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SURGICAL MODALITIES FOR SEGMENTAL LUMBAR CANAL STENOSIS

By

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ABSTRACT

Background: Lumbar Spinal Stenosis (LSS) is one of the most common spinal conditions seen in adults.

Objective: To evaluate different surgical modalities for degenerative segmental lumbar spinal stenosis.

Patients and Methods: This was a study over a period of two years from November 2018 to November 2020 of 100 patients with segmental lumbar canal stenosis subjected to surgery and follow up. The study was carried out at Al-Azhar University, Al-Doaah and Dar-Elshfaa Hospitals. The neurological status before surgery and post-operative examination were assessed.

Results: There was no significant difference in the improvement of leg pain while there was significant difference in improvement of back pain in patients treated with decompression and fixation.

Conclusion: All included modalities improved the element of leg pain with the advantage of the fixation in improving back pain.

Key words: Surgical modalities, lumbar canal stenosis.

INTRODUCTION

Degenerative lumbar spinal stenosis is characterized by decreased spinal canal diameter owing to structural changes of the spine (e.g., facet joints and ligaments) because of aging *(Duan et al., 2016)*.

The term stenosis of the spinal canal has been used to indicate stenosis of the entire cross-sectional area of the vertebral canal, which derives from the latin word (steno) meaning narrowing. This term refers to radiographic observation and don't necessarily correlate with patient symptoms. So, decisions are made based on the nature and severity of an individual's complaints *(Goel and Modi, 2018)*.

It is the most common reason for spinal surgery in patients over 65years, in part because of the increasing quality and availability of radiological imaging. The increasing frequency of LSS surgery also reflects the elevated demand for mobility and flexibility in the aging population. LSS presents equally in males and females. The L4–5 level is involved most frequently, followed by L3-L4 level *(Chou et al., 2011)*.

The classic surgical approach for LSS was a wide bilateral decompressive laminectomy along with resection of the

medial portion of the facet joints to decompress the affected neural elements. Despite its efficacy to relieve stenosis and improve symptoms, many drawbacks were reported especially increasing the possibility of iatrogenic instability *(Liang et al., 2015)*.

The aim of the study was to evaluate different surgical modalities for degenerative segmental lumbar spinal stenosis.

PATIENTS AND METHODS

This was a prospective study done at Al-Azhar University, Al-Doaah and Dar-Elsfaa Hospitals. The Study was over a period of two years from November 2018 to November 2020 of 100 patients with degenerative segmental lumbar spinal stenosis subjected to surgery and follow up.

The study comprised patients having single and multiple levels of degenerative lumbar canal stenosis. The diagnosis of LSS was based on the presence of typical symptoms, such as neurogenic claudication or radicular leg pain, with associated neurological signs.

Inclusion criteria: Patients with segmental lumbar canal stenosis correlated clinically with claudication or radicular pain and failed non-surgical management.

Exclusion criteria: Patients with acquired stenosis due to prior surgery, metabolic, endocrine, infectious, neoplastic causes and post traumatic canal stenosis.

Pre-operative and post-operative neurologic state: General and Neurological assessment using the grading system of the Visual Analogue Scale (VAS) for back and leg pain, and the impact on the functional state of the patient's daily life using the Oswestry Disability Index (ODI).

Radiological evaluation: Preoperative examination included plain radiographes lumbosacral spine (anteroposterior, lateral, and dynamic films 'flexion/extension' showing no instability) and MRI.

Ethical consideration: Informed consent was obtained from every participant after being informed about the aims and process of the study as well as applicable objectives, the study procedures were free from any harmful effects on the participants as well as the service safely. There was no extra fee to be paid by the participants and the investigators covered all the costs in this regard.

Data management and Statistical Analysis: Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Data were summarized using mean, standard deviation, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. For comparing categorical data, Chi square (x2) test, Friedman test and post hoc test were performed. Friedman's non-parametric test was used to compare the within-patient response over time after surgery. Post-hoc with Bonferroni corrections was performed to determine VAS average pain response to different modalities. P-values less than 0.05 were considered as statistically significant.

RESULTS

The study included 100 patients aged from 28 to 69 years old, peaking in the 50s. The majority of patients aged 50 years or over accounted for about 58% of all patients. Regarding sex, 63 (63%) of patients were males, and 37 (37%) were females. There was no statistically significant difference between sex and age distribution among different operation types with p value 0.57 and 0.668 respectively **(Table 1)**.

