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LIMITED LAMINOTOMY AND SELECTIVE DECOMPRESSION IN DEGENERATIVE LUMBAR STENOSIS

DEJENERATİF LOMBER STENOZDA SINIRLI LAMİNEKTOMİ VE SELEKTİF DEKOMPRESYON

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SUMMARY:

Introduction: Degenerative lumbar stenosis is defined as narrowing of the spinal canal with symptomatic compression of neural and vascular elements. Consequently, persistent back pain and neurological symptoms becomes the indications for surgical treatment. The aim of the study is to evaluate the outcome of limited laminotomy and selective decompression in comparison to standard laminectomy and wide decompression in patients with degenerative lumbar stenosis.

Patients and Methods: We performed a retrospective study of 45 (38 female, 7 male) patients with degenerative lumbar stenosis who underwent decompressive surgery between 2003 and 2007. Standard laminectomy was performed in 31 patients, and limited laminotomy in 14 patients. Radiographic evaluation was performed using anteroposterior, lateral, and oblique radiographs. Any concomitant instability was assessed with additional dynamic lateral flexion and extension radiographs. Magnetic resonance imaging was used in all patients to demonstrate and evaluate the level and degree of stenosis. VAS was used to measure pain while walking and during daily activities and pain at rest and night.

Results: The mean age was 62.8 years (37-80) at surgery. Overall, a total number of 67 decompressions were performed. 26 (57.8%) patients were decompressed at one level, 16 (35.5%) at two levels, and 3 (6.7%) at three levels. A mean of 5.3 (2-15) segments were fused in limited laminotomy group, and a mean of 4.6 (3-9) segments in standard decompressive laminectomy group. The mean postoperative follow-up period was 45.7 months (8-84). VAS results improved from 8.5 to 2.2 at limited laminotomy group, and from 8 to 3.5 at wide decompression group. We have one surgery related complication as intraoperative cerebrospinal fluid leakage. No other complications occurred during follow-up period for two groups.

Conclusion: Limited laminotomy is an effective method for surgical treatment of degenerative lumbar stenosis. It provides adequate decompression and pain relief and improves quality of life.

Keywords: *Degenerative lumbar stenosis, laminectomy, decompression.*

Level of evidence: *Retrospective clinical study, Level III*

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ÖZET:

Giriş: Dejeneratif lomber dar kanal hastalığı, daralan kanal içinde nöral ve damarsal yapıların sıkışması ile karakterizedir. İlk tedavi yaklaşımı konservatif olmalıdır. Konservatif tedaviye rağmen devam eden bel ağrıları, nörolojik yakınma ve bulgular durumunda cerrahi tedaviye başvurulmaktadır. Çalışmamızın amacı sınırlı laminotomi ile sağlanan dekompresyonun etkinliğini ve sonuçlarını, standart laminektomi ve dekompresyon sonuçlarıyla karşılaştırılarak değerlendirmektir .

Hastalar ve Yöntem: 2003-2007 yılları arasında, dejeneratif lomber dar kanal nedeniyle cerrahi tedavi uygulanmış, 38 kadın, 7 erkek toplam 45 hasta çalışmaya alındı. 31 hastada klasik standart laminektomi, 14 hastada sınırlı laminotomi ile dekompresyon yapıldı. Radyolojik değerlendirmede ön-arka, yan ve oblik radyografiler çekildi. İnstabilite varlığını araştırmak için fleksiyonda ve ekstansiyonda dinamik yan radyografiler çekildi. Cerrahi tedavi öncesinde darlık seviyeleri ve derecesi manyetik rezonans görüntüleme ile araştırıldı. Hastaların ağrılarının değerlendirilmesi için, aktivite ve istirahat halindeki VAS değerleri kullanıldı.

Sonuç: Cerrahi sırasındaki ortalama yaş 62.8 (37-80) yıl idi. Her iki grupta toplam 67 seviyedeki darlığa cerrahi müdahale uygulandı. 26 (%57,8) hastada tek seviye, 16 (%35,5) hastada iki seviye ve 3 (%6,7) hastada üç seviye cerrahi uygulandı. Sınırlı laminotomi uygulanan grupta ortalama 5,3 (2-15) omur füzyonu yapılırken, standart laminektomi grubunda 4.6 (3-9) omur füzyonu yapıldı. Cerrahi sonrası ortalama takip süresi 45.7 (8-84) ay olarak hesaplandı. Sınırlı laminotomi grubunda cerrahi sonrası VAS değerleri 8,5'tan 2,2'ye gerilemişken, standart laminektomi grubunda bu değer 8'den 3,5'a verileceği görüldü. Standart laminektomi uygulanan bir hastada iyatrojenik dura yaralanması gözlendi. Takipler sırasında her iki grupta da başka bir komplikasyon görülmedi.

