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Anterior Cervical Discectomy and Fusion vs Posterior Key-Hole Foraminotomy in Single Level Cervical Discopathy

Tek Seviye Servikal Disk Hernilerinde Anterior Servikal Diskektomi ve Füzyon ile Posterior Key-Hole Foraminotominin Karşılaştırılması

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Öz

Servikal radikülopatilerde anterior servikal mikrodiskektomi ve füzyon (ACDF) ve posterior servikal foraminotomi (PCF) sık uygulanan cerrahi yaklaşımlardır. Bu çalışmada bu iki yöntem arasındaki klinik sonuçların, komplikasyonların, kanama miktarının, nüks ve reoperasyon oranlarının ve instabilite gelişiminin karşılaştırılarak tekniklerin birbirine üstünlüklerinin incelenmesi planlanmıştır. Retrospektif olarak planlanan çalışma için otomasyon sisteminden hasta arşivleri taranarak klinik ve radyolojik dökümanları incelendi. Ameliyat öncesi var olan şikayetlerin ameliyat sonrası kısa (postop ilk 24 saat) ve uzun dönemde değişimi (1-6 ay), preoperatif ve postoperatif fonksiyonel servikal vertebra grafileri ve servikal MR görüntüleri, komplikasyon varlığı, kanama miktarı, nüks ve reoperasyon durumu kayıt edildi. Travma hastaları, instabilite varlığı ve maligniteye bağlı patolojileri olan hastalar, multiseviye cerrahi girişim bulunan veya daha önce servikal omurga cerrahisi geçiren hastalar, 18 yaş altındaki hastalar ve verilerine ulaşılamayan hastalar çalışma dışında bırakıldı. Kanama miktarı, postoperatif ilk 24 saatte ağrı, 1. ayda ağrı, 6. ayda ağrı, komplikasyon gelişimi, nüks ve reoperasyon oranları ve instabilite gelişimi arasında istatistiksel olarak anlamlı farklılık saptanmamıştır. Posterior foraminotominin cerrahi süresinin daha kısa olduğu ve istatistiksel olarak anlamlı olduğu görülmüştür. Her iki cerrahi tekniğin ameliyat sonrası 6 aylık süre içinde birbirine bariz üstünlüğü bulunmadığı izlenmiştir. Daha büyük örneklem büyüklüğü ve daha uzun dönem takip ile farklı sonuçlara ulaşılabilir.

Anahtar Kelimeler: Anterior Servikal Diskektomi ve Füzyon, Posterior Servikal Foraminotomi, Radikulopati

Abstract

Anterior cervical microdiscectomy and fusion (ACDF) and posterior cervical foraminotomy (PCF) are frequently applied surgical approaches in cervical radiculopathies. It is planned to compare and discuss the clinical results, complications, amount of bleeding, recurrence and reoperation rates, and instability development between these two methods and examine the superiority of the techniques in this study. Patient archives were scanned and clinical and radiological documents were examined for this retrospective study. Short-term (postoperative first 24 hours) and long-term (1-6 months) changes in preoperative complaints, preoperative and postoperative functional cervical spine radiographs and cervical MRI images, presence of complications, amount of bleeding, recurrence and reoperation status were recorded. Trauma patients, patients with instability and malignancy-related pathologies, patients with multilevel surgical intervention or previous cervical spine surgery anamnesis, patients under the age of 18, and patients whose data were not available were excluded from the study. No statistically significant difference was found between the amount of bleeding, pain in the first 24 hours postoperatively, pain in the 1st month, pain in the 6th month, development of complications, recurrence and reoperation rates, and development of instability. It was observed that the surgical time of posterior foraminotomy was shorter and was statistically significant. It was observed that neither surgical technique had any obvious superiority over the other in the 6-month postoperative period. Different results can be achieved with larger sample size and longer term follow-up.

Keywords: Anterior Cervical Discectomy and Fusion, Posterior Cervical Foraminotomy, Radiculopathy

Introduction

Anterior and posterior surgical intervention methods and techniques for the cervical spine have been described in the surgical treatment of cervical disc herniations (1-3). These techniques have advantages and disadvantages depending on the anatomical layers they cover, preservation of cervical lordosis, relief of nerve root compression, fusion requirements, anatomical structures on the surgical path, or possible general complications. Anterior cervical microdiscectomy and fusion (ACDF) and posterior cervical foraminotomies (PF) are frequently applied surgical techniques nowadays, especially in single-level cervical foraminostenosis cases. It is stated in the literature that both techniques have an 87-97% chance of success (4).

It is aimed to compare the clinical results, complications (mortality, neurovascular damage, CSF fistula, deep vein thrombosis, wound infection), recurrence and reoperation rates between anterior cervical discectomy and fusion and posterior foraminotomy in the surgical treatment of single-level cervical disc herniations.

