Clinical Features and Short-Term Outcome Analysis of Anterior Cervical Discectomy; Effect of Instrumented Vs Non-Instrumented Fusion

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ABSTRACT

Objective: To study the effects of instrumented vs non-instrumented anterior cervical decompression & fusion procedures for various degenerative cervical disorders in terms of improvements in pain & disability.

Methods: Twenty three patients who were operated for cervical degenerative disorders from January 2014 to December 2014 were included. Patients with more than one segmental level involvement were excluded. Clinical features and preoperative pain & disability were recorded using the visual analogue scale (VAS), the Japanese Orthopaedic Association (JOA) score, Nurik grading. Postoperative outcome was recorded using improvement or deterioration in VAS, JOA score and Odom criteria.

Results: Twenty three patients were included with average mean of age 58.57 years ±8.71 SD. Anterior Cervical Decompression & Fusion (ACDF) was performed in 13 (56.5%) and anterior cervical discectomy (ACD) only in 10 (43.5%) patients. Median preoperative VAS was 7.00 while at 3-month follow-up it was 2.00 with SD ± 0.85 SD. The preoperative median JOA score was 11.00 while at 3-month follow-up it was 16.00 (mean: 15.13) ± 1.79 SD. The decrease in median VAS ($Z = -4.246$) & JOA scores ($Z = -4.218$) for both groups of intervention was statistically significant at 3-month follow-up ($p < 0.001$).

Conclusion: Anterior cervical procedures are associated with excellent short-term outcome in terms of pain and disability improvement. ACDF takes longer operative time but postoperative length of stay is comparable in both groups.

Keywords: Cervical spondylosis, anterior cervical discectomy, fusion, surgical outcome

INTRODUCTION

Cervical degenerative disorders that include cervical herniated disc (CHD) and cervical spondylosis (CS) are a frequent cause of pain and disability in individuals of middle to old age groups[1]. Clinical presentation is usually neck pain, shoulder or arm pain and symptoms and signs of myelopathy, which include hand or arm weakness, gait disturbance, intrinsic muscles atrophy and sensory disturbances in dermatomal patterns[1,2]. A majority of patients can be managed with conservative treatment while those in whom either the pain is difficult to control or if the disease process ultimately affects functional abilities of a patient, then surgical intervention is indicated[3,4].

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The anterior cervical approach for addressing these degenerative conditions is relatively new especially in tertiary care centres of developing countries like Pakistan[5]. The main aim of anterior cervical approach is to decompress the spinal cord and remove the inciting cause such as disk or osteophytes. There are two main procedures for anterior cervical decompression, the Smith-Robinson technique[6] and Cloward technique[7].

Over the last two decades a plethora of anterior surgical techniques with a diverse variety of fusion instruments that have variable short and long-term outcomes have been introduced[8,9,10]. Despite the overall good outcome, some authors have described a variety of long and short-term complications with subsequent need for additional procedures[11,12]. This variability in outcome warrants further research in order to quantify the impact of anterior cervical decompression procedures in terms of pain and disability relief.

The aim of our study is to determine the short-term outcome results of cervical decompression techniques with or without instrumented fusion. We also aim to quantify the impact of these surgical procedures in terms of pain relief and improvement in individual function.

METHODS

The study was commenced after getting approval of the hospital ethical review committee. This is a prospective case series study conducted in patients of degenerative cervical disease from January 2014 to December 2014. After informed consent of the patients, a preoperatively complete neurological history and examination was performed and findings were noted. Preoperative VAS, Nurick grading and JOA scores were recorded. Postoperatively, VAS was recorded for all patients at 24 hours, 2 weeks and 3 months postoperatively. Similarly, a 3-monthly JOA score and Odom grading was recorded.

Effective pain relief (EPR) was defined as a 50% reduction in VAS postoperatively. Outcome was grouped as favourable or unfavourable for both the JOA and Odom scores.

All patients with confirmed diagnosis of degenerative cervical spine disease in whom either conservative therapy failed or they presented with progressive neurologic deficit were included. The interventional procedure was decided after careful review of each patient for the degree of degenerative spine disease & spinal instability. Patients who primarily had a single level prolapsed disc with mild to moderate degree of spondylotic changes were listed for only discectomy with strut graft while those with advanced degree of spondylotic changes were intervened with discectomy/corpectomy and fusion.

Patients who either had confirmed cervical radiculopathy for less than 12-week duration or those with advanced neurologic deficits with severe atrophic spinal cord changes (as seen on MRI) were excluded. Patients who had two or more levels involvement were also excluded. Diabetic patients with peripheral neuropathy and those with limited evidence of cervical nerve root compression or canal compromise were also excluded at the beginning of the study.

