

THE EFFECTIVENESS OF HEMILAMINECTOMY IN SINGLE LEVEL LUMBAR SPINAL STENOSIS

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Abstract

Degenerative spinal stenosis is a progressive disorder that involves the entire spinal motion segment. It describes abnormal narrowing of the central canal, the lateral recesses or the intervertebral foramina to the point where the neural elements are compromised. When this occurs the patient develops neurological symptoms and signs in the lower limbs. Hemilaminectomy is a surgical procedure, which is designed to relieve pressure on the nerves in the spine. This procedure is performed when patient has degenerative conditions leading to signs and symptoms of neural impairment, because the procedure is invasive, it is usually only recommended when other non-operative treatment approaches failed to relieve the patient complain. Before the procedure can be performed, a neurological examination is conducted to determine which area of the spine is affected. We also typically order medical imaging studies of the spine so that we can clearly visualize the area that requires surgery. The patient undergoes routine blood work to check for underlying medical problems that could complicate surgery, and meets with an anesthesiologist to discuss anesthesia options and prepare for the operation.

This study is a prospective analysis of a randomized collection of 22 patients who underwent surgery for lumbar spinal stenosis at the period from April to the end of July 2012. The procedures were done by orthopaedic surgeons. The period of the follow up was 1 year post-operatively. The follow up criteria depended on the distance the patient could walk uninterrupted for the assessment of the neural claudication, for the assessment of the radicular pain; we depended on the Outcome Measure in Lumbar Spinal Stenosis questionnaire (OMLSS) which is rating from 6 to 30, & for the weakness (weak dorsiflexion) we depended on the Medical Research Council (MRC) Grading of the muscle power, which is rating from 0 to 5. The patients were suspected to have spinal stenosis on the basis of a history, physical examination, & radiological imaging. The final assessment and the decision of the operation were made by the surgeons who operated them.

Twenty two patients were included in the study, 15 of them were females (68%), and the rest were males (32%), with female to male ratio was approximately 2:1. Regarding the age, it was ranging from (55 - 78 years); the majority 14 of 22 of patients (63%) was between the ages of 61 – 65 years old. About the occupation, (50%) of the total number were housewives women & 18% of the total number were earners men. (77%) & (23%) of the patients were complaining of bilateral & unilateral neural claudication respectively, (64%) & (36%) of the patients had bilateral & unilateral radicular pain & paraesthesia respectively, (23%) & (13%) had bilateral & unilateral weak dorsiflexion respectively, who were in grade 3 according to the (MRC) grading system. Post-operatively, (81.8%) of the patients with neural claudication got improvement in the walking distance for up to more than 1 km uninterrupted. Regarding the radicular pain, (59%) had subsided in less than 3 months post-operatively, (27.5%) of them were relieved in the period of 3 - 6 months, & just one patient (4.5%) still had pain for the entire period of the follow up which was rated 15 of 30 according to the (OMLSS). Weak dorsiflexion was also improved post-operatively in the 1st 3 months in (33.3%) & (40%) of the unilaterally & bilaterally affected patients respectively, while (67%) & (60%) of the unilaterally & bilaterally affected patients relieved in the period up to the 6th month post-operatively respectively.

Introduction

The term spinal stenosis is used to describe abnormal narrowing of the central canal, the lateral recesses or the intervertebral foramina to the point where the neural elements are compromised.

The conundrum of spinal stenosis, like many spinal conditions, is that putative "pathologic" anatomy does not equate with pain. The spinal stenosis condition implies patho-morphologic narrowing of the spinal canal, yet spinal stenosis cannot be thought of as a simple compressive lesion. What happens to the contents of the canal is more clinically relevant than what happens to the borders of the spinal canal. If compression were the sole pathologic entity in spinal stenosis, decompressive surgery would be an exquisitely efficacious procedure rendering near total, long-term relief. Empiric, longitudinal and experimental evidence suggests mechanical deformation is not the sole source of nerve root pain¹⁻³.

