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EFFECTIVITY OF INTERBODY FUSION PROCEDURE IN DEGENERATIVE SPINE DISEASES

DEJENERATİF OMURGA HASTALIKLARINDA CİSİMLERARASI FÜZYONUN ETKİNLİĞİ

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ABSTRACT

Objective: The effectively of interbody fusion as a surgical treatment option on the degenerative spine disease and assessment of results.

Patients and Methods: 56 patients who were diagnosed with degenerative spine and treated using interbody fusion in our institute. Anterior-posterior projection and lateral lumbosacral and CT projections were used for radiologic evaluation of patients. Preoperative and postoperative intervertebral disc height, lumbar and segmental lordosis angle and fusion were measured for radiological assessment. Preoperative and postoperative VAS and ODI scores were measured for functional assessment.

Results: Decreases in VAS and ODI scores before and after operation were significant. Increases in intervertebral disc height and lumbar lordosis angle before and after operation were significant. In all patients we have seen circumferential fusion. Adjacent segment degeneration reported in 19 patients. But ODI scores and lumbar lordosis angles between patients who had ASD and no ASD were not significant.

Conclusions: We found effectiveness interbody fusion procedure in our study for the treatment of degenerative spine disease.

Key words: Degenerative lumbar diseases, surgical treatment, fusion, interbody fusion

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Dejeneratif omurga hastalıkları cerrahi tedavileri arasında yer alan cisimler arası füzyon ameliyatının sonuçları ve etkinliğinin değerlendirilmesi.

Hastalar ve Yöntemler: 1995 - 2010 tarihleri arasında kliniğimize başvuran, dejeneratif omurga hastalığı tanısı konulup posterior yaklaşımla cisimler arası füzyon ameliyatı yapılan 56 hasta retrospektif olarak değerlendirildi. Hastaların radyografik ölçümlerinde standart olarak çekilen lumbosakral AP-lateral, lumbosakral lateral fleksiyon ve ekstansiyon grafileri ile bilgisayarlı tomografi kesitleri kullanıldı. Hastaların radyografik değerlendirilmesinde, preop ve postoperatif intervertebral disk yükseklikleri, lomber ve segmental lordoz açıları ile kaynama durumlarına bakıldı. Hastaların fonksiyonel değerlendirilmesinde ODI ve VAS skorları kullanıldı.

Sonuçlar: Hastaların preop VAS değerleri ve ODI skorlarında postoperatif anlamlı olarak iyileşme saptandı. Hastaların preop intervertebral disk yükseklikleri, lomber lordoz açılarında postoperatif anlamlı olarak artış ve iyileşme görüldü. Hastaların tümünde son kontrollerde tam füzyon elde edildiği görüldü. 56 hastanın 19'unda KSD saptandı. KSD ile ODI skorları ve lomber lordoz açıları arasında anlamlı bir ilişki saptanmadı.

Sonuç: Dejeneratif omurga hastalığının cerrahi tedavisinde anterior destek yerleştirilerek elde edilen cisimler arası füzyon işlemi diskojenik ağrıların giderilmesi, orjinal disk yükseklikleri ve foramen çaplarının korunması ile sagittal dengenin geri kazanılmasında etkin ve güvenilir bir yöntemdir.

Anahtar Kelimeler: Dejeneratif lomber hastalıklar, cerrahi tedavi, füzyon, cisimler arası füzyon

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION:

A degenerative spine may cause various complaints and symptoms, for which objective examination findings are hard to come by. In many cases, findings obtained by methods such as computed tomography or magnetic resonance imaging may not accord with clinical ones[21].

During the process of degeneration, the spine goes through the following morphological stages: dysfunction, instability and immobilization. Disk degeneration eliminates the hydrostatic quality of the disk, as a result of which, it loses its resistance to physiological loads and triggers simultaneous degenerative changes in facet joints. In sum, a set of complex pathologies occur, such as subchondral sclerosis, osteophytes, closer anterior vertebral bodies, and spinal canal stenosis[3]. These may be regarded a natural result of spinal aging. The etiology of disk degeneration and concomitant degenerative spine diseases is not yet clear, and despite the many treatment options that exist, their effectiveness is still debated.

