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Clinical Practice Guidelines for the Management of Rotator Cuff Syndrome in the Workplace

Technical Report

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The University of New South Wales, Medicine,
Rural Clinical School, Port Macquarie Campus

2013

RACGP

The Royal Australian and New Zealand College of Radiologists

AUSTRALIAN PHYSIOTHERAPY ASSOCIATION

Australian Rheumatology Association

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Report prepared by: Lukersmith & Associates Pty Ltd
Editors: Dr Lee Krahe, Louise Scahill - WordFix, Kris Vine
Designers: Melinda Jenner and Eva Wong, Print Post Plus (P3) Design Studio

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Research Team: Kate Hopman[2], Lee Krahe[1], Sue Lukersmith[2], Alexander McColl[1], Kris Vine[1].
1 The University of New South Wales, Medicine, Rural Clinical School, Port Macquarie Campus
2 Lukersmith & Associates Pty Ltd

Contents

Executive Summary

In developed countries, managing rotator cuff syndrome in the workplace presents significant challenges for health care providers and industry employers. Rotator cuff syndrome can substantially affect a person's health and functioning with pain and/or weakness arising from the injury often restricting a person's ability to carry out their daily activities and to work. Rotator cuff syndrome frequently results in lost productivity and significant financial costs for industry and employers. It is therefore imperative that appropriate evidence-based management of rotator cuff syndrome is adopted to enhance functioning and minimise negative outcomes for affected individuals, their families and the workplace.

The guidelines have been developed using a rigorous methodology for searching, appraising and grading evidence. Recommendations have been developed using research evidence in conjunction with a multidisciplinary working party. Flowcharts and resources have been developed to support the use of the guidelines. Resources include: assessment and review flowcharts, rotator cuff syndrome information sheet (for injured workers) and return to work (RTW) guides for employers and GPs.

The guidelines are applicable to GPs, medical specialists and other health care providers involved in the treatment of people with rotator cuff syndrome, including physiotherapists, occupational therapists, psychologists, ergonomists, chiropractors and osteopaths. The guidelines can also be used by the injured worker and workplace-based employees involved in coordinating and supporting the RTW for injured workers with rotator cuff syndrome.

1.0 Purpose

The guidelines have been developed to provide recommendations on the best practice management of rotator cuff syndrome in the workplace for adults (18–65 years). The guidelines specifically examine degenerative rotator cuff syndrome in adults (18–65 years) which has occurred following the performance of work tasks. In the guidelines the diagnoses of shoulder impingement syndrome (SIS), subacromial impingement syndrome (SAIS), subacromial bursitis, rotator cuff tendonitis and rotator cuff tears (partial or full-thickness) have been included. A complete list of International Classification of Diseases (ICD) 9 and 10 codes for the conditions included in the guidelines can be found in Appendix 1 of the *Clinical Practice Guidelines for the Management of Rotator Cuff Syndrome in the Workplace.*

The guidelines do not examine acute rotator cuff syndrome related to a major traumatic event or the diagnoses of osteoarthritis of the glenohumeral joint or acromioclavicular joint, subluxation or dislocation of the aforementioned joints, adhesive capsulitis (frozen shoulder) or fractures.

The guidelines are intended to assist medical practitioners, health care providers, employers and injured workers to make informed decisions with consideration of the injured worker's personal and environmental contexts to optimise recovery and functioning. The guidelines intend to inform and guide, but do not replace clinical reasoning or clinical judgment. Adopting best practice methods for the diagnosis and management of rotator cuff syndrome, including management at the workplace, will assist the injured worker to recover, promote minimal disruption to the injured worker's activities and participation, and reduce the potential for longer term disability.

1.1 Intended Users

The intended users of these guidelines are:

- health care providers
  - general practitioners
  - medical specialists
  - health practitioners involved in the treatment of people with rotator cuff syndrome such as physiotherapists, occupational therapists, psychologists, ergonomists, chiropractors, osteopaths
- workplace-based employees and workers compensation insurers involved in coordinating and supporting the return to work of injured workers with rotator cuff syndrome
- OHS professionals involved in musculoskeletal injury prevention such as ergonomists

2.0 Development Process

2.1 Working Party

A working party consisting of general practitioners, medical specialists, allied health care providers, consumer representatives and researchers developed the guidelines. Details of working party members can be found in Appendix 1. Experienced guideline development consultants from Lukersmith and Associates were contracted to assist and facilitate the search for and collation of evidence, the appraisal and presentation of evidence, and technical writing. The working party identified 35 clinical questions of concern to health care providers, injured workers and employers regarding the management of rotator cuff syndrome (see Appendix 2). The guidelines have been developed on the basis of these questions. Working party meetings were held once a month for 11 months.

2.2 Guideline Development Process

The guideline development process is outlined in Table 1 below.

Table 1: Guideline Development Process

Phase of guideline development process	Activity
Define the topic/issue for the guidelines	Essential Energy identifies rotator cuff syndrome in the workplace as a priority for their organisation. They have observed variation in current diagnosis and management of rotator cuff syndrome and in collaboration with the University of New South Wales, Rural Clinical School, Port Macquarie Campus (UNSW) develop a project plan. *Objective*: To devise evidence-based guidelines with best practice recommendations for the management of rotator cuff syndrome in the workplace.
Prepare the work plan – establish procedures and timeframes; form the guideline development group/ multidisciplinary working party	▪ Develop project brief including the scope of the guidelines, potential users, working party membership, projected timeframes, and contract with guideline consultants. ▪ Establish working party with representation from key stakeholders. Working party agrees on guideline development processes and meeting dates. Conflict of interest declarations completed by all working party members. ▪ Initial contact made with professional associations discussing process for endorsement of guidelines (The Royal Australian College of General Practitioners, Royal Australasian College of Surgeons, The Royal Australasian College of Physicians, Occupational Therapy Australia, and the Australian Physiotherapy Association).
Scoping/develop clinical questions	The working party collaboratively identifies the key clinical areas and topics within the proposed scope of the project. Location and review of relevant existing Australian and International guidelines. Appraisal of these guidelines using the Appraisal of Guidelines for Research and Evaluation (AGREE II) tool[32]. Identification of clinical areas, which have already been adequately answered in existing guidelines. Formulation of clinical questions using PICO format (patient, intervention, comparison, outcome) to ensure that questions are specific enough to complete a literature search. Potential clinical questions are presented, discussed and developed in the first and second working party meetings and periodic email contact.
Development phase	▪ search of the literature ▪ appraisal (two appraisers) of the research literature and grading of the strength of the evidence ▪ discussion of the evidence and development of best practice recommendations with the working party. Grading of the evidence in accordance with the National Health and Medical Research Council (NHMRC) grades and matrix for recommendations[143] ▪ discussion with the working party, where there was limited literature available, to reach a consensus decision and recommendation ▪ consumer involvement in the development of the rotator cuff syndrome information sheet (for injured workers) ▪ writing of draft document, reviewed by working party members ▪ editing of draft.
Validation phase	Public consultation and external peer review provides an opportunity for feedback on the draft. Formal endorsement by key stakeholder organisations as appropriate.
Publication and dissemination	The following strategies are developed to disseminate the guidelines: ▪ A summary of the guideline will be submitted for publication in a relevant, peer-reviewed journal (e.g. Scandinavian Journal of Work, Environment & Health or the Journal of Evaluation in Clinical Practice). ▪ The completed guidelines and resource material will be posted on the UNSW website. ▪ Published copies of the guidelines will be circulated to key organisations for dissemination to their members. ▪ Published copies will be forwarded to all members of the working party, expert advisory panel and public peer reviewers. ▪ Guidelines will be presented at relevant conferences and/or meetings of professional associations.
Evaluation	To be determined at a future date after implementation.

Adapted from the *Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury*, 2011[57].

2.3 Framework

The guidelines are informed by the International Classification of Functioning (ICF) framework for functioning, disability and health[214], and the principles of patient-centred care and shared decision-making. A bio-psychosocial model which incorporates a focus on early return to work is likely to result in better vocational outcomes for persons with shoulder pain[183]. As this approach requires consideration of everything that influences health, beyond the individual's injury, it requires the active involvement of all key stakeholders working as a team to facilitate recovery. The team includes the health care provider/s, the injured worker with rotator cuff syndrome, and key people at the workplace.

2.4 Funding

The funding body for this project, Essential Energy, has not been involved at any stage in the guideline development process and method, including the writing, editing and review of the guidelines. As the guidelines were developed in complete isolation of the funding body, their views or interests have not influenced the recommendations or the guidelines.

2.5 Conflict of Interest

All individuals whose names appear as authors or contributors to these clinical practice guidelines provided full written disclosure of any real or perceived conflict of interest prior to participating in the working party (see Appendix 3). Each person was obliged to report any real or perceived conflict of interest (should it have arisen) during the guideline development process.

2.6 External Review

The draft guidelines were widely circulated to 21 key stakeholder organisations and/or individuals for review and comment in September 2012 (see Table 2). All comments received were discussed and considered by the research executive and incorporated into the final document where appropriate.

Table 2: Organisations and/or Individuals who Received the Guidelines Document for External Review and Comment

Organisations		
Dianne Bennett	Senior Policy Officer, Policy and Advocacy Professional Affairs, HR and Advocacy	The Royal Australasian College of Physicians
Nikki Brouwers	NSW Branch President	Australian Rehabilitation Providers Association (NSW)
Rechelle Martinez	Representatives and Endorsements Coordinator	The Royal Australian College of General Practitioners
Dr Phillip Duke	President	Shoulder and Elbow Society of Australia
Jane Grimm	Director, Quality and Safety	The Royal Australian and New Zealand College of Radiologists
Rebecca May	Policy Officer	Australian Physiotherapy Association
Prof Malcolm Smith	Honorary Secretary	Australian Rheumatology Association
Public Peer Reviewers		
Bridget Barrett	Director of Analysis, Strategy and Innovation	WorkCover NSW
Cheryl Coombe	Workers Compensation Clerk	Port Macquarie-Hastings Council
Valerie Johnstone	Clinical Governance Unit	Mid North Coast Local Health District
Niny Panaust	Injury Manager, NSW/ACT	Metcash Trading Limited
Louise Whitby	Ergonomist	Louise Whitby and Associates

Expert Advisory Panel		
Dr Alice Aiken	Physiotherapist	School of Rehabilitation Therapy, Queen's University, Canada
Dr Bill Cumberland	Orthopaedic Surgeon	Private Practice
Dr Natalie Green	Psychologist	Bettalife Solutions
Dr Debbie Kors	General Practitioner	Private Practice
Dr Mary Ann McColl	Occupational Therapist	School of Rehabilitation Therapy, Queen's University, Canada
Dr Kim Nolan	Radiologist	Private Practice
Dr Michael Prowse	Rheumatologist	Private Practice
Prof David Sonnabend	Orthopaedic Surgeon	Private Practice
Dr Karen Smith	Rehabilitation Physician	Department of Physical Medicine and Rehabilitation, School of Medicine, Queen's University, Canada

2.7 Consumer Consultation

Consumer consultation was integral to the guideline development process. The working party consisted of two consumer representatives. As working party members, the consumer representatives were involved in all aspects of the development of the guidelines including determination of key topics, priorities, clinical questions and formulation of consensus-based recommendations. The consumer representatives were also involved in the development of the rotator cuff syndrome information sheet for injured workers.

Consumer input was also sought from key consumer and stakeholder organisations during the peer review process. All comments received were considered in the final editing stage of the guidelines.

3.0 Methodology

The methodology for the development of these guidelines was founded on the National Health and Medical Research Council (NHMRC) *Procedures and requirements to meet the 2011 NHMRC standard for clinical practice guidelines*[144]. It was also informed by two additional documents: the AGREE II tool, which is an international tool used to assess the quality and reporting of practice guidelines; and the *Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury*[57].

3.1 Search Strategies

Systematic searches for relevant published literature were conducted using key terms and a number of databases. Searches were completed in the following areas: national and international guideline portals; evidence-based medicine organisations/websites; and bibliographic databases: Cochrane, MEDLINE, EMBASE, CINAHL, OTseeker, PEDro and PsycINFO, where appropriate. Broad search terms were initially applied, such as 'shoulder', 'pain' and 'work' as variations in international nomenclature for rotator cuff syndrome are common. Details of the guideline portals and websites and the corresponding search terms are provided in Appendix 4. The working party reached a consensus that the literature search would be conducted on relevant literature published between January 2000 and March 2012.

3.2 Existing Guidelines

A systematic search was conducted to identify any existing evidence-based guidelines which could inform the current guidelines' posed clinical questions. A wide range of organisations were searched (see Appendix 4). Five existing guidelines were identified and reviewed. The key recommendations from these guidelines were documented in an evidence table (see Table 4.1). The identified guidelines were appraised by three independent reviewers using the AGREE II instrument. The AGREE II scores were used to determine whether the existing guidelines could be used to inform the rotator cuff syndrome project. The scores are detailed in Appendix 5.

Findings from three of the existing published guidelines were incorporated into the *Clinical Practice Guidelines for the Management of Rotator Cuff Syndrome in the Workplace*. The three guidelines were:

- American Academy of Orthopaedic Surgeons, *Clinical Practice Guideline on the Diagnosis and Treatment of Osteochronditis Dissecans* (2010)[4].
- 'Diagnostic imaging guideline for musculoskeletal complaints in adults – an evidence-based approach: Part 2: Upper extremity disorders' (2008)[35].
- Work Loss Data Institute: Official Disability Guidelines (ODG 2011), Shoulder and Rotator Cuff Disease[213].

Recommendations from the above guidelines were discussed within the working party, and those that were deemed applicable for inclusion in the *Clinical Practice Guidelines for the Management of Rotator Cuff Syndrome in the Workplace* were adapted using the ADAPTE tool*.

**ADAPTE is a tool developed by Guidelines International Network to consider the use or modification of existing guidelines produced in one cultural and organisational setting for application in another context.*

3.3 Clinical Evidence Summaries

While searching for existing guidelines seven evidence summaries were also identified. Evidence summaries are published by databases and provide an evidence-based overview of a health condition for health care professionals. The key findings from these summaries have been documented in evidence table 4.1.1 with key studies being incorporated into the evidence base for specific clinical questions as appropriate.

3.4 Published Studies

A systematic search for published studies was conducted for each clinical question. Appendix 6 lists search terms used. Databases searched include Cochrane, MEDLINE, EMBASE, CINAHL, PEDro, OT Seeker, and where appropriate PsycINFO between January 2000 and March 2012. No methodological filters were used for searching. The guidelines has utilised quantitative literature for the development

of graded recommendations. Qualitative research informed consensus recommendations where this was available for a specific clinical question. All literature searches were supplemented by the hand searching of bibliographies of identified studies for additional studies.

3.4.1 Inclusion/ Exclusion Criteria

The inclusion criteria were:

- studies examining rotator cuff syndrome (see included diagnoses – section 1.0)
- studies addressing the clinical questions (assessment methods, treatment outcomes and RTW approaches)
- studies in English
- adults (18–65 years of age)
- human (not cadaveric, animal or in vitro studies)
- papers published between January 2000 and March 2012.

The exclusion criteria were:

- studies involving children
- studies or guidelines in other languages
- studies published prior to 2000
- studies examining shoulder instability, adhesive capsulitis or labral lesions.

In some instances, large numbers of papers were identified for specific clinical questions. Where this occurred systematic reviews with meta-analysis were appraised as the first priority. If the reviews were appraised as having low levels of bias, only papers published after the systematic literature review dates were critically examined and added to the evidence table.

The RTW and vocational literature was searched using the following inclusion criteria:

3.4.2 Additional Inclusion/Exclusion Criteria for Return to Work Literature

Impairments

- patients with shoulder pain
- patients who had undergone shoulder surgery.

Activities

Studies which examined work tasks associated with higher incidences of rotator cuff syndrome, including:

- heavy lifting
- the use of 'high' hand force (greater than or equal to 10% of maximal voluntary contraction) for one hour or more per day
- repetitive shoulder movements
- overhead work that required upper arm elevations of greater than 90°
- use of vibrating tools.

Participation

Studies which examined the following occupations:

- construction workers
- car assembly workers
- forestry workers
- agriculture
- meat and/or fish processing
- onerous human services, e.g. cleaners, nurses, personal care assistants.

The RTW and vocational literature was searched using the following exclusion criteria:

Impairments

- combined neck and shoulder pain identified as radiating from the trapezius or described as myalgia.

3.5 Evidence Appraisal

Literature identified in the systematic searches was assessed for relevance and appraised by two reviewers. The following appraisal tools were used:

- Appraisal of Guidelines for Research and Evaluation (AGREE II)[32] – for appraisal of clinical guidelines
- Critical Appraisal Skills Programme (CASP)[167] – for appraisal of systematic reviews and qualitative studies
- expanded NHMRC checklist – for quantitative studies
- partitioned PEDro scale[164] for randomised controlled trial, intervention studies
- Single Case Experimental Design scale (SCED) [199] – for appraisal of single case studies.

3.6 Grading the Evidence

Appraised evidence was used to develop clinical recommendations. The strength of the body of evidence for each recommendation was determined using the NHMRC grades for recommendations (see Table 3). The NHMRC grades use a hierarchical model of quantitative research methods where systematic reviews or meta-analysis of randomised controlled trials are considered to be the most robust evidence. All research, on which the guidelines recommendations are based, is detailed in the evidence tables (see section 4).

Table 3: Grades for Recommendation

Grade of Recommendation	Description
A	Body of evidence can be trusted to guide practice. One or more level I or several level II studies with low risk of bias and all studies consistent, or inconsistencies can be explained. The clinical impact is very large. The populations studied in the body of evidence are the same as the target population for the guidelines. The studies are directly applicable to the Australian health care context.
B	Body of evidence can be trusted to guide practice in most situations. One or two level II studies with a low risk of bias or a systematic review/several level III studies with a low risk of bias with most studies consistent, or inconsistencies can be explained. Clinical impact is substantial. Population studied in the body of evidence is similar to the guideline population. Applicable to Australian health care context with few caveats.
C	Body of evidence provides some support for recommendation but care should be taken in its application to individual clinical and organisational circumstances. One or two level III studies with low risk of bias or level I or II studies with a moderate risk of bias. Some inconsistency reflecting some uncertainty. Clinical impact is moderate. Population studied in the body of evidence differs from the guideline population but it is sensible to apply it to target population. Applicable to Australian health care context with some caveats.
D	Body of evidence is weak and recommendation must be applied with caution. Level IV studies or level I to II studies/systematic reviews with a high risk of bias. Evidence is inconsistent. The clinical impact is slight. Population studies in the body of evidence differ to target population and hard to judge whether it is sensible to apply it to the target population.
Consensus	Consensus-based recommendation. A systematic review of the evidence was conducted as part of the guideline research strategy. In the absence of high-quality evidence, the working party utilised the literature available in combination with the best available clinical expertise and practices to reach a consensus on the recommendation.

Adapted from the Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord, 2011[57].

Mandatory	This recommendation is guided by a regulatory requirement established by a statutory authority (e.g. WorkCover NSW).

3.7 Formulation of Recommendations

At each working party meeting, the evidence which addressed specific clinical questions was reviewed. Where evidence existed to answer the clinical questions, evidence-based recommendations were developed. Where there was insufficient evidence to make evidence-based recommendations, clinical questions were addressed by consensus-based recommendations (where appropriate). The development of consensus-based recommendations involved the research executive developing a draft recommendation for discussion. Where necessary the draft recommendations were modified according to working party discussions. Each draft recommendation was reviewed over a minimum of two working party meetings and were only included in the guidelines once there was unanimous support from working party members.

In determining the grade of each evidence-based recommendation, the body of evidence for each clinical question was determined using the NHMRC matrix as described in the NHMRC Evidence Statement[149] (see Appendix 7). The Evidence Statement uses five criteria to rate the body of evidence. These criteria are: the quantity and strength of studies; the consistency of studies; the clinical impact of study results; the generalisability; and the applicability of the body of evidence to the Australian health care context. The grading of each of the guideline's recommendations reflects a synthesis of these five criteria. A summary of the grades ascribed to the body of evidence criteria for each of the evidence-based recommendations within the current guidelines is provided below in Table 4.

Table 4: Summary of the NHMRC Evidence Statement for Evidence-Based Recommendations

Recommendation 5 **X-rays and imaging are not indicated in the first four to six weeks for an injured worker presenting with suspected rotator cuff syndrome in the absence of 'red flags' (see Figure 1).**	**Grade: C**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**B**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**B**
Recommendation 11 **Injured workers should be prescribed paracetamol as the initial choice for mild to moderate pain.**	**Grade: C**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**C**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 12 **Injured workers with acute shoulder pain may be prescribed NSAIDs (either oral or topical) for pain relief. NSAIDs can be prescribed alone or in conjunction with paracetamol.**	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**A**
Consistency – between studies if more than one study	**A**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**C**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**

Recommendation 15 **There must be early contact between the injured worker, workplace and health care provider.**	**Grade: C**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**C**
Generalisability – how well the body of evidence matches the population and clinical settings	**B**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**B**
Recommendation 17 **The RTW program must involve consultation and engagement with a team which includes the injured worker, relevant health care providers and the workplace.**	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 18 **The RTW program should include a workplace assessment and job analysis matching worker capabilities and possible workplace accommodations.**	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**B**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 19 **The RTW program, where possible, should be workplace-based. Improved outcomes occur if rehabilitation processes take place within the workplace.**	**Grade: C**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**B**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**C**
Recommendation 21 **Injured workers should be initially treated with exercise prescribed and reviewed by a suitably qualified health care provider. There is no evidence of adverse impacts for prescribed exercise programs for patients with rotator cuff syndrome.**	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**A**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**

Recommendation 22 Manual therapy may be combined with prescribed exercise by a suitably qualified health care provider for additional benefit for patients with rotator cuff syndrome.	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**B**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 23 Clinicians may consider acupuncture in conjunction with exercise; both modalities should be provided by suitably qualified health care providers.	**Grade: C**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**C**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 24 The evidence suggests that therapeutic ultrasound does not enhance outcomes compared to exercise alone. The health care provider should refrain from using ultrasound for either pain reduction and/or increased function for injured workers with subacromial impingement syndrome (SAIS).	**Grade: C**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**C**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 26 Injured workers with suspected rotator cuff syndrome who have experienced significant activity restriction and pain for four to six weeks following initiation of an active, non-surgical treatment program and have had no response to the treatment program should be referred for MRI and plain film X-ray.	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**B**
Consistency – between studies if more than one study	**A**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 27 In the absence of access to MRI or for those with contraindications for MRI, refer injured workers with suspected rotator cuff syndrome for ultrasound and plain film X-ray. Ultrasound performed by a skilled clinician provides equivalent diagnostic accuracy to MRI for rotator cuff tears (partial- or full-thickness).	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**A**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**B**

Recommendation 28 **For pain reduction in injured workers with persistent pain or who fail to progress following initiation of an active, non-surgical treatment program, the clinician may consider subacromial corticosteroid injection combined with local anaesthetic.**	**Grade: A**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**A**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**
Recommendation 33 **On review, clinicians should refer injured workers for surgical opinion if there is a symptomatic, established small or medium, full-thickness rotator cuff tear.**	**Grade: B**
Evidence base – number of studies, level of evidence, risk of bias in the included studies	**B**
Consistency – between studies if more than one study	**B**
Clinical impact – of the intervention	**B**
Generalisability – how well the body of evidence matches the population and clinical settings	**A**
Applicability – relevance to Australian health care context in terms of services, delivery and cultural factors	**A**

The following section provides the evidence tables for all the existing guidelines, and the studies used for the recommendations.

