An experimental study of Radiofrequency ablation for chronic hip pain

ABSTRACT

Introduction: From 10% to 15% of patients with hip arthrosis suffer from comorbidities which contraindicate THA as a therapeutic option. Radiofrequency offers a promising and minimally invasive alternative for effective pain management and functional improvement in non-surgical patients.
Objectives: To evaluate the effectiveness of radiofrequency (RF) rhizotomy for managing chronic pain in patients with hip osteoarthritis and to describe the surgical technique.
Study design: Experimental study with a 12-month prospective follow-up.
Setting and Duration of the Study: Orthopaedic pain management unit of the Interventional Pain clinic over a 12-month period.
Methodology: A total of 22 patients with chronic hip pain due to osteoarthritis were included in an experimental study conducted over a 12-month period. Patients were divided into two groups: the first treated with RF (n=11) and the second with conservative management (n=11). Function and pain were assessed using the WOMAC score and VAS scale at 0, 3, 6, 9, and 12 months. Data were analyzed using ANOVA to determine RF effectiveness.
Results: RF rhizotomy improved by 65% in WOMAC scores at 12 months (51.5 points). ANOVA statistics revealed significant differences over follow-up intervals at 0, 3, 6, 9 and 12 months ($F = 127.0$, $p < 0.0001$), indicating treatment effects. The greatest reduction was observed at 3 months and sustained throughout the follow-up year. Patients treated with RF reported lower analgesic use, and no adverse effects were noted.
Conclusion: Radiofrequency rhizotomy is a safe and effective alternative for managing chronic hip pain in non-candidate patients for THA, offering sustained functional improvement and a low complication rate. Prospective studies are needed to assess its long-term efficacy.

Keywords: *Radiofrequency ablation, radiofrequency rhizotomy, chronic hip pain, Hip osteoarthritis, WOMAC.*

1. INTRODUCTION

The International Association for the Study of Pain defines it as an “unpleasant sensory and emotional experience associated with actual or potential tissue damage”. [1]

According to its duration, pain can be described as acute (less than 3 months) or chronic (greater than 3 months). Because of its physiopathology, pain can be classified into nociceptive (visceral and somatic), neuropathic, and psychogenic. [2]

An estimated of 240 million individuals worldwide have symptomatic OA, including 10% of men and 18% of women. [3]

Conservative treatment of hip pain includes lifestyle changes, low-impact exercise, rehabilitation, and pharmacologic management with topical medications, nonsteroidal anti-inflammatory drugs (NSAIDs), opioids, and corticosteroids, showing an improvement of 85% of the symptoms, according to a review article published in The Clinical Journal of Pain. However, effectiveness depends on the specific cause of hip pain and individual patient characteristics. [4, 5, 6, 7]

From 10% to 15% of patients with hip arthrosis suffer from comorbidities such as osteoporosis, smoking, obesity, dementia, cardiovascular conditions (ischemic heart disease, pacemaker use, hypertension, congestive heart failure, etc.), which contraindicate THA as a therapeutic option. [8, 9, 10].

It is important to highlight the role of hip radiofrequency in managing patients facing various circumstances, such as medical comorbidities, preferences for avoiding surgical procedures, long waiting times for hip arthroplasty, or persistent pain after the procedure. This technique is highly effective, achieving pain reduction in patients ranging from 40% to over 80%. [11, 12, 13]

