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ORIGINAL ARTICLE

Comparison of the efficacy of continuous radiofrequency thermocoagulation, pulsed radiofrequency denervation applications, and TENS therapies for lumbar facet syndrome: A single-blind randomized controlled trial

Lomber faset sendromunda TENS Tedavisi ile konvansiyonel radyofrekans termokoagülasyon ve pulse radyofrekans denervasyon uygulamalarının etkinliklerinin karşılaştırılması: Tek-kör randomize kontrollü bir çalışma

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Summary

Objectives: We aimed to compare the effectiveness of TENS, used in physical therapy departments, and continuous radiofrequency thermocoagulation (CRF) and pulsed radiofrequency denervation (PRF), used in algology departments, in patients with lumbar facet syndrome (LFS).

Methods: Subjects were selected from patients with LFS visiting outpatient clinics of physical therapy and algology departments at Ege University School of Medicine, whose pain was refractory to medical treatment for at least 3 months. Subjects were randomized into 3 groups. A total of 60 patients, with 20 in each group, were enrolled. The first group received CRF, the second group received TENS for 30 minutes a day for 15 days, and the third group received PRF. Patients were assessed at baseline, at the end of the first and sixth months, for a total of three times.

Results: Improvements at month 1 and month 6 were found to be statistically significant in all three treatment groups with respect to their pain scores, Oswestry Disability Indexes, hand-floor distance measurements, 20-meter walking times, 6-min walking distances, Beck Depression Inventory, and most of the SF-36 domain scores ($p<0.05$). A comparison of the treatment groups showed no superiority of any group over the others in any assessment parameters ($p>0.05$).

Conclusion: We suggest that it might be more appropriate to use TENS, a non-invasive treatment, before trying more invasive procedures like CRF and PRF in these patients. However, it has been stated that further studies involving a larger patient sample are needed.

Keywords: Denervation; facet joint; low back pain; pulsed radiofrequency; radiofrequency thermocoagulation; transcutaneous electrical nerve stimulation.

Özet

Amaç: Bu çalışmanın amacı, lomber faset eklem sendromu (LFS) olan hastalarda, fizik tedavi kliniklerinde uygulanan TENS (Transkütanöz Elektriksel Sinir Stimülasyonu) ile algoloji kliniklerinde uygulanan konvansiyonel radyofrekans termokoagülasyon (CRF) ve pulse radyofrekans denervasyon (PRF) tedavi yöntemlerinin etkinliklerini karşılaştırmaktır.

Gereç ve Yöntem: Çalışmaya, Ege Üniversitesi Tıp Fakültesi Hastanesi Fizik Tedavi ve Rehabilitasyon Anabilim Dalı ile Algoloji Bilim Dalı polikliniklerine, en az 3 aydır devam eden ve medikal tedaviye yanıt vermeyen lomber faset eklem sendromuna bağlı ağrı şikâyeti ile başvuran hastalar arasından seçilenler dahil edildi. Toplam 60 hasta, her bir grupta 20 hasta olacak şekilde üç gruba ayrıldı. İlk gruptaki hastalara konvansiyonel RF işlemi, ikinci gruptakilere 15 gün boyunca günde 30 dakika TENS, üçüncü gruptakilere ise PRF uygulandı. Hastalar başlangıçta, birinci ve altıncı ay sonunda olmak üzere toplamda üç kez değerlendirildi.

Bulgular: Her üç tedavi grubunda da, ağrı skorları, Oswestry Engellilik İndeksleri, el-yer mesafesi ölçümleri, 20 metrelik yürüme süreleri, 6 dakikalık yürüme mesafeleri, Beck Depresyon Envanteri ve SF-36 skorlarındaki değişimler 1. ve 6. aylarda istatistiksel olarak anlamlı bulundu ($p<0.05$). Tedavi grupları karşılaştırıldığında, herhangi bir değerlendirme parametresinde bir grubun diğer bir gruba üstünlüğü saptanmadı ($p>0.05$).

Sonuç: Lomber faset eklem sendromu olan hastalarda, CRF ve PRF gibi daha invaziv prosedürlerden önce non-invaziv bir tedavi yöntemi olan TENS'in kullanılmasının daha uygun olabileceği sonucuna varılmıştır. Ancak, daha büyük hasta örneklemi içeren ileri çalışmalara ihtiyaç olduğu belirtilmiştir.

