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campus savona

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JOINT MANUAL TECHNIQUES OR THERAPEUTIC EXERCISE: WHICH IS THE BETTER APPROACH TO PAINFUL SHOULDER? A SYSTEMATIC REVIEW

Candidati:

Dott.ssa Ft. Chiara Trasatti

Dott.ssa Ft. Valentina Terrazzi

Relatori:

Dott. Ft. OMT Diego Ristori

Dott. Ft. OMT Simone Miele

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ABSTRACT

***Introduction*:** Shoulder pain is a very common issue with multifactorial etiopathogenesis; conservative physiotherapy treatment is a common approach. The evidence is not reliable enough to guide the physiotherapist in choosing the most appropriate treatment tools: frequently the combination of manual therapy and therapeutic exercise are chosen but generally in clinical studies manual therapy and exercises are analyzed in combination compared to other interventions or to placebo.

Objective of study: The aim of this review is to analyze which, between joint manual techniques and therapeutic exercise, is the best strategy for the conservative management of non-specific shoulder pain. The main outcomes considered are function (SPADI, DASH, QuickDASH), pain (VAS, NPRS) and ROM (goniometer).

Materials and methods: Data sources: Medline, Cochrane Library, PEDro, ClinicalTrials.gov databases were searched to May 2017 supplementing the research by hand searching related articles. Study eligibility criteria: RCTs evaluating the effectiveness of manual therapy techniques and therapeutic exercises in participants with non-specific shoulder pain. Methods: Mendeley software was used to manage records and data. Included studies were appraised for risk of bias using the Cochrane Collaboration Risk of Bias Tool and The RevMan software was used to show graphically data. A qualitative synthesis was performed based on levels of evidence by two reviewers and two supervisors.

Results: 2786 trials was reached, for 33 of them were obtained full text and of them 13 trials were included, 11 studies was rated at high risk of bias and 2 at unclear risk of bias. The combination of manual therapy and exercise is a clear effectiveness therapeutic tool for shoulder problems. Therapeutic exercise seems to be better than joint manual techniques as it is effective even individually.

Limitations: The results should be interpreted with caution because of the limited number of studies analyzed and the poor methodological quality of them.

Conclusion: There is limited evidence to conclude which treatment is better, further research are needed to investigate individually the effectiveness of manual therapy

approach not in combination with other interventions. Available literature is methodologically unreliable.

Key words: Shoulder pain, Shoulder impingement syndrome, rotator cuff tendinopathy, Manual Therapy, Mobilization, manipulative therapy, Therapeutic Exercises.

Shoulder pain is a very common issue, about 66% of adults report at least one episode over a lifetime [1] [2] with a prevalence of 7 to 26% [2]. It is a very disabling condition with a big impact on the essential activities of daily life like dressing, eating, treating personal hygiene and working, it involves considerable use of healthcare resources [3] [4] [5] [6]. The most common cause of shoulder pain in primary health care are rotator cuff disorders [7] [8] [9]. There is no agreement and uniformity about diagnostic classification: for this reason literature is suggesting the idea of abolishing the actual diagnostic labels and using wider categories [10]. This diagnostic confusion certainly is not helpful in determining which is the best approach to the problem; in fact some studies show that the results of conservative treatment and the one of surgery approach to subacromial impingement, subacromial pain syndrome, rotator cuff tendinopathy, partial or complete non traumatic cuff tears, are not clinically different [11] [12].

Currently the most common approaches for the management of shoulder disorders are corticosteroid injection, non-steroidal anti-inflammatory drugs, arthroscopy and physiotherapy intervention which includes manual therapy and therapeutic exercise [13] [14] [15]. Frequently the combination of manual therapy and therapeutic exercise, as component of the physiotherapy intervention, are chosen for the rotator cuff disorders' management [7]. While some authors claim that manual techniques and therapeutic exercise combination is the most effective approach [16] [17] [14], others believe that that combination cannot be certainly considered more valid than therapeutic exercise alone [18], considering that exercise seems to be useful for itself in reducing pain and in improving functionality [14] [19] [20] [21] [22]. However some authors suggest that manual therapy [23] [24], specially joint mobilization techniques [25], are useful to improve ROM and reduce pain, with contrasting results about functionality [26][27].

Page et al. in their 2016 Cochrane review [7] have analyzed therapeutic exercise and manual therapy efficacy for subjects with rotator cuff disease: from their analysis arises that it is difficult to isolate the efficacy contribution of each one of the two interventions because they are frequently combined in literature's clinical trials.

To conclude it is not certainly known what is the real effectiveness of these two therapeutic interventions. The discussion on literature is still open: at the moment there aren't systematic reviews that have had as main focus the distinct analysis of the effects of the two individual interventions.

AIM OF THE STUDY

The aim of this review is to analyze which, between joint manual techniques and therapeutic exercise, is the best strategy for the conservative management of patient with shoulder pain, for all the cases where shoulder pain has not specific causes (it cannot be attributed to a specific pathology or clinical condition: shoulder instability, glenoid labrum lesion, adhesive capsulitis, osteoarthrosis, rheumatoid pathologies, red flags).

The main outcomes considered are function (SPADI, DASH, QuickDASH), pain (VAS, NPRS), ROM (goniometer) and quality of life.

This systematic review was developed on the PRISMA Model [28][29], the protocol will be subsequently recorded on PROSPERO International prospective register of systematic reviews. [30]

INCLUSION CRITERIA

Only RCTs published in English were considered and no time restriction was applied. The studied population responds to the following characteristics:

- human adult subjects from 18 years old, without ethnicity restriction
- non specified shoulder pain, shoulder disorders, rotator cuff pathology, shoulder tendinopathy, subacromial bursitis, shoulder impingement syndrome and subacromial impingement.

Studies that include subjects with recent trauma history, massive rotator cuff injury, shoulder instability, acromioclavicular or sternoclavicular joint disease, frozen shoulder or adhesive capsulitis, shoulder pain due to cervical or thoracic disorders, cervical radiculopathy, complex regional pain syndrome, gleno-humeral osteoarthritis, shoulder girdle fracture, shoulder pain with no musculoskeletal origin, neurological, neoplastic or rheumatic pathology, previous surgery on the shoulder, cervical or thoracic spine, or subjects who had undergone physiotherapy in the previous 3 months have been excluded. The treatment of interest includes manual therapy articular techniques applied on the gleno-humeral joint, scapulothoracic joint, cervical spine and thoracic spine, with the exception of manipulations under anesthesia. Joint techniques include joint mobilizations and manipulations as defined by IFOMPT:

- Mobilization: A manual therapy technique comprising a continuum of skilled passive movements to the joint complex that are applied at varying speeds and amplitudes, that may include a small-amplitude/high velocity therapeutic movement (manipulation) with the intent to restore optimal motion, function, and/or to reduce pain.

- Manipulation: A passive, high velocity, low amplitude thrust applied to a joint complex within its anatomical limit with the intent to restore optimal motion, function, and/or to reduce pain.

We studied the comparison of this intervention with therapeutic exercise. The therapeutic exercise approach includes shoulder exercises to increase joint ROM, muscular strengthening, stretching and neuromuscular control. Supervised exercise programs, home self-made or exercise in water programs are included. Considered outcomes are: pain measured by the VAS or NPRS system, function assessed with patient-related outcomes (PRO), active or passive ROM measured with a goniometer and quality of life.
The research was conducted by the following databases: Medline, Cochrane Library, Pedro e ClinicalTrials.gov.

SEARCH STRATEGY

The key words used, in various combinations on all the databases searched, are:

- **Population**: Shoulder pain, shoulder disorders, contractile dysfunction, impingement, rotator cuff, tendinopathy.
- **Intervention**: Manual therapy, mobilization, manipulative therapy, manipulation, physiotherapy, physical therapy, rehabilitation, conservative management.
- **Comparison**: therapeutic exercise
- **Outcome**: SPADI, DASH, VAS, pain, function, ROM
- **Type of studies**: randomized controlled trial.

The search strategies used for each database are shown below.

MEDLINE

- #1 **Population**: (Shoulder pain OR impingement syndrome OR shoulder disorders OR subacromial impingement OR subacromial bursitis OR shoulder contractile dysfunction OR rotator cuff tendinopathy OR rotator cuff disease OR supraspinatus tendinopathy OR rotator cuff tears OR shoulder arthralgia OR shoulder joint disease)
- #2 **Intervention**: Manual therapy OR manipulative therapy OR manipulation OR mobilization OR musculoskeletal manipulations OR physiotherapy techniques OR rehab* OR physical therapy OR conservative management
- #3 **Comparison**: exercise OR therapeutic exercise OR physiotherapy OR evidence based practice
- #4 #1 AND #2
- #5 #1 AND #3
- #6 #4 AND #5

Studies with unknown status were excluded.

DATA COLLECTION AND ANALYSIS

Two reviewers (CT and VT) independently conducted the research on the indicated databases and they selected studies first by analyzing the title, if this is of interest, it has been considered the abstract. At this point studies were divided into two categories:

1. Possibly relevant: studies that by the title and abstract analysis could meet the inclusion criteria

2. Excluded: studies that clearly do not meet inclusion criteria already by the analysis of title and abstract

For all the abstracts that met inclusion criteria or they might do (studies included in the first group) the full text was analyzed. Abstracts containing ambiguous or unclear information were anyway considered by analyzing the full text to clarify any uncertainties and to state clearly whether the study was to be included or not in this review. A third reviewer (DR) had taken part in the discussion about the inclusion or exclusion of studies in case the two reviewers did not get to an agreement, the final decision was taken according to the majority.

Data were extracted independently by the two reviewers (CT and VT) using a data extraction form, successively the results were cross-checked. Each study was analyzed independently by each reviewer, the results were compared. The studies on which there was no agreement were discussed and analyzed by the two reviewers with the help of a third reviewer (SM), the final decision was taken according to the majority.

Data Extraction Form:

General information: author, title, source, year of publication, publication type (article on a magazine, book's chapter).