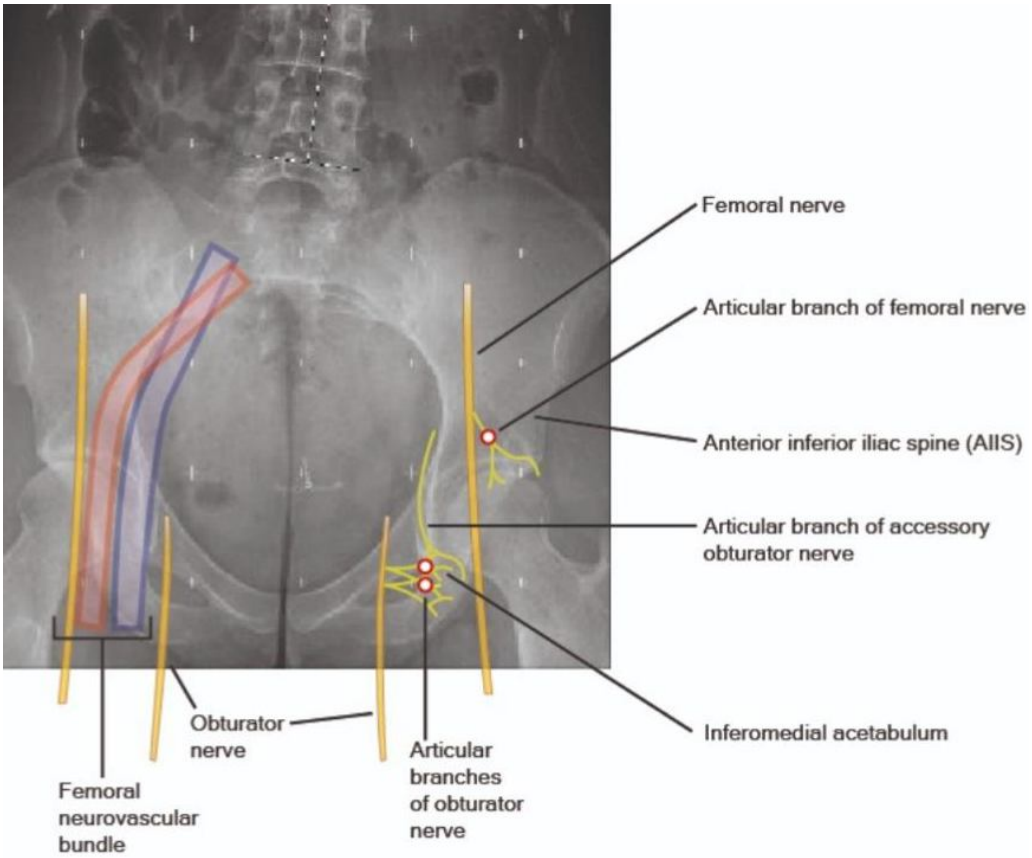

Fig. 1. Hip Anatomy

Radiofrequency is performed through the percutaneous insertion of cannulas that contact the nerve structures responsible for transmitting pain impulses, creating a therapeutic thermal lesion. This procedure involves denervation and percutaneous ablation of the articular branches of the hip, typically targeting the obturator and femoral nerves. The articular sensory branches of the obturator nerve innervate the anteromedial hip joint and are responsible for groin pain associated with this articulation. Conversely, the sensory branches of the femoral nerve innervate the anterior and anterolateral hip joint capsule, contributing to lateral and trochanteric hip pain. [14, 15, 16] (Figure 1)

The procedure involves impedance verification and sensory and motor stimulation tests. Parameters for pulsed radiofrequency (PRF) are set at 45 volts for 120 seconds, maintaining the internal temperature below 42 °C. Following the first PRF cycle, continuous thermal radiofrequency is applied CTR, consisting of low-energy, high-frequency radiofrequency energy to achieve 80 °C for 180 seconds. This temperature is carefully controlled to avoid (>90 °C) tissue carbonization. [17, 18, 19, 20].

2. METHODOLOGY

An experimental study was conducted in 22 patients between August 2022 and August 2023 (one year). Participants were divided into two groups: 11 patients underwent hip RF targeting the obturator and femoral nerves, while the other 11 patients received conservative treatment. Both groups went through rehabilitation as adjuvant management during the follow-up period.

Patients were evaluated during medical consultations through clinical history and physical examination to establish the diagnosis that caused chronic hip pain. Evaluations were conducted at 0, 3, 6, 9, and 12 months using the WOMAC score for function and the VAS scale for pain.

Of the 22 patients evaluated, 14 were diagnosed with hip coxarthrosis, 6 with complex regional pain syndrome CRPS due to hip arthroplasty, and 2 with pain following osteosynthesis for hip fracture/dislocation. (Table 1)

Patient	Age	BMI	Comorbidities	Sex	Diagnosis
1	52	32	Obesity	F	Hip arthrosis
2	25	30	Obesity	M	Hip arthrosis
3	78	31	Obesity	M	Post-osteosynthesis hip fracture
4	86	40	Morbid obesity, post-total hip arthroplasty with persistent pain	F	Post-total hip arthroplasty pain
5	78	33	Ischemic heart disease	F	Hip arthrosis
6	50	28	Pacemaker, obesity	M	Post-total hip arthroplasty pain
7	63	29	Obesity	M	Hip arthrosis
8	55	34	Hypertension	F	Post-osteosynthesis hip fracture
9	48	36	Type 2 diabetes mellitus	M	Hip arthrosis
10	84	31	Hypertension	F	Hip arthrosis
11	65	33	Rheumatoid arthritis	M	Hip arthrosis
12	63	42	Morbid obesity, type 2 diabetes mellitus	F	Post-total hip arthroplasty pain

