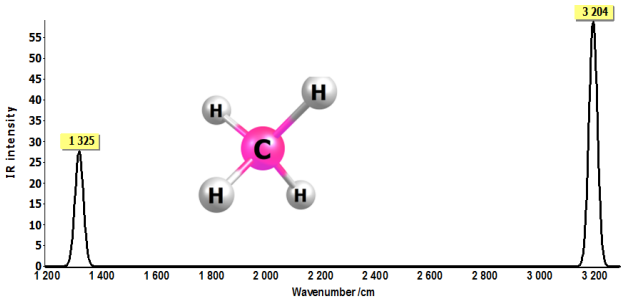
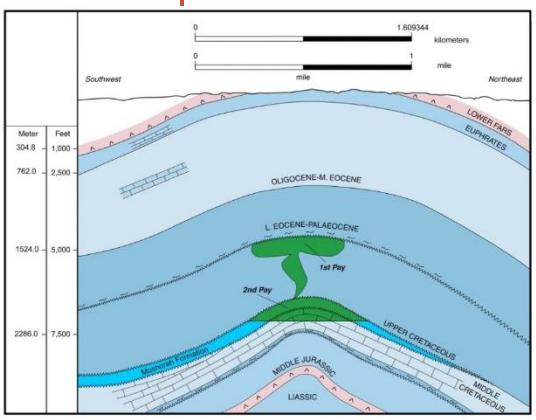
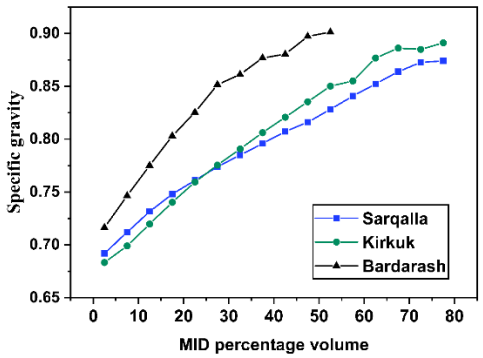
JOURNAL OF ZANKOY SULAIMANI

AUTHOR'S COPY

Part -A- (Pure and Applied Sciences)
VOLUME 25 ISSUE 1 June 2023
ISSN: 1812-4100
www.jzs.univsul.edu.iq







Journal homepage www.jzs.univsul.edu.iq
Journal of Zankoy Sulaimani
Part-A- (Pure and Applied Sciences)
ISSN:1812-4100

The outcomes of flavectomy with foraminotomy versus hemilaminectomy with foraminotomy in patients with lumbar neurogenic intermittent claudication: A comparative study in Sulaimaniyah, Kurdistan region, Iraq

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Article info

Original:
Revised:
Accepted:
Published online:

Keywords:
Lumbar spine stenosis, intermittent neurogenic claudication, flavectomy, foraminotomy, hemilaminectomy

Abstract

Background: The main prominent and classical symptom of lumbar spinal stenosis is intermittent neurogenic claudication, which is characterized by pain, aching, cramping, and paresthesia in the lower extremities induced by standing, walking, and back extension. Surgical decompression is the best choice when conservative methods fail. There are various decompressive techniques have been introduced, among them flavectomy with foraminotomy (F/F) and hemilaminectomy with foraminotomy (H/F). **Objectives:** To compare the outcomes of F/F versus H/F, in patients with neurogenic claudication and to determine the predictors that may interfere with the outcomes. **Materials and methods:** Twenty-one patients with lumbar spinal stenosis having neurogenic claudication were divided into two groups sequentially. The first group (n=10) underwent F/F, and the other group (n=11) underwent H/F. Follow-up was done in the first and sixth months postoperatively for postoperative complications, Oswestry disability index (ODI), claudication distance, and patients' satisfaction regarding symptoms. ***Results:*** In the last follow-up, the first group, after F/F, showed improvement in walking distance as 80% reported unlimited,10% improved with >1500 m, and 10% less improved with 500 m. These cases got lesser ODI scores and mostly were <10% despite one case remaining with moderate disability. Patient satisfaction rates were higher but not significant. While those who underwent H/F, nearly 40% showed unlimited walking distance, 45% improved with >1000 m, the remaining reported less improvement, and one remained with <100 m walking distance. Their ODI scores were higher than the previous group, mostly >10%, and 2 cases remained with moderate disability and complained of remaining back ache and leg paresthesia while improving in walking distance. **Conclusions:** both surgical procedures showed benefits in treating lumbar spinal stenosis, but F/F is better than H/F due to its high success and patient satisfaction rate. It can significantly improve a patient's quality of life by increasing postoperative walking distance, resolving neurogenic claudication, reducing ODI score, and relieving back pain, lower limbs pain, and paresthesia postoperatively. The increase in age is associated with less improvement after both procedures.

