A Systematic Review by the Research Commission of the Council on Chiropractic Guidelines and Practice Parameters

*LITERATURE SYNTHESIS: CHIROPRACTIC MANAGEMENT OF UPPER EXTREMITY PAIN

*A literature synthesis is an academically rigorous analysis of all the available scientific literature on a specific topic. Reviewers use internationally accepted tools to rate each article according to specific criteria. These include the type of study (randomized controlled trial, case series, etc), the quality of the study, size of the study and many other factors that influence the credibility and strength of the study's conclusions. Each reviewer independently rates all the available articles, and the ratings are compared among the members of the review team. When there is disagreement among the reviewers regarding the conclusions, a formal consensus process is followed to arrive at an overall conclusion upon which all reviewers can agree. The resulting conclusions do not represent the reviewers' own beliefs but rather what the literature actually supports. A literature synthesis is a starting point. It indicates only what we can conclude with supportable, scientific evidence. Appropriate therapeutic approaches will consider the literature synthesis as well as clinical experience, coupled with patient preferences in determining the most appropriate course of care for a specific patient.

This document is solely a survey of existing studies, and only expresses the opinion of CCGPP. It is not intended to, nor does it establish a standard of care in specific communities, specific cases, or as to the care of any particular individual or condition. Each case must be determined on the basis of a careful clinical examination and diagnosis of the patient, giving due consideration to the specific condition presented and the individual's informed choice as to care and treatment. No part of this document is intended to support any litigation or proceeding involving the standard of care, medical necessity or reimbursement eligibility.

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CHIIROPRACTIC MANAGEMENT OF UPPER EXTREMITY PAIN

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Quick Reference Source:

Scope: Upper extremity pain, shoulder pain, elbow pain, and wrist pain
Chronicity range: acute, subacute, chronic and recurrent
Applicable ICD codes: 354.0, 723.4, 726.0, 726.1, 726.12, 726.31, 726.32, 726.33, 726.90, 727.3, 739.7, 840.0, 840.4, 840.9, 841.2, 841.9, 842.10, 905.7, 923.0, 923.1

Objectives:

1. To implement an interactive process that will create and successively build a consolidation for systematic summary of various types of evidence on the effectiveness of chiropractic management for upper extremity and related disorders including their quantity, quality and summary of conclusions.
2. Types of evidence ultimately to be rated include: Guidelines, meta-analyses, systematic reviews, randomized controlled trials, cohort studies, case series. Relevant sources that inform on issues of outcome measures, diagnosis, technology assessment, natural/treatment history and prognosis and risk stratification will be reviewed.
3. Initiation of the iterative process will begin by team review of the literature and determination of the most common clinical disorders and treatments involving chiropractors. Unique or particularly current diagnostic methods will also be considered.

Intended audience:

- Chiropractors
- Chiropractic students and prospective students
- Chiropractic educators/educational institutions
- Chiropractic organizations/agencies
- Third-party payers
- Governmental agencies
- Patients and prospective patients

Practices and interventions considered:

- Diagnostic –
  - Patient history
  - Physical, manual and laboratory examinations
  - Plain film radiographs
  - Advanced or specialized imaging
  - Diagnostic Ultrasound
- Therapeutic
  - Assurance and advice
  - Bed rest
  - High velocity, low amplitude manipulation, mobilization and massage
  - Exercise
  - Selected modalities
  - Medical / surgical referral

Methods used to select / collect evidence

Selection: Topics were selected based on the most common disorders seen, and most common classifications of treatments used by chiropractors based on the literature.
Collection - Hand-searches of Published Literature
(Primary Sources) Searches of Electronic Databases

Number of source documents

1,340 source documents were identified. Conclusions were drawn from:

- Upper Extremity
- Shoulder
- Elbow
- Wrist/Hand

70 RCTs, 12 guidelines and 14 systematic reviews

Methods to assess the quality and strength of the evidence

Weighting According to a Rating Scheme (Scheme Given)
Standardized and validated instruments were used for rating evidence

Methods to analyze the evidence

Panel review and rating of
Published Meta-Analyses & Systematic Reviews
Cohort studies
Case series
Diagnostic studies
Review of evidence on natural history, complexity and risk factors

Methods to formulate conclusions

Two strategies were used in consolidating and rating the literature: a) Rate and accept /reject existing published reviews (including guidelines), independently reviewing the underlying literature if the rating was considered substandard and 2) independently review and rate newer or previously unrated literature as appropriate.

Divergence in team member opinions triggered a modified Delphi consensus process in motion. Initial conclusions, herein, are being submitted for stakeholder review. Comments will be reviewed and responded to by the team. Final conclusions with comments and responses released.

Summary of Recommendations

Topic	Conclusion and Strength of Evidence Rating	Page(s)
Shoulder		
Evaluation	**RATING A**: Questionnaires There is strong evidence to suggest that for shoulder function questionnaires, small sample sizes in most studies make conclusions difficult. The DASH is commonly used and has a good rating on systematic review. **RATING A**: Physical Examination There is strong evidence, that clinical tests for the rotator cuff: • Are able to rule-out full tears • Have questionable value for partial tears • For instability and labrum tears the evidence suggests that tests have moderate sensitivity and specificity, but the quality of studies is still questionable • For ROM, evidence indicates moderate reliability • There is moderate evidence to suggest that use of Cyriax testing of the shoulder has not been shown to be reliable.	**17**
Manipulation/ Mobilization	**RATING: B - for mobilization and for HVLA adjustments to the shoulder** There is moderate evidence that manipulation (i.e. mobilization not including grade 5 Maitland [cavitation]) may be of short-term benefit, and limited evidence for long-term benefit for patients with shoulder pain. There is limited evidence for the use of HVLA adjustments for the shoulder girdle.	**21**
Conservative Non-Manipulation	**RATING: B - for exercise for roator cuff disorders and impingement syndrome** **RATING A - for ultrasound for calcific tendinitis** There is moderate evidence that exercise may benefit patients with rotator cuff disorders or impingement syndrome. There is limited evidence that eccentric exercise may be of benefit for patients with impingement syndrome. There is strong evidence that pulsed-ultrasound is useful is resolution of pain and calcific deposits for patients with calcific tendinitis.	**25**
Lateral Epicondylitis		
Manipulation/ Mobilization	**RATING: B- for mobilization;** **Expert Opinion supports the use of HVSA adjustments to the elbow** There is moderate evidence to suggest that mobilization of either the elbow, cervical spine, or wrist may produce some immediate benefit but no evidence for or against long-term beneift. There is no evidence for or against high-velocity, short amplitude (HVSA) adjusting of the elbow in the management of LE.	**28**
Conservative Non-Manipulation	**RATING: C - for exercise, US, and bracing** Chiropractors should consider the use of exercise in the management of LE. There is limited evidence for the use of physiotherapy approaches with some possible short-term benefit for US and bracing.	**30**
Carpal Tunnel		
Evaluation	**RATING: A** There is strong evidence that the standard clinical examination tests used for CTS vary in their ability to rule-in or rule-out CTS if electrodiagnosis is used as the gold standard of compairosn. There is mild evidence that if electrodiagnosis is not used as the comparison standard, the sensitivity and specificity rise to a usable/valuable level.	**32**
Manipulation/ Mobilization	**RATING: B and C** There is limited evidence from one moderate quality RCT to support the use of a chiropractic multi-therapy approach to CTS that includes adjusting of the wrist and cervical spine. Our group's expert opinion supports the use of adjusting of the wrist (most often the lunate and distal radioulnar joint) for CTS.	**34**
Conservative	**RATING: C for use of splinting/bracing:**	**36**

Non-Manipulation	**C no evidence for B6, yoga, laser** There is limited evidence that splinting may be helpful in the initial management of CTS for patients with a new onset of symptoms. There is no strong evidence for the use of B6, yoga, or laser therapy. There is no convincing evidence for or against myofascial approaches or exercise/stretching.	

Upper Extremity Disorders in General

Data from several sources taken together indicate that upper extremity complaints comprise approximately 8%-10% of patient complaints in chiropractic practice. The percentage varies among states and among countries. Hurwitz et al.[1] performed a random sample of U.S. and Canadian chiropractic practices which resulted in a range of 5% to 11.3%. The National Board of Chiropractic Examiners Job Analysis[2] remains within a narrow range over several iterations spanning over a decade. The current percentage of patients with upper extremity complaints is 8.3%. Mootz et al.[3] in a comparison of chiropractic practice in Massachusetts and Arizona demonstrated a 4% and 9% rate of extremity complaints respectively without distinction between upper or lower extremity. They quote in their study the range of previous studies[4-6] from 6% to 13%, but again for extremity complaints as an aggregate not upper extremity alone.

Injuries/disorders associated with repetitive and/or forceful work activity are a major concern and source of health care costs. Most importantly, an increase in the number of repetitive injury traumas reported in the U.S. Bureau of Labor Statistics[7] between 1988-1992 indicated a 144% increase compared to only a 3% increase for all other injuries and diseases. In 2001[8], work-related upper extremity disorders (WRUED) accounted for the majority of the 65% of reported occupational illnesses[9].

Due to the non-specific nature of this broad category and therefore the difficulty in drawing any conclusions about specific conditions we decided to focus our attention on each region and its specific literature. We did review two Cochrane documents to obtain an overview of what exists in this broader category. One of these studies by Verhagen et al.[10] was expectedly very broad and included not only upper extremity work-related disorders but also studies that included chronic non-specific neck or shoulder complaints (Quality Rating = 55). The results were divided into seven main groups which included exercise, massage, manual therapy, ergonomics, multidisciplinary treatment, splinting, and individual versus group therapy. The review indicated limited effectiveness for exercise but for effectiveness of some specific keyboards for patients with carpal tunnel syndrome. No conclusions could be drawn for manual therapy, massage, or multidisciplinary treatment.

A systematic review by Karjalainen et al.[11] focused on biopsychosocial interventions for repetitive upper extremity injury (Quality Rating = 55). Only two studies met the criteria of the review. There was limited evidence for hypnosis combined with comprehensive treatment versus comprehensive treatment alone. There were no differences among applied relaxation, electromyography (EMG) biofeedback plus applied relaxation, and control groups at 8 weeks and at a 6-month follow-up.

Conclusions and recommendations will be discussed under each of the following sections.

Shoulder Pain

Shoulder pain clinically presents as either a generalized regional pain, local shoulder girdle pain or combined with neck pain (i.e. neck/shoulder pain). This current project included only studies addressing shoulder pain not the combination of neck and shoulder pain. Shoulder pain in the general population has been reported as high as 50% in some countries[12]. The range is between 20-50%. In a systematic review by Luime et al.[13] (2004), eighteen studies were evaluated for prevalence and one on incidence. The incidence range was relatively narrow at 0.9-2.5% which varied due to age. Prevalence figures, however, had a wide range from 6.9 to 26% for point prevalence, 18.6-31%, for 1-month prevalence, 4.7-46.7% for 1-year prevalence and 6.7-66.7% for lifetime prevalence. Factors that affected the variance were case definition which allowed some reduction in percentage and inclusion of other regions which increased that

percentage. It is important to keep in mind that policy decisions based on prevalence may be difficult given this variation.

Literature on Natural History

Chronic shoulder pain appears to be common. At 6 months following initial evaluation 34% to 79% of patients report still having shoulder symptoms [14] [15] [16] [17] [18] with 24% to 61% reporting pain 6 to 18 months beyond the initial 6 month follow-up. Most disturbing is that only about half of the elderly who reported having shoulder symptoms sought treatment. Poor recovery from shoulder pain was associated with increasing age, severe symptoms or recurrent symptoms, restricted range of passive abduction, or with concomitant neck pain[19]. The presentation of mild trauma or overuse occurring before the onset of shoulder pain, acute onset, and early presentation to a care giver indicated a favorable outcome.

A prognostic study by Thomas et al.[20] (2005) indicated that baseline characteristics rather than treatment rendered were a better predictor of outcome (Quality Rating = 77). Evaluating 316 subjects in two RCTs, baseline characteristics that independently reduced the likelihood of recovery were being female, reporting a gradual onset, or higher baseline disability scores.

A study by Largacha et al.[21] (Quality Rating – Strong [qualitative study])) attempted to determine the value of patient perception with regard to function and its relationship to the final diagnosis. Also, a correlation to age and time of presentation was investigated. Data was collected over an 11 year period. At time of entry into the primary author's office (orthopedist): 87% of patients were unable to sleep on the affected side and 71% were unable to wash the back of the opposite shoulder. Those with instability seemed to present to a specialist around age 20-35 years. Patients with full-thickness tears present 15 years later than those with partial cuff tears. Those individuals with cuff tear arthropathy presented 13 years later than full-thickness tears. The conditions with greatest female prevalence were RA and adhesive capsulitis. All other conditions were male predominant especially capsulorrrhaphy arthropathy, degenerative joint disease (DJD), and traumatic instability.

Shoulder pain, like low back pain, is being recognized as an enigmatic complaint in that the source of pain and location of pain are not logically manifested as standard clinical presentations[22]. In the search for shoulder pain studies, it became apparent that although there may be a condition-focus of a given study, that there were often overlaps. This ambiguity is likely a reflection of the co-existence of many conditions (e.g. instability and labrum tears or impingement and rotator cuff tears) but also reflects the diagnostic difficulty of pinpointing the pain source. The concern was emphasized in a prospective, reliability study by de Winter et al.[23] (1999) on interobserver agreement on the diagnostic classification of patients into six categories which included: adhesive capsulitis, acute bursitis, acromioclavicular syndrome, subacromial syndrome (e.g. tendonitis), chronic bursitis, rest group (e.g. unclear clinical picture or extrinsic causes), and mixed clinical picture (95% CI 0.37-0.54) for classification. Disagreement was associated with bilateral involvement, chronic complaints, and severe pain.

Summary of Rated Guidelines for Shoulder Pain

New Zealand Guidelines[24]: The Diagnosis and Management o Soft Tissue Shoulder Injuries and Related Disorders – These guidelines were of high quality using a rigorous approach to searching and grading. Stakeholder groups, including chiropractors, were used as part of the panel or as reviewers. The recommendations are formatted in a user-friendly manner and clearly reflect the literature support for the recommendations. The CCGPP Upper Extremity Team recommended the inclusion of these guidelines.

The Philadelphia Panel Evidence-Based Clinical Practice Guidelines on Selected Rehabilitative Interventions for Shoulder Pain[25] – An extensive literature search, rating, and recommendations were made by a group of primarily physical therapists for various regions including the shoulder. The CCGPP Upper Extremity Team felt the recommendations for the use of pulsed ultrasound for calcific tendonitis and the comments regarding lack of literature for other physiotherapy modalities were supported by the literature.

However, the Team felt that the rigor of process, lack of stakeholder input, and lack of conflict-of-interest statements caused the Team to be split on recommendations.

The American Academy of Orthopedic Surgeons (AAOS) Clinical Guidelines for Shoulder Pain – These guidelines developed by orthopedic surgeons were fairly comprehensive with a rational, comprehensive approach to various shoulder conditions. The CCGPP Upper Extremity Team had concerns regarding the limitations and bias of a surgical group evaluating options that did not include conservative options (other than injection). Additionally, the literature search seemed to be piecemeal and may not have included the most recent literature. The document was recommended by most of the Team based on the perspective that it may have value for determining recommendations for referral for surgery.

Australian Guidelines[26]: The Evidence-Based Management of Acute Musculoskeletal Pain (Shoulder Section) – Initially the CCGPP Upper Extremity Team recommended these guidelines, however, there was an overall low rating. The reason for the high recommendation but poor rating was due to the perception by members of the Team of a lack of evidence and inclusion of chiropractic input. Upon further evaluation of source documents and the larger document, it was clear that a strong literature base was present and that there was inclusion of chiropractors.

Literature on Risk factors

In a systematic review by van der Windt et al[18]. 29 studies were included. The review of these studies indicated that although no clear evidence of psychosocial risk factors was found, nearly all studies reported at least one positive association with shoulder pain. The difficulty with interpreting results from these studies was that the results were not consistent and some studies often lacked estimates of risk or made poor attempts at adjusting for confounding factors. Also exposure was poorly quantified for establishing a relationship between dose and response. There was a deficiency, in total, of any longitudinal research. What was found was consistent with data indicating no relationship with both repetitive work and work with vibrating tools. There was less evidence for working in an awkward position and performing work for a prolonged period of time.

In two more recent longitudinal studies, additional factors were proposed. The first, a study by Miranda et al.[27] indicated there was also an association found between an increased risk of shoulder pain and mental stress, obesity, older age, as well as physically strenuous work and working with the trunk forward flexed or with the hand above the shoulder level. The more recent study by Leclerc et al.[28], after adjustment for other risk factors, found that the presence of depressive symptoms was able to predict occurrence of shoulder pain. There was also an association between a low-level of job control and shoulder pain. Men with repetitive tool use and women using vibrating tools and working with arms above shoulder level were also strong predictors of shoulder pain.

The data from two RCTs was combined by Thomas et al.[20] to determine the prognostic value of baseline data compared with the prognostic value of intervention (Quality Rating = 72). Pain scores at follow-up were higher in women and those with longer duration of symptoms, and higher baseline pain or disability scores. Being female, reporting a gradual onset, or having a higher baseline disability each independently reduced the likelihood of recovery.

<u>Evaluation Overview</u>

We reviewed several guideline recommendations for both evaluation and management of shoulder complaints. These included the New Zealand Guidelines[24], The Dutch College of General Practitioners Guidelines[29], the Philadelphia Guidelines[25], and the Australian Guidelines[26]. These documents were in general agreement in statements that suggest that the physical examination is not able to clearly distinguish among shoulder disorders, however, is likely able to rule-out serious disorders. The Dutch guidelines go as far as stating that only three examination procedures are helpful which include active abduction (painful arc), passive abduction, and passive external rotation with the shoulder at 90 degrees abduction.

The evaluation of a patient's shoulder complaint by a chiropractor would be similar to an orthopedist approach from a history and physical examination perspective. Evaluation beyond the clinical examination may include radiographs or the ordering of special imaging. Following is an overview of what the literature reveals regarding these different aspects of evaluation.

History and Questionnaires

In a systematic review of shoulder disability questionnaires, Bot et al.[30] (2004) evaluated 16 questionnaires focusing on those with the most evidence which included the Disability of the Arm, Shoulder, and Hand Scale (DASH), the Shoulder Pain and Disability Index (SPADI), and the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) (Quality Rating = 100). Properties scored included validity, reproducibility, responsiveness, interprobability, and practical burden. The results indicated that none of the questionnaires demonstrated satisfactory results for all properties. Only seven questionnaires showed adequate test-retest reliability (ICC >0.70 with five questionnaires testing as inadequate. Most studies had small sample sizes (n<43) and none had information on the interpretation of test results. The DASH received the best ratings for clinometric properties.

Literature on the Clinical Examination

In an extensive systematic review by Dinnes et al.[31] studies involving clinical examination, ultrasound, magnetic resonance (MR), and MR arthrography (MRA) were evaluated (Quality Rating = 95). The review was specific to impingement syndrome and rotator cuff tear (full or partial). Some of the conclusions from the review were that the prevalence of rotator cuff disorders was high, partial verification of patients was common, in many cases patients were selected retrospectively, and sample sizes were generally very small. Reference tests were often inappropriate. Cohort studies for clinical examination indicated that physical examination used by specialists can rule out the presence of a rotator cuff tear.

<u>Range of Motion (ROM)</u>

We reviewed two studies that evaluated the reliability for measuring range of motion of the shoulder. A study by Hoving, et al.[32] was very small and included patients with varying degrees of pain and stiffness (Quality Rating = 88). Measurement was performed by rheumatologists using a specific inclinometer (Plurimeter V). The intrarater and interrater reliability of different shoulder movements varied widely with only hand-behind-back and total shoulder flexion yielding high intraclass correlation coefficients (ICCs) for both intrarater reliability (0.91 and 0.83 respectively) and interrater reliability (0.80 and 0.72 respectively). Low ICC scores were found for abduction, external rotation in abduction, and internal rotation in abduction. Generalizability is not possible due to the use of a specific inclinometer and testing performed by rheumatologists in this study.

Another small study by Hayes et al.[33] evaluated five methods including visual estimation, goniometry, still photography, "stand and reach", and hand-behind-back reach for six shoulder movements (Quality Rating = 50).. For flexion, abduction, and external rotation fair to good reliability was demonstrated for the ICC using visual (inter-rater Rho = 0.57-0.70, intra-rater Rho = 0.59-0.67, goniometry (inter-rater Rho = 0.54-0.59, intra-rater Rho = 0.53-0.65, and for photography (inter-rater Rho = 0.62-0.73, and intra-rater Rho = 0.56-0.61). The standard errors of measurement were between 14 and 25 degrees (inter-rater) and 11 and 23 degrees (intra-rater). The hand-behind-back was the least reliable. Although fair to good reliability was found for some approaches, the range of standard measurement errors indicates a large variation in precision

Valentine et al.[34] in a more recent RCT (2006) determined the intraobserver reliability of four physiologic movements in subjects with and without symptoms (Quality Rating = 55). The methods used in this study were very specific to each movement measured. These selected measurements were based on a very good literature review. Shoulder flexion and abduction were evaluated using a gravity dependent inclinometer. Shoulder external rotation was measured using a tape measure. The patient with their arm at their side and elbow flexed to 90 degrees would externally rotate to end range (if asymptomatic) or to the

first sense of pain in symptomatic. Measurement was from the ulnar styloid process to the umbilicus with the mean of three measurements used as the data point. Shoulder internal rotation was based on visual estimation. The patient with their arm at their side and the thumb facing forward were asked to internally rotate the arm. Measurements were estimated using 5 degree increments as a visual interpretation of an imaginary bisecting line between the humeral condyles and the angle made by this line at the end point. This was an interesting study because it was focused on testing intraobserver (one examiner) reliability but also measured the reliability for patients with and without pain. This is an important determination given range of motion is often used as an outcome measure of improvement or lack thereof. The findings were also interesting in hat using intraclass correlation coefficients (ICC) the researchers found that, in general, there was good reliability. However, the standard error for shoulder flexion in the symptomatic group was quite large and should be considered in interpreting this measurement finding as an indicator of clinical change in patients.