4.1 Existing Guidelines

Title, Year	Author/ Organisation	Overall Objective	Key Findings Related to Rotator Cuff Syndrome	AGREE II Appraisal/ Comments
ACR Appropriateness Criteria (March 2010)[5]	American College of Radiology	Evidence-based guidelines to assist referring physicians and providers in making the most appropriate imaging or treatment decision for a specific shoulder condition.	MRI is currently the procedure of choice for evaluation of occult fractures and the shoulder soft tissues, and for evaluation of shoulder pain in those >35 years. Ultrasound with appropriate local expertise is excellent in the depiction of rotator cuff and long head of biceps pathology and to guide injections and aspirations	See Appendix 5
Diagnostic imaging guideline for musculoskeletal complaints in adults: an evidence-based approach. Part 2 – Upper extremity disorders (2008)[35]	Bussieres A.E., Peterson C., & Taylor J.A.M.	To assist chiropractors and other primary care providers in decision-making for the appropriate use of diagnostic imaging for upper extremity disorders.	Radiographs not initially indicated for adults with full or limited movement and non-traumatic shoulder pain of less than 4-week duration (B). General indications for radiographs include: no response to care after 4 weeks; significant activity restriction >4 weeks; non-mechanical pain (unrelenting pain at rest). Specialised imaging recommended for: pain and significant disability lasting over 6 months, despite attention to occupation and sporting factors; absence of clinical/functional improvement after 4 weeks. ▪ MRI gold standard for rotator cuff syndrome imaging (A). ▪ Impingement may be assessed by US, however operator dependent (B). ▪ MRA improves diagnostic accuracy. **Grades** A RCTs, meta-analysis, systematic reviews, or B robust experimental or observational studies, or C expert opinion with the endorsement of respected authorities D food practice point.	See Appendix 5
Work Loss Data Institute: Official Disability Guidelines (ODG, 2011) – Shoulder (acute and chronic)[213]	Work Loss Data Institute	To offer evidence-based step-by-step decision protocols for the assessment and treatment of workers compensation conditions	Initial evaluation of the shoulder requires careful inspection and palpation of the shoulder area, testing of ROM and determination of whether injury is result of degenerative changes or acute trauma. Initial conservative treatment: prescribe alteration of activity, no overhead work, stretching and gentle ROM exercises and appropriate analgesia – back-to-work (BTW) modified duties. If no progress after 2 weeks prescribe physical therapy. If no progress after 1 month consider corticosteroid injection. If no progress after 6 weeks refer for imaging – MRI if diagnosis is unclear and surgery is being considered.	See Appendix 5

Title, Year	Author/ Organisation	Overall Objective	Key Findings Related to Rotator Cuff Syndrome	AGREE II Appraisal/ Comments
Optimizing the management of rotator cuff problems: clinical practice guideline (2010)[4]	American Academy of Orthopaedic Surgeons	To provide an educational tool to assist qualified physicians in a series of treatment decisions in an effort to improve quality and efficiency of patient care	Surgery should not be performed for asymptomatic, full-thickness RC tears. RC repair is an option for patients with chronic, symptomatic full-thickness tears. Patients who have RC-related symptoms in the absence of a full-thickness tear should be initially treated non-operatively using exercise and/or non-steroidal anti-inflammatory drugs. It is an option for physicians to advise patients that the following factors correlate with less favourable outcomes after RC surgery: increasing age, MRI tear characteristics and workers compensation status.	See Appendix 5
The diagnosis and management of soft tissue shoulder injuries and related disorders: best practice evidence-based guidelines (2004)[150]	ACC (NZ) – New Zealand Accident Compensation Corporation	Evidence-based summary of the diagnosis and management options available for soft tissue shoulder injuries and related disorders	**Initial diagnosis:** Assessment relies on a thorough history-taking and physical examination. Refer people with massive tears of the rotator cuff urgently for specialist evaluation. If there is a suspected fracture, or a dislocation in a person aged >40 years, arrange an X-ray. **Management:** ▪ Use NSAIDs with caution. Simple analgesics may be sufficient. ▪ Use subacromial corticosteroid injection with caution. A referral for a trial of supervised exercise is usually beneficial. ▪ If a full-thickness rotator cuff tear has not improved with non-operative management by 4–6 weeks, refer the person to an orthopaedic specialist. ▪ Refer those with tendonosis and partial thickness tears at 6 months if there is no improvement with non-operative management.	See Appendix 5

KEY MRI – magnetic resonance imaging RC – rotator cuff RCT – randomised controlled trial ROM – range of motion US – ultrasound NSAIDs – non-steroidal anti-inflammatory drugs

4.1.1 Clinical Evidence Summaries

Title, Year	Organisation	Study objective	Study Outcome/Findings
Rotator cuff injury (2011)[23]	BestPractice –British Medical Journal	Combines the latest research evidence, guidelines and expert opinion – presented in a step-by-step approach, covering prevention, diagnosis, treatment and prognosis	**Treatment:** Typically based on degree of dysfunction, pain, and patient goals and activity level. ▪ In patients with lower functional demands, rehabilitation therapy, including ROM and strengthening exercises, is critical to return patients to better function. A subacromial injection can alleviate pain. ▪ If higher activity level is desired or the tear is acute, surgical intervention has a better functional result than non-operative treatment.
Clinical Knowledge Summaries – Shoulder pain, Scenario rotator cuff disorders (2008)[42]	NHS (UK) Sowerby Centre for Health Informatics at Newcastle	Evidence-based summary	**Assessment**: For rotator cuff syndrome, most pain occurs with overhead activity and pain located at front/side of shoulder, and also at night. Clinical tests: A painful arc of movement between 60–120° abduction and/or positive drop arm test. Full PROM but limited AROM. **Treatment:** ▪ Advise relative rest and modifications of activities**.** Offer analgesia- paracetamol or NSAIDs**.** ▪ Refer to physiotherapy if non-responsive. Consider a subacromial corticosteroid injection for pain relief if non-responsive to initial treatments and/or very poor function (with or without a local anaesthetic). Contraindicated for those with RC tear, who have had more than 3 injections in the past year. ▪ Refer to an orthopaedic or rheumatologist specialist if diagnosis uncertain.
Clinical Review Shoulder Impingement Syndrome	CINAHL Information Systems (Dressendorfer, 2010)[53]	General informational overview of the subject for the health care professional	**Assessment to include**: Examination of mechanism of injury; Is the patient's dominant hand affected?; What are the location, symptoms and patterns of pain?; Previous therapy, home remedies/ alternative therapies**;** Pain-aggravating and easing factors; Sleep disturbances**;** Past medical history including medications previously prescribed**;** Functional limitations**;** Assess body mechanics – scapular dyskinesis; Assess joint integrity and mobility, muscle strength, palpation, posture, reflex testing of upper limbs Special tests – Neer's test, Hawkin's test. **Care plan:** Establish patient goals. Most patients with uncomplicated shoulder impingement return to normal activities after 8–12 weeks. Referral to orthopaedic surgeon for suspected fracture, RC tear and recalcitrant cases. **Treatment:** Icing for pain and edema, activity modification followed by manual therapy, Exercises aimed at restoration of active ROM, strength and scapula-humeral coordination**.**
Acute Pain Management: Scientific Evidence (2010-third edition)[124]	Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine	The document aims to summarise the substantial amount of evidence for the management of acute pain in a concise and easily readable form to assist the practising clinician	Pain is an individual, multifactorial experience influenced by culture, previous pain events, beliefs, mood and ability to cope. Acute pain, if severe and prolonged, can have adverse effects on the outcome. **Treatment**: Regular paracetamol, then if ineffective, provide NSAIDs. NSAIDs given in addition to paracetamol improve analgesia compared with paracetamol alone. Topical and oral NSAIDs improve acute shoulder pain. Subacromial corticosteroid injection relieves acute shoulder pain in the early stages. Exercises improve acute shoulder pain in patients with rotator cuff disease.
Evidence-based management of acute musculoskeletal pain (2003)[14]	Australian Acute Musculoskeletal Pain Guidelines Group	To describe the diagnosis and treatment of acute shoulder pain of unknown or uncertain origin	It is recommended that the clinician and patient develop a management plan for acute musculoskeletal pain comprising the elements of assessment, management and review: Simple interventions (providing information, assurance and encouraging reasonable maintenance of activity) may be used alone or in combination with other interventions for the successful management of acute musculoskeletal pain.

KEY ROM – range of motion PROM – passive range of motion AROM – active range of motion RCI – rotator cuff injury RC – rotator cuff NSAIDs – non-steroidal anti-inflammatory drugs

4.2 Assessment Tables

4.2.1 History Taking and Clinical Examination

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Papadonikolakis et al (2011)[162]	I	Systematic review including level I and II studies (Literature to September 2010)	To identify clinical signs and tests that can reliably differentiate SIS from other conditions	Evidence (including level I and II clinical studies) indicates that the physical findings used to diagnose SIS, i.e. the Neer sign (pain on forced flexion), the Hawkins sign (pain on internal rotation with the arm elevated to 90º), and the Neer injection test (relief of pain on the Neer sign after subacromial injection of local anaesthetic) may be sensitive, but are not specific. **Conclusion:** Clinical tests cannot reliably differentiate between SIS and other conditions.	Limited search strategy, PubMed only using terms 'impingement' and 'shoulder'. Studies appraised by 3 reviewers and evidence level ascribed per study design (not necessarily study quality).
Hegedus et al (2008)[80]	I	Systematic review (Literature to 2006)	Physical examination tests of the shoulder: a systematic review with meta-analysis of individual tests	No tests for impingement demonstrated significant diagnostic accuracy. Tests included in the meta-analysis were Neer's sign, Hawkins-Kennedy test and Speed test. The following tests may have diagnostic potential: Hornblower's sign for severe RC degeneration; external rotation lag sign for an infraspinatus tear; and bear hug and belly press test for a subscapularis tear. Empty can test or infraspinatus test may confirm SIS.	Searched MEDLINE, CINAHL and SPORTDiscus databases. Included 45 studies appraised by 2 raters using QUADAS (22 described as high quality).
Hughes et al (2008)[89]	I	Systematic review (Literature to 2007)	To evaluate whether clinical tests can accurately diagnose rotator cuff pathology	Meta-analysis could not be performed due to variety of study designs and tests used. Most tests of rotator cuff pathology were inaccurate and cannot be recommended for clinical use.	Bias minimised by broad search and independent appraisal of studies using NHMRC criteria (3 raters). 13 studies included.
Dinnes et al (2003)[51]	I	Systematic review (Literature to October 2001)	To evaluate the effectiveness and cost-effectiveness of diagnostic imaging tests as an addition to clinical examination and patient history for the diagnosis of soft tissue shoulder disorders	Pooled results from four studies that evaluated clinical examination as a whole indicated overall sensitivity and specificity to be 0.90 (95% CI: 0.87 to 0.93) and 0.54 (95% CI: 0.47 to 0.61) for detection of full-thickness RCTs. **Conclusion**: Clinical examination by specialists can rule out the presence of a rotator cuff tear. Further research is needed to determine the place of these imaging tests in the diagnosis of RC disorders.	Did not specify databases searched. Listed search strategy and appraised study quality with predetermined criteria. 10 cohort studies included in analysis.
Beaudreuil et al (2009)[19]	n/a	Literature review (Literature to 2006)	Evaluate the accuracy of clinical tests for degenerative rotator cuff disease	No test showed consistently good sensitivity and specificity. Tests need to include efforts to standardise the way which tests are used, performed and interpreted.	Potential for bias as no discussion as to how studies were selected or appraised.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Michener et al (2009)[136]	II	Diagnostic (test-accuracy) Reference standard surgical diagnosis, N=55	Evaluate the reliability and diagnostic accuracy of 5 physical tests for SIS. (Neer sign, Hawkins-Kennedy, painful arc, empty can and external rotation resistance)	Reliability was moderate to substantial agreement (k=0.45–0.67) for painful arc, empty can and external rotation with resistance tests. Reliability was fair strength (k=0.39–0.40) for Neer and Hawkins-Kennedy. The single tests of painful arc, external rotation resistance test and Neer tests provide the best diagnostic utility and reliability. A cut-off of 3 or more positive tests from the 5 tests can confirm a diagnosis of SIS.	Bias minimised by blinded comparison and consecutive series. Possible verification bias as only 55/65 patients had reference standard completed. Two experienced raters (orthopaedic surgeon and physiotherapist).
Kelly et al (2010)[100]	II	Diagnostic (test-accuracy) Reference standard ultrasound, N=34	To evaluate the value of physical tests for SIS (Neer sign, Hawkins-Kennedy, empty can, resisted isometric abduction and external rotation)	The predictive values of these tests were shown to be variable which indicates that the clinical tests have limited use in informing diagnosis. The tests proved to be more sensitive for diagnosing bursitis versus rotator cuff tears.	Question whether US is an adequate reference standard; however, radiologist completing US described as highly experienced in shoulder US.
Silva et al (2008)[186]	II	Diagnostic (test-accuracy) Reference standard MRI, N=30	To evaluate the accuracy of physical examination in SIS	Most tests identify SIS; however, they have a low specificity and are thus not accurate in defining the type of lesion when compared with MRI. Yocum manoeuvre was the most sensitive and accurate for SIS. Although in some patients physical examination tests may be insufficient for the diagnosis, they play an important role in the clinical evaluation of the majority of patients with painful shoulder.	Bias minimised by consecutive sample all completing reference standard. Test and reference standard measured independently of each other in same patients.
Salaffi et al (2010)[175]	II	Diagnostic (test-accuracy) Reference standard US, N=203	To investigate the clinical value of the provocative clinical tests and propose a composite index for the assessment of painful shoulder Tests: Hawkins-Kennedy, Patte, Speed and Gerber	Sensitivity was low for the clinical diagnosis of all shoulder abnormalities. The highest sensitivity and smallest negative likelihood ratio were found for the Hawkins-Kennedy (63.88% and 0.50%) and Patte (62.21% and 0.52%) tests. SNAPSHOT composite index sensitivity and specificity were 75.8% and 87.5% respectively. SNAPSHOT is a feasible, informative and quantitative composite index for the assessment of painful shoulder in the clinical setting.	Question whether US an adequate reference standard. Bias minimised by consecutive sample with reference standard performed independently of test results and blinded sonographer.
Miller et al (2008)[137]	II	Diagnostic (test-accuracy) Reference standard US, N=37	To examine the validity of lag signs in diagnosing full-thickness RC tears (Drop sign and internal rotation lag)	High specificity together with low positive likelihood ratios for both tests indicate that a positive result was poor at identifying a full-thickness RC tear. The clinical diagnosis of full-thickness rotator cuff tears cannot be conclusively reached by using one or more of the lag signs.	Small sample size – authors noted N=290 required for adequate statistical power. Query whether US adequate reference standard.
Nanda et al (2008)[145]	III-2	Diagnostic (test-accuracy) Reference standard arthroscopy, N=50	Examine the accuracy and the reliability of some of the commonly used tests for rotator cuff disease	Clinical signs can be relied upon for diagnosis of impingement but not for rotator cuff deficiency. At best the tests had only moderate agreement between the two raters for assessment of rotator cuff integrity.	Debate as to whether arthroscopy is a valid reference standard. Verification bias as reference standard not completed for all participants.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Kim et al (2007)[102]	III-1	Diagnostic (test-accuracy) Reference standard US, N=120	Examination of the correlation between US findings and physical examination	Physical examination had low sensitivity and specificity for detection of RC tears. Most frequent US finding was effusion in the long head of biceps followed by supraspinatus tendon in the RC.	Not reported whether sample a consecutive series. Query whether US adequate reference standard.
Norregaard et al (2002)[154]	III-2	Diagnostic Reference standard arthroscopy, N=86	To examine the inter-observer agreement of commonly used clinical tests and diagnoses in patients with shoulder pain	Most clinical tests showed poor agreement. Two separate reviewers completed a standardised clinical history questionnaire. The historical information obtained by standardised interview had low inter-rater agreement.	Debate as to adequacy of reference standard; however, this would not have impacted on inter-rater agreement of historical information obtained via standardised interview.
Litaker et al (2000)[120]	III-2	Diagnostic: retrospective chart review Reference standard arthrography N=448	To determine the value of elements of the bedside history and physical examination in predicting arthrography results in older patients with suspected rotator cuff tear	Stepwise logistic regression based on a derivation dataset (N=191) showed that weakness with external rotation (adjusted odds ratio (AOR) 6.96 (3.09, 13.03), age 65 (AOR 4.05 (2.47, 16.07)), and night pain (AOR 2.61 (1.004, 7.39)) best predicted the presence of RCT. The presence of three simple features in the history and physical examination of the shoulder can identify RCT efficiently.	Limited generalisability to working population as study participants described as 'older patients'.

KEY SIS – shoulder impingement syndrome US – ultrasound MRI - magnetic resonance imaging RC – rotator cuff RCT – randomised controlled trial QUADAS – Quality Assessment of Diagnostic Accuracy Studies

4.2.2 Imaging

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
de Jesus et al (2009)[49]	I	Systematic review with meta-analysis (literature 1966–2007)	To compare the diagnostic accuracy of MRI, MRA and US for the diagnosis of rotator cuff tears	MRA is more sensitive and specific than either MRI or US ($p<0.05$). There are no significant differences in either sensitivity or specificity between MRI and US in the diagnosis of partial or full-thickness tears. US may be the most cost-effective imaging method for screening for rotator cuff tears, provided that the examiner is experienced.	Searched MEDLINE only. Bias minimised by including only those studies with a valid reference standard however selection bias noted in many of the included studies.
Ottenheijm et al (2010)[161]	I	Systematic review with meta-analysis (literature 2001–June 2010)	To determine the diagnostic accuracy of US for detecting subacromial disorders	US recommended for patients for whom conservative management has failed, to rule in/out full-thickness tears, to rule in partial thickness tears and to a lesser extent to diagnose tendinopathy, bursitis and calcifying tendonitis. MRI can be reserved for diagnosing concomitant abnormalities in those identified for surgery.	Searched MEDLINE and Embase with search terms provided. Two reviewers appraised 23 studies.
Ardic et al (2006)[10]	II	Diagnostic (test-accuracy) Reference standard MRI, N=58	Evaluate diagnostic accuracy of US and clinical assessment for adults with SIS	High level of accuracy (93%), sensitivity (98%) and modest specificity (60%) for detecting RCT on US. Slightly lower level of accuracy (71%) and sensitivity (78%) and poor specificity (50%) for diagnosing RC tears based on clinical assessment.	Bias minimised by consecutive series and valid reference standard. Blinded assessors.
Cullen et al (2007)[46]	III-2	Diagnostic (test-accuracy) Reference standard surgery, N=68	To examine the sensitivity of US, when used by one experienced radiologist with modern equipment for diagnosing rotator cuff syndrome	Study results are similar to the best published results for MRI and given that US is significantly cheaper and more available, ultrasound by an experienced radiologist should be considered as a primary diagnostic tool for imaging the rotator cuff.	Unclear whether consecutive series. Verification bias as decision to perform surgery not independent of US and surgeon not blinded to US results.
Kang et al (2009)[97]	II	Diagnostic (test-accuracy) Reference standard arthroscopy, N=50	Compare diagnostic accuracy of 3D-US and MRA for diagnosing supraspinatus tendon tears	MRA and 3D-US both accurate for diagnosis of full-thickness tears but less accurate for partial- thickness tears. In direct comparison, 3D-US was less accurate than MRA for diagnosis. MRA more accurate than 3D-US for evaluating size of tears; however, both methods tended to underestimate actual size. Full-thickness: sensitivity 3D-US 88%, MRA 98%, specificity 3-D US and MRA 90%, accuracy 3D-US 88%, MRA 96%. 3D-US Inter-observer agreement was high $\kappa=0.81$.	Bias minimised by consecutive series and valid reference standard. 3D-US and MRA interpreted blind to results of all other tests.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Miller et al (2008)[138]	II	Diagnostic (test-accuracy) Reference standard arthroscopy, N=74	Improve quality of service by introducing US prior to consultation. Evaluate diagnostic accuracy of US for full-thickness RC tears	New protocol involved. Cost saving identified by using US (£38) in comparison to MRI (£139). High level of accuracy (91%), sensitivity (94%) and specificity (100%) for detecting RC tear on US.	Verification bias present as decision to perform arthroscopy based on imaging results. Only 12/74 referred for surgery.
Milosavljevic et al (2005)[139]	II	Diagnostic (test-accuracy) Reference standard arthroscopy, N=185	Evaluate diagnostic accuracy of high-resolution US	High resolution US accurate in detecting full-thickness RC tear, but less sensitive in diagnosis of partial-thickness tears. US correlated with arthroscopy in 91% of cases.	Bias minimised by consecutive series and valid reference standard. Decision to perform arthroscopy independent of US findings.
Oh et al (2010)[157]	II	Diagnostic (test-accuracy) Reference standard arthroscopy, N=148	Evaluate diagnostic accuracy of multidetecter CTA compared to MRA	Diagnostic efficacy of CTA is statistically comparable to MRA for full-thickness rotator cuff tears; however, CTA had poor accuracy for partial-thickness tears. CTA more cost-effective than MRA. Full-thickness: sensitivity CTA=89%; MRA=100%. Partial-thickness: sensitivity CTA=29%; MRA=74%.	Bias minimised by consecutive series and valid reference standard. CTA and MRA scored independently by radiologist.
Zubler et al (2007)[221]	II	Diagnostic (test-accuracy) Reference standard X-ray, N=22	Assess diagnostic accuracy of MRA to diagnose calcific tendonitis	MRA is insufficient for diagnosis of calcific tendonitis. Hypointense areas normally present in the rotator cuff may mimic calcific deposits; therefore, MR images should not be interpreted without corresponding radiographs. MRA inter-observer agreement moderate κ=0.42.	Bias minimised by consecutive series and valid reference standard. MR images evaluated blind to clinical and radiographic findings.
Chun et al (2010)[41]	III-1	Diagnostic (test-accuracy) Reference standard arthroscopy, N=202	Assess diagnostic performance and rater-agreement of MRA in diagnosis of partial-thickness RC tear.	Exact agreement between MRA and arthroscopic classification of partial-thickness tears = 77%. Sensitivity of MRA to partial-thickness RCT varied depending on location of tear: articular-sided (85%); bursal-sided (62%); and both-sided (45%). MRA inter-observer agreement was good overall κ=0.77. Intra-observer agreement ranged from good κ=0.80 to excellent κ=0.87.	MRA analysed by radiologists blind to arthroscopic findings. Arthroscopy performed by surgeon who was not blind to MRA results. Non-consecutive series.
Jung et al (2009)[96]	III-1	Diagnostic (test-accuracy) Reference standard arthroscopy, N=19	Compare diagnostic accuracy of indirect-MRA to direct-MRA in diagnosis of RCT	No significant difference between indirect- and direct-MRA for detection of RC tear. Moderate inter-observer agreement for both methods κ=0.47–1.0.	MR images analysed independently by radiologist blind to arthroscopy results. Risk of selection bias.
Van Dyck et al (2009)[202]	III-1	Diagnostic (test-accuracy) Reference standard arthroscopy, non-consecutive series N=67	Evaluate diagnostic accuracy of indirect MRA in adults with suspected rotator cuff abnormalities	High level of accuracy (97%), sensitivity (93%) and specificity (98%) for detecting full-thickness tears using MRA. Slightly lower level of accuracy (77%), poor sensitivity (44%) and moderate specificity (87%) for detecting partial-thickness tears using MRA. MRA inter-observer agreement was good overall κ=0.72; ranging from κ=0.49 for partial-thickness tears to κ=0.91 for full-thickness tears.	Verification bias present as decision to perform arthroscopy based on imaging results. Assessment of MRA images was blinded. Risk of selection bias.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Johal et al (2008)[91]	IV	Diagnostic N=112 adults with shoulder pain	Correlate the diagnosis made by referring GP to orthopaedic surgeon	GP made a diagnosis in referral letter to surgeon in 64% of cases with traumatic shoulder injury, and only 34% of non-traumatic cases of shoulder pain. In these cases, the orthopaedic surgeon concurred with GP diagnosis in 89% of cases.	Surgeon's diagnosis not independent of the GP diagnosis. Questionable validity of reference standard (surgeon diagnosis).
Spencer et al (2008)[192]	IV	Cohort study of inter-observer agreement Consecutive series N=27	Determine the inter-observer agreement among fellowship trained orthopaedic surgeons with regard to rotator cuff lesions and associated pathologies on MRI	Variable agreement between experienced fellowship trained orthopaedic surgeons. Inter-observer agreement ranged from poor to good κ=0.06 to κ=0.77. Highest agreement for differentiating between full and partial thickness tears on MRI, moderate for number of tendons involved in full-thickness tear, side of partial-thickness tear and degree of retraction, fair agreement for AC joint signal change, presence of spur, muscle quantity and size of tear.	Attempts to reduce bias by recruiting a consecutive series and recruiting experienced surgeons who performed more than 30 rotator cuff repairs per year.

