



**A COMPARATIVE STUDY TRANSFORAMINAL VERSUS INTERLAMINAR  
EPIDURAL STEROID INJECTION IN MANAGEMENT OF SYMPTOMATIC LUMBAR  
DISC HERNIATION.**

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**ABSTRACT**

**♣Background:** Lumbar disc herniation is the 1<sup>st</sup> most common cause of low backache with lower limb radiculopathy. A herniated disc fragment comes from the nucleus pulposus of the disc, when a fragment of nucleus herniates, it irritates and/or compresses the adjacent nerve root. This can cause the pain syndrome known as sciatica and, in severe cases, dysfunction of the nerve. Epidural steroid injections (ESIs) are a common treatment option for low back pain and leg pain. The goal of the injection is pain relief. ESIs are given by interlaminar and transforaminal approaches, the interlaminar (blinded) approach is considered capable of delivering the medication closest to the assumed site of pathology, but the transforaminal (fluoroscopy -guided) approach is considered the most target-specific modality requiring the smallest volume with high concentration to reach the primary site of pathology, so assumed to get better response. **♣Objective:** To compare the effectiveness in short-term pain improvement and functional status between transforaminal and interlaminar epidural steroid injection techniques in management of lumbar disc herniation with radicular pain. **♣Patients and methods:** One hundred thirty-two patients of both sexes with symptomatic lumbar disc herniation who had no improvement after a minimum of six weeks non-invasive treatment were enrolled in our study. Management was done by two types of Epidural Steroid Injection (ESIs): blinded interlaminar and fluoroscopy-guided transforaminal, so the patients were grouped into Transforaminal group (TFg =70 patients) and Interlaminar group (ILg =62 patients). The functional status and the severity of pain of patients in each group were evaluated separately before injection and after injection during six months follow-up period using Verbal Numerical Rating Scale (VNRS) and Oswestry Disability Index (ODI) scales. Comparison between these two groups was made according to VNRS and ODI scores values to determine how much response rate and surgical rate in each group. **♣Results:** This study included 132 patients; 65 (49%) were male and 67 (51%) were female, aged from 22 to 80 years old (mean 51.9). Their groups: TFg was composed of 70 patients, while ILg contained 62 cases. The mean VNRS was 6.7 and 7.9 for TFg and ILg, mean ODI was 34.3, 35.2 for TFg and ILg respectively. The total response was 83.3% (110 cases) and in each group was (87.1% 61 patients) for TFg, and (79% 49 patients) for ILg, all of responded patients developed improvement after injection, they experienced more than 50% pain decrease and well-being, although TFg patients developed little bit better result than ILg in short and long term period, possibly due to more precise and specific-targeted pain generator (nerve root) by ESIs. The failure (surgical) rate was 16.6% (22 patients); 12.8% (9 patients) for TFg, and 21% (13 patients) for ILg, those patients rated their condition as bad. **♣ Conclusion:** The epidural steroid injections gives short term or long term pain relief from symptomatic lumbar disc herniation and specifically transforaminal epidural steroid injections resulted in a more short term pain improvement and fewer long term surgical rates than interlaminar epidural steroid injection, mostly due to ability of targeting the specific area (nerve root) generating pain so the patient can experience much more benefit from the injection.

**♣KEYWORDS:** Lumbar disc herniation, epidural steroid injection, transforaminal vs interlaminar ESIs.

**INTRODUCTION**

Low back pain and concomitant radicular symptoms is the most common chronic pain problem.<sup>[1,2]</sup> Lumbar intervertebral disc herniation and spinal stenosis are the

two most common causes of lumbar radiculopathy which leads to serious restriction in the social lives of more than half of the patients.<sup>[3]</sup> The intervertebral disc has two distinct but inter-related mechanisms that can cause

