Al-Azhar International Medical Journal

Volume 4 | Issue 12 Article 35

2023
Section: Neurosurgery

Role of conventional and pulsed radiofrequency in treatment of low back pain and sciatica

Maamoun Mohammed Abo Shosha
Department of Neurosurgery, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Mohammed Ahmed Ellabbad
Department of Neurosurgery, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Mostafa Soliman Elmaghraby
Department of Neurosurgery, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Ahmed Maher Ahmed Ibrahim
Department of Neurosurgery, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt., ahmedmaher099@gmail.com

How to Cite This Article

Shosha, Maamoun Mohammed Abo; Ellabbad, Mohammed Ahmed; Elmaghraby, Mostafa Soliman; and Ibrahim, Ahmed Maher Ahmed (2023) "Role of conventional and pulsed radiofrequency in treatment of low back pain and sciatica," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 12, Article 35.
DOI: https://doi.org/10.58675/2682-339X.2180

ORIGINAL ARTICLE

Role of Conventional and Pulsed Radiofrequency in Treatment of Low Back Pain and Sciatica

Maamoun Mohammed Abo Shosha, Mohammed Ahmed Ellabbad, Mostafa Soliman Elmaghraby, Ahmed Maher Ahmed Ibrahim*

Department of Neurosurgery, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: **Low back pain is a feeling of discomfort, stiffness, or muscle tension below the costal border in the upper part of the back of the thigh, above the lower gluteal folds. Sciatica can occur with low back pain. The two most common techniques are pulsed radiofrequency (PRF) and conventional radiofrequency (CRF). Both techniques employ heat produced by particle vibration to cause a lesion. PRF employs intermittent high-frequency current injection to diffuse heat into nearby tissues and prevent temperatures from rising beyond 42 °C, known as the neuronal injury threshold.**

Aim: **To assess the efficacy of PRF and CRF applications across the pain and quality of life of persons with sciatica and low-back pain.**

Methodology: **Total 50 patients were studied in the neurosurgical Department of Al-Azhar University Hospitals in Cairo, Egypt.**

Results: **There was a significant decline in the rate of localized back tenderness after radiofrequency compared with before. There was a significant difference regarding Visual Analog Scale (VAS) for low back pain and lumber radicular ache which showed marked decrease after intervention with a gradual increase in the following follow-up periods. L4−L5 was the most spine level detected by MRI.**

Conclusion: **We deduced from the results that PRF and CRF both effectively reduced sciatica and low back pain for the first 3 months, but that pain recurrence happened gradually and was shown by higher visual analog scale scores at the 6 and 12-month follow-up visits.**

Keywords: Back pain, Conventional, Pulsed radiofrequency, Sciatica

1. Introduction

Low back pain is defined as discomfort, stiffness, or muscular tension that is located just above the groyne and beneath the costal margin. It may be accompanied by leg pain (sciatica). From 9.9 % to 25 % of people had low back pain each year along with leg discomfort that can be extended beyond the knee.[1,2]

Intervertebral disc herniation is the major frequent reason of lumbar radicular discomfort, followed by unsuccessful back surgery and spinal stenosis.[3,4]

Even though epidural corticosteroid injections have been used in clinical practice for many years and have a complication rate of between 0 % and 9.65 %, they should be suggested to relieve pain temporarily. Epidural injection appears to be less efficient than transforaminal injection (when performed under radiological guidance).[5,6]

Conventional or thermal radiofrequency (CRF) creates a lesion through the generation of heat by particles vibration. In contrast, pulsed radiofrequency (PRF) uses an electromagnetic field and is generated at the needle's tip to induce a cascade of cellular variations that block neurons from transmitting action potentials.[7,8]

For more than thirty years, CRF, a heat-destructive method, has been utilized to treat chronic pain. The temperature surrounding the needle tip rises

Accepted 1 August 2023.
Available online 2 February 2024

* Corresponding author. Neuro Surgery Department, Faculty of Medicine for Boys, Al-Azhar University, Almokhayyem Al Dayem Street, Nasr City, 11675, Cairo, Egypt. Fax: +201094300033
E-mail address: ahmedmaher099@gmail.com (A.M.A. Ibrahim).

https://doi.org/10.58675/2682-339X.2180

(between 60 °C and 80 °C) during continuous electrical stimulation of the target neurons during CRF, killing the nociceptive input-conducting fibers. Cervicogenic headaches, occipital neuralgia, cervical and lumbar radicular pain, discogenic pain, and pain involving the sacroiliac joint have all been treated with CRF.[9,10]

In this study, we aimed to evaluate the effect of PRF and CRF applications on the pain and quality of life of individuals with sciatica and low back pain.