KEY AC – acromioclavicular MRI – magnetic resonance imaging MRA – magnetic resonance arthrogram CTA – computed tomography arthrography SIS – shoulder impingement syndrome US – ultrasound 3D-US – three-dimensional ultrasound RCI – rotator cuff injuries RC – rotator cuff GP – general practitioner

4.3 Risk Factors for Development of Rotator Cuff Syndrome

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
van Rijn et al (2010)[204]	I	Systematic review (to November 2009)	To provide a quantitative assessment of the exposure–response between work-related physical and psychosocial factors and the occurrence of specific shoulder disorders in occupational populations	Jobs with the highest increased risk for SIS were in the fish and meat processing industry and betel pepper leaf cullers. The occurrence of SIS was associated with: ▪ force requirements of >10% maximal voluntary contraction ▪ lifting >20kg 10 times/day ▪ high level of hand force >1 hour/day ▪ repetitive movements of the shoulder ▪ repetitive motions of the hand/wrist >2 hours/day ▪ hand-arm vibration ▪ working with hand above shoulder level ▪ working in the following postures: upper arm flexion >45% >15% of time combined with forceful exertions >9% of time or duty cycle of forceful pinch >0% of time High psychosocial job demands were also associated with SIS. None of the included articles described the association between job title/risk factors and rotator cuff tears.	Broad search strategies and inclusion of English, German, French and Dutch studies. Studies appraised for methodological strength by two examiners. Authors note the lack of cohort studies means that causality of associations cannot be established. Data unable to be pooled.
Pienimaki (2002)[165]	I	Systematic review (Literature search to 1998)	To investigate how exposure to low temperatures may be associated with musculoskeletal problems either on symptomatic or disease level based on available relevant scientific literature	Musculoskeletal symptoms are more frequent in cold store work and in related conditions than in normal temperature work. In cold store work low back pain and knee pain are more frequent problems than in normal temperature work environment. The association between cold exposure and shoulder pain is still unclear and has been poorly studied. Shoulder pain was identified as being associated with cold or humid working conditions in men in a single study[166]	Studies may have been missed as authors used limited search terms in PubMed and Embase. No appraisal of the methodological quality of studies included.
Andersen et al (2007)[7]	II	Prognostic prospective cohort study (2 years, N=4006)	To quantify the relative contribution of work-related physical and psychosocial factors and individual factors to the development of more severe musculoskeletal pain	Highly repetitive work predicted arm pain. Low job satisfaction predicted neck/shoulder pain. The transition from no or minor pain to more severe pain was influenced by physical and psychosocial workplace factors together with individual and health-related factors.	Follow-up assessment performed for 81% of group. Limitation of the study was that physical exposures were derived from self-report rather than observation of work tasks.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Andersen et al (2003)[8]	II	Prognostic prospective cohort study (4 years, N=3,123)	To quantify the relative contribution of work-related physical factors, psychosocial workplace factors, and individual factors and aspects of somatisation to the onset of neck/shoulder pain	During follow up, 636 (14.1%) of participants (workers in industrial and service companies) reported neck/shoulder pain of new onset. High shoulder repetition was related to being a future symptom case, and a future clinical case. Repetition was strongly inter-correlated with other physical measures. High job demands were associated with future status as a symptom case, and as a clinical case. A high level of distress predicted subsequent neck/shoulder pain. Personality traits measured by Siegrist's intrinsic effort were not related to future pain or clinical signs.	Risk of selection bias as 50% drop-out rate at 4 years (however authors note that baseline characteristics of workplace exposures for participants and drop- outs were similar).
Elfering et al (2008)[56]	IV	Field study: Male adult education workers (N=33)	To identify whether a high level of work stressors is associated with musculoskeletal pain and higher urinary norepinephrine excretion rates	Multi-level regression analysis showed a significant interaction between work stressors and musculoskeletal pain (p=0.011) with elevated excretion rates of catecholamine in those exposed to a high level of work stressors. Increased activity of the sympathetic-adrenal medullary system seems to play an important role in work-related musculoskeletal pain.	Generalisability of results limited due to study having a small sample size of healthy individuals with well-designed jobs.
Borstad et al (2009)[30]	II	Prospective cohort study with control group. Follow-up at 1 and 2 years (N=208)	Determine factors related to the development of new-onset shoulder pain among first- and second-year trade apprentices, and to examine effects of a preventative exercise home program	Three factors related to the increased likelihood of development of new-onset shoulder pain: previous neck pain OR 2.62 (95% CI 1.01–6.78), working in hot, cold or humid conditions, subject height (short stature). The hypothesis that workers who performed exercises would be less likely to develop shoulder pain was not statistically supported.	Bias likely as small sample size, non-random allocation to treatment and control groups, self-reported compliance to exercise program.
Burgel et al (2010)[34]	III-3	Cross-sectional study using a questionnaire (N=493 hotel cleaners)	To assess if job strain, iso-strain, or effort–reward imbalance (ERI) was associated with severe/ very severe shoulder pain, while adjusting for biomechanical, socio-demographic, behavioural and anthropometric factors, including care-giving responsibilities at home	56% of participants reported shoulder pain in the prior four weeks. Room cleaners with ERI were three times as likely to report shoulder pain (OR 2.99, 95% CI 1.95–4.59, p=0.000), even after adjustment for physical workload and other factors. After adjustment for physical workload, job strain and iso-strain were not significantly associated with shoulder pain. The ERI model examines the social exchange balance between the self-perceived amount of extrinsic work effort by the worker, in exchange for 3 types of rewards (salary, self-esteem, job opportunities). An imbalance is created when extrinsic efforts at work are greater than rewards.	The cross-sectional design precludes conclusions about the temporal precedence and therefore causation: ERI could be a causal factor for shoulder pain; shoulder pain could be a causal factor for reported ERI.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
D'Onise et al (2010)[47]	IV	Population-based cohort study with measures taken at two time periods	To determine whether leisure time physical activity (LTPA) reduces the prevalence of shoulder pain in a working population	Of the 1502 working participants, 16% reported having current shoulder pain. Shoulder pain was associated with older age (OR 1.98, 95% CI: 1.31–2.99) (age >50 years), smoking (OR 1.44, CI: 1.02–2.04), secondary-level educational attainment (OR 1.68, 95% CI: 1.07–2.65), high BMI (OR 1.54, 95% CI: 1.14–2.08) and depression (OR 2.42, 95% CI: 1.60–3.64). No effect of LTPA on shoulder pain.	Possible selection bias as only the data for working participants was analysed.
Frost et al (2002)[64]	III-3	Cross-sectional study of 1961 workers in repetitive work and 782 referents. (industrial and service sector workers)	This study evaluates the hypothesis that shoulder loads in repetitive work might contribute to the occurrence of shoulder tendonitis	The prevalence of shoulder tendonitis was higher among exposed workers (OR 3.1, 95% CI 1.3–3.0). Neither frequency of movements (ranging 1±36/min) nor lack of micro-pauses in shoulder flexion (ranging 0±100% of cycle time) was related to disease prevalence. Increasing force requirements (categorised as light.1, somewhat hard.2, hard.3 or very hard.4) increased risk slightly (OR 1.6, 95% CI 1.0±2.6 per unit).The results indicate that workers with repetitive tasks have increased risk of shoulder tendonitis, which partially can be attributed to force requirements.	Possible selection bias as all participants were currently employed.
Leclerc et al (2004)[116]	II	Prognostic study Self-report questionnaire completed in 1993/4 and 3 years later (N=598)	To determine the predictiveness for the onset of shoulder pain in occupations requiring repetitive work	The prevalence of shoulder pain was significantly greater for woman at baseline (49% versus 37%) and increased with age. The incidence of shoulder pain was associated with depressive symptoms, low levels of job control and biomechanical constraints. For men, repetitive use of a tool was a strong predictor of shoulder pain (OR 4.34).	Bias minimised as 85% of participants completed follow-up questionnaires. However biomechanical exposures measured via self-report only.
Nordander et al (2009)[152]	III-3	Analysis of epidemiological data on occupational groups that have been screened for musculoskeletal disorders (N=4961)	To calculate risk for neck and upper limb disorders in repetitive/constrained versus varied/mobile work and to compare the risk of musculoskeletal disorders from repetitive/constrained work between females and males	Repetitive/constrained work showed elevated risks when compared to varied/mobile work in all settings. Females and males showed similar risk elevations. Repetitive/constrained work is harmful not only in industrial but also in office and non-office/non-industrial settings.	Bias minimised by high response rate (>85%) and large sample size.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Roquelaure et al (2011)[170]	III-3	Cross-sectional study of 3710 workers.	To examine the risk factors for rotator cuff syndrome among workers exposed to various levels of shoulder constraints	The personal risk factors for rotator cuff syndrome were age (OR for 1-year increment 1.07 (95% CI 1.05–1.09), among men and 1.08 (95% CI 1.06–1.10), among women. Diabetes mellitus (OR 2.9, 95% CI 1.0–8.6) among women. The work-related risk factors were (i) sustained or repeated arm abduction (≥2 hours/day) >90° among men (OR 2.3, 95% CI 1.3–3.9) and >60° among women (OR 1.8, 95% CI 1.0–3.2) or both conditions among men (OR 2.0, 95% CI 1.1–3.7) and women (OR 3.6, 95% CI 1.8–7.3); (ii) high repetitiveness of the task (≥4 hours/day) among men (OR 1.6, 95% CI 1.0–2.4) and women (OR 1.7, 95% CI 1.1–2.5); (iii) high perceived physical demand among men (OR 2.0, 95% CI 1.3–3.1); (iv) high psychological demand among men (OR 1.7, 95% CI 1.2–2.5); and (v) low decision authority among women (OR 1.5, 95% CI 1.0–2.3).	Good generalisability of study findings due to large sample size and varied occupations examined. Rotator cuff syndrome determined by physical examination by trained physician. Occupational exposures measured by self-report.
Seidler et al (2011)[179]	III-2	Case-control study	To examine the dose relationship between cumulative duration of highly elevated arms (work above shoulder height) as well as of manual handling and ruptures of the supraspinatus tendon	Clear dose response relationships observed for the following factors: For a cumulative duration of greater than 3195 hours work above shoulder level, the risk of supraspinatus rupture is OR 2.0 (CI 95% 1.1–3.5). For a cumulative duration of heavy lifting (>20kg) of greater than 77 hours, the risk of supraspinatus rupture is OR 1.8 (95% CI 1.0–3.2).	Potential for selection bias as low response rate of 63%. Cumulative hours were also calculated from self-report – no direct observation.
Silverstein et al (2008)[187]	III-3	Cross-sectional study (US workers N=733)	To identify factors associated with rotator cuff syndrome (RCS) among active workers	Fifty-five subjects (7.5%) had RCS. Cases were more likely to report low job security (p= 0.04) and to have very high job structural constraints (p=0.03). Age and body mass index were marginally significant. Upper arm flexion ≥ 45° ≥15% of time and either duty cycle of forceful exertions <9% time (OR 2.43, 95% CI 1.04–5.68) or forceful pinch >0% (OR 2.66, 95% CI 1.26–5.59) were significant risk factors.	Bias minimised as health assessors were blinded to job titles and physical exposures at work.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Smith et al (2009)[188]	II	1-year prospective study of full-time employees in 12 health care and manufacturing sites (US, N=424)	To assess the relationship between the psychosocial concepts of the demand–control model and the incidence of shoulder symptoms in a working population. Demand–control quadrants into: low strain (low demand, high control), high strain (high demand, low control), active job (high demand, high control), and passive job (low demand, low control)	Eight-five subjects (20%) became shoulder symptom cases by one year. When adjusted for age and gender, those in passive jobs and high strain jobs had a statistically significantly increased risk of shoulder symptoms compared to those in low strain jobs. Job control was statistically significantly associated with incident shoulder symptoms. Awkward upper arm posture (extension $>5^0$ or flexion $>45^0$) at between 20% and 35% of time was also associated with incident shoulder symptoms. Asian/Pacific Islanders were more likely to develop shoulder symptoms in this analysis than non-Asian/Pacific Islanders. The significance of this finding is not clear, but may be related to stature. Asian/Pacific Islanders were shorter than non-Asian/Pacific Islanders (mean height 64.0 inches versus 67.8 inches) ($p<0.001$)	Risk of bias as self-report of shoulder pain used to determine case definition.
Svendsen et al (2004)[195]	III-3	Cross-sectional study in a historical cohort of male machinists, car mechanics and house painters	To determine whether work performed with the arms in a highly elevated position is associated with alterations in the rotator cuff tendons as assessed by MRI	An exposure–response relationship was found between lifetime upper arm elevation and supraspinatus tendinopathy, with age-adjusted OR 1.27 (95% CI 1.02–1.60) for a 5-month increase in the total number of full-time working months spent with the arm elevated >90°.	Bias minimised as radiologist was blinded to work and symptom histories of participants and all participants had an MRI completed.
MacFarlane et al (2009)[123]	I	Systematic Review	To establish whether systematic review articles provide consistent conclusions on associations between workplace psychosocial factors and musculoskeletal pain and, if differences exist, to explore whether this is related to the methods used	15 review articles were identified that considered one or more of the regional pain syndromes. The studies of upper limb pain were exclusively related to shoulder and/or neck pain, and the most consistent positive conclusions were with high and low job demands (four reviews positive out of six, and two reviews positive out of three respectively). Low work demands included jobs evaluated as monotonous or with insufficient use of skills. None of six reviews that considered upper limb pain found sufficient evidence in relation to either low work support or low job satisfaction.	Potential for bias as no appraisal of review articles completed by authors and limited search strategies utilised to locate studies.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Miranda et al (2008)[140]	II	Prognostic prospective cohort (N=909, follow-up 20 years)	To determine whether occupational physical load predicted subsequent chronic shoulder disorders	The risk of developing a chronic, physician-diagnosed shoulder disorder was increased by 80–150% when workers were consistently exposed to a combination of heavy lifting, working in awkward postures, work involving vibration or repetitive movements. The adverse effects of physical work were seen even among those older than 75 years at follow-up. The statistically significant risk factors differed between genders: for men, vibration and repetitive movements, and for women lifting heavy loads and working in awkward postures. Age BMI modified the effects of the physical exposures. The results remained similar after excluding those with any shoulder pain at baseline.	Follow-up participation was 71% (high considering 20-year follow-up timeframe).
Leijon et al (2007)[118]	II	Prognostic prospective cohort of 11 groups with different working and living conditions. (N=1095, 5-year follow-up)	To investigate whether different combinations of working and living conditions are associated with the risk for persistent neck/shoulder and/or low back disorders	Five of the groups—the onerous human services job, the free agent, the family burden, the mentally stretched and the physically strained groups – had an increased risk for persistent disorders (OR 2.38–2.70). The onerous human services job and family burden groups contained largely women (70% and 87%, respectively) working in the human services or service branch. The free agent and physically strained groups consisted mainly of men (78% and 88%, respectively) working in the production branch.	Overall response rate of 82% with no differences observed in response rate of different groups. 85% of respondents reported that they had worked in the same type of job and had worked continuously during the follow-up period.
Madan et al (2008)[125]	III-3	Cross-sectional survey at factories and offices in Mumbai, India and in the UK.	To test the hypothesis that cultural factors such as health beliefs have an important influence on common musculoskeletal symptoms and associated disability	Three groups of computer operators and 3 groups of manual workers –(Europeans, UK workers of Indian decent and Indian workers). In comparison with the Indian manual workers, the prevalence of back, neck and arm pain was substantially higher in all of the other 5 occupational groups. Our findings support the hypothesised impact of cultural factors on common musculoskeletal complaints.	Regression modelling adjusted for age, gender and job satisfaction (identified confounders).

KEY RCS- Rotator Cuff Syndrome SIS – shoulder impingement syndrome OR – odds ratio CI – confidence interval BMI – body mass index RCI – rotator cuff injuries

4.4 Intervention Evidence Tables

4.4.1 Medication

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Faber et al (2006)[61]	I	Systematic review (Literature search to April 2004)	To evaluate the effectiveness of different treatments for impingement syndrome and rotator cuff tear on the improvement in functional limitations and concomitant duration of sick leave	Four 4 studies investigated medication as intervention. All 4 studies compared steroid injections to another form of medication, either injections or oral medication. There is conflicting evidence on the improvement of functional limitations for steroid and analgesic injections.	Bias minimised by comprehensive search, clearly defined study inclusion criteria, appraisal of studies and use of 2 reviewers to extract data.
Massey et al (2010)[131]	I	Cochrane systematic review (Literature search to December 2009)	To review the evidence from randomised, double-blind, controlled trials on the efficacy and safety of topically applied NSAIDs in acute pain	For all topical NSAIDs combined, compared with placebo, the number needed to treat to benefit (NNT) for clinical success, equivalent to 50% pain relief, was 4.5 (3.9 to 5.3) for treatment periods of 6 to 14 days. Topical diclofenac, ibuprofen, ketoprofen, and piroxicam were of similar efficacy, but indomethacin and benzydamine were not significantly better than placebo.	Bias minimised by comprehensive search, inclusion of high quality studies. Study appraisal completed by 2 reviewers using Jadad scale.
Edwards et al (2000)[54]	I	Cochrane systematic review (Literature search to 1998	Quantitatively assess analgesic efficacy and adverse effects of a single-dose of aspirin in acute pain of moderate to severe intensity	Aspirin is an effective analgesic for acute pain of moderate to severe intensity with a clear dose-response. Drowsiness and gastric irritation were seen as significant adverse effects even though the studies were single-dose (600/650mg). The pain relief achieved with aspirin similar milligram for milligram to that seen with paracetamol.	Bias minimised by strict study inclusion criteria and comprehensive literature search. Results pooled from 72 RCTs comparing aspirin to placebo.
Speed (2006)[191]	I	Systematic Review (Literature search to February 2006)	To examine the effects of oral drug treatment and topical drug treatment for rotator cuff syndrome	Authors concluded that it is not known whether oral or topical NSAIDs, oral paracetamol, opioid analgesics or transdermal glyceryl trinitrate improve shoulder pain. Compared with placebo oral NSAIDs may reduce pain in people with acute tendonitis and/or subacromial bursitis (low quality evidence).	Searched broad range of databases and appraised body of evidence using GRADE. Search terms not listed.
Sachs (2005)[174]	n/a	Literature review	Evaluate efficacy of commonly used oral analgesics for acute pain: acetaminophen, (NSAIDs), (Cox-2) inhibitors, tramadol (Ultram) and opiates.	Supports the use of acetaminophen in doses up to 1000 mg as the initial choice for mild to moderate acute pain. Direct comparative studies of acetaminophen and NSAIDs have shown that NSAIDs are more effective than acetaminophen in some situations (e.g. dental and menstrual pain). Higher prescription doses of naproxen and ibuprofen are however associated with increased GI side effects. For more severe acute pain, the evidence supports the addition of oral narcotic medications such as hydrocodone, morphine or oxycodone. Specific oral analgesics that have shown poor efficacy and side effects include codeine, propoxyphene and tramadol.	No description of search strategy or inclusion criteria for studies provided. No appraisal of studies reported.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Petri et al (2004)[163]	II	RCT	To investigate the efficacy of celecoxib in managing patients with acute shoulder tendonitis/bursitis.	The primary outcome measure was the mean reduction in maximum pain intensity at rest, measured using a visual analogue scale. On day 7, the mean reduction from baseline was significantly greater in the celecoxib group compared with the placebo group (–27.7±2.75 mm; 18.4±2.63 mm respectively; $p<0.05$). Similarly, on day 14, the mean reduction from baseline was greater in the celecoxib group compared with placebo (–35.0±3.06 mm; 25.0±3.05 mm; $p<0.05$). The mean reduction from baseline was also greater in the naproxen group compared with the placebo group at day 7 (–26.4±2.70 mm versus –18.4±2.63 mm; $p<0.05$), but not on day 14.	Bias minimised by double blind, placebo controlled study which used an ITT analysis (N=306, with 254 completing study). PEDro score 7/10

KEY NSAIDs – non-steroidal anti-inflammatory drugs NNT – number needed to treat Cox-2 – cyclooxygenase selective inhibitors GI – gastrointestinal ITT – intention to treat RCT – randomised controlled trial

4.4.2 Heat/Cold and Rest

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Bleakley et al (2004)[27]	I	Systematic review	To assess the evidence base for cryotherapy in the treatment of acute soft-tissue injuries.	Twenty-two trials met the inclusion criteria. There was a mean PEDro score of 3.4 out of 10. There was marginal evidence that ice plus exercise is most effective, after ankle sprain and post-surgery. Few studies assessed the effectiveness of ice on closed soft-tissue injury, and there was no evidence of an optimal mode or duration of treatment.	Bias minimised by use of broad search strategies, large number of databases and appraisal of studies using PEDro.
Nash et al (2004)[147]	I	Systematic review	To examine evidence of benefit or harm from immobilisation or mobilisation of acute limb injury in adults.	49 trials of immobilisation for soft tissue injuries and fractures of both upper and lower limbs were identified (3366 patients). All studies reported either no difference between rest and early mobilisation protocols, or found in favour of early mobilisation. Reported benefits of mobilisation included earlier RTW; decreased pain, swelling, and stiffness; and a greater preserved joint ROM.	Bias minimised by broad searching: MEDLINE, Embase, Web of Science and Cochrane library and critical appraisal of methodological strength of trials.
Giombini et al (2006)[70]	II	Randomised controlled trial (N=37)	To evaluate the differences after the use of hyperthermia, ultrasound, and exercises for tendinopathy of the supraspinatus tendon.	37 athletes with tendinopathy were randomised to the following groups: A (N=14) received hyperthermia at 434 MHz; B (N=12) received continuous ultrasound at 1 MHz at an intensity of 2.0 w/cm^2 3 times a week; C (N=11) undertook exercises, consisting of pendular swinging and stretching exercises 5 minutes twice a day, every day. Treatments provided for 4 weeks and outcomes assessed 6 weeks post treatment. Patients who received hyperthermia experienced significantly better pain relief than did patients receiving ultrasound or exercises.	Potential for bias as no blinding of assessors, participants or therapists. Generalisability of results limited as study population was athletes with a mean age of 26.7. PEDro score 7/10
Baskurt et al (2006)[18]	II	Randomised controlled trial N=92	To compare the immediate effects of heat, TENS and heat + TENS applications on the pain related to stage I SIS Group I: heat 20mins Group II: TENS, 100Hz, 0.1ms pulse duration, biphasic, 20mins Group III: heat + TENS	Pain threshold values increased immediately after applications in all groups. VAS pain scores decreased immediately after application in all groups. When the groups were compared there was no statistically significant difference between pain scores.	Potential for bias as therapists, subjects and assessors not blinded. Allocation procedures unclear. Selection bias not controlled after allocation. ITT analysis not performed. PEDro score 4/10
Wilson & Best (2005)[212]	n/a	Literature review	To review treatments for common overuse tendon injuries	Relative rest and reduced activity prevent further damage and promote healing and pain relief. No clear recommendations for the duration of rest and avoidance of activity. Graded as level C= generally accepted practice. *Complete immobilisation should be avoided to prevent muscular atrophy and deconditioning. Cryotherapy provides acute relief of tendinopathy pain and its use is widely accepted. Repeated applications of melting ice water through a wet towel for 10-minute periods are most effective. Graded as level B= inconsistent or limited quality patient-oriented evidence (MacAuley, 2001)[122]	No discussion of how literature was searched and appraised.

