



## The Effectiveness of Isometric Contractions Combined with Eccentric – Concentric Training and Simple Lumbo-Pelvic Control Exercises on Pain and Disability in Chronic Patellar Tendinopathy: A Case Report

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### Abstract

Eccentric exercises are not effective for all patients with chronic patellar tendinopathy (CPT). The aim of the present case report is to present the effect of eccentric - concentric training combined with isometric contraction and simple lumbo-pelvic control exercises on pain and disability in a patient experiencing CPT. A patient with unilateral CPT for 4 months was included in the present report. The patient followed a supervised exercise five times per week for 6 weeks consisting of, isometric quadriceps exercise, and slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises. The programmer was individualized on the basis of the patient's description of pain experienced during the procedure. The patient was evaluated using the VISA – P questionnaire at baseline, at the end of treatment (week 6), and 1 month (week 10) after the end of treatment. At the end of the treatment and at the follow – up there was a decline in pain and a rise in function. The results of the present trial suggest that the combination of isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises can produce significant improvements in terms of pain and disability in CPT.

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### Introduction

Chronic Patellar Tendinopathy (CPT) is a common clinical condition that is managed by physical therapists and is common among athletes and non-athletes alike. CPT is characterized by the absence of inflammatory cells and prostaglandins and an increased presence of fibroblasts and disorganized collagen [1]. Therefore, this condition is not inflammatory as originally thought but is a degenerative condition. The ideal term for clinical diagnosis is patellar tendinopathy because this term refers to the painful tendon without implying the pathology [2]. Jumper's knee was the first diagnostic term used for this condition. However, this condition can occur in people who are not athletes and athletes who do not perform jumping in their sports. Thus, jumper's knee is not an appropriate term for clinical diagnosis [3]. Patellar tendonitis is also an incorrect term for clinical diagnosis because the condition is not inflammatory but is degenerative as mentioned. The best diagnostic term may be the term patellar tendinosis because this term refers to the pathology of the tendon [4].

Extrinsic factors such as inappropriate footwear, sport technique, training errors, and intrinsic factors such as muscle weakness and/or inflexibility, and misalignment are the main factors that lead to CPT [1]. It is most commonly characterized by pain at the inferior pole of the patella; although pain can also be at the tibial attachment, in the attachment of the tendon to the superior pole of the patella as well as midsubstance pain has been reported [3]. The pain can be caused by performing a functional activity such as squat or hop [5].

However, no ideal treatment has emerged for the management of CPT. Many clinicians advocate a conservative approach [5] and physiotherapy is usually recommended [4]. A wide array of physiotherapy treatments has been recommended for the management of CPT such as electrotherapeutic/physical modalities, exercise programmes, soft tissue manipulation, and manual techniques [1]. These treatments have different theoretical mechanisms of action, but all have the same aim, to reduce pain and improve function. Such a variety of treatment options suggests that the optimal treatment strategy is not known, and more research is needed to discover the most effective treatment in patients with CPT.

**Table 1:** VISA-P score before each evaluation.

	VISA - P
WEEK 0	42
WEEK 6	81
WEEK 10	86

One of the most common physiotherapy treatments for CPT is exercise. Eccentric exercise has shown good clinical results in CPT [6] as well as in conditions similar to CPT in clinical behaviour and histopathological appearance, such as lateral elbow [7], rotator cuff [8] and Achilles tendinopathy [6].

Eccentric training is not enough for all patients with CPT [9]. Malliaras and his colleagues [3] 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 [10,11]. Moreover, a component lacking from evidence-based programs is adequate consideration of the kinetic chain and therefore poor lumbo-pelvic control has the potential to alter load distribution on the lower limb kinetic chain and increase the risk of lower limb tendinopathy [5]. Perhaps if the eccentric-concentric training combines to isometric contractions and simple lumbo-pelvic control exercises the success rate in the management 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 simple lumbo-pelvic control exercises for the management of CPT. Therefore, the aim of the present case report is to present the effect of eccentric-concentric training combined with isometric contraction and simple lumbo-pelvic control exercises on pain and disability in a patient experiencing CPT.

