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ORJİNAL ÇALIŞMA / *ORIGINAL ARTICLE*

EVALUATION AND RESULTS OF DEGENERATIVE SPINE DISEASE TREATED WITH POSTERIOR LOMBAR INTERBODY FUSION BY USING CAGES

KAFES KULLANILARAK YAPILAN POSTERİOR CİSİMLER ARASI FÜZYON İLE TEDAVİ EDİLEN DEJENERATİF HASTALIKLARIN DEĞERLENDİRİLMESİ VE SONUÇLARI

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SUMMARY:

Objectives: *We evaluated patients in whom cages were used for posterior lombar interbody fusions for the diagnosis of degenerative spine disease.*

Methods: *We retrospectively inspected 35 patiences having degenerative spine between may 1999 – january 2004. There were 29 female 6 male mean age 59.4, mean follw up 32.7 months.*

Results: *We found 22 bony bridging between the vertebral bodies, and 10 fusions with below 4 degrees angulation without bony bridging. Radiologicaly approwed fusion rate was obtained 32 patients (91.4 %). Clinical evaluation: 26 excellent (74.2 %), 6 good (17.3 %), 2 fair (5.7 %), 1 poor (2.8 %). As a whole 32 (91.5 %) patients wew accepted as satisfactory and 3 (8.5 %) as unsatisfactory. The complications we had for posterior interbody fusions were different in ferequency and in numbers.*

Conclusions: *The cages we applied with the posterior approach only causes 360 degree fusions, and solves the instability problem by correcting the alingnment and spinal load bearing. By adding the posterior enstrumantation to this technique affects the clinical results positively and degreases the needs for reoperation. But one should keep in mind this technique increases the possibility of regional osteopenia. This technique has a long learning curve and should be used by experienced surgeons.*

Key words: *Spine, interbody fusions, cage, degenerative disease*

Level of Evidence: *Retrospetive Cohort Study, Level III*

ÖZET:

Amaç: *Ankara Üniversitesi Tıp Fakültesi Ortopedi ve Travmatoloji Anabilim Dalı'nda dejeneratif omurga hastalıklarında yapılan kafes ile posterior lomber interbody füzyon uygulamalarını değerlendirmektir.*

Çalışma planı: *Mayıs 1999 – Ocak 2004 tarihleri arasında kliniğimizde, dejeneratif omurga hastalığı nedeniyle kafes ile interbody füzyon uygulanan 35 hasta değerlendirildi. 35 Hastanın*

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29'u kadın, 6'ü erkek olup ortalama yaşları 59,4 ortalama takip süresi ise 32,7 aydır.

Sonuçlar: *Hastaların füzyonları değerlendirilirken, olguların 22 ünde korpuslar arasında kemik köprü tespit edilmiş, 10 unda kemik köprü olmaksızın 4 derece altında açılanma tespit edilerek füzyon olarak kabul edildi. Toplamda radyolojik olarak tespit edilen füzyon, 32 hasta ile % 91.4 bulundu. Klinik sonuçlarda, değerlendirme kriterlerine göre çalışmaya alınan hastaların 26'sı (% 74.2) mükemmel, 6'si (%17.3) iyi, 2'si (%5.7) orta ve 1'i(%2.8) kötü olarak bulunmuştur. Toplamda tedavinin başarılı olarak kabul edildiği grup 32 (% 91.5), başarısız kabul edilen ise 3 (%8.5)'dır. Posterior interbody füzyon uygulamalarımızda karşımıza çıkan komplikasyonlar, literatür ile görülme sıklıkları ve oransal olarak farklılıklar göstermektedir.*

Çıkarımlar: *Kafes ile posteriordan yapılan interbody füzyon sadece posterior girişimle 360 derece füzyon oluşmasına imkan vererek, instabilitenin giderilmesine, omurga yük aktarımı ve diziliminin fizyolojik hale gelmesine izin verir. Bu yönteme posterior enstrümantasyon eklenmesi, klinik sonuçları olumlu yönden etkiler, ayrıca hastaların tekrar cerrahi gereksinimlerini azaltır. Ancak bu uygulamanın bölgesel osteopeni yapabileceği akıldan çıkartılmamalıdır. Dejeneratif omurga hastalıklarına uygulanan kafes ile posterior interbody füzyon yöntemi, öğrenme eğrisi uzun zaman alan güç bir teknik olup, omurga cerrahisi konusunda tecrübeli cerrahlarca uygulanması gerekmektedir.*

Anahtar sözcük: *Omurga, interbody füzyon, kafes, dejeneratif hastalıklar*

Kanıt Düzeyi: *Retrospektif klinik çalışma, Düzey III*

INTRODUCTION:

