

Assessment of Unilateral Approach and Bilateral Decompression for Lumbar canal Stenosis

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Abstract

Background and objective: Microsurgical treatment using unilateral approach and bilateral decompression is a minimally invasive procedure for Degenerative Lumbar canal stenosis. Hence the present study was undertaken to assess the unilateral approach and bilateral decompression for lumbar canal stenosis.

Methodology: This was a observational clinical study carried among participant who underwent unilateral laminotomy and bilateral decompression during 2008-10. Patients with lower backpain, Neurogenic claudication, radicular pain with single canal stenosis were included in the study. Diagnosis was based on clinical profile, MRI scan X ray and SF 36. The patients were followed for 1 year post surgery to assess the improvement in quality of life.

Results: 45 patients were assessed in our study, the mean age of the patient were 61 years and male were more affected than females. The microsurgical treatment showed significant improvement in quality of life within 3 months post operation whereas 47% within 1 years of life.

Conclusion: The microsurgical procedure for patients with DLSS is the most recommended surgical procedure. Since. It is less invasive and showed a statistically significant improvement in the quality of life.

Keywords: Spinal stenosis; Radicular pain, Unilateral laminotomy, Bilateral decompression.

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Introduction

Spinal stenosis is defined the clinical syndrome of lumbar stenosis in patients who had bilateral radicular pain and motor and sensory disturbances in the legs caused by standing and walking. It is described as myelographic block in the lumbar spine in every case, and at surgery a shallow canal with a compressed dural sac was observed. Verbiest postulated encroachment upon the canal

by an enlarged articular process as a possible cause for the symptoms.^{1,2} Kirkaldy-Willis and colleagues postulated that rotation and compression injuries led to degenerative changes of the three-joint complex.³ As a result of injuries, the intervertebral discs can develop circumferential or radial annular tears, internal disruption, loss of disc height, and protrusion. The zygapophyseal joints can undergo synovitis, cartilage destruction, osteophyte formation, capsular laxity, ligamentum hypertrophy or buckling, and joint instability or subluxation. The results of these changes to the three-joint complex create degenerative spondylolisthesis, retrolisthesis, degenerative scoliosis, and rotational deformities.

Degeneration of the spine with aging leads to alteration in the anatomy causing gradually progressive narrowing of the spinal canal. Symptoms usually occur on the basis of the location of neural compression. Radiologically

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MRI spine shows narrowing of canal diameter associated with hypertrophied ligamentum flavum or facet arthropathy. Lumbar canal stenosis is usually treated conservatively with medications, life style modification or physiotherapy. Surgery is considered in cases in which conservative treatment has failed to relieve symptoms. The surgical procedure typically consists of wide laminectomy which consists of unroofing of spinous process and laminae thus decompressing neural structures. Such decompressive procedure frequently associated with spinal instability need spinal fixation and fusion procedure at later date. Stenosis can be anatomically classified as central, lateral recess, and foraminal on the basis of the location of neural compression. With aging, central canal stenosis occurs as degenerative changes progress. As the axial height of the disc and facet joints decreases, the disc bulges into the spinal canal. The central canal is further narrowed by posterior impingement from enlarged facets and the hypertrophied ligamentum flavum. Hypertrophy of the soft tissues is responsible for 40% of spinal stenosis. With extension, the hypertrophied ligamentum buckles centrally into the canal and worsens the central stenosis. Acquired stenosis can be caused by trauma, neoplasms and infection along with other causes.

