



## 270° FUSION FOLLOWING DECOMPRESSION WITH UNILATERAL HEMILAMINECTOMY: A NOVEL TECHNIQUE FOR THE SURGICAL TREATMENT OF DEGENERATIVE LUMBAR SPINAL STENOSIS IN MIDDLE-AGED PATIENTS

TEK TARAFLI HEMİLAMİNEKTOMİ İLE DEKOMPRESYONU TAKİBEN 270° FÜZYON: ORTA YAŞ HASTALAR DAKİ DEJENERATİF LOMBER SPİNAL STENOZ İÇİN YENİ BİR TEKNİK

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### SUMMARY:

*Introduction: The purpose of the study is to present a new surgical technique in the surgical treatment of degenerative lumbar spinal stenosis in middle-aged patient population in whom there is central canal stenosis requiring intervertebral disc removal and stabilization with or without involvement of the nerve roots.*

*Materials and Methods: Twelve patients with symptomatic degenerative lumbar spinal stenosis were treated in our center. Plain X-rays including dynamic views, CT, myelo-CT, axial loading CT, axial loading MRI and neurophysiologic studies were performed. Postoperative follow-up data were gathered by means of VAS, Oswestry score and patients'*

*declaration of satisfaction. In the surgery, after posterior pedicle screw instrumentation of the effected levels; following procedures were done in order: unilateral hemilaminectomy in the effected or symptomatic side, removal of ipsilateral ligamentum flavum, removal of the contralateral ligamentum flavum as well as cortical bone on the ventral surface of the spinous processes, ipsilateral facetectomy, intervertebral disc removal and interbody fusion then finally contralateral posterior fusion.*

*Results: The patients comprised 7 women and 5 men with a mean age of 57 (range; 52 to 63) years. The mean postoperative follow-up was 24 months. Seven patients underwent hemilaminectomies at two adjacent levels, 3 at*

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three levels, one at four levels and one at five levels. The average hospital stay was 6.2 days. The VAS score decreased from 9.6 to 2.8 and Oswestry Score from 28.5 to 8 at follow-up review. All patients had satisfied with the procedure. During the follow-up period; no pseudoarthrosis, no infection and no neurological events were seen.

**Conclusion:** The results from this initial study of a new surgical intervention for the treatment of lumbar stenosis appear encouraging. Discectomy and interbody fusion, and

contralateral decompression via unilateral approach prevents the formation of dead space. The procedure appears safe with very few complications, minimal blood loss, and brief hospital stays. However, more definitive conclusions about its success will require a long-term follow-up review and a prospective randomized study of the procedure.

**Key words:** Spinal stenosis, surgical treatment, fusion, posterior instrumentation

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

## **ÖZET:**

*Giriş: Bu çalışmanın amacı, sinir tulumu olsun olmasın merkezi kanal darlığı yapan intervertebral diskin çıkartılması ve omurganın stabilizasyonu gereken orta yaş dejeneratif lomber spinal stenozu olan hastaların cerrahi tedavisinde yeni bir tekniği sunmaktır.*

*Materyal-Metot: Merkezimizde semptomatik dejeneratif lomber spinal stenozu olan 12 hasta tedavi edilmiştir. Bunların dinamik röntgen, bilgisayarlı tomografi (BT), myelo-BT,eksiyel yüklenme BT, aksiyel yüklenme MR incelemesi ve nörofizyolojik çalışmaları yapılmıştır. Hastaların memnuniyetinin belirlenmesi için VS ve Oswestry skorları (ODS) hesaplanmıştır. Cerrahide tutulum düzeylerine posterior pediküler vida enstrümantasyonunu takiben, tutulan taraftaki faset eklem çıkartılıp, spinöz prosesin ventral yüzü, her iki taraftaki ligamentum flavum, disk çokartılmış, hemilaminektomi yapılan tarafa cisimler arası füzyon karşı tarafta posteriyor füzyon uygulanmıştır.*

*Sonuçlar: Hastaları 7'si kadın, 5'i erkek olup, ortalama yaş 57 (52-63)'dir. 7 hastaya 2, 3 hastaya 3, birer hastaya 4 ve 5 seviye hemilaminektomi yapılmıştır. Son kontrolde VAS skoru 9.6'dan 2.3'e ve ODS ise 28.5'dan 8'e inmiştir. Tüm hastalar işlemden memnun kalmıştır. Hiç bir hastada psödoartroz, enfeksiyon ve nöral bozukluğa rastlanmamıştır.*

*Çıkarımlar: Lomber stenozun bu yeni cerrahi tedavisinin sonuçları cesaret verici bulunmuştur. Diskektomi ve cisimler arası füzyon ve karşı taraf posterior füzyon uygulaması ile klasik dekompresyonda oluşan ölü boşluk oluşumu minimize edilmiştir. İşlem güvenli olup, daha az kan kaybına yol açmakta ve daha aza hastanede yatış ve minimal komplikasyona neden olmaktadır. Ancak kesin bir yargıya varmak için uzun dönem ve prospektif çalışmalara da ihtiyaç vardır.*

