ORIGINAL ARTICLE

Role of Endoscopic Decompression in Lumbar Canal Stenosis

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Abstract

Background: ***Hypertrophy of the ligamentum flavum, degeneration of the discs, arthropathy of the facet joints, and osteophytes all contribute to the narrowing of the spinal canal and the compression of nerve roots, making lumber canal stenosis a prevalent medical condition.***

Aim and objectives: ***To evaluate the efficacy of endoscopic lumbar decompression in the treatment of patients presenting with secondary single-level lumbar canal stenosis.***

Patients and methods: ***This prospective study was carried out on 40-patients who underwent endoscopic lumbar decompression for lumbar canal stenosis, at Al-Azhar University Hospitals(Sayed Galal and Al-Hussien) during September 2022 till September 2024.***

Results: ***In our study, the 20 patients with unilateral canal stenosis, the Denis pain score preoperatively ranged between 4 and 5 with a mean of 4.35; postoperatively, the Denis pain score ranged between 1 and 3 with a mean of 1.3. Among the 20 patients with bilateral canal stenosis, the Denis pain score preoperatively ranged between 4 and 5, with a mean of 4.45; postoperatively, pain ranged between 1 and 4, with a mean of 1.95. In the 20 patients of unilateral canal stenosis, we achieved 16(80%) patients with Denis's score-1(which is the best score, meaning no pain). In the 20 patients with bilateral canal stenosis, 11(55%) patients had Denis's score 1.***

Conclusion: ***The best approach to treating lumbar canal stenosis involves careful planning before surgery, during the procedure, and in the recovery period afterwards. The majority of patients with lumbar spinal stenosis undergo a laminectomy as their treatment. Due to its advantages of less stress, less bleeding, and faster recovery, endoscopic spinal surgery has lately become frequently utilized to treat various kinds of lumbar stenosis.***

Keywords: Endoscopic decompression; Lumbar canal stenosis

1. Introduction

Hypertrophy of the ligamentum flavum, degeneration of the discs, arthropathy of the facet joints, and osteophytes all contribute to the narrowing of the spinal canal and the compression of nerve roots, making lumbar canal stenosis a prevalent medical condition.[1]

Degenerative lumbar spinal stenosis (DLSS) is a new condition that primarily affects the elderly. By 2025, it is projected that 64 million people in this age group would be impacted by this condition, with the number of affected patients increasing by 59%.[2]

Leg discomfort, numbness, and neurogenic claudication are the primary symptoms, and they get worse when you push yourself.[3]

Over the last 30 years, minimally invasive spine surgery has developed and grown in favour among spine surgeons as an alternative to more invasive open procedures. The increasing number of patients undergoing endoscopic spine surgery has led to a gradual evolution of the procedure.[4]

We set out to see how well endoscopic lumbar decompression worked for patients who had subsequent single-level lumbar canal stenosis.

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2. Patients and methods

The records of 40 patients who underwent endoscopic lumbar decompression for lumbar canal stenosis were obtained in this prospective, randomized controlled study. They were divided into two groups: 20 patients with unilateral canal stenosis with major unilateral neurogenic claudication and/or leg symptoms, and 20 patients with bilateral canal stenosis having bilateral neurogenic claudication, leg pain and with or without low back pain.

The surgeries were in Al-Azhar university hospitals from September 2022 till September 2024 and follow up was done over 1-week, 3-months and 6-months.

For both groups, we have dedicated the Interlaminar Endoscopic Decompression. By using of the endoscopic EasyGo system by Karl Storz(GmbH, Germany), we have unified the instrumentational system for all cases seeking unified relevant results. Written informed consent was obtained from patients who participated in this study.

Inclusion criteria:

Above 18 years old and both sexes who had secondary single-level lumbar canal stenosis with unilateral or bilateral neurogenic claudication, leg pain and without predominant associated low back pain.

Exclusion criteria:

Patients with multiple levels of lumbar canal stenosis were offered surgical intervention after failure of conservative management.

Methodology:

Preoperative Patient Evaluation

The following pieces of personal information were requested: name, age, sex, profession, place of residence, marital status, and any health-related unusual habits. On top of all the other symptoms the patient was experiencing, the presenting complaint was the most upsetting one.

