined in file 91 and is ignored
S21 7403 INJECTION?/TI,AB,DE..

? s s10 and s21
1532 S10
7403 S21
S22 94 S10 AND S21

? s (bursa? or intrabursa? or intra (W) bursa? or periartic? or peri (W) artic? or intraartic? or
intra (W) artic?) (3W) inject?/ti,ab,de
239 BURSA?/TI,AB,DE
2 INTRABURSA?/TI,AB,DE
3027 INTRA/TI,AB,DE
239 BURSA?/TI,AB,DE
1 INTRA/TI,AB,DE(W)BURSA?/TI,AB,DE
225 PERIARTIC?/TI,AB,DE
336 PERI/TI,AB,DE
23756 ARTIC?/TI,AB,DE
26 PERI/TI,AB,DE(W)ARTIC?/TI,AB,DE
592 INTRAARTIC?/TI,AB,DE
3027 INTRA/TI,AB,DE
23756 ARTIC?/TI,AB,DE
867 INTRA/TI,AB,DE(W)ARTIC?/TI,AB,DE
9111 INJECT?/TI,AB,DE
S23 335 (BURSA? OR INTRABURSA? OR INTRA (W) BURSA? OR PERIARTIC?

OR PERI (W) ARTIC? OR INTRAARTIC? OR INTRA (W) ARTIC?)
(3W) INJECT?/TI,AB,DE
? s s10 and s23
1532 S10
335 S23
S24 23 S10 AND S23

? s (subacromial or acromioclavicular or glenohumeral) (3W) inject?/ti,ab,de
235 SUBACROMIAL/TI,AB,DE
282 ACROMIOCLAVICULAR/TI,AB,DE
758 GLENOHUMERAL/TI,AB,DE
9111 INJECT?/TI,AB,DE
S25 24 (SUBACROMIAL OR ACROMIOCLAVICULAR OR GLENOHUMERAL) (3W)

INJECT?/TI,AB,DE
? s (extra (W) articular or extraarticular or shoulder?) (3W) inject?/ti,ab,de
1137 EXTRA/TI,AB,DE
6439 ARTICULAR/TI,AB,DE
227 EXTRA/TI,AB,DE(W)ARTICULAR/TI,AB,DE
143 EXTRAARTICULAR/TI,AB,DE
6053 SHOULDER?/TI,AB,DE
9111 INJECT?/TI,AB,DE
S26 17 (EXTRA (W) ARTICULAR OR EXTRAARTICULAR OR SHOULDER?) (3W)
INJECT?/TI,AB,DE

? s s22 or s24 or s25 or s26
94 S22
23 S24
24 S25
17 S26
S27 113 S22 OR S24 OR S25 OR S26

? s physiotherapy or physiotherapies or physical (W) therap? or manual(W) therap?/ti,ab,de
1824 PHYSIOTHERAPY
1 PHYSIOTHERAPIES
27577 PHYSICAL
58031 THERAP?
5273 PHYSICAL(W)THERAP?
3870 MANUAL/TI,AB,DE
58031 THERAP?/TI,AB,DE
662 MANUAL/TI,AB,DE(W)THERAP?/TI,AB,DE
S28 7178 PHYSIOTHERAPY OR PHYSIOTHERAPIES OR PHYSICAL (W) THERAP?
ORy MANUAL(W) THERAP?/TI,AB,DE

? s passive (W) (motion or movement)/ti,ab,de
3275 PASSIVE/TI,AB,DE
12870 MOTION/TI,AB,DE
8522 MOVEMENT/TI,AB,DE
S29 395 PASSIVE (W) (MOTION OR MOVEMENT)/TI,AB,DE

? s CPM/ti,ab,de
S30 117 CPM/TI,AB,DE

? s (stretching or stretches)/ti,ab,de
1453 STRETCHING/TI,AB,DE
200 STRETCHES/TI,AB,DE
S31 1555 (STRETCHING OR STRETCHES)/TI,AB,DE

? s (mobilisation or mobilization)/ti,ab,de
248 MOBILISATION/TI,AB,DE
1532 MOBILIZATION/TI,AB,DE
S32 1749 (MOBILISATION OR MOBILIZATION)/TI,AB,DE

? s exercise? (2W) (program? or strength? or intervention? or training or prescription? or prescrib?)/ti,ab,de
21844 EXERCISE?/TI,AB,DE
21676 PROGRAM?/TI,AB,DE
13678 STRENGTH?/TI,AB,DE
20015 INTERVENTION?/TI,AB,DE
15534 TRAINING/TI,AB,DE
2502 PRESCRIPTION?/TI,AB,DE
2943 PRESCRIB?/TI,AB,DE
S33 3545 EXERCISE? (2W) (PROGRAM? OR STRENGTH? OR INTERVENTION? OR TRAINING OR PRESCRIPTION? OR PRESCRIB?)/TI,AB,DE

? s exercise? (2W) (therap? or therapeutic)/ti,ab,de
21844 EXERCISE?/TI,AB,DE
58031 THERAP?/TI,AB,DE
15559 THERAPEUTIC/TI,AB,DE
S34 1871 EXERCISE? (2W) (THERAP? OR THERAPEUTIC)/TI,AB,DE

? s (home or supervis?) (2W) exercis?/ti,ab,de
5568 HOME/TI,AB,DE
1564 SUPERVIS?/TI,AB,DE
21993 EXERCIS?/TI,AB,DE
S35 448 (HOME OR SUPERVIS?) (2W) EXERCIS?/TI,AB,DE

? s (pendular or pendulum) (W) exercis?/ti,ab,de
30 PENDULAR/TI,AB,DE
209 PENDULUM/TI,AB,DE
21993 EXERCIS?/TI,AB,DE
S36 5 (PENDULAR OR PENDULUM) (W) EXERCIS?/TI,AB,DE

? s (isokinetic or resist?) (2W) exercise?/ti,ab,de
1921 ISOKINETIC/TI,AB,DE
7695 RESIST?/TI,AB,DE
21844 EXERCISE?/TI,AB,DE
S37 720 (ISOKINETIC OR RESIST?) (2W) EXERCISE?/TI,AB,DE

? s s28:s37
S38 14795 S28:S37

? s s10 and s38
1532 S10
14795 S38
S39 313 S10 AND S38

? s chiropractic?/ti,ab,de
S40 18676 CHIROPRACTIC?/TI,AB,DE

? s osteopath?/ti,ab,de
S41 8326 OSTEOPATH?/TI,AB,DE

? s manipulat? (3W) (anesthesia or anaesthesia or anesthetic? or anaesthetic? or musculoskeletal)/
ti,ab,de
8789 MANIPULAT?/TI,AB,DE
1764 ANESTHESIA/TI,AB,DE
384 ANAESTHESIA/TI,AB,DE
860 ANESTHETIC?/TI,AB,DE
293 ANAESTHETIC?/TI,AB,DE
6860 MUSCULOSKELETAL/TI,AB,DE
S42 237 MANIPULAT? (3W) (ANESTHESIA OR ANAESTHESIA OR ANESTHETIC?
OR ANAESTHETIC? OR MUSCULOSKELETAL)/TI,AB,DE

? s MUA/ti,ab,de
S43 41 MUA/TI,AB,DE

? s s40:s43
S44 26435 S40:S43

? s s10 and s44
1532 S10
26435 S44
S45 168 S10 AND S44

? s (TENS or ALTENS)/ti,ab,de
367 TENS/TI,AB,DE
4 ALTENS/TI,AB,DE
S46 369 (TENS OR ALTENS)/TI,AB,DE

? s electric? (2W) stimulat? or transcutaneous (2W) stimulat? or transdermal (2W)
electrostimulat? or cutaneous (2W) electrostimulat? or electroanalgesia or electro(W)analgesia/
ti,ab,de
5115 ELECTRIC?
13078 STIMULAT?
2781 ELECTRIC?(2W)STIMULAT?
716 TRANSCUTANEOUS
13078 STIMULAT?
592 TRANSCUTANEOUS(2W)STIMULAT?
184 TRANSDERMAL
116 ELECTROSTIMULAT?
0 TRANSDERMAL(2W)ELECTROSTIMULAT?
1545 CUTANEOUS
116 ELECTROSTIMULAT?
1 CUTANEOUS(2W)ELECTROSTIMULAT?
7 ELECTROANALGESIA
565 ELECTRO/TI,AB,DE
1688 ANALGESIA/TI,AB,DE
2 ELECTRO/TI,AB,DE(W)ANALGESIA/TI,AB,DE
S47 2821 ELECTRIC? (2W) STIMULAT? OR TRANSCUTANEOUS (2W) STIMULAT?
OR TRANSDERMAL (2W) ELECTROSTIMULAT? OR CUTANEOUS (2W)
ELECTROSTIMULAT? OR ELECTROANALGESIA OR
ELECTRO(W)ANALGESIA/TI,AB,DE

? s muscle (2W) stimulat?/ti,ab,de
25048 MUSCLE/TI,AB,DE
13078 STIMULAT?/TI,AB,DE
S48 317 MUSCLE (2W) STIMULAT?/TI,AB,DE

? s neuromodulation or neuro (W) modulation or neurostimulation or neuro (W) stimulation/
ti,ab,de
60 NEUROMODULATION
492 NEURO
1698 MODULATION
1 NEURO(W)MODULATION
47 NEUROSTIMULATION
492 NEURO/TI,AB,DE
8205 STIMULATION/TI,AB,DE
0 NEURO/TI,AB,DE(W)STIMULATION/TI,AB,DE
S49 102 NEUROMODULATION OR NEURO (W) MODULATION OR
NEUROSTIMULATION OR NEURO (W) STIMULATION/TI,AB,DE

? s interferential/ti,ab,de
S50 76 INTERFERENTIAL/TI,AB,DE

? s s46:s50
S51 3178 S46:S50

? s s10 and s51
1532 S10
3178 S51
S52 44 S10 AND S51

? s biofeedback/ti,ab,de
S53 1148 BIOFEEDBACK/TI,AB,DE

? s s10 and s53
1532 S10
1148 S53
S54 2 S10 AND S53

? s (cold or ice or heat or hot) (W) (pack? or therap? or treat?)/ti,ab,de
2091 COLD/TI,AB,DE
805 ICE/TI,AB,DE
2522 HEAT/TI,AB,DE
1323 HOT/TI,AB,DE
1446 PACK?/TI,AB,DE
58031 THERAP?/TI,AB,DE
79900 TREAT?/TI,AB,DE
S55 306 (COLD OR ICE OR HEAT OR HOT) (W) (PACK? OR THERAP? OR
TREAT?)/TI,AB,DE

? s thermograph? or thermotherap? or thermo (W) therap? or hypertherm? or hyper (W) therm?
or diatherm? or cryotherap? or cryo(W) therap?/ti,ab,de
413 THERMOGRAPH?
45 THERMOTHERAP?
32 THERMO

58031 THERAP?
1 THERMO(W)THERAP?
328 HYPERTHERM?
243 HYPER
2786 THERM?
1 HYPER(W)THERM?
113 DIATHERM?
272 CRYOTHERAP?
24 CRYO/TI,AB,DE
58031 THERAP?/TI,AB,DE
0 CRYO/TI,AB,DE(W)THERAP?/TI,AB,DE
S56 1124 THERMOGRAPH? OR THERMOTHERAP? OR THERMO (W) THERAP? OR
HYPERTHERM? OR HYPER (W) THERM? OR DIATHERM? OR
CRYOTHERAP? OR CRYO(W) THERAP?/TI,AB,DE

? s s55:s56
S57 1368 S55:S56

? s s10 and s57
1532 S10
1368 S57
S58 22 S10 AND S57

? s laser (W) therapy/ti,ab,de
1300 LASER/TI,AB,DE
43530 THERAPY/TI,AB,DE
S59 145 LASER (W) THERAPY/TI,AB,DE