KEY ITT – intention to treat VAS – visual analogue scale TENS – transcutaneous electrical nerve stimulation RTW – return to work ROM – range of motion SIS – shoulder impingement syndrome

4.4.3 Exercise and Manual Therapy Evidence Table

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Green et al (2010)[74] (reviewed original SR of 2003 – no change in conclusions)	I	Cochrane systematic review with meta-analysis	To determine the efficacy of physiotherapy interventions for disorders resulting in pain, stiffness and/or disability of the shoulder	Supervised exercise was demonstrated to be effective in terms of short-term recovery in rotator cuff disease (RR 7.74 (1.97, 30.32), and longer term benefit with respect to function (RR 2.45 (1.24, 4.86). Combining mobilisation and exercise resulted in additional benefit compared to exercise alone for rotator cuff syndrome.	Potential for bias as 26 trials of variable methodological quality and small sample sizes were included.
Michener et al (2004)[135]	I	Systematic review	To examine the evidence for rehabilitation interventions for SAIS	Evidence was limited, but exercise, joint mobilisation and laser therapy appeared to be effective in the reduction of pain and improvement of function in patients with SAIS. Exercises were aimed at stretching the anterior and posterior shoulder girdle, muscle relaxation and motor learning to normalise dysfunctional patterns of muscles.	Potential for bias as searching on a small range of databases. 6 RCTs assessed efficacy of exercise.
Verhagen et al (2007)[206]	I	Systematic review	To evaluate whether conservative interventions have a significant impact on outcomes for work-related complaints of arm, neck and/or shoulder	There is limited evidence for the effectiveness of exercises when compared to massage; adding breaks during computer work; massage as add-on treatment to manual therapy and manual therapy as add-on treatment to exercises. For other interventions, no clear effectiveness could be demonstrated.	Bias limited by good searching strategies and appraisal of studies by 2 assessors.
Kuhn (2009)[108]	I	Systematic review	To evaluate the role of exercise in treating rotator cuff impingement and to synthesise a standard evidence-based rehabilitation protocol	Many studies had methodologic concerns but exercise had statistically and clinically significant effects on pain function, but no effect on range of motion or strength. Manual therapy augments the effects of exercise, yet supervised exercise was not different than home exercise programs.	Eleven RCTs included most with small study sizes. Potential for bias as poor reporting of key findings, including statistical significance.
Cardoso de Souza et al (2009)[38]	I	Systematic review	To determine the efficacy of progressive resistance training in patients with SIS	There is a single RCT of high quality (PEDro ≥6) which provides evidence of the efficacy of progressive resistance training for SIS.	Search – Lilacs, MEDLINE, PubMed and Web of Knowledge in English and Portuguese
Ho et al (2009)[83]	I	Systematic review	To examine the effectiveness of manual therapy in the management of musculoskeletal disorders of the shoulder	Manual therapy was not shown to be more effective than other interventions for SIS.	Results were based on a few small studies and there is possibility of publication and language biases.
Kromer et al (2009)[107]	I	Systematic review	To assess the effectiveness of physiotherapy in patients with clinical signs of SIS	Physiotherapist-led exercises appeared to be as effective as surgery in the long term and home-based exercises appeared to be as effective as combined physiotherapy exercises. Passive treatments did not appear to be effective. Trials differed widely and there was insufficient good-quality evidence to reach definite conclusions.	Broad search strategies located 16 RCTs for the review. English, Dutch and German language studies included. RCTs appraised using PEDro and studies excluded if scoring <5.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Kelly et al (2010)[101]	I	Systematic review	To review the effectiveness of exercise intervention for the management of SAIS	There was limited evidence to support the use of exercise in the treatment of SAIS. Further well-defined clinical trials on specific exercise interventions were needed.	Bias minimised via broad search: MEDLINE, Embase, CINAHL, SPORTDiscus, PEDro, AMED, Cochrane Library, National Research Register, Index to Chiropractic Literature with comprehensive search string. 8 trials included and appraised by 2 reviewers using PEDro.
Marinko et al (2011)[128]	I	Systematic review with meta-analysis	To examine the effectiveness of therapeutic exercise as an intervention across all patho-anatomic mechanisms of shoulder pain in terms of ROM, pain, and function	Significant heterogeneity in reporting among included studies (N=17) limited quantitative assessment (meta-analysis only 11 studies included). Overall, therapeutic exercise has a positive effect on pain and function above all other interventions (excluding surgery). The findings for ROM were inconclusive.	Bias limited by study selection and appraisal being completed by two assessors. Studies excluded if scored <6 on PEDro. Only 11 included studies were included in meta-analysis.
Seida et al (2010 – University of Alberta Evidence-based Practice Centre)[172]	I	Systematic review	Comparative effectiveness of operative versus non-operative treatment of RC tears	For the majority of interventions, only sparse data are available, precluding firm conclusions for any single approach or for the optimal overall management of this condition.	Comprehensive literature search and appraisal of 137 studies included, ranging from level IV to level II.
Brantingham et al (2011)[31]	I	Systematic review	To review the efficacy of manual and manipulative therapy for common shoulder pain and disorders	There is 'Fair' evidence (Grade B) for the treatment of a variety of rotator cuff disorders using manual and manipulative therapy to the shoulder, shoulder girdle and/or the full kinetic chain combined with or without exercise and/or multimodal therapy.	Search of physical therapy and chiropractic databases. 35 studies ranging from RCTs to single subject research- rated using PEDro scale.
Valen & Foxworth, (2010)[201]	IV	Literature review	To evaluate recent trials and reviews of physical modalities and conservative treatments for selected upper extremity musculoskeletal conditions	The most consistent positive treatment effects for rotator cuff tendonitis were achieved by ultrasound-guided subacromial corticosteroid injection as well as manual therapy in conjunction with therapeutic exercise.	Potential for bias as no discussion of literature search strategies or systematic appraisal of the quality of studies.
Bennell et al (2010)[20]	II	RCT with blinded placebo control (N=120)	To investigate the efficacy of a program of manual therapy and exercise treatment compared with placebo treatment delivered by physiotherapists for people with chronic rotator cuff disease	A standardised program (10 weeks) of manual therapy and home exercise did not confer additional immediate benefits for pain and function compared with a realistic placebo treatment that controlled for therapists' contact in middle-aged to older adults with chronic rotator cuff disease. However, greater improvements were apparent at follow-up (22 weeks), particularly in shoulder function and strength, suggesting that benefits with active treatment take longer to manifest.	Bias minimised via randomisation procedures, blinded participants, blinded assessors and intention to treat analysis. PEDro score 9/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Andersen et al (2011)[9]	II	RCT	To determine the effectiveness of small daily amounts of progressive resistance training for relieving neck/ shoulder pain in healthy adults with frequent symptoms	As little as 2 minutes of daily progressive resistance training for 10 weeks resulted in clinically relevant reductions of pain and tenderness in healthy adults with frequent neck/ shoulder symptoms (computer operators).	Bias minimised by blinded assessors. PEDro score 8/10
Bernhardsson et al (2011)[22]	n/a	Single-subject research design	To evaluate the effect on pain intensity and function of an exercise concept focusing on specific eccentric strength training of the rotator cuff in patients with SAIS	A 12-week eccentric strengthening program targeting the rotator cuff (specifically supraspinatus and infraspinatus – 3 sets of 15 repetitions, 2 times per day for 7 days a week) and incorporating scapular control and correct movement pattern, can be effective in decreasing pain and increasing function in patients with SAIS.	Findings replicated in 8 of 10 participants. Bias limited by specificity of outcomes and sufficient sampling in baseline and treatment phases.
Osteras et al (2009)[160]	II	RCT	To compare the effect of two exercise programmes: 1) high-dosage (HD) medical exercise therapy versus 2) low-dosage (LD) exercise therapy programme for subjects with long-term subacromial pain *based on progressive resistance training	HD medical exercise therapy is superior to a conventional LD exercise programme (The HD group was to perform three sets of 30 repetitions and the LD group was to do two sets of 10 repetitions). For clinicians to obtain similar positive results with HD exercise therapy, factors such as good communication skills, constant close personal supervision and having from three to five subjects in a group setting are important.	Potential for bias as no assessor blinding and a drop-out rate of greater than 15% in the HD group. PEDro score 7/10
Engebretsen et al (2011)[59]	II	RCT	To evaluate the results of radial extracorporeal shock wave therapy (rESWT) and supervised exercises (SE) provided to patients with subacromial shoulder pain after 1 year	No significant differences between the 2 groups for self-reported pain, function and medication use. Twenty-nine participants (60%) in the SE group versus 24 participants (52%) in the rESWT group were categorised as clinically improved. Thirty-eight participants in the SE group were at work compared with 30 participants in the rESWT group (OR 1.1, 95% CI 1.0 to 1.2). Fewer patients in the SE group had received additional treatments between 18 weeks and 1 year.	Potential for bias as a large number of participants had additional treatments over the study period and there was no placebo control group. PEDro score 7/10
Yiasemides et al (2011)[219]	II	RCT	Does passive mobilisation of shoulder region joints add treatment benefit over exercise and advice alone for people with shoulder pain and minimal movement restriction?	No statistically significant differences were detected in any of the outcome measurements between the control and experimental groups at short-, medium- or longer term follow-up.	Potential for bias as participants and therapists were not blinded. PEDro score 8/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Senbursa et al (2011)[182]	II	RCT	To assess the efficacy of manual therapy in the treatment of patients with symptomatic supraspinatus tendinopathy	Three treatment groups: supervised exercises, supervised exercises plus manual therapy and a home program (12 weeks duration). All groups experienced significant decrease in pain and an increase in shoulder muscle strength and function by both the 4th and 12th weeks of treatment ($p<0.05$). There was no significant difference between the groups in terms of function ($p>0.05$). All 3 treatments are effective and promising methods in the rehabilitation of the patients with SAIS.	Potential for bias as no blinding of assessors, participants or therapists and no ITT analysis. PEDro score 3/10
Ma et al (2011)[121]	II	RCT	To compare the effects of biofeedback with active exercises and passive treatment in treating work-related neck and shoulder pain (related to computer use)	Four groups: biofeedback, active exercises (daily independent program), passive (interferential and hot packs) and control (education booklet). Treatment duration 6 weeks and follow-up at 6 weeks and 6 months. Biofeedback, active exercise and passive treatments all improved pain and disability. Biofeedback yielded the greatest improvement with significantly more favourable outcomes in reducing pain and improving muscle activation.	Potential for bias as no blinding of subjects or therapists and outcomes measures were self-report. High drop-out rate by 6 months (24/72). PEDro score 4/10
Zebis et al (2011)[220]	II	RCT	Evaluates the effect of implementing strength training at the workplace on non-specific neck and shoulder pain among industrial workers (laboratory technicians)	Participants were randomised to 20 weeks of high-intensity strength training for the neck and shoulders 3 times a week (N=282) or a control group receiving advice to stay physically active (N=255). High-intensity strength training relying on principles of progressive overload can be successfully implemented at industrial workplaces, and results in significant reductions of neck and shoulder pain.	Potential for bias as participants not blinded. High adherence to training protocol (85%). PEDro score 6/10
Virta et al (2009)[207]	IV	Case series	To explore how large the proportion of patients with SIS was that did not need surgery when first treated with a supervised exercise program (exercise and manual therapy)	72 of 97 consecutive SIS patients completed the training program; 87% scored excellent or good results. 10 patients went on to surgery with only one of them from the training group. No significant difference was seen in the number of treatments or final results related to age, sex or duration of symptoms. An average of 11 treatments during 8 weeks was required.	No longer term follow-up to determine whether surgery required at a later date. Assessor was therapist who was not blinded to treatment.
Levy et al (2008)[119]	IV	Case series	To determine the efficacy of an anterior deltoid rehabilitation program for older adults with non-operable RC tears	The pain cycle was initially controlled by subacromial injection of a local anaesthetic and NSAIDs (ibuprofen) or analgesics. In 90% of patients, the stabilising effect of recruiting the anterior deltoid was sufficient to improve function and pain adequately. The final constant score was low compared with the postoperative constant score in other conditions. In this group with few options, we recommend a structured deltoid rehabilitation program.	Small sample size N=17. Potential for bias as drop-out rate (12/72) at six weeks and 22/60 at six months.

KEY NSAIDs – non-steroidal anti-inflammatory drugs ITT – intention to treat RC – rotator cuff RR – relative risk RCI – rotator cuff injuries RCT – randomised controlled trial SIS – shoulder impingement syndrome SAIS – subacromial impingement syndrome

4.4.4 Acupuncture Evidence Table

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Green et al (2008)[73]	I	Cochrane systematic (review to 2004)	To determine the safety and efficacy of acupuncture in the treatment of adults with shoulder pain	There was no significant difference in short-term improvement associated with acupuncture when compared to placebo; however, small sample sizes may have resulted in type 2 errors. Acupuncture was of benefit over placebo in a single trial demonstrating improvement in the CMS at 4 weeks. There was no difference in adverse events between acupuncture and placebo (in a single trial). There is little evidence to support or refute the use of acupuncture for shoulder pain although there may be some short-term benefit with respect to pain and function.	Included randomised and pseudo-randomised trials. Nine trials of varying methodological quality and small sample sizes.
Johansson et al (2011)[92]	II	RCT	To compare the efficacy of subacromial CSI by a GP with physiotherapy combining acupuncture and home exercises as treatments for SAIS	Patients diagnosed with SAIS (pain >2 months) were randomised to either subacromial CSI(s) and home exercises or 10 acupuncture treatments combined with home exercises. There were no significant differences between treatments with regard to pain, shoulder function and HRQL in change over time. However, both treatment groups improved significantly from baseline.	Potential for bias as participants and therapists not blinded and moderate drop-out rate >20%. PEDro score 7/10
Molsberger et al (2010)[141]	II	RCT	424 outpatients with chronic shoulder pain (CSP) >6 weeks were randomly allocated to Chinese acupuncture (verum), sham acupuncture (sham) or conventional conservative orthopaedic treatment (COT-physiotherapy)	Participants received 15 treatments over 6 weeks. The results were significant for verum over sham and verum over COT ($p<0.01$) at 3 months post treatment. Chinese acupuncture is an effective alternative to conventional orthopaedic treatment for CSP.	Therapists and assessors not blinded, patients were blinded as to acupuncture or sham acupuncture but not to COT condition. Moderate drop-out rate by 6 month follow-up – 27%. PEDro score 7/10
Szczurko et al (2009)[196]	II	RCT	To explore the effectiveness of naturopathic care (NC) on rotator cuff tendonitis using a prospective randomised clinical trial design (N=85)	NC group received dietary counselling, acupuncture and Phlogenzym (2 tablets 3 times/day). The placebo intervention group received passive, active-assist and active range of motion exercises and matched placebo tablets. Final total SPADI scores decreased by 54.5% ($p<0.0001$) in the NC group and by 18% ($p<0.0241$) in the PE group. NC and PE provided significant improvements, with greater improvement in shoulder function in the NC group compared with the PE group. Statistically significant improvements in quality of life measures were observed in the NC group as compared with the PE group.	Bias minimised by blinded assessors, adequate follow-up and ITT analysis. PEDro score 8/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Lathia et al (2009)[115]	II	RCT (single-blind)	To evaluate the efficacy of acupuncture as a treatment for chronic shoulder pain and to compare the efficacy of individualised acupuncture to fixed, standard point acupuncture treatment	Three treatment groups: individualised acupuncture, fixed-standard acupuncture (conventional points used for shoulder pain) and sham non-penetrating acupuncture. Treatment consisted of 12 treatments over 6 weeks. At 6 weeks the treatment effects of groups 1 and 2 compared to the sham acupuncture group were 13.8 (95% CI: 2.2– 25.4, $p<0.015$) and 13.9 (2.0– 25.8, $p<0.013$), respectively. There was no difference between the individualised acupuncture and standardised acupuncture treatments. Acupuncture may be an effective treatment for chronic shoulder pain.	Findings should be interpreted with caution as small sample size (N=31), predominantly male. No longer term follow-up) and assessors were not blinded. PEDro score 8/10
Vas et al (2008)[205]	II	RCT	Evaluate the efficacy of single-point acupuncture associated with physiotherapy for patients with painful shoulder	All participants received 15 sessions of physiotherapy during the 3 weeks that the treatment lasted and were randomised to additionally receive, once a week, acupuncture or mock TENS At 4 weeks post treatment the mean difference between the two groups on the CMS was statistically significant (6.0 points; 95% CI 3.2, 8.8 points; $p<0.001$). By the end of the treatment, 53% of the patients in the acupuncture group had decreased their consumption of analgesics, compared with a corresponding 30% among the control group ($p<0.001$). Single-point acupuncture associated with physiotherapy improves function and alleviates pain in the shoulder to a greater degree than does physiotherapy as the sole treatment.	Assessors blinded (N=425). Researchers used an ITT analysis for drop-outs. PEDro score 8/10
Razavi et al (2004)[168]	III-1	Prospective, alternate allocation controlled trial	To compare the effect of acupuncture with placebo transcutaneous electrical nerve stimulation (TENS) when added to the exercise treatment of rotator cuff tendonitis	Standardised exercise training program with either 10 treatments of acupuncture or placebo TENS, 1–2 times per week. After treatment both groups improved (pain and ROM), the improvement persisted at the 6-month follow-up with no differences between the groups. There is no difference between the effect of additional acupuncture treatment and placebo TENS in the treatment of rotator cuff tendonitis.	Potential for bias as non-random allocation to groups and unable to determine whether groups were similar at baseline. Patients not blinded to treatments. Small sample size (N=37). PEDro score 4/10

KEY ITT – intention to treat NSAIDs – non-steroidal anti-inflammatory drugs CMS – Constant-Murley Score CSI – corticosteroid injection SAIS – subacromial impingement syndrome HRQL – health related quality of life COT – conservative orthopaedic treatment CSP – chronic shoulder pain NC – naturopathic care TENS – transcutaneous electrical nerve stimulation ROM – range of motion SPADI – shoulder pain and disability index

4.4.5 Therapeutic Ultrasound

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Kromer et al (2009)[107]	I	Systematic review of RCTs (to 2007)	To critically summarise the effectiveness of physiotherapy in patients presenting clinical signs of SIS focusing on outcomes of pain and functioning	Specific to US: Limited evidence (primarily pre-2000): ▪ US is not more effective than sham for improving pain and function. ▪ US is not more effective than acupuncture for improving pain and function.	18 studies included in review. Data pooled when appropriate. Provides relative risk and weighted mean differences with 95% CI.
Michener et al (2004)[135]	I	Systematic review of RCTs (to 2003)	To examine the evidence for rehabilitation strategies for patients with SAIS – specifically non-surgical non-pharmacological treatment	Specific to US. Limited evidence (all US studies pre-2000): ▪ US is not more effective than sham, acupuncture, steroid injection or NSAIDs for improving pain, ROM or function in patients with SAIS.	12 studies included in review. Data not pooled. Limited information beyond original 2 studies.
Johansson et al (2002)[93]	Review	Systematic review of RCTs, non-randomised, concurrent and historical cohorts, and case series	To determine which treatments for patients with subacromial pain are trusted by GPs and physiotherapists, and to compare trusted treatments with evidence from a systematic critical review of the scientific literature	US trusted by 71% of GP/physiotherapists but the systematic review resulted in tentative evidence for lack of efficacy. All US studies were RCT and pre-2000: ▪ No difference between true ultrasound and placebo. ▪ Tentative evidence for lack of efficacy.	40 studies of varying study design.
Ainsworth et al (2007)[2]	II	RCT	Compare the effectiveness of manual therapy and US with manual therapy and placebo US for treatment of 221 new episodes of unilateral shoulder pain (diagnosis unclear) US: pulsed, av intensity 0.5 W/cm^2, av duration 4.5 mins, Frequency 1 or 3 MHz	No differences between groups and no difference from baseline to 6 weeks or 6 months on : 1°: shoulder disability questionnaire 2°: pain, ROM, QoL	71% follow-up at 6 months US was insufficient dosage (too short treatment time, too low intensity and wrong US frequency)[103] PEDro score 10/10
Santamato et al (2009)[176]	II	RCT	To evaluate the short-term effectiveness of high-intensity laser therapy versus US therapy in the treatment of SAIS. US: continuous, intensity 2 W/cm^2, duration 10 mins, frequency 1 MHz	1° pain and daily function: VAS, Constant-Murley Scale and the Simple Shoulder Test. Significant changes observed in both treatment groups after 10 treatment sessions over 2 weeks. HILT showed a greater reduction in pain and more improvement in articular movement, functionality, and muscle strength than in the US treated subjects.	100% follow-up at 2 weeks. Short-term efficacy only. Subjects and therapists not blind. Assessors blind. All participants remained in study to end point, no drop-outs. PEDro score 8/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Johansson et al (2005)[94]	II	RCT	Compare manual acupuncture and continuous ultrasound, both applied in addition to home exercises, for 85 patients diagnosed with SIS US: continuous, intensity 1 W/cm^2, duration 10 mins, frequency 1 MHz	The between-group analysis showed a larger change in the combined score for the acupuncture group when analysed with only those subjects adhering to the study protocol. In the ITT analyses, no differences were found across the 4 data collection periods.	81% follow-up at 6 months, 75% follow-up at 12 months. Subjects and therapists not blind to treatment. Between- group differences were minimal and when ITT analysis performed, no longer significant. PEDro score 8/10
Ginn & Cohen (2005)[69]	II	RCT	Compare the short-term effectiveness of an exercise program with other conservative treatments in 138 subjects with shoulder pain with and without accompanying stiffness. Group 1 = corticosteroid injection Group 2 = exercise Group 3 = combination of US, interferential therapy, heat and ice packs, and ROM exercises	Subjects in each treatment group improved significantly over the 5-week treatment period with no difference between groups in level of change. Outcome measures were similar for subjects with and without accompanying stiffness.	92% follow-up at 5 weeks – only evaluated short -term efficacy. Blind assessors but subjects and therapists not blind. No ITT analysis. Self-developed outcome measure for functional limitations. PEDro score 7/10
Kurtaiş Gürsel et al, (2004)[110]	II	RCT	Assess the effectiveness of US over a placebo intervention when added to other physical therapy interventions and exercise in the management of 40 patients with bicipital tendonosis, rotator cuff tendonosis/tears, subacromial bursitis. Calcific tendonitis excluded. US: continuous, intensity 1.5 W/cm^2, duration 10 mins, frequency 1 MHz	Both groups improved on measures of pain, ROM and on the Health Assessment Questionnaire and Shoulder Disability Questionnaire The pre–post differences did not show any statistical difference between groups.	Lower methodological quality than previous RCTs. Allocation not concealed, therapists were not blind, only 82.6% completed to end of protocol and no longer term follow-up past 15 days of treatment. ITT analysis not performed. PEDro score 6/10
Calais et al (2011)[37]	II	RCT	To compare the efficacy of US, laser and exercise in the treatment of SAIS Laser: Ga As (Model Laserpet 100), 904nm wavelength, 6mW average power, 1J/cm^2 dosage, 16 Hz frequency for 2 mins US: Model Sonoplus 46. 1.5 W/cm^2 at a frequency of 3MHz for 5 mins	Patients were treated 5 days a week for 3 weeks. Three groups: 1. Hotpack, US and exercise 2. Hotpack, laser and exercise 3. Hotpack and exercise. There was a statistically significant improvement in pain (VAS) and function (constant scores) in each of the three groups ($p<0.05$). No differences between groups. Thus US and laser were not superior to each other or exercise. Exercise should form the base for conservative treatment of SAIS.	High potential for bias as patients, therapists and assessors not blinded. High drop-out rate which was not controlled for using an intention to treat analysis. PEDro score 5/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Saunders (2003)[177]	II	RCT	To compare the effectiveness of low power laser therapy, US and no therapy for supraspinatus tendonosis. Laser: The laser dose was 30 J/cm2 via 50 mW 820 nm (infrared) laser probe. Operated for 90 seconds at 5000 Hz over two areas. US: 1.5 W/cm2 using a 9.6 cm^2 treatment head of 1 MHz frequency pulsed at 1:4.	Treatment for the experimental groups comprised nine therapeutic doses over a 3-week period of either laser therapy or US; the control group had no treatment for three weeks. Comparisons after treatment showed that the laser group had less muscle weakness ($p < 0.01$) and pain ($p < 0.01$) than the US and control groups and had less disability ($p<0.05$) and tenderness ($p<0.01$) after treatment than the control group. Based on these results laser therapy should be the treatment of choice for supraspinatus tendonosis rather than US.	Potential for bias as patients and therapists not blinded. Assessors were blinded. Small sample size with N=12 in each group. Limited reporting of results. PEDro score 5/10

KEY RCT– randomised controlled trial SIS – shoulder impingement syndrome SAIS – subacromial impingement syndrome US – ultrasound ROM – range of motion QoL – quality of life ITT – intention to treat VAS - visual analogue scale HILT – high intensity laser therapy ITT – intention to treat

