ORIGINAL ARTICLE

Unilateral Approach for Bilateral Decompression of Lumbar Spinal Stenosis: A Minimal Invasive Surgery

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ABSTRACT

Objective: To assess the feasibility and efficacy of a novel, minimally invasive spinal surgery technique for the correction of lumbar spinal stenosis involving unilateral approach for bilateral decompression.

Study Design: Cross-sectional observational study.

Place and Duration of Study: Neurosurgery Department of PGMI, Lady Reading Hospital, Peshawar, from January to December 2010.

Methodology: A total of 60 patients with lumbar stenosis were randomly assigned to undergo either a conventional laminectomy (30 patients, Group A), or a unilateral approach (30 patients, Group B). Clinical outcomes was measured using the scale of Finneson and Cooper. All the data was collected by using a proforma and different parameters were assessed for a minimum follow-up period of three months. Data was analyzed by descriptive statistics using SPSS software version 17.

Results: Adequate decompression was achieved in all patients. Compared with patients in the conventional laminectomy group, patients who received the novel procedure (unilateral approach) had a reduced mean duration of hospital stay, a faster recovery rate and majority of the patients (88.33%) had an excellent to fair operative result according to the Finneson and Cooper scale. Five major complications occurred in all patient groups, 2 patients had unintended dural rent and 2 wound dehiscence each and fifth patient had worsening of symptoms. There was no mortality in the series.

Conclusion: The ultimate goal of the unilateral approach to treat lumbar spinal stenosis is to achieve adequate decompression of the neural elements. An additional benefit of a minimally invasive approach is adequate preservation of vertebral stability, as it requires only minimal muscle trauma, preservation of supraspinous/intraspinous ligament complex and spinous process, therefore, allows early mobilization. This also shortens the hospital stay, reduces postoperative back pain, and leads to satisfactory outcome.

Key Words: *Unilateral approach. Lumbar spinal stenosis. Laminectomy. Minimal invasive surgery.*

INTRODUCTION

Lumbar spinal stenosis (LSS) is very common problem of the lumbar spine in people over 65 years of age and surgery is required with increasing frequency.[1] It is defined as "buttock or lower extremity pain, which may occur with or without low back pain associated with diminished space available for the neural and vascular elements in the lumbar spine".[2] Narrowing can be well localized at three different anatomic structures, like the central canal, lateral recess, or the neural foramina. Patients usually complain of symptom of neurogenic claudication, which is actually the pain in the buttocks and lower extremities with or without low back pain provoked by walking or extended standing and the relieving is the rest and bending forward, that is compatible with a narrowing of the lumbar spinal canal.[3]

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Approximately 1.2 million people in the USA have back and leg pain which is related to LSS.[4] The treatment of LSS can be non-operative and operative, non-operative treatment may include epidural steroid injections, oral steroids, non-steroidal anti-inflammatory medication, analgesics and physical therapy. If the patient fails to respond to these therapies then the only choice left is the decompressive surgery. The traditional surgical treatment of LSS has involved wide laminectomy and undercutting of the medial facet with foraminotomy with success rate varying from 62 to 70% and the frequent surgical failures have been attributed to local tissue trauma and to postoperative spinal instability that have led to a dramatic increase in lumbar fusion surgery.[5] The other operative techniques that are less invasive, such as bilateral and unilateral laminotomy for bilateral decompression (ULBD), have been introduced. The unilateral approach preserves both facet joints and the neural arches, thus limiting postoperative destabilization and protecting the neural structure against posterior scarring. A recent report showed that satisfaction rates after ULBD ranged from 85% to 94%.[6,7]

The unilateral approach was initially described by Young *et al*. in 1988,[8] and subsequently modified by McCulloch.[9]

This microscopic technique that is characterized by ipsilateral microdecompression and contralateral micro-decompression performed under the midline posterior structures.

The purpose of this prospective study was to evaluate the safety and the clinical outcome after unilateral laminotomy for bilateral decompression and also to compare the clinical outcomes with conventional laminectomy in patients with LSS.

METHODOLOGY

This prospective observational study was conducted on all patients of LSS who underwent surgical decompression, from January to December 2010, in the Neurosurgery Department of the Postgraduate Medical Institute, Lady Reading Hospital, Peshawar, Pakistan. All the patients with symptoms of radiculopathy or neurogenic claudication, radiological/neuroimaging evidence of LSS involving the central canal and/or foraminal stenosis, failure of conservative treatment with medication and physiotherapy for a minimum of three months were included in the study, while patients with spondylolisthesis, associated co-morbid conditions and recurrent LSS were excluded. All patients were operated on by two neurosurgical surgeons in a single institute. A total of 60 patients with lumbar stenosis were randomly assigned to undergo either a conventional laminectomy (30 patients, Group A), or a unilateral approach (30 patients, Group B).

