Original Article

Lumbar canal stenosis in "young" - How does it differ from that in "old" - An analysis of 116 surgically treated cases

ABSTRACT

Objective: Patients treated for lumbar canal stenosis (LCS) were retrospectively analyzed to evaluate the differences in clinical management in those below (Group A) and those above (Group B) the age of 50 years. All patients were treated with the premise that instability is the nodal point of the pathogenesis of LCS and "only-stabilization" is the surgical treatment.

Materials and Methods: During the period June 2014 to June 2020, 116 cases were diagnosed to have LCS and surgically treated by the Goel modification of Camille's transarticular screw fixation technique.

Results: Twenty-four patients in Group A and six patients in Group B had a history of "significant" injury to the back at the onset of clinical symptoms. The indices suggested that the intensity of symptoms was relatively more severe in Group A than in Group B. Unilateral leg symptoms were more common in Group A (68%) than in Group B (31.8%). Neurological motor deficits were more common in Group A (28%) than in Group B (12%) patients. Spinal segments surgically treated in Group A ranged from 1 to 4 (average 2 levels) and in Group B it ranged from 2 to 5 (average 3 levels). During the follow-up period that ranged from 6 to 72 months (average 37 months), 100% of patients had varying degrees of relief from symptoms.

Conclusions: LCS is confined to a lesser number of spinal segments in the Group A patients. The symptoms were radicular in nature and relatively severe in Group A than in Group B patients.

Keywords: Lumbar canal stenosis, spinal instability, trans-articular fixation

INTRODUCTION

Characteristic symptoms and radiological features make the diagnosis and treatment of lumbar canal stenosis (LCS) relatively straightforward.[1,2] The study analyses the differences in probable pathogenesis, presenting clinical and radiological features and their impact on surgical treatment between younger (<50 years - Group A) and older patients (above 50 years - Group B). The clinical management is based on the previously published premise that segmental or multi-segmental spinal instability forms the basis of the pathogenesis of LCS.[3,4]

MATERIALS AND METHODS

During the period June 2014–2020, 116 patients presenting with classically described symptoms of LCS were treated surgically in the departments of neurosurgery of the authors. This is a retrospective analysis of consecutively treated cases. All patients provided written informed consent before surgery, and all clinical tests and surgical procedures were

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conducted according to the principles of the Declaration of Helsinki. Patients analyzed in the previous report on the subject of LCS have been included in the study.[3-5] Patients having significant disc herniation or protrusion and presenting with acute clinical symptoms were excluded. All patients were analyzed and treated with the basic concept that vertical spinal instability is the nodal point of the pathogenesis of a range of entities included in the umbrella term of degenerative spinal diseases that includes LCS.[6,7]

There were 81 males and 35 female patients. There were 50 patients in Group A and 66 patients in Group B. All patients had classically described symptoms that are attributed to LCS. Table 1 summarizes the clinical symptoms in the two groups. Radiological observations are summarized in Table 2. The Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) were used to grade the symptoms [Table 3]. All patients had progressive symptoms and were experiencing failure of nonsurgical or conservative forms of treatment. All patients were investigated both before and after surgery with magnetic resonance imaging and dynamic (flexion and extension views) plain radiographs and computed tomography scan. Patients having herniated disc and presenting with acute related symptoms were excluded. Patients in whom there was radiographic evidence that suggested spinal instability or any degree of spondylolisthesis were excluded.

Table 1: The clinical symptoms in the two groups

Parameter	Number of patients	
	Group A	Group B
Number of patients	50	66
Duration of symptoms	3-24 months (8 months)	3-120 months (27 months)
Backpain	50	66
Radicular pain		
Unilateral	34	21
Bilateral	14	45
No radiation	2	-
Motor deficit	14	8
Sensory deficit	16	11

Table 2: The radiological features

Feature	Number of patients	
	Group A	Group B
Radiological level involved		
L1-L2	-	9
L2-L3	3	33
L3-L4	7	12
L4-L5	72	82
L5-S1	77	68
Levels fixed		
One	6	-
Two	29	15
Three	15	32
Four	1	15
Five	-	3

Surgical technique

The basic surgical steps have been described by us earlier and are summarized here.[3-5] All patients underwent surgery in the prone position by adopting classically described maneuvers to break the operation table that obliterated the lumbar lordosis and led to flexed back position. Modified Camille's transarticular screw fixation technique that involved 2 or 3 screws (double or triple insurance screws) was adopted at each level[7,8] [Figures 1-4]. The self-tapping monoaxial screws were approximately 18 mm long and 2–6 mm in diameter.

