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Degenerative lumbar spinal canal stenosis surgery by endoscopy approach

Eshkulov Dostonjon Ilkhomovich

Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics, Ministry of Health of the Republic of Uzbekistan (Tashkent), Tashkent Medical Academy, Uzbekistan

Khujanazarov Ilkhom Eshkulovich

Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics, Ministry of Health of the Republic of Uzbekistan (Tashkent), Tashkent Medical Academy, Uzbekistan

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Abstract: Lumbar degenerative spinal canal stenosis (LDSS) is a prevalent condition that significantly impacts the quality of life of patients, leading to substantial economic costs in the healthcare system. It is commonly observed in individuals aged over 50 and is primarily caused by degenerative disc disease. Traditional treatment options, including laminectomy, come with potential complications, including nerve damage, infection, and prolonged recovery times. An emerging alternative is percutaneous spinal lumbar decompression (PSLD), a minimally invasive procedure that aims to reduce these complications while improving clinical outcomes.

Methods: The study was conducted at the Republican Center of Traumatology and Orthopedics in Uzbekistan from 2020 to 2025. A total of 50 patients diagnosed with lumbar spinal stenosis were included in the analysis. The patients were divided into two groups: the endoscopic PSLD group (n=27) and the traditional decompressive surgery group (n=23). All patients underwent preoperative assessments using radiography, multislice computed tomography (MSCT), and magnetic resonance imaging (MRI) to evaluate spinal canal dimensions, foraminal opening size, and the severity of stenosis. Visual Analog Scale (VAS) used for evaluation of pain. Statistical analyses, including t-tests and chi-square tests, were used to compare outcomes between the two groups, with a significance level set at $p<0.05$.

Results: The mean age of patients in the endoscopic PSLD group was 56.86 ± 7.7 years, and in the traditional surgery group, it was 54.25 ± 5.08 years, with no significant difference observed between the two groups in terms of age. Postoperatively, the mean VAS score for the traditional surgery group was 3.8 (SD=0.96), while for the endoscopic PSLD group, it was significantly lower at 2.51 (SD=1.01), indicating that the PSLD group experienced significantly less postoperative pain ($p<0.05$).

Conclusion: This study demonstrates that endoscopic PSLD is a promising alternative to traditional decompressive surgery for the treatment of lumbar stenosis. The procedure offers significant advantages in terms of postoperative pain relief and reduced recovery time, making it a favorable option for patients.

Keywords: Lumbar spinal stenosis, endoscopic PSLD, Visual Analog Scale (VAS), degenerative disc disease, lumbar decompression surgery.

Introduction: Lumbar degenerative spinal canal stenosis is a significant medical and social problem that affects the quality of life of patients and imposes a substantial economic burden on the healthcare system due to the complexities of treatment. The prevalence of lumbar spinal canal stenosis is estimated to be between 11–39% based on clinical diagnoses and 11–38% based on radiological data [6]. The frequency of lumbar spinal stenosis increases sharply in individuals over 50 years of age, reaching between 1.8% and 8% in this age group. According to Danish studies, lumbar spinal stenosis occurs at a rate of 272 cases per

1,000,000 population per year [5]. Such patients complain of a "burning, aching, twisting" sensation, and even minimal irritation can trigger a burning pain. Another classic symptom of lumbar spinal stenosis is episodes of painful muscle spasms (cramps) in the calf or foot area [7, 11]. The complexity of the disease lies in the fact that the symptoms significantly impact the quality of life of patients. Among patients with a combination of leg and lower back pain, 70% report equal intensity of pain in both areas, while in 58% of cases, the pain is localized to one leg, and in 42%, it is bilateral 12% [5]. When walking and standing, these patients exhibit signs of cauda equina root dysfunction: bilateral radicular pain, sensory disturbances, and decreased muscle strength in the legs. When the patient lies down, these symptoms resolve quickly, and neurological examination in the lying position does not reveal any abnormalities. Myelography shows a block with signs of extradural compression [10].