Procedure

Under general anaesthesia the patient was positioned supine with head slightly extended and a pad under the shoulders. After aseptic measures and before neck incision a bicortical autologous bone graft was prepared from iliac crest of the patient. Transverse neck incision was utilised with layer-by-layer blunt dissection and step-by-step haemostasis until the vertebras were approached. The desired vertebral level was identified using intraoperative C-arm fluoroscopy. Longus coli muscles were dissected away from the vertebral bodies. Discectomy was performed under loupe magnification. Posterior longitudinal ligament in cases of OPLL and hypertrophy was dissected carefully away from the dura. Foraminal patency was checked and foraminotomy was performed if there was significant stenosis present. At the completion of the procedure, haemostasis was established using spongestone and cottonoids. Graft or cage with bone graft was placed in the resected space. Anterior fixation with interlocking plates was done where indicated. Position of the plate and sagittal alignment was confirmed intraoperatively using fluoroscopy. Wound was closed in layers after adequate washing and haemostasis.

Statistical analyses were performed using the IBM SPSS (version 22.0). A p value ≤ 0.05 was defined as statistical significance level. For assessment of normality of the data error-bar plots were utilised. The Chi-square and independent sample t-test were used for categorical variables. Wilcoxon signed-rank test was used for assessment of improvement between preoperative and postoperative pain and disability scores.

RESULTS

A total of 23 patients were included in the study with 15 (65.2%) males and 8 (34.8%) females. The average mean age was 58.57 years ±8.71 SD. The mean symptoms duration was 14.17 months ±9.61 SD. The overall mean postoperative length of stay was 4.35 days ±1.07 SD.

Sixteen (69.6%) patients presented with neck pain, 13 (56.5%) cases with radiculopathy symptoms and sensory deficits in 11 (47.8%). On examination 10 (43.5%) patients presented with features of cervical myelopathy. Hand weakness was present in 10 (43.5%) cases and reduced neck range of motion (ROM) in 13 (56.5%) of cases. The detailed clinical features are presented in.

Furthermore, 10 (43.5%) patients were diagnosed with acute prolapsed cervical disk, 10 (43.5%) with chronic degenerative cervical spondylotic changes while 3 (13.0%) patients were diagnosed with

ossification of posterior longitudinal ligament (OPLL). The most common 10 (43.5%) spinal level involvement was C5-C6, followed by C4-C5 8 (34.8%) and C3-C4 5 (21.7%).

In 34.8% (n=8) patients presented at a preoperative Nurick grade 2 (Difficulty in walking without effect on employment) and 26.1% (n=6) patients presented in Nurick grade 1 (Signs of spinal cord disease without difficulty in walking). (Table 2)

We operated 13 (56.5%) patients with anterior cervical discectomy and fusion (ACDF) and 10 (43.5%) patients with anterior cervical discectomy (ACD). The mean procedure time for ACDF was 237.69 minutes ±22.42 SD while it was 147.0 minutes ±17.67 SD. (Table 3) The independent-samples t-test showed a significance difference for procedure time ($p < 0.001$, $t=10.51$, 95% confidence interval (95% CI): 72.75 – 108.64) across the two treatment groups. Similarly, mean symptoms duration in the ACD group was 5.6 months ±2.12 SD while it was 20.78 months ±7.59 SD for the ACDF group ($p < 0.001$, $t=6.10$, 95% CI: 10.00 – 20.33). Additionally, the mean postoperative length of stay (LOS) was 4.00 days ±0.816 SD for ACD group while it was 4.62 days ±1.19 SD for ACDF group ($p=0.18$, $t=1.39$, 95% CI: -0.302 – 1.53). The score of LOS was not significant ($p>0.05$) and shows no difference between ACD and ACDF.

Pre & Postoperative Comparative Analysis

The median preoperative VAS was 7.00 (mean; 6.74) ± 1.05 SD while the median postoperative VAS at 2-week follow-up was 3.00 (mean; 3.04) ± 0.64 SD and it was 2.00 (mean; 1.91) ± 0.85 SD at 3-month follow-up. Similarly, the preoperative median JOA score was 11.00 (mean: 11.74) ± 2.73 SD while at 3-month follow-up, it was 16.00 (mean: 15.13) ± 1.79 SD. (Table 3).

