

**Hanratty CE, McVeigh JG, Kerr DP, and et al. The Effectiveness of Physiotherapy Exercises in Subacromial Impingement Syndrome: A Systematic Review and Meta-Analysis. Seminars in Arthritis and Rheumatism Journal 2012 Dec; 42(3):297-316.**

**Design:** Systematic Review and meta-analysis of randomized clinical trials

**Objective:** To evaluate the effectiveness of exercise in the treatment of people with subacromial impingement syndrome (SAIS).

**PICOS:**

- **Patient population:** subacromial impingement syndrome or rotator cuff disease/tendinopathy
- **Intervention:** one or more types of exercise
- **Comparison:** Various comparisons alone or with exercise such as no treatment, placebo, NSAIDS, physiotherapy, ultrasound therapy, joint mobilization, cortisone injections, shockwave therapy, acupuncture, advice only
  - o Excluded were studies that had recruited patients with rotator cuff rupture, alternative diagnoses, or postsurgical patients
  - o Excluded were studies in which exercise was a minor component of a multimodal approach
- **Outcomes:** Pain, function, strength and quality of life
  - o Short-term was defined as 6 to 12 weeks
  - o Long term was defined as > 12 weeks
- **Study types:** Randomized controlled trials only

**Study selection:**

- Databases included MEDLINE, EMBASE, CINAHL, Allied and Complementary Medicine Database, Cochrane Central Register of Controlled Trials, Pedro, ProQuest Health and SPORTDiscus, Index to Theses, and openSIGLE databases through August 2010
- All studies were screened by the main author and ambiguous studies were discussed with 2 other researchers
- Both the van Tulder Criteria and the Cochrane Risk of Bias Tool were used to assess the quality and the risk of bias for the studies.
- For inclusion in the quantitative meta-analysis:
  - o Studies were required to score greater than 6/12 on the van Tulder Scale
  - o Studies must also satisfy at least two of the following: adequate randomization, concealed treatment allocation, or blinding of assessors
- The clinical relevance of qualitative results were summarized using best-evidence synthesis criteria

- Strong evidence was consistent findings in at least 2 high-quality RCTs
- Moderate evidence was one high-quality RCT or 2 medium quality RCTs
- Limited evidence was one medium quality RCT or at least 2 low quality RCTs
- No evidence was conflicting results among RCTs or the absence of any RCT on the intervention
- Authors emphasized these 5 criteria in risk of bias which were used to judge the quality of the studies; inadequate randomization, inadequately concealed treatment allocation, non-blinding of assessors, no intention-to-treat analysis, and no measurement of compliance with the exercise intervention
  - High quality studies must include at least 4 of the above 5 criteria, score at least 6/12 on the van Tulder Scale, and must include concealed allocation
  - Medium quality studies must include at least 3 of the above 5 criteria, and score at least 6/12 on the van Tulder Scale
  - Low quality must include at least 2 of the above 5 criteria, and can score less than 6/12 on the van Tulder Scale
- Four studies were deemed to be of high quality, seven of medium quality, and five of low quality
- When data could be pooled, the effect size was reported in standardized mean differences (SMD) with 95% confidence intervals (CIs) at each follow-up point, where the differences in groups were how many standard deviations (SD) separated the two groups. Follows general conventions, SMD between 0.2 and 0.5 SD is “small effect size,” SMD between 0.5 and 0.8 SD is a “medium effect size,” and SMD greater than 0.8 SD is a “large effect size”. A random effects model was used to determine the overall summary effect.

## **Results:**

- Sixteen studies (1162 participants) were included in the systematic review/qualitative analysis; of these, 6 were suitable for meta-analysis/quantitative analysis (519 participants).
- Qualitative analysis
  - There is strong evidence that exercise is effective at reducing pain and improving function at short-term follow-up (6 to 12 weeks) supported by consistent, statistically significant between group differences in 2 of the 4 high-quality RCTs.
  - There is strong evidence that exercise is effective at improving long-term (> 12 weeks) function, supported by consistent, statistically significant between-group differences in 2 of the 4 high-quality RCTs.

