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The Efficacy of Epidural Steroid Injection in the Management of Lumbar Intervertebral Disc Prolapse

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Background: Low back pain and radiculopathy are the most troublesome symptoms in patients with degenerative disc disease. Epidural steroid injection (ESI) is commonly used to reduce pain and improve functional disability by suppressing the inflammatory response at the affected nerve root caused by disc herniation. This study aimed to evaluate the efficacy of lumbar ESI in improving pain intensity and functional outcome. **Materials and Methods:** This prospective randomized study included 30 patients aged 30–60 years presenting with low back pain and lumbar radiculopathy secondary to lumbar intervertebral disc prolapse, without absolute indications for surgery. Patients were treated with lumbar epidural steroid injections and randomly divided into two groups: Group 1 underwent lumbar interlaminar ESI, and Group 2 underwent lumbar transforaminal ESI. Pain intensity was assessed using the Visual Analog Scale (VAS), and functional disability was evaluated using the Oswestry Disability Index (ODI). Follow-up assessment was performed at 4 weeks post-injection using the same evaluation tools. **Results:** Overall, the mean VAS score for the study population improved by 58% after 4 weeks ($P < 0.001$), while the mean ODI score improved by 36% ($P < 0.001$). In Group 1, the mean VAS and ODI scores improved by 52% and 32%, respectively ($P < 0.001$). In Group 2, the mean VAS and ODI scores improved by 64% and 40%, respectively ($P < 0.001$). The improvement in both pain and functional scores was significantly greater in the transforaminal group compared with the interlaminar group ($P < 0.001$). **Conclusion:** Epidural steroid injection is a safe and effective modality for alleviating radicular pain and improving functional outcomes in patients with lumbar disc prolapse. The transforaminal approach provides superior clinical and functional improvement compared with the interlaminar approach.

Keywords: Epidural steroids; Interlaminar; Lumbar disc prolapse; Radicular pain; Transforaminal

Introduction

Chronic low back pain, with or without associated sciatica due to prolapsed lumbar intervertebral disc, is a common condition encountered by orthopaedic surgeons [1,2]. Low back pain is a major global health problem, affecting up to 80% of the population at some point during their lifetime [3]. It has been identified as the sixth highest contributor to disease burden among 291 studied conditions and is responsible for more disability than any other musculoskeletal disorder. Furthermore, low back pain accounts for a substantial proportion of healthcare expenditure, with costs increasing at a rate faster than overall healthcare spending [4].

Low back pain and sciatica continue to be leading causes of disability worldwide, particularly among young and middle-aged adults. In developing countries, the prevalence is higher due to physically demanding occupations, poor ergonomics, and adverse living conditions. This disabling condition is one of the most common causes of limitation of physical activity and contributes significantly to loss of productivity and “working man-days” [5].

The etiology of chronic low back pain is complex and multifactorial, commonly arising from degenerative changes in the lumbar spine. Pain may originate from intervertebral disc degeneration, vertebral malalignment, zygapophysial joint arthritis, muscles, fascia, ligaments, or neural structures, making precise identification of the pain generator challenging. DePalma et al. reported that lumbar discs accounted for 42% of cases of chronic low back pain, followed by zygapophysial joints (31%) and sacroiliac joints (18%), confirming lumbar disc pathology as the most frequent cause in adults [6].

Sciatica is most commonly caused by lumbar intervertebral disc prolapse; however, a subset of patients presenting with clinical features of sciatica may not demonstrate disc herniation on MRI or CT imaging, creating a diagnostic paradox and suggesting alternative mechanisms [7]. Advances in imaging and molecular research have enhanced the understanding of sciatica, indicating that its pathogenesis involves a combination of mechanical compression, inflammation, and immune-mediated processes [8].

Corticosteroids are known to reduce inflammation by acting on chemical, immunological, and mechanical components of neural injury. Although the exact mechanism of action remains incompletely understood, evidence suggests that corticosteroids provide pain relief by inhibiting pro-inflammatory mediators and exerting a reversible local anesthetic effect [9]. Systemic steroids may be considered in patients with sciatica unresponsive to non-steroidal anti-inflammatory drugs; however, local delivery into the epidural space allows higher drug concentrations at the site of pathology with prolonged therapeutic effects. According to the NICE guidelines (2009), epidural steroid injections (ESI) may be administered to patients who fail to respond to conservative management for at least three months and are either unsuitable for or unwilling to undergo surgical intervention. Epidural steroid injections have been in use for over six decades, yet the results of various studies remain inconclusive [10].