? s ultrasonic (W) therapy/ti,ab,de
482 ULTRASONIC/TI,AB,DE
43530 THERAPY/TI,AB,DE
S60 115 ULTRASONIC (W) THERAPY/TI,AB,DE

? s ultrasound/ti,ab,de
S61 2326 ULTRASOUND/TI,AB,DE

? s ultrasonography/ti,ab,de
S62 1004 ULTRASONOGRAPHY/TI,AB,DE

? s electrotherapeutic (W) (intervention? or treat?)/ti,ab,de
12 ELECTROTHERAPEUTIC/TI,AB,DE
20015 INTERVENTION?/TI,AB,DE
79900 TREAT?/TI,AB,DE
S63 3 ELECTROTHERAPEUTIC (W) (INTERVENTION? OR TREAT?)/TI,AB,DE

? s s59:s63
S64 3169 S59:S63

? s s10 and s64
1532 S10
3169 S64
S65 61 S10 AND S64

? s pulsed (W) electromagnetic (W) field (W) therapy/ti,ab,de
533 PULSED/TI,AB,DE
754 ELECTROMAGNETIC/TI,AB,DE
6784 FIELD/TI,AB,DE
43530 THERAPY/TI,AB,DE
S66 7 PULSED (W) ELECTROMAGNETIC (W) FIELD (W) THERAPY/TI,AB,DE

? s (electromagnetic? or magnetic?) (3W) field?/ti,ab,de
787 ELECTROMAGNETIC?/TI,AB,DE
6966 MAGNETIC?/TI,AB,DE
8099 FIELD?/TI,AB,DE
S67 572 (ELECTROMAGNETIC? OR MAGNETIC?) (3W) FIELD?/TI,AB,DE

? s biomagnetic? or bio (W) magnetic? or pulsed signal/ti,ab,de
10 BIOMAGNETIC?
392 BIO
6966 MAGNETIC?
2 BIO(W)MAGNETIC?
0 PULSED SIGNAL/TI,AB,DE
S68 12 BIOMAGNETIC? OR BIO (W) MAGNETIC? OR PULSED
SIGNAL/TI,AB,DE

? s PEMF/ti,ab,de
S69 42 PEMF/TI,AB,DE

? s s66:s69
S70 578 S66:S69

? s s10 and s70
1532 S10
578 S70
S71 2 S10 AND S70

? s neuromuscular (W) blockade/ti,ab,de
3130 NEUROMUSCULAR/TI,AB,DE
802 BLOCKADE/TI,AB,DE
S72 81 NEUROMUSCULAR (W) BLOCKADE/TI,AB,DE

? s nerve (2W) block?/ti,ab,de
13003 NERVE/TI,AB,DE
6218 BLOCK?/TI,AB,DE
S73 453 NERVE (2W) BLOCK?/TI,AB,DE

? s s72:s73
S74 533 S72:S73

? s s10 and s74
1532 S10
533 S74
S75 9 S10 AND S74

? s acupuncture?/ti,ab,de
S76 7224 ACUPUNCTURE?/TI,AB,DE

? s electroacupuncture? or electro (W) acupuncture?/ti,ab,de
996 ELECTROACUPUNCTURE?
565 ELECTRO/TI,AB,DE
7224 ACUPUNCTURE?/TI,AB,DE
303 ELECTRO/TI,AB,DE(W)ACUPUNCTURE?/TI,AB,DE
S77 1223 ELECTROACUPUNCTURE? OR ELECTRO (W) ACUPUNCTURE?/TI,AB,DE

? s osteopuncture? or osteo (W) puncture?/ti,ab,de
0 OSTEOPUNCTURE?
86 OSTEO/TI,AB,DE
587 PUNCTURE?/TI,AB,DE
0 OSTEO/TI,AB,DE(W)PUNCTURE?/TI,AB,DE
S78 0 OSTEOPUNCTURE? OR OSTEO (W) PUNCTURE?/TI,AB,DE

? s perioste? (3W) (stimulat? or therap? or needling)/ti,ab,de
455 PERIOSTE?/TI,AB,DE
13078 STIMULAT?/TI,AB,DE
58031 THERAP?/TI,AB,DE
657 NEEDLING/TI,AB,DE
S79 7 PERIOSTE? (3W) (STIMULAT? OR THERAP? OR
NEEDLING)/TI,AB,DE

? s s76:s79
S80 7685 S76:S79

? s s10 and s80
1532 S10
7685 S80
S81 88 S10 AND S80

? s massag? or acupressure or shiatsu or shiatzu or zhi (W) ya or chih (W) ya/ti,ab,de
1535 MASSAG?
201 ACUPRESSURE
58 SHIATSU
0 SHIATZU
105 ZHI
21 YA
0 ZHI(W)YA
10 CHIH/TI,AB,DE
21 YA/TI,AB,DE
0 CHIH/TI,AB,DE(W)YA/TI,AB,DE
S82 1692 MASSAG? OR ACUPRESSURE OR SHIATSU OR SHIATZU OR ZHI (W)
YA OR CHIH (W) YA/TI,AB,DE

? s s10 and s82
1532 S10
1692 S82
S83 43 S10 AND S82

? s rehabilitat? (2W) (program? or protocol?)/ti,ab,de
12934 REHABILITAT?/TI,AB,DE
21676 PROGRAM?/TI,AB,DE
6815 PROTOCOL?/TI,AB,DE
S84 2040 REHABILITAT? (2W) (PROGRAM? OR PROTOCOL?)/TI,AB,DE

? s s10 and s84
1532 S10
2040 S84
S85 53 S10 AND S84

? s watch? (2W) wait? or conservative (2W) treat?/ti,ab,de
500 WATCH?
875 WAIT?
18 WATCH?(2W)WAIT?
3381 CONSERVATIVE/TI,AB,DE
79900 TREAT?/TI,AB,DE
1533 CONSERVATIVE/TI,AB,DE(2W)TREAT?/TI,AB,DE
S86 1551 WATCH? (2W) WAIT? OR CONSERVATIVE (2W) TREAT?/TI,AB,DE

? s s10 and s86
1532 S10
1551 S86
S87 51 S10 AND S86

? s management (2W) (decision? or option? or choice?)/ti,ab,de
18593 MANAGEMENT/TI,AB,DE
5371 DECISION?/TI,AB,DE
3950 OPTION?/TI,AB,DE
4823 CHOICE?/TI,AB,DE
S88 219 MANAGEMENT (2W) (DECISION? OR OPTION? OR
CHOICE?)/TI,AB,DE

? s s10 and s88
1532 S10
219 S88
S89 1 S10 AND S88

? s s85 or s87 or s89
53 S85
51 S87
1 S89
S90 101 S85 OR S87 OR S89

? s s16 or s20 or s27 or s39 or s45 or s52 or s54 or s58 or s65 or s71 or s75 or s81 or s83 or s90
11 S16
32 S20
113 S27
313 S39
168 S45
44 S52
2 S54

22 S58
61 S65
2 S71
9 S75
88 S81
43 S83
101 S90
S91 685 S16 OR S20 OR S27 OR S39 OR S45 OR S52 OR S54 OR S58 OR
S65 OR S71 OR S75 OR S81 OR S83 OR S90

? s py=1966:2010
S92 89245 PY=1966:2010

? s s91 and s92
685 S91
89245 S92
S93 189 S91 AND S92

NHS Economic Evaluation Database (NHS EED)

Interface: Cochrane Library Issue 3 2010
Search date: 23 March 2010
Strategy: as below

ID	Search	Hits
#1	(frozen NEAR/6 shoulder*):ti,ab,kw	65
#2	(stiff* NEAR/3 shoulder*):ti,ab,kw	63
#3	MeSH descriptor **Bursitis** explode all trees	127
#4	(adhesive NEXT (capsulitis or capsulitides)):ti,ab,kw	44
#5	(bursitis or bursitides) NEAR/6 shoulder*:ti,ab,kw	11
#6	(capsulitis or capsulitides) NEAR/6 shoulder*	39
#7	(periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) NEAR/6 shoulder*:ti,ab,kw	77
#8	MeSH descriptor **Shoulder Pain** explode all trees	240
#9	(shoulder* NEAR/3 (pain or pains or painful or complain*)):ti,ab,kw	682
#10	MeSH descriptor **Shoulder Impingement Syndrome** explode all trees	84
#11	(shoulder* NEAR/6 impinge*):ti,ab,kw	107
#12	"subacromial impingement syndrome":ti,ab,kw	20
#13	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12)	964
#14	MeSH descriptor **Arthrography**, this term only	148
#15	(arthrograph* NEAR/6 (distension* or distention*)):ti,ab,kw	10
#16	(arthrogram* NEAR/6 (distension* or distention*)):ti,ab,kw or (glenohumeral NEAR/6 (distension* or distention*)):ti,ab,kw	3
#17	MeSH descriptor **Dilatation**, this term only	281
#18	(dilatation or hydrodilat*):ti,ab,kw	2541
#19	(#14 OR #15 OR #16 OR #17 OR #18)	2695
#20	(#13 AND #19)	25
#21	MeSH descriptor **Arthroscopy** explode all trees	835
#22	(arthroscop* NEAR/6 (releas* or decompress* or capsulotom*)):ti,ab,kw	64
#23	(capsular NEAR/2 releas*):ti,ab,kw or "interventional microadhesiolysis":ti,ab,kw or (capsulotomy):ti,ab,kw	197

#24	(#21 OR #22 OR #23)	1048
#25	(#13 AND #24)	51
#26	MeSH descriptor **Injections, Intra-Articular** explode all trees	628
#27	(#13 AND #26)	62
#28	MeSH descriptor **Injections** explode all trees	15,394
#29	(#13 AND #28)	115
#30	(bursa* or intrabursa* or intra bursa* or periartic* or peri artic* or intraartic* or intra artic*) NEAR/3 inject*:ti,ab,kw	813
#31	(#13 AND #30)	79
#32	(subacromial or acromioclavicular or glenohumeral) NEAR/3 inject*:ti,ab,kw or (extra articular or extraarticular or shoulder*) NEAR/3 inject*:ti,ab,kw	72
#33	(#27 OR #29 OR #31 OR #32)	169
#34	MeSH descriptor **Physical Therapy Modalities** explode all trees	9583
#35	(physiotherapy or physiotherapies or (physical therap*) or (manual therap*)):ti,ab,kw or (passive NEXT (motion or movement)):ti,ab,kw or (CPM):ti,ab,kw	10,737
#36	MeSH descriptor **Muscle Stretching Exercises** explode all trees	82
#37	(stretching or stretches):ti,ab,kw or (mobilisation or mobilization):ti,ab,kw or (exercise* NEAR/2 (program* or strength* or intervention* or training or prescription* or prescrib*)):ti,ab,kw or (exercise* NEAR/2 (therap* or therapeutic)):ti,ab,kw	10,643
#38	(home or supervis*) NEAR/2 exercis*:ti,ab,kw or (pendular or pendulum) NEXT exercis*:ti,ab,kw or (isokinetic or resist*) NEAR/2 exercise*,:ti,ab,kw	1658
#39	(#34 OR #35 OR #36 OR #37 OR #38)	23,617
#40	(#13 AND #39)	300
#41	MeSH descriptor **Musculoskeletal Manipulations** explode all trees	4745
#42	(chiropractic*):ti,ab,kw or (osteopath*):ti,ab,kw or (manipulat* NEAR/3 (anesthesia or anaesthesia or anesthetic* or anaesthetic*)):ti,ab,kw or (MUA):ti,ab,kw	728
#43	(#41 OR #42)	5242
#44	(#13 AND #43)	119
#45	(TENS or ALTENS):ti,ab,kw or (electric* NEAR/2 stimulat*) or (transcutaneous NEAR/2 stimulat*) or (transdermal NEAR/2 electrostimulat*) or (cutaneous NEAR/2 electrostimulat*) or electroanalgesia or (electro analgesia):ti,ab,kw or (muscle NEAR/2 stimulat*):ti,ab,kw or (neuromodulation or (neuro modulation) or neurostimulation or (neuro stimulation)):ti,ab,kw or (interferential):ti,ab,kw	17,526
#46	(#13 AND #45)	76
#47	MeSH descriptor **Biofeedback (Psychology)** explode all trees	710
#48	(biofeedback):ti,ab,kw	1348
#49	(#47 OR #48)	1348
#50	(#13 AND #49)	6
#51	MeSH descriptor **Cryotherapy** explode all trees	866
#52	MeSH descriptor **Ice** explode all trees	63
#53	MeSH descriptor **Diathermy** explode all trees	620
#54	MeSH descriptor **Hyperthermia, Induced** explode all trees	981
#55	MeSH descriptor **Hot Temperature** explode all trees	1079
#56	(cold or ice or heat or hot) NEXT (pack* or therap* or treat*):ti,ab,kw or (thermograph* or thermotherap* or (thermo therap*) or hypertherm* or (hyper therm*)):ti,ab,kw or (diatherm* or cryotherap* or (cryo therap*)):ti,ab,kw	2278
#57	(#51 OR #52 OR #53 OR #54 OR #55 OR #56)	4273
#58	(#13 AND #57)	51
#59	MeSH descriptor **Laser Therapy** explode all trees	2372
#60	MeSH descriptor **Ultrasonic Therapy** explode all trees	523
#61	MeSH descriptor **Ultrasonography, Interventional** explode all trees	529
#62	(ultrasound):ti,ab,kw or (electrotherapeutic NEAXT (intervention* or treat*)):ti,ab,kw	5557
#63	(#59 OR #60 OR #61 OR #62)	8267
#64	(#13 AND #63)	58
#65	MeSH descriptor **Magnetic Field Therapy** explode all trees	369