Spinal fusion subsequent to decompression in spinal stenosis, instability, degenerative disc disease and many other degenerative diseases is a surgical therapy used successfully.[1,3,5,8,12, 25, 26,] First planned posterior lumbar interbody fusion was done by Dr. Ralph Cloward in 1943 and in 1945 when the operation was published including 100 cases; it was defined as optimal fusion in terms of biomechanics.[1, 5, 11, 13 25,26,)]

Autologous cancellous graft which was placed between vertebral bodies during classic lumbar interbody fusion, includes factors that may induce fusion, however it is not strong enough to resist compressive force in the disc distance. [2, 6, 17, 14)] In three cortex grafts this resistance is maintained nevertheless fusion induction is lesser. Thus, hard support and soft graft is the combination of choice. [16)]

Cages are implants developed to provide mechanical necessities of interbody fusion at the end of our attempts for a stronger fixation to increase uniting rate and decrease complications of interbody fusion performed with bone graft. [1, 2, 6, 11, 13, 17,)]

Primary reason for championing posterior interbody fusion is that, while neural structures are dynamically decompressed and protected; affected vertebral bodies are stabilized by compiling them into one dynamic segment. Moreover, it has many advantages as regulating load bearing in posterior column, no additional morbidity subsequent to autografting and anterior interbody fusion technique, brief operational time, less haemorrhage, shorter hospitalization period and the return of the patient to daily activity. [(,2,5, ,11, 16, 20,22,23,) 25)]

MATERIALS AND METHOD:

We retrospectively evaluated 35 patients treated with posterior interbody fusion using cage systems by one surgeon in University of Ankara Medical School, Department of Orthopedics and Traumatology between May 1999 and January 2004. There were 29 (82.8%) women and 6 (17.2%) men, and mean age was 59.4 (40 – 81 years) and mean follow up period was 32.7 months (8 – 57 months).

We accessed the data on personal history, physical and laboratorial examination findings, information on surgery and periodic examinations during follow-up period after the surgery. We did detailed physical examination on patients and questioned their current physical examinations, contentment, daily activity situation and the need for medication except one patient who died during this period.

Patient inclusion criteria were longstanding serious back pain, spinal stenosis, degenerate disk disease, spondilolisthesis or patients with instability related to previous disk surgery. Patients with significant local infection or who had interbody fusion previously were not included in the study.

Direct radiograms (anteroposterior, lateral, oblique, and flexion-extension) were evaluated preoperatively for all patients in the study group. CT and MRI examinations were performed to evaluate corpus height, cross-section of spinal channel, and level of degeneration and herniation of the disk.

Etiological profile of patients is shown in Figure 1. All 35 cases' primary complaints were backache and limited waist movement. Furthermore, 18 patients had neurogenic clodication significantly limiting capacity to walk, 31 patients had pain expanding through leg (19 of them through one leg), 15 patients had loss of sensation in various areas and size, 13 of them had motor loss in different levels, 6 had combined sensation motor and sensory loss, 9 had decrease in deep tendon reflexes and 1 had neurogenic bladder symptoms. (Figure 1)