The primary objective of epidural steroid injection is to deliver corticosteroids close to the site of pathology, particularly an inflamed nerve root, thereby achieving higher local drug concentrations [11,12]. Epidurally administered steroids reduce inflammation by inhibiting the synthesis and release of pro-inflammatory mediators and also provide a reversible local anesthetic effect [13]. Lumbar epidural injections can be administered via interlaminar, caudal, or transforaminal approaches.

Initially, the interlaminar approach was considered preferable to the caudal approach because it enables more direct access to the presumed site of pathology using smaller volumes of injectate [14–16]. However, this technique has several limitations, including unrecognized extradural needle placement without fluoroscopic guidance and preferential cranial spread of the injectate, resulting in posterior epidural deposition. In contrast, disc herniation and nerve root pathology typically involve the anterior epidural space [17]. Moreover, several studies have reported limited or statistically insignificant clinical improvement following interlaminar ESI [14,15,18].

Transforaminal epidural steroid injection (TFESI) has emerged as an alternative to interlaminar and caudal approaches. Since its widespread adoption in the early 2000s, TFESI has gained popularity due to its ability to deliver medication directly to the affected nerve root while simultaneously aiding in the morphological and functional diagnosis of radiculopathy [3]. Despite its increasing use, considerable controversy remains regarding the comparative efficacy of different ESI techniques, appropriate patient selection, indications, and overall cost-effectiveness [19].

Materials and Methods

Study Design and Population

This was a prospective, randomized study conducted on 50 patients presenting with low back pain and lumbar radiculopathy secondary to lumbar intervertebral disc prolapse (degenerative disc disease). The study was carried out at SBIMS, Riapur, CG. Approval was obtained from the Institutional Ethics Committee of SBIMS Faculty of Medicine, and written informed consent was obtained from all participants prior to enrollment.

All patients were treated with lumbar epidural steroid injections. Using a random allocation method, 25 patients underwent lumbar interlaminar epidural steroid injection (ILESI), and 25 patients underwent lumbar transforaminal epidural steroid injection (TFESI). All procedures were performed under C-arm fluoroscopic guidance.

Inclusion Criteria

Patients aged between 30 and 60 years with low back pain and radiculopathy secondary to lumbar disc prolapse, failure of conservative management for at least 3–6 months, and significant disability affecting daily activities were included in the study.

Exclusion Criteria

Patients younger than 30 years or older than 60 years; those with radiculopathy due to spinal canal stenosis; post-traumatic fracture cases; patients with back pain associated with infection, inflammatory disorders, or tumors; patients with cauda equina syndrome; and patients with contraindications to epidural steroid injection were excluded. Contraindications included hypersensitivity or allergy to steroids or local anesthetics, sepsis or local infection at the injection site, bleeding diathesis or anticoagulant therapy (e.g., warfarin or oral anticoagulants), uncontrolled diabetes mellitus, and pregnancy.

Clinical and Radiological Evaluation

Among the 50 patients, 35 were males and 15 were females. The age of the patients ranged from 36 to 60 years, with a mean age of 51.80 ± 7.81 years. All patients were evaluated clinically and radiologically prior to intervention.

All patients presented with low back pain. Pain radiation was noted in 15 patients to the right lower limb, 9 patients to the left lower limb, and 6 patients to both lower limbs. All patients had received various analgesics for a minimum duration of 3 months without satisfactory improvement, while only 20 patients had previously attempted physical therapy, also without significant benefit.

On clinical examination, 46 patients had a positive straight leg raising test, of whom 2 demonstrated crossed straight leg raising. Two patients had a positive femoral nerve stretch test. Mild motor weakness (Medical Research Council grade 4) was observed in 8 patients, while 22 patients had sensory impairment along the dermatome of the affected nerve root. No patient exhibited features of cauda equina syndrome.

The nature of the study, procedural details, and potential risks were explained to all participants, and informed consent was obtained prior to intervention.

Intervention Technique

Interlaminar Lumbar Epidural Steroid Injection

Patients were positioned in a sitting posture on the procedure table. Anatomical landmarks were identified, and the patient was instructed to sit upright with the head flexed and arms hugging a pillow. The patient was asked to arch the back into a “C-shaped” posture to maximize opening of the intervertebral spaces (Fig. 1). Strict aseptic precautions were maintained, including sterilization of the patient’s back prior to needle insertion.

