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Case Report

448 kHz Capacitive Resistive Monopolar Radiofrequency and a Supervised Exercise Programme in Chronic Patellar Tendinopathy: A Case Report

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Abstract

The aim of the present case report is to present the effect of eccentric - concentric training combined with isometric contraction, simple lumbo-pelvic control exercises and thermal (thermia or hyperthermia) mode of 448kHz Capacitive Resistive Monopolar Radiofrequency (CRMRF) in continuous wave on pain and disability in a patient experiencing CPT. A patient with unilateral CPT for 9 months was included in the present report. The patient followed a supervised exercise three times per week for 6 weeks consisting of, isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises. The programme was individualized on the basis of the patient's description of pain experienced during the procedure. In addition, the patient received CRMRF three times per week, totally 18 applications. The patient was evaluated using the VISA - P questionnaire, Pain Pressure Threshold (PPT) algometry and a handheld dynamometer to measure knee extensor strength at baseline, at the end of treatment (week 6), 1 month (week 10) and 3 months (week 18) 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 and strength. The results of the present case study suggest that the combination of isometric quadriceps exercise, slow progressive eccentric-concentric training of quadriceps, simple lumbo-pelvic control exercises and the application of thermal mode of 448kHz CRMRF in continuous wave can produce significant improvements in terms of pain and disability in CPT.

Keywords: Capacitive resistive monopolar radiofrequency; VISA - P; Pain pressure threshold

Introduction

Chronic Patellar Tendinopathy (CPT) commonly referred to as Jumper's knee or patellar tendonitis is the most common tendinopathy in the knee area. CPT is degenerative or failed healing tendon response rather than inflammatory [1]. Pain and decreased function are the main symptoms of CPT. Diagnosis is simple. The symptoms are reproduced by (1) lower limb activities such as squat or hop; (2) palpation on the site of pain (mainly at the inferior pole of the patella); and (3) clinical tests such as decline test [1].

The management of CPT is usually conservative. 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. The most common physiotherapy treatment for CPT is exercise.

Although an exercise program is an effective treatment approach, a supplement to the exercise program should be found to reduce the treatment period. One such modality is 448kHz Capacitive Resistive Monopolar Radiofrequency (CRMRF) which is a relatively new treatment approach, but it is reported to be used by clinicians worldwide. To our knowledge, there have been no studies to investigate the effectiveness of 448kHz CRMRF in the management of CPT. Therefore, the aim of the present case report is to present the effect of exercise training combined with 448kHz CRMRF on pain and disability in a patient experiencing CPT.

Case Presentation

History

The subject was a 27-year-old female volleyball player with a nine- 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 fifteen 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 three 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.

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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) [2], 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 [2]. 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 programme 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 1min 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 [3] 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 three 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 [3,4]. 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.

The subject received 448kHz CRMRF intervention. The CRMRF at 448kHz was delivered using 'INDIBA Activ 902', a new factory calibrated device with a peak power of 200W and 450VA, which deliver continuous-wave RF energy in two modes: Capacitive (CAP) and Resistive (RES), using metallic electrodes via a coupling medium. The CAP mode was delivered in thermal dose (according to patient feedback on his perception of moderate heating) in muscles around the knee. CAP mode was delivered 5 minutes for each muscle. The RES mode was delivered in thermal (thermia or hyperthermia) in continuous wave. The RES mode was delivered for 10 minutes. Finally, CAP mode in non-thermal dose was delivered in the symptomatic area for 5 minutes. The return electrode was placed in the calf area. Treatment was delivered once every other, three times per week providing eighteen sessions in total.

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.

Pain, function and strength were measured in the present study. The patient was evaluated at the baseline (week 0), at the end of treatment (week 6) 1 month (week 10) and 3 months (week 18) 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 [5]. Pain was also measured using the Pain Pressure Threshold (PPT) algometry according to Kregel et al. (2013) [6] study. A handheld dynamometer was used to measure knee extensor strength. The procedure described by Silva et al. (2016) [7] was followed.

Results

VISA-P score was 38 at the initial evaluation. At the end of the treatment (week 6), there was a rise in VISA - P score of 46 units. At week 10, the VISA - P score was 88 and at week 18, the VISA - P was 91 (Table 1). PPT score was 35 at the initial evaluation. At the end of the treatment (week 6), there was a rise in PPT score of 22 units. At week 10, the PPT score was 60 and at week 18, the PPT was 63 (Table 1). Knee extensor strength score was 58 at the initial evaluation. At the end of the treatment (week 6), there was a rise in knee extensor strength score of 33 units. At week 10, the Knee extensor strength score was 93 and at week 18, the knee extensor strength was 94 (Table 1).