Resisted Testing

Hayes et al.[35] , performed a study on the reliability of resistive testing as proposed by Cyriax (Quality Rating = 90). The study included both the upper and lower extremities with the knee, shoulder, and elbow included. Examiners used maximum contraction testing and were unaware of previous testing results. The intrarater kappa values ranged from 0.44 to 0.82; with the interrater kappa coefficients ranged from 0.00-0.46. A small number of patients who were classified as weak affected the kappa coefficients. In the intrarater evaluation percentages for the knee evaluators averaged 91% of maximum kappa while for the shoulder the average was 66.5%. For the interrater evaluation, the average was 60.4% of the maximum kappa for both the knee and the shoulder. The intrarater and interrater reliability were not acceptable for the shoulder.

Impingement Syndrome

For impingement syndrome, diagnostic testing was evaluated in a cross-sectional study by Ardic et al.[36] and in a prospective study by Park et al.[37] In the Ardic study, comparison between clinical findings to diagnostic ultrasound and MRI was performed (Quality Rating = 81). The most painful shoulders had a more frequent finding of glenoid labral tear and this correlated with more restricted extension on physical examination. Subacromial bursal effusion/hypertrophy visible on imaging was correlated with shoulder disability and impingement test maneuvers. Clinical tests as a whole had modest accuracy for rotator cuff tears and biceps pathology. In the Park study, 913 patients underwent physical examination and diagnostic arthroscopy (Quality Rating = 69). The physical examination included eight clinical tests: Hawkins-Kennedy, Neer's, empty-can, Speeds, cross-body adduction, infraspinatus strength test, drop-arm sign, and painful arc. Results indicated that the combination of the Hawkins-Kennedy, painful arc, and infraspinatus muscle tests yielded the best post-test probability (95%) for any degree of impingement. The combination of the painful arc, drop-arm sign, and infraspinatus muscle test produced the best post-test probability (95%) for a full-thickness rotator cuff tear. Given the likelihood ratio for these patients (knowing that they were surgical candidates) test performance may appear inflated as far as sensitivity. If impingement has a functional rather than a structural component which is then not visible on arthroscopy, it is possible that arthroscopy may not be the gold standard for these functional cases

Instability and Labrum Tears

For instability, specifically labrum tears, a number of diagnostic procedures have been developed and promoted over the last 10 years. A systematic review by Luime et al.[38] attempted to determine the value of six tests commonly used to evaluate instability and/or labrum tears (Quality Rating = 74). Results for each test were:

- the relocation test (LR, 6.5; 95% CI, 3.0-14.0)
- anterior release (LR, 8.3; 95% CI, 3.6-19)
- biceps load I and II (LR, 29; 95% CI, 7.3-115.0 and LR, 26; 95% CI, 8.6-80.0), respectively,
- pain provocation of Mimori (LR, 7.2; 95% CI, 1.6-32.0)
- internal rotation resistance strength (LR, 25; 95% CI, 8.1-76.0).
- the apprehension, clunk, release, load and shift, and sulcus sign tests proved less useful.

The researchers conclude that results should be cautiously interpreted because studies were completed in select populations in orthopedic practice, mostly assessed by the test designers, and evaluated in single studies only. No accuracy studies were found for history taking or for clinical tests in primary care in this study

A prospective, cohort-study by Parentis et al.[39] (2006) evaluated provocative maneuvers for the diagnosis of superior labral anterior to posterior (SLAP) tears of the shoulder (Quality Rating = 88). One-hundred thirty-two consecutive patients scheduled for diagnostic shoulder arthroscopy were included. The sensitivity for type II SLAP lesions was highest for the active compression test and Hawkin's, followed by Speed's, Neer's, and Jobe's. They were statistically different from the other four tests ($P< 0.5$) but not from each other. The Hawkins and active compression tests were the least specific. The most specific for type II lesions was Yergason's and pain provocation tests ($P< 0.5$). Positive predictive values were low for all tests. Negative predictive values were in the 80% range for each test. The authors conclude that finding negative test results might be valuable in ruling out a SLAP lesion. Patients were referral patients and may not reflect primary entry patient types. In other words, patients were pre-screened and this would affect examiners interpretation of positive versus negative findings. Some of the tests used were not designed specifically for SLAP lesions.

Rotator Cuff Tears

In a retrospective study by Ito et al.[22] common sites of pain were evaluated using clinical charts of 149 patients diagnosed with either rotator cuff tears or adhesive capsulitis confirmed by arthroscopic findings (Quality rating = 80). The lateral and anterior shoulder were the most common sites of pain regardless of the existence of whether there was a tear or where the tear occurred. Motion pain was more common than pain at rest for patients with rotator cuff tendonitis or tears. The authors conclude that pain location is not useful in locating the site of a tear, however, the physical exam based on positive results to muscle tests with appropriate thresholds for muscle weakness was clinically useful. Specifically;

- Supraspinatus - the full can test and empty can test showed the higher accuracy when assessed with muscle weakness (78% and 79% respectively) then when assessed with pain (74% and 71% respectively)
- Infraspinatus – external rotation strength showed accuracy of 50% using pain and between 58% and 74% using weakness as a positive.
- Subscapularis – lift-off test accuracy was 65% with pain and 62%-85% when using strength.

The researchers evaluated both pain reported in the history and pain provoked by muscle testing including the muscle grade at which a positive test occurred. Supraspinatus testing was the most accurate with muscle strength less than grade 5; infraspinatus testing most accurate when the threshold of a positive was less then grade 4; and for subscapularis, muscle strength less than grade 3.

Clinical Evaluation Evidence Statement:

RATING: A

There is strong evidence to suggest that for shoulder function questionnaires, small sample sizes in most studies make conclusions difficult. The DASH is commonly used and has a good rating on systematic review.

There is strong evidence, that clinical tests for the rotator cuff:

- Are able to rule-out full tears
- Have questionable value for partial tears
- For instability and labrum tears the evidence suggests that tests have moderate sensitivity and specificity, but the quality of studies is still questionable
- For ROM, evidence indicates moderate reliability

- There is moderate evidence to suggest that use of Cyriax testing of the shoulder has not been shown to be reliable.

Chiropractors should consider use of a functional questionnaire such as DASH. A clinical evaluation should be performed in an effort to rule-out serious disease and to consider the need for special imaging

Literature on Diagnostics – Plain Film Radiography

We reviewed the American College of Radiology Guidelines for the Appropriateness of Radiography of the Upper Extremity [40] which included the shoulder. This and other documents support the use of radiography for primarily bone-related conditions including suspicion of:

- Fractures
- Dislocations
- Infections
- Cancer/tumors

All guidelines reviewed indicated that radiography is of little diagnostic value for the evaluation of soft-tissue disorders unless there is an acute traumatic presentation.

More recently, we reviewed the radiographic guidelines published in the *Journal of Manipulative and Physiological Therapeutics* (JMPT) in 2008 for the upper extremity[41]. Our group highly recommends these comprehensive, evidence-based guidelines. These guidelines were developed through a very extensive and inclusive group of chiropractors and other experts. They provide a valuable charting based on patient presentation for when radiographs should be considered and, when ordered, which views. They also provide a path for when to consider other diagnostic entities and imaging options.

Literature on Diagnostics – Diagnostic Ultrasound

In the previously mentioned review by Dinnes et al.[31] thirty-eight cohort studies for diagnostic US indicated it to be most accurate for detection of full-thickness tears; sensitivity was lower for partial-thickness. The authors felt that given the low cost, diagnostic US might be the initial choice for detecting full-thickness and perhaps partial-thickness tears keeping in mind the caveat that the accuracy and reliability are operator dependence.

Ardic et al.[36] evaluated the value of MRI and diagnostic ultrasound (US) for soft-tissue disorders of the shoulder. They found a high sensitivity for US in detecting rotator cuff tears (98.1%) and biceps pathologies (100%),

Literature on Diagnostics - MRI

The Dinnes et al review evaluated twenty-nine cohort studies for MRI which indicated a high sensitivity for full-thickness tears, however, for partial thickness tears the pooled sensitivity estimate was much less. Six cohort studies for MRA indicated high accuracy for full-thickness tears, however for partial-thickness tears, it was less consistent.

In the Ardic et al.[36] study, MRI was superior to US for glenoid labral tears and subacromial bursal effusion hypertrophy ($P<0.01$).There were more correlations between clinical and MRI findings than clinical and US findings. The severity of disability (measured by DASH) was associated with either subacromial bursal effusion or labral tear on MRI and clinically, with restricted shoulder extension. The more painful shoulders had more frequent findings of glenoid labral tear and more restricted extension. Subacromial bursal effusion/hypertrophy was correlated with shoulder disability and impingement test maneuvers. Clinical tests as a whole had modest accuracy for detecting rotator cuff tears and biceps pathology.

Literature on Adjusting, Manipulation, and Mobilization

The literature on manipulation for the shoulder is both sparse and complex. Most studies that use the term manipulation are utilizing what chiropractors would consider mobilization (e.g. Maitland grade 1-4; not 5). A literature search for mobilization and manipulation of the shoulder produces results that include manipulation under anesthesia for adhesive capsulitis (the vast majority of articles) and studies that address not only joint but soft-tissue mobilization/ manipulation. From an interpretation and usage standpoint there is a lack of focus. Studies on manipulation include the cervical spine as much or more than the shoulder joint itself.

The basic science evidence for glenohumeral manipulation is sparse. A study by Hsu et al.[42] using cadavers incorporated a dorsal translational mobilization (DTM) and ventral translational mobilization (VTM) of the glenohumeral joint. Increases in abduction ROM for both DTM and VTM occurred, however, these were only 2 degrees with a large standard deviation. No changes were found in the resting position. Small increases were found with lateral rotation ROM after VTM in the resting position, however, even less than for abduction.

The largest RCT on manipulation and the shoulder was conducted by Winters et al.[43] (Quality Rating = 75). Their group performed a follow-up study 2 years later[44]. In the original study, patients from general practices in the Netherlands were included. There were 198 patients with shoulder complaints divided into diagnostic groups; a shoulder girdle group (n = 58) and a synovial group (n = 114). These diagnostic groups were based on testing that indicated, for the synovial group, pain or limited movement that was assumed to be due to the synovial structures about the shoulder including subacromial structures, the acromioclavicular joint, the glenohumeral joint, or a combination of these. Patients in the shoulder girdle group had pain and sometimes slightly limited range of active movement of the glenohumeral joint. The assumption was that for patients with shoulder problems (i.e. pain or restriction) without specific clinical findings for the shoulder, the source was unrelated to the synovial structures but could be due to functional disorders of the cervical spine, upper thoracic spine, or the upper ribs. Manipulation was performed by physical therapists and they were allowed to include manipulation of the cervical spine, upper thoracic spine, the upper ribs, the acromioclavicular joint, or the glenohumeral joint. The method of "manipulation" was not clearly described. The shoulder girdle group was randomized to manipulation or physiotherapy. Patients in the synovial group were randomized to corticosteroid injection, manipulation, or physiotherapy. In the shoulder girdle group, at five weeks, 70% of the manipulation group considered themselves cured compared to only 10% of the physiotherapy group. In the synovial group, at five weeks, 75% of patients in the injection group, 20% of the physiotherapy group, and 40% of the manipulation group reported a "cure". There was a shift of patients from the synovial group to the shoulder girdle group as a result of treatment success with non-steroidal anti-inflammatory drugs (NSAIDs). Drop-out rates due to treatment failure in the synovial group were high in the manipulation group (59%) and physiotherapy group (51%). In the shoulder girdle group drop-out was 20% in the manipulation group and 45% in the physiotherapy group. The large drop-out rates are of concern. There are several concerns with regard to the "manipulation" approach in this study. The first concern is that there is no description of the method used. Secondly, the treatment was not standardized, in that, any given patient might have had manipulation of the cervical spine only or the glenohumeral joint only or multiple joints. There is no indication of who received which. The advantage to this approach is it may be more representative of clinical practice where the approach varies from patient to patient based on their specific needs. However, drawing conclusions about specific manipulation approaches is not possible with this methodology.

The follow-up study two years later[44] indicated that the advantage of manipulation or corticosteroid injection was lost over time. Part of the reason may have been the high attrition rate and failure of "success" cases to respond.

A more recent RCT by Bergman et al.[45] studied the effectiveness of manipulative therapy for the shoulder girdle in addition to usual medical care for relief of shoulder pain and dysfunction (Quality Rating = 70). The study design was based on a prior paper published in the *Journal of Manipulative and Physiological Therapeutics (JMPT).*[46] One-hundred and fifty patients from 50 general practices in the

Netherlands were included. The inclusion criteria were patients who were 18 years and older who had not had a consultation or treatment for shoulder symptoms in the past 3 months. Patients had to have demonstrated dysfunction of the cervicothoracic spine and adjacent ribs. The premise that cervicothoracic spine dysfunction is a cause or risk factor for shoulder pain was based upon one systematic review by Sobel et al.[47] and two studies by Norlander et al.[48, 49]

All patients received usual medical care from general practitioners. Only the intervention group received additional manipulative therapy to the cervicothoracic area or adjacent ribs (but not to the shoulder). Treatment consisted of up to 6 sessions in a 12 week period. Follow-up was over a one-year period. At 6 weeks, no differences between groups were demonstrated. At 12 weeks, 43% of the intervention group (manipulation plus usual medical care) and 21% of the control group reported full recovery. At 52 weeks, the same difference in recovery rate was reported.

A limitation of the Bergman study was that patients had shoulder pain 'accompanied" by neck symptoms. Also, patients in the medical group might have received corticosteroid injections. Patients in the manipulation group might have received other treatment because therapists were only "discouraged" from deviating from the treatment protocol. Sixteen percent of patients, in fact, had manipulation of a vertebral segment or joint outside the shoulder region.

In a small RCT by Conroy et al[50]. patients were assigned to either a "joint mobilization/comprehensive treatment group" or a "comprehensive treatment group only" which consisted of hot packs, active ROM, physiologic stretching, muscle strengthening, soft-tissue mobilization, and patient education (Quality Rating = 61). The joint mobilization utilized in the first group was of the Maitland type. Maitland mobilization involved applying oscillatory pressure at 2-3 oscillations/second. There was no indication of a grade 5 Maitland (i.e. manipulation) being used. The experimental group (the one with joint mobilization) improved on all variables, while the control group improved only with mobility and function. The mobilization group had less 24-hour pain and pain with a subacromial compression test when compared to the comprehensive treatment group but no differences in ROM and function were reported.

A very specific manipulation approach was evaluated in a study by Kebl et al.[51] involving 29 elderly patients with pre-existing shoulder problems including tendonitis, bursitis, osteoarthritis, healed fracture, or neurologic impairment and chronic pain in one or both shoulders (Quality Rating = 75). They were randomized to an osteopathic manipulation therapy (OMT) or a control group for 14 weeks. The OMT was a technique utilizing end-range isometric contractions against doctor resistance. The control group received a placebo treatment which involved positioning only with no contractions. Both groups had significantly increased ROM ($p < 0.1$) and decreased perceived pain ($p < 0.1$). Those receiving the OMT demonstrated continued improvement in their ROM while ROM in the placebo group decreased over several months. The manipulative technique was a specific approach called the Spencer technique (sometimes referred to as "muscle energy technique"). It is not true "manipulation" but, in fact, a mobilization technique involving seven positions held as an isometric contraction against resistance

A case-report by Vermeulen et al.[52] involving several patients diagnosed with adhesive capsulitis tested the effects of three months of end-range mobilization on increases in range of motion and increases in joint capsule volume. Out of the seven participants, four patients rated their improvement as excellent, two patients rated it as good, and one patient rated improvement as moderate as related to shoulder function. At the 9-month follow-up, all patients appeared to maintain any gain in joint mobility.

Recently, Vermeulen et al[53] published an RCT comparing the effects of high-grade mobilization techniques (HGMT) with that of low-grade mobilization techniques (LGMT) (Quality Rating = 67). The HGMT was described as intensive passive mobilization applied at end-range positions whereas, LGMT were performed within the pain-free zone. Range of motion and disability questionnaires were the outcome measures used. Patients were treated twice per week for 30 minutes for a maximum of 12 weeks. At 12

months the overall difference between the two groups was small with those treated with HGMT having greater changes in the disability questionnaires. The HGMT may have had slightly more external rotation and passive abduction at the one year period.

Only one small RCT on high-velocity, low amplitude adjusting (manipulation) of the shoulder has been published (Quality Rating = 78). This study by Munday et al.[54] evaluates the effect of a more typically used chiropractic adjustment on patients with impingement syndrome. The study randomized patients to a placebo group using detuned ultrasound or a shoulder-girdle adjustment group. It is interesting to note that although any part of the shoulder could be adjusted. The AC joint was the most frequently adjusted, not the glenohumeral joint. The study is a good initial pilot evaluation using a small group of 30 participants. The follow-up period was only one-month. However, the outcomes for that one-month follow-up indicate a significant treatment effect for algometry, visual analog pain scale, and the Short-Form McGill Pain Questionnaire. Future studies should include a larger patient group with a more lengthy follow-up period of one to two years.

All other studies were case studies that tended to either be general [55-57], specific to spinal adjusting for shoulder problems[58-60], or specific to disorder [61-69].

Manipulation Evidence Statement:

RATING: B - for mobilization and for HVLA adjustments to the shoulder

There is moderate evidence that manipulation (i.e. mobilization not including grade 5 Maitland [cavitation]) of the glenohumeral joint and cervical spine may be of short-term benefit, and limited evidence for long-term benefit for patients with shoulder pain. There is moderate evidence for long-term benefit for patients with adhesive capuslitis. There is limited evidence for HVLA adjustments for the shoulder specifically for impingement syndrome.

Recommendation: Chiropractors should consider mobilization approaches to the glenohumeral joint or cervical spine for patients with shoulder pain. For adhesive capsulities, mobilization should be considered.

The expert opinion of our group supports the use of high-velocity, short-amplitude (HVSA) manipulation (adjustment) of the shoulder with some recommendations for use that include avoidance of any anticipated risk. Further evaluation and/or change in management is required for patients who fail to respond to treatment within a reasonable period of time.

- For all patients who have fracture, suspected fracture, dislocation, severe generalized or local osteoporosis, infection, tumor, or infection HVSA manipulation is contraindicated.
- For patients who have had surgery of the shoulder, consider date of surgery, extent of surgery, type of procedure, and other related factors in making decisions about use of HVSA manipulation
- For all patients, an evaluation for joint stability must be performed. Based on the findings, it is recommended that no HVSA manipulation be used for patients with medical subluxation, hypermobility syndromes (e.g. Marfan's, Ehlers-Danlos syndrome), or gross looseness indicating multidirectional instability. Mobilization such as applying a load-and-shift or Maitland grade 1-4 type of translational movement may be appropriate in these case settings.
- For patients with adhesive capsulitis or any acute inflammatory condition such as rheumatoid arthritis, active hemarthrosis or extensive swelling, rheumatoid variant disease, crystalline disease (e.g. gout), or acute bursitis it is recommended not to use HVSA. There is some literature evidence that aggressive mobilization may worsen or prolong the natural history of adhesive capsulitis[70]. Based on this evidence and the experience of our panel, we feel that an HVSA approach is highly risky for certainly the early stages of adhesive capsulitis. For the middle and later stages of adhesive capsulitis chiropractors should consider a progressive application of

increasing the grade of amplitude of manipulation. It is recommended that by using patient feedback and response as a guide, increasing grades of amplitude may be applied.

- For patients with impingement syndrome with a known structural cause (e.g. type 3 acromion, arthritis, etc.), we strongly recommend that any HVLA manipulation not be applied in a superior direction.

Literature on Non-Manipulative Approaches

There are several systematic reviews and a number of RCTs that investigate non-manipulative yet conservative approaches to the management of shoulder pain. The complication is that, like clinical practice, these studies often combine treatments into regimens that are heterogeneous. The most frequent combinations of therapy are physiotherapy which include ultrasound, exercise, and stretching among other approaches. Even when exercise alone is the primary approach, the type of exercise, method of prescription, environment, type of prescription (e.g. repetitions and sets) are not homogenous between studies or even within studies. Given the two primary approaches are ultrasound and/or exercise prescription, our group focused on each as the main types of therapy that might be employed by chiropractors.

Literature on Exercise

Three major systematic reviews were evaluated for exercise in the management of shoulder pain. Two by Green et al.[71, 72] are for generalized shoulder pain and include a review of multiple interventions, while the systematic review by Desmeules et al.[73] was specific to impingement syndrome and exercise. The earlier study by Green (2000) was intended to be for generalized shoulder pain, however, the breakdown of disorders was clearly into adhesive capsulitis and rotator cuff tendonitis (Quality Rating = 92). Only three trials met the inclusion criteria for pooling of data for rotator cuff tendonitis. The conclusion was that there was little evidence to support or refute common interventions for treatment of shoulder pain in adults including subacromial injections, distension arthrography, physiotherapy, corticosteroids, manipulation under anesthesia versus placebo or another intervention. Three years later, a Cochrane review by Green et al. (2003) drew different conclusions presented in sub-groups based on disorder (Quality Rating = 74). Exercise was demonstrated effective for short-term recovery in rotator cuff disease (RR 7.74 [1.97,30.32]) and a benefit for long term restoration of function (RR 2.45 [1.24, 4.86]). For rotator cuff disease a combination of exercise and mobilization resulted in additional benefit over exercise alone

In the Desmeules[73] systematic review of the same year (2003), exercise or manual therapy were evaluated (Quality Rating = 84). Although the review appears to be focused (at least in title) on impingement, rotator cuff tendonitis or bursitis were also included in the literature search and evaluation. Four studies (rating of 67% for top three) suggested some benefit for therapeutic exercise or manual therapy when compared with other treatments such as acromioplasty, placebo, or no intervention.

Several RCTs have evaluated exercise for the management of shoulder pain. Two by Ginn et al.[74, 75] indicate some benefit to exercise or equal benefit compared to other treatments such as corticosteroid injection (Quality Rating = 95). The earlier RCT of 1997 randomized patients to a treatment group who were treated with exercise and stretching for a period of one month while the control group received no treatment over the same time period (Quality Rating = 58). Physical therapy included sessions 4-10 times over a 1-month period which consisted of stretching for shoulder muscles found to be short, strengthening exercises for shoulder muscles found to be weak, and retraining for restoration of scapulohumeral rhythm. However, the type, frequency, and duration were at the discretion of the treating physical therapist. The treatment group reported greater improvement in symptoms. The treatment group also demonstrated greater increases in pain-free abduction and flexion with a mean increase of 22 degrees abduction compared to a mean decrease of 5 degrees in the control group. After 1 month of no treatment, 50% of control group deteriorated.

