The Effectiveness of Eccentric-Concentric Training and Isometric Contractions on Pain and Disability in Achilles Tendinopathy: A Case Report

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Abstract

Purpose: Many patients with Achilles Tendinopathy do not respond to eccentric training. The aim of the present case report is to find out the effect of eccentric - concentric training of gastrocnemius and soleus combined with isometric contraction of gastrocnemius and static stretching exercises of gastrocnemius and soleus on pain and disability in a patient experiencing Achilles Tendinopathy.

Methods: A patient with unilateral Achilles Tendinopathy for 6 months was included in the present study. The patient followed a supervised exercise five times per week for 6 weeks consisting of, isometric gastrocnemius exercise, and slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus. The programme was individualized on the basis of the patient’s description of pain experienced during the procedure. The VICTORIAN INSTITUTE OF SPORTS ASSESSMENT – ACHILLES QUESTIONNAIRE was used to evaluate the patient at baseline, at the end of treatment (week 6), and 1 month (week 10) after the end of treatment.

Results: At the end of the treatment and at the follow – up there was a decrease in pain and an increase in function.

Conclusions: The results of the present study suggest that the combination of isometric gastrocnemius exercise, slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus can produce significant improvements in terms of pain and disability in Achilles Tendinopathy.

INTRODUCTION

Achilles Tendinopathy (AT) is one of the two most common tendinopathies of the lower limb. It is appeared not only among athletes but also in non-athletes. AT is characterized by an increased presence of fibroblasts and disorganized collagen and the absence of prostaglandins and inflammatory cells [1]. Therefore, this condition is a degenerative and not inflammatory as originally thought. Therefore, the term Achilles tendonitis is incorrect for diagnosis [2]. The term Achilles tendinosis is suitable for diagnosis [2]. However, the best clinical diagnostic term is the term AT [3].

Intrinsic factors such as misalignment, inflexibility and/or muscle weakness and extrinsic factors such as training errors, sport technique, inappropriate footwear, are the main factors that lead to AT [4]. Diagnosis is based on reproducing pain with palpation specific and clinical tests as well as defining pain features (e.g. localized pain) [5]. Mid – portion AT presents with pain 2-6 cm proximal to the tendon insertion, whereas insertion AT, which is less common than mid – portion AT, presents with pain at the insertion of the Achilles tendon [3]. Pain occurs after exercise [6]. As the process progresses, pain occurs at the beginning of the exercise and disappears during the exercise [6]. Later pain may occur during exercise [6]. Pain interferes with activities of daily living in severe cases [6].

However, the ideal treatment for the management of AT does not exist. A conservative approach is advocated by many clinicians [3]. Therefore, physiotherapy is usually recommended. A wide array of physiotherapy approaches has been proposed for the management of AT such as exercise programmes, manual techniques, electrotherapeutic/physical modalities and soft tissue manipulation [3]. The theoretical mechanisms of action of the above treatment is different, but all have the same aim, improve function and to reduce pain. Such a variety of treatment techniques suggests that the optimal management strategy is not known, and further research is required to find the most effective treatment in patients with AT.

One of the most common physiotherapy treatments for AT is an exercise training. Eccentric exercise has shown good clinical results in AT [7] as well as in conditions similar to AT in histopathological appearance and clinical behaviour, such as rotator cuff [8], patellar [9] and lateral elbow tendinopathy [10].
Eccentric training is not enough for all patients with AT [11]. Therefore, eccentric training of the injured tendon is combined with static stretching exercises of the injured tendon in the treatment of tendinopathies as it was first proposed by Stanish et al [12]. Furthermore, Malliaras and his colleagues [13] concluded that clinicians should consider eccentric-concentric loading alongside or instead of eccentric loading in lower limb tendinopathy. Recently, isometric exercises are indicated to reduce and manage tendon pain [14-16]. Perhaps if the eccentric-concentric training combines to isometric contractions and static stretching exercises of the injured tendon the success rate in the treatment of tendinopathy will be higher.

To our knowledge, there have been no studies to investigate the effectiveness of these kinds of contractions (concentric, eccentric and isometric) and static stretching exercises of the injured tendon for the management of AT. Therefore, the aim of the present case report is to present the effect of eccentric-concentric training combined with isometric contraction and static stretching exercises of the injured tendon on pain and disability in a patient experiencing AT.

**CASE PRESENTATION**

**History**

The subject was a 26-year-old male basketball player with a six-month history of Achilles tendon pain, in his left leg. A specialist (orthopaedic) diagnosed the AT. He has played basketball for about ten years. The site of pain was about 4 cm above of Achilles tendon and he complained of pain after his training only. The pain subsided within 20 or 40 minutes after his training. He did not complain of pain in other activities. He did not have any problems with the other joints. He did not complain of other symptoms such as locking, giving away, stiffness, swelling or crepitus. He took no drugs at the time of assessment; he had no history of trauma in the ankle before, only one hamstring strains in the other leg. He had followed a physiotherapy rehabilitation program following the hamstring strains. He had no prior physiotherapy treatment for the problem in his Achilles tendon. He did not have a history of epilepsy, cancer or diabetes and none in his family did. He did not have any illness or operation in the past.

