DOI: https://doi.org/10.53350/pjmhs221641139

ORIGINAL ARTICLE

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

FARYAL[1], MADIHA AHSAN[2], AFNAN[3], WALEED ALI[4], SAJID KHAN[5], ZOHAIB ALI[6]
[1]*Trainee Medical Officer, Orthopedics and Trauma, Ayub Teaching Hospital, Abbottabad*
[2]*Trainee Medical Officer, Plastics Surgery, Hayatabad Medical Complex, Peshawar*
[3]*Trainee Medical Officer, General Surgery, Ayub Teaching Hospital, Abbottabad*
[4]*Consultant Orthopaedic Surgeon, DHQ Hospital, Hafizabad*
[5]*Assistant Professor Neurosurgery, Prime Teaching Hospital/ Peshawar Medical College*
[6]*Physical Therapist, Institute of Physical Medicine and Rehabilitation KMU, Peshawar*
Corresponding author: Afnan, Email: afnanfayaz@gmail.com, Cell: +92 312 2800050

ABSTRACT

Aim: To investigate the impact of instrumental and non-instrumental anterior cervical decompression and fusion procedures on various cervical degenerative diseases in terms of reducing pain and disability.

Study Design: A prospective case series.

Place and Duration: The study was conducted in the Neurosurgery Ward of Ayub Medical Complex, Abbottabad and Neurosurgery department of Hayatabad Medical Complex, Peshawar for duration 1 year from 1st Jan 2021 to 31st Dec 2021.

Material and Methods: A total of 40 patients who underwent surgery for cervical degenerative diseases were selected and patients with more than one level segment were excluded from the study. Clinical symptoms and preoperative pain and disability were recorded using the Japanese Orthopaedic Association (JOA) score, visual analogue scale (VAS) and the Nurick grading. Post-operative score was recorded with improvement or deterioration in VAS, JOA score, and Odom criteria.

Results: 40 patients, 24 (60%) men and 16 (40%) women were enrolled in the analysis. The mean age was 56.6 years ± 6.7 SD. Mean length of symptoms was 12.05 months with 5.65 SD. The total mean span of stay in the postoperative period was 4.55 days ± 1.05 SD. 24 (62.5%) patients reported neck pain, 18 (45%) patients with symptoms of radiculopathy, and 12 (30%) sensory deficits. In the study, 13 (32.5%) patients had features of cervical myelopathy. There was hand weakness in 11 (27.5%) cases and reduced range of neck motion in 15 (37.5%) cases. Anterior cervical decompression and fusion (ACDF) were performed in 24 (60%) patients, and anterior cervical discectomy (ACD) was performed in only 16 (40%) patients. The median of pre-operative VAS was 7.9 (mean 7.2) ± 1.35 SD, and the median of post-operative VAS after 2 weeks of follow-up was 3.00 (mean 3.04) ± 0.64 SD and 2.00 (mean 1.91) ± 0.94 SD after 3-month follow-up. Similarly, the median pre-operative JOA score was 15.20 (mean: 12.7) ± 3.30 SD, and after 3 months of follow-up, it was 16.00 (mean: 15.5) ± 1.01 SD. The reduction of the median VAS (Z = -4.46) and JOA (Z = -4.22) scores for both intervention groups was statistically significant after 3 months of follow-up ($p < 0.001$).

Conclusions: Anterior cervical procedures are associated with excellent short-term outcomes in reducing pain and disability. ACDF requires longer operative time, but the length of postoperative stay was comparable in both groups.

