

# Comparative Study of Unilateral Laminotomy versus Conventional Laminectomy

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## Abstract

**Introduction:** Lumbar canal stenosis and prolapsed intervertebral disc (PIVD) have been a major challenging problem of humankind since ages. Many different methods have been evolved for its diagnosis and management. The purpose of this study is to determine the efficacy and safety of unilateral laminotomy for decompression in case of PIVD and lumbar canal stenosis compared to conventional laminectomy.

**Materials and Methods:** A retrospective and prospective study of 40 etrosopes who had undergone surgery for PIVD or lumbar canal stenosis at our institute was carried out. They were assigned in the two groups: Group 1 ( $n = 20$ ) consisted of patients who underwent laminotomy for decompression and Group 2 ( $n = 20$ ) consisted of patients treated by decompressive laminectomy. Neurological status of the patients was evaluated by physical examination both pre-land post-operatively. Pain, disability, and other criteria were assessed by Greenough scoring system. Plain anteroposterior and lateral radiographs and magnetic resonance imaging of concerned segment were obtained of every patient. Lumbar flexion-extension films were obtained to assess spinal instability. Minimum follow-up was done at 6 at dhs, and the results were assessed using Greenough scoring system and radiographs at final follow-up.

**Result:** Excellent-good clinical outcome was obtained in 80% of patients in Group 1 and in 65% of patients in Group 2. Increase in Greenough score was more in Groupe1. Post-operative spinal instability occurred in four patients in Group 2 and none in Group 1. Early rehabilitation and early return to work were more possible in Group 1. There was one surgical complication in each group (dural tear dealt during surgery). Post-operative infection developed in four patients (two in each group), among which one requires surgical debridement in Groupi2. Neurological impairment occurred in one patient in Group 2.

**Conclusion:** Duration of hospital stay is significantly reduced among the patients operated by unilateral laminotomy compared with laminectomy, and rehabilitation was also faster by starting earlier sitting and thereby reducing morbidity and burden to hospital. Consequent earlier return to normal routine life can be expected. Although overall outcome of the patients at final follow remains mostly unchanged, technique of sparing unilateral paraspinal muscles and thereby sparing supraspinous and interspinous ligaments does help in earlier rehabilitations of the patients, fastens the recovery thereby reducing psychiatric problems related to it, saves many man hours of one to get back to normal routine life.

**Key words:** Laminotomy, Laminectomy, Lumbar canal stenosis, Prolapsed intervertebral disc

## INTRODUCTION

Lumbar canal stenosis and prolapsed intervertebral disc (PIVD) have been major challenging problem of mankind since ages. Low back pain, sciatica, is one of the common

problems of patient in orthopedic clinic. It is always seen that the difficulty is encountered by surgeon in arriving at definite diagnosis and haunting for etiology for back pain syndrome. Accurate diagnosis is most important for early recognition of cauda equina syndrome or significant functional illness of a patient, who complains of backache. Various imaging techniques are available nowadays to find the cause of this illness, starting from plain X-ray to the new world of advanced magnetic resonance imaging (MRI) technique. Many different methods have been evolved for its diagnosis and management.

Unilateral laminotomy for the decompression of lumbar canal stenosis was described as subarticular fenestration

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technique in 1988.<sup>[1]</sup> Spetzger *et al.* investigated the practical application of unilateral laminotomy for lumbar canal stenosis in a cadaveric study,<sup>[2]</sup> and Weiner *et al.* modified and put this technique into practice.<sup>[3]</sup> There are many clinical studies on decompression by unilateral laminotomy and other minimally invasive techniques such as bilateral foraminotomies and laminoplasty.<sup>[3-8]</sup> Minimally invasive techniques are not the standard surgical treatment modalities for lumbar canal stenosis yet. A minimally invasive technique preserves the structural integrity of the spine and has its own advantage of that. However, decompressive wide laminectomy is still being the most common surgical technique for this condition. Unilateral laminotomy for the decompression of lumbar canal stenosis is the most outstanding of minimally invasive techniques as compared to bilateral foraminotomies, laminoplasty, transforaminal endoscopic surgery, and endoscopic interlaminar canal decompression. Bilateral foraminotomies and laminoplasty require bilateral muscle dissection which makes the procedure disputable. The aim of this study is to investigate the efficacy and safety of unilateral laminotomy for patients of lumbar canal stenosis and PIVD.

