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Research Paper Review

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Achilles and patellar tendinopathy loading programs: A systematic review comparing clinical outcomes and identifying potential mechanisms for effectiveness

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ABSTRACT

Introduction

Achilles and patellar tendinopathy are overuse injuries that are common among athletes. Isolated eccentric muscle training has become the dominant conservative management strategy for Achilles and patellar tendinopathy but, in some cases, up to 45 % of patients may not respond. Eccentric-concentric progressing to eccentric (Silbernagel combined) and eccentric-concentric isotonic (heavy-slow resistance; HSR) loading have also been investigated. In order for clinicians to make informed decisions, they need to be aware of the loading options and comparative evidence. The mechanisms of loading also need to be elucidated in order to focus treatment to patient deficits and refine loading programmes in future studies.

Objectives

The objectives of this review are to evaluate the evidence in studies that compare two or more loading programmes in Achilles and patellar tendinopathy, and to review the non-clinical outcomes (potential mechanisms), such as improved imaging outcomes, associated with clinical outcomes.

Methods

Comprehensive searching (MEDLINE, EMBASE, CINAHL, Current Contents and SPORTDiscus(™)) identified 403 studies. Two authors independently reviewed studies for inclusion and quality. The final yield included 32 studies; ten compared loading programmes and 28 investigated at least one potential mechanism (six studies compared loading programmes and investigated potential mechanisms).

Results

This review has identified limited (Achilles) and conflicting (patellar) evidence that clinical outcomes are superior with eccentric loading compared with other loading programmes, questioning the currently entrenched clinical approach to these injuries. There is equivalent evidence for Silbernagel combined (Achilles) and greater

evidence for HSR loading (patellar). The only potential mechanism that was consistently associated with improved clinical outcomes in both Achilles and patellar tendon rehabilitation was improved neuromuscular performance (e.g. torque, work, endurance), and Silbernagel-combined (Achilles) HSR loading (patellar) had an equivalent or higher level of evidence than isolated eccentric loading. In the Achilles tendon, a majority of studies did not find an association between improved imaging (e.g. reduced anteroposterior diameter, proportion of tendons with Doppler signal) and clinical outcomes, including all high-quality studies. In contrast, HSR loading in the patellar tendon was associated with reduced Doppler area and anteroposterior diameter, as well as greater evidence of collagen turnover, and this was not seen following eccentric loading. HSR seems more likely to lead to tendon adaptation and warrants further investigation. Improved jump performance was associated with Achilles but not patellar tendon clinical outcomes. The mechanisms associated with clinical benefit may vary between loading interventions and tendons.

Conclusion

There is little clinical or mechanistic evidence for isolating the eccentric component, although it should be made clear that there is a paucity of good quality evidence and several potential mechanisms have not been investigated, such as neural adaptation and central nervous system changes (e.g. cortical reorganization). Clinicians should consider eccentric-concentric loading alongside or instead of eccentric loading in Achilles and patellar tendinopathy. Good-quality studies comparing loading programmes and evaluating clinical and mechanistic outcomes are needed in both Achilles and patellar tendinopathy rehabilitation.

ANALYSIS

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Background Information

Achilles and patellar tendinopathy are overuse injuries characterized by localized tendon pain with loading and varying degrees of activity. Both conditions are common amongst athletes and, in addition, Achilles injuries are increasingly common among the less-active portions of the population. Injury to these major tendons can severely impact recreational and everyday activities, not to mention professional sporting capability.

Eccentric muscle loading has become the dominant conservative intervention strategy for Achilles and patellar tendinopathy over the last decade. Eccentric loading in this context typically involves isolated, loaded, slow-lengthening muscle contractions. Previous systematic reviews have concluded that outcomes are promising but high-quality evidence is lacking (1-7). In short, the evidence suggests that not all patients respond positively to eccentric loading. The objectives of this systematic review were to synthesize evidence from studies comparing two or more loading programs in Achilles and patellar

tendinopathy, and to investigate the non-clinical outcomes (potential mechanisms), such as improved strength and imaging findings (pathology), associated with improved clinical outcomes following Achilles and patellar tendinopathy rehabilitation.

PERTINENT RESULTS:

The initial literature search yielded 403 studies. Ninety-two studies were assessed in full text, resulting in 33 studies comparing two loading programs or evaluating at least one non-clinical outcome ultimately being chosen for inclusion in the review.

Comparison of Loading Programs

Ten studies investigated loading programs in either the Achilles or patellar tendons. Regarding the Achilles, there was limited evidence to support the use of the Alfredson eccentric loading model that has become popular in clinical settings. Likewise, there was limited evidence that the Silbernagel-combined loading program offered superior outcomes. The evidence supporting each protocol is relatively equal, and the authors concluded that a gradual progression from eccentric-concentric to eccentric, followed by faster loading, may benefit patients who are unable to start with an Alfredson eccentric program due to pain or calf weakness.

Regarding the patellar tendon, there is conflicting evidence that eccentric loading is superior to other loading programs. Good-quality evidence is lacking for both Achilles and patellar tendinopathy, but there is clearly benefit from loading programs that involve eccentric-concentric muscle actions.

Neuromuscular Performance and Muscle Size

Loading was shown to be associated with improved neuromuscular outcomes (e.g. 1RM torque) in most studies. The highest level of evidence supported eccentric and Silbernagel-combined loading in the Achilles (moderate evidence) and heavy-slow resistance (HSR) loading in the patellar tendon (strong evidence). Overall, Silbernagel and eccentric loading in the Achilles and HSR loading in the patellar tendon have the highest level of evidence for improving neuromuscular function in Achilles and patellar tendinopathy.