Keywords: Anterior cervical discectomy and fusion, Cervical spondylosis and Surgical result

INTRODUCTION

Cervical degenerative disorders, including cervical disc herniation (CHD) and cervical spondylosis (CS), are a communal reason of disability and pain in elderly and middle-aged people[1-2]. The clinical picture is usually pain in the neck, shoulder, or arm, and symptoms and signs of myelopathy, including weakness in the hand or arm, gait disturbance, internal muscle atrophy, and sensory disturbances in dermatomic patterns[3-4]. Although most patients can be treated conservatively, surgical intervention is indicated when pain is difficult to control or when the disease process ultimately affects the patient's functional abilities[5-6]. The antero-cervical approach to treating these degenerative conditions is relatively new, particularly in tertiary care settings in developing countries such as Pakistan[7-8]. The primary purpose of accessing the anterior cervical segment is to open the spinal cord and remove a triggering cause, such as a disc or osteophyte[9-10]. There are two main procedures to decompress the anterior cervical bone: the Smith-Robinson technique and the Cloward technique[11]. Over the past two decades, many prior surgical techniques have been introduced with different fusion instruments with different short- and long-term outcomes[12]. Despite a good overall score, some authors have identified several short- and long-term complications that require additional procedures. This variability in results warrants further studies to quantify the effects of anterior cervical decompression procedures on pain relief and disability[13].

The aim of this research is to determine the short-term results of anterior cervical decompression techniques with or without instrumental fusion. We also aim to measure the effect of these surgical procedures on pain relief and improvement of specific functions.

MATERIAL AND METHODS

This prospective case series study held in the Neurosurgery Ward of Ayub Medical Complex, Abbottabad and Neurosurgery department of Hayatabad Medical Complex, Peshawar for duration 1 year from 1st Jan 2021 to 31st Dec 2021 among patients with degenerative cervical disease. The study began after approval by the hospital's ethics review committee. After obtaining the informed consent of the patients, preoperative complete neurological examination and history were performed, and the results were recorded. Pre-operative VAS scores, Nurick and JOA scores were recorded. After the surgery, VAS was documented in all patients at 24 hours, 2 weeks and 3 months. Similarly, the 3-month JOA score and the Odom score were recorded. Effective Pain Relief (EPR) was defined as a 50% reduction in VAS postoperatively. The results are grouped as unfavourable and favourable for the JOA and Odom scoring. The analysis involved all subjects with a confirmed diagnosis of cervical spine with degenerative disease, in whom conservative treatment was unsuccessful or in whom progressive neurological deficits occurred. The interventional procedure was undertaken after each patient was carefully examined to determine the severity of spinal instability and spinal disease. Primarily, patients with single level prolapse of the vertebral disc with mild or moderate spondylotic changes of moderate degree were only enrolled in discectomy, while patients with severe spondylotic changes underwent discectomy / corpectomy and fusion. Patients with confirmed cervical radiculopathy less than 12 weeks old or with advanced neurological deficits with severe atrophic changes in the spinal cord (visible on MRI) were excluded. Patients with at least two levels of involvement were also not included. Diabetic patients with peripheral neuropathy and symptoms of limited cervical root compression or canal involvement were also excluded at baseline.

Procedure: Under general anesthesia, patient was positioned in a supine position with a slightly extended head and a cushion under the shoulders. After aseptic measurements, and before incision of the neck, a bicortical autologous bone graft was taken from the patient's iliac crest. Until the vertebrae were approached, a layer-by-layer blunt dissection was performed and a transverse incision of the neck with step-by-step haemostasis was used. The desired level of vertebrae was determined by intraoperative C-arm fluoroscopy and Longus coli muscles were dissected from the vertebral bodies. The discectomy was performed using a loupe magnification. In cases of OPLL and hypertrophy, the posterior longitudinal ligament was carefully severed from the dura mater. The patency of the foramina was checked and a foraminotomy was performed in case of significant stenosis. After the finishing of operation, hemostasis was achieved with sponges and cotton. The bone graft or graft cage has been placed in the resection area. The anterior interlocking was made with the help of interlocking plates in the indicated places. The plate position and sagittal position were confirmed intraoperatively by fluoroscopy. After adequate irrigation and haemostasis, the wound was closed in layers. Statistical analyses were performed using IBM SPSS (version 22.0). P ≤ 0.05 was definite as the statistical significance level. Error bar plots were used to evaluate the normality of the data. The chi-square test was applied for categorical variables, and the t-test for independent samples. Wilcoxon's rank test was applied to assess the improvement between preoperative and postoperative pain and disability scores.