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Material and Method

After obtaining the approval of the Izmir Bakırçay University Clinical Research Ethics Committee (dated 08/01/2025 and decision number 1961), patients who were operated on by the same surgeon in the same hospital between January 2017 and December 2024, who were operated on due to single level cervical disc herniation, who underwent anterior cervical discectomy and fusion (ACDF) or

cervical posterior key-hole foraminotomy were included in the study. Trauma patients, patients with instability and malignancy-related pathologies, patients who underwent multilevel surgery, patients who had previously undergone cervical spine surgery, patients under the age of 18, and patients whose data could not be accessed were excluded from the study. The patients' age, gender and comorbidity information, pathology level, surgical procedure, surgery duration, amount of bleeding, preoperative Visual Analog Scale (VAS), VAS in the first 24 hours postoperatively, VAS scores in the first postoperative month and postoperative 6th month, peroperative and postoperative complications, development of instability in postoperative 1st and 6th month flexion and extension radiographs, and reoperation situations were documented.

Statistical Analysis

All records and data regarding the patients were analyzed with the SPSS 23.00 statistical package program. The minimum number of participants needed to perform statistical analyzes was calculated using the G*Power program. Significance level α=0.05, power of statistical test (Power 1-β = 0.80) and medium effect size (ES = 0.5) were taken into account in the calculation. At least 100 patients were planned to be included in the study, as the sample size should consist of at least 92 participants according to the power analysis. Data and descriptive statistics (number, percentage distribution, mean, standard deviation) were examined with t-test and ANOVA. Continuous variables were analyzed using the Student t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. Categorical variables were examined using Pearson's Chi-Square test analysis and Fisher tests when appropriate. The confidence interval and significance level of the findings were evaluated.

Results

81 patients out of 114 were excluded from the study according to the exclusion criteria and the data of 114 patients were evaluated statistically in this study.

Table 1. Descriptive data of cervical pathologies

	C3-C4 (n:8)	C4-C5 (n:22)	C5-C6 (n: 54)	C6-C7 (n:30)	p
Age (mean±SD)	59.7 ± 4.49	66.13 ± 14.11	50.37 ± 13.16	52.83 ± 7.18	<0.001*
Gender, n(%)					0.230
Female	6 (75%)	10 (45.5%)	25 (46.3%)	19 (63.3%)	
Male	2 (25%)	12 (54.5%)	29 (53.7%)	11 (36.7%)	
Surgery duration (minute) (mean±SD)	68.75 ± 9.5	58.18 ± 13.23	61.11 ± 11.31	59.83 ± 14.32	0.202
Blood loss (ml) (mean±SD)	112.5 ± 15.6	113.63 ± 8.81	98.88 ± 6.84	126.33 ± 10.22	0.118
Preoperative VAS score (mean±SD)	7.5 ± 0.53	7.6 ± 1.09	7.57 ± 0.79	7.4 ± 0.813	0.754
Postoperative 24 hours VAS score (mean±SD)	1.75 ± 0.88	1.63 ± 0.49	1.46 ± 0.92	1.4 ± 0.77	0.589
Postoperative 1 month VAS score (mean±SD)	0.50 ± 0.53	0.59 ± 0.50	0.37 ± 0.55	0.63 ± 0.49	0.131
Postoperative 6 month VAS score (mean±SD)	0	0.18 ± 0.39	0.18 ± 0.39	0.16 ± 0.37	0.631
Postoperative complication, n(%)					0.087
No	7 (87.5%)	20 (90.9%)	52 (96.3%)	30 (100%)	
Vocal cord paralysis	-	-	2 (3.7%)	-	
Local infection	1 (12.5%)	2 (9.1%)	-	-	
Comorbidity, n(%)					<0.001*
No	6 (75%)	4 (18.2%)	46 (85.2%)	26 (86.7%)	
1 comorbidity	-	12 (54.5%)	3 (5.6%)	3 (10%)	
At least 2 comorbidity	2 (25%)	6 (27.3%)	5 (9.3%)	1 (3.3%)	
Hypertension, n(%)					0.004*
No	6 (75%)	13 (59.1%)	46 (85.2%)	29 (96.7%)	
Yes	2 (25%)	9 (40.9%)	8 (14.8%)	1 (3.3%)	
Diabetes (type 1 or 2)					<0.001*
No	6 (75%)	10 (45.4%)	53 (98.1%)	27 (90%)	
Yes	2 (25%)	12 (54.5%)	1 (1.9%)	3 (10%)	
Coronary arter dissease					0.663
No	8 (100%)	21 (95.5%)	52 (96.3%)	30 (100%)	
Yes	-	1 (4.5%)	2 (3.7%)	-	
Rheumatoid arthritis					0.644
No	8 (100%)	20 (90.9%)	52 (96.3%)	29 (96.7%)	
Yes	-	2 (9.1%)	2 (3.7%)	1 (3.3%)	