Study characteristics: design, methodology, outcomes, intervention, quality assessment (groups comparability, groups dimension, follow up duration).

Outcome measures: effect size (confidence interval, level of statistical significance, charts).

Data variables researched were: typology, number of participants, and aim of the study. Population's characteristics such as: age, symptomatology (localization, duration, severity degree of pain, functional restriction and active and passive ROM

restrictions), previous intervention (surgery, pharmacological, physiotherapy), comorbidity. Interesting data concerning the intervention are: duration, frequency, modality (used techniques and dosage) and follow up duration. Used outcome measures: pain, function, ROM, and disability; baseline and follow up average values, adverse effects.

Outcome measures considered were:

- The use of VAS (Visual Analogue Scale) or NRS (numeric rating scale) for pain evaluation. For this measure it has been considered a MCID of 1,4 cm on the VAS [31].
- Range of motion (ROM) of the shoulder both active and passive
- Function/Disability: if studies report data concerning more than one functional or disability related scale it was considered data from SPADI (Shoulder Pain and Disability Index), DASH (Disabilities of the Arm, Shoulder and Hand) [32] and QuickDASH. [33]

Cochrane Collaboration's tool was used to establish risk of bias assessment [34] the following aspects were considered:

- Generation of the randomization sequence
- Allocation concealment
- Blinding of participants and personnel
- Blinding of outcome assessment
- Incomplete outcome data
- Selective reporting
- Other bias

Bias risk was assessed for each element: low, unclear or high. Successively, overall risk of bias will be categorized as:

- Low risk: every domain results as a low risk domain
- High risk: there is at least one high risk domain
- Unclear: there is at least one unclear domain and no high risk domain

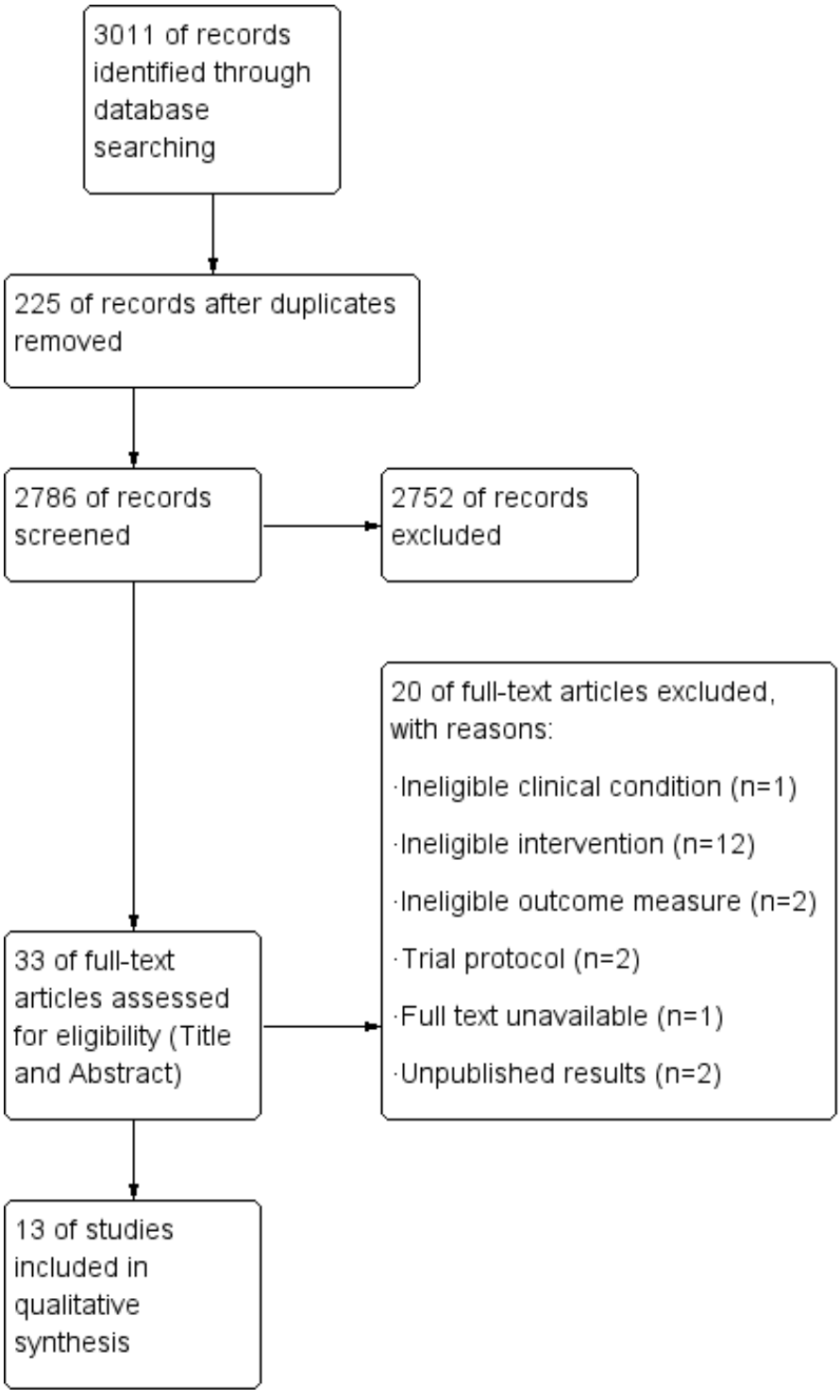
The software RevMan 5.3 [35] has been used to show results of potential bias detected. Results disagreements between the two reviewers (CT and VT) were discussed with a third reviewer (DR) and final decision was taken according to the majority.

Description of studies

Results of the search

The search, which was conducted up to May 2017, yielded 3011 records across the four databases. After duplicates were removed, 2786 unique records remained. Of these, 33 were retrieved for full-text screening on the basis of title and abstract. Thirteen trials were deemed eligible for inclusion (Bang 2000 [36], Camargo 2015 [37], Chen 2009 [38], Conroy 1998 [39], Cook 2014 [40], Kachingwe 2008 [41], Kromer 2013 [42], Kromer 2014 [43], Mintken 2016 [44], Satpute 2015 [45], Senbursa 2007 [46], Senbursa 2011 [47], Yiasemides 2011 [48]). A flow diagram of the study selection process is presented in Figure 1.

Figure 1: study flow diagram



Included studies

A full description of all included trials is provided in the Appendix.

Design

All included trials were described as RCTs. All trials used a multiple-treatment trial design (which involves the application of two or more treatments for a single participant and was used to assess differences among three interventions in two groups of participants). Eleven trials included two intervention arms [36] [37] [38] [39] [40] [42][43] [44] [45] [46] [48], one included three arms [47] and one included four arms. [41]

Participants

A total of 872 participants were included in the 13 trials, and the number of participants per trial ranged from 14 to 140. The median of the mean age of participants was 49 years, and the median of the mean duration of symptoms was 5,5 months. Fifty-one per cent of participants were female.

Interventions

A detailed description of the interventions delivered in each trial is summarized in the Appendix. Of thirteen studies analyzed in this review eleven compared Manual Therapy and exercises with exercises [36][37][38][39][40][42][43][44][45][46][48], one compared Home exercises with supervised exercises and manual therapy with supervised exercises [47] and one compared exercises with exercises and manual therapy mobilization with exercises and Mobilization With Movement with control home exercises [41].

Three authors used a personalized exercise program based on the patient's characteristics [40], [42], [43]. Supervised exercise as main intervention for at least one intervention group was applied in ten trials [36][37][38][39][40][41][42] [43][44][45] while effectiveness of home exercise as main intervention for at least

one intervention group was studied in only two trials [46][47]. Six studies used home exercise as part of the intervention [36], [38], [41], [47], [48]. All trials applied as component of the exercise intervention strengthening, stretching and ROM improving exercises directed to the shoulder rotator cuff muscles, one trial included also cervical and thoracic exercises [44], seven trial applied scapular exercises [39], [40], [42], [44], [45], [47], [48] and two made also posture exercises [40], [44].

Manual therapy treatment were too heterogeneous about technique's target. Three trials analyzed the effect of manual therapy applied only to the gleno-humeral joint [39], [41], [45], three trials included also the scapulo-thoracic joint [46]–[48], one targeted techniques on the shoulder griddle [38] one extended the intervention even to the cervical spine [37], one applied manual therapy only to the cervical spine [40] and four acted on shoulder griddle, scapula-thoracic joint, cervical spine and upper thoracic spine [36], [42]–[44].

In three trials were used also neural techniques [42], [43], [46], [47] and six studies have added soft tissue mobilization [36], [37], [39], [42], [43], [46], [47].

In two trials were applied in both intervention groups hot packs [39], [45] and one applied ice [46].

Outcomes

Pain was evaluated with visuo-analogic scale (VAS) in seven of thirteen trials [36], [37], [39], [41], [45]–[47] while in two trials authors used NPRS [40], [44].

Authors have considered many aspects of pain characteristics and painful conditions: pain during resisted break tests [36], pain at rest, during shoulder movement, greatest pain during the prior week, least pain during the prior week [37], pain severity during maximal HBB movement [45], night pain level, pain at rest and with motion [46], [47], maximum pain over the preceding 24-hour, pain intensity with the Neer test, pain intensity with the Hawkins-Kennedy test [41] Mechanical sensitivity

PPT with algometer [37], [46], Supraspinatus muscle trigger point tenderness: algometry[46].

To assess the **shoulder function** and **disability** one study used the DASH [37], two used the shortened version: QuickDASH [40], [44], in other seven studies authors have chosen the SPADI [38], [41]–[45], [48]. Other Outcome measure tools used to assess the shoulder function: Functional skills on a S point scale [39], Functional assessment questionnaire [46], isometric strength by an electronic dynamometer [36], Modified American Shoulder and Elbow Surgeon's (MASES) questionnaire [47], Manual muscle testing for flexion, abduction, internal and external rotation strength, Shoulder muscle strengths flexion, abduction, internal and external rotation: Dr. Lovett's manual muscle test [46].