RESULTS

40 patients, 24 (60%) men and 16 (40%) women were enrolled in the analysis. The mean age was 56.6 years ± 6.7 SD. Mean length of symptoms was 12.05 months with 5.65 SD. The total mean span of stay in the postoperative period was 4.55 days ± 1.05 SD. 24 (62.5%) patients reported neck pain, 18 (45%) patients with symptoms of radiculopathy, and 12 (30%) sensory deficits. In the study, 13 (32.5%) patients had features of cervical myelopathy. There was hand weakness in 11 (27.5%) cases and reduced range of neck motion in 15 (37.5%) cases. It is presented in Table-1 with detailed clinical features.

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

Clinical feature	ACD (n=16)	ACDF (n=24)	Significance
	Frequency (%)	Frequency (%)	
Gender	0.7		
Male	11 (68.8%)	13 (54.2%)	
Female	5 (31.2%)	11 (45.8%)	
Neck pain	11 (68.8%)	12 (54.5%)	0.4
Arm pain	10 (62.5%)	6(27.3%)	0.004
Sensory deficits	7 (43.8%)	5 (22.7%)	0.008
Hand weakness	2 (12.5%)	9 (40.9%)	0.006
Reduced neck ROM	4 (25%)	11 (50%)	0.03
Spurling's test	8 (50%)	5(22.7%)	0.004
Hoffman's test	4 (25%)	8 (36.4%)	0.41
Axial traction test	10 (62.5%)	6 (27.3%)	0.006
Gait disturbance	5 (31.2%)	9 (40.9%)	0.4
Muscle atrophy	6 (37.5%)	9 (40.9%)	0.6
Clonus	3 (18.8%)	4 (18.2%)	0.8
Lhermitte's test	3 (18.8%)	5 (22.7%)	0.6
Romberg's test	3 (18.8%)	7 (31.8%)	0.2
Sphincters disturbance	-	4 (18.2%)	0.2
Co-morbids	8 (60%)	11 (50%)	0.5
Hypertension	4 (25%)	4(18.2%)	
Ischemic heart disease	5 (31.2%)	2 (9.1%)	
Osteoarthritis	2 (11.1%)	4 (18.2%)	
Obesity	2 (12.5%)	3 (13.6%)	
Diabetes	2 (12.5%)	2 (9.1%)	

Moreover, 17 (42.5%) patients were diagnosed with acute cervical disc prolapse, 15 (37.5%) patients were diagnosed with chronic spondylotic degenerative changes of the cervical spine 8 (20.0%) patients with ossification of the posterior longitudinal ligament. The most common level involvement at the spine was C5-C6 among 20 (50%), trailed by C4-C5 13 (32.5%) and C3-C4 in 7 (17.5%) cases. Before surgery, 32.5% (n = 13) of patients had Nurick Grade 2 (difficulty walking without impact on employment)) and 22.5% (n = 9) had Nurick Grade 1 (signs of spinal cord disease without walking difficulties) (Table 2).

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

Clinical Variable	ACD (n=16)	ACDF (n=24)	Significance
Complications			
Early Dysphagia	4 (25%)	10 (41.7%)	0.05
Bleed/hematoma	-	4 (16.7%)	0.2
Transient Weakness	-	5 (20.8%)	0.2
Postop Odom's Grades			0.057
Excellent	15 (93.8%)	2 (8.3%)	
Good	-	10 (41.7%)	
Fair	-	1 (4.2%)	
Effective pain relief	14 (87.5%)	9 (37.5%)	0.3

Anterior cervical decompression and fusion (ACDF) were performed in 24 (60%) patients, and anterior cervical discectomy (ACD) was performed in only 16 (40%) patients. The mean operative time for ACDF was 239.40 min ± 20.91 SD, and 146.0 min ± 15.52 SD for ACD. (Table 3). Similarly, the mean duration of symptoms in the ACD group was 5.9 months ± 3.10 SD, while in the ACDF group it was 18.20 months ± 8.20 SD ($p < 0.05$) and there was no difference between ACD and ACDF.

