

A retrospective comparison of laminectomy and unilateral fenestration with foraminotomy on outcome of patients with lumbar spinal stenosis

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Abstract: *Background:* Neural decompression for lumbar spinal stenosis (LSS) can be performed, besides conventional lumbar laminectomy, by many other surgical techniques. *Objective:* The goal of this study is to analyze the results of laminectomy versus unilateral fenestration and foraminotomy with bilateral neural decompression in LSS patients. *Methods:* A number of 58 patients with lumbar spinal stenosis were divided into two groups: group A (no.=22) consists of patients that underwent a laminectomy procedure and group B (no.=36) of cases where unilateral fenestration with foraminotomy was used. Outcome was assessed at 1, 6 and 12 months postoperatively. Two parameters were evaluated: level of pain with the VAS (Visual Analogue Scale) score and the ODI (Oswestry Disability Index) scale for functional improvement. *Results:* The level of pain was reduced in both patient groups. Cases in group A maintained higher levels of back pain in the first postoperative month versus group B. Improvement was faster for those operated by unilateral approach. At 6 months and 1 year follow-ups, VAS values were very similar. All patients presented functional recovery evaluated with the ODI scale, that showed continuous improvement at 6 months and 1 year. *Conclusions:* Bilateral decompression by unilateral approach is an efficient method that represents the first option of treatment for patients with lateral lumbar spinal stenosis with unilateral or predominantly unilateral symptoms. For patients with severe central stenosis, classic laminectomy remains the first surgical choice.

Key words: lumbar spinal stenosis, laminectomy, unilateral approach

With improvement in overall life expectancy and widespread use of MRI, an increasing number of patients are diagnosed with lumbar spinal stenosis (LSS), a frequent

condition among the elderly population. Prior to the emergence of modern imagistic techniques, in the de Sèze classification based on clinical presentation, it corresponded to

stage IV and had conservative treatment as the sole therapeutic method.

CT-scan and MR images have brought on clearer information regarding the morphology of the spinal canal and revealed its stenosis, which can be central or lateral (of the lateral recess or foraminal).

The failure of conventional therapy has fostered the discovery of different surgical techniques for decompression of the affected nervous elements, which have proven superior to conservative treatment options. (1, 2, 3)

Laminectomy has been the gold standard of surgical treatment for central lumbar spinal stenosis. Subsequently, less invasive techniques have been conceived: unilateral laminectomy, bilateral fenestration and foraminotomy, unilateral fenestration and foraminotomy with ipsilateral and contralateral nerve root decompression.

The goal of the study is to investigate if by using bilateral decompression performed with unilateral foraminotomy, the same or even better results can be obtained compared to the classical technique of laminectomy.

Material and methods

The study was conducted on 58 consecutive patients with lumbar spinal stenosis operated in the year 2013 by the senior neurosurgeon (D.A.). Diagnosis was based on clinical symptoms (e.g.: neurogenic claudication, leg pain) and signs, correlated with MR images.

Preoperatively, conservative therapy for 3 to 6 months failed to improve symptoms for all cases included.

Patients were investigated using lumbar MRI that confirmed lumbar spinal stenosis. Cases with a clinical diagnosis of

polyradiculopathy with a variable clinical presentation at different preoperative examinations and clinical-imagistic discrepancy, were further investigated with EMG (electromyography) in order to objectively establish the most affected level.

In cases with neurogenic claudication and a central LSS on MR scan, a standard lumbar laminectomy was performed.

For patients that presented unilateral or predominantly unilateral radicular pain and lumbar MRI showed lateral recess and/or foraminal stenosis, a unilateral fenestration at the most affected side and bilateral decompression of nerve roots at the level of interest was performed. On the ipsilateral side, the ligamentum flavum and the internal third of the superior facet were resected. Contralaterally, the ligamentum flavum was resected after the ablation of a portion of the spinous process, tilting of the operating table and protection of the dural sac with a spatula.

All surgical interventions were performed under general anesthesia.

For both groups of patients, a retrospective analysis was carried out on operative time, postoperative hospital length of stay and complications that occurred (e.g.: incidental durotomy, wound infection).

Neurological examinations performed preoperatively and during follow-up assessed VAS (Visual Analogue Scale) score and ODI (Oswestry Disability Index) scale at 1, 6 and 12 months. Spinal instability signs were sought for with the use of conventional X-rays in neutral (anteroposterior and profile) and dynamic positions.

The characteristics of the two treatment groups were compared at the time of admission and during follow-up (Table I).

