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Prospective Study on the Treatment of Degenerative Lumbar Spinal Canal Stenosis: Surgical Versus Conservative Intervention

By

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Keywords

- Degenerative lumbar spinal canal stenosis,
- Physical rehabilitation,
- Decompressive surgery
- Exercise therapy

Abstract

Background: The treatment decision of patients with moderately severe cases of degenerative lumbar spinal canal stenosis (LSS) whether conservative or surgical is highly dependable on physician evaluation without clear standards. The purpose of this study is to evaluate the effectiveness of conservative treatment of patients complaining of moderately severe degenerative LSS in comparison with surgical intervention throughout one year follow up. The present study was conducted on 60 patients with LSS: 30 patients treated with rehabilitation program and 30 patients treated with decompression surgery. All patients were assessed for pain and physical function before treatment, 3 months, 6 months and 12 months after treatment. **Results:** Both groups showed significant improvement of Oswestry Disability Index (ODI), ODI walk, and Zurich Claudication Questionnaire (ZCQ) symptoms and function subscales at 3, 6 and 12 months after treatment compared to baseline. However, at 1 year, the most patients of the conservative group did not maintain improvement in ODI and ZCQ subscales scores. The beneficial effect of operative treatment sustained throughout the 1-year follow-up. No serious complications were encountered in conservative group but, there were two patients in surgical group had serious complications. **Conclusion:** The conservative treatment yielded statistical significant improvement among patients with moderately severe LSS for three, six and twelve months follow up compared to baseline. Nonetheless, at all follow-up end points, the surgical group outperformed the conservative group statistically.

INTRODUCTION

Degenerative Lumbar spinal stenosis (LSS) is an anatomical impairment characterized by narrowing of central lumbar spine and nerve root canals, resulting in compression of the vascular and neural structures within the canals, that may be a widespread and disabling musculoskeletal disease [1]. This degenerative process is started by disc dehydration and bulging, causing disc space narrowing, and overstressing on the facet joints. This can produce facet joint cartilage degeneration and osteophyte formation. Such degenerative changes often produce central and lateral canals stenosis, which can lead to vertebral displacement and thus to degenerative spondylolisthesis. These stenotic changes can produce neural compression that cause variable degrees of back and leg pain, numbness, weakness and neurogenic claudication [2]. Lumbar spinal stenosis is classified into mild, moderate and severe grades according to clinical or radiological classification [3, 4].

Disability of patients with LSS are also classified according to Oswestry Disability Index with score (ODI) [5]. Mild cases are usually characterized by only neurogenic claudication while severe cases are complicated by paresis [3]. Lines of treatments for LSS are surgical or conservative. The conservative treatment as medical treatment, physical rehabilitation or epidural injection, is principally aimed at decreasing the clinical manifestation and may bring long term relief [6]. Exercise is a core part of physiotherapy program that enhances self-management. It decreases lumbar lordosis, promotes the spine flexibility and combats the psychological and physical effects of deconditioning related to pain and functional

restrictions [7]. If therapeutic ultrasound added to exercise program, the need of analgesics will decrease. This is important for the decrease of adverse effects of chronic analgesic intake and the cost of long-term treatments [8]. The other line of treatment of LSS is surgical decompression that is effective as it results into decompressing the nerve roots, vessels, and dura matter [9]. Complication rates for surgery range from 14% to 35% or more. These complications include wound infection, thromboembolic complications, dural injury, epidural hematomas, instability, reoperation and inadequate decompression with residual stenosis [10]. Based on the fact that patients with mild stenosis undergo the conservative treatment, while those with severe stenosis undergo the surgical treatment, comparisons between surgical and conservative treatments are complicated [6]. On the other hand, moderate and moderately severe cases still represent a matter of an argument for such cases and the treatment decision depends on patient's degree of pain and surgeon's opinion without clear standard for treatment [6, 11]. In this paper we argue that proper conservative therapy will be beneficial in reducing the percentage of patients receiving the surgical solution before making immediate decision of surgical treatment.

