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A Case Study: Immediate Effects of Dry Needling with Direct Current on a Patient with Anterior Knee Pain

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Abstract

Anterior knee pain could be caused by excessive lateral patellar displacement rooted from over-activation of vastus lateralis. In this prospective observational case study, the effectiveness of dry needling with direct current in a male adult with anterior knee pain was documented with surface electromyography and magnetic resonance images. After a single-session treatment, a comparison between pre- and post-treatment electromyographic data and medical images revealed that the muscle tension and lateral patellar displacement were reduced; those biomechanical changes likely contributed to a decrease on the numeric pain rating scale reported by the patient. The positive finding in the present case warrants further investigation.

I. Introduction

The anterior knee pain affects approximately 25% of the population at some stage of their lives; if the pain is chronic that can be a disabling condition and can drastically limits daily activities. Excessive lateral patellar displacement, associated with over-activation of vastus lateralis or weakness of vastus medialis, has been long regarded as one of the causing factors [1]. The displacement can lead to strain on the retro-patellar subchondral bone during movements (Figure 1), thus it is also named as lateral patellar compression syndrome (LPCS) [2]. The present paper illustrates a patient with LCPS treated by dry needling with direct current and relevant immediate physiological effects.

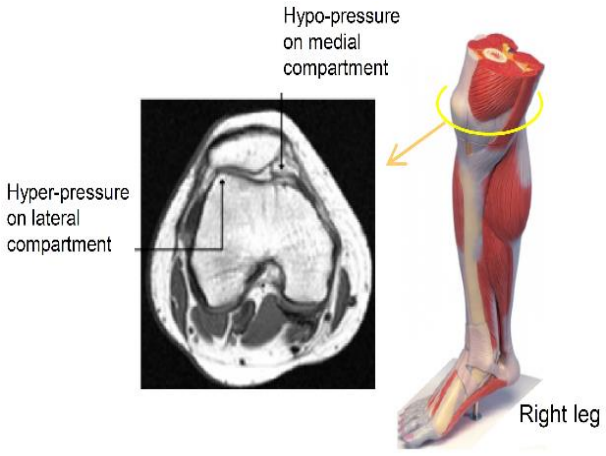

Figure 1: Lateral patellar compression syndrome

II. Clinical case

Patient:
A 29-year-old male, amateur soccer player for 4 years.

Complaint:
Right anterior knee pain for the past 8 months which was aggravated by squat or running. Recently he retained from sport activates due to the pain.

Diagnosis:
LPCS, right side. No other medical conditions.

1. Pre-treatment evaluations:

a. Surface electromyography (EMG):
Two surface EMG electrodes (Flexcomp, Thought Technology Ltd., Canada) were placed on the distal portion of vastus medialis and lateralis muscles for detecting the electrical signal of muscular activities while the patient performed right single-leg isometric squat at 45-degree knee flexion for 10 seconds (Figure 2). The collected EMG data indicated that the average EMG signal was 153 micro-volts for the vastus medialis and 231 micro-volts for the vastus lateralis. This implies that the vastus lateralis was relatively overactive [1,3].

b. Numeric pain rating scale:
The knee pain during the above isometric squat, the score was 5/10 before treatment.

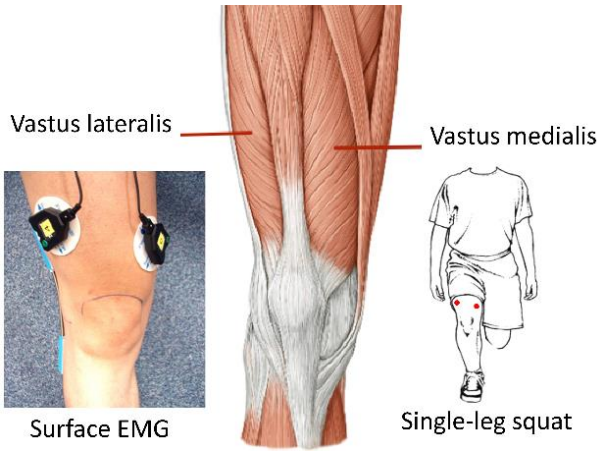

Figure 2: Surface EMG for vastus muscles

c. Magnetic resonance imaging (MRI):
MRI (Magneton Avanto 1.5T, Siemens Medical Solutions, Inc., USA) was used to scan the affected knee and determine the degree of lateral patellofemoral displacement in supine lying position. The patient was asked to isometrically contract the quadriceps and worked against his own lower-leg weight for 60 seconds while the knee flexion angle was 15-degree. The MRI revealed the presence of lateral patellar displacement (Figure 3A) [4].

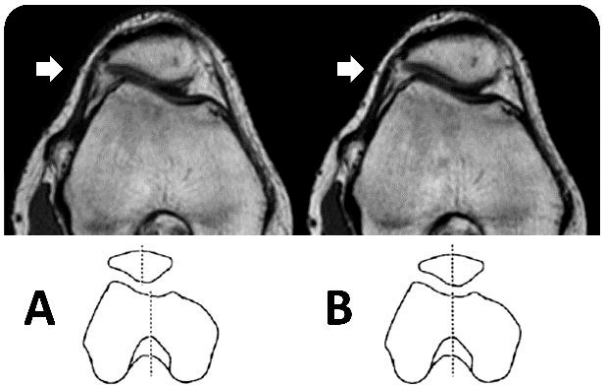

Figure 3: A = pre-treatment. B = post-treatment. Dash-lines were used to illustrate the relative patellar positions. Both A and B shown the lateral patellar displacement, but the B is of less severe.

2. Treatment:
The patient was treated using three acupuncture needles (L-type needle, gauge 3, Seirin Corporation, Japan) inserted 2-cm deep into the vastus lateralis at points $F_6$12-14, a direct current of 12 volts and 200 micro-amperes was applied for 30 seconds for each needle using a Ryodoraku device (ES-160, ITO Co. Ltd., Japan) .

3. Post-treatment evaluations:
Immediately after the treatment, surface EMG and MRI were repeated in order to detect possible changes induced by the needling.

a. Surface EMG: The average EMG signal was 164 micro-volts for the vastus medialis and 187 micro-volts for the vastus lateralis. This means the vastus lateralis was less tense after the treatment.

b. **Numeric pain rating scale:** The score for right knee decreased from 5/10 to 1/10 after the treatment.

c. **MRI:** The figure 3B indicated that the patellar position was less laterally displaced after the treatment.

III. Discussion

Based on the above, the lowered muscular activation of the vastus lateralis likely contributed to the improved patellar position after treatment, then the more optimal patellofemoral joint contact led to reduced intra-articular pressure as well as the knee pain. We propose that the over-activation of vastus lateralis may be caused by improper function of motor end plates with an excessive release of acetylcholine, and the needling with direct current may damage the motor endplates in a controlled manner. The damage may suppress motor endplate activity, such as depleting acetylcholine levels, thus reduce the muscle tension of vastus lateralis [5].

There are limitations in the present study, firstly it did not include a long term follow-up for the patient, thus cannot confirm how long the therapeutic effects can last. Also, a possibility cannot be ruled out which the vastus lateralis adapts to the needling over time as the recognized EMG and MRI observations may change with repeated treatments.

IV. Conclusuion

The observations in the present case study point to clinically relevant beneficial effects of dry needling with direct current in a patient with LPCS and warrant further investigation.

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