Apart from clinical guiding parameters and indications from radiological imaging that included the presence of osteophytes, buckled ligamentum flavum and bulging discs, direct physical assessment of instability at the facetal articulation by manual manipulation of bones in the adjoining spinal segments were adopted to identify unstable spinal segment/s and assess the indication for stabilization. Observation of an open articular cavity, osteophytes in the vicinity of the facets, and excessive or abnormal mobility of the facets on manipulation were the indicators that suggested the levels of unstable spinal segments. No bone, osteophyte, disc or ligaments were resected for the purpose of "decompression" of the spinal or root canal. Spinous processes in the surgical field were transected at their base, shredded into small pieces and used as bone graft. All interspinous and interlaminar ligaments were sharply cut and resected. Posterior cortical bone of laminae and facets were drilled to make them suitable as host bone for the bone graft. Table 2 shows the levels of the lumbar spine that were fixated during surgery.

The patients were mobilized as soon as possible. They were advised to use the external lumbar belt and to restrict activities for 6 weeks. Imaging was done in the immediate postoperative period and at follow-up examination.

RESULTS

The duration of follow-up ranged from 6 to 72 months (average 37 months). Symptoms in all patients improved to varying degrees in the immediate postoperative period. Table 3 shows the clinical outcome using ODI and VAS parameters at the time of the last clinical follow-up. Apart from these parameters, a personalized patient self-assessment satisfaction score was developed on the basis of selected questions as detailed in Table 4. This score was evaluated

Table 3: The preoperative and postoperative Visual Analogue Scale and Oswestry Disability Index scores

Scoring system	Group A, mean (range)		Group B, mean (range)	
	Preoperative	Postoperative	Preoperative	Postoperative
VAS				
Backpain	7.8 (6-9)	0.4 (0-1)	6.9 (4-9)	0.2 (0-1)
Radicular pain	8.2 (7-9)	0.2 (0-1)	6.5 (3-9)	0.2 (0-1)
ODI (number of patients)				
0%-20% minimal disability	0	42	0	59
21%-40% moderate disability	10	8	8	7
41%-60% severe disability	32	-	47	-
61%-80% crippled	8	-	11	-
81%-100% bedridden	-	-		-

VAS - Visual Analog Scale; ODI - Oswestry Disability Index

Figure 1: Images of a 42-year-old female patient. (a) T2 weighted MRI shows evidence of lumbar canal stenosis. (b) CT scan showing canal stenosis. (c) Sagittal cut of CT scan showing the facets. (d) Postoperative sagittal CT scan showing transfacetal screws at two levels. (e) Postoperative axial CT scan showing two transfacetal screws or double insurance fixation. (f) 3D reconstructed postoperative CT scan showing the implants. MRI - Magnetic resonance imaging; CT - Computed tomography; 3D - Three-dimensional

in the vernacular language of the patient. There was no recurrence of symptoms that forced any kind of reoperation.

At the minimum follow-up of 6 months, all patients had radiological demonstration of facetal arthrodesis. Basic parameters to assess fusion included stable screw position, fusion across the articular surfaces and over the posterior surface of the facets, and no relative movement of bones on dynamic imaging. There was no instance of screw failure.

DISCUSSION

Kitab *et al*. identified in a cross-sectional population study that approximately 80% of participants older than 40 years had at least moderate and 31% had severe radiographic evidence of LCS.[9,10] The exact degree of intensity of clinical symptoms and the number of patients subjected to surgical treatment varies widely in various reports.

Narrowing of the spinal and root canals leading to restriction of traverse space for neural and vascular structures form the basis of the most frequently diagnosed spinal disorder, namely LCS. Narrowing of spinal and root canal related to disc herniation, disc bulges, facet "hypertrophy", ligamentum flavum "hypertrophy" and such pathological observations have been classically identified with LCS. It is generally agreed that the radiological alterations may not be significant or remarkable and generally do not match the severity of symptoms.

