The Efficacy of Ultrasound-Guided Intra-Articular Pulsed Radiofrequency for Hip Osteonecrosis: A Case Report

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Abstract: Osteonecrosis of the hip is a common cause and the ultimate destination of total hip arthroplasty. The current conservative treatments are typically not effective or short-lived. Recently, a few studies have shown some benefit of intra-articular pulsed radiofrequency (PRF) on chronic painful joints, e.g. knee osteoarthritis, atlantoaxial joint, cervical facet joint, sacroiliac joint, scapholunate, and shoulder joint. However, there is no report describing the effect of intra-articular PRF on the hip joint.

We describe successful long-term pain relief using ultrasound-guided intra-articular PRF in a 43-year-old man with left hip osteonecrosis. Thirty minutes after treatment, the patient reported decreased pain from 6 to 2 on the visual analogue scale (VAS) with no side effects observed. Ten months after PRF therapy, the patient’s VAS score remained more than 50% lower than the baseline and no additional conservative treatment was needed during the follow-up period.

To the best of our knowledge, this is the first reported case of the long-term benefits of ultrasound-guided intra-articular PRF in reducing pain in a patient with hip osteonecrosis. Ultrasound-guided intra-articular PRF is a simple, safe, and easily learned technique.

Keywords: Ultrasound-guided, Pulsed radiofrequency, Osteonecrosis, Avascular necrosis.

1. INTRODUCTION

Osteonecrosis (also known as avascular necrosis) of the hip is a common cause and often results of a total hip arthroplasty. The underlying causes of hip osteonecrosis are multifactorial and poorly understood [1]. There are approximately 10000 to 20000 newly-diagnosed patients in the United States each year [2]. Conservative treatments recommended in the early stages include restriction of weight-bearing, medication, local anesthetic injection, shock wave therapy, hyperbaric oxygen, or pulsed electromagnetic fields, but the effectiveness of these treatments is typically limited or short-lived. Operative managements, including core decompression, osteotomy, vascularized/nonvascularized bone-grafting, and joint arthroplasty, are often recommended in the middle to late stages [3]. However, the long recovery times and short life spans of hip joints limit the efficacy of these procedures. Moreover, the operation is contraindicated for some people [2].

Pulsed radiofrequency (PRF) is designed to alleviate pain by delivering an electrical field and heat bursts to neural tissue at a temperature less than 42°C [4,5]. In contrast to conventional radiofrequency, PRF maintains temperatures below 42°C and does not damage nerves. Many studies have shown its effectiveness in reducing pain for certain chronic pain conditions [6-11]. Some authors perform intra-articular PRF on the chronic painful joints e.g. knee osteoarthritis [6-8], shoulder joint [9], cervical facet joint [10], sacroiliac joint [10], scapholunate [10], and atlantoaxial joint [11] due to the difficulties of a direct nerve block on the complex or small supplying nerves of these joints. Excellent long-term effects have been reported in these cases. However, there is no report demonstrating intra-articular PRF on the hip joint. We have therefore described our successful experience of long-term pain relief by using ultrasound-guided intra-articular PRF in a patient with hip osteonecrosis.

2. CASE PRESENTATION

A 43-year-old man was diagnosed with bilateral hip osteonecrosis in August 2013 (more severe on the right side). A total replacement of the right hip was performed in January 2014 due to persistent pain, which was poorly controlled by conservative treatments (Figure 1). After surgery, despite some reduction of pain and increased range of motion (ROM) in the right hip, the activities of daily living (ADL) were still limited due to the intermittent pain. In July 2014, the patient started to experience increased pain over the left hip. Initially, he responded relatively well to analgesics, intra-articular hyaluronic acid injections, and shock wave therapy, but
the effects were short-lived. Progressive difficulties in walking, going upstairs, and squatting were noted. The pain visual analogue scale (VAS) score was about 6 and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was 141 [12,13]. He refused treatment with a total hip arthroplasty in the left hip for personal reasons and conservative treatments were not effective. In order to relieve the pain, he agreed to try intra-articular PRF under ultrasound guidance.

Figure 1: Radiograph of the pelvis (anterior-posterior view) following right hip arthroplasty and showing advanced degenerative changes with subchondral cyst and osteonecrosis on the left side.