In this study, we investigated the effectiveness of interbody fusion surgery performed in our clinic by evaluating pre- and postoperative pain and life comfort experienced by patients, and intervertebral disk space and union in postoperative follow-up.

PATIENTS AND METHOD:

Here, we retrospectively investigated the files of a total of 56 patients with a mean age of 54,4 years (21-77) who had been diagnosed with degenerative spine disease and underwent posterior interbody fusion surgery at Istanbul University Istanbul Medical School, Department of Orthopaedics and Traumatology between January 1995 and January 2010. Patient assessment included preop anamnesis and epicrisis information, clinical examination findings, direct graphs, MR and CT images. In the final control, all patients were assessed with respect to clinical examination findings, direct graphs and CT images. Clinical assessment relied on VAS and ODI scoring. In all patients' preop and postoperative lumbosacral lateral graphs, intervertebral disk space was taken as the distance between the upper and lower end-plates in the middle of disk balance. Lordosis angle and segmental lordosis angles were measured from preop and postoperative standing lateral lumbar graphs. Lumbar lordosis angle was determined by measuring the angle between a perpendicular line to one drawn from the upper plate of the first vertebra and a similar perpendicular line to one drawn from the upper end-plate of the first sacral vertebra. Segmental lordosis angle was determined by measuring the angle between a perpendicular line to one drawn from the upper end-plate of the upper vertebra of the segment that received interbody fusion and a similar perpendicular line to one drawn from the lower end-plate of the lower vertebra (Figure-1).

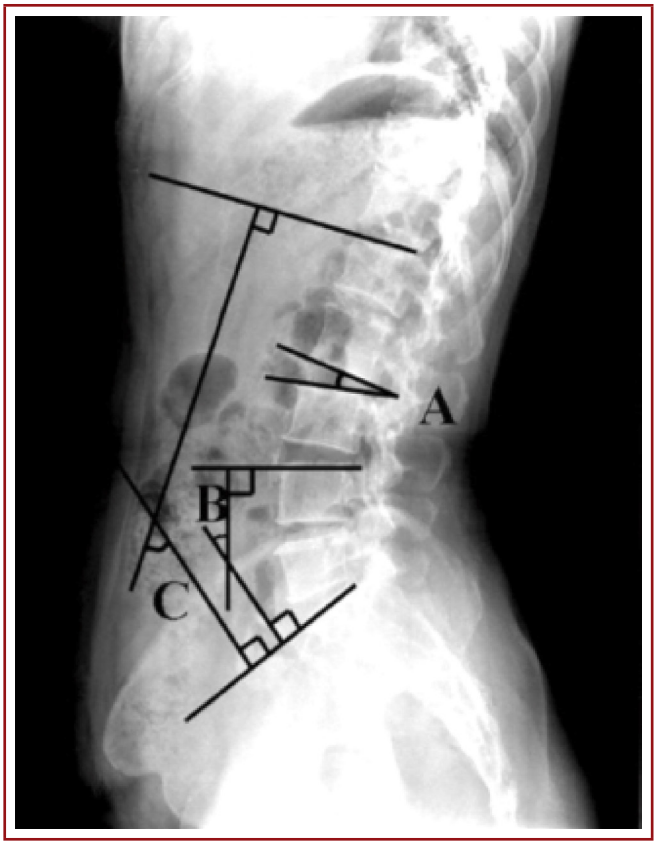

Figure-1. Measurement of lumbar lordosis angle and segmental lordosis angle

Full fusion was accepted when final postoperative follow-up lateral graphs and computed tomography displayed bone bridge between the two vertebra in the fusion area, and flexion extension graphs showed no movement.

