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Research Article

An Analysis of The Effectiveness of Transforaminal Epidural Steroid Injection for Lumbosacral Radiculopathy

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Abstract

Background: Epidural steroid injection has been commonly used to alleviate low back pain with radiculopathy. The transforaminal route is one of the techniques for steroid injection. This study analyses the effectiveness of this procedure in treating patients with acute disc herniation.

Methods: In this study, 110 patients participated, each being followed up for six months. The total duration of the study was four years. Oswestry Disability Index (ODI), Visual Analogue scale (VAS), and Straight leg raise test (SLR) were used as parameters to determine the effectiveness.

Results: 110 patients received transforaminal steroid injections over four years. Each patient was followed up for six months. The ODI and VAS scores were reduced significantly immediately following the procedure. SLR also improved in patients following the procedure. However, ODI, VAS, and SLR did not improve after three months.

Conclusion: Transforaminal epidural steroid injection is an effective short-term treatment for acute lumbosacral radiculopathy.

Keywords: Lumbosacral Radiculopathy, Transforaminal Epidural steroid injection, Straight Leg Raise Test (SLR).

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Introduction

Lumbosacral radiculopathy is a common cause of persistent low back pain, affecting around 30% of the population at some point in their lives ⁽¹⁾. Over half of patients have reported being unable to carry out their regular activities ⁽²⁾. Compression or inflammation of the spinal nerve root causes symptoms. The main symptoms and signs include pain extending beyond the knee, leg discomfort greater than low back pain, weakening in the myotome distribution of the afflicted nerve, and sensory abnormalities in the dermatomal distribution of the involved nerve ⁽³⁾. Spinal disc herniation is considered the primary cause of radiculopathy, with an inflammatory reaction impinging onto the nerve roots being the most prevalent mechanism generating pain ⁽⁴⁾. Conservative therapy techniques are successful for patients with lumbosacral radiculopathy ⁽⁵⁾. A combination of bed rest, oral medicine, lumbar corset, and physical therapy may be used to treat radiculopathy without surgery ⁽⁶⁾.

Initially introduced by Robecchi and Capra in 1952 to reduce inflammation, epidural steroid injections are still one of the most widely used minimally invasive procedures today ⁽⁷⁾. Caudal, interlaminar, and transforaminal are among the various techniques used in epidural steroid injections. Transforaminal epidural steroid injections are preferred over other injection routes due to their ability to inhibit neural transmission, thereby efficiently reducing nociceptive input. They have anti-inflammatory effects, producing pain relief primarily for radiculopathy ⁽⁸⁾.

Using the lumbar transforaminal injection approach, which is done under fluoroscopy, a high concentration of corticosteroid may be selectively administered to the dorsal aspect of the herniated disc and the ventral side of the lumbar nerve root ⁽⁹⁾. This study aims to learn how effectively transforaminal injections can be used to treat lumbosacral radiculopathy.

Materials and Method

This study was conducted at a major university hospital after obtaining ethical clearance from the institutional ethics committee. The study duration was four years, from 2014 to 2018, with a minimum of 6 months follow-up, involving 110 participants who received transforaminal steroid injections.

Inclusion Criteria:

1. Age at least 18 but not older than 70 years.
2. Patients suffering from back pain with unilateral lower limb radiating pain for less than six months.
3. Positive straight leg raising test.
4. Magnetic resonance imaging of the lumbar spine showing signs of a single-level posterolateral disc herniation.

Exclusion Criteria:

1. Patients with multiple-level disc herniation.
2. Pregnant ladies.
3. Those who had a history of spinal surgery for intervertebral disc prolapse.
4. Patients with concomitant spinal instability and stenosis.