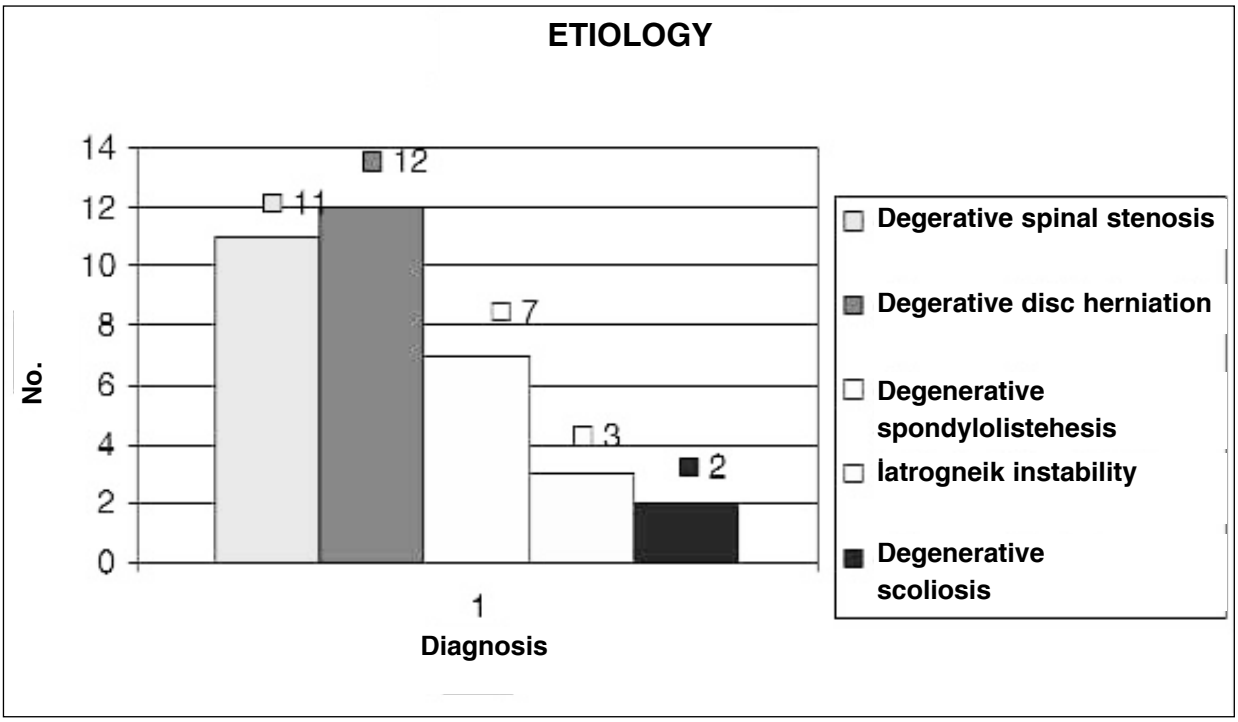

Figure-1. Aetiology of the patients.

All patients underwent conservative treatment program including 3 to 6 months drug usage, recreation and physical therapy rehabilitation, however the ones whose complaints did not diminish were conducted to surgery.

About the distribution of levels in the practice of posterior lumbar interbody fusion; 24 patients had level one, 10 had level two and 1 had level three, among a total of 35 patients who got their 47 dynamic segments performed fusion. Distribution of levels was as below: 21 L4-L5, 10 L5-S1, 12 L3-L4, 2 L2-L3, 1 L1-L2, 1 Th12-L1. And when cage diameters evaluated, 51 (54.2%) of 94 cages were 12 millimeters and 43 of them (45.8%) were 14 millimeters.

Two cages each were used after total laminectomy for all levels in all patients, and carbon ribbed in 2 patients and titanium ribbed cages in 33 of them were administered. Posterior instrumentation was performed to increase stability and rigidity of dynamic vertebral segment.

When we assess the study group according to surgery and early period, it has been found that mean operation length is 3 hours and 25 minutes (3 hours – 4 hours 15 minutes), and necessary blood transfusion need is approximately 1.4 units (1 – 2 units) for patients with level one fusion application. Same parameters for level two fusion applied patients were 4 hours 20 minutes (3 hours 40 minutes – 5 hours) and 2.4 units of blood (2 – 3 units). Level three application and percutanous applications were not included in the assessment since there was only one patient in level three.

Patients were mobilized with a corset two days after the surgery. All patients used vitraten lumbosacral hyperextention corset for 3 months.

Clinic results assessment criteria were;[4] for excellent, totally recovered, painless and returned to previous daily activity patient,[3] for good, rarely having pain, not in need of medication and returned to activity patient, [2] for fair, postopera-

tively healing, usually in need of medication and performing activities uncomfortably patient,[1] for poor, with no feeling of healing, on medication and without performing of daily activity patient. in clinical assessment 1 and 2 are accepted to be insufficient while 3 and 4 were sufficient.

Preoperative and postoperative follow up graphics for 76 years old women with instability related to spondylolisthesis and stenosis are given in figures 2 – 3. (Figures 2,3,4,5,6,7)

