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Original Article

Comparison of Intra-articular Lumbar Facet Steroid Injection vs Radiofrequency Denervation in Chronic Low Back Pain

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ABSTRACT

Background and Aims: A major contributor to disability globally is chronic low back pain (CLBP) (1). For a considerable percentage of patients (15–45%), lumbar facet joints (FJ) are a major cause of CLBP (2,3). Corticosteroid injections into FJ are commonly used for pain relief, while radiofrequency (RF) medial branch neurotomy is an alternative denervation technique. However, comparative efficacy of these treatments remains unclear. In patients with chronic facet-mediated low back pain (LBP), this research compared the safety, functional results, and relief from pain of lumbar FJ, RF denervation with intra-articular FJ steroid injection.

Methods: Sixty patients with CLBP linked to facet arthropathy (verified by clinical examination and MRI) were randomized to one of two therapies in this prospective, randomized study: Group B underwent RF denervation of medial branch nerves at matching facet levels, whereas Group A received fluoroscopy-guided intra-articular lumbar facet injections with 40 mg of methylprednisolone and 0.5% bupivacaine. Results evaluated encompassed Visual Analog Scale (VAS) pain scores, duration of pain relief (time until pain recurrence), neuropathic pain score (DN4 questionnaire), functional disability (Roland-Morris Questionnaire, RMQ), health-related quality of life (Nottingham Health Profile, NHP), analgesic usage, and any complications. Patients have been assessed at baseline and followed at 12 hours, 1 day, 1 week, 1 month, 3 months, and 6 months post-procedure. Statistical analysis has been accomplished by employing unpaired t-tests for group comparisons, with $P<0.05$ considered significant.

Results: 57 patients completed the study (Group A: n=28; Group B: n=29) after 3 dropouts. Both treatments resulted in significant pain reduction. The mean period of pain relief was significantly longer in RF group than the steroid injection group (5.03 ± 0.72 months vs 3.19 ± 0.89 months, $P<0.001$). VAS pain scores was initially reduced in both groups; however, by 6 months post-procedure, pain scores in Group A had returned near baseline (mean VAS 3.93 ± 0.98 vs 4.82 ± 1.15 pre-treatment), whereas Group B maintained lower pain levels (mean VAS 2.17 ± 0.89 vs 4.93 ± 0.99 pre-treatment, $P<0.001$ between groups). Correspondingly, at 6 months RF group displayed superior improvement in neuropathic pain symptoms (DN4 score 2.59 ± 0.63 vs 4.36 ± 1.06 in steroid group, $P<0.001$) and functional disability (RMQ score 6.10 ± 1.65 vs 8.32 ± 2.07, $P<0.001$). A significantly smaller proportion of RF patients required analgesic medications for back pain at 6 months (38% vs 79% in steroid group, $P=0.0045$). The NHP quality-of-life scores improved for all groups, but the RF group's benefits were more pronounced in the areas of pain, sleep, and emotional well-being. Neither group experienced any significant side effects or problems.

Conclusion: In patients with chronic FJ-mediated LBP, lumbar RF denervation provided more prolonged pain relief and better 6-month outcomes in pain intensity, functional status, and analgesic use compared to intra-articular facet corticosteroid injection. While steroid injections yielded immediate pain relief, their benefits diminished by about 3 months, whereas RF denervation sustained pain reduction for approximately 5–6 months. Both interventions were safe and improved quality of life (QoL), but RF denervation appears to offer superior mid-term relief. Further researches with longer follow-up are warranted to evaluate long-term outcomes beyond 6 months.

Keywords*: Facet joint, low back pain, steroid injection, radiofrequency ablation, medial branch block, chronic pain, randomized trial.*

INTRODUCTION

CLBP is among the most prevalent causes of disability worldwide, impacting quality of life and productivity (1). Lumbar facet (zygapophysial) joints were identified as a significant source of CLBP in approximately 15–45% of patients (2,3). FJ pain is typically localized to lower back and buttocks, often exacerbated by spinal extension or twisting and not radiating past the knee – a pattern distinguishing it from discogenic or radicular pain (4). When conservative treatments (like physiotherapy, analgesics, and exercise) fail to adequately control facet-mediated back pain, interventional procedures are considered.

Intra-articular FJ injections with corticosteroid and local anaesthetics are commonly employed second-line treatment for facet joint pain. These injections aim to reduce inflammation within the facet joint and provide pain relief. Some studies demonstrated significant short-term improvement in pain and function after facet corticosteroid injections (5). However, the duration of relief can be limited, and at least one placebo-controlled trial found no difference among facet steroid injections as well as saline injections at long-term follow-up (6). Overall, the evidence for FJ injections is modest – providing adequate benefit in short term, but with limited long-term effectiveness in many cases (7). Potential adverse effects of repeated steroid use (like systemic effects or joint changes) also merit consideration.

RF denervation of medial branch nerves innervating FJ is another established interventional approach for chronic facet joint pain. In this procedure, thermal lesions are created to ablate the tiny nerve fibers (medial branches of dorsal rami) that transmit pain from FJ. RF medial branch neurotomy (also called RF ablation or rhizotomy) has shown efficacy in providing pain relief lasting for several months in appropriately selected patients (8,9). Systematic reviews have found this technique to have moderate-to-strong evidence of pain relief for facetogenic back pain, especially when strict diagnostic criteria (such as positive facet blocks) are met (8,9).

There is a relative paucity of direct comparisons between FJ steroid injections and RF denervation. The optimal treatment for facet-mediated CLBP remains debated. Some studies have suggested that RF denervation yields longer-lasting relief than steroid injections, whereas other trials have reported similar outcomes for the two modalities Lakemeier et al. showed that intra-articular steroid injections and medial branch RF denervation provided similar relief from pain and functional improvement at 6 months (11). However, research by Civelek et al. reported superior long-term pain control with RF denervation compared to facet injections (10). Given these mixed findings, further investigation is needed to clarify relative benefits of each treatment.