## MATERIALS AND METHODS

A retrospective and prospective study of 40 retrosps who had undergone surgery for PID or lumbar canal stenosis at our institute was carried out. The study protocol was approved by the institutional ethics committee and scientific committee. 40 committs underwent surgery for lumbar stenosis, and PID refractory to conservative treatment was included.

Inclusion criteria were as follows:

1. Symptoms of neurogenic claudication or radiculopathy;
2. Radiological evidence of lumbar stenosis or PID;
3. Absence of associated pathological entities such as instability and infective etiology;
4. Absence of previous surgery for lumbar spine disorder;
5. Patients who were treated with fixation or fusion in first surgery were excluded.

Forty patients were assigned in the following groups: Group 1 ( $n = 20$ ) consisted of patients who underwent laminotomy for decompression and Group 2 ( $n = 20$ ) consisted of patients treated by decompressive laminectomy.

### Pre-operative Assessment

Neurological status of the patients was evaluated by physical examination. Pain, disability, and other criteria were assessed by Greenough and Fraser scoring system<sup>[9]</sup> consisting of 13 different parameters. Plain anteroposterior (AP) and lateral radiographs were obtained of every patient. MRI of the concerned segment was also done of each

patient. MRI was the main investigation for diagnosis and surgical planning. Lumbar flexion-extension films were obtained to assess spinal instability. Spinal instability was evaluated as the following criteria:

1. Anterior translation  $>8\%$  (L1-2 to L4-5) or  $>6\%$  (L5-S1) of the vertebral body width;
2. Posterior translation  $>9\%$  (L1-S1);
3. Angular displacement (sagittal rotation) in flexion  $>-9.6\%$  (L5-S1) of the vertebral body S1).<sup>[10]</sup>

### Surgical Procedure

All patients underwent surgery under general endotracheal anesthesia in prone position on bolsters on the radiolucent operative table.

### Decompression by Unilateral Laminotomy

Image intensifier was used to localize the involved segment. The skin and fascia were incised in the midline. The paraspinal muscles were dissected free from their bony attachments on the spinous process and the lamina to expose the bony detail. Unilateral laminotomy was performed followed by ipsilateral foraminotomy and facetectomy if required. Adequate decompression was achieved by removing thickened *Ligamentum flavum* and the medial aspects of the facet joints; as well as other structures causing stenosis were resected partially by Kerrison Rongeur for decompression.

### Decompressive Laminectomy

The skin and fascia were incised in the midline. The paraspinal muscles were dissected free bilaterally from their bony attachments on the spinous process and lamina to expose the bony detail. The spinous process and the laminae of the involved segment or segments were resected totally; the medial aspects of the facet joints were resected partially if the required, otherwise, facet joint left untouched to prevent the complication of iatrogenic instability.

### Post-operative Assessment

The patients were examined neurologically, and Greenough score was assessed at post-operative 1<sup>st</sup> month and final follow-up. Post-operative AP and lateral radiographs were obtained and flexion-extension films to investigate instability were obtained at final follow-up. Average time of follow-up was 10.3 months (6 months to 2 years). Patients with minimum follow-up of 6 months were included; those not satisfying it were excluded from the study. Patients of all age groups were included in the study.

The safety of surgical techniques both unilateral laminotomy and laminectomy was assessed as surgical complication rate. These complications include neural injury, dural tear, and infection. In Greenough scoring system, total score = SUM (points for all 13 parameters).

Interpretation: Minimum score: 0 maximum score: 75.

Results were graded according to the scoring system into four groups [Table 1].