pain. These can include compression of neural structures by a herniated disc, and pathologic changes that can occur within the disc, serving as a primary pain generator.<sup>[4,7]</sup> Lumbar disc herniation most frequently irritates the displaced nerve root. With very large herniations, the entire cauda equina can be compressed and functionally compromised.<sup>[8]</sup> This causes saddle anesthesia and can cause urinary retention and incontinence. Almost 5% of males and 2.5% of females experience sciatica at some time in their lifetime.<sup>[9]</sup> Approximately 25% of the normal population between ages 40-50 years have evidence of disc prolapse/herniation on MRI scan. Disc herniation typically causes radicular limb pain. On the contrary, central lumbar disc herniation may cause low back pain only.<sup>[10]</sup> The treatment of low back pain with radicular involvement has remained a matter of controversy because of multifactorial etiology and varying therapeutic modalities. Non-steroidal anti-inflammatory drugs, antidepressant, parenteral steroids, trans-cutaneous electrical nerve stimulation (TENS), traction and ultrasound have been used alone or in combination but without any proved efficacy.<sup>[11]</sup> Surgery is particularly indicated in cases with definite surgically correctable herniated discs but with a failure rate of as high as 30%. The incidence of persistent back pain after surgery was found to be inversely proportional to the degree of herniation.<sup>[12]</sup> Hence Epidural Steroid Injection (ESI) was found to be an alternative treatment modality with good results in symptomatic herniated disc. ESI have been used since the 1950s for treatment of back pain.<sup>[13,14]</sup> Since that time, ESI have changed from blind (interlaminar) techniques performed in the office to targeted injections, performed under fluoroscopic guidance. The goal of this study was to compare short-term improvement in pain and long-term surgical rates and the need for repeat injections between these two techniques. Our hypothesis was that transforaminal ESI provide better outcomes than interlaminar ESI.

#### PATIENTS AND METHODS

This study was done in Baquba's Pain Management Center of Baquba Teaching Hospital from March 2016 to June 2017. During this period one hundred thirty-two patients were collected from those who presented or referred to our center complaining of low back pain radiating to legs, with duration ranged from 3 months to 2.3 years (mean 13.7 months). Patients having back pain and radicular pain not responding to conservative treatment for at least 6 weeks and had MRI proven lumbar disc herniation at different level were included in the study. Exclusion criteria included motor deficit, prior lumbar disc surgery, bleeding disorder, and patient refusal. The patients were 65 (49%) male, 67 (51%) female, aged from 22 to 80 years old (mean 51.9). Those patients were managed by Epidural Steroid Injection (ESI) as a 2<sup>nd</sup> line of management after failure of conservative treatment. Lumbar epidural steroid injections were made by transforaminal technique in 70 patients (Transforaminal group TFg) and interlaminar

technique in 62 patients (Interlaminar group ILg). The choice as to whether to use the transforaminal or interlaminar approach was made according to the MRI finding of patients in order to acquire maximum clinical response. Transforaminal approach was chosen in patients with foraminal disc herniation, moderate to severe foraminal stenosis, lateral recess stenosis and neural root indentation, while interlaminar approach was chosen in patients with posterior diffuse disc herniation, central canal stenosis in condition that neural foramen was stenosed but not obstructed. Written and informed consent was obtained from each patient. Thorough history was taken and detailed clinical examination was done. The findings of straight leg raising test (SLR), motor and sensory deficit, and deep tendon reflexes (DTR) were noted. Routine laboratory investigations including prothrombin time, bleeding time, clotting time, platelets and random blood sugar were done. Before the injection baseline pre-procedure Verbal Numeric Rating Scale (VNRS) and Oswestry Disability Index (ODI) values were assessed for each patient in order to compare with post-injection values. During the procedure, G 20 canula was secured in the hand dorsum veins for all patients. Patients were connected to the patient monitor for monitoring ECG, heart rate, non-invasive blood pressure (NIBP), and pulse oximetry. Cleaning and draping of the injected part was done under complete aseptic precaution. The disc level for ESI was located using fluoroscopic guidance. Using strict aseptic technique, five millilitres of 1% lidocaine was infiltrating to the skin and subcutaneous tissue for surface anaesthesia. After the procedures, the patients were kept supine in recovery room at least 2 hours time for observation of vital signs, complications or any neurological deficit.

#### Interventional Techniques

(1) Transforaminal Epidural Steroid Injection Technique  
The patient was positioned prone with a pillow under the abdomen to decrease lumbar lordosis. AP imaging was obtained to identify the desired spinal level followed by an ipsilateral oblique angle tilt. The 6 o'clock position of the pedicle was marked and infiltrated with 1% lidocaine using a 23-gauge, 1.5-inch needle. A 22-gauge 3.5-inch spinal needles were directed under intermittent fluoroscopic guidance into the neural foramina such that the tip rested within the subpedicular safe triangle, composed of the nerve root medially, the bony pedicle superiorly, and the lateral border of the foramen laterally. Needle depth was checked by lateral fluoroscopic view so as to be in mid-neural foramen, confirmation was made by observing flow of 1 mL of injected iohexol 300 contrast medium along the affected nerve root. One milliliter of methylprednisolone acetate 40 mg/mL + hyaluronidase 1500 I.U.+ 2 ml 0.5% bupivacaine was injected with a total injectate volume of 5 mL.