A database was compiled using inpatients and out-patients medical records by an independent observer who was not part of the operative team and/or in patient care. Data collection included variables, such as age, gender; length of operative time, length of stay in hospital, number and nature of complications in both groups as well as clinical and functional outcome after surgery was also recorded. Clinical outcome was measured using the scale of Finneson and Cooper (Table I). Ratings of excellent, good, and fair were classified as a successful operative result.[10] All the patients were followed-up for a minimum period of three months. Data was analyzed by descriptive statistics, in terms of frequencies, percentages and mean ± standard deviation using Statistical Package for Social Sciences (SPSS) software version 17. The p-value was calculated by independent-samples t-test and statistical significance was defined as $p < 0.05$.

Complete blood count (CBC) was done in all patients. Other laboratory investigations, like chest X-ray and viral serology (HbsAg and Anti-HCV Ab) were also done. MRI of lumbo-sacral spine was performed in all the cases. An informed consent was taken from the patients pre-operatively, explaining the prognosis. The ethical approval was taken from the Postgraduate Medical Institute, Institutional Research and Ethics Board. All the patients received a prophylactic third generation cephalosporin intravenously, Injection Ceftriaxone sodium before the induction of anaesthesia and remained for 24 hours on this and then changed to oral antibiotics.

Table I: Rating scale of Finneson and Cooper.

Rating	Definition	Group A (conventional laminectomy)	Group B (unilateral approach)
Excellent	Pain free and able to function well	30% (n=9)	36.66% (n=11)
Good	Pain improved and able to function well	33.33% (n=10)	40% (n=12)
Fair	Pain improved, but occasional medication and time off from activities	20% (n=6)	10% (n=3)
Marginal	Pain improved, but considerable discomfort that requires frequent medication and time off from activities	6.66% (n=2)	3.33% (n=1)
Poor	Pain unimproved or worse	10% (n=3)	10% (n=3)

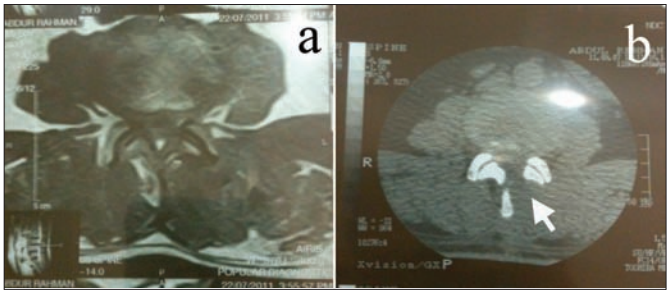

Figure 1: (a) Pre-operative MRI showing LSS, **(b)** Postoperative CT scan showing Rt. hemilamina dissected out (white arrow).

Following endotracheal inhalational anaesthesia, the patient was turned prone; midline incision made and extended over limited to the underlying region of stenosis as documented on magnetic resonance imaging. A linear median fascial incision was then made on the patient's most symptomatic side. Unilateral laminotomy was performed with partial resection of the inferior aspect of the cranial hemilamina and the superior aspect of the caudal hemilamina by using microscope or operative loupes. After performing ipsilateral decompression, the base of the spinous process was undercut and the base of contralateral hemilamina was also cut. After that, bilateral flavectomy was performed, and the lateral recess and neural foramina were decompressed contralaterally. Both the ipsilateral and contralateral nerve roots were well visualized after the bilateral decompression. When decompression was confirmed with direct inspection under surgical microscope/operative loupes, the operation was considered completed. All the patients were mobilized on the first postoperative day and followed up with the radiological images (Figures 1 a and b).

RESULTS

There were 18 males and 12 females in Group A (conventional laminectomy) and 16 males and 14 females in Group B (unilateral approach). Majority of the patients

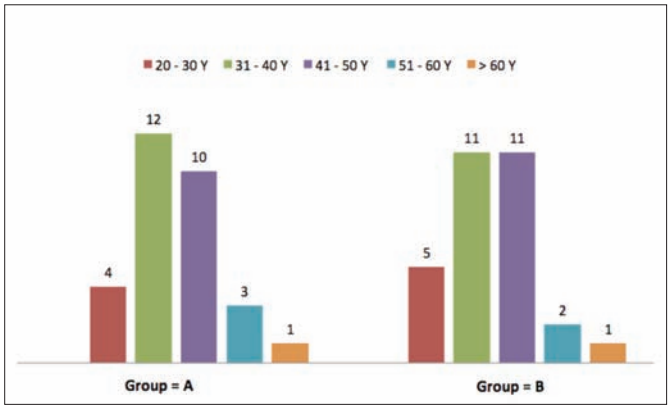

Figure 2: Age-wise distributiton.

Table II: Outcome comparison between Group "A" and Group "B".

Variable	Group A (Conventional approach) n = 30	Group B (Unilateral approach) n = 30	p-value
Operating time	65 ± 0.1	69 ± 0.1	< 0.0001
Hospital stay (postoperatively)	4.67 ± 0.479	3.50 ± 0.509	< 0.0001
Successful results in percentage (Finneson and Cooper scale)	83.33 ± 2.061	86.66 ± 1.921	< 0.0001

i.e., 22 (73.33%) each in Group A and in Group B were in the age range of 31 – 50 years (Figure 2).