- There is moderate evidence demonstrating the effectiveness of exercise for improving strength and quality of life at short-term follow-up, supported by 2 and 1 high-quality RCTs, respectively.
- There is limited evidence that exercise is effective in reducing pain at long-term follow-up, supported by 1 medium-quality RCT.
- There is insufficient evidence to describe a definitive evidence-based exercise protocol for those with subacromial impingement syndrome. However, common exercise contained within 3 high quality and 3 medium quality studies are scapular stability training and progressive rotator cuff strengthening exercises using pulley equipment or elastic resistance bands. Exercises should be conducted through range to 90° abduction.
- There is insufficient evidence to recommend any particular frequency of exercise that may be associated with better outcomes; however, 4 studies, 2 of high quality and 2 of medium quality conducted supervised exercises 1 to 2 times per week along with daily home exercises.
- Quantitative analysis/Meta-analysis
  - Pooled data from 4 high quality studies (n=369) of exercise therapy versus other modalities showed no significant effect (SMD = -0.13 SD) on short-term pain relief.
  - Pooled data from 5 (same 4 high quality and one medium quality) studies (n=429) showed no significant effect (SMD = -0.17 SD) of exercise on short-term patient-reported function.
  - Pooled data from 2 high quality studies (n=224) of exercise therapy versus ultrasound or shock wave therapy showed a small effect (SMD = -0.31 SD) of exercise in providing long-term improvement in patient-reported function.
  - Pooled data from 2 high quality studies (n=180) of exercise therapy versus ultrasound or no treatment showed a small effect (SMD = -0.45 SD) of exercise in providing short-term improvement in strength of the rotator cuff.
  - Pooled data from 2 high quality studies (n=205) of exercise therapy versus ultrasound, acupuncture or naturopathic care showed a small (SMD = -0.20 SD) and statistically nonsignificant effect favoring exercise on mental health function compared to other modalities.

### **Authors' conclusions:**

- Overall, exercise is effective at reducing pain and improving function for the 6 to 12-week period following treatment, but is said cautiously, since it is supported by only 6 medium and 4 high-quality RCTs.
- There is strong evidence that the improvements in function are maintained at long-term follow-up, but this is said cautiously, because it is supported by only 2 high quality RCTs.

- There is moderate evidence that exercise is effective in terms of improving short-term mental health and strength.
- Exercise may be effective in providing short-term strength gains and improving function in the longer term.
- The wide variety of exercise interventions prevented definitive conclusions about which types of exercises produce better outcomes.
- Common types of exercise used in high- and medium-quality articles, and associated with decreased pain and increased function, were scapular stability exercises and rotator cuff strengthening exercises using pulley equipment or elastic band resistance and progressing through range to 90° abduction. These were conducted in supervised sessions 1 to 2 times per week and in daily home exercise programs.