Tartışma: Lomber dar kanal tedavisinde sınırlı laminotomi başarılı bir cerrahi tedavi yöntemidir. Sınırlı laminotomi ile yeterli dekompresyon sağlanabilmekte ve yüksek oranda hasta memnuniyeti sağlamaktadır.

Anahtar Kelimeler: *Dejeneratif lomber dar kanal, laminektomi, dekompresyon.*

Kanıt Düzeyi: *Retrospektif klinik çalışma, Düzey III.*

INTRODUCTION:

Degenerative lumbar stenosis is defined as narrowing of the spinal canal with symptomatic compression of neural and vascular elements. Almost in every case there is some kind of hypertrophy of the yellow ligament, degeneration of the intervertebral discs and synovial facet joints. Conservative treatment is the first choice in patients with spinal stenosis where the common complaint is severe low back pain. The mainstays of this treatment include the use of a brace, medication, activity modification, physical therapy and epidural injections. The majority of the complaints resolve within one year without surgical intervention [18,23]. Some patients become worse with increased frequency of symptoms and decreased ambulation potential. Consequently, persistent back pain and neurological symptoms becomes the indications for surgical treatment.

Surgery of lumbar stenosis includes standard wide decompression which involves complete removal of the vertebral lamina, spinous processes, interspinous ligaments, facet joints, and ligamentum flavum at the stenotic level. Traditional wide decompressive laminectomy, medial facetectomy and foraminotomy have been used with varying degrees of success [13,27,29,36]. This extensive open decompression is associated with significant pain, morbidity, prolonged recovery period and increased risk for medical complications. By sparing as much as possible the lamina, spinous processes and interspinous ligamentous complex, limited laminotomy preserves the biomechanical integrity of the spine while maintaining a good long term outcome rate of 79% to 85% [2]. Some authors advocate limited decompression [3,14,16,24,28] when the others favor more extensive laminectomy [7,15,19] despite of increased morbidity.

The aim of the study is to evaluate the outcome of limited laminotomy and selective decompression in comparison to standard laminectomy and wide decompression in patients with degenerative lumbar stenosis.

PATIENTS AND METHODS:

We performed a retrospective clinical study of 45 patients with degenerative lumbar spinal stenosis who underwent decompressive surgery between 2003 and 2007, by the senior orthopaedic surgeon (UD) at our institution. Standard decompressive lumbar laminectomy was performed in 31 patients, and limited laminotomy sparing spinous processes was performed in 14 patients, consecutively.

All patients had degenerative lumbar spinal canal stenosis presenting with clinical signs and symptoms, persistent back pain, typical intermittent neurogenic claudication, and radicular pain related to exercise and increased activity.

Radiographic evaluations were made by preoperative anteroposterior, lateral, and oblique radiographs with the patient recumbent. Any concomitant instability was assessed with additional dynamic lateral flexion and extension radiographs. Magnetic resonance imaging (MRI) was used in all patients to demonstrate the level and degree of stenosis. Computerized tomography (CT) scans were also used in some patients and routine myelography was not performed for this group of patients.

Exclusion criteria were previous spine surgery, gross instability in radiographs, and developmental spinal deformities. Before surgery, all patients had undergone an unsuccessful attempt of conservative therapy for more than 3 months.

All patients were evaluated for symptom characteristics and severity with Visual Analog Scale (VAS), whereas their satisfaction was surveyed with the subjective satisfaction measure.

VAS was used to measure pain at rest, pain while walking, pain at night, and pain during daily activities. A combined VAS score was then calculated by adding the four scales together [33].

Operative procedure:

After induction of hypotensive general anesthesia, the patient is positioned on a support frame in prone position. The hips and lumbar spine are flexed increasing interlaminar distance, placing the vertebral canal in widest arrangement, and decreasing the intraabdominal pressure which reduces potential epidural venous bleeding. The patient is fitted with tromboembolic preventive stockings. A midline posterior skin incision is made over the affected stenotic segments. Subperiosteal dissection of the paraspinal muscles from spinous process and lamina is made. Surgical levels are verified with lateral radiographs or fluoroscopy guidance.