## RESULT

Excellent-good clinical outcome was obtained in 80% of patients in Group 1 and in 65% of patients in Group 2.

There was one surgical complication in each group (dural tear dealt during surgery). Post-operative infection developed in four patients (two in each group), among which one requires surgical debridement in Group 2. Neurological impairment occurred in one patient in Group 2. Post-operative spinal instability occurred in four patients in Group 2 and none in Group 1 [Figure 1].

### Improvements in Greenough Scores

The increase in Greenough score was more in Group 1.

## DISCUSSION

Difference in mean age of both the groups suggestive of double peak occurs in the lumbar disc disease; first group of patients presents earlier in life due to having risk factors such as trauma or heavy weight lifting or undue exertion, while the second peak occurs after the age of 50 peaks suggestive of degenerative lumbar spine pathology. The difference in sex ratio in both the groups suggests that overall number of operated male persons exceeds far more than females reflecting Indian work distribution. As males are engaged more in heavy outdoor duties and more labored work against females linked to more indoor sedentary duties, thereby males become more prone to traumatic and degenerative lumbar disc disease [Table 2].

In both the groups, almost 50–55% of the patients were associated with the laborious job, suggesting that heavy weight lifting or repeated trauma or undue exertion could be a precipitating factor in early development of lumbar disc disease. History of trauma or exertion is more in laminotomy group patients, suggesting that, in younger age group patients, trauma may act as a precipitating factor and lead to early disc degeneration while older patients have more of age-related degenerative disc disease.

Among the laminotomy group, 70% of the patients were discharged within 10 00% of operation, while in laminectomy operated patients, only 25% of the patients could be discharged within a 10 days, suggesting that overall duration of hospital stay could be reduced with choosing laminotomy as a procedure, and this could be

**Table 1: Greenough score outcome**

The higher the score, the better the patient's status Score	Status
≥65	Excellent
50–64	Good
30–49	Fair
0–29	Poor

**Table 2: Comparison between two groups**

Parameters	Group 1 unilateral laminotomy (%)	Group 2 conventional laminectomy (%)
Number of patients	20	20
Male: Female	14:6	10:10
Mean age (in years)	42.4	52.5
Occupation		
Heavy to moderate	55	50
Sedentary	45	50
History of trauma or exertion	55	20
Neurological claudication	55	75
Affected level		
L2-L3	1	1
L3-L4	1	6
L4-L5	11	17
L5-S1	7	8
Number of level operated		
One level	20	10
More than one	0	10
Duration of hospital stay (mean, in days)	9.1	13.85
Pain free sitting (mean in weeks)	3.9	5.6
Return to normal work (mean, in months)	4.5	6.6
Complication		
Major	10	15
Minor	15	10
Improvement in greenough score (mean)	30	24.25

**Table 3: Improvement in Greenough scores**

Score	Laminotomy (%)	Laminectomy (%)
<20	4 (20)	9 (45)
20–35	6 (30)	7 (35)
>35	10 (50)	4 (20)
Total	20 (100)	20 (100)

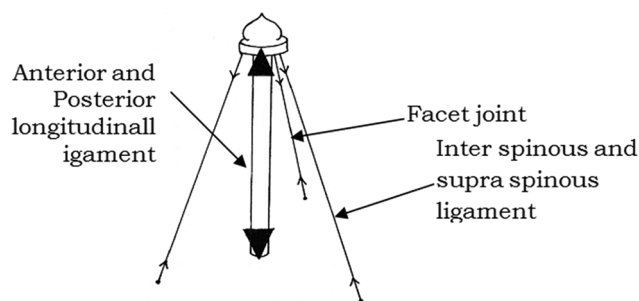
attributed to reduced soft tissue dissection and preventing damage to unilateral paraspinal muscles, supraspinous, and interspinous ligaments in this procedure with minimizing damage and reducing operative time thereby further reducing chances of developing procedure-related complications in perioperative and post-operative period, and thereby patients could be discharged uneventfully.