In taking the patient's current history, we looked at their neurological symptoms, as well as when they started, how they progressed, and how long they lasted. Among the neurological symptoms were signs of sphincteric dysfunction, sensory affection, or motor affection. Examining the patient's medical history involved looking for signs of diabetes, hypertension, and radiation exposure, as well as any prior surgeries, drugs, or treatments.

Examination:

We checked every patient's vitals, as well as their weight, height, neck, chest, and abdomen, as part of our comprehensive general checkup. All patients underwent a comprehensive neurological evaluation that included testing of their senses (both superficial and deep), motor skills (including reflexes), and pain (using the Denis functional pain scale).

Investigations:

Comprehensive blood count (CBC), glucose, liver and kidney function tests, and coagulation profile are all part of the standard preoperative laboratory workup. Prior to surgery, patients had non-neurological tests ordered by the anaesthesia team. These tests included chest X-rays, electrocardiograms (ECGs), and echocardiographies for a subset of patients.

Radiological investigations:

The following diagnostic tools were utilized to identify lumbar canal stenosis and its subtypes, namely unilateral, foraminal, and bilateral:AP: Low-Side Slope X-Ray Both static and moving images can be used to rule out spinal instability. Spinal cord compression, nerve root impingement, ligamentum flavum hypertrophy, grade of stenosis, type of stenosis (bilateral or unilateral canal), and imaging modalities for MRI LSS.

MRI grading system for lateral recess bilateral stenosis:

Level 0 indicates no narrowing of the lateral recess or root compression; Level 1 indicates narrowing of the recess but no root compression is visible; Level 2 indicates more significant narrowing of the recess (angular or trefoil), with the nerve root appearing flattened or widened, but the cerebrospinal fluid (CSF) surrounding the root in the recess is preserved; Level 3 indicates severe compression of the nerve root within the recess and complete obliteration of CSF from the recess.5

Postoperative management:

For an average of fourteen days, patients were prescribed antibiotics and non-steroidal anti-inflammatory medications. There was no delay in the patients' ability to walk the day after surgery.

Nerve root and dural exploration:

Find the shoulder of the nerve root that is traversing the dura mater once you've located its lateral edge. In order to properly decompress the travelling nerve root, the medial facet may be undercut. To relieve pressure on the nerve root in the shoulder, a cottonoid is pushed laterally and cranially. The surgeon may have difficulty passing the cottonoid if the nerve root is not sufficiently decompressed. Then, to provide room for the nerve root laterally, it's best to undercut the medial facet. Retracting the cottonoid from the nerve root's shoulder medially.

Central canal stenosis decompression:

In cases of bilateral canal stenosis, the previous steps are done in the same sequence, with adding to the decompression to the other side using the 'over top' technique, which means laminectomy is continued to the contralateral side on top of the remaining ligamentum flavum. After sufficient laminectomy, removal of the remaining ligamentum flavum, followed by contralateral foraminotomy, is done. Patient's positioning by tilting the table away from the surgeon facilitates

adequate visualization and decompression of the contralateral side.

Physical Rehabilitation:

It was recommended that all patients be mobilized on the day of operation. It was recommended that during the 14 days following the operation, you should not lift heavy objects or twist your lower back too much. We advised that you seek out physical treatment to help improve your core muscles.

Follow-up and Outcome:

Early follow for evidence of improvement or worsening of the major complaints, presence of new complaints, infection or any serious postoperative events during the hospital stay period.

Assessed by using the Denis Pain Score

At2,3, and 6 months intervals, all patients were re-evaluated. Patients were not included in the trial if they did not appear during the designated times.

Patients' clinical and functional state at their most recent follow-up appointment was used to rate their result. Denis' pain score classified the patients' radicular pain as either "excellent," "good," "fair," or "poor," depending on the severity of their symptoms.

Statistical analysis:

IBM SPSS software package version 20.0 was used to analyze the data.(IBM Corp, Armonk, NY) Qualitative data were described using number and percent. The Shapiro-Wilk test confirmed normal distribution. Quantitative data were described using range(minimum and maximum), mean, standard deviation, median and interquartile range(IQR). The results were significant at the 5% level.

