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Original Research Article

COMPARISON OF LUMBAR INTERLAMINAR EPIDURAL STEROID VERSUS CAUDAL EPIDURAL STEROID IN TREATMENT OF LUMBAR SPINAL STENOSIS

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ABSTRACT

Background: *Lumbar spinal stenosis (LSS) is a common cause of low back pain and disability in adults. Epidural steroid injections are frequently used for symptomatic relief, but the optimal approach remains debated.* ***Objective:*** *To compare clinical outcomes between caudal and interlaminar epidural steroid injections in patients with lumbar spinal stenosis.* ***Study Design:*** *Randomized controlled trial.* ***Setting:*** *Orthopedic Unit I, Mayo Hospital, Lahore, Pakistan.* ***Duration of Study:*** *02-March-2024 to 02-September-2024.* ***Methods:*** *A total of 416 patients with clinically and radiologically confirmed LSS (Lee Grade 1–3 on MRI) were randomly allocated into two groups. Group A received fluoroscopically-guided interlaminar epidural steroid injections at the L2–L3 level, while Group B received fluoroscopically-guided caudal epidural steroid injections. The Oswestry Disability Index (ODI) and Numeric Pain Rating Scale (NPRS) were assessed at baseline and at 12 weeks post-intervention.* ***Results:*** *At the 12-week follow-up, Group A demonstrated significantly lower mean NPRS scores (2.65 ± 1.084) compared to Group B (3.25 ± 1.332; p = 0.0001). Functional improvement was also greater in Group A, with a lower mean ODI score (13.97 ± 2.045) versus Group B (15.91 ± 3.277; p = 0.0001).* ***Conclusion:*** *Interlaminar epidural steroid injection provided superior pain relief and functional improvement compared to caudal epidural steroid injection in patients with lumbar spinal stenosis.*

Keywords: Lumbar Spinal Stenosis, Epidural Steroid Injection, Interlaminar Approach, Caudal Approach, Oswestry Disability Index, Numeric Pain Rating Scale

INTRODUCTION

Lumbar spinal stenosis (LSS) is described as a constriction of the lumbar vertebrae within the central canal and the lateral recess. Central canal stenosis may irritate thecal sac as well as bilateral spinal segments, possibly resulting in bilateral symptoms within severe cases. Lateral recess, along with neural foraminal stenosis, may press on nerve roots, leading to unilateral lumbar radiculopathy signs (1-3). Central stenosis is caused by hypertrophy of the anterior ligamentum flavum, aggravated by posterior disk protrusion. This condition exhibits a higher incidence at the L4-L5 level compared to other spinal sections. Lateral recess stenosis develops due to facet arthropathy as well as osteophyte formation, which results in nerve compression before its passage via the intervertebral foramen. Foraminal stenosis is caused by a reduction in disk height or the formation of osteophytes (4-6). The changes affect the nerve root within the intervertebral foramen. Extraforaminal stenosis usually arises from far-lateral disk bulging. This condition results in irritation of the nerve root as it exits the intervertebral foramen laterally. The lack of an accepted standard for LSS hinders the determination of its epidemiology. A study revealed that 19.4% of individuals aged 60 to 69 had a spinal inner diameter of under 10 mm. A population-based study revealed an increasing incidence of symptomatic LSS across different age groups: 1.9% among people aged 40-49, 4.8% in those aged 50-59, 5.5% in the 60-69 age group, as well as 10.8% in the population aged 70-79 (7).

Various methods of treatment have been proposed for the non-surgical treatment of spinal stenosis. Injections of epidural steroids were identified as the primary invasive treatment option following inadequacy of conservative management in reducing pain in patients who were afterwards assigned for surgical treatment (8, 9). Epidural injections in the lumbar spine are given via three methods: caudal epidural, lumbar transforaminal, and lumbar interlaminar. Lumbar interlaminar epidural offers a rapid neural blockade that is adjustable and can be extended, integrating the advantages of both spinal and epidural blockade (10, 11). Conversely, caudal epidural injection serves as a safer option, decreasing risk of dural or subarachnoid penetration, showing efficacy in addressing multilevel disc prolapse, as well as facilitating simpler administration to individuals with prior spinal surgery (12, 13).

To our understanding, no local studies have been conducted on this topic. Since the findings from international studies are conflicting, our study will compare the efficacy of lumbar interlaminar epidural steroid injections versus caudal epidural steroid injections in the treatment of lumbar spinal stenosis. The results of this study will help in the better management of such patients in future practice.

