Eccentric overload training in patients with chronic Achilles tendinopathy: a systematic review

J J Kingma, R de Knikker, H M Wittink, T Takken


Background: Eccentric overload training seems to be a promising conservative intervention in patients with chronic Achilles tendinopathy. The efficacy of eccentric overload training on the outcome measures of pain and physical functioning is not exactly clear.

Study design: Systematic review of the literature.

Methods: Electronic databases were searched for randomised clinical trials concerning eccentric overload training in patients with chronic Achilles tendinopathy. The Delphi list was used to assess the methodological quality of the studies.

Results: Nine clinical trials were included. Only one study had sufficient methodological quality. The included trials showed an improvement in pain after eccentric overload training. Because of the methodological shortcomings of the trials, no definite conclusion can be drawn concerning the effects of eccentric overload training in patients with chronic Achilles tendinopathy.

Conclusion: The effects of eccentric exercise training in patients with chronic Achilles tendinopathy on pain are promising; however, the magnitude of the effects cannot be determined. Large, methodologically sound studies from multiple sites in which functional outcome measures are included are warranted.

Achilles tendinopathy is a frequent disorder among recreationally active people and among recreational and professional athletes. Achilles tendinopathy occurs in men and women of all age categories, but especially in men of middle age (35–45 years).1–4 The prevalence of the disorder is higher in sports that involve running or jumping.2–5 About 7%–9% of professional athletes participating in these sports are confronted with this disorder and in 6%–18% of all injuries in recreational runners the Achilles tendon is involved.1–4–6 Remarkably, in recent studies it was shown that 33% of patients with chronic Achilles tendinopathy are not physically active, and that physical activity does not correlate with histopathological findings of the Achilles tendon.5–7

Physical load on the Achilles tendon should be more seriously considered as a factor that provokes the disorder and not as an aetiological factor.5–7–10

There is no clear, widely accepted definition or test for the diagnosis of chronic Achilles tendinopathy. Many predisposing factors have been reported, but the exact aetiology of Achilles tendinopathy is unknown. Patients have a slowly developing pain in the Achilles tendon, initially only during Achilles tendon loading activities but later also during rest. Achilles tendinopathy causes many patients to significantly reduce their physical activity level or to quit their sporting activities completely, with a potentially negative effect on their overall health and general wellbeing.1–2–6–10 Typical for chronic Achilles tendinopathy is pain at the initiation of exercise and stiffness.3–7 The degree of pain and stiffness is a good indicator of severity of the tendinopathy.2–3

Physical therapeutic interventions for the treatment of patients with chronic Achilles tendinopathy are mostly conservative.3 Treatments include therapeutic applications, such as ultrasound and deep transverse friction, and remedial treatment, such as strengthening and flexibility exercises. Currently, eccentric overload training is much used and seems to be promising. The eccentric overload training model that is used in most studies was described by Alfredson et al.4 This model consists of two types of eccentric exercises, done under the guidance of a physical therapist: (1) with the knee straight, to maximise the activation of the gastrocnemius muscle, and (2) with the knee bent, to maximise the activation of the soleus muscle.

It is not exactly clear why eccentric overload training results in a direct histological effect on the injured tendon resulting in a reduction in stiffness and better functioning of the patient.3 The question for this systematic review was: what is the effectiveness of eccentric overload training in patients with chronic Achilles tendinopathy?

METHODS

To examine the effectiveness of eccentric overload training in patients with chronic Achilles tendinopathy, a systematic literature search was performed.

Strategy for literature search
Two researchers independently searched the electronic databases of CINAHL, PubMed, Medline, Cochrane Library, EMBASE, PEDro and Google Scholar from 1966 to December 2005. The following keywords were used in various compositions: Achilles tendon, tendinopathy, tendinosis, tendonitis, physical therapy, exercise, eccentric training, eccentric overload, treatment, calf muscle, pain, stiffness and physical function.

Method of selecting studies found by the literature search
Two independent reviewers carried out the selection of studies in two consecutive screening phases. In the initial screening phase, selection criteria were applied only to the titles and abstracts of the articles. In case of lack of clarity, the studies were advanced to the second screening phase, in which the selection criteria were applied to the full-text articles.

Abbreviations: VISA-A, Victorian Institute of Sport Assessment-Achilles tendon
Studies were included if they met the following five selection criteria:

1. The study population consisted of men and/or women with a diagnosis of chronic Achilles tendinopathy.
2. The study was a randomised clinical or clinical controlled trial.
3. The intervention was contained in the professional domain of the general-practice physical therapist and included at least eccentric overload training.
4. The study used at least one patient-oriented outcome measure such as pain, stiffness or physical functioning.
5. The study had to be in Dutch or English and must have been published as a full-text article in a peer-reviewed journal. Abstracts and congress reports were not included.