Table 1: Preoperative clinical features and their distribution for both treatment arms (Chi-Square test is used to examine the significant difference between ACD and ACDF)

Clinical feature	**ACD (n=10)**	**ACDF (n=13)**	**Significance**
	Frequency (%)	**Frequency (%)**	
Gender			0.6
Male	7 (70.0%)	8 (61.5%)	
Female	3 (30.0%)	5 (38.5%)	
Neck pain	6 (60.0%)	10 (76.9%)	0.3
Arm pain	9 (90%)	4 (30.8%)	0.005
Sensory deficits	8 (80.0%)	3 (23.1%)	0.007
Hand weakness	1 (10%)	7 (53.8%)	0.005
Reduced neck ROM	3 (30%)	10 (76.9%)	0.02
Spurling's test	9 (90%)	4 (30.8%)	0.005
Hoffman's test	3 (30%)	6 (46.2%)	0.43
Axial traction test	9 (90%)	4 (30.8%)	0.005
Gait disturbance	4 (40%)	8 (61.5%)	0.3
Muscle atrophy	5 (50%)	8 (61.5%)	0.5
Clonus	4 (40%)	5 (38.5%)	0.9
Lhermitte's test	4 (40%)	7 (53.8%)	0.5
Romberg's test	2 (20%)	6 (46.2%)	0.1
Sphincters disturbance	-	3 (23.1%)	0.1
Comorbids	9 (90%)	10 (76.9%)	0.4
Hypertension	3 (30%)	3 (23.1%)	
Ischemic heart disease	3 (30%)	1 (7.7%)	
Osteoarthritis	1 (10%)	3 (23.1%)	
Obesity	1 (10%)	2 (15.4%)	
Diabetes	1 (10%)	1 (7.7%)	

The Wilcoxon singed-rank test was run comparing the preoperative VAS and JOA scores to the postoperative VAS and JOA scores at 3-month follow-up. The decrease in median VAS (Z = - 4.246) & JOA scores (Z = - 4.218) for both groups of intervention was statistically significant at 3-month follow-up ($p < 0.001$). This shows that overall outcome for surgical intervention in mild to moderate cervical degenerative disorders is good with significant impact both in terms of pain relief and functional improvement.

Table 1, Table 2 and Table 3 show the comparative analysis of the clinical features (both pre- and postoperative) for both treatment groups. It can be seen that despite the significant differences in various preoperative variables, such as age, symptoms duration and operative time etc., the overall impact on pain relief is similar for both treatment groups. It is however, apparent that functional scores improved for those of corpectomy with fusion group rather than simple discectomy and grafting.

Table 2: Postoperative complications and outcome parameters for the two treatment arms (Chi-Square test is used to examine the significant difference between ACD and ACDF)

Clinical Variable	**ACD (n=10)**	**ACDF (n=13)**	**Significance**
Complications			
Early Dysphagia	2 (20%)	8 (61.5%)	0.04
Bleed/hematoma	-	2 (15.4%)	0.1
Transient Weakness	-	3 (23.1%)	0.1
Postop Odom's Grades			0.054
Excellent	10 (100%)	2 (15.4%)	
Good	-	10 (76.9%)	
Fair	-	1 (7.7%)	
Effective pain relief	9 (90%)	9 (69.2%)	0.2

Table 3: Comparison of continuous variables for the two treatment groups (independent t-test significance is shown for each variable)

Variable	**ACD (n=10)**	**ACDF (n=13)**	**Significance**
	MEAN ± SD	**MEAN ± SD**	
Patient age (years)	52.0 ± 9.59	63.62 ± 2.53	<0.0001
Symptoms duration (months)	5.6 ± 2.1	20.77 ± 7.59	<0.0001
Preoperative JOA	14.10 ± 1.6	9.9 ± 1.84	<0.0001
Preoperative VAS	7.7 ± 0.67	6.0 ± 0.57	<0.0001
Procedure time (min)	147.0 ± 17.6	237.69 ± 22.4	<0.0001
Length of stay (days)	4.0 ± 0.82	4.6 ± 1.19	0.17
VAS at 3 months	2.0 ± 0.82	1.85 ± 0.8	0.67
JOA at 3 months	16.6 ± 0.52	14.0 ± 1.5	<0.0001