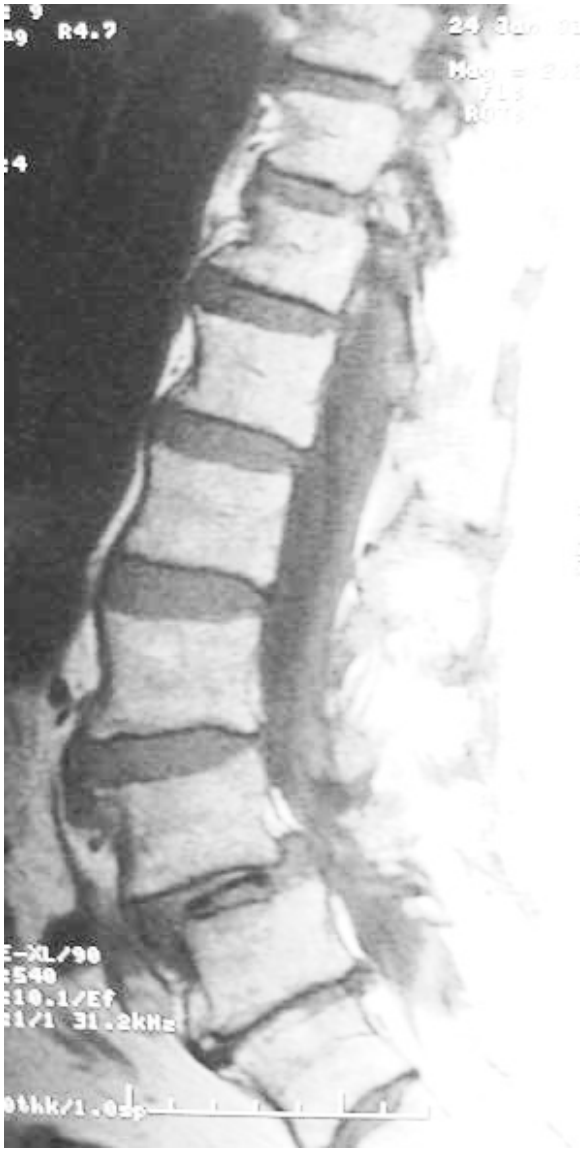

Figure-2. Sagittal MRI of the patient

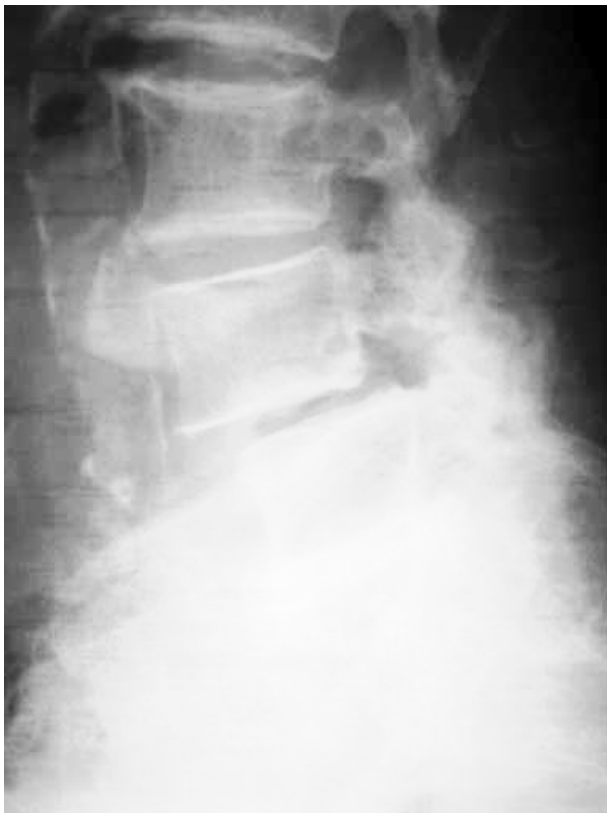

Figure-3. Lateral plain radiography of the patient

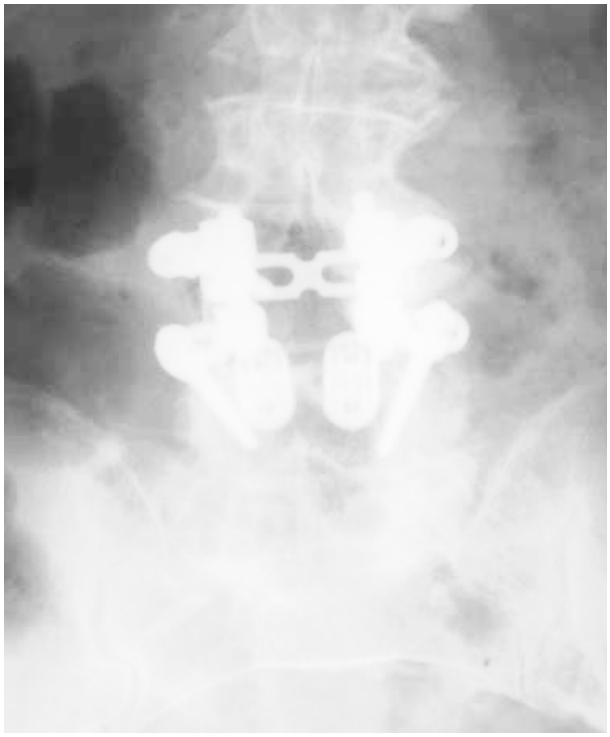

Figure-4. Post operative A-P view of the patient.