Introduction

The main prominent daily life-affecting classic symptom of lumbar spine stenosis is intermittent neurogenic claudication or pseudo claudication, which consists of symptoms including pain, aching, cramping, and paresthesia in the lower extremities induced by standing, walking, and back extension, usually in advancing spinal stenosis (1).
The spine extension and axial loading further narrow the central and lateral canals. Patients with symptomatic lumbar spinal stenosis may have neurogenic claudication, nerve root compression, central lower back pain, and non-radicular referred lower limbs pain. Reduction in walking tolerance (decrease in walking distance) because of neurogenic claudication is often the reason for seeking medical intervention, mainly in the aged group (2).
The exact cause behind neurogenic claudication is vague. Still, the vascular effect has been hypothesized that it is related to pressure on the venules surrounding the nerve roots, leading to engorgement and ischemic nerve impairment. In contrast, others stated that mechanical compression is a cause of intermittent neurogenic claudication (1,3).

Usually, there is a female predominance, and the symptoms like aching, heaviness, numbness, and paresthesia in the lower extremities, which often start after standing up or walking for more than five minutes, and it is improved by sitting, squatting, or leaning against a wall to flex the spine. The patient may prefer walking uphill rather than downhill because the first flex the spine (and increases the spinal canal), and the latter extends it (4). The diagnosis of lumbar spine stenosis is based on the patient's presenting signs and symptoms, clinical examination, and sets of radiological and electrodiagnostic studies after excluding other differentials (5). The diagnostic and imaging tools used for diagnosis are plain radiographs of the lumbar spine (AP and Lateral views), Computed Tomography (CT) scan, myelography, and Magnetic Resonance Imaging (MRI) which is considered a gold standard in this field (6).

Regarding the treatment of lumbar spine stenosis, there is a wide range of conservative measures like pharmacotherapy, muscle strengthening exercises, physiotherapy, aerobic fitness, activity modification, and epidural steroid injection. Still, they are not entirely successful in relieving symptoms and lifestyle improvement, according to the recent Spine Patient Outcomes Research Trial (SPORT) (7, 8).

If the conservative methods fail, the surgical option includes various decompression techniques and procedures ranging from standard open to minimally invasive and endoscopic techniques. Among these procedures, flavectomy with foraminotomy (F/F) or bilateral decompression through unilateral or bilateral laminotomy is one of the less invasive techniques that have the added benefit of minimizing paraspinal muscle disruption on the ipsilateral side with a small incision and blood loss (9-12). On the other hand, H/F is more invasive than F/F; but less invasive than interlaminar decompression, as it preserves the spinous process and interspinous and supraspinous ligaments (11-13).

In this study, we aimed to compare F/F and H/F to determine the outcomes of patients with lumbar spinal stenosis having neurogenic claudication and to evaluate the predictors that may interfere with the outcomes.

Materials and Methods

Sample size and study setting

Between December 2021 to August 2022, this prospective single-center study was conducted at Zhyan Private Hospital, Sulaimaniyah, Iraq, on twenty-one patients aged >40 years, regardless of gender.

