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Retrospektif Çalışma

Microdiscectomy and Intervertebral Disc Replacement for Herniation Involving Fifth and Sixth Cervical Vertebras: Our Experience with 53 Patients

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Objective: To present our clinical outcomes with anterior approach microdiscectomy and artificial disc replacement in patients with C5-6 disc hernias.
Material and Methods: This cohort study is based on data collected during follow-up of a total of 53 patients (23 women, 30 men; mean age: 40.6±4.4 years) operated in the neurosurgery departments of 3 institutions between February 2010 and February 2013. Pain and neck disability were evaluated preoperatively and at postoperative 6th, 12th and 24th months by means of visual analogue scale (VAS) and neck disability index (NDI), respectively. Alterations in VAS and NDI scores were compared during the follow-up period.
Results: Scores in VAS and NDI were improved significantly at postoperative 6th, 12th and 24th months ($p<0.001$ for all). Furthermore, VAS and NDI scores at 12th and 24th months were better than those at 6th month ($p=0.021$ and $p=0.006$ for VAS; $p<0.001$ for NDI). However, no differences were observed between VAS ($p=0.192$) and NDI scores ($p=0.258$) at postoperative 12th and 24th months.
Conclusion: We suggest that microdiscectomy and implantation of the artificial cervical disc prosthesis is a safe and effective procedure for reduction of pain and improvement of neck disability in patients with disc herniation at the level of C5-C6. Long- term follow-up in larger series and controlled trials are required for documentation of the safety and efficacy of the procedure more accurately.

Keywords: Cervical, disc herniation, treatment, microdiscectomy, artificial disc, replacement

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C5-6 Disk Herniasyonunda Mikrodiskektomi ve İntervertebral Disk Protezi Yerleştirme: Elli Üç Hastalık Tecrübemiz

Amaç: C5-6 servikal disk hernili hastalarda anterior mikrocerrahi ve yapay disk protezi yerleştirme işleminin klinik sonuçlarını sunmak.
Gereç ve Yöntem: Bu çalışma şubat 2010 ve şubat 2013 tarihleri arasında 3 kuruluşun nöroşirürji bölümlerinde ameliyat edilen 53 hastanın (23 kadın, 30 erkek, ortalama yaş: 40.6±4.4) izlenimi sırasında toplanan verilere dayanmaktadır. Ağrı ve boyun kısıtlılığı ameliyat öncesi, ameliyat sonrası 6., 12. ve 24. aylarda VAS ve NDI skorları yardımıyla değerlendirildi. İzleme peryodu döneminde VAS ve NDI'deki değişiklikler karşılaştırıldı.
Bulgular: VAS ve NDI değerleri ameliyat sonrası 6., 12. ve 24. aylarda önemli ölçüde iyileşti. Ayrıca 12. ve 24. aylardaki VAS ve NDI değerleri 6 aylık izleme göre daha iyiydi ($p=0,021$ ve $p=0,006$ VAS için; $p<0,001$ NDI için). Bu arada 12. ve 24. aylardaki VAS ve NDI değerleri arasında fark gözlenmedi.
Sonuç: C5-6 düzeyindeki disk herniasyonlu hastalarda boyun kısıtlılığının ve ağrının azalmasında mikrocerrahi ve servikal disk protezi yerleştirme işleminin güvenilir ve etkili bir yol olduğunu öne sürüyoruz. Daha doğru bir şekilde, işlemin etkinliğini ve güvenirliğini belgelemek için daha geniş serilerde uzun dönem ve kontrollü izlemler gerekmektedir.

Anahtar kelimeler: Servikal, disk herniasyonu, tedavi, mikrocerrahi, yapay disk, yerleştirme

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Intervertebral disc degeneration and cervical spondylosis may cause cervical spondylodiscoarthosis (SDA) that in turn leads to biochemical and morphological modifications of cervical spine. These changes in the cervical spine may clinically present as neck pain, cervical myelopathy and radiculopathy in neurosurgical practice [1,3].

A cervical herniated disc can be treated via removal of a part of the disc through a small incision and this technique is termed as microdiscectomy [2]. If this method is implemented via posterior approach, spinal fusion is not required. Alternatively, anterior cervical discectomy and fusion procedure (ACDF) can be applied and this method constitutes the current gold standard for the management of symptomatic anterior cervical disc disease [4]. After it was initially described almost 50 years ago, its efficacy in terms of rapid recovery and improvement in the quality of life has been demonstrated [4,6].