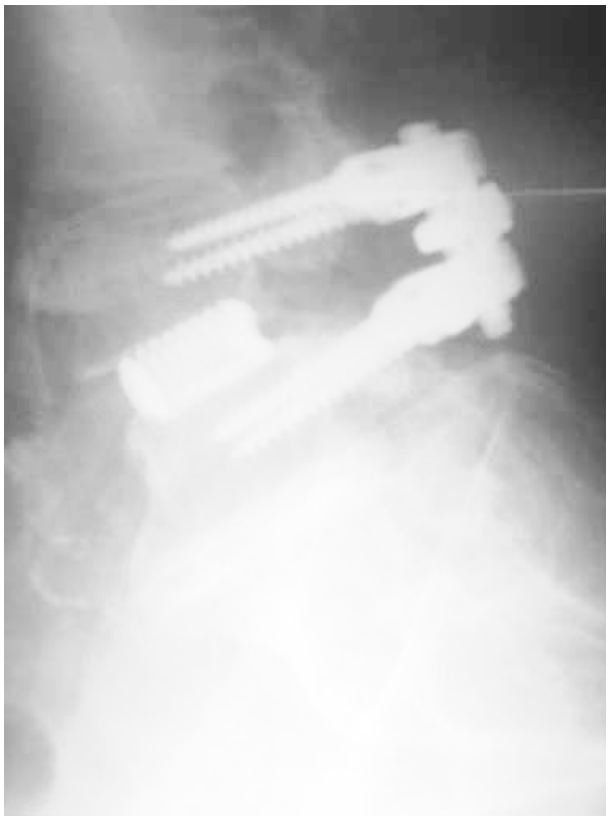

Figure-5. Postoperative lateral view of the patient.

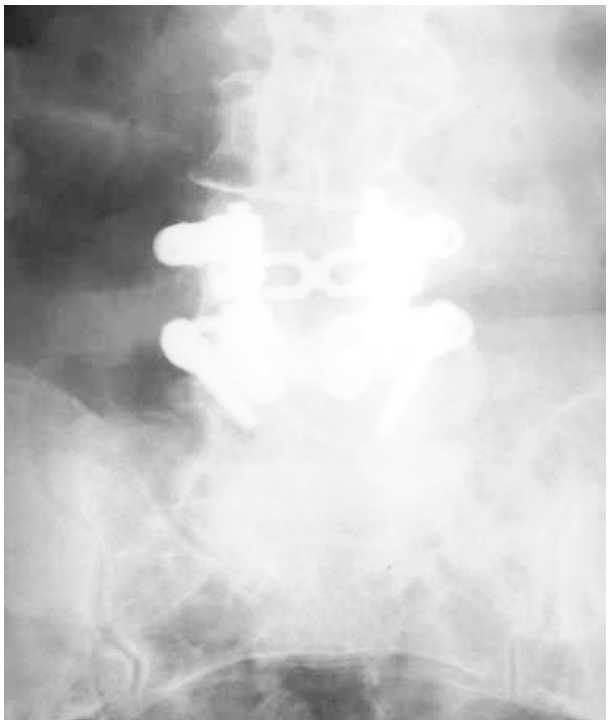

Figure-6. Two years follow up A-P graphy.

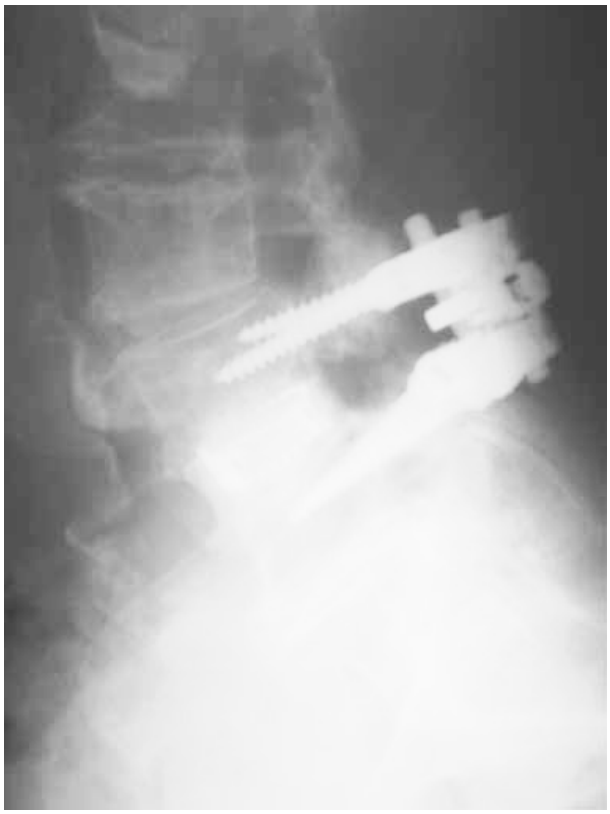

Figure-7. Two years follow up lateral graphy.