Individuals with spinal stenosis on radiography may be asymptomatic or present with a variety of symptoms. When symptoms do occur, the classic presentation is leg pain upon walking, coined neurogenic intermittent claudication (NIC). NIC, a clinical diagnosis distinct from vascular claudication, occurs in patients with central or lateral lumbar stenosis who develop lower limb complaints during ambulation, spinal extension, or standing⁴.

Unlike vascular claudication, pain is typically relieved with lumbar flexion. Contrary to popular belief, not all spinal stenotic patients present with NIC. They may also present with pain at rest or frank radiculopathy with or without radicular pain. Radicular pain is sharp, band-like pain that radiates in a dermatomal distribution. Radiculopathy, on the other hand, is a neurologic condition due to nerve root injury sufficient enough to cause objective signs such as weakness,

sensation loss, and reflex loss. It has become apparent that spinal stenotic patients have a multi-factorial cause of these symptoms. In the setting of patho-morphologic compression, several biochemical and biomechanical factors lead to the sine qua non of nerve root injury and the dreaded flare of symptoms⁵.

Patients & methods

This study is a prospective analysis of 22 consecutive patients who underwent surgery for lumbar spinal stenosis at the period from April to the end of July 2012 in Al-Sulaimaniyah Teaching Hospital in Al-Sulaimaniyah governorate, Iraq & in Tikrit Teaching Hospital in Salah Al-Deen governorate.

Inclusion criteria: Degenerative central spinal canal stenosis, single level stenosis, patients age 55 years or older, and conservative treatment lasting longer than 3 months with failure.

Exclusion criteria: Contra-lateral recess stenosis, bilateral root canal stenosis, multiple level spinal stenoses, inflammatory spondylopathy, spinal instability, and spinal tumor.

Demographic data includes: Name, age, sex, occupation, chief complain & duration, unilateral or bilateral, clinical examination, radiological tests, response to non-surgical treatment, response to surgical treatment, & follow up. For statistical analysis, SPSS (Fisher exact test) was used.

Intra-operatively: assessment of the spine, dura, nerve roots, facet joints, & the disc state which causes the stenosis was done.

History and Examination:

When taking the patient's history, the main symptoms which were asked about; neurogenic claudication, radicular pain, motor weakness, back pain, & sphincter disturbances which were not responding to medical treatment. The duration of this history was also significant. Family history for similar complaints was

enquired to exclude disorders like achondroplasia and familial idiopathic canal stenosis.

Clinical examination included recording of spinal abnormalities and neurological deficit. Patients with profound subjective symptoms and minimal or absent neurological findings at rest, were re-examined after making the patient walk till the symptoms appeared.

The clinical examination was followed by a vascular investigation to exclude vascular claudication.

Radiological Evaluation: All the patients underwent MR imaging of the lumbar spine, and the extent of the spinal stenosis could be estimated. Compression of the lumbar dural sac was clearly delineated. We also routinely performed plain antero-posterior and lateral radiography of the lumbar spine prior the surgery to exclude developmental disorders.

Indications for Surgery: Clear symptoms of neural claudication with corresponding signs of a radiological correlate, 3 months of conservative treatment did not improve the patient's symptoms, and the exclusion criteria were met.

The target criterion of this study was to achieve decompression of the spinal stenosis. All patients presented with signs of neural claudication, and in all patients lumbar spinal stenosis was found on radiological examinations as the anatomical correlate.

Statistical analysis of the patients regarding the distribution of age, clinical symptoms, & signs revealed that it was possible to retrospectively study the outcomes of this surgery.