Range of motion was assessed by using a universal goniometer [39], [46], [47], authors selected different movement to measure: pain-free active flexion and scaption ROM [41], pain-free passive glenohumeral internal rotation ROM [45]. Other authors used a photographic method to measure ROM for flexion and abduction [38], [48], finally in two studies was used a tape to measure ROM in HBB position [38], [45]. Some authors studied more specific aspects of movement: scapular kinematics [37].

To assess **patients' satisfaction** were used Functional assessment questionnaire [36], Self perceived Global improvement on a 6 point scale [38], Self-rated improvement: 6-point Likert scale [48], Patient's Global Impression of Change (PGIC), Individual complaints and restrictions: Generic Patient-Specific Scale (GPSS) [42], [43], Point global rating of change (GROC) scale, Patient Acceptable Symptom State (PASS) [44].

For assessing **central factors** some authors used the Modified version of the Fear Avoidance Beliefs Questionnaire (FABQ) and the Pain Catastrophizing Scale (PCS) [42], [43].

Mean follow-up was 12,35 ± 13,08 weeks, the range of follow-up was 1-52 weeks.

Excluded studies

Of 20 full-text articles retrieved for further scrutiny, most (n = 12) were excluded because intervention was ineligible, they included interventions such as physical therapy, cortisone injections or even the exclusion of manual therapy or exercise. One trials comprised traumatized shoulders and was excluded for ineligible clinical condition. Two trials considered outcome not related to our research. Two studies were trial protocol, other two had unpublished results and for an article, full text was not available.

Risk of bias in included studies

A summary of the risk of bias in included trials is presented in Figure 2 and Figure 3.

Randomization

We rated 11 trials at low risk of random sequence generation bias because the method of randomization was displayed and adequate. In two trials the method of random sequence generation was not reported [39], [47]; the risk of allocation bias in these trials was therefore unclear.

Allocation

Eleven trials reported using an adequate method to generate a random allocation sequence [36]–[38], [40]–[45], [47], [48], and only six trial reported using an adequate method of allocation concealment [38], [42]–[45], [48]. Two trials did not report how the allocation sequence was generated [39], [46], and seven trials did not report how the allocation sequence was concealed [36], [37], [39]–[41], [46], [47]. The risk of selection bias in these trials was therefore unclear.

Blinding

We differentiate this item between self-related patients and non self-related patients outcome:

A) Participants and personnel: For self-related patients outcome: Two trials were rated at low risk of performance bias because of successful blinding of participants [41], [45]. Two trials were rated at unclear risk of performance bias because there was insufficient information to judge [39], [46]. All remaining trials were rated at high risk of performance bias, as participants were not blinded and may have had different expectations about the benefits of each intervention.

For non self related patients outcome: three trials were rated at low risk of performance bias because of successful blinding of participants [41], [45] and the other one because the review authors judge that the outcome is not likely to be influenced by lack of blinding [38]. Eight trials were rated at unclear risk of performance bias because in six trials this type of outcomes is not exposed [36], [37], [40], [42]–[44] and for insufficient information to judge them [39], [46]. All remaining trials were rated at high risk of performance bias, as participants were not blinded and may have had different expectations about the benefits of each intervention. No trials report personnel blinding.

B) Outcome assessor: For self-related patients outcome two trials were rated at low risk of detection bias because in the first one to maintain assessor blinding, participants "were specifically requested not to discuss any aspects of their intervention with the assessor at any stage of reassessment", the second one the review authors judged that the outcome is not likely to be influenced by lack of blinding [38], [47]. All remain trials were rated at unclear risk of detection bias because there were insufficient information to judge them [37], [39], [41], [45], [46], [48] or assessors were blinded but there are no details provided [39]–[41],

[44], [45], [48] or because patients acting as assessors were kept naive to their allocation [42], [43].

For non self-related outcomes one trial was rated at low risk of detection bias because the measurer blinded to group allocation and participants were specifically requested not to discuss any aspects of their intervention with the assessor [38]. In six trials this type of outcomes is not exposed [36], [37], [40], [42]–[44], in six trials assessors were blinded but there are no details [39], [41], [45], [46], [48]. The risk of selection bias in these trials was therefore unclear. One trial was rated at high risk of detection bias because the measurer was no blinded [47].

Incomplete outcome data

Six trials had no dropouts, losses to follow-up or exclusions, or had a small quantity of incomplete data that was deemed unlikely to bias the results [39], [41], [45]–[48]. One trial reported high number of losses to follow-up across groups and thus was rated at high risk of attrition bias [38]. One trial's report data sets were incomplete for one of subjects so had an unclear risk of attrition bias [36]. In five trials the non self-related outcomes are not exposed so it were rated at unclear risk of incomplete outcome data bias [37], [40], [42]–[44].

Selective reporting

Four trials were rated at low risk of selective reporting bias because all outcomes specified in the trial registry entry or the trial protocol were fully reported in the trial publication [40], [42]–[44]. The remaining seven were rated at unclear risk of selective reporting bias because (1) outcome data were completely reported for all outcomes specified in the methods section of the publication, but none of these trials were registered in a trials registry or had an available trial protocol, so it is unclear whether other outcomes were measured but not reported based on the results, or (2) outcome data were incompletely reported (e.g. reporting means

without measures of variation), but it was unclear whether data were incompletely reported based on the statistical significance or magnitude of the results.

Other potential sources of bias

All trials were rated as free from other potential sources of bias (specifically, baseline imbalance).

Figure 2: Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies

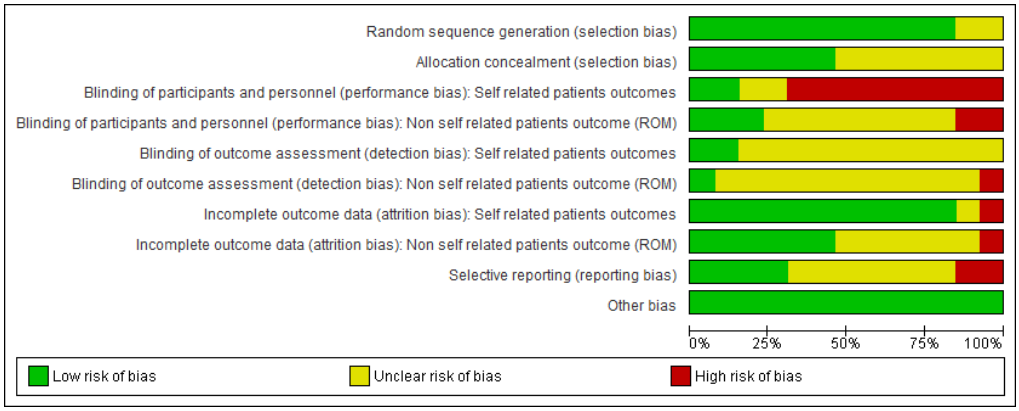
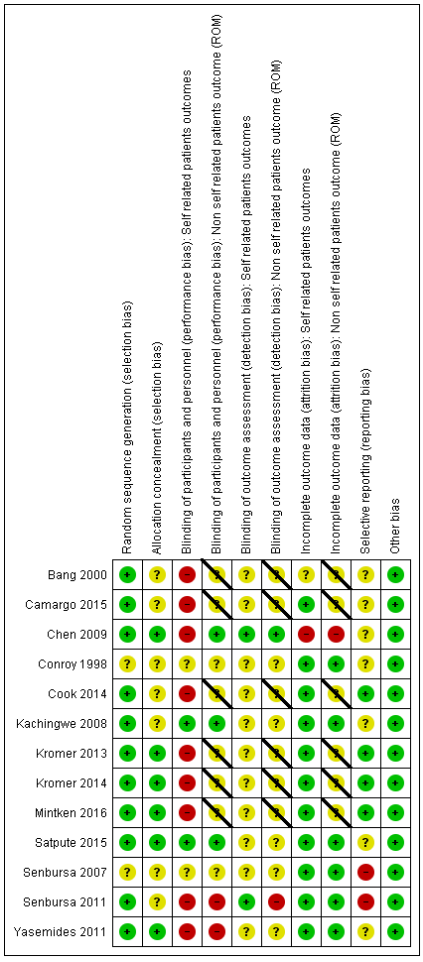


Figure 3: Risk of bias summary: review authors' judgements about each risk of bias item for each included study. Banned boxes: non-self related patients outcome not considered.



RESEARCH OF EVIDENCE

A small number of studies satisfying our clinical query emerged from databases research despite our search strategy was focused on a large and well-defined population and included many shape of intervention. This happened because there are several clinical approaches to the painful shoulder. Through this, the most investigated are the medical one (surgery, corticosteroid injection, drugs) and the rehabilitative one which includes a wide use of physical therapy strategy (ultrasound, laser, electrotherapy, extracorporeal shock wave) as well as the therapeutic exercise and manual therapy [13] [14] [15]. Another reason of the low number of results could be that interventions are usually analyzed in combination (manual therapy, exercise and ultrasound [49], manual therapy, exercise vs arthroscopic subacrormial decompression [50][51] manual therapy, exercise and corticosteroid injections vs corticosteroid injections [52].

RELEVANCE TO THE RESEARCH QUESTION

Most of the studies examined (12/13) [36] [37] [39] [40] [41] [42] [43] [44] [45] [46] [47][48] showed a statistically significant improvement for both the intervention groups without significant differences between groups; a small part of them (3/12)[36][39][45] revealed a greater effect for the groups treated with joints manual techniques and exercise. The authors of the remaining study [38] did not find statistically significant differences between the intervention groups and the improvement of the two groups has not reached significant levels. Despite our efforts, we did not find any studies making a direct comparison between manual therapy joint techniques and therapeutic exercise but only indirect comparisons. Further studies in this direction are needed to permit a complete analysis; this review confirm that few studies are available in literature on this topic. Our review highlights the validity of physiotherapy intervention (especially the use of therapeutic exercise and manual therapy) for the shoulder pain management confirming papers that support the efficacy of the conservative treatment [11][12].