### **Comments:**

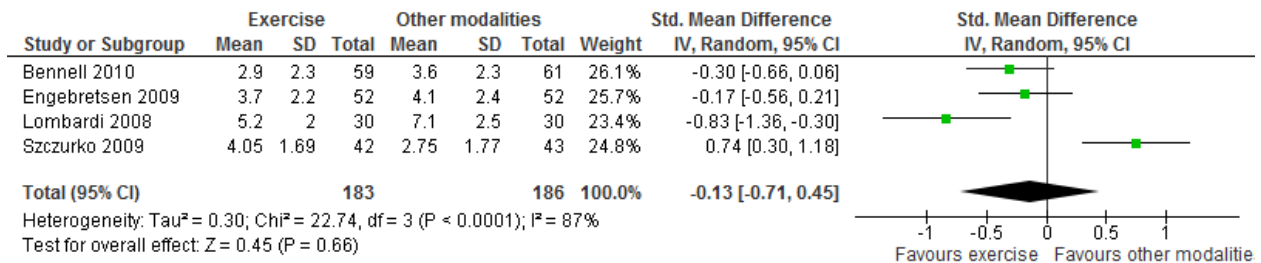
- One previous qualitative review had a similar aim as the current review using best evidence synthesis, and it concluded that there was limited or unclear evidence for the effectiveness of exercise in the management of subacromial impingement syndrome. However, this qualitative review did not consider the timing of outcomes or compliance with the intervention, which are highly relevant when reviewing exercise interventions.
- One limitation of the review was that blinding of the assessors was not reported in 7 trials. This would have the greatest impact on the 2 high quality studies that evaluated objective outcomes such as dynamometric measurement of strength and were assessed in the meta-analysis.
- Six studies were eligible for inclusion in the meta-analyses, but one RCT by Haahr was not included in any of the meta-analyses reported in this review.
- A convoluted screening system was developed for determining which studies to include in the meta-analysis and the assessment of the quality of the studies was also somewhat confusing.
- Even though the authors tested to determine the degree of heterogeneity using the  $I^2$  measure, they did not discuss or comment on the heterogeneity observed in the meta-analyses.
- The results of the meta-analyses (quantitative analyses) showed no significant effect of exercise on short-term pain relief (4 studies) and patient-reported function (5 studies), and directly conflict with the qualitative results that provided strong evidence that exercise is effective at reducing pain and improving function at short-term follow-up. The authors did not include these disparate results in their discussion. Of the 4 studies in the meta-analysis evaluating exercise on short-term pain relief, three favored exercise. Four of the five studies alone showed a reasonable small effect favoring exercise on short-term patient-reported function. For both pain and function,

only the Szczurko study did not favor exercise, even though both groups showed significant improvements in shoulder pain.

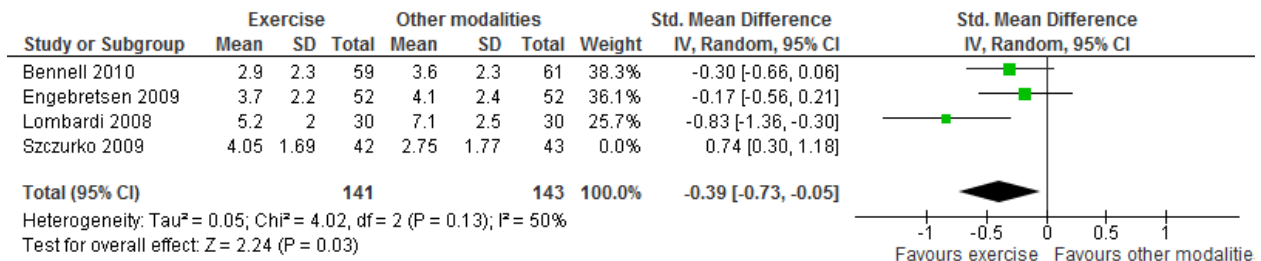
- However, the results of the meta-analyses may be questionable due to the large amount of heterogeneity observed in these 2 analyses. The  $I^2$  for the pain relief analysis was 87% and the  $I^2$  for the patient -reported function analysis was 74%. Most of the heterogeneity appears to come from the inclusion of the Szczurko study. This study probably should not have been included in the pooled analyses for the following reasons;
  - The Szczurko study is conceptually different than the other studies. Exercise was not the intervention, but the control group. This role/reversal of control/intervention is different from the other studies. The intervention group in the Szczurko study was naturopathic care that included acupuncture, an anti-inflammatory diet, and Phlogenzym (an enzyme anti-inflammatory supplement) for 12 weeks. Both groups improved in terms of pain relief and function.
  - The Szczurko study recruited participants differently and thus ended up with a different patient population. Patients were volunteer postal workers wanting to participate in an acupuncture study versus impingement syndrome patients recruited by doctors in a clinic setting. Szczurko selected those participants interested in acupuncture and this population probably expected to improve from acupuncture, whereas the population in the other studies expected to improve from exercise. Different patient populations add to the heterogeneity and variance in the meta-analysis.
  - The exercise intervention used in the Szczurko study may be different than the exercise used in the other 4 studies. Since the Szczurko study included an exercise protocol designed for both neck and shoulder patients, the isometric shoulder exercise training was intended to improve endurance and strength in the upper part of the trapezius muscle, but increasing resistance was not used. This exercise intervention may not be better than acupuncture, but acupuncture may not be better than progressive eccentric strengthening rotator cuff and scapular exercises used in the other studies. Bennell's exercise intervention was directed at improving dynamic scapular control, strengthening scapular stabilizer and rotator cuff muscles, improving shoulder and thoracic posture, and increasing range of motion of thoracic extension. Lombardi used muscle-building equipment to strengthen the flexors of the shoulder and the medial and lateral rotators with gradually increasing resistance. Engebretsen corrected dysfunctional shoulder patterns and then performed endurance exercise with gradually increasing resistance using a thin elastic cord to provide resistance. Ludewig used elastic band