Chi-square test for categorical variables to compare groups. Fisher's precise test, Correction for chi-square, is used when more than 20% of the cells have an anticipated count of less than 5. Student t-test for normally distributed quantitative data, to compare between two examined groups. The Mann-Whitney test was used for erratically distributed quantitative variables to compare the two examined groups. The Wilcoxon signed-rank test was used to compare irregularly distributed quantitative variables in two periods.

3. Results

Table 1. Comparison between the two studied groups according to sex.

SEX	LATERAL RECESS (N=20)		CENTRAL STENOSIS (N=20)		X2	P
	No.	%	No.	%		
MALE	11	55.0	12	60.0	0.102	0.749
FEMALE	9	45.0	8	40.0		

p:p-value and the 2:Chi square test for comparing the two groups under study.

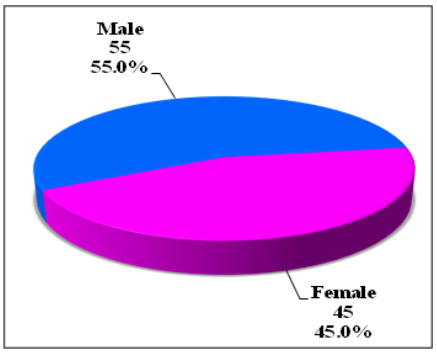

Figure 1. Comparison of the two groups under study in unilateral canal stenosis based on sex.

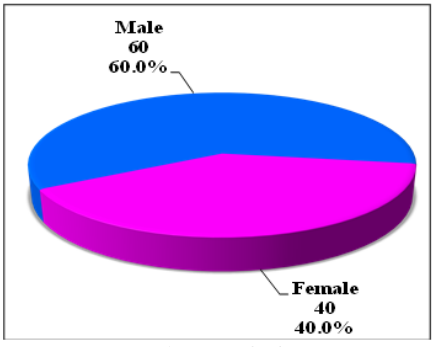

Figure 2. Comparison of the two groups under study in bilateral stenosis based on sex.

Table 2. Comparison of the two groups under study based on complications.

	UNILATERAL STENOSIS (N=20)		BILATERAL STENOSIS (N=20)		FET	P
	No	%	No	%		
COMPLICATIONS						
NONE	20	0.5	16	80.0	3.690	0.106
DURAL TEAR	1	5	2	10.0		
RE-OPERATED	0	0.0	2	10.0		

FET:Fisher Exact test, p:p-value for comparing between the two studied groups, *:Statistically significant at p≤0.05

Among the 20-patients with unilateral canal stenosis, there was one case of dural tear that was managed conventionally. Among the 20-patients with bilateral canal stenosis, there were 2(10%) dural tear and 2(10%) re-operated.

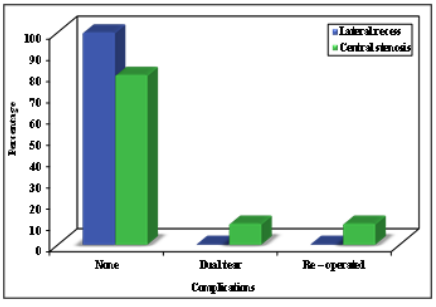

Figure 3. Complications-based comparison of the two groups under study.

Table 3. Denis's score is used to compare the two groups under study.

DENIS'S SCORE	UNILATERAL STENOSIS (N=20)	BILATERAL STENOSIS (N=20)	U	P
PREOPERATIVE				
MIN-MAX.	4.0-5.0	4.0-5.0	180.0	0.602
MEAN±SD	4.35±0.49	4.45±0.51		
MEDIAN (IQR)	4.0(4.0-5.0)	4.0(4.0-5.0)		
POSTOPERATIVE				
MIN-MAX.	1.0-3.0	1.0-4.0	142.0	0.121
MEAN±SD	1.30±0.66	1.95±1.19		
MEDIAN (IQR)	1.0(1.0-1.0)	1.0(1.0-3.0)		
Z	4.029*	3.965		
P0	<0.001*	<0.001*		

IQR:Inter quartile range, SD:Standard deviation, U:Mann Whitney test

Z:Wilcoxon signed ranks test, p:p-value for comparing between the two studied groups

p0:p-value for comparing between preoperative and postoperative, *:Statistically significant at p≤0.05

Among the 20-patients with unilateral stenosis, the Denis pain score preoperatively ranged between 4-5 with a mean of 4.35, postoperatively the Denis pain score ranged between 1-3 with mean of 1.3.

