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Systematic review

Exercise for rotator cuff tendinopathy: a systematic review

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Abstract

Background Shoulder pain due to rotator cuff tendinopathy is a common problem. Exercise is one intervention used to address this problem but conclusions from previous reviews have been mixed.
Objective To systematically review the effectiveness of exercise, incorporating loaded exercise (against gravity or resistance), for rotator cuff tendinopathy.
Data sources An electronic search of AMED, CiNAHL, Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, PEDro and SPORTDiscus was undertaken from their inception to November 2010 and supplemented by hand searching related articles and contact with topic experts.
Study eligibility criteria Randomised controlled trials evaluating the effectiveness of exercise, incorporating loaded exercise, in participants with rotator cuff tendinopathy.
Study appraisal and synthesis methods Included studies were appraised for risk of bias using the tool developed by the Cochrane Back review Group. Due to heterogeneity of studies, a narrative synthesis was undertaken based upon levels of evidence.
Results Five articles detailing four studies were included, all of which were regarded as presenting a low risk of bias. Overall, the literature was supportive of the use of exercise in terms of pain and functional disability.
Limitations The results should be regarded with some degree of caution due to limitations associated with the studies including lack of blinding, no intervention control groups and limitations of the outcome measures used.
Conclusion and implications of key findings The available literature is supportive of the use of exercise but due to the paucity of research and associated limitations further study is indicated.

Keywords: Rotator cuff; Tendinopathy; Exercise; Systematic review

Introduction

Shoulder pain is a common problem with up to half of the population experiencing at least one episode per year [1]. The morbidity associated with shoulder pain is commonly encountered in primary care and physiotherapy [2] where pathology of the rotator cuff is thought to be the commonest cause [3]. The natural history of these disorders is not always favourable and the long-term outcome is frequently poor [4].

Systematic reviews have been undertaken which assess the effect of various interventions, including exercise, for problems relating to the rotator cuff [5–12] but results have been mixed. One reason for this conflict might be the failure to define adequately the conditions being treated [13]. Studies refer to 'subacromial impingement' which, although a common diagnosis in clinical practice, is nothing more than an umbrella term used to describe a variety of conditions which present with varied signs and symptoms [14]. It is perhaps unsurprising that conflict arises when the effects of poorly defined interventions are evaluated in studies where the condition under treatment is also poorly defined.

As with low back pain, diagnostic sub-groups have been identified in the shoulder which when targeted with appropriate intervention might demonstrate superior outcomes [15].

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One such diagnostic sub-group is rotator cuff tendinopathy, which would be termed contractile dysfunction in one classification system and has been recognised as a useful classification upon which to base treatment [4]. The signs and symptoms associated with rotator cuff tendinopathy have been reported to include symptom duration greater than three months, minimal resting pain, largely preserved range of shoulder motion and pain exacerbated through resisted testing [4]. This is in stark contrast to other presentations of 'subacromial impingement' which might include constant pain and marked limitation of motion [14]. With such varied clinical presentations, it seems sensible to suggest that the underlying pathology might also vary.

The pathology of rotator cuff tendinopathy has been shown to demonstrate similar pathological changes to tendon disorders in other areas of the body, e.g. the elbow, where loaded (against gravity or resistance) exercise has shown beneficial results [16]. Hence, it seems plausible that loaded exercise may also have a role to play in the management of these disorders.

No previous reviews have been identified that define this diagnostic sub-group as a focus for evaluation and considering that previous reviews have been guarded regarding the effectiveness of exercise in the treatment of 'subacromial impingement' there is justification to undertake a review with the aim of assessing the effectiveness of exercise in the management of rotator cuff tendinopathy.

Methods

This systematic review was carried out using a predetermined protocol in accordance with the PRISMA statement [17].

Data sources and search strategy

An electronic search of AMED, CiNAHL, Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, PEDro and SPORTDiscus was undertaken from their inception to November 2010. The Cochrane highly sensitive search for identify randomised trials was adopted [18]. The search terms used for the MEDLINE search are displayed in Table 1.