The absence of direct comparison analysis between the two interventions make the results not completely helpful in answering our clinical query.

CORRELATION WITH THE BACKGROUND

The poor availability of studies did not surprise us because it confirms the literature background that we found when starting the scoping research. Three studies have achieved positive results for manual therapy, they have analyzed three different kind of manual intervention: passive accessory or passive physiological joint mobilization Maitland grades I-V at the shoulder, shoulder girdle, cervical spine, upper thoracic spine [36], Maitland mobilization techniques to the subacromial, glenohumeral joints [39], MWM Hand-behind-back [45]. We judged them one at high risk of bias because of the unblinding of participants and personnel, there were also unclear risk of bias related to poor information about allocation concealments method, blinding of outcome assessor and for missing data without providing reasons [36]. The others were rated at unclear risk because insufficient information were provided for random sequence generation, allocation concealments method, blinding of participants and personnel and blinding of outcome assessor [39] and at unclear risk because information were not provided for blinding of assessor method [45].

STRENGHTS AND LIMITATIONS OF INCLUDED STUDIES

The interventions we found analyzing the selected studies were heterogeneous: exercises were done under supervision, at home or both and the dosage and progression changed according to the exercise program. Manual therapy was also applied trough several techniques and dosage [39][40][42][44][45]. Study's characteristics are also too heterogeneous. Some studies have follow-up measures too short [45][36][37]or have only evaluated outcomes at the discharge of patients thus assessing the short-term effect but not the medium to long-term effect [40]. Others studies had a too small sample of patients [39] and other divided a small sample of patients into too much intervention groups [41]. Furthermore, not all studies have specified the randomization process [39][46] and/or the method used

to generate the allocation sequence [39][47] or to conceal the allocation [36][37][39][40][41][46][47]. In very few studies patients and personnel were blinded [38][41][45] and were specified the measures used to do that. Some studies did not report clearly data publishing only graph [46][47] and in general we found a poor methodological quality.

STRENGHTS AND LIMITATIONS OF THE REVIEW PROCESS

The results of this review have some limitations: we searched only articles published in English and only completed trials. The small size of the sample analyzed, the quality of the studies included is poor and interventions and outcomes are heterogeneous.

We tried to do an inclusive recruitment strategy, regarding population's characteristics, patients' in-come diagnosis and strategy of intervention. Time or setting restriction were not applied and the research was extended to other publications of the papers' authors and related articles.

To make a good assessment we evaluated the methodological quality of included articles, data were always cross-checked by the two reviewers and a third check was made by the two supervisors. The review protocol and data analysis were properly conducted using the Prisma Model [28], the Cochrane Collaboration risk of bias tool [34] and the RevMan 5.3 software[35].

GENERALIZATION OF FINDINGS

From our review it arises that supervised therapeutic exercise or exercise combined with manual therapy are effective and we could recommend it because almost all studies found a positive response for this kind of treatment. This can be easily transferable in common clinical practice of physiotherapists. We cannot state if the use of manual therapy only, for shoulder pain management, could be recommended due to the small number of evidences and the poor consistency of them.

CONCLUSIONS

The combination of manual therapy and exercise is a clear effectiveness therapeutic tool for shoulder problems. Therapeutic exercise seems to be better than joint manual techniques in the management of the non-specific shoulder pain as it is effective even individually; however nowadays there are not studies that have analyzed a direct comparison between the two interventions and available literature is methodologically unreliable.

There is limited evidence to conclude which treatment is better, further research are needed to investigate individually the effectiveness of manual therapy approach for the painful shoulder not in combination with other interventions. More high methodological quality trials are needed, with the aim to investigate the direct comparison between therapeutic exercise and manual therapy and to define which manual therapy intervention is more appropriate for non-specific shoulder pain.

KEY POINTS

- Therapeutic exercise and joint manual techniques in combination are effective for the management of non-specific shoulder pain
- Therapeutic exercise seems to be better than joint manual techniques in the management of painful shoulder
- There is limited evidence to conclude which treatment is better
- There are not studies analyzing a direct comparison between the two interventions and available literature is methodologically unreliable
- More high methodological quality trials are needed comparing directly manual therapy and therapeutic exercise for shoulder pain

Appendix – Features of the studies included and results [In alphabetical order by author]

Author(s), year	General information: Title Source Type of publication Doi	Population and setting: Groups dimension Age Pathology/diagnosis Comorbidities	Outcomes: Primary, Secondary Measure timing	Intervention	Comparison	Result	Effect size, Confidence interval Level of statistical significance
Michael D. Bang, Gail D. Deyle 2000	*Comparison of Supervised Exercise With and Without manual Physical Therapy for Patients With Shoulder Impingement Syndrome* Journal of Orthopaedic& Sports Physical Therapy (Journal article) Prospective randomized clinical trial	52 patients Intervention n=28 (18M 10F) Comparison n=24 (12M 12F) 18-65 years **Shoulder impingement syndrome** **Rotator cuff tendinitis** Inclusion criteria (1) **pain** with 1 of the 2 **tests** in category I + (2) **pain** with 1 **test** from category II or III Category I: impingement signs	*Primary outcomes:* 1- Functional assessment questionnaire 2- VAS for pain during resisted break tests 3- Isometric strength (electronic dynamometer). *Measure timing:* Outcome 1 and 2 -At the beginning - 60 days later Outcome 3 -At 7th visit 1 month follow-up	n=24 **Exercise** As the intervention group program + **Manual therapy** Twice weekly For 3 weeks For a total of 6 visits One-half hour lasting MT techniques: Passive accessory or passive physiological joint mobilization Maitland grades I-V 1- at the shoulder 2- at the shoulder girdle 3- at the cervical spine	n=28 **Exercise** 1-Supervised Standardized flexibility and strengthening program Twice weekly for 3 weeks one-half hour in length. For a total of 6 visits + 2-At home 2 passive stretching exercises once daily 6 strengthening exercise with Theratubing,	**OUTCOME 8 weeks** / **INTERVENTION Mean ±SD** / **CONTROL Mean±SD** / **EFFECT ESTIMATE Mean difference (95% CI)** / **pValue .05 §Bonferroni corrected a = .017** Isometric Abduction Strength (Newtons): 225.3 ±111.86 / 147.14± 81.11 / 78.16 (24.50, 131.82) / >0.05 Isometric External Rotation Strength (Newtons): 159.05 ±77.83 / 101.88± 42.06 / 57.17 (23.15, 91.19) / >0.05 Isometric Internal Rotation Strength (Newtons): 191.96 ±82.29 / 153.62 ±58.63 / 38.34 (-0.87, 77.55) / >0.05 Strenght composite score*: 576.31±228.75 / 402.64±162.50 / -173.670 (-283.06, -64.2822) / 0.0155 Abduction AROM Pain: 16.82 ±21.02 / 37.54 ±29.01 / 20.72 (-34.98, -6.46) / >0.05	Alpha level 0.05, (95% CI)

		1. **Passive overpressure** at full **shoulder flexion** with the scapula stabilized. 2. **Passive internal rotation** at **90° shoulder flexion** in the scapular plane and in progressive degrees of horizontal adduction. Category II: **active shoulder abduction**, subject standing against a wall Category III: **Resisted break tests**: Subject supine, 1. **Abduction**. 2**. Internal rotation**. *3.* **External rotation**		4-at the upper thoracic spine + Soft tissue massage/ muscle stretching + 1 or 2 additional home cervical and thoracic postural exercises		Resisted abduction pain: 22.70± 26.27 / 32.64 ±29.45 / 9.94 (-25.53, 5.65) / >0.05 Resisted external rotation pain: 15.85± 21.92 / 30.23± 29.72 / 14.38 (-29.07, 0.31) / >0.05 Resisted internal rotation pain: 21.04± 27.97 / 33.5 ±27.57 / 12.46 (-27.90, 2.98) / >0.05 Functional Pain: 98.00±107.37 / 226.73±194.73 / 128.73 (39.02, 218.44) / >0.05 Pain composite score*: 174.41±183.06 / 360.64± 272.32 / -186.23 (-319.33, -53.13) / 0.0017 Function (Functional Assessment Questionnaire): 38.22±4.68 / 33.26±7.84 / 4.96 (1.30, 8.62) / 0.049 *Composite dependent variables	
Paula R. Camargo et al. 2015	*Effects of stretching and strengthening exercises with and without manual therapy on scapular kinematics, function, and pain in individuals with shoulder impingement –*	46 patients Intervention n=23 (10M 13F) Comparison n=23 (14M 9F) **Shoulder impingement syndrome** Inclusion criteria	*Primary outcomes* 1- Scapular kinematics (the Flock of Birds® hardware integrated with MotionMonitor™ software) 2- DASH	n=23 **Exercise** Supervised -3 stretching -3 strengthening exercises Strengthening exercises completed by using Theraband® with 3	n=23 **Manual therapy** For 4 weeks 45 minutes lasting Grade III and IV mobilizations, including: -Arthrokinematic -Osteokinematic movements for the	***OUTCOME POST-INTERVENTION (4 weeks)*** / **Exercises + manual therapy group (Mean±SD)** / **Exercises alone group (Mean±SD)** / **Between-Group Differences in Change Scores Mean (95% CI)** / **Between-Group Effect Sizes, Cohen *d* Mean (95% CI)** / **P value** DASH SCORE: 12.4 ± 12.3 / 11.7 ± 9.5 / -3.9 (-10.5, 2.8) / -0.34 (-0.92, 0.25) / >0.05 SPE: Scapular internal rotation: 45.3 ± 9.4 / 46.4 ± 7.4 / 0.8 (-3.5, 5.1) / 0.11 (-0.47, 0.69) / >0.05 SPE: Scapular upward rotation: 21.5 ± 14.7 / 19.6 ± 14.6 / -0.4 (-5.2, 4.4) / -0.05 (-0.63, 0.53) / >0.05	Between and within-group effect sizes for all quantitative variables were measured with Cohen's d coefficient.