About 45% of the patients in laminotomy group had started sitting in first 4 rroups with minimum pain as

compared to only 20% of patients in laminectomy group. In laminotomy group, at least 60% of the patients returned to their work within 6 hrs of duration as compared to 25% in laminectomy group. This suggests that the sparing supraspinous and interspinous ligaments with causing minimum damage to paraspinal muscles prevent gross instability and help in early mobilization of the patients and early rehabilitation [Table 3].

Lumbar canal stenosis and PIVD are a common degenerative process of lumbar spine in elder age group patient and may significantly affect the quality of life. Indeed, lumbar canal stenosis is now the most common indication for spinal surgery in patients over 65 of 1s of age.<sup>[7]</sup> Extensive laminectomy with medial facetectomy and foraminotomy is commonly used for the treatment of lichen sclerosis (LS). The aim of techniques such as laminectomy or other unroofing procedures is wide decompression, but they may frequently cause spinal instability.<sup>[11-13]</sup> Long-term results of decompressive laminectomy for lumbar canal stenosis<sup>[6,13]</sup> and a meta-analysis demonstrate that successful short-term results of surgery are not maintained in a substantial percentage of patients.<sup>[14]</sup> Loss of midline supraspinous/interspinous ligament complex may lead to a loss of flexion stability, thereby increasing the risk of delayed spinal instability.<sup>[15]</sup> Instability with resultant chronic pain syndrome has been suggested as a potential cause of poor outcome.

Anterior longitudinal ligament anteriorly, facet joints on either side laterally, and interspinous and supraspinous ligament posteriorly act as three wires under tension around flagpole. Even if one wire is broken, the stability of the spine is reduced. This is known as “flagpole concept of Evan.”<sup>[16]</sup>



Our technique of laminotomy keeps this in mind and preserves spinous process and supraspinous and interspinous ligaments and half the paraspinal muscles along with underlying ALL and PLL, thereby reducing the chances of developing instability.

Mullin *et al.* detected instability in 54% of flexion-extension radiograms of wide decompressive laminectomy patients with long-term follow-up.<sup>[11]</sup> The use of wide

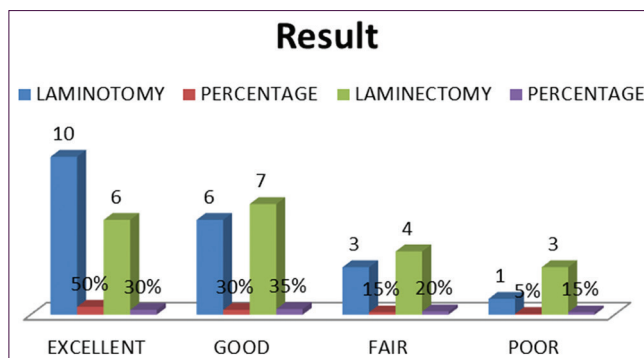


Figure 1: Greenough score comparison

decompressive procedures for lumbar canal stenosis, without regard for the integrity of the laminae and facet joints and without preservation of the spinous processes and interspinous ligaments, may lead to mechanical failure of the spine and a chronic pain syndrome.<sup>[6,12,14,15]</sup> According to Rompe, Schultz observed 46 observes after decompressive laminectomy for 3–10 Oamis,<sup>[13]</sup> of which 30% developed spinal instability; a correlation between low back pain and instability was found.