Surgical Approach: Hemi-laminectomy;

The unilateral partial hemi-laminectomy was our most common choice. The spine was exposed via a midline incision. The thoraco-lumbar fascia was incised, and the para-vertebral muscles were carefully mobilized from the bony structures only on the side of the operation. Partial hemilaminectomy of the ipsilateral lamina was done subsequently. Hypertrophic

parts of the facet joints were trimmed (partial undercutting facetectomy). The base of the spinous process was also trimmed. The ligamentum flavum, which was mostly thickened, was removed. Thereafter, both the ipsilateral & contra-lateral recesses were decompressed also. The contra-lateral foramen could also be inspected and decompressed under direct vision. This approach resulted in a good expansion of the dural sac and was used whenever possible.

Surgical Procedure: All patients underwent surgery in the kneeling position after induction of anesthesia. Surgery was performed in a standardized manner. Care was taken in all patients to minimize facet joint resection. An undercutting technique was used to remove osteo-ligamentous structures on the opposite side. Suction drains were placed routinely. The patients were mobilized on day 1 after surgery.

Postoperative Evaluation:

The patients were examined 3, 6, & 12 months postoperatively. The evaluation included performing a full neurological examination, determining the duration of the postoperative pain and type of pain medication, and assessing the improvement of neural claudication measured by the distance the patient could walk uninterrupted (assessment of neural claudication).

Statistical Evaluation: For statistical analysis, the differences between preoperative and postoperative characteristics (pain, sciatica, assessment of neural claudication, sensory & motor changes, use of pain medication, and overall patient satisfaction) were used.

Results

Patient Population: During the period from April to the end of July 2012, a 22 patients with lumbar spinal stenosis met our inclusion criteria & they were all received non-operative measures regarding the management of spinal stenosis but with no benefits. All of them

returned the questionnaires and were included in this study. The data were analyzed by statistical package for social science SPSS v.16.

Age: Range of patient's age was between 55 & 78 years. The majority (63%) of them were between the ages of (61–65) years old (Figure 1).

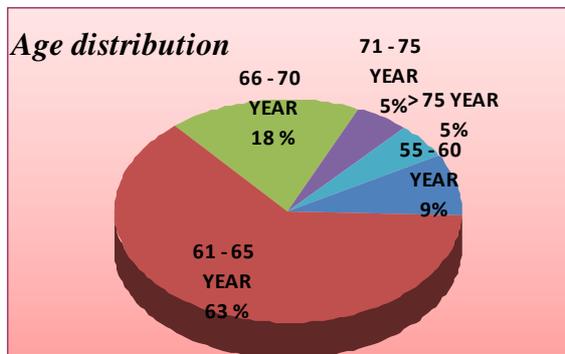


Figure 1: The most common age of spinal stenosis which was between 61 - 65 years.

Sex: About the gender; the majority (32%) were males, female to male ratio (68%) the patients were females, while was approximately 2:1 Figure (II).

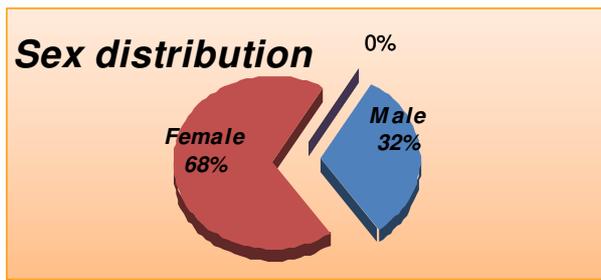


Figure 2: Spinal stenosis is more common in females than in males.

Occupation: Spinal stenosis was more while in males it was more common common in housewives women (73.3%), (57.1%) in earners (Figure 3).