In a RCT assessing the effect of a standardized 8 week home exercise program on workers diagnosed with shoulder pain, Ludwig et al.[76] randomized 67 male workers diagnosed with impingement syndrome into either an at-home exercise group or a no treatment control group (Quality Rating = 78). The intervention group showed significantly greater improvements in the Shoulder Rating Questionnaire and shoulder satisfaction score compared to the control group. Also they found there was a greater reduction in pain and disability compared to controls. This was a particularly good study in that it compared symptomatic groups with the exercise intervention or no intervention and then compared to an asymptomatic control group. This study is also unique in that it specifically addressed the working population.

In an RCT by Haahr et al.[77], 90 consecutive patients diagnosed with impingement syndrome were randomized into a subacromial decompression (surgery) group or an exercise group (Quality Rating = 75). The exercise prescription for each patient was directed toward strengthening and decompression of the shoulder with emphasis on periscapular muscles and rotator cuff muscles. The frequency was 3 times for the first two weeks, 2 times a week for the next three weeks, and 1 time per week for the remaining seven weeks. Outcomes were measured using the Constant score and a pain and dysfunction score. The Constant score is a combination measure of four subscores: pain with a visual-analog scale (VAS), activities-of-daily-living (ADLs), active ROM in four directions and isometric shoulder strength.

At baseline the Constant score was 34.8 for the training group and 33.7 for the surgery group. At 12 months the score improved to 57.0 and 52.7 respectively; the difference not being significant. No group difference in mean pain and dysfunction improvement scores was found. The authors conclude that subacromial decompression was not shown to be superior to physiotherapy with exercise. Some limitations include possible bias due to unblinded assessment of Constant scores by physiotherapists and patient preference influencing scores, although the authors suggest the effect would be small.

Bang et al.[78] performed an RCT with patients diagnosed with impingement, rotator cuff tendonitis, or “shoulder tendonitis”, and randomized them into two treatment groups (Quality Rating = 83). The first group received supervised flexibility and strengthening exercises while the second group also received the same flexibility and strengthening program but also received manual therapy. Both groups received their respective interventions 6 times over a three week period. Subjects in the combined treatment group (manual therapy plus exercise) had significantly more improvement in pain and increases in function although both groups had some improvement. Strength in the manual therapy group improved significantly while not in the exercise group. Manual therapy as described in this study included “gliding” mobilization, not manipulation, soft tissue massage, and muscle stretching.

A study by Malliou et al.[79] employed a RCT approach to compare various training methods for the shoulder (Quality Rating = 50). There were four comparative groups. Group one performed multi-joint dynamic resistance exercise, the second performed dumbbell training, the fourth performed isokinetic exercise while the control group performed no exercise. The volunteers in this study were young (mean age of 22.3) asymptomatic individuals. There was an initial isokinetic assessment performed as a baseline comparison which was followed by a six-week training period for all groups at 3 times per week. All subjects were then reassessed isokinetically. One way analysis of variance found no difference between the groups for initial tests. Analysis of variance demonstrated improvement in all groups with the most improvement in the isokinetically-trained group. The small sample size is a limitation. Given these are asymptomatic physical-education students, results can not be extrapolated to symptomatic patients. Testing pre- and post-intervention was performed isokinetically. It is likely that those training isokinetically would have an advantage over those who had not. Training is recognized as demand-specific. One conclusion might be that all methods were effective.

A recent (2006) prospective study by Jonnson et al.[80] evaluated the effect of an eccentric training program on patients with chronic shoulder pain (Quality Rating = 100). The study was quite small with only 9 patients, therefore, conclusions are certainly preliminary. The patients were diagnosed with

impingement syndrome and on a waiting list for surgical treatment (mean of 13 months). The eccentric training program was designed for the supraspinatus and deltoid muscles; 3 sets of 15 repetitions, 2 times/day, 7 days a week for 12 weeks. After 12 weeks, 5 patients were satisfied with treatment. At 1 year follow-up all 5 patients had still not elected for surgery. Their mean VAS and Constant scores were 31 and 81 respectively. Among the satisfied patients, one had a partial supraspinatus tendon tear and three had type 3 acromions (i.e. hooked acromions).

Literature on Physiotherapy

Ultrasound

In the Green systematic analysis of 2003[72], ultrasound and pulsed electromagnetic field were judged effective when compared to placebo for pain in calcific tendonitis (RR 1.81 [1.26,2.60] and RR 19 [1.16, 12.43]) respectively (Quality Rating = 74). There was no evidence for effectiveness of US for other causes of shoulder pain such as, adhesive capsulitis, or rotator cuff tendonitis. There was evidence that compared to exercise, US had no additional benefit. A RCT by Gursel et al.[81] randomized patients into two groups; one receiving superficial heat, electrical stimulation, and the other an exercise program, were randomized into a true US or sham US group with treatment administered 3 days a week for three weeks (Quality Rating = 47). The patients had shoulder pain and limitation of movement with a diagnosis confirmed by diagnostic US or MRI. Subjects showed within-group differences but these did not reach significance when compared to between-groups differences for pain, ROM, Shoulder Disability Questionnaire scores, and Health Assessment Questionnaire scores. Results indicate that true-US versus sham-US added no further benefit when applied in addition to other physical therapy interventions. Patients with calcific tendonitis were excluded from the study which may explain differences compared to other studies. Given there were diagnostic differences in the groups and given there were within-group differences, it would be interesting to know if responses were diagnosis (disorder) specific.

In a strong study by Ebenbichler et al.[82] 63 consecutive patients with a diagnosis of calcific tendonitis, (type 1 and 2) were randomized either to US or sham US. US consisted of twenty-four, 15 minute sessions of pulsed US (frequency 0.89 mHz, intensity 2.5 W per square centimeter, pulsed mode 1:4) (Quality Rating = 89). After 6 weeks, in six of the shoulders (19%) calcium deposits had resolved. Calcium deposits resolved at least 50% in nine shoulders (28%) compared to zero shoulders and three shoulders (10%) respectively in the sham groups. At 9 months, nine shoulders (42%) had resolution with improvement seen in seven shoulders (23%). At the end of the treatment period, there were greater decreases in pain and greater improvements in quality of life for those with real US versus sham US. This was a very good study that was able, through the sham group, to determine a sense of natural history for calcific tendonitis. The randomization and blinding were at a high level in this study.

Exercise and Physiotherapy Evidence Statement:

RATING: B - for exercise for roator cuff disorders and impingement syndrome,

A - for ultrasound for calcific tendinitis

There is moderate evidence that exercise may benefit patients with rotator cuff disorders or impingement syndrome. There is limited evidence that eccentric exercise may be of benefit for patients with impingement syndrome. There is strong evidence that pulsed-ultrasound is useful for resolution of pain and calcific deposits for patients with calcific tendinitis.

Chiropractors should consider the use of exercise for patients with rotator cuff disorders or impingement syndrome. For patients with calcific tendinitis, chiropractors should consider the use of pulsed-ultrasound. Other forms of physical therapy, although potentially helpful in the short-course, may not have long-term effects on outcome.

Lateral Epicondylitis (Tennis Elbow)

Lateral epicondylitis is a condition characterized by the development of lateral elbow pain made worse by resisted wrist extension and gripping. It is not an inflammatory condition as once thought, but is a degenerative process. Lateral epicondylitis (LE) is a relatively common disorder, however, prevalence studies are limited and the most commonly reported study is from 1974[83]. The range reported is between 1% to 10% with a range of 1% to 3% quoted most often. The incidence of LE in general practice is estimated between 4-7 per 1000 patients[84]. For chiropractic practice, the incidence is less clear.

Risk Factors and Natural History

Even though LE is also referred to as tennis elbow and does account for between 75% to 80% of the 50% of recreational tennis players who complain of lateral elbow pain, tennis players account for only 5% of all LE patients[85-88] By far, the most commonly reported causes are work-related[89-92] Thirty-five to 61% are related to work and 27% with leisure activities. Thirty percent are unmatched to a known precipitating cause[93] Among workers, LE results in an average time-off from work of 12 weeks in as many as 30% of those affected[94]. A U.S. National Institute of Occupational Safety and Health (NIOSH)[95] review found no evidence for an association between repetitive work and LE or postural factors with LE. The study did find strong evidence for a relationship between a combination of risk factors (i.e. force, repetition, and posture) and LE.

Lateral epicondylitis is seen more often in individuals between the ages of 40 to 60 years; equal distribution between men and women[94, 96]. Lateral epicondylitis appears to be self-limiting with a reported duration per episode of between 6 months and 2 years[97].

In a prospective study of patients with LE, Waugh et al.[98] (2004) indicated that women were more likely than men to have a work-related onset, repetitive keyboarding jobs, and cervical joint signs (Quality Rating = 68). Among women, these factors were associated with higher final DASH and VAS scores. Women and patients who report nerve symptoms are more likely to experience a poorer short-term outcome after physiotherapy management of LE[99].

We evaluated two systematic reviews for LE; one by Bisset et al.[100] and one by Smidt et al.[101]. It is clear from these reviews that although there is a large number of studies, many have insufficient power, and some have conflicting results. Also, there are a low number of quality studies per intervention. In addition, we rated some of the key RCTs that were addressed in these reviews and also more recent RCTs not included in these systematic reviews.

There were no clinical studies found on the diagnostic accuracy or reliability for the clinical examination of LE.

Literature on Diagnostics – Plain Film Radiography

We reviewed the American College of Radiology Guidelines for the Appropriateness of Radiography of the Upper Extremity[102] which included the chronic elbow pain. This and other documents support the use of radiography for primarily bone-related conditions including suspicion of:

- Fractures
- Dislocations
- Infections
- Cancer/tumors

All guidelines reviewed indicated that radiography is of little diagnostic value for the evaluation of soft-tissue disorders unless there is an acute traumatic presentation.

Literature on Adjusting, Manipulation, and Mobilization

The literature includes studies on both local manipulation/mobilization of the elbow and non-local manipulation for lateral epicondylitis. The non-local manipulative approaches include cervical and/or cervicothoracic spine manipulation and manipulation of the wrist. The systematic reviews by Smidt[101] in 2003 which included all physiotherapy approaches, concluded that there was insufficient evidence for mobilization techniques, specifically for the wrist for LE (Quality Rating = 95). The systematic review by Bisset[100] in 2004 indicated that there was some evidence that local manipulation may have an immediate effect, however, the study was a single treatment approach without follow-up (Quality Rating = 95). The study referred to by Bisset was by Vicenzino[103]. He demonstrated a substantial increase in pain-free grip during treatment using a lateral-glide mobilization (Mulligan-type). Patients were randomized to a lateral-glide treatment group or a position-only (no gliding) group. As mentioned above, the study only indicates the immediate effect but had no follow-up to determine now long effects lasted (Quality Rating = 58).

The Bisset review also concluded that wrist manipulation did not demonstrate a significant difference when compared to a treatment group that included cross-friction massage, exercise, and pulsed-ultrasound. The study referred to was an RCT by Struijs et al.[104] that utilized a Lewit-type mobilization of the wrist. This study demonstrated a similar positive outcome for both groups in a visual analog scale, grip strength, and pain threshold at the end of 6 weeks. This study was rated low by our group (Quality Rating = 38).

Specific studies related to chiropractic management of lateral epicondylitis are non-existent other than one randomized, prospective study[105] and an occasional case report[106] .In the randomized, prospective report by Langen-Peters et al.[105] patients were treated either with adjusting (manipulation) of the elbow with associated stretching or ultrasound. Both groups demonstrated improvement, however, there was no control group for comparison. This small study indicated that either manipulation of the elbow with stretching/strengthening or ultrasound are effective in the short term.

Two studies involving cervical spine manipulation/mobilization were evaluated. An RCT by Vicenzino et al.[107] utilized a lateral-glide mobilization at the C5-C6 vertebral segments (Quality Rating = 92). This small study of 15 patients demonstrated significant improvements in pain threshold, pain-free grip strength, and pain scores relative to placebo or control. There was no measure of duration of effect in any short-term or long-term follow-up. The second study was a retrospective evaluation by Cleland et al.[108] . This study compared ultrasound, soft-tissue mobilization, and elbow joint mobilization versus a group treated with cervical spine manual therapy which included passive accessory mobilization and movement techniques. Data was derived from a telephone interview over an undesignated period time which appears to be at least 1-3 years. Seventy-five percent of the local treatment group and 80% of the local plus manual therapy group had a successful outcome. The local plus manual therapy to the cervical spine group achieved a successful long-term outcome in fewer visits (mean of 9.6 visits for local versus a mean of 5.6 visits for the local plus C-spine manipulation group). This study was rated low by our group (Quality rating = 25).

Manipulation Evidence Statement:

RATING: B- for mobilization;
D - for HVSA adjustments to the elbow

There is moderate evidence to suggest that mobilization of either the elbow, cervical spine, or wrist may produce some immediate benefit but no evidence for or against long-term beneift. There is no evidence for or against high-velocity, short amplitude (HVSA) adjusting of the elbow in the management of LE.

Recommendation: Chiropractors should consider the use of mobilization techniques for the elbow, cervical spine, and possibly wrist in the management of LE, however, effects may not necesaarily be long-lasting. Use of a high-velocity, short amplitude approach to the elbow is recommended based on expert opinion.

Given there is no clear literature evidence for or against manipulation of the elbow joints for the management of lateral epicondylitis (with the exception of some case studies) our panel formed an expert consensus on this topic. The expert opinion of our group supports the use of high-velocity, short-amplitude (HVSA) manipulation (adjustment) of the elbow with some recommendations for use that include avoidance of risk. Further evaluation and/or management is required for patients who fail to respond to treatment within a reasonable period of time.

- For all patients who have fracture, suspected fracture, dislocation, active hemarthrosis or extensive swelling, severe generalized or local osteoporosis, infection, tumor, or infection HVSA manipulation is contraindicated.
- For patients who have had surgery of the elbow, consider date of surgery, extent of surgery, type of procedure, and other related factors in making decisions about use of HVSA manipulation
- Cautious or modified application of manipulation should be considered for the following: known joint mice, traction spurs, or olecranon arthrosis
- For all patients, an evaluation for joint stability must be performed. Based on the findings, it is recommended that no HVSA manipulation be used for patients with hypermobility syndromes (e.g. Marfan's, Ehler-Danlos syndrome), or gross looseness indicating multidirectional instability. Mobilization such as applying a Maitland grade 1-4 type of translational movement may be appropriate in these case settings.
- For patients with any acute inflammatory condition such as rheumatoid, crystalline disease (e.g. gout), or acute bursitis it is recommended not to use HVSA. For some patients with olecranon bursitis, HVSA manipulation may be safely applied if the bursitis is chronic or the application is not specific to the olecranon.

Literature on Physiotherapy, Exercise, or Combination Approach

In an RCT evaluating cost-effectiveness for interventions for LE, Karthals-de Bos et al.[109] determined that the success rate for a physiotherapy group was 91%, for a corticosteroid injection group; 69%, and for a wait-and-see group; 83% at one year (Quality Rating = 56). They concluded that from a cost perspective a wait-and-see approach should be the first approach.

Similar to the Karthals-de Bos study, Smidt et al [110] randomized patients to corticosteroid injection, physiotherapy, or a wait-and-see group (Quality Rating = 69). Follow-up was at 3, 6, 12, 26, and 52 weeks. There was a clear advantage at 6 weeks for corticosteroid injection. However, there was a high recurrence rate in the injection group. At 52 weeks, there was no advantage with 69% reporting success compared to 91% of patients reporting success with physiotherapy, and 83% of patients in the wait-and-see group reporting success. As a long-term approach, it was suggested that either physiotherapy or wait-and-see are the more effective approaches, however, dependent on pain levels, injection may be needed.

Exercise

Although the Bisset[100] review indicated lack of evidence for long-term benefit using physical interventions for lateral epicondylitis, there was limited evidence that exercise may have an effect on pain reduction but not maximum grip strength (Quality Rating = 95). Also, some limited evidence was found for an effect using a combination treatment that included ultrasound, exercise, and transverse friction massage when compared to a corticosteroid injection. The one study included in the Bisset review was a follow-up, prospective study by Pienimake et al.[99] of a RCT conducted in 1996[111] (Quality Rating = 64). The exercise utilized in this study consisted of a four-step exercise for 8 weeks with a 36 month follow-up (n= 30 patients). The exercise group improved more when compared to a pulsed-ultrasound group with lower pain scores on visual analog scale. At the 3-year follow-up, the exercise group had pain scores and pain drawings that had improved significantly more than the ultrasound group. Five patients in the ultrasound group had resorted to surgery whereas only one patient in the exercise group had surgery.

Ultrasound

In the Smidt[101] review only ultrasound demonstrated a clinically and statistically relevant positive effect although the evidence was rated as weak (Quality Rating = 95). They did conclude though that one study determined that exercise was significantly better that ultrasound combined with friction massage.

Braces/Splints

Braces/splints are commonly used for LE. These range from small "counter-force" braces to larger braces and even wrist braces. There is some disagreement as to whether the imposed rest by bracing/splinting is beneficial or detrimental to the initial or overall outcome. This concern arises from conflicting results in the literature. In a retrospective study by Derebery et al.[112] of 4614 workers, those who were splinted had higher rates of limited duty, more medical visits and charges, and higher total charges, and longer treatment durations compared to patients who were not splinted. One criticism of the study is that as a retrospective study the pretreatment differences between patients would not have been randomly allocated, although the study attempted to neutralize some of the effect using propensity score methodology. Another criticism is that the types of braces were not standardized. Our group rated this study low (Quality Rating = 42).

In a RCT by Struijs et al.[113] a brace-only group was compared to a combination group that received physiotherapy (Quality Rating = 83). At 6 weeks, physiotherapy was superior to brace-only for pain, disability, and satisfaction. The brace-only group was superior on ability of daily activities. At 6 months and one year follow-up there were no significant differences between treatment approaches.

A more recent RCT by Faes et al.[114] used a specialized dynamic extensor brace custom-made for each patient (Quality Rating = 78).They compared a brace group to a no brace group. Brace treatment resulted in significant pain reduction, improved functionality of the arm, and improvement in pain-free grip strength. After the treatment period, the brace group maintained beneficial effects at a one year follow-up. Unfortunately, this specific brace is not necessarily available and the cost of the brace was not stated or considered.

Non-Manipulative Evidence Statement:

RATING: C - for exercise, US, and bracing
There is moderate evidence for the use of exercise in the management of LE. There is conflicting evidence for the use of US and bracing with some possible short-term benefits.
Recommendation: Chiropractors should consider the use of exercise in the management of LE. There is limited evidence for the use of physiotherapy approaches with some possible short-term benefit for US and bracing.

Carpal Tunnel Syndrome

The prevalence of CTS is not entirely clear. The most often quoted percentage is 3.7% from a population-based study by Atrosi et al.[115]. One of the lowest reported prevalence is by Katz et al [116] and Levine et al[117] at 1%. The range, however, is between 0.7% to 9.2% for women and from 0.4% to 2.1% for men in the general population[118-120]. Certainly in some high-risk populations, this percentage is higher[121-123] with a prevalence as high as 61%. Tanka's[124] study on self-reported CTS indicated that approximately 0.5% of the population has been diagnosed with CTS.

Risk Factors and Natural History

Atroshi[115] found that obesity is associated with an increased incidence of CTS. They found that women in their 40s and 50s are four more times likely to suffer from CTS than men.

Further confusing the identity and therefore management of CTS is the variable and unpredictable course. Some studies[125] indicate a cyclic, unpredictable occurrence of "silent" periods alternating with periods of exacerbation. Other studies[126] indicate spontaneous improvement without management.

There is strong evidence for an association between exposure to a combination of risk factors and CTS. Carpal Tunnel Syndrome is an important contributor to work-related health care costs. There was some concern when the U.S. Department of Labor, Bureau of Labor Statistics reported a tenfold increase in the number of disorders "associated with repeated trauma" between 1981-1991[127]. CTS is reported as the most frequent of these disorders[128]. There was some speculation about the introduction of computer use including keyboard and mouse usage. Recent studies contradict the assumption of a causative relationship to keyboard use. The evidence points to a combination of highly repetitive work or in combination with forceful work and work involving hand and wrist vibration. Specifically, risk is high for work that demands intensive manual exertion[95, 124] such as automobile assembly workers, meatpackers, and poultry processors but not necessarily frequent computer users (when compared to the general population)[119]. There is no literature evidence at this time between posture and CTS.

Literature on the Clinical Examination

There is no clear "gold standard" for the diagnosis of CTS. Although the clinical examination is used as a standard which is then often "confirmed" by electrodiagnostic (ED) studies, it is clear that there is overlap among other neurological conditions and that ED studies may produce false positives and false negatives for patients with CTS[129]. More confounding is that the sensitivity and specificity for ED has been based on the standard of a positive clinical evaluation such as a positive Tinel's sign! This is worrisome considering the convincing evidence in the Kuschner et al[130] review of Tinel's sign and Phalen's test that clearly demonstrated a wide range of sensitivity and specificity questioning their value. Sensitivity for Phalen's ranged from 40% to 88% with an overall average sensitivity of 60% or 80% dependent on the inclusion of a study by Posch et al.[131] Specificity was overall 80%. Tinel's sign had an overall sensitivity of 49% with the Posch et al data and 64% without. Specificity overall was 55%.

On the other hand a more recent review by LaJoie et al.[132] applies a different statistical approach to determine the sensitivity and specificity of these commonly used tests. The authors claim that latent class analysis is necessary if there is no reference standard (gold standard). In other words, if there is an assumption that the reference test is 100% sensitive and specific, underestimation may occur when evaluating other tests in comparison. With that approach, these authors re-evaluated Tinel's and Phalen's and found them to be highly sensitive (0.97 and 0.92, respectively) and specific (0.91 and 0.88, respectively). The sensitivity and specificity of nerve conduction velocity testing was 0.93 and 0.87, respectively.

A systematic review and narrative review by MacDermid et al.[133, 134] (2004) are somewhat intermediate to the conclusions drawn in the LeJoie and Kuschner reviews. They agree with Kuschner et al stating that the quality of many of the studies was poor. The overall estimate for Phalen's was 68% for sensitivity and 73% for specificity. Tinel's estimated sensitivity was 50% and specificity, 77%. The carpal compression test had estimates of 64% and 83% for sensitivity and specificity, respectively. Specific but not sensitive were two-point discrimination and testing of atrophy or strength of the abductor policis brevis.

A prospective study by Nora et al.[135] (2004) demonstrated a wide range of findings that seemed to vary based on overlapping disease and patient subjectivity. Out of a total of 1528 hands were diagnosed with CTS the severity was considered mild in 42% of cases, moderate in 18% and severe in 40%. Patients had a female predominance of 5.6:1 female to male. Symptoms were restricted to the hand and wrist in 51.8% of cases with paresthesia and in 18.5% of cases with pain. In 92.5% of the partially affected hands, paresthesia was present in at least one of the first three fingers, while pain affected the three first fingers in 78.8% of these hands. Matching to the Katz's hand diagram, showed a classic pattern in 12.6% of affected hands with a pattern rated as probable CTS in 66.3%. Tinel's and Phalen's sign were positive in 34.2% and 56.3% of these hands, respectively.