Aim of the work:

The purpose of this study is to evaluate the effectiveness of conservative treatment of patients complaining of moderately severe degenerative LSS in comparison with surgical intervention throughout one year follow up.

Methods

(I) Study Design:

Randomized comparative clinical trial.

(II) Patients:

Between September 2017 and May 2019, a total number of 200 patients with low back pain and characteristic neurogenic claudication (pain and/or discomfort with walking or prolonged standing that radiates to one or both lower extremities and relieved by rest or lumbar flexion) were clinically diagnosed as degenerative LSS [12]. These patients were recruited from the outpatient Clinic of Neurosurgery department and the diagnosis was confirmed by MRI imaging [13]. Those who met the inclusion criteria were selected. Conversely, those who did not meet inclusion criteria or met the exclusion criteria were excluded. The inclusion criteria included: Patients aged 50 years or older, moderately severe disabled patients according to Oswestry Disability Index with score (ODI) ranging from 30 to 50 [5], more than 3-months-history of intermittent neurogenic claudication without sphincteric disturbances with unremarkable neurologic deficit and narrowed lumbar spinal canal confirmed by MRI. While the exclusion criteria were: Patients with vascular claudication (in which lower extremity pain was not affected by posture and starting from distal to proximal and characterized by loss of pulsation), patients with progressive neurologic deficit or Cauda Equina syndrome, severe spinal stenosis (ODI more than 50), severe osteoporosis or metastasis to the vertebrae, previous laminectomy operation and history of spinal fracture.

Sample size: Convenient sample from the Neurosurgery outpatient Clinics of our hospital were assessed for eligibility to participate in this study.

Randomization: Sixty patients who met the inclusion criteria were randomly allocated into 2

treatment groups. For assigning groups; pieces of paper were prepared as the same number of patients. The name of treatment methods was written on the pieces of paper. Then each patient was asked to take one paper that showed the treatment type specified for him. As a result we had two treatment groups: figure 1

(1) Surgical group: Thirty patients received decompressive surgery.

(2) Conservative group: Thirty patients received physical rehabilitation and medical treatment.

Ethical Approval: The study protocol was reviewed and approved by the local committee for medical research, MFM-IRB (code: MS/16.05.53). Informed written consents were provided by all patients sharing in the study.

This study adheres to CONSORT guidelines and include a completed CONSORT checklist as an additional file.

All patients were subjected to the following:

I History and clinical examination: Spinal examination (spinal mobility, deformity) and special tests such as straight leg raising test and Schober's test. Neural examination (muscle power grading of the lower limb, pinprick sensation testing in the dermatomes of the lower limb and testing for reflexes at the lower limbs).

II Assessment of pain and function

Patients were assessed before treatment, 3 months, 6 months and 12 months after treatment by Visual analog scale (VAS), Oswestry Disability Index (ODI) and Zurich Claudication Questionnaire (ZCQ).

A) **Visual analog scale (VAS)** [14]: was a validated, subjective measure for pain.

Scores were registered by making a mark on a 10-cm line that reflected a spectrum between “no pain” and “worst pain.”

B) Oswestry Disability Index (ODI):

It was a self-administered questionnaire composed of 10 sections; each section was scored on a 0–5 scale. Five on the scale was representing the greatest disability. It was calculated by dividing the summed score by the total score, then it was multiplied by 100 and expressed as a percentage. For the not answered questions, the denominator was decreased by 5 for each [5].

Interpretation of scores: 0% to 20%: (minimal disability), 21%-40%: (moderate disability), 41%-60%: (severe disability), 61%-80% (crippled) and 81%-100%: (bed-bound). ODI responder was defined as patient who achieved \geq 10-point improvement in ODI score after the intervention [15].