Subsequent to report by Hillibrand, a symptomatic adjacent segment disease was diagnosed in 2.9% of the candidates for ACDF [5]. Owing to the alteration of kinematics, this circumstance led to the development of prosthesis implantation as a motion-sparing alternative to fusion [8].

In the past, cervical spine surgery was mainly carried out by means of a posterior approach. The first ventral cervical spine stabilization was performed with an onlay fusion and the operative technique with an interbody graft was described later [7]. Subsequent to the modification of the anterior cervical decompression and interbody fusion (ACDF) procedure, ACDF was implemented with autografts harvested from the iliac crest bone, tibia, fibula, and ribs (autograft). Nevertheless, utility of autologous cancellous bone resulted in several complications including acute or chronic pain at the donor site and graft subsidence [7].

Attributed to these drawbacks and the likelihood of adjacent segment disease, cervical total disc replacement can be a reasonable alternative to fusion. Up to now, three devices were described for cervical total disc replacement (TDR) at single- level anterior disc procedures. These devices consist of the Bryan Disc (Medtronic Sofamor Danek, Memphis, TN, USA), the Prestige Disc (Medtronic Sofamor Danek, Memphis, TN, USA), and the ProDisc-C (Synthes Spine West Chester, PA, USA) [8]. There are several TDR models currently under investigation, but we used the Bryan Disc in this series.

The objective of the current study was to analyze and present our results with microdiscectomy and intervertebral artificial disc implantation in 53 patients diagnosed with SDA at the level of C5-6.

MATERIAL and METHODS

Study design: This cohort was formed by collaboration of 3 neurosurgery departments in 3 distinct tertiary care centers. A total of 53 patients (23 women, 30 men) diagnosed with spondylodiscoarthropathy at the level of C5-6 were operated by the same surgical teams between February 2010 and February 2013 using anterior microdiscectomy with artificial disc replacement. Pain and neck disability were assessed with visual analogue scale (VAS) and neck disability index (NDI) before the operation and at 6th, 12th, and 24th months postoperatively. The mean age of the study group was 40.6±4.4 (range, 34 to 52).

Diagnosis of cervical SDA was established by history, physical examination and magnetic resonance imaging technique. Patients presented with unilateral disc extrusion with radiculopathy, cervical spondylosis with radiculopathy or myelopathy or central herniation of the disc with compression of the cord. Chief complaints comprised of neck pain, arm pain, neurological changes, loss of reflexes, radicular numbness or sensation of tingling. Weakness in motor function was particularly prominent on extension or flexion of wrist, and forearm. Magnetic resonance images demonstrated compression of the nerve root or the spinal cord due to prolapse of the disc or osteophytes between C5-6 cervical vertebras.

Surgical procedure: Anterior cervical microdiscectomy was implemented in supine position while the head was maintained in neutral position while the neck is extended. To achieve the aimed position, a soft sand bag was placed under the shoulders. A 3 cm skin incision extending from the midline to the medial border of sternocleidomastoid muscle was made. Platysma, deep cervical fascia and the avascular plane between the carotid sheath and pharynx was passed through. Following the incision of prevertebral fascia, cervical spine was exposed and further steps were taken under microscopic view. Disc forceps and curettes were used for removal of the disc material. The disc space was distracted with a vertebral spreader and discectomy was performed to the level of uncinate process until the disc space was cleared of the disc material. The posterior longitudinal ligament was exposed and removed along the width of disc space. Diamond burr was used for discectomy and adequate decompression of the exiting nerve roots was accomplished. Bleeding through the epidural veins on the lateral margin of the disc space was managed with Surgicel.

Drilling was performed on the vertebral endplates and an artificial titanium cervical disc was placed between the contoured endplates without fixation to the vertebral bodies. To this end, Cervical Disc System was used to achieve a mobile joint. Incisions were sutured by absorbable stitches and patients were mobilized either on the same or the next day.

No remarkable complications such as brachalgia or segmental kyphosis were detected. The minor and temporary complications reported by a few patients in our series were mild dysphagia and neck pain.

All patients in our series were under follow-up for 2 years and VAS as well as NDI were applied at postoperative 6th, 12th and 24th months. No permanent and serious complications were experienced during the insertion of the prosthesis, or during the postoperative course. Temporary dysphagia and dysphonia which recovered spontaneously within a few days were seen in 3 patients. Recovery of neurological deficits was observed in the vast majority of patients, however, in one patient loss of motor function in the wrist deteriorated postoperatively. In this case, control images demonstrated the presence of sequestrum in the foramen. During revision surgery sequestra were removed and larger disc prosthesis was placed. At the end of 2 years, motor function in the wrist was found to be the same as its preoperative state. Other than this case, all patients experienced immediate postoperative resolution of their radicular pain and they were discharged the following day. At nine months following surgery, both patients maintained their complete relief of radicular symptoms. Postoperative radiograms at six months

following surgery confirmed accurate placement of the prosthesis and preserved mobility of the functional spinal unit.

