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Klinik Araştırma

Long-term radiological angles after anterior cervical discectomy and fusion operation made by intervertebral cage

Intervertebral kafes ile anterior servikal diskektomi ve füzyon sonrası uzun dönem radyolojik açılar

Ozan GANİÜSMEN[1], Engin ÇİFTÇİ[2], Ali SAMANCIOĞLU[3], Hakan KORKMAZ[1], Güven ÇITAK[1], Sultan TARLACI[4]

[1]Şifa Üniversitesi Tıp Fakültesi, Nöroşirürji Anabilim Dalı, İzmir
[2]Denizli Devlet Hastanesi, Nöroşirürji Kliniği, İzmir
[3]Seyfi Demirsoy Hastanesi, Nöroşirürji Kliniği, İzmir
[4]Şifa Üniversitesi Tıp Fakültesi, Nöroloji Anabilim Dalı, İzmir

ABSTRACT

Objective: At present, the use of a cervical cage has become an accepted and widely practiced surgical intervention for the treatment of cervical disc disease (CDD). Polycarbon PEEK cage has been used in the treatment of cervical disc disease as a spacer with good long-term outcomes.
Methods: A retrospective study was performed with 16 consecutive patients who underwent single-level anterior cervical discectomy and fusion (ACDF) with a PEEK cage. Lateral plain radiographs were obtained both preoperatively, and at postoperative two years. Patients were followed for a minimum of 24 months.
Results: The surgical procedures used were technically successful for all patients and there were no major complications related to anesthesia or the overall surgical procedure. The mean intervertebral disc height (DH) was 4.6±1.4 mm preoperatively, and height was 4.5±1.4 mm at the postoperative 24-month of the follow-up period. The mean angle of lordosis (LA) was 14.5±16.8° preoperatively and 17.5±13.5° at the 24-month follow-up. The mean segment angle (SA) was13.4±15.2º preoperatively, and 12.6±11.9º at the 24 month of the postoperative follow-up period. There was no PEEK cage dislodgment or failure. The clinical symptoms improved in all monitored patients.
Conclusion: ACDF is an effective way for the treatment of CDD. Using a cage prevents segmental collapse. This technique can also put AL, SA and SH within normal limits, so postoperative pain reduces and quality of life of the patients improve. Long-term clinical outcome of the stand-alone cages used in the surgical treatment of one cervical disc disease is satisfactory.

Key words: Anterior microdiscectomy, fusion, lordosis angle, segment angle

ÖZET

Amaç: Zamanımızda, servikal disk hastalığının (CDH) tedavisinde servikal kafes kullanımı yaygın olarak kabul edilmiş ve bir cerrahi müdahale hâline gelmiştir. Polikarbon PEEK kafes iyi uzun vadeli sonuçlar ile servikal disk hastalığında kullanılmaktadır.
Yöntemler: İntervertebral PEEK kafes ile tek mesafe anterior servikal diskektomi ve füzyon (ACDF) uygulanan 16 hastaya retrospektif çalışma yapıldı. Preoperatif, postoperatif ve iki yıl sonra lateral düz grafiler alındı. Hastalar en az 24 ay takip edildi.
Bulgular: Kullanılan cerrahi işlemler tüm hastalar için teknik olarak başarılı olup, genel anestezi ve cerrahi ile ilgili hiçbir majör komplikasyon olmadı. Ortalama intervertebral disk yüksekliği (DY) preoperatif 4,6±1,4 mm ve yüksekliği 24 aylık takipte 4,5±1,4 mm idi. Ortalama lordoz açısı (LA) preoperatif 14,5±16,8 iken, 24 aylık takipte 17,5±13,5'tu. Ortalama segmenti açısı prepoperatif 13,4±15,2 iken, postoperatif 12,6±11,9'du. Hiçbir PEEK kafes yerinden oynamadı ya da başarısızlık olmadı. Klinik belirtiler, tüm takip hastalarda geriledi.
Sonuç: ACDF CDH tedavisi için etkili bir yoldur. Bir kafes kullanılarak segmental çökme önlenir. Bu teknik LA, SA ve DY'liğini normal sınırlar içerisinde tutarak postoperatif ağrıyı azaltır ve kaliteli yaşam sağlar. Servikal disk hastalığı cerrahi tedavisinde tek başına kafeslerin uygulanması uzun süreli takip klinik sonuçları yüz güldürücüdür.