Among the 20-patients with bilateral canal stenosis, the Denis pain score preoperatively ranged between 4-5 with a mean of 4.45, postoperatively pain ranged between 1-4 with mean of 1.95.

p0 comparing between preoperative and postoperative Denis's score with<0.001 in both groups which is statistically significant P-value indicating pain relief post operatively for the two groups.

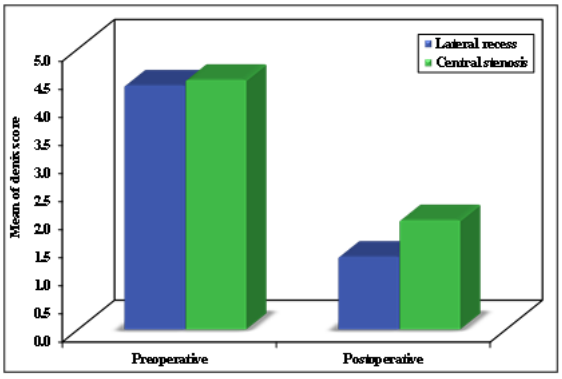

Figure 4. Comparison between the two examined groups according to Denis score.

Table 4. Comparison of the two groups under study based on Denis's score (postoperative).

DENIS SCORE (POSTOPERATIVE)	UNILATERAL STENOSIS (N=20)		BILATERAL CANAL STENOSIS (N=20)		2.849	P
	No	%	2.849	%		
1	16	80.0	2.849	55.0	2.849	0.091

p:p-value and the 2:Chi square test for comparing the two groups under study

In the 20-patients of unilateral canal stenosis, we achieved 16(80%) patients with Denis's score-1(which is the best score means no pain). In the 20-patients with bilateral canal stenosis, 11(55%) patients with Denis's score-1. This has no statistically significant P-value but with noticeable difference in percentage of pain relief between the studied groups.

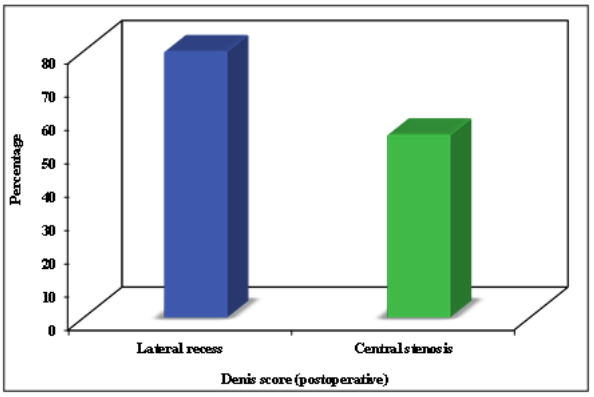

Figure 5. Comparison of the two groups under study based on the postoperative Denis score.

Table 5. Relation between Stenosis grade and Denis's score(postoperative) in lateral recess(n=20).

DENIS'S SCORE (POSTOPERATIVE)	STENOSIS GRADE 2(n=7) No	%	3(n=13) No	%	TEST OF SIG.	P
1	6	85.7	10	76.9	FET=	0.775
2	1	14.3	1	7.7	1.276	
3	0	0.0	2	15.4		
MEAN±SD.	1.14±0.38		1.38±0.77		U=40.50	0.699
MEDIAN (MIN-MAX.)	1.0(1.0-2.0)		1.0(1.0-3.0)			

FET: Fisher Exact test, U: Mann Whitney test, SD: Standard deviation, and p: p-value for comparing several categories

In the group of lateral recess stenosis there were 7-patients with grade-2 stenosis in MRI and 6(85.7%) of them were Denis's score-1 postoperative and only 1(14.3%) with Denis's score-2 postoperatively.

Thirteen-patients were graded-3 stenosis in MRI m there were 10(76.9%) of them had Denis's core-1 postoperatively, 1(7.7%) with Denis's score-2 postoperatively and 2(15.4%) with Denis score-3 postoperative.