D'Arcy et al[136] performed a systematic review of history taking and physical examination for diagnosing CTS and used ED testing as the comparative standard (Quality Rating = 95). In the studies that

met the inclusion criteria, the following were indications of the value of history and physical examination findings confirmed by ED testing:

- hypalgesia in the median nerve territory (LR, 3.1, 95% CI, 2.0-5.1)
- classic or probable Katz hand diagram[137] results (LR, 2.4 95% CI, 1.6-3.5), and
- weak thumb abduction strength (LR, 1.8, 95% CI, 1.4-2.3)

Findings arguing against CTS are:

- unlikely Katz hand diagram results (LR, 0.2, 95% CI, 0.0-0.7), and
- normal thumb abduction strength (LR, 0.5, 95% CI 0.4-0.7))
- Some standard tests such as Phalen's and Tinel's signs, thenar atrophy, and nocturnal paresthesia had little or no diagnostic value for positive ED test findings

It is important to note that the degree or severity of CTS in these patients was likely beyond that seen by many primary care physicians or chiropractors because these were patients seen by orthopedic surgeons, physical therapists, and ED laboratories further questioning the value of these standard clinical examination approaches in less severe cases.

Clinical Examination Evidence Statement:

RATING: A
There is strong evidence that the standard clinical examination tests used for CTS vary in their ability to rule-in or rule-out CTS if electrodiagnosis is used as the gold standard of compairosn. There is mild evidence that if electrodiagnosis is not used as the comparison standard, the sensitivity and specificity rise to a usable/valuable level.
Recommendation: Chiropractors should use a clinical evaluation for CTS in patients with hand symptoms. Although somewhat variable in differentiating between those patients with or without CTS, they may be used as a reflection of the severity of the disorder.

Literature on Diagnostics - Electrodiagnostics

With regard to nerve conduction studies, a sensitivity and specificity analysis was performed in a study by Lew et al.[138] in 2005 (Quality Rating = 75). The results indicate that measurement of a single short-nerve segment tended to be superior to results obtained by either long-segment studies or differential subtraction between 2 segments of the same nerve. Short segment, onset-latency transcarpal mixed NCV yielded the highest sensitivity (75%).

Literature on Keyboard Use

Both the surveys by Bernard[95] and Andersen[139] clearly demonstrated no association between keyboard use and CTS. However, there is still some question regarding mouse usage and CTS. On the other hand, the Verhagen et al.[10] Cochrane systematic review (Quality Rating = 55) indicated some evidence for the effectiveness of some specific keyboard for patients with CTS[140]. Evidence for expensive ergonomic interventions was not clearly demonstrated in their review.

Literature on Conservative versus Surgical Management

We rated four systematic reviews that were focused on conservative management of carpal tunnel syndrome (CTS). Two of the reviews were Cochrane Systematic Reviews. In addition, we list some of the key RCTs that were addressed in these reviews and also more recent RCTs not included in these systematic reviews.

The difficulty and complexity of reviews is the lack of a defined standard for the diagnosis of CTS. Although it has become acceptable and even recommended in some guidelines to use various electrodiagnostic criteria, it is clear that not all patients with CTS have positive findings and some patients without CTS test positive.

In the Cochrane reviews on non-surgical management of CTS by Verdugo et al. [141] only 2 RCTs met the criteria for inclusion (Quality Rating = 71). One by Garland[142] was published in 1964 when surgical treatment would be different than current standards. The other study by Gerritsen[143] compared splinting to surgery for the management of CTS. Both studies produced evidence in favor of surgery, however, on closer inspection, the Gerritsen study although showing a statistically significant advantage for surgery, demonstrated a CI that was quite low and close to a non significance with a RR of 1.38 (95% CI 1.08 to 1.75). The surgery rated in this study was an open carpal tunnel release which would currently be not the standard. For these reasons, our group did not include these studies as rated.

Literature on Adjusting, Manipulation, and Mobilization

Recommendations are preliminary due to the small number of well-controlled studies, variability in duration, and the broad range of outcome measures. It is clear that the term manipulation is not synonymous with an "adjustment" or grade 5 mobilization. Only one randomized controlled trial by Davis[144] evaluated chiropractic management versus usual medical care (Quality Rating = 81). Even this study is not specific to manipulation/adjustment of the wrist including manipulation of the spine as part of the overall management. In both Cochrane reviews on conservative management of CTS by O'Connor[145] and Verdugo[141] , the Davis study was included, however, the conclusions reached were inconsistent. This is partly due to the different outcome measures used, but also because the determination was to focus on whether chiropractic management was of benefit beyond usual medical care. The Davis study, in fact, indicated that in the short-term, both approaches were essentially equal. The improvement reported was in perceived comfort and function, and nerve conduction and finger sensation overall, but no significant differences between groups. In the Davis' study, medical treatment consisted of medication and nocturnal wrist supports. Chiropractic treatment included nocturnal wrist support, myofascial massage/loading, and ultrasound in addition to "manual thrusts" to the wrist and spine. No other high-quality studies on chiropractic management were found other than case reports [146].

In a comparative study by Tal-Akabi[147] a small number of patients were treated with carpal bone mobilization, a "median nerve stretching" (neurodynamic mobilization), or a control group with no treatment. Although the study indicated a significant effect on patient symptom improvement, there was no significant effect of carpal bone mobilization on improving pain, hand function, active wrist motion, or a decreased need for carpal tunnel release surgery. The symptom relief was demonstrated for the short-term (with three weeks of treatment). This low quality study was not included in rating.

Manipulation Evidence Statement:

RATING: B and C for manipulation of the wrist

There is limited evidence from one moderate quality RCT to support the use of a chiropractic multi-therapy approach to CTS that includes adjusting of the wrist and cervical spine. Our group's expert opinion supports the use of adjusting of the wrist (most often the lunate and distal radioulnar joint) for CTS.

Reommendation: Chiropractors should consider the addition of adjusting of the wrist and/or cervical spine in the management of CTS.

Given there is limited literature evidence for manipulation of the wrist for CTS with the exception of one RCT and some case studies, our panel also formed an expert consensus on this topic. The expert opinion of our group supports the use of high-velocity, short-amplitude (HVSA) manipulation (adjustment) of the wrist with some recommendations for use that include avoidance of risk. Further evaluation and/or management is required for patients who fail to respond to treatment within a reasonable period of time.

- For all patients who have fracture, suspected fracture, dislocation, active hemarthrosis or extensive swelling, severe generalized or local osteoporosis, infection, tumor, or infection HVSA manipulation is contraindicated.
- For patients who have had surgery of the wrist/hand, consider date of surgery, extent of surgery, type of procedure, and other related factors in making decisions about use of HVSA manipulation
- For all patients, an evaluation for joint stability must be performed. Based on the findings, it is recommended that no HVSA manipulation be used for patients with dissociation (i.e. instability), hypermobility syndromes (e.g. Marfan's, Ehler-Danlos syndrome), or gross looseness indicating multidirectional instability. Mobilization such as applying a Maitland grade 1-4 type of translational movement may be appropriate in these case settings.

Literature on Physiotherapeutics – Splinting/Bracing, Ultrasound, B6

In addition to manipulation/mobilization for carpal tunnel syndrome, chiropractors may utilize other management approaches including wrist supports/splints, ultrasound, and/or B6 vitamins (pyridoxine). Other approaches that have been studied include laser therapy, nerve/tendon gliding/stretching, or yoga. In the O'Connor[145] Cochrane systematic review, all of the above approaches were evaluated for evidence (Quality Rating = 90). In the Verdugo[141] Cochrane review, only splinting was compared to surgery (Quality Rating = 71).

Splinting

Splinting has been used as a treatment approach for CTS with the theoretical purposes of both preventing use and also decreasing pressure within the carpal tunnel. Additional variations include neutral/extension splinting and nocturnal versus full-time usage. Braces/splints can be custom made or stock. The findings in the Verdugo[141] systematic review are similar to other reviews such as Gerritsen[148], D'Arcy[136], and Feurstein[149] and RCTs such as Gerritsen[143] that indicate outcomes that favor surgery. Gerritsen's RCT indicated that at the end of an 18 month follow-up, 41% of patients in a splint group had eventually resorted to surgery (Quality Rating = 73). However, in this prospective evaluation for splinting Gerritsen et al.[143] found a 31% success rate for splinting. Only two prognostic indicators were identified. For patients with both a short duration of CTS complaints (one year or less) and a score of 6 or less for severity of paresthesia at night at baseline the predicted probability of success was 62%. The percentage of patients correctly identified by this model was 78% (95% CI, 69%-87%).

All studies indicate some success in the short-term for some patients. A more recent RCT by Werner et al[150]. demonstrated not only significant decreases in discomfort and symptoms but also maintained the success at a 1 year follow-up (Quality Rating = 31). The weakness of the study was the high drop-out rate of 30%.

Ultrasound

Ultrasound was evaluated in two trials, one by Ebenbichler[151] and the other by Oztas[152], which demonstrated that two weeks of treatment was not beneficial. However, these trials did demonstrate significant improvement following seven weeks of treatment. Interestingly, O'Connor pooled the data for these studies even though one trial used continuous US while the other used pulsed-US. In the Goodyear-Smith[153] systematic review of non-surgical management for CTS, they conclude that the Ebenbichler and Oztas studies provide conflicting evidence with a high drop-out rate. They summarize stating that there is limited evidence for US in the short and medium term (up to 6 months) (Quality Rating = 69). A more recent study supports this finding[154].

B6 (pyridoxine), nerve/tendon gliding exercises, yoga and low-level laser

Numerous approaches may be included in the conservative management of CDS. The evidence is limited for each.

- B6 – Two RCTs on the effects of 10-12 weeks of vitamin B6 therapy have been evaluated[155, 156]. There is limited evidence for improvement of finger swelling and movement discomfort with 12

weeks of treatment. However, there is also limited evidence that B6 does not improve any of the symptoms or signs of CTS.

- One study by Akalin et al.[157] on nerve/tendon gliding exercises compared these exercises to wrist splint only or combined with the exercises. Our group rated this study and did not include it as a high level paper, however, given the apparent level of interest in this approach, it was included in the discussion (Quality Rating = 44). Although there was some improvement with static-two-point discrimination, there was no advantage over wrist splint-only treatment for improving hand symptoms and signs.
- One study by Garfinkel et al.[158] evaluated yoga stretching compared to wrist splinting for CTS. There was limited evidence that yoga improved pain and Phalen's sign findings better than wrist splinting. There was limited evidence that yoga and wrist splinting were similar in providing short-term improvement with Tinel's sign, grip strength, and nocturnal awakening.
- There is limited evidence that low-level laser treatment has not been shown to have an advantage over a sham-laser treatment[159].

Non-Manipulative Evidence Statement:

RATING: C for use of splinting/bracing:
C for B6, yoga, laser

There is limited evidence that splinting may be helpful in the initial management of CTS for patients with a new onset of symptooms. There is no strong evidence for the use of B6, yoga, or laser therapy. There is no convincing evidence for or against myofascial approaches or exercise/stretching.
Recommendation: Chiropractors should consider the use of brace/splint for the initial management of CTS particularly in patients with recent onset of symptoms. The use of B6, yoga, and laser require further investigation.

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References from Cochrane and Other Reviews

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1

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Appendices and Tables

Appendix 1 – Specific Processes for the Upper Extremity Section

The scope of investigation for the upper extremity team included both general topics related to the upper extremity, as a whole, and specific named conditions. The organization of presentation of findings and recommendations will follow the same sequence; first a general upper extremity discussion, followed by specific conditions in a top-down regional approach beginning with the shoulder. For the shoulder, there are a number of conditions for which we found published research, whereas, for the elbow, the only condition was lateral epicondylitis and for the wrist, only carpal tunnel.

In establishing a search strategy was utilized that would be reflective of the types of conditions managed by chiropractors. Considerations included education and training, scope of practice, and data related to the most common conditions seen by chiropractors. Although the scope of practice varies widely, there is the common, self-imposed restriction to non-drug, non-surgical, conservative management. This allowed for exclusion of articles on medications or surgery unless they were included as a comparison to conservative management. Other exclusion criteria included:

- Fractures
- Dislocations (unless related to conservative management after reduction)
- Infections
- Cancer/tumors
- Vascular etiology
- Stroke related (e.g. hemiplegia)
- Neck-related shoulder pain (typically nerve root)
- Manipulation under anesthesia (e.g. adhesive capsulitis)

A search strategy was devised to gather information that included both randomized trials and other forms of data regarding upper extremity pain. This strategy was adapted from past work done by the Cochrane Collaboration. This resulted in an initial yield of approximately 5,600 papers. Further exclusion was possible using the EndNote search tool to cull out those papers that evaded the search strategy eliminators. This process resulted in approximately 1,340 papers. Further selection was based on hand search strategies to identify guidelines, systematic reviews, and randomized controlled studies.

Scoring of Reviews for the CCGPP Upper Extremity Team

The scoring (rating) of the literature using the SIGN checklists did not have a "scientific" method for generating a global rating; only a plus, minus or neutral rating, We developed several schemes to try to objectify this somewhat subjective approach. In essence, this is an attempt to quantify a qualification approach.

The goals of this approach are:

1. to provide global information on each study with regard to the group ratings
2. to provide a sense of how the group rated each item
3. to provide a sense of individual voting as it compares to other members
4. to provide a point of discussion for areas that appear either to be in disagreement or when very low ratings render a "recommend" or + rating

Below is the method upon which each is quantified. Each rating possibility was given a point value as follows:

- Well Covered = 2 points
- Adequately Covered = 1 point
- Poorly Covered = -1
- Not Addressed or Reported = -2 points
- Not Applicable = 2 points

By doing so, higher quality studies would accrue higher point values and vice a versa. For guidelines, we also averaged the total points for each and turned it into a percentage so that a global sense

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of group rating would be evident. This percentage can also be translated into a point scale out of 100 possible points. As our group reviewed the highest rated studies versus the lowest rated studies it became apparent that studies in the range of 75 points or above were highly rated with regard to degree of recommendation by the group, those 50 and above were judged acceptable, and those below 50 were of concern with regard to validity/quality. Thus, this rating is not similar to standard grading by percentage where one might assume that 90 or above would be necessary for high quality.

For guidelines the AGREE checklist was used and for the AGREE ratings, we followed the direction of the AGREE document which states that domain scores should not be aggregated into a total or average score. We presented scores for each domain as directed by the AGREE document.

For systematic reviews/meta-analysis and randomized controlled trials we organized ratings into an item analysis and individual ratings. The item analysis allowed us to look at each item and how the group voted, while the "By Reviewer" section demonstrated how each individual rated each study as a global rating.

Seed statements regarding the evaluation and management for upper extremity pain and specific regional considerations were prepared and were sent to each team member, and an overall rating was applied to each statement. Consensus was then reported on these seed statements. The grading systems have been integrated into a single system with explanations and examples.

The grading system was agreed upon and standardized for this process by all team leads and CCGPP leadership. Following is the system with associated criteria:

Definitions for evidence ratings

GRADE A:

Supported by good evidence from relevant studies. Must be included in evidence tables and reference(s).

Explanation

- The evidence consists of results from studies based on appropriate research designs of sufficient strength to answer the questions addressed.
- The results are both clinically important and consistent with minor exceptions at most.
- The results are free of any significant doubts about generalizability, bias, and flaws in research design.
- Studies with negative results have sufficiently large sample sizes to have adequate statistical power.

Examples

- Supporting evidence may consist of a systematic review of randomized controlled trials (RCT's) with comparable methodology and consistent results or the preponderance of evidence from several relevant RCT's with consistent results.
- For diagnostic tests - a systematic review of studies meeting standards of reporting diagnostic accuracy; or at least 1 study meeting standards of diagnostic accuracy, including cohort studies with good reference standards.
- For the question of natural history of a disorder, in the absence of evidence to the contrary, the evidence might be results from a single well done prospective cohort study.

GRADE B:

Supported by fair evidence from relevant studies. Must be included in evidence tables and reference(s).

Explanation

- The evidence consists of results from studies based on appropriate research designs of sufficient strength to answer the questions addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies, or because of minor doubts about generalizability, bias, and research design flaws, or adequacy of sample size.
- Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent with major exceptions at most.

Examples

- Supporting evidence might consist of several RCT's with differing results although overall the results support the conclusion.
- The evidence might also be the result of a single randomized controlled trial with a clinically significant conclusion but doubtful generalizability.
- Alternatively, the evidence might come from a systematic review of RCT's with similar methodologies but differing results.
- For diagnostic tests, exploratory cohort studies with good reference standards, or instrumentation studies of reliability and validity.
- For a question of harm or adverse events, the evidence might consist of 2 or more independent case control studies with similar conclusions and minimal bias and research design flaws.

GRADE C:

Supported by limited evidence from studies or reviews. Do not include in evidence tables but in reference(s).

Explanation

- The evidence consists of results from studies of appropriate design for answering the question addressed, but there is substantial uncertainty attached to the conclusions because of inconsistencies among the results from different studies, or because of serious doubts about generalizability, bias, research design flaws, or adequacy of sample size.
- Alternatively, the evidence consists solely of results from a limited number of studies or because of weak design for answering the question addressed.

Examples

- For a question of treatment efficacy or effectiveness, the evidence might consist of systematic or narrative reviews or RCT's with contradictory results and/or serious methodological flaws.
- From relevant cohort, case control, ecological studies, and outcomes research.
- Alternately, the evidence might consist of individual case series.
- For diagnostic studies, the evidence might consist of non-consecutive studies without appropriate reference standards and case control studies unconfirmed by other studies.
- For a question or harm, the evidence might consist of results from a single case control study, or case series.

GRADE I:

No recommendation can be made because of insufficient or non-relevant evidence. It should not be included in evidence tables or reference(s).

Explanation

- There is no evidence that directly pertains to the addressed question because either the studies have not been performed or published, or are non-relevant.

Examples

- No studies could be identified using optimal search strategies of appropriate data bases, or by hand searching. Alternately, the literature cited does not have direct bearing on the question being addressed.

Expert Opinion

Supported by expert opinion, and usual and customary clinical practice. Include in reference(s).

Explanation

- The evidence consists of expert opinion. Research studies cannot be or have not been performed.

Examples

- The literature cited might consist of a consensus report, a consensus opinion based on practice guidelines, an editorial, a position statement from a national body without citations of the results of research studies, and single case reports.

Strengths and Weaknesses

In addition to the processes listed in the general introduction, our group met in total on two separate occasions in addition to several teleconferences. The remainder of communication was through e-mail. The last face-to-face meeting in May of 2006 involved a review of all materials rated and a discussion of:

- Ratings that had an inconsistent rating between or among raters and dialogue to resolve these or determine why there was a discrepancy. These observations or solutions are noted in the main document.
- Agree on language for the Considered Judgment statements which form the core of our ratings and recommendations.

All of the materials including the literature reviewed, ratings, summary breakdowns of ratings in Excel spreadsheets, and Considered Judgment forms were placed in three large ring binders organized by region and condition. The final draft was then created and sent to all members for final comment in August of 2006.

Some weaknesses or perceived weaknesses that resulted from either the process or available literature:

- For all regions/conditions, there is no clear distinction between acute, sub-acute, and chronic as there is in the low back literature. We simply kept recommendations focused on acute/sub-acute. For chronic, statements are made mainly related to long-term outcomes of care or predictors of recovery.
- We chose not to rate the value of radiography and special imaging at this time. We were disappointed by the lack of focus and direction in the ACR Guidelines. Knowing that the a project in Canada is just about complete with pending publication of their document, we were hoping to rate and use these guidelines in the final document.
- Due to the amount of literature and the loss of two members through the process, we were limited to 2 member ratings on RCTs. For systematic reviews and guidelines, most if not all members rated these.

