Percutaneous radiofrequency in management of chronic pain in osteoarthritis

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Aims and objectives

Osteoarthritis (OA) is the most common chronic joint disease and its prevalence is increasing in adults aged 50 years and over [1]. The hip OA has the worst outcome and patients have also the worst work ability scores [2, 3]. Radiographic signs of OA early appear in joints underload as knee one [4]. The peak onset of "hallux valgus" is around the age of 30-60 years, although it has been reported being highly prevalent among older people [5, 6]. A study found that up to 37% of over 65-year-old people experience a degree of the deformity [7].

Conservative treatments for OA include pharmacological and physical approaches, followed by intra-articular injections of drugs and devices [8, 9, 10]. In advanced OA pain relief usually lasts a few months and it is necessary to repeat the procedures [8, 10]. The surgical management is not appropriate solution to all patients with regards to pain management [11, 12]. In recent decades radiofrequency (RF) has been introduced in the management of chronic pain in patients with OA [13]. This is a prospective, non randomized study, which reports the results of a three-years single-center experience in management of chronic pain with palliative intra-articular RF.
Methods and materials

Between October 2010 and December 2013 RF was performed on 254 patients (138 male; 116 female) (Median age of 67.4; Range 50.3-90.8 years). These patients were divided as follows: 80 had third or fourth degree trapezio-metacarpal OA according to the Eaton and Glickel classification; 58 patients were enrolled for a moderate or severe hallux valgus (Manchester scale); 40 patients were treated for a third or fourth degree painful coxo-femoral OA (Kellgren-Lawrence scale); 76 had moderate or severe femoro-tibial OA (Kellgren-Lawrence scale). All patients were refractory to conservative therapies for at least six months. Surgery was contra-indicated or not preferred from all patients. An electromyography or imaging techniques (Ultrasonography or Magnetic Resonance) were performed in cases where the cause of the pain was questionable, e.g. to exclude soft tissue diseases. All patients had no history of psychiatric disorders, rheumatologic diseases, system or local infection, trauma, coagulation disorders or excessive use of opioids. In patients with a bilateral pathologic condition, the most symptomatic side was only treated.

Topical anesthesia was not necessary and the skin was disinfected with a iodine antiseptic solution. Under fluoroscopic guidance a cannula, with different caliber and length according to the target joint, was placed intra-articularly with a percutaneous access (Fig 1). After removing the spindle, a RF needle, with a proper "active tip", was introduced with a co-axial technique (Fig. 2). No sensorial or motor stimulation was needed. RF was performed in Pulse-Dose modality (Pulse-Dose Radiofrequency, PDRF). The following parameters were used: 1200 pulses at high voltage (45 V) with 20 msec duration, followed by 480 msec silent phases. After the end of the procedure, patients remained in our department for 30 minutes. In the following days they could use some analgesic drugs, if they felt pain, and moved the treated joint as comfort allowed.

A clinical follow-up visit was performed at 1 month, 3 months and 6 months. Pain relief was measured at rest with visual analogue scale (VAS) at the baseline and during each follow-up visit. Because the analgesic effect finished 6 months after the first PDRF treatment, in all patients PDRF was again performed between 7 and 9 months after the first treatments with a new follow-up scheme at 1 month, 3 months, 6 months and 9 months.

The Student t test was used to compare the means VAS scores of each follow-up with their respective baselines. A p value less than 0.05 was considered statistically significant in all analyses.
**Fig. 1:** Under fluoroscopic guidance a cannula, with different caliber and length (20 G and 10 cm length for coxo-femoral and femoro-tibial joint, 22 G and 5 cm length for trapezio-metacarpal and first metatarso-phalangeal joint) according to the target joint, was placed intra-articularly with a percutaneous access.

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Fig. 2: After removing the spindle, a RF needle, with a proper length "active tip" (10 mm for coxo-femoral and femoro-tibial joint, 5 mm for trapezio-metacarpal and first metatarso-phalangeal joint) according the treated joint, was introduced with a co-axial technique. No sensorial or motor stimulation was needed.

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Results

Procedural success, defined as the correct positioning of the device, was achieved in all procedures. Figures 3 to 6 showed the intra-procedural positioning and the fluoroscopic control of the RF needle.