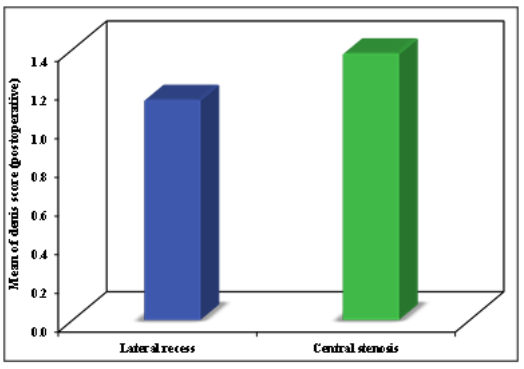

Figure 6. Relation between stenosis grade and Denis's score(postoperative) in lateral recess(n=20).

Table 6. Relation between Stenosis grade and Denis's score(postoperative) in central stenosis(n=20)

DENIS'S SCORE (POSTOPERATIVE)	STENOSIS GRADE				TEST OF SIG.	P
	2(n=8)		3(n=12)			
	No	%	No	%		
1	4	50.0	7	58.3	FET=	0.775
2	0	0.0	2	16.7	1.276	
3	2	25.0	2	16.7		
4	2	25.0	1	8.3		
MEAN±SD	2.25±1.39		1.75±1.06		U=39.0	0.521
MEDIAN(MIN-MAX.)	2.0(1.0-4.0)		1.0(1.0-4.0)			

FET: Fisher Exact test, U: Mann Whitney test, SD: Standard deviation, and p: p-value for comparing several categories

In the group of bilateral canal stenosis there were 8-patients with grade-2 stenosis in MRI and 4(50%) of them were Denis's score-1 postoperative, 2(25%) with Denis's score-3 postoperative and 2(25%) with Denis's score-4 postoperative.

Twelve-patients were graded-3 stenosis in MRI, there were 7(58.3%) of them had Denis's score-1 postoperatively, 2(16.7%) with Denis's score-2 postoperatively, 2(16.7%) with Denis's score-3 and only 1(8,3%) with Denis's score-4 postoperative.

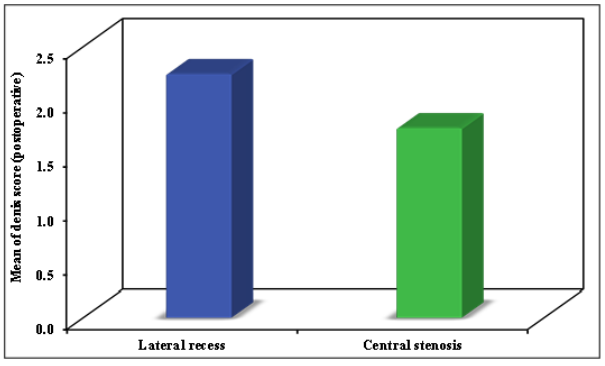

Figure 7. Relation between stenosis grade and Denis's score(postoperative) in central stenosis(n=20).

Case presentation:

Case(1):

A 63-year-old female patient presented with low back pain and neurogenic claudication in both lower limbs while walking., this pain was not relieved by regular analgesic and anti-inflammatory. pain degree was assessed by Denis's pain score, and it was grade-4. Her MRI lumber showed L4-5 level central canal stenosis with hypertrophied ligamentum flavum bilaterally. Grade-3 by MRI grading system. Patient was operated for endoscopic decompression from uni-portal approach using EASYGO endoscope. Post operatively patient bilateral lower limb pain was improved, and it was grade-2. No intraoperative or postoperative complications occurred.

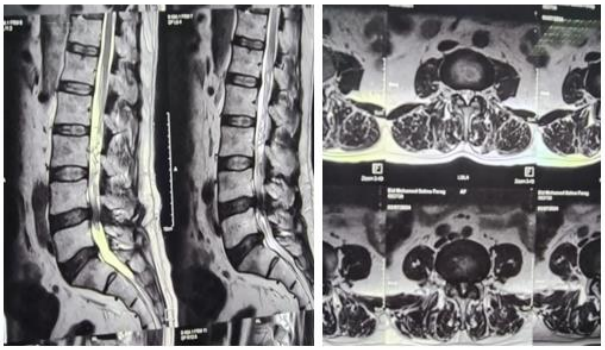

Figure 8. Preoperative MRI lumber spine of L4-5 central canal stenosis.