B) Zurich Claudication Questionnaire (ZCQ):

ZCQ, was a questionnaire that measures health status of LSS. It consisted of three subscales: symptom severity subscale, physical function subscale, and patient's satisfaction subscale. The score was calculated by the mean value of each of the subscales [16]. ZCQ responder was patient who achieved 0.5-point improvement in ZCQ symptom severity and physical function subscales [17].

III Imaging

MRI was done to all patients and diagnosis of LSS was based on quantitative and qualitative criteria. The quantitative criteria included central canal stenosis with midsagittal diameter of dural sac $<$ 12 mm. And qualitative criteria included, the presence of disc protrusion,

absence of fluid around the cauda equine, lack of perineural intraforaminal fat, degeneration of facet joint, and ligamentum flavum hypertrophy [13].

Our patients in the conservative group received a comprehensive rehabilitation program that included medical treatment, physical therapy and exercise therapy.

1) Medical treatment:

Was in the form of combination of Acetaminophen 2 gm /day and non-steroidal anti-inflammatory drugs; Ibuprofen (maximal dose 2400 mg/day), or Diclofenac (maximal dose 150 mg/day) for 2 weeks. Anticonvulsant such as Pregabalin was added for one month with a maximal dose of 150 mg/day.

2) Physical rehabilitation Program:

The participants received three treatment sessions per week over 8-weeks period in the hospital. In the form of active and passive exercise plus continuous US on the lumbar paravertebral region, applied for 10 minutes of 1 MHz, 1.5 W/cm² intensity [8].

3) Exercise therapy included:

[1] Flexion Exercises [18]:

A) Posterior pelvic tilt: The patient was in supine position with knees flexed. He/ she was instructed to flex spine while pressing the lumbar spine against the supporting surface. (10 repetitions and hold time was 20 seconds).

B) Flexion in supine: The patient was in supine with knees flexed. He/ she was instructed to perform posterior pelvic tilt, then grasp behind one thigh and pull the knee to the chest. (10 repetitions and hold time was 10 seconds).The criteria for progression were represented by:

1- The ability of the patient to perform 10 repetitions of the exercise bilaterally

2- To do pelvic tilt in supine and to maintain posterior tilt while bringing knee to chest.

C) Flexion in sitting: The patient was in seated position with feet supported. Patient was instructed to flex forward, running the hands down the legs (10 repetitions and hold time was 5 seconds).

The ability of the patient to perform 10 repetitions of each exercise depended on if the patient would be able to progress to the next advanced one or not.

[2] Aerobic exercise and lower extremity flexibility exercises were:

1-Treadmill walking (for 20 minutes): The duration of walking was dependant on patient tolerance.

2- Lower extremity flexibility exercises for hamstring and hip flexors muscles. And strengthening exercises for gluteus medius and quadriceps muscles.

3- Closed chain exercise:

The patient was standing and he/she was instructed to do a half squat without spinal flexion or extension (3 sets of 20 repetitions, with each leg separately).

4- Home Exercise Program

All patients were asked to perform home exercise program five days per week for four weeks and each session was 1 hour. The program consisted of single knee-to-chest exercises, double knee-to-chest, thoracic extension, self-mobilization exercises, lumbar rotation stretching, iliopsoas self-stretching and lower abdominal and hip abduction strengthening exercises [19]. In The surgical group, patients stayed for only two days and then were asked to perform home exercises 10 days after the operation.

Patients in surgical group underwent open interlaminar decompression surgery by the same surgeon. The operation objective was to decompress the central canal, lateral recess and/or intervertebral foramina, via laminotomy, flavectomy, foraminotomy and/or discectomy according to individual cases [20, 21].