**Anahtar Kelimeler:** Spinal stenoz, cerrahi tedavi, füzyon, posterior enstrümantasyon.

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

## INTRODUCTION:

Posterolateral fusion (PLF) is one of the frequently done procedure for pain relief and decrease of the disability in patients who suffer from lumbar spinal stenosis<sup>(23)</sup>. Rates of fusion and success vary with diagnosis, number of levels fused, and number of prior surgeries and prior fusion attempts<sup>(24-27)</sup>. Fusion rates may reach 80-90% when transpedicular instrumentation is added<sup>(12)</sup>. Performing fusions are the treatment of choice for lumbar spinal stenosis and anterior lumbar interbody fusions (ALIF) and posterior lumbar interbody fusions (PLIF) have become more popular<sup>(12,18-19)</sup>.

ALIF combined with PLF and transpedicular instrumentation, commonly called circumferential or 360° fusion, has a high fusion rate and a high level of patient satisfaction<sup>(7-8,13,15,21)</sup>. However, it requires two surgeries, is expensive, and in some patients the bone graft in the posterolateral gutters does not form a solid arthrodesis, from which it might be inferred that ALIF is the more important structural component<sup>(9)</sup>. Therefore, ALIF plus transpedicular instrumentation without PLF the so called “270° fusion” have previously been introduced<sup>(20)</sup>.

PLIF, on the other hand, has the advantages of restoring the disc height, immobilizing the unstable degenerated intervertebral disc area, decompressing the nerve roots, and restoring load bearing to anterior structures<sup>(2)</sup>. As a routine standard PLIF technique, the use of two cages have become popular<sup>(4,6)</sup>. However, while inserting two appropriate sized cages from posterior, extensive laminectomy and bilateral facetectomy is mandatory, which may cause iatrogenic instability of the posterior elements, and this is why additional pedicle screw fixation is highly recommended<sup>(10,14)</sup>. Wide exposure causing lumbar musculoligamentous complex

injury may lead to poor postoperative outcomes<sup>(1)</sup>.

In order not to damage the posterior stabilizing structures of the vertebral column, we present a novel 270° fusion technique for patients suffering from lumbar spinal stenosis with or without nerve root involvement.

## MATERIALS AND METHODS:

Twelve patients with symptomatic degenerative lumbar spinal stenosis unresponsive to conservative treatments for at least six months were operated in our center. Patients who had a structural problem potentially amenable to fusion, had failed conservative care, and had no psychological contraindications for surgery were included to study. There were 7 female and 5 male patients, with a mean age of 57 (range; 52 to 63) years. Plain X-rays including dynamic views, computed tomography (CT), myelo-CT, axial loading CT, axial loading magnetic resonance imaging (MRI) and neurophysiologic studies were performed. Postoperative follow-up data were gathered by means of visual analog scale (VAS), and Oswestry low back disability questionnaire (OSI). Patient satisfaction was evaluated by asking them, “Would you have the same treatment again for the same outcome?”. Their response was evaluated as “Yes” or “No”.

### *Surgical technique:*

The patients were operated in the prone position and under general anesthesia. After a posterior midline is performed, the paravertebral muscle of the symptomatic side was split and retracted laterally. Pedicle screws were inserted at the effected levels. Unilateral hemilaminectomy in the effected is performed. The ipsilateral ligamentum flavum is removed.

Then, the contralateral ligamentum flavum as well as cortical bone on the ventral surface of the spinous processes are removed. After ipsilateral facetectomy, the intervertebral disc is excised and interbody fusion via cages and allogeneous grafts is performed. These steps are followed by posterior fusion of the contralateral side (*figure-1*). After posterior-anterior fluoroscopic control, and complete hemostasis, the wound was closed in layers in the usual fashion. On the first postoperative day, all patients were allowed to ambulate with a lumbar orthosis, which was usually worn for 1-2 months. The Student's t-test was used for statistical analysis.  $p < 0.05$  was considered to be statistically significant.

#### RESULTS:

The mean postoperative follow-up was 24 (range, 22-34) months. Seven patients underwent hemilaminectomies at two adjacent levels, 3 at three levels, one at four levels and one at four levels. The average hospital stay was 6.2 (range, 5-8) days. The preoperative VAS score decreased from 9.6 to 2.8 ( $p < .05$ ) and the preoperative Oswestry disability index decreased from 28.5 to 8 at the last follow-up ( $p < .05$ ). All patients were satisfied with the

procedure and answered the declaration of satisfaction as "Yes". During the follow-up period; no pseudoarthrosis, no infection and no neurological events were recorded. Radiologically, fusion was assessed via CT scans, and found to be fused completely in all of the patients. Stability assessment was done by obtaining dynamic flexion-extension lateral lumbar views. There were no plain radiographic signs of angular instability in any patient.

