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Prospective analysis of surgical outcomes in patients undergoing decompressive laminectomy and posterior instrumentation for degenerative lumbar spinal stenosis

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Objectives: The aim of this study was to evaluate the outcome of wide surgical decompression and concomitant posterior instrumentation in patients with degenerative lumbar spinal stenosis.

Methods: Thirty-seven consecutive patients (14 men, 23 women; mean age 64 years; range 36 to 82 years) with degenerative lumbar spinal stenosis were prospectively evaluated following surgical treatment with spinal decompression and concomitant instrumented posterior fusion. The mean duration of symptoms before surgery was 24 months (range 12 to 60 months). Preoperatively, six patients had degenerative spondylolisthesis (grade 1) and two patients had degenerative lumbar scoliosis. Decompression was performed at one level in four patients, at two levels in 16 patients, at three levels in 11 patients, and at four levels in six patients. Discectomy was also performed in seven patients. Preoperatively and postoperatively, the patients were assessed by the Oswestry Disability Index and a visual analog scale for overall pain (leg and low back pain). The satisfaction level of the patients for surgical outcome was also questioned. The mean follow-up period was 4.6 years (range 1 to 7 years).

Results: Preoperatively, the mean Oswestry Disability Index score was 60.5% and the mean overall pain score was 7.5. Postoperatively, the Oswestry Disability Index score significantly decreased to 36.8% and the overall pain score significantly decreased to 3.5 ($p<0.001$). Preoperative and postoperative walking distances of the patients were as follows, respectively: more than 1,000 meters (6 and 14 patients), 500 to 1,000 meters (5 and 7 patients), less than 500 meters (26 and 16 patients). Twenty patients did not use any analgesics and eight patients used analgesics on a weekly basis. Twenty-six patients were satisfied with the surgical outcome, nine patients were somewhat satisfied, and two patients were dissatisfied. Overall, the outcomes were excellent to good in 22 patients (59.5%). None of the patients required revision surgery.

Conclusion: Most patients with degenerative lumbar spinal stenosis benefit from decompressive surgery. Patients with long-standing preoperative symptoms and concomitant diseases often have poor results and are less satisfied with the postoperative outcome.

Key words: Decompression, surgical; laminectomy; lumbar vertebrae; spinal stenosis/surgery; treatment outcome.

Lumbar spinal stenosis refers to any narrowing of the spinal canal, nerve root canal, or intervertebral foramen, resulting in highly variable signs and symptoms such as low back pain, radiating pain in the lower extremities, decreased walking capacity, and disability.[1,2]

Conservative therapies may be helpful, but in most cases do not result in long-term improvement.[2] Controlled clinical studies comparing conservative and surgical treatment are rare and there are few reports on long-term results. The outcome of these

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studies favors surgical treatment over conservative methods.[3,4] The most widely used surgical techniques are based on the principles of decompression alone or decompression and fusion, with or without instrumentation.[5-8] These operations are performed with an increasing frequency, but documentation on their long-term efficacy is sparse and debatable.[9] During the past few decades, a number of studies describing the short-term outcomes of surgical treatment of lumbar spinal stenosis have been published. Success rates of 26-100% have been reported for different surgical interventions.[9] There is also an ongoing debate as to whether fusions should be instrumented or not.[10,11]

Although the short-term outcomes of laminectomy are good, the long-term outcomes still remain unsatisfactory. Katz et al.[12] reported that 23% of the patients required reoperation and 33% had severe back pain 7 to 10 years after decompressive surgery for spinal stenosis. Even in unilateral laminotomy cases, 85.3% of the patients had excellent-to-fair operative results, and the incidence of complications was 9.8%.[13]

The aim of this prospective study was to evaluate the outcomes of wide surgical decompression and concomitant posterior instrumented fusion in patients with degenerative lumbar spinal stenosis.

Patients and methods

Between 2001 and 2007, we prospectively evaluated 37 patients (14 men, 23 women; mean age 64 years; range 36 to 82 years) undergoing surgery for degenerative lumbar spinal stenosis. Eleven patients had concomitant diseases (diabetes mellitus, Parkinson's disease, Addison's disease, and epilepsy).