strengthening exercises for the rotator cuff and scapular muscles, similar to Bennell and Engebretsen.

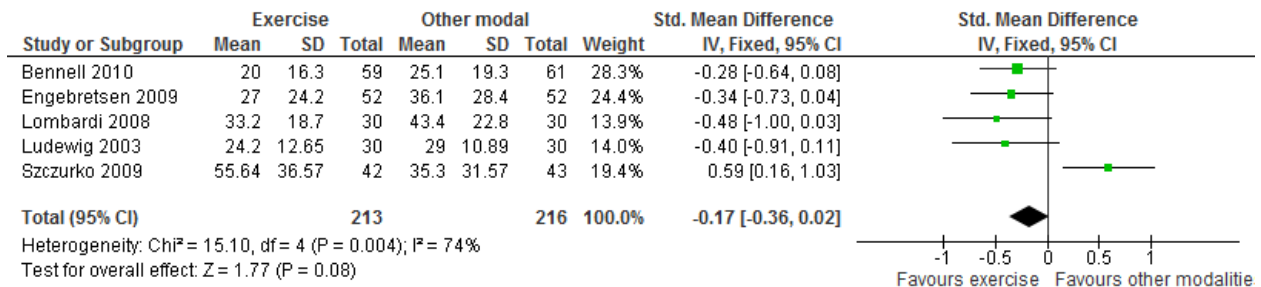
- When the Szczurko study is excluded from the meta-analyses, the effect sizes for both pain relief and function go from trivial to small/moderate favoring exercise. The effect size for short-term pain relief goes from SMD = -0.13 SD to SMD = -0.39 SD. The effect size for short-term function goes from SMD = -0.17 SD to SMD = -0.36 SD.
- When the Szczurko study is excluded from the meta-analyses, the heterogeneity of the studies is greatly reduced and is in the expected range for pooled analyses. The  $I^2$  for the pain relief analysis that was originally 87%, decreased to 50%. The  $I^2$  for the patient -reported function analysis that was originally 74%, decreased to 0%.