## Case Presentation

### History

The subject was a 20-year-old female volleyball player with a four-month history of anterior knee pain, in her right knee. She was diagnosed by a specialist (orthopaedic) as having CPT. She has played volleyball for about six years. The site of pain was over the inferior pole of the patella without spreading down and she complained of pain after her training only. The pain subsided within one or two hours after her training. She did not complain of pain after prolonged sitting or while walking downstairs. She did not have any problems with the other joints. She did not complain of other symptoms such as stiffness, swelling, locking, crepitus or giving away. She took no drugs at the time of assessment; she had no history of trauma in the knee before, only two ankle sprains in the same leg. She had followed a physiotherapy rehabilitation program following the ankle sprains. She had no prior physiotherapy treatment for the problem in her knee. She did not have a history of diabetes, epilepsy or cancer and none in her family did. She did not have any operation or illness in the past.

### Examination findings

Although the condition was diagnosed by a specialist, the physiotherapist D. S. assessed her knee to rule out other conditions and confirm the diagnosis.

No pain was mentioned during gait and posture. Body deformity, colour changes, muscle wasting or swelling were not noted. In palpation, signs of inflammatory activity like heat, swelling and synovial thickening were not found.

On physical examination, the movements of the low back, hip and ankle were pain free, with full range of motion and full power. All ligamentous stress tests were normal, meniscal stress tests were normal, muscle strength tests were normal and no capsular pattern was found. Isotonic resisted extension reproduced mild pain on the inferior pole of the patella; what is more, after ten fast squats (decline test) [3], she experienced a mild pain. The squats were carried out, because the researcher wanted to reproduce the pain. Knee extension by gliding the patella medially was negative, without reproducing the pain; furthermore the position of the patella was normal [12]. These two latter procedures ruled out the patellofemoral joint dysfunction. Tenderness with palpation over the inferior pole of the patella was found, confirming the diagnosis.

### Procedure

The patient followed a supervised exercise programmer consisting of, isometric quadriceps exercise, slow progressive eccentric-concentric training of quadriceps and simple lumbo-pelvic control exercises. Firstly, the patient performed the Spanish squat as an isometric quadriceps exercise. The Spanish squat is a double leg squat to be performed at an angle of approximately 70-90° of knee flexion with the assistance of a rigid strap fixating the lower legs. The patient performed 3 sets of five repetitions of Spanish squat with 1-min rest interval between each set. Each repetition was painless and lasted 45 seconds. Later, the patient carried out the eccentric-concentric training. As eccentric-concentric training, the participant carried out three sets of 15 repetitions of unilateral squat on a 25° decline board with 1-min rest interval between each set. The squat was performed at a slow speed at every treatment session. The patient counted to 6 during the squat. As the subject moved from the standing to the squat position, the quadriceps muscle and patellar tendon by inference were loaded eccentrically; followed by concentric loading, as the injured leg was used to get back to the start position. At the beginning the load consisted of the body weight and the participant was standing with all her body weight on the injured leg. 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 squat was pain-free the load was increased by holding hand weights. Finally, the patient performed two simple lumbo-pelvic control exercises such as single leg bridging in supine and four-point prone bridging exercises. The patient performed 3 sets of five repetitions of each of the above lumbo-pelvic control exercises with 1-min rest interval between each set. Each repetition was painless and lasted 45 seconds. Static stretching exercises of quadriceps and hamstrings were performed as described by Stasinopoulos and his colleagues [2] before and after the eccentric training. Each stretch lasted 30 seconds and there was a one minute rest between each stretch.

Supervised exercise programme was given five times a week for 6 weeks and was individualized on the basis of the patient's description of pain experienced during the procedure. The patient was instructed to use her knee during the course of the study but to avoid activities that irritated pain such as jumping, hopping and running [2,9,11]. She was also told to refrain from taking anti-inflammatory drugs throughout the course of the study. Patient compliance was monitored using a treatment diary.