2. Patients and methods

Type of study and study location: this is a descriptive prospective and retrospective study for evaluating the clinical outcomes of cases with low back pain and sciatica treated with CRF and PRF for 12 months follow-up period. This descriptive study was carried out on 50 patients with low back pain (LBP) and sciatica treated with conventional and pulsed radiofrequency.

The investigation was carried out at Cairo, Egypt's Al-Azhar University Hospitals' Neurosurgery Department. 50 instances of sciatica and LBP were treated using CRF and PRF techniques.

2.1. Methods

2.1.1. Preoperative assessment

Full history taking, general examination, and detailed neurological examination were recorded. Pain was assessed by visual analogue scale (VAS).

2.1.2. Investigations

MRI of lumbosacral spine, Dynamic radiography of the lumbar spine and routine laboratory investigation including complete blood count (CBC), bleeding profile, kidney and liver function tests, and random plasma sugar were performed.

2.1.3. Follow-up

LBP and lumber radicular pain were measured before intervention and All cases were followed for 12 months at 0, 3, 6, 12 month after surgery and pain were assessed using VAS for pain which is a (0–10 cm) scale where (0) means no pain and (10) is the greatest pain conceivable.

The inclusion criteria were chronic radicular pain, radiating down to the leg, persistent for at least three months and despite the conventional medicine and physical therapy with indication for open surgery, and imaging with magnetic resonance showed evidence of nerve root compression, absence of progressive motor defect and failed medical treatment and physiotherapy for at least 3 months.

The Exclusion criteria were older than 80 and younger than 18, Coagulopathy patients with cancer to explain their symptoms, patients with known anatomical deformity or derangement, either congenital or acquired, such as excessive scoliosis, pregnancy, disc extrusion-migration, and Spondylolisthesis.

2.2. Procedure

2.2.1. Radiofrequency application

Under fluoroscopy guidance, the targeted spinal level(s) of interest were identified and confirmed. 1 % lignocaine was used to infiltrate the skin at the entry point. A licensed RF needle/probe was used. The needle was inserted at the intended spot while being viewed properly under fluoroscopy.

2.2.2. Target locations

The articular facet joint and dorsal root ganglia (DRG). The nerves are mixed and formed from the fusion of ventral (anterior) motor and dorsal (posterior) sensory root. The DRG is an enlargement formed by the dorsal nerve root just prior to the fusion of the roots. This lies in the upper medial part of the intervertebral foramen. Antero-posterior (AP) fluoroscopy was used to locate the target area and needle was advanced, if required, until the tip was located one-third to halfway into the pedicle column.

2.2.3. Target confirmation

Appropriate fluoroscopic guided placement of needle near the targeted facet joint was done. Appropriate fluoroscopic placement of needle near DRG was noted. In lumbar area on AP fluoroscopic view, DRG was described to lie immediately behind the lateral aspect of the facet column at all spinal levels and on lateral view was localized to the dorsocranial quadrant of the intervertebral foramen. Proximity of the needle to DRG was determined by appropriate sensory stimulation with 50 Hz, at more than 0.24 V (avoid intraganglionic placement) and less than or equal to 0.6 V; motor stimulation at 2 Hz with threshold 1.5–2 times greater than sensory threshold to avoid placement near the anterior nerve root. A radiculogram was also done to confirm the appropriate placement and to recognize inadvertent intradural placement of the needle.

2.2.4. Treatment

PRF applied at 45 °C 300 s one cycle in the selected DRG. CRF applied by 80 °C for 90 s 3 cycles in the selected facet joint. After the procedure the patient was moved to a recovery area for monitoring and managing any side effects.

2.2.5. Measurements

Patients low back pain and radicular pain was measured before intervention and immediate after intervention and at 3rd, 6th, 12th months post-intervention using Visual analogue scale of pain which is a 0−10 cm scale where 0 means no pain and 10 is the worst imaginable pain.

2.3. Ethical approval

The Ethical Research Board (ERB)at Al-Azhar University's Faculty of Medicine in Cairo, Egypt, approved the study. Before the trial began, all patients submitted written consent after a clear description of the potential adverse outcomes.