All patients had limited functional activities due to leg or back pain, and the mean duration of symptoms before surgery was 24 months (range 12 to 60 months). Preoperative plain radiographic findings included degenerative spondylolisthesis (grade 1) in six patients and degenerative lumbar scoliosis in two patients with a curvature of 22° and 28°, respectively. Computed tomography and magnetic resonance imaging performed in each patient documented central or centro-lateral compression of the cauda equina by degenerative changes of the surrounding structures.

All patients underwent total laminectomy, medial facetectomy, and foraminotomies at the affected levels. The level of decompression was determined by preoperative diagnostic imaging studies. Operative procedures included decompression at one level in four patients, at two levels in 16 patients, at three levels in 11 patients, and at four levels in six patients (Fig. 1, 2). Discectomy was also performed in seven

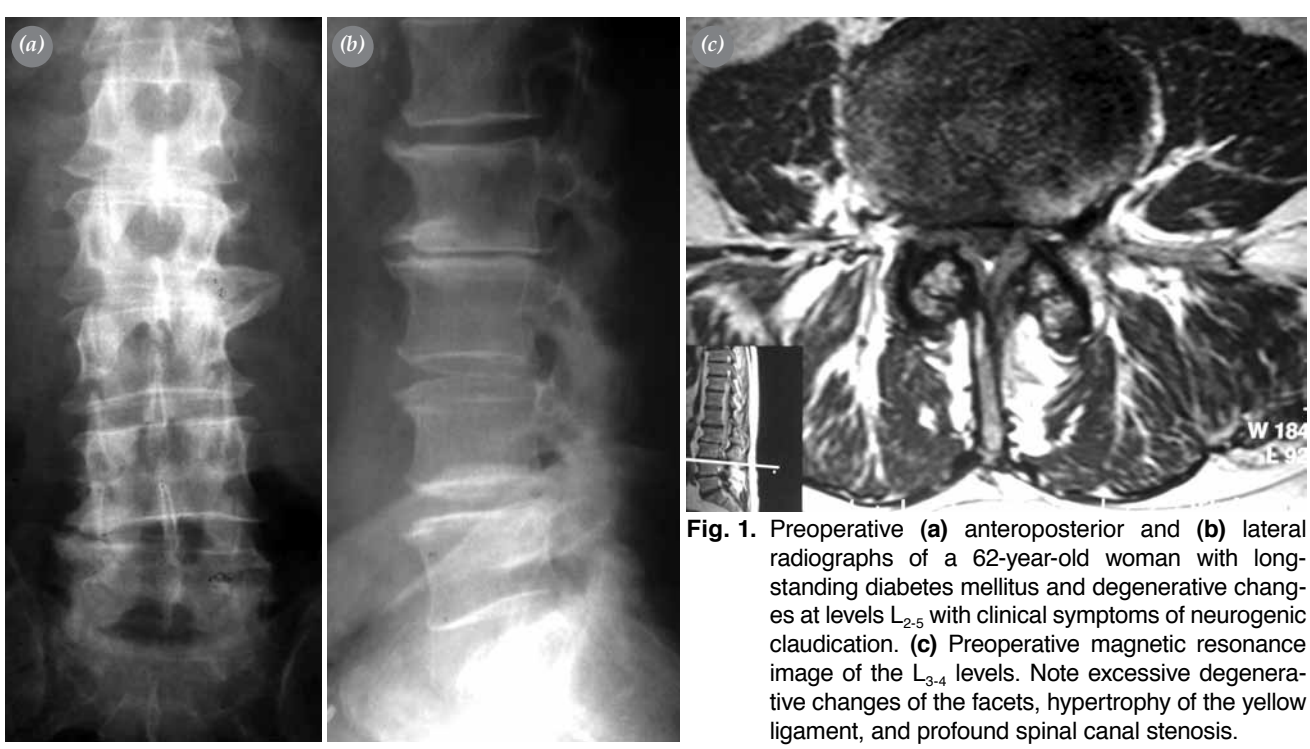

Fig. 1. Preoperative **(a)** anteroposterior and **(b)** lateral radiographs of a 62-year-old woman with long-standing diabetes mellitus and degenerative changes at levels L_{2-5} with clinical symptoms of neurogenic claudication. **(c)** Preoperative magnetic resonance image of the L_{3-4} levels. Note excessive degenerative changes of the facets, hypertrophy of the yellow ligament, and profound spinal canal stenosis.