13	70	35	Hypertension, COPD	M	Hip arthrosis
14	46	32	Congestive heart failure	F	Post-total hip arthroplasty pain
15	49	41	Morbid obesity, type 2 diabetes mellitus	M	Hip arthrosis
16	48	33	Hypertension	F	Hip arthrosis
17	72	38	Coronary artery disease, type 2 diabetes mellitus	M	Post-total hip arthroplasty pain
18	69	34	Rheumatoid arthritis	F	Hip arthrosis
19	60	31	Hypertension, chronic hip pain	M	Hip arthrosis
20	74	33	Hypertension	F	Hip arthrosis
21	58	39	Obesity, hypertension	M	Post-total hip arthroplasty pain
22	67	32	Coronary artery disease, type 2 diabetes mellitus	F	Hip arthrosis

Table 1. Characteristics of the patients participating in the study

The function of both groups was assessed using the WOMAC score at 0, 3, 6, 9, and 12 months post-treatment. ANOVA was used for statistical analysis to assess variability across time and identify significant differences.

Inclusion Criteria

1. Chronic hip pain, unresponsive to conservative management (physical therapy, rehabilitation, and lifestyle changes).
2. Pain relief of >50% on the VAS after in-office anesthetic block.
3. Non- consent for joint replacement surgery.
4. Unsuitability for surgical management due to comorbidities. [21, 22, 23]

Exclusion Criteria

1. Refusal to participate in the study.
2. Patients with mild to moderate hip pain according to the VAS (score <7).
3. Presence of local infection at the skin or hip tissue, systemic sepsis, pregnancy, or blood dyscrasias. [24, 25]

2.1 Protocol

Characteristic	RF Group (n=11)	Conservative Group (n=11)
Age (years)	62.1 (SD 17.6)	61.4 (SD 9.6)
Sex		
Female (%)	7 (63.6%)	6 (55%)
Male (%)	4 (36.4%)	5 (45%)
Pain Location		
Left (%)	4 (36.4%)	3 (27.3%)
Right (%)	5 (45.5%)	5 (45.5%)
Both (%)	2 (18.2%)	3 (27.3%)

Table 2. Demographics of both groups. SD = Standard Deviation

The patients were divided into two groups: the first group consisted of patients who received treatment with radiofrequency neurotomy, while the second group included patients managed with conservative treatment, which comprised physical rehabilitation, nonsteroidal anti-inflammatory drugs (NSAIDs), and opioid therapy.

