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Case Report / Olgu Sunumu

Ultrasound-guided percutaneous needle electrolysis of rectus femoris muscle injury: A case report

Rektus femoris kas yaralanmasının ultrasonografi kılavuzluğunda perkütan iğne elektroliz ile tedavisi: Olgu sunumu

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ABSTRACT

Quadriceps strains are common in sports, including kicking and repetitive sprinting activities like football. The rectus femoris, a muscle located in the front of thigh that crosses two joints, is the most often damaged muscle in the quadriceps group. Percutaneous electrolysis therapy is an invasive procedure that is used for treating several musculoskeletal problems. It was initially developed and used to treat chronic patellar tendinopathy; however, its spectrum of applications have rapidly expanded.

A 34-year-old male recreative football player admitted with pain in the anterior region of his thigh started by a sudden sharp sensation while playing football. Following musculoskeletal examination and imaging evaluations, a grade 2 rectus femoris injury was identified. This patient received successful ultrasonography-guided percutaneous electrolysis therapy.

Keywords: *Rectus femoris tear, percutaneous needle electrolysis, pain management*

ÖZ

Kuadriseps yaralanmaları, futbol gibi topa vurma ve tekrarlayan sprint aktivitelerinin olduğu sporlarda yaygındır. Uyluğun ön tarafında bulunan ve iki eklemi geçen bir kas olan rektus femoris, kuadriseps grubunda en sık yaralanan kastır. Perkütan elektroliz tedavisi, kas-iskelet sistemi sorunlarını sorunlarının çözümünde kullanılan invaziv bir işlemdir. Başlangıçta kronik patellar tendinopati tedavisi için geliştirilmiş olsa da, uygulama alanı hızla genişlemiştir.

Bu olgu sunumunda, maç sırasında uyluğun ön bölgesinde aniden başlayan keskin ağrı ile başvuran 34 yaşında erkek rekreatif futbol oyuncusunda, muayene ve görüntüleme ile 2. derece rektus femoris kas yaralanması saptanmıştır. Hastanın tedavisi, ultrasonografi kılavuzluğunda perkütan iğne elektroliz yöntemiyle başarıyla gerçekleştirilmiştir.

Anahtar Sözcükler: *Rektus femoris yırtığı, perkütan iğne elektrolizi, ağrı yönetimi*

INTRODUCTION

The majority of muscle injuries in high-level sports occur in the lower limbs, with a range of 68-88%. Among these, 25% are indirect thigh muscle strains that occur without direct contact (1). Quadriceps strains are common in sports, including kicking and repetitive sprinting activities like football. The rectus femoris (RF), a muscle located in the front of the body that crosses two joints, is the most often injured muscle in the quadriceps group. It aids in straightening the knee, bending the hip, and stabilizing the pelvis on the thigh bone while supporting weight. The RF is especially prone to damage due to its significant percentage of type II fibers (2). RF injuries require more time for recovery when compared to hamstring and groin injuries, and they also have a greater likelihood of recurring. Intramuscular strains of the musculotendinous junction are frequently observed in RF injuries (2, 3). Approximately 94% of RF injuries essentially affect the proximal tendons, with the indirect tendon being more typically affected (56%) than the direct tendon insertion. RF injuries are classified into subgroups to guide the specific anatomical therapeutic method. The subgroups include myofascial (MF) strains, myotendinous (MT) strains, free tendon (FT) tears, and anterior inferior iliac spine (AIIS) avulsions (4). The MT injury refers to any area of the RF that experiences

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muscle extension. Conservative treatment methods, including rest, reduced activity, physical therapy, and the administration of analgesics, are commonly employed as the initial course of treatment. Surgical intervention is necessary when there is a direct tendon avulsion and the tendon has retracted more than 2 cm, as seen on Magnetic Resonance Imaging (5).

Recently, a new treatment method has been introduced among conservative approaches for tendinopathies. Percutaneous Needle Electrolysis Therapy (PNET) is a minimally invasive procedure used to treat musculoskeletal disorders (6). This method involves administering a continuous micro-galvanic electric current to the lesion using an acupuncture needle under ultrasound guidance (7). The galvanic current stimulates a localized inflammatory response by delivering negatively charged ions, promoting the removal of damaged cells by immune cells and facilitating tissue regeneration.