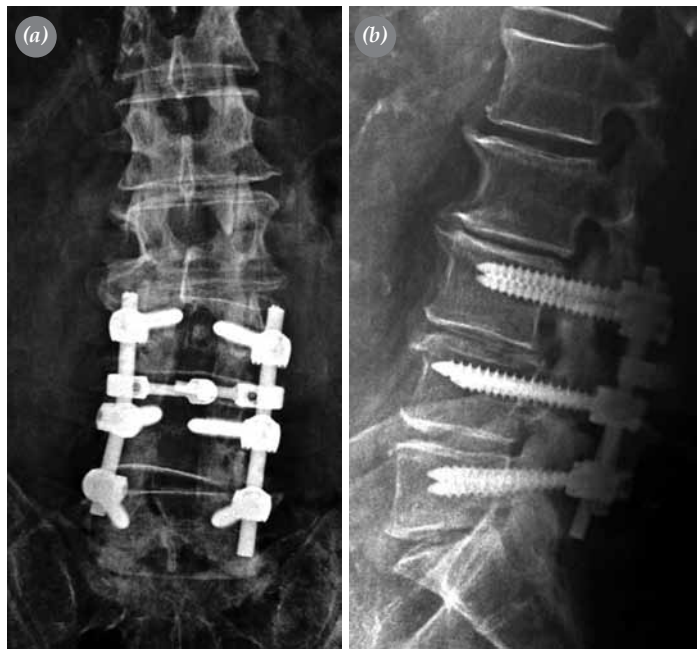

Fig. 2. Postoperative **(a)** anteroposterior and **(b)** lateral radiographs of the same patient. Note posterior bilateral transpedicular stabilization and laminectomy at levels L_{3-5}. Despite degenerative changes at L_{2-3} levels, no instrumentation was performed due to the absence of canal stenosis on magnetic resonance scans at that level. Despite adequate surgical management, the patient had minimal improvement postoperatively in clinical symptoms of neurogenic claudication.

patients. All patients underwent spondylodesis via posterolateral fusion and posterior bilateral transpedicular stabilization. Posterolateral fusion was performed using autogenous cancellous bone graft in 32 patients and fresh-frozen morselized femoral head bone graft in five patients.

The decompression was considered satisfactory if a small Nelaton catheter could enter freely into the undecompressed part of the spinal canal and if the dural sac and nerve roots showed no gross evidence for compression. Usually, a free fat graft was used to cover the dura. There were two patients with intraoperative dura rupture which was sutured and one patient with postoperative superficial soft tissue infection which was successfully treated with administration of intravenous antibiotics.

Preoperative data included age, sex, duration and type of symptoms, neurophysiologic and electromyographic findings, walking ability, use of analgesics, coexisting diseases, Oswestry Disability Index score, and visual analog scale for overall pain (leg and low back pain).

All patients had varying degrees of leg pain, and/or back pain prior to surgery, which required daily use of analgesics.

The follow-up was performed by one of the authors (G.C.) who was blinded to patient care. The follow-up included Oswestry Disability Index score, visual analog scale for overall pain, walking ability, use of analgesics, and overall patient satisfaction with postoperative results. The mean follow-up period was 4.6 years (range 1 to 7 years).

Results

Preoperatively, the mean Oswestry Disability Index score was 60.5% and the mean overall pain score was 7.5. Postoperatively, the Oswestry Disability Index score significantly decreased to 36.8% and the overall pain score significantly decreased to 3.5 (for both, $p<0.001$). The overall improvements in the Oswestry Disability Index score and pain score were 23.7% and 4 points, respectively.

Preoperatively, six patients were able to walk more than 1,000 meters without pain and/or sen-

sory disturbances; five patients could walk 500 to 1,000 meters; 12 patients were able to walk 100 to 500 meters; and 14 patients were unable to walk more than 100 metres without serious sensory disturbances and pain. Postoperative walking distances were as follows: more than 1,000 meters in 14 patients, 500 to 1,000 meters in seven patients, less than 500 meters in eight patients, and less than 100 meters in eight patients. Twenty patients did not use any analgesics, eight patients used analgesics weekly, five patients used almost every other day, and four patients used consistently. Twenty-six patients were satisfied with the surgical outcome, nine patients were somewhat satisfied, and two patients were dissatisfied.