All of the patients had pain relief the initial 3 months after the PDRF. The analgesic effect began to cease 4 months after the PDRF with a return back to the pre-procedural values at 6 months follow-up visit (Fig. 7). The second PDRF treatment was performed between 7 and 9 months after the first procedure. The VAS scores had a similar outcome to the values recorded after the first treatment (Fig. 8).

After the first PDRF treatments authors observed statistically significant differences between the pre-procedural values and the means VAS Scores, reported at each follow-up visit (p<0,05). In all patients treated with two PDRF procedures, there were statistically significant differences with a p value <0,05 between the mean VAS scores recorded at 6 months after the first treatments (considered as the new baseline), and the means VAS Scores recorded at every clinical follow-up after the second PDRF.

No complications were recorded.
**Fig. 5:** A RF needle with a 5 mm active tip is placed in the trapezio-metacarpal joint space. Intra-procedural image (A) and fluoroscopic control (B). The needle is correctly placed.

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**Fig. 7:** Means VAS Scores of the 4 groups of patients before the first mini-invasive procedure of PDRF and after 1 month, 3 months and 6 months.
**Fig. 3:** A RF needle with a 10 mm active tip is placed in the femoro-tibial joint space. Intra-procedural image (A) and fluoroscopic control (B). The needle is correctly placed.
Fig. 4: A RF needle with a 5mm active tip is placed in the first metatarsophalangeal joint space. Intra-procedural image (A) and fluoroscopic control (B). The needle is correctly placed.

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**Fig. 8:** Means VAS Scores of the 4 groups of patients before the second mini-invasive procedure of PDRF and after 1 month, 3 months, 6 months and 9 months.

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**Fig. 6:** Antero-posterior fluoroscopic control. A RF needle with a 10 mm active tip is correctly positioned in the coxo-femoral joint space.

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Conclusion

The study documented the role of PDRF as palliative technique in management of chronic pain in joint degenerative pathology. A RF generator creates an high-frequency alternative electrical current, which is transferred by a needle with an "active tip" positioned near the target tissue [14, 15, 16].

According to the modality of current transfer, there are three RF technique: continuous radiofrequency (CRF), pulsed radiofrequency (PRF) and PDRF. In CRF the purpose is the lysis of the target nerves with a local temperature between 60° and 80°C [14, 15, 16].

In PRF technique, the RF generator sends pulses of electrical current and the operator can decide the number of pulses. Pulse parameters include an amplitude of 45 V, a duration of 20 ms, followed by a silent phase of 480 ms [14, 15, 16]. The purpose is to reach a tissue temperature under 45-50°C without causing an irreversible damage [14, 15]. The RF generator modifies the pulses amplitude or duration if the tissue temperature exceeds the desired not-lytic values [16]. PDRF is a technical evolution of PRF [13, 14]. In PDRF as in PRF pulse parameters are exactly the same; if the temperature is too high, when PDRF is performed the generator does not send pulses (no pulses parameters are modified), until a value under 45-50°C is again recorded [14, 15, 16].

The PDRF mechanism of action remain unclear. Some studies about PRF biological effects have been published. Since PDRF is a technical evolution of PRF, the biological PRF effects should be expected when PDRF is performed. A neuro-modulatory effect was documented on nerve fibers with ultrastructural changes of the nociceptive C- and A-delta fibers [17]. An anti-inflammatory effect was also reported with inhibit production of pro-inflammatory cytokines as interleukin-1β and interleukin-6 [18]. No long-lasting effects were found [13].

In this study PDRF has been performed with promising results to manage chronic pain in OA. PDRF is a palliative treatment for OA. Authors treated patients who did not respond to conservative therapies for at least six months and surgery was contra-indicated or not preferred.

The pericapsular nerve-endings with a sensitive function are the target and motor stimulation is not needed [13, 14, 15]. The fluoroscopic control is only needed for the correct positioning of the device in the joint space, therefore the exposure to ionizing radiation is minimal.
PDRF clearly provides short term pain relief. However, there is a rapid recurrence of symptoms. Authors repeated two times the treatment without any complications.

Finally percutaneous RF is an effective, safe and repeatable technique for management of chronic pain. A more larger, randomized and controlled study is needed to confirm these results.
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