Inclusion criteria

Patients with two or more levels of lumbar spinal stenosis confirmed by MRI, corresponding to the radicular symptoms, those with intermittent neurogenic claudication, walking distance <250 m, and those with these symptoms >3 months with failure of conservative measures were enrolled in this study.

Exclusion criteria

Patients were excluded if they had mechanical instability, previous spine operation, vascular claudication, also those with diabetes mellitus for >10 years, neuromuscular disorders, other causes that affected their gait and posture such as severe arthritic change of hip joint, and other causes of stenosis like congenital, traumatic, neoplastic, and deformity (scoliosis).

Ethical considerations and patient consent

Ethics approval from the Ethics and Scientific Committee of the College of Medicine, University of Sulaimani, was obtained (No. 14 on 06/02/2022). The informed consent was taken from each patient to participate in this study. At the same time, they felt free to quit whenever they preferred.

Study protocol

A thorough history and physical examination were performed for involved patients preoperatively. Patient's information would include ID, residency, occupation, gender, age, body mass index (BMI) before the operation, social history, their chief complaint, and duration of their symptoms including such as limited walking distance, lower limbs pain, or paresthesia and lower back ache, any other comorbidities and chronic illness if present were recorded. Furthermore, a preoperative neurological examination focused on the lower extremities' motor reflexes, sensory analysis, and sphincter function. Then, the Oswestry disability index (ODI) questionnaire was used; that contains ten sections, each with six statements scoring from zero to five, related to impairments and disabilities like pain, personal care, standing, sitting, lifting, walking, sleeping, social life, sex life and traveling. The percentages of disability were interpreted and classified as; 0–20%: minimally disabled, 21-40%: moderate disability, 41-60%: severely disabled, 61-80%: crippled, and 81-100%: bed bound (14, 15).

Next, the patient’s diagnosis was confirmed by MRI imaging, revealing central, lateral recess, and/or foraminal lumbar stenosis that corresponds to the radicular symptoms, lateral flexion and extension views, and CT scan for selected cases (if any bone pathology is suspected) was taken. The surgical options were taken according to having neurogenic claudication and radiculopathy that reduced the walking distance and the patient’s quality of life, neurological deficit, and/or failure of other conservative methods.

Study procedure

The selected confirmed cases were categorized into two groups sequentially, in a manner that the first patient got type 1 operation (F/F) and the second patient underwent type 2 operation (H/F).

Surgical Technique and Approach

Patients were operated on in a prone position and received general anesthesia. The confirmation of the levels to be operated on was done by intraoperative fluoroscopy. In both operations done through a midline incision, posterior elements (spinous process, supraspinous, and interspinous ligament) are preserved, and surgical loupes are used for field magnification. Patients received perioperative one-dose intravenous antibiotic prophylaxis and repeated as required postoperatively.

Flavectomy with Foraminotomy (F/F)

The paraspinal muscle is elevated from the spinous process and lamina from the affected side to the facet joint level, but the capsule and muscle attachments are preserved. The rostral and caudal laminae were minimally reduced, and the ligamentum flavum was removed starting from the midline toward the lateral direction (flavectomy). With care to the neural elements, decompression is completed by undercutting resection of the facet joint medially (up to <50% in case of unilateral decompression and <30% in bilateral decompression) and neural foramen (foraminectomy). In the case of bilateral stenosis, the contralateral side was decompressed using the "over-the-top technique" by tilting the operating table away from the surgeon and changing the angle of the lens for exposure of the contralateral ligamentum flavum and the facet joint. The base of the spinous process and inner cortex of the contralateral lamina are removed then ligamentum flavum resected with a Kerrison rongeur until the contralateral pedicle, and lateral border of the dural sac are identified. The decompression of the contralateral side down to the neural foramen over the top of the dural sac was completed.