(2) Interlaminar Epidural Steroid Injection Technique  
The patient was positioned prone with a pillow under the abdomen. Anteroposterior (AP) imaging was obtained to

identify the desired interlaminar space. The interlaminar space between 2 adjacent spinous processes was marked and the skin and tissue overlying the target point was infiltrated with 1% lidocaine using a 23-gauge, 1.5-inch needle. An 18-gauge Tuohy needle was advanced toward the epidural space just above the lower spinous process, under AP and lateral fluoroscopic guidance. Loss-of-resistance-to-air was the primary sign of entry into the epidural space. Once the epidural space was entered, a lateral fluoroscopic view was obtained to ensure that the needle tip rested in the posterior epidural space. Then 1 mL to 2 mL of iohexol 300 contrast medium was injected to confirm needle tip placement. If the gaining of epidural space for the predetermined Inter-Laminar (IL) level was unsuccessful, then an adjacent IL level was attempted. Once epidural placement was confirmed, 2 mL of 80 mg methylprednisolone acetate + 2 mL 0.5% bupivacaine + 1500 I.U. hyaluronidase for a total of volume of 12 mL was injected.

The outcome of patients were assessed by Verbal Numerical Rating Scale (VNRS) on a horizontal 0 (no pain) to 10 (worst pain possible) scale, and Oswestry Disability Index (ODI) range from 0 (no disability) to 100 (maximum disability possible) with scoring as follows :

- 0 to 20 : Minimal disability
- 21 to 40 : Moderate disability
- 41 to 60 : Severe disability
- 61 to 80 : Crippling back pain
- 81 to 100 : These patients are either bed-bound or have an exaggeration of their symptoms.<sup>[15]</sup>

The VNRS, ODI values were recorded immediately before the injection, at 15<sup>th</sup> day, 30<sup>th</sup> day, 3 months and 6 months after the injection. A reduction in VNRS of more than 50% after the procedure was defined as successful treatment, and a decrease of a minimum of 20% in ODI scores was considered a significant clinical improvement.

If the patient response didn't reach 50% improvement at 15<sup>th</sup> day post-injection, then a 2<sup>nd</sup> ESI was given within 2 weeks, to be re-evaluated at another 15 days later, and if 50% improvement couldn't be obtained after 2<sup>nd</sup> injection, failure of ESI was considered and patient referred to surgery.

## RESULTS

In our study 132 patients 65 male, and 67 female, they had clinical presentation of lumbar disc herniation associated with lower limb radicular pain, were managed by lumbar ESI after failure of conservative treatment for a sufficient period. Injections were made by transforaminal (TF) technique in 70 patients and interlaminar (IL) technique in 62 patients so they were divided into two groups: transforaminal (TFg) and interlaminar (ILg). The symptom duration was between 3 - 27.6 months (mean 13.7). The demographic features of two groups were 36 (51.4%) male and 34 (48.6%) was female in TFg while ILg was composed of 29 (46.8%) male and 33 (53.2%) female. The mean VNRS was 6.7 and 7.9 for TFg and ILg, mean ODI was 34.3, 35.2 for TFg and ILg respectively (*Table 1*).

**Table (1): Demographic features of groups**

		Transforaminal (TFg)	Interlaminar (ILg)
Gender	Male (Total): 65 (49%)	36 (51.4%)	29 (46.8%)
	Female (Total): 67 (51%)	34 (48.6%)	33 (53.2%)
Age	Mean ± SD	51.9 ± 14.9	50 ± 12.3
Weight	Mean ± SD	72.2 ± 7.3	80.1 ± 9.5
Height	Mean ± SD	161.7 ± 3.8	161.9 ± 3.9
Verbal Numerical Rating Scale (VNRS)	Mean ± SD	6.7 ± 1.3	7.9 ± 0.76
Oswestry Disability Index (ODI)	Mean ± SD	34.3 ± 8.5	35.2 ± 7.9
Pain Duration (months)	Mean ± SD	13.7 ± 5.8	13.1 ± 5.6
Number of Injections	173	93 (23 repeated )	82 (20 repeated )

The most disc level herniated was L4L5 96 patients (72.7%) and 2<sup>nd</sup> one is L5S1 32 cases (24.2%). Bulging is the most type of herniation was present in 54 patients (56.2%) of L4L5 level and in 19 cases (59.4%) of L5S1 disc while the 2<sup>nd</sup> most type was protrusion mostly in L4L5 40 patients (41.7%) and 10 (31.2%) in L5S1 cases. Most bulged herniated discs were managed by transforaminal route [30 (55.6%)] while most protruded

discs were managed by interlaminar technique [25 (62.5%)] and all extruded discs were managed by transforaminal injection. The response rate all cases was (83.3% 110 patients), for TFg was (87.1% 61) and for ILg was (79% 49). The surgical reate for all patients was (16.7% 22 patients), for TFg was (12.8% 9) and for ILg was (21% 13)(*Table 2*).