4.4.6 Electro-physical Agents Evidence Table (Laser Therapy)

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Green et al (2010)[74]	I	Cochrane systematic review	To determine the efficacy of physiotherapy interventions for disorders resulting in pain, stiffness and/or disability of the shoulder	Laser therapy was demonstrated to be more effective than placebo (RR 3.71 (1.89, 7.28) for adhesive capsulitis but not for rotator cuff tendonitis.	Literature appraised to 2002.
Michener et al (2004)[135]	I	Systematic review	To examine the evidence for rehabilitation interventions for SAIS.	The current evidence is conflicting; however, it appears that LLLT is more beneficial than placebo when applied as a single intervention for patients with SAIS.	Potential for bias as searching on a small range of databases and based on only 3 trials examining laser therapy.
Calis et al (2011)[37]	II	RCT	To compare the efficacy of US, laser and exercise in the treatment of SAIS Laser: Ga As (Model Laserpet 100), 904nm wavelength, 6mW average power, 1J/cm^2 dosage, 16Hz frequency for 2 mins US: Model Sonoplus 46 1.5 W/cm^2 at a frequency of 3MHz for 5 mins	Patients were treated 5 days a week for 3 weeks. Three groups: 1. Hotpack, US and exercise 2. Hotpack, laser and exercise 3. Hotpack and exercise. There was a statistically significant improvement in pain (VAS) and function (constant scores) in each of the 3 groups ($p<0.05$). No differences between groups. Thus US and laser were not superior to each other or exercise. Exercise should form the base for conservative treatment of SAIS.	High potential for bias as patients, therapists and assessors not blinded. High drop-out rate which was not controlled for using an intention to treat analysis. PEDro score 5/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Abrisham et al (2011)[1]	II	RCT – double-blind	To evaluate the additive effects of LLLT with exercise in comparison with exercise therapy alone in treatment of the SAIS Laser: Mustang 024, wavelength 890nm, variable pulse speed (80Hz – chronic degenerative – 1,500Hz acute inflammation) 2–4J/cm^2 energy density	Ten sessions completed over 2 weeks. Outcomes measured at end of 2 weeks. In comparison between the 2 groups (laser and placebo laser), a significant improvement was noted in all movements in LLLT group (p=0.00) and in VAS scores (p=0.00) which showed significant pain reduction in group LLLT. This study indicates that LLLT combined with exercise is more effective than exercise therapy alone in relieving pain and in improving ROM in patients with SAIS.	Low potential for bias as double-blind study with no drop-outs. Outcomes however impairment-based only and no longer term follow-up. PEDro score 9/10
Dogan et al (2010)[52]	II	RCT	To investigate the effectiveness of 850nm gallium arsenide aluminium (GaAs) laser therapy on pain, range of motion and disability in SAIS Therapy 5 times/week for 14 sessions	Group I (N=30, laser group) received laser therapy (5J/cm^2 at each point over maximum 5–6 painful points for 1 minute). Group II (N=22, placebo laser group) received placebo laser therapy. Initially cold pack (10 mins) was applied to all of the patients and patients were given an exercise program. No significant differences in outcomes were recorded between the groups (p>0.05) at 5 weeks.	High quality double-blind trial. PEDro score 9/10
Santamato et al (2009)[176]	II	RCT	To evaluate the short-term effectiveness of high-intensity laser therapy (HILT) versus US therapy in the treatment of SAIS. Laser: high peak power (1kW), a wavelength of 1,064nm, a maximum energy for a single impulse of 150mJ, an average power of 6W, a fluency of 760mJ/cm^2. US: SONOPLUS 492,† a device that was operated at a frequency of 1 MHz, an intensity of 2 W/cm^2 for 10 minutes	At the end of the 2-week intervention (10 sessions), participants in the HILT group showed a significantly greater decrease in pain than participants in the US therapy group. Statistically significant differences in change in VAS, CMS, and SST scores were observed after 10 treatment sessions from the baseline for participants in the HILT group compared with participants in the US therapy group.	Patients and therapists not blinded; however, assessors were. No control group and HILT group was physiatrist-led while US group was physiotherapy-led (N=70) PEDro score 8/10
Yeldan et al (2009)[218]	II	RCT	To investigate the effectiveness of LLLT in addition to exercise program on shoulder function in SAIS Laser: GaAs diode laser (Roland Serie Elettronica Pagani), wavelength 904nm, frequency 2MHz, three pulses (3J) to each of a maximum of 5 tender points found on clinical examination	Laser or placebo laser, superficial cold and a progressive exercise program were administered to both groups, 5 days a week, for 3 weeks. There were no significant differences between the 2 groups after treatment. There is no fundamental difference between LLLT and placebo LLLT when they are supplementing an exercise program for patients with SAIS.	Possible bias as treating therapists were not blinded and there was no intention to treat analysis performed for the 7 participants who withdrew. No longer term follow-up. PEDro score 7/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Bal et al (2009)[16]	II	RCT	To assess whether GaAs laser therapy improves the outcome of a comprehensive home exercise program in patients with SIS. Program also included hot/cold packs Laser: GaAs diode laser (Roland Serie, Elettronica Pagani), wavelength 904nm, 5.5MHz frequency, 27W maximum power output per pulse, power density of 16.5mW/cm^2. Applied for 10 minutes	There were no significant differences between groups in mean actual changes in night pain and SPADI scores at the second week from baseline. When values at the 12th week were compared to baseline, mean actual changes in night pain differed significantly between the groups, with a larger change in GaAs group, but there was no difference between groups in mean actual change in SPADI scores. This study was unable to demonstrate any distinct advantage of low-level laser therapy over exercise alone.	Potential for bias as neither participants nor therapists blinded. Good longer term follow-up. Small sample size (N=44) and lack of sham treatment. PEDro score 7/10
Bingol et al (2005)[25]	II	RCT	To investigate the effect of low-power gallium-arsenide laser treatment on the patients with shoulder pain Laser: GaAs diode laser instrument (Roland Serie Elettronica Pagani), wavelength 904nm, frequency 2MHz for 5 mins	Group 1 – patients were given laser treatment Group 2 – placebo laser with both groups completing an exercise protocol for 10 sessions during a period of 2 weeks. Superior results ($p<0.01$ and $p<0.001$) in Group I for the parameters of passive extension and palpation sensitivity but no significant difference for other parameters.	Double-blind study with mod-low potential for bias; however, small sample size (N=40) and groups appeared significantly different in terms of gender with group 2 having 19 females (versus 12 in group 1). PEDro score 8/10
Saunders (2003)[177]	II	RCT	To compare the effectiveness of low-power laser therapy, US and no therapy for supraspinatus tendonosis Laser: The laser dose was 30J/cm^2 via 50mW 820nm (infrared) laser probe. Operated for 90 seconds at 5000Hz over 2 areas US: 1.5W/cm^2 using a 9.6cm^2 treatment head of 1MHz frequency pulsed at 1:4.	Treatment for the experimental groups comprised 9 therapeutic doses over a 3-week period of either laser therapy or ultrasound; the control group had no treatment for 3 weeks. Comparisons after treatment showed that the laser group had less muscle weakness ($p<0.01$) and pain ($p<0.01$) than the ultrasound and control groups and had less disability ($p<0.05$) and tenderness ($p<0.01$) after treatment than the control group. Based on these results laser therapy should be the treatment of choice for supraspinatus tendonosis rather than ultrasound.	Potential for bias as patients and therapists not blinded. Assessors were blinded. Small sample size with N=12 in each group. Limited reporting of results. PEDro score 5/10

KEY RR– relative risk SAIS – subacromial impingement syndrome LLLT – low-level laser therapy US – ultrasound VAS – visual analogue scale ROM – range of motion HILT – high-intensity laser therapy SIS – shoulder impingement syndrome RCT– randomised controlled trial GaAs - gallium arsenide aluminium CMS – Constant-Murley Score SST – simple shoulder test SPADI – shoulder pain and disability index

4.4.7 Electro-physical Agents

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
Extracorporeal shock wave therapy (ESWT)					
Huisstede et al (2011)[90]	I	Systematic review of RCTs	Assess the evidence for effectiveness of ESWT as a treatment alternative for calcific and non-calcific rotator cuff tendonosis	Calcific RC tendonosis: Strong evidence for effectiveness in favour of high-ESWT versus low-ESWT in short term. Moderate evidence in favour of high-ESWT versus placebo in short, mid and long term and versus low-ESWT in mid and long term. High-ESWT was more effective (moderate evidence) with focus on calcific deposit versus focus on tuberculum major in short and long term. Non-calcific RC-tendonosis: No strong or moderate evidence was found in favour of low-, mid- or high-ESWT versus placebo, each other, or other treatments.	17 RCTs included. Searched up to October 2010 (no start date). Varying methodological quality of studies. Most common problems included lack of blinding of treatment provider and lack of ITT analysis.
Lee et al (2011)[117]	I	Systematic Review of RCTs	Explore the mid-term (greater than 6 months) effectiveness of ESWT in reducing pain and improving shoulder function in patients with calcified rotator cuff tendonitis ESWT varied: 1000–6000 impulses, 0.06 to 0.55mJ/mm^2	Most studies reported significant improvements in pain scores exceeding 6 months after ESWT treatment, except the low-energy intervention arm in one RCT. Shoulder function improved significantly for the intervention arms at 6 months and 1 year of follow-up. Only 2 studies reported follow-up at both 6 months and 1 year, and both reported improvements at both times. Moderate (level B) overall evidence for the mid-term effectiveness of ESWT in reducing pain and improving shoulder function for chronic calcific rotator cuff tendonitis.	9 RCTs included. Moderate study quality. Heterogeneity in the ESWT intervention parameters in the dosage, area of target, and the number of treatment sessions and interval between each session.
Harniman et al (2004)[77]	I	Systematic review of RCTs and also includes cohort, case controlled and case series –evaluated for methodological quality using a different tool and in separate section to RCTs	To assess the effectiveness of ESWT for the treatment of calcific and non-calcific tendonitis of the rotator cuff ESWT calcific tendonitis: 1–8 sessions, usually weekly, 1000–3000 impulses, density 0.18 to 0.42mJ/mm^2, guided (fluoroscope, radiographic or US) ESWT non-calcific tendonitis: 3 sessions, usually weekly, 1500–2000 impulses, density 0.08 to 0.14mJ/mm^2	Calcific RC tendonitis: Moderate evidence that high-energy ESWT focused on calcific deposit provides effective long-term treatment. Non-calcific RC tendonitis: Moderate evidence that low-energy ESWT is not more effective than placebo (ESWT sham) for short-term improvement.	Includes studies from 1966 to 2003. Varying methodological quality of studies: most common problems included sample size, possible selection and/or treatment provider biases, lack of randomisation and/or blinding, lack of basic descriptive information.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
Mouzopoulos et al (2007)[144]	n/a	Descriptive review of literature	Discuss the indications, mechanism of therapeutic effect, efficacy of treatment and complications after ESWT application for calcific tendonitis of the rotator cuff	Efficacy of ESWT depends on the amount of total energy applied, the frequency of shockwave delivered per second and the guidance method.	Descriptive review only. Search strategy not provided, methodological quality assessment not conducted and no pooling of data.
Seil et al (2006)[180]	n/a	Report of selected literature	To report on experimental studies and clinical application of ESWT for various tendinopathies (including rotator cuff calcifying and non-calcifying tendonitis)	Calcific RC tendonitis: Reabsorption of calcium deposits occurred in all studies following ESWT. High-energy ESWT is superior to low-energy ESWT. Non-calcific RC tendonitis: Low-energy ESWT is not more effective than sham.	Includes 2 studies published before 2000 and 6 studies after 2000 Search strategy not provided, methodological quality assessment not conducted and no pooling of data. Minimal addition to existing knowledge.
ESWT compared to placebo/sham					
Hearnden et al (2009)[79]	II	RCT	To investigate the efficacy of ESWT as a treatment modality for calcific tendonitis of the supraspinatus tendon, and to assess the pain patients experienced during the treatment ESWT: 2000 impulses, 0.28mJ/mm^2 Control: 20 impulses, 0.03mJ/mm^2	There was no improvement in CMS score of the control group but an increase of 11 in the treated group. Between-group difference was statistically significant at 6 months. 9/11 of the patients in treatment group complained of pain after the treatment when the local anaesthetic had worn off. All patients were able to drive home after treatment and return to work the next day; this represents an advantage over other treatments.	N=20, 100% follow-up at 6 months Subjects and assessors blind but physician was not. Statistical analysis questionable – ITT analysis not completed, only group average data shown, no measures of variability. PEDro score 7/10
Hsu et al (2008)[88]	III-1	Pseudo-randomised controlled trial	To study ESWT for calcific tendonitis of the shoulder in 46 consecutive patients. ESWT: 2 sessions, 2 weeks apart, 1000 impulses at 2Hz, 0.55mJ/mm^2 Control: 20 impulses, 0.03mJ/mm^2	Pain reduction and change in CMS scores were statistically significant for the ESWT group but not for the control group. Differences between the two groups were significant. A significant reduction in mean size of calcium deposits for the ESWT group but not for the control group.	N=46 Low methodological quality – randomisation process unclear. Limited reporting of blinding, selection bias. Statistical analysis questionable – ITT analysis not completed. PEDro score 2/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
Notarnicola et al (2011)[155]	IV	Case series with pre-test/post-test	To assess the effect of ESWT on tissue perfusion in the treatment of non-calcific tendonosis ESWT: 3 sessions, 3–4 days apart, US-guided, 2000 impulses at 0.04 to 0.07mJ/mm^2, 2Hz	Significant improvement in pain and CMS scores. US demonstrated complete resolution of the initial picture in 8 patients (27%), an improvement in 17 (57) and persistence in 5 (17%). There was a statistically significant reduction in the oxymetry values in the affected shoulder compared with baseline.	N=50, 100% follow-up at 6 months Observation case series only. No blinding of assessors, subjects or therapists. Good follow-up and sound statistical analysis.
ESWT – comparison of energy level/intensity/guidance techniques					
Gerdesmeyer et al (2003)[68]	II	RCT	To determine if fluoroscopy- guided ESWT improves function, reduces pain and diminishes size of calcium deposits in patients with chronic calcific tendonitis of the shoulder. ESWT: 2 sessions,14 days apart, fluoroscope-guided High-energy: 1500 impulses at 0.32mJ/mm^2, 2Hz Low-energy: 6000 impulses at 0.08mJ/mm^2, 2Hz Sham: 1500 impulses at 0.32mJ/mm^2 (blocked by foil)	1° outcomes: function and pain. 2° outcomes: radiographic disappearance of calcifications. High-energy and low-energy significantly increased function and reduced pain compared to sham. High-energy superior to low-energy. Gains maintained at 6 and 12 month follow-up. Calcium deposit completely disappeared at 12 months in 86% of high-energy; 37% of low-energy and 25% of sham participants.	N=144 , 93% follow-up at 6 months High methodological quality. Subjects and assessors blind but therapists were not. Concealed allocation, baseline group similarity, ITT analysis completed. Sound statistical analysis. PEDro score 9/10
Albert et al (2007)[3]	II	RCT	A prospective randomised trial comparing high-energy and low-energy ESWT for management of calcifying tendonitis of the RC. ESWT: 2 sessions,14 days apart, 2500 impulses, fluoroscope guided High-energy: density up to 0.45mJ/mm^2 Low-energy (control): density 0.02–0.06mJ/mm^2	Mean change in the CMS was significantly greater in the high-energy ESWT group than in the low-energy ESWT group. Mean activities of daily living score also improved significantly in the high-energy ESWT group compared with the control group. Pain relief as assessed by the mean VAS score was more marked in the high-energy ESWT group than in the control group. No treatment effect of low-energy in control group.	N=80. Treatment was well accepted in both groups. Evaluated at 3 months. Subjects blind but therapists and outcome assessor were not. Concealed allocation, baseline group similarity, ITT analysis completed. Sound statistical analysis. PEDro score 8/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
Sabeti et al (2007)[173]	II	RCT	To analyse whether the outcome of navigated low-energy shock-wave therapy for calcifying tendonitis can be improved by raising energy flux density to middle-energy levels ESWT: weekly intervals Group 1: low energy 3 sessions, 1000 impulses, 0.08mJ/mm^2 Group 2: middle energy 2 sessions, 2000 impulses, 0.2mJ/mm^2	Pain and CMS scores: pain significantly reduced and CMS significantly increase in both groups after treatment. No difference between groups receiving different energy levels. Radiographic reports of calcium reabsorption not compared statistically.	N=50, 88% follow-up at 12 weeks. No longer term data. Limited reporting of concealed allocation, patients and therapists not blinded. PEDro score 7/10
Sabeti-Aschraf et al (2005)[172]	II	RCT	Analyse the outcome of low-energy SWT by using a radiographically guided, computer-assisted navigation device to localise the calcium deposit (group 2), compared to conventional localisation through patient feedback (group 1) EWST: 3 sessions, weekly, 1000 impulses at 4Hz, 0.08mJ/mm^2	Both groups significantly reduced pain levels and increased CMS scores – group 2 (radiographically guided) significantly more than group 1 (patient feedback guided). Significantly greater reabsorption on radiographically guided group.	N=50, 100% follow-up at 12 weeks. No longer term data. Limited reporting of concealed allocation, patients and therapists not blinded. ITT analysis not completed. PEDro score 6/10
Moretti et al (2005)[143]	IV	Case series, pre-test/post-test	Evaluate the effectiveness of medium-energy ESWT to treat chronic rotator calcifying tendonitis EWST: 4 sessions, 3-day intervals, 2500 impulses at 2Hz, 0.11mJ/mm^2	Significant reduction in pain and improved constant scores pre to post. 90% subjects calcium deposits disappeared or reduced by more than half.	N=54, 100% follow-up at 6 months. Observation case series only. No blinding of assessors, subjects or therapists.
RSWT – Radial shockwave therapy					
Cacchio et al (2006)[36]	II	RCT	To evaluate the effectiveness of RSWT on pain relief, restoration of shoulder function and resolution of calcific tendonitis of the shoulder RSWT: 4 sessions, weekly, density 0.10mJ/mm^2. 2500 impulses up to 2.5bar pressure, 10Hz Control: 25 impulses	1° outcomes: functionality and pain 2° outcomes: radiographic disappearance of calcifications Clinical and radiographic results showed that RSWT is effective in reducing pain, improving shoulder function and removing calcifications. These results were maintained at the 6-month follow-up.	N=90, 100% follow-up immediately, 93% at 6 months High methodological quality. Subjects and assessors blind but physician was not. Concealed allocation, baseline group similarity, ITT analysis completed. Sound statistical analysis. PEDro score 9/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
Avancini-Dobrovic et al (2011)[15]	IV	Case series with pre-test/post-test	Evaluate the effectiveness of RSWT on a group of 30 patients with calcific tendonitis of the shoulder RSWT: 3–5 sessions, weekly, 2000 impulse, 3 bar pressure, 10Hz	Significant reduction in pain and improvement in ROM and muscle strength. There was a statistically significant reduction in the diameter of shoulder calcification.	N=30, 100% follow-up immediately after treatment and at 6 months. Observation case series only. No blinding of assessors, subjects or therapists. Proportion of sample with data at follow-up not reported.
Engebretsen et al (2011)[59]	II	RCT	To evaluate the results of RSWT and supervised exercise provided to patients with subacromial shoulder pain after 1 year. Group 1:RSWT: 4–6 sessions, weekly, 2000 impulse, 2.5–4 bar pressure, 8–12Hz Group 2: Supervised exercise	Both groups improved but no significant difference between the 2 groups for the 1° outcome (SPADI), or 2° outcomes: pain, function, medication use, work status after 1 year. RSWT is not more effective than supervised exercise in the long term.	N=104, 90% follow-up at 12 months High methodological quality. Assessors blind. Concealed allocation, baseline group similarity, ITT analysis completed. Sound statistical analysis. PEDro score 7/10
ELECTROMAGNETIC FIELD THERAPY					
Kromer et al (2009)[107]	I	Systematic review of RCTs	To critically summarise the effectiveness of physiotherapy in patients presenting clinical signs of SIS focusing on outcomes of pain and functioning.	Specific to EMFT: Conflicting evidence: ▪ When only considering post-2000 studies EMFT is not more effective than sham for improving pain and function ▪ Pre-2000 study suggests EMFT reduced pain more significantly than sham	Includes studies from 1996 to 2007
Aktas et al (2007)[12]	II	RCT	To demonstrate whether pulsed electro-magnetic field (PEMF) provides additional benefit when used with other conservative treatment modalities in acute phase rehabilitation program of SIS Group I - PEMF Group II: sham	Significant improvements in pain, ADL, CMS scores were observed at the end of the treatment in both groups. No significant differences between treatments were observed.	N=46, 87% at follow-up immediately post-therapy – short-term effects only. Blind subjects and assessors but therapists not blind. No ITT analysis. Sound statistical analysis. PEDro score 8/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
Bipolar interferential current					
Fuentes et al (2010)[65]	I	Systematic review and meta-analysis	To analyse the available information regarding the efficacy of IFC in the management of musculoskeletal pain	The single relevant shoulder study fits into the systematic review category of: IFC as a supplement to another treatment versus comparison on pain intensity at discharge. In this comparison the mean difference indicated that IFC as a co-intervention was no better than other conventional interventions such as exercise, TENS, or US plus hot packs at decreasing pain intensity at discharge.	Includes studies from 1950 to 2010. From 2235 abstracts there were 20 included studies – 3 were related to shoulder pain. Strong quality systematic review with meta-analysis.
Ginn & Cohen (2005)[69]	II	RCT	Compare the short-term effectiveness of an exercise program with other conservative treatments in 138 subjects with shoulder pain with and without accompanying stiffness Group 1: corticosteroid injection Group 2: exercise Group 3: combination of US, interferential therapy, heat and ice packs, and ROM exercises	Subjects in each treatment group improved significantly over the 5-week treatment period with no difference between groups in level of change. Outcome measures were similar for subjects with and without accompanying stiffness.	92% follow-up at 5 weeks – only evaluated short-term efficacy. Blind assessors but subjects and therapists not blind. No ITT analysis. Self-developed outcome measure for functional limitations. PEDro score 7/10
Taskaynatan et al (2007)[198]	II	RCT	To compare the effects of steroid iontophoresis and interferential current therapy on bicipital tendonitis. Intervention: hot packs (15 mins), ultrasound (1.5 w/cm^2, five mins), and a standard exercise program Group 1 –steroid iontophoresis: 0.5% hydrocortisone acetate given with the negative electrode, 3–4 mA galvanic current, 15 mins. Group 2 – interferential current: 0–100 Hz, 15 mins.	Pain, ROM, shoulder scale scores improved significantly in Group 1 immediately after the treatment and at 1-month follow-up. Group 2 showed statistically significant improvements immediately post-treatment but the improvements in pain, rotations and ROM were not statistically significant 1 month later. Differences between groups were NOT significant at 1 month.	N=47, 100% follow-up at 1 month. Evaluated short-term efficacy only. Randomisation and concealed allocation. Blind assessors but subjects and therapists not blind. No ITT analysis. Group statistical comparisons sound. PEDro score 7/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question (intervention and sample)	Study Outcome/Findings	Comments/Appraisal
TENS					
Eyigor et al (2010)[60]	II	RCT	To compare intra-articular CSI with conventional TENS for treatment of rotator cuff tendonitis Group 1: Corticosteroid injection Group 2: TENS, 30 mins 5 time/week, 15 sessions, 100Hz, 15mA, 150msn	Both groups reduced pain, improved ROM, SDQ scores, reduced paracetamol use but no change on depression symptoms. Group 1 significantly greater pain reduction, reduction of paracetamol use, and slightly better SDQ scores at one week. No group differences in ROM, SF-36 or depression symptoms.	N=40, 100% follow-up at 1, 4, 12 weeks. No report on concealed allocation. Blind assessors but subjects and therapists not blind. Sound group statistical comparisons with full follow up. PEDro score 7/10
Korkmaz et al (2010)[106]	II	RCT	To compare the efficacy of pulse radiofrequency applied to the suprascapular nerve with the efficacy of conventional TENS treatment in patients with shoulder pain Group 1: radiofrequency needle, sited using fluoroscopy, 45V, 200msn, 42 degrees, 4 mins Group 2: TENS 20 mins five times/week, 20 sessions, 100 Hz, 15mA, 150 msn	Statistically significant improvements in pain, ROM, SPADI, and most SF-36 sub-scales in BOTH groups at in weeks 1, 4 and 12 compared with pre-treatment. No significant difference between the groups in terms of pain, ROM, SPADI SF-36 sub-scores and paracetamol consumption for all weeks.	N=40, 100% follow-up at 1, 4, 12 weeks. No report on concealed allocation. Blind assessors but subjects and therapists not blind. Sound ITT analysis and group statistical comparisons. PEDro score 7/10
Baskurt et al (2006)[18]	II	RCT	To compare the immediate effects of heat, TENS and heat + TENS applications on the pain related to stage 1 SIS Group 1: heat 20mins Group 2: TENS, 100Hz, 0.1ms pulse duration, biphasic, 20mins Group 3: heat + TENS	Pain threshold values increased immediately after applications in all groups. VAS pain scores decreased immediately after application in all groups. When the groups were compared, no statistically significant difference.	N=92. Poor quality RCT. No blinding. Selection bias not controlled after allocation. ITT analysis not performed. PEDro score 4/10

KEY RC – rotator cuff RCT – randomised controlled trial ITT – intention to treat CMS – Constant-Murely Score US – ultrasound VAS – Visual Analogue Scale ROM – range of motion CSI – corticosteroid injection SIS – shoulder impingement syndrome SPADI – shoulder pain and disability index SF 36 – Medical Outcome Score –short from SDQ – shoulder disability questionnaire ICF – international classification of functioning TENS – transcutaneous electrical nerve stimulation ADL – activities of daily living