Aim

We conducted this prospective research to relate efficacy of fluoroscopy-guided intra-articular lumbar FJ corticosteroid injection versus lumbar FJ, RF neurotomy in patients with CLBP attributed to facet joint arthropathy. We hypothesized that RF denervation would provide longer duration of pain relief and greater improvement in function and QoL than steroid injections. Key outcomes evaluated included pain intensity over time, duration of pain relief, functional disability, analgesic requirements, and any procedure-related complications.

MATERIALS & METHODS

Study Design and Patients

This study was an open-label, single-center, randomized controlled experiment. We enrolled 60 adult patients with lumbar FJ arthropathy-related CLBP for at least two years (≥24 months) after obtaining institutional ethics committee approval and signed informed consent. Every patient was selected from a tertiary care hospital's Anesthesia and Pain Clinic between December 2019 and October 2021. Clinical characteristics and imaging were used to establish a diagnosis of facet-mediated pain. Clinical criteria included primarily axial LBP (with minimal or no leg radiation) that was aggravated by facet loading maneuvers (extension and rotation of lumbar spine) and local paraspinal tenderness over the facets. Lumbar spine magnetic resonance imaging (MRI) was employed to confirm FJ degenerative changes (hypertrophy, joint space narrowing, or fluid in the joint) at the affected levels, and to exclude other major pain generators such as significant disc herniation, spinal canal stenosis, or vertebral tumors.

Inclusion criteria: Patients above 30 years of age, with CLBP for ≥2 years, who had an unsatisfactory response to at least 3 months of conservative management (analgesics, physiotherapy, etc.), and who fulfilled the clinical and MRI criteria for facet joint pain as described. The pain was required to be predominantly localized to the low back (facet region) without signs of active radiculopathy.

Exclusion criteria:

Central spinal canal or foraminal stenosis >50%, or any other spinal pathology (e.g., disc extrusion, vertebral fracture, infection, neoplasm) that could explain the pain.

Morbid obesity (body mass index >35).

Uncontrolled diabetes mellitus or other severe uncontrolled comorbid conditions that increase procedural risk.
Bleeding diathesis or inability to discontinue anticoagulation if needed.
Local infection at the procedure site.
Prior surgery or RF treatment at the same levels, or any condition precluding the interventions.

Randomization and Interventions

Sixty eligible patients were randomly allotted in equal proportion (1:1) to one of two treatment groups (30 patients each). Group A received intra-articular facet joint injection with corticosteroid, Group B underwent RF denervation of medial branch nerves supplying FJ. An allocation sequence was generated, and patients were assigned sequentially, ensuring equal group sizes; this was an open-label study, so neither patients nor treating physicians had been blinded to group assignment.

All procedures were carried out under fluoroscopic supervision by experienced pain physicians in an operating theatre setting. Standard aseptic precautions were followed, and patients were placed prone on a radiolucent table for both interventions.

Facet Joint Steroid Injection (Group A): The target facet joint levels for injection were selected based on patient's clinical pain localization and MRI findings (most commonly L4–L5 and L5–S1; some patients also had L3–L4 involvement). After skin sterilization (povidone-iodine or chlorhexidine) and local anesthesia with 2% lidocaine at the entry point, a 22-gauge spinal needle was then advanced into FJ under fluoroscopy. Using an oblique fluoroscopic view, the needle was directed to contact inferior articular process, then walked into joint space of facet (confirmed by anteroposterior and lateral fluoroscopic views). To verify intra-articular placement, a small volume (0.2mL) of non-ionic contrast was injected; proper needle position was confirmed by visualization of contrast outlining the joint capsule without vascular uptake or epidural spread. Once confirmed, a mixture of 1mL of 0.5% bupivacaine and 40 mg of methylprednisolone acetate has was slowly injected into the FJ. The needle has been then withdrawn, and procedure was repeated for each affected facet level identified (typically 1–2 levels per patient). After each injection, the patient was observed for any signs of immediate complications or allergic reaction for about 30–60min in recovery area.

Lumbar Facet RF Denervation (Group B): Target levels for RF neurotomy corresponded to medial branch nerves innervating same FJ that would meet inclusion criteria (L3 to L5 dorsal rami for facets L4–L5 and L5–S1, etc.). A 20-gauge RF cannula with a 10mm active tip was advanced under fluoroscopic guidance to target levels L1–L4 at the anatomical location of medial branch nerve, which is intersection of transverse process and superior articular process. For L5 medial branch (which runs near sacral ala as well as superior articular process of S1), cannula was directed toward the appropriate location under fluoroscopic visualization. Correct placement of each cannula was confirmed in multiple views (AP, oblique, lateral) to ensure the tip was at the intended target. After reaching the target, sensory as well as motor nerve stimulation tests were accomplished through the RF probe to confirm proximity to medial branch nerve: a sensory stimulation at 50 Hz produced concordant local pain/tapping at <0.5 V, and no motor response at 2Hz up to 2V (to ensure the needle was not affecting a motor nerve root). Once confirmed, 1–2mL of 2% lidocaine was injected for local anesthesia at the target nerve. The RF generator (80°C) was then applied to create a thermal lesion for 120 seconds at each targeted medial branch nerve. Typically, bilateral medial branch nerves at two or three segmental levels were lesioned, depending on the pain distribution. Following the process, patients were observed for ~2 hours in recovery area and then discharged home with advice on post-procedure care (e.g., rest, use of ice at the site for soreness).

All patients in both groups were given similar post-procedure instructions and a short course of oral medications for comfort: a combination of NSAID and acetaminophen for 3 days, a prophylactic antibiotic for 5 days, and PPI for 5 days. Patients were advised to gradually resume normal activities over the next few days and to continue any previously instructed back exercises or physical therapy after a short rest period.

Outcome Measures and Follow-up

Patients have been assessed at baseline (pre-treatment) and then at the following time points after the intervention: 12hrs, 1 day, 1 week, 1 month, 3 months, 6 months. At each follow-up, outcomes have been assessed by an investigator and recorded. The primary outcome of interest is pain relief, quantified by the VAS for back pain intensity. VAS ranged from 0 ("no pain") to 10 ("worst imaginable pain"). We specifically noted VAS score at each follow-up and also determined duration of pain relief, stated as time (in months) until patient's pain returned to a significant level (operationally, VAS ≥5 or when the patient felt the pain had substantially returned, whichever came first). If a patient's VAS reached 5 or higher again during the follow-up period, it was considered the end of their pain relief period; if pain remained low, the duration was counted as the full 6 months.

