

Original Article

Single Level Anterior Cervical Discectomy without Interbody Fusion: A Prospective Analysis of Outcome

Akbar Farzannia¹, Shahram Hadidchi¹, Mohammad Hossein Forouzanfar²¹Department of Neurological Surgery, Tabriz University of Medical Sciences, Tabriz, Iran²Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

Kuwait Medical Journal 2005, 37 (4): 271-276

ABSTRACT

Objective: To evaluate the outcome in patients who underwent anterior cervical discectomy without interbody fusion.

Design: Prospective study.

Setting: Imam Hospital, Tabriz, Iran.

Patients and methods: Forty-one patients with single level cervical disc herniation were included in the study. Simple anterior cervical discectomy technique without fusion was performed in all patients by one surgeon.

Outcome measure: Morbidity and functional disability.

Results: The study was carried out between March 1999 and March 2003. The mean age was 41 years. Thirty-one (75.6%) patients were male whereas ten (24.4%) were female. C5-C6 level was the most common site of discal herniation. Presentation was as follows: 80% radiculopathy, 5% myelopathy, and 15% radiculomyelopathy. 80% patients had soft disc and 20% hard disc herniation. Twenty-five (61%) patients had excellent, 13 (31.5%) good, 2 (5%) satisfactory and 1 (2.5%) poor outcome. Result was significantly better in patients with radiculopathy than in

patients with myelopathy or radiculomyelopathy ($p < 0.001$). All patients with soft disc herniation and 62.5% patients with hard disc herniation had good or excellent results ($p < 0.05$). Outcome was not significantly related to sex, age, and disc level ($p > 0.05$). Postoperative complications included transient neck and interscapular pain (46.3%), and transient hoarseness (9.7%). Transient dysphagia (lasting for less than two weeks) was also seen in three out of four patients with hoarseness. Postoperative neck pain was more frequent in patients with hard disc herniation ($p = 0.016$). Definite fusion was seen in 75.6%, partial fusion in 9.8%, and non-union in 14.6% cases. 87.8% patients were able to return to work post-operatively.

Conclusion: Single level cervical discectomy without fusion was found to have satisfactory outcomes. This method may provide a good approach for achieving root and cord decompression without the potential for graft-related complications.

KEYWORDS: cervical disc, discectomy, herniated disc, outcome, spinal fusion

INTRODUCTION

Anterior approach to the cervical spine for surgical treatment of degenerative disc disease is a widely accepted method, but there is a controversy regarding the necessity for fusion following anterior discectomy. Although interbody fusion (IBF) seems to cause biomechanical stability, decreased incidence of kyphotic deformity and decreased pain, it is accompanied by significant graft and donor site morbidity^[1].

New instruments and techniques have been introduced to compensate for morbidities associated with simple autograft insertion methods in order to improve outcome. Using allografts and xenografts do not implicate any donor site morbidity^[2]. The use of locking cervical plates prevents displacement of the graft and reduces the rate of postoperative kyphosis^[1]. Interbody cervical

cages were introduced because of their theoretical ability to prevent collapse with the potential advantages of indirect foraminal decompression by restoration and preservation of disc height and lordosis^[3].

Disc arthroplasty is another emerging treatment for patients with disc degenerations. It's theoretical advantages are to maintain motion, decrease the incidence of adjacent segment degeneration, avoid complications related to fusion and allow early return to function^[4,5]. On the other hand, there are several studies demonstrating that outcome in patients treated with anterior cervical discectomy (ACD) with IBF is not obviously better than ACD without IBF and specific complications related to the use of these new techniques are also noticeable^[6-8]. Therefore the question remains unanswered: Is fusion beneficial or not?