5. Allergies to steroids or iodine-based dye or any contraindications to steroids.

Technique:

The intervertebral disc level in the spine for which transforaminal injection is planned has been decided after thorough clinical examinations and imaging. A straight leg raise test where the limb is raised passively from the couch level to measure the angle from which pain starts using a goniometer was done (**Figure 1**). To begin with, 1-2 ml of 2 percent Xylocaine local anaesthetic was injected into the skin directly over the targeted disc level, while the patient was positioned in the prone posture. The image intensifier was aligned to ensure that the epiphyseal plates of both the upper and lower vertebral bodies were in a parallel arrangement (**Figure 2**). A 23-gauge needle was inserted under fluoroscopic guidance into the anterior and superior part of the foramen, within the safe triangle formed by the spinal nerve, the pedicle, and the outer line of the foramen (**Figure 3**). Iohexol, a non-ionic contrast agent, was injected to identify the dorsal root ganglia and the spinal nerve (**Figure 4**). Once the target was confirmed, a mixture of 0.25% bupivacaine (in 3 ml) and 80 mg triamcinolone (2 ml) was injected.

Periodic evaluations were conducted at 1st month, 3rd month, and 6th month on patients to examine for pain relief and to evaluate neurological function. Using the Oswestry disability index, the visual analogue scale, and the straight leg raise test, we assessed the effectiveness of the therapy at each visit.

Results and Analysis

The 110 individuals in this study who underwent the procedure had an average age of 39 years. Males (n=73) were more likely than females (n=37) to have received the treatment. The most common level of disc herniation was L4-5 (n=66) followed by L5-S1 (n=44) and L3-4 (n=4). Paracentral disc herniation (n=74) was the most prevalent form.

Improvements were compared using repeated measurements and analysis of variance by calculating the group averages of the visual analogue scale (VAS) and Oswestry Disability Index (ODI) at each follow-up. Following the first intervention, the mean VAS improved from 4.9 to 2.17 in the first month, 2.37 in the third month, and increased to 2.56 at the six-month follow-up. The mean pain score on the ODI dropped from 17.62 before surgery to 15.25 after the first month, indicating a statistically significant improvement in pain and quality of life. However, further follow-ups revealed no statistically significant improvement. The data showed no significant difference in the pain score improvement between men and women.

The median of straight leg raise (SLR) of the entire study group at each follow-up was calculated (**TABLE 1**), and improvement between follow-ups was compared with Friedman's ANOVA. The first and third-month follow-up after treatment showed a substantial ($p < 0.05$) improvement in the median SLR compared to the pre-procedure value. SLR did, however, worsen between the third and sixth follow-up months ($p = 0.14$).

Out of the eleven patients who had either recurrence of pain or were non-responders during the follow-ups, nine patients developed motor or sensory deficits and subsequently underwent discectomy. The other two patients had a recurrence of symptoms and underwent repeat transforaminal injection. We had no dye-related complications or infections.

Discussion

The pain in lumbosacral radiculopathy is generated by a local inflammation on the nerve roots caused by chemical irritants from the disc material and not exclusively by mechanical compression⁽¹⁰⁾. Therefore, the concept of administering a local steroid injection directly to the inflamed and compressed nerve root emerged as a viable option. The use of epidural steroids is supported by studies revealing abnormal levels of inflammatory and nociceptive mediators surrounding herniated lumbosacral discs, which result in chemical neuro-radiculitis⁽¹¹⁾. Corticosteroids restrict prostaglandin synthesis, reduce humoral and cell-mediated immune responses, stabilize cellular membranes, and prevent nociceptive C-fiber conduction to relieve pain and lessen local inflammation^(12,13).

The most common injectable treatment for this condition involves administering steroids into the epidural area through either the caudal or interlaminar channels⁽¹⁴⁾. Both techniques are done without fluoroscopy and require a large volume of injectate to deliver steroids to the intended disc level. Some studies have shown that saline injections are more efficient than corticosteroid injections in decreasing pain when injected through the interlaminar channel^(15,16). Controlled studies have shown that an interlaminar steroid injection is less successful than a transforaminal steroid injection in terms of reducing disability and easing pain⁽¹⁷⁾. Studies on steroid injections into the caudal epidural region have not been successful in demonstrating that they are better than local anesthetics when administered alone^(18,19). Both techniques also involve the risk of extra epidural or intravascular needle placement. The procedure of transforaminal injection involves fluoroscopic guided delivery of steroids to the afflicted spinal nerve⁽²⁰⁾.