The electronic search was complemented by hand searching the reference lists of the articles found and previous systematic reviews. Where pilot studies were identified the authors of these studies were contacted to determine whether further subsequent published or unpublished research had been undertaken. In addition to this a recognised expert in this field was consulted in an attempt to identify any further published or unpublished studies [19]. This process was undertaken by CL and BS.

Study selection

Studies had to meet the following criteria to be included:

Participants

Studies of adult patients presenting with signs and symptoms suggestive of rotator cuff tendinopathy, defined as:

1. Symptom duration greater than three months.
2. Minimal resting pain.
3. Largely preserved range of shoulder motion.
4. Pain exacerbated consistently through resisted testing, usually abduction and/or lateral rotation.
5. No cervical spine involvement [4].

For inclusion, criteria 3 and 5 had to be met along with at least one from criteria 1, 2 and 4. Studies which included participants with painful/stiff shoulder associated with other diagnoses, e.g. frozen shoulder, were excluded.

Interventions

Any exercise intervention which included loaded (against gravity or resistance) exercise as a component. Initial scoping searches highlighted that it would be unlikely that studies evaluating the effect of loaded exercise alone would be identified. Combined interventions, e.g. exercise and electrotherapy or exercise and manual therapy, which do not enable a judgement about the comparative efficacy of exercise were excluded.

Table 1
MEDLINE search strategy.

	Search term	Limited to
1	Shoulder pain or shoulder impingement$ or shoulder tend$ or shoulder burs$ or rotator cuff$ or subacromial impingement$ or subacromial burs$ or supraspinatus$ or impingement$ or contractile dysfunction or painful arc$	Title & abstract
2	Rotator cuff/shoulder pain/shoulder impingement syndrome	MeSH
3	1 or 2	
4	Exercis$ or eccentric$ or concentric$ or loaded$ or resistance$ or muscle$ or physiotherap$ or physical therap$ or rehabil$ or conservative management	Title & abstract
5	Exercise/resistance training/physical therapy modalities/physical therapy speciality/rehabilitation/muscle strength/exercise therapy	MeSH
6	4 or 5	
7	Randomized controlled$ or randomised controlled$ or controlled clinical trial or randomized or placebo or randomly or trial or groups	
8	Animals NOT humans	
9	3 and 6 and 7 not 8	

Outcomes

Any clinical outcome including, but not restricted to, measures of pain and disability.

Study design

Randomised controlled trials (RCTs). Quasi-experimental and case studies/series were excluded due to the risk of bias associated with these designs [20].

Language

No restriction.

Following the search, screening of titles and abstracts was undertaken independently by two reviewers (BS/CL) who subsequently agreed upon the articles that should be retrieved for full-text review. In the event of disagreement, a third reviewer (SM) was available to arbitrate but this was not needed.

Following a pilot phase, two reviewers (CL/KCL) assessed the full-text articles that had been retrieved. One reviewer (KCL) translated three German language papers that were retrieved. At this stage, percentage agreement for inclusion was 87% with Kappa (K) = 0.67 which is regarded as a good level of agreement between the reviewers [21]. The reviewers agreed that one study [22] required further clarification regarding the intervention before a decision could be made. The author of this study was contacted and subsequently the study was excluded as the interventions did not meet the inclusion criteria. Disagreements were resolved through discussion without the need for further arbitration.

Data extraction

Two independent reviewers (JA/BS) used a standardised form to extract data regarding study characteristics, participant characteristics, interventions, settings and outcome data/results [23]. The data extraction process was initially piloted by the two reviewers before the process proper was undertaken. Upon completion the reviewers met to agree upon the data to be extracted. A third reviewer (CL) was available in the event of disagreement but this was not needed.

Risk of bias assessment

The risk of bias of the included studies was undertaken independently by two reviewers (CL/SM) using the Cochrane Back Review Group (CBRG) risk of bias tool [19]. It has been recognised that this tool is also useful for the assessment of trials in other conditions [24]. The completed risk of bias tool is displayed in Table 2 and the guidelines upon which judgments were made are displayed in Table S1 [19]. Each item was rated as yes (=1), no (=0), unclear (=0). In all cases study authors were contacted for clarification of methodological issues where information offered in the article was unclear. The level of agreement between reviewers was 90% and K = 0.74 which is regarded as a good level of agreement [21]. Disagreements relating to interpretation of

Table 2
Completed risk of bias tool.