Secondary outcome measures included:

Neuropathic Pain Component: Assessed by "Douleur Neuropathique 4 (DN4)" questionnaire, a 10-item clinician-administered tool (score range 0–10) where higher scores indicate more neuropathic pain features. DN4 was recorded at baseline and follow-ups to see if facet interventions reduced any neuropathic characteristics of the pain.

Functional Disability: measured using the Roland-Morris Disability Questionnaire (RMQ), which consists of 24 physical function-related yes/no questions (score 0–24, with higher scores indicating greater disability). To assess improvement in everyday functioning, RMQ was evaluated at baseline and follow-up visits.
Health-Related Quality of Life: Pain, sleep, physical mobility, social isolation, energy, and emotional reactivity are the six areas covered by the NHP. To measure overall QoL changes, we recorded NHP domain scores at baseline and at the 6-month follow-up. Each domain has a value ranging from 0 (best health) to 100 (worst health).

Analgesic Use: We tracked the use of additional analgesic medications for back pain in each group over time. Patients were asked at each follow-up whether they were currently requiring any analgesics for their back pain. This was recorded as a simple yes/no.

Complications: Any adverse events or complications related to the procedures were monitored. Patients were specifically queried and examined for signs of nerve injury (new neurologic deficits), infection, injection site pain, neuritis, or any other issue at each follow-up. Immediate procedure-related side effects (e.g., transient numbness, soreness at injection site, vasovagal reactions) were noted on the day of procedure.

Statistical Analysis
"SPSS Statistics software (Version 15.0, SPSS Inc., Chicago, IL)" was utilized to analyze the gathered data. The mean ± standard deviation (SD) is used to represent continuous variables, including VAS, DN4, and RMQ scores. Numbers and percentages are used to display categorical data, such as the proportion of individuals using analgesics and the distribution of sex. The chi-square test (or Fisher's exact test, if applicable) was used for categorical variables and unpaired Student's t-tests for continuous variables in the main comparison of results between the two groups (steroid injection vs. RF). Statistical significance has been defined as a P value <0.05. For key outcomes, 95% confidence intervals (CI) for the difference between group means were calculated. No interim analyses were performed. All analyses were conducted on the basis of treatment actually received (per-protocol analysis excluding dropouts).

RESULT
Figure 1: CONSORT flow diagram of patient enrollment, randomization, and follow-up: The research included 60 chronic facetogenic low back pain patients: 30 in Group A received facet joint steroid injections, and 30 in Group B received RF denervation. Three patients had been lost to follow-up throughout the 6-month period (2 in Group A and 1 in Group B), leaving 57 patients (28 in Group A, 29 in Group B) for final analysis. All patients received their interventions, and protocol violations did not exclude anyone. Most baseline characteristics were similar for the two groups. Group A patients had a mean age of 62.4 ± 11.7 years, somewhat higher than Group B's 55.9 ± 10.3 years (P=0.028 for age difference). The average length of chronic back pain before therapy was 1.73 ± 0.85 years in Group A and 2.26 ± 0.92 years in Group B (P=0.025), with Group B patients having a slightly longer history of pain. Sex distribution was nearly equal (Group A: 15 males/13 females; Group B: 15 males/14 females). Baseline pain intensity and functional scores were comparable between groups: the mean baseline VAS pain score had been 4.8 ± 1.2 in Group A vs 4.9 ± 1.0 in Group B (no significant difference), reflecting moderate pain levels; mean baseline DN4 scores were 5.1 ± 1.1 vs 5.0 ± 0.9 (indicating both groups had some neuropathic pain features); and baseline RMQ disability scores were 12.1 ± 2.6 vs 11.6 ± 2.3 (out of 24, indicating moderate functional disability; P>0.4 for both DN4 and RMQ differences). Thus, aside from age and pain chronicity (which were slightly higher in the injection group), the two groups were well matched at the start of the study.

Pain Relief Outcomes: Both interventions resulted in substantial pain relief in the early post-treatment period. Group A (steroid injection) exhibited a more immediate reduction in pain severity than Group B. At 12 hours after the procedure, mean VAS score in Group A had dropped to 0.75 ± 1.14, whereas in Group B it was 1.65 ± 0.90; this difference had been statistically significant (P=0.002), suggesting that local anesthetic used with steroid injection produced prompt pain abolition in most patients. By 1 day and 1 week post-procedure, pain scores remained low in both groups (average VAS ~0.9–1.1) with no significant inter-group difference at those points. At the 1 month follow-up, mean VAS scores were 1.61 ± 1.23 in Group A and 1.21 ± 0.77 in Group B (P=0.145, not significant). However, differences began to emerge by 3 months: Group A's mean VAS had increased to 2.11 ± 1.40, while Group B's remained relatively low at 1.31 ± 0.97 (P=0.015). By the 6-month endpoint, there was a clear divergence in pain levels – the steroid group's pain had returned nearly to pre-treatment intensity, with a mean VAS of 3.93 ± 0.98 (almost equal to their baseline 4.82), whereas the RF group maintained considerably lower pain, with a mean VAS of 2.17 ± 0.89 (P<0.001 comparing groups at 6 months). The beneficial effect of a single steroid injection largely wore off by about 3–4 months for many patients, while a single RF denervation continued to provide meaningful pain relief through 6 months for most patients.

Correspondingly, mean duration of pain relief (time until pain recurred to VAS ≥5 or patient requested retreatment) differed significantly between the groups. In Group A, mean duration of effective pain relief was 3.19 ± 0.89 months, whereas in Group B it was 5.03 ± 0.72 months. This difference was highly significant (P<0.0001). In practical terms, patients in steroid injection group reported their pain returning to moderate levels around 3 months post-injection (on average), whereas those in the RF group maintained pain relief nearly twice as long, with many still experiencing >50% pain reduction at the 6 - month mark.