Anahtar kelimeler: Anterior mikrodiskektomi, füzyon, lordoz açısı, segment açısı

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Yazışma adresi: Yrd. Doç. Dr. Ozan Ganiüsmen, Fevzi Paşa Bulvarı No:172/2, Basmane 35240 İzmir
e-mail: ganiusmen@hotmail.com

INTRADUCTION

The concept of cervical interbody fusion for the treatment of cervical disc disease has developed progressively over the last 50 years. The basic idea is to stabilize the treated segment sufficiently to allow new bone ingrowth, and to maintain disc height and avoid graft collapse until fusion occurs.

The principal advantage of cervical cage is the reduction in donor site morbidity. Since a cervical cage can provide immediate loadbearing support to the anterior column, a structural bone graft is unnecessary. Despite its several disadvantages many surgeons advocate cervical cages. Theoretically, the ideal procedure for ACDF would have no complications, promote successful arthrodesis, restore disc height, and maintain normal cervical lordosis.

From September 2008 to September 2009, a retrospective study was designed for patients who underwent single-level ACDF with a PEEK cage. Therefore the changes of cervical lordosis and segment angles are compared with literature.

MATERIAL and METHODS

Patient population

Between September 2008 and September 2009, 16 consecutive patients with single-level cervical disc herniation underwent single-level ACDF with hollow PEEK cage stabilization. Patients were included if they had severe symptomatic single-level compressive radiculopathy due to cervical disc herniation for more than three months, with compatible magnetic resonance imaging (MRI) and clinical findings. Patients with evidence of cervical instability, whiplash injury, myelopathy, systemic infection, psychiatric disturbance, metabolic bone disease, active malignancy, previous cervical spinal surgery, or drug abuse, were excluded from the study. Clinical and radiographic data were collected before, immediately after surgery and at the 24-month of the follow-up periods.

Surgical technique

Surgery was performed after the patient had received general anesthesia. A standard anterior cervical microdiscectomy, osteophytectomy, and nevre root decompression were performed in every patient. Endplate cartilage was removed with a cutting burr and curette. We used 10-12 mm long policarbon PEEK cages -with 5 degree- angle (TIP MED Medical ind. Co ltd-Izmir-Turkey) countersunk at least 1 to 2 mm from the ventral surface of the vertebral bodies. Each patient was instructed to use a cervical collar for protection during the first 10 postoperative weeks.

Outcome measures

Preoperatively, and at postoperative 24 months lateral plain radiographs, were obtained. Lordosis angle (LA) is meusured as the angle between lines drawn at posterior borders of C2 and C7 vertebrae on cervical roentgenograms (Figure 1). Kyphosis is defined as angle<0 °, lordosis is defined as angle>10°. Angles between 0-10 degrees are defined as cervical straightening [11]. Segment angle is measured between a line passing through posterior of C2 corpus and line connecting posterior borders of upper and lower neighbor vertebras of the operated segment (Figure 2). Kyphosis is defined as angle <0°. Lordosis is

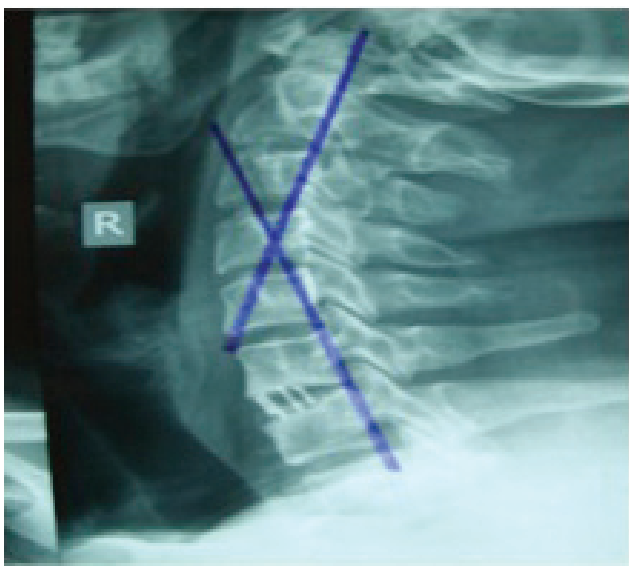

Figure 1. Lordotic angle.

defined as angle of ≥ 1° (3.11). Intraoperatively, disc distance heights were meusured on lateral roentgenograms at corpus mid points.We used 10-12 mm long policarbon cages with 5° angle.