Abbreviations; SD: standart deviation, VAS: Visual Analog Scala

Table 2. Descriptive data of surgical procedure

	ACDF (n:65)	PF (n:49)	p
Age (mean±SD)	55.24 ± 13.28	54.02 ± 12.80	0.329
Gender, n(%)			0.112
Female	30 (46.2%)	30 (61.2%)	
Male	35 (53.8%)	19 (38.8%)	
Pathology level			0.265
C3-C4	4 (6.2%)	4 (8.2%)	
C4-C5	11 (16.9%)	11 (22.4%)	
C5-C6	36 (55.4%)	18 (36.7%)	
C6-C7	14 (21.5%)	16 (32.7%)	
Surgery duration (minute) (mean±SD)	69.30 ± 8.0	49.30 ± 8.04	0.011*
Blood loss (ml) (mean±SD)	81.84 ± 34.72	147 ± 44.11	0.337
Preoperative VAS score (mean±SD)	7.78 ± 0.83	7.20 ± 0.73	0.666
Postoperative 24 hours VAS score (mean±SD)	1.5 ± 0.73	1.48 ± 0.91	0.057
Postoperative 1 month VAS score (mean±SD)	0.43 ± 0.49	0.57 ± 0.57	0.086
Postoperative 6 month VAS score (mean±SD)	0.13 ± 0.34	0.20 ± 0.40	0.068
Postoperative complication, n(%)			0.231
No	62 (95.4%)	47 (95.9%)	
Vocal cord paralysis	2 (3.1%)	-	
Local infection	1 (1.5%)	2 (4.1%)	
Comorbidity, n(%)			0.067
No	43 (66.2%)	39 (79.6%)	
1 comorbidity	11 (16.9%)	7 (14.3%)	
At least 2 comorbidity	11 (16.9%)	3 (6.1%)	
Hypertension, n(%)			0.019*
No	49 (75.4%)	16 (91.8%)	
Yes	45 (24.6%)	4 (8.2%)	
Diabetes (type 1 or 2)	52 (80%)	44 (89.8%)	0.122
No	13 (20%)	5 (10.2%)	
Yes			
Coronary arter dissease			0.576
No	64 (98.5%)	47 (95.9%)	
Yes	1 (1.5%)	2 (4.1%)	
Rheumatoid arthritis			0.632
No	62 (95.4%)	47 (95.9%)	
Yes	3 (4.6%)	2 (4.1%)	

ACDF: Anterior cervical discectomy and fusion, PF: Posterior foraminotomy

52.6% (n:60) of the patients are women, the average age of all patients is 54.7 ± 13.08. While 71.9% (n: 82) of the patients did not have any comorbidities, 1 chronic disease was detected in 15.8% (n: 18) and at least 2 chronic diseases were detected in 12.3% (n: 14). Hypertension was the most frequently encountered in patients with comorbidities (17.5%, n: 20).

The most common pathology was at C5-C6 (n:54, 47.4%) level, while the least pathology was found at C3-C4 (n:8, 7%) level. 57% (n: 65) of all patients underwent anterior cervical discectomy and fusion (ACDF), and 43% (n: 49) underwent posterior foraminotomy (PF).

There were no peroperative complications, no need for reoperation, and no instability in any patient included in the study.

Age, presence of multiple comorbidities, hypertension and diabetes were found to be statistically significant (in order of p: <0.001, <0.001, 0.005,<0.001) when patients are grouped and evaluated according to their cervical pathology levels (Table 1).

Surgical duration and the presence of hypertension were found to be statistically significant (in order of p: 0.011, 0.026) when patients were grouped according to the surgical procedure performed (Table 2).

A low to moderate correlation was found between the level of cervical pathology and age, comorbidity, hypertension and diabetes (in order of r: -0.313, -0.394, -0.305, -0.342), but a very significant (p<0.001) negative correlation was found for all of them at the correlation matrix.

A negative correlation was found between the surgical procedure and surgical time, preoperative VAS scores and the presence of hypertension. This relationship showed an excellent correlation for surgical time, a low-moderate correlation for the preoperative VAS score, and a low correlation for the presence of hypertension (in order of r: -0.817, -0.323, -0.214; p: <0.001, <0.001, 0.022). While a good correlation was found for the amount of bleeding, this was found to be statistically significant (r: 0.667, p< 0.001).

Discussion

Anterior cervical discectomy and fusion (ACDF) and posterior foraminotomy (PF), which are frequently applied surgical techniques in single-level cervical disc herniations were examined in this study. No statistically significant difference was found between the amount of bleeding, pain in the first 24 hours postoperatively, pain in the 1st month, pain in the 6th month, development of complications (mortality, neurovascular damage, CSF fistula, deep vein thrombosis, wound infection), recurrence and reoperation rates, and development of instability. It was observed that the surgical time of posterior foraminotomy was shorter and was statistically significant.