Patients with Lumbar spinal stenosis usually presents with back pain, neurogenic claudication or radicular leg pain. Neurogenic claudication - feeling of pain, heaviness, numbness, cramping, burning or weakness which bilaterally radiate down below the knees. Abnormal sensations are typically worse with extension of the lumbar spine during walking or standing for a prolonged time.^{4,5}

Since most symptomatic patients are elderly more minimally invasive procedures are needed. Minimally invasive surgery using microsurgical techniques are commonly performed for lumbar canal stenosis over the last decade. In these procedures' maximal preservation of structural components such as midline structures, facet joints and paravertebral muscles are needed to prevent post-operative instability. Among all decompressive procedures good results have been achieved using bilateral laminotomy and unilateral laminotomy with bilateral decompression.^{6,7,8} Radiculopathy and neurogenic claudication associated with spinal stenosis are attributed to either direct mechanical compression or indirect vascular insufficiency leading to lack of adequate blood flow and oxygenation of the lumbar nerve roots or cauda equina. Standing and walking transiently increase

lordosis, accentuating stenosis by exaggerating the infolding of the ligamentum flavum into the central canal or lateral recesses, thus exacerbating symptoms. In contrast, sitting and laying down typically reverses the lordosis, opens the canal, improves blood flow, and relieves symptoms. Hence the present study was undertaken with the objective for assessment of Unilateral approach and bilateral decompression for lumbar canal stenosis.

Methodology

The participants in the study were all the patient who underwent unilateral laminotomy and bilateral decompression at our institute during the period 2008-2010. Inclusion criteria were patients with low back pain, neurogenic claudication, radicular pain with single canal stenosis (MRI lumbar with evidence of canal stenosis) and without spinal instability. Exclusion criteria were patients with vascular claudication and associated medical co-morbidities. Diagnosis was based on clinical evaluation, MRI, X ray and SF 36.

Ethical clearance was obtained from Institutional Ethical committee and written informed consent was obtained from the study participants before commencement of the study.

Statistical Methods: Microsoft excel and SPSS 20 version was used for statistical analysis. Descriptive and inferential statistical analysis had been carried out in the present study. Results on continuous measurements are presented on Mean \pm SD and results on categorical measurements were presented in Number and percentage. Significance is assessed at 5 % level of significance. P value and chi square test was used to study the association. P value of $0.01 < P \leq 0.05$ was considered as statistically significant.

Surgical Procedure Employed

The patient were placed prone, in marked flexion and a standard intervertebral paraspinous process approach was performed. After the positioning of a standard Caspar retractor, the procedure was performed micro surgically, using a surgical microscope that provides constant clear monitoring of anatomical structures. A small interlaminotomy and removal of the LF were performed with the aid of a microdrill and Kerrison rongeurs, preserving the facet joints and exposing the dural sac.

The superior lamina exceeding the midline of

the attachment of the spinous process and facet joint were partially thinned using a microdrill in a V shape to allow further removal of the remaining bone using a 2 -mm Kerrison punch. The Kerrison tip was forced beneath the lamina, starting from the midline where the Ligamentum flavum attachment was very loose. The laminar thinning performed, leaving the Ligamentum flavum beneath intact to protect the dural sac. Bone thinning was extended until the upper border of the Ligamentum flavum and the dural sac were visible. The Ligamentum flavum was elevated using dissectors creating a neat cleavage plane with the dural layer. At this point, with the dural layer clearly in view, bone and the Ligamentum flavum were removed in a standard fashion, reaching the midline and decompressing the ipsilateral radicular recess. Finally, the operative microscope was gradually tilted toward the opposite side at the proper angle, thus allowing as much of the contralateral Ligamentum flavum as possible to be removed using the small Kerrison rongeurs. Part of the spinous process was further drilled, and the inner portion of the facet joint was undercut until the contralateral spinal nerve root and dural border were seen. The narrowing of the spinal canal mostly caused by the degenerative changes affecting the Ligamentum flavum and the facet joints. The facet joints, the pedicle, and the entire posterior intrasupraspinous ligament complex were preserved. The same procedure was performed at multiple levels.