2.4. Statistical analysis

SPSS v27 (IBM, Armonk, NY, USA) was used for statistical analysis. The Shapiro-Wilks test and histograms were employed to assess the normality of the data distribution. The unpaired student *t*-test was used to analyse quantitative parametric data, which were provided as mean and standard deviation (SD). The Mann Whitney-test was used to analyse quantitative nonparametric data, which were reported as the median and interquartile range (IQR). When appropriate, qualitative variables were given as frequency and percentage (%) and analyzed using the χ^2 test or Fisher's exact test. Statistical significance was defined as a two-tailed *P* value of less than 0.05.

A study's findings may have been the result of random chance, and the *P*-value is a statistical measure of that possibility.

3. Results

Table 1.

This table shows: Patients varied in age between 28 and 72 years. With mean ± SD 45.42 ± 11.38 years and median of 45 years. The total number of affected males was 19 (38 %) and females 31 (62 %) with male: female ratio 0.61 : 1 (Table 2).

This table shows that L4-L5 was the most spine level detected by MRI representing 42 % cases and L5-S1 level in 9 (18 %) cases. Nine (18 %) patients had a composite lesion at L3-L4 and L4-L5, and 6 (12 %) patients had a composite lesion at L4-L5 and L5-S1while in 5 (10 %) patients showed 3-levels involvement at L3-L4, L4-L5 and L5-S1 (Tables 3 and 4).

There was a significant decline in the rate of localized back tenderness after radiofrequency compared with before radiofrequency.

This table shows: there was a significance between patients regarding VAS for lower back pain (Table 5).

This table shows that Lower back pain in the studied patients had a mean VAS score of 0.50 ± 0.65. After 3 months after radiofrequency, lower back pain in the studied patients had a mean VAS score of 0.96 ± 0.90 that is not differ significantly from initial results. A significant increase in pain intensity was seen 6 months following radiofrequency therapy, with an average VAS score of 2.22 ± 1.15. 12 months after the start of therapy, this difference is maintained (mean VAS was 2.76 ± 1.20) (Fig. 1, Tables 6 and 7).

This table shows that there was a significant increase ($P = 0.001$) in pain intensity 3 months

Table 1. Distribution of the deliberate patients as per demographic data.

Parameters	Studied cases (*N* = 50) *N* (%)
Sex	
Male	19 (38.0 %)
Female	31 (62.0 %)
Age (y)	
Mean ± SD	45.42 ± 11.38
Median	45.0
Range	28.0−72.0
Previous operations	
No	50 (100.0 %)
Yes	0

Table 2. Distribution of studied patients as per MRI of lumbosacral spine.

Parameters	Studied patients (*n* = 50) *N* (%)
MRI of lumbosacral spine	
L4-L5	21 (42.0 %)
L5-S1	9 (18.0 %)
L3-L4 and L4-L5	9 (18.0 %)
L4-L5 and L5-S1	6 (12.0 %)
L3-L4,L4-L5 and L5-S1	5 (10.0 %)

Table 3. Localized back tenderness before and after radiofrequency in the studied patients.

Parameters	Studied patients (*n* = 50)		
	Before intervention *N* (%)	After intervention *N* (%)	*P*-value*
Localized back tenderness			
	6 (12.0 %)	41 (82.0 %)	<0.001
Yes	44 (88.0 %)	9 (18.0 %)	

Table 4. Visual Analog Scale for lower back pain at different follow-up period.

VAS for lower backpain	Studied patients (n = 50)				Test value	P-value*
	Mean ± SD	Median	Min.	Max.		
Initial	0.50 ± 0.65	0.0	0.0	2.0	110.2	<0.001
After 3 months	0.96 ± 0.90	1.0	0.0	3.0		
After 6 months	2.22 ± 1.15	2.0	0.0	5.0		
After 12 months	2.76 ± 1.20	3.0	1.0	7.0		

Table 5. Pairwise comparisons of visual analog scale for low back pain at different follow-up period.

Sample 1-Sample 2	Test statistic	P-value
LBP VAS 0-LBP VAS 3	0.450-	0.488
LBP VAS 0-LBP VAS 6	1.710-	<0.001
LBP VAS 0-LBP VAS 12	−2.120-	<0.001
LBP VAS 3-LBP VAS 6	1.260-	<0.001
LBP VAS 3-LBP VAS 12	1.670-	<0.001
LBP VAS 6-LBP VAS 12	0.410-	0.674

following radiofrequency therapy for lumber radicular pain in the investigated patients, with a mean Visual Analog Scale score of 1.56 ± 0.91, compared with the initial Visual Analog Scale score of 0.50 ± 0.65. This difference lasted for at least a year after therapy ended (mean Visual Analog Scale, 3.76 ± 1.55) and for 6 months (mean Visual Analog Scale, 2.52 ± 1.18).