Hemilaminectomy with Foraminotomy (H/F)

Paraspinal muscle was dissected down and reflected on the side of decompression. Williams's hemilaminectomy retractors were introduced as needed for visualization. Dissection continued to the base of the spinous process, lamina, and medial facet on the side of the hemilaminectomy. The hemilamina and lateral recess were drilled and removed then ligamentum flavum were resected completely on that side. The hemilaminectomy was then carefully expanded, and foraminotomy was performed using Kerrison rongeurs. The exiting nerve root was visualized, and the foramen was palpated. In the case of bilateral decompression, an "over-the-top technique" was used, as mentioned above.

Wound irrigation and closure by layers done after proper hemostasis without drains are used in both operation types. Ambulation is done with a lumbar brace, and they were discharged from the hospital the day after surgery after giving instructions for postoperative care and rehabilitation. Patient follow-up was done at the first and sixth months postoperatively, assessing for postoperative complications, filling the ODI for each patient, and taking out the score. Then, they were asked for claudication distance and their satisfaction level regarding preoperative symptoms (pain and paresthesia).

Statistical analysis

Data collection, data entry, and questionnaire coding were done; firstly, data entry was performed on Microsoft Excel 2010, then statistical analysis was performed by IBM SPSS program version 26. The frequencies were obtained from descriptive statistics in the SPSS program. The quantitative and scale data were analyzed using the ANOVA test, while the analysis of the categorical variables was performed using the Chi-square test after cross-tabulation.

Results

In this study total of 21 patients were included with lumbar spine stenosis having symptoms of neurogenic claudication not improving with the conservative measures were divided into two groups sequentially; 47.6% (n=10) patients underwent type 1 operation F/F and 52.4% (n=11) patients underwent type 2 operation H/F. The age of the patients ranged from 41 to 70 years, with a mean of 56 years. Males were 38.1% (n=8), and females were 61.9% (n=13). The duration of their symptoms at the time of presentation was from 3 months up to 5 years, with a mean of 20 months. Nearly 71% (n=15) had back pain, and 95% (n=20) had pain and paresthesia in lower limbs (radiculopathy), which was mainly to the left side, followed by bilateral and then right side radiculopathy. In comparison, 6 patients (28%) had radiculopathy in lower limbs without back pain (Table 1).

Regarding examination at the time of presentation, 18 patients (86%) showed positive for the straight leg raising test, 16 patients (76%) showed sensory disturbances in lower limbs, mostly in L4, L5, and S1 dermatomes. Furthermore, 9 patients (42.8%) showed lower limb weakness in motor examination (7 cases were grade 4 MRC scale, and only 2 were grade 3). In addition, half of the patients (n=10) had decreased knee and ankle reflexes, and only one had bladder sphincter dysfunction. Diagnosis by clinical assessment and imaging revealed that among 48 patients with stenosis, 43.7% were L4-5, 33.3% with L3-4, 12.5% with L5-S1, and 10.4% with L2-3.

Table 1. The demographic data and patients' characteristics with their effect on the outcome.

Variable	Characteristic	Frequency	Percentage	P-value
Age (Year)	Median ± SD=56 ± 9.0	-	-	0.05*
Gender	Male Female	8 13	38.1 61.9	0.80
Body Mass Index (BMI, kg/m^2)	Normal (18.5-24.9) Overweight (25-29.9) Obese (30-39.9)	5 10 6	23.8 47.6 28.6	0.39
Comorbidity	No Diabetes mellitus (DM) Hypertension (HTN) DM + HTN DM+HTN+Hypothyroidism	10 3 5 2 1	47.6 14.3 23.8 9.5 4.8	0.647
Symptoms	Lower limb pain Lower limb paresthesia Back pain	20 20 15	95.2 95.2 71.4	0.317
Duration	<6 months >6 months	8 13	38.1 61.9	0.15
Stenosis level	L3/4/5 L2/3/4/5 L4/5- S1 L3/4/5-S1	10 5 5 1	47.6 23.8 23.8 4.8	0.55

*Significant difference

The outcomes of the patients postoperatively were assessed by ODI score, claudication distance, and patient's level of satisfaction in 1st and 6th month postoperatively, compared with the preoperative records. The ODI interpretation before the operation indicated that ten patients (47.6%) showed moderate disability, 9 patients (42.9%) showed severe disability, and two patients (9.5%) were crippled. While at one month postoperative, 11 patients (52.4%) showed minimal disability, and 10 patients (47.6%) showed moderate disability. At the last follow-up, only 3 patients (14.3%) remained with a moderate disability; the rest had minimal disability or scores below 10%. (Table 2 and Figure 1).