#66	"pulsed electromagnetic field therapy":ti,ab,kw or (electromagnetic* or magnetic*) NEAR/3 field*:ti,ab,kw or (biomagnetic* or (bio magnetic*) or (pulsed signal)):ti,ab,kw or (PEMF):ti,ab,kw	793
#67	(#65 OR #66)	1121
#68	(#13 AND #67)	12
#69	MeSH descriptor **Nerve Block** explode all trees	1994
#70	MeSH descriptor **Neuromuscular Blockade** explode all trees	266
#71	(nerve NEAR/2 block*):ti,ab,kw	2595
#72	(#69 OR #70 OR #71)	2854
#73	(#13 AND #72)	49
#74	MeSH descriptor **Acupuncture Therapy** explode all trees	1830
#75	(acupuncture*):ti,ab,kw or (electroacupuncture* or (electro acupuncture*)):ti,ab,kw or (osteopuncture* or (osteo puncture*)):ti,ab,kw or (perioste* NEAR/3 (stimulat* or therap* or needling)):ti,ab,kw	4213
#76	(#74 OR #75)	4239
#77	(#13 AND #76)	58
#78	MeSH descriptor **Massage** explode all trees	595
#79	(massag* or acupressure or shiatsu or shiatzu or (zhi ya) or (chih ya)):ti,ab,kw	1277
#80	(#78 OR #79)	1277
#81	(#13 AND #80)	20
#82	(rehabilitat* NEAR/2 (program* or protocol*)):ti,ab,kw or (watch* NEAR/2 wait*) or (conservative NEAR/2 treat*):ti,ab,kw or (management NEAR/2 (decision* or option* or choice*)):ti,ab,kw	2974
#83	(#13 AND #82)	34
#84	(#20 OR #25 OR #33 OR #40 OR #44 OR #46 OR #50 OR #58 OR #64 OR #68 OR #73 OR #77 OR #81 OR #83)	588

National Technical Information Service (NTIS)

Interface: Dialog Classic
Search date: 30 March 2010
Strategy: as below
Records identified: 8

File 6:NTIS 1964–2010/Mar W4
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? s frozen (6W) shoulder?/ti,ab,de
4683 FROZEN/TI,AB,DE
1917 SHOULDER?/TI,AB,DE
S1 5 FROZEN (6W) SHOULDER?/TI,AB,DE

? s stiff? (3W) shoulder?/ti,ab,de
11654 STIFF?/TI,AB,DE
1917 SHOULDER?/TI,AB,DE
S2 1 STIFF? (3W) SHOULDER?/TI,AB,DE

? s adhesive (W) (capsulitis or capsulitides)/ti,ab,de
4903 ADHESIVE/TI,AB,DE
1 CAPSULITIS/TI,AB,DE
0 CAPSULITIDES/TI,AB,DE
S3 1 ADHESIVE (W) (CAPSULITIS OR CAPSULITIDES)/TI,AB,DE

? s (bursitis or bursitides) (6W) shoulder?/ti,ab,de
10 BURSITIS/TI,AB,DE

0 BURSITIDES/TI,AB,DE
1917 SHOULDER?/TI,AB,DE
S4 0 (BURSITIS OR BURSITIDES) (6W) SHOULDER?/TI,AB,DE

? s (capsulitis or capsulitides) (6W) shoulder?/ti,ab,de
1 CAPSULITIS/TI,AB,DE
0 CAPSULITIDES/TI,AB,DE
1917 SHOULDER?/TI,AB,DE
S5 1 (CAPSULITIS OR CAPSULITIDES) (6W) SHOULDER?/TI,AB,DE

? s (periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or
pericapsulitis) (6W) shoulder?/ti,ab,de
3 PERIARTHRITIS/TI,AB,DE
0 PERI-ARTHRITIS/TI,AB,DE
0 PERIARTHRITIDES/TI,AB,DE
0 PERI-ARTHRITIDES/TI,AB,DE
0 PERI-CAPSULITIS/TI,AB,DE
0 PERICAPSULITIS/TI,AB,DE
1917 SHOULDER?/TI,AB,DE
S6 0 (PERIARTHRITIS OR PERI-ARTHRITIS OR PERIARTHRITIDES OR PERI-
ARTHRITIDES OR PERI-CAPSULITIS OR PERICAPSULITIS) (6W) SHOULDER?/TI,AB,DE

? s shoulder? (3W) (pain or pains or painful or complain?)/ti,ab,de
1917 SHOULDER?/TI,AB,DE
1751 PAIN/TI,AB,DE
121 PAINS/TI,AB,DE
245 PAINFUL/TI,AB,DE
2900 COMPLAIN?/TI,AB,DE
S7 19 SHOULDER? (3W) (PAIN OR PAINS OR PAINFUL OR COMPLAIN?)/TI,AB,DE

? s shoulder? (6W) impinge?/ti,ab,de
1917 SHOULDER?/TI,AB,DE
2858 IMPINGE?/TI,AB,DE
S8 1 SHOULDER? (6W) IMPINGE?/TI,AB,DE

? s subacromial (W) impingement (W) syndrome/ti,ab,de
0 SUBACROMIAL/TI,AB,DE
1922 IMPINGEMENT/TI,AB,DE
3547 SYNDROME/TI,AB,DE
S9 0 SUBACROMIAL (W) IMPINGEMENT (W) SYNDROME/TI,AB,DE

? s s1:s9
S10 26 S1:S9

? s arthrograph? (6W) (distension? or distention?)/ti,ab,de
4 ARTHROGRAPH?/TI,AB,DE
50 DISTENSION?/TI,AB,DE
39 DISTENTION?/TI,AB,DE
S11 0 ARTHROGRAPH? (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s arthrogram? (6W) (distension? or distention?)/ti,ab,de
0 ARTHROGRAM?/TI,AB,DE

50 DISTENSION?/TI,AB,DE
39 DISTENTION?/TI,AB,DE
S12 0 ARTHROGRAM? (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s glenohumeral (6W) (distension? or distention?)/ti,ab,de
5 GLENOHUMERAL/TI,AB,DE
50 DISTENSION?/TI,AB,DE
39 DISTENTION?/TI,AB,DE
S13 0 GLENOHUMERAL (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s dilatation or hydrodilat?/ti,ab,de
336 DILATATION
0 HYDRODILAT?/TI,AB,DE
S14 336 DILATATION OR HYDRODILAT?/TI,AB,DE

? s s11:s14
S15 336 S11:S14

? s s10 and s15
26 S10
336 S15
S16 0 S10 AND S15

? s arthroscop? (6W) (releas? or decompress? or capsulotom?)/ti,ab,de
11 ARTHROSCOP?/TI,AB,DE
45473 RELEAS?/TI,AB,DE
1628 DECOMPRESS?/TI,AB,DE
8 CAPSULOTOM?/TI,AB,DE
S17 0 ARTHROSCOP? (6W) (RELEAS? OR DECOMPRESS? OR CAPSULOTOM?)/TI,AB,DE

? s capsular (2W) releas? or interventional (W) microadhesiolysis or capsulotomy/ti,ab,de
121 CAPSULAR
46080 RELEAS?
0 CAPSULAR(2W)RELEAS?
72 INTERVENTIONAL
0 MICROADHESIOLYSIS
0 INTERVENTIONAL(W)MICROADHESIOLYSIS
5 CAPSULOTOMY/TI,AB,DE
S18 5 CAPSULAR (2W) RELEAS? OR INTERVENTIONAL (W) MICROADHESIOLYSIS OR
CAPSULOTOMY/TI,AB,DE

? s s17:s18
S19 5 S17:S18

? s s10 and s19
26 S10
5 S19
S20 0 S10 AND S19

? s injection?/ti,ab,de
>>>Term "DE.." is not defined in file 6 and is ignored
S21 22468 INJECTION?/TI,AB,DE..

? s s10 and s21
26 S10
22468 S21
S22 1 S10 AND S21

? s (bursa? or intrabursa? or intra (W) bursa? or periartic? or peri (W) artic? or intraartic? or intra (W) artic?) (3W) inject?/ti,ab,de
54 BURSA?/TI,AB,DE
1 INTRABURSA?/TI,AB,DE
2614 INTRA/TI,AB,DE
54 BURSA?/TI,AB,DE
0 INTRA/TI,AB,DE(W)BURSA?/TI,AB,DE
2 PERIARTIC?/TI,AB,DE
84 PERI/TI,AB,DE
55035 ARTIC?/TI,AB,DE
1 PERI/TI,AB,DE(W)ARTIC?/TI,AB,DE
0 INTRAARTIC?/TI,AB,DE
2614 INTRA/TI,AB,DE
55035 ARTIC?/TI,AB,DE
16 INTRA/TI,AB,DE(W)ARTIC?/TI,AB,DE
37102 INJECT?/TI,AB,DE
S23 8 (BURSA? OR INTRABURSA? OR INTRA (W) BURSA? OR PERIARTIC? OR PERI (W) ARTIC? OR INTRAARTIC? OR INTRA (W) ARTIC?) (3W) INJECT?/TI,AB,DE

? s s10 and s23
26 S10
8 S23
S24 0 S10 AND S23

? s (subacromial or acromioclavicular or glenohumeral) (3W) inject?/ti,ab,de
0 SUBACROMIAL/TI,AB,DE
1 ACROMIOCLAVICULAR/TI,AB,DE
5 GLENOHUMERAL/TI,AB,DE
37102 INJECT?/TI,AB,DE
S25 0 (SUBACROMIAL OR ACROMIOCLAVICULAR OR GLENOHUMERAL) (3W) INJECT?/TI,AB,DE

? s (extra (W) articular or extraarticular or shoulder?) (3W) inject?/ti,ab,de
4370 EXTRA/TI,AB,DE
82 ARTICULAR/TI,AB,DE
0 EXTRA/TI,AB,DE(W)ARTICULAR/TI,AB,DE
0 EXTRAARTICULAR/TI,AB,DE
1917 SHOULDER?/TI,AB,DE
37102 INJECT?/TI,AB,DE
S26 2 (EXTRA (W) ARTICULAR OR EXTRAARTICULAR OR SHOULDER?) (3W) INJECT?/TI,AB,DE

? s s22 or s24 or s25 or s26
1 S22
0 S24
0 S25
2 S26
S27 3 S22 OR S24 OR S25 OR S26