Address correspondence to:

Dr Akbar Farzannia, Department of Neurological Surgery, Imam Hospital, Daneshgah Ave., Tabriz 51666, P.O. Box: 51665-348 (Tabriz), Iran. Tel:+98-411-3342127, Fax:+98-411-6584848, E-Mail: hadidchi@hotmail.com



Fig. 1: Sagittal MRI of a patient with symptoms compatible with C6-C7 discal herniation (left). Axial view of the same level showing right sided discal herniation (right). Although disc bulging is also seen in C5-C6 level, according to clinical findings and axial views, operation was performed only at C6-C7 level and the outcome was excellent.

Numerous studies have shown that cervical disc disease can be successfully treated by anterior approaches without fusion^[6,9-17]. For many years, we have been managing most of our patients without IBF with satisfactory results. This study, involving 41 patients who underwent anterior cervical discectomy for one level cervical disc disease without IBF was undertaken to try and answer the question. The outcome was evaluated prospectively in this series of patients.

PATIENTS AND METHODS

From March 1999 to March 2003, 41 consecutive patients with single level cervical disc herniation were selected for this study at the Department of Neurological Surgery, Imam Hospital, Tabriz. The inclusion criteria required more than three months of neck pain and radiculopathy not responding to conservative therapy with compatible MRI and clinical findings (Fig. 1). In patients with progressive deficit, myelopathy or radiculomyelopathy surgery was performed before completion of conservative therapy. Conservative management included any of the following: nonsteroidal anti-inflammatory drugs, muscle relaxant, short course of steroids, soft collar, physical therapy and intermittent cervical traction. Exclusion criteria included traumatic

discal herniation, canal stenosis not related to discal herniation, previous spine surgery, drug abuse, and major psychological problems. Preoperative dynamic X-ray studies were not performed. Electromyography was only performed in patients with poorly compatible MRI and clinical findings and in patients with myelopathy and radiculomyelopathy to rule out other probable disorders. Patients satisfying all the inclusion and exclusion criteria were invited to participate and were enrolled in the study after signing informed consent. All surgeries were performed by the first author including pre and postoperative management.

In all patients, a right-sided vertical incision was taken and after exposing the anterior aspect of cervical spine, the correct level was confirmed by a lateral X-ray film. Self-retaining Cloward's retractors were used and discectomy was performed using a surgical microscope. All the disc material and osteophytes were removed using curettes, pituitary forceps, and Kerrison's punches. Canal space and foramina were inspected for disc fragments. Posterior longitudinal ligament (PLL) was opened in patients with a suspicion of presence of disc materials posterior to PLL or when PLL was thickened and seemed to produce an additional pressure on cord.



Fig. 2: Definite fusion at C5-C6 level after 12 months

All patients were discharged two or three days after the operation with a Philadelphia collar. The collar was worn for two months. Cervical spine radiographs were obtained between six and 12 months after surgery in all patients in order to evaluate kyphotic deformity and fusion. Dynamic X-ray studies were also performed in patients with non-union and patients with satisfactory or poor outcome.

Clinical outcome was assessed as excellent, good, satisfactory, and poor according to Odem's criteria^[18]. An excellent outcome meant that the patient had no complaints and could perform his daily chores without any impairment. A good outcome was one in which the patient experienced intermittent discomfort which did not interfere with his or her occupation. A satisfactory result was one in which the patient's status was improved; however, the patient remained significantly handicapped. A poor result meant that the patient exhibited no improvement or worsened postoperatively.

Statistical analysis of outcome, complications, and radiographic data was performed using SPSS software (version 10.0 SPSS, Inc., Chicago, IL). Ordinal interpretation of operation success was

Table 1 : Patient demographics

Characteristics	n	Characteristics	n
Total No. of Patients	41		
Sex		Pathology	
Male	31	Radiculopathy	33
Female	10	Myelopathy	2
Age		Radiculomyelopathy	6
Mean	41	Disc type	
Std deviation	9.5	Soft	33
Time of follow up (months)		Hard	8
Mean	25.5		
Median	24		
Range	6-52		

Table 2 : Outcome according to gender

Outcome	Male n (%)	Female n (%)	Total n (%)
Excellent	17 (54.8)	8 (80.0)	25 (61.0)
Good	11 (35.5)	2 (20.0)	13 (31.7)
Satisfactory	2 (6.5)	0 (0)	2 (4.9)
Poor	1 (3.2)	0 (0)	1 (2.4)

performed at four levels: poor, satisfactory, good, and excellent using Chi-square and Chi-square for trend. Evaluation for statistical significance for ordinal values was performed by non-parametric tests. To study the relationship between outcome, age and fusion, the Spearman correlation coefficient was calculated.