4. Case presentation

4.1. Case 1

A 36-year-old male patient complained of lower back pain (LBP) and left (Lt) Sciatica, MRI revealed, LV4—5 diffuse disc bulge encroaching upon the corresponding neural foramina. Fluoroscopically verified pulsed RF for the Lt L4 nerve root was

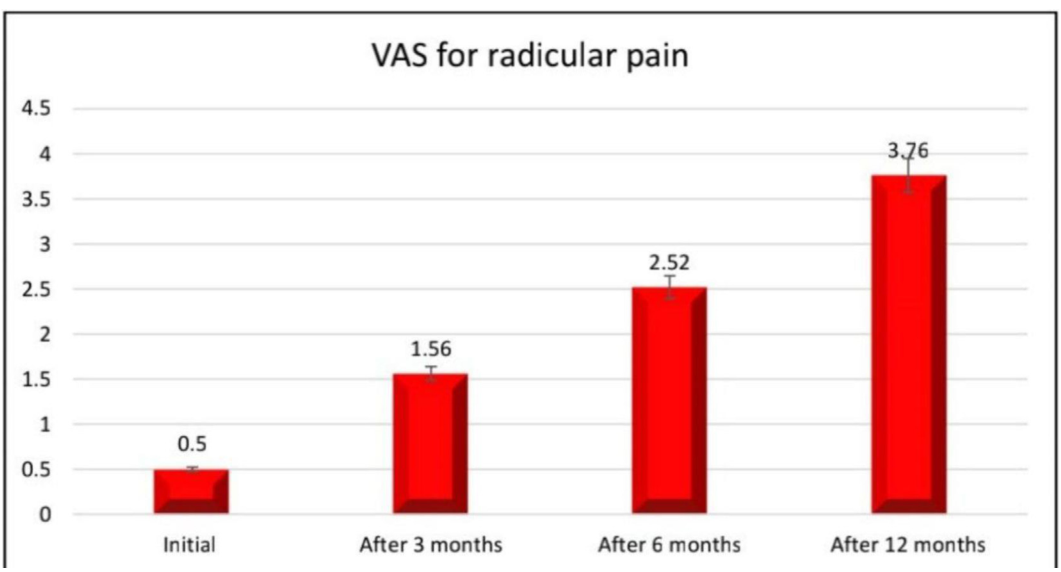

Fig. 1. Visual Analog Scale for lumber radicular pain at different follow-up period.

Table 6. Visual analog scale for lumber radicular pain at different follow-up period.

VAS for lumberradicular pain	Studied patients (n = 50)				Test value	P-value[a]
	Mean ± SD	Median	Min.	Max.		
Initial	0.50 ± 0.65	0.0	0.0	2.0	122.8	<0.001
After 3 months	1.56 ± 0.91	1.0	0.0	4.0		
After 6 months	2.52 ± 1.18	2.0	1.0	6.0		
After 12 months	3.76 ± 1.55	3.0	1.0	8.0		

SD, standard deviation.

[a] Friedman's Two-Way analysis of variance Test; P less than or equal to 0.05 shows statistical significance; P less than or equal to 0.01 shows highly statistical significance.

Table 7. Pairwise comparisons of Visual analog scale for lumber radicular pain at different follow-up period.

Sample 1-Sample 2	Test statistic	*P*-value
LBP VAS 0-LBP VAS 3	−0.970-	0.001
LBP VAS 0-LBP VAS 6	−1.810-	<0.001
LBP VAS 0-LBP VAS 12	−2.540-	<0.001
LBP VAS 3-LBP VAS 6	0.840-	0.007
LBP VAS 3-LBP VAS 12	1.570-	<0.001
LBP VAS 6-LBP VAS 12	0.730-	0.028

performed, and conventional RF was done for the L4, 5 facet joint (Fig. 2).

4.2. Case 2

A 40-year-old male patient complained of LBP and right sciatica, MRI LSS showed L 4, 5 and L5 S1 disc prolapse. Pulsed RF was done on right (Rt) L5 nerve root, and conventional RF was done for the L4, 5 and L5 S1 facet joints (Fig. 3).