? s physiotherapy or physiotherapies or physical (W) therap? or manual(W) therap?/ti,ab,de
38 PHYSIOTHERAPY
0 PHYSIOTHERAPIES
226243 PHYSICAL
19307 THERAP?
1223 PHYSICAL(W)THERAP?
37866 MANUAL/TI,AB,DE
18488 THERAP?/TI,AB,DE
1 MANUAL/TI,AB,DE(W)THERAP?/TI,AB,DE
S28 1253 PHYSIOTHERAPY OR PHYSIOTHERAPIES OR PHYSICAL (W) THERAP? OR
MANUAL(W) THERAP?/TI,AB,DE

? s passive (W) (motion or movement)/ti,ab,de
13922 PASSIVE/TI,AB,DE
56426 MOTION/TI,AB,DE
19107 MOVEMENT/TI,AB,DE
S29 11 PASSIVE (W) (MOTION OR MOVEMENT)/TI,AB,DE

? s CPM/ti,ab,de
S30 356 CPM/TI,AB,DE

? s (stretching or stretches)/ti,ab,de
2022 STRETCHING/TI,AB,DE
319 STRETCHES/TI,AB,DE
S31 2331 (STRETCHING OR STRETCHES)/TI,AB,DE

? s (mobilisation or mobilization)/ti,ab,de
41 MOBILISATION/TI,AB,DE
2774 MOBILIZATION/TI,AB,DE
S32 2812 (MOBILISATION OR MOBILIZATION)/TI,AB,DE

? s exercise? (2W) (program? or strength? or intervention? or training or prescription? or
prescrib?)/ti,ab,de
14367 EXERCISE?/TI,AB,DE
480068 PROGRAM?/TI,AB,DE
72882 STRENGTH?/TI,AB,DE
8460 INTERVENTION?/TI,AB,DE
71866 TRAINING/TI,AB,DE
2399 PRESCRIPTION?/TI,AB,DE
8170 PRESCRIB?/TI,AB,DE
S33 651 EXERCISE? (2W) (PROGRAM? OR STRENGTH? OR INTERVENTION? OR
TRAINING OR PRESCRIPTION? OR PRESCRIB?)/TI,AB,DE

? s exercise? (2W) (therap? or therapeutic)/ti,ab,de
14367 EXERCISE?/TI,AB,DE
18488 THERAP?/TI,AB,DE
5073 THERAPEUTIC/TI,AB,DE
S34 37 EXERCISE? (2W) (THERAP? OR THERAPEUTIC)/TI,AB,DE

? s (home or supervis?) (2W) exercis?/ti,ab,de
14925 HOME/TI,AB,DE
10621 SUPERVIS?/TI,AB,DE

14861 EXERCIS?/TI,AB,DE
S35 17 (HOME OR SUPERVIS?) (2W) EXERCIS?/TI,AB,DE

? s (pendular or pendulum) (W) exercis?/ti,ab,de
39 PENDULAR/TI,AB,DE
952 PENDULUM/TI,AB,DE
14861 EXERCIS?/TI,AB,DE
S36 0 (PENDULAR OR PENDULUM) (W) EXERCIS?/TI,AB,DE

? s (isokinetic or resist?) (2W) exercise?/ti,ab,de
223 ISOKINETIC/TI,AB,DE
74785 RESIST?/TI,AB,DE
14367 EXERCISE?/TI,AB,DE
S37 68 (ISOKINETIC OR RESIST?) (2W) EXERCISE?/TI,AB,DE

? s s28:s37
S38 7465 S28:S37

? s s10 and s38
26 S10
7465 S38
S39 1 S10 AND S38

? s chiropractic?/ti,ab,de
S40 39 CHIROPRACTIC?/TI,AB,DE

? s osteopath?/ti,ab,de
S41 199 OSTEOPATH?/TI,AB,DE

? s manipulat? (3W) (anesthesia or anaesthesia or anesthetic? or anaesthetic? or musculoskeletal)/
ti,ab,de
13446 MANIPULAT?/TI,AB,DE
1006 ANESTHESIA/TI,AB,DE
47 ANAESTHESIA/TI,AB,DE
723 ANESTHETIC?/TI,AB,DE
41 ANAESTHETIC?/TI,AB,DE
1646 MUSCULOSKELETAL/TI,AB,DE
S42 1 MANIPULAT? (3W) (ANESTHESIA OR ANAESTHESIA OR ANESTHETIC? OR
ANAESTHETIC? OR MUSCULOSKELETAL)/TI,AB,DE

? s MUA/ti,ab,de
S43 27 MUA/TI,AB,DE

? s s40:s43
S44 257 S40:S43

? s s10 and s44
26 S10
257 S44
S45 0 S10 AND S44

? s (TENS or ALTENS)/ti,ab,de
2334 TENS/TI,AB,DE
0 ALTENS/TI,AB,DE
S46 2334 (TENS OR ALTENS)/TI,AB,DE

? s electric? (2W) stimulat? or transcutaneous (2W) stimulat? or transdermal (2W)
electrostimulat? or cutaneous (2W) electrostimulat? or electroanalgesia or electro(W)analgesia/
ti,ab,de
170950 ELECTRIC?
18749 STIMULAT?
518 ELECTRIC?(2W)STIMULAT?
84 TRANSCUTANEOUS
18749 STIMULAT?
13 TRANSCUTANEOUS(2W)STIMULAT?
93 TRANSDERMAL
17 ELECTROSTIMULAT?
0 TRANSDERMAL(2W)ELECTROSTIMULAT?
810 CUTANEOUS
17 ELECTROSTIMULAT?
1 CUTANEOUS(2W)ELECTROSTIMULAT?
3 ELECTROANALGESIA
6549 ELECTRO/TI,AB,DE
133 ANALGESIA/TI,AB,DE
1 ELECTRO/TI,AB,DE(W)ANALGESIA/TI,AB,DE
S47 524 ELECTRIC? (2W) STIMULAT? OR TRANSCUTANEOUS (2W) STIMULAT?
OR TRANSDERMAL (2W) ELECTROSTIMULAT? OR CUTANEOUS (2W)
ELECTROSTIMULAT? OR ELECTROANALGESIA OR ELECTRO(W)ANALGESIA/TI,AB,DE

? s muscle (2W) stimulat?/ti,ab,de
4028 MUSCLE/TI,AB,DE
18526 STIMULAT?/TI,AB,DE
S48 35 MUSCLE (2W) STIMULAT?/TI,AB,DE

? s neuromodulation or neuro (W) modulation or neurostimulation or neuro (W) stimulation/
ti,ab,de
17 NEUROMODULATION
262 NEURO
15752 MODULATION
0 NEURO(W)MODULATION
2 NEUROSTIMULATION
246 NEURO/TI,AB,DE
7638 STIMULATION/TI,AB,DE
0 NEURO/TI,AB,DE(W)STIMULATION/TI,AB,DE
S49 19 NEUROMODULATION OR NEURO (W) MODULATION OR NEUROSTIMULATION
OR NEURO (W) STIMULATION/TI,AB,DE

? s interferential/ti,ab,de
S50 29 INTERFERENTIAL/TI,AB,DE

? s s46:s50
S51 2929 S46:S50

? s s10 and s51
26 S10
2929 S51
S52 0 S10 AND S51

? s biofeedback/ti,ab,de
S53 218 BIOFEEDBACK/TI,AB,DE

? s s10 and s53
26 S10
218 S53
S54 0 S10 AND S53

? s (cold or ice or heat or hot) (W) (pack? or therap? or treat?)/ti,ab,de
26659 COLD/TI,AB,DE
15533 ICE/TI,AB,DE
118199 HEAT/TI,AB,DE
35308 HOT/TI,AB,DE
47432 PACK?/TI,AB,DE
18488 THERAP?/TI,AB,DE
132040 TREAT?/TI,AB,DE
S55 11411 (COLD OR ICE OR HEAT OR HOT) (W) (PACK? OR THERAP? OR TREAT?)/
TI,AB,DE

? s thermograph? or thermotherap? or thermo (W) therap? or hypertherm? or hyper (W) therm?
or diatherm? or cryotherap? or cryo(W) therap?/ti,ab,de
1380 THERMOGRAPH?
4 THERMOTHERAP?
2400 THERMO
19307 THERAP?
0 THERMO(W)THERAP?
735 HYPERTHERM?
654 HYPER
200235 THERM?
8 HYPER(W)THERM?
45 DIATHERM?
19 CRYOTHERAP?
241 CRYO/TI,AB,DE
18488 THERAP?/TI,AB,DE
0 CRYO/TI,AB,DE(W)THERAP?/TI,AB,DE
S56 2170 THERMOGRAPH? OR THERMOTHERAP? OR THERMO (W) THERAP? OR
HYPERTHERM? OR HYPER (W) THERM? OR DIATHERM? OR CRYOTHERAP? OR
CRYO(W) THERAP?/TI,AB,DE

? s s55:s56
S57 13561 S55:S56

? s s10 and s57
26 S10
13561 S57
S58 2 S10 AND S57

? s laser (W) therapy/ti,ab,de
61371 LASER/TI,AB,DE
14631 THERAPY/TI,AB,DE
S59 15 LASER (W) THERAPY/TI,AB,DE

? s ultrasonic (W) therapy/ti,ab,de
10590 ULTRASONIC/TI,AB,DE
14631 THERAPY/TI,AB,DE
S60 15 ULTRASONIC (W) THERAPY/TI,AB,DE

? s ultrasound/ti,ab,de
S61 1689 ULTRASOUND/TI,AB,DE

? s ultrasonography/ti,ab,de
S62 180 ULTRASONOGRAPHY/TI,AB,DE

? s electrotherapeutic (W) (intervention? or treat?)/ti,ab,de
6 ELECTROTHERAPEUTIC/TI,AB,DE
8460 INTERVENTION?/TI,AB,DE
132040 TREAT?/TI,AB,DE
S63 0 ELECTROTHERAPEUTIC (W) (INTERVENTION? OR TREAT?)/TI,AB,DE

? s s59:s63
S64 1841 S59:S63

? s s10 and s64
26 S10
1841 S64
S65 1 S10 AND S64

? s pulsed (W) electromagnetic (W) field (W) therapy/ti,ab,de
15810 PULSED/TI,AB,DE
38066 ELECTROMAGNETIC/TI,AB,DE
195700 FIELD/TI,AB,DE
14631 THERAPY/TI,AB,DE
S66 0 PULSED (W) ELECTROMAGNETIC (W) FIELD (W) THERAPY/TI,AB,DE

? s (electromagnetic? or magnetic?) (3W) field?/ti,ab,de
38583 ELECTROMAGNETIC?/TI,AB,DE
85629 MAGNETIC?/TI,AB,DE
243256 FIELD?/TI,AB,DE
S67 42083 (ELECTROMAGNETIC? OR MAGNETIC?) (3W) FIELD?/TI,AB,DE

? s biomagnetic? or bio (W) magnetic? or pulsed signal/ti,ab,de
96 BIOMAGNETIC?
2195 BIO
86544 MAGNETIC?
3 BIO(W)MAGNETIC?
0 PULSED SIGNAL/TI,AB,DE
S68 98 BIOMAGNETIC? OR BIO (W) MAGNETIC? OR PULSED SIGNAL/TI,AB,DE

? s PEMF/ti,ab,de
S69 5 PEMF/TI,AB,DE

? s s66:s69
S70 42137 S66:S69

? s s10 and s70
26 S10
42137 S70
S71 0 S10 AND S70

? s neuromuscular (W) blockade/ti,ab,de
839 NEUROMUSCULAR/TI,AB,DE
582 BLOCKADE/TI,AB,DE
S72 19 NEUROMUSCULAR (W) BLOCKADE/TI,AB,DE

? s nerve (2W) block?/ti,ab,de
6188 NERVE/TI,AB,DE
25659 BLOCK?/TI,AB,DE
S73 170 NERVE (2W) BLOCK?/TI,AB,DE