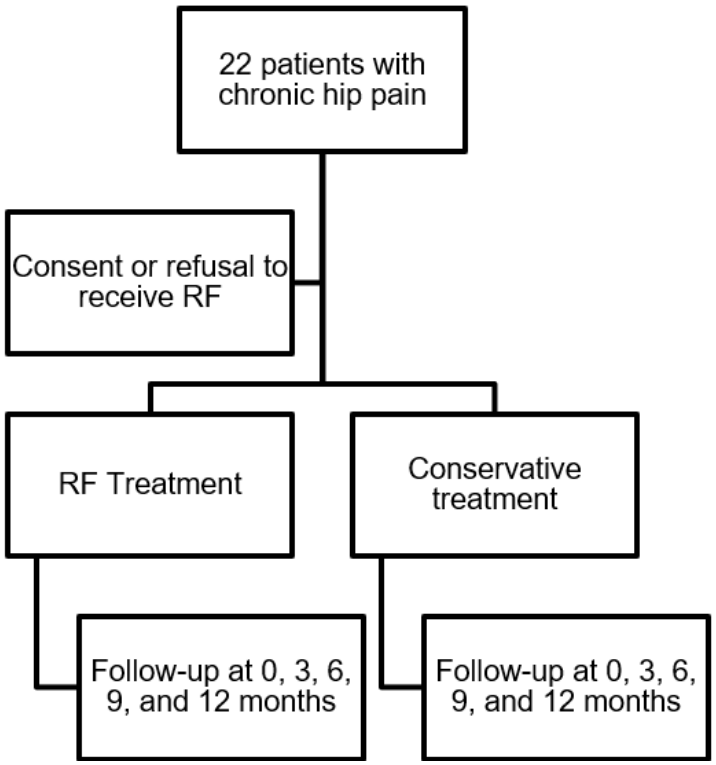

Figure 2. Patient Assignment and Follow-Up

2.2 Technique

The patient is positioned in the supine position, asepsis and antisepsis are performed over the anterior portion of the hip, the inguinal region, and the medial thigh. The femoral vascular bundle is palpated, and the arterial pathway is marked below the inguinal ligament (Figure 3). A fluoroscope is used in the anteroposterior position to locate the hip joint. A needle is used to infiltrate the skin with local anesthetic. Subsequently, a radiofrequency cannula with a 100-mm length and a 10-mm active tip is inserted (Figure 4). The electrode is directed to the articular sensory branch of the femoral nerve at the superior portion of the acetabular roof. A second radiofrequency cannula is then placed for ablation of the obturator nerve at the ischiopubic branch (Figure 5).

Fig 3. Marking of arterial and venous pathways below the inguinal ligament.

Fig 4. Placement of a 20 G, 100-millimeter (mm) radiofrequency cannula with a 10 mm active tip.

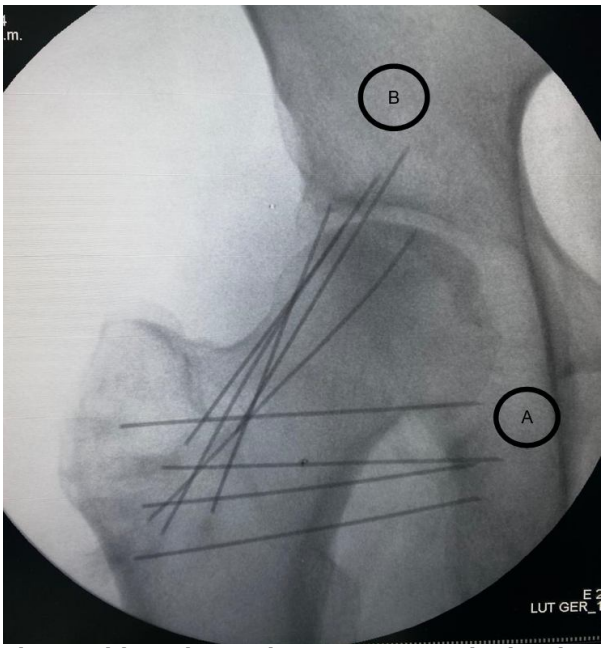

Fig 5: A. Radiofrequency cannula positioned on the sensory articular branch of the obturator nerve. B. Radiofrequency cannula for ablation of the femoral nerve at the superior portion of the acetabulum.

3. RESULTS

The average age of the study population was 61.8 years, with a range of 25 to 86 years.

The analgesic effect was evaluated using the Visual Analog Scale (VAS) at baseline (0 months) in both groups, with an initial mean score of 8.4 (severe pain) and a range of 6 to 10 (Figure 7). Following the radiofrequency procedure, pain was reduced by 76.1%, resulting in a mean score of 2/10 (mild pain) with a range of 0 to 4.

Function was assessed using the WOMAC questionnaire prior to treatment (0 months) and at 3, 6, 9, and 12 months. The average pre-treatment score was 79.9, indicating severe symptoms of pain, stiffness, and physical function limitations.

Function as measured by the WOMAC scale improved by 74.8% in 3 months and remained stable at 6, 9, and 12 months.

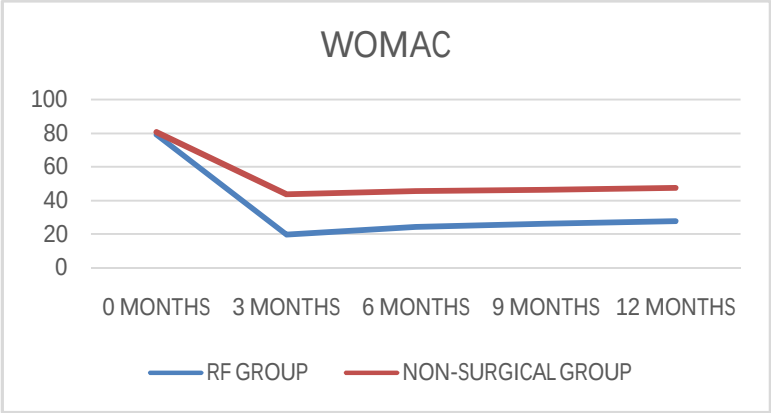

Fig. 6. WOMAC questionnaire results for both groups during the treatment follow-up period. (RF GROUP IN BLUE, NON-SURGICAL GROUP IN RED)

The analysis of variance (ANOVA) showed significant differences among the various follow-up periods of treatment. The results showed a statistical difference over the function ($F = 127.0$, $p < 0.0001$). The low p-value suggests that obtaining these results without a treatment effect is unlikely. The critical F value (2.6) further confirms the significance of the findings, as the calculated F statistic far exceeds this threshold.