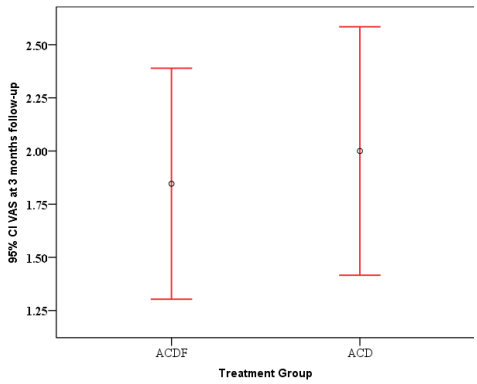

Figure 1: Error bar plot for VAS at 3-month follow-up

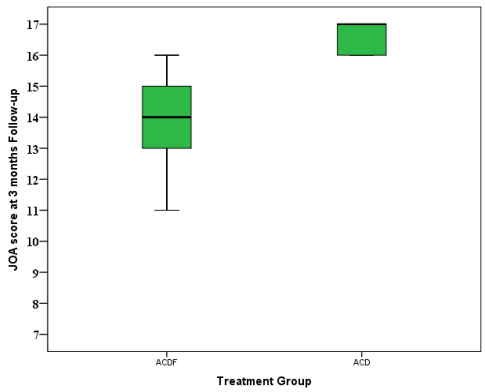

Figure 2: JOA at 3 months follow up for ACDF and ACD

DISCUSSION

Cervical degenerative disorders such as prolapsed cervical disc (PCD), chronic instability and ossification or hypertrophy of the posterior longitudinal ligament (PLL) frequently lead to clinical symptoms primarily pain, movement restriction and weakness[13]. The controversy of a particular surgical approach still continues, however, experts agree that initial conservative treatment for at least 6-12 weeks is necessary in order to allow for spontaneous recovery[14]. The aims of surgical intervention are to control pain & halt the progression of the spinal degenerative process. It has been advised that before undertaking surgical intervention, patients should be adequately educated about these aims of surgery, however, a majority of patients do achieve improvement in established neurological deficits as well as control of pain[1].

Neural decompression whether anterior or posterior solely depends upon the site and type of pathology as well as the extent of involvement of the spinal canal, however, in an involvement of three or more levels a posterior approach is indicated[15]. The current emphasis for anterior approaches is to improve outcome in terms of good pain and functional improvement as well as to reduce the risks and complications such as adjacent segment degeneration, fusion failure, kyphosis development and failure of clinical symptoms improvement[14,16]. Abd-Alrahman N et al[17] in a long-term prospective randomised study evaluated the clinical and radiological outcome for patients undergoing ACD or ACDF. They concluded that ACD was significantly associated with kyphosis ($p = 0.02$), less bony union and less overall satisfaction as compared to ACDF. However, they have indicated that clinical improvement was comparable and good in both groups. Similarly, Oktenoglu T et al[18] reported that both ACD and ACDF were comparable in achieving pain relief and functional improvement; however, ACDF was superior to ACD in terms of neck pain improvement and disc space plus neural foramen height achievement[18]. Although, we did not record radiological parameters, our subset of patients achieved good overall pain and disability improvement within the first 3-month follow-up. This shows that carefully selected patients can achieve the desired levels of pain relief and functional improvement.

In another prospective non-randomised study by Bjarne L et al[19], who compared the effect of various fusion techniques upon achievement of pain relief, they concluded that effective pain relief was achieved in all patients irrespective of fusion technique application. They also noted that 48% of the operated patients returned to work within 6 months of surgery and only 11% of patients were rated as treatment failure. Treatment success in terms of pain relief and functional recovery is a very encouraging factor, however, failure or deterioration after surgical intervention is particularly alarming and should be looked into very carefully. In our series, we achieved excellent outcome in 52.2% (Odom's Grade 1) while another 43.5% patients achieved good outcome (Odom's Grade 2). In the present series, we recorded 4.3% fair outcome and no cases of poor outcome. According to JOA scores, 52.2% achieved normal function scores (16 and 17 points on JOA scale), 43.4% patients achieved grade 1 scores (12-15 points on JOA scale) while 4.3% fell under grade 2 (JOA scores: 8-11). Although we face many constraints in terms of equipment, higher patient loads and somewhat compromised in-patient care facilities; the outcome goals in our study are encouraging and particularly important with respect to proper patient selection. In our study, as discussed earlier, the only drawbacks of ACDF is longer operation times (mean: 237.69 minutes ±22.42 SD) and somewhat higher costs of fusion instruments (plates & cages), otherwise the outcomes are comparable in both ACD and ACDF. Despite comparable clinical outcome in terms of pain and functional improvement, recent evidence favours ACDF for managing patients of cervical spondylosis[20,21].

The limitations of our study are a smaller sample size, shorter follow-up and non-randomised design. These can be improved by conducting well-designed randomised controlled trials with larger sample sizes and long-term follow-up.

CONCLUSION

Short-term outcome for anterior cervical decompression with or without fusion is good to excellent in terms of pain relief and functional improvement. Both procedures are comparable in terms of length of hospital stay and postoperative complications, however, the cost of fusion instruments confer a negative mark on patient affordability.

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