RESULTS:

Mean hospitalization was detected as 5.75 days (5 – 7 days) when we consider the patients mobilized for 2 days after surgery. However, it has been found mean 5 weeks (3 – 6 weeks) for patients to return to their daily activity.

While evaluating fusion six months after surgery in follow-up direct anteroposterior and flexion extension radiograms 22 of patients (62.8%) were detected for bony bridge between corpuses, 10 of them (28.6%) were accepted as total fusion detecting angulation below 4 degrees without bony bridge. Total fusion rate determined radiologically was 91.4% with 32 patients.

26 (74.2%) of patients who were included according to evaluation criteria were found to be excellent, 6 of patients (%17.3) were found to be

good, 2 (5.7%) of them fair and 1 of them (2.8%) poor in clinical results. Groups which we accepted as successful and unsuccessful consisted of 32 cases (91.5%) and 3 cases (8.5%) respectively.

Complications which we confronted during posterior interbody fusion applications differ in frequency and ratio within the literature.

DISCUSSION:

Posterior lumbar interbody fusion is a common treatment method, the success of which is recognized in degenerative spine diseases.[1, 5,8,11, 25,] Many studies have shown that posterior instrumentation used alone is insufficient for anterior stabilization and the center of segment motion is shown to be the most efficient region to stop the movement permanently. [4,16,17] With this method, load bearing is more physiological because the implant generally thought to be exist in vertebral body is placed on immediate axle and rotation base. Load bearing is rearranged, narrowed disc distance and motional segment revert into its normal alignment and structural rigidity increases. Additional posterior instrumentation need and implant application decrease the risk of failure.[25,11,13,6,2,16,23,22,9]

After it was accepted that cages provide efficient and simple fusion, many researcher started to study on the designs of implants like Bagby cage in 1980's and Ray used the first titanium ribbed punched cage on human in 1988.[7]

The cages provide higher stability by stretching disc distance in functional unit while increasing the neural foramen volume.[13,16,17] In biomechanical studies on cages, the rigidities of normal, laminectomy and cage applied spines were compared and it was confirmed that cage applied spine has at least 2 times higher rigidity.(3,25) It was shown that the pull out resistance of the cage depends on how tight the implant is placed into vertebral interval and also how much it resists to shearing forces.[7]

Bony bridge formed radiologically in front of the cage and the absences of osteopenic halo provide the best evidence for the presence of fusion. However, the fusion to be in direct radiograms is not always compatible with clinic.[11,22,9,15] In the evaluation of fusion the surgery exploration is thought to be golden standard on the ground that the accuracy rate of direct radiograms is accepted to be low. [1,15,22] In many studies fusion rate detected in radiological and surgical explorations is found to have 90% compatibility.[1] While evaluating the post-surgery fusion of our patients we accepted the bone bridge formation between vertebral bodies and the angulation lower than 4 degrees between bodies as fusion in follow up direct anteroposterior and flexion extension radiograms.[26,11,20,22,9,15] We accepted it as full fusion because the bone bridge was found in 22 cases (62.8%) and we found an opening lower than 4 degrees without bony bridge in 10 cases (28.6%) in the outcomes after six months. We found the radiological fusion rate as %91.5 with 32 patients in total. Fusion rate in the most comprehensive study carried out by Ray and et al. was found to be 96 %.[17] In the towel clamp test regarding to the fusion presence during surgery, fusion was found to be present in 15 cases out of 16 cases who don't have clinical complaints after surgery, whose fusions were detected radiologically but whose posterior instruments were removed to make MRG examination by taking into consideration the osteopenia, restenosis related with epidural fibrosis and disc pathologies in different levels and this rate which is 93.7% shows that radiological fusion evaluation is reliable enough.

It was shown that stability was ensured until the union was obtained after the surgery with an additional instrument used in cage and fusion application.[1,3,4,15] Need for reoperation decreases significantly in patients with posterior instrumentation. In in-vitro biomechanical study outcomes, early stability increases in cage applications in which posterior instrumentation is used, circular fusion is secured with only posterior interference and anterior and posterior colon is stabilized. [20,15] It was shown that apart from fusion rate also the rigidity increased in posterolateral fusion supported with posterior instrument but there is an osteopenia related to implant. This ostepenia is clinically vital because it may cause screw loosening and implant failure.[18] Osteopenia was detected in 7 patients (20 %).

