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Review

Effectiveness of the eccentric exercise therapy in physically active adults with symptomatic shoulder impingement or lateral epicondylar tendinopathy: A systematic review

Miguel Ortega-Castillo, Ivan Medina-Porqueres*

Department of Physical Therapy, University of Malaga, Malaga, Spain

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ABSTRACT

Objectives: To identify and criticize the evidence for the effectiveness of the eccentric exercise to treat upper limb tendinopathies.
Design: Systematic review.
Methods: Relevant randomized controlled trials (RCTs) were sourced using MEDLINE, SPORT Discus, Physiotherapy Evidence Database (PEDro) and CINAHL databases. Inclusion criteria were: (1) studies in English or Spanish; (2) adult participants with clinical diagnosis of tendinopathy; (3) RCT study design; (4) results regarding pain or strength were assessed; and (5) eccentric exercise was employed to treat upper extremity tendinopathies. Two blinded reviewers independently extracted data concerning trial methods, quality and outcomes. PEDro scale was employed to assess methodological quality. Results were summarized in a best evidence synthesis.
Results: The selected studies ($n = 12$) scored an average of 6/10 based on the PEDro score. In 11 studies, pain decreased significantly with eccentric exercise, but only in five studies, the reduction was significantly better than in the non-eccentric group (in all or some of the parameters). Strength was assessed in nine studies; within-group evaluations show that strength significantly improved in the eccentric-group in seven studies, whereas inter-group changes were only significantly better in the eccentric-group in three studies for all the parameters and in two studies for some of the parameters.
Conclusions: Eccentric exercise may reduce pain and improve strength in upper limb tendinopathies, but whether its effectiveness is much better than other forms of treatment remains questionable. Further investigations are needed, not only focused on shoulder impingement or epicondylar tendinopathy, but on tendinopathies in other areas of the upper limb.

1. Introduction

Sport medicine is becoming relevant, being tissue degeneration a common finding in many sport-related tendon complaints.[1] In the last 20 years, sports activities have become increasingly important in our modern society.[2] More than 30% of sport injuries arise from or have an element of tendinopathy.[3] Tendinous injuries and other tendon diseases represent a therapeutic and diagnostic challenge.[4]

As part of common upper limb tendinopathies, the incidence of lateral epicondylitis (tennis elbow) in tennis players of all ages is as high as 9–40%,[5,6] and between 1 and 3% in the general population, being 2–3.5 times more frequent in people over the age of 40, particularly if playing tennis more than 2 h per day.[6] It is estimated that shoulder tendinopathies prevalence within physical workers is 15–20%, and hand and wrist tendinopathies between the interval ranging from 4 to 56%. The risk increases when high strength, repetitions, or exposure to vibrations during repetitive work are combined.[7] On the other hand, De Quervain's disease, caused by stenosing tenosynovitis of the first dorsal compartment of the wrist (abductor pollicis longus and extensor pollicis brevis), is probably the best known form of tendinopathy of the wrist and hand and is approximately six times more common in women than in men.[5] This condition is the third most reported tendinopathy of the upper extremity in physical workers and it is promoted by diabetes or rheumatoid arthritis.[7]

Some controversy exists and there is little evidence supporting the use of conservative treatments such as ultrasound (US), iontophoresis with NSAIDs, deep transverse friction massage (DTFM), or acupuncture for treating tendinopathy.[8–10] Nevertheless, in some studies, these treatments show positive effects in the

* Corresponding author.
E-mail address: imp@uma.es (I. Medina-Porqueres).

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reduction of pain or in improvement in the function of patients with tendinopathies (e.g. lateral epicondylitis).[10–13] Other therapies, including extracorporeal shock wave therapy (ESWT),[14,15] glyceril trinitrate patch,[16] percutaneous tenotomy,[17] and injection of substances such as autologous blood,[18] corticosteroid,[19] prolotherapy,[20] or platelet-rich plasma (PRP)[21] may be considered if patients do not respond to the mentioned treatments and remain limited significantly in function or activity due to pain.[22]

The failed healing response which apparently underlies tendinopathy has been proposed to be counteracted by eccentric exercise (EE) through promoting collagen fiber cross-linkage formation within the tendon, thereby facilitating tendon remodeling.[2] The lack of knowledge regarding pathophysiology of tendinopathy and the ultimate mechanisms by which EE may help resolve tendinopathy remain nowadays hard to determine. Beyond this, it is crucial that the clinical effectiveness of physical modalities such as EE is established as a matter of priority.