Observational studies showed that the administration of transforaminal steroid injections has successfully aided in preventing surgery for patients in some cases⁽²¹⁾, as well as significantly reducing pain in more than 70% of individuals⁽²²⁾. "The surgery-sparing benefit"⁽²³⁾ was confirmed by a controlled study that was conducted after a 5-year follow-up⁽²⁴⁾.

Using fluoroscopic guidance along with contrast enables precise medication delivery at a high concentration to the interface between the disc and the nerve^(25,26). Diffusion distributes corticosteroids ventrally into the target area, whereas the conventional caudal and translaminar epidural injection techniques are dorsal⁽²⁵⁾. The dorsal median epidural septum may also limit the distribution of dorsal epidural flow towards the contralateral side after injection⁽²⁶⁾. Therefore, it is unlikely that standard translaminar or caudal injection techniques could provide the target tissues with a sufficient dosage of corticosteroids.⁽²⁵⁾

The treatment decision for lumbosacral radiculopathy is made while considering the costs, success rate, and expected benefits. This condition can be well managed conservatively when there is no evidence of significant nerve compression in clinical presentation and MRI images. Though lumbosacral radiculopathy can be managed adequately through conservative means⁽⁵⁾, many patients experience persistent pain necessitating further intervention. Furthermore, this mode of treatment increases the diagnostic certainty of lumbar radiculopathy before more invasive surgical therapies are undertaken.

Following the injection, we observed a statistically significant decrease in the mean pain score (VAS) that persisted for three months. These findings align with earlier studies conducted by Nasir et al.⁽²⁷⁾ and Anuj Bhatia et al.⁽²⁸⁾. Quality of life (ODI) increased significantly over the first month of follow-up but subsequently plateaued. Sinemsari et al.⁽²⁹⁾ observed no statistically significant change in patients' ODI scores, which measures their quality of life. John MacVicar⁽³⁰⁾ observed that contained disc herniation showed significant clinical improvement compared to the cases in which herniation was not contained, a finding not explored in this study. Our study compared the improvement in the straight leg raising test during the follow-ups, which showed significant improvement in the first three months. However, our research could not reveal any previous studies in which this parameter was compared.

According to our findings, in the first few months after therapy, the transforaminal steroid injection greatly enhanced pain relief and quality of life.

A few limitations of this study include a limited sample size and a short follow-up period. Comparison of response to treatment among paradiscal and foraminal disc herniation could not be assessed as the number in the foraminal group was inadequate.

Conclusion

Our study demonstrates that transforaminal steroid injections are effective in providing significant pain relief and improving the quality of life in the first few months following treatment for lumbosacral radiculopathy. Despite the overall positive results, the improvement plateaued over time, and no significant difference in the pain score improvement was observed between male and female patients. The improvement in the straight leg raise test further supports the efficacy of the treatment, although more research is needed to evaluate long-term outcomes and compare treatment responses between different types of disc herniations. Further studies with larger sample sizes and longer follow-up durations are recommended to evaluate long-term outcomes and treatment responses between different types of disc herniations.

Conflict of Interest:

There is no conflict of interest in this study.