Case(2):

Walking caused low back pain and neurogenic claudication in the left lower limbs of a 73-year-old male patient, can't exceed 100-meter walking without pain in LT lower limb, this pain was not relieved by regular analgesic and anti-inflammatory. The pain degree was assessed by Denis's pain score, and it was grade-5. His MRI lumber showed L4 level lateral recess stenosis with narrowing of the recess grade-3 by MRI Grading system.

Patient was operated for endoscopic decompression from uni-portal approach using EASYGO endoscope. Lamina of L4 was endoscopically removed unilateral on LT side and foraminotomy was done. Post operatively patient left lower limb pain was improved, and it was grade-1. No intraoperative or postoperative complications occurred.

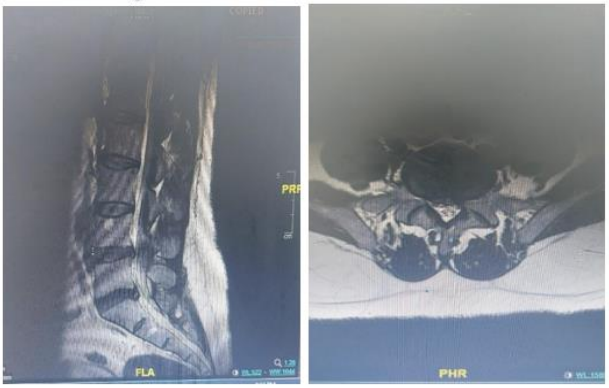

Figure 9. Preoperative MRI of L4-5 LT lateral recess stenosis.

4. Discussion

In the current study, the 1st group(UL complaining Group) (20-patients) included 11-males(55%) and 9-females(45%) while the 2nd group(BL complaining Group) (20-patients) included 12-males(60 %) and 8-females(40%).

In the current study, the mean age in the 1st group was 65.0±4.99 with the youngest patient 56-year-old and the oldest 78-year-old while the mean age in the 2nd group was 64.65±3.75 with

the youngest patient 59-year-old and the oldest 72-year-old.

In the first group(UL-lateral recess stenosis), there were 7-patients(35%) with grade-2 in MRI lumber spine, and 13(65%) patients grade-3 with MRI imaging while in the 2nd group(BL-central canal stenosis) there was 8(40%) patients grade-2 in MRI imaging, and 12(60%) patients grade-3 in MRI imaging. There were no patients with grade-1 stenosis in both groups, as they had a good outcome with conservative management.

In the current study, the lumbar level with the highest rate in both groups was the L4-5 level, with 35% in the 1st group(UL-Lateral recess stenosis) and 50% in the 2nd group(BL-central canal stenosis). The next highest rated level in the 1st group was L2-3 with 25% followed by L5-S1 with 20% but in the 2nd group, L3-4 level came with 25% followed by L2-3 level with 15% and L5-S1 in 2 patients (10%).

In the current study, regarding the postoperative complications, we have found that in the 1st group(UL-canal stenosis) there were no complications identified during the hospital stay. In the 2nd group(BL-canal stenosis), we had 2-patients with dural tear(10%) and 2(10%) cases needed reoperation by open microscopic decompression.

In the current study, we have used the Denis Pain score as the preoperative and postoperative pain score for the two groups. Among the 20 patients with lateral canal stenosis, the Denis pain score preoperatively ranged between 4 and 5, with a mean of 4.35±0.49; postoperatively, the Denis pain score ranged between 1 and 3, with a mean of 1.3±0.66.

Among the 20 patients with bilateral canal stenosis, the Denis pain score preoperatively ranged between 4 and 5, with a mean of 4.45±0.51; postoperatively, pain ranged between 1 and 4, with a mean of 1.95±1.19. P0 comparing between preoperative and postoperative Denis's score with<0.001 in both groups, which is statistically significant, P-value indicating pain relief postoperatively for the two groups, indicating that the endoscopic decompression in both different types of lumbar canal stenosis is a good surgical option in the treatment of such cases.