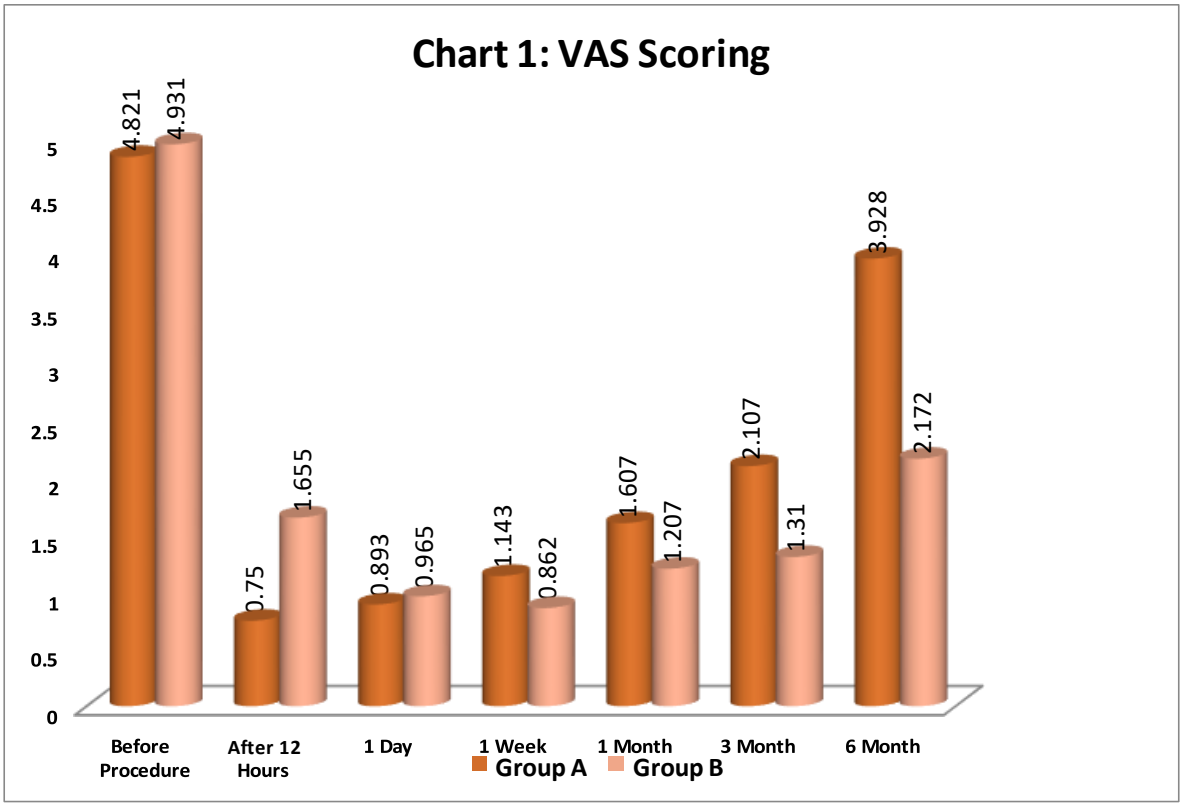
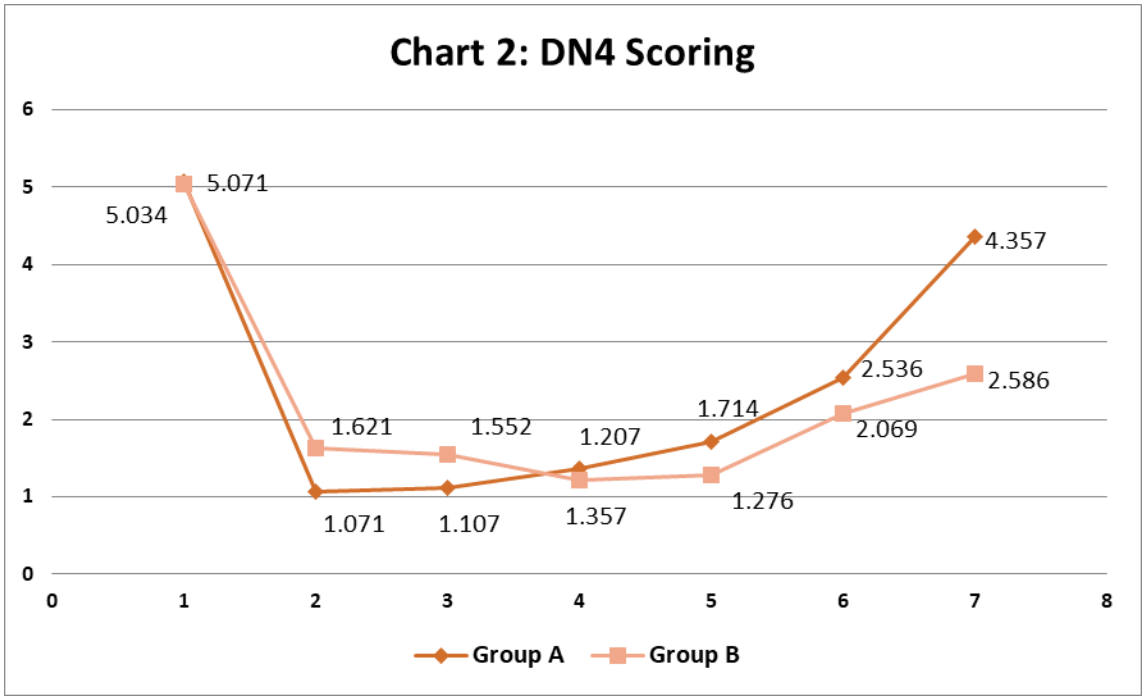
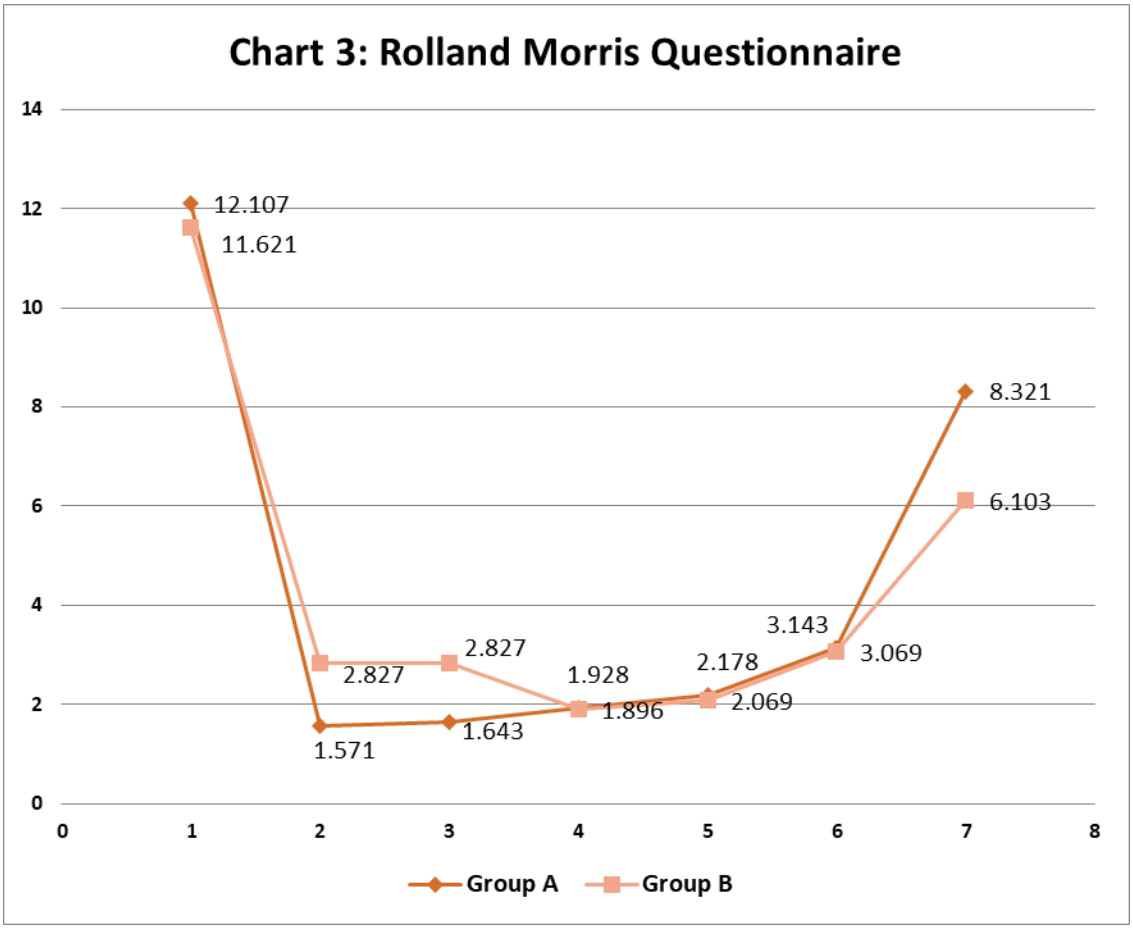