Evaluation of methodological quality

The Delphi list for quality assessment of randomised clinical trials was used to evaluate the methodological quality of the individual studies. This is a list of criteria that measures the three dimensions of quality: internal validity, external validity and statistical considerations. It can be used to report the methodological quality per dimension or as a total score. The Delphi list consists of nine items, all given the same weights; hence it yields a non-weighted score. The total score for methodological quality consists of the number of items that are evaluated as satisfactory (yes) and are scored 1. The list therefore has a range of 0–9 points.

Two reviewers independently evaluated the methodological quality of the studies. Their scores were compared, to detect any differences in scoring. These differences were discussed by the reviewers during a consensus meeting to identify why they had arisen. A consensus on how to score the specific items was reached by discussion. Those studies in which initially there were differences in scoring between the two reviewers were jointly rescored together by the reviewers, resulting in an overall score for methodological quality. The studies that received an overall score of >5 were considered to be of high quality.

Evaluation of conclusive power of the studies’ conclusions

The studies’ conclusions were evaluated for conclusive power according to the classification system of the Dutch Institute for Healthcare Improvement (table 1).

On the basis of methodological quality, every study was assigned a certain status (A1, A2, B, C, D). Thereafter, it was evaluated how much conclusive power could be awarded to the physical therapy. This was done according to the number of studies that described the physical-therapy interventions and by means of the status of the study. This procedure gave us a level of conclusive power.

Two reviewers independently performed the evaluation of conclusive power. The researchers reached definite scores during a consensus meeting, resulting in an overall score for the conclusive power of each individual study.

RESULTS

Literature search strategy

We identified 47 primary studies for possible inclusion in our study; 28 (59%) were excluded on the basis of the title and the abstracts (because of comorbidity such as tendon rupture, study designs such as case descriptions, medical interventions and study population such as status after surgery). The remaining 19 (41%) studies were included for the second phase of the screening procedure, in which 10 (21%) studies were excluded on the basis of diagnosis (n = 5), intervention (n = 3) or outcome measures (n = 2) after evaluation of the full text (fig 1).

Methodological quality

Only moderate agreement for the overall scores of methodological quality (κ = 0.521) was found preceding the consensus meeting between the two independent reviewers, because of their different interpretations of item 1A and a lack of information in item 3. During the consensus meeting the reviewers decided to use the interpretation of item 1A by Verhagen et al., namely, that a point can be awarded to item 1A when the article provides a detailed description of the randomisation procedure, but not if it only mentions that a randomisation procedure was performed.

Table 2 shows the scores for methodological quality of the included studies. The overall Delphi scores ranged from 0 to 9 points (mean 2.8). Only one (11%) study was considered to be of sufficient quality (score = 6); the remaining eight (89%) were of insufficient methodological quality. In five (56%) the population samples had comparable baseline measures. In six (67%), the point estimates and the measures of variability were described in the article and were evaluated as sufficient.

In only two (22%) of the studies was a detailed description given of the randomisation procedure and the method of concealment of the treatment allocation. Two (22%) studies were given points for the items of blinding with regard to the assessor. None were given points for the items of blinding with regard to the care provider.

Table 2 shows the evaluation of the conclusive power of the conclusions of these studies included as a result of the consensus meeting between the two independent reviewers.

Conclusive power of the studies’ conclusions

Moderate agreement regarding the conclusive power of the studies’ conclusions (level of evidence κ = 0.550; degree of evidence κ = 0.609) was found preceding the consensus meeting between the two independent reviewers.

Table 2 shows the evaluation of the conclusive power of the conclusions of the studies included as a result of the consensus meeting. In all, five (56%) of the studies represent level B evidence—that is, they were based on randomised clinical trials of moderate methodological quality or insufficient size or on other comparative studies. In four (44%) of the studies, the conclusions were substantiated on non-comparative studies (level C). The substantiation of the studies included can therefore be considered insufficient.

Accordingly, the conclusive power of the degree of evidence of the conclusions of these studies was low. In 78% (n = 7) of
the studies the degree of evidence of the conclusions is on level 2 and, in the remaining two (22%) it is on level 3.