The age range of our patients was 21-77 years, with a mean of 54.4. Of our 56 cases, 41 (73 %) were female and 15 (27 %) male. Patients were followed for an average of 66 months (8-230 months). Etiology was specified as spinal stenosis in 25 patients, degenerative spondylolisthesis in 14, novo scoliosis in 2, and discogenic pain related to degenerative disk disease in 15. Twenty eight patients underwent PLIF, and the remaining 28 underwent TLIF surgery. While 39 patients received single level interbody fusion, 17 received double level interbody fusion. All patients received posterior instrumentation with pedicle screws in the same session as interbody fusion. The distribution of posterior instrumentation level by patient number is displayed in the table.

The results were analyzed by using SPSS (Statistical Package for Social Sciences) for Windows 12.0. In addition to descriptive statistics (mean and standard deviation), student t-test and Paired Sample t tests were used t compare quantitative data. Qualitative data, on the other hand, were compared by using the Chi-Square and Fisher's Exact Chi-

Square tests. The results were evaluated in a 95% confidence interval, and p<0,05 was considered significant.

In the visual analog scale used for pain assessment, the visual preop mean value was 7,4 and postoperative 2,9. The ODI survey given out to measure functional assessment revealed a preop high of 91 and low 60 (mean 74,5), while the postoperative high was 66 and low 9 (mean 31,2).

RESULTS:

During clinical examination, preop and postoperative VAS mean scores were found as 7,4 and 2,9, respectively. The change in the VAS scores was significant (p<0,05). The preop-postoperative ODI mean scores of patients were 74,5 and 31,23, respectively. The change in ODI scores was also significant (p<0,05).

The lateral lumbosacral graphs of our patients revealed preop intervertebral disk heights between minimum 2 mm and maximum 11 mm (mean 5,46 mm), while postoperative heights ranged between minimum 8 mm and maximum 15 mm (mean 11.18).

In preop standing lateral x-rays, patients' lumbar lordosis angles ranged between minimum 4 and maximum 37 (mean 20,34) and, in postoperative, they ranged between minimum 12 and maximum 51 (mean 32.41). The difference between preop and postoperative lumbar lordosis angles was statistically significant. In preop standing lumbar lateral graphs, patients' segmental lumbar lordosis angles ranged between minimum 3,8 and maximum 27,7 (mean 12,6), while postoperative they ranged between minimum 5,4 and maximum 34,2 (mean 19,7) (Table 1).

Table-1. TLLA ve SLA preoperative and postoperative

	PREOPERATİVE MEAN	POSTOPERATIVE MEAN
Lumbar lordosis angle	20,34 (4-37)	32,41 (12-51)
Segmental lordosis angle	12,6 (3,8-27,7)	19,7 (5,4-34,2)

In radiological assessment, patients' mean intervertebral disk height was 5,46 mm preop and 11,18 mm postoperative. The difference between intervertebral disk height was significant (p<0,05).

In final follow-up, x-rays and CT images showed full union in all 56 patients (Figure-2).