Table 2. The Oswestry disability index in patients postoperatively after 1st and 6th months compared with preoperative records in both operation types.

Oswestry Disability Index (ODI)		Operation Type		Total
		Flavectomy with Foraminotomy	Hemilaminectomy with Foraminotomy	
Preoperative Score	**Mean**	43.5	45.0	44.3
	SD	13.3	10.2	11.5
	No.	10	11	21
Postoperative 1-month score	**Mean**	19.4	20.2	19.8
	SD	8.7	5.6	7.1
	No.	10	11	21
Postoperative	**Mean**	13.8	16.3	15.1

6 months score	**SD**	6.8	6.0	6.4
	No.	10	11	21

The comparison between patients' outcomes with respect to operation types showed differences (P<0.001) between them; the lower ODI scores were by patients who underwent type 1 operation (F/F).

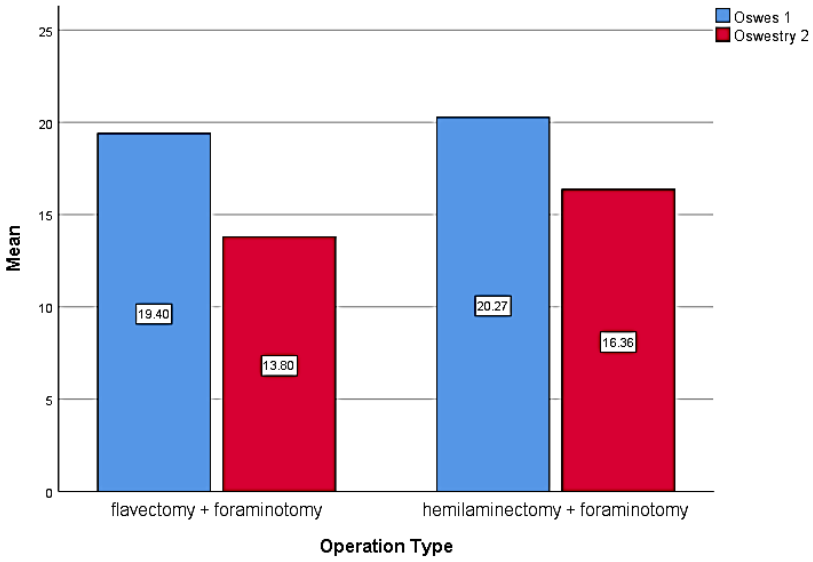

Figure 1. Shows the comparison between ODI scores according to operation type in 1st and 6th month. Oswestry 1 = ODI score in one-month postoperative, Oswestry 2 = ODI score in six months postoperative.

The outcome regarding claudication distance showed a noticeable improvement in pre and postoperative measurements. Thirteen patients (61%) had unlimited walking distance or >2500 m in the last follow-up, and only 9.5% (n=2) had <500 m walking distance at the same follow-up time. While at a one-month follow-up, 28.5% of patients (n=6) had an unlimited walking distance, and 23.8% (n=5) were <500 m. There was a significant difference (P<0.001) between the two operation types (Table 3 and Figure 2), and there was a greater improvement in walking distance in cases that underwent type 1 operation (F/F).

Table 3. The claudication distance in patients postoperatively after 1st and 6th months compared with preoperative records in both operation types.