TABLE I
Patient characteristics

Number of cases: 58	Group A (no.=22) Laminectomy no. (%)	Group B (no.=36) Unilateral approach no. (%)
Mean age	68	69
Male no.	12 (54%)	22 (55%)
Comorbidities		
• Hypertension	12 (54%)	16 (44%)
• Diabetes	3 (13%)	6 (16%)
• Osteoporosis	4 (18%)	5 (13%)
• Depression	2 (9%)	3 (8%)
Symptoms		
• Leg pain	15 (68%)	29 (80%)
• Back pain	20 (90%)	36 (100%)
• Neurogenic claudication	19 (86%)	7 (19%)
Stenosis type		
• Central	22 (100%)	0
• lateral	0	36 (100%)
Level of stenosis		
• L2 - L3		3 (8%)
• L3 - L4	1 (4%)	7 (19%)
• L4 - L5	3 (13%)	16 (44%)
• L5 - S1	11 (50%)	10 (27%)
	7 (31%)	
No. of operated levels		
• 1		18 (50%)
• 2	7 (31%)	12 (33%)
• 3	10 (45%)	6 (16%)
	5 (22%)	
Incidental durotomy	1 (4,55%)	0
Infections	0	0
Operative time (min.)		
• Mean	105	70
• Range	70 - 135	45 - 95

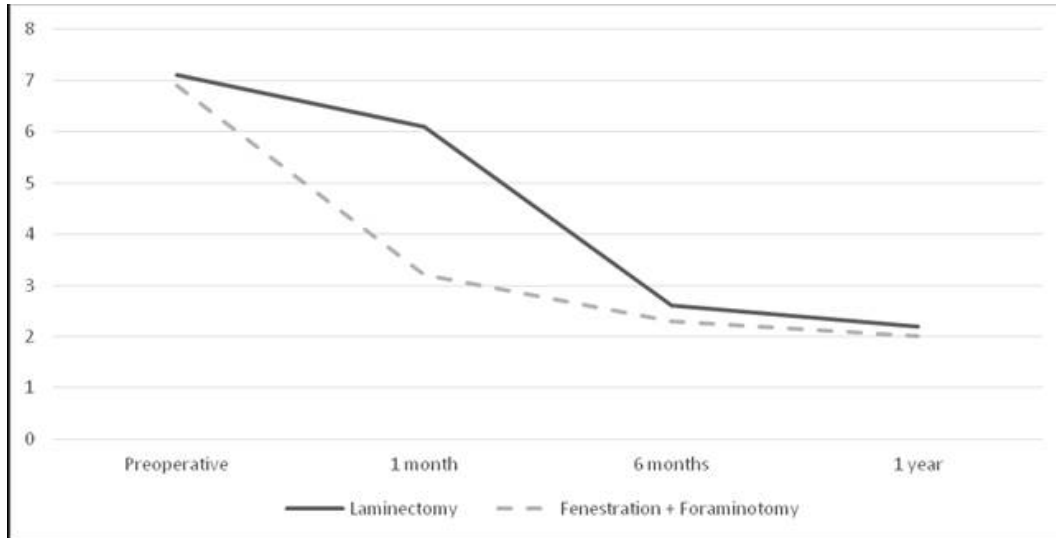


Figure 1 - VAS back pain score
(Patients with unilateral approach benefited more in terms of back pain relief at 1 month postoperative)

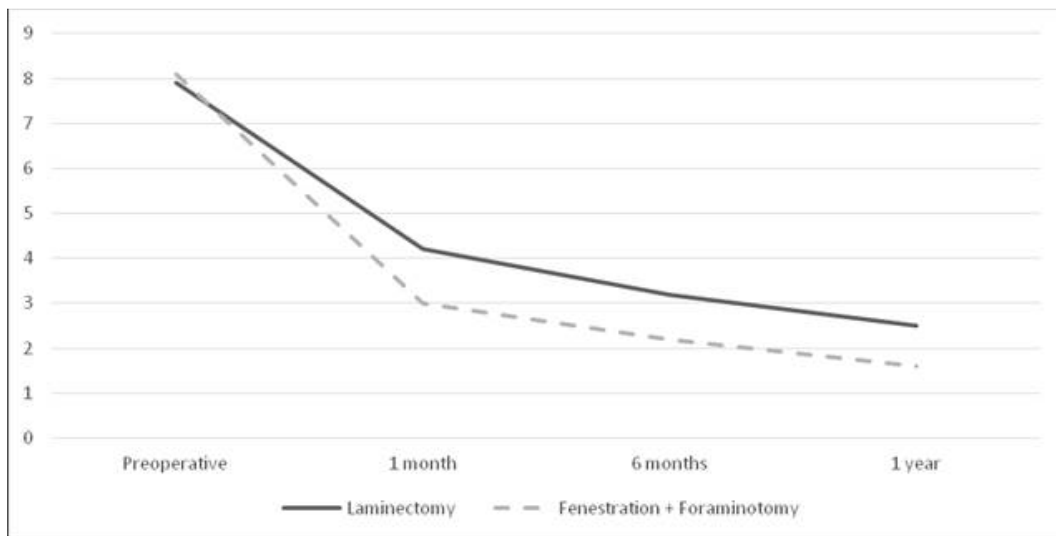


Figure 2 - VAS leg pain score
(Postoperative leg pain reduction was important in both groups, with a nonsignificant difference between them)