Chart 1: Trend of mean VAS pain scores in each group over 6 months after treatment. Both groups had similar baseline pain levels and showed significant improvement post-procedure. The steroid injection group (Group A) achieved almost complete pain relief in the first days after injection due to the immediate anesthetic effect, but their pain gradually returned, approaching baseline by 6 months. The RF denervation group (Group B) also showed rapid pain reduction (though slightly less dramatic in the first 12 hours), and notably, their pain relief was better sustained over time, with VAS scores remaining low at 3 and 6 months. By 6month follow-up, the difference in pain among groups had been marked, favoring RF denervation for longer-lasting relief.



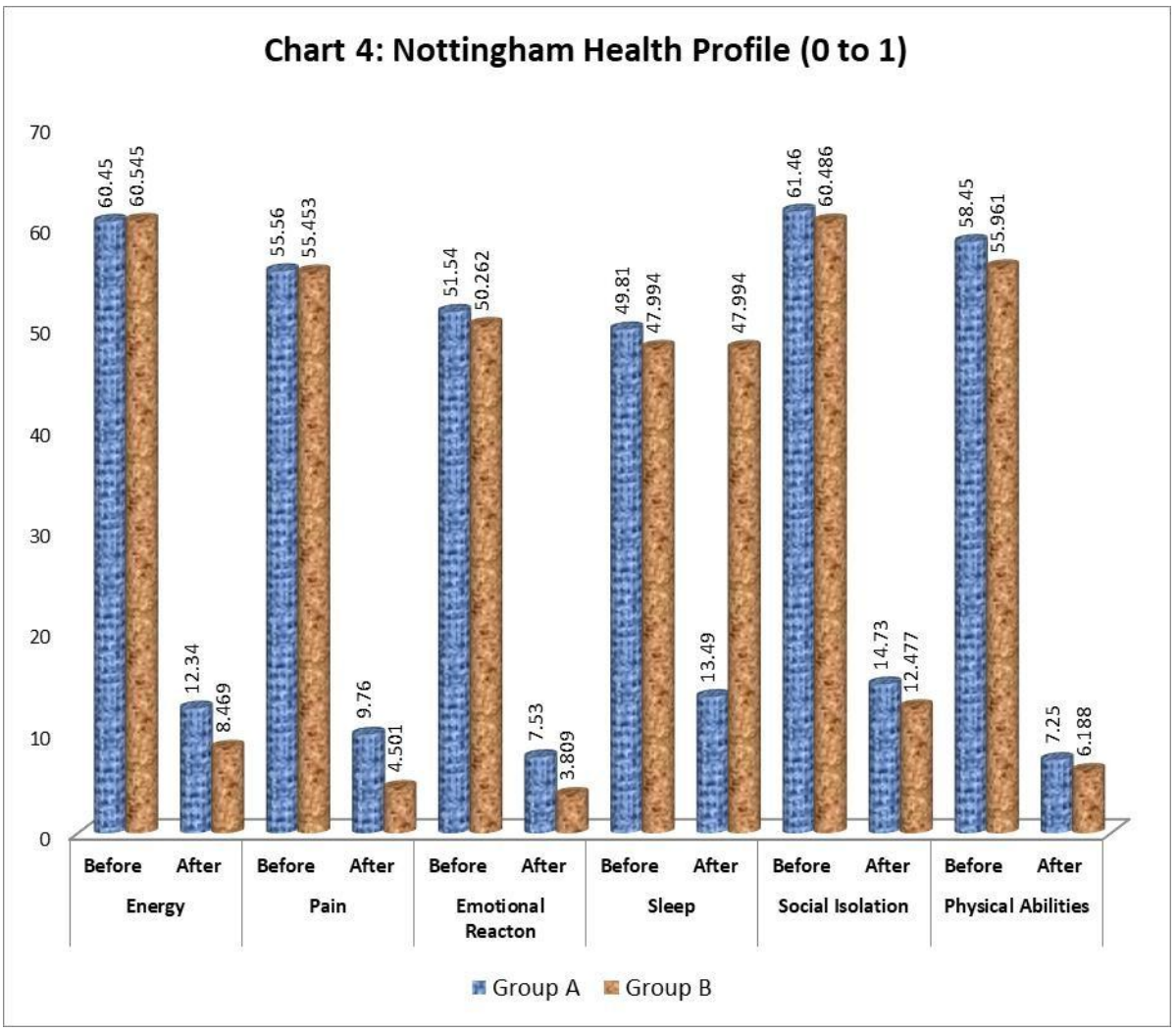
Neuropathic pain symptoms, as measured by the DN4 questionnaire (Chart 2), both treatments significantly reduced in both treatments shortly after the intervention. The mean DN4 score in Group A decreased from 5.07 at baseline to about 1.1 at 1 day post-injection, reflecting a reduction in sharp, burning, or electric shock-like pain components due to the local anesthetic/steroid effect. Group B's DN4 score similarly decreased from 5.03 to roughly 1.5 at 1 day post-RF(some patients