Walking Distance (m)		**Operation Type**		**Total**
		Flavectomy with Foraminotomy	**Hemilaminectomy with Foraminotomy**	
Preoperative	**Mean**	85.0	61.3	72.6
	SD	49.0	52.8	51.2
	No.	10	11	21
Postoperative One month	**Mean**	1870.0	950.9	1388.5
	SD	768.9	920.4	954.4
	No.	10	11	21
Postoperative Six months	**Mean**	2300.0	1578.1	1921.9
	SD	632.4	958.9	881.0
	No.	10	11	21

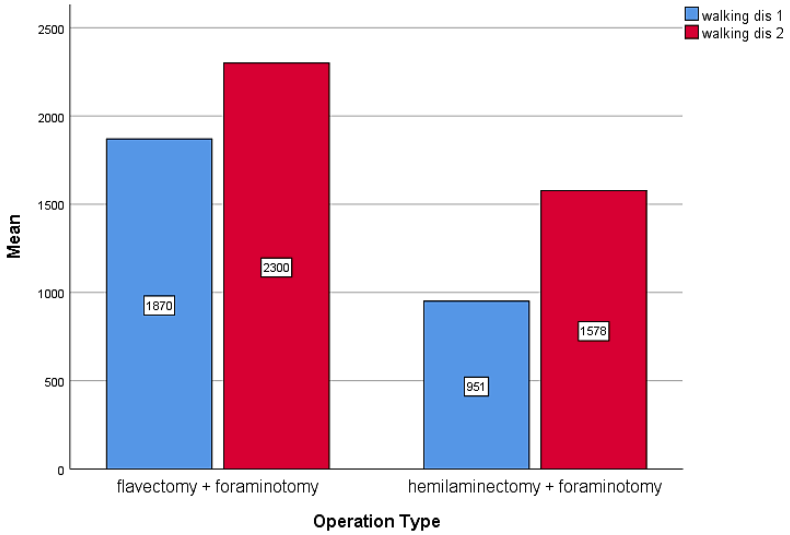

Figure 2. Shows the comparison between the operation types' walking distance improvement in the 1st and 6th months. Walking distance 1= the 1st month postoperative, and Walking distance 2= the 6th month postoperative.

Patients' level of satisfaction regarding the symptoms, including neurogenic claudication, pain, and paresthesia, was at a high level in both operation outcomes postoperatively but without significant differences between them (P=0.317) (Table 4).

Table 4. Patients' level of satisfaction regarding the improvement of the symptoms postoperatively.

Patient's level of satisfaction (Symptoms improvement)			Operation Type		Total
			Flavectomy + Foraminotomy	Hemilaminectomy + Foraminotomy	
Post Operation-One month	Not Relived	Count	0	1	1
		Within Operation Type	0.0%	9.1%	4.8%
	Better	Count	7	8	15
		Within Operation Type	70.0%	72.7%	71.4%
	Relived	Count	3	2	5
		Within Operation Type	30.0%	18.2%	23.8%
Post Operation-Six months	Not Relived	Count	1	1	2
		Within Operation Type	10.0%	9.1%	9.5%
	Better	Count	3	6	9
		Within Operation Type	30.0%	54.5%	42.9%
	Relived	Count	6	4	10
		Within Operation Type	60.0%	36.4%	47.6%
Total		Count	10	11	21
		Within Operation Type	100.0%	100.0%	100.0%

In the current study, there was a linear correlation between the age of the patients and poor outcomes in both types of operations; patients >60 years had a lesser response to the surgeries and got higher ODI scores during the last follow-up session (P=0.05) (Table 5). On the other hand, the factors like gender, BMI, duration of symptoms preoperatively, number of stenosis levels, and presence of comorbidities (like diabetes mellitus, hypertension, and hypothyroidism) had no significant effect (P>0.05) on the outcome and patient's level of satisfaction in both types of operation.

Table 5. The age classes and their ODI score in the 6th month postoperative.

ODI score (6th month)	Age Group (Year)			Total
	40-50	51-60	61-70	
Mean	11.8	12.3	19.2	15.14
SD	3.1	2.5	7.7	6.413
No.	6	6	9	21

In another aspect, all cases were free from intra/postoperative surgical complications (like bleeding, dural tear, and spine segment instability), except three patients (two of them had diabetes) found to have surgical site infection (superficial infection) during 1st month of follow-up postoperatively (n=2 in F/F group and n=1 in H/F group). No complications were found in any of the patients during the last follow-up.