Table (1): Distribution of sex and age according to operation type

Sex \ Type of operation		Decompression alone		Decompression +fixation	Total	P value
		Single level	multiple			
Males	Count	29	24	10	63	0.57
	% Within type	64.44%	66.67%	52.63%	63%	
Females	Count	16	12	9	37	
	% Within type	35.56%	33.33%	47.73%	37%	
Age \ Type of operation		Decompression alone		Decompression +fixation (N=19)	Total (N=100)	P value
		Single level (N=45)	Multiple level (N=36)			0.668
Age	Range	28-69	32-63	28-69	28-69	
	Mean ± S.D	50.07±10.88	51.25±10.14	48.63±9.53	50.22±10.41	

In single level cases, Friedman's test of the VAS leg reported a Chi-squared value of 67.78$p < 0.05$. There was a statistically significant decrease in VAS leg from preoperative mean to the immediate postoperative mean and the improvement continued at the 6-months mean. Therefore, a post-hoc analysis was warranted. Friedman's test was non-significant to VAS back from preoperative mean to the immediate postoperative mean and the 6 months mean, reporting a Chi-squared value of 0.078 ($p = < 0.05$). Changes in VAS leg and back pain **(Table 2)**.

Table (2): Difference between pre- and post-operative scores in the single level patients

Parameters \ Follow up	**Preoperative**	**Postoperative (Immediate)**	**Postoperative (6 months)**	***Post hoc test***	
				P value	
VAS leg Mean ±SD	7.09±0.98	3.07±1.0	2.78±0.92	pre-Immediate	<0.001
				Immediate -6months	0.161
Range	6-8	2-4	2-4	pre-6monts	<0.001
VAS back Mean ±SD Range	2.98±1.06 2-6	2.93±1.08 2-4	2.89±0.99 2-4	----------	
ODI Mean±SD Range	45.98±8.11 26-58	----------	21.11±7.4 11-42	<0.001	

In multiple level fixation cases, Friedman's test of the VAS leg reported a Chi-squared value of 30.63 ($p < 0.05$). There was a statistically significant decrease in VAS leg from preoperative mean to the immediate postoperative mean and the improvement continued at the 6-months mean. Therefore, a post-hoc analysis was warranted. Friedman's test was nonsignificant to VAS back from preoperative mean to the immediate postoperative mean and the 6 months mean, reporting a Chi-squared value of 2.237 **(Table 3)**.

Table (3): Difference between pre- and post-operative scores in the fixation patients

Follow up / Parameters	**Preoperative**	**Postoperative (Immediate)**	**Postoperative (6 months)**	***Post hoc test P value***	
VAS leg Mean ±SD Range	8.00±0.86 6-9	3.26±1.16 2-6	2.26±0.71 1-3	Pre-Immediate Immediate-6months pre-6monts	<0.001 0.004 <0.001
VAS back Mean ±SD Range	6.21±1.06 4-8	2.74±0.91 2-4	2.53±0.68 1-4	----------	
ODI Mean±SD Range	54.84±5.49 42-62	----------	25.37±4.54 16-35	<0.001	

In multiple leve decompression alone cases, Friedman's test of the VAS leg reported a Chi-squared value of 36.93($p < 0.05$). There was a statistically significant decrease in VAS leg from preoperative mean to the immediate postoperative mean and the improvement continued at the 6-months mean. Also, friedman's test was significant to VAS back from preoperative mean to the immediate postoperative mean and the 6 months mean, reporting a Chi-squared value of 5.99 ($p = < 0.05$). Therefore, a post-hoc analysis was warranted **(Table 4)**.

Table (4): Difference between pre- and post-operative scores in the multiple level (decompression alone) patients

Follow up / Parameters	**Preoperative**	**Postoperative (Immediate)**	**Postoperative (6 months)**	***Post hoc test P value***	
VAS leg Mean±SD Range	7.00±1.00 6-8	3.08±0.86 2-4	4.89±2.47 2-8	Pre-Immediate Immediate-6months pre-6monts	<0.001 <0.001 <0.001
VAS back Mean±SD Range	2.94±1.10 2-6	2.47±0.87 1-4	3.44±1.38 2-6	Pre-Immediate Immediate-6months pre-6monts	0.05 <0.001 0.099
ODI Mean±SD Range	46.25±8.55 26-58	----------	21.22±8.01 11-42	<0.001	

DISCUSSION

LSS is probably one of the most prevalent symptomatic spinal diseases in older patients *(Duan et al., 2016)*.

Patients complaining from severe LSS with significant symptoms can benefit from lumbar decompressive surgery. However, patients with moderate LSS with less severe symptoms have unclear results from surgery. A randomized, controlled study of 94 patients with moderate LSS who underwent either surgical or non-surgical treatment suggested that decompressive surgery of moderate lumbar spinal stenosis can provide slight, but consistent, functional ability improvement, especially compared with non-operative measures. The results were based on a 6-year follow-up *(Slätis et al., 2011)*.

North American Spine Society (NASS) guidelines suggest the use of decompressive surgery as a mean of improving outcome not only in patients with severe symptoms of LSS but in those with moderate symptoms as well *(Bostelmann and Steiger, 2014)*.