	randomized controlled trial J Orthop Sports PhysTher www.clinicaltrials.gov (NCT02035618)	1-History of non-traumatic onset of shoulder pain 2- Painful arc during active elevation 3-1 or more positive SIS tests (Hawkins-Kennedy, Jobe, Neer) OR Pain during **passive** or **isometricresisted external rotation** at 90° of abduction AND Pain with **palpation of the rotator cuff tendon**s 4-All individuals had to be able to reach 150° of arm elevation Comorbidity -A systemic illness -Individuals with a Beck Depression Inventory score higher than 9 (cut-off score for screening depression status) were excluded from pain and mechanical sensitivity assessments;	3- VAS for Pain -Current pain at rest -During shoulder movement -Greatest pain during the prior week -Least pain during the prior week 4- Mechanical sensitivity (PPT) with algometer *Measure timing:* -Pre-intervention -At the end of the 4 week intervention 4 weeks Follow-up	progressive levels of resistance Treatment duration 4 weeks	-GH, -ScT, - AC, -SC joints -cervical spine -Upper thoracic spine + -Soft tissue techniques (deep frictions, kneading) -Proprioceptive neuromuscular facilitation -Rhythmic stabilizations -Strain-counterstrain -Contract-relax techniques	SPE: Scapular tilt	-3.3 ± 6.6	0.9 ± 7.9	-3.3 (-7.2, 0.6)	-0.50 (-1.08, 0.09)	>0.05	An effect size greater than 0.8 was considered large, around 0.5 moderate, and less than 0.2 small 95% confidence interval significance level of 0.05, and a power of 0.80 to detect a difference on scapular upward rotation of 4° with a standard deviation of 4.5°
						ScPE: Scapular internal rotation	34.8 ± 9.8	35.9 ± 6.3	0.0 (-4.4, 4.3)	0.01 (-0.58, 0.57)	>0.05		
						ScPE: Scapular upward rotation	21.9 ± 15.1	21.3 ± 15.2	-0.2 (-5.5, 5.0)	-0.02 (-0.60, 0.55)	>0.05		
						ScPE: Scapular tilt	-2.2 ± 7.0	1.9 ± 8.3	-2.5 (-6.5, 1.5)	-0.37 (-0.95, 0.22)	>0.05		
						Current pain at rest	6.3 ± 11.6	3.6 ± 6.1	-0.6 (-2.1, 0.8)	-0.28 (-0.89, 0.34)	>0.05		
						Pain during movement	16.2 ± 27.4	13.4 ± 12.3	0.1 (-1.7, 1.8)	0.02 (-0.59, 0.63)	>0.05		
						Greatest pain last week	23.6 ± 29.5	26.8 ± 22.5	-0.3 (-1.8, 1.3)	-0.12 (-0.73, 0.50)	>0.05		
						Lowest pain last week	5.4 ± 9.4	5.8 ± 7.7	-10.6 (-17.7, -1.5)	-0.75 (-1.37, -0.10)	>0.05		
						PPT: I. upper trapezius	3.0±1.9	3.8±1.6	0.5 (-0.3; 1.2)	0.41 (-0.21; 1.03)	>0.05		
						PPT: U upper trapezius	3.3±1.8	3.9±1.4	-0.1 (-1.0; 0.8)	-0.09 (-0.70; 0.52)	>0.05		
						PPT: I infraspinatus	4.2±1.8	5.5±2.5	1.4 (0.5; 2.3)	0.96 (0.30, 1.59)	>0.05		
						PPT: U infraspinatus	4.3±1.7	5.5±2.2	0.5 (-0.3, 1.3)	0.43 (-0.20, 1.04)	>0.05		
						PPT: I supraspinatus	4.1±2.8	5.0±2.1	0.1 (-1.1, 1.3)	0.06 (-0.55, 0.67)	>0.05		
						PPT: U supraspinatus	3.8±2.1	5.1±2.0	0.5 (-0.2, 1.3)	0.48 (-0.15, 1.09)	>0.05		
						PPT: I deltoid	2.6±1.8	3.6±1.7	0.1 (-0.5,	0.08 (-0.54,	>0.05		

									0.6)	0.69)	
						PPT: U deltoid	2.5±1.9	3.6±3.7	0.3 (-0.4, 0.9)	0.20 (-0.42, 0.81)	>0.05
						PPT: I levator scapulae	3.3±1.7	4.1±1.6	0.2 (-0.4, 0.8)	0.18 (-0.43, 0.79)	>0.05
						PPT: U levator scapulae	3.3±1.6	4.0±1.4	0.1 (-0.5, 0.6)	0.06 (-0.55, 0.67)	>0.05
						PPT: I C5-C6	1.7±1.2	2.5±0.9	0.7 (0.1, 1.2)	0.70 (0.05, 1.31)	>0.05
						PPT: U C5-C6	1.8±1.2	2.5±0.9	0.6 (0.2, 1.0)	1.03 (0.36, 1.66)	>0.05
						PPT: I tibialis anterior	5.8±3.3	6.8±2.3	0.2 (-1.4, 1.8)	0.09 (-0.52, 0.70)	>0.05
						PPT: U tibialis anterior	5.0±2.1	6.4±2.5	0.6 (-0.5, 1.8)	0.36 (-0.26, 0.97)	>0.05
						SPE: Sagittal Plane Elevation; ScPE: Scapular Plane Elevation; PPT: Pressure Pain Threshold; I: Involved; U: Uninvolved					
Judy F Chen et al. 2009	*Passive mobilisation of shoulder region joints plus advice and exercise does not reduce pain and disability more than advice and exercise alone: a randomised trial* Australian Journal of Physiotherapy Journal article DOI: ACTRN 12605000080628	90 patients >18 years old **Shoulder pain and stiffness** *Inclusion criteria* 1- Shoulder pain and stiffness of > than 1 month's 2- Understood spoken English. 3- Shoulder unilateral pain over the glenohumeral joint OR in the proximal upper	*Primary outcome* 1-SPADI for pain and disability *Secondary outcomes*. 1- Self-perceived global improvement on a 6-point scale 2- AROM (still photography) in -flexion -abduction -hand-behind back (using a tape	n=45 **Manual therapy** Passive joint low-velocity mobilizations at the -glenohumeral -acromioclavicular -sternoclavicular joint Twice weekly then once a week 30 minutes lasting For a maximum of 10 session 8 weeks period + **Advice** for painful and everyday	n=45 **Exercise** + **Advice** For a maximum of 10 sessions 8 weeks period	**OUTCOME** / **Month 1 minus Month 0 Exp minus Con Mean (95% CI)** / **Month 6 minus Month 0 Exp minus Con Mean (95% CI)** / **P Value** Flexion *ROM (deg)* — 5 (–4 to 14) — 0 (–10 to 11) — >0.05 Abduction ROM *(deg)* — 4 (–9 to 17) — 3 (–12 to 19) — >0.05 Hands behind Back ROM *(m)* — 0.00 (–0.03 to 0.04) — 0.00 (–0.02 to 0.03) — >0.05 SPADI *(%)* — –3 (–11 to 5) — –1 (–16 to 13) — >0.05	95% CI; Alpha level 0.05

		limb AND -Reproduced during shoulder movements 4-Needed to have <140° of -active shoulder flexion AND -abduction OR -hand-behind-back deficit >10 cm compared to the unaffected side 5- Pain and/or stiffness during accessory movements of the shoulder region joints *Comorbidity* -Local neoplastic disorder	measure)	activities + **Home Exercise** At least twice daily -Neuromuscular control -Dynamic stability -Muscle force couple co-ordination		GPE *(–2 to 3)* –0.1 (–0.4 to 0.2) 0.1 (–0.5 to 0.6) >0.05	
Douglas E. Conroy, Karen W. Hayes 1998	*The Effect of Joint Mobilization as a Component of Comprehensive Treatment for Primary Shoulder Impingement Syndrome* Journal of Orthopaedic& Sports Physical Therapy Journal article	14 patients **Primary shoulder impingement syndrome** *Inclusion criteria* Pain about the superolateral shoulder region + One or more of the following findings:	*Primary outcome* 1-24hour VAS pain 2-subacromial compression test VAS pain 3-AROM: goniometry 4- Functional skills on a S point scale assessed by the examiner	N=7 **Exercise** -Hot packs, -AROM -Stretching -Muscle strengthening exercises for the rotator cuff and parascapular musculature -Soft tissue mobilization -Patient education	N=7 **Exercise** -Hot packs -AROM -Stretching -Muscle strengthening exercises for the rotator cuff and parascapular musculature -Soft tissue mobilization -Patient education	**OUTCOME (3 weeks)** / **Control Group Mean±SD** / **Experimental Group Mean±SD** / **Mean difference (CI 95%)** / **P (one-tailed)** 24-h pain (mm) / 44.09 ±31.98 / 12.02 ±14.35 / -32.07 (3,24; 60,93) / .008 Subacromial compression test pain (mm) / 43.43±25.49 / 21.57 ±13.59 / -21.86 (-1,92; 45,64) / .032 Abduction (degrees) / 133.86 ±27.82 / 125.71 ±26.21 / -8.15 (-23,326; 39,626) / >0.05 Elevation (degrees) / 148.57 ±15.47 / 141.29 ±19.54 / -7.28 (-13,24; 27,80) / >0.05 Extemal rotation (degrees) / 81.1 4 ±18.05 / 75.71 ±17.51 / -5.43 (-15,27; 26,13) / >0.05	Alpha level 0.05

<table>
<tr>
<td></td>
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<td>-AROM deficits in humeral elevation
-painful subacromial compression
-Limited functional movement patterns in an elevated position</td>
<td>Measure timing