RESULTS

The patient characteristic and results are shown in Table 1 through 7. Most of the 41 patients were followed for more than two years. The mean follow up period for patients in different groups and with different complications was the same. Minimum follow up time was six months, which appeared to be sufficient to evaluate outcome and surgical complications. The operated levels were C3-C4 (7.4%), C4-C5 (31.7%), C5-C6 (34.1%), C6-C7 (24.4%), and C7-T1 (2.4%). The mean duration of symptoms prior to surgery was 4.85 months (minimum = 10 days and maximum = 14 months).

Outcome was excellent in 60% patients and more than 92% experienced good or excellent outcome. Less than 3% patients experienced a poor outcome. Excellent results were more frequent in females (Table 2) but this was not statistically significant ($p = 0.67$). The mean age of patients with poor results was higher than other groups. Because there were only a few patients with poor outcome, evaluation of the effect of age upon poor outcome was not feasible. The age difference between patients with good and excellent outcomes versus

Table 3 : Outcome among different presenting syndromes

Outcome	Radiculopathy n (%)	Myelopathy n (%)	Radiculomyelopathy n (%)
Excellent	24 (72.7)	0 (0)	1 (16.7)
Good	9 (27.3)	0 (0)	4 (66.7)
Satisfactory	0 (0)	1 (50.0)	1 (16.7)
Poor	0 (0)	1 (50.0)	0 (0)

p value Kruskal-Wallis = 0.001

Table 4 : Outcome among different disc levels

Outcome	Level				
	C 3-4 n (%)	C 4-5 n (%)	C 5-6 n (%)	C 6-7 n (%)	C 7-t1 n (%)
Excellent	2 (66.7)	8 (61.5)	10 (71.4)	5 (50.0)	0 (0)
Good	1 (33.3)	4 (30.8)	3 (21.4)	4 (40.0)	1 (100.0)
Satisfactory	0 (0)	0 (0)	1 (7.1)	1 (10.0)	0 (0)
Poor	0 (0)	1 (7.7)	0 (0)	0 (0)	0 (0)

p value Kruskal-Wallis = 0.692

patients with poor and satisfactory results had no clinical importance; despite this, our analysis demonstrated a better outcome in younger patients ($p = 0.038$).

The response to operation was different in patients with different presentations (Table 3). Most patients with radiculopathy had excellent results, but patients with myelopathy had a satisfactory or poor result. As shown in Table 3, patients with radiculopathy had a significantly better outcome in comparison to the two other groups ($p = 0.001$).

Clinical outcome at different disc levels was nearly the same (Table 4). The small difference in outcome between different levels involved was most likely due to the small number of patients in some groups ($p = 0.692$).

Definite fusion on X-ray was found to have occurred, if the endplates disappeared and the vertebral bodies above and below formed a solid block (Fig. 2). A partial fusion occurred, if the majority of the disc space showed evidence of bony fusion as described above but some of the endplates of the vertebral bodies were still visible on radiography. Non-union was diagnosed, if there was gap surrounded by sclerosis between the vertebrae. Definite fusion was seen in 31 (75.6%), partial fusion in four (9.8%), and non-union in six (14.6%) cases. There was no correlation between fusion rate and outcome (Table 6). In addition there was no significant relationship between fusion rate and disc level, clinical presentation, age, and sex.

We have not had any significant postoperative kyphosis (more than 10 degrees) or instability.