METHODOLOGY

The methodology for this study was designed as a randomized controlled trial conducted at Orthopedic Unit I, Mayo Hospital, Lahore, from March 2, 2024, to September 2, 2024. The study commenced after obtaining ethical approval from the institution and acquiring written informed consent from all participants. Four hundred sixteen patients diagnosed with lumbar spinal stenosis, as confirmed by clinical presentation of buttock or lower extremity pain which occurred with or without back pain, who had a diminished space available for the perivascular and neural elements in the lumbar spine and Lee Grade 1–3 on MRI, were enrolled using a non-probability consecutive sampling technique. Lee's grade system classifies the severity of central canal stenosis based on axial T2-weighted magnetic resonance imaging (MRI) findings, specifically focusing on the degree of cerebrospinal fluid (CSF) space obliteration anterior to the cauda equina within the dural sac. The system is defined by the following four grades: Grade 0 (No stenosis): This grade indicates a normal finding where the anterior CSF space is completely

preserved and not obliterated. Grade 1 (Mild stenosis): This grade is characterized by a mild obliteration of the anterior CSF space. Despite this narrowing, all individual nerve roots of the cauda equina can still be clearly visualized and distinguished from one another. Grade 2 (Moderate stenosis): This grade involves a moderate obliteration of the anterior CSF space. The compression is significant enough that the individual nerve roots of the cauda equina can no longer be visually separated and are instead aggregated into bundles. Grade 3 (Severe stenosis): This grade denotes a severe obliteration of the anterior CSF space, resulting in marked compression of the entire dural sac. The cauda equina nerves are so severely compressed that they appear as a single, consolidated bundle with no individual nerve roots discernible from each other. Inclusion required participants to be between 20 and 60 years of age, of either gender, with a clinical history of lower limb pain persisting for at least six months. Furthermore, eligible individuals had undergone a minimum of four weeks of conservative management, including analgesics, anti-inflammatory treatments, exercise, and physical therapy without experiencing significant symptomatic improvement. Patients who were malnourished (BMI < 18.5 kg/m^2, those with a Diagnosis of diabetic neuropathy, patients with a previous history of spinal surgery or congenital spinal pathology, patients presenting with paresthesias, and any patient with a known adverse reaction to corticosteroids were not included. Participants were randomly assigned to one of two intervention groups via the lottery method. The sample size was calculated based on the mean ODI scores of 15.2±5.7 (14) in the lumbar epidural and 17±7.3 (14) in the caudal epidural, with a 95% confidence interval and 80% power of the test.

All procedures were performed in an operating room under fluoroscopic guidance. Standard monitoring, including pulse oximetry, blood pressure, and heart rate, was maintained throughout the procedure and during a one-hour observation period following the injection.

Both groups received the same epidural formulation: 120 mg of methylprednisolone acetate (40 mg/mL) mixed with 3 mL of 2% lignocaine and diluted in 14 mL of normal saline, making a total injectate volume of 20 mL. Group A received a lumbar interlaminar epidural injection. For this procedure, patients were positioned prone, often with a bolster to optimize the interlaminar space. After sterile preparation and local anesthesia, an 18-gauge needle was advanced under fluoroscopic guidance into the L2-L3 interlaminar space. Correct epidural placement was confirmed before the solution was administered. Group B received a caudal epidural injection. Patients were similarly positioned prone with a wedge-shaped pillow under the hips to accentuate the sacral hiatus. Following sterile preparation and local anesthetic application, an 18-gauge needle was inserted into the sacral hiatus under fluoroscopic guidance. Correct needle placement was confirmed before the injection of the steroid solution.

The outcomes were the Oswestry Disability Index (ODI) and the Numeric Pain Rating Scale (NPRS), which were recorded after 12 weeks of giving injections. The ODI is a validated 10-item questionnaire assessing functional disability, and the NPRS is a 10-point scale where 0 represents no pain and 10 represents the worst imaginable pain. The researcher himself recorded all the data.

Data was analyzed with SPSS 25. Pain score, ODI, age, and duration of pain were recorded as means and standard deviations. Gender and Lee grade were evaluated in terms of frequency and percentage. For comparison of pain scores and ODI between the two groups, an independent t-test was applied, with a P-value considered statistically significant at ≤ 0.05. Demographics and pain duration were stratified between the two groups using the test above, and the P value was considered statistically significant at a value of ≤ 0.05.