-at the beginning -- at the end of the treatment period

3 weeks follow-up</td>
<td>45-60 minutes lasting

+

Manual therapy

Mobilization techniques (Maitland) to the
-subacromial
-glenohumeral joints

3 times weekly
3 weeks</td>
<td>45-60 minutes lasting

3 times weekly
3 weeks</td>
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<table>
<tr><td>Internal rotation (degrees)</td><td>49.57± 16.42</td><td>44.86 ±12.25</td><td>-4.71 (-12,16; 21,58)</td><td>>0.05</td></tr>
<tr><td>Function:</td><td></td><td></td><td></td><td>>0.05</td></tr>
<tr><td>N°of participants who can reach</td><td></td><td></td><td></td><td></td></tr>
<tr><td>reach with pain</td><td>5</td><td>4</td><td></td><td></td></tr>
<tr><td>can’t reach</td><td>1</td><td>2</td><td></td><td></td></tr>
<tr><td>to external occipital protuberance</td><td>1</td><td>1</td><td></td><td></td></tr>
<tr><td>N°of participants who can reach</td><td></td><td></td><td></td><td></td></tr>
<tr><td>reach with pain</td><td>5</td><td>5</td><td></td><td></td></tr>
<tr><td>can’t reach overhead 135 degrees</td><td>2
0</td><td>1
1</td><td></td><td>>0.05</td></tr>
<tr><td>N°of participants who can reach</td><td></td><td></td><td></td><td></td></tr>
<tr><td>reach with pain</td><td>2</td><td>2</td><td></td><td></td></tr>
<tr><td>can’t reach to the spinous processes</td><td>2
3</td><td>1
4</td><td></td><td>>0.05</td></tr>
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<tr>
<td>Chad Cook et al. 2014</td>
<td>The addition of cervical unilateral posterior anterior mobilisation in the treatment of patients with shoulder impingement syndrome: A randomised clinical trial

Manual Therapy Journal article http://dx.doi.org/10.1016/j.math.2013.05.007</td>
<td>74 patients
≥18 years old

Subacromial impingement syndrome

Inclusion criteria

1-External or internal impingement signs
2-Pain or dysfunction with overhead activities
3-Pain during active shoulder movements
4-Positive Neer/Hawkins-Kennedy test</td>
<td>Primary outcome

1-QuickDASH

Secondary outcome

2-The numeric pain rating scale for pain (NPRS)

3-Patient Acceptable Symptom State (PASS)

Measure timing

Both 1 and 2:</td>
<td>n= 38

Exercise

1-Self- and externally-applied stretching
2-Isotonic strengthening
3-Restoration of ROM
4- Active ROM
5- Posterior and anterior shoulder stretch
6-Rotator cuff strengthening with the TheraBand
7- Home exercise program (Rotator cuff strengthening with the TheraBand)
+</td>
<td>n= 36

Exercise

1-Self- and externally-applied stretching
2-Isotonic strengthening
3-Active training of the scapula muscles
3- Posture exercises
4- Active ROM
5- Posterior and anterior shoulder stretch
6-Rotator cuff strengthening with the TheraBand
7- Home exercise program (Rotator cuff strengthening with the</td>
<td>
<table>
<tr><th>OUTCOME</th><th>Shoulder and neck treatment Mean ±SD</th><th>Shoulder treatment only Mean ±SD</th><th>Mean difference (CI 95%)</th><th>P-value</th></tr>
<tr><td>Discharge NPRS score</td><td>2.3±1.8</td><td>2.2 ±1.2</td><td>-0.10 (-0,61; 0,81)</td><td>0.75</td></tr>
<tr><td>Discharge QuickDASH score</td><td>13.6±10.5</td><td>13.6 ±6.6</td><td>0.00 (-4,09; 4,09)</td><td>0.99</td></tr>
<tr><td>Raw change score NPRS</td><td>3.4 ± 2.3</td><td>3.9 ±2.1</td><td>0.50 (-1,52; 0,52)</td><td>0.42</td></tr>
<tr><td>Raw change score QuickDASH</td><td>19.4 ±17.4</td><td>24.7 ±16.6</td><td>5.30 (-13,19; 2,59)</td><td>0.20</td></tr>
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<td>Alpha level 0.05</td>
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		5-Recent onset within the last 12 months 6-Non-traumatic onset 7-Painful arc from 60° to 120° of flexion 8-Baseline pain level of 2/10 on an 11 point numeric scale *Comorbidity* Red flags	-at baseline -2 days, -at discharge	**Manual therapy** MT to the neck Grade III posterior-anterior mobilizations C5-C6 or C6-C7(at the same side of shoulder pain) 3 times weekly	TheraBand) 3 times weekly	PASS scores	28 =Acceptable 7 =Unacceptable	27 =Acceptable 3 =Unacceptable		0.44		
Aimie F. Kachingwe et al. 2008	*Comparison of Manual Therapy Techniques with Therapeutic Exercise in the Treatment of Shoulder Impingement: A Randomized Controlled Pilot Clinical Trial* *The journal of manual & manipulative therapy* *Journal article*	33 patients Between 18 and 74 years old **Primary shoulder impingement** *Inclusion criteria* 1-Superiolateral shoulder pain and two out of four specified objective signs and symptoms: -Positive (painful) Neer impingement test -Positive (painful) Hawkins-Kennedy impingement test -Painful limitation of active shoulder elevation (flexion, abduction, scaption)	*Primary outcome* 1-Maximum pain over the preceding 24-hour period: VAS 2-Pain intensity with the Neer test: VAS 3-Pain intensity with the Hawkins-Kennedy test: VAS; 4-Pain-free active flexion and scaption ROM: standard goniometer 5-Measurement of shoulder function: SPADI (modified)	**Group 1** **Exercise** n=8 At the end cold pack for 10–15 minutes 1-Exercises under the direct supervision: -posterior capsule stretching -postural correction -exercise program focusing on rotator cuff strengthening -scapular stabilization 2- Home exercise program (repetition of the same exercises done during treatment) once a day 1 time weekly	**Group 3** **MWM** N=9 Glenohumeral joint MWM technique as described by Mulligan + **Exercise** 1-Exercises under the direct supervision: -posterior capsule stretching -postural correction -exercise program focusing on rotator cuff strengthening -scapular stabilization 2-Home exercise program (repetition of the same exercises done during treatment) once a day	**OUTCOME (Post treatment)**	**Control Mean ±SD**	**Exercise Mean ±SD**	**Mobilization group (n=9)**	**MWM (n=9)**	***P value***	Alpha level 0.05
						VAS	14.4 (119.8)	20.8 (112.3)	44.2 (38.6)	55.2 (31.9)	>.05	
						Neer impingement test	46.4 (49.5)	44.0 (57.2)	57.6 (38.7)	66.5 (36.6)	>.05	
						Hawkins-Kennedy impingement test	11.2 (130.7)	39.5 (54.9)	52.1 (62.9)	60.2 (43.3)	>.05	
						Flexion	42.6 (15.8)	27.6 (41.7)	-15.9 (116.6)	46.7 (31.9)	>.05	
						Scaption	29.8 (49.0)	19.8 (70.3)	2.5 (88.8)	66.5 (28.1)	>.05	
						SPADI	34.2 (58.9)	61.6 (35. 9)	56.7 (29.8)	55.5 (20.1)	>.05	

		-Pain or limitation with the functional movement patterns of hand-behind-back or hand-behind-head *Comorbidity* systemic or neurological disorder	6 weeks Follow-up	For 6 weeks **Group 2** **Exercise** n=9 1-Exercises under the direct supervision: -posterior capsule stretching -postural correction -exercise program focusing on rotator cuff strengthening -scapular stabilization 2-Home exercise program (repetition of the same exercises done during treatment) once a day + **Manual therapy Mobilization** Glenohumeral joint mobilization techniques: anterior, posterior, and inferior glides, and long-axis distraction passive accessory motions - grade I-II mobilizations -grade III-IV accessory motions 1 time weekly For 6 weeks	**Group 4** **Control** n=7 -Patient education on postural awareness and limitation of overhead activities -Standard shoulder impingement home exercise program without any input from the physical therapist subjects in this group did not receive physical therapy intervention 1 time weekly For 6 weeks		
Thilo O.	*Physiotherapy in*	90 patients	*Primary Outcome*	*n* = 46	*n* = 44		(95% CI)

Kromer 2013	*patients with clinical signs of shoulder impingement syndrome: a randomized controlled trial* J Rehabil Med Journal article http://dx.doi.org/10.2340/16501977-1142	Between 18 and 75 years **Shoulder complaints Shoulder impingement syndrome** *Inclusion criteria* - Symptoms for at least 4 weeks -Main complaints in the glenohumeral joint region or the proximal arm -One of the following signs indicating SIS: Neer impingement sign, Hawkins-Kennedy impingement test, painful arc with active abduction or flexion, -Pain during one of the following resistance tests: external rotation, internal rotation, abduction, or flexion *Comorbidity* -Neurological involvement with sensory and muscular deficit -Inflammatory joint	1-Pain and disability: SPADI 2-Patient's Global Impression of Change (PGIC) *Secondary Outcome* 3-Individual complaints and restrictions: Generic Patient-Specific Scale (GPSS) 4.Modified version of the Fear Avoidance Beliefs Questionnaire (FABQ) 5-Pain Catastrophizing Scale (PCS) *Measure timing* - At baseline - at 5 weeks - 12 weeks 12 weeks follow-up	**Individually adapted exercises (IAEX)** 1. Dynamic exercises with rubber band repetitions progressive levels of resistance 2-Shoulder and neck stretches 3-Isometric scapular training positions. + **Individualized manual physiotherapy (IMPT)** Manual assessment of: - glenohumeral shoulder girdle joints -cervical -upper thoracic spine - Local manual pain treatment -Manual glide techniques (Kaltenborn concept of angular and/or translator restricted peripheral joints) - posterior-anterior glides or coupled movements for signs of the spine segments -stretch of shortened muscles and treatment of neural tissue 20-30 min lasting	**Individually adapted exercises (IAEX)** 1. Dynamic exercises with rubber band repetitions progressive levels of resistance 2-Shoulder and neck stretches 3-Isometric scapular training positions. 2 times a week For 5 weeks then at home 3 times a week for 7 weeks. 10 treatments over 5 weeks; Home exercises for another 7 weeks	**OUTCOME** SPADI (0–100) Pain SPADI (0–100) Function SPADI (0–100) Pain (0-10) Generic Patient-Specific Scale (0–10) Global assessment of treatment success ("much better" on PGIC)	**Difference between Groups at 5 weeks** **Mean (95% CI) *p*-value** 1.8 (–5.7 to 9.2) 0.64 –0.1 (–8.8 to 8.6) 0.99 3.6 (–3.7 to 10.9) 0.34 0.6 (–0.2 to 1.5) 0.15 0.7 (–0.3 to 1.6) 0.16 **Risk ratio(95% CI)** 1.05 (0.68–1.64)	**Difference between groups at 12 weeks (change scores 6–12 weeks)** **Mean (95% CI) *p*-value** 0.4 (–5.1 to 6.0) 0.88 2.4 (–4.3 to 9.1) 0.48 –1.5 (–6.5 to 3.5) 0.54 –0–4 (–1.1 to 0.2) 0.20 –0.8 (–1.6 to 0.0) 0.05 **Risk ratio(95% CI)** 0.96 (0.66–1.39)	*p*≤ 0.05. Alpha level 0.05