Figure no..1:Patient in the sitting position, with his back arched as the letter C and his arms hugging a pillow.

After identifying the target level, local anesthesia was achieved by infiltrating 1–2 ml of lidocaine without adrenaline into the skin and subcutaneous tissues. An 18-gauge Tuohy epidural needle was then introduced via the midline approach, passing sequentially through the interspinous ligament and ligamentum flavum. The epidural space was identified using the standard loss-of-resistance technique.

Once the epidural space was accessed, correct needle placement was confirmed, and a 10-ml syringe was attached. The needle was advanced slowly and steadily until loss of resistance was appreciated (Fig. 2). Subsequently, a mixture consisting of 2 ml of betamethasone, 2 ml of sterile normal saline, and 2 ml of 2% lidocaine was injected into the epidural space under fluoroscopic guidance.

Figure no.2: Advancement of the needle using the loss-of-resistance technique.

Transforaminal Epidural Steroid Injection (Oblique Approach)

The patient was positioned prone on a radiolucent table (Fig. 3). Strict aseptic precautions were maintained, including thorough sterilization of the patient's back. Local anesthesia was administered by infiltrating 1–2 ml of lidocaine at the skin over the target intervertebral level on the symptomatic side.

Under fluoroscopic guidance, the C-arm was rotated to obtain an oblique projection of the pedicle corresponding to the affected nerve root. The optimal oblique view was achieved when the superior articular process was visualized between the anterior and posterior margins of the vertebral body, with the base of the articular process aligned with the pedicle, producing the characteristic "Scotty dog" appearance.

A 22-gauge spinal needle was inserted slightly superior to the superior articular process and directed toward the base of the pedicle (beneath the "chin" of the Scotty dog). The needle was advanced slowly until gentle contact with the bone inferior to the pedicle was achieved. Fluoroscopy was then switched to the anteroposterior projection followed by a lateral projection to confirm accurate needle position and depth, after which the oblique projection was re-established.

The target for injection was the "safe triangle," bounded superiorly by the pedicle, laterally by the exiting nerve root, and medially by the posterolateral border of the vertebral body, inferior to the pedicle. To confirm correct needle placement, 0.5–1 ml of non-ionic contrast medium (Omnipaque) was injected slowly. Appropriate contrast spread was confirmed by visualization of contrast tracking along the nerve root and entering the epidural space locally (Fig. 4).

Following confirmation of proper needle positioning, a mixture consisting of 2 ml of betamethasone, 2 ml of sterile normal saline, and 2 ml of 2% lidocaine was injected slowly into the epidural space. The needle was then withdrawn, and the puncture site was cleaned using alcohol or povidone-iodine solution.

After the procedure, patients were placed in the supine position and monitored for vital signs to ensure cardiovascular and respiratory stability before discharge.

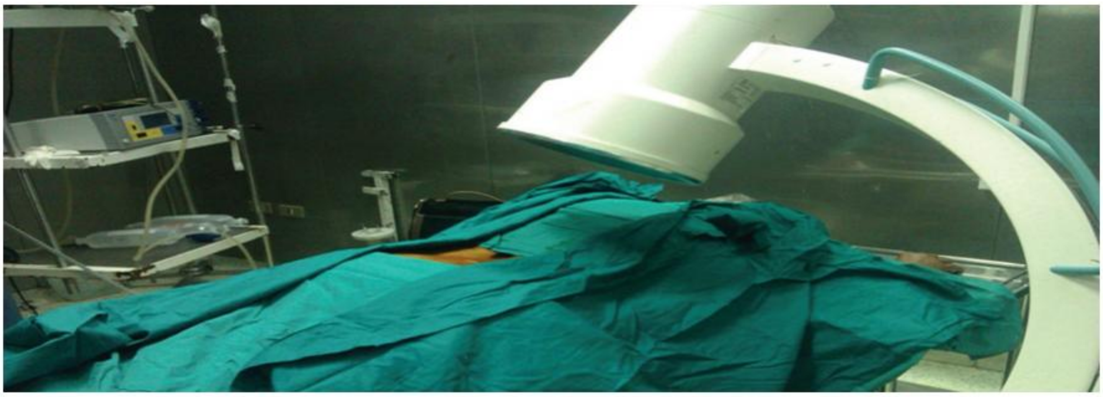

Figure no.3: Patient in the prone position, where a C-arm fluoroscopy is in the oblique position.