Table 5 : Comparison of hard and soft disc outcomes

Outcome	Soft n (%)	Hard n (%)
Excellent	24 (72.7)	1 (12.5)
Good	9 (27.3)	4 (50.0)
Satisfactory	0 (0)	2 (25.0)
Poor	0 (0)	1 (12.5)

Table 6 : Outcome and fusion type

Outcome	Definite n (%)	Partial fusion n (%)	Non-union n (%)
Excellent & Good	29 (93.6)	3 (75)	6 (100)
Satisfactory & Poor	2 (6.4)	1 (25)	0 (0)
Total	31 (75.6)	4 (9.8)	6 (14.6)

Dynamic X-ray studies were performed in patients with non-union and satisfactory or poor outcome but they did not show evidence of instability.

Postoperative MRI was performed in patients with satisfactory or poor results six months or more after the surgery. There was no recurrence of disc prolapse at the operated level. On the other hand, postoperative MRI showed removal of pressure from the adjacent neural tissues without recurrence at the operated level or other levels.

Complications were seen in 23 (56%) patients. Transient neck and interscapular pain was the most common and happened in 46.3% patients. Transient hoarseness was found in 9.7% patients. Transient mild dysphagia, which resolved in less than two weeks, occurred in three out of four patients with hoarseness. Prevalence of complications among different sex, age groups, disc levels, and clinical presentations was similar. Neck pain was significantly more common in patients with hard disc herniation (Table 7) ($p = 0.016$). There was no correlation between postoperative neck pain and fusion ($p = 0.32$).

At the final follow-up assessment, patients with satisfactory or poor results had retired from work. All except two patients with excellent or good results returned to their previous jobs. 87.8% patients had returned to their jobs within the first eight weeks after surgery. None of the patients required revision surgery.

DISCUSSION

Cervical disc disease is a part of a general pathologic process of cervical spondylosis. Cervical spondylosis is a process in which degeneration and instability in the spine are compensated by hypertrophy of the supporting

Table 7: Complications among different disc levels and disc types

		Hoarseness			Neckache		
		Yes n (%)	No n (%)	p-Value	Yes n (%)	No n (%)	p-Value
Level	C3-4	1 (33)	2 (67)	0.192	0 (0)	3 (100)	0.142
	C4-5	1 (8)	12 (92)		7 (54)	6 (46)	
	C5-6	0 (0)	14 (100)		5 (36)	9 (64)	
	C6-7	2 (20)	8 (80)		7 (70)	3 (30)	
	C7-t1	0 (0)	1 (100)		0 (0)	1 (100)	
Type	Soft	3 (9)	30 (91)	1	12 (36)	21 (64)	0.016
	Hard	1 (13)	7 (87)		7 (87)	1 (13)	

ligamentous structures and bony outgrowths. The endpoint of this process is autofusion of the involved joint space and the proximity of neurological structures to the spine can lead to undesirable neurological side effects. By narrowing the bony spaces within which neural structures lie, compression and dysfunction can occur. Joint narrowing, ligamentous thickening, and bone spurs can cause compression at the root level (radiculopathy), the spinal cord level (myelopathy) or at both levels (radiculomyelopathy). Nonoperative therapy may be successful in cases of mild nerve root inflammation. However, patients with true mechanical compression of neurological structures often require surgical intervention^[13].

There is no doubt that the major aim of the surgical procedure is to eliminate compression from neural tissues by removing hypertrophic (osteophytes) or displaced elements (herniated disc), but the necessity of adding a fusion procedure to the surgery is not universally accepted. Although fusion rate after surgery in both types of surgery (with IBF and without IBF) are different in most reports, it has not been proven that radiographic fusion after surgery is necessarily accompanied by a better outcome. Connolly *et al* found using cine radiographs, that motion was detectable at operative levels that appeared fused on plain X-ray films^[13,19]. Fusion has been evaluated in a goat model in which histological investigations found only 25% osseous union in levels exhibiting radiographic fusion^[13,20]. There was also no significant relationship between fusion rate and outcome in our study. This suggests that bone fusion is poorly evaluated by radiographic measures and may be inappropriate as an endpoint. Therefore, a better goal is relief of symptoms and patient satisfaction^[13].