4.3. Case 3

Male patient 32 Y complaining of LBP and left sciatica MRI LSS showed L4, 5 disc prolapse pulsed RF was done for L4 DRG and conventional RF for L4, 5 facet joint (Fig. 4).

5. Discussion

Discomfort or stiffness in the back (or both) that begins below the costal boundary and travels over the inferior gluteal folds, with or without radiating pain down the legs, is often diagnosed as low back pain (sciatica).

Radiofrequency (a high-frequency current operating at 500 kHz) has been widely adopted as an effective pain control tool. Spinal pain conditions such as trigeminal neuralgia, cervical radicular pain, posterior degenerative spinal disease, sacroiliac joint discomfort, spondylolisthesis, and infection are just a few of the areas where PRF showed promising results.[11]

Total 50 patients with low back pain and sciatica who had been treated with traditional and PRF were included in this descriptive study. The neurosurgical unit at Al-Azhar University Hospitals was the site of the research.

Specifically, this research aimed to assess the influence of PRF and CRF applications on pain and

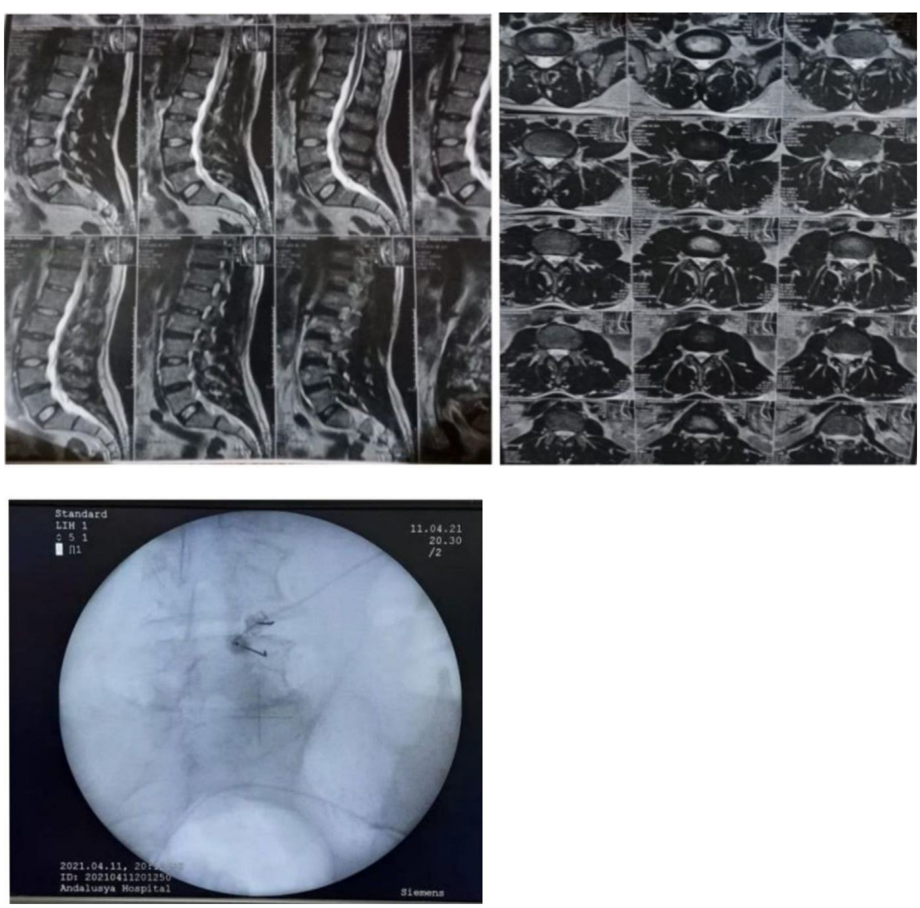

Fig. 2. Case 1 MRI on LSS and fluoroscopy image.