Anahtar sözcükler: Bel ağrısı; denervasyon; faset eklem; pulse radyofrekans; radyofrekans termokoagülasyon; transkutanöz elektriksel sinir stimülasyonu.

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Introduction

Analgesics, anti-inflammatory drugs, physiotherapy procedures such as manipulations, transcutaneous electrical nerve stimulation (TENS), and exercise, and interventional treatment methods can be used in the treatment of lumbar facet syndrome.[1,2] In patients who do not respond to conservative treatments, including physical therapy approaches, minimally invasive modalities are preferred in clinical practice.[2] However, the evidence regarding the efficacy of these treatments and their superiority over one another is limited. [1,2]

Unfortunately, there are a limited number of studies and insufficient evidence on TENS, one of the physiotherapy agents used in the treatment of chronic low back pain. Although some data show that it is effective for lumbar low back pain, there is reportedly a lack of evidence with respect to functional benefits, quality of life, and depression.[3–8] Data about its effects on lumbar facet joint pain are not available in the literature.

Well-designed studies have demonstrated that radiofrequency therapy is effective compared to placebo in chronic low back pain.[9–12] In any case, there is inadequate evidence on its effect on functional aspects and quality of life.[12] There are again very few studies on pulsed radiofrequency (PRF) denervation in chronic facet joint pain.[13–17] These studies provide limited data with respect to patient diagnoses, follow-up periods, and assessment parameters used.

As there are no guidelines for the treatment of lumbar facet pain, difficulties arise in clinical practice. Since there is not sufficient evidence regarding both TENS and radiofrequency in the treatment of lumbar facet syndrome and no studies comparing them, we aimed to compare TENS therapy as a physical therapy agent with PRF and continuous radiofrequency thermocoagulation (CRF) therapies as invasive treatment methods.

Material and Methods

Patient Selection

The study included patients who presented to the outpatient clinics of these units with complaints of chronic low back pain persisting for at least 3 months and that had not responded to previous medical treatments. They were assessed using their two-way lumbar X-rays taken within the last year and lumbar magnetic resonance imaging outcomes. Following these examinations and assessments, patients were excluded from the study if they had a coagulation disorder, a history of malignancy, a mental disorder, a psychiatric disorder, pregnancy, prior low back surgery, a history of TENS or radiofrequency procedures in their low back region within the last year, an advanced (grade 3–4) spondylolisthesis defect in their lumbar vertebrae, an extruded and sequestrated disk hernia or a spinal narrow canal in their magnetic resonance imaging, cauda equina syndrome or advanced paresis, examination findings suggesting radiculopathy with pain noticeably extending below the knee, a history of systemic inflammatory disease, advanced cardiac deficiency, or a diagnosis of pulmonary disease. Patients who were believed to have facet joint syndrome, based on their medical history, examination findings, and other tests, and who did not meet any of the exclusion criteria, were informed about the study and treatment procedures.

Patients who agreed to receive treatment, based on the information given to them, underwent a diagnostic test dose in the operating room of the Algology Division to confirm whether their present pain was associated with facet syndrome, meeting the inclusion criteria. This diagnostic procedure involved the injection of 0.4 cc of bupivacaine under fluoroscopy into the median of the dorsal ramus that enables innervation of lumbar facet joints. Patients whose pain receded more than 50% after this test dose administration, and who met the other two inclusion criteria, a visual analogue scale pain level >3 and age 18–75 years, were included in the study.

The included patients were informed both in writing and verbally about the purpose and length of the study, the implementation method, and potential side effects and problems. They signed the "subject informed consent form," and local ethics committee approval was obtained (Ethics number: 15.04.2014.13-12,1/11). Our study was conducted in accordance with the Helsinki Declaration.

Intervention

The study was designed as a prospective, randomized, single-blind study and was registered with

ClinicalTrials.gov (ID: NCT02942147). While patients were aware of their treatment, the physician assessing them before and after treatment was blinded to the treatment each patient received. Patients were randomized using a template from www.randomizer.org.

Patients were divided into three groups according to the randomization template. Group 1 (n=20) received CRF thermocoagulation, Group 2 (n=20) received TENS therapy, and Group 3 (n=20) underwent PRF denervation.

In the CRF therapy for Group 1, the target for needle placement was between the neck of the superior articular process and the superomedial aspect of the transverse process, not exceeding the ventral border of the facet column.[18] For the L5 dorsal ramus, the needle was positioned at the groove between the S1 articular process and the sacral ala.[19] Needle placement was confirmed using anteroposterior, oblique, and lateral fluoroscopic views. The intervention used a 22G, 10 cm radiofrequency cannula with a 0.5 cm active tip and employed the tunneled vision technique. CRF was applied at four levels (L2-5) at 80 degrees for 1 minute at each level. Patients were monitored for 2 hours post-procedure and discharged after confirming no complications. Adverse events during the procedures were recorded.