experienced transient neuritic discomfort immediately after RF, but overall neuropathic pain descriptors improved as the facet pain was relieved). There have been no significant differences in DN4 scores among groups at early follow-ups (12h, 1day, 1week, 1month). However, by 3 months a trend emerged (Group A mean DN4 ~2.54 vs Group B ~2.07, P=0.126), by 6months Group B had significantly lower DN4 scores on average (2.59 ± 0.63 vs 4.36 ± 1.06 in Group A, P<0.0001). This indicates that neuropathic characteristics of pain (such as tingling or radiating elements) were more completely kept at bay in RF group at 6 months, whereas in the injection group, these symptoms had largely returned in parallel with overall pain recurrence.



Functional and Quality-of-Life Outcomes (Chart 3): Improvement in functional status and disability was observed in both groups following treatment, but with notable differences in longevity. The Roland-Morris Disability Questionnaire (RMQ) scores dropped dramatically in the immediate post-treatment period for both groups. At baseline, patients had moderate disability (mean RMQ ~12 out of 24 in both groups). By 1 week post-procedure, mean RMQ scores had fallen to ~1.9 in Group A and ~1.9 in Group B (indicating minimal disability when pain was effectively relieved; there has been no significant difference among groups at that point). The improvement has been maintained through 1-3 months in both groups (mean RMQ around 2–3 at 1 month and ~3 at 3 months for both treatments, with no significant inter-group difference). However, at 6 months, Group A patients reported a worsening of function corresponding to their pain recurrence: the mean RMQ in Group A rose to 8.32 ± 2.07, whereas Group B's mean RMQ remained lower at 6.10 ± 1.65. This difference at 6 months was statistically significant (P<0.0001). Thus, patients who underwent RF denervation sustained better functional improvement compared to those who received a single steroid injection, who had lost a considerable portion of their functional gains by 6 months.

Analgesic medication usage mirrored the pain relief patterns. All patients were taking pain medications (at least as-needed NSAIDs or other analgesics) prior to the interventions. After treatment, nearly all patients in both groups were able to stop regular analgesics for some time. At 12 hours, 1 day, and 1 week follow-up, none of patients in either group required additional analgesics for back pain (0/28 in Group A, 0/29 in Group B). By 1 month post-procedure, a small number of patients had resumed taking occasional pain medication: in Group A, 3 out of 28 patients (11%) had started analgesics again (typically mild analgesics on an as-needed basis), and in Group B, 2 out of 29 patients (7%) did so. At 3 months, the proportion of patients needing pain medication increased to 6/28 (21%) in steroid group versus 2/29 (7%) in RF group. At 6 months, there has been a marked difference: 22 of 28 patients in Group A (78.6%) had gone back to using analgesics (many on a regular daily basis due to return of pain), compared to only 11 of 29 patients in Group B (37.9%) who required analgesics at 6 months. This difference in analgesic intake rates has been statistically significant (P=0.0045). Essentially, patients treated with RF denervation were about half as likely to be taking pain medications at 6 months compared to those treated with steroid injection, underscoring the more enduring pain relief provided by RF.



QoL, as assessed by NHP (Chart 4), improved in both groups after treatment. We recorded NHP scores in six domains at baseline and at the 6-month follow-up. At baseline, patients had high scores (indicating poorer status) in domains such as Pain, Physical abilities, and Sleep, consistent with the impact of chronic pain. After 6 months, both groups showed significant reductions in their Pain domain scores (improvement) in contrast to baseline. However, Group B exhibited slightly better outcomes in certain domains. For instance, in the Pain domain of NHP, Group A's score improved from ~55.6 to 9.8, while Group B improved from ~55.5 to 4.5 (P=0.038 between groups for pain domain improvement). Similarly, the Emotional Reaction domain (reflecting emotional distress) showed more improvement in Group B (mean score 3.8 vs 7.5 in Group A, P=0.0008), and the Sleep domain improved more in Group B (7.5 vs 13.5, P=0.01). Domains such as Energy level, Social Isolation, and Physical Mobility improved from baseline in both groups but did not differ significantly between Group A and B at 6 months (for example, both groups had reduced "Physical abilities" scores to single digits, with P>0.3 for group difference). These results indicate that both treatments led to better quality of life, but RF denervation provided a greater benefit in aspects closely related to pain and its emotional impact, likely owing to the longer sustained pain relief.