According to the four subgroups of the Oswestry Disability Index, preoperatively there were no patients with minimal disability (group 1, 0-20%), two patients had moderate disability (group 2, 21-40%), 18 patients had severe disability (group 3, 41-60%), and 17 patients were classified as being crippled (group 4, >60%). Postoperatively, 10 patients had minimal disability, 12 patients had moderate disability, 10 patients had severe disability, and five patients were classified as crippled.

Overall, the outcomes were excellent to good in 22 patients (59.5%). Patients with prolonged preoperative symptoms and concomitant diseases were all in group 4. These patients were less satisfied with the results of surgery. No patient required revision surgery.

Discussion

Booth et al.[14] assessed 36 patients with degenerative spondylolisthesis with a minimum follow-up of five years following treatment with decompression, autogenous bone grafting, and instrumented posterior fusion. Eighty-three percent of patients were extremely or somewhat satisfied with the results of surgery. After a follow-up period of 5 to 14 years, Kornblum et al.[15] achieved good or excellent clinical outcomes in 86% of patients with successful instrumented fusion for degenerative spinal stenosis. The authors recommended instrumentation to achieve better fusion rates and long-term outcomes. In a meta-analysis for degenerative lumbar spinal spondylolisthesis, Mardjetko et al.[16] concluded that instrumentation might improve the fusion rate.

Cornefjord et al.[17] reported excellent or good results in 62% of patients undergoing first-time surgery for lumbar spinal stenosis after a mean follow-up period of 7.1 years. Improvement in walking ability was significant and of clinical importance. Many studies reported better results in patients with degenerative spondylolisthesis treated with combined decompression and fusion compared to similar patients treated with decompression alone.[5,6,18] Fischgrund et al.[10] concluded that instrumentation improved fusion rate but did not change the clinical outcome in degenerative spondylolisthesis. The authors proposed the following indications for the addition of instrumentation following decompression and fusion for spinal stenosis: correction of a supple or progressive deformity, fusion of two or more motion segments, recurrent spinal stenosis with spondylolisthesis, and presence of translational or angular instability.

In our study, all patients underwent combined decompression and instrumented fusion. Degenerative spondylolisthesis (grade 1) was present in six patients and two patients had degenerative lumbar scoliosis with a curvature of 22° and 28°, respectively. These patients had no signs of nerve root traction as the listhesis was long-standing and their symptoms were correlated with degenerative lateral stenosis and inability to walk a certain distance. These patients had good to excellent results.

Based on their experience with 157 consecutive surgically treated cases of spinal stenosis, Hansraj et al.[19,20] suggested a therapeutic classification of degenerative spinal stenosis into simple or typical stenosis and complex stenosis. The main challenge in the operative treatment of both simple and complex forms is to provide adequate decompression without compromising stability of the lumbar spine. Extensive laminectomy and facetectomy often provide sufficient decompression, but the mechanical integrity can be severely impaired. In our series, all patients had a high degree of central and lateral narrowing of the spinal canal due to degenerative changes in the surrounding structures: disc, facet joints, and yellow ligament. Wide decompression was accomplished by total laminectomy, medial or total facetectomy, and foraminotomy compromising stability of the operated spinal segment. Thus, in all patients, a concomitant instrumentation was mandatory in order to provide postoperative stabil-

ity and to preserve sagittal balance of the lumbar spine.

Prolonged duration of nerve root compression may cause irreversible damage to the neural elements, which may compromise the functional outcome. Jönsson et al.[21] reported that a long preoperative duration of sciatica was associated with a poor outcome in patients with lateral spinal stenosis. Likewise, in our series, patients with prolonged preoperative symptoms were less satisfied with the results of surgery. The mean duration of preoperative symptoms in these patients was 48 months (range 31 to 60 months).

We suggest that decompression of the lumbar spine in spinal stenosis be extensive and concomitant spinal fusion be considered only in the presence of instability (i.e. degenerative spondylolisthesis, degenerative scoliosis) or high risk of intraoperative instability due to extensive decompression.

Most patients with degenerative lumbar spinal stenosis report relief of symptoms after decompressive surgery. Most of our patients were satisfied with the outcome of the operation, and we think that our results justify the patients' decision to try for an improved lifestyle through decompressive surgery. However, patients with long duration of preoperative symptoms had poor to fair results and were less satisfied with the results of the operation. Further studies with long-term follow-up are needed in order to evaluate the effects of surgery for lumbar spinal stenosis.

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