Communication and interaction (verbal and non-verbal) between the therapist and patient was kept to a minimum, and behaviours sometimes used by therapists to facilitate positive treatment outcomes were purposefully avoided. For example, patients were given no

indication of the potentially beneficial effects of the treatments or any feedback on their performance in the pre-application and post-application measurements [13].

Pain and function were measured in the present study. 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 VISA-P 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 patellar tendinopathy [14].

## Results

VISA-P score was 42 at the initial evaluation. At the end of the treatment (week 6), there was a rise in VISA - P score of 39 units. At week 10, the VISA - P score was 86 (Table 1).

## Discussion

The present study examined the effect of isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises in a patient experiencing CPT and its findings have demonstrated significant improvements in terms of pain and disability. The results obtained from this case report are novel; as to date, similar studies have not been conducted.

Alfredson et al. [1] first proposed the eccentric training of the injured tendon. It is the most commonly used conservative approach in the treatment of tendinopathy. Malliaras and his colleagues [3] concluded that clinicians should consider eccentric-concentric loading alongside or instead of eccentric loading in Achilles and patellar tendinopathy. A Heavy Slow Resistance (HSR) program is recommended in the management of lower limb tendinopathy [16,17]. The HSR program was produced equivalent pain and function improvement (VISA) than the Alfredson eccentric program, but significantly better patient satisfaction at six month follow-up. In the Achilles tendon, eccentric and HSR have recently been shown to yield similar clinical outcomes (VISA and patient satisfaction) at 1 year follow up. Based on the above findings, the HSR program can be recommended as an alternative to the Alfredson eccentric program lower limb tendinopathy rehabilitation.

Recently, isometric exercises have been recommended to reduce and manage tendon pain increasing the strength at the angle of contraction without producing inflammatory signs [3,10]. Five repetitions of 45-second isometric mid-range quadriceps exercise at 70% of maximal voluntary contraction have been shown to reduce patellar tendon pain for 45 minutes post exercise and this was also associated with a reduction in motor cortex inhibition of the quadriceps that was associated with patellar tendinopathy [10]. The dosage of isometric contractions in the present was based on clinical experience [3,10,11] and their effect on pain in patients with CPT requires further study. The 'Spanish squat was used as isometric contraction in the present study and is useful when there is limited or no access to gym equipment as in the present situation. 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 treatment of CPT, increasing the lower limb function.

A component lacking from evidence-based programs is adequate consideration of the kinetic chain. Poor lumbopelvic control has the potential to alter load distribution on the lower limb kinetic chain and increase the risk of lower limb tendinopathy [5,18]. It is our belief that the improvement of lumbo-pelvic control can be achieved by performing simple exercises such as single leg bridging in supine and four point prone bridging exercises. Future research is needed to confirm this suggestion.

In addition, hip extensors weakness has been associated with patellar tendinopathy [19]. Exercises to strengthen these muscle groups should be considered in exercise protocols and patellar tendinopathy. However, hip extensors were not strengthened in the present case trial because the strength of hip muscles in the assessment was normal. Functional activities such as jumping, cutting and sprinting should also be included in lower limb tendinopathy rehabilitation programs among athletes, but have so far not been included in popular programs in the literature [19]. 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 [20]. Furthermore, eccentric exercises were performed at a low speed in every treatment session because this allows tissue healing [21]. 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 [22]. Finally, the avoidance of painful activities is crucial for tendon healing, because training during the treatment period increases patients' symptoms and delays tendon healing [23].

Eccentric exercises appear to reduce the pain and improve function. The mechanism by which eccentric training achieves these outcomes remains uncertain, as there is a lack of 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 [22]. Although many ways can be recommended to improve the compliance of patients with the home exercise programme such as phone calls, exercise monitors and better self-management education, 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 our experience has shown that many patients stopped 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 CPT have been reported in the present 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 CPT. 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.

## Conclusions

The exercise programme, consisting of isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises, had reduced the pain and improved the function in a patient with CPT 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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