In this study, our main intention was to evaluate complications and outcome of ACD without IBF, which is the preferred method of cervical discectomy in our hospital. We also compared our results with similar studies.

Table 8: Results of ACD without IBF in various series

Authors and Years	Excellent & good %	Satisfactory %	Poor %	Total cases
Hankinson & Wilson 1975	88	6	6	51
Cuatco 1981	95	2.5	2.5	81
Pointillart <i>et al</i> 1995	87.7	7	5.2	68
Donaldson <i>et al</i> 2002	91	9	0	64
Farzannia <i>et al</i> 2004	92.7	4.9	2.4	41

Table 8 shows the results of ACD without IBF in various series. In most of these studies excellent and good results were higher than 90%. Hankinson and Wilson reported one of the first series of microscopic ACD without IBF and they had 88% excellent or good results. In our series, outcome was excellent or good in 92.7% of patients. The outcome was significantly worse in our patients with hard disc herniation and myelopathy. Donaldson *et al* performed ACD without IBF and the outcome in patients with myelopathy was nearly the same as patients with radiculopathy^[9]. In another study, outcome was better in patients with pure radiculopathy and pure radicular sign was the most important factor in predicting a good overall outcome^[21]. Although outcome in patients with myelopathy was not as good as patients with radiculopathy or radiculomyelopathy, it seems to be a result of natural history of the lesion and not a result of the operation technique. Therefore, other techniques should be considered in these patients. In a similar study (Donaldson *et al*)^[9], there was no relationship between hard disc herniation and outcome but this relationship was significant in our study. We had more patients with hard disc herniation and myelopathy that may have caused this result.

The most frequent complication was postoperative neck pain. Patients usually complain of a dull, nagging ache that usually involves the posterior cervical or interscapular region, bilaterally or unilaterally. It happens in 46.35% of patients postoperatively but resolves in most cases within a few weeks or months with or without symptomatic treatment. The range of postoperative cervicgia was 9.8 to 56.1% in other reports^[9,10,22]. Hoarseness was the other complication that happened in 9.7% of patients. It was transient in all cases. This is thought to be due to the traction on the recurrent laryngeal nerve. This complication is well described in the literature and the incidence ranges from 1.1 to 2.4%^[13,22,23]. The higher incidence in our series may be due to the right side approach used in our patients (the senior author is a right-handed surgeon), and the course of the right recurrent laryngeal nerve, which is inconsistent and usually aberrant.

We have not had any significant postoperative kyphosis (more than 10 degrees) or instability. Other complications such as wound infection, CSF leak, breathing difficulties, and Horner's syndrome were not seen. We did not have any carotid artery, jugular vein, trachea or esophagus injuries.

As there was no control group in our study comparison with other methods and operation was not possible. Since the study was not blind, some results, especially descriptions, can be influenced by bias. Moreover, selection of patients was not random and generalization of results should be made with some caution. We recommend additional studies that compare groups and control important factors and conditions for true validation of current findings.

CONCLUSION

Single level anterior cervical discectomy without interbody fusion could be effective and safe. This procedure was not associated with persistent serious complications, although transient complications such as neck pain and hoarseness were considerable in this study. No serious complications associated with interbody fusion such as donor-site problems, cord or soft tissue injury from graft displacement and complications associated with metallic implants were seen in this operative procedure. In patients with myelopathy, operative results were not as desirable as in other patients. Hence, other surgical methods should be considered for them.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance and advice of Dr David Chesler, PhD in preparation of this manuscript.