✓ = yes – = no ? = unclear	Was the method of randomisation adequate?	Was the treatment allocation concealed?	Was the patient blinded to the intervention?	Was the care giver blinded to the intervention?	Was the outcome assessor blinded to the intervention?	Was the drop-out rate described and acceptable?	Were all randomised participants analysed in the group to which they were allocated?	Free of selective reporting?	Similarity of baseline characteristics?	Co-interventions avoided or similar?	Compliance acceptable?	Timing of outcome assessments similar?	Total
Brox 1993 [25]	✓	✓	–	–	✓	✓	✓	✓	✓	–	✓	✓	9
Brox 1999 [26]					–								8
Lombardi 2008 [28]	✓	✓	–	–	✓	✓	✓	✓	✓	✓	✓	✓	10
Ludewig 2003 [27]	✓	✓	–	–	–	✓	✓	✓	✓	✓	?	✓	8
Walther 2004 [29]	✓	✓	✓	–	✓	✓	✓	✓	✓	✓	✓	✓	11

the criteria were resolved through discussion except where 2 of the studies [25,27] presented with differences in baseline characteristics (criteria 9). Both studies had undertaken statistical adjustment for these baseline differences and as the adjusted analysis was similar to the unadjusted analysis and the outcomes were consistent these studies were rated favourably with regards to this criterion. A third reviewer (KCL) was available to arbitrate at this stage but was not needed.

A study with a low risk of bias was defined as one fulfilling six or more of the criteria items and with no fatal flaw which is defined as:

1. Drop-out > 50%.
2. Statistically and clinically significant differences between groups at baseline indicating unsuccessful randomisation.

This approach has previously been validated [24].

Data synthesis

Due to the low number of studies retrieved and heterogeneity with regards to the exercise interventions offered a qualitative synthesis using a rating system for levels of evidence from the CBRG was used [30]. This rating system, displayed in Table S2, is used to summarise the results in which the quality and outcomes of individual studies are taken into account [30].

Results

Study selection

Fig. 1 depicts the study selection process. The electronic search yielded a total of 2224 records which reduced to 1800 when the duplicates were removed. One additional source was retrieved through hand searching [31]. Two pilot studies were identified in this initial search [13,32] and in the first instance [13] no further study had been conducted and in the second [32] a potentially relevant study was underway but further data was not available. No further studies were identified through expert consultation.

The title and abstracts of 1801 articles were screened with 30 potentially relevant studies identified for full-text review. Of these 30, three were published in German and 27 in English. No unpublished studies were retrieved. Finally, 5 articles describing 4 studies were selected [25–29]. A list of the excluded studies is available from the corresponding author.

