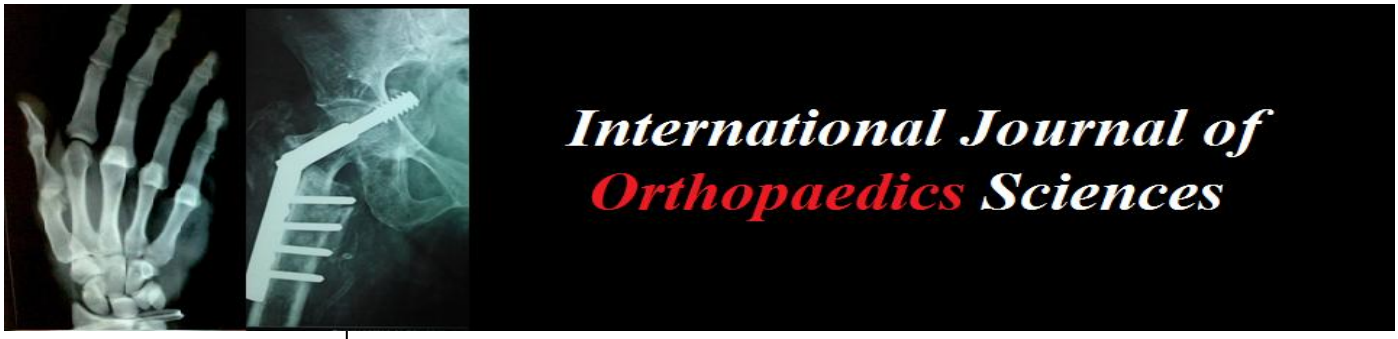

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(4): 755-758

www.orthopaper.com
Received: 09-09-2020
Accepted: 19-10-2020

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Functional outcome of lumbar canal stenosis treated by decompression and fixation

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DOI: https://doi.org/10.22271/ortho.2020.v6.i4k.2416

Abstract
Introduction: Low back pain affects every population and is one of foremost debilitating condition and is considered as one of the most unrewarding problems, especially in the age group 40 –75 years, during the stage of instability. Despite an improving understanding of degenerative disc disease, treatment results vary greatly, and we studied the functional outcomes of lumbar canal stenosis treated by Decompression and Pedicle Screw Fixation.
Methods: Our study included a total of 30 diagnosed cases of lumbar intervertebral disc prolapse between age group 40-75 years between February 2018 and February 2019 at KIMS Hospital, Bengaluru, unresponsive to conservative management during the period. The patient's clinical characteristics had been reviewed prospectively including clinical presentations, preoperative medical comorbidities, intraoperative status, and postoperative status. Oswestry disability index (ODI), visual analog scale (VAS) and patient satisfaction were evaluated before surgery and last follow-up period.
Results: There was no significant difference in diagnosis with respect to the level of IVDP and number of levels operated. There were improvements in ODI and VAS and functional outcome of patients before and after the operation. During the average follow-up period, 100% of patients had varying degrees of symptomatic relief. The lumbar interbody fusion with pedicle screw technique provided strong spinal segment fixation and a reliable ground for bone arthrodesis. No patient needed any additional modality of treatment or reoperation for recurrence of symptoms.

Keywords: Degenerative disc disease, pedicle screws fixation, oswestry disability index, visual analogue scale

Introduction
Lumbar back pain affects 70% of individuals on an average during their lifetime [1]. Disc degeneration is a normal aging process. However Lumbar spinal degeneration that leads to lumbar canal stenosis is a disabling clinical condition. It is a multifactorial process causing the discs to lose height due to vertical spinal instability and telescoping of the facets resulting in nerve pathways narrowing [3, 4]. And Osteophyte formation and *Ligamentum flavum* buckling lead to compromise of the spinal canal causing compression of the traversing nerve roots of the cauda equina, inflammation and pain. In severe cases, this neurogenic pain may be constant. The basic concept that involves decompression of the neural structures has remained the basis for surgical treatment. The treatment protocol has been based on the traditionally agreed-upon and more than a century old concept that disc degeneration and disc space reduction is the core pathogenetic issue for the ultimate development of spinal canal stenosis.
Decompression for lumbar canal stenosis is widely used and accepted and is considered to be a gold standard treatment.
The Swedish Lumbar Spine Study Group (SLSSG) provided the first systematic evidence that fusion for DDD resulted in superior outcomes when compared to non-surgical treatments [5]. Historically, posterolateral fusion was performed without instrumentation, but due to the relatively high non-fusion rate [6, 7], pedicle screws instrumentation has become standard.
However, the evidence of an improved functional outcome for an instrumented fusion instead of a non-instrumented one remains very limited [6, 7]. In this presentation we analyze the surgical results and functional outcome in 30 cases diagnosed with lumbar canal stenosis that were treated by decompression, discectomy and fixation.