? s s72:s73
S74 180 S72:S73

? s s10 and s74
26 S10
180 S74
S75 0 S10 AND S74

? s acupuncture?/ti,ab,de
S76 87 ACUPUNCTURE?/TI,AB,DE

? s electroacupuncture? or electro (W) acupuncture?/ti,ab,de
6 ELECTROACUPUNCTURE?
6549 ELECTRO/TI,AB,DE
87 ACUPUNCTURE?/TI,AB,DE
4 ELECTRO/TI,AB,DE(W)ACUPUNCTURE?/TI,AB,DE
S77 8 ELECTROACUPUNCTURE? OR ELECTRO (W) ACUPUNCTURE?/TI,AB,DE

? s osteopuncture? or osteo (W) puncture?/ti,ab,de
0 OSTEOPUNCTURE?
6 OSTEO/TI,AB,DE
602 PUNCTURE?/TI,AB,DE
0 OSTEO/TI,AB,DE(W)PUNCTURE?/TI,AB,DE
S78 0 OSTEOPUNCTURE? OR OSTEO (W) PUNCTURE?/TI,AB,DE

? s perioste? (3W) (stimulat? or therap? or needling)/ti,ab,de
38 PERIOSTE?/TI,AB,DE
18526 STIMULAT?/TI,AB,DE
18488 THERAP?/TI,AB,DE
14 NEEDLING/TI,AB,DE
S79 1 PERIOSTE? (3W) (STIMULAT? OR THERAP? OR NEEDLING)/TI,AB,DE

? s s76:s79
S80 89 S76:S79

? s s10 and s80
26 S10
89 S80
S81 0 S10 AND S80

? s massag? or acupressure or shiatsu or shiatzu or zhi (W) ya or chih (W) ya/ti,ab,de
69 MASSAG?
2 ACUPRESSURE
0 SHIATSU
0 SHIATZU
2 ZHI
125 YA
0 ZHI(W)YA
12 CHIH/TI,AB,DE
122 YA/TI,AB,DE
0 CHIH/TI,AB,DE(W)YA/TI,AB,DE
S82 71 MASSAG? OR ACUPRESSURE OR SHIATSU OR SHIATZU OR ZHI (W) YA OR CHIH (W) YA/TI,AB,DE

? s s10 and s82
26 S10
71 S82
S83 0 S10 AND S82

? s rehabilitat? (2W) (program? or protocol?)/ti,ab,de
8675 REHABILITAT?/TI,AB,DE
480068 PROGRAM?/TI,AB,DE
14132 PROTOCOL?/TI,AB,DE
S84 864 REHABILITAT? (2W) (PROGRAM? OR PROTOCOL?)/TI,AB,DE

? s s10 and s84
26 S10
864 S84
S85 1 S10 AND S84

? s watch? (2W) wait? or conservative (2W) treat?/ti,ab,de
2243 WATCH?
2348 WAIT?
18 WATCH?(2W)WAIT?
5006 CONSERVATIVE/TI,AB,DE
132040 TREAT?/TI,AB,DE
28 CONSERVATIVE/TI,AB,DE(2W)TREAT?/TI,AB,DE
S86 46 WATCH? (2W) WAIT? OR CONSERVATIVE (2W) TREAT?/TI,AB,DE

? s s10 and s86
26 S10
46 S86
S87 0 S10 AND S86

? s management (2W) (decision? or option? or choice?)/ti,ab,de
218292 MANAGEMENT/TI,AB,DE
69503 DECISION?/TI,AB,DE
30662 OPTION?/TI,AB,DE
21235 CHOICE?/TI,AB,DE
S88 4609 MANAGEMENT (2W) (DECISION? OR OPTION? OR CHOICE?)/TI,AB,DE

? s s10 and s88
26 S10
4609 S88
S89 0 S10 AND S88

? s s85 or s87 or s89
1 S85
0 S87
0 S89
S90 1 S85 OR S87 OR S89

? s s16 or s20 or s27 or s39 or s45 or s52 or s54 or s58 or s65 or s71 or s75 or s81 or s83 or s90
0 S16
0 S20
3 S27
1 S39
0 S45
0 S52
0 S54
2 S58
1 S65
0 S71
0 S75
0 S81
0 S83
1 S90
S91 8 S16 OR S20 OR S27 OR S39 OR S45 OR S52 OR S54 OR S58 OR S65 OR S71 OR S75 OR S81 OR S83 OR S90

PASCAL

Interface: Dialog Classic
Search date: 30 March 2010
Strategy: as below
Records identified: 631

File 144:Pascal 1973–2010/Mar W1
(c) 2010 INIST/CNRS

? s frozen (6W) shoulder?/ti,ab,de
29523 FROZEN/TI,AB,DE
18440 SHOULDER?/TI,AB,DE
S1 265 FROZEN (6W) SHOULDER?/TI,AB,DE

? s stiff? (3W) shoulder?/ti,ab,de
47795 STIFF?/TI,AB,DE
18440 SHOULDER?/TI,AB,DE
S2 74 STIFF? (3W) SHOULDER?/TI,AB,DE

? s adhesive (W) (capsulitis or capsulitides)/ti,ab,de
31322 ADHESIVE/TI,AB,DE
165 CAPSULITIS/TI,AB,DE
0 CAPSULITIDES/TI,AB,DE
S3 131 ADHESIVE (W) (CAPSULITIS OR CAPSULITIDES)/TI,AB,DE

? s (bursitis or bursitides) (6W) shoulder?/ti,ab,de
673 BURSITIS/TI,AB,DE
1 BURSITIDES/TI,AB,DE
18440 SHOULDER?/TI,AB,DE
S4 38 (BURSITIS OR BURSITIDES) (6W) SHOULDER?/TI,AB,DE

? s (capsulitis or capsulitides) (6W) shoulder?/ti,ab,de
165 CAPSULITIS/TI,AB,DE
0 CAPSULITIDES/TI,AB,DE
18440 SHOULDER?/TI,AB,DE
S5 66 (CAPSULITIS OR CAPSULITIDES) (6W) SHOULDER?/TI,AB,DE

? s (periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or
pericapsulitis) (6W) shoulder?/ti,ab,de
109 PERIARTHRITIS/TI,AB,DE
0 PERI-ARTHRITIS/TI,AB,DE
1 PERIARTHRITIDES/TI,AB,DE
0 PERI-ARTHRITIDES/TI,AB,DE
0 PERI-CAPSULITIS/TI,AB,DE
0 PERICAPSULITIS/TI,AB,DE
18440 SHOULDER?/TI,AB,DE
S6 25 (PERIARTHRITIS OR PERI-ARTHRITIS OR PERIARTHRITIDES OR PERI-
ARTHRITIDES OR PERI-CAPSULITIS OR PERICAPSULITIS) (6W) SHOULDER?/TI,AB,DE

? s shoulder? (3W) (pain or pains or painful or complain?)/ti,ab,de
18440 SHOULDER?/TI,AB,DE
131547 PAIN/TI,AB,DE
1672 PAINS/TI,AB,DE
10410 PAINFUL/TI,AB,DE
19751 COMPLAIN?/TI,AB,DE
S7 1529 SHOULDER? (3W) (PAIN OR PAINS OR PAINFUL OR COMPLAIN?)/TI,AB,DE

? s shoulder? (6W) impinge?/ti,ab,de
18440 SHOULDER?/TI,AB,DE
5891 IMPINGE?/TI,AB,DE
S8 179 SHOULDER? (6W) IMPINGE?/TI,AB,DE

? s subacromial (W) impingement (W) syndrome/ti,ab,de
598 SUBACROMIAL/TI,AB,DE
3975 IMPINGEMENT/TI,AB,DE
394414 SYNDROME/TI,AB,DE

S9 147 SUBACROMIAL (W) IMPINGEMENT (W) SYNDROME/TI,AB,DE

? s s1:s9
S10 2177 S1:S9

? s arthrograph? (6W) (distension? or distention?)/ti,ab,de
2195 ARTHROGRAPH?/TI,AB,DE
5134 DISTENSION?/TI,AB,DE
1532 DISTENTION?/TI,AB,DE
S11 8 ARTHROGRAPH? (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s arthrogram? (6W) (distension? or distention?)/ti,ab,de
228 ARTHROGRAM?/TI,AB,DE
5134 DISTENSION?/TI,AB,DE
1532 DISTENTION?/TI,AB,DE
S12 0 ARTHROGRAM? (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s glenohumeral (6W) (distension? or distention?)/ti,ab,de
1197 GLENOHUMERAL/TI,AB,DE
5134 DISTENSION?/TI,AB,DE
1532 DISTENTION?/TI,AB,DE
S13 1 GLENOHUMERAL (6W) (DISTENSION? OR DISTENTION?)/TI,AB,DE

? s dilatation or hydrodilat?/ti,ab,de
56041 DILATATION
7 HYDRODILAT?/TI,AB,DE
S14 56047 DILATATION OR HYDRODILAT?/TI,AB,DE

? s s11:s14
S15 56055 S11:S14

? s s10 and s15
2177 S10
56055 S15
S16 10 S10 AND S15

? s arthroscop? (6W) (releas? or decompress? or capsulotom?)/ti,ab,de
8274 ARTHROSCOP?/TI,AB,DE
261595 RELEAS?/TI,AB,DE
13807 DECOMPRESS?/TI,AB,DE
1046 CAPSULOTOM?/TI,AB,DE
S17 306 ARTHROSCOP? (6W) (RELEAS? OR DECOMPRESS? OR CAPSULOTOM?)/TI,AB,DE

? s capsular (2W) releas? or interventional (W) microadhesiolysis or capsulotomy/ti,ab,de
6434 CAPSULAR
261595 RELEAS?
92 CAPSULAR(2W)RELEAS?
9302 INTERVENTIONAL
0 MICROADHESIOLYSIS
0 INTERVENTIONAL(W)MICROADHESIOLYSIS
925 CAPSULOTOMY/TI,AB,DE

S18 1012 CAPSULAR (2W) RELEAS? OR INTERVENTIONAL (W) MICROADHESIOLYSIS OR CAPSULOTOMY/TI,AB,DE

? s s17:s18
S19 1264 S17:S18

? s s10 and s19
2177 S10
1264 S19
S20 99 S10 AND S19

? s injection?/ti,ab,de
>>>Term "DE.." is not defined in file 144 and is ignored
S21 225170 INJECTION?/TI,AB,DE..