Several studies have investigated the effects of this treatment on pain relief, tissue healing, and the speed of functional recovery in various conditions (6, 7). These include patellar, hamstring, and Achilles tendinopathies, as well as soleus and rotator cuff pathologies (6–9). Although the efficacy of PNET has been demonstrated in tendinopathies and myofascial pain syndrome, its effectiveness in treating acute muscular injuries remains largely unknown.

Here, we present a case of a recreative football player who developed a rectus femoris (RF) tear and was successfully treated with PNET.

CASE REPORTS

A 34-year-old male patient presented to the Physical Medicine and Rehabilitation outpatient clinic with complaints of discomfort in the anterior aspect of his right thigh, which began while shooting during a football match two weeks prior. He had not received any treatment following the injury and had limited his activities by resting.

Clinical examination and magnetic resonance imaging (MRI) revealed a rectus femoris (RF) tear. The patient reported a sudden and intense pain in the front of his thigh at the time of injury. Walking typically aggravated the discomfort. During examination, he exhibited an antalgic gait favoring the right limb.

On physical examination, there was no bruising, discoloration, or visible tissue edema in the right thigh. Palpation revealed localized tenderness, though the RF muscle was intact. Passive range of motion (ROM) in the knee and hip joints was normal, but active hip flexion ROM was limited. The Numeric Rating Scale (NRS) score for pain was 5/10 during walking. Muscle strength was graded 4/5 in both the hip flexors and knee extensors. No pain was reported at rest.

Magnetic resonance imaging (MRI) revealed a partial tear in the central tendon at the anterior part of the rectus femoris (RF) muscle, accompanied by edema at the musculotendinous junction **(Figure 1).** Ultrasound examination confirmed a partial rupture of the RF muscle in close proximity to the central tendon **(Figure 2).**Based on the mechanism of injury, clinical symptoms, and imaging findings (MRI and ultrasound), the patient was diagnosed with a musculotendinous tear of the rectus femoris.

The patient was initially advised to follow the PEACE & LOVE protocol, an evidence-based guideline for managing soft tissue injuries. The acronym stands for: Protection, Elevation, Avoid anti-inflammatories, Compression, Education & Load, Optimism, Vascularisation, and Exercise. During the early phase of recovery, emphasis was placed on the LOVE components to alleviate pain and discomfort.

After the first week, the patient began weekly sessions of Percutaneous Needle Electrolysis Therapy(PNET) to expedite recovery and support return to activity **(Figure 3).** The treatment protocol included ultrasound-guided PNET at an intensity of 350 microamperes (μA) for 80 seconds, applied to the clinically painful areas. In addition to PNET, the patient followed a home-based rehabilitation program consisting of eccentric and isometric strengthening exercises, initiated 24 hours after each session. During follow-up, the patient reported progressive improvement in daytime Numeric Rating Scale (NRS) pain scores.

