

ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXVIII | No. 2

June 2024

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DOI: 10.33962/roneuro-2024-029



Multilevel interlaminar fenestration with soft tissue decompression in lumbar canal stenosis. A single centre experience

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ABSTRACT

Introduction: Lumbar Canal Stenosis is the narrowing of the Spinal Canal and/or the intervertebral foramina, which causes compression of the thecal sac and/or caudal roots at a single vertebral level. Stenosis may be local, segmental, or generalised; bone or soft tissue can cause it. Stenosis can involve the bony canal, dural sac or both.[9]

Aim: Assessment of outcomes of multilevel fenestration with soft tissue decompression in lumbar canal stenosis.

Material and method: A prospective study comprised patients with two or more lumbar canal stenosis levels. The Study eliminated patients with infective pathology or recurrent surgery on identical levels. The surgical technique of canal decompression via multilevel fenestrations was used in this study, which enables the decompression of the neural structures while preserving as much of the bony and ligamentous structures as possible. Post-op clinical measures such as motor, sensory, post-op complications, and VAS score improvement assessed study outcomes.

Result: Studies showed improvement in symptoms of pain, motor power and sensory deficit, post-operative improvement in VAS score for pain, and improved quality of life in almost all the patients from day 7 to day 60 after surgery.

Conclusion: The study shows that "Multilevel interlaminar fenestration with Soft Tissue Decompression in Lumbar Canal Stenosis" is a feasible, safe, and effective approach to lumbar canal stenosis and is associated with minimal complications and minimal perioperative morbidity.

INTRODUCTION

Lumbar Canal Stenosis may be defined as the narrowing of the Spinal Canal and/or the intervertebral foramina, causing compression of the thecal sac and/ or caudal roots at a single vertebral level; narrowing may affect the whole canal or part of it. It may be local, segmental or generalised. The cord's normal dural tube cross-sectional area is about 180mm² (±50). The manifestation of stenosis becomes evident within the range of 100 to 130 mm², while relative stenosis is observed when the cross-sectional area of the dural tube measures 100mm² or below. Absolute stenosis is observed when the cross-sectional area of the dural tube measures 70mm² or below. Spinal stenosis refers to morphology,

Keywords

lumbar canal stenosis,
visual analogue scale,
fenestration



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ISSN online 2344-4959
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Neurosurgery



First published
June 2024 by
London Academic Publishing
www.lapub.co.uk

not the symptoms. Neurogenic claudication, alternatively referred to as pseudo-claudication, is a clinical manifestation that serves as a diagnostic indicator for the presence of spinal canal stenosis.

The condition above is characterized by a constellation of symptoms, including discomfort in the lower extremities, abnormal sensations such as tingling or numbness, and diminished muscular strength. These manifestations are notably exacerbated during ambulation and exertion. The prevailing characteristic observed in this case is the sensation of pain, which can manifest as either unilateral radicular pain or diffuse non-dermatomal symptoms. These symptoms typically originate from the buttock region and can extend to varying distances along the leg.

Wilson [12] classified Neurogenic claudication into postural due to positional accentuation of stenosis and ischemic due to failure to meet the oxygen demand of nerve root due to compressed canal. The primary objective of surgical intervention for lumbar canal stenosis entails alleviating compression exerted on neural tissue within the central and nerve root canal. The prevailing surgical modality for addressing lumbar canal stenosis is the implementation of decompression through a comprehensive laminectomy procedure.

Verbiest [1] suggests that nerve compression is due to encroachment by the articular process on the spinal cord, and the laminectomy alone is not sufficient without the removal of the medial part of the articular process. Amundson et al. [3] stated that radiological changes were more extensive than expected from the clinical picture, and the degree of narrowing did not correspond to the degree of clinical affection. Herno et al. [7] stated that the patient's satisfaction with the surgery result was more important in surgical outcome than the degree of decompression detected on the CT scan. Surgery for lumbar canal stenosis can be very successful in most cases for the leg symptoms. However, depending on the severity of the nerve compression and the length of time the nerve has been compressed, there may be some permanent damage that is not relieved with surgery. Success for back pain relief is less reliable with surgery than the relief of leg symptoms.

PATIENT SELECTION

All consecutive patients with acute traumatic SCI

presenting within 24 hours of the injury between 18 and 65 years of age were included. Patients outside the specified age limit, 24 hours beyond the SCI, those with involvement of only the radicles or nerve roots, with firearm injury, with life-threatening morbidities, history of drug addiction or on steroids, pregnant women and unwilling for a minimum six months regular follow up were excluded from the study.

AIM

This study aimed to evaluate the results of multilevel fenestration with soft tissue decompression in lumbar canal stenosis.