Although most eccentric exercise research regarding tendinopathies has classically focused on the lower extremity (specifically Achilles and patellar tendons), the upper extremity also warrants scrutiny because of the high incidence of tendon problems.[6] Exercise programmes incorporating eccentric muscle activity are becoming increasingly popular as they are considered to provide a more effective treatment than other forms of exercise therapy.[23] However, in everyday life, only around 60% of patients take advantage of this exercise regime.[24]

The objectives of this systematic review are the following: (1) to identify studies investigating the effect of eccentric exercise on upper extremity tendinopathies; (2) to describe the supplemental forms of treatment used in combination with eccentric exercise protocols in the treatment of tendinopathies; (3) to evaluate the strength of evidence supporting the use of eccentric exercise to treat tendinopathies; and (4) to make recommendations for future research.

2. Methods

The study protocol was developed based on the framework outlined in the guidelines provided by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement).[25] The registration of this systematic review was properly accomplished in PROSPERO. The registration identifier of the protocol is CRD42014009952.[26]

A literature search was performed using MEDLINE, SPORT Discus, CINAHL, and Physiotherapy Evidence Database (PEDro) to gather information relating to the treatment of upper extremity tendinopathies with eccentric exercise. Each database was searched since its start date. Study details extracted were organized in two tables: synopsis of the selected studies (pathology, duration of symptoms, intervention, outcome, post-treatment follow-up, and PEDro score) were summarized in Table 1, and parameters of the eccentric strengthening protocols (description, frequency/week, duration, sets, reps, progression of the intensity) can be found in Table 2. Two authors (M.O. and I.M.) independently searched the databases. This systematic review followed PRISMA recommendations.

The search terms for this systematic review were obtained based on MeSH (*Thesaurus*) and they were: *tendon, tendinopathy, exercise, eccentric, training*.

The articles finally included in this systematic revision were filtered depending on the following criteria: (1) studies in English or Spanish; (2) adult participants with clinical diagnosis of tendinopathy; (3) studies design was RCT; (4) results regarding pain or strength were assessed; and (5) eccentric exercise was employed to treat upper extremity tendinopathies. The studies were obtained from each database, in order of relevance, using these inclusion criteria and only reading title and abstract. Those which could be clearly determined that did not meet the criteria were excluded. Two authors (M.O. and I.M.) independently screened titles and abstracts, and if necessary full texts, to determine whether the paper met the inclusion criteria. The papers of which the authors' opinion was initially different were discussed until consensus was reached.

The methodological quality of each of the studies was assessed independently by two reviewers (M.O., I.M.) using the PEDro criteria. Reviewers were not masked to trial identifiers such as authors' and journals' names. The scored portion of the PEDro scale assesses eight items pertaining to internal validity and two items added to ensure that the statistical results would be interpretable to the reader. Regarding score, 1 point was given if the item was accomplished and 0 points if not, reaching a maximum of 10 points. The closer the score was to 10, the better the quality of the study.[27,28]

Results were analyzed using a rating system with levels of evidence for each extracted outcome.[29] These levels are:

- Strong evidence: consistent findings among multiple high-quality RCTs;
- Moderate evidence: consistent findings among multiple low-quality RCTs and/or one high-quality RCT;
- Limited evidence: one low-quality RCT; conflicting evidence: inconsistent findings among multiple trials;
- No evidence from trials.

For the purpose of this review, consistency was defined as similar results between trials for a particular outcome. In this review, since blinding the patient and/or treating therapist would have been unlikely, the cutoff for a high-quality trial was 5/10 or better; 4/10 was established as moderate quality and 3/10 or below as low quality.

For each continuous outcome, between-group effect sizes were reported with 95% confidence intervals. Categorical variables were reported as ratios (percentages) when possible.

Two authors (M.O. and I.M.) independently extracted data from the selected studies regarding: (i) authors; (ii) sample size; (iii) location of tendinopathy; (iv) treatment group; (v) control group; (vi) outcome measure; (vii) previous treatments; (viii) PEDro score; and (ix) the variables in the eccentric exercise protocol, such as description of the exercise, sets, repetitions, time of rest, progression of the intensity, and frequency per week. Other information obtained included group sizes and sociodemographic data (age, gender), length of symptoms, dominance according to tendinopathy, previous treatments, and follow-up post-treatment. Any discrepancies will be resolved through discussion until consensus is reached.

3. RESULTS

The number of full-text studies retrieved and the number of studies excluded are reported in Fig. 1. Reasons for exclusion included: tendinopathies were not treated ($n = 1$); participants were cadavers ($n = 1$); participants were non-human ($n = 1$); eccentric work was not mentioned for the treatment of tendinopathies ($n = 1$); RCT design was not respected ($n = 2$).

The mean PEDro score for the 12 studies was 6/10, with a range from 3 to 8. Overall, these scores are relatively good, considering that the intervention of eccentric exercise does not allow for blinding of the participant or therapist. Blinding of the assessors and concealed allocation were two other criteria that was poorly reported in most of the selected studies. Thus, the highest achievable score was 8/10. The two reviewers had initial agreement on