? s s10 and s21
2177 S10
225170 S21
S22 161 S10 AND S21

? s (bursa? or intrabursa? or intra (W) bursa? or periartic? or peri (W) artic? or intraartic? or intra (W) artic?) (3W) inject?/ti,ab,de
3240 BURSA?/TI,AB,DE
54 INTRABURSA?/TI,AB,DE
66732 INTRA/TI,AB,DE
3240 BURSA?/TI,AB,DE
3 INTRA/TI,AB,DE(W)BURSA?/TI,AB,DE
1029 PERIARTIC?/TI,AB,DE
9053 PERI/TI,AB,DE
705828 ARTIC?/TI,AB,DE
162 PERI/TI,AB,DE(W)ARTIC?/TI,AB,DE
2544 INTRAARTIC?/TI,AB,DE
66732 INTRA/TI,AB,DE
705828 ARTIC?/TI,AB,DE
2857 INTRA/TI,AB,DE(W)ARTIC?/TI,AB,DE
309289 INJECT?/TI,AB,DE
S23 1060 (BURSA? OR INTRABURSA? OR INTRA (W) BURSA? OR PERIARTIC? OR PERI (W) ARTIC? OR INTRAARTIC? OR INTRA (W) ARTIC?) (3W) INJECT?/TI,AB,DE

? s s10 and s23
2177 S10
1060 S23
S24 34 S10 AND S23

? s (subacromial or acromioclavicular or glenohumeral) (3W) inject?/ti,ab,de
598 SUBACROMIAL/TI,AB,DE
667 ACROMIOCLAVICULAR/TI,AB,DE
1197 GLENOHUMERAL/TI,AB,DE
309289 INJECT?/TI,AB,DE
S25 62 (SUBACROMIAL OR ACROMIOCLAVICULAR OR GLENOHUMERAL) (3W) INJECT?/TI,AB,DE

? s (extra (W) articular or extraarticular or shoulder?) (3W) inject?/ti,ab,de
40008 EXTRA/TI,AB,DE
15525 ARTICULAR/TI,AB,DE
608 EXTRA/TI,AB,DE(W)ARTICULAR/TI,AB,DE
321 EXTRAARTICULAR/TI,AB,DE
18440 SHOULDER?/TI,AB,DE
309289 INJECT?/TI,AB,DE
S26 54 (EXTRA (W) ARTICULAR OR EXTRAARTICULAR OR SHOULDER?) (3W) INJECT?/
TI,AB,DE

? s s22 or s24 or s25 or s26
161 S22
34 S24
62 S25
54 S26
S27 229 S22 OR S24 OR S25 OR S26

? s physiotherapy or physiotherapies or physical (W) therap? or manual(W) therap?/ti,ab,de
5062 PHYSIOTHERAPY
2 PHYSIOTHERAPIES
540408 PHYSICAL
661276 THERAP?
1884 PHYSICAL(W)THERAP?
35077 MANUAL/TI,AB,DE
661276 THERAP?/TI,AB,DE
120 MANUAL/TI,AB,DE(W)THERAP?/TI,AB,DE
S28 6839 PHYSIOTHERAPY OR PHYSIOTHERAPIES OR PHYSICAL (W) THERAP? OR
MANUAL(W) THERAP?/TI,AB,DE

? s passive (W) (motion or movement)/ti,ab,de
62904 PASSIVE/TI,AB,DE
175972 MOTION/TI,AB,DE
109985 MOVEMENT/TI,AB,DE
S29 511 PASSIVE (W) (MOTION OR MOVEMENT)/TI,AB,DE

? s CPM/ti,ab,de
S30 2329 CPM/TI,AB,DE

? s (stretching or stretches)/ti,ab,de
18320 STRETCHING/TI,AB,DE
1979 STRETCHES/TI,AB,DE
S31 20093 (STRETCHING OR STRETCHES)/TI,AB,DE

? s (mobilisation or mobilization)/ti,ab,de
10059 MOBILISATION/TI,AB,DE
14519 MOBILIZATION/TI,AB,DE
S32 19880 (MOBILISATION OR MOBILIZATION)/TI,AB,DE

? s exercise? (2W) (program? or strength? or intervention? or training or prescription? or
prescrib?)/ti,ab,de
83485 EXERCISE?/TI,AB,DE
496453 PROGRAM?/TI,AB,DE

289246 STRENGTH?/TI,AB,DE
201443 INTERVENTION?/TI,AB,DE
104948 TRAINING/TI,AB,DE
30046 PRESCRIPTION?/TI,AB,DE
30651 PRESCRIB?/TI,AB,DE
S33 6656 EXERCISE? (2W) (PROGRAM? OR STRENGTH? OR INTERVENTION? OR
TRAINING OR PRESCRIPTION? OR PRESCRIB?)/TI,AB,DE

? s exercise? (2W) (therap? or therapeutic)/ti,ab,de
83485 EXERCISE?/TI,AB,DE
661276 THERAP?/TI,AB,DE
209433 THERAPEUTIC/TI,AB,DE
S34 704 EXERCISE? (2W) (THERAP? OR THERAPEUTIC)/TI,AB,DE

? s (home or supervis?) (2W) exercis?/ti,ab,de
46815 HOME/TI,AB,DE
33017 SUPERVIS?/TI,AB,DE
84078 EXERCIS?/TI,AB,DE
S35 629 (HOME OR SUPERVIS?) (2W) EXERCIS?/TI,AB,DE

? s (pendular or pendulum) (W) exercis?/ti,ab,de
498 PENDULAR/TI,AB,DE
3918 PENDULUM/TI,AB,DE
84078 EXERCIS?/TI,AB,DE
S36 3 (PENDULAR OR PENDULUM) (W) EXERCIS?/TI,AB,DE

? s (isokinetic or resist?) (2W) exercise?/ti,ab,de
2366 ISOKINETIC/TI,AB,DE
709778 RESIST?/TI,AB,DE
83485 EXERCISE?/TI,AB,DE
S37 1273 (ISOKINETIC OR RESIST?) (2W) EXERCISE?/TI,AB,DE

? s s28:s37
S38 57015 S28:S37

? s s10 and s38
2177 S10
57015 S38
S39 186 S10 AND S38

? s chiropractic?/ti,ab,de
S40 289 CHIROPRACTIC?/TI,AB,DE

? s osteopath?/ti,ab,de
S41 20440 OSTEOPATH?/TI,AB,DE

? s manipulat? (3W) (anesthesia or anaesthesia or anesthetic? or anaesthetic? or musculoskeletal)/
ti,ab,de
73206 MANIPULAT?/TI,AB,DE
97112 ANESTHESIA/TI,AB,DE
15154 ANAESTHESIA/TI,AB,DE
37671 ANESTHETIC?/TI,AB,DE

7809 ANAESTHETIC?/TI,AB,DE
7339 MUSCULOSKELETAL/TI,AB,DE
S42 130 MANIPULAT? (3W) (ANESTHESIA OR ANAESTHESIA OR ANESTHETIC? OR
ANAESTHETIC? OR MUSCULOSKELETAL)/TI,AB,DE

? s MUA/ti,ab,de
S43 258 MUA/TI,AB,DE

? s s40:s43
S44 21093 S40:S43

? s s10 and s44
2177 S10
21093 S44
S45 48 S10 AND S44

? s (TENS or ALTENS)/ti,ab,de
9868 TENS/TI,AB,DE
1 ALTENS/TI,AB,DE
S46 9869 (TENS OR ALTENS)/TI,AB,DE

? s electric? (2W) stimulat? or transcutaneous (2W) stimulat? or transdermal (2W)
electrostimulat? or cutaneous (2W) electrostimulat? or electroanalgesia or electro(W)analgesia/
ti,ab,de
640281 ELECTRIC?
347681 STIMULAT?
15569 ELECTRIC?(2W)STIMULAT?
3402 TRANSCUTANEOUS
347681 STIMULAT?
843 TRANSCUTANEOUS(2W)STIMULAT?
4939 TRANSDERMAL
1104 ELECTROSTIMULAT?
6 TRANSDERMAL(2W)ELECTROSTIMULAT?
40793 CUTANEOUS
1104 ELECTROSTIMULAT?
0 CUTANEOUS(2W)ELECTROSTIMULAT?
22 ELECTROANALGESIA
31673 ELECTRO/TI,AB,DE
20137 ANALGESIA/TI,AB,DE
4 ELECTRO/TI,AB,DE(W)ANALGESIA/TI,AB,DE
S47 15738 ELECTRIC? (2W) STIMULAT? OR TRANSCUTANEOUS (2W) STIMULAT?
OR TRANSDERMAL (2W) ELECTROSTIMULAT? OR CUTANEOUS (2W)
ELECTROSTIMULAT? OR ELECTROANALGESIA OR ELECTRO(W)ANALGESIA/TI,AB,DE

? s muscle (2W) stimulat?/ti,ab,de
248852 MUSCLE/TI,AB,DE
347681 STIMULAT?/TI,AB,DE
S48 1748 MUSCLE (2W) STIMULAT?/TI,AB,DE

? s neuromodulation or neuro (W) modulation or neurostimulation or neuro (W) stimulation/
ti,ab,de
1804 NEUROMODULATION

11977 NEURO
134029 MODULATION
11 NEURO(W)MODULATION
428 NEUROSTIMULATION
11977 NEURO/TI,AB,DE
187063 STIMULATION/TI,AB,DE
17 NEURO/TI,AB,DE(W)STIMULATION/TI,AB,DE
S49 2211 NEUROMODULATION OR NEURO (W) MODULATION OR
NEUROSTIMULATION OR NEURO (W) STIMULATION/TI,AB,DE

? s interferential/ti,ab,de
S50 264 INTERFERENTIAL/TI,AB,DE

? s s46:s50
S51 28886 S46:S50

? s s10 and s51
2177 S10
28886 S51
S52 26 S10 AND S51

? s biofeedback/ti,ab,de
S53 2966 BIOFEEDBACK/TI,AB,DE

? s s10 and s53
2177 S10
2966 S53
S54 0 S10 AND S53

? s (cold or ice or heat or hot) (W) (pack? or therap? or treat?)/ti,ab,de
95776 COLD/TI,AB,DE
45475 ICE/TI,AB,DE
392650 HEAT/TI,AB,DE
106420 HOT/TI,AB,DE
138939 PACK?/TI,AB,DE
661276 THERAP?/TI,AB,DE
1969126 TREAT?/TI,AB,DE
S55 87567 (COLD OR ICE OR HEAT OR HOT) (W) (PACK? OR THERAP? OR TREAT?)/
TI,AB,DE

? s thermograph? or thermotherap? or thermo (W) therap? or hypertherm? or hyper (W) therm?
or diatherm? or cryotherap? or cryo(W) therap?/ti,ab,de
7907 THERMOGRAPH?
1946 THERMOTHERAP?
16853 THERMO
661276 THERAP?
20 THERMO(W)THERAP?
15178 HYPERTHERM?
9780 HYPER
1038992 THERM?
48 HYPER(W)THERM?
1188 DIATHERM?

2472 CRYOTHERAP?
2537 CRYO/TI,AB,DE
661276 THERAP?/TI,AB,DE
5 CRYO/TI,AB,DE(W)THERAP?/TI,AB,DE
S56 27977 THERMOGRAPH? OR THERMOTHERAP? OR THERMO (W) THERAP? OR
HYPERTHERM? OR HYPER (W) THERM? OR DIATHERM? OR CRYOTHERAP? OR
CRYO(W) THERAP?/TI,AB,DE

? s s55:s56
S57 115050 S55:S56

? s s10 and s57
2177 S10
115050 S57
S58 6 S10 AND S57

? s laser (W) therapy/ti,ab,de
317814 LASER/TI,AB,DE
401563 THERAPY/TI,AB,DE
S59 1412 LASER (W) THERAPY/TI,AB,DE

? s ultrasonic (W) therapy/ti,ab,de
65537 ULTRASONIC/TI,AB,DE
401563 THERAPY/TI,AB,DE
S60 19 ULTRASONIC (W) THERAPY/TI,AB,DE

? s ultrasound/ti,ab,de
S61 87233 ULTRASOUND/TI,AB,DE

? s ultrasonography/ti,ab,de
S62 26006 ULTRASONOGRAPHY/TI,AB,DE

? s electrotherapeutic (W) (intervention? or treat?)/ti,ab,de
17 ELECTROTHERAPEUTIC/TI,AB,DE
201443 INTERVENTION?/TI,AB,DE
1969126 TREAT?/TI,AB,DE
S63 3 ELECTROTHERAPEUTIC (W) (INTERVENTION? OR TREAT?)/TI,AB,DE

? s s59:s63
S64 107999 S59:S63

? s s10 and s64
2177 S10
107999 S64
S65 92 S10 AND S64

? s pulsed (W) electromagnetic (W) field (W) therapy/ti,ab,de
67481 PULSED/TI,AB,DE
103327 ELECTROMAGNETIC/TI,AB,DE
810883 FIELD/TI,AB,DE
401563 THERAPY/TI,AB,DE
S66 7 PULSED (W) ELECTROMAGNETIC (W) FIELD (W) THERAPY/TI,AB,DE

? s (electromagnetic? or magnetic?) (3W) field?/ti,ab,de
105704 ELECTROMAGNETIC?/TI,AB,DE
508832 MAGNETIC?/TI,AB,DE
896260 FIELD?/TI,AB,DE
S67 167375 (ELECTROMAGNETIC? OR MAGNETIC?) (3W) FIELD?/TI,AB,DE