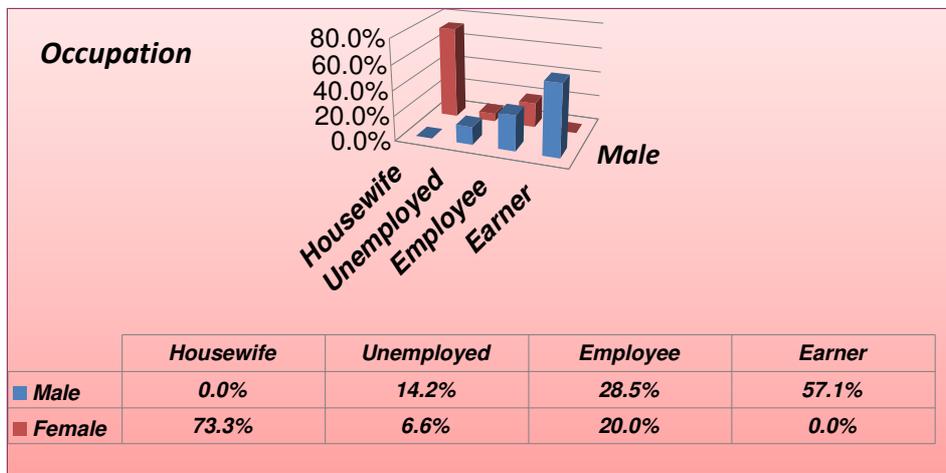


Figure 3: Housewives & the earner men are more affected by spinal stenosis.

Duration of symptoms: Range of symptoms duration was between 2 & 8 years. The mean value was 5 years (Figure 4).

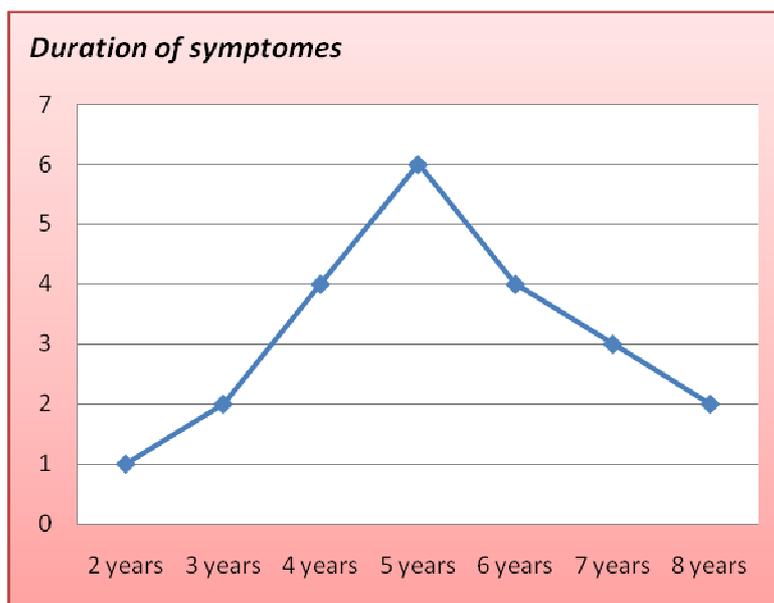


Figure 4: The distribution of symptoms duration pre-operatively.

Most complaining symptom: All of the patients were complaining of spinal claudication, 77% bilaterally & 23% unilaterally. Radiculopathy was present in all of them also, (64%) bilaterally & (36%) unilaterally, while weakness was found in about (36%) of the patients only; (13%) unilaterally & (23%) bilaterally (Figure 5).