Disc level	No. (%)	Herniation Type	Mode of Injection	
			Interlaminar	Transforaminal
L2L3	1 (0.8%)	Bulging 1 (100%)	1 (100%)	
L3L4	3 (2.3%)	Bulging 1 (33.3%)	1 (100%)	
		Protrusion 2 (66.7%)		2 (100%)
L4L5	96 (72.7%)	Bulging 54 (56.2%)	30 (55.6%)	24 (44.4%)
		Protrusion 40 (41.7%)	15 (37.5%)	25 (62.5%)
		Extrusion 2 (2%)		2 (100%)
L5S1	32 (24.2%)	Bulging 19 (59.4%)	13 (68.4%)	6 (31.6%)
		Protrusion 10 (31.2%)	2 (20%)	8 (80%)
		Extrusion 3 (9.4%)		3 (100%)
<b>Total</b>	132 (100%)	132 (100%)	62 (46.7%)	70 (53.3%)
<b>Response rate</b>		110 (83.3%)	49 (79%)	61 (87.1%)
<b>Surgical rate</b>		22 (16.7%)	13 (21%)	9 (12.8%)

The mean VNRS values for TFg group at 15<sup>th</sup> day, 30<sup>th</sup> day, 3<sup>rd</sup> month and 6<sup>th</sup> month post-injection were: 3.8, 3.6, 3.7 and 3.2 respectively, while those for ILg group were :4, 3.6, 3.8 and 4.1 respectively. 9 patients (12.8%) of TFg group failed to respond to ESI and they had been operated, while 13 cases (21%) Of ILg group had been managed by surgery after failure of ESI (*Table*

3). The ODI values for TFg group at 15<sup>th</sup> day, 30<sup>th</sup> day, 3<sup>rd</sup> month and 6<sup>th</sup> month post-injection were: 26.3, 25.8, 22.9 and 18.6 respectively, while those for ILg group were: 28.5, 26.2, 23.1 and 21.2 respectively, so the TFg had been having better response and less surgical rates than ILg (*Table4*).

**Table(3): Comparative responses from Verbal Numeric Rating Scale (VNRS) pre-and post-injection for both Transforaminal Epidural Steroid Injection (TFg) and Interlaminar Epidural Steroid Injection (ILg).**

	Pre-procedure VNRS Mean± SD	Post-injection VNRS 15 <sup>th</sup> day Mean± SD	Post-injection VNRS 30 <sup>th</sup> day Mean± SD	Post-injection VNRS 3 <sup>rd</sup> month Mean± SD	Post-injection VNRS 6 <sup>th</sup> month Mean± SD	Repeated injections	Surgery
<b>Transforaminal (TFg = 70 Patients)</b>	6.7 ± 1.3	3.8 ± 0.4	3.6 ± 1.3	3.7 ± 0.5	3.2 ± 1.2	23 (25%)	9 (12.8%)
<b>Interlaminar (ILg =Patients 62)</b>	7.9 ± 0.76	4 ± 0.4	3.6 ± 0.3	3.8 ± 1.4	4.1 ± 0.5	20 (32%)	13 (21%)

**Table(4): Comparative responses from Oswestry Disability Index (ODI) pre-and post-injection for both Transforaminal Epidural Steroid Injection (TFg) and Interlaminar Epidural Steroid Injection (ILg) .**

	Pre-procedure ODI Mean± SD	Post-injection ODI 15 <sup>th</sup> day Mean± SD	Post-injection ODI 30 <sup>th</sup> day Mean± SD	Post-injection ODI 3 <sup>rd</sup> month Mean± SD	Post-injection ODI 6 <sup>th</sup> month Mean± SD
<b>Transforaminal (TFg = 70 patients)</b>	34.3 ± 8.5	26.3 ± 1.8	25.8 ± 1.7	22.9 ± 1.8	18.6 ± 1.8
<b>Interlaminar (ILg = 62 patients)</b>	35.2 ± 7.9	28.5 ± 1.9	26.2 ± 1.9	23.1 ± 1.9	21.2 ± 1.5