Statistical methods:

Data entry and statistical analyses were performed using SPSS Inc., Chicago, IL, USA for Microsoft Windows, version 21.0. The quantitative values were examined for normality of data distribution using Kolmogorov Smirnov test. Continuous normally distributed data were expressed in mean and standard deviation, while abnormally distributed data were expressed in median and range. For comparison between the two groups we used; Student unpaired T test for continuous normally distributed data and Pearson's chi-squared (χ^2) test or Fisher's exact test for comparing categorical data. Statistically significant difference between groups was considered when the probability (P) value less than or equal to 0.05.

Results

Table 1 shows the baseline characteristics of patients in each group. There were no significant differences between both groups regarding age, gender, duration of disease, occupation and medication for neurogenic claudication.

In table 2, there were no statistical significant differences between two studied groups with respect to symptomatology and clinical neurological findings. In the conservative group (30 patients with low back pain, 28 patients with leg pain, 30 patients with neurogenic claudication, 19 patients with positive schober test, 18 patients

with positive SLRT, 16 with positive Femoral Stretch test, 3 were with abnormal knee reflex, 3 were with abnormal ankle reflex and no patient with sphincteric disturbance.) in the surgical group (30 patients with low back pain, 30 patients with leg pain, 30 patients with sensory symptoms, 30 patients with neurogenic claudication, 14 patients with Schober test, 24 patients with SLRT, 11 with Table 4 shows significant improvement in symptoms severity and function subscales of ZCQ in the conservative group at 3, 6 months ($P < 0.001$) and at 1 year ($P = 0.001$) after treatment compared to baseline (mean difference of symptoms subscale: 1.26, 1.03 and 0.33 - mean difference of function subscale: 1.25, 1.02 and 0.32).

In the conservative group table 5 shows, that the assessment of ODI at 3 months, 6 months and 1 year after treatment demonstrated significant improvement compared to baseline (mean difference from baseline 13.0, 10.7, 4.13) ($P < 0.001$)

Table 6 shows that there was a significant improvement ($P = 0.006$) in surgical group compared to conservative one at 3 months with respect to ODI (mean \pm SD 23.6 \pm 3.5, 26.13 \pm 3.4 respectively). And a very significant improvement ($P = 0.01$) in surgical group regarding ZCQ symptoms, function and satisfaction scores (mean \pm SD: 1.97 \pm 0.41, 1.9 \pm 0.3, 1.97 \pm 0.4) compared

Femoral Stretch test, 3 patients with abnormal knee reflex, 9 patients with abnormal ankle reflex and no patient with sphincteric disturbance).

At baseline, table 3 shows that there were no statistical significant differences between the two studied groups regarding VAS, ZCQ symptoms severity subscale, ZCQ function subscale, and ODI (P were 0.711, 0.8, 0.8 and 0.7 respectively).

to conservative group (mean \pm SD 2.23 \pm 0.24, 2.23 \pm 0.23, 2.23 \pm 0.4) at 3 months follow up (symptoms, function and satisfaction scores). There was a significant difference ($P < 0.001$) in surgical group compared to the conservative one at 6 months with respect to ODI (mean \pm SD: 20.5 \pm 4.8, 28.4 \pm 5.4) and ZCQ subscales (symptoms, function and satisfaction scores) (mean \pm SD: 1.6 \pm 0.61, 1.6 \pm 0.5 and 1.6 \pm 0.6) (mean \pm SD: 2.5 \pm 0.5, 2.5 \pm 0.4 and 2.47 \pm 0.5). There was a high significant difference ($P < 0.001$) favoured surgical group compared to the conservative group after one year regarding ODI (mean \pm SD: 18.2 \pm 2.5, 35.0 \pm 3.9), and ZCQ subscales (symptoms, function and satisfaction scores) (mean \pm SD: 1.34 \pm 0.41, 1.4 \pm 0.3 and 1.34 \pm 0.4) (mean \pm SD: 3.17 \pm 0.37, 3.17 \pm 0.36 and 3.17 \pm 0.3).

In the conservative group, no complications occurred, whereas in the surgical group, one patient had wound infection and the other required re-operation for fixation.