**Examination findings**

Although the condition was diagnosed by a specialist, the physiotherapist D. S. assessed his ankle to rule out other conditions and confirm the diagnosis. No pain was mentioned during posture and gait. Color changes, muscle wasting, swelling or body deformity were not noted. In palpation, signs of inflammation like swelling, synovial thickening and heat were not found.

On physical examination, the low back, hip and knee movements were pain free, with full power and full range of motion. The active and passive movements of the ankle and subtalar joints were normal. Muscle strength tests were normal and no capsular pattern was found. The heel raise test also known as calf raise or toe raise test (the patient carries out plantar flexion from the standing position) was positive. The Thompson’s (Simmonds) test (examiner squeeze the calf musculature while observing for ankle plantar flexion) was positive. The painful arc sign (thickened portion of tendon moves with active plantar flexion and dorsiflexion of the ankle) was positive. The compression test (examiner compress Achilles tendon and the pain diminishes during plantar flexion and dorsiflexion) was positive. Tenderness with palpation about 4 cm above of Achilles tendon was found, confirming the diagnosis.

**Procedure**

The patient followed a supervised exercise programme consisting of, isometric gastrocnemius exercise, slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus. Firstly, the patient performed the isometric gastrocnemius exercise with the ankle in maximum plantar flexion and knee in full extension. Each repetition was painless and lasted 45 seconds. The patient performed 3 sets of five repetitions of isometric contraction with 1-min rest interval between each set. Later, the patient carried out the eccentric-concentric training. The calf muscle was loaded both with the knee straight (gastrocnemius) and to maximize the activation of the soleus muscle also with the knee bent. Each of the two exercises included 15 repetitions done in three sets. Between each set there was 2-minute rest. In the beginning, the loading consisted of the body weight, with the patient standing with 100% body weight on the affected leg. From an upright body position, the calf muscle was loaded by having the patient lower the heel beneath the forefoot.

The patient counted to 6 during the exercise. As the subject moved from the standing to the new position, the calf muscle and Achilles tendon by inference were loaded eccentrically, followed by concentric loading, as the injured leg was used to get back to the start position. Each exercise was performed at a slow speed at every treatment session. The subject was told to go ahead with the exercise even if she experienced mild pain. However, she was told to stop the exercise if the pain became disabling. When the exercises were pain-free the load was increased by using a backpack that was successively loaded with weight. Finally, static stretching exercises of gastrocnemius and soleus were performed as described by Stanish et al. [12], before and after the eccentric-concentric training. Each stretch lasted 30 seconds and there was a one-minute rest between each stretch.

The recommended programme was followed five times a week for 6 weeks. It was individualized on the basis of the patient’s description of pain experienced during the procedure. The patient was instructed to avoid activities that irritated pain such as jumping, hopping and running [11,15,17] but to use his ankle during the course of the study. He was also told to refrain from taking anti-inflammatory drugs throughout the course of the study. A treatment diary monitored the patient compliance.

Communication and interaction (verbal and non-verbal) between the therapist and patient was kept to a minimum, and behaviors sometimes used by therapists to facilitate positive treatment outcomes were purposefully avoided. For example, patient was given no indication of the potentially beneficial effects of the treatment or any feedback on his performance in the pre-application and post application measurements [18].

In the present study function and pain measured. The patient
was evaluated at the baseline (week 0), at the end of treatment (week 6) and at 1 month (week 10) after the end of treatment.

The Victorian Institute Of Sports Assessment – Achilles Questionnaire (VISA-A) questionnaire was used to monitor the pain and function of patients. The instrument is a simple questionnaire, consisted of eight questions that takes less than five minutes to complete and once patients are familiar with it they will be able to complete most of it themselves. It is a valid and reliable outcome measure for patients with AT [19].

RESULTS

VISA-A score was 39 at the initial evaluation. At the end of the treatment (week 6), there was a rise in VISA - A score of 35 units. At week 10, the VISA - A score was 81 (Table 1).

DISCUSSION

The present case report examined the effect of isometric gastrocnemius exercise, slow progressive eccentric - concentric training of gastrocnemius and static stretching exercises of gastrocnemius and soleus in a patient experiencing AT. The findings of the study have shown significant improvements in terms of pain and disability. The results obtained from this case study are novel; as to date, similar studies have not been carried out.

The eccentric training is the most commonly used conservative treatment in the management of AT. Clinicians should consider eccentric-concentric loading alongside or instead of eccentric loading in Achilles tendinopathy [13]. The management of AT can be obtained by a Heavy Slow Resistance (HSR) program [20]. The HSR program was produced significantly better patient satisfaction at six-month follow-up than the conventional eccentric program. Therefore, the HSR program can be proposed as an alternative to the conventional eccentric program AT rehabilitation.