All patients underwent single-level procedures as mentioned in the inclusion criteria. For conventional laminectomy, the mean operating time was 65 ± 0.1 minutes, while for unilateral approach it was 69 ± 0.1 minutes (Table II). The mean hospital stay after surgery in patients receiving conventional laminectomy was 4.67 ± 0.479 days, while it was 3.50 ± 0.509 days in unilateral approach (Table II).

Patients had experienced clinical outcome assessment as measured on Finneson and Cooper scale (Table I). The mean of successful results was 83.33% ± 2.061 in conventional laminectomy group, while it was 86.66% ± 1.921 in patients of unilateral approach (Table II). The difference between the two groups was statistically significant, as the p-value was < 0.0001 which was less than 0.05.

Five complications occurred in all patient groups, 2 patients had wound dehiscence and 2 unintended dural rent each, while fifth patient with no improvement, developed discitis and was re-operated later on. There was no mortality.

DISCUSSION

Degenerative lumbar spinal stenosis is a common disease, increasing in frequency in the elderly population around the globe but it is also common in adults (older than 35 – 40 years) in the poor strata of our society, because of the fact that most of them are labour and they are misusing their spine by heavy manual work. Therefore, surgical treatment of LSS has increased year by year. The overall success rate of conventional laminectomy ranges from 62 to 70%,[11-13] with surgical failure caused by secondary spinal instability. Different factors play role regarding this, like the techniques for exposing the lumbar posterior elements, which include stripping the multifidus muscles bilaterally, with subsequent wide retraction, have potentially serious consequences/complications.

Mayer *et al*. established the fact that there is decrease in muscle strength, with associated atrophy on post-operative CT studies.[14] Other researchers found long-term changes in electromyographic studies for as long as 4 years postsurgery.[15] Sihvonen *et al*. also noted CT and electromyographically confirmed abnormalities and correlated them with postoperative failed-back surgery syndrome.[16] One of the possible patho-physiologic mechanism behind this is that the multifidus muscle is innervated by the medial branch of the dorsal ramus.[17] The medial branch courses around the superior articular process lie in a groove between the mammillary process and the accessory process, where it may be covered by a fibro-osseous ligament. The retraction of the multifidus is quite likely to tether the medial branch, with subsequent risk of muscle denervation. Furthermore, open/conventional decompression is associated with significant pain, prolonged hospitalization as well as recovery period, morbidity, and an increased incidence of medical complications. The most devastating event leading to the stress response is tissue trauma. Indeed, the greater the trauma, the greater the response[18] and extensive surgical tissue trauma also results in delayed functional sequelae as well.

On the other hand, preservation of the multifidus attachment contralaterally mechanically limits this retraction. Furthermore, spinous process and supraspinous/interspinous ligaments complex act as important posterior support mechanisms for spinal stability. Hurri *et al.* demonstrated load with flexion in both the supraspinous and interspinous ligaments. Prestar observed similar findings and hypothesized that in regions where there is absence of this ligamentous support the paraspinal musculature must aid stability.[19] Recently, minimal invasive surgery to treat LSS is gaining popularity. The report by Costa *et al*. on clinical outcomes of unilateral laminotomy for bilateral decompression observed significant improvement in patients with lumbar stenosis.[20] In addition, the preservation of contralateral paraspinal muscles and pars interarticularis reduces the potential complications like postoperative infection and cicatrization by decreased dead space as well as enhanced stability.[21] Keeping all these facts and advancement in mind, we started this procedure in our department. This procedure preserves the spinous process and supraspinous/

interspinous ligaments complex, which is a most probable reason that is why this provides significantly better postoperative results regarding improvements in clinical outcomes.[22]

For conventional laminectomy, the mean operating time was 65 minutes, while for unilateral approach it was 69 minutes and it is comparable with an international researcher, which shows 63.6 minutes for conventional laminectomy and 71.1 minutes for unilateral approach.[22] The mean hospital stay after surgery, in patients receiving conventional laminectomy, was 4.67 ± 0.479 days, while it was 3.50 ± 0.509 days in unilateral approach and this is compatible with reported mean hospital stays for LSS conventional laminectomy series that range from 3 to 7.2 days, and for minimally invasive series that range from 1.2 to 4.0 days.[23,24]

The success rate of unilateral approach in this study, according to Finneson and Cooper scale, was 86.66%, which is slightly higher than the results of Hwang *et al*. who observed success rate of 83.8%.[25] The probable reason behind this is that we had short follow-up of our patients.

Limitation of the study was that the follow-up time was relatively short as minimum follow-up was 3 months. Subsequently the complication rate was also low as compared to other international studies.[7,25]

CONCLUSION

The novel procedure of unilateral approach for bilateral lumbar canal decompression provides effective spinal decompression while preserving the spinous processes and supraspinous/interspinous ligaments complex. Although this method requires somewhat longer operating time than open laminectomy, it causes less muscle trauma, maintains spinal stability by preserving facet joints, and consequently promotes early mobilization. All this result in a shorter hospital stay, reduced postoperative back pain, and an overall satisfactory neurological and functional outcome in the form of Finneson and Cooper scale. Unilateral-approach for bilateral decompression provides an adequate and safe decompression for patients with degenerative spinal stenosis.

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