Group 2 patients underwent TENS therapy for 30 minutes daily for 15 days at the outpatient physiotherapy unit. This therapy was conducted using conventional TENS subtype with a frequency of 80–100 Hz, applying four electrodes on the most painful area.

For Group 3's PRF denervation, the needle placement targets were similar to those in CRF therapy. The procedure used a 22G, 10 cm radiofrequency cannula with a 0.5 cm active tip and the tunneled vision technique. PRF treatment characteristics were: (1) electrode tip temperature not exceeding 42°C; (2) duration of 240 seconds; (3) voltage of 45 V; (4) pulse rate of 2 Hz; and (5) pulse width of 20 ms. After the procedure, patients were monitored for 2 hours and discharged post-confirmation of no complications. Adverse events were also recorded.

Additionally, all three groups of patients were provided with a home exercise program consisting of lumbar range of motion and lumbar isometric exercises, excluding extensional and rotational movements. These were to be performed at least twice a week throughout the follow-up period. Patients were contacted weekly to encourage compliance with the exercise program.

Outcome Measures

Demographic and Clinical Characteristics: The demographic and clinical characteristics of all patients included in the study were recorded before administering the treatments.

Assessment Timings

The following assessments were conducted before the treatment procedures (month 0) and at months 1 and 6 after the treatments.

Visual Analogue Scale

Patients were asked to assess their pain on a 10-cm scale.

Oswestry Disability Index

This 10-item index evaluates the extent to which low back pain affects activities of daily living. Scores are assigned as A=0, B=1, C=2, D=3, E=4, and F=5 for each answered question.[20]

Short Form 36

A 36-question test designed to measure the extent to which a patient's physical and psychological condition affects their quality of life. It allows scoring for 8 subscales: physical functioning, physical role, pain, general health, vitality, social functioning, emotional role, and mental health.[21]

Beck Depression Inventory

A 21-item test that explores how the patient has felt over the last week. Scores of 0–9 are interpreted as normal, 10–16 as mild depressive symptoms, 17–29 as moderate depressive symptoms, and 30–63 as severe depressive symptoms.[22]

Hand-Floor Distance

Patients are asked to bend forward without bending their knees and touch the floor with their fingers. The distance between the fingers and the floor is recorded in centimeters.

6-Min Walking Test

Patients walk at their maximum speed without running for 6 minutes, and the total walking distance is measured in meters and recorded.[23]

20-Meter Walking Test

Patients walk a distance of 20 meters at their maximum speed without running, and the time taken to walk this distance is measured in seconds and recorded.

Sleeping Status

Patients are asked whether they experience sleep problems due to their current pain, responding with 1 for yes or 2 for no.

Patient Satisfaction

Patients are questioned about their current condition at post-treatment months 1 and 6 and their satisfaction with the treatment. Satisfaction levels range from 1 (Very Poor) to 5 (Very Well).

Statistical Analysis

For statistical analyses, IBM SPSS Statistics 20 (version 20 for Windows) was used. Intergroup categorical data were compared using the Chi-Square test. Variance analyses were carried out for age, height, weight, and body mass index. Changes within groups with respect to sleeping status at months 0, 1, and 6 were compared using the Cochrane Q test. Since further changes were found afterwards, dual comparison analyses were performed using the McNemar test to determine the origins of these changes. The Wilcoxon Signed Ranks test was run to calculate the in-group changes in patients' satisfaction levels. Intergroup comparisons were conducted using the Kruskal Wallis test. The Friedman test was performed to calculate in-group changes in assessing the hand-floor distance parameter; when a difference was found, the Wilcoxon Signed Ranks test was used to identify the origin of this difference. The Shapiro-Wilk test was used to check if the numeric variables had a normal distribution. Variance analyses were used for the repetitive measurements in the in-group and intergroup comparison of variables with a normal distribution. The Bonferroni test was applied for paired comparisons following the variance analysis. To assess treatment performance, differences between the periods were calculated, and the Kruskal Wallis analysis was run for the obtained differences. When a difference was found, the Mann Whitney U test was used for a paired comparison.