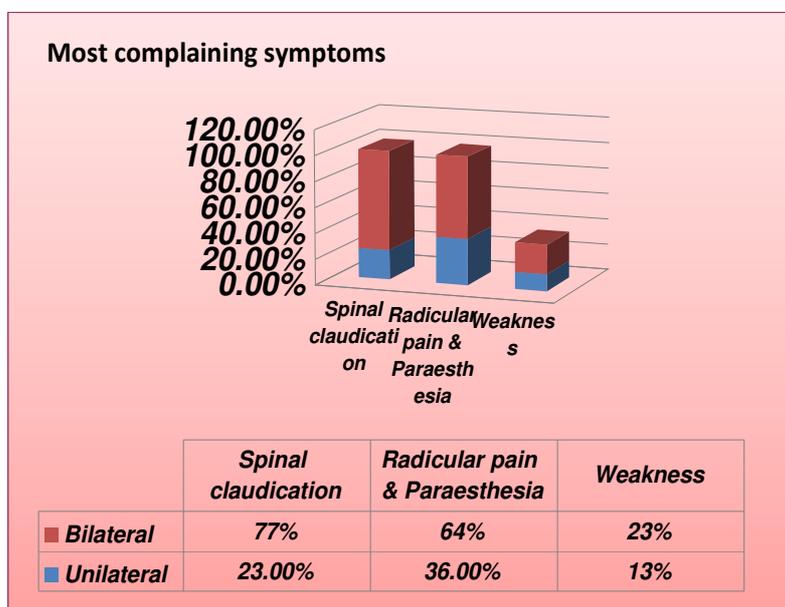


Figure 5: The most presenting symptom.

Neural claudication: Pre- and post-operative neural claudication was assessed by the distance a patient could walk uninterrupted (assessment of neural claudication). There was good overall improvement after the surgery with respect to the neural claudication. Preoperatively, the majority of the patients (72.7%) could walk uninterrupted just less

than 100 m., while postoperatively, more than (81%) of the patients could walk uninterrupted for more than 1 km (Figure 6). P value was (0.001), means significant.

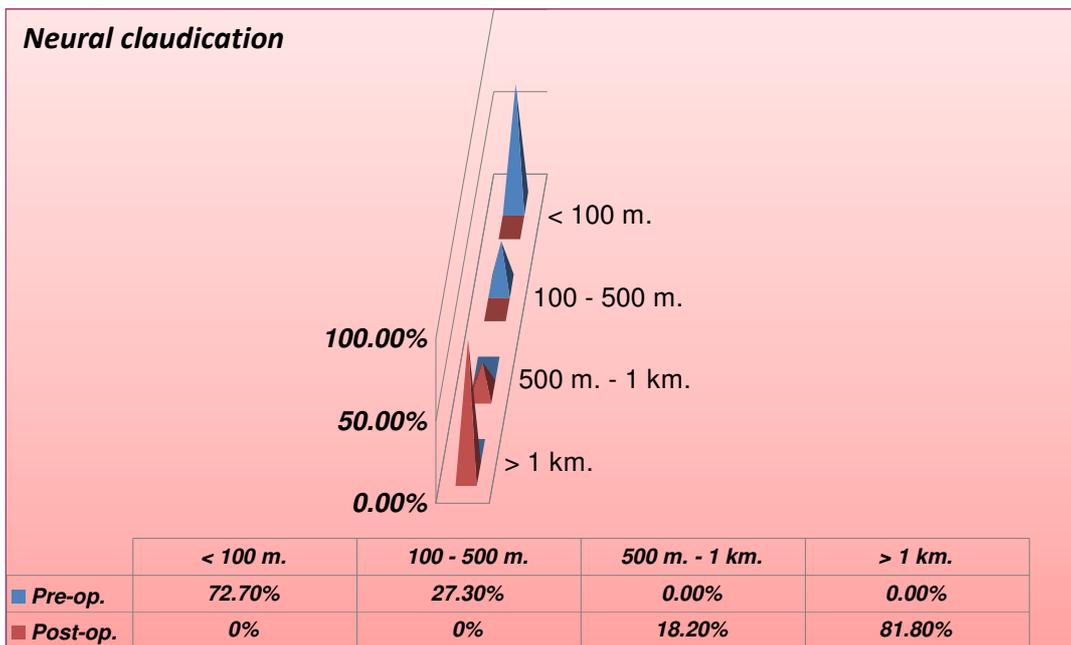


Figure 6: Assessment of neural claudication before and after hemilaminectomy.

Radicular pain:- Most of patients (59%) had complete relief of the pain during the first 3 months post-operatively, (27.5%) of patients relieved from the pain between 3rd & 6th months post-operatively, & just (4.5%) of them still had pain for up to 1 year (Figure 7).