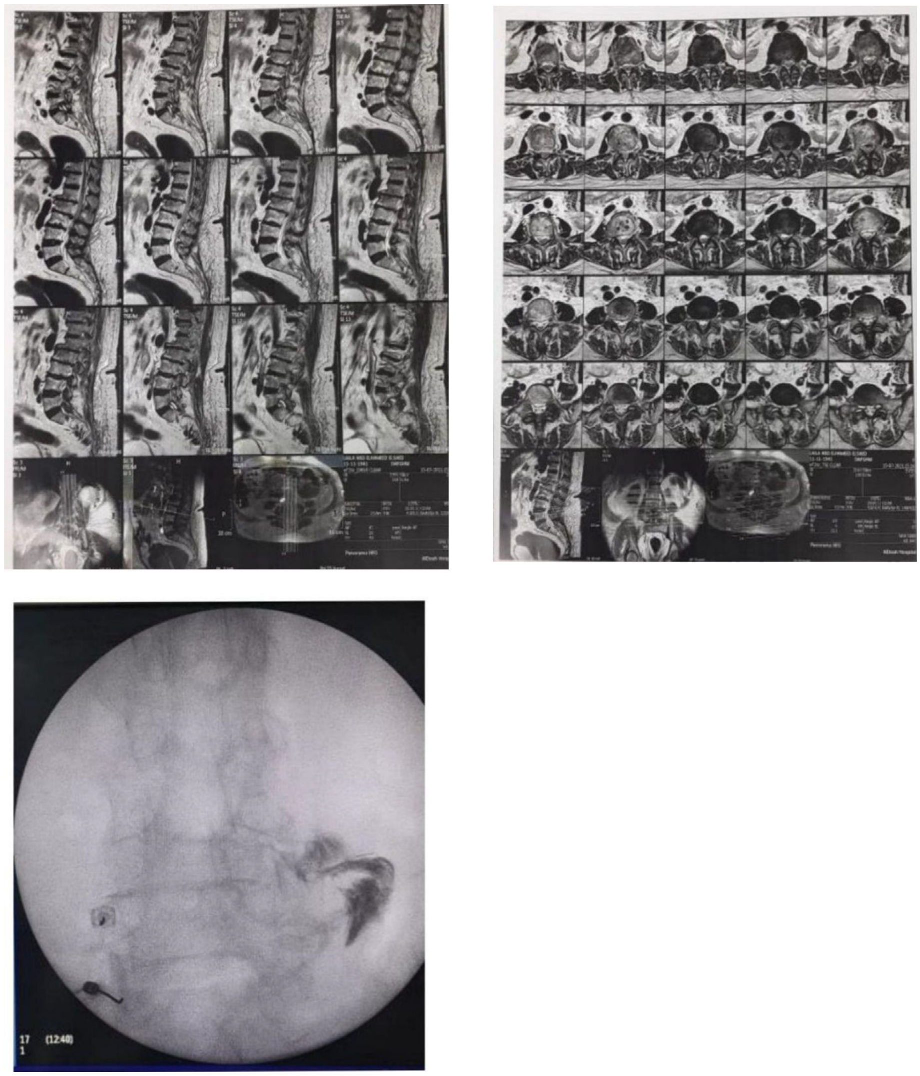

Fig. 3. Case 2 MRI on LSS and fluoroscopy image.

quality of life of patients experiencing low back discomfort and sciatica.

Among 50 patients enrolled in our study, there was 19 (38 %) males and 31 (62 %) females, their age ranged from 28 to 72 years with mean ± SD 45.42 ± 11.38 years. None of the patients had previous history of spine operations. Low back pain was assessed before intervention and revealed that the mean VAS ranged from 8 to 10 with mean ± SD 9.32 ± 0.62.7.

Cervical radicular pain affects around one in a thousand people, as stated by the research of Van Boxem et al.[12] Radicular pain is described as pain that radiates into the leg. Pain in the lumbosacral region is the most prevalent kind of radicular pain, affecting between 9.9 % and 25 % of the population each year.

Radicular pain is linked to injuries that either mechanically damage the DRG or inflame and/or ischemia of the axons of the spinal nerve and its roots, albeit the exact pathophysiology is not well known.

In the current study, L4-L5 was the most prominent spine level detected by MRI, representing 42 % of cases, and L5-S1 level in 9 (18 %) cases. There was a significant decline in the rate of localized back tenderness after radiofrequency compared with before radiofrequency ($P < 0.001$).

Conventional and pulsed RF have shown an excellent security profile, with just a few mild side effects, including headaches or procedure-related discomfort, being documented in literature.[13] Consistent with our findings, there were no post-intervention or follow-up problems recorded.