The G. Power 3.0.8 package program was used for power analysis. Using the T test for two paired samples, it was determined that 15 data points were needed to achieve an effect size (type d2) of 0.8 (80%), with an alpha error of 5%. When calculated for the results obtained in our study, the achieved power value was found to be between 0.98 and 1 (98%–100%) in the analyses carried out, with the alpha error at a 5 percent significance level.

Results

The study included 60 patients who did not respond to medical treatment, had no neurological deficits, and were diagnosed with facet syndrome. Five patients from the CRF group, one patient from the TENS group, and two patients from the PRF denervation group were unable to complete the study (Fig. 1).

The pre-treatment socio-demographic data of all the patients are presented in Table 1. No statistically significant difference was found between the groups for most of the socio-demographic and clinical data ($p>0.05$). However, there was a significant difference between the group averages in education, Oswestry Disability Index, and Beck Depression Inventory scores (Tables 1, 2).

The results of the assessments of the groups made at pre-treatment, post-treatment month 1, and post-treatment month 6 visits are detailed in Table 3.

A comparison of the three treatment groups for months 0–1, 0–6, and 1–6 with respect to the visual analogue scale, Oswestry Disability Index, and Beck Depression Inventory scores, scores of all Short Form 36 domains, hand-floor distance, 6-min walking distance, 20-m walking time, sleep symptoms, amount of analgesic use, and patient satisfaction showed no statistically significant difference ($p>0.05$).

Regarding side effects observed in our study, there was excessive pain at the procedure site in 2 patients in the CRF group and 1 patient in the PRF denervation group at post-procedural month 1. Syncope occurred in 1 patient during the administration of the diagnostic test dose. No other side effects were observed.

Table 1. Demographic characteristics

	Conventional RF n=20	TENS n=20	Pulse RF n=20	Total n=60	p
Sex					
Male/female	7(35)/13(65)	8(40)/12(60)	5(25)/15(75)	20(33.3)/40(66.7)	0.592
Age, Mean±SD (Min–Max)	52.1±13.31 (31–76)	51.1±13.29 (25–70)	50.2±7.53 (35–66)	51.1±11.5 (25–76)	0.871
BMI, Mean±SD (Min–Max)	27.45±3.77 (20.8–34.8)	27.67±5.09 (17.6–35.7)	29.38±6.01 (20.9–42.2)	28.16±5.03 (17.6–42.2)	0.422
Marital status					0.105
Married	18 (90)	15 (75)	19 (95)	52 (86.7)	
Widowed	1 (5)	1 (5)	0 (0)	2 (3.3)	
Divorced	1 (5)	0 (0)	1 (5)	2 (3.3)	
Single	0 (0)	4 (20)	0 (0)	4 (6.7)	
Education					**0.019**
Elementary	8 (40)	6 (30)	17 (85)	31 (51.7)	
High school	7 (35)	6 (30)	2 (10)	15 (25)	
College/higher	3 (15)	5 (25)	0 (0)	8 (13.3)	
Illliterate	2 (10)	3 (15)	1 (5)	6 (10)	
Occupation					0.186
Retired	7 (35)	7 (35)	4 (20)	18 (30)	
Housewife	9 (45)	5 (25)	13 (65)	27 (45)	
Officer	1 (5)	3 (15)	0 (0)	4 (6.7)	
Private	3 (15)	5 (25)	3 (15)	11 (18.3)	
Activity level					0.198
Sedentary	16 (80)	12 (60)	17 (85)	45 (75)	
Walking for fun	4 (20)	6 (30)	3 (15)	13 (21.7)	
Regular/athletic	0 (0)	2 (10)	0 (0)	2 (3.3)	
Additional disease					0.934
Yes/No	8 (40)/12 (60)	9 (45)/11 (55)	9 (45)/11 (55)	26 (43.3)/34 (56.7)	
Smoking habit					0.678
Yes	4 (20)	7 (35)	4 (20)	15 (25)	
No	13 (65)	9 (45)	13 (65)	35 (58.3)	
Quit	3 (15)	4 (20)	3 (15)	10 (16.7)	

Oneway ANOVA (Brown-Forsythe); Perason Chi-Square Test; Min: Minimum; Max: Maximum; TENS: Transcutaneous electrical nerve stimulation.