Table A1- Conditions Covered

Coverage by ICD9 Code[1[1]]		
Code	**Official ICD9 Name**	**Description (from ODG)**
354.0	Carpal tunnel syndrome	Compression of the nerve that travels through the wrist to the thumb side of the hand causing pain, tingling, or numbness along the wrist, palm, and fingers. Pain may also be felt in the arm or shoulder, and is often worse while sleeping. Median nerve entrapment, Partial thenar atrophy
723.4	Brachia neuritis or radiculitis NOS	Inflammation in the brachial nerves in the shoulder area causing pain and changes in sensation along the pathway. Symptoms include a severe shoulder ache that sometimes extends to the arm and neck. The pain is constant for about a day and then disappears, and is followed by weakness in the upper arm and shoulder three to ten days later. Other names: Brachial neuropathy, Cervical radiculitis, Radicular syndrome of upper limbs
726.0	Adhesive capsulitis of shoulder	Chronic inflammation of the shoulder joint tissue. The "freezing" of the shoulder starts gradually and causes loss of motion and constant pain. Other names: Frozen shoulder
726.1	Rotator cuff syndrome of shoulder and allied disorders	Tearing and swelling of the muscles and joints that hold the upper arm in the shoulder joint caused by repeatedly moving the arm over the head such as in sports. The movement causes the top of the arm bone to rub against part of the shoulder joint and its tendons, which tears individual fibers. Shoulder pain (especially with movement) and sometimes a squeaking sound when moving the arm are among the symptoms. Other names: Swimmer's shoulder, Tennis shoulder, Pitcher's shoulder, Shoulder impingement syndrome
726.12	Bicipital tenosynovitis	Inflammation of a tendon sheath caused by calcium deposits, repeated strain or trauma, high levels of blood cholesterol, rheumatoid arthritis, gout, or gonorrhea.
726.31	Medial epicondylitis	Painful inflammation of the muscle and tissues of the elbow caused by repeated strain or violent extension of the wrist against a resisting force. Golfers' elbow
726.32	Lateral epicondylitis	Painful inflammation of the muscle and tissues of the elbow caused by repeated strain or violent extension of the wrist against a resisting force. Epicondylitis NOS, Tennis elbow
726.33	Olecranon bursitis	Inflammation of the connective tissue of the elbow due to arthritis, infection, injury, or excessive exercise or effort. Other names: Miner's elbow
726.90	Enthesopathy of specified site	Inflammatory process involving the area where a ligament or tendon is inserted into bone. Pain and other symptoms depend on where the inflammation occurs.
727.3	Other bursitis	Inflammation of the bursae (fluid-filled sacs that are located at sites of friction and facilitate normal movement). Inflammation causes localized pain, swelling, and limits. Other names: Bursitis NOS
739.7	Nonallopathic lesions, upper extremities	Segmental dysfunction or somatic dysfunction of the upper extremities, especially the acromioclavicular or

[1[1]] The examples of ICD9 codes given are just that and not intended to be an exclusive representation of all conditions seen in a typical chiropractic practice.

		sternoclavicular region
840.0	Sprains and strains of acromioclavicular (joint) (ligament)	Injury to the ligament (sprain) or to the muscle (strain) of the acromioclavicular (joint) (ligament). Sprains and strains are usually accompanied by a tearing of the tissue as well as symptoms of pain, limited motion, swelling, bruising, and/or a change in sensation.
840.4	Sprains and strains of the rotator cuff	Injury to the ligament (sprain) or to the muscle (strain) of the rotator cuff. Sprains and strains are usually accompanied by a tearing of the tissue as well as symptoms of pain, limited motion, swelling, bruising, and/or a change in sensation. Other names: Sprained rotator cuff, Strained rotator cuff
840.9	Sprains and strains of an unspecified site of shoulder and upper arm	Injury to the ligament (sprain) or to the muscle (strain) of the arm or shoulder that is not elsewhere specified. Sprains and strains are usually accompanied by a tearing of the tissue as well as symptoms of pain, limited motion, swelling, bruising, and/or a change in sensation.
841.2	Sprains and strains of the radiohumeral (joint)	Injury to the ligament (sprain) or to the muscle (strain) of the radiohumeral (joint). Sprains and strains are usually accompanied by a tearing of the tissue as well as symptoms of pain, limited motion, swelling, bruising, and/or a change in sensation.
841.9	Sprains and strains of unspecified site of elbow and forearm	Injury to the ligament (sprain) or to the muscle (strain) of the radiohumeral (joint)an otherwise unspecified site of the elbow and forearm. Sprains and strains are usually accompanied by a tearing of the tissue as well as symptoms of pain, limited motion, swelling, bruising, and/or a change in sensation.
842.10	Sprains and strains of wrist and hand at an unspecified site	Injury to the ligament (sprain) or to the muscle (strain) of the wrist or hand. Sprains and strains are usually accompanied by a tearing of the tissue as well as symptoms of pain, limited motion, swelling, bruising, and/or a change in sensation.
905.7	Late effect of sprain and strain without mention of tendon injury	Residual problem of a sprain/strain of an upper limb that occurs after the acute phase.
923.00	Contusion of upper limb of the shoulder region	Bruise of an upper limb in the shoulder region. Symptoms include localized tenderness, pain, swelling, and blue/purple color where the bruise forms.
923.1	Contusion of upper limb of the elbow or forearm	Bruise of an upper limb of the elbow or forearm region. Symptoms include localized tenderness, pain, swelling, and blue/purple color where the bruise forms.

Table A2 – Search Strategies

Search Strategy for Cochrane

Part A

1. Therapeutics explode all (MeSH) OR Braces single term (MeSH)

Part B

2. Chiropractic single term (MeSH) OR Physical medicine single term (MeSH) OR Physical therapy (specialty) single term (MeSH)

Part C

3. upper extremity (explode)
4. bones of the upper extremity (explode)
5. brachial plexus (explode)
6. shoulder joint
7. acromioclavicular joint
8. sternoclavicular joint
9. rotator cuff
10. elbow joint
11. wrist joint
12. finger joint
13. scaphoid bone
14. metacarpophalangeal joint
15. finger joint
16. thumb
17. Arm injuries (explode)
18. shoulder impingement syndrome
19. shoulder pain
20. Brachial Plexus neuropathies (explode tree 1)
21. Ulnar neuropathies (explode)
22. reflex sympathetic dystrophy
23. hand deformities (explode)
24. hand injuries (explode)
25. Median neuropathy (explode)
26. radial neuropathy (explode)
27. set 3- 26 ORed
28. COMBINE SET 27 RESULTS WITH SET 1
29. COMBINE SET 27 WITH SET 2

Search Strategy Upper Extremity MEDLINE

Part A RCT and CCT

1. randomized controlled trial [pt]
2. randomized controlled trials [mh]
3. controlled clinical trial [pt]
4. Random Allocation [mh]
5. Double-Blind Method [mh]
6. Single-Blind Method [mh]
7. Part A 1 #1 OR #2 OR #3 OR #4 OR #5 OR #6
8. #7 limit to human
9. clinical trial [pt]
10. clinical trials [mh]
11. “deep Clinical Trials”
12. “latin square”
13. Placebos [mh]
14. epidemiologic research design [mh]
15. random* [tiab]
16. Research Design [mh]
17. Part A2 #9 OR #10 OR #11 OR ….to #15
18. #17 limit to human
19. Case-Control Studies [mh]
20. Cohort Studies [mh]
21. Comparative Study [mh]
22. Evaluation Studies [mh]
23. Evaluation studies [pt]
24. feasibility studies [mh]
25. Follow-Up Studies [mh]
26. multicenter study [pt]
27. multicenter study [mh]
28. validation studies [pt]
29. Prospective Studies [mh]
30. (control* OR prospective* OR Volunteer*) [tw]
31. Cross-Over Studies [mh]
32. Part A3 search terms # 19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31
33. results #32 limit to human
34. clinical protocols [mh]
35. meta-analysis [mh]
36. meta-analysis [pt]
37. pilot projects [mh]
38. systematic review*
39. treatment outcomes [mh]
40. practice guideline [pt]
41. Part A4 search terms #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40
42. limit search #41 to human
43. results of set #8(A1) OR #18 (A2) OR #33 (A3) OR #42 (A4)

Major subject headings for the region :
Part B Specific Search for upper extremity problems

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44. Shoulder[mh]
45. Shoulder Joint [mh]
46. Upper Extremity [mh]
47. Arm [mh]
48. Forearm [mh]
49. Acromioclavicular Joint [mh]
50. Sternoclavicular Joint [mh]
51. Rotator Cuff [mh]
52. Elbow [mh]
53. Elbow Joint [mh]
54. Wrist [mh]
55. Wrist Joint [mh]
56. Hand [mh]
57. Fingers [mh]
58. Finger Joint [mh]
59. Carpal Bones [mh]
60. Scaphoid Bone [mh]
61. Humerus [mh]
62. Clavicle [mh]
63. Scapula [mh]
64. Radius [mh]
65. Ulna [mh]
66. Metacarpophalangeal Joint [mh]
67. Finger Joint [mh]
68. Thumb [mh]
69. result of set 44-68 #44 OR #45 OR to 69
70. set number 69 NOT Fractures [mh]
71. set number 69 NOT Infection [mh]
72. set number 69 NOT Neoplasms [mh]
73. set number 69 NOT surgery [mh]
74. set number 69 NOT surgery [sh]
75. set number 69 NOT drug therapy [mh]
76. set number 69 NOT drug therapy [sh]
77. results of sets number 70-76 OR'ed
78. set #77 AND #43

Part C Specific conditions of the upper extemity

79. Arm injuries [mh]
80. Forearm Injuries [mh]
81. Wrist Injuries [mh]
82. Shoulder Impingement Syndrome [mh]
83. Shoulder Pain [mh]
84. Shoulder Dislocation [mh]
85. Brachial Plexus Neuritis [mh]
86. Reflex Sympathetic Dystrophy [mh]
87. Tennis Elbow [mh]
88. Cubital Tunnel Syndrome [mh]
89. Hand Deformities [mh]
90. Hand Deformities, Acquired [mh]
91. Hand Injuries [mh]
92. Finger Injuries [mh]
93. Carpal Tunnel Syndrome [mh]
94. Ulnar Nerve Compression Syndromes [mh]
95. Median Nerve [mh]
96. Median Neuropathy [mh]
97. Radial Nerve [mh]
98. Radial Neuropathy [mh]
99. set #79 OR #80 OR #81 to #98
100. set number 99 NOT Fractures [mh]
101. set number 99 NOT Infection [mh]
102. set number 99 NOT Neoplasms [mh]
103. set number 99 NOT surgery [mh]
104. set number 99 NOT surgery [sh]
105. set number 99 NOT drug therapy [mh]
106. set number 99 NOT drug therapy [sh]
107. Set #100 OR #101 OR #102 OR #103 OR #104 OR #105 OR #106
108. Set #107 AND #43

Part D, General conditions of all parts of the body. :

109. Osteoarthritis [mh]
110. Sprains and Strains [mh]
111. Tendon Injuries [mh]
112. Tendinitis [mh]
113. Bursitis [mh]
114. Soft Tissue Injuries [mh]
115. Myofascial Pain Syndromes [mh]
116. Rheumatic Diseases [mh]
117. Joint Instability [mh]
118. Tenosynovitis mh]
119. Palpation [mh]
120. Range of Motion, Articular [mh]
121. Cumulative Trauma Disorders [mh]
122. Musculoskeletal System[mh]
123. Ligaments [mh]
124. Hand Strength [mh]
125. set #109 OR #110 OR to #119
126. set number 125 NOT Fractures [mh]
127. set number 125 NOT Infection [mh]
128. set number 125 NOT Neoplasms [mh]
129. set number 125 NOT surgery [mh]
130. set number 125 NOT surgery [sh]
131. set number 125 NOT drug therapy [mh]
132. set number 125 NOT drug therapy [sh]
133. results of sets #126-132 OR'ed
134. set #133 AND #77
135. set #134 AND #43

Part F Types of Therapy that might apply

136. Manipulation, Osteopathic [mh]
137. Manipulation, Chiropractic [mh]
138. Manipulation, Orthopedic [mh]
139. Musculoskeletal Manipulations [mh]
140. Chiropractic [mh]
141. Physical Medicine [mh]
142. Transcutaneous Electric Nerve Stimulation [mh]
143. Braces [mh]
144. Exercise [mh]
145. Exercise Therapy [mh]
146. Exercise Movement Techniques [mh]
147. Therapeutics [mh]
148. therapy [sh]
149. Laser Therapy, Low-Level [mh]
150. Massage [mh]
151. Motion Therapy, Continuous Passive [mh]
152. Short-Wave Therapy [mh]
153. Electric Stimulation Therapy [mh]
154. Combined Modality Therapy [mh]
155. Physical Therapy (Specialty) [mh]
156. Physical Therapy Techniques [mh]
157. Ultrasonic Therapy [mh]
158. Occupational Therapy [mh]
159. Therapies, Investigational [mh]
160. Complementary Therapies [mh]
161. set #136 OR #137 to #160
162. set #161 AND #77
163. set #162 AND #43
164. Set #161 AND #107
165. set #164 AND #43
166. set #161 AND #134
167. set #166 AND #43
168. set #163 OR #165 OR #167

CINAHL SEARCH TERMS

Part A RCT and CCT's

Explode these terms:

1. Clinical Trials
2. Convenience Sample
3. Evaluation Research
4. Omaha System

Search as a regular subject heading:

5. Epidemiological Research
6. Study Design
7. Case Control Studies
8. Prospective Studies
9. Comparative Studies
10. Pilot Studies
11. Concurrent Prospective Studies
12. Validation Studies
13. Crossover Design
14. Clinical Effectiveness
15. Systematic Review
16. Treatment Outcomes
17. Practice Guidelines
18. Number 1-18 OR ed

Part B Anatomy Upper Extremity Region
Explode:

19. Upper Extremity
20. Shoulder Joint
21. Finger Joint
22. Arm Bones
23. Brachial Plexus

Search as regular subject heading

24. Shoulder
25. Acromioclavicular Joint
26. Rotator Cuff
27. Wrist Joint
28. Elbow Joint
29. Number 19 to 28 OR ed
30. Number 29 NOT MH fractures
31. Number 29 NOT MH infection
32. Number 29 NOT MH neoplasms
33. Number 29 NOT MH Surgery, Operative
34. Number 29 NOT MH Drug Therapy
35. Number 30 to number 34 OR ed
36. Set 35 AND Set 18

Part C specific conditions of the upper extremity
Explode

37. Brachial Plexus Neuropathies
38. Arm Injuries

Search as subject heading

39. Elbow Dislocation
40. Tennis Elbow
41. Rotator Cuff Injuries
42. Shoulder Dislocation
43. Shoulder Impingement Syndrome
44. Shoulder Pain
45. Hand injuries
46. Finger injuries
47. Wrist dislocation
48. Carpal Tunnel Syndrome
49. Hand Deformities, Acquired
50. Raynaud's Disease
51. Result of set 37 to 50 OR ed
52. Set number 51 NOT MH fractures
53. Set number 51 NOT MH infection
54. Set number 51 NOT MH neoplasms
55. Set number 51 NOT MH Surgery, Operative
56. Set number 51 NOT MH Drug Therapy
57. Set number 52-56 OR ed
58. Set number 57 AND 18

Part D General Conditions of the body
Search as a subject heading

59. Nerve Compression Syndromes
60. Osteoarthritis
61. Adhesive Capsulitis

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62. Sprains and Strains
63. Tendon Injuries
64. Bursitis
65. Soft Tissue Injuries
66. Myofascial Pain Syndromes
67. Rheumatic Diseases
68. Joint Instability
69. Tenosynovitis
70. Palpation
71. Range of Motion
72. Cumulative Trauma Disorders
73. Musculoskeletal Diseases
74. Musculoskeletal System
75. Ligaments
76. Set number 59 to 75 OR ed
77. Set number 76 NOT MH fractures
78. Set number 76 NOT MH infection
79. Set number 76 NOT MH neoplasms
80. Set number 76 NOT MH Surgery, Operative
81. Set number 76 NOT MH Drug Therapy
82. Set number 77-81 OR ed
83. Set number 82 AND set number 35
84. Set number 83 AND set number 18

Part F Therapy

Explode

85. Therapeutics
86. Electric Stimulation
87. Diathermy

Regular subject heading search

88. Orthoses
89. Motion Therapy, Continuous Passive
90. Therapeutic Exercise
91. Physical Therapy
92. Occupational Therapy
93. Set #85-91 OR ed
94. Set #93 AND 35
95. Set 94 AND 18
96. Set 93 and 57
97. Set 96 and 18
98. set 93 and 83
99. set 98 and 18
100. set 95 OR 97 OR 99

Table A3 - **Guideline Ratings**

Philadelphia Guidelines

Rater	Scope	Stakeholder	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	8	12	22	6	5	3	not
F	12	14	25	17	3	2	recommend
S	8	13	24	7	4	5	recommend
R	11	11	21	9	4	1	not
C	11	8	19	13	4	6	recommend
	50	58	111	52	20	17	
Score	**78%**	**63%**	**72%**	**53%**	**11%**	**23%**	

New Zealand Guidelines

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	10	14	26	14	8	8	recommend
F	12	10	27	14	3	2	recommend
S	9	9	28	16	7	5	recommend
R	12	16	28	16	12	8	highly recommend
C	11	8	22	14	5	4	recommend
	54	57	131	74	35	27	
Score	**87%**	**62%**	**91%**	**90%**	**44%**	**57%**	

Australian Guidelines

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	11	10	18	17	7	4	highly recommend
F	12	11	23	16	8	4	recommend
S	8	11	23	12	6	4	highly recommend
R	9	13	17	13	5	5	recommend
C	9	13	13	14	3	5	recommend
	49	58	94	72	29	22	
Score	**76%**	**63%**	**56%**	**87%**	**31%**	**40%**	

AAOS Guidelines

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	12	12	25	14	5	2	recommend
F	12	12	26	16	5	2	recommend
S	11	13	2	13	4	2	recommend
R	9	10	9	7	4	2	recommend

C	12	7	21	11	3	3	unsure
	56	54	83	61	21	11	
Score	**91%**	**57%**	**46%**	**68%**	**13%**	**3%**	

ACR Shoulder Guidelines – MRI

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	10	9	17	11	4	2	recommend
F	12	8	16	11	3	2	recommend
S	8	10	19	12	4	2	recommend
R	7	7	9	11	4	2	recommend
C	12	9	17	14	5	2	recommend
	49	43	78	59	20	10	
Score	**76%**	**38%**	**41%**	**65%**	**11%**	**0%**	

WLDI (work Loss Data Institute) Shoulder Guidelines

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	9	7	14	11	6	3	not recommend
F	12	7	11	13	3	2	recommend
S	8	7	14	11	6	4	not recommend
R	12	7	8	10	5	2	recommend
C	8	6	10	9	4	2	not recommend
	49	34	57	54	24	13	
Score	**76%**	**23%**	**21%**	**57%**	**20%**	**10%**	

ACR Radiography Guidelines – Upper Extremity

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	9	7	11	9	4	2	recommend
F	12	8	16	11	3	2	recommend
S	7	9	17	11	3	2	recommend
R	8	7	10	12	4	2	recommend
C	12	8	15	13	5	2	recommend
	48	39	69	56	19	10	
Score	**73%**	**32%**	**32%**	**60%**	**9%**	**0%**	

Carpal Tunnel

Washington State Guidelines for Carpal Tunnel

Rater	Scope	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence	Recommendation
H	9	10	18	9	7	4	Recommend
F	12	7	10	11	3	2	not recommend
S	9	10	18	11	7	2	not recommend
C	7	6	7	7	3	2	not recommend
	37	33	53	38	20	10	

Score	**69%**	**35%**	**30%**	**46%**	**22%**	**8%**	

Table A5 - Moose score rating - systematic reviews/meta-analyses

Reporting of background should include	
	Problem definition
	Hypothesis statement
	Description of study outcome(s)
	Type of exposure or intervention used
	Type of study designs used
	Study population
Reporting of search strategy should include	
	Qualifications of searchers (eg, librarians and investigators)
	Search strategy, including time period included in the synthesis and keywords
	Effort to include all available studies, including contact with authors
	Databases and registries searched
	Search software used, name and version, including special features used (eg, explosion)
	Use of hand searching (eg, reference lists of obtained articles)
	List of citations located and those excluded, including justification
	Method of addressing articles published in languages other than English
	Method of handling abstracts and unpublished studies
	Description of any contact with authors
Reporting of methods should include	
	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested
	Rationale for the selection and coding of data (eg, sound clinical principles or convenience) Documentation of how data were classified and coded (eg, multiple raters, blinding, and interrater reliability)
	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)
	Assessment of study quality, including blinding of quality assessors; stratification or regression on possible predictors of study results
	Assessment of heterogeneity
	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated
	Provision of appropriate tables and graphics
Reporting of results should include	
	Graphic summarizing individual study estimates and overall estimate
	Table giving descriptive information for each study included
	Results of sensitivity testing (eg, subgroup analysis)
	Indication of statistical uncertainty of findings
Reporting of discussion should include	
	Quantitative assessment of bias (eg, publication bias)
	Justification for exclusion (eg, exclusion of non–English-language citations)
	Assessment of quality of included studies
Reporting of conclusions should include	
	Consideration of alternative explanations for observed results
	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)
	Guidelines for future research
	Disclosure of funding source

Score by putting page numbers in the left-column. Tally the number of checks and represent as the percentage of items present by dividing by 34 and multiplying the result by 100.

Table A6: Scoring for Systemtatic Reviews and RCTs

Upper Extremity

Primary Author	Quality Rating Score
Verhagen AP, et al.[10] (2003)	55
Karjalainen K, et al.[11] (2000)	55

Shoulder – Systematic Reviews

Primary Author	Quality Rating Score
Bot SDM, et al.[30] (2004)	100
Desmeules, F, et al.[73] (2003)	84
Dinnes et al.[31] (2003)	95
Ejnisman B, et al.[160] (2004)	90
Green JMG, et al, (1997)	92
Green S, et al,[72] (2003)	74
Green S, et al.[71] (2000)	76
Luime JJ,et al. [38] (2004)	74
Vermeulen HM, et al.[53] (2006)	67

Shoulder – RCTs

Primary Author	Quality Rating Score
Bang MD, et al.[78] (2000)	83
Bergman GJD, et al.[45] (2004)	70
Conroy DE, et al.[50] (1998)	61
Ebenbichler GR[82] (1999)	89
Ginn KA, et al.[75] (1997)	58
Ginn KA[74] (2005)	43
Godges JJ, et al.[161] (2003)	42
Gursel YK, et al.[81] (2004)	47
Haahr JP, et al.[77] (2005)	75
Kneb JA et al .[51](2002)	75
Ludwig PM, et al.[76] (2003)	78
Malliou PC, et al.[79] (2004)	50
Rahme H, et al.[162] 1998	42
Winters JC et al.[163] (1997)	75
Vermeulen HM, et al.[53] (2006)	67

Shoulder – Reliability Studies for Diagnostic Testing

Primary Author	Quality Rating Score
Ardic F, et al.[36] (2006)	81
Hayes K, et al.[33] (2001)	50

Hayes KW, et al.[35] ((2003)	90
Hoving JL, et al.[32] (2002)	88
Parentis MA, et al.[37] (2006)	88
Park BH, et al.[37] (2005)	69
Valentine, RE, et al.[34] (2006)	55

Lateral Epicondylitis – Systematic Reviews

Primary Author	Quality Rating Score
Bisset L, et al.[100] (2005)	95
Smidt N, et al.[101] (2003)	95

Lateral Epicondylitis - RCTs

Primary Author	Quality Rating Score
Struijs PAA, et al.[164] (2003)	38
Struijs PAA, et al.[165] (2004)	83
Korthals-de Bos IBC, et al.[109] (2004)	56
Faes M, et al.[114] (2006)	78
Vicenzino B et al.[103] (2001)	58
Vicenzino B, et al.[107] (1996)	92

Carpal Tunnel – Systematic Reviews

Primary Author	Quality Rating Score
Goodyear-Smith F Arroll B[153] (2004)	69
Verdugo RJ, et al.[141] (2003)	71
O'Connor D, et al.[145] (2003)	90
Gerritsen AAM, et al.[148] (2002)	59
D'Arcy CA, et al.[136] (2000)	95
Feuerstein M, et al.[149] (1999)	40

Carpal Tunnel - RCTs

Primary Author	Quality Rating Score
Werner RA, et al.[150] (2005)	31
Akalin E, et al.[157] (2002)	44
Gerritsen AAM, et al .[143] (2002)	73
Walker WC, et al.[166] (2000)	67

Table A7 - Systemtatic Reviewws and Meta-Analyses SIGN Rating

SIGN	Methodology Checklist 1: Systematic Reviews and Meta-analyses		
Study identification (*Include author, title, year of publication, journal title, pages*)			
Guideline topic:		Key Question No:	
Checklist completed by:			
Section 1: Internal validity			
In a well conducted systematic review		In this study this criterion is::	
1.1	The study addresses an appropriate and clearly focused question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.2	A description of the methodology used is included.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.3	*The literature search is sufficiently rigorous to identify all the relevant studies.*	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.4	Study quality is assessed and taken into account.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable

1.5	There are enough similarities between the studies selected to make combining them reasonable.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
SECTION 2: OVERALL ASSESSMENT OF THE STUDY			
	How well was the study done to minimise bias? How valid is the study? Code +, n, or –		

Table A8 – SIGN RCT Checklist

SIGN	Methodology Checklist 2: Randomised Controlled Trials	
Study identification (*Include author, title, year of publication, journal title, pages*)		
Guideline topic:	Key Question No:	
Checklist completed by:		
Section 1: Internal validity		
In a well conducted RCT study…..		In this study this criterion is::
1.1	The study addresses an appropriate and clearly focused question.	Well covered / Adequately addressed / Poorly addressed / Not addressed / Not reported / Not applicable
1.2	The assignment of subjects to treatment groups is randomised	Well covered / Adequately addressed / Poorly addressed / Not addressed / Not reported / Not applicable
1.3	*An adequate concealment method is used*	Well covered / Adequately addressed / Poorly addressed / Not addressed / Not reported / Not applicable
1.4	Subjects and investigators are kept 'blind' about treatment allocation	Well covered / Adequately addressed / Poorly addressed / Not addressed / Not reported / Not applicable

1.5	The treatment and control groups are similar at the start of the trial	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.6	The only difference between groups is the treatment under investigation	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.7	All relevant outcomes are measured in a standard, valid and reliable way	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.8	What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?		
1.9	*All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis)*	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.10	Where the study is carried out at more than one site, results are comparable for all sites	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
SECTION 2: OVERALL ASSESSMENT OF THE STUDY			
	How well was the study done to minimise bias? How valid is the study? Code +, n, or –		

Table A9 - Evidence Tables
Upper Extremity Pain – Systematic Review/Meta-Analysis

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Results	Quality Rating Score	Notes/Comments
Verhagen AP, et al.[10] (2003)	Cochrane systematic review	-Work-related injuries to the upper extremity; RCTs and concurrent-controlled studies. No language restrictions. - Outcome measures considered include pain intensity, global status, SF36, Sickness Impact Profile, DASH, an other functional tools, ability to work, and health care consumption and costs	Conservative treatment including exercise, education, physical application, biofeedback, myofeedback, and work-related adjustments	15 trials involving 925 people; 12 included patients with chronic non-specific neck or shoulder complaints 20 interventions were evaluated with 7 main groups including exercises, manual therapy, massage, ergonomics, multidisciplinary treatment, energized splint, and individual versus group therapy - 10 studies on exercises found limited evidence for effectiveness when compared to no Tx - 1 study on manual therapy, 4 on massage, 1 n multidisciplinary Tx, and 1 on splint allowed no conclusion to be drawn - limited evidence for effectiveness of specific keyboards for patients with CTS - evidence for expensive ergonomic interventions was not clearly demonstrated	55	Limit is due to broadness of topic with regard to conditions and range of care.
Karjalainen K, et al.[11] (2000)	Systematic review of biopsychosocial rehabilitation of upper limb repetitive strain injuries in working age adults	RCTs and controlled trials comparing biopsychosocial measures for the treatment of repetitive upper limb strain injury	Biopsychosocial therapies including hypnosis, applied relaxation, EMG-biofeedback plus applied relaxation	Only two studies met the criteria both considered low quality and not clinically relevant. Limited evidence for hypnosis combined with comprehensive treatment versus comprehensive treatment alone, and no differences in effect between applied relaxation, EMG-biofeedback plus applied relaxation, and waiting for controls in eight weeks and six month follow-ups	55	The researchers state that there is little scientific evidence for psychosocial intervention fro repetitive stress injuries and there is a need for high quality RCTs

Shoulder Pain –Systematic Reviews and Meta-Analysis

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Results	Quality Rating Score	Notes/Comments
General Shoulder						
Bot SDM, et al.[30] (2004)	Systematic review of clinimetric evaluation of shoulder disability questionnaires	Studies were included if they were self-assessed, condition-specific, and included items on disability or physical functioning. Full reports and those in English were included. Instruments that were developed for groups whose primary condition did not involve the shoulder were excluded.	Evaluation of 16 questionnaires with most evidence for Disability of the Arm, Shoulder, and Hand scale (DASH), the Shoulder Pain and Disability Index (SPADI), and the American Shoulder and Elbow Surgeons Standardized Shoulder assessment Form (ASES) Properties scored included validity, reproducibility, responsiveness, interprobability, , and practical burden	None of the questionnaires demonstrated satisfactory results for all properties. Only seven questionnaires showed adequate test-retest reliability (ICC >0.70 with five questionnaires testing as inadequate. Most studies had small sample sizes (n<43) and none had information on the interpretation of test results. The DASH received the best ratings for clinimetric properties.	100	An excellent review process with very strict criteria that indicated that questionnaires tend to be created without testing for reliability, and sensitivity to change. The difficulty is that if these tools are used as outcome measures, the data on effect is potentially unreliable. The DASH is a standard instrument used in many studies as an outcome measure.
Luime JJ,et al. [38] (2004)	Systematic review of RCTs, and quasi-RCTs	Studies comparing the performance of history items or physical examination with a reference standard were included. Studies on fibromyalgia, fractures, or systemic disorders were excluded	NA	Results for each test were: - the relocation test (LR, 6.5; 95% CI, 3.0-14.0) -anterior release (LR, 8.3; 95% CI, 3.6-19) -biceps load I and II (LR, 29; 95% CI, 7.3-115.0 and LR, 26; 95% CI, 8.6-80.0), respectively, -pain provocation of Mimori (LR, 7.2; 95% CI, 1.6-32.0) - internal rotation resistance strength (LR, 25; 95% CI, 8.1-76.0). The apprehension, clunk, release, load and shift, and sulcus sign tests proved less useful.	74	Results should be cautiously interpreted because studies were completed in select populations in orthopedic practice, mostly assessed by the test designers, and evaluated in single studies only. No accuracy studies were found for history taking or for clinical tests in primary care in this study
Green S, et al,[72] (2003)	Systematic review , meta-analysis (Cochrane)	Patients treated for soft tissue disorders of the shoulder with physiotherapy. - adults >16 y/o -should pain> 3 weeks -excluded were trauma, systemic inflammatory conditions, hemiplegic shoulders, pots and per-operative shoulder pain,	Physiotherapy including US, laser, manipulation/mobilization, exercise	Results were presented in sub-groups based on disorder (e.g. rotator cuff disease, adhesive capsulitis, instability, etc.) Twenty-six trials met inclusion criteria. Exercise was demonstrated effective for short-term recovery in rotator cuff disease (RR 7.74 [1.97,30.32]) and a benefit for long term restoration of function (RR 2.45 [1.24, 4.86])	74	Limits to conclusions based on small sample sizes, variable methodological quality and heterogeneity in terms of populations studied, follow-up time in RCT.

		complex myofascial neck/shoulder pain		- for rotator cuff, combination of exercise and mobilization resulted in additional benefit over exercise alone - laser therapy more effective than placebo (RR 3.71 [1.89,7.28]) for adhesive capsulitis but not for rotator cuff tendonitis - ultrasound and pulsed electromagnetic field effective when compared to placebo for pain in calcific tendonitis (RR 1.81 [1.26,2.60] and RR 19 [1.16, 12.43]) respectively - no evidence for US for shoulder pain, adhesive capsulitis, rotator cuff tendonitis - compared to exercise, US had no additional benefit - some evidence for corticosteroid injections over physiotherapy for rotator cuff disease, and no evidence for physiotherapy alone for adhesive capsulitis		
Dinnes et al.[31] (2003)	Systematic Review	Studies involving clinical examination, ultrasound, MRI, or MR arthrography Only cohort studies were used	Outcomes assessed were clinical impingement syndrome or rotator cuff tear (full or partial)	The prevalence of rotator cuff disorders was high, partial verification of patients was common, and in many cases patients were selected retrospectively Sample sizes were generally very small Reference tests were often inappropriate10 cohort studies for clinical examination which indicated that used by specialists, they can rule out the presence of a rotator cuff tear 38 cohort studies for US indicated it to be most accurate for detection of full-thickness tears; sensitivity was lover for partial-thickness 29 cohort studies for MRI indicated high for full-thickness tears, however, for partial thickness tears the pooled sensitivity estimate was much less 6 cohort studies for MRA indicated high accuracy for full-thickness, however for partial-thickness it was less consistent	95	The study indicates that the more cost-effective use of US might be a good alternative to MR and indicates that the more expensive, invasive MRA shows no distinct advantage. Limitation is the operator expertise for US
Green S, et al.[71] (2000)	Systematic review of RCTs	Shoulder pain in adults (>18 years old), no diagnostic label, exclusion criteria included duration of shoulder pain < 3 weeks, rheumatoid	NSAIDs, intra- or subacromial corticosteroid injection, oral corticosteroids, manipulation under	31 trials met inclusion criteria mean quality score of 16.8 out of 40 (range 9.5 – 22) Results of only 3 trials pooled for rotator cuff tendonitis.	76	Weakness in comparing all diagnostic entities when, in fact, certain interventions such as manipulation under anesthesia and distension

		arthritis, or fracture Although there was no diagnostic separation, studies tended to fall broadly into two categories (1) adhesive capsulitis, and (2) rotator cuff tendonitis	anesthesia, distension arthrography, physiotherapy or surgery, versus placebo or another intervention	Benefit for subacromial injection over placebo for improving abduction was the only positive finding Little evidence to support or refute common interventions for treatment of shoulder pain in adults		arthrography are specific to "frozen shoulder" and would not apply to other conditions.
Green JMG, et al, (1997)	Systematic Review	Patients treated for soft tissue disorders of the shoulder with physiotherapy. Outcome measures included success rates, mobility, pain, and functional status	Phyisotherapy including US, laser, manipulation/mobilization, exercise	Six of 20 trials satisfied at least 5 of 8 validity criteria. Trials were small; only 6 trials included intervention groups of more than 25 patients - Ultrasound was should not to be effective when compared to paced or another TX, , although 4 trials favored physiotherapy (laser therapy or manipulation), however the validity was unsatisfactory - insufficient evidence to support low level laser, heat, cold, electrotherapy, exercise, and mobilization.	92	Study indicates that studies are limited due to small sample sizes and unsatisfactory methods
Rotator Cuff Tears						
Ejnisman B, et al.[160] (2004)	Systematic review of RCTs, quasi-RCT	Adults treated conservatively or surgically for rotator cuff tear, partial or total tear of any rotator cuff tendon confirmed either by physical examination, MRI, ultrasound, or arthrogram	NSAIDs, intra or subacromial cortisone injection, oral corticosteroid, physiotherapy, acupuncture, and open or arthroscopic surgery	Eight trials; 455 patients with 393 analyzed Trials divided into 8 categories of conservative or surgical treatment Only results from 2 studies comparing open repair to arthroscopic debridement were pooled. No RCT comparing conservative to surgical intervention Little evidence to support or refute common interventions for tear of the rotator cuff in adults. Weak evidence for the superiority of open repair of RC tears with arthroscopic debridement. Limited data suggests conservative option over surgery because it is less invasive and less expensive.	90	
Impingement Syndrome						
Desmeules, F, et al.[73] (2003)	Systematic review of RCTs	RCTs which evaluated impingement, rotator cuff tendonitis, or bursitis	Treatment including therapeutic exercise or manual therapy	Seven trials met inclusion criteria. - Four studies suggested some benefit for therapeutic exercise or manual therapy when compared with other Tx's such as acromioplasty, placebo, or no intervention	84	Strength is that the focus was impingement syndrome and RCTs only

Shoulder Pain - RCTs

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
General Shoulder							
Munday SL et al.[54] (2007)	Randomized. Single-blinded, placebo-controlled	Inclusion criteria included Hx of shoulder pain > 6 weeks, <40 y/o, no local or systemic pathology, no Tx in last 6 weeks Exclusion criteria included trauma, frequent, severe crepitus, weakness of internal rotation/abduction, pain radiation below elbow, shoulder surgery in previous 2 years	Shoulder girdle adjustments and a placebo of detuned ultrasound	1 month	Significant Tx effect for algometry, VAS score, and Short-Form McGill Pain Questionnaire at 1 month follow-up compared to the placebo group	78	Limitations include the small number of patients, the short follow-up period, and it is important to note that although the shoulder girdle was adjustment, by far, the most frequently adjusted was the AC joint; good pilot study
Vermeulen HM, et al. [34] (2006)	Randomized controlled trial	100 patients with adhesive capsulitis from 6 hospitals in the region of Leiden. Included were patients with adhesive capsulitis with at least 50% loss of movement. Exclusion criteria were previous manipulation under anesthesia, other conditions involving the shoulder, and neurological conditions.	Subjects were randomized either to high-grade mobilization technique involving grade III-IV (Maitland grading) into restriction with pain or low-grade mobilization techniques in pain free movement	12 months	Overall, subjects in both groups improved with a slight advantage for high-grade mobilization for passive abduction at 3 and 12 months. And for active and passive external rotation at 2 months.	67	A good comparison study that focused on patients with specific criteria for adhesive capsulitis including significant loss of motion. Study needed a comparison control or sham group to determine if better than natural history.
Bergman GJD, et al.[45] (2004)	Randomized controlled trial	150 patients from 50 general practices in the Netherlands; 18 years and older who had no consultation or Tx for shoulder symptoms in past 3 months Patients had to have demonstrated dysfunction of the cervicothoracic spine and adjacent ribs	All patients received usual medical care from general practitioners Only the intervention group received additional manipulative therapy to the cervicothoracic area or adjacent ribs (but not to the shoulder) ; up to 6 treatment sessions in a 12 week period	52 weeks (1 year)	At 6 weeks, no difference between groups At 12 weeks, 43% of intervention group and 21% of control reported full recovery At 52 weeks, the same difference in recovery rate was reported	70	Patients had shoulder pain 'accompanied" by neck symptoms. Patients in the medical group might have received corticosteroid injections. Patients in the manipulation group might have received other treatment because therapists were only "discouraged" from deviating from the treatment protocol. 16% in fact had manipulation of a vertebral segment or joint outside the shoulder region.
Malliou PC, et al.[79] (2004)	RCT comparative study of various	48 volunteers, physical education students randomly assigned Mean age of 22.3; age not	4 groups: 1. multi-joint dynamic resistance 2. dumbbell training	Initial isokinetic assessment was followed	One way analysis of variance found no difference between the groups for initial tests. Analysis of variance	50	Small sample size is a limitation Given these are asymptomatic PE students , results can not be extrapolated to symptomatic patients

	training methods for the shoulder	mentioned Free from shoulder injury over preceding 2 years All had full range of motion	3. isokinetic group 4. control group	by a 6-week training for all groups at 3 times per week All subjects were then reassessed isokinetically	demonstrated improvement in all groups with the most improvement in the isokinetically-trained group		Testing pre- and post- was performed isokinetically. It is likely that those training isokinetically would have an advantage over those who had not given training is demand-specific. One conclusion might be that all methods were effective.
Winters JC et al.[163] (1997)	Randomized, single-blind trial	Patients from general practices in the Netherlands 198 patients with shoulder complaints divided into diagnostic groups; a shoulder girdle group (n = 58) and a synovial group (n = 114)	Patients were randomized to manipulation or physiotherapy, and patients in the synovial group were randomized to corticosteroid injection, manipulation, or physiotherapy	2, 6, and 11 weeks	In the shoulder girdle group, at five weeks, 70% of the manipulation group considered them selves cured compared to only 10% of the physiotherapy group. In the synovial group, at five weeks, 75% of patients in the injection group, 20% of the physiotherapy group, and 40% of the manipulation group reported a "cure"	75	There was a shift to the number of patients in the shoulder girdle group as a result of Tx success with NSAIDs. Drop-out rates due to treatment failure in the synovial group was high in the manipulation group (595) and physiotherapy group (51%). In the shoulder girdle group drop out was 20% in the manipulation group and 45% in the physiotherapy group
Ginn KA, et al.[75] (1997)	RCT	66 patients who were > 18 y/o, unilateral shoulder pain referred by general and specialist physicians from a large metropolitan teaching hospital Exclusion criteria were subjects with shoulder pain due to inflammatory, neoplastic, vertebral column, trauma, within previous 4 weeks, or if bilateral	Physical therapy 4-10 times over a 1-month period which consisted of stretching for shoulder muscles found to be short, strengthening exercises for shoulder muscles found to be weak, retraining for restoration of scapulohmeral rhythm, however, type, frequency, and duration were at the discretion of the treating PT	3-month duration with a reassessment 1 month later	Tx group had better outcome on 2 of the 3 outcome measurements. Tx group reported greater improvement in symptoms (median score of 2 vs median score of 4 in control group Tx group demonstrated greater increases in pain-free abduction and flexion; mean increase of 22 degrees abduction compared to a mean decrease of 5 degrees in control. After 1 month of no tx, 50% of control group deteriorated	58	Small sample size General shoulder pain cases without differentiation makes conclusions specific to disorders difficult, however, the clinical point may have been that regardless of cause, mechanical pain may respond to a focus on stretching, strengthening, and retraining.
Impingement Syndrome							
Haahr JP, et al.[77] (2005)	RCT	90 consecutive patients meeting diagnostic criteria for rotator cuff disease including a positive impingement sign Ages 18-55 y/o Symptom duration between 6 months and 3 years Exclusion criteria: impaired	Arthroscopic subacromial decompression or physiotherapy with exercise directed toward strengthening and decompression of the shoulder with emphasis	12 months	Outcome was by the Constant* score and a pain and dysfunction score At baseline was 34.8 for the training group and 33.7 for the surgery group At 12 months the score improved to 57.0 and 52.7	75	* The Constant score is a joint measure of four subscores: pain with a VAS, ADLs, active ROM in four directions and isometric shoulder strength Limitations included possible bias due to unblended assessment of Constant scores by physiotherapists and patient

		rotation of GH joint, previous history of acute trauma, fracture or surgery of shoulder, known osteoarthritis, tendon rupture, calcifications extending > 2cm in the rotator cuff, or cervical root causes	on periscapular muscles and rotator cuff muscles Frequency was 3 times first two weeks, 2 times a week for next 3 weeks, and 1 time per week for remaining 7 weeks		respectively the difference being not significant. No group difference in mean pain and dysfunction score improvement were found Authors conclude the subacromial decompression was not shown to be superior to physiotherapy with exercise		preference influencing scores, although the authors suggest the effect would be small
Ludwig PM, et al.[76] (2003)	RCT	67 male construction workers diagnosed with shoulder pain and impingement syndrome randomized into a Tx group (n = 24) or control group)n = 33) with asymptomatic subjects (n = 25) as an additional control group Exclusion factors included history of rotator cuff surgery, dislocation or other traumatic injury, cervical pain, or shoulder symptoms reproduced with cervical assessment	Tx group instructed in a standardized 8 week home exercise program of shoulder stretching and strengthening exercises Subjects in control group received no intervention.	8-12 weeks following completion of the 8 weeks	The intervention group showed significantly greater improvements in the Shoulder Rating Questionnaire and shoulder satisfaction score compared to the control groups. Also, a greater reduction in pain and disability compared to controls	78	A good study in that it compared symptomatic groups with the intervention or no intervention and then compared to an asymptomatic control
Bang MD, et al.[78] (2000)	RCT – no "control" group but comparison between treatments	30 men and 22 women referred by physicians with a diagnosis of impingement, rotator cuff tendonitis, or shoulder tendonitis Patients between 18-65 y/o Patients had to have positive tests in three categories of testing procedures Patients were excluded if they received any other form of medical Tx during the course of the study Also excluded if litigation, past PT or chiropractic Tx in past 12 months, Hx of trauma, cervical radiculitis, systemic or neurological disease	2 treatment groups: - exercise group: supervised flexibility and strengthening exercises, or - manual physical therapy group: received manual therapy and performed same exercise program as exercise group Both groups received selected intervention 6 times over a 3 week period	2 months after initiation of Tx	Subjects in the combined treatment group (MT + exercise) had significantly more improvement in pain and increases in function although both groups had some improvement Strength in the manual therapy group improved significantly while not in the exercise group	83	Small sample size Manual therapy as described in this study included "gliding" or mobilization, not manipulation, and included soft tissue massage and muscle stretching that was not part of the exercise program done by both groups.
Conroy DE, et al.[50] (1998)	RCT	8 men and 6 women randomly assigned to two groups (n = 7 per group) with a Dx of primary impingement Patients with 2nd impingement	2 treatment groups: - joint mobilization and comprehensive treatment or - comprehensive	1-3 days following last treatment	The experimental group (the one with joint mobilization) improved on all variables, while the control group improved only on mobility and function.	61	Maitland mobilization applying oscillatory pressure of 2-3 oscillations/second. No indication of a grade 5 Maitland (manipulation). Small sample size.

		or those with any other shoulder problem (e.g. neurological, fracture, etc.) were excluded	treatment only Comprehensive Tx consisted of hot packs,, active ROM, physiologic stretching, muscle strengthening, soft tissue mobilization and patient education Joint mobilization was of the Maitland type		The mobilization group had less 24-hour pain and pain with subacromial compression test but no differences in ROM and function		
Calcific Tendinitis							
Ebenbichler GR, et al.[167] (1999)	Randomized controlled trial	63 consecutive patients (170 shoulders) with a diagnosis of calcific tendonitis type 1 or 2 diagnosed from radiographs and ultrasonograms; the diameter had to be > 5.00 mm Mild to moderate pain for more than 4 weeks or restricted ROM of involved shoulder Exclusion factors – type 3 calcific tendonitis, systemic disease associated with the calcium deposition, or any prior Tx Randomized to shoulders rather than to patients	Randomized to either US or sham US (not turned on) US Tx consisted of 24 15-minute sessions of pulsed US (frequency 0.89 MHz; intensity 2.5 W per square centimeter, pulsed mode, 1:4)	9 months	After 6 weeks – 6 shoulders (19%) calcium deposits had resolved with a decreased at least 50% in 9 shoulders (28%) compared to zero and three (10%) of the sham group At 9 months – 9 shoulders (42% had resolution and improvement in 7 shoulders (23%) compared to 2 (8%) resolution and improvement in 3 (12%) in the sham Tx group At the end of Tx, there were greater decreases in pain and greater improvements in quality of life for those with real vs sham Differences were lost at the 9 months follow-up	89	A very good study that was able through the sham group to determine a sense of natural history for calcific tendonitis The randomization and blinding were at a high level in this study