The origin of the disease can be mainly of two types: acquired and congenital. Congenital stenosis occurs relatively rarely, accounting for about 5-9% of cases. This condition arises when a person is born with a naturally narrow spinal canal. Acquired lumbar stenosis is the most common cause, accounting for about 90-95% of cases in elderly individuals [1]. Degenerative disc disease is often the primary factor leading to intervertebral disc weakness syndrome. As intervertebral discs undergo degeneration, they lose height and hydration, which can result in protrusion and herniation [4]

Furthermore, subgroups can be combined, creating heterogeneous patient cohorts. In lumbar stenosis, narrowing of the central spinal canal, lateral recess, intervertebral foramen, and the area where the nerve root exits the intervertebral foramen, or a combination of these, leads to compression of the respective structures. Currently, there are several surgical approaches to treat the condition, with laminectomy being a relatively common surgical procedure [3]. Although this method can be highly effective in treating conditions such as spinal canal stenosis, herniated discs, or spinal tumors, there are several drawbacks and complications associated with the procedure, including infection, nerve damage, bleeding, and others [8].

Traditional treatment of intervertebral disc herniations and degenerative spinal stenosis is associated with a range of complexities and potential complications, including prolonged recovery periods, significant pain, risk of infection, nerve structure damage, and possible development of spinal instability due to the removal of bony structures (such as the lamina). These complications can significantly limit functional outcomes and the long-term quality of life of the patient.

Due to these drawbacks, the use of the percutaneous spinal lumbar decompression (PSLD) method, developed by South Korean neurosurgeon Dr. Kim Taek Lim, represents an optimal approach for treating this pathology. This method employs a minimally invasive interlaminar decompression technique, effectively relieving pressure on nerve roots and the spinal canal, while significantly reducing recovery time and minimizing risks associated with open surgery.

The interlaminar decompression method within PSLD involves the removal of only the tissues that directly compress nerve structures, ensuring a more precise and gentle intervention. This also reduces the likelihood of complications such as nerve root damage, infection, or excessive bleeding [2].

The study aim to improve the outcomes of surgical treatment for patients with degenerative lumbar spinal stenosis through the use of endoscopic methods aimed at minimizing tissue trauma.

METHODS

The study was conducted at the Republican Center of Traumatology and Orthopedics in Uzbekistan from 2020 to 2025. To assess spinal canal dimensions and the severity of degenerative stenosis, all patients underwent radiography, multislice computed tomography (MSCT), and magnetic resonance imaging (MRI). A total of 50 patients diagnosed with lumbar spinal stenosis who underwent either endoscopic posterior spinal lumbar decompression (PSLD) (n=27) or conventional decompressive surgery (n=23) were included. The study population consisted of individuals aged 44 to 84 years, comprising 22 males (44%) and 28 females (56%). Endoscopic decompression was performed using the PSLD technique. The severity of preoperative and postoperative symptoms was evaluated using the Visual Analog Scale (VAS) and other clinical indicators. Data collected included patient age, sex, lumbar spinal canal stenosis (LSCS) classification, spinal cord dimensions, foraminal opening size, and symptom severity. Statistical analyses involved t-tests for continuous variables and chi-square tests for categorical variables. Additionally, paired t-tests were used to compare preoperative and postoperative outcomes, with statistical significance set at $p<0.05$.

RESULTS

A total of 50 patients diagnosed with lumbar stenosis were analyzed. The mean age in the endoscopic PSLD group was 56.86 ± 7.7 years, while in the traditional surgery group, it was 54.25 ± 5.08 years. No statistically significant difference was observed between the two

groups in terms of age.