? s biomagnetic? or bio (W) magnetic? or pulsed signal/ti,ab,de
304 BIOMAGNETIC?
16712 BIO
508832 MAGNETIC?
10 BIO(W)MAGNETIC?
0 PULSED SIGNAL/TI,AB,DE
S68 314 BIOMAGNETIC? OR BIO (W) MAGNETIC? OR PULSED SIGNAL/TI,AB,DE

? s PEMF/ti,ab,de
S69 62 PEMF/TI,AB,DE

? s s66:s69
S70 167554 S66:S69

? s s10 and s70
2177 S10
167554 S70
S71 2 S10 AND S70

? s neuromuscular (W) blockade/ti,ab,de
26402 NEUROMUSCULAR/TI,AB,DE
30108 BLOCKADE/TI,AB,DE
S72 1096 NEUROMUSCULAR (W) BLOCKADE/TI,AB,DE

? s nerve (2W) block?/ti,ab,de
126557 NERVE/TI,AB,DE
266755 BLOCK?/TI,AB,DE
S73 2152 NERVE (2W) BLOCK?/TI,AB,DE

? s s72:s73
S74 3241 S72:S73

? s s10 and s74
2177 S10
3241 S74
S75 23 S10 AND S74

? s acupuncture?/ti,ab,de
S76 4547 ACUPUNCTURE?/TI,AB,DE

? s electroacupuncture? or electro (W) acupuncture?/ti,ab,de
699 ELECTROACUPUNCTURE?
31673 ELECTRO/TI,AB,DE
4547 ACUPUNCTURE?/TI,AB,DE
160 ELECTRO/TI,AB,DE(W)ACUPUNCTURE?/TI,AB,DE
S77 768 ELECTROACUPUNCTURE? OR ELECTRO (W) ACUPUNCTURE?/TI,AB,DE

? s osteopuncture? or osteo (W) puncture?/ti,ab,de
1 OSTEOPUNCTURE?
2078 OSTEO/TI,AB,DE
11990 PUNCTURE?/TI,AB,DE
0 OSTEO/TI,AB,DE(W)PUNCTURE?/TI,AB,DE
S78 1 OSTEOPUNCTURE? OR OSTEO (W) PUNCTURE?/TI,AB,DE

? s perioste? (3W) (stimulat? or therap? or needling)/ti,ab,de
3737 PERIOSTE?/TI,AB,DE
347681 STIMULAT?/TI,AB,DE
661276 THERAP?/TI,AB,DE
240 NEEDLING/TI,AB,DE
S79 19 PERIOSTE? (3W) (STIMULAT? OR THERAP? OR NEEDLING)/TI,AB,DE

? s s76:s79
S80 4792 S76:S79

? s s10 and s80
2177 S10
4792 S80
S81 23 S10 AND S80

? s massag? or acupressure or shiatsu or shiatzu or zhi (W) ya or chih (W) ya/ti,ab,de
2665 MASSAG?
92 ACUPRESSURE
18 SHIATSU
0 SHIATZU
97 ZHI
1802 YA
0 ZHI(W)YA
36 CHIH/TI,AB,DE
1802 YA/TI,AB,DE
0 CHIH/TI,AB,DE(W)YA/TI,AB,DE
S82 2754 MASSAG? OR ACUPRESSURE OR SHIATSU OR SHIATZU OR ZHI (W) YA OR
CHIH (W) YA/TI,AB,DE

? s s10 and s82
2177 S10
2754 S82
S83 6 S10 AND S82

? s rehabilitat? (2W) (program? or protocol?)/ti,ab,de
42771 REHABILITAT?/TI,AB,DE
496453 PROGRAM?/TI,AB,DE
137423 PROTOCOL?/TI,AB,DE
S84 2831 REHABILITAT? (2W) (PROGRAM? OR PROTOCOL?)/TI,AB,DE

? s s10 and s84
2177 S10
2831 S84
S85 22 S10 AND S84

? s watch? (2W) wait? or conservative (2W) treat?/ti,ab,de
5496 WATCH?
15532 WAIT?
579 WATCH?(2W)WAIT?
29616 CONSERVATIVE/TI,AB,DE
1969126 TREAT?/TI,AB,DE
5597 CONSERVATIVE/TI,AB,DE(2W)TREAT?/TI,AB,DE
S86 6168 WATCH? (2W) WAIT? OR CONSERVATIVE (2W) TREAT?/TI,AB,DE

? s s10 and s86
2177 S10
6168 S86
S87 36 S10 AND S86

? s management (2W) (decision? or option? or choice?)/ti,ab,de
441599 MANAGEMENT/TI,AB,DE
154755 DECISION?/TI,AB,DE
66900 OPTION?/TI,AB,DE
104349 CHOICE?/TI,AB,DE
S88 7785 MANAGEMENT (2W) (DECISION? OR OPTION? OR CHOICE?)/TI,AB,DE

? s s10 and s88
2177 S10
7785 S88
S89 1 S10 AND S88

? s s85 or s87 or s89
22 S85
36 S87
1 S89
S90 58 S85 OR S87 OR S89

? s s16 or s20 or s27 or s39 or s45 or s52 or s54 or s58 or s65 or s71 or s75 or s81 or s83 or s90
10 S16
99 S20
229 S27
186 S39
48 S45
26 S52
0 S54
6 S58
92 S65
2 S71
23 S75
23 S81
6 S83
58 S90
S91 631 S16 OR S20 OR S27 OR S39 OR S45 OR S52 OR S54 OR S58 OR S65 OR S71 OR S75 OR S81 OR S83 OR S90

Physiotherapy Evidence Database (PEDro)

Interface: http://www.pedro.org.au/
Search date: 19 April 2010
Strategy: The database interface does not allow sophisticated searches to be undertaken so a broad search was carried out using the advanced search option. The body part 'upper arm, shoulder or shoulder girdle' was selected from the dropdown list provided and all the records identified from this search were downloaded.
Records identified: 718

PREMEDLINE

Interface: OvidSP
Search date: 25 March 2010
Strategy: as below
Records identified: 82

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <March 24, 2010>

1. (frozen adj6 shoulder$).ti,ab. (22)
2. (stiff$adj3 shoulder$).ti,ab. (16)
3. (adhesive adj (capsulitis or capsulitides)).ti,ab. (19)
4. ((bursitis or bursitides) adj6 shoulder$).ti,ab. (0)
5. ((capsulitis or capsulitides) adj6 shoulder$).ti,ab. (9)
6. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ti,ab. (7)
7. (shoulder$adj3 (pain or pains or painful or complain$)).ti,ab. (191)
8. (shoulder$adj6 impinge$).ti,ab. (23)
9. subacromial impingement syndrome.ti,ab. (11)
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 (245)
11. (arthrograph$adj6 (distension$or distention$)).ti,ab. (1)
12. (arthrogram$adj6 (distension$or distention$)).ti,ab. (0)
13. (glenohumeral adj6 (distension$or distention$)).ti,ab. (0)
14. (dilatation or hydrodilat$).ti,ab. (780)
15. (arthroscop$adj6 (releas$or decompress$or capsulotom$)).ti,ab. (25)
16. ((capsular adj2 releas$) or interventional microadhesiolysis or capsulotomy).ti,ab. (43)
17. ((bursa$or intrabursa$or intra bursa$or periartic$or peri artic$or intraartic$or intra artic$) adj3 inject$).ti,ab. (92)
18. ((subacromial or acromioclavicular or glenohumeral) adj3 inject$).ti,ab. (8)
19. ((extra articular or extraarticular or shoulder$) adj3 inject$).ti,ab. (1)
20. (physiotherapy or physiotherapies or physical therap$or manual therap$).ti,ab. (929)
21. (passive adj (motion or movement)).ti,ab. (51)
22. CPM.ti,ab. (129)
23. (stretching or stretches).ti,ab. (2719)
24. (mobilisation or mobilization).ti,ab. (806)
25. (exercise$adj2 (program$or strength$or intervention$or training or prescription$or prescrib$)).ti,ab. (641)

26. (exercise$adj2 (therap$or therapeutic)).ti,ab. (112)
27. ((home or supervis$) adj2 exercis$).ti,ab. (89)
28. ((pendular or pendulum) adj exercis$).ti,ab. (1)
29. ((isokinetic or resist$) adj2 exercise$).ti,ab. (126)
30. chiropractic$.ti,ab. (454)
31. osteopath$.ti,ab. (136)
32. (manipulat$adj3 (anesthesia or anaesthesia or anesthetic$or anaesthetic$)).ti,ab. (13)
33. MUA.ti,ab. (75)
34. (TENS or ALTENS).ti,ab. (1018)
35. ((electric$adj2 stimulat$) or (transcutaneous adj2 stimulat$) or (transdermal adj2 electrostimulat$) or (cutaneous adj2 electrostimulat$) or electroanalgesia or electro analgesia).ti,ab. (759)
36. (muscle adj2 stimulat$).ti,ab. (93)
37. (neuromodulation or neuro modulation or neurostimulation or neuro stimulation).ti,ab. (93)
38. interferential.ti,ab. (41)
39. biofeedback.ti,ab. (119)
40. ((cold or ice or heat or hot) adj (pack$or therap$or treat$)).ti,ab. (661)
41. (thermograph$or thermotherap$or thermo therap$or hypertherm$or hyper therm$or diatherm$or cryotherap$or cryo therap$).ti,ab. (821)
42. ((laser or ultrasonic) adj2 (therap$or treat$)).ti,ab. (384)
43. ultrasound.ti,ab. (4964)
44. (electrotherapeutic adj (intervention$or treat$)).ti,ab. (2)
45. pulsed electromagnetic field therapy.ti,ab. (1)
46. ((electromagnetic$or magnetic$) adj3 field$).ti,ab. (6171)
47. (biomagnetic$or bio magnetic$or pulsed signal).ti,ab. (29)
48. PEMF.ti,ab. (9)
49. (nerve adj2 block$).ti,ab. (233)
50. neuromuscular block$.ti,ab. (117)
51. acupuncture$.ti,ab. (676)
52. (electroacupuncture$or electro acupuncture$).ti,ab. (130)
53. (osteopuncture$or osteo puncture$).ti,ab. (0)
54. (perioste$adj3 (stimulat$or therap$or needling)).ti,ab. (4)
55. (massag$or acupressure or shiatsu or shiatzu or zhi ya or chih ya).ti,ab. (223)
56. (rehabilitat$adj2 (program$or protocol$)).ti,ab. (373)
57. ((watch$adj2 wait$) or (conservative adj2 treat$)).ti,ab. (690)
58. (management adj2 (decision$or option$or choice$)).ti,ab. (328)
59. or/11–58 (23503)
60. 10 and 59 (82)
61. limit 60 to yr="1966 -Current" (82)
62. from 61 keep 1–82 (82)
63. from 62 keep 1–82 (82)

Science Citation Index

Interface: Web of Science (ISI) via Web of Knowledge
Search date: 30 March 2010
Strategy: as below
Records identified: 3140