Illustrative case

A 59 year old male who underwent bilateral decompression with unilateral laminotomy for canal stenosis at L4-5 level. There was no instability in Lumbar X-ray pre op (Image No.1A). There was no significant improvement in functional status post operatively. (Image No.1B). The postoperative dynamic X- ray showed Gr I listhesis at L4-5 level (Previously operated site) (Image No. 2 C,D)

Results

This was an observational clinical study carried out among 45 patients during the period 2008-2010. The cases were in the age group 40 to 80 years, mean age of the patients being 61 years. Majority (42%) of them belonged to age group 61-70 years followed by 26.7% belonging to 51-60 years (Table No. 1). Males comprised 69% of the cases. As per the clinical presentation of the cases 82% of the cases had N. claudication followed by LBA and radicular pain among 9 % cases respectively. As per the radiation

distribution 71 % had both whereas 20 percent had right and 9% had left radiation distribution. Majority of the patients (86%) were studied for 12 months whereas 9 were followed less than 6 months (Table No.1). Majority (60%) presented with L4 and L5 canal stenosis (Table No.1).

SF36 was used to assess the improvement in the quality of life post treatment which showed a statistically significant (24%) improvement within 3 months of operation and 47% within 1 year of operation (Table No.2).

Discussion

The present study comprised of 45 patients between age group 40-70 years with predominant neurogenic claudication with duration of symptoms from 4 months to 1 year. The patients were assessed based on clinical symptoms, MRI scanning, X ray and with SF36 evaluation scale at admission, post op and follow up. The standard unilateral laminotomy and bilateral decompression was performed among all the patients. The decompression performed through fascial incision preserving the midline structures with aid of microscope, the technique begins with excision of the lower half of the anterior portion of lamina proximal to the origin of ligamentum flavum. The insertion of ligamentum removed by removing the superior edge of the caudal lamina. After removing the medial edge of facet joint so that is flush with medial border of pedicle, the stenosing ligamentum flavum is removed from top down.

In recent years more attention has been concentrated on minimizing the invasiveness of decompressive technique to reduce soft tissue injury, intraoperative complication and blood loss thus producing shorter hospital stay, speedy recovery and essentially better surgical outcome. There were numerous minimally invasive procedures - partial interspinous laminectomies, modification of spinous process osteotomies, bilateral laminotomy and unilateral laminotomy for decompression. The success rate of unilateral and bilateral laminotomy are higher than laminectomy.

In a study demonstrated that under normal condition the supraspinous, interspinous experienced the greatest force when exposed to external flexion across the anatomic segment. In the pathologic setting of severe degenerative disease viz lumbar spinal stenosis may increase the demands of these posterior elements.⁹ In

expansive laminectomy it may injure and deform the posterior ligamentous support, facet joint biomechanics and facet joints which will lead to postoperative paraspinal muscle insufficiency which all together create segmental instability. Meyer et al demonstrated decrease in paraspinal muscle strength with atrophy after extensive muscle retraction during open surgical decompression. Some study also demonstrated electromyographic abnormalities of paraspinal muscle after expansive surgery which led to increased incidence of failed back syndrome.^{10,11}

Mc Culloch and Young developed unilateral laminotomy and bilateral ligamentectomy and reported excellent outcome in 90.9% of 22 patients with lumbar spinal stenosis.¹² Weiner et al reported limited osteoplastic laminectomy with spinous process osteotomy preserving midline osseoligamentous structures found good outcome in 87%. Longterm clinical outcome of less invasive decompressive procedures Oertel et al reported 85.3% of 102 patients had excellent results (Mean follow up 5.6 yrs). Costa et al reported that 87.9% of 374 patient experienced good results mean duration of follow up 30 3 months. Cavusoglu et al reported good results in 68% at 4 years. These results are similar to our study were in good clinical outcome was seen within 3 months postoperatively and increased significantly during 1 year of follow up.