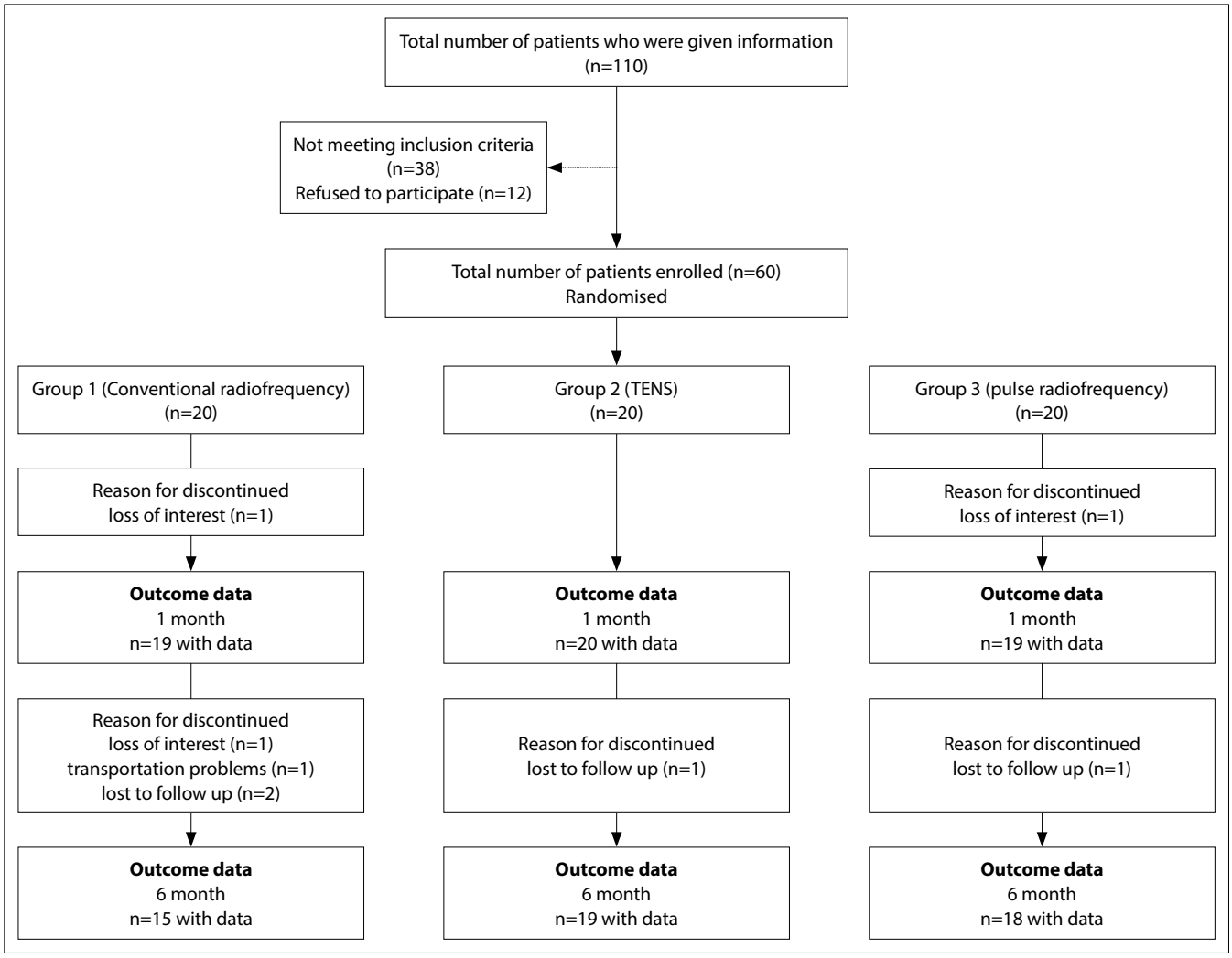

Figure 1. Flowchart of the study.

Discussion

In our study, where we compared TENS therapy as a physical therapy agent with the invasive interventions of PRF denervation and CRF therapies, we found that all three treatments were effective in managing pain, functioning, disability, and quality of life. However, no single group demonstrated superiority over the others in any assessment parameter.

Chronic low back pain is frequently cited in the literature as a common reason for seeking medical attention, leading to considerable health expenditures.[2] Studies on the use of TENS therapy for low back pain suggest that it can be effective in pain relief, yet the evidence remains inadequate.[3–8] Despite mixed results, TENS is widely used in clinical practice. Notably, data on the effect of TENS on pain in patients with lumbar facet pain are scarce. In our study, patients treated with TENS experienced pain relief that persisted until month 6.

