Pulse-Dose Radiofrequency on trapezio-metacarpal osteoarthritis

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Aims and objectives

Osteoarthritis (OA) has a growing prevalence in people over 50's [1]. In terms of frequency OA affects hand joints, after knee and hip ones [2]. Trapeziometacarpal joint (TMJ) and interphalangeal ones can be involved.

Clinical presentation comprehends spontaneous pain or pain elicited by compression at the base of the thumb and, late, a limited range of motion caused by formation of ostheophytes [3]. Pinch and grasp maneuvers, circumduction and opposition movements may arouse a painful condition [3].

X-Ray has a pivotal role in staging the Trapezio-metacarpal Osteoarthritis (TMOA) [3, 4, 5]. The antero-posterior (AP) and lateral views are mandatory, but the oblique projection (forearms as in AP projection and hands in partial pronation) is more specific for an optimal evaluation of TMJ.

In the Eaton and Glickel classification TMOA is divided in four stages [3, 4, 5].

Conservative therapies are useful in early stages and comprehend pharmacological (analgesic and anti-inflammatory drugs) and physical (ionophoresis, ultrasound and electrotherapy) treatments [4, 6].

In advanced TMOA mini-invasive treatments are attempted as intra-articular injections of anesthetics, steroids or hyaluronic acid (HA) [7, 8, 9]. Serious adverse effects may be observed after surgical therapies [3, 10].

Purpose of our study was to evaluate the effectiveness and the safety of the Pulse-Dose Radiofrequency (PDRF) in palliative management of chronic pain in patients with TMOA refractory to conservative therapies.
Methods and materials

The study was approved by our institutional review board.

Between October 2010 and January 2013 PDRF was performed on 67 patients (28 male; 39 female) (Median age of 72.8; Range 55.7-85.8 years) with TMOA refractory to conservative therapies for at least six months.

Clinical and radiological criteria were used for enrolling patients.

Clinical examination documented a spontaneous pain or pain elicited by compression at the base of the thumb. Pinch and grasp maneuvers, circumduction and opposition movements increased pain intensity [3].

X-ray examinations with PA, lateral and oblique views documented a 3rd (bone sclerosis, narrowing or obliteration of the joint space, osteophytes >2mm in size, different degree of subluxation) or 4th (OA involving the joints between the trapezium and other carpal bones) TMOA degree according to Eaton and Glickel classification (Figure 1) [3, 5].

All patients had no history of psychiatric disorders, rheumatologic disease, system or local infection, trauma, coagulation disorders or excessive use of opioids.

Patients did not feel relief with conservative therapies for at least six months. All patients refused surgery.

Pain intensity was recorded on a 10-cm Visual Analogue Scale (VAS), ranging from zero (no pain) to 10 (maximum pain ever had) [11].

If some patients had bilateral 3rd or 4th degree TMOA, we only treated the TMJ with the VAS intensity the highest.

Procedures were performed in an angiographic suite with the seated patient and the affected hand in a prone position on the fluoroscopic table. The thumb was abducted. Topical anesthesia was not necessary.

The AP fluoroscopic projection of the TMJ was obtained in order to make the trapezium and 1st metacarpal bone outlines as aligned as possible. A 22 gauge Radiofrequency (RF) cannula with a 5 cm length was introduced with a percutaneous access and placed in an equidistant point from the trapezium and the 1st metacarpal bone lateral borders under fluoroscopic control. Therefore the cannula's tip was placed intra-articularly (Figure 2). After removing the spindle, a RF needle with a 5 mm active tip was introduced (Figure 3).

The RF needle was positioned in the joint space in order to treat pericapsular nerves endings with a sensitive function.
The following parameters were used to perform PDRF: 1200 pulses at high voltage (45 V), with 20 milliseconds duration followed by 480 milliseconds silent phases. Purpose was to reach a tissue temperature under 45-50°C in order to arouse a neuromodulatory effect on pericapsular nerve endings.

After the end of the procedure, patients remained in our departments for 30 minutes and, then, they were discharged home.

Pain intensity increased between 4 and 8 months by PDRF, therefore we performed a second treatment in all patients between 7 months and 9 months after the first procedure.