Statistical Analysis: Data were analyzed using "IBM SPSS Statistics 20" program. Normal distribution of data was assessed with Kolmogorov-Smirnov test. Parametric tests were used for variables with normal distribution, while non-parametric tests were utilized for variables that do not have normal distribution. Two dependent groups were compared with Paired-Samples t test and Wilcoxon test. Confidence interval was 95% and level of significance was set at $p<0.05$.

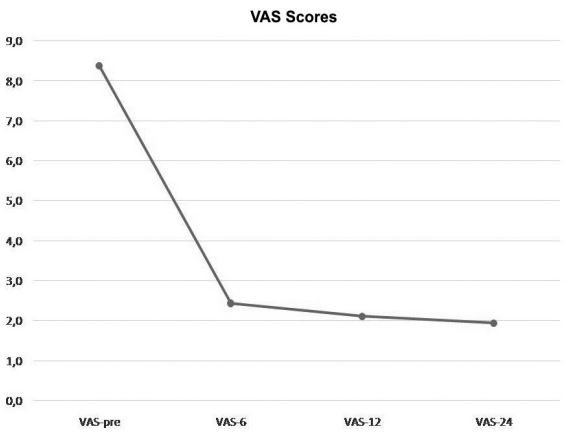

Figure 1. Alteration of visual analogue scale (VAS) score before the operation and during the 2-year follow-up period.

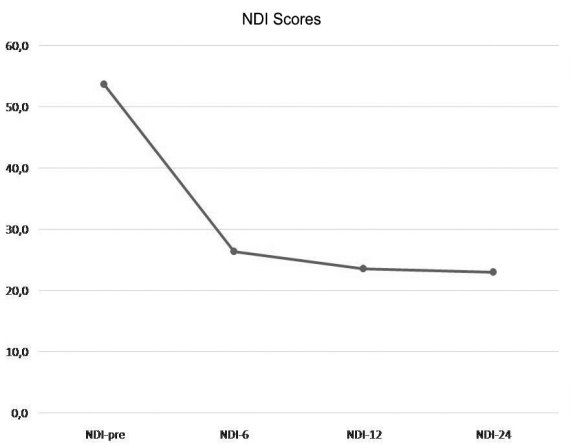

Figure 2. Course of neck disability index (NDI) from the preoperative period onto the follow-up for 2 years.

RESULTS

The vast majority of patients were discharged within 1 or 2 days after surgery. All cases reported improvement in terms of neurological and functional state both objectively and subjectively as documented in VAS and NDI scores (Figures 1 and 2).

Table 1 demonstrates the VAS and NDI scores in the study group and Table 2 comparatively presents VAS and NDI scores in the preoperative period as well as postoperative 6th, 12th and 24th months.

Table 1. Visual analogue scale and neck disability index scores in women, men and the whole study group at various periods.

		Groups		
Variable	**Period**	**Women**	**Men**	**Overall**
Age		41.0±5.1	40.4±3.8	40.6±4.4
Visual analogue scale	Preoperative	8.3±0.9	8.5±0.9	8.4±0.9
	6th month	2.7±0.9	2.2±0.8	2.4±0.9
	12th month	2.3±0.5	1.9±0.6	2.1±0.6
	24th month	1.9±0.7	2.0±0.6	1.9±0.6
Neck disability index	Preoperative	53.0±9.1	54.1±8.2	53.7±8.5
	6th month	26.5±5.0	26.3±3.7	26.4±4.3
	12th month	24.5±3.8	22.9±3.3	23.6±3.6
	24th month	22.4±3.4	23.5±3.8	23.0±3.0

Table 2. Comparison of visual analogue scale and neck disability index scores in the preoperative period and 6th, 12th and 24th months postoperatively.

Variable	**Period**		**Period**
Visual analogue scale	Preoperative	6th month	<0.001*
		12th month	<0.001*
		24th month	<0.001*
	6th month	12th month	0.018*
		24th month	0.006*
	12th month	24th month	0.192
Neck disability index	Preoperative	6th month	<0.001*
		12th month	<0.001*
		24th month	<0.001*
	6th month	12th month	<0.001*
		24th month	<0.001*
	12th month	24th month	0.258

*(Hint: *: statistically significant)*

It is clear that the change in VAS scores in the postoperative period was significant. Of note, no difference was observed between VAS scores on 12th and 24th months postoperatively. Similarly, postoperative improvement of NDI compared to the preoperative scores was noteworthy. However, no difference was detected between NDI scores at 12th and 24th months.