RESULTS

The mean age of participants in Group A was 43.83 ± 12.35 years compared to 42.51 ± 12.16 years in Group B. The average duration of pain was also similar, reported as 2.22 ± 0.96 years for the interlaminar group and 2.16 ± 0.99 years for the caudal group.

Gender distribution was comparable across both groups. In Group A, 79 (38.0%) patients were male and 129 (62.0%) were female. Similarly, Group B consisted of 75 (36.1%) male and 133 (63.9%) female patients. The severity of stenosis as classified by the Lee grade was also assessed (Table 1)

Clinical outcomes demonstrated a statistically notable difference between the two interventions. The mean numerical pain scale score was significantly lower in Group A (2.65 ± 1.08) compared to Group B (3.25 ± 1.33) (P = 0.0001). Similarly, functional improvement, as measured by the Oswestry Disability Index, was significantly lower in the interlaminar group, which reported a mean score of 13.97 ± 2.05, compared to 15.91 ± 3.28 in the caudal group (P = 0.0001). Stratifications can be seen in tables 3 to 6.

Table 1: Lee grade in both groups

Lee grade	Groups			
	Group A (Interlaminar injection)		Group B (Caudal epidural injection)	
	N	%	N	%
1	90	43.3%	77	37.0%
2	78	37.5%	95	45.7%
3	40	19.2%	36	17.3%

Table 2: Comparison of numerical pain score and Oswestry disability index between both groups

	Groups	N	Mean	Std. Deviation	P value
Numerical pain scale	Group A (Interlaminar injection)	208	2.65	1.084	0.0001
	Group B (Caudal epidural injection)	208	3.25	1.332	
Oswestry disability index	Group A (Interlaminar injection)	208	13.97	2.045	0.0001
	Group B (Caudal epidural injection)	208	15.91	3.277	

Table 3: Stratification of numerical pain score and Oswestry disability index between both groups with age

Age distribution (years)		Groups	N	Mean	Std. Deviation	P value
20 to 35	Numerical pain scale	Group A	64	2.48	1.084	P < 0.05
		Group B	60	3.27	1.425	
	Oswestry disability index	Group A	64	13.84	2.002	
		Group B	60	16.07	3.303	
36 to 50	Numerical pain scale	Group A	54	2.67	1.082	P < 0.05
		Group B	72	3.38	1.305	
	Oswestry disability index	Group A	54	14.06	2.078	

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		Group B	72	16.10	3.259	
51 to 60	Numerical pain scale	Group A	90	2.76	1.084	P < 0.05
		Group B	76	3.13	1.289	
	Oswestry disability index	Group A	90	14.01	2.074	
		Group B	76	15.61	3.295	

Table 4: Stratification of numerical pain score and Oswestry disability index between both groups with gender

Gender		Groups	N	Mean	Std. Deviation	P value
Male	Numerical pain scale	Group A	79	2.75	1.080	P < 0.05
		Group B	75	3.33	1.308	
	Oswestry disability index	Group A	79	13.90	1.952	
		Group B	75	15.81	3.447	
Female	Numerical pain scale	Group A	129	2.59	1.087	P < 0.05
		Group B	133	3.21	1.349	
	Oswestry disability index	Group A	129	14.02	2.106	
		Group B	133	15.96	3.189	

Table 5: Stratification of numerical pain score and Oswestry disability index between both groups with Lee grade

Lee grade		Groups	N	Mean	Std. Deviation	P value
1	Numerical pain scale	Group A	90	2.67	1.049	P < 0.05
		Group B	77	3.23	1.395	
	Oswestry disability index	Group A	90	14.08	2.024	
		Group B	77	15.78	3.267	
2	Numerical pain scale	Group A	78	2.55	1.147	P < 0.05
		Group B	95	3.40	1.300	
	Oswestry disability index	Group A	78	13.74	2.073	
		Group B	95	15.99	3.217	
3	Numerical pain scale	Group A	40	2.80	1.043	P < 0.05
		Group B	36	2.92	1.251	
	Oswestry disability index	Group A	40	14.18	2.049	
		Group B	36	15.97	3.533	

Table 6: Stratification of numerical pain score and Oswestry disability index between both groups with duration of pain