Discussion

Surgical decompression is highly recommended for the treatment of symptomatic lumbar spinal stenosis when conservative methods fail, especially in the elderly population (9). Weinstein *et al*. (2010) (16), in their prospective SPORT study of 654 cases, declared that patients with symptomatic spinal stenosis treated surgically compared to those treated conservatively showed greater improvement in pain and function through 4 years. Our results demonstrate that patients distinctly benefitted from both surgical procedures. Both surgical options provide functional improvement and a high patient level of satisfaction. At the last follow-up interview, only 3 patients showed moderate disability by ODI score, and 2 of them had walking tolerance <500 m.

The patient's baseline characteristics in our study, regarding age, were older than Nath et al., 2012 (17), 45.1 years, and younger than the Finnish study, 61.6 years (18). In addition, there was a female predominance of 61.9% in our study, nearly the same as reported by other studies (12, 18, and 19).
All patients in our study had neurogenic claudication and limited walking distance with other symptoms like back pain, lower limbs radiculopathy, and sensory and/or motor dysfunction. In this regard, the exact spinal stenosis symptoms and physical function were found by Nath et al., 2012 (17)**,** which were back pain (71.8%), leg pain (87.5%), and claudication distance < 100 m. with positive straight leg raising test (93.7%), sensory disturbance in lower limbs (62%), and motor weakness (46.8%). Nearly the same values as in our study. Despite that, the physical findings improved in their research but remained the same in 2 cases in our study. The stenosis level by imaging and clinical correlation revealed L4-5(43.7%), followed by L3-4(33.3%), L5-S1(12.5%), and L2-3 (10.4%), which are consistent with other studies (12,16).
In general, spinal stenosis treatment aims to improve function and symptoms through various decompression techniques. So, it's thought that the most effective evaluation of the treatment results for spinal stenosis is a functional improvement (20). In the current study, although the decompression was more complete in H/F than in F/F, the neurologic improvement was not better than that after F/F. However, at the final follow-up, the back and leg pain and the leg numbness were eliminated or improved, the leg weakness resolved or improved, the neurogenic claudication improved ratios along with claudication distance, and ODI scores were even better after F/F than those after H/F. Despite that, in both techniques, the posterior elements were preserved. Still, more bone debulking, skin incision, blood loss, and hematoma formation in hemilaminectomy may cause remaining back pain in those patients who undergo this type of operation, as declared by Muting et al., 2015 (12) also. Moreover, a minimal removal decompression as in F/F preserves the structural integrity of the lumbar spine and minimizes alterations to segmental motion than hemilaminectomy, as reported by Rahim et al., 2010 (11) though, in our study, the cases were free from postoperative instability.

In their prospective study, Fu et al., 2008 (9) revealed the same results while comparing a minimal removal decompressive procedure "Windows technique" to traditional laminectomy in 152 patients in all aspects regarding ODI score, VAS for back and leg pain, and claudication distance. In the laminoforaminotomy group, at the final evaluation (2 years), the overall results were good to excellent in 89% (68/76) of the patients, fair at 11% (8/76), and poor at 0.0%. In the laminectomy group, at the final evaluation, the overall results were good to excellent in 63% (48/78) of the patients, fair in 30% (23/76), and poor in 7% (5/76). They started with a good to excellent outcome was described as absent or mild back and leg pain. Additionally, claudication tolerance was >1 mile or 20 minutes, and they hadn't restrictions in usual activities. A fair result implied persistent mild back or leg pain with occasional moderate pain and less than 1 mile or 20 minutes of ambulation ability. They had mild restrictions on their physical activities. A poor outcome implied little to no pain relief from surgery, activity restrictions, or both.