# 20	3140	#19 OR #17 OR #15 OR #13 OR #11 OR #9 OR #5 OR #3
		Timespan=All Years
# 19	729	#18 AND #1
		Timespan=All Years
# 18	>100,000	Topic=("nerve block") OR Topic=("neuromuscular blockade") OR Topic=(acupuncture) OR Topic=(electroacupuncture or "electro acupuncture") OR Topic=(osteopuncture or "osteo puncture") OR Topic=("perioste* stimulat*" or "perioste* therap*" or "perioste* needling") OR Topic=(massag* or acupressure or shiatsu or shiatzu or "zhi ya" or "chih ya") OR Topic=("rehabilitat* program*" or "rehabilitat* protocol*") OR Topic=("watch* wait*" or "conservative treat*") OR Topic=("management decision*" or "management option*" or "management choice*")
		Timespan=All Years
# 17	221	#16 AND #1
		Timespan=All Years
# 16	>100,000	Topic=(biofeedback) OR Topic=(thermograph* or thermotherap* or "thermo therap*" or hypertherm* or "hyper therm*" or diatherm* or cryotherap* or "cryo therap*") OR Topic=("cold pack*" or "cold therap*" or "cold treat*" or "ice pack*" or "ice therap*" or "ice treat*" or "heat pack*" or "heat therap*" or "heat treat*" or "hot pack*" or "heat therap*") OR Topic=("Laser Therapy" or "ultrasonic therapy" or "Interventional ultrasonography") OR Topic=("electrotherapeutic intervention*" or "electrotherapeutic treat*") OR Topic=("magnetic field therapy") OR Topic=("electromagnetic field therapy") OR Topic=("Biomagnetic therapy")
		Timespan=All Years
# 15	162	#14 AND #1
		Timespan=All Years
# 14	>100,000	Topic=(TENS or ALTENS) OR Topic=("electric* stimulat*" or "transcutaneous stimulat*"or "transdermal electrostimulat*"or "cutaneous electrostimulat*"or electroanalgesia or "electro analgesia") OR Topic=("muscle stimulat*") OR Topic=(neuromodulation or "neuro modulation" or neurostimulation or "neuro stimulation") OR Topic=(interferential)
		Timespan=All Years
# 13	184	#12 AND #1
		Timespan=All Years
# 12	19,962	Topic=(chiropractic*) OR Topic=(osteopath*) OR Topic=(manipulat* and (anesthesia or anaesthesia or anesthetic* or anaesthetic*)) OR Topic=(MUA)
		Timespan=All Years
# 11	1502	#10 AND #1
		Timespan=All Years
# 10	>100,000	Topic=(physiotherapy or physiotherapies or "physical therap*" or "manual therap*") OR Topic=("passive motion" or "passive movement") OR Topic=("muscle stretching" or "muscle stretches" or "muscle stretch") OR Topic=(mobilisation or mobilization) OR Topic=("exercis* program*" or "exercis* intervention*" or "exercis* train*" or "exercis* prescription*" or "exercis* prescrib*") OR Topic=("exercis* therap*" or "therapeutic exercis*") OR Topic=("home exercis*" or "supervis* exercis*") OR Topic=("pendular exercis*" or "pendulum exercis*") OR Topic=("isokinetic exercis*" or "resist* exercise*")
		Timespan=All Years
# 9	609	#8 OR #7
		Timespan=All Years
# 8	121	Topic=("subacromial inject*" or "acromioclavicular inject*" or "glenohumeral inject*") OR Topic=("extra articular inject*" or "extraarticular inject*") OR Topic=("shoulder* inject*")
		Timespan=All Years
# 7	533	#6 AND #1
		Timespan=All Years

# 6	>100,000	Topic=(injections) OR Topic=("intraarticular injection*" or "intra-articular injection*" or "intra articular injection*") OR Topic=("bursa* inject*" or "intrabursa* inject*" or "intra bursa* inject*" or "periartic* inject*" or "peri artic* inject*")
		Timespan=All Years
# 5	800	#4 AND #1
		Timespan=All Years
# 4	20,598	Topic=(Arthroscopy) OR Topic=("arthroscop* releas*" or "arthroscop* decompress*" or "arthroscop* capsulotom*") OR Topic=("capsular releas*" or "interventional microadhesiolysis" or capsulotomy)
		Timespan=All Years
# 3	12	#2 AND #1
		Timespan=All Years
# 2	67	Topic=("arthrograph* distension*" or "arthograph* disten") OR Topic=("arthrogram* distension*" or "arthogram* distention*") OR Topic=("glenohumeral distension*" or "glenohumeral distention*") OR Topic=(arthography)
		Timespan=All Years
# 1	8973	Topic=("frozen shoulder*") OR Topic=("stiff* shoulder*") OR Topic=("adhesive capsulitis") OR Topic=("shoulder bursitis") OR Topic=(periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) OR Topic=("shoulder pain*" or "pain* shoulder" or "shoulder complaint*") OR Topic=("shoulder* impinge*") OR Topic=("subacromial impingement syndrome")
		Timespan=All Years

Additional quality of life search strategy for information to inform the decision-analytic model

Database: Ovid MEDLINE(R) <1950 to October Week 4 2010>

1. (sf36 or sf 36).tw. (9054)
2. (eq5d or eq 5d or euroqol or euro qol).tw. (2024)
3. (short form 36 or shortform 36 or sf thirtysix or sf thirty six or shortform thirtysix or shortform thirty six or short form thirtysix or short form thirty six).tw. (4194)
4. (hrql or hrqol or h qol or hql or hqol).tw. (5810)
5. (hye or hyes or health$year$equivalent$or health utilit$).tw. (733)
6. health related quality of life.tw. (13228)
7. rosser.tw. (67)
8. (standard gamble$or time trade off or time tradeoff or tto or willingness to pay).tw. (2460)
9. (disutilities or disutility or daly or disability adjusted life).tw. (1022)
10. "Quality of Life"/(87323)
11. health status indicators/(15760)
12. quality adjusted life year/(4741)
13. (qaly$or quality adjusted life or quality of life or life quality).tw. (98027)
14. qwb$.tw. (157)
15. (quality of wellbeing or quality of well being).tw. (275)
16. factor analysis.tw. (15866)
17. preference based.tw. (418)
18. health status.tw. (27567)
19. (state adj2 (value or values or valuing or valued)).tw. (1507)
20. hspv.tw. (2)
21. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 (185879)
22. "VAS 0–100mm".mp. (4)
23. "VAS 0–10cm".mp. (1)
24. (VAS and pain).mp. (7387)
25. 10 point numeric scale.mp. (5)

26. "4 point category rating scale".mp. (0)
27. Category rating scale.mp. (24)
28. Likert scale 0–10.mp. (2)
29. (likert scale and pain).mp. (295)
30. SPADI 5-item pain subscale.mp. (0)
31. SPADI.mp. (76)
32. 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 (7739)
33. 21 and 32 (1173)
34. American Shoulder & Elbow Surgeons score.mp. (2)
35. Constant score.mp. (869)
36. Flexilevel Scale of Shoulder Function.mp. (6)
37. Oxford shoulder scale.mp. (1)
38. Problem Elicitation Technique score.mp. (1)
39. Shoulder Disability score.mp. (1)
40. SPADI total score.mp. (3)
41. UCLA shoulder score.mp. (24)
42. Shoulder Disability Questionnaire.mp. (28)
43. Croft score.mp. (1)
44. DASH score.mp. (420)
45. (shoulder and Telephone questionnaire).mp. (4)
46. 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 (1313)
47. 21 and 46 (131)
48. 33 or 47 (1282)

Appendix 2

Search strategy for review of views of people with frozen shoulder

Three databases (CINAHL, MEDLINE and PsycINFO) were searched to identify qualitative studies, with searches being restricted to English-language studies published from 1980 onwards. The search strategies used are given in full below.

Cumulative Index to Nursing and Allied Health Literature (CINAHL)

Interface: EBSCO
Search date: 3 June 2010, date coverage 1980–2010
Strategy: as below
Records identified: 311

S24	(S21 and S22 and S23)
S23	(ZR "1980") or (ZR "1981") or (ZR "1982") or (ZR "1983") or (ZR "1984") or (ZR "1985") or (ZR "1986") or (ZR "1987") or (ZR "1988") or (ZR "1989") or (ZR "1990") or (ZR "1991") or (ZR "1992") or (ZR "1993") or (ZR "1994") or (ZR "1995") or (ZR "1996") or (ZR "1997") or (ZR "1998") or (ZR "1999") or (ZR "2000") or (ZR "2001") or (ZR "2002") or (ZR "2003") or (ZR "2004") or (ZR "2005") or (ZR "2006") or (ZR "2007") or (ZR "2008") or (ZR "2009") or (ZR "2010")
S22	(ZL "english")
S21	(S15 or S16 or S17 or S18 or S19) and (S14)
S20	S15 or S16 or S17 or S18 or S19
S19	TX qualitative
S18	(ZU "interviews")
S17	TX interview*
S16	TX findings
S15	TX findings
S14	S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13
S13	subacromial impingement syndrome
S12	shoulder* N6 impinge*
S11	(MH "Shoulder Impingement Syndrome")
S10	shoulder* N3 pain or shoulder* N3 pains or shoulder* N3 painful or shoulder* N3 complain*
S9	(MH "Shoulder Pain")
S8	periarthritis N6 shoulder* or peri-arthritis N6 shoulder* or periarthritides N6 shoulder* or peri-arthritides N6 shoulder* or pericapsulitis N6 shoulder* or peri-capsulitis N6 shoulder*
S7	capsulitis N6 shoulder*
S6	bursitides N6 shoulder*
S5	bursitis N6 shoulder*
S4	adhesive N3 capsulitis
S3	(MH "Adhesive Capsulitis")
S2	stiff* N3 shoulder*
S1	frozen N6 shoulder*

MEDLINE

Interface: OvidSP
Search date: 3 June 2010
Strategy: as below
Records identified: 915

Database: Ovid MEDLINE(R) <1950 to May Week 4 2010>

1. (frozen adj6 shoulder$).ti,ab. (599)
2. (stiff$adj3 shoulder$).ti,ab. (361)
3. exp bursitis/(3130)
4. (adhesive adj (capsulitis or capsulitides)).ti,ab. (336)
5. ((bursitis or bursitides) adj6 shoulder$).ti,ab. (65)
6. ((capsulitis or capsulitides) adj6 shoulder$).ti,ab. (195)
7. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ti,ab. (176)
8. shoulder pain/(1861)
9. (shoulder$adj3 (pain or pains or painful or complain$)).ti,ab. (4029)
10. Shoulder Impingement Syndrome/(953)
11. (shoulder$adj6 impinge$).ti,ab. (505)
12. subacromial impingement syndrome.ti,ab. (117)
13. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 (9213)
14. findings.af. (930557)
15. interview$.af. (174135)
16. Interview/(20706)
17. qualitative.af. (81067)
18. 14 or 15 or 16 or 17 (1132990)
19. 13 and 18 (1085)
20. limit 19 to english language (928)
21. limit 20 to yr="1980 -Current" (915)

PsycINFO

Interface: OvidSP
Search date: 3 June 2011
Strategy: as below
Records identified: 79

Database: PsycINFO <1967 to May Week 4 2010>

1. (frozen adj6 shoulder$).ti,ab. (6)
2. (stiff$adj3 shoulder$).ti,ab. (22)
3. (adhesive adj (capsulitis or capsulitides)).ti,ab. (2)
4. ((bursitis or bursitides) adj6 shoulder$).ti,ab. (2)
5. ((capsulitis or capsulitides) adj6 shoulder$).ti,ab. (2)
6. ((periarthritis or peri-arthritis or periarthritides or peri-arthritides or peri-capsulitis or pericapsulitis) adj6 shoulder$).ti,ab. (0)
7. (shoulder$adj3 (pain or pains or painful or complain$)).ti,ab. (234)
8. (shoulder$adj6 impinge$).ti,ab. (7)
9. subacromial impingement syndrome.ti,ab. (1)

10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 (263)
11. findings.af. (407232)
12. interview$.af. (228353)
13. interviews/(4877)
14. qualitative.af. (117407)
15. 11 or 12 or 13 or 14 (613112)
16. 10 and 15 (81)
17. limit 16 to (english language and yr="1980 -Current") (79)
18. from 17 keep 1–79 (79)

Appendix 3

R code for standard deviation

```
M <- 10000000
N <- 15
omean <- 3.47

thesds <- rep(–1, 100000)
j <- 1

for (i in 1:M){
x <- sample(0:5, N, replace=T)
mu <- mean(x)
if(signif(mu, 3) == omean){
thesds[j] <- sd(x)
j <- j + 1
}
}

thesds <- thesds[thesds != –1]
mean(thesds)
```

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