There are many published complications of interbody fusion surgery using cage. These complication frequencies change in literature. [5,1,12,11,17,21] Nonunion which is one of the complications is developed as a result of continuation of activity by not providing sufficient widening in disc distance related to small cage usage. Rates changing between 4 and 12.4% were found in literature.[5,1, 3, 12, 11] It is the most frequent complication found in 2 cases (5.7%) in our series. Cage sizes were reported up to 18 millimeters in various publications and it was noted that facet excision decreases spinal stability. [17,24] However, nonunion to be the most frequent complication in our study might be associated with that the sizes of cages we use are smaller comparing with literature.

In most publications, the most frequent complication in cage and interbody fusion procedure is the dural tear with rates between 6 and 10 %.[1,5,12] Dural tears were developed in our 3 cases, two of which was fixed during operation and it didn't initiate additional complication. But in the other case subdural hematoma was detected after uncontrollable cerebrospinal leak subsequent to dural fixation. Patient applied with hematoma drainage died ten days after the operation. This case was accepted as a single poor result.

Infections whether they require operations or not are frequently noted complications with 4.5% average rate in literature although there might be change in their percentages. [5,12,11,20] Postoperative superficial infection was detected in 1 cases of our series (2.8%) but none of them necessitated surgical intervention and antibiotics therapy was sufficient for the cure. Again in 2 cases (5.7%) postoperatively ongoing sciatialgia was detected. Complaints of one patients have finished by the 3rd month, however for the other patient that was not the case. In 34th month, his complaints continued and 3 centimeters of thinning was detected in his left tight diameter.

Most frequent complication in the wide-range study about complications related to cage application by Ray was foot drop which was seen in 10% of patients. (11, 25) In our series we don't have such a complication.

Postoperatively ongoing back and radicular pain are frequently encountered consequences of insufficient surgical technique, epidural fibrosis, and implant migration. [5,23] 13 (37.1%) of our patients' back pain continued for 6 weeks after the surgery, however subsequent to anti-inflammatory medication all 12 patients recovered totally. In only one patient back pain continued although other symptoms present before the surgery were reduced. After evaluating the other patient who had rheumatoid arthritis for back and hip pain, it was decided to operate arthroplasthy. In 3 (8.5%) of our patients of our series, we observed epidural fibrosis on the MRI when symptoms reiterated long after the surgery.

Another frequently reported complication is retropulsion of the cage. Kustick evaluated ner-

ve root irritation related to retropulsion and development of spinal stenosis and he found implant migration necessitating surgery was 1.7% and not necessitating 1.4%.[23] We did not encounter with complications as cage or screw breaking related to retropulsion or implantation in our series. The reason for it might be that we provide additional stabilization with posterior instrumentation in all our cage applications. The first of four patients that we applied percutaneous expansive cage technique was not satisfied with the result of the surgery so on the fourth day we reoperated her with open surgery applying partial laminectomy and foraminotomy and subjoining posterior instrumentation. In that case it was concluded that diagnosis and surgical indications were flawed.

CONCLUSIONS:

26 (74.2%) of patients who were included according to evaluation criteria were found to be excellent, 6 of them (%17.3) were found to be good, 2 (5.7%) of them fair and 1 of them (2.8%) poor in clinical results. Groups which we accepted as successful and unsuccessful consisted of 32 cases (91.5%) and 3 cases (8.5%) respectively. Fusion rate was 91.5% with 32 patients and it was found to be compatible with the literature. Complications which we confronted differ in frequency and ratio within the literature.

The need for second surgical intervention decreases and clinical results are affected positively by adjoining posterior instrumentation to posterior interbody fusion application using cage. But one should bear in mind that this application might result in regional osteopenia.

We observe that all patients who were regarded clinically and radiologically insufficient were the ones operated at the very early times of application. Posterior interbody fusion method using cage to degenerative spinal diseases is a time taking technique with a long learning curve and must be applied by experienced surgeons.

REFERENCES:

1. Brantigan JW, Steffee AD, Lewis ML, Linda M, Quinn MS, Peresenaire JM. Lumbar interbody fusion usin the Brantigan I/F cage for posterior lumbar interbody fusion and teh variable pedicle screw placement system. Spine 2000; 25: 1437-1446.
2. Brantigan JW, Steffee AD, Geiger JM. A carbon fiber implant to aid interbody lumbar fusion. Spine 1991; 16: 277-282.
3. Brodke DS, Dick JC, Kunz DN, McCabe R, Zdeblick TA. Posterior lumbar interbody fusion. A Biomechanichal comparison, including a new threaded cage. Spine 1997; 22(1) : 26-31.
4. Cunningham BW, Polly DW. The use of interbody cage devices for spinal deformity: A biomechanichal perspective. Clin Orthop 2002; 394: 73-83.
5. Elias WJ, Sımmons NE, Kartain GJ, Chadduck JB, Whıtehıll R. Complications of posterior lumbar interbody fusion when using a titanium threaded cage device. J Neurosurg 2000; 93: 45-52.
6. Goh JCH, Wong HK, Thambyan A. Influence of plıf cage size on lumbar spine stability. Spine 2000; 25: 35-40.
7. Goldstein JA, Macenski MJ, Griffith SL, McAffee PC. Lumbar saggital alignmentafter fusion with a threaded interbody cage. Spine 2001; 26: 1137-1142.
8. Hashimoto T, Shigenobu K, Kanayama M, harada M, Oha F. Clinical results of single level posterior lumbar interbody fusion usıng the brantigan I/F cage filled with a mixture of local morserized bone and bioactive ceranic granules. Spine 2002; 27: 258-262.

9. Hutter CG. Spinal stenosis and posterior lumbar interbody fusion. Clin Orthop 1985; 193: 103-114
10. Kandziora F, Pflugmacher R, Kleeman R, Duda G, Wise DL, Lewandrowski KU. Biomechanichal analysis of biodegradable interbody fusion cages augmented with polly(propylene glycol-co-fumaric acid). Spine 2002; 27: 1644-1651.
11. Lin PM, Cautilli RA, Joyce MF. Posterior lumbar interbody fusion. Clin Orthop 1983; 180: 154-168.
12. McAffee PC, Cunningham BW, Lee GA, Orbegoso CM, Haggerty CJ, Fedder IL, Griffith SL. Revision strategies for improving failed cylindirical cages. Spine 1999; 24: 2147-2153.
13. McAffee PC, Lee GA, Fedder IL, Cunningham BW. Anterior BAK instrumentation and fusion: Complete versus partial discectomy. Clin Ortop 2002; 394: 55-63.
14. Palm WJ, Rosenberg W, Keaveny TM. Load transfer mechanism in cylindirical interbody cage constructs. Spine 2002; 27: 2101-2107.
15. Pape D, Fritsch E, Kelm J, Muller K, Georg T, Kohn D, Adam F. Lumbosacral stability of consolidated anteroposterior fusion after instrumentation removal determined by rontgen stereophotogrammetic analiysis and direct surgical exploration. Spine 2002; 10: 269-274.
16. Ray CD. Threaded fusion cages for lumbar interbody fusions. An echonomic comparioson with 360 degrees fusions. Spine 1997; 22: 681-685.
17. Ray CD. Threaded fusion cages for lumbar interbody fusions. Spine 1997; 22: 667-680
18. Rapoff A, Ghanayem A, Zdebrick TA. Biomechanichal comparison of posterior lumbar interbody fusion cages. Spine 1997; 22: 2375-2379.
19. Rupert H, Dietl J, Krammer M, Kettler A, Wilke HJ, Cales L, Lumenta CB. Pullout test with three lumbar ınterbody fusion cages. Spine 2002; 27: 1029-1036.
20. Suk SI, Lee CK, Kim JW, Lee JH, Cho KJ, Kim HG. Adding posterior lumbar interbody fusion to pedile screw fixation and posterolateral fusion after decompression in spondylolytic spondylolisthesis. Spine 1997; 22: 210-219.
21. Taylor BA, Vaccaro AR, Hilibrand AS, Zlotolow DA, Albert TJ. The rirk of foraminal violation and nerve root impingement after anterior placement of lumbar interbody fusion cages. Spine 2001; 26: 100-104.
22. Togawa D, Bauer TW, Brantigan JW, Lowery GL. Bone graft incorporation in radiographically successful human intervertebtal body fusion cages. Spine 2001; 26: 2744-2750.
23. Uzi EA, Dabby D, Tolessa E, Finkelstein JA. Early retropulsion of titanium threaded cages after posterior lumbar interbody fusion: a report of two cases. Spine 2001; 26: 1073-1075.
24. Wong HK, Goh JCH, Sun P. Paired cylindrical interbody cage fit and facetectomy in posterior lumbar interbody fusion in an Asian population. Spine 2001; 26: 572-577
25. Zhao J, Hai Y, Ordway NR, Park CK, Yuan HA. Posterio interbody fusion using posterolateral placement of a single cylindirical threaded cage. Spine 2000; 25: 425-430.
26. Zhao J, Wang X, Hou T, He S. One versus two BAK fusion cages in posteripr lumbar interbody fusion to L4-L5 degenerative spondylolisthesis: A randomized controlled prospective study in 25 patients withj minimum two-yearr follow-up. Spine 2002; 27: 2753-2757.