Laminotomy is started at interlaminar area nearby the spinous process. Ipsilateral cephalad and caudal parts of the hemilaminae are resected using a high speed burr to extend surgical exposure (Figure-1). Hypertrophied yellow ligament is removed with Kerrison rongeurs. Medial partial facetectomy is carried out to decompress the affected nerve root, until the pedicle could be identified. Lateral recess and neural foramina are decompressed using Kerrison rongeurs. Central and foraminal decompression are checked with dural retractor. Care is made to avoid excessive bone resection of the medial facets. All lateral recesses in which nerve roots entrapped are decompressed.

All spinous processes are removed with the attached interspinous and supraspinous ligaments in standard decompressive laminectomy group, allowing decompression of the central canal, both lateral recesses, and neural foraminae. Laminectomy is performed for only stenotic segments.

Segmental pedicle screw fixation is used to prevent the risk of postoperative instability and to provide immediate stabilization. We routinely used cancellous allograft between transvers processes to improve the rate of posterolateral spinal fusion.

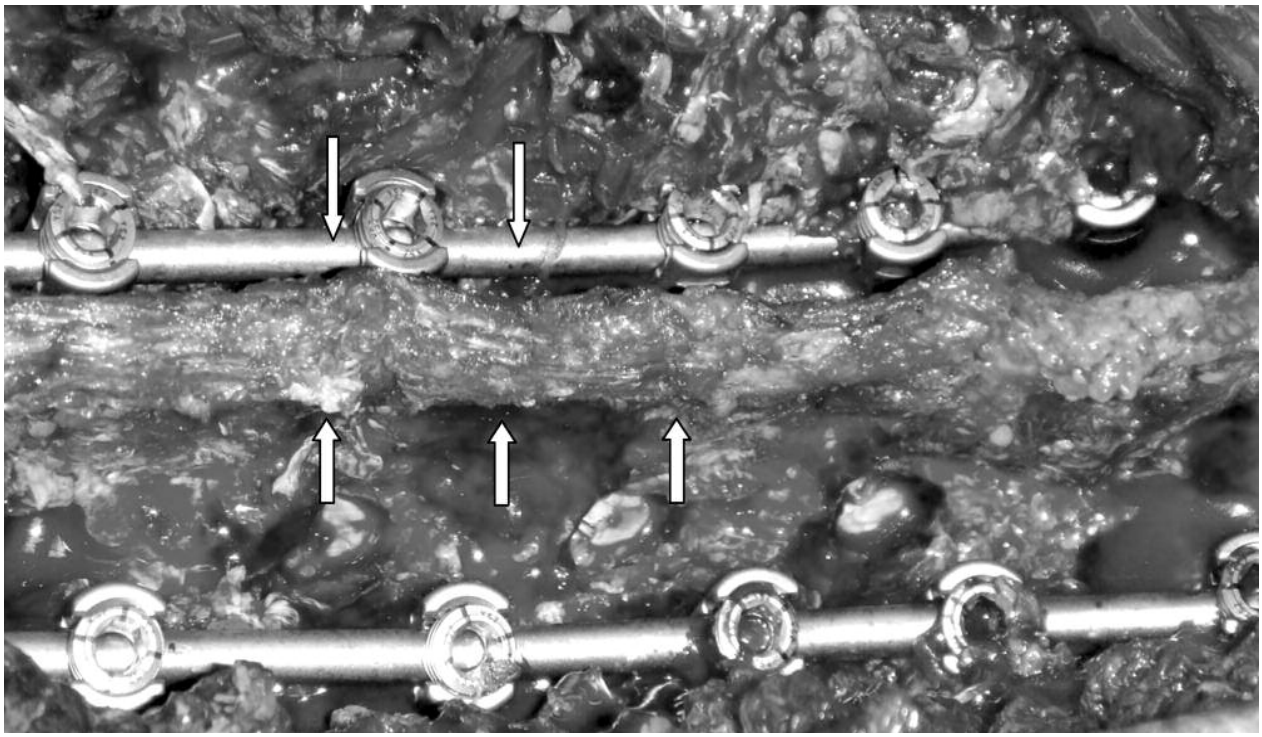

Figure-1. 54 years old man. Lumbar spinal stenosis. L2-5 limited laminotomy and T10-L5 posterior instrumentation. White arrows show limited laminotomy area. Intact spinous processes and posterior structures are showed by yellow arrows.

RESULTS:

Overall, a total number of 67 decompressions were performed in 45 patients. 26 (57.8 %) patients were decompressed at one level, 16 (35.5 %) patients at two levels, and 3 (6.7 %) patients at three levels.

14 (31 %) patients received limited laminotomy sparing spinous processes, and 31 (69 %) patients received standard decompressive laminectomy.