Research has shown that both CRF and PRF denervation therapies are effective in patients with chronic low back pain associated with lumbar facet joints.[11,12,15,24–26] However, there are limited studies specifically on the effect of PRF denervation on facet joint pain.[13–17,26] In alignment with our findings, Colini-Baldeschi et al.[17] demonstrated that PRF denervation could maintain pain control for at least 6 months in 70% of patients. A study comparing CRF and PRF denervation found that the pain relief effect of CRF therapy could last up to a year, which was longer than the relief provided by PRF denervation.[15] In another comparative study of CRF and PRF denervation therapies over a 6-month period, patients with chronic lumbar facet pain who did not respond to conservative care showed improvement following PRF denervation.[27] Our study also observed pain relief lasting until month 6 with both radiofrequency procedures, and all three treatment methods were similarly effective in pain management.

Table 2. Intergroup evaluation at the beginning of the study (month 0)

Measurement	Conventional RF	TENS	Pulse RF	p
Sleeping problems (yes/no)	12 (60%)/8 (40%)	7 (35%)/13 (65%)	9 (45%)/11 (55%)	0.280
Hand-to-floor distance (cm)	Median: 8.5 (range: 0–17)	Median: 0 (range: 0–27)	Median: 1 (range: 0–45)	0.568
6-min walk test (meters)	Mean: 513.70±60.13	Mean: 525.90±88.03	Mean: 500.30±56.99	0.514
20-meter walk test (seconds)	Median: 12 (range: 10–17)	Median: 12.5 (range: 9–20)	Median: 13.5 (range: 10–16)	0.325
Use of pain killers (pills/week)	Median: 0 (range: 0–14)	Median: 0 (range: 0–7)	Median: 0 (range: 0–7)	0.776
VAS pain level	Median: 6.5 (range: 5–9)	Median: 6.5 (range: 4–9)	Median: 7 (range: 4–9)	0.829
Oswestry Disability Index score	Mean: 49.80±14.84	Mean: 40.85±12.50	Mean: 56.40±15.14	0.004*
Beck Depression Scale	Median: 14.5 (range: 2–35)	Median: 10.5 (range: 1–24)	Median: 16 (range: 4–45)	0.045*
SF-36: Physical functioning	Median: 57.5 (range: 30–85)	Median: 67.5 (range: 35–85)	Median: 52.5 (range: 10–80)	0.084
SF-36: Physical role functioning	Median: 0 (range: 0–100)	Median: 0 (range: 0–100)	Median: 0 (range: 0–75)	0.473
SF-36: Bodily pain	Median: 41 (range: 0–72)	Median: 41 (range: 0–62)	Median: 32 (range: 0–51)	0.249
SF-36: General health	Mean: 45.90±19.85	Mean: 42.60±15.99	Mean: 35.75±16.08	0.180
SF-36: Vitality	Median: 45 (range: 15–75)	Median: 50 (range: 30–75)	Median: 45 (range: 5–60)	0.611
SF-36: Social role functioning	Median: 56.5 (range: 13–100)	Median: 63 (range: 25–100)	Median: 50 (range: 0–88)	0.357
SF-36: Emotional role functioning	Median: 33 (range: 33–100)	Median: 67 (range: 0–100)	Median: 67 (range: 33–100)	0.494
SF-36: Mental health	Mean: 55.80±20.33	Mean: 63.80±16.08	Mean: 56.60±17.23	0.308

*: The p-values in the table indicate the statistical significance of differences between groups for each measurement, with a p-value greater than 0.05 suggesting no significant difference except for the Oswestry Disability Index Score and Beck Depression Scale where p-values are less than 0.05, indicating a significant difference when compared to Pulse RF. TENS: Transcutaneous electrical nerve stimulation.