DISCUSSION

The results of the present study imply that anterior microdiscectomy together with artificial disc replacement is a safe and effective treatment modality for SDA involving C5 6 cervical vertebras. The improvement in patients' complaints including pain and neck disability after surgery was satisfactory and the beneficial effect of the operation was more obvious especially within the first year.

Even though ACDF is a common and satisfactory procedure for degenerative disorders of cervical spine, interbody fusion converts a functional and mobile spinal unit into a fixed and non-functional one. Moreover, the increased stress on discs neighbouring the fused segment may accelerate degeneration and instability at these levels. Spondylosis and instability at spinal segments adjacent to the fused level have been already documented radiographically [11].

Whether these changes are associated with process of fusion or are linked with the natural clinical course of disease is debateful [6]. Beyond these controversial circumstances, biomechanical developments have provided restoration of function via artificial disc replacement [8]. In other words, an artificial cervical disc can be useful for the treatment of degenerative cervical disease and may replace the need for segmental fusion. Thereby, not only a functional spinal unit will be preserved but also possibility of degeneration in adjacent segments will be avoided. In accordance with recent publications, we noted that cervical disc systems are safe and effective for the management of complaints arising from symptomatic radiculopathy [8,9].

Microdiscectomy procedure is mostly implemented on lower cervical disks such as C5-6 and C6-7. Since microsurgical techniques allow identification of potential sites for air entrainment and the distance between the operative site and the right atrium is decreased, risk of venous air embolism is decreased [12]. We didn't come across significant complications such as venous air embolism and other morbidities calling for repeat surgery.

Efficacy and safety of The Cervical Disc System for the treatment of single level degenerative disc disease have been already documented both for short and long term in recent trials [8,11]. It is especially notable that implantation of artificial disc can prevent development of adjacent segment disease in addition to outcomes comparable to ACDF.

Cervical segments C5-6 and C6-7 have the highest range of motion and are under greater risk for adjacent segment disease [10]. Therefore, insertion of an artificial cervical disc successfully into these segments is particulary important for these levels. In this perspective, our long-term results are important to elucidate whether artificial disc replacement can prevent development of adjacent segment disease. Complications like screw failure did not exist in our series and a self-resolving temporary dysphagia occurring in 3 cases might be associated with the bulks of the anterior compartment. Two-year follow-up

period revealed that artificial joint mobility was sufficient for restoration of motility and alleviation of pain before the surgery. Nevertheless, it must be remembered that clinical and radiological findings may not necessarily occur in association.

Artificial disc replacement is a biocompatible and durable alternative that provides stability of the joint in the long term. Its elasticity and compressibility allows motion and the surgical procedure seems to be safe and practical without prolongation of operation time [9]. Our preliminary results remind that clinical outcomes are comparable to those of standard procedures of discectomy and single level fusion. Yet, we have not detected any problems such as settling or migration of disc leading to functional or clinical problems in our series. Insertion of artificial disc calls for meticulous technique since injury to the vertebral artery or spinal cord may occur despite usage of calibrated tools [8]. To avoid such a complication, preoperative analysis of images must be made carefully.

Placement of artificial disc is indicated in patients presenting with symptoms consistent with cervical radiculopathy and myelopathy accompanied by the radiological evidence of neural compression due to osteophyte or herniated disc material [10]. Young patients with an increased lifetime risk for adjacent segment disease are candidates for artificial disc implantation. Furthermore, this procedure is indicated for asymptomatic cases with spondylotic changes at other levels of spinal cord and patients with previous history of ACDF having new complaints consistent with myelopathy or radiculopathy attributed to a degenerative disc [10].

The present study posseses some limitations. First, we have a relatively small sample size and our results reflect the experience of 3 institutions. Factors like bias effect, technical facilities and experience cannot be uniformly standardized for clinics contributing to this study. In addition, lack of a control group and impacts of socioeconomical and environmental factors cannot be ignored. Since VAS and NDI are subjective measures, further clinical and radiological assessments can provide more accurate and reliable information on the clinical outcomes. Long- term results must be carefully analyzed for making healthier conclusions.

We suggest that microdiscectomy together with implantation of the Bryan artificial cervical disc prosthesis is a safe and effective procedure for reduction of pain and improvement of neck disability in patients with disc herniation at the level of C5-C6. Long- term follow-up in larger series and controlled trials are required for documentation of the safety and efficacy of the procedure more accurately.

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