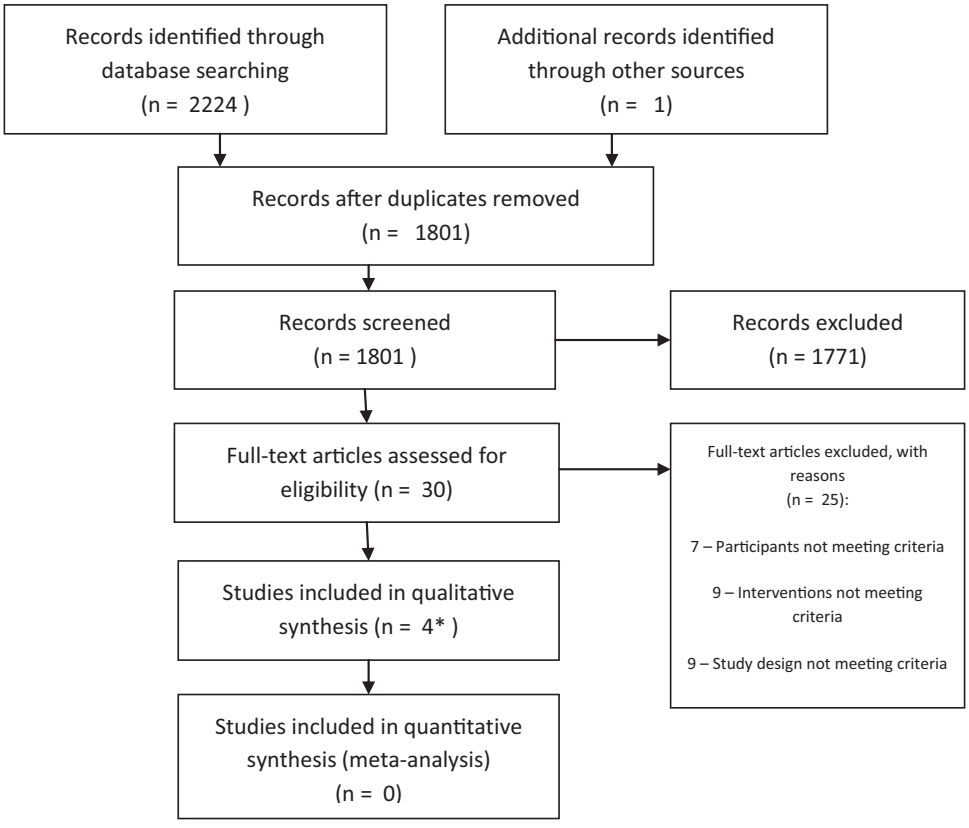

Fig. 1. Study selection process (* the findings of 2 full-text articles [Brox J, Staff P, Ljunggren A, Brevik J. Arthroscopic surgery compared with supervised exercises in patients with rotator cuff disease (stage II impingement syndrome). British Medical Journal 1993;307:899–903; Brox.J., Gjengedal.E., Uppheim.G., Bohmer.A., Brevik.J., Ljunggren.A. et al. Arthroscopic surgery versus supervised exercises in patients with rotator cuff disease (stage II impingement syndrome): A prospective randomized, controlled study in 125 patients with a 2 1/2 year follow-up. Journal of Shoulder & Elbow Surgery 1999; 8(2):102-111 were combined and treated as one study because the second article reported the long-term follow-up only).

Table 3
Characteristics of included studies.