However, a significant gender disparity was found (p = 0.003). In the endoscopic PSLD group, 19 patients (70.3%) were female, whereas in the traditional surgery group, only 8 (30.7%) were female. Preoperatively, 15 patients (55%) in the endoscopic PSLD group were classified as Schizas Type C LSCS, compared to 10 patients (43%) in the traditional surgery group. No statistically significant differences were observed between the two groups in terms of the three classified stenosis sizes before the surgery. Among all patients, the most commonly reported symptoms were chronic pain (37 patients, 74%), neurogenic intermittent claudication (36 patients, 72%), and sensory deficits (35 patients, 70%). The most common complaints in the traditional surgery group were restriction of the static-dynamic function of the spine in 19 patients (82%), neurogenic intermittent claudication in 20 patients (86%), and sensory deficits in 17 patients (73%) and not statistically significant found. Neurogenic intermittent claudication was reported in 16 patients (59%) in the endoscopic PSLD group and 20 patients (86%) in the traditional surgery group, with a statistically significant difference (p = 0.03) Table 1.

Table 1:

Demographic and clinical characteristics of Patients

Variables	Total	Endoscopic surgery (N=27)	Traditional surgery (N=23)	p-value
Age (Mean, ± SD)	55.62	56,86 ±7,7	54,25 ±5,08	0.44*
Sex				
Male (N/%)	22 (44%)	9(39.1%)	14(60.9%)	0.003**
Female (N/%)	28 (56%)	19 (70.3%)	8(30.7%)	
LSCS classification by Schizas				
C (N/%)	25 (50%)	15 (55%)	10 (43%)	0.15**
D (N/%)	25 (50%)	12 (45%)	13 (57%)	
Anteroposterior size of the spinal cord (mm, ± SD)	3.1	3.88 ±1.09	2.98 ±0.05	0.47*
Transverse size of the spinal cord (mm, ± SD)	3.9	3.23 ±0.62	3.09 ±1.21	0.97*
Anteroposterior diameter of the foraminal opening (mm)	3.21	3.18 ±0.69	3.18 ±0.69	0.8*
Symptoms				
Visual Analog Scale (VAS) for Pain Intensity		8.3 ±0.95	8.1 ±0.94	0.65*
Chronic pain (N, %)	37(74%)	14 (54%)	13(56%)	0.87**
Muscle-tonic syndrome (N, %)	24 (48%)	12 (44%)	12 (52%)	0.58**
Restriction of the static-dynamic function of the spine (N, %)	37 (48%)	18 (66%)	19 (82%)	0.2**
Neurogenic intermittent claudication (N, %)	36 (72%)	16 (59%)	20 (86%)	0.03**
Sensory deficits (N, %)	35 (70%)	18 (66%)	17 (73%)	0.57**
Disorders of pelvic organ function (N, %)	23 (46%)	12 (44%)	11 (47%)	0.057**
*T-test, **Chi-Squared test				

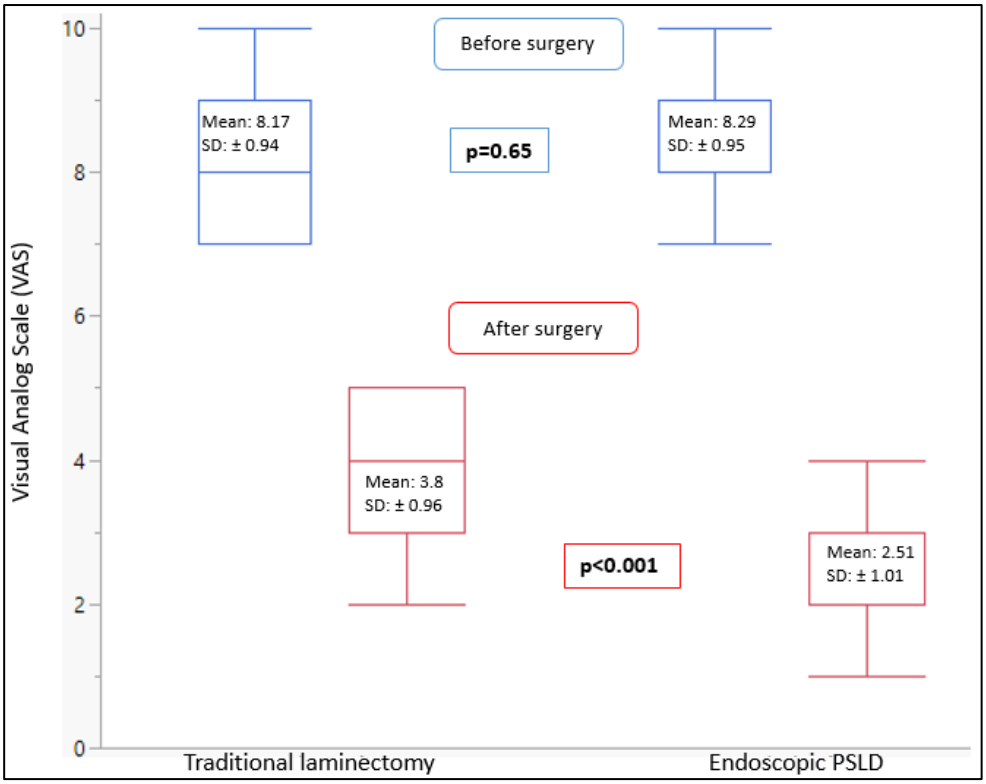
In the analysis of spinal cord measurements, including the anteroposterior size of the spinal cord, transverse size of the spinal cord, and anteroposterior diameter of the foraminal opening, no significant differences were observed between the two types of surgery. Specifically, the Traditional Laminectomy group had a mean anteroposterior size of the spinal cord of 7.7 mm, while the Endoscopic PSLD group had a slightly larger mean of 8.11 mm. However, the p-value of 0.31 indicates that this difference is not statistically significant (Table 2)