Finally, no major adverse events or complications have been observed in either group throughout the 6-month follow-up. There were no instances of infection, hematoma, nerve injury, or new neurologic deficits. A few mild, self-limited side effects were noted: some RF patients experienced temporary localized soreness or a mild burning sensation at the treatment site, which resolved within a few weeks with conservative measures (ice packs and mild analgesics). One patient in Group B reported transient numbness in the skin over the lower back that lasted about 2 weeks. No steroid-related systemic effects were detected in Group A (such as steroid flush, hyperglycemia beyond transient elevations, etc.). Both interventions were generally well tolerated.

In summary, the results demonstrate that while facet joint steroid injections provide quick pain relief, their effects tend to wane by around 3 months, leading to recurrence of pain and disability. RF denervation, on the other hand, achieved longer-lasting pain control, with many patients maintaining significant relief through 6 months, along with better functional outcomes and less need for pain medications.

DISCUSSION

Facet joints are well-recognized contributors to CLBP in a substantial subset of patients, with reported prevalence ranging up to about 45% in selected populations (2,3). Managing facet joint pain can be challenging. First-line treatments typically include conservative measures (physical therapy, exercises, and medications), and if those fail, interventional approaches, namely FJ injections or medial branch nerve blocks/ablations, are considered. In this research, we assessed and examined 6-month clinical outcomes of two commonly used interventional treatments – intra-articular facet corticosteroid injections & RF facet denervation – in patients with chronic lumbar facet pain.

Our findings indicate that RF medial branch neurotomy offers more enduring pain relief and functional benefit than a single intra-articular steroid injection for facet-mediated back pain. Group B (RF) patients experienced approximately 5 months of pain relief on average, significantly longer than the ~3 months in Group A (steroid). By 6 months after treatment, the majority of RF patients still reported substantially reduced pain (average VAS about 2/10), whereas the steroid group's pain had essentially returned to moderate levels (VAS ~4/10, nearly back to their pre-treatment baseline). These results support the premise that RF denervation, by ablating the pain-transmitting medial branch nerves, can achieve a longer duration of analgesia in facet joint syndrome compared to the temporary anti-inflammatory effects of corticosteroid injection.

The differentiation in duration of relief observed aligns with prior evidence in the literature. Boswell et al. observed in a systematic review of FJ interventions that medial branch RF neurotomy was linked to longer-term pain relief (typically defined as ≥3 months) in appropriately selected patients, while facet injections typically only provide short-term relief (weeks to a few months) in many cases (7). Our data reinforce this: the steroid injection's benefit largely fell into the "short-term" category (around 3 months), while the RF group clearly achieved "long-term" relief beyond 3 months for most patients. In fact, using the threshold definitions proposed by Boswell et al. – pain relief >3 months as long-term – the majority of RF-treated patients in our study had a successful long-term outcome, whereas steroid injection patients generally did not. Other reviews and guidelines have similarly rated evidence for RF medial branch neurotomy as moderate-to-strong for providing significant pain relief in chronic facet pain (8,9), which is consistent with the superior outcomes we observed with RF denervation.

It is worth noting that the steroid injection group did have excellent immediate pain relief, often achieving near-zero pain scores within hours after the procedure. This is attributable to the local anesthetic used (bupivacaine) and possibly to the early effect of the corticosteroid reducing synovial inflammation. Patients often report dramatic short-term improvement after facet injections, as we saw in our study. However, the challenge has always been maintaining that relief. Steroids act to suppress inflammation and may interrupt pain signals temporarily, but the underlying degenerative facet joint changes persist. As the steroid wears off, inflammation and pain can recur. Our results showed that by 3 to 4 months post-injection, many patients' pain had returned. In contrast, RF neurotomy physically interrupts the nerve supply to FJ for a longer period – until nerve fibers regenerate, which typically takes 6–12 months or more. Therefore, RF could provide a longer window of pain relief. In our cohort, pain began creeping back for RF patients by 6 months in some cases (VAS mean rose from ~1 at 3 months to ~2 at 6 months), suggesting that some nerve regeneration or alternative pain pathways might start to have an effect by that time, but the relief was still significantly better than in the injection group.

Our study's results both concur and contrast with previous comparative studies. Lakemeier et al. (2013) showed a double-blind randomized trial comparing lumbar FJ steroid injections versus RF medial branch denervation in 56 patients; they reported that both treatments led to significant pain reduction and functional improvement at 6 months, with no statistically significant difference among 2 groups for their primary outcomes (11). In Lakemeier's study, VAS for pain decreased in both groups similarly, and Roland-Morris scores improved in both, with no difference at 6 months (11). Our findings differ in that we found a clear advantage for RF at the 6-month mark. This discrepancy could be due to several factors. One notable difference is the dose and type of steroid used: Lakemeier et al. used a smaller dose of corticosteroid (they injected 3 mg of betamethasone into each facet joint) (11), whereas we used a larger dose (40 mg of methylprednisolone). One might expect a higher steroid dose to prolong relief; paradoxically, our injection group had a shorter relief duration. It is possible that other factors overshadowed the effect of steroid dose – for example, differences in patient selection or definition of a positive outcome. Lakemeier's trial required a positive response to diagnostic medial branch blocks for inclusion, which might have enriched their sample with patients particularly likely to respond to either intervention. Our study included patients based on clinical/MRI diagnosis without prior diagnostic blocks, which could introduce some patients whose pain might have a less robust response to injection. Additionally, our study was open-label, whereas Lakemeier's was double-blind; placebo effects or patient expectations could influence subjective outcomes like VAS. Nonetheless, despite these differences, in both studies the RF group had numerically lower pain scores at follow-up – Lakemeier et al. noted the RF group's VAS was slightly lower than the injection group's at 6 months, though not significantly so (11). Our results amplify that signal, suggesting RF may indeed be superior by a meaningful margin when assessed in a slightly different patient population and study design.