4.4.8 Return to Work (RTW) Programs

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Karjalainen et al (2010)[98]	I	Cochrane systematic review (Literature to Nov 2002)	To determine the effectiveness of multidisciplinary bio-psychosocial rehabilitation for neck and shoulder pain among working age adults.	Found only two relevant studies: a methodologically low-quality RCT and a methodologically low-quality CCT. There was limited scientific evidence for the effectiveness of multidisciplinary bio-psychosocial rehabilitation for neck and shoulder pain. High-quality trials in this field are required.	Eligibility criteria clearly specified. Broad search strategies used and appraisal of studies by 2 reviewers.
van Oostrom et al (2009)[203]	I	Cochrane systematic review (updated to March 2008)	To determine the effectiveness of workplace interventions compared to usual care or clinical interventions on work-related outcomes and health outcomes	Six RCTs (749 workers): 3 on low back pain, 1 on upper extremity disorders, 1 on musculoskeletal disorders and 1 on adjustment disorders. Workplace interventions were defined by either changes to the workplace or equipment, changes in work design and organisation, changes in working conditions or environment, and occupational (case) management with active stakeholder involvement. Conclusion: There is moderate-quality evidence to support the use of workplace interventions to reduce sickness absence among workers with musculoskeletal disorders when compared to usual care.	Thorough review with authors contacting the included study authors for additional data and study description to assist with data analysis and appraisal of study methodology.
Kuoppala & Lamminpaa (2008)[109]	I	Systematic review (Literature to 2005)	To evaluate the effects of rehabilitation on sickness absenteeism, return to work and disability pensions among persons of working age	Forty-five studies were included in the analysis. There is moderate evidence that RTW programs decrease long sick leaves (RR 0.46, range 0.25–1.10) and multimodal rehabilitation decreases the risk of disability pension (RR 0.64, range 0.52–1.14). Multimodal medical rehabilitation should be combined with vocational rehabilitation if the aim is to increase employees' RTW.	Non-specific diagnosis. Only two databases searched, studies appraised but methods of appraisal poorly described.
Williams et al (2004)[211]	I	Systematic review	To evaluate the available evidence on workplace rehabilitation interventions for work-related upper extremity disorders (WRUEDs).	Eight studies with small sample sizes, lack of standardised outcome measures and inadequate reporting of interventions/ results. The interventions examined included: individual physical therapy, exercises in the workplace, worksite analysis, case management and ergonomic modifications. The findings of this review indicate that the evidence for workplace interventions for WRUEDs has not been established.	Broad search strategies in MEDLINE, CINAHL and Embase. Two reviewers appraised studies using a 24-item quality checklist.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Franche et al (2005)[63]	I	Systematic review (Literature to November 2005)	A systematic review was conducted to review the effectiveness of workplace-based RTW interventions.	Ten studies of RTW interventions provided at the workplace (musculoskeletal conditions). There was strong evidence that work disability duration is significantly reduced by work accommodation offers and contact between health care provider and workplace; and moderate evidence that disability duration and associated costs are reduced by interventions which include early contact with worker by workplace (within 3 months), ergonomic work site visits and presence of an RTW coordinator. Evidence for sustainability of these effects was insufficient or limited. Evidence regarding the impact of interventions on quality of life was insufficient or mixed.	Broad search strategies, appraisal of studies by a minimum of two reviewers and inclusion of range of quantitative studies.
Selander et al (2002)[181]	n/a	Literature review	Overview of factors associated with RTW following vocational rehabilitation for musculoskeletal problems	Subjects receiving earlier vocational rehabilitation, who were offered modified work and/or who were able to influence their own rehabilitation processes were more likely to RTW.	Broad search strategies No appraisal of the methodological strength of studies. Many factors based on a single study.
Martimo et al (2010)[129]	II	RCT	To investigate the effectiveness of an ergonomic intervention on the productivity loss at work caused by upper extremity disorders (N=177)	The intervention consisted of a physician contacting the worker's supervisor and an occupational physiotherapist conducting an ergonomic worksite assessment and modifications where required. At 12 weeks the intervention group had significantly lower self-reported productivity losses; however, the intervention appeared to benefit only those that had productivity losses of <20% at baseline.	Potential for bias as participants and therapists not blinded. Small sample size PEDro score 7/10
Cheng & Hung (2007)[39]	II	RCT 103 workers were recruited and randomly assigned into Clinic (CWH) or Workplace-based Work Hardening (WWH) groups	To investigate the effect of a workplace-based rehabilitation program on the return to work outcome of work-related rotator cuff disorder	After 4 weeks, a higher RTW rate was obtained in WWH group compared to CWH group (71.4% versus 37%, $p<0.01$). A statistically significant difference ($p<0.05$) was also noted in lowering of self-reported shoulder problems and functional work capabilities. The workplace-based rehabilitation program appeared to be more effective in facilitating the RTW of the injured worker as assessed immediately following intervention.	Possible bias as unclear how participants were allocated to treatment groups and no subject or assessor blinding. PEDro score 5/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Feuerestein et al (2003)[62]	II	RCT	To examine an integrated case management (ICM) approach to RTW for Claimants with work-related upper-extremity disorders (WRUED)	ICM (N=96): included medical case management and initial interview focused on domains that may affect injury recovery and RTW. Development of case management plan, active problem-solving to overcome RTW barriers. Work site ergonomic assessment and consequent accommodations. Interventions also aimed at increasing the claimant's self-efficacy for monitoring and preventing future symptoms. Usual care (N=100): included case management in which services often limited to monitoring of the claims process. The ICM group assignment was significantly associated with greater patient satisfaction. Regression analyses found higher patient satisfaction levels predicted decreased symptom severity and functional limitations at 6 months and a shorter RTW. Median RTW time: ICM = 21 weeks, usual care = 23.1 weeks; hazard ratio = 1.09 (van Oostrom et al, 2009).	Potential for bias as no ITT performed and high drop-out rate (only 69.3% completed post-intervention satisfaction survey). PEDro score 3/10
Jorgensen et al (2011)[95]	II	RCT	To evaluate the effect of physical coordination training (PCT) or cognitive behavioural training (CBTr) on musculoskeletal pain, work ability and sickness absence among female cleaners	No overall reduction in musculoskeletal pain, work ability or sickness absence from either PCT or CBTr compared with control group was found in ITT analyses. People with chronic neck/shoulder pain (baseline) were more frequently non-chronic at follow-up after PCT compared with control group (p=0.05). CBTr showed indications of a prevention effect on neck/shoulder pain, but this was non-significant.	Potential for bias due to high drop-out rates which reduced sample size/ power. Bias reduced through ITT analysis. PEDro score 5/10
Shiri et al (2011)[185]	II	RCT	To assess the effect of an ergonomic intervention on pain and sickness absence caused by upper extremity musculoskeletal disorders	Participants (N=177) were workers with UE pain (symptoms >30 days) but who did not require immediate sick leave (69% nurses, 25% clerical, 8% warehouse). Total number of sickness absence days in the intervention group (physical ergonomic assessment) was about half of that in the control (mean 6.2 versus mean 9.8). No differences in the total percentage of employees per group with sickness absence for UED. Authors concluded that early ergonomic intervention reduces sickness absence but does not affect UE pain levels.	Potential for bias as high drop-out rate and no ITT analysis. Subjects and clinicians were not blinded. Study also significantly underpowered. PEDro score 6/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
De Bruijn (2007)[48]	II	RCT with cost-effectiveness analysis	To complete a cost-effectiveness analysis alongside a randomised clinical trial comparing the effectiveness of the early activation program (EAP) in addition to usual care with that of usual care alone (UC group) for prevention of chronicity in patients with acute shoulder complaints	*EAP aim – to prevent the development of inadequate cognitions and maladaptive behaviours by maintaining or inducing proper cognitions and stimulating adequate behaviour.* The comparison of total costs between treatment groups showed no significant (p=.077) difference after 26 weeks. The majority (82%) of the cost-effect pairs after bootstrap analysis were located in the northeast quadrant, suggesting EAP more effect but at higher costs. In view of the clinical relevance of the clinical outcomes and the considerable costs needed to achieve this, it was concluded that the EAP was not cost-effective.	Potential for bias as no blinding of patient or clinician, high drop-out rate. ITT performed; however, insufficient reporting of clinical outcome data. PEDro score 5/10
Osteras et al (2008)[159]	II	RCT	To investigate sick leave and the associated costs after a medical exercise therapy program in patients with longstanding subacromial pain/ impingement	Sixty-one patients were randomly assigned either to a high-dosage medical exercise therapy group (HD) (N=31) or to a low dosage exercise therapy group (LD) (N=30). Both groups were given 3 treatments a week over 3 months. The differences between the groups were number of repetitions, number of sets and time performing global aerobic exercises. The reduction in costs for sick leave for the HD group was 59.1%, whereas for the LD group, the reduction was only 42.3%, which is a significant difference (p<0.05).	Potential for bias as no assessor blinding and a drop-out rate of greater than 15% in the HD group. PEDro score 7/10
Horneij et al (2001)[87]	II	RCT	To evaluate the effects of two different prevention programs on: (1) reported neck, shoulder and back pain; (2) perceived physical exertion at work	(N=282) Intervention programs: (i) individual physical training (N=90) and (ii) stress management (group program meeting 7 times over 7 weeks for 1½ hours, N=93). Control – no intervention (N=99). Improvements in neck and shoulder pain did not differ within the 3 groups over the study period.	High potential for bias as high drop-out rate (40%) and no ITT. Groups also not similar as baseline with regards to satisfaction with work supervisors. PEDro score 4/10
Yassi et al (2001)[217]	II	RCT	To compare the effectiveness of training and equipment to reduce musculoskeletal injuries, increase comfort and reduce physical demands on staff performing patient lifts and transfers at a large acute care hospital	This 3-armed RCT (N=346) consisted of a 'control arm', a 'safe lifting' arm, and a 'no strenuous lifting' arm. Self-perceived work fatigue, back and shoulder pain, safety, and frequency and intensity of physical discomfort associated with patient handling tasks were improved on both intervention arms, but staff on the no strenuous lifting arm showed greater improvements. Musculoskeletal injury rates were not significantly altered.	Potential for bias as no assessor, subject or clinician blinding. No ITT analysis. PEDro score 5/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Arnetz et al (2003)[11]	III-1	Pseudo-RCT (alternate allocation)	To compare the effects on sickness absenteeism of a more proactive role for insurance case managers as well as workplace ergonomic interventions with that of traditional case management (Sweden)	One-hundred and thirty-seven patients with extended sick leave (due to musculoskeletal disorders) were randomised to work intervention (N=65) or usual care (N=72). Work intervention (WI) consisted of early workplace-based interview focused on the social and occupational situation, possible adaptation at work, possibility of vocational training, all stakeholders meeting, ergonomic assessment, introduction of appropriate ergonomic improvements, optional vocational training via a personal training schedule and instruction at work by the ergonomist, the employer was also encouraged to complete a rehabilitation investigation. Mean (SD) duration of sick leave at 12 months: WI = 144.9 (11.8) days, usual care = 197.9 (14) days ($p<0.01$). The benefit-to-cost ratio, based on direct benefits and costs only, was calculated to be 6.8, representing cost savings of 7,200 Skr (USD 1195) per case.	Moderate potential for bias as inadequate allocation concealment and no reporting of study drop-outs. Assessors were blinded. PEDro 3/10* ** This study included in van Oostrom et al (2009) Cochrane review in which additional information from the authors confirmed ITT had been performed.*
Hogelund et al (2010)[84]	III-3	Retrospective cohort study	To examine the effect of a national graded RTW program on the probability of sick-listed workers returning to regular working hours. *The national graded RTW program allows the sick-listed worker to return to the pre-illness job at reduced working hours. During the period of reduced working hours, the worker receives his or her normal hourly wage for the hours worked and sickness benefit for the hours off work.*	The study consisted of 934 workers who were sick-listed for more than 8 weeks. Found that graded RTW program participation significantly increased the probability of sick-listed workers returning to regular working hours. A total of 265 (28%) of the sick-listed workers participated in the graded RTW program after an average of 16 weeks of sick leave. The graded RTW period lasted an average of 11 weeks. Of those who participated in the program, 17% ended the program without returning to regular working hours. Detailed analysis revealed that sick-listed workers with few previous visits to a general practitioner, low age, a post-secondary education, and greater previous labour market experience have a high probability of participating in the program. These factors were adjusted for within the data analysis.	Used an econometric model with adjustment for confounders such as age and educations levels.
Wergeland et al (2003)[209]	III-2	Comparative study with concurrent controls	To examine the relationship between daily work hours and the occurrence of neck/shoulder or back pain in physically demanding care work	Unpublished data were obtained from 3 intervention projects in care institutions. The intervention was a reduction of daily work hours from >7 to 6 hours (or 30 hours weekly). Full-time salary was retained, and extra personnel were employed to compensate for the reduction in work hours. The prevalence of neck/shoulder pain decreased from 40.9% to 25.6% in Oslo and from 57.1% to 39.1% in Helsingborg after 1½ years with a 6-hour workday; for Stockholm the decrease was from 81.6% to 68.3% after 1 year. No decrease was observed in the reference groups.	Potential for bias as no description of how participants were recruited or allocated to groups at each site.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Landstad et al (2001)[114]	III-2	Prospective cohort study with concurrent control	To describe the intensity, frequency and location of pain, and changes in the clinical pain picture after personnel supporting interventions for female hospital cleaners and home-help workers	Two intervention and 2 reference groups. Hospital cleaners (N=23) received a group program focusing on group development, leadership training, lectures on somatic and mental health problems, massage, better cleaning methods, drawing up of a working environment program. Home-help (N=25): a 2-week stay at an orthopaedic rehabilitation unit during which the women were offered physical and mental training and lectures on anatomy, ergonomics, training theory, stress handling, relaxation, analgesics, crises and crisis management, sleep disturbance and diet. Hospital cleaners intervention group, 73.9% were clearly improved or slightly improved (as judged by physician) compared to 27.3% in the ref group. The hospital cleaners given personnel support had a tendency to lower intensity of 'least pain' after the intervention (p=0.055). In the home-help personnel intervention group, 60% improved or slightly improved compared to 17.2% ref group.	High potential for bias as assessing physicians were not blinded. Clinicians and participants also not blinded.
Grooten et al (2007)[75]	III-2	Comparative cohort study	To examine the effect of 2 types of ergonomic intervention on pain and pain-related disability in the neck/shoulder and low back regions	The study group consisted of 492 subjects, representing a total of 125 occupations: 54% were blue-collar workers, 14% white-collar workers in lower positions, 24% white-collar workers in medium/higher positions and 8% others, i.e. self-employed. Based on responses to follow-up questionnaires, 40% of subjects with neck/shoulder and/or low back pain received ergonomic intervention during a 5–6-year period. Educational worksite intervention had a negative effect on the reduction in pain and pain-related disability. The lack of success of educational worksite intervention could have originated from a discrepancy in perception between employers and employees of the causes of neck/shoulder and low back pain. It seems important that before applying ergonomic intervention employers and employees should both agree on which form of intervention would be best.	One-hundred and sixty-four subjects (33%) did not answer the questions concerning ergonomic interventions as the questionnaire design was such that only those who had experienced 7 consecutive days of pain prior to answering the questionnaire had to reply. A dilution of the results could also have occurred when effective and non-effective interventions were grouped into the same category.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Shaw et al (2008)[184]	IV	Mixed methods: case-study approach which comprised of interviews, onsite visits, a document review and a retrospective analysis of the RTW experiences of 184 workers with shoulder injuries	To investigate and evaluate the current workplace management of rotator cuff syndrome in a manufacturing plant	The workplace-based RTW program process included: ▪ Report early symptoms of an injury to their supervisor. The worker and supervisor work together to resolve issue, e.g. ergonomic modification or change in rotation schedule (if not resolved then step 2) ▪ Referral is made to the occupational therapist (OT). The OT conducts an intake interview, functional assessment and an assessment of the worker's jobs. ▪ A RTW plan is collaboratively created including suitable work duties and expected work outcomes. Regularly reviewed. If progress not made then referral to medical specialists initiated. Principles: (i) Involving the worker in self-management and self-direction within the program; (ii) Respect for all involved; (iii) systematic approach to problem-solving; (iv) collaborative communication. Outcomes: One-third of workers were placed on modified duties within 3 days, 56% of workers who engaged in an early RTW program returned to work within 1 month. Overall, 87.8% of workers with rotator cuff syndrome successfully returned to pre-injury work. According to a workplace insurance board the expected time to return-to-function post RC injury is 112 days. For this automotive industry, 80% of workers met or returned to work faster than this standard.	Findings from a single workplace and there was no control group comparison.
McClelland et al (2005)[132]	IV	Prospective case series	To evaluate the return to work and return to driving of a cohort of patients undergoing arthroscopic subacromial decompression (N=68)	Only 1 non-manual worker did not return to work within 6 weeks (N=13). Eighty-five per cent of manual workers returned to manual work within 3 months (N=25). The difference in RTW between the manual and the non-manual groups was significant (p=0.036; independent sample *t*-test). Fifty-one patients held driving licences. The average time to return to driving was 28.9 days. From our study we have concluded that return to work for non-manual occupations can be expected within 6 weeks, and for manual occupations by 3 months for the majority of patients.	Small sample size as only 38/68 were employed prior to surgery.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Westman et al (2006)[210]	IV	Prospective case series	To assess quality of life and the effect of early multimodal rehabilitation on 91 patients with musculoskeletal pain and disability at a 5-year follow-up	Participants completed a group program 3.5 hours per day, 5 days a week for 8 weeks (8–10 patients in each). Program consisted of physical training; warm water pool training, circulation exercises and/or lightweight training, body awareness exercise, relaxation training and creative activities (e.g. music, dance, art). The activities alternated with group discussions and education in pain physiology and psychology, ergonomics, stress and pain management, lifestyle, diet and discussions of existential issues. The project established early contact with the employer and work training started as soon as possible. All patients were on sick leave at the start of the study. At the 1-year follow-up, 81% of the patients were at work part or full-time. At the 5-year follow-up, this percentage dropped to 58% with 7% of the patients >65 (retired). Improvements in pain, perceived health and symptoms were maintained at the 5-year follow-up.	No control group, musculoskeletal pain of mixed aetiologies.
Sood et al (2007)[190]	Task analysis	Laboratory-based simulation of overhead work was conducted, at 3 working heights	To identify shoulder fatigue and potential non-linear effects of overhead work height	Used subjective ratings of perceived discomfort and found that the effects of work height appeared to be related to a combination of muscle activation levels and demands on precision/control at the highest location. These results demonstrate increasingly detrimental fatigue and performance effects at extremes in reach during overhead work.	n/a
Nordqvist et al (2003)[153]	n/a	Qualitative study – focus groups with laypersons with experience of long-term sickness absence	To examine the views of laypersons regarding factors that hinders or promotes return to work	Laypersons spontaneously emphasised the importance of the employer. Specifically, they stressed the need for a structured BTW program at each workplace, which should include contacting absent employees and informing fellow workers of possible changes in task assignments upon return of the absent person. Reported hindering factors included lack of such information, leading to envy and harassment. Respondents also asserted the importance of work supervisors in creating a positive emotional atmosphere.	No comment on whether saturation of data occurred.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal (PEDro)
Stenlund et al (2002)[193]	Task analysis	Case series (N=40)	To identify work techniques that would be less strenuous to the arms and shoulders during sanding work by house painters	A biomechanical model was applied to quantify the shoulder loads during sanding and to determine the likely muscle force distribution. Three different work techniques were identified: the normal technique, the reversed grip and the pushing technique. The pushing technique was characterised by shorter stroke length and lower speed of the grinding block than the other techniques. The painters among the group of subjects who used the pushing technique were found to report fewer shoulder disorders during sanding than the others.	n/a

KEY RTW – return to work RR – risk ratio EAP – early activation program WRUED – work-related upper extremity disorders RCT – randomised controlled trial CCT – clinical controlled trial CWH – clinic-based hardening WWH – workplace-based hardening ICM – integrated case management UE – upper extremity EAP – early activation program RCI – rotator cuff injuries RC – rotator cuff UED – upper extremity disorder

4.4.9 Corticosteroid Injections (CSI)

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Buchbinder et al (2009)[33]	I	Cochrane systematic review	To determine the efficacy and safety of CSI in the treatment of adults with shoulder pain	CSI may be of limited short-term benefit for shoulder pain. The number, site and dosage of injections varied widely between studies. For rotator cuff disease, subacromial CSI was demonstrated to have a small benefit over placebo in some trials; however, no benefit over NSAIDs was demonstrated based upon the pooled results of 3 trials.	Included randomised and pseudo-randomised trials – 26 trials in total.
Coombes et al (2010)[44]	I	Systematic review	To establish clinical efficacy and risk of adverse events for treatment of tendinopathy by CSI	Forty-one RCTs met inclusion criteria, providing data for 2672 participants. Short-term efficacy of CSI for rotator cuff tendinopathy was not clear. Of studies that reported adverse events, only one participant (0ĸ1%) had a serious adverse event (tendon rupture).	Searched 8 databases and appraised each RCT with a modified version of the PEDro scale and excluded studies that scored below 50%.
Gaujoux-Viala et al (2009)[66]	I	Systematic review with meta-analysis	To assess the efficacy and safety of CSI for patients with tendonitis of the shoulder or elbow	CSI are well tolerated and more effective for tendonitis in the short term than pooled other treatments, though similar to NSAIDs. No long-term benefit was shown. The effectiveness of steroids (ES) versus the pooled controls for pain: at weeks 1–3 ES=1.18 (95% CI 0.27–2.09), at week 4–8 ES=1.30 (95% CI 0.55–2.04), and at week 48 ES=0.07 (95% CI 20.60–0.75). The main side effects were transient pain after injection (10.7%) and skin modification (4.0%).	Included RCT and clinical trials (8 studies examined shoulder tendonitis). Two authors rated trial quality.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Grant et al (2004)[72]	I	Systematic review	To review evidence for surgical and conservative treatments for RC disease	Due to the low methodological quality of studies available in this area, there is insufficient evidence to support or refute the effectiveness of any available treatment for RC disease.	Bias minimised as large number of databases searched and studies appraised by 2 assessors.
Koester et al (2007)[104]	n/a	Literature review	To investigate whether subacromial corticosteroid injections are effective in the treatment of rotator cuff disease	There is little reproducible evidence to support the efficacy of subacromial corticosteroid injection in managing rotator cuff disease.	Potential for bias as searched – MEDLINE only. Appraised 9 RCTs and determined that results from studies could not be pooled due to heterogeneity in subjects.
Arroll & Goodyear-Smith (2005)[12]	I	Systematic Review with meta-analysis	To determine the effectiveness of intra-articular and subacromial injections of corticosteroid for rotator cuff tendonitis and frozen shoulder	Subacromial injections of corticosteroids are effective for improvement of rotator cuff tendonitis up to a 9-month period. They are also probably more effective than NSAIDs medication. Higher doses may be better than lower doses for rotator cuff tendonitis. The number needed to treat based on the pooled relative risk was 3.3 (95% CI = 1.8–7.7) patients to obtain one improvement. The relative risk for improvement with steroids compared with NSAIDs was 1.43 (95% CI = 0.95–2.16).	Pooled results of 5 appraised RCTs. Pooling completed under dichotomous outcome variable of none/improvement.
Soh et al (2011)[189]	I	Systematic review with meta-analysis	To assess the efficacy and safety of image-guided versus blind CSI in improving pain and function in adults with shoulder pain	Patients who underwent image-guided (ultrasound) injections had statistically significant greater improvement in shoulder pain and function at 6 weeks after injection.	Results based on meta- analysis of data from 2 moderate-sized trials (Naredo et al, 2004; Uncuncu et al, 2009).
Johansson et al (2011)[92]	II	RCT	To compare the efficacy of subacromial CSI by a GP with physiotherapy combining acupuncture and home exercises as treatments for SIS	Patients diagnosed with SIS (pain >2 months) were randomised to either subacromial CSI(s) and home exercises or 10 acupuncture treatments combined with home exercises. There were no significant differences between treatments with regard to pain, shoulder function and HRQL in change over time. However, both treatment groups improved significantly from baseline.	Potential for bias as participants and therapists not blinded and moderate drop-out rate >20% PEDro score 7/10
Crawshaw et al (2010)[45]	II	RCT	To compare the effectiveness of subacromial CSI combined with timely exercise/ manual therapy (injection plus exercise) or exercise/ manual therapy alone (exercise only) in patients with SIS	At week 12 there was no significant difference in change in total SPADI between the groups (mean difference between change in groups 3.26 (95% confidence interval −0.81–7.34), p=0.116). Improvement was significantly greater in the injection plus exercise group at week 1 (6.56, 4.30–8.82) and week 6 (7.37, 4.34–10.39) for the total SPADI (P<0.001)	Potential for bias as no blinding of participants, treating therapists or assessors. PEDro score 7/10
Ekeberg et al (2009)[55]	II	RCT	To compare the effectiveness of ultrasound-guided corticosteroid injection in the subacromial bursa with systemic CSI in patients with rotator cuff disease	No important differences in short-term (6-week) outcomes were found between local ultrasound- guided CSI and systemic CSI in rotator cuff disease. The study did not include a sham injection group, so whether either treatment is superior to placebo could not be determined.	Participants and assessors were blinded to treatment groupings. PEDro score 9/10

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Henkus et al (2006)[81]	II	RCT	To assess the accuracy of shoulder infiltrations in the subacromial bursa (SAB) by a posterior or an anteromedial approach. Magnetic resonance imaging (MRI) and clinical outcome were used for evaluation	Thirteen injections (76%) were in the SAB with a posterior approach and 10 (69%) with an anteromedial approach. Many surrounding structures were hit as well. Only injection of the SAB alone resulted in a significant decrease of the pain (p=.004) and an increase in function scores. Infiltration of the RC was high and correlated with increased pain scores. At 6 weeks there were no differences between pain and functional scores for any group compared to their baseline measures.	Groups similar at baseline. Small sample size (N=33). All participants received treatment as allocated. PEDro score 5/10
Uncuncu et al (2009)[200]	III-1	RCT	To compare the effectiveness of landmark-guided (LMG) local injections and ultrasonography (USG) guided injections for shoulder pain	18 patients in LMG and 24 patients in USG had limited shoulder ROM – 6 returned to normal values in LMG group and 12 in USG group at 6 weeks after injection ($p<0.05$). The injection of CS to patients with shoulder pain due to soft tissue disorders under USG may improve therapeutic effectiveness and reduce adverse effects.	Potential for bias as treating therapists and subjects were not blinded. Mixed shoulder pathologies. PEDro score 5/10
Rutten et al (2007)[171]	II	Study of accuracy using a valid reference standard (MRI)	To compare the accuracy of blind injection (by orthopaedic surgeon) to that of US-guided injection (radiologist) into the subacromial bursae using MRI	The accuracy of blind and US-guided injection was the same. Blind injection into the subacromial bursae is as reliable as US-guided injection and could therefore be used in daily routine.	Small sample size (N=20). Assessors blinded to injection technique. No statistical reporting of key findings.
Eyigor et al (2010)[60]	II	RCT	To compare intra-articular CSI to conventional TENS treatment in the treatment of RC tendonitis (both groups also completed a home exercise program)	CSI and TENS are effective in the treatment of RC tendonitis evidenced by significant decreases in pain, disability and paracetamol use over a 12-week period. When compared CSI provided greater efficacy in the first few weeks with regard to pain relief, ROM and disability.	Small sample size (N=40). Potential for bias as participants and therapists not blinded. Assessor blinded. No control group. PEDro score 7/10
Hong et al (2011)[86]	II	RCT	To determine whether subacromial injection with high-dose corticosteroid in patients with periarticular shoulder disorders is better than low-dose corticosteroid or placebo in improving pain, function and active range of motion (AROM)	Three groups: high dose, low dose and placebo. Between-group comparison identified significant differences in VAS score, SDQ score, and AROM between groups 1 and 2 and group 3 at weeks 2, 4, and 8 ($p< 0.0167$)This study showed no significant differences between the high- (triamcinolone acetonide, 40mg) and low-dose (20mg) corticosteroid groups, indicating preferred use of a low dose at the initial stage.	Low level of bias as therapists, assessors and participants were blinded and low drop-out rate. Valid for short-term findings (8 weeks). PEDro score 9/10
Naredo et al (2004)[146]	II	RCT	To compare the short-term response to randomized blind injection versus sonographic-guided injection of local CSI in patients with painful shoulder.	Sonographic-guided CSI should be indicated, at least, in patients with poor response to previous blind injection to ensure accurate medication placement.	Subjects and treating clinicians not blinded PEDro score 6/10