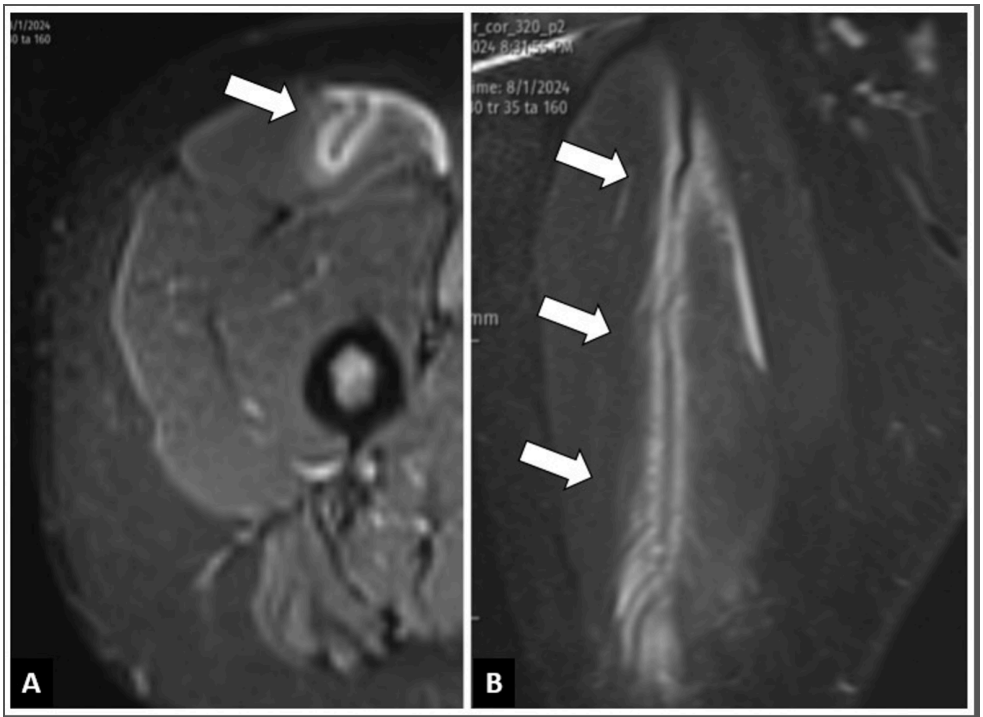

Figure 1. Right thigh axial (A) and coronal (B) T2 short tau inversion recovery (STIR) showing extensive high signal intensities at the myotendinous junction indicating central rectus femoris tear. Figures illustrating also focal central intramuscular hematoma with edema (arrows).

The following rehabilitation program was recommended for the patient: eccentric exercises and active range of motion (ROM) exercises, performed three times per week for a duration of four weeks. Written informed consent was obtained from the patient for all treatment procedures.

Resistance training targeting the major muscle groups around the knee and hip joints was prescribed at 60-80% of the one-repetition maximum (1-RM), with three sets of 10-15 repetitions per session. The eccentric component consisted of three sets of up to 15 repetitions of eccentric exercises performed daily. These exercises specifically targeted the injured region and were performed within a range of motion that induced only mild discomfort, without impairing normal mobility.

To prevent aggravation of the injury, excessive stretching activities were discouraged, as they could potentially worsen the musculotendinous condition.

DISCUSSION

Percutaneous Needle Electrolysis Therapy (PNET) is a minimally invasive procedure used to address a range of musculoskeletal conditions (6). Initially developed for the treatment of chronic patellar tendinopathy (7), its clinical applications have since broadened significantly. Numerous studies have investigated the effects of PNET on pain relief, tissue healing, and the speed of functional recovery in various conditions, including chronic soleus injuries, rotator cuff pathologies, hamstring tendinopathy, Achilles tendinopathy, carpal tunnel syndrome, and lateral epicondylalgia. In these conditions, PNET has demonstrated efficacy, particularly in the management of tendinopathy and myofascial pain syndrome (8, 9). However, its utility in acute muscular injuries remains largely unexplored (6).

PNET operates by inducing a controlled inflammatory response in the treated tissue. A galvanic current is delivered through a needle (acting as a cathode), causing a significant local pH increase that can hydrolyze scar tissue. This response is part of the mechanism that stimulates tissue healing (10). Biological tissues primarily contain sodium chloride (NaCl) and water (H_2O). During electrolysis, the galvanic current separates these into their constituent components, producing sodium hydroxide (NaOH), chlorine gas (Cl_2), and hydrogen gas (H_2). NaOH, commonly known as caustic soda, has a highly alkaline pH and contributes to the local biochemical changes that facilitate healing.