Shoulder Pain – Diagnostic Tests

Primary Author	Study type	Participants Incl/Excl Criteria	Results	Quality Rating Score	Notes/Comments
General Shoulder					
Valentine RE, et al.[34] (2006)	Reliability study for shoulder range of motion	Patients with no symptoms and those with symptoms were included to compare differences in intraobserver measurement. Patients under 18, pregnant, those with kidney disease, systemic disease, or diabetes, symptoms in the spine and for extremities except for the symptomatic group who had shoulder complaints.	For patients without symptoms the ICC ranged from .85-.96; standard error (SE) for angular movements was 2.1 to 2.8 degrees and for linear measurements (external rotation) 1.1 to 1.6 cm. For subjects with symptoms, ICC ranged from .82-.98; SE for angular movement was 1.5-13.3 degrees and for linear, 1.3 to 1.6 cm.	55	This paper contains an excellent review of the literature for measurement of shoulder ROM. The study is important because it tests intraobserver evaluation of ROM in both symptomatic and non-symptomatic subjects. Another study should evaluate interobserver reliability. Use of the data may be limited due to the specific measurement approaches for each movement pattern.
Hayes KW, et al.[35] ((2003)	Reliability study of the resistive testing of Cyriax selective tension testing for both shoulder and knee	18 males, 22 female with pain in one knee and 21 males and 25 females with pain in one shoulder tested twice Diagnoses included ligament injuries, overuse syndrome, joint instability and patients with post-surgical symptoms. Some patients entered with no diagnosis.	2 physical therapists evaluated 2 knee motions or 6 shoulder and elbow motions Examiners used maximum contraction testing and were unaware of previous testing results. Intrarater kappas ranged from 0.44 to 0.82; interrater kappa coefficients ranged from 0.00-0.46 A small number of patients who were classified as weak affected the kappa coefficients In the intrarater evaluation percentages for the knee evaluators averaged 91% of maximum kappa while for the shoulder the average was 66.5% For the interrater the average was 60.4% of the maximum kappa for both the knee and the shoulder	90	Intrarater and interrater reliability were not acceptable for the shoulder
Hoving JL, et al.[32] (2002)	Reliability study of shoulder ROM	6 patients with varying degrees of pain and stiffness in the shoulder and varying diseases were recruited from a private rheumatology practice. Subjects were excluded if repeated testing was likely to aggravate the condition Prior to testing, patients were	The intrarater and interrater reliability of different shoulder movements varied widely with only hand behind back and total shoulder flexion yielding high intraclass correlation coefficients (ICCs) for both intrarater reliability (0.91 and 0.83 respectively) and interrater reliability (0.80 and 0.72 respectively). Low ICC scores were found for abduction external rotation in abduction, and internal	88	This study used a specific gravity inclinometer (Plurimeter-V) which limits generalization to all gravity inclinometers Rheumatologists were the examiners yet none had used this inclinometer.

		taken through a series of warm up exercises.	rotation in abduction.		
Kneb JA et al .[51] (2002)	RCT, double-blind	29 elderly patients with pre-existing shoulder problems including tendonitis, bursitis, osteoarthritis, healed fracture or neurologic impairment, and chronic pain n one or both shoulders. Randomized into osteopathic manipulative therapy (OMT) or a control group for 14 weeks The control group received a placebo Tx which involved positioning without the isometric contractions	Assessed each week of Tx and a final assessment in week 19 Both groups had significantly increased ROM ($p < 0.1$) and decreased perceived pain ($p< 0.1$) Those receiving the OMT demonstrated continued improvement in their ROM while ROM in the placebo group decreased.	75	The manipulative technique was a specific approach called the Spencer technique. It is not true "manipulation" but, in fact, a mobilization technique involving 7 positions held as an isometric contraction
Impingement Syndrome					
Ardic F, et al.[36] (2006)	Cross-sectional, clinical, and radiologic study	50 shoulders of 58 consecutive patients waiting for physical therapy with clinically suspected shoulder impingement syndrome, specifically no history of trauma, pain of > 3 months and unresponsive to analgesic medication after 3 weeks. Exclusion factors were shoulder or cervical trauma, cervical discopathy, neurologic origin, or additional musculoskeletal problems, metabolic, inflammatory, or systemic disease. Clinical exam, radiography, shoulder US, and MRI were performed in the same month	High sensitivity of US for rotator cuff tears (98.1%) and biceps pathologies (100%), MRI was superior to US for glenoid labral tears and subacromial bursal effusion hypertrophy ($P<0.01$) There were more correlations between clinical and MRI findings than clinical and US findings Severity of disability (measured by DASH) was associated with either subacromial bursal effusion or labral tear on MRI and restricted shoulder extension. The more painful shoulders had a more frequent finding of glenoid labral tear and more restricted extension. Subacromial bursal effusion/hypertrophy was correlated with shoulder disability and impingement test maneuvers. Clinical tests as a whole had modest accuracy for rotator cuff tears and biceps pathology.	81	Uncontrolled study with a small sample size. Unique in that researchers attempt to determine the value of the clinical examination in the face of information provided by imaging.
Park BH, et al.[37] (2005)	Prospective study for diagnostic accuracy of clinical tests for impingement syndrome	913 patients who underwent physical examination and diagnostic arthroscopy PE included eight clinical tests: Hawkins-Kennedy, Neer's, empty-can, Speed, cross-body adduction, infraspinatus strength test, drop-arm sign, and painful arc	The combination of the Hawkins-Kennedy, painful arc, and infraspinatus muscle tests yielded the best post-test probability (95%) for any degree of impingement The combination of the painful arc, drop-arm sign, and infrapsinatus muscle test produced the best post-test probability (95%) for a full-thickness rotator cuff tear	69	Given the likelihood ratio for these patients since they were surgical candidates based on initial evaluation, test performance may appear inflated as far as sensitivity If impingement has a functional component not visible on arthroscopy, it is possible that

					arthroscopy may not be the gold standard for these functional cases
Instability and Labrum Tears					
Parentis MA, et al.[37] (2006)	Prospective, cohort study evaluating provocative maneuvers for the diagnosis of super labral anterior posterior (SLAP) tears	132 consecutive patients scheduled for diagnostic shoulder arthroscopy were included Excluded were patients with adhesive capsulitis The following tests were evaluated for sensitivity, specificity, positive and negative predictive value: Active compression, Jobe relocation test, pain provocation, crank, anterior slide, Yergason, Speed, Hawkins, and Neer tests	The sensitivity for type II SLAP lesions was highest for active compression, Hawkins, followed by Speed, Neer, Jobe. They were statistically significantly different from the other 4 tests (P< 0.5) but not from each other. The Hawkins and active compression were the least specific. The most specific for type II lesions was Yergason and pain provocation tests (P< 0.5) Positive predictive values were low for all tests Negative predictive value was in the 80% range for each test. Finding negative test results might be valuable in ruling out a SLAP lesion.	88	Patients were referral patients and may not reflect primary entry patient types. In other words, patients were pre-screened and this would affect examiners interpretation of positive versus negative findings. Some of the tests used were not designed specifically for SLAP lesions.

Shoulder Pain – Prognostic and Other Studies

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
General Shoulder							
Largacha M, et al.[21] (2006)	Entry study testing self-assessment tool (the Simple Shoulder Test [SST]) and comparing age, gender, and diagnosis and perceived deficit	New shoulder complaint patients seen from January 1991 through September 2002; total of 2674 patients who completed an SST and SF-36 at the time of initial diagnosis and with 1 of the 16 diagnosis represented by at least 50 patients	None	Entry data only; study length = about 11 years	At time of entry into the primary author's office (orthopedist): - 87% of patients were unable to sleep on the affected side and 71% were unable to wash the back of the opposite shoulder - instability presents to specialist around age 20-35 years - patients with full-thickness tears present 15 years later than those with partial cuff tears - those with cuff tear arthropathy present 13 years later than full-thickness tears - conditions with greatest female prevalence were RA and adhesive capsulitis - all other conditions were male predominant especially capsulorrrhaphy arthropathy, DJD, and traumatic instability	No score Qualitative study rated Strong	An interesting prevalence study that focused more on self-assessment through a questionnaire (the Simple Shoulder Test0 which consists of questions which the patient responds to as perceptions regarding function. This approach is evident and the main format for the textbook by Matsen et al. Practical Evaluation and Management of the Shoulder. Its value is in establishing the relationship to age and diagnosis and between diagnosis and self-perceived function.
Thomas E, et al.[20] (2005)	2 RCTS combined to evaluate prognostic indicators	316 subjects with a new episode of shoulder pain > 18 y/o Exclusion factors: bilateral shoulder pain, contraindication to the treatments rendered, recent treatment, or in patients with previous fracture, dislocation or surgery	Both studies compared corticosteroid injection vs. physiotherapy	12-18 months	Pain scores at follow-up were higher in women and those with longer duration of symptoms, and higher baseline pain or disability scores Being female, reporting a gradual onset, or higher baseline disability each independently reduced the likelihood of recovery	72	The authors conclude that baseline characteristics rather hen the treatment rendered were the strongest predictors of outcome
Rotator Cuff Tear							
Ito E, et al.[22] (2006)	Retrospective	Clinical charts of 160 shoulders of 149 patients with a mean age of 53 y/o with either rotator cuff tears (140 shoulders) or cuff tendonitis (20 shoulders) all based on arthroscopic findings	NA	NA	The lateral and anterior shoulder were the most common sites of pain regardless of the existence of whether there was a tear or where the tear existed Motion pain was more common than pain at rest for patients with rotator cuff tentinitis or tears. The authors conclude that pain location is	80	This study seemed to be evaluating both pain reported by patients and pain provoked by muscle testing including the muscle grade at which a positive test occurred. Supraspinatus testing most accurate with muscle strength less than grade 5; infraspinatus testing most

					not useful in locating the site of a tear, however, the physical exam based on positive results to muscle tests with appropriate threshold for muscle weakness was clinically useful. Specifically; Supraspinatus - the full can test and empty can test showed the higher accuracy when assess with muscle weakness (78% and 79% respectively) hen when asses with pain (74% and 71% respectively) Infraspinatus – external rotation strength showed accuracy of 50% using pain and between 58% and 74% using weakness Subscapularis – lift-off test accuracy was 65% with pain and 62%-85% when using strength		accurate when threshold of a positive less then grade 4 and for subscapularis, less than grade 3.
Ostor AJK, et al.[168] (2004)	Prospective study	136 consecutive patients referred to the rheumatology unit of a teaching hospital and patients identified in the rheumatology outpatient department with a chief complaint of shoulder pain Patients were between the ages of 20-85 with shoulder pain regardless of possible cause The three examiners were a consultant rheumatologist, a specialist registrar in rheumatology without specific shoulder training, and a research nurse.	NA	NA	For observations of tenderness, painful arc, and external rotation there was fair to substantial agreement. Tests for supraspinatus (empty-can) and for subscapularis (lift-off) showed fair to moderate agreement. Concordance between observers was in 40/55 (73%); a kappa coefficient at >0.2 and in 21/55 (38%) a kappa at >0.4.	100	The researchers went beyond the scope of the study by evaluating the ability of examiners to agree on the diagnosis of patients. With no gold standard used to establish the Dx, the validity of the examiners determination can not be established. In other words, they may be in perfect agreement on the wrong Dx; no value. The Dx ranged from referred pain, AC disorders, adhesive capsultitis and impingement in addition to rotator cuff. The setting of this study is not generalizable to the chiropractic setting.
Impingement Syndrome							
Jonsson et al.[80]. (2006)	Prospective study	9 patients (5 females, 4 males) with a mean age of 54 years having a history of chronic shoulder pain (> 4 months) diagnosed with having shoulder impingement syndrome on a waiting list for surgical treatment (mean of 13 months). Excluded were patients with arthrosis of the AC joint, large calcifications causing	Eccentric training program for the supraspinatus and deltoid muscles 3 x 15 repetitions, 2 times/day, 7 days a week for 12 weeks	12 weeks and then at 52 weeks	After 12 weeks, 5 patients were satisfied with treatment. At 1 year follow-up all 5 patients had still not elected for surgery. Their mean VAS and Constant scores were 31 and 81 respectively. Among the satisfied patients, one had a partial supraspinatus tendon tear and 3 had type 3 acromions.	100	The study has a small *n* and the follow-up is short

		mechanical impingement					

Lateral Epicondylitis: Systematic Reviews /Meta-Analysis

Primary Author	Study type	Incl/Excl Criteria	interventions	Results	Quality Rating Score	Notes/Comments
Bisset L, et al.[100] (2005)	Systematic review and met-analysis	Any study that was an RCT, systematic review involving physical intervention but not surgery	Any physical intervention not solely pharmaceutical or surgical including exercise, manipulation, orthotics/taping, acupuncture, laser, ESWT, electromagnetic field, US	Seventy-six RCTs identified with 28 meeting criteria for meta-analysis - extracorporeal shock wave therapy is not beneficial - lack of evidence for long term benefit of physical interventions Specifically: - exercise may have effect on pain but not MGS* - manipulation may have an immediate effect with local manipulation but it was a single TX without follow-up; wrist manipulation did not demonstrate a significant difference when compared to a Tx group that included cross-friction, exercise, and pulsed US - acupuncture: there may be some short-term benefit over placebo - laser: pooled data demonstrated no effect over placebo - some evidence of effect for combined Tx with US, exercise, and transverse massage when compared to a corticosteroid injection	95	*MGS = maximum grip strength
Smidt N, et al.[101] (2003)	Systematic review of RCTs	Physiotherapy; no language restrictions	Physiotherapy laser, US, exercise, mobilization, and electrotherapy	23 RCTs were included; 14 studies satisfied internal validity criteria; pooling could only be done for US - only US demonstrated a clinically and statistically relevant effectiveness although the evidence was rated as weak - insufficient evidence for all laser therapy, electrotherapy, exercise and mobilization techniques	95	Although a large number of studies exist, many have insufficient power, some have contradicting results, and there are a low number of studies per intervention.

Lateral Epicondylitis - RCTs

Primary Author	Study type	Participants Incl/Excl Criteria	interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Struijs PAA, et al.[165] (2004)	RCT	180 patients recruited from general practice and physical therapy practices - patients were diagnosed with LE using the criteria of tenderness at the LE and pain with resisted dorsiflexion of the wrist - excluded were patients with bilateral complaints, pain decreasing in prior 2 weeks, those treated in last 6 months for LE, or those unable to fill out form	3 groups: brace-only, physical therapy, or a combination group - 6 week intervention program Physical therapy included US, friction massage and a graduated exercise protocol	Att 26 and 52 weeks (1 year)	Evidence suggests physical therapy was superior to brace only at 6 weeks for pain, disability, and satisfaction - brace-only was superior on ability of daily activities - Combination Tx was superior to brace on severity of complaints, disability, and satisfaction. - at 26 and 52 weeks, no significant differences among Tx approaches	83	Authors suggest that the conflicting results in their study may indicate brace treatment may have a benefit as initial therapy. Although the effects wash out over 6 months and a year, there may be some advantage to these approaches in relieving pain earlier than natural history.
Faes M, et al.[114] (2006)	RCT followed by a cross-over period of 12 weeks	63 self-referred patients with a medical diagnosis of LE confirmed with PE before inclusion, age 18 to 70 years, recurrence of symptoms after initial treatment or persistent symptoms despite alternate treatments Exclusion criteria symptoms less than 6 weeks, neuralgic rheumatic, inflammatory muscle, neural or bone injuries or lower arm or wrist pain	Patients were randomized into group 1 brace treatment or group no brace. The brace was a dynamic extensor brace based on the agonist/antagonist principle. Tailor-made for each patient.	Outcomes collected every 6 weeks: 6, 12, 18, and 24 months Outcome measures included VAS, pain-free grip strength, max grip strength, and functionality of the arm.	Brace treatment resulted in significant pain reduction, improved functionality of the arm, and improvement in pain-free grip strength. After group one was put on brace-free time, the beneficial effects were sustained. There was no correlation between duration of symptoms and treatment effects.	78	The brace is a very specific approach individualized to each patient. Availability and cost were not stated.
Korthals-de Bos IBC, et al.[109] (2004)	RCT	Patients recruited by 85 GPs in the Netherlands. Total of 185 patients Patients were included if: pain at lateral side of elbow for at least 6 weeks, pain increasing with pressure on the lateral epicondyle and during resisted dorsiflexion, age between 18-70 Patients excluded were those	Patients randomly assigned to 6 weeks of PT, corticosteroid injection or a wait-and-see policy. All patients were discouraged but permitted to get prescriptions of pain medication if necessary	3, 6, 12, 26, and 52 weeks Outcome measures included general improvement, pain during the day, elbow disability and utility	After 12 months the success rate in the PT group was 91%, for the injection group 69%, and for the wait-and-see group 83% The differences in cost and effect showed no dominance for any of the three groups. The authors recommend retaining the recommendation of the Dutch Guidelines to use a wait-and-see approach to LE	56	This was an intervention RCT that also looked at cost effectiveness for LE.

		who received PT or corticosteroid injection for LE in the previous 6 months, bilateral symptoms, contraindications to corticosteroid injection, any evidence of a specific pathology such as malignancy, fracture, or inflammation					
Smidt et al [110] (2002)	RCT	185 patients with LE of at least 6 weeks duration Exclusion factors included fracture, dislocation, surgery, tendon rupture, systemic disorders, and neurological disorders.	Patients were randomized into either a corticosteroid injection group, physiotherapy group, or wait-and-see group.	Outcomes assessed at 3, 6, 122, 26, and 52 weeks. Severity of complaints, grip strength, and pressure pain threshold were used as measures.	Initial results favored corticosteroid injection at 6 weeks. (92% compared to PT at 47% and wait-and-see at 32%) However, recurrence was common in the corticosteroid injection group. At 52 weeks, 69% success with corticosteroid injection, 91% for PT, and 83% for the wait-and-see group.	69	Apparent short term advantage of injection must be weighed against the high recurrence in this group and the long term lack of advantage compared to PT and wait-and-see.
Vicenzino B et al.[103] (2001)	Randomized doubled-blind, placebo-controlled repeated-measures study	24 volunteers (10 female, 14 male) with unilateral LE for > 6 weeks. Confirmed on clinical exam with pain at lateral epicondyle and at least one positive test for extensor brevis contraction or extensor stretch Exclusion factors: neck or upper limb problems, previous experience of manipulative therapy of the elbow, heath conditions precluding manipulative therapy, neurological impairment, and concomitant use of medications	Patients were randomized into a lateral-glide mobilization group (Mulligan), a placebo group (contact with no glide), and a control group (no contact; patient positioning only)	Patients were randomized through all 3 groups and measured before and immediately after Measures included pain-free grip and pain-pressure threshold	Results demonstrated a significant and substantial increase in pain-free grip strength of 58% on average (on the order of 60 N) during treatment but not during placebo or control.	58	Only indicates immediate effect; no follow-up to determine how long effect lasts
Vicenzino B, et al.[107] (1996)	Randomized double blind, placebo controlled	15 subjects with unilateral LE (8 female; 7 male) Duration of pain 8 months (+/- 2 months); standard clinical findings for LE Exclusion included sequela of previous pain, dysfunction, or impaired sensation in the cervical spine to the hand necessitating treatment or recent steroid injection into the	Patients were randomized into a treatment group consisting of a contralateral lateral-glide mobilization at the C5/C6 segments of the cervical spine, a placebo group (contact with no glide), and a control	Patients were randomized through all 3 groups and measured before and immediately after and a 24-hour measure of pain and function Measures included pain-free grip and pain-pressure	Results demonstrated a significant and substantial improvement in pain threshold, pain-free grip strength, neurodynamics, and pain scores relative to placebo or control ($P < 0.05$).	91	Limited by very small n which would question the p values. No measure of duration of effect in short term or long term.

		elbow	group (no contact; patient positioning only)	threshold			

Lateral Epicondylitis – Prognostic Studies

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Waugh EJ, et al.[98] (2004)	Multi-center, prospective design	86 subjects from 9 urban sports medicine and orthopedic clinics and 2 hospital outpatient departments Inclusion if they had tenderness on or near the LE and pain was present on at least 2-3 pain provocation tests, gripping, resisted wrist extension, and resisted middle finger extension Excluded were those with a Hx of elbow fracture or surgery, bilateral symptoms, concurrent upper quadrant pathology, or symptoms unrelated to the lE	8 weeks of physical therapy including US, deep transverse friction massage, and a stretching and strengthening program for wrist extensor muscles 37% of patients received treatment for the cervical spine or shoulder in addition to the lateral elbow	8-week follow-up	Disability of the Arm Shoulder and Hand (DASH) scores and a visual analog scale (VAS) were used as the dependent variables DASH scores at baseline (95% CI, 0.34-0.66, sex (female) (95% CI, 3.3-14.5), and self-reported nerve symptoms (95% CI, 0.8-13.8). At 8-weeks VAS scores included the baseline score (95% CI 0.01-0.37), sex (female) (95% CI 0.4-18.2), and self-reported symptoms (95% CI, 4.7-25.5). A sub-analysis indicated that women were more likely than men to have work-related onset, repetitive keyboarding jobs, and cervical joint signs Among women, these factors were associated with higher final DASH and VAS scores Women and patients who report nerve symptoms are more likely to experience a poorer short-term outcome after PT management of LE	68	This study found that the origin of the extensor carpi radialis brevis (ECRB) was the primary site in 60% of patients. Another study found that the origin was the site in only 20%. 55% of patients had involvement of the supinator muscle
Pienimaki T, et al. [99] (1998)	Prospective and retrospective study on chronic tennis elbow, long-term follow-up of conservative treatment	30 chronic tennis elbow patients with clinical findings including positive Mill's, pain with resisted wrist or middle finger extension, and pain at the lateral epicondyle Exclusion included other causes of elbow pain	Comparison of an four-step-exercise group and an local pulsed-ultrasound group 8-week	Mean follow-up was 36 months Prospectively measured with a VAS and pain drawings classified into 5 categories;	The exercise group improved more compared to the US group with lower pain scores on VAS, also less physiotherapy or medical consultations. At follow-up the exercise group had pain scores and pain drawings that had improved significantly more than the US group. The US group improved only for pain under strain	64	Small sample, questionnaire not validated This is a follow-up study of an rCT done in 1996

		including cubital osteoarthritis, RA, severe cervical spondylosis, carpal tunnel, shoulder disorders		retrospectively via a postal questionnaire	5 patients in the US group had surgery whereas only one in the exercise group had surgery		