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Legend to Table

Table 1: Showing comparison of the difference in median of Straight Leg Raise Test with respect to duration

Duration	Difference in Median (degrees)	p-value
Pre-procedure to 1 month	9.11	<0.05*
Pre-procedure to 3 months	9.08	<0.05*
Pre-procedure to 6 months	8.54	<0.05*
1 month to 3 months	3.71	<0.05*
3 months to 6 months	-5.53	>1

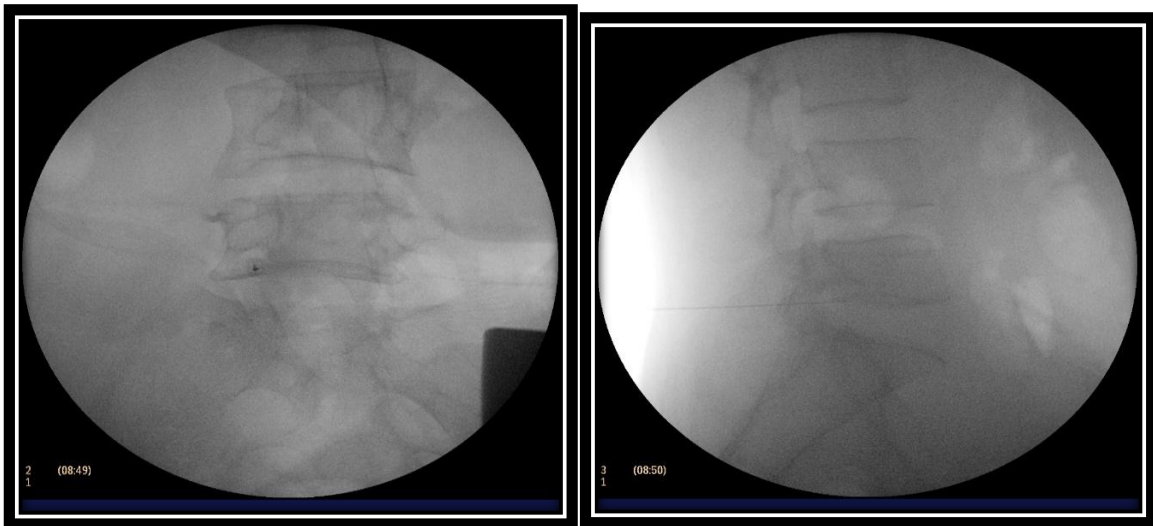
* Statistically significant



Figure 1: Pre-procedure assessment of SLR



Figure 2: Fluoroscopy-guided needle placement



(A) Antero-posterior view (B) Lateral view
Figure 3: Entry into right S1 foramen for L5-S1 right paracentral disc herniation

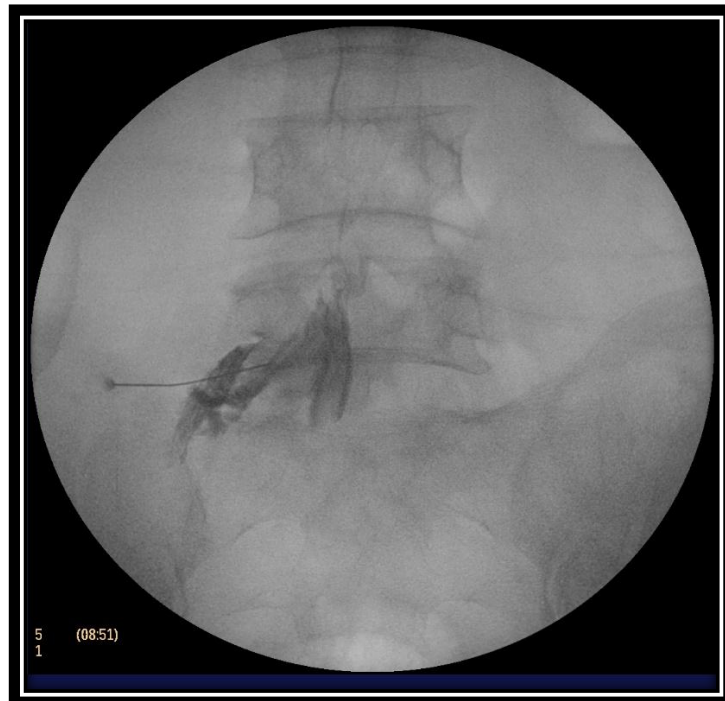


Figure 4: Right S1 traversing root delineated with radio-opaque dye