Table (1): The characteristics data of patients in both groups.

Variable	Conservative group (n=30)		Surgical group (n=30)		Test of significance	P value
	No	%	No	%		
Gender: Male Female	7 23	23.3 76.7	6 24	20 80	X ² = 0.098	0.745
Occupation: Sedentary Light Heavy	5 12 13	16.7 40.0 43.3	9 11 10	30.0 36.7 33.3	X ² = 1.5	0.4
Age (years): Mean±SD Range	57.03±5.7 (50-70)		57.9±5.3 (50-70)		T=0.67	0.503
Disease duration (months): Mean±SD Range	25.94±1.18 (9-60)		22.03±1.07 (9-48)		T = 1.22	0.229

SD: Standard deviation t: Independent t test X²: Chi square test
Significant difference: P ≤ 0.05.

Table (2): The Clinical features of the conservative and surgical groups

Finding	Conservative group (n=30)		Surgical group (n=30)		P value
	No	%	No	%	
Low back pain	30	100	30	100	1
Leg pain	28	93.3	30	100	0.089
Sensory symptoms	30	100	30	100	1
Neurogenic claudication	30	100	30	100	1
Schober test <5 cm	19	63.3	14	46.7	0.152
SLRT	18	60	24	80	0.091
Femoral stretch	16	53.3	11	36.7	0.292
Abnormal knee reflex	3	10	3	10	1
Abnormal ankle reflex	5	16.7	9	30	.0226

SLRT: Straight Leg Raising Test
Chi square test significant difference: P ≤ 0.05.

Table (3): Comparison between the conservative and the surgical groups regarding Baseline VAS for pain, ZCQ and ODI

Finding	Surgical mean±SD	Conservative mean±SD	P
VAS(mm)	7.65±1.51	7.43±1.25	0.711
ZCQ symptoms subscale (0-26)	3.5 ±0.53	3.5 ±0.52	0.8
ZCQ function subscale (0-20)	3.5 ±0.5	3.5 ±0.5	0.8
ODI (0-50)	39.6±5.7	39.13±5.3	0.7

VAS: Visual analog scale for pain. ZCQ: Zurich Claudication Questionnaire
 ODI: Oswestry Disability Index.
Independent t test significant difference: P ≤ 0.05.

Table (4): Comparison of Symptoms severity and function subscales of ZCQ before and after treatment in the conservative group.

<u>Symptoms subscale</u>	min- max	Mean±SD	Mean difference	Test of Significance	P* value
Pre treatment	3-4	3.5±0.5		-	-
At 3month	2-3	2.23±0.24	1.26	15.4	<0.001
At 6 month	1-3	2.5 ±0.5	1.03	7.4	<0.001
At 1 year	3-4	3.17±0.37	0.33	3.8	0.001
Function subscale					
Pre treatment	3-4	3.5±0.4		-	-
At 3month	2-3	2.23±0.23	1.25	15.3	<0.001
At 6 month	1-3	2.5 ±0.4	1.02	7.3	<0.001
At 1 year	3-4	3.17±0.36	0.32	3.7	0.001

P*: significance versus pre treatment

Paired t test significant difference: $P \leq 0.05$.**Table [5]:** The comparison between ODI scores before and after treatment in conservative group.

ODI	min-max	Mean±SD	Mean difference from baseline	Test of significance	P*value
Pre treatment	32-50	39.1±5.2	-	-	-
At 3 month	22-32	26.1±3.4	13.0	25.7	<0.001
At 6 month	18-38	28.4±5.4	10.7	8.19	<0.001
At 1 year	30-44	35.0±3.9	4.13	10.7	<0.001