Recently, isometric exercises have been recommended to manage and reduce tendon pain. These exercises increase the strength at the angle of contraction without producing inflammatory signs [14,16,21]. Five repetitions of 45-second isometric mid-range quadriceps exercise at 70% of maximal voluntary contraction have shown to reduce patellar tendinopathy pain for 45 minutes post exercise. This was also associated with a reduction in motor cortex inhibition of the quadriceps that was associated with patellar tendinopathy [21]. The dosage of isometric contractions in the present was based on clinical experience [14-16,21] and their effect on pain in patients with AT requires further study. Therefore, it was hypothesized that the simultaneous use of these two kinds of contractions (isotonic and isometric) will further enhance the analgesic effect of contractions in the management of AT, increasing the lower limb function.

Table 1: VISA - A score before each evaluation.

<table>
<thead>
<tr>
<th>Week</th>
<th>VISA - A</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>6</td>
<td>74</td>
</tr>
<tr>
<td>10</td>
<td>81</td>
</tr>
</tbody>
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It has also been proposed that the positive effects of exercise programmes for tendon injuries may also be attributable to the effect of stretching. The aim of stretching is to lengthen the muscle-tendon unit, orientate the new collagen fibers and experience consequently less strain during joint motion [22]. Stretching may increase the range of motion of the relevant joint and strengthen the tendon or make it more resistant to strain [12,23].

Adequate consideration of the kinetic chain is a component lacking from evidence-based programs. Poor lumbopelvic control has the potential to increase the risk of lower limb tendinopathy and alter load distribution on the lower limb kinetic chain [3,16,24]. It is believed that the improvement of lumbopelvic control can be achieved by performing simple exercises such as four point prone bridging exercises and single leg bridging in supine. Further research is required to confirm this suggestion.

In addition, weakness of hip extensors has also been associated with AT [25]. Exercises to strengthen the previously reported muscle groups should be considered in exercise programs in the management of AT. However, hip extensors were not strengthened in the present trial because the strength of hip muscles in the assessment was normal. Functional activities such as sprinting, cutting and jumping should also be included in AT rehabilitation programs among athletes, but have so far not been included in popular programs in the literature [25]. These activities were included in the present study. The athlete carried out these activities in the court under the supervision of the gymnast.

The load of exercises was increased according to the patients’ symptoms otherwise the results are poor [26]. Furthermore, eccentric exercises were performed at a low speed in every treatment session because this allows tissue healing [27]. Ice was not recommended at the end of the treatment because research has shown that ice as a supplement to an eccentric exercise programme offers no benefit to patients with tendinopathy [28]. Finally, the avoidance of painful activities is crucial for tendon healing, because training during the treatment period increases patients’ symptoms and delays tendon healing [29].

Eccentric exercises appear to improve function and reduce the pain. The way by which eccentric exercises achieves these outcomes remains unknown, as there is not good quality evidence relating to physiological effects. The clinical improvement of the HSR group was accompanied by increased collagen turnover. It is unknown if the isometric contractions can reverse the pathology of the tendinopathy and in this case the pathology of CPT.

Although a home exercise programme can be performed any time during the day without requiring supervision from a therapist, our clinical experience has shown that patients fail to comply with the regimen of home exercise programmes [28]. Although many ways can be recommended to improve the compliance of patients with the home exercise programme such as better self-management education exercise monitors and phone calls, it is believed that this problem can be solved by the supervised exercise programmes performed in a clinical setting under the supervision of a therapist. It is believed because clinicians’ experience has shown that many patients stopped.

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the home exercise programme without giving an explanation, whereas patients completed the supervised programme. One possible reason why they continue the supervised exercise programme could be the cost. In the supervised exercise programme, the patients visit the therapist more times than the home exercise programme, and this is more expensive. A future study will combine the both types of exercise programmes in order to maximize the compliance of the patients.

Even though the positive effects of such an exercise programme in AT have been reported in the present case report, its study design limits the generalization of these findings. Future well-designed clinical trials are needed to confirm the positive results of this case study establishing the effectiveness of such an exercise program in the management of AT. In addition, structural changes in the tendons related to the treatment interventions and the long-term effects (6 months or more after the end of treatment) of these treatments are needed to investigate. Further research is needed to establish the possible mechanism of action of this treatment approach, and the cost effectiveness of such treatment, because reduced cost is an important issue for the recommendation of any given treatment.

CONCLUSION

The exercise programme, consisting of isometric gastrocnemius exercise, slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus, had reduced the pain and improved the function in a patient with AT at the end of the treatment and at one month follow-up. Further well-designed trials are needed to confirm the results of the present case report.

WHAT THIS STUDY ADDS

This study has shown that an exercise programme, consisting of isometric gastrocnemius exercise, slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus, had reduced the pain and improved the function in a patient with AT at the end of the treatment and at one month follow-up. Further well-designed trials are needed to confirm the results of the present case report.

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REFERENCES