KEY RC – rotator cuff AROM – active range of motion CSI – corticosteroid injections RC – rotator cuff SIS – shoulder impingement syndrome MRI – magnetic resonance imaging ROM – range of motion TENS – transcutaneous electric nerve stimulation US – ultrasound VAS – visual analogue scale SDQ – shoulder disability questionnaire

4.5 Rotator Cuff Surgery

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Studies comparing outcomes of surgical versus conservative treatment					
Huisstede et al (2011)[90]	I	Systematic review of RCTs and other systematic reviews	Review includes patients with a rotator cuff tear where the tear was not caused by an acute trauma or systemic disease, results on pain, function or recovery with a follow-up time of at least 2 weeks were reported	Operative versus non-operative treatment: For small or medium tears, moderate evidence was found in favour of surgery versus physiotherapy in mid and long term (based on one RCT).	Includes studies up to July 2010. Three RV + 14 RCTs included (7 high qual). 13/14 RCTs performed adequate randomisation and were free of suggestions of selective outcome reporting. The care provider was not blinded in any of the RCTs.
Gebremariam et al (2011)[67]	I	Systematic review of RCTs	Review included studies of patients with SIS who received surgery for treating SIS. Results on pain, function or recovery were reported at a follow-up period of at least 2 weeks	This review shows that there is no evidence that surgical treatment is superior to conservative treatment or that 1 particular surgical technique is superior to another for SIS. Because of possibly lower risks for complications and reduced cost, conservative treatment may be preferred. When choosing surgery, arthroscopic decompression may be preferred because of the faster recovery of ROM and the less invasive character of the procedure.	Includes studies up to February 2008. One RV + 5 RCTs (2 high quality, 3 low quality) included. (The review is the Cochrane review below.) The most prevalent flaws were: care provider not blinded (as expected in surgery) and no ITT analysis.
Coghlan et al, (2009)[43]	I	Cochrane systematic review of RCTs	Adults with rotator cuff disease, confirmed by physical examination, magnetic resonance imaging (MRI), ultrasound or arthrogram. Eleven trials included participants with impingement, 2 trials included participants with rotator cuff tear and 1 trial included participants with calcific tendonitis. Four trials compared either open or arthroscopic subacromial decompression with active non-operative treatment	Surgery (open or arthroscopic) versus active non operative treatment for impingement syndrome (physiotherapy or exercise programme: no differences in outcome between treatment groups were reported in any of these trials. Participants in both groups that received active treatment were reported to have improved significantly more than those in the placebo group. Arthroscopic versus open subacromial decompression: no significant differences in outcome between groups at any time point although 4 trials reported a quicker recovery and/or return to work with arthroscopic decompression.	Includes studies up to March 2006. A total of 4235 screened. Forty-one retrieved and 14 studies included in review involving 829 participants. No study met all methodological quality criteria and minimal pooling could be performed. None of the pre-planned subgroup or sensitivity analyses were performed due to small sample sizes, small number of trials in most comparisons and heterogeneity of interventions and outcomes.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Seida et al (2010)[178]	IV	Systematic review of RCTs and cohort studies with no control group (Level II to IV studies)	Questions: Early versus late surgical repair, operative versus non-operative treatments, complications and prognostic factors. 1° outcomes: quality of life, functional outcomes, time to return to work, cuff integrity	Operative versus non-operative: Five studies (low quality in general, only 1 RCT) – all groups showed statistically significant improvements regardless of the intervention. Statistically significant differences in function that favoured operative repair were seen in 4/5 studies. In general, the evidence was too limited to make conclusions regarding comparative effectiveness.	Includes studies from 1990 to 2009. A total of 137 studies included. All RCTs and controlled clinical trials had a high risk for bias. The most common sources of potential bias were inadequate blinding, inadequate allocation concealment and incomplete outcome data. Methodological quality of the cohort studies was moderate.
Moosmayer et al (2010)[142]	II	RCT	Purpose of this study was to present an RCT comparing operative repair with physiotherapy in the treatment of small and medium-sized full-thickness tears of the rotator cuff	Analysis of between-group differences showed better results for the surgery group on the constant scale, on the American shoulder and elbow surgeons scale, for pain-free abduction and for reduction in pain.	Follow-up at 12 months was 90%. Subjects and therapists NOT blind. Concealed allocation. Assessors blind. Sound statistical analysis including ITT. PEDro score 8/10
What are the clinical indictors of rotator cuff surgery? General findings					
Marx et al (2009)[130]	n/a	Descriptive literature review (non-systematic)	Review of 6 leading orthopaedic journals to ascertain whether the indications for surgery actually are described in outcome studies of rotator cuff surgery	Tear size (range small to massive) reported in 88% studies. Duration of symptoms reported in 56% studies – most 6–12 months (range 1 month–244 months) Failure of non-operative treatment reported 52%. Period of treatment most commonly 3 months (ranged <3 months to 24 months); 44% reported history of trauma; 31% reported ADL limitation; 16% reported nocturnal pain.	Very low quality review, strong bias as only 6 journals reviewed. Provides general not specific information to answer question.
Tanaka et al (2010)[197]	III-3	Retrospective cohort study	Determine the factors related to the successful outcome following conservative treatment for full-thickness tears of the rotator cuff	After 3 months of conservative treatment, clinical symptoms improved in 62 patients, but remained unchanged or aggravated in 56 patients, who eventually underwent surgical repair. Clinical features differentiating groups: ▪ range of external rotation movement ▪ positive impingement sign = surgery ▪ muscle atrophy of supraspinatus ▪ intramuscular tendon of supraspinatus (ruptured = surgery)	Retrospective study, based on available data; therefore, high potential for subject bias. Measurement at body structure/function level only. Sound statistical comparison with odds ratios provided.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Oh et al (2006)[158]	IV	Systematic review of clinical studies (outcomes studies and prognostic studies, including all study designs)	To investigate factors influencing the decision to surgically repair symptomatic, full-thickness rotator cuff tears	Disagreement regarding the duration of symptoms and ultimate clinical outcome; duration of symptoms does not necessarily reflect the duration a patient has had a rotator cuff tear as not all rotator cuff tears are symptomatic.	Included studies up to 2005. Systematic search but no appraisal of study quality. Included all levels of evidence. Results descriptive only.
Symptomatic versus asymptomatic tears					
AAOS, 2010[4]	I	Clinical guidelines with systematic review	Assist physicians to improve quality and efficiency of patient care. Focused on adults with rotator cuff problems, in particular full-thickness tears for surgical recommendations	Rotator cuff repair is an option for patients with chronic, symptomatic full-thickness tears. (Weak evidence – 6 studies.) Consensus opinion that surgery not be performed for asymptomatic, full-thickness rotator cuff tears. (Consensus opinion only – insufficient evidence.)	Includes studies from 1965 to 2008. A total of 5664 abstracts screened, and 388 retrieved and 75 studies included in guidelines.
Mall et al (2010)[126]	III	Prospective cohort study	Purposes of this study were to identify changes in tear dimensions, shoulder function and glenohumeral kinematics when an asymptomatic rotator cuff tear becomes painful	N=44/195 patients with asymptomatic shoulders developed pain mean 1.9 years. The size of the rotator cuff tear was significantly greater in the group that became symptomatic. Shoulder function significantly reduced in group that became symptomatic. Substantial tear progression observed in group that became symptomatic compared to non-symptomatic group.	N=196 with 100% follow-up over period of 0.5–5 years. Markers of risk identified and prospectively followed at yearly intervals. Outcomes assessed across all ICF levels.
Tear size/number of tendons involved					
Bjornsson et al (2011)[26]	III-3	Retrospective cohort study	Investigated whether the structural and clinical outcomes after surgical repair of an acute rotator cuff tear are influenced by delay in repair, age at repair and the extent of the initial cuff injury	There was no significant relationship between the number of tendons involved at the primary injury and the clinical or structural outcomes. Results do not appear to support the idea that more than 1 full-thickness cuff tear or multiple tendon tears result in increased structural risk or worse mechanical properties and shoulder function after repair.	N=42, mean age 59 years. Retrospective study – unclear what proportion of all surgeries were recruited to study. Follow-up at 39 month. Standardised assessments performed by independent assessor.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Lähteenmäki et al (2007)[111]	III-3	Retrospective cohort study	To evaluate the results of late repair of rotator cuff lesions and analyse the factors determining the long-term outcome	Improvements were recorded across all tear size groups. Smaller tears were significantly associated with less post-op pain, improved function, increased strength and patient satisfaction. Authors present some conflicting interpretations of findings: 'The history of trauma and size of the tear were the most dominant factors affecting the final outcome', and 'We recommend operative treatment of the rotator cuff for all cases in which the tear is full-thickness, regardless of tear size, if patients have any symptoms, especially pain'.	Retrospective study – included approximately 60% of all RCT repairs in facility over 10-year period. Standardised assessments performed. Outcome assessments not blind. Recommendations do not directly follow from the study findings – contradictory.
Wu et al (2003)[215]	III-3	Retrospective cohort study	To identify any clinical and radiologic findings of rotator cuff injury that predicts whether patients will undergo shoulder surgery	The only statistically significant predictor of surgical intervention was full-thickness tears (with or without tendon retraction) on sonography. Patients with full-thickness tears were 4.3 times more likely to undergo surgery than those with no tears.	Retrospective study based on available data; therefore, high potential for subject bias. Sound statistical comparison with odds ratios provided.
Oh et al (2006)[153]	IV	Systematic review of clinical studies (outcomes studies and prognostic studies)	To investigate factors influencing the decision to surgically repair symptomatic, full-thickness rotator cuff tears	Found general agreement tear size predicts long-term results. There is level III and IV evidence that larger size of tear is associated with worse results after surgical repair.	Included studies up to 2005. Systematic search but no appraisal of study quality. Results descriptive only.
Strauss et al (2011)[194]	IV	Systematic review – all studies were level IV evidence, case series	To compare the results of the recommended arthroscopic treatments and evaluate which potential variables are associated with successful outcomes for patients with partial-thickness rotator cuff tears	Treatment for partial-thickness rotator cuff tears can be separated into 2 main categories: debridement and repair. On the basis of the available data, partial-thickness tears of less than 50% or Ellman grade II or less can be successfully treated with debridement alone. It does not appear that formal subacromial decompression leads to superior outcomes when compared with debridement alone.	Includes studies from 1996–2009. Reviewed 29 studies and included 16. Systematic search but no appraisal of study quality
Fatty infiltration					
AAOS, 2010[4]	I	Clinical guidelines with systematic review	Assist physicians to improve quality and efficiency of patient care. Focused on adults with rotator cuff problems, in particular full-thickness tears for surgical recommendations	Negative effect of supraspinatus and infraspinatus muscle atrophy and fatty degeneration on tendon healing and clinical outcomes: Weak evidence (6 studies).	Includes studies from –2008. A total of 5664 abstracts screened, 388 retrieved and 75 studies included in guidelines.
Gladstone et al (2007)[71]	II	Prospective cohort study	To determine if preoperative muscle quality impacts on outcome	Pre-operative muscle atrophy and fatty infiltration of supraspinatus and muscle atrophy of infraspinatus negatively correlate with functional outcome. Tear size was the only significant predictor of repair integrity.	Prospectively recruited, retrospectively followed-up after surgery. Follow-up 100%. Blinding not mentioned.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Melis et al (2010)[134]	IV	Case series, retrospective chart review	To analyse the natural history of infraspinatus fatty infiltration in rotator cuff tears to determine the timing of the appearance and the speed of progression	Stage 2 fatty infiltration appears at an average of 2½ years after the onset of symptoms, and surgical repair should be done within this timeframe if possible.	N=1688, sound follow-up. Low-quality study design, retrospective chart review – subject to biased recording. Standardised outcome measures. Blinding not reported.
Radiographic indictors					
Lam et al (2006)[113]	n/a	Descriptive literature review	Review of the published papers evaluating each treatment modality for calcifying tendonitis of the rotator cuff	Indications for performing an acromioplasty for calcifying tendonitis are: ▪ radiological evidence of mechanical impingement ▪ intraoperative evidence of mechanical impingement ▪ type C calcium deposits with an ill-defined contour and heterogeneous appearance on X-ray.	Descriptive review only. Search strategy not provided, methodological quality assessment not conducted, no pooling of data. Strong potential bias in selection of studies contributing to review.
When should rotator cuff surgery occur?					
Seida et al (2010)[178]	I	Systematic review of RCTs and cohort studies	Questions: Early versus late surgical repair, operative versus non-operative treatments, complications and prognostic factors. 1° outcomes: quality of life, functional outcomes, time to RTW, cuff integrity	<u>Early versus late surgical repair:</u> One RCT which compared early versus late surgical repair after failed non-operative treatment found superior functional outcome scores with early repair but did not report the statistical significance of this difference. Overall, the evidence was too limited to make a conclusion.	Includes studies from 1990-2009. A total of 5677 studies identified and included 137. See above for discussion about quality of included studies.
Chillemi et al (2011)[40]	II	Prospective cohort study	To evaluate if the histopathological changes biopsied at the time of surgery could predict future clinical evolution	Surgery, whether open or arthroscopic, should be done as soon as possible to approach a recent and smaller lesion in a younger patient (evidence of rotator cuff tear on MRI examination).	N=84, mean age 64 years. Prospective study, 100% follow-up and blind outcome assessors.
Bjornsson et al (2011)[26]	III-3	Retrospective cohort study	Investigated whether the structural and clinical outcomes after surgical repair of an acute RCT are influenced by delay in repair, age at repair and the extent of the initial cuff injury	Mean time to repair was 38 days in the defect group and 39 days in the intact group. No significant differences in Constant-Murley score, DASH score, or WORC index were found between the groups, irrespective of whether the repair had been performed within 3 weeks, within 6 weeks or within 12 weeks.	N=42, mean age 59 years. Retrospective study – unclear what proportion of ALL surgeries were recruited to study. Follow-up 39 month. Standardised assessments performed by independent assessor.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Lähteenmäki et al (2006)[112]	IV	Case series with pre-test/post-test outcomes	Analysed the functional outcome of a strictly selected group of 26 patients with sudden onset of symptoms, full-thickness rotator cuff tear who were operated on within 3 weeks of injury	Significant post-surgical improvements in pain, function and active ROM. With regard to both pain and function, a satisfactory outcome can be achieved even in large ruptures, if the operation is performed within 3 weeks of the acute onset of symptoms.	Follow-up 90%, mean 6 years post-surgery. Highly biased group. Only 26/548 met criteria. No comparison group to determine if early is better than late.
Berhouet et al (2008)[21]	IV	Cohort study of patients at different stages of disease	Descriptive study of 112 patients aged less than 65 years, suffering from a massive rotator cuff tear	Fatty degeneration of supraspinatus and infraspinatus muscles and narrowing of the subacromial space are greater when symptom duration exceeds 6 months and when cause of rotator cuff tear is non-traumatic. Early consultation with surgeon preferable.	Low-quality study. Limited follow-up reported. Nil reporting of outcome assessor blinding.
Oh et al (2006)[153]	IV	Systematic review of clinical studies (outcomes studies and prognostic studies, including all study designs)	To investigate factors influencing the decision to surgically repair symptomatic, full-thickness rotator cuff tears	The timing of surgery seems to be based largely on practice preferences of experienced surgeons in the field because sound evidence-based data for guiding treatment are limited. Prompt surgical treatment is recommended for: acute traumatic full-thickness tear, immediate pain and weakness, with no prior history of shoulder symptoms. Another retrospective study found no correlation between time to surgery and final outcome. It seems satisfactory results can be obtained with delayed repair.	Included studies up to 2005. Systematic search but no appraisal of study quality. Included all levels of evidence. Results descriptive only.
What factors affect prognosis post-rotator cuff syndrome surgery?					
AAOS, 2010[4]	I	Clinical guidelines with systematic review	Assist physicians to improve quality and efficiency of patient care. Focused on adults with rotator cuff problems, in particular full-thickness tears for surgical recommendations	Confounding factors: ▪ increasing patient age is a negative predictor/correlate of outcomes and healing after rotator cuff surgery: Weak evidence (23 studies) ▪ negative effect of supraspinatus and infraspinatus muscle atrophy and fatty degeneration on tendon healing and clinical outcomes: Weak evidence (6 studies) ▪ workers compensation status correlates with less favourable outcomes: Moderate evidence (3 studies) ▪ diabetes: Inconclusive (2 studies) ▪ comorbidities: inconclusive (1 study) ▪ smoking: inconclusive ▪ infection: inconclusive ▪ cervical disease: inconclusive.	Includes studies from 1965–2008. A total of 5664 abstracts screened, 388 retrieved and 75 studies included in guidelines.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Gulotta et al (2011)[76] and Nho et al (2009)[151]	II	Prognostic	To report prognostic factors for successful clinical and radiographic outcomes following arthroscopic RC repair at 5 years	There were no pre- or intraoperative variables that were predictive of an ASES score >90 (good functional result). This may be due to the fact that most patients in this cohort had an excellent result, thus making it difficult to statistically compare them to the limited number of patients with poor results. Factors predictive of a radiographic defect were larger size of the lesion (OR 1.72, 95% CI 1.04–2.85, p==0.03), multiple tendon involvement (OR 5.56, 95% CI 1.23-25.22, p=0.02), older age (OR 1.15, 95% CI 1.04–1.28, p=0.01), concomitant biceps, and acromioclavicular joint procedures. Radiographic healing did not correspond to clinical outcomes. The functional outcome variables, such as satisfaction (OR 3.92; 95% CI, 2.00–7.68; p< .001) and strength (OR 10.05; 95% CI, 1.61– 62.77; p=0.01), had a greater role in predicting an ASES >90. Variables that did not have a significant association with tendon healing that are notable include anti-inflammatory and tobacco use.	The rate of follow-up was 66% at 1 year and 55% at 5 years. Data on preoperative imaging was not recorded in this study. Therefore, factors such as tendon retraction and muscle fatty infiltration were not evaluated for their association with clinical outcome.
Warrender et al (2011)[207]	III	Retrospective case-control design, treatment study (N=149)	To evaluate the outcomes of arthroscopic rotator cuff repairs in obese patients	A statistically significant correlation was found between obesity and worse functional outcomes, longer operative times and longer length of hospital stay. The obese group, however, still reported significant improvements from the surgery. Although there is increased complexity with obese patients, ARCR is still a safe procedure in these patients, as evidenced by a lack of significant intraoperative and postoperative complications.	Short follow-up period of average 16 months. Many of the obese patients had a comorbidity of diabetes mellitus (a potential confounder).
Razmjou et al (2008)[169]	III-3	Cross-sectional study of patients who experienced continued impairments following surgical treatment for work-related RC injuries	To examine the prevalence of identifiable causes of rotator cuff surgery failure and to examine the relationship among the existence of these causes and outcome scores, patient expectations, and overall satisfaction	Failure was defined by the presence of at least 2 of the following criteria: (1) persistence of significant symptoms and functional disability following surgery; (2) lack of a successful return to regular duties at work; and (3) consideration of additional treatment, including further surgery. Fifty per cent (19/38) patients had at least one identifiable reason for failure. This included physical factors such as size of tear, fixation failure and shoulder instability. Satisfaction is a complex concept related to factors such as lifestyle, past experiences and expectations as well as to both individual and societal values. Injured workers who continue to report significant disability without any identifiable factors may require a multidisciplinary approach, including detailed assessment of psychosocial issues, expectations and job-related concerns.	Findings generalisability is limited by recruitment of a small sample size of consecutive patients from a single centre. Causes of failure were identified through X-ray and MRI or US.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Tanaka et al (2010)[197]	III-3	Retrospective cohort study	Determine the factors related to the successful outcome following conservative treatment for full-thickness tears of the rotator cuff	After 3 months of conservative treatment, clinical symptoms improved in 62 patients, but remained unchanged or aggravated in 56 patients, who eventually underwent surgical repair. Clinical features differentiating groups: ▪ range of external rotation movement ▪ positive impingement sign = surgery ▪ muscle atrophy of supraspinatus ▪ intramuscular tendon of supraspinatus (ruptured = surgery).	Retrospective study based on available data therefore high potential for subject bias. Measurement at body structure/ function level only. Sound statistical comparison with ORs provided.
Nove-Josserand et al (2011)[156]	IV	Case series Questionnaire sent to 290 patients who had undergone surgery for work-related rotator cuff syndrome. Sent out minimum 2 years post-surgery with 87.6% response rate (N=254)	To establish the occupational outcome after surgery in patients with a rotator cuff tear from a work-related injury (WRI) or occupational disease (OD) and determine which factors and conditions affected return to work	Return to work occurred in 59.5% of the cases. The primary reason for not returning to work was related to the shoulder injury in 16% of the cases and not related to the injury in 24.4% of the cases. Factors that prevented RTW included retirement (14.1%), an unrelated medical condition (10.3%). Gender had no effect on return to work or amount of time away from work. The type of work and nature of tendon injury did not affect return to work, but did affect time away from work. In 120 cases (45.8% of the whole population), the return to work was in the same position. The average time away from full-time work was 9.8±6.2 months. In 25% of the cases, the job was modified within the same professional environment, and in 75% of cases, professional retraining was required, resulting in an average time away from full-time work of 12.4±6.5 months.	Isolated supraspinatus tears were most common. Only one rotator cuff tendon was injured in 64.1% of cases, 2 tendons were injured in 28.2% of cases and 3 tendons were injured in 7.6% of cases.
Manaka et al (2011)[127]	IV	Retrospective evaluation of 201 patients who had undergone arthroscopic RC repair (ARCR)	To determine how long it takes to obtain functional recovery after ARCR, and what preoperative factors influence functional recovery time	A total of 144 patients (72%) obtained functional recovery within 6 months after ARCR. Age, shoulder stiffness and rotator cuff tear size influenced functional recovery time.	n/a

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective/Question	Study Outcome/Findings	Comments/Appraisal
Wylie et al (2010)[216]	IV	Retrospective case series of patients who were undergoing shoulder surgery for either RC pathology or osteoarthritis	To investigate further the effect of medical comorbidity on a patient reported shoulder specific health related quality of life (HRQoL) measure	While controlling for risk factors (age, gender, BMI, severity of OA or RC pathology and general psychological wellbeing), medical comorbidity related specifically to the chest region had a significant detrimental effect upon shoulder specific HRQoL, while medical comorbidity that did not specifically affect the chest region did not. The patient's general psychological wellbeing was highly correlated with the HRQoL of their shoulder, suggesting that psychotherapy or pharmacologic intervention for psychological wellbeing may lead to better patient self-reported shoulder pain and function.	Large proportion of study sample underwent arthroplasty for osteoarthritis (68%) so may not necessarily reflect those undergoing surgery for RC pathology (27%). Cohort also restricted to those undergoing surgery thus a population with severe injury/pain.
Studies examining the influence of workers compensation status on recovery post-shoulder surgery are discussed in Table 4.6					

KEY RCT – randomised controlled trial SIS – shoulder impingement syndrome ASES – American Shoulder and Elbow Surgeons Standardised Shoulder Assessment MRI – magnetic resonance imaging US – ultrasound ICF – international classification of functioning BMI – body mass index HRQol – health-related quality of life OA – osteoarthritis RC – rotator cuff RCI – rotator cuff injury ARCR – arthroscopic rotator cuff repair RTW – return to work OD – occupational disease OR – odds ratio WRI – work-related injury