The procedure took place on 26 January 2015. The patient was placed in a supine position with slight hip abduction. Musculoskeletal ultrasonography (Terason, t3000, Teratech, Massachusetts, USA) was used for guidance. The probe was covered with an adhesive sterile dressing and was placed parallel to the left femoral neck. The femoral head, femoral neck, and anterior capsular recess were identified. A 54-mm radiofrequency probe with a 4-mm active tip was then inserted in-plane into the anterior capsular recess, using real-time ultrasound guidance (Figure 2).

When the needle tip was clearly visualized in the joint space, the sensory (50-100 Hz, 1 ms pulse width, up to 0.5 volt) and motor (2 Hz, 1 ms pulse width, up to 1 volt) stimulation were tested and the patient did not report feeling specific discomfort [14]. Thereafter, PRF lesioning was performed for 480 seconds with 2 Hz, 30 ms pulse width at 42°C. Thirty minutes after treatment, the patient reported decreased pain (VAS reduced from 6 to 2). No particular side effects were observed. Ten months after PRF therapy, the patient’s VAS score remained more than 50% lower than the baseline and he did not need additional conservative treatment during the follow-up period. The follow-up WOMAC score was 74 and ADLs as well as passive ROM of his left hip also improved. The patient was satisfied with the ultrasound-guided intra-articular PRF treatment.

Figure 2: Real-time imaging of needle insertion for the ultrasound-guided intervention. FH = Femoral head, FN = Femoral neck, AJR = anterior joint recess.

3. DISCUSSION

The sensory innervation of the hip joint capsule is complicated and can be divided into four parts, including the anteromedial, anterolateral, posteromedial, and posterolateral sections, innervated by the articular branches of the obturator nerve, femoral nerve, sciatic nerve, and superior gluteal nerve respectively [15]. Although PRF targeted at the articular branches of the obturator and femoral nerves under fluoroscopic guidance has been reported as an alternative method for treating hip joint pain, the technical difficulties associated with nerve blocks limits its popularity and use in clinical practice [16].

Sluijter et al. [10] first revealed the effectiveness of intra-articular PRF in six patients with arthrogenic pain.
in the cervical facet, knee, sacroiliac, shoulder, radiocarpal, and atlantoaxial joints. The effective duration of pain relief persisted from several months to one year without recurrence. Subsequent studies also supported the use of intra-articular PRF as a novel alternative treatment in certain joint disorders [6-9, 11]. Halim et al. [11] applied fluoroscopy-guided PRF to the lateral atlantoaxial (C1-2) joint in patients with cervicogenic headache (n=86) and reported long-term efficacy (nearly one year). Karaman et al. [8] performed a retrospective analysis and found significant pain relief at the first and six-month follow-up after blind intra-articular PRF in 31 patients with knee osteoarthritis. Masala et al. [6] also reported significant pain relief one year after intra-articular PRF under fluoroscopic guidance in 40 patients with knee osteoarthritis. The present case is consistent with these previous studies. To the best of our knowledge, this is the first reported long-lasting successful ultrasound-guided intra-articular PRF in a patient with hip osteonecrosis.

The precise mechanism of intra-articular PRF is poorly understood. PRF might suppress the excitation of C-fiber response and synaptic transmission to cause desensitization of nerve endings in the joints. This might explain the immediate pain relief in small joints [10]. Moreover, the electric field produced by PRF might gradually influence the immune cells and diminish the production of inflammatory cytokines such as interleukin-1 beta, tumor necrosis factor alpha and interleukin-6 [10]. Further studies are needed to reveal the actual mechanism.

Over the past decade, ultrasound-guided intra-articular hip injection has been verified as an effective and safe technique [17]. In contrast to fluoroscopy- or CT-guidance, which have been most commonly used for PRF in the past, ultrasound-guided injections provide real-time convenience and visualization of the needle and target tissue to avoid the associated complications [5]. Moreover, the ultrasound-guided method does not involve radiation exposure and is less expensive than other methods. Ultrasound-guided intra-articular PRF is a simple, safe, and easily-learned technique.

4. CONCLUSION

Ultrasound-guided intra-articular PRF may provide long-term effects in patients with osteonecrosis of the hip. A prospective, placebo-controlled, randomized study is ongoing to investigate the long-term efficacy of the technique.

REFERENCES