Carpal Tunnel – Systematic Reviews

Primary Author	Study type	Participants Incl/Excl Criteria	Results	Quality Rating Score	Notes/Comments
Goodyear-Smith F Arroll B[153] (2004)	Systematic review of RCTs	Restricted to non-surgical management of CTS; English-language only. No indication of inclusion/exclusion related to gender, age, work, etc.	2 systematic reviews, 16 RCTs, and 1 before-and-after study. Findings: Considerable % of CTS resolve spontaneously Strong evidence for steroid injection; less for oral Limited evidence efficacy for splinting, laser-acupuncture, yoga, and therapeutic US in the short to medium term (up to 6 months) Evidence for tendon and nerve gliding is more tentative Evidence does not support NSAIDs, diuretics, B6, chiropractic Tx, or magnet Tx	69	When statement of evidence does not support is made, it generally refers to lack of evidence versus evidence against.
Verdugo RJ, et al.[141] (2003)	Systematic review of RCTs and quasi-RCTs - Cochrane Review	All patients diagnosed with CTS were included regardless of Dx criteria, etiology, associated pathology, age, or gender. Comparison of surgical vs. non-surgical treatment	2 RTCs involving 198 participants were included. First was 22 participants divided into surgery or splinting; not blinded nor allocation concealed. Second involved 87 allocated to surgery; 89 to splinting. Confidence interval favored surgical group (relative risk 1.27; 95% confidence interval 1.08 to 1.75). Pooled estimate for secondary outcomes also favored surgery.	71	Weakness of including all CTS patients regardless of Dx criteria, etiology, associated pathology, gender, age. Due to existing literature, only splinting could be compared to surgery as the only non-surgical alternative.
O'Connor D, et al.[145] (2003)	Systematic review of RCTs and quasi-RCTs - Cochrane Review	Patients with a diagnosis of CTS who had not previously undergone surgical release. All non-surgical methods other than local steroid injections were evaluated The primary outcome was improvement in clinical symptoms after at least 3 months following the end of treatment.	21 trials involving 884 people Summary: - hand brace significantly improved symptoms after 4 weeks - pooled data for two trials of US 2 weeks was not beneficial, however, one trial showed significant improvement after 7 weeks of US which was maintained at 6 months - some indications of steroid effectiveness in the short term - no evidence to support B6 - one trial indicated improvement with yoga - one trial demonstrated improvement with carpal bone mobilization - no benefit for chiropractic care	90	As stated in the review, there is limited evidence to suggest that chiropractic and medical treatment provide similar short-term improvement in mental distress, vibrometry, hand function, and health-related quality of life
Gerritsen AAM, et al.[148] (2002)	Systematic review of RCTs	Restricted to conservative management of CTS with reports published in	Fourteen publications were identified. No pooling of data due to the heterogeneous patient populations, interventions, and outcome measures used.	59	Although some studies indicated they were RCTs, the reviewers found no evidence

		English, German, French, or Dutch. No indication of inclusion/exclusion related to gender, age, work, etc.	Findings: Diuretics, pyridoxine (B6), NSAIDs, yoga, and laser-acupuncture seem to be ineffective for short-term symptom relief Steroid injections seem to be effective (limited evidence) Conflicting evidence for US and oral corticosteroids For long-term relief, limited evidence that US is effective and splinting is less effective than surgery		of randomization. No chiropractic studies met the criteria.
D'Arcy CA, et al.[136] (2000)	Systematic review for precision and accuracy of history taking and physical examination of diagnosing CTS in adults	Studies of patients presenting to clinicians with symptoms suggesting CTS based on physical exam independently compared with electrodiagnostic (ED) testing.	Twelve of 42 articles met the criteria. In patients with hand dysesthesias, findings that best distinguish between patients with ED evidence of CTS and those who do not are: hypalgesia in the median nerve territory (LR, 3.1, 95% CI, 2.0-5.1) classic or probable Katz hand diagram results (LR, 2.4 95% CI, 1.6-3.5), and weak thumb abduction strength (LR, 1.8, 95% CI, 1.4-2.3) Findings arguing against CTS are: unlikely Katz had diagram results (LR, 0.2, 95% CI, 0.0-0.7), and normal thumb abduction strength (LR, 0.5, 95% CI 0.4-0.7)) Some standard tests such as Phalens and Tinel signs, thenar atrophy, and nocturnal paresthesias had little or no diagnostic value for positive ED test findings	95	The main limitation of literature is lack of a gold standard for CTS so when comparing testing to electrodiagnosis (the gold standard) results may be inaccurate. In all studies patients were seen by orthopedic surgeons, physical therapists, and electrodiagnostic labs but not to primary care physicians. Authors state that their findings are likely more applicable to patients with severe enough symptoms to warrant such a referral.

Carpal Tunnel – RCTs

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Gerritsen AAM, et al .[143] (2002)	RCT	176 patients with clinically and electrophysiologically confirmed idiopathic CTS Exclusion criteria were previous treatment with splinting or surgery, a history of wrist trauma, a history of a history suggesting cause of CTS, clinical signs/symptoms or electrophysiological findings the could mimic CTS such as cervical radiculopathy	Wrist splinting at night for at least 6 weeks or open carpal tunnel release Outcome measured through a questionnaire indicating general improvement, number of nights waking up due to symptoms or severity of symptoms	3, 6, 12, and 18 months	In the intention-to-treat analysis, surgery was more effective than splinting on all outcome measures After 3 months success for surgery group was 80% vs 54% for the splinting group (95% CI 12%-40%, P=.001) After 18 months the success rate was 90% for surgery and 75% for the splinting group, however at the end of the study 41% of patients in the splint group had also received the surgical treatment	R	Limited in that night only splinting was used and compared only with open carpal tunnel release
Davis PT, et al[144] (1998)	RCT	Men and women 21-45 y/o with self-reported symptoms of CTS then confirmed clinically and with NC tests Exclusion criteria were patients with currently prescribed Tx, WC claim based on CTS, pregnancy, disease related to CTS, prior wrist surgery, anti-inflammatory meds, vit. B6 supplementation, prescription wrist brace, ED findings inconsistent with CTS	Medical group received ibuprofen, cock-up splint worn at night Subjects in the chiropractic group received HVLA for the wrist, elbow, and shoulder as well as cervical and upper thoracic regions, US, soft-tissue work. 3/wk for 2 weeks; 2/wk for 3 weeks, and 1/wk for 4 weeks	1 month post-treatment	There were significant improvements in both groups with no significant differences between groups for perceived comfort and function,, nerve conduction, and finger sensation overall.	81	This study probably reflects normal practice with multiple interventions including HVLA. However, it does make drawing conclusions specifically about HVLA difficult. Also, there was a high drop-out rate: 22% for the medical group and 31% for the chiropractic group
Walker WC, et al.[166] (2000)	RCT	21 subjects enrolled with 17 completing the study (only 1 woman); age range of 44-81 y/o VA Hospital patients referred for electrodiagnostic studies with symptoms of CTS Subjects were included if positive for electrodiagnostic confirmation of CTS whether unilaterally or bilaterally	Thermoplastic, custom-molded, neutral wrist splint receiving either full-time or night-time only wear instructions	6-week	Through the use of validated, reliable measures, this study demonstrated symptoms, functional deficits, and median nerve impairments improve in patients with CTS who use 6 weeks of neutral wrist splinting Thee was an advantage to full-time use in improving physiological function as measured by distal latency improvement in both motor and sensory aspects	67	Small sample size may limit results as would the drop-out rate of 19% (17 out of 21 completed) Compliance seemed to be a factor This study used a rigid splint, so therefore, it is not necessarily a reflection on results from other types of

							splints

Carpal Tunnel – Diagnostic Studies

Primary Author	Study type	Participants Incl/Excl Criteria	Results	Quality Rating Score	Notes/Comments
Lew HL, et al.[138] (2005)	Sensitivity and specificity analysis	44 normal and 136 symptomatic hands Reference/control group – no symptoms or signs of median neuropathy: no numbness tingling, no other neuropathies, and no diabetes CTS group – numbness, tingling, or pain in a median nerve distribution at least 3 times/week for at least 3 months; patients with release surgery, absent SNAP diminished SNAP amplitude, or prolonged ulnar sensory distal latency were excluded.	Results from measurement of a single short-nerve segment tended to be superior to results obtained by either long-segment studies or differential subtraction between 2 segments of the same nerve Short segment, onset-latency transcarpal mixed NCV yielded the highest sensitivity (75%)	75	Comments regarding specificity were limited by the design of the study

Carpal Tunnel – Prognostic Studies

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Gerritsen AAM, et al.[143] (2003)	Conducted within an RCT on the efficacy of splinting and surgery for CTS	89 patients with electrophysiologically confirmed CTS were randomly assigned to neutral night-splinting for at least 6 weeks	Night-splinting for at least 6 weeks	12 months	31% success rate for splinting Only two prognostic indicators were identified: For patients with both a short duration of CTS complaints (one year or less) and a score of 6 or less for severity of paresthesia at night at baseline the predicted probability of success was 62% The % of patients correctly identified by this model was 78% (95% CI, 69%-87%)	73	Over half of patients who improved had enlisted other treatments

Low Scoring Studies Not Included

Shoulder Pain
RCTs

Primary Author	Study type	Participants Incl/Excl Criteria	interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Ginn KA[74] (2005)	RCT	138 subjects > 18 y/o with unilateral shoulder pain of mechanical origin with duration of more than 1 month with and without associated stiffness Patients were excluded if pain was bilateral, associated with instability, due to an inflammatory or neoplastic disorder, or referred from the vertebral column or due to trauma in the last 4 weeks	Treatment groups included exercise therapy, or subacromial corticosteroid injection, or a combination of physical modalities and ROM exercises	1 year	The mean/median changes in all outcome measurements at 5 weeks indicated that subject in all groups improved significantly with no differences between treatment groups	43	Follow-up study from the original Ginn study on exercise therapy indicated that Tx groups improved faster than with natural history
Gursel YK, et al.[81] (2004)	Randomized, placebo-controlled trial	40 patients from an outpatient clinic who met the following criteria: - shoulder pain and limitation of movement for at least 4 weeks prior to study - diagnosis of a soft tissue disorder by US or MRI - no trauma or memory of trauma - Absence of other known diseases - no PT administered for 4-5 weeks prior to study	Two groups who both received superficial heat, electrical stimulation, and an exercise program were randomized to true US or sham US, 3 days a week for 3 weeks	3 weeks (post-program assessment) only	Subjects showed within-group differences but these did not reach significance compared between groups for pain, ROM, Shoulder Disability Questionnaire scores, and Health Assessment Questionnaire scores. Results indicate that true-US versus sham-US added no further benefit when applied in addition to other physical therapy interventions.	47	Patients with calcific tendonitis were excluded from the study which may explain differences compared to other studies. Given there were diagnostic differences in the groups and given there were within-group differences, it would be interesting to know if responses were diagnosis (disorder) specific
Godges JJ, et al.[161] (2003)	RCT 2-group, pretest/post-test multivariant study	20 subjects; 10 male/10 female) between ages 21-83 y/o with shoulder pathology of 1 year or less Subjects refereed to an outpatient physical therapy clinic Subjects were included if they exhibited limitations in overhead reach as well as	Soft-tissue mobilization to the subscapularis and PNF to rotator cuff	Single treatment measured pre- and post-test only	Tx group improved by a mean of 16.4 inches (95% CI 12.5-20.3) for external rotation compared to the control mean improvement of less than 1 degree (95% CI -0.2-2.o). Overhead reach in the treatment group improved by a mean of 9.6 cm (95% CI, 5.2-14.0 cm) compared to the mean	42	Although randomly assigned, the range of shoulder conditions could have influences on outcome. In other words, those with the more limiting conditions could have randomly been assigned more to the control group Other limitations include the testing of immediate effect only, therefore, unknown how long effects last. Very wide range of age which could

		glenohumeral external rotation when measured at 45 degrees of shoulder abduction.			improvement of the control group of 2.4 cm (95% CI, -0.8-5.6 cm)		be a positive if the sample group had been larger. Small sample group size decreases the power of the conclusions.
Rahme H, et al.[162] 1998	RCT – no "control" group but comparison between treatments	42 patients with subacromial impingement syndrome Patients were referred for surgery. Inclusion factors were isolated shoulder disease, working age, pain for the preceding year present at rest made worse with overhead movements and a positive impingement sign (relief with a corticosteroid injection)	Arthroplasty or physiotherapy Physiotherapy consisted of patient education, avoidance advice, shoulder strengthening and focus on correction of any scapulohumeral rhythm problems	6 months and 1 year	At 6 months 57% (12/21) of surgically group had a successful outcome (pain reduction of >50% on a VAS pain scale)while 33% 6/18) of the physiotherapy group had a successful outcome At 1 year 76% (16/21) of the surgery group had success. One year follow-up for PT group was not possible because 13 patients chose surgery after initial PT regimen.	42	Two active movements were found to be predictive for surgical success. These included the "pour out of pot" maneuver and the "hand in neck" maneuver. When combining three pain-related variables into a prediction for success, a sensitivity of 78% and a specificity of 90% was attained.
Hayes K, et al.[33] (2001)	Reliability study of shoulder ROM	8 volunteers, 3 males, 5 females ages between 57-72 (mean age = 66) All subjects had a current shoulder complaint 6 patients had undergone rotator cuff repair surgery within the past 24 months one patient had scapulothoracic fusion, and one patient had adhesive capsulitis	Five methods included visual estimation, goniometry, still photography, "stand and reach", and hand behind back reach for 6 shoulder movements For flexion, abduction, and external rotation fair to good reliability was demonstrated for ICC using visual (inter-rater Rho = 0.57-0.70, intra-rater Rho = 0.59-0.67, goniometry (inter-rater Rho = 0.54-0.59, intra-rate Rho = 0.53-0.65, and for photography (inter-rater Rho = 0.62-0.73, intra-rater Rho = 0.56-0.61) The standard errors of measurement were between 14 and 25 degrees (inter-rater) and 11 and 23 (intra-rater) Hand behind back was the least reliable			R	Although fair to good reliability was found for some approaches, the range of standard measurement errors indicates a large variation in the precision
Ginn KA, et al.[169] 2004	Cohort study evaluating prognostic indicators of outcome for conservative Tx of shoulder pain	82 subjects who participated in an RCT that compared short-term effectiveness of conservative treatment for chronic, unilateral shoulder pain of mechanical origin, with and without accompanying stiffness and who were available for longer term follow-up 6 months after cessation of formal treatment	Conservative Tx consisting of various combinations of exercise therapy, passive joint mobilization, electrophysical modalities, and corticosteroid injections	Average time to follow-up was 9 months	Patient showed significant improvement in all outcome measurements including pain intensity, functional limitation, perceived change in symptoms, active range of motion, and muscle force. Long-term outcome could not be predicted by hand dominance, clinical history of shoulder condition, severity of the shoulder problem or shoulder mechanics.	R	A mixed purpose study which evaluated long-term affects of a conservative treatment program and at the same time attempted to determine prognostic indicators of success. In the initial study patients were randomized to exercise, corticosteroid injection or multiple modalities. There was some cross-over of patients and no clear indicator in this follow-up study of which group faired best in the long-run. Most importantly, there seems to be no control group to determine natural history.

Lateral Epicondylitis
RCT

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Struijs PAA, et al.[164] (2003)	RCT	Inclusion criteria were Hx & exam confirmation of LE Exclusion criteria were if the complaint was less than 6 weeks, there were severe neck/shoulder problems, or if the complaint was bilateral	Wrist manipulation compared to a combination Tx program of transverse friction massage, pulsed US, and exercise;	End-point at 6 weeks	No significant difference between groups in global improvement; both groups reported improvement At the end of the 6 weeks, PVAS, grip strength, and pain threshold were not significantly different.	38	- PVAS = continuous visual analog scale - The manipulation of the wrist for LE was performed 15-20 times alternating with either forced passive extension of the wrist or extension against resistance. Duration was 15-20 minutes. - Tx based on Lewit description.
Haahr JP, et al. [170] (2003)	RCT	289 subjects who were consecutively diagnosed with LE, aged 18-66 y/o, consulting GP with lateral elbow pain who met criteria for LE (presence of pain in elbow and direct and indirect tenderness at or within 2 cm of LE on resisted extension of wrist and/or third finger Cases with previous elbow operations or a known inflammatory rheumatoid disorder were excluded	Randomized into either general practitioner with "usual" care or a minimal intervention by an occupational specialist involving information about the disorder, encouragement to stay active and instructions in graded self-performed exercise	3, 6, and 12 months	At 1 year, 83% of cases showed improvement in the condition, but no intervention was found to have an advantage Poor overall improvement was associated with employment in manual jobs Odds Ratio (OR) 3.0 (95% CI 1.0-8.7), a high level of physical strain at work OR 2.3, CI 1.0-5.3). Pain reduction less than 50% was associated with manual jobs, high physical strain and high baseline distress and tennis elbow on the dominant side.	75	Not clear what care was given by GPs The stretch given to patients was only given once. It was a contract-relax type of stretch. Not clear on compliance with the stretch
Retrospective							
Derebery VJ, et al.[112] (2005)	Retrospective cohort study using propensity score methodology	4614 injured workers at 253 occupational medicine clinics receiving primary care for lateral epicondylitis	Splinting, however, some patients received PT and some did not	Overall, patients with splints had higher rates of limited duty (P,.001) more medical visits and charges (P<.001), higher total charges (P<.001) and longer treatment durations (P<.01)		R	Some limitations are that the type of splint was not considered As a retrospective study the pretreatment differences between patients would not have been randomly allocated, although this study attempted to neutralize some of this

						effect with propensity score methodology
Cleland JA, et al.[108] (2004)	Retrospective	Inclusion: pain during palpation of LE, pain with resisted wrist extension or with resisted middle finger extension Exclusion: worker's compensation case, involved in seeking litigation, multiple diagnoses, had received a corticosteroid injection with a year, or PT, surgery at any time for condition, if it Was not the first time having symptoms, if it was bilateral, or if exam indicated radial tunnel syndrome	Local direct treatment to LE including US, iantophoresis with dexamethazone, soft-tissue mobilization, elbow joint mobilization, stretching/strengthening, and cold modalities OR Local treatment plus cervical manual therapy which included intervertebral passive accessory mobilization and movement techniques	Data was from a telephone interview over an undesignated period time which appears to be at least 1-3 years 75% of the local treatment group and 80% of the local plus manual therapy group had a successful outcome The local plus manual therapy to cervical spine group achieved a successful long-term outcome in fewer visits (mean of 9.6 visits for local versus mean of 5.6 for local plus C-spine manipulation)	25	

Carpal Tunnel
Systematic Review

Primary Author	Study type	Participants Incl/Excl Criteria	Results	Quality Rating Score	Notes/Comments
Feuerstein M, et al.[149] (1999)	Systematic review of single and multiple group prospective and retrospective studies	Although the focus was on work-related CTS , it was not possible to exclude non-work-related studies. No other inclusion or exclusion criteria were used. Search terms included outcome, surgery, therapy, and treatment.	129 studies were reviewed and categorized into six types of interventions: surgery, pharmacological/vitamins/steroids, physical therapy/splinting, chiropractic/manipulation, biobehavioral therapies, and occupational/work rehabilitation. Using six classifications of study design, 34 English language articles were included. Findings: • Steroid injection and oral B6 were associated with pain reduction • Range of motion exercises were associated with less pain and fewer day to return to work compared to splinting • Cognitive behavior therapy reduced pain, anxiety, and depression • Multidisciplinary occupational rehabilitation was associated with a higher % of chronic cases returning to work than usual care	40	Conclusions are preliminary due to the small number of well-controlled studies, variability in duration, and broad range of outcome measures used.

RCT

Primary Author	Study type	Participants Incl/Excl Criteria	Interventions	Length of Follow-Up from Study Start	Results	Quality Rating Score	Notes/Comments
Akalin E, et al.[157] (2002)	Prospective randomized, before-and-after trial	28 patients with CTS in 36 hands age range of 34-64 y/o; 8 patients had bilateral CTS Exclusion criteria: underlying metabolic disorders, RA, pregnancy, Hx of steroid injection, severe thenar atrophy, and Hx of splint use	Two groups: a custom made neutral volar wrist splint was given to group 1 and 2 instructed to wear the splint(s) at night and as much during the day as possible for 4 weeks Patients in group 2 also were instructed to perform a series of tendon and nerve gliding exercises	Range of 5 to 11 months	Statistically significant improvement was obtained in all parameters in both groups with a slightly higher improvement in group 2 but the difference between groups was not significant except for lateral pinch strength Satisfaction for group 1 (splint only) was 72% compared to 93% in group 2 (combined therapy)	44	The exercises were based on Totten and Hunter (ref) which involve 6 hand positions for tendon stretching and 6 for nerve gliding; each position held for 5 seconds with the intent of breaking up adhesions and allowing freedom of movement of the median nerve
Werner RA, et al.[150] (2005)	RCT	Active workers from a Midwestern auto assembly	Treatment group received customized	1 year	The splinted group had a significant reduction in discomfort and a decrease in	31	Patients in the splinted group had a higher job

		plant with symptoms suggestive of CTS on a hand diagram Exclusion criteria – workers with musculoskeletal disorder secondary to trauma on or off job, Hx of bilateral carpal tunnel release surgery, or pregnant women	wrist splints worn at night for 6 weeks and received ergonomic education Control group received ergonomic education alone		symptom severity as measured by the Levine CTS index; controls did not Secondary finding was that more median nerve impairment at baseline was associated with less clinical improvement among controls but not among the splinted subjects Benefits were evident at the 1 year follow-up		dissatisfaction rating prior to the intervention than did the controls Drop-out rate of 30% was high

Basic Science Article

Hsu A-T, et al.[42] (2002)	In vivo simulation	14 fresh frozen shoulder specimens; 5 men and 3 women (mean age = 77.3), SD = 10.1, range of 62-91)	Each specimen underwent 5 repetitions of dorsal (DTM) and ventral translational mobilization (VTM) in the plane of the scapula in the resting position and at end range of abduction with 100 N of force. Abduction and rotation were assessed as the main outcome measure before and after each mobilization mechanically monitored by a material testing system and a servomotor.	NA	There were increases in abduction ROM for both DTM Increases in abduction ROM for both DTM and VTM, however, these were approximately 2 degrees with a large standard deviation. No changes were found in the resting position. Small increases were found with lateral rotation ROM after VTM in the resting position., however, even less than for abduction.	R	There are major limitations given it was a cadeveric study. The increases are statistically significant, however, the clinical usefulness of such small increases would be unlikely.