Power and Jump Performance

There is moderate evidence showing that calf power and jump performance improves alongside symptoms following Silbernagel-combined loading, but only at 6 months. Also, there is moderate evidence suggesting that improvement in both outcomes is greater if sport is continued – this may surprise some clinicians! Side-to-side deficits (e.g. torque, work, endurance) were only evaluated in the Achilles tendon. There is moderate evidence that deficits resolve in the short term (10–12 weeks), but also that they are present at longer-term follow up (12 months to 5 years).

Muscle-Tendon Unit Compliance and Length-Tension Relationship

Although this review provides conflicting evidence for change in dorsiflexion and plantar flexion range with Silbernagel-combined loading, others (8) have reported an increase in ankle dorsiflexion range of motion and muscle-tendon unit compliance (reduced resistance to passive stretch) after 6 weeks of eccentric loading performed without any additional load. In general, eccentric contraction has also been widely reported to lead to a rightwards shift of the length-tension curve (greater force potential at longer lengths). This finding was supported by this systematic review.

Blood Flow
Decreased blood flow had been implicated as a possible causal mechanism for tendinopathy pathogenesis, although this review was unable to provide substantive evidence of this relationship. There is limited evidence that Achilles capillary flow and post-capillary pressure decreased following 12 weeks of eccentric loading, a finding noted in a very low (13%) percentage of anatomical sites.

Pain System
There is no direct evidence that direct mechanical stimulation in the form of aggressive, painful eccentric calf drops are a source of pain during tendon injury rehabilitation, as has been suggested by Alfredson et al (9).

Isolated Eccentric Contractions
This review found only limited evidence from one study in the Achilles tendon, and conflicting evidence in the patellar tendon, which showed that isolating eccentric muscle contraction is superior to other loading. Furthermore, there was no evidence that mechanistic outcomes improve more following eccentric loading compared with other forms of loading.

CLINICAL APPLICATION & CONCLUSIONS

There are 4 main take-home points from this systematic review:

1. Clinicians should consider eccentric-concentric loading alongside, or instead of, eccentric loading in Achilles and patellar tendinopathy.
2. Eccentric-concentric loading may be particularly important among patients with marked concentric weakness that may not recover with isolated eccentric loading, due to muscle contraction type specificity.
3. In the Achilles tendon, continued sport may lead to specific gains that are less evident with other loading.
4. Pain was an acceptable feature of rehabilitation in most studies in this review. Clinicians should, however, use common sense when pushing patients during rehab, as the axiom “No pain, no gain” is true, but only to a point.

STUDY METHODS

Search Strategy
The authors performed searches of MEDLINE, EMBASE, CINAHL, Current Contents and SPORTDiscus electronic databases from inception to June 2012. Search terms relating to exercise (‘eccentric’, ‘rehabilitation’, ‘resistance training’, ‘exercise therapy’), pathology (‘tendinopathy’, ‘tendinitis’, etc.) and the site (‘Achilles’, ‘patellar’) were combined in the final search.

Selection Criteria
Studies investigating clinical outcomes of loading programs in Achilles and patellar tendinopathy were included. Studies had to involve humans and have a minimum follow-up period of 4 weeks. Single cohort studies and trials comparing two or more groups were included (randomized controlled trials [RCTs] and controlled clinical trials [CCTs] that were not randomized). Studies that did not include

any participants with tendinopathy were excluded, as were studies that investigated loading following another primary intervention, such as injections or surgery.

STUDY STRENGTHS / WEAKNESSES

Limitations

While addressing related topics, the paper could easily have been separated into unique manuscripts addressing the Achilles tendon and the patellar tendon separately. The combined analysis made for a long and difficult read (we hopefully solved this for you in this review!).

Strengths

This was a very comprehensive review. The authors used appropriate search strategies and evaluation techniques, including following the PRISMA guidelines.

Additional References

1. Kingma JJ, de Knikker R, Wittink HM, et al. Eccentric overload training in patients with chronic Achilles tendinopathy: a systematic review. Br J Sports Med 2007; 41: e3–5.
2. Wasielewski NJ, Kotsko KM. Does eccentric exercise reduce pain and improve strength in physically active adults with symptomatic lower extremity tendinosis? A systematic review. J Athl Train 2007; 42: 409–21.
3. Woodley BL, Newsham-West RJ, Baxter GD. Chronic tendinopathy: effectiveness of eccentric exercise. Br J Sports Med 2007; 41: 188–98.
4. Meyer A, Tumilty S, Baxter GD. Eccentric exercise protocols for chronic non-insertional Achilles tendinopathy: how much is enough? Scand J Med Sci Sports 2009; 19: 609–15.
5. Satyendra L, Byl N. Effectiveness of physical therapy for Achilles tendinopathy: an evidence based review of eccentric exercises. Isokinet Exerc Sci 2006; 14: 71–80.
6. Visnes H, Hoksrud A, Cook J, et al. No effect of eccentric training on jumper's knee in volleyball players during the competitive season: a randomised controlled trial. Clin J Sport Med 2005; 15: 225–34.
7. Gaida JE, Cook J. Treatment options for patellar tendinopathy: critical review. Curr Sports Med Rep 2011; 10: 255–70.
8. Mahieu NN, McNair P, Cools A, et al. Effect of eccentric training on the plantar flexor muscle-tendon tissue properties. Med Sci Sports Exerc 2008; 40: 117–23.
9. Alfredson H, Pietila T, Jonsson P, et al. Heavy-load eccentric calf muscle training for the treatment of chronic Achilles tendinosis. Am J Sports Med 1998; 26: 360–6.