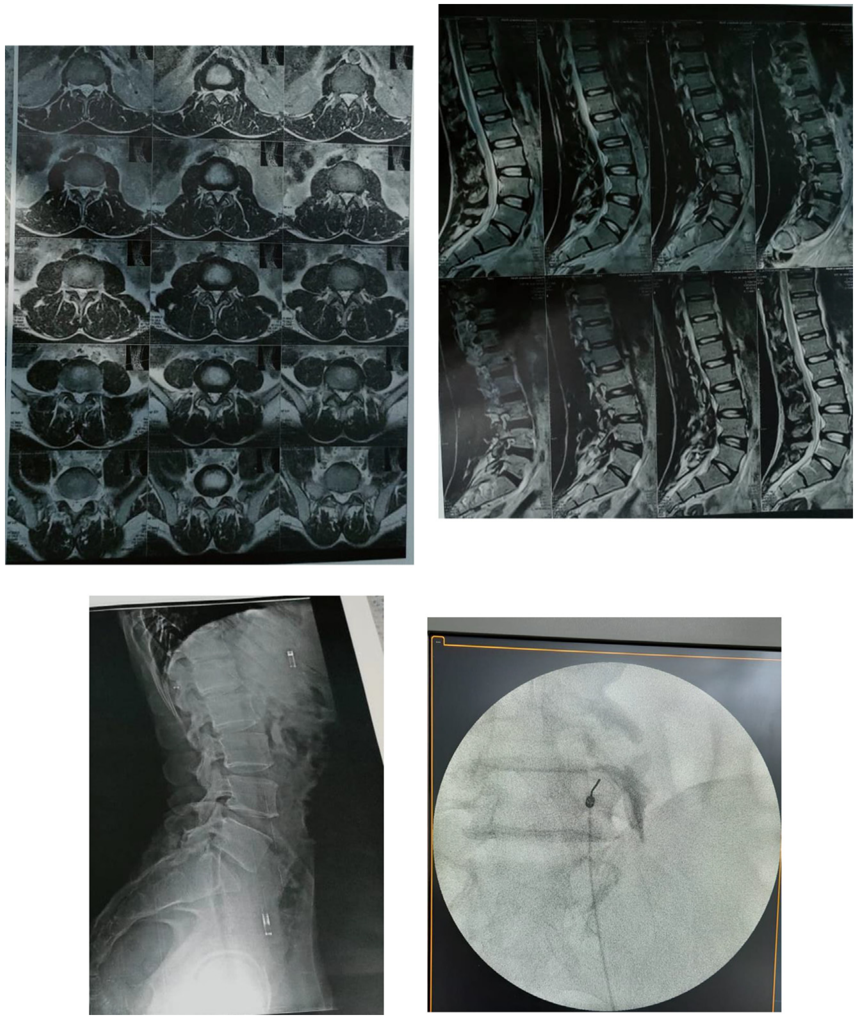

Fig. 4. Case 3 MRI on LSS and fluoroscopy image.

Our results observed that, initially, lower back pain in the studied patients had a mean VAS score of 0.50 ± 0.65. After 3 months after radiofrequency treatment, lower back pain in the studied patients had a mean VAS score of 0.96 ± 0.90 that did not differ significantly from initial results. We found that the average VAS score for pain was 2.22 ± 1.15 months after radiofrequency therapy, a statistically significant increase ($P < 0.001$). Twelve months following therapy, this difference still existed (mean VAS was 2.76 ± 1.20).

In agreement with our results Lu et al.[14] noted that, in the CRF group, the VAS scores were significantly lower at 3 months (1.6 ± 1.1, $P < 0.001$) and 6 months (2.6 ± 1.9, $P = 0.001$). In the PRF group, the VAS scores were also lower at 3 months (2.9 ± 1.6, $P < 0.001$) and 6 months (4.0 ± 2.0,$P < 0.001$).

In order to treat the patients, RF heat lesion of the medial branch of the dorsal ramus in prior research by Shabat et al.[15] 'Clinically substantial pain relief was reported by 43 (74 %) patients at 4 weeks post-procedure. Sixty-six percent of the 38 patients who were followed up with after 3 months reported feeling better. Only 9 of the patients saw no pain relief, 21 claimed good outcomes, 8 reported moderate, and 34 saw no impact. 33 (57 %) patients reacted to RF at the third evaluation (6 months following management) (7 patients stayed pain-free, 18 achieved good outcomes, and 18 got fair results), whereas 25 (43 %) patients showed no improvement.

Patients with lumber radicular pain had an average VAS score of 0.50 ± 0.65 before receiving radiofrequency therapy, however this increased to an average VAS score of 1.56 ± 0.91 3 months later, showing a statistically significant increase ($P = 0.001$). This difference remained in both 6 months (VAS mean = 2.52 ± 1.18) and 12 months (VAS mean = 3.76 ± 1.55) following therapy.