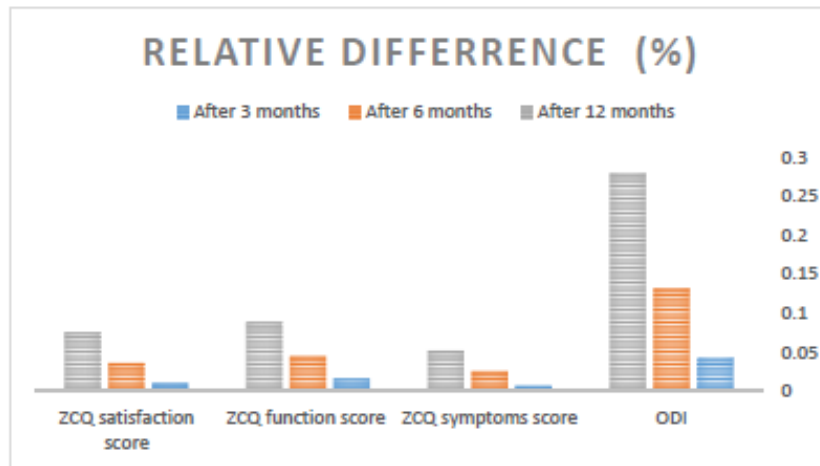
Paired t test significant difference: $P \leq 0.05$.**Table (6):** The Comparison between both studied groups regarding ODI and ZCQ after treatment.

Finding	Surgical mean±SD	Conservative mean±SD	P* Value
3 months			
ODI (50)	23.6 ±3.5	26.13 ±3.4	0.006
ZCQ symptoms score (26)	1.97 ±0.41	2.23± 0.24	0.01
ZCQ function score (18)	1.9 ±0.3	2.23± 0.23	0.01
ZCQ satisfaction score (18)	1.97 ±0.4	2.23± 0.4	0.01
6 months			
ODI	20.5 ±4.8	28.4 ±5.4	<0.001
ZCQ symptoms score	1.6 ±0.61	2.5± 0.5	<0.001
ZCQ function score	1.6 ±0.5	2.5± 0.4	<0.001
ZCQ satisfaction score	1.6 ±0.6	2.47± 0.5	<0.001
12 months			
ODI	18.2 ±2.5	35.0±3.9	<0.001
ZCQ symptoms score	1.34± 0.41	3.17 ±0.37	<0.001
ZCQ function score	1.4± 0.3	3.17 ±0.36	<0.001
ZCQ satisfaction score	1.34± 0.4	3.17 ±0.3	<0.001

Independent t test significant difference: $P \leq 0.05$.