The non-surgical group had an initial average WOMAC score of 80.7 (at 0 months), showed an improvement in 45.6% of the function at 3 months. However, this improvement declined over time, with the treatment effect stabilization.

The analgesic effect in the non-surgical group showed a mean VAS score of 7.4/10 (range 6 to 10) at baseline, with an 11.9% reduction in pain following physical therapy and medication use.

9 patients of the non-surgical group chose hip radiofrequency neurotomy, while 2 of them underwent total hip arthroplasty.

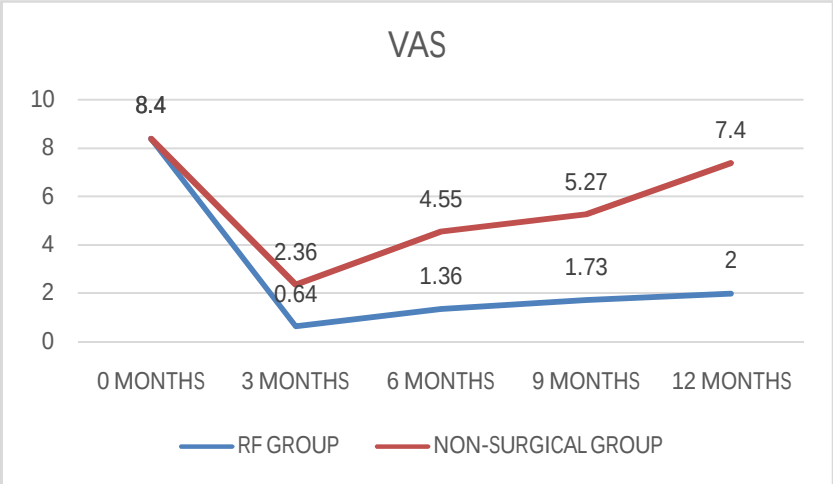

Fig. 7. EVA scale results for both groups during the treatment follow-up period.

3.1 DISCUSSION

Total hip arthroplasty (THA) is the preferred method for osteoarthritis, however 15% of those patients with grade IV hip arthrosis are not candidates for this procedure due to its comorbidities. [26, 27, 28]

Previous studies demonstrated that obturator and femoral nerve blocks can provide temporary pain relief for approximately 2 weeks, long-term benefits are limited as the pain typically returns to baseline. [29, 30, 31]

In this article, the RF group showed a 76.1% pain reduction, and a 74.8% function improvement which remained at 3, 6, 9, and 12 months in the RF group, offering additional benefits such as minimal invasiveness, shorter recovery times, the advantages of local anesthesia, and the absence of significant adverse effects.

4. CONCLUSION

RF group improved in 76.1% showing a decrease of pain from 8.4 down to 2.0 points at 12 months according to VAS scale.

The non-surgical group (combining medication and physical therapy) showed pain relief starting at 3 months (61%), but the pain worsened at 6 months (39%), and 9 months (32%), and even returned to its baseline pain at 12 months (11.9%).

Functional assessment using the WOMAC score in the RF group showed a 74.8% improvement in 3 months, which remained at 6 months (54.7%), 52.7% in 9 months, and 51.1% at 12 months.

No significant complications in RF group were reported, in contrast to the complications commonly associated with THA, and compared to the conservative approach.

Even though further clinical evidence is needed, RF is shown to be an effective method for managing chronic hip pain in non-surgical patients.

COMPETING INTERESTS

There are no conflicts of interest that could potentially influence or bias the study conducted by the authors of this article. Neither is there any denial of participation or relationship with financial support from any individual or organization. There is no interest in employment, honoraria, or financial remuneration associated with this study.

CONSENT

All authors declare that written informed consent was obtained from the patient (Except patients undergone joint replacement surgery) for the publication of this case report and accompanying images.

ETHICAL APPROVAL

All authors declare that all experiments have been reviewed and approved by the relevant ethics committee and, therefore, were conducted in accordance with the ethical standards set forth in the 1964 Declaration of Helsinki.

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