LCS is characterized by its insidious onset, progressively worsening, and chronicity of clinical symptoms. Both developmental and degenerative factors are generally considered in the pathogenesis of LCS. Bone dysplasia and genetic aberrations have been considered to be possible etiological factors, particularly in younger patients.[9-12]

In our earlier articles on the subject, we related weakness of the muscles of the low back due to their disuse, abuse, or injury and related spinal instability as the nodal point of pathogenesis.[13-17] Standing human posture and life-long stress on the muscles form the basis of LCS. Rather than disc degeneration or disc space reduction, we speculated that vertical spinal instability and facetal listhesis related to muscle weakness formed the initial point of generation of the disease complex. While listhesis of the inferior facet of the rostral lumbar vertebra over that of the superior facet of caudal vertebral is the primary event, disc space reduction, "buckling" and not pathological "hypertrophy" of the intervertebral ligaments that include posterior longitudinal ligament and ligamentum flavum, osteophyte formation, bulging of the intervertebral disc into the spinal canal and eventual reduction in the spinal and neural canal

Table 4: The patient satisfaction score

Parameter	Number of patients			
	Score 0 Not satisfied	Score 1 Minimally satisfied	Score 2 Satisfied	Score 3 Remarkably satisfied
Are you happy with the operation?	-	-	11	105
Are you relieved of back and leg pain?	-	-	14	102
Can you walk better?	-	-	0	116
Would you recommend the operation to someone else?	-	-	6	110

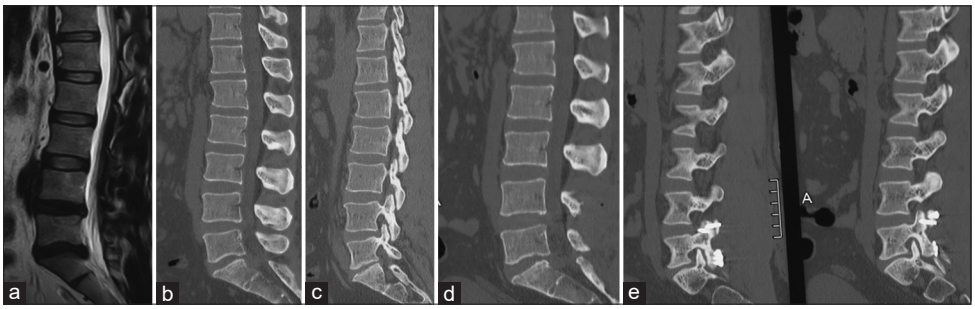

Figure 2: Images of a 41-year-old male patient. (a) T2-weighted MRI shows evidence of lumbar canal stenosis. (b) CT scan showing canal stenosis. (c) Sagittal cut of CT scan showing the facets. (d) Postoperative CT scan. (e) Postoperative sagittal CT scan showing the double insurance transfacetal screws at L4-L5 level and triple insurance screws at L5-S1 level. MRI - Magnetic resonance imaging; CT - Computed tomography

Figure 3: Images of a 60-year-old male patient. (a) T2 weighted MRI shows evidence of lumbar canal stenosis. (b) CT scan showing canal stenosis. (c) Sagittal cut of CT scan showing the facets. (d) Postoperative sagittal CT scan showing no decompression by resection of any part of the lamina. (e) 3D reconstructed postoperative CT scan showing the implant. (f) Antero-posterior view of 3D reconstructed CT scan showing the double insurance transfacetal screws at 3 levels. MRI - Magnetic resonance imaging; CT - Computed tomography; 3D - Three-dimensional

are secondary events. Our articles discuss that not direct neural compression but instability is the cause of neurological symptoms.[17]

In the year 2010, we identified that facet distraction using "Goel-facet spacer" had the potential for reversal of all the known so-called pathological features of spinal degeneration.[13,14,18,19] Accordingly, we described facet distraction and segmental arthrodesis as a philosophical form of surgical treatment for single or multiple level spinal degenerations (both lumbar and cervical). Facet distraction resulted in an indirect decompression of the spinal and root canals. Essentially, our articles are the first in the literature where it is mentioned that "decompression" of the spinal or root canal by resection or removal of bone, osteophytes and soft tissue that included ligamentum flavum, osteophyte, and disc is not necessary in the treatment of degenerative spinal disease. More recently, we identified that instability is the cause of the clinical complaints and obvious radiological features and "only" stabilization is the treatment. No direct or indirect decompression of the spinal canal is necessary.[3-5]