MATERIAL AND METHOD

In this prospective study, 14 patients were included with a clinic-radiological diagnosis of lumbar canal stenosis of two or more two levels. All patients were evaluated clinically and radiologically. Patients having recurrent surgery on the same level, infective pathology, or spinal instability were excluded. Out of 14 patients, four patients had an intraoperative conversion to laminectomy and were excluded. The subjects underwent surgical procedures while positioned in the prone position while under the effects of general anaesthesia. During the procedure of interlaminar fenestration, the bone surrounding the interlaminar space of the affected segment (as indicated by abnormal clinical and myelographic findings) was carefully removed. This removal was performed along with removing the ligamentum flavum and a portion of the facet joint, known as partial undercutting facetectomy. However, it is important to note that this surgical intervention intentionally preserved the neighbouring laminae, spinal process with interspinous ligament, and zygapophyseal joints. The procedure involved a lateral extension of fenestration, specifically a foraminotomy, to alleviate the compression on nerve roots exhibiting signs of swelling and oedema. The operative finding has been duly documented and its correlation with the clinic-radiological impression has been noted. The assessment of decompression adequacy was conducted intraoperatively through the evaluation of root mobility and the probing of the root canal.

The study outcome was evaluated in the post-op period based on clinical parameters like Sensory/Motor examination and improvement in

pain assessed by visual analogue scale. The outcome was assessed according to Modified MacNab criteria. [10]

RESULT

Backache (100%) and radiculopathy (30%) were the most frequent symptoms. The neurogenic claudication was also present in all patients. Only one patient had involvement of the bladder and bowel. The mean duration of symptoms was 44.2 ± 15.92 months. Eighty (80%) patients had a clinical history of more than 24 months. The mean walking capacity was 440 ± 107.5 meters, ranging from 300-600 meters, and 60% of patients had a walking capacity of <400 meters. Six (60%) patients also had sensory loss of variable dermatomes. The SLR was positive in 90% of patients on the right side and all patients (100%) on the left side. On motor examination, right and left lower limb weakness was found in 50% and 90%, respectively. In the preop period, 30% of patients had radicular numbness in the lower limb. 60% population had a sensory deficit, and 90% of the population had a motor deficit of grade 2/5 to grade 4/5. In the post-op period, no patients had a sensory deficit, and 100% had motor power between 4/5 to 5/5. Preoperatively in the right lower limb, SLR tests were positive in 90% of cases, and 10.0% were negative. During the follow-up period at day 14 in the right lower limb, 30% of cases were SLR-positive, and 70% were negative. Preoperatively, in the left lower limb, 100% of cases were SLR test positive. During the follow-up period on day 14 in Lt. Lower limb, 90% of cases were SLR negative, and 10% were positive. On radiological evaluation, it was found that on plain digital X-rays, all patients had features of degenerative changes. The degenerative changes in the ratio of vertebral body diameter vs canal A.P diameter in A.P and lateral view, which was less than 1 cm, showed the presence of osteophytes and bone spurs. The MRI findings are summarised in Table 1 and 2. The disc prolapse was most common at L4-5 levels in 80% of patients. The second most common site was L5-S1 in 40% of patients.

Table 1. Levels of spinal canal stenosis on MRI images

No. of stenosed levels	Up to 2 levels	Up to 3 levels	Up to 4 levels
No. of patients	1	7	2

Table 2. Levels of disc prolapse

PIVD	L1-2	L2-3	L3-4	L4-5	L5-S1
Yes	1	1	2	8	4
No	10	9	8	2	6

The ten patients who underwent multilevel fenestration were analysed. Intraoperative images of representative cases are shown in Figure 1. Interlaminar fenestration was done up to four levels in 2 cases, up to three levels in 7 patients and up to two in 1 case. Based on MRI findings, disc excision was done up to a single level in 5 patients, up to two levels in 3 patients and the rest two patients, up to 3 levels. Facet joint hypertrophy was present in all cases, for which partial medial facetectomy was done in all cases. 9 cases out of 10 had lateral root canal stenosis for which foraminotomy was done, and adequacy of canal diameter was checked with probing of the root canal. Postoperatively, patients had significant improvement in radiculopathy and improvement in claudication distance. There was also a significant improvement in SLR in both legs (Table 3) in follow-up. The mean VAS score in follow-up was also significantly lower than preop VAS (Table 4). The average period of ambulation was 48 ± 5.57 hrs. No wound infection, CSF leak or residual pain and mobility restriction were noted during the post-op period.

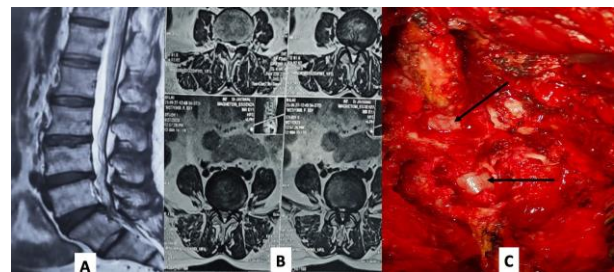


Figure 1. Shows preoperative MRI images of canal stenosis (A & B), intraoperative image (C) with interlaminar fenestration at two levels

Table 3. Pre-op and postop VAS scoring

Patients	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Vas score (preop)	7	6	6	6	6	5	6	7	7	7