4.6 Outcomes

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Bonde et al (2003)[28]	III-3	Retrospective cohort study (N=3073 with N=167 with shoulder tendonitis)	To determine recovery rates from shoulder tendonitis in a working population. To examine physical and psychosocial factors and their correlation with slow recovery	Fifty per cent of workers recovered within 10 months (95% CI 6–14 months). This recovery rate, however, probably likely to be slower than true rate as was calculated from data collected at 12-month follow-up. Older age was strongly related to slow recovery, while physical job exposures were not. Perception of demands, control, and social support at diagnosis were associated with delayed recovery but did not predict slow recovery.	Risk of selection bias as follow-up data only available for 113/167 workers with shoulder tendonitis.
Atroshi et al (2002)[13]	II	Prospective cohort study (musculoskeletal pain) (N=189)	To investigate long-term sick leave among primary care patients with musculoskeletal disorders and the predictive value of health-status measures	Thirty-six (19%) were sick-listed for at least 3 months before and/or after their visit. The duration of sick leave taken at baseline and the SF-36 bodily pain score were significant predictors of continuous 1-year work disability.	Follow-up data obtained for 72% of participants at 1 year.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Borg et al (2001)[29]	II	Prospective cohort study (Swedish- 11 years follow-up)	To identify predictive factors for disability pension among young persons, initially sick-listed following greater than 28 days sick leave spell due to neck, shoulder or back pain	Twenty-two per cent of those sick-listed in 1982–1984 (N=213) had been granted a disability pension by 1996. The relative risk for disability pension was higher for women (2.4, p=0.010) persons with foreign citizenship (3.6, p=0.009) and those who had greater than 14 days sick leave per spell during the 3 years before inclusion in the study than those that had <7days/spell (3.1, p=0.003).	Bias minimised as data available for all 213 participants who had been sick-listed.
Engebretsen et al (2010)[58]	II	Secondary analyses of data from a randomised clinical controlled trial	To identify predictors for pain and disability (SPADI) and work status in patients with subacromial shoulder pain	A total of 104 patients were included. Low education (≤12 years), previous shoulder pain and a high baseline SPADI score predicted poor results with these variables explaining 29.9% of the variance in SPADI score at 1 year. Low education and poor self-reported health status predicted a work status of 'not working': OR = 4.3 (95% CI 1.3–14.9). Adjustments for age, gender and treatment group were performed, but did not change the results.	The limitations are the small sample size and that missing values were not imputed. In particular, 8 patients who were not working at baseline and dropped out at 1 year.
Harris et al (2011)[78]	II	A multicentre, prospective, non-randomised cohort study	To determine which factors correlate with pain and loss of function in patients with symptomatic, atraumatic, full-thickness rotator cuff tears who are enrolled in a structured physical therapy program	Time-zero patient data were reviewed to test which factors correlated with Western Ontario Rotator Cuff (WORC) index and American Shoulder and Elbow Surgeons (ASES) scores. The following variables were associated with higher WORC and ASES scores: female sex (p=.001), education level (higher education, higher score; p<0.001), active abduction (degrees; p=.021), and strength in forward elevation (p=.002) and abduction (p=.007). The following variables were associated with lower WORC and ASES scores: male sex (p=.001), atrophy of the supraspinatus (p=.04) and infraspinatus (p=.003) and presence of scapulothoracic dyskinesia (p< 0.0001). Non-surgically modifiable factors, such as scapulothoracic dyskinesia, active abduction and strength in forward elevation and abduction, were identified that could be addressed non-operatively with therapy.	Possible selection bias as not all patients presenting with symptomatic, atraumatic rotator cuff were enrolled in the physical therapy program. Authors state only 19% of presenting patients were enrolled.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Keijsers et al (2010)[99]	II	Prospective cohort study	To evaluate the differences in predictors of non-recovery between patients with a specific diagnosis at arm, neck, and/or shoulder, versus patients with a non-specific diagnosis in general practice at 6 months after the first consultation	At 6 months, 38% (N=298) of the specific-group members and 49% (N=249) of the non-specific-group members reported non-recovery. Duration of complaints was predictive of non-recovery in both groups. Other predictors in the specific group were as follows: more somatisation, low social support, older age, high BMI and unemployment. In the non-specific group, the predictors were as follows: musculoskeletal comorbidity, recurrent complaint, poor perceived general health, multiple-region complaints and high level of kinesiophobia.	No adjustment for confounding factors groups not similar at baseline.
Selander et al (2002)[181]	I	Systematic review	To obtain an overview of factors associated with RTW following vocational rehabilitation for problems in the neck, back, and/or shoulders	'People with greater chance of job return following vocational rehabilitation are younger, native, highly educated, have a steady job and high income, are married and have stable social networks, are self-confident and happy with life, not depressed, have low level of disease severity/ first injury and no pain, high work seniority, long working history, and an employer that cares and wishes them back to the workplace.' Subjects getting earlier vocational rehabilitation, who were offered modified work and/or who were able to influence their own rehabilitation processes were more likely to RTW.	Broad search strategies. No appraisal of the methodological strength of included studies or papers. Many associated factors based on a single study.
Koljonen et al (2009)[105]	I	Systematic review (1998–2007)	To review the association between compensation status and surgical outcome especially of the shoulder	Reviewed 28 studies. The total number of cases recorded in these 28 studies was 3133 among which 1125 were WC and 1988 were non-WC. Of the 28 studies, only one described a negative correlation between WC status and poor surgical outcome. The compensation status of an individual receiving shoulder surgery is a consistent positive predictor of poor functional outcome.	No appraisal of included studies.
Balyk et al (2008)[17]	II	Prognostic prospective cohort (N=141)	Comparison of preoperative differences between WC recipients and non-recipients and determine the impact on their 6-month postoperative outcome following RC surgery	WC recipients were younger and more likely to smoke, have a traumatic injury and undergo surgery within 6 months of injury. Regression analyses to control for baseline differences were completed. A single outcome difference identified, with 6-month WORC Index score lower in WC recipients. No difference in shoulder ROM or on the ASES score. Clinicians should consider preoperative characteristics before concluding WC recipients experience less recovery after surgical repair.	Small sample size with only 36/141 participants classified as WC recipients (25%).

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Bhatia et al (2010)[24]	IV	Therapeutic case series (N=78)	To investigate the ability of patients to return to their preoperative work level and to identify functional prognostic factors in a group of WC patients after arthroscopic repair of full-thickness rotator cuff tears	Of patients (N=69), 88.5% returned to their preoperative level of work at a mean time to Maximal Medical Improvement of 7.6 ± 2.6 months. Alcohol use was the only prognostic factor to show a significant association with return to restricted-duty employment and repair failure.	Consecutive series; however, limited detail available on occupations.
Didden et al (2010)[50]	III-3	Retrospective cohort study (Belgium) (N=73)	To assess time off work following rotator cuff repair and its relation to WC and shoulder loading demand at work	Compared 3 compensation tiers: high tier: those with work-related tear (employer funded); middle tier for those with RC tear resulting from private activities or chronicity (nationally funded); and low tier for self-employed persons. Found a significantly longer postoperative time off work in the highest compensation group (7 months versus 2.5 months for the lowest compensation group). Conclusion: The probable postoperative absence from work can be roughly estimated for each patient after rotator cuff surgery in relation to the particular compensation system and particular occupational demand level.	Open to selection bias; small numbers in the 'high tier' and 'low tier'; N=9 for both.
Henn et al (2008)[82]	II	Prospective cohort study	Hypothesized that patients with Workers' Compensation claims who undergo rotator cuff repair have worse outcomes, even after controlling for confounding factors	Multivariable analysis controlling for age, sex, comorbidities, smoking, marital status, and education, duration of symptoms, work demands, expectations, and tear size confirmed that Workers' Compensation status was an independent predictor of worse DASH scores. Patients in the Workers' Compensation group were significantly younger, had greater work demands, and had lower marital rates, education levels, and preoperative expectations for the outcome of treatment as compared with those in the non-Workers' Compensation group (p = 0.001 to 0.016).	Did not analyse the effect of anatomic factors such as repair integrity, fatty degeneration of muscle, or tendon quality on outcomes. Patients were evaluated prior to the settlement of the claim which may limit how our results can be generalised to studies of patients after the settlement of claims.

Author, Year	Level of Evidence (NHMRC)	Study Description	Study Objective	Study Outcome/Findings	Comments/Appraisal
Holtby & Razmjou (2010)[85]	III	Retrospective matched case-control study (N=220)	To examine the impact of an active compensation claim following a work-related shoulder injury on reporting disability, as measured by subjective and objective outcomes at 1 year postoperatively.	A total of 45 patients (41%) had undergone a repair and 65 (59%) had undergone a decompression surgery (acromioplasty with or without resection of lateral clavicle). Both WC and non-WC groups improved significantly regardless of their claim status ($p<.0001$). There was a significant difference overall improvement with the compensation group having a significantly higher level of disability at 1 year post surgery.	Generalisability of results may be limited as based on a single study site and only patients who had returned for review 1 year post-operatively were included.
McRae et al (2011)[133]	II	Retrospective cohort study (N=54)	To investigate the significance of BMI and other potential contributing factors: age, sex, smoking status, tear size and workers compensation (WC) involvement to self-reported shoulder pain/function in patients awaiting surgery	Our hypothesis that BMI is negatively related to magnitude of pain/level of function was not supported. Factors found to be related were sex, WC involvement and smoking.	Bias minimised by consecutive series; however, it was a small sample size.

KEY SPADI – Shoulder Pain and Disability Index SF-36 – Medical Outcome Study Short Form DASH – disabilities of the arm, shoulder and hand ROM – range of motion WC – workers compensation OR – odds ratio WORC – Western Ontario Rotator Cuff ASES – American Shoulder and Elbow Surgeons BMI – body mass index RTW – return to work

5.0 Use of the Guidelines

5.1 Implementation

The following strategies will be undertaken to disseminate the guidelines:

1. A summary of the guidelines will be submitted for publication in a relevant, peer- reviewed journal (e.g. *Scandinavian Journal of Work, Environment and Health or Journal of Evaluation in Clinical Practice).*
2. The completed guidelines and resource material will be posted on the UNSW website.
3. Published copies of the guidelines and the UNSW hyperlink for electronic copies will be circulated to key organisations for dissemination to their members.
4. Published copies and the UNSW hyperlink for electronic copies will be forwarded to all members of the working party, expert advisory panel and public peer reviewers.
5. Guidelines will be presented at relevant conferences and/or meetings of professional associations.

It will also be suggested that Essential Energy develop a detailed implementation plan for implementation within their organisation. This plan would include monitoring and auditing criteria to assess the impact of the guidelines.

5.2 Consideration of Resources

In developing the recommendations for these guidelines the working party considered the possible resource implications of individual recommendations such as those involving diagnostic imaging, surgery and return to work (RTW). In the case of imaging, emphasis was placed on highlighting the limitations of imaging and identifying criteria for when imaging was deemed to be necessary. Access in rural and remote areas to imaging techniques such as magnetic resonance imaging (MRI) was noted by the working party. It was also recognised that efficient use of imaging could potentially lead to cost savings.

5.3 Tools to Assist Implementation

The guidelines provide three tools to assist with implementation of the guidelines as follows:

1. rotator cuff syndrome information sheet for injured workers
2. return to work information guides for general practitioners and employers
3. summary flowcharts (with a list of all recommendations).

5.4 Review

It is anticipated that the guidelines will be updated every five years. A systematic literature search for new evidence will be completed and the current recommendations reviewed on the basis of studies located. Any changes that are made to the guidelines will be circulated to relevant professionals and organisations for review and agreement. This process would require further funding.

APPENDIX 1 Working Party Members

Name	Role	Organisation
Dr David Allen	Occupational & Environmental Physician	Private Practice
Dr Roslyn Avery	Rehabilitation Physician	Private Practice
Mr Greg Black	Consumer Representative	Self Employed – Trade Industry
Mr Patrick Frances	Consumer Representative	Volunteer Worker
Ms Kate Hopman	Independent Guideline Development Expert	Lukersmith & Associates
Dr Lee Krahe	Head of Research	Port Macquarie Campus, Rural Clinical School, UNSW
Dr Yong Hian Liaw	Orthopaedic Surgeon	Port Macquarie Base Hospital and Private Practice
Ms Sue Lukersmith	Independent Guideline Development Expert	Lukersmith & Associates
Dr AR (Sandy) McColl (Chairperson)	General Practitioner Head of Campus	Private Practice Port Macquarie Campus, Rural Clinical School, UNSW
Dr Christopher Needs	Rheumatologist	Private Practice Royal North Shore Hospital
Mr Jeremy Rourke	Physiotherapist	Port Macquarie Base Hospital
Mr John Scullin	Physiotherapist	Private Practice
Ms Amy Vallentine	Occupational Therapist	Private Practice
Ms Kris Vine	Research Officer	Port Macquarie Campus, Rural Clinical School, UNSW
Dr Stephen Young	General Practitioner	Private Practice

APPENDIX 2 Clinical Questions

Assessment	Treatment	Prognosis
1. What is the diagnostic accuracy of ultrasound? 2. When should an ultrasound be performed?	1. What is the benefit of paracetamol in the management of rotator cuff syndrome? 2. What is the benefit of oral steroids in the management of rotator cuff syndrome? 3. What is the benefit of oral anti-inflammatories (NSAIDs) in the management of rotator cuff syndrome? 4. What is the benefit of glucosamine in the management of rotator cuff syndrome? 5. What is the benefit of fish oil in the management of rotator cuff syndrome?	1. What are the barriers and facilitators to an RTW following rotator cuff syndrome? **Body impairments** ▪ Size of tear **Activities and participation** ▪ type of employment ▪ sports, tasks performed at home **Contextual factors** ▪ personal factors ▪ time since injury ▪ previous injury ▪ type of employment ▪ attitude of client ▪ age, sex ▪ length of time in present occupation ▪ height/weight **Environmental factors** ▪ surgery ▪ therapy ▪ family attitude ▪ employer attitude ▪ support
3. What is the diagnostic accuracy of MRI? 4. When should an MRI be performed?	6. What is the benefit of steroid injection in the management of rotator cuff syndrome?	2. Which outcome measures are appropriate, reliable and valid to use following rotator cuff syndrome?
5. Is the X-ray useful to the identification of rotator cuff syndrome? 6. Under what circumstances should X-rays be performed?	7. What is the benefit of exercise in the management of rotator cuff syndrome? 8. What is the benefit of ultrasound in the management of rotator cuff syndrome? 9. What is the benefit of electro-physical agents in the management of rotator cuff syndrome? 10. What is the benefit of soft tissue techniques/ manual therapy (excluding massage)?	

Assessment	Treatment	Prognosis
7. Is CT useful to the identification of rotator cuff syndrome? 8. When should a CT be performed?	11. What is the benefit of the heat/cold in the management of rotator cuff syndrome? 12. What is the benefit of rest in the management of rotator cuff syndrome? 13. What is the benefit of acupuncture in the management of rotator cuff syndrome?	
9. Is MRA useful to the identification of rotator cuff syndrome? 10. When should an MRA be performed?	14. What are the clinical indicators for surgery? 15. When should surgery be considered for rotator cuff syndrome (timing)? 16. What factors affect rotator cuff syndrome post-surgery prognosis?	
11. What is the preferred means of imaging to determine pathology?	17. What factors should be considered for an RTW program (informed by prognosis RTW questions)?	
12. What factors should be included in history-taking when diagnosing rotator cuff syndrome?	18. When should an RTW be considered for rotator cuff syndrome?	
13. What should be included in a physical assessment for diagnosis of rotator cuff syndrome?	19. How should a RTW program be implemented following rotator cuff syndrome?	
14. Is subacromial injection useful to the identification of rotator cuff syndrome?		

APPENDIX 3 Declaration of Interest and Confidentiality Obligations

The aim of this declaration is to ensure that the *Clinical Practice Guidelines on the Management of Work-Related Rotator Cuff Injury* resulting from this Working Party is free from real or perceived conflicts of interest and breaches of confidentiality. Declared interests will be collected by the Working Party Chair and listed in the project's *Technical Report* to ensure transparent methodological processes are followed.

Conflict of Interest

A conflict of interest arises where a working party member's other interests or associations could, or be seen to, improperly influence an individual's judgment about a specific recommendation. Clinical Practice Guidelines for Rotator Cuff Injury Working Party members must declare any financial association or intellectual property with the funding organisation, Essential Energy.

Working Party members must also declare their potential or real conflicts of interest, intellectual conflicts and involvement (financial and non-financial) in companies or organisations with an interest in any aspect of work-related rotator cuff injury management. Please indicate below if you have any potential conflict of interest, either perceived or real, to declare in relation to your membership on this Working Party.

- Financial association or intellectual property with Essential Energy or its subsidiaries Y / N
- Consultancy agreements with companies or organisations with an interest in any aspect of work-related rotator cuff injury management Y / N
- Board memberships Y / N
- Financial support to or from companies or organisations whose products or services are related to the treatment, management or diagnosis of rotator cuff injury, including attendance at events Y / N
- Shares in companies or organisations whose products or services are related to the treatment, management or diagnosis of rotator cuff injury Y / N
- Prior participation in the development or endorsement of rotator cuff injury guidelines Y / N
- Participation in research, privately or publically funded, relating to rotator cuff injury that may be used in a guideline recommendation Y / N
- Other *(please specify):* _____ Y / N

Declaration

I certify that I have provided to the Working Party Chair details of my private and other interests that could be, or perceived to be, a potential conflict to my role as a member for this Working Party.

I shall advise the Working Party Chair of any further conflicts of interest (perceived, potential or actual) in the event that any arise throughout the course of developing these guidelines.

I acknowledge that my declared interests will be generally disclosed in the guideline's *Technical Report*.

Other than where I have obtained the prior written approval of the Working Party Chair, I agree to maintain confidentiality concerning all discussions held during the development of these guidelines.

NAME: _____

SIGNATURE: _____ DATE: / /

APPENDIX 4 Searches for Existing Guidelines

Organisations and websites searched, plus search terms used to identify existing guidelines and other relevant publications.

Organisation	Search Terms
National Health and Medical Research Council (NHMRC– AUS)	Rotator cuff Shoulder Pain
Guidelines International Network (GIN)	Rotator cuff Shoulder
National Guidelines Clearing House (USA)	Rotator cuff Shoulder
National Institute for Health and Clinical Excellence (NICE – UK)	Rotator cuff Shoulder
Scottish Intercollegiate Guidelines Network (SIGN)	Rotator cuff Shoulder
Canadian Medical Association Clinical Practice Guidelines	Rotator cuff Shoulder
New Zealand Guidelines Group	Rotator cuff Shoulder Pain
Centre for Evidence-based Medicine (Oxford)	Rotator cuff Shoulder
Agency for Healthcare Research and Quality	Rotator Cuff Shoulder
Royal College of Nursing Clinical Guidelines (RCN – UK)	Rotator Cuff Shoulder
Clinical Knowledge Summaries (UK)	Rotator Cuff Shoulder
Physiotherapy Evidence Database (PEDro)	Rotator Cuff
OTseeker	Shoulder
Cochrane Database	Rotator Cuff

APPENDIX 5
AGREE II Ratings of Existing Guidelines

Organisation/Guideline	Domain					
	Scope and Purpose	Stakeholder Involvement	Rigour	Clarity	Applicability	Editorial Independence
Official Disability Guidelines (ODG, 2011) – Shoulder (acute 7 chronic)[207]	72%	74%	83%	100%	78%	74%
American College of Radiology (ACR) Appropriateness Criteria (March 2010)[5]	50%	33%	9%	67%	1%	2%
American Academy of Orthopaedic Surgeons (AAOS) Optimizing the management of rotator cuff problems: Clinical Practice Guidelines (2010)[4]	70%	43%	89%	67%	13%	59%
The diagnosis and management of soft tissue shoulder injuries and related disorders: best practice evidence-based guidelines (2004)[145]	81%	76%	63%	65%	24%	57%
Diagnostic imaging practice guidelines for musculoskeletal complaints in adults: an evidence-based approach. Part 2: Upper extremity disorders (2008)[35]	87%	70%	80%	81%	63%	72%

APPENDIX 6 Search Terms

The search for relevant studies using MEDLINE, Embase and PsychINFO included the following search strategy:

* Limits (English language and humans and year=2000–current)

Rotator cuff syndrome:

1. Shoulder Pain/ or shoulder pain.mp.
2. Rotator Cuff/ or rotator cuff.mp.
3. Shoulder Impingement Syndrome/ or shoulder impingement.mp.
4. Bursitis/ or bursitis.mp.
5. (shoulder$ or rotator cuff or subacromial) adj5 (bursitis or impingement or tendonitis or tendinitis or tendinopathy or pain$).

Assessment/diagnosis:

- Diagnosis/
- Assessment/
- Physical Examination/
- Diagnostic Imaging/
- Magnetic Resonance Imaging/
- Ultrasound/
- Not frozen shoulder.mp.
- Not Arthroscopy/ or arthroscopic$mp.

Return to Work:

- Work Simplification/
- Work/ or work.mp.
- Work Capacity Evaluation/
- Work Schedule Tolerance/

Non-surgical Treatment:

- Analgesia/
- Medication Therapy Management/ medication$.mp.
- Exercise Movement Techniques/ or Exercise/ or Exercise Therapy/ or exercise.mp.
- Injections, Intra-Articular/ or corticosteroid injection$.mp.
- Musculoskeletal Manipulation/ or manual therapy.mp.
- Acupuncture Therapy/ or Acupuncture/ or acupuncture.mp.
- Electrical Stimulation Therapy/ or extracorporeal shock wave therapy.mp.
- Laser Therapy/ or laser therapy.mp.
- Ultrasonic Therapy/ or therapeutic ultrasound.mp.
- Transcutaneous Electric Nerve Stimulation/ or TENS.mp.
- interferential.mp.
- Hot Temperature/tu, th(Therapeutic Use, Therapy)
- Ice/ or icing.mp.
- Rest/ or rest.mp.

Surgical Treatment:

- General Surgery/ or surgery.mp.
- surg$.mp.
- repair.mp.
- Not Arthroplasty, Replacement/ or shoulder replacement.mp.
- indicator$.mp.
- timing.mp.
- Prognosis/ or prognostic.mp.

The search for relevant studies using CINAHL included the following search strategy:

Rotator Cuff Syndrome

'rotator cuff' OR 'shoulder impingement' OR 'subacromial' OR (infraspinatus OR supraspinatus OR subscapularis OR tears AND minor) AND (tear OR impingement)

Assessment/ Diagnosis:

- Diagnosis
- Diagnosis Differential
- Assessment
- Diagnostic Imaging

Return to Work:

- Work
- Work Capacity

Non-surgical Treatment:

- Analgesia
- Analgesics
- Medication
- Exercise
- Exercise Therapy
- Injections
- Injection
- Musculoskeletal Manipulation
- Physiotherapy
- Acupuncture
- Electrical Stimulation
- TENS
- Transcutaneous electrical nerve stimulation
- Laser Therapy
- Ultrasound Therapy
- Heat
- Ice
- Icing
- Rest

Surgical Treatment:

- Surgery (restricted to Adult aged 19–64)
- Not Arthroplasty

Prognosis:

- Prognosis

NHMRC Evidence Statement
(If rating is not completely clear, use the space next to each criteria to note how the group came to a judgment. Part B of this document will assist with the critical appraisal of individual studies included in the body of evidence)

Key question(s):		Evidence table ref:
1. Evidence base *(number of studies, level of evidence and risk of bias in the included studies)*		
	A	One or more level I studies with a low risk of bias or several level II studies with a low risk of bias
	B	One or two Level II studies with a low risk of bias or SR/several Level III studies with a low risk of bias
	C	One or two Level III studies with a low risk of bias or Level I or II studies with a moderate risk of bias
	D	Level IV studies or Level I to III studies/SRs with a high risk of bias
2. Consistency *(if only one study was available, rank this component as 'not applicable')*		
	A	All studies consistent
	B	Most studies consistent and inconsistency can be explained
	C	Some inconsistency, reflecting genuine uncertainty around question
	D	Evidence is inconsistent
	NA	Not applicable (one study only)
3. Clinical impact *(Indicate in the space below if the study results varied according to some unknown factor (not simply study quality or sample size) and thus the clinical impact of the intervention could not be determined)*		
	A	Very large
	B	Substantial
	C	Moderate
	D	Slight/Restricted
4. Generalisability *(How well does the body of evidence match the population and clinical settings being targeted by the Guideline?)*		
	A	Evidence directly generalisable to target population
	B	Evidence directly generalisable to target population with some caveats
	C	Evidence not directly generalisable to the target population but could be sensibly applied
	D	Evidence not directly generalisable to target population and hard to judge whether it is sensible to apply
5. Applicability *(Is the body of evidence relevant to the Australian healthcare context in terms of health services/delivery of care and cultural factors?)*		
	A	Evidence directly applicable to Australian healthcare context
	B	Evidence applicable to Australian healthcare context with few caveats
	C	Evidence probably applicable to Australian healthcare context with some caveats
	D	Evidence not applicable to Australian healthcare context

Other factors *(Indicate here any other factors that you took into account when assessing the evidence base (for example, issues that might cause the group to downgrade or upgrade the recommendation)*

EVIDENCE STATEMENT MATRIX

Please summarise the development group's synthesis of the evidence relating to the key question, taking all the above factors into account.

Component	Rating	Description
1. Evidence base		
2. Consistency		
3. Clinical impact		
4. Generalisability		
5. Applicability		

Evidence statement

Indicate any dissenting opinions

RECOMMENDATION *What recommendation(s) does the guideline development group draw from this evidence? Use action statements where possible.*	GRADE OF RECOMMENDATION	

UNRESOLVED ISSUES *If needed, keep note of specific issues that arise when each recommendation is formulated and that require follow-up.*

IMPLEMENTATION OF RECOMMENDATION *Please indicate yes or no to the following questions. Where the answer is yes please provide explanatory information about this. This information will be used to develop the implementation plan for the guidelines.*	
Will this recommendation result in changes in usual care?	YES
	NO
Are there any resource implications associated with implementing this recommendation?	YES
	NO
Will the implementation of this recommendation require changes in the way care is currently organised?	YES
	NO
Are the guideline development group aware of any barriers to the implementation of this recommendation?	YES
	NO

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