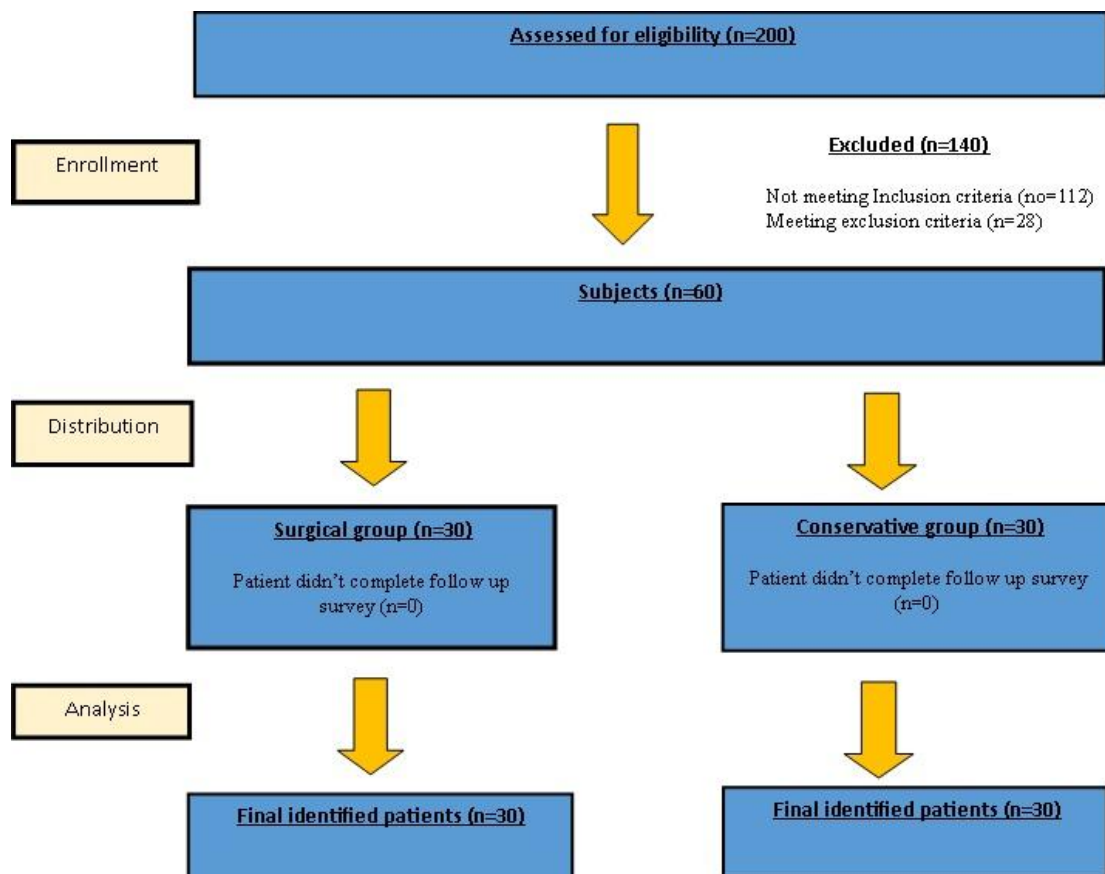
Subjects flow diagram

Figure (1)



Relative difference between surgical and conservative at 3,6 and 12 months regarding ODI and ZCQ scores

Figure (2)



Discussion

There is no consensus guidelines from national or international organizations for treatment of LSS. It is well known that mild cases are usually treated by conservative measures and severe cases are treated with surgical intervention. On the other hand, the treatment decision in moderate and moderately severe cases are still non obvious [11]. Different studies determined that conservative methods may bring some patients long lasting relief [6]. Other studies reported similar satisfactory outcomes in moderate patients with delayed surgery and those who proceeded immediate surgery [21]. The aim of this study was to detect the efficacy of conservative measures in the treatment of moderately severe cases of LSS without neither sphincteric disturbances nor unremarkable neurologic deficit versus surgical treatment. This is due to that, in our region, many patients do not prefer to do surgical interventions and choose to continue conservative measures.

In this study, there was a significant improvement of the conservative group throughout the whole follow up duration. This improvement may be attributed to the effect of exercise therapy on lumbar alignment. Exercises can increase the activation of paravertebral muscles, improve the stability and coordination of lumbar spine and lumbar lordosis angle. Exercises, also can adjust the lumbar alignment and subsequently can relieve nerve compression [22, 23]. Additionally, ultrasound usually increases motion of soft tissue molecules generating frictional heat and consequently increases tissue temperature. This increased temperature, is thought to cause changes in contractile activity of skeletal muscles, increase in collagen tissue extensibility, local blood flow,

pain threshold, and reducing muscle spasm [23]. This finding was in concordance with Malmivaara and his colleagues [24], who reported clinical improvement of 44 patients with mild and moderate degree of LSS treated with conservative therapy. The outcome was based on the ODI scale and follow up examinations performed at 6, 12, and 24 months. Their conservative therapy included exercises and braces and the improvement was detected during follow-up duration of one year. However, at the end of the second year, deterioration of the cases was clear.