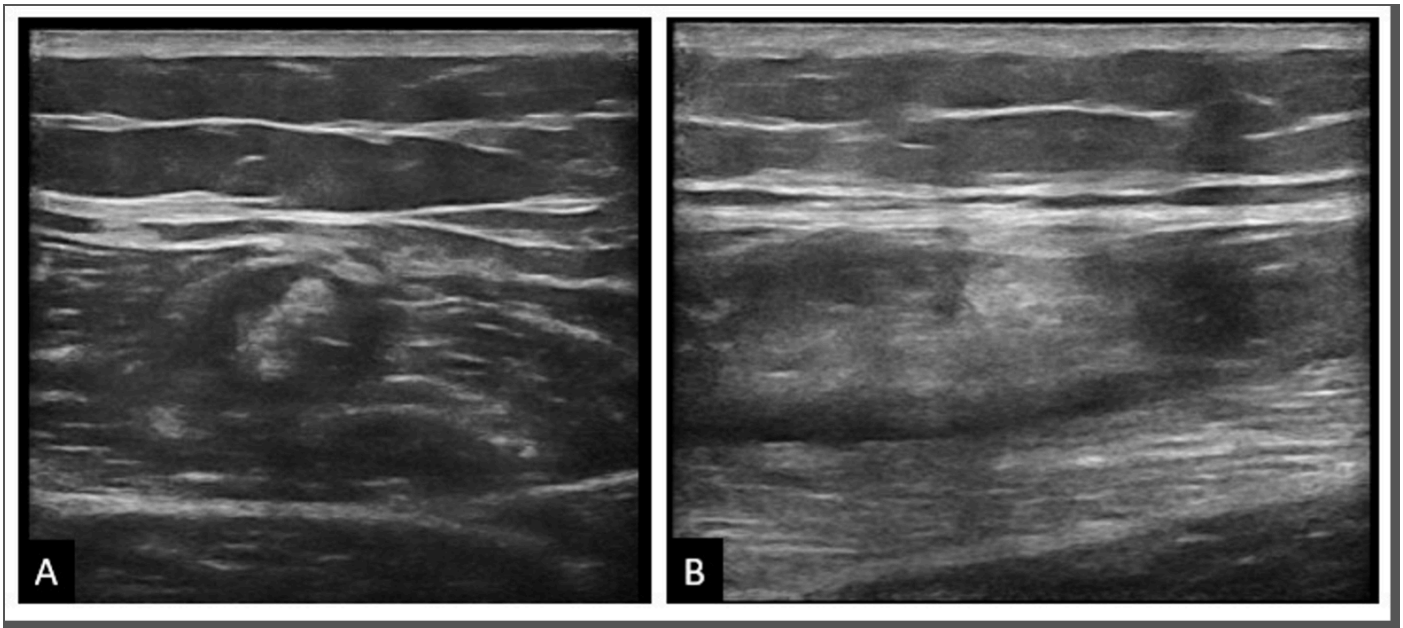

Figure 2. An axial (A) and longitudinal (B) ultrasound examination revealed a partial rupture of the rectus femoris muscle in close proximity of the central tendon.

Figure 3. The image shows ultrasound-guided PNET session for rectus femoris muscle tear.

The rise in NaOH levels has been linked to the induction of an inflammatory response. While traditionally attributed to this chemical effect, a newer hypothesis suggests that the inflammatory response may also be mediated through activation of the nucleotide-binding domain and leucine-rich repeat protein-3 (NLRP3) inflammasome (11). NLRP3 plays a critical role in regulating inflammation following tissue injury by activating inflammatory caspase-1, which in turn cleaves pro-inflammatory cytokines in the IL-1 family. This process leads to the release of interleukin-1β (IL-1β) and interleukin-18 (IL-18), which contribute to inflammation and subsequent healing (12, 13). Current hypotheses for PNET's therapeutic effects focus on both the chemical (NaOH-mediated) and immunologic (NLRP3-mediated) pathways.

According to a systematic review (13), PNET may act as a modulator of inflammation. In chronic conditions characterized by low inflammatory activity, PNET can induce a local pro-inflammatory effect to initiate the healing process. Conversely, in highly inflammatory environments-such as those seen in acute injuries-PNET may help downregulate excessive inflammation, thus preventing tissue damage and promoting recovery. The initial inflammatory effect of electrolysis typically persists for up to seven days post-treatment. From day seven onward, PNET has been shown to support healing by enhancing extracellular matrix synthesis.

In conclusion, PNET functions as a modulator of inflammation and has demonstrated efficacy in reducing pain and improving functional outcomes in both chronic tendinopathies and acute muscle injuries. Performing PNET under ultrasound guidance is essential for targeting

the affected area precisely, optimizing treatment outcomes, and minimizing the risk of adverse effects or complications.

Conflict of Interest / Çıkar Çatışması

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