Study characteristics	Participant characteristics	Interventions & settings	Outcome data/results
Brox 1993 [25] Brox 1999 [26] RCT with concealed allocation. Outcome assessor blinding at short term follow-up. 3 groups: 1. Arthroscopic subacromial decompression followed by supervised exercise. 2. Supervised exercise. 3. Detuned laser (placebo).	125 patients referred from general practitioners in Norway (mean age = 47.6 years/47% female). Diagnosis established through: a. Shoulder pain > 3 months, b. Painful arc on abduction, c. Pain with resisted shoulder movements, d. Maintained glenohumeral ROM. e. Positive impingement tests.	Hospital setting. 1. $N = 45$. Arthroscopic surgery including bursectomy and resection of the anterior and lateral part of the acromion and corocoacromial ligament followed by supervised physiotherapy. 2. $N = 50$. Supervised exercise undertaken for 1 hour × 2/week plus home exercises involving gradual addition of resistance. 3. $N = 30$. 12 sessions of detuned laser within 6 weeks.	Main outcomes assessed using: 1. Neer shoulder score at 3, 6 months and 2 (1/2) years. Groups 1 and 2 demonstrated statistically significantly improvements with regard to Group 3 but no statistically significant differences between groups 1 and 2 at any point except 2 (1/2) years with statistically significant change in favour of exercise group being able to take something down from a wall cupboard ($p < 0.01$). Neer score has not been formally validated and minimal clinical important difference (MCID) not reported Wright 2010 [34].
Lombardi 2008 [28] RCT with concealed allocation. Outcome assessor blinding. 2 groups: 1. Supervised exercise. 2. Waiting list control.	60 participants selected from clinics in Sao Paulo, Brazil (mean age = 55.6 years/77% female). Diagnosis established through: a. Painful arc, b. Positive impingement tests.	Home or physiotherapy department. 1. $N = 30$. Progressive resistance training × 2/week over 8 weeks with level of resistance determined by 6 repetition maximum. 2. $N = 30$. Waiting list (physiotherapy) control. Both groups were also offered the same advice regarding use of analgesics/NSAID's.	Main outcomes assessed using: 1. Visual analogue scale. 2. Disabilities of the arm and shoulder questionnaire (DASH). Statistically significant ($p < 0.05$) improvement across all outcomes in favour of intervention group at 2 month follow-up. A mean change in VAS of 1.8 and DASH of 11.8 is regarded as clinically significant Wright 2010 [34] Roy 2009 [35] Tashjian 2009 [36].
Ludewig 2003 [27] RCT with concealed allocation. No blinding. 3 groups: 1. Symptomatic subjects with impingement syndrome (intervention group). 2. Symptomatic control (no treatment). 3. Asymptomatic control (no treatment).	92 construction journeymen volunteers in the USA (mean age = 48.8 years/100% male). Diagnosis established through clinical examination including presence of: a. Minimum of 130° abduction b. Painful arc on abduction, c. Local tenderness to palpation, d. Pain with resisted shoulder movements. e. Positive impingement tests.	Home based setting. 1. $N = 34$. Home exercise programme, with up to 3 contacts with a physiotherapist permitted, including stretching and strengthening exercises × 3/week. 3 sets of 10 repetitions 1st week. 15 repetitions 2nd week. 20 repetitions 3rd week with increasing resistance using Theraband subsequently over an 8 week period. 2. $N = 33$. Symptomatic control. 3. $N = 25$. Asymptomatic control.	Main outcomes assessed using: 1. Shoulder rating questionnaire (SRQ). *ITT analysis*: Statistically significant ($p < 0.01$) improvements in favour of the intervention group at 8 to 12 weeks. A mean change in SRQ of 9.9 might not be regarded as clinically significant [37].
Walther 2004 [29] RCT with concealed allocation. Participant and outcome assessor blinding. 3 groups: 1. Self-training. 2. Multimodal physiotherapy. 3. Functional shoulder brace.	60 consecutive patients in Dusseldorf, Germany (mean age = 50.7 years/43% female) with painful disabling impingement of the shoulder. Diagnosis established through clinical examination including presence of: a. Positive impingement test, and radiographs and ultrasound.	Home or physiotherapy department. 1. Self-training (using Theraband) including 7 strengthening exercises and 1 cervical stretch at least × 5/week for 10 to 15 minutes with guidance from a physiotherapist for a maximum of 4 sessions. 2. Conventional physiotherapy for up to 10 sessions × 2 to 3/week. 3. Functional shoulder brace worn during the day and night if possible. 12 weeks in total.	Main outcomes assessed using: 1. Constant–Murley score. 2. Visual analogue scale. All groups demonstrated statistically significant ($p < 0.05$) within group changes at follow-up but no statistically significant difference between groups at baseline and 6 and 12 weeks follow-up ($p < 0.05$). A mean change at 12 weeks in VAS of 2.0, 2.0, 2.0 for Groups 1, 2 and 3 for pain at night and change in VAS of 4.5, 2.8, 3.5 for Groups 1, 2 and 3 for pain under load is regarded as clinically significant but change in VAS of 1.1, 0.7, 1.3 for pain at rest is not Tashjian 2009 [36]. MCID for the Constant–Murley score has not been reported Roy 2010 [38] Stiller 2005 [39]

Risk of bias assessment

The results of the risk of bias assessment are shown in Table 2. All studies were regarded as presenting a low risk of bias in accordance with the CBRG guidance [24] and other previously published systematic reviews [33]. It is interesting to note that the rating of all studies improved when clarification was received from the authors of the studies.

Study characteristics

A summary of the characteristics of the included studies along with the main results is shown in Table 3. All of the studies included symptomatic participants but three of the studies [25,26,28,29] included participants accessing health care and one study [27] included participants not currently accessing health care for their shoulder problem.