## DISCUSSION

Herniation is defined as a localized or focal displacement of disc material beyond the limits of the intervertebral disc space. The disc material may be nucleus, cartilage, fragmented apophyseal bone, annular tissue, or any combination thereof. Herniated discs may be considered as protrusion or extrusion. As the nucleus pulposus loses its turgor and the elasticity of the annulus diminishes, the disc bulges outward beyond the vertebral body margins, causing bulging of the disc. Herniation of the nucleus pulposus (HNP) through an annular defect causes focal

protrusion of the disc material beyond the margins of the adjacent vertebral endplate, resulting in disc herniation.<sup>[16,17,18,19,20]</sup> Trauma is the single most common cause of rupture of the nucleus pulposus through the annulus fibrosus. Other potentiating factors include the following: age, abnormalities in collagen, vascular ingrowth, loads placed on the disc, abnormal proteoglycan, obesity, sedentary lifestyle and poor physical fitness.<sup>[22,23,23]</sup> With any herniated disc pain, sometimes coughing, sneezing, straining and moving the affected extremity can make the pain worse. Possible

treatments range from non-invasive therapy such as physical therapy and medication to minimally invasive options such as an epidural steroid injection. These epidural steroid injections provide significant reduction in inflammation and pain. They also help localize and confirm the source of the pain, providing diagnostic information and allowing the creation of a more well-defined and accurate long-term plan of treatment. ESI are given by two types interlaminar and transforaminal, the interlaminar approach is considered capable of delivering the medication closest to the assumed site of pathology, but the transforaminal approach is considered the most target-specific modality requiring the smallest volume medication with highest concentration to reach the primary site of pathology.<sup>[24,26]</sup> If a patient has failed conservative, non-surgical options including ESI, it is reasonable to consider surgical intervention. This study was conducted to evaluate and compare the effects of two different lumbar steroid injection approaches transforaminal and interlaminar in managing lumbar disc herniation that associated with radiculopathy. More recent studies have suggested that targeting steroid medication to specific sites of pathology may lead to better outcomes. Ackerman treated patients with L5/S1 disc herniations with either an interlaminar, caudal, or transforaminal approach and found the transforaminal approach superior in providing pain relief.<sup>[27]</sup> Rosenberg evaluated whether spinal stenosis, post-surgical pain, or disc pathology would respond to a transforaminal (TF) injection, and it was found that patients with disc pathology experienced the greatest response. Additional studies have also demonstrated a better effect when the pathology is related to the intervertebral disc.<sup>[28,29]</sup> Schaufele<sup>[30]</sup> demonstrated that there may be an advantage to using transforaminal ESIs over interlaminar ESIs for the treatment of lumbar disc herniation with radicular pain. In another recent study, interlaminar injection provided superior pain relief in up to 92% of patients, whereas transforaminal injection provided pain relief in up to 90.5% of patients; however, in 9.5% of patients the condition worsened after TFESI, indicating that both steroid injections largely provided pain relief.<sup>[31]</sup> The transforaminal group on average felt significantly better immediately after the procedure. However, the pain improvement was less pronounced at follow-up, indicating a short-term treatment effect mainly due to the local anesthetic injection. On the other hand, the interlaminar group had significant improvement of VNRS scores directly after the injection, which was largely maintained at follow-up. In our study at the 6 month follow-up, the VNRS, and ODI scores significantly decreased after epidural steroid injections in both groups. This decrease was reflected clinically as increased satisfaction scores. Most of the patients (87.1%) of TFg, and (79%) of ILg improved after injection, and expressed improved well-being. However, the symptoms worsened in (12.8%) of TFg, and (21%) of ILg, of the patients who rated their condition as bad, so we agree with others that the more targeted delivery of the injectate along the inflamed spinal nerve is the most

likely explanation for these better outcomes.<sup>[32]</sup> Our study supports the findings of Riew et al (4) that transforaminal ESIs decrease the need for discectomies for lumbar disc herniations. Our surgical rates (16.7%) were lower than those reported in that study (29%). Our results are very similar to previous studies looking at the outcomes from interlaminar and transforaminal epidural steroid injections independently.

## CONCLUSION

In the current study, An epidural steroid injections provides temporary or prolonged relief from symptomatic lumbar disc herniation and transforaminal epidural steroid injections resulted in a better short term pain improvement and fewer long term surgical interventions than interlaminar epidural steroid injection, mostly due to ability of placing the needle in exactly the right location to target the specific area that is the pain generator so the patient can perceive maximum benefit from the injection.

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