Another comparative research by Civelek et al. in 2012 (a Turkish study) found that RF denervation provided better pain relief at long-term follow-up than intra-articular facet injections (10). Their outcomes are more in line with ours, reinforcing that RF's benefits last longer. Moreover, functional outcomes and medication usage in our study favored RF. By 6 months, patients who received RF were more active (as reflected in lower disability scores) and far less reliant on analgesic medications than those who had the injection. Lakemeier et al. reported that analgesic consumption remained

similar in their two groups (no significant difference) by end of the research, with many patients in both groups using some analgesics
(11). In contrast, we observed a notable divergence: only 38% of RF patients versus 79% of injection patients were taking pain medications again at 6 months. This could indicate that in real-world, unblinded conditions, patients who get an injection might be quicker to resume medications as pain returns, whereas RF patients enjoy a longer drug-free interval. It's also possible that our threshold for prescribing or patients' threshold for taking medications differed. Regardless, the reduced analgesic requirement in the RF group is an important outcome, as chronic use of NSAIDs or opioids carries its own risks.

Importantly, both treatments improved quality of life. Even though pain recurred for the injection group by 6 months, their overall health profile was still better at 6 months than at baseline (just not as much improved as the RF group's). For domains like sleep and emotional well-being, the prolonged pain relief with RF had tangible benefits – patients in the RF group reported better sleep and mood scores. The injection group, when their pain relapsed, saw a corresponding decline in those domains again.

We did not encounter any serious complications in either group. This underscores that both facet joint injections and RF neurotomy, when performed carefully under imaging guidance, are relatively safe interventions with low incidence of adverse events – a finding echoed in other studies and reviews (7,9). Transient post-procedural pain or dysesthesias can occur after RF (sometimes termed neuritis due to partial nerve injury), but in our series, these were mild and self-resolving. There were also no infections, likely aided by aseptic technique and (in the case of RF) the heat having a sterilizing effect locally. No patients in the steroid group reported steroid-related complications in our short follow-up, but it's worth acknowledging the known potential side effects of corticosteroids (endocrine effects, osteoporosis, etc.), especially with repeated injections (25). By focusing on a single injection vs a single RF in this study, we limited that risk.

Study limitations: The follow-up duration was only 6 months. While this period is sufficient to observe medium-term differences, facet joint pain is a chronic, fluctuating condition. The COVID-19 pandemic disrupted our ability to conduct longer follow-ups, as elective visits were curtailed during lockdown periods (hence, we concentrated on 6-month outcomes). Ideally, a longer observation (12 months or more) would help determine if the superiority of RF persists and how soon repeat interventions might be needed in each group. We had a relatively small sample size (especially after losing 3 patients to follow-up), which might limit generalizability. However, the differences we found were quite pronounced and statistically robust despite the sample size. The study was unblinded – patients knew which treatment they received, and outcomes like pain ratings could be influenced by expectation bias. A double-blind design (using sham RF or placebo injections) was not utilized due to practical constraints, but future studies could employ blinding to strengthen the evidence. Another point is that not all patients had confirmatory diagnostic medial branch blocks before treatment; while we used clinical and MRI criteria to select facet pain patients, some cases might have had mixed pain generators. We tried to mitigate this by only including those with clear facet involvement and excluding those with other major pathologies. Still, including only block-positive patients might yield different absolute success rates (though in clinical practice, facet blocks themselves have false-positive/negative issues (43)). Patient selection in terms of comorbid conditions could influence outcomes – e.g., patients with concurrent degenerative disc disease or psychosocial factors might respond differently. We noted that patients without significant additional comorbid pain sources tended to do better overall. In practice, careful patient selection (e.g., confirming facet pain diagnosis and ensuring no confounding issues) likely improves the success of both injections and RF (15).

Despite these limitations, our study provides practical clinical insight. It suggests that for patients with truly facet-mediated LBP, RF denervation may be the preferred option if the goal is longer-lasting relief and reduction in pain medication usage. In contrast, intra-articular steroid injections can be very useful for immediate pain reduction and perhaps in situations where a shorter-term relief is acceptable (for example, providing a window for rehabilitation or in patients who cannot undergo RF for some reason). Steroid injections might also be favored if pain relief needed is expected to be temporary or diagnostic in nature. However, clinicians should be aware that a single facet injection often has a limited duration of benefit, and repeated injections carry diminishing returns and potential steroid-related risks. RF neurotomy, while a slightly more invasive procedure and requiring technical expertise, appears to offer a better payoff in terms of extending the pain-free period.

Our findings are in line with the general trend seen in interventional pain management – moving towards longer-acting solutions for chronic pain. Similar comparisons in cervical facet joint pain have also shown RF to have longer efficacy than steroid injections (24). Additionally, newer variations of RF (such as cooled RF or pulsed RF) are being explored. Pulsed RF, which delivers short bursts of current without full nerve coagulation, has been used intra-articularly in some studies. A recent investigation by Do et al. (2017) in fact found that pulsed RF applied inside the lumbar facet joint was as effective as intra-articular steroid injection in relieving facet pain up to 6 months (this was studied in cervical facets as well, with similar outcomes), see Pain Physician 2017】. Pulsed RF might offer pain modulation without permanent nerve destruction, potentially avoiding some nerve irritation, but its long-term efficacy is still under scrutiny. In our study, we used conventional continuous RF, which completely coagulates the nerve; this likely explains the strong and lasting effect observed.

CONCLUSION

This randomized trial demonstrates that fluoroscopy-guided lumbar facet joint RF denervation outcomes in significantly longer pain relief, better 6-month outcomes than intra-articular corticosteroid facet injections in patients with chronic facet-related LBP. RF-treated patients enjoyed extended pain reduction, greater improvement in disability scores, and reduced need for analgesics, without increased risk of adverse effects. Steroid injections provided excellent but short-lived relief, indicating their benefit may be confined to the short term. These findings support the use of RF medial branch neurotomy as a more effective therapeutic option for sustained management of FJ pain. Longer-term follow-up is required to determine if repeated RF lesions maintain superiority over serial injections beyond 6 months. Ultimately, treatment should be individualized, but for patients seeking prolonged relief from facetogenic back pain, RF denervation should be strongly considered.

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