		disease (e.g. rheumatoid arthritis) -Diabetes mellitus		+ **Advices** -Understanding about the pathology -Instructions for the most provocative ADLs 2 times a week For 5 weeks then at home 3 times a week For 7 weeks 10 treatments over 5 weeks than Home exercises for another 7 weeks			
Thilo O. Kromer 2014	*Effectiveness of physiotherapy and costs in pa tients with clinical signs of shoulder impingement syndrome: one-year follow-up of a randomized controlled trial* Journal of Rehabilitation Medicine Journal article http://dx.doi.org	90 patients Between 18 and 75 years **Shoulder complaints** **Shoulder impingement syndrome** *Inclusion criteria* - Symptoms for at least 4 weeks -Main complaints in the glenohumeral joint region or the proximal arm -One of the following	*Primary Outcome* 1-Pain and disability SPADI 2-Patient's Global Impression of Change (PGIC) *Secondary Outcome* 3-Individual complaints and restrictions: Generic Patient-Specific Scale (GPSS)	*n* = 46 **Individually adapted exercises (IAEX)** + **Individualized manual physiotherapy (IMPT)** Manual assessment of: - glenohumeral shoulder girdle joints -cervical -upper thoracic spine - Local manual pain treatment	*n* = 44 **Individually adapted exercises (IAEX)** 1. Dynamic exercises with rubber band repetitions progressive levels of resistance 2-Shoulder and neck stretches 3-Isometric scapular training positions. 2 times a week For 5 weeks then 3 times a week	**Outcome (1 year follow up)** / **Difference between groups Mean (95% CI)** / **P Value** SPADI (0–100) / 1.8 (–5.7 to 9.2) / 0.64 SPADI adjusted / 3.6 (–2.8 to 10.0) / 0.27 Pain SPADI (0–100) / –0.1 (–8.8 to 8.6) / 0.99 Function SPADI (0–100) / 3.6 (–3.7 to 10.9) / 0.34 Pain (VAS 0–10) / 0.6 (–0.2 to 1.5) / 0.15 Generic Patient-Specific Scale (0–10) / 0.7 (–0.3 to 1.6) / 0.16 **At 5 week s** / **Risk ratio (95% CI)** Global assessment / 1.05 (0.68–1.64)	Alpha level 0.05,

	/10.2340/16501977-1867	signs indicating SIS: Neer impingement sign, Hawkins-Kennedy impingement test, painful arc with active abduction or flexion, -Pain during one of the following resistance tests: external rotation, internal rotation, abduction, or flexion *Comorbidity* -Neurological involvement with sensory and muscular deficit -Inflammatory joint disease (e.g. rheumatoid arthritis) -Diabetes mellitus	4-Modified version of the Fear Avoidance Beliefs Questionnaire (FABQ) 5-Pain Catastrophizing Scale (PCS) *Measure timing* - at baseline -at 5 weeks -at 12 weeks 52 weeks follow-up	-Manual glide techniques (Kaltenborn concept of angular and/or translator restricted peripheral joints) - posterior-anterior glides or coupled movements for signs of the spine segments -stretch of shortened muscles and treatment of neural tissue 20-30 min lasting + **Advices** -Understanding about the pathology -Instructions for the most provocative ADLs 2 times a week For 5 weeks then 3 times a week For 7 weeks 10 treatments over 5 weeks than Home exercises for another 7 weeks	for 7 weeks. 10 treatments over 5 weeks; Home exercises for another 7 weeks	of treatment success ("much better" on PGIC)	
Paul E. Mintken 2016	*Cervicothoracic Manual Therapy Plus Exercise*	140 patients between 18 and 65 years	*Primary outcomes* 1-Pain and	n=70 **Exercises**	n=70 **Exercise**	**OUTCOME** / **Between-Group Mean Difference (CI 95%)** / ***P* Value** / **Effect Size, Cohen *d***	Alpha level 0.05

	Therapy Versus Exercise Therapy Alone in the Management of Individuals With Shoulder Pain: A Multicenter Randomized Controlled Trial Journal of Orthopaedic& Sports Physical Therapy Journal article http://dx.doi.org/10.2519/jospt.2016.6319	**Primary complaints of shoulder** *Inclusion criteria* Primary report of shoulder pain (defined as pain between the neck and the elbow at rest or during movement of the arm) + Baseline Shoulder Pain and Disability Index (SPADI) score of 20% or greater *Comorbidity* -Serious pathology (cancer, fracture, metabolic diseases, rheumatoid arthritis, osteoporosis, history of prolonged steroid use) - Diagnosis of cervical spinal stenosis - Evidence of central nervous system (CNS) involvement	shoulder disability: SPADI 2-Pain intensity: NPRS scale *Secondary outcomes* 3-Upper extremity disability: quick DASH 4-15-point global rating of change (GROC) scale 5-Patient Acceptable Symptom State (PASS) *Measure timing* -At baseline -Follow-up: at 1 at 4 weeks at 6 months At each follow-up, individuals completed the SPADI, QuickDASH, NPRS, PASS, and GROC	Visit 1-2: Cervicothoracic ROM exercises: -general cervical ROM exercise -general thoracic-mobility exercise 10 repetitions, 3 to 4 times per day Visits 3-8: -Stretching exercise -Strengthening exercise -Muscle re-education for the scapular stabilizers and rotator cuff -Flexibility exercises -Posture exercises 2 times weekly For 4 weeks For a total of 8 sessions + **Manual therapy** High-dose cervicothoracic manual therapy Including - 5 thoracic spine high-velocity, low-amplitude techniques targeting the upper, middle, and lower thoracic spine	Visit 1-2: Cervicothoracic ROM exercises: 1.general cervical ROM exercise 2.general thoracic-mobility exercise 10 repetitions, 3 to 4 times per day Visits 3-8: -Stretching exercise -Strengthening exercise -Muscle re-education for the scapular stabilizers and rotator cuff -Flexibility exercises -Posture exercises 2 times weekly For 4 weeks For a total of 8 sessions	SPADI Change from baseline to 1 wk SPADI Change from baseline to 4 wk SPADI Change from baseline to 6 mo SPADI Collapsed across time, baseline to 6 mo PAIN Change from baseline to 1 wk PAIN Change from baseline to 4 wk PAIN Change from baseline to 6 mo PAIN Collapsed across time, baseline to 6 mo QuickDASH Change from baseline to 1 wk QuickDASH Change from baseline to 4 wk QuickDASH Change from baseline to 6 months	1.1 (–4.7, 6.7) 2.9 (–5.6, 5.5) 1.0 (–6.6, 2.8) –2.6 (–5.6, 0.5) 0.1 (–0.8, 0.7) 0.2 (–0.9, 0.6) –0.04 (–0.9, 0.4) -0.2 (–0.5, 0.1) –0.7 (–4.2, 6.2) –0.2 (–3.4, 6.8) 1.0 (–3.3, 5.7)	>.05 >.05 >.05 0.10 >.05 >.05 >.05 .22 >.05 >.05 >.05	0.28 0.20	

				-1 low-velocity technique at the lower cervical spine Each individuals received each high-velocity technique up to 2 times, unless a cavitation was noted For up to 10 high-velocity interventions per treatment session 2 times weekly For 4 weeks For a total of 8 sessions		QuickDASH Collapsed across time, baseline to 6 months −1.1 (−3.5, 1.4) >.05 GROC 1wk 0.51 GROC 4wk 0.03 GROC 6wk 0.04 PASS 1wk 0.06 PASS 4 wk 0.009 PASS 6wk 0.18	
Kiran H. Satpute et all. 2015	*Efficacy of Hand Behind Back Mobilization with Movement for Acute Shoulder Pain and Movement Impairment: a Randomized Controlled Trial* Journal of Manipulative and Physiological Therapeutics Journal Article http://dx.doi.org/10.1016/j.jmpt.2015.04.003	44 patients Between 18 and 65 years **Shoulder pain and movement impairment** *Inclusion criteria* Subjects had to -be able to reach the dorsum of their hand on the affected side to the buttock (but not above the iliac crest) - be able to lie on the affected side for internal rotation measurement	*Primary outcome* 1-Range of a pain-free functional measure of HBB: tape measure *Secondary Outcomes* 2-Pain-free passive glenohumeral internal rotation ROM: universal goniometer 3-Pain severity during maximal HBB movement: VAS 3-Pain and	**Exercise** -Exercises -Hot pack during -Home exercise program Twice on non-treatment days during the 3-week intervention period + **MWM** -Hand-behind-back MWM 3 sets of 10 repetitions with a rest interval of 60 seconds between each set 3 sessions per week	**Exercise** Exercises -Hot pack during -Home exercise program -Strengthening exercises with resistant bands -Isometric strengthening protocol: shoulder flexion, scapular retraction, shoulder internal and external rotation with the arm by the side, and scapular protraction -Stretching exercises (sleeper's position and HBB) 3 sessions per week For 3 weeks	**OUTCOME (over 3 wks)** / **Mean Difference Scores (95% CI)** / **Cohen d (95% CI)** / **P value** VAS with maximal HBB −1.77 (−2.17 to −1.36) 2.73 (2.54-2.92) P<.05/04 IR ROM° 7.75 (5.71-9.80) 2.44 (1.46-3.36) P<.05/04 HBB ROM° 9.31 (7.38-11.27) 2.97 (2.04-3.90) P<.05/04 SPADI score −22.17 (−25.64 to −18.70) 3.98 (5.62-2.34) P<.05/04	95% confidence interval (CI).