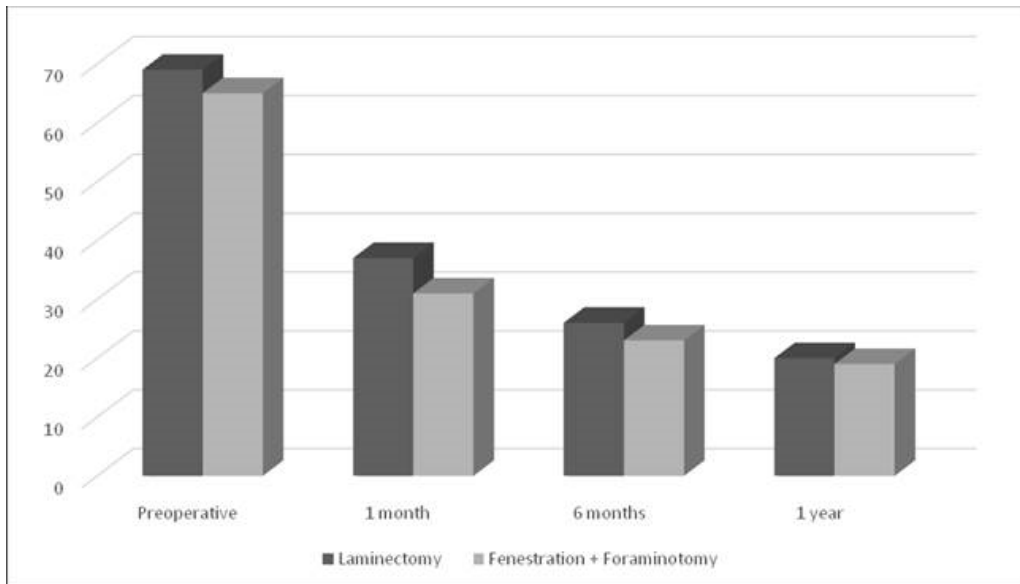


Figure 3 - ODI scale during follow-up

TABLE II

Postoperative results

	Group A	Group B
Hospitalization days	7	3
VAS back pain		
Preoperative	7,1	6,9
1 month	6,1	3,2
6 months	2,6	2,3
1 year	2,2	2
VAS leg pain		
Preoperative	7,9	8,1
1 month	4,2	3,0
6 months	3,2	2,2
1 year	2,5	1,6
ODI score		
Preoperative	69	65
1 month	37	31
6 months	26	23
1 year	20	19

Results

Sex distribution for the two groups of patients was similar, in both cases the male gender being more frequently affected (54% and 55%, respectively).

The average age and number of comorbidities that constitute preoperative risk factors were evaluated using the ASA (American Society of Anesthesiologists) classification and proved to be similar in both groups.

Neurogenic claudication was predominant in group A (19 versus 7), while radiculopathy was more common in group B (29 versus 15).

The lumbar level most frequently affected by spinal stenosis was L4-L5, followed by L5-S1.

There were 22 cases of central stenosis and 36 cases of lateral stenosis. The lateral recess and foraminal stenosis were grouped together under the name of lateral stenosis.

The two types of surgery were performed: at 1 level in group A for 7 cases versus 18 patients in group B, at 2 levels in 10 and 12 cases respectively, and at 3 levels in 5 and 6 cases respectively.

There have been cases in which patients presented with a history of bilateral alternating radiculopathy or bilateral radiculopathy, but prevalent on one side at the time of presentation.

One patient for whom decompression was performed with the laminectomy technique, with a severe central stenosis, suffered an incidental durotomy that was repaired by dural suturing.

The average duration of surgery was higher

in the case of laminectomy (a mean duration of 105 versus 70 minutes), but also varied with the number of levels operated on (70 – 135 minutes versus 45 – 95 minutes, respectively).

The duration of postoperative hospital stay was higher in the laminectomy group (a mean of 7 versus 4 days).

Patients presented alleviation of pain levels during the postoperative period, regardless of the method used for nervous decompression. (Table II)

For patients in group A, a lesser degree of back pain reduction was achieved 1 month after surgery compared to group B patients. (Figure 1)

The decrease of VAS score for leg pain had close values in both patient groups. (Figure 2)

Functional recovery assessed using the ODI scale appears almost superimposable, which demonstrates that both methods are efficient and equally beneficial for patients with LSS.

During the one-year follow-up period, only two patients from group B required a supplementation of the decompression by unilateral approach, contralateral to the first intervention.