For each patient a follow-up was performed with a clinical examination at 1 month, 3 months and 6 months after first procedures. A new follow-up was realized at 1 month, 3 months, 6 months and 9 months by second PDRF treatments. Every time VAS intensity was recorded.

The paired samples t test was used to compare the means VAS scores of each follow-up with their respective baselines. A p<0.05 was considered statistically significant in all analyses. The values were given as mean ± standard deviation.
Images for this section:

**Fig. 2:** A 22 Gauge cannula with a 5 cm length introduced in the TMJ space: A. Positioning of the cannula; B. AP fluoroscopic projection.

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**Fig. 3:** A RF needle with a 5 mm active tip placed intra-articularly: A. Positioning of the needle; B. AP fluoroscopic control.

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Fig. 1: X-Ray documented an advanced TMOA according to the Eaton classification.

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Results

The mean pre-procedural VAS scores was 8.5±1.1.

The means VAS scores were 2.3±0.7 at 1 month’s (p<0.05) and 3.1±0.9 at 3 months' follow-up (p<0.05).

The mean VAS Scores increased to 7.7±1.3 after 6 months by first treatments (p<0.05).

In all patients the second treatment was performed between 7 and 9 months after PDRF and the following means VAS scores were documented: 2.5±0.4 at 1 month (p<0.05), 3.3±0.8 at 3 months (p<0.05), 6.9±0.8 at 6 months (p<0.05), 7.8±1.6 after 9 months (p<0.05) by the second PDRF procedure.

No complications were observed.
In RF techniques a generator creates an alternative electrical current (in the frequency of radio waves) and a needle with an "active tip", which is positioned near the target tissue, transfers the current [12, 13].

In CRF the result is a tissue temperature between 60° and 80°C with the lysis of the target nerves [14].

In PRF technique a selected number of pulses of electrical current, which are created by the RF generator, can be transferred to the target. Pulses parameters include an amplitude of 45 V and a duration of 20 ms; a silent phase of 480 ms follows each pulse [12]. In this way the tissue temperature reaches a value under 45-50°C without causing an irreversible damage [15, 16]. Tissue temperature can exceed non-lytic values; therefore, the RF generator modifies parameters of next pulses until the temperature return to 45-50°C: the signal amplitude (Volt) or the pulse duration are often modified [13].

Sluijter et al. affirmed an anti-inflammatory effect of PRF: radio waves affect immune cells and inhibit production of pro-inflammatory cytokines as interleukin-1β and interleukin-6 [17].

PDRF is a technical evolution of PRF [18, 19]. In PDRF as in PRF pulse parameters include an amplitude of 45V and an "active phase" with a 20 milliseconds duration, followed by a 480 milliseconds silent phase [18, 19].

In PDRF, if the tissue temperature exceeds 45-50°C, the RF system stop next pulses (no pulses parameters are modified), until the temperature does not reach normal values [18, 19].

In 2013 Masala S. et al. documented PDRF clinical effectiveness (pain relief) and safety (absence of complications) when this technique is performed as a palliative care in knee OA and pudendal neuralgia (PN) [18, 19].

In our study PDRF has been performed in TMOA with good results in the mild period. PDRF is a palliative treatment for OA. Patients had a pain relief in the first months after treatments, but we noticed pain intensity again increased after 4-8 months by PDRF. PDRF does not modify the OA progression. Patients used their hands thanks to the low pain intensity, but this condition can expedite OA progression. Some authors documented histological neuromodulatory effects without the lysis of the nerve-endings, therefore painful symptomatology increased when the PDRF effectiveness finished and nerve-endings recovered their functions.
The PDRF safety is also documented by the intra-articular approach. In this way the pericapsular nerve-endings fibers with a sensitive function were the targets; motor nerve fibers could not be damaged. During the trial no complications were observed.

In conclusion this study documented PDRF can be used in management of chronic pain in patients refractory to conservative therapies. PDRF is also a therapeutic choice in patients who refused surgery.

This study has some limits: the low number of involved patient and the short-term follow-up. It is necessary a prospective, double-bind, randomized clinical trial which may confirm the results showed in our investigation.
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