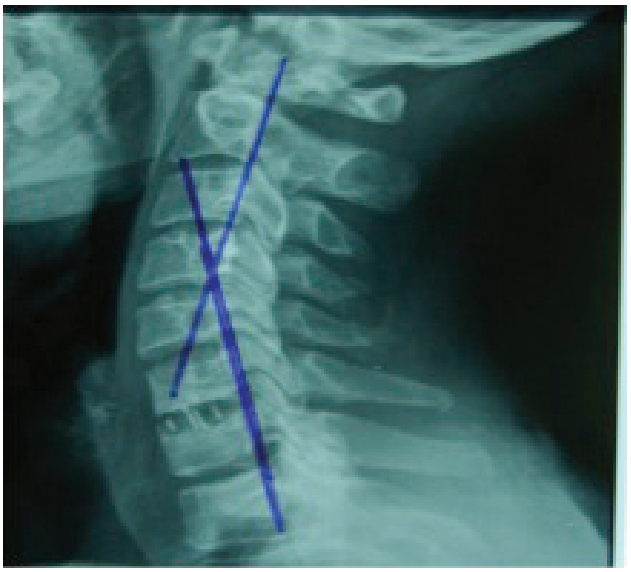

Figure 2. Segment angle.

Statistical analysis

Statistical analysis was performed using the R language R studio V.0.98.501 with the help of the software. The suitability of the analytical method variables with normal distribution (Kolmogorov-Smirnov/Shapiro-Wilk tests) were examined. Descriptive statistics was expressed as mean±standard deviation (Table 1). Since the angle of lordosis and segment, distance height, and pain variables in Preop, Postop and Postop 2 year groups do not show normal distribution, comparison between groups were made by using Wilcoxon test. P-value (Asymp. Sig.) of less than 0.05 was considered as statistically significant (Tables 2 and 3).

Table 1. Preoperative and postoperative variables descriptive statistics.

	N (patient)	mean	Std. Deviation	Min.	Max.
preop_LA	16	14,56	16,828	-10	50
preop_SA	16	13,44	15,293	-15	35
preop_DH	16	4,69	1,448	2	8
preop_Pain	16	81,81	8,526	65	93
postop_LA	16	14,81	10,068	4	36
postop_SA	16	15,75	9,248	5	35
postop_DH	16	5,06	1,731	1	7
postop_Pain	16	16,56	15,161	0	55
postop_2year_LA	16	17,50	13,510	-4	44
postop_2year_SA	16	12,69	11,993	-5	32
postop_2year_DH	16	4,50	1,414	3	8
postop_2year_Pain	16	15,63	14,004	0	50

LA: Lordosis Angle, SA: Segment Angle, DH: Distance Heigt

Table 2. Comparison of the angle between the preoperative and postop 2 year groups.

	Preop_LA Postop 2 year LA	Preop_SA Postop 2 year SA	Preop_DH Postop 2 year DH	Preop_Pain Postop 2 year Pain
Asymp. Sig. (2-tailed)	,711	,826	,565	,000

Table 3. Comparison of the angle between the postoperative and postoperative-2 year groups.

	Preop_LA Postop 2 year LA	Preop_SA Postop 2 year SA	Preop_DH Postop 2 year DH	Preop_Pain Postop 2 year Pain
Asymp. Sig. (2-tailed)	,717	,102	,261	,027

Clinical outcome

The overall clinical outcome was assessed as excellent, good, fair, or poor by the patient according to Odom's criteria [19]. Work status before surgery and at the follow-up assessments was documented. Neck and arm pain was assessed by asking the patients to quantify their degree of pain on Huskisson's visual analogue scale (VAS: 0 mm=no pain; 100 mm=worst pain possible). The group VAS values were evaluated.

RESULTS

A total of 16 patients completed the study and were followed up for at least 2 years. Their mean age was 42 years (range 26. to 61 years). The surgical procedures used were technically successful for all patients, and there were no major complications related to anesthesia or the overall surgical procedure. No hoarseness or no wound infection was noted. There was no cage dislodgment or failure.

The mean midpoint of the intervertebral body height was 4.6±1.4 mm preoperatively, 5.0±1.7.mm

immediately aftegr the operation, (within an average of 3 days), and 4.5±1.4 mm at the postoperative 24. month. The mean intervertebral disc height was about the same at the postoperative 24. month. The mean lordosis angle was 14.5±16.8° preoperatively .14.8±10.0° immediately after the operation, and .17.5±13.5° at the postoperative 24. month. The lordotic angle had increased at the postoperative 24. month (Fig. 1). The segment angle was 13.4±15.2° preoperatively, 15.7±9.2° immediately aftegr the operation and 12.6±11.9° at the postoperative 24. month . Pain complaints decreased from 81.8±8.5 ° at preoperative baseline to 16.5±15.1° on postoperative 3 days and 15.6±14.0 °at postoperative 24. months. LA, SA, SH pretreatment, posttreatment (immediately and at postoperative 2. year) comparisons did not reveal statistically significant difference. But all results were within normal limits. The reduction in pain was statistically significant between the preoperative baseline and postoperative follow-up periods. All patients were able to return to their previous activities and improved their quality of life before the 6. month of the follow-up period . The clinical symptoms improved in all followed-up patients. The self-rated clinical outcome was excellent in 9 (56.2%) patients good in 6 (%37) and moderate in 1 (6.25%) of the 16 patients. The mean hospitalization period was 3.5 days (range, 3 to 7 days).