Discussion

Lumbar spinal stenosis, a pathological entity whose prevalence has risen in the last decades, is now more frequently diagnosed and treated surgically.

In the category of degenerative diseases of the spinal column, the preeminence of spinal stenosis is disputed with that of spinal disc herniation.

In a German study, surgical interventions for lumbar spinal stenosis at the present time are three times more frequent than those for disk herniations when compared to 1999. (4) In the US, the incidence of surgeries for this condition has risen 8 times in the period between 1972 and 1992. (2)

Recent studies have demonstrated that lumbar spinal stenosis is better treated surgically than by nonsurgical means. (1, 5, 6, 7)

Laminectomy is the classical technique in the surgical treatment of lumbar spinal stenosis. This approach allows for decompression of nervous elements at 1 or more levels. The disadvantages of this method consist of: prolonged postoperative pain, atrophy of the paravertebral muscles, a greater risk of incidental durotomy and spinal destabilization when discectomy or facetectomy are associated.

Different surgical techniques for decompression have been implemented, among them being bilateral or unilateral fenestration at the stenosed level. The unilateral approach was initially described in 1988 by Young et al. (8). We are now applying the two techniques (laminectomy or unilateral fenestration) depending on the type of LSS.

In the case of a severe central lumbar spinal stenosis, the decompression is achieved with the use of bilateral laminectomy, with ablation of the ligamentum flavum and the internal third of the facet (facetectomy). By using this method, decompression of the dural sac and nerve root for approximately 15 mm is obtained. A discectomy is associated only if a disc protrusion of appropriate size is present.

In the case of lateral recess or foraminal stenosis, decompression is performed with the use of fenestration and facetectomy at the respective level. These patients have either an alternating radiculopathy, or a bilateral radiculopathy predominant on one side. All patients were operated on by unilateral fenestration with foraminotomy, undercutting of the base of the spinous process and resection of the contralateral ligamentum flavum.

The same type of approach is used for patients with strictly unilateral radiculopathy, for which MRI scan shows a bilateral stenosis to prevent an ulterior new contralateral surgical intervention. This type of approach is mini-open, with a skin incision of 3-4 cm depending on the patient's BMI (Body Mass Index). Bilateral decompression by unilateral approach is also performed in other neurosurgical centers. (4, 9, 10)

The average operative duration was significantly higher in the laminectomy group (105 versus 70 minutes).

In recent years, several studies on minimally invasive interventions for LSS have been published, with results comparable to those of "open" interventions. (3, 10, 11, 12)

In our opinion, by unilateral approach, results as good as in the case of laminectomy can be obtained, in regard to medium and long term outcomes.

By using this approach, lumbar pain levels are reduced faster and operative time and post-operative hospital length of stay are shortened.

However, each technique targets a different category of patients: laminectomy for central

LSS and unilateral approach for lateral LSS. Regarding the latter, especially when the symptoms are unilateral, an “open”, wide approach may be waived.

Patients with bilateral laminectomy continue to experience higher levels of pain for the first postoperative month when compared to cases with a unilateral approach. For the former, pain may be caused by ischemia of the paravertebral muscle, an opinion shared by Datta et al (13). In cases with a fenestration and foraminotomy approach, the paravertebral muscles are retracted unilaterally and the operative time is shorter. They present reduced postoperative hospitalization and begin recovery earlier.

Evaluation of VAS and ODI scores during follow-up has shown continuous improvement, so that at 1 year postoperative, VAS leg pain score was 2,5 in group A versus 1,6 in group B.

Similar results have been reported by other studies¹ (4, 15), improvement obtained with fenestration and foraminotomy, a less invasive method, being grater when compared to bilateral laminectomy, although the difference in results at 6 months and 1 year is not statistically significant.

Niggemeyer et al (16) have shown that better results were obtained by using less invasive surgical techniques to decompress LSS.

Incidental durotomy occurred in only one patient with severe lumbar spinal stenosis. The immediate dural suture avoided the development of a cerebrospinal fluid fistula and the patient did not present any other neurological complication. Desai et al. (17)

have found that incidental durotomy in the SPORT study did not have any long term effects on affected patients.

This is a retrospective study with its inherent limitations. A larger number of patients is necessary to perform a statistical analysis representative for the general population. Longer follow-up would be helpful in evaluating if additional surgery becomes necessary for both groups, because LSS is a progressive condition.

Conclusions

Neurogenic claudication, back and leg pain of patients with LSS are alleviated by surgical treatment.

Laminectomy is indicated for patients with severe lumbar spinal stenosis. In the case of foraminal stenosis, by using a unilateral approach with ipsilateral and contralateral decompression, similar results can be obtained.

Both techniques led to significant improvement in clinical outcome.

The unilateral approach is faster, safer and not inferior regarding neural decompression and overall pain relief.

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