Interventions

The studies compared supervised exercise, with a resisted component, to no intervention [28], placebo [25,26], and surgery [25,26] or home exercise, with a resisted component, to no intervention [27], functional brace [29] and multimodal physiotherapy [29]. For the purpose of this review home exercise was defined as exercise undertaken without regular contact with a health care professional (HCP). Supervised exercise was defined as exercise undertaken with regular contact, e.g. 1/week, 2/week over the duration of the intervention, with the HCP. The content of the exercise programmes was heterogeneous across the studies but generally consisted of stretching and progressive resistance exercises using Theraband or other external exercise equipment. Again for the purpose of this review, multimodal physiotherapy was defined as largely therapist-led intervention which might incorporate a range of treatment options, e.g. exercise, manual therapy, and electrotherapy.

- Supervised exercise vs no intervention

There is moderate evidence from one RCT ($n = 60$) [28] with a low risk of bias to support effectiveness of exercise in terms of pain and function in the short term.

- Supervised exercise vs placebo

There is moderate evidence from one RCT ($n = 125$) [25,26] with a low risk of bias to support effectiveness of exercise in terms of pain and function in the short, intermediate and long term but the clinical significance of this result is not clear because the outcome measure utilised has not been formally validated and a minimally clinically importance difference (MCID) has not been established.

- Supervised exercise vs surgery

There is moderate evidence from one RCT [25,26] with a low risk of bias suggesting no difference between the interventions in terms of pain and function in the short, intermediate and long term but the clinical significance of this result is not clear because the outcome measure utilised has not been formally validated and a MCID has not been established.

- Home exercise programme vs no intervention

There is moderate evidence from one RCT ($n = 92$) [27] with a low risk of bias to support effectiveness of exercise in terms of shoulder pain and disability in the short term but this result might not be clinically significant.

- Home exercise programme vs functional brace

There is moderate evidence from one RCT ($n = 60$) [29] with a low risk of bias suggesting no difference between the interventions in the short term.

- Home exercise programme vs multimodal physiotherapy

There is moderate evidence from one RCT [29] with a low risk of bias suggesting no difference between the interventions in the short term.

Discussion

This systematic review summarises the results of four studies that have evaluated the effect of exercise programmes, incorporating loaded exercise, for rotator cuff tendinopathy. It is suggested that both home and supervised exercise programmes might be more effective than no intervention or placebo and as effective as minimal comparators, e.g. functional brace, or active comparators, e.g. multimodal physiotherapy, surgery.

These findings are more optimistic than some previous reviews [8,10,12,40,41] but in keeping with others [9,11]. One possible reason for the difference in outcomes of this systematic review with others could be the more specific inclusion criteria relating to study population, i.e. rotator cuff tendinopathy, rather than the more generic term ‘subacromial impingement’, the intervention, i.e. exercise incorporating a loading strategy, and study type, i.e. RCTs only to minimise the impact of bias associated with other study types.

A second possible reason for the discrepancy could relate to the systematic review methods employed. Whilst undertaking this review it became clear that the studies included in this review have been included in other reviews but different conclusions regarding the risk of bias or quality and hence the strength of evidence have been reported [8,9,11,40,41]. One reason for this discrepancy might be that all of the authors of the included studies were contacted for study clarification. A response was gained from all which, without exception, resulted in favourable modification of the risk of bias tool. This means that a full assessment of the risk of bias was undertaken rather than just an assessment of the quality of the report writing. This has implications for previous reviews that have

not carried out this process which might be misrepresentative of the strength of the available evidence.

Limitations of the included studies

Although these results are favourable there are limitations associated with the included studies that warrant consideration. One of the studies [27] utilised a non-clinical population which might limit the capacity to generalise these findings. In the context of only four included studies, this aspect needs to be carefully considered but it is reassuring that findings are consistent across studies.

Two of the studies [27,28] compared their intervention to no intervention control groups. The limitations of such a design should be recognised for not taking into account the possible effect of the working alliance between therapist and patient [42–44]. However, again, it is reassuring to note that the exercise programmes still returned better outcomes when compared to a placebo group in one study [25,26] which would tend to control for such confounding factors.