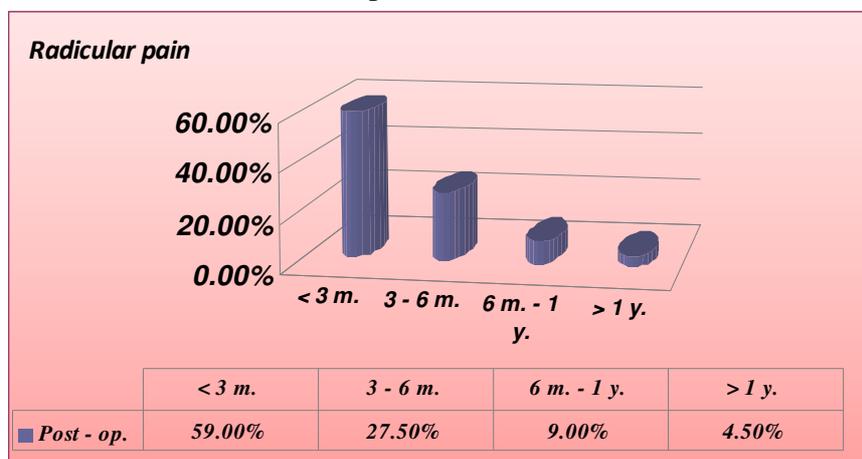


Figure 7: The duration of radicular pain post-operatively.

Weakness: Recovery from weak dorsiflexion needed 3 months in (33.3%) & (40%) in unilaterally & bilaterally affected patients respectively, while it took 6 months in (67%) & (60%) in

unilaterally & bilaterally affected patients respectively. None of the followed cases needed 1 year for recovery (Fig. 8). P value was (0.001), means significant.

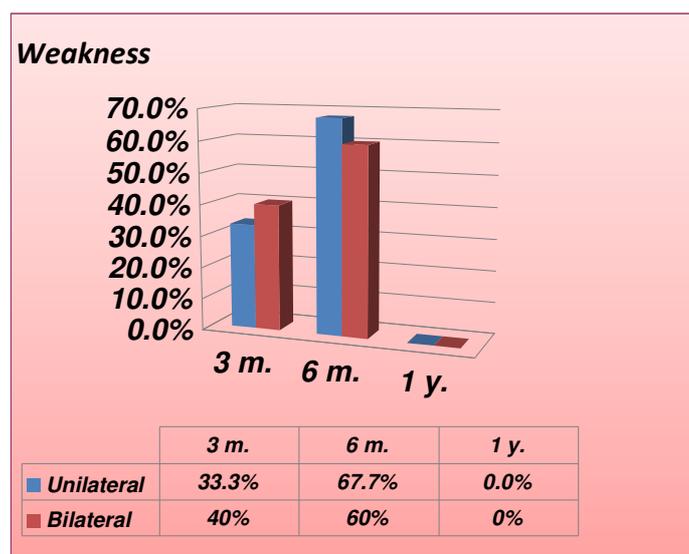


Figure 8: The duration of weakness recovery post-operatively.

Discussion

Lumbar spinal stenosis is a pathological condition that is increasingly seen in elderly patients. It originates from typical patho-anatomical changes leading to a narrowing of the spinal canal. The ligamenta flava thicken, the facet joints hypertrophy, and a progressive disc degeneration results in a narrowing of the neural pathways⁶. Patients often present with a history of numbness, weakness, and radicular pain. Neural claudication is one of the key features, and it may be difficult to differentiate it from vascular impairment.

Due to a change in the age distribution of the population, lumbar spinal stenosis is gaining more clinical significance. There is an increasing interest in the quality of life, and more elderly patients are prepared to undergo surgery as a result.