Methods

During the period February 2018 to February 2019, 30 cases diagnosed with lumbar canal stenosis were surgically treated at our institution. This is a prospective analysis of the 30 consecutively treated cases. 6 Months of minimum follow up. All patients provided written & informed consent prior to procedure, and every clinical test and surgeries were directed by the standards of the Declaration of Helsinki.

There were 18 male and 12 female patients. The ages of the patients ranged from 40 to 70 years (average 54 years).

All patients had classically described symptoms that are attributed to lumbar canal stenosis, which include paresthesia along the distribution of one or more nerve roots (20), lower back claudication pain and radiation along the posterior aspect of the legs (30) and weakness of muscle groups (12).

The Oswestry Disability Index (ODI) [2] and visual analog scale (VAS) were used to grade the symptoms (Table 2). Radiological observations are summarized in Table 1.

The patients had progressive symptoms and were experiencing failure of nonsurgical or conservative forms of treatment for atleast 3 months.

All patients were investigated both before and after surgery with plain radiographs and MRI.

Patients in whom there was radiographic and clinical evidence that suggested infection, tumour, or any degree of spondylolisthesis were excluded.

Table 1: Radiological features in 30 cases of lumbar canal stenosis

Feature	No. of Patients
Radiological Level Involved	
L1-L2	4
L2-L3	10
L3-L4	19
L4-L5	21
L5-S1	17
No. of levels fixed	
1	5
2	12
3	10
4	3
5	0

Table 2: Preoperative and postoperative vas and odi scores

Scoring System	Pre-op	Immediate Post-op	6 Months Post-op
VAS			
Back Pain	7.5(4-9)	3 (0-4)	0.8(0-1)
ODI			
0-20% Minimal Disability			26
21-40% Moderate Disability	4		4
41-60% Severe Disability	16		
61-80% Crippled	9		
81-100% Bedridden	1		

VAS scores are expressed as the mean (range); 0 = no pain, 10 = maximum pain.

Surgical Procedure

All the 30 patients underwent the surgery in a prone position and Wagoner's posterior approach was used. The patients were placed on an relton hall frame allowing the abdomen to hang free; as a result collapsing of the epidural venous plexus, the intravenous pressure and blood loss are decreased. Standard described precautions and care were adopted. The level of the main pathology is marked and confirmed using fluoroscopy and a midline longitudinal incision over the spinous processes of the appropriate vertebrae is made and superficial fascia, the lumbodorsal fascia, and the supraspinous ligaments are incised longitudinally, precisely over the tips of the processes. After subperiosteal dissection the facetal articulation was exposed widely on both sides.

Although the clinical symptoms and radiological information were suggestive, direct physical observation and manual manipulation of the facets finally determined the levels of spinal fixation that were carried out. Observation of the open articular cavity, osteophytes in the vicinity of facets, and excessive or abnormal mobility of the facets on manipulation were the indicators that suggested the level of spinal fixation that was indicated and performed. Bone or soft-tissue removal to affect decompression of the dural tube or the traversing neural structures was carried out. Spinous process was cut sharply at the base, and the bone obtained was shredded and used as a graft material.

Pedicle screw instrumentation with posterolateral autologous bone and transforaminal lumbar interbody fusion with allograft bone from the excised spinous process was performed on all the patients. The self tapping monoaxial and polyaxial screws of 5.5mm and 6.5mm were used.

Following screw implantation, all interspinal ligaments were widely resected, and bone of the lamina and the screw-adjoining surface of the facets were decorticated to make the environment suitable as the host bone for graft. The patients were mobilized as soon as possible, but were advised to use lumbar spinal belt and to restrict activities for a period of 6 weeks. The patients were then advised to engage in normal physical activity after confirmation of the status of screws. Postoperative imaging was done in the immediate postoperative phase and at follow up examination (Fig. 1).

Fig 1: A: T2-weighted MRI showing multilevel lumbar canal stenosis. B: Anteroposterior radiograph showing posterior lumbar interbody fusion performed using 2 pedicle screws at each articulation. C: Lateral radiograph showing the spinal fixation with screws.