Vas score Day 7	4	4	5	4	5	5	6	4	4	5
Vas score Day 14	2	2	3	3	2	3	3	2	3	4
Vas score Day 28	2	2	2	3	2	3	3	2	3	3
Vas score Day 60	1	2	2	2	2	2	3	2	3	2

Table 4. VAS score mean value

	Preoperatively	D7	D14	D28	D60
VAS score mean value	6.3	4.6	2.7	2.5	2.1

DISCUSSION

In this study, an effort has been made to "Evaluate the Results Of Multilevel Fenestration With Soft Tissue Decompression In Lumbar Canal Stenosis". All patients presented with a positive history suggestive of lumbar canal stenosis. The average duration of localised back pain was 44.2 ± 15.92 months, shorter than the duration reported in the study conducted by Ahmet Colak et al. [2], where it was 4.4 years. In all of these cases, the patients have had radicular pain before the pain in their lower limb, which is likely due to degenerative changes in the lumbar spine. Only one patient out of 10 has a positive history of bladder-bowel involvement. Neurogenic claudication was present in all cases. Similar findings were recorded by Ahmet Colak et al.

In a study done by Patond KR, Kakodia SC, [11] A total of sixteen patients, consisting of seven males and nine females, who exhibited clinical, neurological, and radiological symptoms of lumbar canal stenosis, underwent interlaminar (fenestration) decompression treatment. During a two-and-a-half-year follow-up, the results were good in 73.3% of cases and fair in 26.7%. The post-operative phase was uniformly uneventful.

According to a study by Puneet Gupta et al., [6] patients with acquired degenerative lumbar canal

stenosis multilevel interlaminar fenestration with discectomy, if required, were carried out. Retrospective analysis assessed the outcome by assessing the relief of backache and neurological claudication. The mean age of patients was 50.4 years, and the average duration of neurological claudication was nine months. Diagnosing the degenerative lumbar canal stenosis was made by clinical examination and confirmed by radiological and MRI measurements of the cross-section area of the neural canal. Interlaminar fenestration was done at four levels and three levels in six patients each, while it was done at two levels in the remaining three patients. None of the patients reported immediate or late onset of backache or spinal movement restriction, indicating spinal stability. None of the patients had neurological claudication in the postoperative period.

Our study assessed pre and post-operative pain with VAS score. The VAS score was assessed pre-operatively and post-operatively on day 7, day 14, day 28, and 60 when all the analgesic medications were stopped. VAS score was significantly reduced gradually on follow-up in all the patients. During the preop period, the mean VAS score was 6.3 ± 0.67 . On day 7, all patients' mean VAS score was 4.60 ± 0.69 , similarly on day 14 was 2.70 ± 0.67 ; on day 28 was 2.50 ± 0.52 , and on day 60 was 2.1 ± 0.56 . On comparison from pre-op VAS score vs postoperative VAS score on day 7, day 14, day 28 and day 60 had a p-value < 0.05 which shows a statistically significant association in relief of pain during follow up period after surgery done in our institution. All the patients showed a gradual improvement in pain due to lumbar canal stenosis after surgery. In the Ahmet Colak et al. [11] study, the results of VAS scoring during preop. at three months and 12 months after decompression surgery in Lumbar canal stenosis was 7.0, 5.5, and 4.0, respectively. According to Devkota UP et al. [4], with minimally invasive open lumbar discectomy, 98.33 % of patients had an improvement in the radicular pain and ambulation commenced from the first postoperative day. There were three instances of inadvertent dural tear without fascicle injury and one instance of residual disc requiring reoperation. The outcome was accessed according to Modified MacNab criteria, and results were Excellent in 1 case, Good in 7 cases and Fair in 2 cases. Our results are almost the same compared to the study done by Iwatsuki [8] and Fu YS. [5]

Table 5. Shows the comparison of outcomes among various studies according to Modified MacNab criteria

Pain relief	Iwatsuki K. [8]	Fu YS, Zeng [5]	Patond KR, Kakodia SC [11]	Present study
Excellent	45(95.8%)	68(89%)	0%	1(10%)
Good	1(2.1%)	8 (11%)	11(73.3%)	7 (70%)
Fair	1(2.1%)	0	4(26.7%)	2(20%)
Poor	0	0	0%	0
Total of excellent and good outcome	46(97.9%)	76(100%)	11(73.3%)	8(80.0%)

CONCLUSION

Degenerative lumbar spinal stenosis can be decompressed adequately with Multilevel Fenestration with Soft Tissue Decompression, including resection of the Interspinous Ligament, except in cases with severe spinal stenosis where Laminectomy is still the procedure of choice. Although resection of the interspinous ligament may be associated with fear of spinal instability, it provides a wider room to work, so fewer chances of intraoperative dural and nerve root injury and complete removal of pressure over the spinal column. The Fenestration operations combined with soft tissue decompression, including resection of the Interspinous Ligament, obtained satisfactory outcomes at low cost, and it can be a standard procedure for the surgical treatment of mild to moderate-grade degenerative lumbar spine stenosis.

Limitation of study

1. Study population is small, so it is hard to generalize the result.
2. Follow-up period is small, especially for long-term recurrence and the need for re-surgery.

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