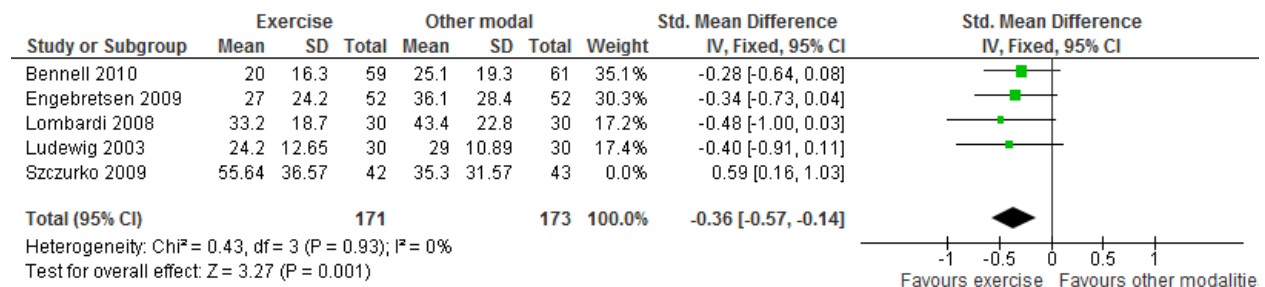
Forest plot showing results of exercise vs other modalities for short-term pain including Szczurko study.



Forest plot showing results of exercise vs other modalities for short-term pain excluding Szczurko study.



Forest plot showing results of exercise vs other modalities for short-term patient-reported function including Szczurko study.



Forest plot showing results of exercise vs other modalities for short-term patient-reported function excluding Szczurko study.

- Quantitative analysis was limited to only 6 trials. Studies were limited by heterogeneity in the type, reporting, or length of follow-up of clinically relevant outcome measures. Two articles of otherwise sufficient quality could not be included in statistical pooling as results were presented as medians without the range of scores and so means and standard deviations could not be calculated.
- Within the current meta-analysis, 3 studies involved exercise as part of a multimodal treatment incorporating treatments such as manual therapy (shoulder, spinal, soft tissue, and radial nerve mobilizations), postural taping, ice, heat, and placebo medication. Although it was deemed that the exercise component was the substantial intervention, the effect sizes calculated from these studies are not solely reflective of the exercise component and could therefore be somewhat imprecise.
- Although there have been two recently published reviews on this topic, this current review rigorously assessed bias both within and across the studies using the Cochrane risk of bias tool and the van Tulder scale which had not been previously conducted. The latter rating scale was used as it highlights two specific criteria fundamentally important when deciding if improvement could be attributed to any exercise intervention, such as acceptable rate of compliance and similar timing of outcome assessment. Even though this study purports that it highlights these criteria, specifically acceptable rate of exercise compliance, exercise compliance is scored as “unsure” for 3 of the 4 high quality studies.
- On balance, the evidence from the included studies is that exercise is effective in reducing pain and improving function in the short-term, also improving function in the long-term, and providing some improvement in strength and mental health in the short-term. There is insufficient evidence to describe a definitive evidence-based exercise protocol or frequency for those with subacromial impingement syndrome. However, common exercises contained in the studies are scapular stability training and progressive rotator cuff strengthening exercises using pulley equipment or elastic resistance bands under supervision 1 to 2 times per week along with daily home exercises. Exercises should be conducted through range to 90° abduction.

## Assessment:

- Adequate for strong evidence for those with subacromial impingement syndrome that;
  - o exercise has a small to moderate effect in reducing pain and improving function in the short-term
  - o exercise has a small to moderate effect in improving function in the long-term
- Adequate for good evidence that exercise provides moderate improvement in strength in the short-term
- Inadequate for evidence in describing a definitive evidence-based exercise protocol or frequency
  - o Common exercises used in the studies are scapular stability training and progressive rotator cuff strengthening exercises using pulley equipment or elastic resistance bands under supervision 1 to 2 times per week along with daily home exercises. Exercises are conducted through range to 90° abduction.

## References:

Lombardi I, Magri AG, Fleury AM, and et al. Progressive Resistance Training in Patients with Shoulder Impingement Syndrome: A Randomized Controlled Trial. *Arthritis & Rheumatism* 2008; 59(5): 615-622.

Bennell K, Wee E, Coburn S, and et al. Efficacy of standardized manual therapy and home exercise programme for chronic rotator cuff disease: randomized placebo controlled trial. *BMJ* 2010; 340:2756-2765.

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Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction workers. *Occup Environ Med* 2003;60(11):841-9.