Table 2:

Comparision size of spinal cord before and after surgery

Parameters	Traditional laminectomy	Endoscopic PSLD	p-value
Anteroposterior size of the spinal cord (mm)	7.7 ±1.39	8.11 ±1.44	0.31
Transverse size of the spinal cord (mm)	11.29 ±0.7	11.57 ±0.50	0.13
Anteroposterior diameter of the foraminal opening (mm)	7.3 ±0.75	7.52 ±0.8	0.55

Before surgery, the Visual Analog Scale (VAS) analysis revealed no significant differences between the two groups. However, post-surgery results showed that the mean VAS score for the traditional treatment group was 3.8 (SD = 0.96), while the



1-Figure. Comparison of VAS Before and After Surgery

mean VAS score for the endoscopic PSLD group was 2.51 (SD = 1.01). This difference was statistically significant (Graph 1).

DISCUSSION

In this study, the mean age of patients in both groups was comparable, with no significant differences observed between the groups. However, there was a notable gender disparity, as a higher proportion of females were present in the endoscopic PSLD group compared to the traditional surgery group (p = 0.003). This gender difference may reflect a selection bias or a preference for less invasive treatment options among females. In terms of spinal cord measurements, including the anteroposterior size of the spinal cord and the transverse size of the spinal cord, no significant differences were noted between the two surgical techniques. This suggests that both endoscopic PSLD and traditional surgery provided similar anatomical outcomes in terms of spinal cord dimensions and foraminal opening size.

Most notably, post-surgery VAS scores revealed a significant difference between the groups. The mean VAS score for the traditional surgery group was 3.8 (SD = 0.96), while the endoscopic PSLD group showed a lower mean score of 2.51 (SD = 1.01). This finding

indicates that patients who underwent endoscopic PSLD experienced significantly less postoperative pain than those who underwent traditional surgery, which could be attributed to the less invasive nature of the endoscopic procedure.

CONCLUSION

In conclusion, this study highlights the potential

advantages of endoscopic PSLD over traditional surgery for the treatment of lumbar stenosis. Although both groups were similar in terms of preoperative characteristics, the endoscopic PSLD group demonstrated significantly lower postoperative pain levels, as evidenced by the reduced VAS scores. While both techniques showed similar anatomical outcomes, the endoscopic PSLD procedure offers a less invasive alternative with promising results in pain relief and symptom management. These findings suggest that endoscopic PSLD could be a beneficial option for patients with lumbar stenosis, warranting further investigation into its long-term effectiveness and broader applicability

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