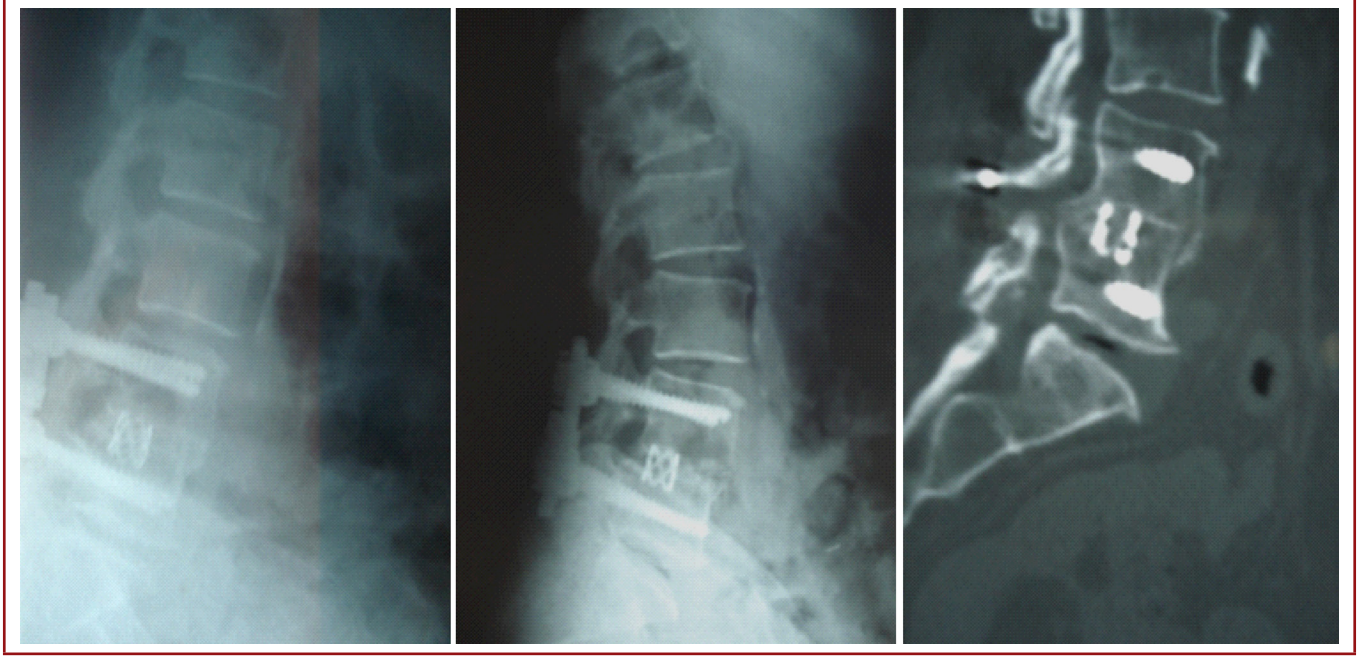

Figure-2. Postoperative flexion and extansion lateral xrays and CT.

Radiologically, final CT images and x-rays showed adjacent segment degeneration in 19 (37,3 %) of the 56 patients. The postoperative ODI scores of patients with and without adjacent segment degeneration were compared. Mean postoperative ODI score was 32,57 in the KSD group, and 30,54 in the non-KSD group. In either group, postoperative ODI scores did

not vary significantly (p>0,05). Postoperative lumbar lordosis of ASD and non-ASD groups was compared. Postoperative lumbar lordosis angle was 32.65 in the ASD group, and 32,22 in the non-ASD group. Postoperative lumbar lordosis angles did not vary significantly in either group (p>0,05).

While narrowness occurred in one patient in the opposite foramen, another one experienced dural injury which was restored through surgery, and another experienced superficial infection. Other than the patient who developed symptomatic narrowness in the opposite foramen, no other patient needed a second surgery. This patient underwent foraminotomy 10 days after primary surgery. Superficial infection was controlled with antibiotic therapy.

DISCUSSION:

The etiology of disk degeneration and concomitant degenerative spine diseases is not yet clear, and despite the many treatment options that exist, their effectiveness is still debated. As the etiology is not known, treatment methods target problems, or complications, created by the pathological process, rather than aiming to shape the course of the disease. Conservative treatments aim to alleviate pain, decrease stimulation of the nerve or disk, and improve the physical condition of the patient for spinal protection[10].