#### DISCUSSION:

The choice of lumbar fusion technique must be individualized based on the clinical needs of each patient, the reported outcomes for each procedure, and the individual skills and experience of the surgeon. PLF remains popular. Fusion rates vary, but they are generally acceptable and have improved with the addition of transpedicular instrumentation<sup>(26)</sup>. PLF is effective for spondylolisthesis and for instability after wide decompression for spinal stenosis, but results for discogenic pain are variable (26-27). PLF may not restore the disc space height or sagittal segmental alignment, even when spinal instrumentation is used.

Interbody fusion has become more popular for discogenic pain<sup>(18-19)</sup>. Because outcomes for



**Figure-1. a and b.** 58 years old male patients surgically treated by 270 degrees fusion and decompression.

stand-alone ALIF are fair at best, interbody fusion cages placed either via an anterior or posterior approach have become popular<sup>(19,23)</sup>. However, interbody fusion cages are not well suited for patients with large disc spaces because of concerns with implants loosening, and it is not possible to be sure if the fusion is solid because of the radiographic artifact produced by the cages<sup>(5,11)</sup>.

Bilateral facetectomy and wide laminectomy is needed for bilateral placement of the cage to the disc space in the PLIF procedure. Therefore, supplementation by spinal instrumentation is recommended<sup>(14,22)</sup>. Also, iatrogenic neuropathic pain caused by the retraction of the cauda equina during the placement of the cages have been reported<sup>(28)</sup>. Extensive decompression with removal of most of the posterior elements may lead to a significant loss of stiffness. And, this may also result in a loss of the lumbar lordosis<sup>(28)</sup>.

Circumferential fusion became popular as both a primary fusion technique and as a salvage procedure<sup>(7-8,13)</sup>. It allows nearly complete discectomy for discogenic pain, full decompression of severe foraminal or central stenosis, inspection of the spinal canal, and removal of large disc extrusions or fragments. There is a high fusion rate and a high degree of patient satisfaction reported to be 90-100 % and 72-80 %, respectively<sup>(7-8,21)</sup>. However, 360° fusion requires two surgeries, one anterior and one posterior. Additionally, excessive dissection and retraction of the paravertebral musculature may lead to denervation and muscle atrophy, which may cause poor postoperative results. Extensive facetectomy, on the other hand, may be another cause of prolonged postoperative disability.

Transforaminal lumbar interbody fusion (TLIF), in which the intervertebral access is

through the neural foramen unilaterally, is another surgical method to achieve successful fusion<sup>(16-17)</sup>. Even this approach has the disadvantage of a wide exposure. Blume was the first introducer of a unilateral PLIF with a bone dowel and cancellous bone chips<sup>(3)</sup>. With this technique, there is a risk of graft resorption and disc space collapse, which has led many surgeons to add posterior instrumentation to stabilize the construct.

Obliquely placed single threaded interbody fusion cage placed via a unilateral hemilaminectomy have been reported to maintain the important supporting posterior spinal structures<sup>(28)</sup>. And this unilateral facetectomy and hemilaminectomy method was found to be stiffer than the insertion of two cages through a bilateral facetectomy and laminectomy<sup>(28)</sup>.

The method we have presented in this study, allows us to protect most of the posterior spinal structures, such as the spinous processes and all the structures on the contralateral side. Two cages can be used even in this unilateral approach. Decompression of the unilateral stenosis can be achieved without major complication. A standard simple disc herniation procedure is composed of a unilateral partial hemilaminectomy and medial facetectomy. We think that via this approach decompression and insertion of two cages for a PLIF procedure is quite enough. Although the remaining posterior structures may maintain their supporting behaviour we additionally inserted pedicle screws routinely in order to augment the construct. In order to achieve a solid fusion, adequate grafting is crucial. With the present technique, bone graft can be implanted into the contralateral intervertebral space before the insertion of the cage, with no difficulty and no risk of graft retropulsion.

Our primary indication for this novel technique was degenerative lumbar spinal stenosis in middle-aged patients in whom there was central canal stenosis requiring intervertebral disc removal and stabilization, with or without involvement of the nerve roots. Both symptoms can be managed successfully by this technique without the need for a circumferential fusion. Instability with a normal disc height, spondylolisthesis and bilateral foraminal stenosis requiring bilateral decompression are the limitations of this technique.

In conclusion, we think that, the results from this initial study of a new surgical intervention for the treatment of lumbar stenosis appear encouraging. Discectomy and interbody fusion and contralateral decompression via unilateral approach prevents the formation of dead space. The procedure appears safe with very few complications, minimal blood loss, and brief hospital stays. However, more definitive conclusions about its success will require a long-term follow-up and a prospective randomized study design.

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