Results

The follow-up duration ranged from 6 to 12 months (average 8 months). The Chief surgeon himself and the subordinates did clinical assessment and radiological interpretations. All patients symptoms improved in the immediate postoperative period to varying degrees, mostly favourable. VAS and ODI scales were compared both pre and post operative. Apart from these measures, a patient satisfaction in the local vernacular language assessed the status of clinical recovery. A summary of the questionnaire and the assessment outcome is shown in Table 3. No recurrence of symptoms in any case was noted in the minimum follow up period of 6 months (Table 2). Arthrodesis of the treated spinal segments was considered to be successful when at the minimum follow-up of 6 months the screw position remained in place, bony fusion across the facets was observed, and no relative movement of any vertebral component observed on dynamic imaging. With

these minimum parameters, successful segmental arthrodesis was achieved in all cases. All the patients were satisfied with the clinical outcome and are professionally active. The operation was not repeated in any of the cases nor any additional surgical maneuver done on the same level or at any other spinal level.

Table 3: Patient satisfaction score in 70 patients with lumbar canal stenosis

Parameter	Score 0 (Not Satisfied)	Score 1 (Minimally Satisfied)	Score 2 (Satisfied)	Score 3 (Remarkably Satisfied)
Are you happy with the generation?			6	24
Are you relieved of back and leg pain?			2	28
Can you walk better?				30
Would you recommend the operation to someone?			4	26

Discussion

Lumbar canal stenosis, a common clinical diagnosis is a debilitating condition observed more commonly in the elderly age group. Approximately 20% of the population in the USA above 60 years develop symptoms of the lumbar canal stenosis spectrum [8]. The exact data from a developing country like India is not available yet but can be considered to be similary high based on the daily clinical cases and complaints, hence there is a need for constant evaluation and further inspection into this subject.

Lumbar traction and use of lumbar belts have been the popular non-operative form of management for a long time and the popularity for the the lumbar canal decompression as operative management grew in the past few decades with decent and yet not completely satisfying outcomes in a longer run and the quest for the last word in the treatment format is yet to be said and proved.

Aggravated intervertebral disc dehydration or herniation has been a generally accepted view as the pathogenesis of Lumbar canal stenosis and the prequele to this being a spectrum of reasons like loss of disc space height, telescoping of the facets, bugle of the posterior anulus and the posterior longitudinal ligament and the hypertrophy of the *Ligamentum flavum* eventually leading to the narrowing of the spinal canal dimension.

It is widely accepted and given that the factors like standing position, aging of the muscles, obese weight and type of profession a person is involved in will commit to the pathogenesis of the degeneration.

On our further understanding of the spinal degeneration, we realized it is the subtle instability, telescoping related microinjury to the dura and the exiting nerve roots that was the cause of the neurological symptoms and deficits and not just because of the neural compression or deformation in the longstanding and progressive degenerative disease [9].

The symptoms of lumbar canal stenosis are linked with the posture and typically increase on extension of the back and are triggered on prolonged standing or walking and after a period of rest, the symptoms are relieved; Going by the orthodox point of view the apparent fatigue of the muscles of the back leads to facetal overriding or telescoping leading to subsequent stenosis in an otherwise stable spine but spinal instability as primary pathogenesis in this ladder of events is a relatively newer view that is to be analyzed and supported.

Since the radiological confirmation of the vertical instability is non conclusive due to the lateral location of the facets and their oblique angulation [11]. Direct observation was the only confirmatory method to identify the status of the facets instability. The instability of lumbar spinal segments was diagnosed by direct physical observation and manual manipulation of the facet joint Intraoperatively [10].

Pedicle fixation performed using 2 screws, one each for the two pedicles of a vertebra was identified to be safe, simple, and quick, and it is an effective technique of stabilization that works at the site of the fulcrum of spinal movements at the facet joint. Zero local movement that is provided by the technique results in immediate postoperative relief from symptoms and provides a reliable environment for bone arthrodesis.

Decompression of compressed or stenosed nerves forms the basic precept of spine surgery.

The cases where significant disc impingement was observed the disc material was excised and a mandatory decompression laminectomy and discectomy was performed

Symptomatic recovery was observed immediate post operatively and was progressive.

The drawback of our study is the quantity of the sample being limited and that a parallel cohort of patients in whom the surgery was done in the traditional method of solely decompression without fixation for multiple level lumbar degenerative disease was not available.

And our method of approach helps in supporting fixation to create a vertical stability as an alternative and a superior modality for a long standing positive outcome in multiple level lumbar degenerative disease.

Conclusion

On the basis of our present experience, we conclude that vertical spinal instability (i.e., telescoping or overriding of the facets) that exaggerates on physical activity has a defining role in the generation of symptoms of claudication pain and in the pathogenesis of lumbar canal stenosis. Only fixation at the site of the fulcrum of spinal movement is a rational and effective form of surgical treatment.

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