Table 3. Results from evaluation of 3 groups after therapy

	Conventional RF			p	TENS			p	Pulse RF			p
	Month 0	Month 1	Month 6		Month 0	Month 1	Month 6		Month 0	Month 1	Month 6	
Hand-to-floor distance (cm)**	8.5 (17–0)[bc]	0 (19–0)	0 (21–0)	**0.014**	0 (27–0)	0 (19–0)	0 (25–0)	0.054	1 (45–0)[bc]	0 (35–0)	0 (35–0)	**0.021**
6-min walk test*	513.70±60.13	522.89±78.24	525.33±84.78	0.317	525.90±88.03	539.50±86.3	545.00±88.71	0.084	500.3±56.9[bc]	520.50±65.12	519.12±68.04	**0.003**
20-meter Walk Test**	12 (17–10)	12 (21–10)	12 (21–10)	0.488	12.5 (20–9)	12 (20–9)	11 (21–9)[ab]	**0.031**	13.5 (16–10)	13 (17–10)	13 (17–0)	0.057
Use of pain killers (number of pills/week)**		0 (14–0)	1 (5–0)	0.858		0 (7–0)	0 (7–0)	0.731		0 (7–0)	0 (14–0)	0.786
Visual Analogue Scale**	6.5 (9–5)[bc]	3 (7–0)	2 (9–0)	**0.001**	6.5 (9–4)[bc]	3 (5–0)	3 (6–0)	**<0.001**	7 (9–4)[bc]	4 (9–0)	4 (9–0)	**<0.001**
Oswestry Disability Index*	49.80±14.84[bc]	29.37±15.73	30.67±20.54	**0.007**	40.85±12.50[bc]	26.30±12.59	24.21±16.82	**0.001**	56.40±15.14[bc]	34.95±19.88	32.89±21.86	**0.001**
Beck Depression Inventory**	14.5 (35–2)[bc]	9 (35–2)	9 (29–1)	**0.010**	10.5 (24–1)	9.5 (28–0)	9 (21–0)	0.170	16 (45–4)[bc]	13 (39–1)	9.5 (31–0)	**0.027**
Short Form 36												
Physical functioning**	57.5 (85–30)	70 (90–15)	75 (95–20)	0.211	67.5 (85–35)	72.5 (95–25)	75 (100–15)	0.146	52.5 (80–10)[c]	65 (95–30)	70 (95–15)	**0.005**
Physical role functioning**	9 (100–0)	20 (100–0)	55 (100–0)[a]	**0.003**	4 (100–0)	15 (100–0)	35 (100–0)[a]	**0.001**	5 (75–0)	16 (100–0)	22 (100–0)[a]	**0.018**
Bodily pain**	41 (72–0)[bc]	52 (100–12)	62 (100–12)	**0.026**	41 (62–0)[bc]	57 (100–22)	64 (100–0)	**0.023**	32 (51–0)[bc]	41 (100–21)	51 (100–0)	**0.006**
General health *	45.90±19.85	48.42±17.64	50.93±23.29	0.434	42.60±15.99	49.40±23.63	51.16±19.80	0.253	35.75±16.08	40.47±22.00	48.22±22.25	0.122
Vitality **	45 (75–15)	55 (70–30)	50 (65–30)	0.472	50 (75–30)[bc]	57.5 (75–30)	55 (70–35)	**0.010**	45 (60–5)	50 (70–30)	45 (65–25)	0.052
Social role functioning**	56.5 (100–13)	75 (100–13)	75 (100–38)	0.069	63 (100–25)	69 (100–25)	88 (100–25)	0.438	50 (88–0)[bc]	75 (100–25)	75 (100–25)	**0.007**
Emotional role functioning**	33 (100–33)	67 (100–33)	67 (100–0)	0.301	67 (100–0)	67 (100–0)	67 (67–0)	0.657	67 (100–33)	67 (100–0)	67 (100–0)	0.542
Mental health*	55.80±20.33	67.58±19.36[a]	65.87±14.65	**0.002**	63.80±16.08	70.80±15.03	70.53±16.23	0.118	56.60±17.23	64.63±16.98	63.78±16.43	0.243
Oswestry Disability Index[Φ]				**0.002**				**0.001**				**<0.001**
Minimal disability	0 (0)	5 (26.3)	6 (40)	p(0–1)=0.002	0 (0)	6 (30)	10 (52.6)	p(0–1)=0.005	0 (0)	5 (26.3)	7 (38.9)	p(0–1)=0.002
Moderate disability	7 (35)	10 (52.6)	5 (33.3)	p(0–6)=0.020	12 (60)	12 (60)	5 (26.3)	p(0–6)=0.002	2 (10)	6 (31.6)	5 (27.8)	p(0–6)=0.001
Severe disability	8 (40)	4 (21.1)	2 (13.3)		6 (30)	2 (10)	4 (21.1)		12 (60)	7 (36.8)	5 (27.8)	
Crippling back pain	5 (25)	0 (0)	2 (13.3)		2 (10)	0 (0)	0 (0)		5 (25)	1 (5.3)	0 (0)	
Bed-bound	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)	0 (0)		1 (5)	0 (0)	1 (5.6)	
Depression[Φ]				**0.070**				**0.356**				**0.043**
Normal	7 (35)	10 (52.6)	8 (53.3)		9 (45)	10 (50)	11 (57.9)		3 (15)	8 (42.1)	9 (50)	p(0–1)=0.013
Mild	4 (20)	3 (15.8)	2 (13.3)		6 (30)	8 (40)	7 (36.8)		8 (40)	8 (42.1)	4 (22.2)	p(0–6)=0.048
Moderate	5 (25)	5 (26.3)	5 (33.3)		5 (25)	2 (10)	1 (5.3)		5 (25)	2 (10.5)	4 (22.2)	
Severe	4 (20)	1 (5.3)	0 (0)		0 (0)	0 (0)	0 (0)		4 (20)	1 (5.3)	1 (5.6)	