Muting et al., 2015 (12) compared four decompressive techniques for lumbar spinal canal stenosis in a multicenter review study based on Spine Tango Registry; they revealed that after 12 to 24 months of follow-up, none of the treatment choices was definitively superior to the another. However, in 642 patients who underwent laminotomy and 196 patients that underwent hemilaminectomy, the weighted Core Outcome Measure Index COMI score improvement in the hemilaminectomy group had significantly lower improvement in comparison with laminotomy (P=0.027), laminotomy was more recommendable than hemilaminectomy for minimum relevant pain relief. The latter was more associated with non-relieved back and leg pain postoperatively.

Yukawa et al. (2002) (21) observed 62 patients with lumbar spinal stenosis having neurogenic claudication prospectively for two years after surgical decompression. The mean preoperative scores on the ODI and visual analog pain scale were 58.4 and 7.1, respectively. Postoperatively, these scores decreased to 21.1 and 2.3, respectively, and both were significant ($p<0.05$). About 58 patients (94%) had positive provocation of symptoms on treadmill tests preoperatively, whereas only 6 patients (9.6%) remained with positive tests postoperatively.

In the last follow-up in our study after F/F, improvement in walking distance was the most dramatic and significant benefit of the reported procedure, of which 80% reported unlimited,10% improved with >1500 m, and 10% less improved with 500 m. These cases got lesser ODI scores (<10%), although one remained with moderate disability. Patient satisfaction rates were higher but were not significant. While 40% of those who underwent H/F showed unlimited walking distance, 45% improved with >1000 m, the remaining reported less improvement, and one remained with <100 m walking distance. Their ODI scores were higher than the previous group (>10%), and two cases stayed with moderate disability and complained of remaining back aches and leg paresthesia while improving walking distance. These results are consistent with the above studies (9, 12, and 21).

Patients in our study were highly satisfied after both types of operations; 71% encountered them self as "better," 23% as "relieved" from the baseline symptoms at the 1st-month follow-up, and the rest were dissatisfied. In comparison, at the 6th-month follow-up, 43% stated "better," 47% as "relieved," and 10% were dissatisfied with the outcomes. Thornes et al., 2011 (22) revealed in their study that approximately 76% of the patients at 3 months and 70% at the last interview after 12 months regarded themselves as highly satisfied with the operation outcome. On the other hand, Sinikallio et al., 2007 (18) concluded that 66% of patients were satisfied and 34% were dissatisfied with the surgery outcomes.

Factors like gender, BMI, duration of symptoms preoperatively, presence of comorbidities, and the number of stenosis levels do not affect the outcome of our study. Still, the Patients in older age groups were lesser satisfied with the operation outcome and had higher ODI scores (p=0.05). This is consistent with the study of Yamashita K. et al., 2006 (23) that declared elderly patients in their study had poor outcomes after

laminotomy regarding symptoms of back pain, leg pain, leg numbness, and walking difficulty (P≤0.008). Meanwhile, Yukawa et al. (2002) (21) declared that the stenosis levels were irrelevant to the surgical outcome, and Thornes et al., 2011 (22) showed that gender has no significant effect on the patient's outcome postoperatively.

Conclusions

Surgical decompression is the best treatment for lumbar spinal stenosis to improve functional outcomes in patients with symptoms of neurogenic claudication and limited walking distance when conservative methods fail. F/F and H/F are both beneficial in treating lumbar spinal stenosis and provide functional improvement and high patient satisfaction. F/F is better due to its high success and lower complication rate. It can significantly improve a patient's quality of life by increasing postoperative walking distance, resolving neurogenic claudication, reducing ODI score, and satisfying a significant proportion of cases in terms of eliminating or relieving back pain and lower limbs pain, and paresthesia postoperatively. Age inversely impacts the outcome of surgery, while factors like gender, BMI, duration of symptoms preoperatively, number of stenosed levels, and presence of comorbidities had no significant effect on the functional outcome and patients' level of satisfaction postoperatively.

Acknowledgments

The authors appreciate the health staff from Zhyan Private Hospital, Sulaimaniyah, Iraq, for their kind help and support to this study.

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