**Effect of eccentric overload training**

Nine studies (100%)—three randomised control trials,

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<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Method</th>
<th>Inclusion criteria</th>
<th>Intervention</th>
<th>Outcome measure</th>
<th>Duration of intervention</th>
<th>Result in intervention group</th>
<th>Result in control group</th>
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<tr>
<td>Roos et al (2004)(^{20})</td>
<td>44</td>
<td>RCT</td>
<td>Chronic Achilles tendinopathy</td>
<td>Eccentric training</td>
<td>FAOS</td>
<td>12 weeks</td>
<td>↓ 37%</td>
<td>C1: ↓ 23%</td>
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<tr>
<td>Mafi et al (2001)(^{16})</td>
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<td>↓ 83%</td>
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<tr>
<td>Niesen-Vertommen et al (1992)(^{21})</td>
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<td>Chronic Achilles tendinopathy</td>
<td>Eccentric training</td>
<td>Ordinal Scale</td>
<td>12 weeks</td>
<td>↓ 78%</td>
<td>↓ 46%</td>
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<tr>
<td>Silbernagel et al (2001)(^{4})</td>
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<td>RCT</td>
<td>Chronic Achilles tendinopathy</td>
<td>Eccentric training</td>
<td>VAS</td>
<td>12 weeks</td>
<td>↓ 29%</td>
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<tr>
<td>Alfredson et al (1998)(^{12})</td>
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<td>CT</td>
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<td>Eccentric training</td>
<td>VAS</td>
<td>12 weeks</td>
<td>↓ 94%</td>
<td>↓ 70%</td>
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<tr>
<td>Fahlström et al (2003)(^{26})</td>
<td>78</td>
<td>CT</td>
<td>Chronic Achilles tendinopathy: (A) Midportion of the Achilles tendon and (B) insertion of the Achilles tendon</td>
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<td>VAS</td>
<td>12 weeks</td>
<td>A: ↓ 85%</td>
<td></td>
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<td>Shalabi et al (2004)(^{27})</td>
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<td>CT</td>
<td>Chronic Achilles tendinopathy</td>
<td>Eccentric training</td>
<td>Ordinal Scale</td>
<td>12 weeks</td>
<td>B: ↓ 81%</td>
<td>↓ 40%</td>
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<tr>
<td>Alfredson et al (2003)(^{14})</td>
<td>6</td>
<td>CT</td>
<td>Chronic Achilles tendinopathy</td>
<td>Eccentric training</td>
<td>VAS</td>
<td>12 weeks</td>
<td>↓ 75%</td>
<td></td>
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<tr>
<td>Stanish et al (1986)(^{28})</td>
<td>200</td>
<td>CT</td>
<td>Chronic Achilles tendinopathy</td>
<td>Eccentric training</td>
<td>Ordinal Scale</td>
<td>6 weeks</td>
<td>↓ 87%</td>
<td></td>
</tr>
</tbody>
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C, control group; CT, clinical trial; I, intervention group; FAOS, Foot and Ankle Outcome Score; RCT, randomised clinical trial; VAS, visual analogue scale; ↓, improvement in pain score.
The VISA-A Questionnaire is an index of the clinical severity of Achilles tendinopathy and evaluates three domains that are clinically relevant to patients: pain, function, and participation. The VISA-A has been successfully used to monitor clinical progress of Achilles tendinopathy in daily living and sports activity. The VISA-A includes questions that are more discriminating between different health levels in the most severely affected patients and contain questions that are more familiar and comprehensible to patients and more relevant to clinicians.
We therefore recommend its use as an outcome measure in future research.

CONCLUSION

No definite answer can be given to the question of whether eccentric overload training in patients with chronic Achilles tendinopathy has a beneficial effect on pain and function, because of the methodological shortcomings of the studies. The studies did show that eccentric overload training resulted in a decrease in pain intensity in patients with chronic Achilles tendinopathy. The effect of such training on function and (sports) participation cannot be established definitely at the moment. Large, methodologically sound studies from multiple sites in which functional outcome measures are included are warranted.

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REFERENCES


What is already known on this topic

- Achilles tendinopathy is a major cause of chronic pain and disability.
- Eccentric overload training is a widely used and promising conservative intervention in patients with chronic Achilles tendinopathy.

What this study adds

- Studies on the effectiveness of eccentric overload training in patients with Achilles tendinopathy show many methodological shortcomings
- Studies use “pain” as the only primary outcome measure
- There is a lack of studies in which functional outcome measures are used
- The Victorian Institute of Sport Assessment-Achilles Questionnaire is recommended as a valid and reliable functional outcome measure