DISCUSSION

CDD cause symptoms by compressing the spinal cord anteriorly or anterolaterally. If there is a surgical indication for treatment of a CDD, decompression of the spinal cord by ACD relieves the symptoms. The aim of all surgical procedures is to decompress nerve roots and the spinal cord and alleviate pain. However, segmental collapse, caused by losing SH because of the removal of disc material, and consequently changing of AL, become new sources of pain and discomfort for the patient [22]. After a simple ACD procedure the cervical foraminal area diminishes and new symptoms of cervical root compression can be evident [12]. Besides, removing disc material entirely results in instability in the cervical spine because of lack of support to the anterior column. The need to preserve SH and restore AL after an ACD, and the fact that supporting the anterior column can prevent symptoms depending on these changes, led to the idea of including fusion in ACD operations. However, some distraction may occur after operation and the gap can be reduced to some extent. SH seemed unchanged after the procedures in this study. Distraction was avoided by using just the right size interbody cage instead of a cage that distracts the interbody space.In this study the segment angle was measured.

In this study, little decrease in the SA was detected. But mean LA, and SA were within normal limits. This may be because of improvement in pain. There are several clinical studies supporting the use of stand--alone cage in ACDF, but reliability of this technique remains controversial. In a multicenter study [10] comparing the cylindrical cage with non-instrumented bone-only fusion, similar success rates were shown for the two techniques. The functional and neurological outcomes of the cages were better than that of the autogenous iliac crest graft fusion. However, based on a systematic literature review, there is limited evidence supporting the use of a cervical interbody fusion device in place of autologous bone [23,24]. There are many methods for providing fusion. Autograft, allograft, cage application and anterior plating are widely used methods. No statistically significant difference has been found among these four major methods [5]. The graft used for fusion can be easily displaced after the operation unless stabilization is achieved. Furthermore, graft materials can be compressed, so SH and AL cannot be achieved. In addition to all of these, graft particles can move to epidural areas, leading to new compression sites. Fusion materials were put in a cage to avoid graft movements and compression. At the same time, cage applications preserve SH and AL within normal limits. Slipping of grafts that have a cage was less frequently observed. An anterior plate can prevent

anterior slipping and can also compress the graft to fuse quickly. Sophisticated technology produced cages that hold on to the vertebral endplates better. These cages minimized the need for an anterior plate.

All of these developments have made ACDF a popular surgical option for treatment of CDD [12]. It provides a wider angle of sight, enables removal all of the disc material and osteophytes, faciliştates bony decompression and sufficient fusion, and makes ACDF the preferred technique for the treatment of soft CDH [6,8,9,22].

Adding fusion to the ACD operation diminishes SH losses and in parallel prevents foraminal compressions [18,21]. Although autografts provide better fusion rates, because of donor site complications and the fact that it requires more time, cage and artificial grafts are preferred [7,17,20]. Prevention of postoperative kyphosis is another advantage of cage fusion. Lordotic cages in particular can provide normal cervical alignment [1,2,9,13,14,16]. This technique can also place AL and SA within normal limits, so postoperative pain is reduced and quality of life of the patients increases [4,15,18]. Changes in Odom's criteria and VAS show that clinical improvement is parallel to these radiological measurements. In particular a sharp decline in VAS after three days of the operation may be considered as evidence of the effectiveness of this procedure.

Subsidence of the cage is another issue that needs to be considered. Many reports in the literature describe risk factors for cage subsidence [2,12]. In this study, subsidence of the cage was not encountered.To our knowledge, there are few reports of the long-term results of stand-alone cage used in ACDF. İn the present study, stand-alone PEEK cages were used for the surgical treatment of one level cervical disc disease, and sixteen patients were followed up for at least 2 years. After a minimum of 2 years of follow-up both the neck and radicular pain was significantly improved. There were no complications associated with the cages. All results suggest that the long-term clinical outcome of the stand-alone cages used in the surgical treatment of one cervical disc disease is satisfactory.

CONCLUSIONS

ACDF is an effective way for the treatment of CDD. Using a PEEK cage prevents segmental collaps. This technique can also put AL and SA within normal limits, so postoperative pain is reduced, and quality of life of the patients improves. Long-term clinical outcome of the stand-alone cages used in the surgical treatment of one cervical disc disease is satisfactory. An important limitation of this study is its small sampling size. Comparative future studies about fusion rates will clarify this issue.

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