Minimally invasive operative technique like unilateral laminotomy and bilateral decompression has been based on the goals of minimization of destruction to nonpathological tissues and optimization of desired result. Weiner et al reported satisfactory results following a credible prospective 2-year follow-up study of 30 consecutive patients with lumbar spinal stenosis without treated using the unilateral approach 87% of the patients reported a high rate of satisfaction.¹³ Halit Cavusoglu et al performed unilateral laminotomy for bilateral decompression, demonstrated good results in 87% patients (26 of 30 patients) at 9 months; the ODI scores decreased significantly and, SF-36 scores demonstrated a marked and significant improvement in late follow-up evaluations which is similar to our results.¹⁴

Cavuşoglu et al., concluded that for degenerative lumbar spinal stenosis without DS, unilateral approaches allow sufficient and safe decompression of the neural structures and adequate preservation of vertebral stability. Results showed a highly significant reduction in symptoms

and disability as well as a health-related quality of life.¹⁵ Spetzer, HBertalanffy et al. Postoperatively, 25 of the 27 patients with neurogenic claudication (93%) demonstrated a marked improvement of the walking distance.¹⁴ The follow-up of 25 patients (mean follow-up time was 18 months) demonstrated an excellent Postoperative evaluation showed clinical improvement of the patient's symptoms clearly demonstrated that bilateral ligamentectomy and recess decompression were adequately and successfully achieved via unilateral approach. Compared to previous expansive laminectomy procedures, no patient has developed instability which was evaluated on follow up with dynamic lumbar X ray.

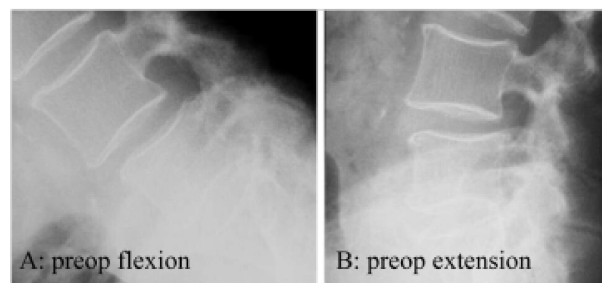


Image No. 1: Lumbar X-ray Preoperative and postoperative.

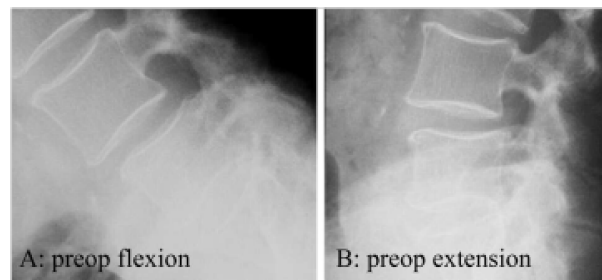


Image No. 2: Postoperative Dynamic X-ray of previous operated site.

Table No. 1: Sociodemographic and clinical profile.

Characteristics	Variable	No. of patients	%
Age	40-50	7	15.6
	51-60	12	26.7
	61-70	19	42.2
	71-80	7	15.6
Gender	Female	14	31.1
	Male	31	68.9
Clinical presentation	LBA	4	8.9
	N.claudication	37	82.2
	Radicular pain	4	8.9
Radiation Distribution	Both	32	71.1

Cont...

Duration studied	Left	4	8.9
	Right	9	20.0
	<6 months	4	8.9
	6-12 months	39	86.7
	>12 months	2	4.4
MRI LS Spine	L4 L5 Canal Stenosis with IVDP	5	11.1
	L4 L5 Canal Stenosis	27	60.0
	L5-S1 Canal Stenosis	4	8.9
	L3-L4 Canal Stenosis	8	17.8
	L2 L3 Canal Stenosis	1	2.2
X-ray Findings	Instability	0	0.0
	No Instability	45	100.0

Table No. 2: SF36 evaluation for quality of life in patients studied.

SF36	Min-Max	Mean ± SD	Difference	t value	P value
Baseline	54.00-76.00	65.24±4.42	-	-	-
Post op 3 months	30.00-60.00	41.20±6.54	24.044	26.561	<0.001**
Post op 6 months	12.00-35.00	23.60±4.75	41.644	58.357	<0.001**
Post op 1 year	10.00-48.00	18.04±6.10	47.200	44.070	<0.001**

Conclusion

The microsurgical procedure of Unilateral laminotomy to achieve bilateral decompression is the best and safe procedure for patients with DLSS. Statistically significant clinical improvement was noted post operatively which confirms the feasibility of this minimally invasive procedure among young and elderly population.

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