REFERENCES

- Alvarez JA, Hardy RW Jr. Anterior cervical discectomy for one and two-level cervical disc disease: the controversy surrounding the question of whether to fuse, plate, or both. *Crit Rev Neurosurg* 1999; 9:234-251.
- Lofgren H, Johannsson V, Olsson T, Ryd L, Levander B. Rigid fusion after Cloward operation for cervical disc disease using autograft, allograft, or xenograft. *Spine* 2000; 25:1908-1916.
- Vavrouch L, Hedlund R, Javid D, *et al*. A prospective randomized comparison between the Cloward procedure and a carbon fiber cage in the cervical spine. A clinical and radiological study. *Spine* 2002; 27:1697-1701.
- Wigfield C, Gill S, Nelson R, Langdon I, Metcalf N, Robertson J. Influence of an artificial cervical joint compared with fusion on adjacent-level motion in the treatment of degenerative cervical disc disease. *J Neurosurg* 2002; 96S:17-21.
- Anderson PA, Rouleau JP. Intervertebral disc arthroplasty. *Spine* 2004; 29:2779-2786.
- Savolainen S, Rinne J, Hernesniemi J. A prospective randomized study of anterior single-level cervical disc operations with long-term follow-up: surgical fusion is unnecessary. *Neurosurgery* 1998; 43:51-55.
- Lundsford LD, Bissonette DJ, Jannetta PJ, *et al*: Anterior surgery for cervical disc disease. Part 1: treatment of lateral cervical disc herniation in 253 cases. *J Neurosurg* 1980; 53:1-11.
- Caspar W, Geisler FH, Pitzen T, *et al*. Anterior cervical plate stabilization in one and two-level degenerative disc disease: overtreatment or benefit? *J Spinal Disord* 1998; 11:1-11.
- Donaldson JW, Nelson PB. Anterior cervical discectomy without interbody fusion. *Surg Neurol* 2002; 57:219-225.
- Pointillart V, Cernier JM, Vital JM, Senegas J. Anterior discectomy without interbody fusion for cervical disc herniation. *Eur Spine J* 1995; 4:45-51.
- Maurice-Williams RS, Dorward NL. Extended anterior cervical discectomy without fusion: a simple and sufficient operation for most cases of cervical degenerative disease. *Br J Neurosurg* 1996; 10:261-266.
- Maurice-Williams R, Dorward NL. Extended anterior cervical decompression without fusion: a long-term follow-up study. *Br J Neurosurg* 1999; 13:474-479.
- Dowd GC, Wirth FP. Anterior cervical discectomy: is fusion necessary? *J Neurosurg* 1999; 90:8-12.
- Rosenorn J, Hansen E, Rosenorn M. Anterior cervical discectomy with and without fusion: a prospective study. *J Neurosurg* 1983; 59:252-255.
- Sonntag VK, Klara P. Controversy in spine care. Is fusion necessary after anterior cervical discectomy? *Spine* 1996; 21:1111-1113.
- Wilson D, Campbell D. Anterior cervical discectomy without bone graft. *J Neurosurg* 1977; 47:551-555.
- Martins AN. Anterior cervical discectomy with and without interbody bone graft. *J Neurosurg* 1976; 44:290-295.
- Odom G, Finney W. Cervical disk lesions. *JAMA* 1958; 166:23-22.
- Connolly ES, Seymour RJ, Adams JE. Clinical evaluation of anterior cervical fusion for degenerative cervical disc disease. *J Neurosurg* 1965; 23: 431-437.
- Zdeblick TA, Cooke ME, Wilson D, *et al*: Anterior cervical discectomy, fusion and plating: a comparative animal study. *Spine* 1993; 18:1974-1983.
- Gaetani P, Tancioni F, Spanu G, Rodriguez Y, Baena R. Anterior cervical discectomy: an analysis on clinical long-term results in 153 cases. *J Neurosurg Sci* 1995; 39:211-218.
- Hankinson H, Wilson C. Use of the operating microscope in anterior cervical discectomy without fusion. *J Neurosurg* 1975; 43:452-456.
- Bertalanffy H, Eggert H. Complications of anterior cervical discectomy without fusion in 450 consecutive patients. *Acta Neurochir* 1989; 99:41-50.