Although different surgical methods of decompression are available, the general aim is to achieve a sufficient decompression while maintaining segmental stability. Patients with symptomatic stenosis should undergo multimodal conservative treatment for up to 3 months and then be considered for surgery^{7,8}.

Radiological Evaluation: Radiographs should include plain as well as functional views to exclude spondylolisthesis and

developmental disorders. Some of the characteristics of spinal stenosis, such as short pedicles, a short inter-pedicular distance, and degenerative changes in the 3-joint complex, will also be present on plain radiographs⁹.

To delineate the level of the stenosis, several techniques were available, including MRI, & CT scanning. The advantages of these techniques are the accuracy in demonstrating the levels of the stenosis & the possible compressive elements on neural structures.

Magnetic resonance imaging can represent not only morphological but also pathological changes of osteo-ligamentous and neural components of the lumbar spine¹⁰.

The modality seems to offer the greatest potential for the future evaluation of lumbar spinal stenosis. Measurements of central stenosis, the transverse area of the dural sac, and the lateral stenosis can be performed¹¹.

Partial Hemilaminectomy

Less invasive procedures, such as partial hemilaminectomies with transmedian removal of the compressive elements, are being used more frequently for the decompression of lumbar spinal stenosis in elderly patients¹². This procedure is of a shorter duration. Compared with laminectomy, partial hemilaminectomy

results in less injury to paraspinal structures and provides a sufficient decompression. In their series, Kalbarczyk and colleagues⁵⁶ reported that a high percentage of results after interlaminar decompression (32%) were the similar to that after a standard laminectomy. Although interlaminar decompression uses a more limited but tissue- and stability-preserving approach, it still seemed to be sufficient for decompression.

Spetzger et al¹³ demonstrated that less invasive and more limited interlaminar decompression resulted in an increase in interfacet diameter measured on postoperative neuro-radiological images, as well as in gross pathological specimens. This surgical approach preserved the neural arch and protected the dura from epidural scarring.

The main advantages of this limited approach are a reduction of the surgical trauma and the avoidance of surgically induced instability. The facet joints are spared, because only the hypertrophic and compressive medial parts are resected. Midline structures (interspinous ligaments and thoracolumbar fascia) are completely preserved. The contralateral supporting lumbar musculature with its physiological attachment to the spinous process is not disrupted, and the integrity is left intact¹³.

Radiographic evaluation for the assessment of possible postoperative instability was performed on a routine basis.

Neurogenic claudication: - In this study, 18 of the 22 patients with neurogenic claudication (81.8%) demonstrated a marked improvement of the walking distance after the decompression. Spetzger

U and colleagues found in their study that 25 out of 27 patients with neurogenic claudication (93%) demonstrated a marked improvement of the walking distance postoperatively; their mean follow-up time was 18 months¹³. Charles G. diPierro and colleagues found in their study that of the patients with neurogenic claudication, (69%) reported complete relief at follow-up review; their minimum and mean postoperative follow-up times were 2 and 2 1/2 years, respectively¹⁴.

Radicular pain:- In this study, radicular pain had been subsided within the first 3 months postoperatively in (59%) of the patients, while in about (27.5%) of the patients, the pain had been relieved in the period of 3 – 6 months post-operatively, & just (4.5%) of the patients still had pain for up to 1 year. Charles G. diPierro and colleagues found in their study that (41%) of the cases with radicular pain had complete relief and (23%) had mild residual pain that was rated 3 or less on a pain functionality scale of 0 to 10¹⁴.

Papavero L,¹⁵ and colleagues found in their study that at the first week after surgery, pain decreased in (85.9%) of patients, & at the first year after the surgery, the pain "remained decreased" in (83.9%) of the patients.

Conclusion:

1- Hemilaminectomy is an effective procedure for decompression of single level lumbar spinal stenosis.

2- Hemilaminectomy is a less invasive procedure and carries a less risk of destabilization of spine in single level spinal stenosis.

3- It is effective procedure for bilateral decompression of spinal stenosis.

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