Duration of pain (Years)		Groups	N	Mean	Std. Deviation	P value
1 to 2	Numerical pain scale	Group A	122	2.62	1.063	P < 0.05
		Group B	129	3.21	1.379	
	Oswestry disability index	Group A	122	14.13	2.093	
		Group B	129	15.98	3.348	
> 2	Numerical pain scale	Group A	86	2.69	1.119	P < 0.05
		Group B	79	3.33	1.258	
	Oswestry disability index	Group A	86	13.74	1.966	
		Group B	79	15.80	3.176	

DISCUSSION

The baseline characteristics of the 416 patients were well-matched, with the interlaminar group having a mean age of 43.83 ± 12.35 years and the caudal group 42.51 ± 12.16 years, and comparable pain durations of 2.22 ± 0.96 and 2.16 ± 0.99 years, respectively. A significant reduction in both the numerical pain scale and Oswestry Disability Index was observed in the interlaminar group compared to the caudal approach, suggesting a superior outcome for the interlaminar technique in this study. This aligns with a study that reported a mean NRS of 3.7±1.4 at 3 months in the interlaminar group, 4.1±1.9 in the caudal group, and a mean ODI of 15.2±5.7 in the interlaminar group and 17±7.3 in the caudal group (14).

The results also align with those of Manchikanti et al., who, in a randomized controlled trial, found that lumbar interlaminar epidural injections with local anesthetic, with or without steroids, to be an effective long-term treatment for central spinal stenosis, with significant improvement reported in the majority of patients at two years (15). Similarly, another comparative analysis suggested a potential superiority for the interlaminar approach over the caudal route in managing chronic axial discogenic pain, particularly when using local anesthetic alone (16). This is consistent with the current study's demonstration of better outcomes for the interlaminar group. The proposed mechanism for this superiority often centers on the interlaminar approach's ability to deliver medication more directly to the site of pathology under fluoroscopic guidance, potentially achieving a higher concentration of the therapeutic agent at the affected nerve roots.

However, the broader scientific conversation presents a more nuanced picture. The study by Beyaz found no significant difference in outcomes between fluoroscopically guided transforminal and interlaminar epidural steroid injections for chronic lumbar pain over 12 months, challenging the notion that the latter approach can be equally effective when performed with precision imaging (17). Furthermore, research by Do KH et al. indicates that while interlaminar ESI can be effective for pain from moderate to severe lumbar central stenosis, its effectiveness is notably limited in cases of severe stenosis, with only 17.9% of severe stenosis patients achieving successful pain relief at three months. This suggests that the severity of anatomical compression is a critical moderator of injection efficacy. This variable was not stratified in the present study, but it could influence the interpretation of the results.

Interpreting these findings, the results from the current investigation,

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which show a statistically notable advantage for the interlaminar approach, add a valuable data point to this ongoing discourse. The rigorous design, combined with a substantial sample size, strengthens its contribution. A prudent suggestion based on these collective findings is to consider the interlaminar approach as a highly effective first-line option, as indicated by the strong results in this study. Furthermore, future research should aim to incorporate a third arm utilizing transforminal injections for a three-way comparison and consider stratifying patients based on the severity of their stenosis.

CONCLUSION

In conclusion, lumbar interlaminar steroid injection exhibited superior outcome in terms of mean numeric pain scale and Oswestry disability index when compared to caudal epidural steroid in the treatment of lumbar spinal stenosis.

DECLARATIONS

Data Availability Statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned. (IRB)
Consent for publication
Approved
Funding
Not applicable

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTION

SHEHAR YAR KHAN (Postgraduate Resident)
Conception of Study, Data Acquisiton, Data Analysis, Study Design, Review of manuscript, and final approval of manuscript.
MUHAMMAD AKRAM (Associate Professor)
Conception of Study, Supervision, and Final approval of manuscript.