One of the studies [25,26] utilised a primary outcome measure, i.e. the Neer shoulder score, that, as far as the review authors are aware, has not been validated and another study [29] utilised a measure, i.e. the Constant–Murley score, where a MCID has not been established. These factors are important as a means of reassurance that the measure is measuring what it is expected to measure as well as enabling research consumers to interpret the outcomes of a study in relation to practice. The MCID is the smallest change in status on the outcome measure which is considered to be clinically relevant [45]. Where this has not been determined [29] any positive outcomes associated with an intervention remain uncertain. Two of the four studies measured change in pain status [28,29] by utilising accepted formats of the Visual Analogue scale which have been validated and an MCID detected [36] and two studies utilised measures of function that had been validated and an MCID detected [27,28] although only one of these studies reported a change which met the MCID [28]. Although the treatment effects of all included studies across varied outcome measures suggests a beneficial response to exercise, the limitations of utilising unvalidated outcome measures should not be underestimated.

Finally, a consistent feature across all included studies is a failure to blind care givers and a majority of the studies did not incorporate participant blinding. These short-comings are widely regarded as typical in pragmatic studies of this nature [46]. However, it is important to recognise the possible influence of care giver and patient expectations or preferences upon treatment outcome in terms of an under or over exaggeration of treatment effect [47].

Implications for practice

Despite the aforementioned limitations there appears to be a trend suggesting that exercise, incorporating a loading strategy, has a useful role to play in the management of rotator cuff tendinopathy. Clearly loaded exercise is safe and not detrimental to outcome. However, the optimal parameters of exercise and load have yet to be determined as has the mechanism by which therapeutic response occurs. The apparent anomaly to consider is the comparable effects that a functional shoulder brace has upon pain and function in this population which suggests that responses other than purely mechanical, e.g. vascular, neural or a combination of factors might be involved [48].

Furthermore, it should be recognised that home based exercise appears to confer consistent benefit and that multimodal physiotherapy did not offer any additional benefit [29].

Implications for future research

Due to the paucity of high quality research and aforementioned limitations associated with the current literature, clearly, further studies are warranted. These studies should consider the role of loaded exercise and clearly define the parameters employed to enable translation of any positive findings into practice. Furthermore, studies should include comparators consisting of credible usual care and measure outcomes using tools that have been validated and an MCID detected.

It is recognised that there might be difficulties associated with patient blinding in some studies, e.g. exercise vs surgery, but it seems possible to achieve blinding or patient 'naivety' where interventions might be regarded as similar, e.g. supervised exercise vs multimodal physiotherapy. Including this feature in future studies might help to counteract the influence of patient expectations or preference on treatment outcome. Furthermore, the differential influence of care givers when they are asked to deliver both interventions in a two arm RCT might be minimised through the design of RCTs utilising cluster randomisation by site or randomisation by therapist in accordance with any predefined preference.

Alongside such pragmatic RCTs, economic analyses could consider self-managed or home based regimes vs usual interventions.

Strengths and limitations of this review

This review was undertaken in accordance with published guidelines by a team of reviewers with more than one member involved at each stage to minimise bias. This is a clear strength of the review as is the extensive search strategy employed. However, no unpublished studies were identified for inclusion. It has been suggested that identifying unpublished studies for inclusion is important to minimise publication bias [18]. However, others have questioned this suggesting that many unpublished studies eventually become published and truly unpublished studies might have poor or unclear methodology which in turn might serve to introduce bias to the review [49]. It might be preferable to devote

time to regularly updating reviews to capture studies when they are published [49]. It is difficult to determine whether a lack of unpublished studies is a weakness of this review and whether inclusion, if available, would alter the conclusions drawn.

Conclusions

The role of exercise in the treatment of rotator cuff tendinopathy is promising but due to the paucity of high quality research and limitations relating to lack of blinding, treatment comparisons and outcome measures employed further research is warranted to fully evaluate the likely benefit.

Conflict of interest

None.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.physio.2011.08.002.

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