Whilst the symptoms are prominent and frequently disabling, positive clinical signs are distinctly uncommon in LCS. Claudication pain and the progressively reducing claudication distance is a classical and diagnostic clinical symptom. We earlier related claudication pain to muscle weakness and their incompetence or "giving away" after walking for a distance and related facetal listhesis as the point of initiation and generation of this symptom.[3-5] Resting back and radiating pain and tingling/numbness paresthesiae are generally late clinical events. Patients usually prefer flexed back posture during walking and lateral recumbent position is preferred during sleeping rather than the supine position.

Figure 4: Images of a 71-year-old female patient. (a) T2 weighted MRI shows evidence of lumbar canal stenosis. (b) CT scan showing canal stenosis. (c) Sagittal cut of CT scan showing the facets. (d) Postoperative sagittal CT scan showing no evidence of decompression by bone removal. (e) Postoperative CT scan showing the implant. MRI - Magnetic resonance imaging; CT - Computed tomography

Although the developmental issues have been considered to have significance in the younger population group, morphometric examination did not identify any direct evidence of reduction in the spinal canal dimensions.[12] Even in the elderly population group, some authors have identified that both developmental canal stenosis and degenerative spinal changes take part in the ultimate generation of the symptom complex of LCS.[20,21] We identified trauma to the back as possible initiating factor in 24 patients (48%) in Group A and 6 patients (9%) in Group B. Pain as a symptom was significantly more severe in Group A than in Group B patients. Unilateral radicular symptoms were in 68% in Group A and 31.8% in Group B patients. Focal motor neurological deficits were identified in 28% Group A patients and 12% in Group B patients. The number of spinal segments affected and surgically stabilized in Group A was one in six patients, two in 29 patients, three in 15 patients and four in one patient. On the other hand, the number of spinal segments treated in Group B ranged from 2 to 5 (2 segments in 15 patients, 3 segments in 32 patients, 4 segments in 15 patients, and 5 segments in three patients). Kitab *et al*. also identified more frequent involvement of upper lumbar spinal segments in the older patient cohort.[9,10]

Instability was identified to be the primary issue in both groups. Multisegmental spinal stabilization was done in all patients. Stabilization involved transarticular screw insertion by using Camille's technique. We inserted two screws (double insurance screws) at each level. In selected segments three transarticular or triple insurance screws were used. No decompression of the spinal or neural canal was done in any case by resection of bone, soft tissues, or disc.

Our observations suggest that in the elderly muscle weakness is not limited to isolated segments and is usually multisegmental and hence LCS generally affects multiple spinal segments. On the other hand, in younger individuals trauma-related damage to the muscle fiber group initiates instability that is usually limited to one or two spinal segments and is more often unilateral. The symptoms of unilateral radiating pain, focal radicular deficits, and scoliosis suggest a more localized disease rather than the involvement of multiple spinal segments. The severity of pain and resting pain are other evidences of the symptom complex that suggest focal spinal segmental involvement. The identification of levels of unstable spinal segments and their stabilization forms a crucial surgical issue. Apart from clinical parameters, the levels of spinal instability are indicated by the presence of disc bulges, osteophytes, and ligamentum flavum bulging. We identified direct manipulation of bones during surgery as additional parameter to assess and confirm spinal instability in segments adjacent to those indicated by clinical and radiological parameters.

Our remarkably gratifying clinical outcome following surgical treatment that involved only spinal fixation and no decompression of bone or soft tissues of any kind is suggestive of instability as the primary or nodal point of the pathogenesis of symptoms in both groups.

CONCLUSIONS

LCS in the elderly is an outcome of "age-related" muscle weakness secondary to their disuse or misuse. In younger adults (Group A) muscle weakness is often initiated or related to moderate or severe injury. The symptoms are relatively severe; radiation of pain in more often unilateral and lumbar scoliosis in more pronounced in the Group A patients. We proposed "only-stabilization" as treatment for both groups and identified the futility of any kind of bone or soft tissue decompression. Our 100% successful and gratifying clinical outcome is a testimony to the validity of the concept.

Declaration of patient consent

The authors certify that they have obtained all appropriate

patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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