REFERENCES

1. Kwon JW, Moon SH, Park SY, Park SJ, Park SR, Suk KS, et al. Lumbar spinal stenosis: review update 2022. Asian Spine Journal. 2022;16(5):789–798. https://doi.org/10.31616/asj.2022.0366
2. Jensen RK, Jensen TS, Koes B, Hartvigsen J. Prevalence of lumbar spinal stenosis in general and clinical populations: a systematic review and meta-analysis. European Spine Journal. 2020;29(9):2143–2163. https://doi.org/10.1007/s00586-020-06339-1
3. Walter KL, O'Toole JE. Lumbar spinal stenosis. JAMA. 2022;328(3):310. https://doi.org/10.1001/jama.2022.6137
4. Lee BH, Moon SH, Suk KS, Kim HS, Yang JH, Lee HM. Lumbar spinal stenosis: pathophysiology and treatment principle: a narrative review. Asian Spine Journal. 2020;14(5):682–693. https://doi.org/10.31616/asj.2020.0472
5. Hennemann S, Abreu MR. Degenerative lumbar spinal stenosis. Revista Brasileira de Ortopedia. 2021;56(1):9–17. https://doi.org/10.1055/s-0040-1712490
6. Jensen RK, Lauridsen HH, Andresen AD, Mieritz RM, Schiøttz-Christensen B, Vach W. Diagnostic screening for lumbar spinal stenosis. Clinical Epidemiology. 2020;12:891–905. https://doi.org/10.2147/CLEP.S263646
7. Yabuki S, Fukumori N, Takegami M, Onishi Y, Otani K, Sekiguchi M, et al. Prevalence of lumbar spinal stenosis, using the diagnostic support tool, and correlated factors in Japan: a population-based study. Journal of Orthopaedic Science. 2013;18(6):893–900. https://doi.org/10.1007/s00776-013-0455-5
8. Lee BH, Moon SH, Suk KS, Kim HS, Yang JH, Lee HM. Lumbar spinal stenosis: pathophysiology and treatment principle: a narrative review. Asian Spine Journal. 2020;14(5):682–693. https://doi.org/10.31616/asj.2020.0472
9. Chen X, Zheng Z, Lin J. Clinical effectiveness of conservative treatments on lumbar spinal stenosis: a network meta-analysis. Frontiers in Pharmacology. 2022;13:859296. https://doi.org/10.3389/fphar.2022.859296 .
10. Do KH, Kim TH, Chang MC. Effects of interlaminar epidural steroid injection in patients with moderate to severe lumbar central spinal stenosis: a prospective study. Annals of Palliative Medicine. 2020;9(2):163–168. https://doi.org/10.21037/apm.2020.02.20
11. Kwak SG, Choo YJ, Kwak S, Chang MC. Effectiveness of transforaminal, interlaminar, and caudal epidural injections in lumbosacral disc herniation: a systematic review and network meta-analysis. Pain Physician. 2023;26(2):113–123.
12. Hasoon J, Viswanath O, Orhurhu V, Abd-Elsayed A. Caudal epidural steroid injections: a retrospective pilot study of safety and patient-reported outcomes. Orthopedic Reviews. 2025;17:134102. https://doi.org/10.52965/001c.134102
13. Nagpal AS, Vu TN, Gill B, Conger A, McCormick ZL, Duszynski B, et al. Systematic review of the effectiveness of caudal epidural steroid injections in the treatment of chronic low back or radicular pain. Interventional Pain Medicine. 2022;1(4):100149. https://doi.org/10.1016/j.inpm.2022.100149
14. Manchikanti L, Falco FJ, Pampati V, Hirsch JA. Lumbar interlaminar epidural injections are superior to caudal epidural injections in managing lumbar central spinal stenosis. Pain Physician. 2014;17(6):E691–E702. https://doi.org/10.36076/ppj.2014/17/E691
15. Manchikanti L, Cash KA, McManus CD, Damron KS, Pampati V, Falco FJ. A randomized, double-blind controlled trial of lumbar interlaminar epidural injections in central spinal stenosis: 2-year follow-up. Pain Physician. 2015;18(1):79–92. https://doi.org/10.36076/ppj/2015.18.79
16. Manchikanti L, Pampati V, Benyamin RM, Boswell MV. Analysis of efficacy differences between caudal and lumbar interlaminar epidural injections in chronic lumbar axial discogenic pain: local anesthetic alone vs. local combined with steroids. International Journal of Medical Sciences. 2015;12(3):214–222. https://doi.org/10.7150/ijms.10870
17. Beyaz SG. Comparação das técnicas transforaminal e interlaminar de injeções epidurais de esteroides para o tratamento de dor lombar crônica [Comparison of transforaminal and interlaminar epidural steroid injections for the treatment of chronic lumbar pain]. Revista Brasileira de Anestesiologia. 2017;67(1):21–27. https://doi.org/10.1016/j.bjan.2016.09.010.

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