In order to tackle pain in degenerative spine diseases, the underlying pathology needs first be identified. If this pathology results from an irritation in a nerve root, such as in disk hernia, it may often be eliminated with ease through simple discectomy. However, if disk hernia is accompanied by a pathological motion in the movement segment or mechanical pain, a discectomy may eliminate radicular symptoms for a certain time but not alleviate pain. Also, while a simple laminectomy may improve neural claudication in older central spinal stenosis patients with severely limited segmental mobility during the stabilization stage of degeneration, the same outcome cannot be obtained in younger patients of spinal stenosis with segmental hyper mobility without using instrumental fusion in addition to decompression[23]. Therefore, the problem needs to be fully clarified, and treatment methods should be selected and used accordingly.

Lumbar fusion surgery is a treatment method that particularly aims at the elimination of the pathological segmental mobility during the instability stage of degeneration and the symptoms caused by this. Compared to conservative treatment or decompression alone, fusion has yielded better results ever since the early 1990s[10,17].

To illustrate, Herkowitz et al. studied 50 patients and concluded that fusion was superior to conservative treatment and decompression alone with respect to both clinical and disease progression dimensions[25].

Mardjetko et al. reviewed 889 spinal stenosis patients with accompanying spondylolisthesis, and found a clinical recovery rate of 90 % with fusion but 69 % with compression[14]. In 2001, Fritzell et al. compared surgical treatment and conservative treatment in 294 patients with chronic discogenic back pain and found that the fusion group yielded significantly better clinical results[7].

However, considering the biomechanical structure of the spine and the fact that load distribution mostly happens from the middle colon and fusion requires a larger surface, it is obvious that posterolateral fusion may not be adequate. This brings forward interbody fusion. Many previous studies have shown its advantages.

Yashiro et al. reported a union rate of 60 % in the month 11 follow-up of their PL fusion patients. In PLIF patients, 91 % union was found in month 6 follow-up. Additionally, there was more improvement and sagittal balance in the PLIF group[28]. Brantigan et al. followed their PLIF patients for 10 years and reported a union rate of 96.7 % and a significant clinical recovery rate of 87 %[2].

La Rosa et al. studied 35 spondylolisthesis patients and found significantly better union and radiological improvement parameters (disk height, correction, subluxation) in the PLIF group, but no significant difference with respect to clinical functional results[19]. Similarly, Xiuxin et al. compared interbody fusion and posterolateral fusion in a 2009 meta analysis and found no significant difference between the two groups regarding clinical functional results, but significant fusion rates in the interbody fusion group (92.4%) than PL (85.7%)[26]. Glassman et al. studied 497 patients in 2006 and found no significant difference between PLF, ALIF VE PLIF/TLIF groups considering SF 36 and ODI scale[8].

We have obtained 100 % union in the patients in our series, a mean 5,72 mm increase in disk height, and an improvement of 12,07 and 7,1 degrees in lumbar lordosis and segmental lordosis angles, thus supporting the biological and biomechanical benefits of interbody fusion.

Our clinical findings revealed a significant increase in ODI (preoperative mean 74.48 postoperative mean 31.23) and VAS (preop mean 7.37 postoperative mean 2.93), revealing the effectiveness of the intervention.

The presence of many indications for interbody fusion and its recent popularity has triggered debates. Among the complications mentioned are dural injury (particularly for PLIF), pseudoarthrosis, infection and cage migration[11,25]. Greiner et al. followed 1,680 PLIF patients for 5 years and found a pseudoarthrosis rate of 4.5%, a wound problem of 1.5%, and an implant insufficiency rate of 1.2%. Dural injury was only seen in one patient[9].

Anand et al., in a 2006 study, detected no dural injury or implant insufficiency in 100 patients that undertook TLIF. They reported full fusion in 99 patients[1]. In our series, we detected dural injury in one patient, and superficial infection treated with antibiotic therapy in another. No patient requires re-operation due to these complications.