We observed a female predominance, with 38 (84.4 %) women and 7 (15.6 %) men. The mean age was 62.8 years at surgery (range, 37-80 years). The mean postoperative follow-up period was 45.7 months (range, 8-84 months). The average number of segments fused was 5.3 (range, 2-15 segments) in limited laminotomy group, and 4.6 (range, 3-9 segments) in standard decompressive laminectomy group, respectively (Figure-2).

The most affected level was L4-5 (43 %) followed by L3-4 (32 %) in our patient groups. The most frequent preoperative clinical complaints were neurogenic claudication, back pain, and radicular pain in some patients.

We have confronted only one surgery related complication. It was intraoperative cerebrospinal fluid leakage due to dural tear. We performed primary repair of the dural tear at surgery with expansion of the operative field. We used fibrin glue on the operating field before the wound closure. We did not have any other complications during follow-up period related to surgery.

Patients started to stand and walk at an average of 2 (range, 1-3) days after surgery. There were no neurological complications in both groups.

VAS score results improved from 8.5 to 2.2 at limited laminotomy group and from 7.5 to 3.5 at standard wide decompression group (Table-1).

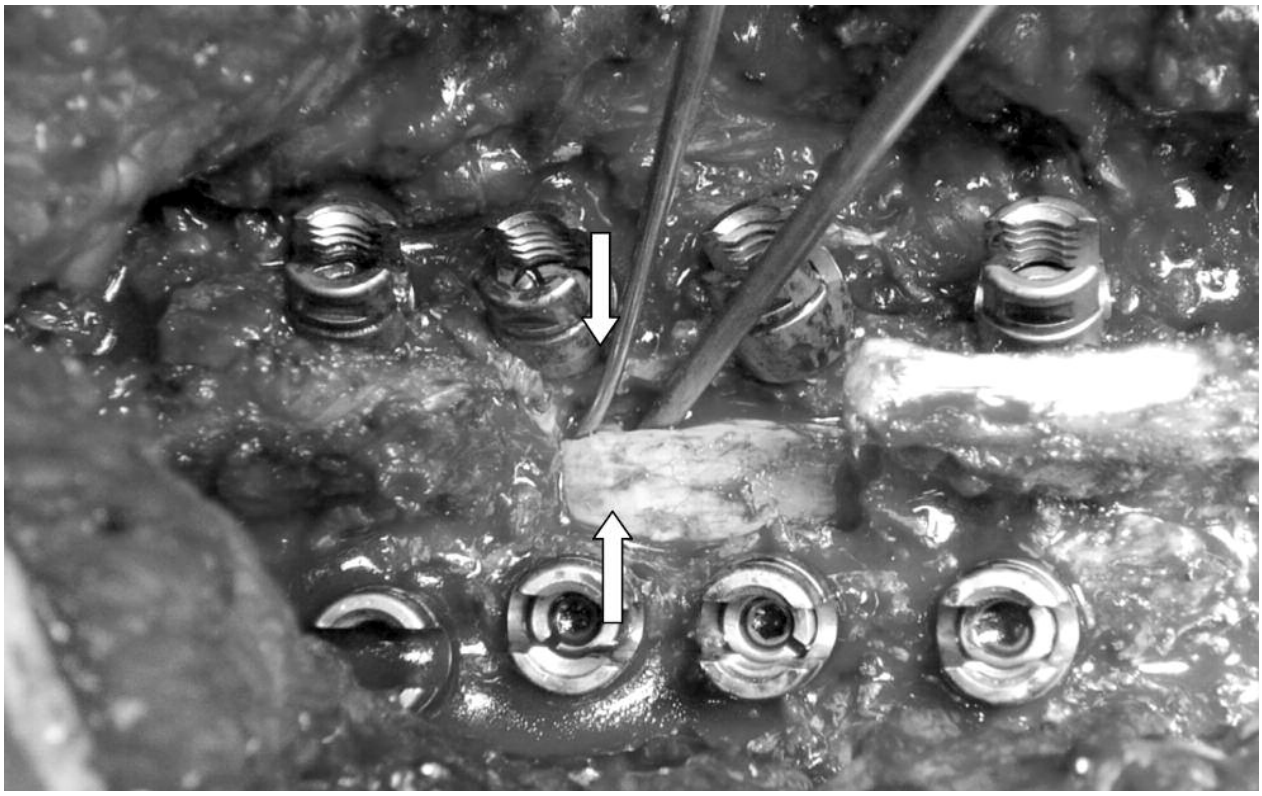

Figure-2. 50 years old female. Lumbar spinal stenosis. L3-4 standard decompressive laminectomy and L2-5 posterior enstrumantation. White arrows show standard laminectomy area without sparing posterior structures. Decompression is checked with dural retractor.