Different surgical techniques for LSS decompression have been described over last decades. The surgical aim of treatment for symptomatic LSS is to relief of symptoms by adequate neural decompression while preserving much of the anatomy and the biomechanical function of the lumbar spine *(Försth et al., 2016)*.

For patients who were ineffective by conservative treatment, decompression of the neural elements by surgery such as laminectomy has been the treatment of choice. It is important that the whole length of the facetal joint complex is adequately decompressed. However, a standard wide decompression involves removal of the lamina and ligamentum flavum from the lateral border of one lateral recess to that of the other at the involved spinal levels, which will induce instability *(Ghogawala et al., 2016)*.

In this study, 55 patients were operated for multilevel LSS and 45 patients were operated for single level after being evaluated clinically and radiologically and after failure of conservative measures. For multilevel patients treated by decompression and fixation, there was a significant improvement of VAS for back pain postoperatively. To be considered that patients with multilevel LSS associated with severe back pain preoperatively were directed to fusion to be treated with laminectomy and fixation, while patients with mild to moderate back pain were directed to be treated by decompression alone surgery.

For multilevel LSS patients treated by decompression without fusion, there was a statistically non-significant difference of VAS back immediately post-operatively, while at 6 months postoperatively, there was a significant increase in back pain. For single level patients, there was non-significant improvement of VAS for back pain post-operatively with p value 0.332.

There was a significant improvement in back pain in patients treated by posterior decompression and spinal instrumentation and observed that postoperatively 83.33% of patients had no back pain, and occasional mild pain was seen in 16.66% of patients *(Kumar et al., 2019)*.

In this study, there was a significant improvement of leg pain in all patients treated by all included modalities, with no significant difference between them. *Nath et al (2012)*, showed that most of the patients (87.5%) had presented with posture related severe leg pain. All patients had preoperatively claudication distance less than100 m, but 93.75% patients had normal gait with walking distance more than 500m and no claudication symptoms postoperatively. 93.74% patients had abnormal straight leg raising test, but postoperatively all patients had normal straight leg raising test.

In this study, there was a significant improvement of ODI by 6 months postoperatively, with no significant difference between patients treated by decompression and fixation and patients treated by decompression alone, However the overall satisfaction in the fusion cases was better, because the element of back pain was more prominent beside the leg pain preoperatively, while the other patients the leg pain was the main complaint preoperatively.

Airaksinen et al. (2010) conducted a retrospective review of surgical outcomes for LSS. Of the 497 patients, 438 were available for follow up at a mean of 4.3 years. The ODI was used as an outcome measure. Overall, there were good or excellent results in 62% of patients.

In this study, the age had no significant effect on surgery with no statistically significance difference between the mean of age between the patients. Also, there was no significant difference between fusion cases and the other cases treated by decompression alone regarding post-operative hospital stay. Seven patients in this study had unintended dural tear which was repaired intraoperatively and caused no subsequent sequelae, one patient had a superficial surgical site infection on the 3rd day postoperatively which required parentral antibiotics. There was no significant difference regarding surgical modalities.

In the study of *Duan et al. (2016)*, overall intraoperative and postoperative complications occurred in 7.1% in the decompression group, whereas in 15% in the fusion group.

In the study of *Kumar et al. ((2019)*, complications were found in 12.5%. Of those, 8.33% had dural tears and 4% had wounf infection.

CONCLUSION

All included surgical modalities for LSS decompression improved the element of leg pain with the advantage of instrumented fixation in improving back pain.

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الوسائل الجراحية في حالات ضيق القناة الشوكية القطنية

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خلفية البحث: تضيق العمود الفقري القطني هو أحد أكثر حالات العمود الفقري شيوعًا عند البالغين.

الهدف من االبحث: تقييم الأساليب الجراحية المختلفة لتضيق العمود الفقري القطني التنكسي.

المرضي و طرق البحث: كانت هذه دراسة على مدى عامين من نوفمبر 2018 إلى نوفمبر 2020 على 100 مريض يعانون من تضيق القناة القطنية الخاضعين للجراحة والمتابعة. أجريت الدراسة بمستشفيات الأزهر الجامعي والدعاة ودار الشفاء. تم تقييم الحالة العصبية قبل الجراحة والفحص بعد الجراحة.

نتائج البحث: لم يكن هناك فرق معنوي في تحسين آلام الساق بينما كان هناك فرق معنوي في تحسين آلام الظهر لدى المرضى الذين عولجوا باستئصال الصفيحة الفقرية والتثبيت.

الإستنتاج: جميع الطرق المتضمنة حسنت عنصر آلام الساق مع ميزة التثبيت في تحسين آلام الظهر.

الكلمات الدالة: الوسائل الجراحية، ضيق القناة العصبية.