Figure no.4: The dispersal pattern of the nerve root after injection of the contrast dye (Omnipaque).

Evaluation of Pain Severity and Functional Outcome

Accurate assessment of pain severity and functional status before intervention is essential for comparison with post-injection outcomes and for evaluating treatment efficacy. Pain intensity was assessed using the Visual Analog Scale (VAS). Patients were asked to rate the severity of their pain on a 10-cm horizontal line ranging from 0 (no pain) to 10 (worst imaginable pain). Assessments were performed before the procedure and at 1 month after injection. A modified version of the VAS, the Verbal Numerical Rating Scale (VNRS), was also used to allow verbal reporting of pain severity.

Functional status was evaluated using the Oswestry Disability Index (ODI). The ODI consists of multiple sections, each scored on a scale from 0 to 5, with higher scores indicating greater disability. The total score was calculated by dividing the sum of the obtained scores by the maximum possible score and multiplying by 100 to yield a percentage. For unanswered questions, the denominator was reduced accordingly. The maximum possible score was 50. Based on the ODI percentage, disability was categorized as minimal, moderate, severe, crippled, or poor. Outcomes were categorized according to both VAS (VNRS) and ODI scores.

Statistical Methods

Data were statistically analyzed and expressed as mean ± standard deviation (SD), median and range, or frequency and percentage, as appropriate. Comparison of numerical variables between the two study groups was performed using Student's *t*-test for independent samples. Categorical variables were compared using the chi-square (χ^2) test, and Fisher's exact test was applied when the expected cell count was less than five. A P value < 0.05 was considered statistically significant. All statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (SPSS), version 24.0 (IBM Corp., Armonk, NY, USA) for Microsoft Windows.

Results

Patient Demographics

A total of 50 patients were enrolled and randomly allocated into two equal groups based on the technique of epidural steroid injection. Group 1 consisted of 25 patients who received interlaminar epidural steroid injection, while Group 2 included 25 patients who received transforaminal epidural steroid injection (Tables 1 and 2).

At baseline, all patients were evaluated using the VAS for pain intensity and the ODI for functional disability. The same evaluation tools were applied at the first follow-up visit, 4 weeks after the injection.

Overall Outcome

Comparison of baseline and 4-week follow-up scores for all 50 patients revealed a statistically significant improvement in both pain and functional outcomes (Table 3). The mean VAS score improved by **58.33%**, while the mean ODI score improved by **35.4%** at 4 weeks following injection ($P < 0.001$).

Group 1: Interlaminar Epidural Steroid Injection

In Group 1, comparison of baseline and 4-week follow-up scores demonstrated a significant reduction in pain intensity and disability (Table 4). The mean VAS score improved by **52%**, and the mean ODI score improved by **31.13%** after 4 weeks ($P < 0.001$).

Group 2: Transforaminal Epidural Steroid Injection

In Group 2, patients who received transforaminal epidural steroid injections showed greater improvement in both pain and functional scores (Table 5). The mean VAS score improved by **64.66%**, and the mean ODI score improved by **39.66%** after 4 weeks ($P < 0.001$).

Comparison Between Groups

At 4 weeks post-injection, both groups were compared with respect to mean values, standard deviation, and percentage improvement in VAS (VNRS) and ODI scores (Table 6). The improvement in pain and functional outcomes was significantly greater in the transforaminal group compared to the interlaminar group ($P < 0.001$).

Table no.1: Patients' demographics

Variables		n	%
Sex	Male	35	70
	Female	15	30
Age (years)	Mean ±SD	48.98±9.8	
	Range	33-67	
Level of the lesion	L4-L5	19	38

	L5-S1	10	20
	L3-L4	10	20
	L4–L5, L5–S1	5	10
	L2–L3, L4–L5	3	6
	L3–L4, L4–L5	2	4
	L2–L3, L3–L4	2	4
Side of the radiculopathy	Right	25	50
	Left	15	30
	Bileteral	10	20

Table no.2: Demographics of both groups

Variables		**Group 1 (interlaminar approach)**	**Group 2 (transforaminal approach)**
Sex	Male	15	17
	Female	10	8
Age (years)	Mean ±SD	48.7±8.6	50.4±8.4
	Range	33-67	36-62
Level of the lesion	L4-L5	9	10
	L5-S1	5	5
	L3-L4	5	5
	L4–L5, L5–S1	3	2
	L2–L3, L4–L5	2	1
	L3–L4, L4–L5	1	1
	L2–L3, L3–L4	1	1
Side of the radiculopathy	Right	13	12
	Left	8	7
	Bileteral	5	5