Although anterior cervical discectomy and fusion and posterior foraminotomy techniques are frequently used in single-level cervical disc herniations and radiculopathies, studies comparing these two techniques in the literature were mostly limited to low sample sizes.

Different results were found between ACDF and PF techniques among studies determining surgical duration. Although there are studies stating that there is no superiority between the two techniques (5,6), there are also studies stating that posterior foraminotomy is statistically significant in terms of

surgical time (7-9). Posterior foraminotomy (49.30 ± 8.04 minutes) was found to be statistically significant compared to ACDF surgery (69.30 ± 8.0 minutes) when surgical times were examined in our study (p:0.011).

There are limited randomized trials that have tried to determine the superiority between ACDF and PF about pain relief. Herkowitz et al randomized 33 patients to ACDF or PCF and showed that 94% of patients who underwent ACDF reported an excellent or good outcome (as defined by relief of pain or improvement of pain requiring occasional analgesics without lifestyle restrictions) vs 75% of the PCF group (10). Wirth et al. compared ACDF and PCF and showed no difference in recurrent symptoms and reoperation rate in 72 patients (11). While the preoperative VAS score was 7.78 ± 0.83 and 7.20 ± 0.73 in ACDF and PF in order, it decreased to 1.5 ± 0.73 and 1.48 ± 0.91 at the postoperative 24th hour, and 0.43 ± 0.49 and 0.57 ± 0.57 in the first postoperative month in our study. VAS score also decreased to 0.13 ± 0.34 and 0.20 ± 0.40 in the 6th month. No statistically significant difference was found at the postoperative 24th hour, 1st month and 6th month (in order of p: 0.057, 0.086, 0.068) in terms of regression of radiculopathy between these two surgical techniques.

The overall complication rate in a meta-analysis was 3.89% in the ACDF group and 3.97% in the PF group (12). Lin et al. found an increase in the incidence of complications following PF compared to ACDF, which they did not describe complications (13). Wound infections have been cited to be the most common complication after PCF, ranging from 1% to 4.5% (14). Santangelo et al found that wound complications were associated with reoperation in 1.4% of the PCF group and in no patients undergoing ACDF. Risk factors for reoperation in this population were told to be younger age, male patients, preoperative diabetes, and lower BMI (15). Vocal cord paralysis was observed in 2 of 65 patients who underwent ACDF and local infection was observed in 1, while local infection was observed in 2 of 49 patients who underwent PF when the postoperative complications observed in our study were examined. There is no statistically significant difference between the postoperative complication rates of the two techniques. No other complications, including instability, were observed in the early or late stages for either technique. There is no recurrence or reoperation during the 6-month follow-up period. The operating level of 2 patients with vocal cord paralysis in ACDF surgery was found to be C5-C6. These patients' symptoms resolved at approximately week 4. Local infections with both techniques have been seen in patients with at least two comorbidities. Infections regressed with oral or intravenous antibiotic therapy given to patients in both groups, and none of them required surgical debridement. As it is known, one of the causes of infection is the amount of bleeding. The bleeding amount for ACDF was 81.84 ± 34.72 milliliters and for PF was 147 ± 44.11 milliliters. There was no statistically significant difference in the amount of bleeding between the two techniques (p: 0.337).

Lubelski et al published the first propensity-matched analysis comparing 188 ACDF with 140 PF with 2 year follow-up and found that the same level reoperation rate was not different (4.8% and 6.4%) (16). Another study compared ACDF with endoscopic PF in 175 patients and found no difference in reoperation between the groups (4.7% and 6.7%) (17). Only one study found an increased reoperation rate after PF (13). The reason for this difference in the literature may be that there were no patients followed for longer than 4 years, as seen in most studies and in our study. There was no reoperation in either group until the 6th month follow-up in this study. Longer follow-up time and larger sample size may be required to determine the real superiority of ACDF vs PF.

The main limitation of this study is its retrospective design. Although statistical evaluation can be made, a larger sample size will increase the effectiveness of the further studies.

Conclusion

Anterior cervical discectomy and fusion (ACDF) and posterior foraminotomy (PF) did not demonstrate a significant advantage in terms of blood loss, postoperative VAS score, complication rate, relapse or reoperation rate and spinal instability, but operation time, in 6 months follow-up. Further researches with longer follow-up time and larger sample size may give more information to determine the superiority of ACDF and PF in treating single level cervical discopathy.

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Regarding the limitations of our study, this was a retrospective review with a small sample size in a single center in a restricted region.

Conflict of interest statement

The authors declare that there is no conflict of interest.

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