The major advantage of performing minimally invasive procedures is in reduction of tissue exposure and soft tissue trauma. As tissue disruption is the most important trigger of the surgical stress response, it is reasonable to modify current practice in favor of minimally invasive procedures.<sup>[5]</sup> Despite having this advantage, minimally invasive techniques are still not performed widely. Possible causes of this condition are high-cost hardware, high learning curve for these procedures, and lack of convincing clinical studies on minimally invasive procedures. Among the minimally invasive techniques described for the treatment of lumbar canal stenosis, unilateral laminotomy for decompression is the most outstanding. Although there are many clinical studies reporting affirmative results,<sup>[2-5,7,8,13,17,18]</sup> a number of randomized comparative studies on this technique are insufficient.<sup>[8,13,17,18]</sup> Studies investigating unilateral laminotomy for decompression do not report post-operative spinal instability.<sup>[2-8,13,17]</sup> Mayer *et al.* demonstrated a decrease in paraspinal muscle strength with atrophy after extensive muscle retraction during surgical decompression.<sup>[19]</sup> Retraction of multifidus muscle beyond the midpoint of the facet joint tethers the medial branch of dorsal ramus within the mamilloaccessory groove, risking muscular denervation. Unilateral laminotomy for bilateral decompression limits ipsilateral retraction to the level of the medial facet border. Contralaterally, no elevation or retraction of the paraspinal musculature is undertaken, thereby minimizing the risk of iatrogenic muscular trauma.<sup>[3]</sup> Unilateral laminotomy for decompression preserves the integrity of both facet and ligament-muscle complex. Bresnahan *et al.* biomechanically evaluated



graded posterior element removal for the treatment of lumbar stenosis.<sup>[20]</sup> They suggested that the removal of posterior bony elements associated with laminectomy produces the greatest change in segmental motion during flexion, extension, and left and right axial rotation; while following a minimally invasive procedure, post-operative segmental motion is similar to the intact spine; increased posterior element removal resulted in increased motion when compared to the minimally invasive approach in all loading conditions except for lateral bending; preservation of the posterior spinal elements associated with minimally invasive surgery could minimize rates of developing *de novo* post-operative changes in spinal alignment.<sup>[20]</sup> Therefore, this technique is optimal to preserve spinal stability.

We evaluated clinical outcome after surgery using Greenough scoring system. In Group 1, there was excellent-good result in 16, (80%), while 13 (65%) had excellent-good result in Group 2. Although this difference is statistically insignificant, the success rate of unilateral laminotomy is apparently higher than that of laminectomy. Another indicator of clinical outcome after surgery is less hospital stay, early pain-free sitting, and earlier return to work in Group 1 compared to Group 2. There was no post-operative instability in unilateral laminotomy group in this study, while four patients (20%) had post-operative spinal instability in the laminectomy group.

The results of this study show that unilateral laminotomy for the decompression of LS eliminates most of the reasons of failure and seems as an optimal surgical technique. Only one issue remains to be discussed; whether unilateral laminotomy is safe or not. In many studies comparing unilateral laminotomy and laminectomy for the treatment of LS complications, rates differ.<sup>[3,4,7,8,12]</sup> Dural tear is the most frequent surgical complication in these surgical procedures whose incidence in one comparative study was 12.5% in unilateral laminotomy group and 20% in laminectomy group.<sup>[17]</sup> In our study, the incidence of dural tear was equal in both the groups. Another frequent surgical complication is nerve root injury; fortunately, severe nerve root injury is infrequent in all techniques. In our study, there was no severe nerve root injury in both the groups. These results show that unilateral laminotomy is safe for the decompression of lumbar canal stenosis and PID.

## CONCLUSION

Duration of hospital stay is significantly reduced among the patients operated by unilateral laminotomy and decompression as compared with laminectomy, thereby

reducing morbidity and burden to hospital and preventing hospital-acquired complications. Rehabilitation of the patient becomes faster as patient starts earlier sitting, and consequent earlier return to normal routine life can be expected. Complications requiring active interventions are far less in patients operated by laminotomy. Chances of developing instability over the long term are higher in laminectomy group. Although overall outcome of the patients at final follow remains mostly unchanged, technique of sparing unilateral paraspinal muscles and thereby sparing supraspinous and interspinous ligaments does help in earlier rehabilitations of the patients, fastens the recovery from one of the most debilitating disease-disc prolapse and lumbar canal stenosis, and thereby reducing psychiatric problems related to it, saves many man hours as compared with laminectomy, thereby reducing morbidity and burden to hospital.

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