Postoperative VAS result was better at limited laminotomy group. All patients were mobilized following day after surgery in limited laminotomy group. This period was shorter than the standard laminectomy group.

Table-1. Data of the patients

	Number of patients	Total stenotic segment	Mean fusion length (segments)	Preop VAS	Postop VAS
Limited laminotomy	14	17	5.3	8.5	2.2
Standard laminectomy	31	50	4.6	7.5	3.5

Patient satisfaction was surveyed with the subjective satisfaction measures. Rapid recovery time and good quality of life was achieved in all patients with limited laminotomy. Patients were not satisfied with the results of wide decompression at the standard laminectomy group in early postoperative period. All patients reported improvement in their complaints and neurologic symptoms at the last follow-up for both groups.

DISCUSSION:

Lumbar spinal canal stenosis has been used to indicate stenosis of the entire cross-sectional area of the vertebral canal. It occurs frequently in elderly patients. Surgical indications are the persistent signs and symptoms of moderate or severe compression of the nerves. The quality of life is decreased in patients with spinal canal stenosis. Mild cases are treated successfully with conservative modalities [18,23].

Current studies report variable success rates for surgical intervention in the treatment of spinal stenosis [8,11-12,24,34]. The goal of the surgery is decompression of all neural structures. Although the pathophysiology is well known, there is no consensus for proper decompression technique. Total laminectomy is the standard method including removal of spinous processes, hypertrophied ligamentum flavum and medial aspect of facet joints. Good surgical outcomes can be achieved with balanced bone resection.

Recent studies showed 2 % to 15 % instability rates after decompression [31,35]. Therefore other studies suggest decompression with fusion to decrease segmental instability [7,15]. Pintar et al showed that interspinous and supraspinous ligaments have restrictive role in maintaining the motion segment's integrity under flexion loading [1]. Biomechanically, excision of the posterior structures and facetectomy affects the motion and induces additional stresses to the remaining components of the spine [1,10,20,26]. Lee et al noticed that facetectomy would lead to segmental instability under physiological loadings. Arthrodesis is required to minimize postoperative complications and to increase patient's satisfaction [20].

Spine surgeons are looking for new techniques between the wide decompression and minimal excision of the posterior structures. Although some authors advocate more conservative decompression [3,14,16,24,28] others advocate excessive decompression [7,15,19]. Unilateral or bilateral laminotomy techniques were described for conservative decompression. These surgical techniques are reported to be effective as much as wide decompression with total laminectomy. There is no statistical difference for pain and complication rates between total laminectomy and conservative decompression techniques [5,9,16, 25].

Thome et. al. compared less invasive three surgical techniques; unilateral laminotomy, bilateral laminotomy and laminectomy [32]. They concluded that unilateral and bilateral laminotomy allow adequate decompression and significantly reduce clinical symptoms. Limited laminotomy allows as much as wide decompression compared to classical laminectomy. Posterior elements, spinous processes, interspinous and supraspinous

ligaments remain intact with limited laminotomy. Segmental stability is augmented with posterolateral fusion. Some authors advocate that decompression procedure alone can cause segmental instability. Residual mobility of the adjacent vertebrae can cause stenosis after posterior fixation and fusion [21]. We believe that the protection of the posterior spinal elements as much as possible can resolve this problem.

Some authors demonstrated that surgical outcomes were significantly better in relief of pain in patients who had posterolateral fusion [17,22,30]. Few authors advocate that they had good clinical results after decompression alone [6]. Recent studies showed improved fusion rate after posterior segmental instrumentation [7]. Persistent neurologic symptoms resolved at the last follow-up for both groups. Patient's satisfaction was higher in limited laminotomy group. Posterolateral instrumentation and fusion was performed without any pseudoarthrosis in all patients. All patients started to walk the day after the operation in limited laminotomy group. This is not true for the standard laminectomy group. Early mobilization reduces complications caused by immobilization and contributes to an improved quality of life.

Limited laminotomy is an effective method for surgical treatment of lumbar spinal stenosis. It provides adequate anatomical decompression, clinical pain relief and contributes to an improved quality of life. Persistent neurological symptoms resolved at the last follow-up for both groups. Complication rate is low and similar for both groups. Patients with limited laminotomy have shorter hospital stay.

This study was limited in some aspects since it was not randomized and we did not have biomechanical evaluation of the patients.

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