Lu et al.[14] examined 34 patients who were given CRF/PRF, and their findings were consistent with ours. Additionally, the PRF group's pain ratings increased between the third and sixth months ($P = 0.004$). At 6 months, the CRF group also had greater pain scores than the control group ($P = 0.03$). Significant improvements in VAS ratings were seen after 3 and 6 months of therapy ($P = 0.01$).

5.1. Conclusion

From these outcomes, we concluded that during the first three months, both PRF and CRF effectively reduced sciatica and low back pain. After that, the pain slowly began to return, and a higher VAS score was seen in the 6 and 12 month of follow-up as a sign of pain escalation.

Authorship

All authors have a substantial contribution to the article.

Conflicts of interest

The authors declared that there were NO conflicts of Interest.

Acknowledgments

Disclosure: The authors have no financial interest to declare in relation to the content of this article.

References

1. Tanwar P, Naagar M, Garima Malik G, et al. Various mechanisms of low back pain in elderly population. *Int J Recent Adv Multidisc Topics*. 2022;3:55−61.
2. Van Boxem K, van Bilsen J, de Meij N, et al. Pulsed radiofrequency treatment adjacent to the lumbar dorsal root ganglion for the management of lumbosacral radicular syndrome: a clinical audit. *Pain Med*. 2011;12:1322−1330.
3. Hooten WM, Cohen SP. Evaluation and treatment of low back pain: a clinically focused review for primary care specialists. *Mayo Clin Proc*. 2015;90:1699−1718. Elsevier.
4. Abejón D, Garcia-del-Valle S, Fuentes ML, Gómez-Arnau JI, Reig E, van Zundert J. Pulsed radiofrequency in lumbar radicular pain: clinical effects in various etiological groups. *Pain Pract*. 2007;7:21−26.
5. Yang S, Kim W, Kong HH, Do KH, Choi KH. Epidural steroid injection versus conservative treatment for patients with lumbosacral radicular pain: a meta-analysis of randomized controlled trials. *Medicine*. 2020;99:30.
6. Valat JP, Genevay S, Marty M, Rozenberg S, Koes B. Sciatica. *Best Pract Res Clin Rheumatol*. 2010;24:241−252.
7. Benny B, Azari P. The efficacy of lumbosacral transforaminal epidural steroid injections: a comprehensive literature review. *J Back Musculoskelet Rehabil*. 2011;24:67−76.
8. Bronfort G, Hondras MA, Schulz CA, Evans RL, Long CR, Grimm R. Spinal manipulation and home exercise with advice for subacute and chronic back-related leg pain: a trial with adaptive allocation. *Ann Intern Med*. 2014;161:381−391.
9. Salahuddin H, Gebreyohanns M. Central nervous system pain. In: *Book of Pain Management for Clinicians: Chapter: A Guide to Assessment and Treatment*. 2020:307−387. https://doi.org/10.1007/978-3-030-39982-5_14.
10. Zhao W, Guo G, Wang Q, Yang L. Ultrasound-guided transforaminal epidural injection with fluoroscopy confirmation for the treatment of unilateral lumbar radiculopathy: a randomized controlled non-inferiority study. *Clin Neurol Neurosurg*. 2023;231:107849. https://doi.org/10.1016/j.clineuro.2023.107849.
11. Facchini G, Spinnato P, Guglielmi G, Albisinni U, Bazzocchi A. A comprehensive review of pulsed radiofrequency in the treatment of pain associated with different spinal conditions. *Br J Radiol*. 2017;90:20150406.
12. Van Boxem K, Huntoon M, Van Zundert J, Patijn J, van Kleef M, Joosten EA. Pulsed radiofrequency: a review of the basic science as applied to the pathophysiology of radicular pain. *Reg Anesth Pain Med*. 2014;39:149−159.
13. Vanharanta H, Ohnmeiss DD, Aprill CN. Vibration pain provocation can improve the specificity of MRI in the diagnosis of symptomatic lumbar disc rupture. *Clin J Pain*. 1998;14:239−247.
14. Lu K, Liliang P-C, Liang C-L, Wang K-W, Tsai Y-D, Chen H-J. Efficacy of conventional and pulsed radiofrequency for treating chronic lumbar facet joint pain. *Formosan J Surg*. 2012;45:107−112.
15. Shabat S, Leitner Y, Bartal G, Folman Y. Radiofrequency treatment has a beneficial role in reducing low back pain due to facet syndrome in octogenarians or older. *Clin Interv Aging*. 2013;8:737−740.