Table no.3: Visual analog scale and Oswestry Disability Index of the 50 patients all through the follow-up period

		Mean±SD	**Improvement (%)**	**P value**
VAS	On admission	92.4±6.8	60	< 0.001
	After 4 weeks following injection	35.12±7.5		
ODI	On admission	72.4±9.4	36	< 0.001
	After 4 weeks following injection	38.3±9.5		

Table no.4: Visual analog scale and Oswestry Disability Index in group 1, all through the follow-up period

		Mean±SD	Improvement (%)	P value
VAS	On admission	91.5±8.6	52	< 0.001
	After 4 weeks postinjection	39.4±8.3		
ODI	On admission	72.9±9.5	32	< 0.001
	After 4 weeks postinjection	40.4±9.8		

Table no.5: Visual analog scale and Oswestry Disability Index in group 2 all through the follow-up period

		Mean±SD	Improvement (%)	P value
VAS	On admission	92.6±6.7	64	< 0.001
	After 4 weeks following injection	28.8±9.4		
ODI	On admission	71.9±7.9	40	< 0.001
	After 4 weeks following injection	32.1±8.7		

Table no.6: Comparison between groups 1 and 2 regarding visual analog scale and Oswestry Disability Index

		Interlaminar approach (group 1)	Transforaminal approach (group 2)	P value
VAS	VAS postoperative (mean±SD)	39.4±8.3	28.8±9.4	< 0.001
	Improvement (%)	52	64	
ODI	VAS postoperative (mean±SD)	40.4±9.8	32.1±8.7	< 0.001
	Improvement (%)	**32**	**40**	

Comparative Outcome Between Groups

The results demonstrated that the mean improvement in pain intensity, as assessed by VAS (VNRS), and functional disability, as assessed by ODI, was significantly greater in Group 2 (transforaminal epidural steroid injection) compared with Group 1 (interlaminar epidural steroid injection).

Complications

In Group 1 (interlaminar epidural steroid injection), one patient developed a post-dural puncture headache that lasted for four days. This was managed conservatively with analgesics and resolved without further intervention.

In Group 2 (transforaminal epidural steroid injection), three patients experienced increased pain at the injection site. These patients were treated with analgesics, and symptoms improved by the second post-procedure day. No major complications were observed in either group.

Discussion

Low back pain with lumbosacral radiculopathy represents a major clinical, social, and public health concern worldwide [20]. It affects approximately 3–5% of the population, with comparable incidence in both sexes. Men are more commonly affected in their fourth decade, whereas women are more frequently affected between the ages of 50 and 60 years [21]. Lumbar intervertebral disc herniation with nerve root irritation remains one of the most common etiologies of lumbosacral radicular pain [22].

Epidural steroid injections are among the most frequently performed interventional procedures for the management of lumbar radiculopathy [20]. These injections can be administered via interlaminar or transforaminal approaches. Previous studies have suggested that the therapeutic efficacy of epidural steroids is maximized when the drug is delivered as close as possible to the site of pathology [23,24]. Although the interlaminar approach is widely practiced, its effectiveness may be limited due to preferential deposition of the injectate in the dorsal epidural space with minimal ventral spread. In contrast, the transforaminal approach allows targeted delivery of a high concentration of corticosteroid to the ventral epidural space, where disc herniation and nerve root inflammation commonly occur [25].

In the present study, we evaluated the efficacy of lumbar epidural steroid injections in patients with radicular pain and low back pain secondary to lumbar disc prolapse who failed conservative treatment for at least three months. Pain and functional status were assessed using the VAS and ODI before injection and at 4 weeks post-procedure.

The overall results demonstrated significant improvement in both pain and functional outcomes. Among all 50 patients, the mean VAS score improved by **58%**, and the mean ODI score improved by **36%** after 4 weeks ($P < 0.001$). In the interlaminar group, mean VAS and ODI scores improved by **52%** and **32%**, respectively ($P < 0.001$). In contrast, the transforaminal group demonstrated greater improvement, with mean VAS and ODI scores improving by **64%** and **40%**, respectively ($P < 0.001$). These findings indicate superior short-term efficacy of the transforaminal approach.