<table>
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<td></td>
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<td>-internal rotation measurement not more than 25°
- have at least 90° shoulder abduction

Comorbidity

- History of cardiac surgery
-Cervical spine surgery within the last 6 months
-Cervical radiculopathy
-History of myocardial infarction</td>
<td>disability score: SPADI

Measure timing

-before
-after 9 treatment over 3 weeks

3 weeks Follow-up</td>
<td>For 3 weeks</td>
<td></td>
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<tr>
<td>Gamze Senbursa et all. 2007</td>
<td>Comparison of conservative treatment with and without manual physical therapy for patients with shoulder impingement syndrome: a prospective, randomized clinical trial

Knee Surgery, Sports Traumatology, Arthroscopy

Journal Article</td>
<td>30 patients
30 and 55 years of age

Shoulder mobility, tenderness and impingement

Inclusion criteria

-Neer test +
-Shoulder pain with no major shoulder trauma
-No physiotherapy treatment in the last 2 years
-Marked loss of active and passive shoulder motion</td>
<td>Primary outcome

1-Pain level: VAS
-night pain
-at rest
-in motion

2-ROM: goniometer

3-Pain threshold: algometry

4-Function: functional assessment questionnaire.

5-Manual muscle testing for</td>
<td>n=15

Self-Exercise

Strengthening the depressors of the humeral head

-active ROM exercise
-stretching exercise
-strengthening exercise for rotator cuff muscles, rhomboids, levator scapulae and serratus anterior with an elastic band

at home 10–15 min

7 times a week</td>
<td>n=15

Manual therapy

-joint and soft tissue mobilization techniques
-ice application
-stretching and strengthening exercise
-patient education

The manual therapy included -deep friction massage
on supraspinatus muscle tendon
-radial nerve stretching
-scapular mobilization
-glenohumeral joint mobilization</td>
<td>The ROM and outcome data is presented graphically, and extraction of actual values was impossible. The Pain threshold and function outcome data are not reported.
<table>
<tr><th>Outcome At 3 months</th><th>CONTROL Mean ±SD</th><th>INTERVENTION (MT Group) Mean ±SD</th><th>EFFECT ESTIMATE Mean difference (95% CI)</th><th>P value</th></tr>
<tr><td>Night Pain</td><td>1.2 ±1.6</td><td>2.2 ±2.4</td><td>1.00 (-2.52; 0.52)</td><td>>.05</td></tr>
<tr><td>Pain at Rest</td><td>0.9 ±0.2</td><td>0.7 ± 1.4</td><td>-0.20 (-0.54; 0.94)</td><td>>.05</td></tr>
<tr><td>Pain with motion</td><td>2.5 ±1.5</td><td>3.1 ± 2.0</td><td>0.60 (-1.92, 0.72)</td><td>>.05</td></tr>
</table>
</td>
<td>P-value<0.05</td>
</tr>
</table>

	http://dx.doi.org/10.1007/s00167-007-0288-x	-Painful range of motion -Magnetic resonance imaging as a reference standard *Comorbidities* -Degenerative arthritis of the glenohumeral joint -Elbow, hand, wrist and cervical spine disorders.	flexion, abduction, internal and external rotation strength 6-Supraspinatus muscle trigger point tenderness: algometry *Measure timing* -At baseline -4 weeks after start of treatment -3 months after the initiation of treatment 3 months Follow-up	For 4 weeks In addition the patients were advised to avoid overhead sports and overhead work.	-proprioceptive neuromuscular facilitation techniques + **Self-Exercise** For self-training at home, an elastic band was used In addition the patients were advised to avoid overhead sports and overhead work. 3 times per week For 4 weeks		
Gamze Senbursa et all. 2011	*The effectiveness of manual therapy in supraspinatus tendinopathy* Acta Orthopaedica et Traumatologica Turcica Journal Article https://doi.org/10.3944/AOTT.2011.2385	77 patients 33 to 55 years **Shoulder impingement syndrome** *Inclusion criteria* - Neer and Hawkins tests + -Stage 1 rotator cuff tear (diagnosed by clinical examination and MRI)	1-Night pain: VAS 2-Rest pain: VAS 3-Pain with movement: VAS 4-ROM: goniometer 5-Shoulder muscle strengths Flexion, abduction, internal and external rotation: Dr. Lovett's manual	**Group 1** **Manual treatment group** n=30 **Exercise** -ROM -stretching -strengthening exercises for the rhomboid, elevator scapulae, serratus anterior and rotator cuff muscles **+** **Manual therapy**	**Group 2** **Home-based exercise** n=22 ROM -stretching -strengthening exercises for the rhomboid, elevator scapulae, serratus anterior and rotator cuff muscles Self-exercise program at home. 3 times a week For 12 weeks	The relevant outcome data (apart from P values) is presented graphically, and extraction of actual values was impossible. There was no significant difference between the pain levels, rest pain, night pain, shoulder ROM, muscle strengths of the groups at 4 and 12 weeks follow-up (p>0.05). The groups showed a significant difference in their MASES score at 4 weeks, while there was no difference at the 12 week follow-up (p>0.05)	P values<0.05

			muscle test 6-Functionality: Modified American Shoulder and Elbow Surgeon's (MASES) questionnaire *Measure timing* -before the treatment -at 4 weeks -at 12weeks 12 weeks Follow-up	-Deep friction massage on the supraspinatus muscle -Radial nerve stretching -Scapular mobilization -Glenohumeral joint mobilization -Proprioceptive neuromuscular facilitation techniques Sporting activities not allowed for 12 weeks 3 times a week For 12 weeks	Sporting activities not allowed for 12 weeks **Group 3** **Supervised Exercise** n=25 -ROM -stretching -strengthening exercises for the rhomboid, elevator scapulae, serratus anterior and rotator cuff muscles In all groups, Sporting activities not allowed for 12 weeks. Daily with 3 sets of 10 repetitions Glenohumeral and scapulothoracic exercises under supervision of a physiotherapist 3 times a week For 12 weeks		
Ross Yiasemides et all.	*Does Passive Mobilization of Shoulder region*	98 patients >18 years old	*Primary outcomes* 1-Shoulder	**Manual therapy** -Joint Mobilization:	**Exercise** -Stretching exercises	**Outcome** / **1 Month Between** / **3 Months Between** / **6 Months Between** / **P value**	Alpha level 0.05 95% confidence

2011	*Joints Provide Additional Benefit Over Advice and Exercise Alone for People Who Have Shoulder Pain and Minimal Movement Restriction? A Randomized Controlled Trial* Physical Therapy Journal Article http://dx.doi.org/10.2522/ptj.20100111	**Shoulder pain of local mechanical origin and minimal shoulder movement restriction** *Inclusion criteria* 1-Painful active flexion or abduction of more than 1 month's duration and minimal shoulder movement restriction 2-Pain, tenderness, or restriction during passive accessory movements at the -glenohumeral -acromioclavicular -sternoclavicular joint OR during passive scapular movements *Comorbidity* Inflammatory or neoplastic disorder	pain and disability: SPADI 2-Self-rated improvement: 6-point Likert scale *Secondary Outcomes* 3-Painful AROM (flexion, abduction): photographic method *Measure Timing* -at baseline -at 1 month -at 3 months -at 6 months after entry into the trial 6 months Follow-up	Low-velocity passive joint mobilizations on the shoulder region joints -Passive mobilization of the scapula 1 or 2 session/week for first month Followed additional treatment over the next 4 weeks to maximum 12 sessions if necessary over maximum 8 weeks + **Exercise** **+** **Advice** How to avoid or minimize painful shoulder movements during activities of daily living	-Strengthening exercises for weakened muscles -Improving muscle coordination -Restoring normal scapulo-humeral rhythm -Muscles within one force couple -All shoulder muscle force couples Daily home-based program Reviewed by the therapist 1 or 2 times per week. + **Advice** How to avoid or minimize painful shoulder movements during activities of daily living		**Groups Difference (95% CI); Effect size**	**Groups Difference, (95% CI); Effect Size**	**Groups Difference, (95% CI); Effect Size**		interval
						Total SPADI score (%)	1 (-7 to 9) -0.05	-5 (-12 to 3) 0.25	0 (-7 to 7) 0.02	>.05	
						SPADI pain score (%)	3 (-6 to 11) -0.13	-2 (-10 to 7) 0.07	-1 (-8 to 7) 0.02	>.05	
						SPADI disability score (%)	-3 (-11 to 6) 0.13	-6 (-14 to 2) 0.32	(-7 to 7) 0.02	>.05	
						Flexion painful arc (°)	5 (-3 to 14) -0.25	-1 (-7 to 5) 0.08	-1 (-4 to 2) 0.12	>.05	
						Abduction painful arc (°)	8 (-2 to 18) -0.32	1 (-7 to 9) -0.06	-1 (-7 to 4) 0.10	>.05	
						Self-rated change in symptoms	-0.2 (-0.6 to 0.1) 0.28	0.2 (-0.3 to 0.6) -0.15	0.1 (-0.2 to 0.5) -0.12	>.05	

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