Adjacent segment degeneration is a popular debate in interbody fusion, which centers around two factors. The first is the belief that degenerative disk disease results from genetic factors and adjacent segment degeneration is a part of its natural course. The second is the claim that fusion creates mechanical stress in the adjacent segment, leading to or exacerbating degeneration. It may be noted that while radiological findings of degeneration exist in the majority of patients who underwent fusion in almost all series, not all display similar and equal clinical symptoms. Therefore, radiological symptoms are usually defined as "adjacent segment degeneration", and those that display clinical symptoms as "adjacent segment disease".

Several biomechanical studies have shown that interbody fusion increases intradiscal pressure in other segments by changing loads in end-plates, thus leading to degeneration particularly in the cranial segment.

Cunningham et al. published an in vitro biomechanical study in 1998 in which they found a 45% increase in the intradiskal pressure in the proximal of the segment where fusion was performed, but could not associate this increase with the level of degeneration in the adjacent segment[5]. Lee et al. found in 1988 that lumbar fusion increases adjacent segment degeneration[13].

However, a parallelism between adjacent segment degeneration and clinical findings is another debate. In 2008, Yang et al. examined 217 patients retrospectively and found a clinical correlation with ASD. They reported less favorable clinical functional results in patients with ASD[27]. On the other hand, in 2006, Okuda et al. reported a ASD rate of 22% in a study with 109 patients and found no correlation between radiological degeneration and clinical functional results[16].

Schulte et al. followed 27 patients who received lumbar fusion due to DDD for 10 years. Even though they concluded that adjacent segment disk space was significantly reduced thus leading to adjacent segment degeneration, they could not correlate this significantly with clinical functional results[20]. Wai et al. published a 20-year follow-up study of 39 ALIF patients in 2006, in which they reported adjacent segment degeneration in 23% but no correlation between radiological degeneration and functional results[22].

In recent years, several studies have attempted to determine risk factors to prevent adjacent segment degeneration. Some authors have associated age, sex, length of fusion level, sagittal alignment, and menopause to ASD[18].

Okuda et al. studied 87 patients and found no correlation between ASD and age, sacral inclination and bone density[15]. While Djurasoviç et al.[6] found sagittal alignment as a major risk factor; Kumar et al. reported a correlation between ASD and increased sacral inclination angle and length of fusion level[12].

In 2011, Chen et al. reported 22% ASD in 109 patients who underwent single level fusion. Having examined many risk parameters such as age, bone mineral density, sacral inclination angle, lumbar lordosis angle, intervertebral disk height and movement in fusion level and its upper level, they correlated ASD only to age, concluding that age increases the risk of developing ASD[4].

In our study, we found that a mean postoperative ODI score of 30.54 among non-ASD patients as opposed to 32.57 in patients who developed ASD. The difference was not significant. It should be remembered that sagittal balance is an important factor in preventing symptomatic ASD. Our results corroborate the literature regarding the effectiveness of interbody fusion in providing and maintaining segmental lordosis.

Degenerative spine diseases currently affect a large part of the population and their treatment is essential to patients having comfortable daily lives. Despite the presence of many treatment methods for degenerative spine diseases, supporting disk space and union in the anterior and interbody fusion surgeries are the gold standard in treatment as they eliminate discogenic pain, restore disk height and open the foramen, and restore local sagittal balance. The literature shows that long-term results of non fusion methods are still inadequate. In this study, we evaluated the effectiveness of interbody fusion, which is a routine procedure in our clinic. We saw full fusion in all patients. Additionally, complaints of pain in follow-up controls were significantly reduced as compared to preop and the functional state of patients was improved. Radiologically, we found that lumbar lordosis was restored and a local lordosization effect was obtained after the surgery. Even though in our series we detected 37 % adjacent segment degeneration, which is a widely mentioned side effect of interbody fusion in the literature, we found no significant relationship with respect to clinical and radiological results.

In light of these findings and the latest literature mentioned in the discussion, we recommend interbody fusion surgery in degenerative spine patients with instability and pain. This surgery improves pain, sagittal balance, and functional outcomes. More clinical large comparative cohort series are needed to confirm these results.

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