Our results are consistent with previously published studies. Pandey et al. [25], in a study of 140 patients, reported that the transforaminal approach was significantly more effective than caudal and interlaminar approaches at both 6 months and 1 year of follow-up. Schaufele et al. [26] demonstrated significantly better pain relief with transforaminal injections compared to interlaminar injections in patients with lumbar disc herniation. Similarly, Gharibo et al. [27] reported superior pain relief and functional improvement with the transforaminal approach in patients with subacute lumbar radicular pain.

Regarding procedural safety, complications in our study were minor and self-limiting. Only one patient in the interlaminar group developed post-dural puncture headache, and three patients in the transforaminal group experienced transient post-injection pain. No serious complications such as epidural hematoma, infection, neural injury, or intravascular injection were encountered. These findings are consistent with existing literature, which indicates that serious complications of lumbar ESIs are rare [28]. Karaman et al. [29] reported a vascular penetration rate of 7.4% in transforaminal injections but noted no major complications in their large series.

Conclusion

Epidural steroid injection is a safe and effective modality for short-term alleviation of radicular pain and improvement of functional status in patients with lumbar disc prolapse. Both interlaminar and transforaminal approaches demonstrated significant clinical benefits; however, the transforaminal approach resulted in superior pain relief and functional improvement at 4 weeks. Although technically simpler, the interlaminar approach appears to be less effective. Therefore, transforaminal epidural steroid injection may be considered the preferred approach in patients with lumbar radiculopathy secondary to disc prolapse.

Strengths and Limitations of the Study

This study was designed as a prospective randomized trial, which strengthens the validity of the findings by minimizing selection bias. The use of standardized and widely validated outcome measures, including the Visual Analog Scale (VAS/VNRS) and the Oswestry Disability Index (ODI), allowed objective assessment of pain severity and functional outcomes. All injections were performed under fluoroscopic guidance, ensuring accurate needle placement and enhancing procedural safety. Furthermore, the direct comparison between interlaminar and transforaminal epidural steroid injection techniques provides clinically relevant information to guide decision-making in the management of lumbar radiculopathy secondary to disc prolapse.

The study has several limitations. The sample size was relatively small, which may limit the generalizability of the results. Follow-up duration was short (4 weeks), preventing assessment of long-term efficacy and recurrence of symptoms. The study was conducted at a single center, which may introduce institutional bias. Blinding of patients and evaluators was not performed, potentially introducing observer and reporting bias. Additionally, radiological parameters such as degree of disc herniation and nerve root compression were not correlated with clinical outcomes. Finally, complications were assessed clinically, and subclinical adverse events may have gone undetected.

Conflicts of Interest: None declared.

REFERENCES

1. Walker BF. The prevalence of low back pain: a systematic review of the literature from 1966 to 1998. *J Spinal Disord*. 2000;13:205–17.
2. Damian H, Christopher B, Gail W, Lyn M, Peter B. A systematic review of global prevalence of low back pain. *Arthritis and Rheumatism*. 2012;64:2028-37.
3. Spijker-Huiges A, Groenhof F, Winters JC, et al. radiating low back pain in general practice: Incidence, prevalence, diagnosis, and long - term clinical course of illness. Scand J Prim Health Care 2015; 33:27–32.
4. Hoy D, March L, Brooks P, et al. The global burden of low back pain: estimates from the global burden of disease 2010 study. Ann Rheum Dis 2014; 73: 968 -974.
5. Martin BI, Deyo RA, Mirza SK, et al. Expenditures and health status among adults with back and neck problems. JAMA 2008; 299:656-664.
6. DePalma MJ, Ketchum JM, Saullo T. What is the source of chronic low back pain and does age play a role? Pain Med 2011; 12:224-233.