Table 1: VISA-P, PPT and knee extensor strength score before each evaluation.

	VISA - P	PPT	Knee Extensor Strength
WEEK 0	38	35	58
WEEK 6	84	57	91
WEEK 10	88	60	93
WEEK 18	91	63	94

Discussion

The present study examined the effect of an exercise program consisting of isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises as well as the application of thermal (thermia or hyperthermia) of 448kHz CRMRF in continuous wave in a patient experiencing CPT. 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. [8] first proposed the eccentric training of the injured tendon. Unilateral squat eccentric training of the patellar tendon was the most commonly used conservative approach in the treatment of CPT [9] when the problem is at the inferior pole of the patella. Later, it was found that the unilateral squat eccentric training on a 25o decline board applied more load on the tendon [2]. However, squat eccentric training of the patellar tendon alone, on decline board or not, was not effective for many patients with CPT. Malliaras and his colleagues [10] 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 CPT [11]. 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 and therefore recommended as initial conservative treatment for CPT [12]. 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 for young active people.

Recently, isometric exercises have been recommended to reduce and manage tendon pain increasing the strength at the angle of contraction without producing inflammatory signs [2,13]. 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 [13]. The dosage of isometric contractions in the present was based on clinical experience [2,4,13] 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. However, conflicting results have been reported in terms of immediate and short-term pain relief [14]. Definitive conclusions about the effectiveness of isometric exercise in tendinopathy are yet to be made [14]. 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 [1]. 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 [15]. 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 tendinopoathy rehabilitation programs among athletes, but have so far not been included in popular programs in the literature [15]. These activities were included in the present study. The athlete carried out these activities in the court under the supervision of the gymnast.

Others recommend lunges for the management of CPT. There are different techniques for lunges, including variations in step length, walking or jumping lunges, or different trunk positions [16]. Keeping the knee behind the toes is a common cue during performing a proper form of lunges [16]. However, the results of a recently published case study suggest that the slow progressive eccentric - concentric loading of quadriceps using forward step lunge (FSL) with the anterior knee motion going in front of the toes (FT) can produce significant improvements in terms of pain and disability in CPT [17].

Eccentric exercises appear to reduce the pain and improve function. The mechanisms 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. 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.

Although a supervised exercise program is an effective treatment approach, a supplement to the exercise program should be found to reduce the treatment period. One such modality is 448kHz CRMRF which is a relatively new treatment approach, but it is reported to be used by clinicians worldwide. Many clinicians think that Shortwave Diathermy (SWT) and 448kHz CRMRF is the same. However, the 448kHz CRMRF differs from SWT mainly in two ways - firstly the operating frequency (SWT commonly operates at 27.12MHz) and secondly, unlike SWT it is applied using a coupling medium since CRMRF cannot be delivered through air [18]. Hence, one hypothesized advantage of 448kHz CRMRF over SWT is that scattering of the RF waves is potentially considerably lower [18].

Since pain relief and improvements in function and strength were noted in the present study on a long term, it is proposed that the 448kHz CRMRF energy may potentially have promoted an important effect in the management of soft tissues [18]. However, to understand the potential changes to the tissues in response to 448kHz CRMRF treatment, future studies should consider employing outcome assessments that are capable of monitoring the changes in deeper tissues.

The present case study was the first report to examine the effectiveness of 448kHz CRMRF on CPT. Previous studies assessed the effectiveness of this treatment on chronic knee osteoarthritis [28], acute ankle sprain [19] and rotator tendinopathy [20]. However, ankle sprain, tendinopathy and knee osteoarthritis are three different conditions and the results are not comparable. The three previously reported trials found that a course of 448kHz CRMRF may improve patients' symptoms. The findings of these trials encourage the design of future well-designed RCTs that might produce strong evidence for the effectiveness of 448kHz CRMRF on sports/musculoskeletal injuries.

A course of 448kHz CRMRF treatment was applied in the present case study based on manufacturers' claims. It is a dose-response modality and the optimal treatment dose has obviously not yet been discovered. Future studies are needed to standardize 448kHz CRMRF parameters in the management of RCT (acute, chronic and calcific).

Even though the positive effects of such a therapeutic approach (supervised exercise programme and 448 kHz CRMRF) in the management of 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.

Conclusion

This case study showed that an exercise programme consisting of isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises and thermal (thermia or hyperthermia) mode of 448kHz CRMRF in continuous wave, had reduced the pain and improved function and strength in a patient with CPT at the end of the treatment and at the follow-ups. Further well-designed trials are needed to confirm the results of the present case report.

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