In the current study, the best postoperative Denis Score(P1) was evaluated in both groups. In the 1st group(UL-canal stenosis), 16 patients (80%) had a P1 Denis score, and in the 2nd group(BL-canal stenosis), 11 patients(55%) had a P1 Denis score, with a P-value of 0.091. There is no statistically significant P-value between the two groups, but there is a noticeable difference in the percentage of pain relief between the studied groups(80% in the 1st group and 55% in the 2nd group).

In the current study, we have presented the relationship between the degree of stenosis and the postoperative Denis score in both groups. In the 1st group(UL-canal stenosis), patients with grade-2 stenosis were 7(35%) with P1 Denis score in 6-patients(85.7 %) and P2 Denis score in 1-patient(14.3 %). In the same group, patients with grade-3 stenosis were 13(65%) with P1 Denis score in 10-patients(76.9%), P2 Denis score in 1-patient(7.7%) and P3 Denis score in 2-patients(15.4%).

On the other hand, in the 2nd group, patients with Grade-2 stenosis were 8-patients(40%) with P1 Denis score in 4-patients(50%), P3 Denis score in 2-patients(25%) and P4 Denis Score in 2-patients(25%). In the same group, patients with Grade-3 stenosis were 12-patients(60%) with P1 Denis score in 7-patients(58.3%), P2 Denis score in 2-patients(16.7%), P3 Denis Score in 2-patients(16.7%) and P4 Denis score in 1-patient(8.3%). The collected data revealed significant percentage differences in the postoperative results in relation to the grade of stenosis and the type of stenosis.

Xin et al.,[6] he studied the outcome of 47-patients with bilateral leg symptoms who were treated with percutaneous spinal endoscopy(PSE) via a unilateral posterior interlaminar approach with bilateral decompression in a retrospective study that was conducted from May 2014 to June 2016. This study can be compared with the 2nd group(BL-canal stenosis) in our study.

In his study, he had 26 female patients(55.3%) and 21 male patients(44.6%) with a mean age 63.4±10.4-year-old but in our study, we had 12 male patients(60%) and eight female patients(40%), with a slight predominance of male patients. The mean age in our study was 64.65±3.75, which is mostly the same as Xin et al. study.

Xin et al.,[6] Our study included two patients with dural tears (10%) and two patients (10%) who required reoperation, whereas his study included two patients with dural tears (4.26%) and one patient with temporary dysesthesia (2.13%). Consistent with the majority of endoscopic lumbar decompression studies, the primary consequence in both investigations was a dural tear.

Ruetten et al.,[7] conducted a study comparing microscopic and complete endoscopic techniques for individuals with lumbar lateral recess stenosis, unilateral radiculopathy, and low back discomfort or absence of pain. He found that in the full endoscopic group 76.5% of patients no longer had radiculopathy, compared to 73% in the microscopic group; in the endoscopic group, 21% of patients experienced occasional pain, while in the microscopic group, 20% did; and in the group that showed no improvement, 2.5% of

endoscopic patients and 7% of microscopic patients were involved. He came to the conclusion that a comprehensive endoscopic treatment, with fewer risks and a shorter hospital stay, is just as beneficial as a microscopic method.

Kesornsak et al.,[8] have studied the results of 129-patients who underwent full endoscopic decompression for lateral recess stenosis in the lumbar area between 2009-2013 for patients complaining of unilateral radiculopathy. They have reported a complete pain relief in 93.02% of patients. They have followed the patients for a period of 10-years and they found that 8.06% needed reoperation.

In comparison to the current study of the 1st group(UL-canal stenosis), our results were nearly the same with 80% of patients showed complete relief of radiculopathy, 10% showed relief with infrequent use of medications and 10% with frequent use of medications.

4. Conclusion

The best approach to treating lumber canal stenosis involves careful planning before surgery, during the procedure, and in the recovery period afterwards. The majority of patients with lumbar spinal stenosis undergo a laminectomy as their treatment. Due to its advantages of less stress, less bleeding, and faster recovery, endoscopic spinal surgery has lately become frequently utilized to treat various kinds of lumbar stenosis.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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