7. Srujun V. Functional outcome in patients with sciatica after giving epidural steroid injection. Doctoral dissertation, Christian Medical College, Vellore, India.
8. Stafford MA, Peng P, Hill DA. Sciatica: A review of history, epidemiology, pathogenesis, and the role of epidural steroid injection in management. British J Anaesthesia 2007; 99:461-73.
9. Abdi S, Datta S, Trescot AM, et al. Epidural steroids in the management of chronic spinal pain: A systematic review. Pain Physician 2007; 10:185-212.
10. Young IA, Hyman GS, Packia- Raj LN, et al. The use of lumbar epidural/ transforaminal steroids for managing spinal disease. J Am Acad Orthop Surg ;2007; 15:228–38
11. Dooley JF, McBroom RJ, Taguchi T, Macnab I. Nerve root infiltration in the diagnosis of radicular pain. Spine 1988; 13:79–83.
12. Stanley D, McLaren MI, Euinton HA, Getty C. A prospective study of nerve root infiltration in the diagnosis of sciatica. A comparison with radiculography, computed tomography, and operative findings. Spine 1990; 15:540–543.
13. Pasqualucci A, Varrassi G, Braschi A, Peduto VA, Brunelli A, Marinangeli F, et al. Epidural local anesthetic plus corticosteroid for the treatment of cervical brachial radicular pain: Single injection versus continuous infusion. Clin J Pain 2007; 23:551–557.
14. Manchikanti L, Datta S, Gupta S, Munglani R, Munglani R, Bryce DA, et al. A critical review of the American Pain Society clinical practice guidelines for interventional techniques: part 2. Therapeutic interventions. Pain Physician 2010; 13: E215–E264.
15. Manchikanti L, Singh V, Falco FJ, Cash KA, Pampati V. Evaluation of the effectiveness of lumbar interlaminar epidural injections in managing chronic pain of lumbar disc herniation or radiculitis: a randomized, double-blind, controlled trial. Pain Physician 2010; 13:343–355
16. Roberts ST, Willick SE, Rho ME, Rittenberg J. Efficacy of lumbosacral transforaminal epidural steroid injections: a systematic review. PM R 2009; 1:657–668.
17. Rados I, Sakic K, Fingler M, Kapural L. Efficacy of interlaminar vs transforaminal epidural steroid injection for the treatment of chronic unilateral radicular pain: prospective, randomized study. Pain Med 2011; 12:1316–1321.
18. Fredman B, Nun MB, Zohar E, Iraqi G, Shapiro M, Gepstein R, Jedeikin R. Epidural steroids for treating ‘failed back surgery syndrome’: is fluoroscopy really necessary? Anesth Analg 1999; 88:367–372. Wilkinson I, Cohen S. Epidural steroids for spinal pain and radiculopathy: a narrative, evidence-based review. Curr Opin Anaesthesiol 2013; 26:562–572.
19. Vidyasagar KY. Assessment of the growth of epidural injections in the Medicare population from 2000 to 2011. Pain Physician 2013; 16: E349–E364.
20. Tarulli A, Raynor E. Lumbosacral radiculopathy. Neurol Clin 2007; 25:387–405.
21. Buenaventura RM, Datta S, Abdi S, Smith H. Systematic review of therapeutic lumbar transforaminal epidural steroid injections. Pain Physician 2009; 12:233–251.
22. Ghai B, Vadaje KS, Wig J, Dhillon M. Lateral parasagittal versus midline interlaminar lumbar epidural steroid injection for management of low back pain with lumbosacral radicular pain: a double-blind, randomized study. Anesth Analg 2013; 117:219–227.
23. McLain RF, Kapural L, Mekhail NA. Epidural steroid therapy for back and leg pain: mechanisms of action and efficacy. Spine J 2005; 5:191–201.

24. Ackerman WE, Ahmad M. The efficacy of lumbar epidural steroid injections in patients with lumbar disc herniations. Anesth Analg 2007; 104:1217–1222.
25. Pandey RA. Efficacy of epidural steroid injection in management of lumbar prolapsed intervertebral disc: a comparison of caudal, transforaminal and interlaminar routes. J Clin Diagn Res 2016; 10:RC05.
26. Schaufele MK, Hatch L, Jones W. Interlaminar versus transforaminal epidural injections for the treatment of symptomatic lumbar intervertebral disc herniations. Pain Physician 2006; 9:361.
27. Gharibo CG, Varlotta GP, Rhame EE, Liu E, Bendo J, Perloff MD. Interlaminar versus transforaminal epidural steroids for the treatment of subacute lumbar radicular pain: a randomized, blinded, prospective outcome study. Pain Physician 2011; 14:499–511.
28. Manchikanti L, Buenaventura R, Manchikanti K, Ruan X, Gupta S, Smith HS, et al. Effectiveness of therapeutic lumbar transforaminal epidural steroid injections in managing lumbar spinal pain. Pain Physician 2012; 15:199–245.
29. Karaman H, Kavak GÖ, Tüfek A, Yldrm Z. The complications of transforaminal lumbar epidural steroid injections. Spine 2011; 36: E819–E824.