General Linear Model (RepeatedAnova) (Post Hoc Test: Bonferonni) - Friedman Test – Wilcoxon Signed Ranks Test; *: Mean±SD; **: Median range (Maximum–Minimum); Φ: n(%); a: Significant when compared tomonth 0; b: Significant when compared to month 1; c: Significant when compared to month 6.

At the conclusion of our study, we found that all three treatments similarly impacted the patients' quality of life. There is evidence suggesting that PRF denervation improves the quality of life in patients with chronic low back pain.[28] However, the impact of radiofrequency therapy on quality of life is less clear, partly due to the infrequent use of validated scales.[12] Our study indicated that PRF denervation had a more pronounced effect on various domains of the Short Form 36, though this was not statistically significant. Zaniewska et al.[8] observed an improvement in the quality of life in patients treated with TENS for low back pain, especially when used in conjunction with other methods. Conversely, a study comparing sham and active TENS found no significant difference in their impact on quality of life.[4] The effect of TENS on quality of life remains a matter of debate due to varying study outcomes.[5–7] Overall, current literature provides only limited evidence on the impact of these three therapies on quality of life.

A comparison of depression levels in our study revealed minimal improvement in the CRF and TENS groups, without statistical significance. However, in the PRF denervation group, the changes in Beck Depression Inventory scores were significant, with more patients showing improvements in their depression levels. Literature suggests that TENS therapy for chronic low back pain is effective against anxiety and depression.[29,30] Yet, these studies often use TENS in conjunction with other physical therapy methods, making it difficult to isolate its individual effectiveness. Interestingly, there is limited research on the effect of radiofrequency procedures on depression.[31] Given the importance of psychological symptoms in chronic low back pain, the lack of sufficient evidence indicates a need for further research in this area.

In our study, CRF and PRF denervation therapies were effective in hand-floor measurements, TENS therapy in 20-m walking time measurements, PRF denervation in 6-min walking distance measurements, and all three therapies in Oswestry Disability Index scores. It should be noted that the p-value was at a statistical limit for improvement in hand-floor distance measurements. Although radiofrequency therapy is reported to be effective on lumbar movements and disability, supporting evidence is limited.[12] Similarly, the impact of TENS therapy on functioning is controversial. The combination of physiotherapy procedures complicates the assessment of TENS's individual effectiveness.[30]

We found no significant differences between the groups in terms of satisfaction levels. Several studies have reported patient satisfaction with physical therapies and radiofrequency treatment methods for chronic low back pain.[32,33]

The strengths of our study include its novelty in comparing CRF, PRF denervation, and TENS or other physical therapy agents, a follow-up period of 6 months, a randomized and single-blind design, and a comprehensive assessment of disability, functioning, sleep, quality of life, and depression. Additionally, the application of a diagnostic test dose to all patients ensured accurate diagnosis of facet joint pain syndrome. However, the application of a diagnostic test dose, while a strength, may also limit the study. This procedure might contribute to pain relief, influencing treatment outcomes. Studies by Manchukonda et al.[34] and others[35,36] have shown that diagnostic blocks can provide pain relief and contribute to long-term treatment of low back pain. Other limitations include the relatively small sample size and the potential lack of power to detect differences between treatments.

Conclusions

Our study concluded that TENS, CRF, and PRF denervation therapies were all effective in managing pain, functioning, disability, and quality of life in patients with facet joint pain. However, none of these treatment groups demonstrated superiority over the others in any assessment parameter. TENS therapy, being non-invasive and safe, can be considered a preferable initial treatment option before resorting to more invasive modalities like CRF and PRF denervation in the management of facet joint pain. This approach allows for effective pain management while minimizing potential risks associated with invasive procedures.

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