In our study, there was statistical significant improvement of ODI, ZCQ symptoms and function subscales in the surgical group at 3, 6 and 12 months after treatment compared to baseline due to the effectiveness of decompression of the spinal canal and release of the nerve roots. This result was in consistent with many studies. In a review article, nine RCTs were included and compared spinal surgery versus various types of nonsurgical treatment of LSS. Two studies determined that patients were satisfied with X-STOP implanted at 6 weeks, 6 months, and 12 months after surgery [8]. In addition, Anderson and colleagues [25] reported good postsurgery responsiveness, in the form of increased walking ability at 3 months follow up besides decreased neurogenic claudications at 6 and 12 months follow up durations.

The current trial showed, that operative treatment was more effective in reducing pain and disability than conservative treatment in patients with LSS, and that the beneficial effect sustained throughout the 1-year follow-up. The difference was statistically significant at 3, 6, and 12 months. Similar results were also obtained by the Spine

Patient Outcomes Research Trial (SPORT), the largest RCT which reported that patients who underwent surgery showed significantly greater improvement than patients who were treated non-surgically for 4 years [26]. On the other hand, in a review article [8] there were no significant differences in ODI scores between the surgical and conservative groups at first 6 months after treatment ($P > 0.05$).and significant higher ODI scores at one and two years in the surgery group ($P < 0.05$). Besides, another two studies reported no significant differences between laminectomy and conservative treatment for the SF-36 physical function scores at 3, 6, 12 and 24 months ($P > 0.05$) [26].

In this study, the relative differences between conservative and surgical groups were considerably low at 3 months follow up (ODI: 4.21%, ZCQ symptoms score: 0.74%, ZCQ function score: 1.65% and ZCQ satisfaction score: 1.08 %). At 6 months follow up, the relative differences were still low (ODI: 13.16%, ZCQ symptoms score: 2.57%, ZCQ function score: 4.5%, and ZCQ satisfaction score: 3.62%). While at the end of 1 year follow up the relative differences became high (ODI: 28%, ZCQ symptoms score: 5.2%, ZCQ function score: 8.85% and ZCQ satisfaction score: 7.6%) figure (2). It was evident from these results that after 3 and 6 months follow up, the relative difference between surgical and conservative was low. Based on these results we can detect that, for the first 6 months of the disease we can rely on the conservative treatment and can achieve satisfactory improvement. Also, the physical rehabilitation care received in our study was inadequate either due to non-adherence to best care

standards in physical rehabilitation environments. The barriers to adherence to physical rehabilitation were the burden of co-payments or poor commitment to exercise program due to low level of patient education, culture and most of them were old age and continuation of exercise programme in such age was to some extent difficult. So, if we can overcome these obstacles to continuation of physical therapy, the improvement duration can be extended beyond one year. Furthermore, the, difference between surgical and conservative treatment will be insignificant.

Considering the complications that could arise from surgery (for example in this study, one patient had wound infection and the other needed re-operation for fixation). So when we took into account the risks, the conservative approach appeared to be better than surgical treatment.

These finding were in consistent with Anderson and colleagues [25], who reported that, the surgical groups had higher complication rates than non-surgery groups throughout the follow-up duration.

Conclusion:

In conclusion, the conservative treatment in the current study yielded satisfactory clinically meaningful improvement in function and reduction of pain among patients with LSS who were surgical candidates up to 6 months follow up. This improvement regressed at 1 year follow up but still statistically significant in comparison to baseline. It was noted that all outcome measures achieved statistical superiority in the surgical group compared to the conservative group at all follow up end points, but the serious complication rate was higher for surgical approach.

Recommendations:

- Continued research in the area of non-surgical intervention for patients with LSS to identify the most optimal and cost effective intervention program resulting in the greatest reduction in symptoms and improvement in function.
- As Egyptians are not compliant with exercise program, more strict supervision on patients with qualified physical therapists is recommended.

Abbreviations: Lumbar spinal canal stenosis (LSS), Visual analog scale (VAS), Oswestry Disability Index (ODI) and Zurich Claudication Questionnaire (ZCQ).

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