Comparative analysis before and after surgery: The median of pre-operative VAS was 7.9 (mean 7.2) ± 1.35 SD, and the median of post-operative VAS after 2 weeks of follow-up was 3.00 (mean 3.04) ± 0.64 SD and 2.00 (mean 1.91) ± 0.94 SD after 3-month follow-up. Similarly, the median pre-operative JOA score was 15.20 (mean: 12.7) ± 3.30 SD, and after 3 months of follow-up, it was 16.00 (mean: 15.5) ± 1.01 SD. (Table 3).

Table 3: Comparison of continuous variables among the two treatment groups (Chi-Square test is applied to determine the significant difference between ACDF and ACD)

Variable	ACD (n=16)	ACDF (n=24)	Significance
	MEAN ± SD	MEAN ± SD	
Patient age (years)	51.0 ± 10.11	62.12 ± 3.23	<0.0001
Symptoms duration (months)	5.9 ± 3.10	18.20 ± 8.20	<0.0001
Preoperative JOA	15.20 ± 1.2	10.1 ± 2.10	<0.0001
Preoperative VAS	7.9 ± 0.75	6.4 ± 0.60	<0.0001
Procedure time (min)	146.0 ± 15.5	239.4 ± 20.9	<0.0001
Length of stay (days)	4.2 ± 0.90	4.9 ± 1.20	0.15
VAS at 3 months	2.10 ± 0.88	1.90 ± 1.0	0.70
JOA at 3 months	16.0 ± 0.52	15.0 ± 1.5	<0.0001

Wilcoxon's rank test was performed for comparing the pre-operative VAS and JOA scores with the post-operative VAS and JOA scores after 3 months of follow-up. The reduction of the median VAS ($Z = -4.46$) and JOA ($Z = -4.22$) scores for both intervention groups was statistically significant after 3 months of follow-up ($p < 0.001$). This directs that the overall outcome of surgical intervention in mild to moderate cervical degeneration is good, with significant results in both pain relief and recovery. Table 1, Table 2 and Table 3 present the comparative analysis of clinical features (both pre-operative and post-operative) for both treatment groups. Despite significant differences in several pre-operative variables such as age, symptom duration and duration of surgery etc, it is clear that functional outcomes improved in the fusion corpectomy group rather than grafting and simple discectomy.

DISCUSSION

Cervical degenerative disorders, such as cervical disc prolapse, chronic instability, and posterior longitudinal ligament (PLL) ossification or hypertrophy often cause clinical symptoms, most notably pain, restriction of movement, and weakness[14]. The discussion about a specific surgical approach is still ongoing; however, experts agree that a minimum of 6-12 weeks of initial conservative treatment is required for spontaneous recovery[15-16]. The aim of surgical intervention is to control pain and stop the degenerative process of the spine from progressing. It is recommended that patients be adequately informed about these purposes of surgery before undergoing surgery; however, most patients achieve improvement in established neurological deficits as well as pain control[17-18]. Nerve decompression, be it anterior or posterior, depends only on the location and type of pathology and the degree of involvement of the spinal canal; however, if three or more levels are involved, a posterior approach is advisable[19-20]. Currently, the emphasis on an anterior approach is to improve good pain and recovery outcomes, while reducing risk and problems like adjacent degeneration of segment, fusion failure, progression towards kyphosis, and persistent clinical symptoms[21-22]. Abd-Alrahman N et al. Evaluated the radiological and clinical outcomes of patients undergoing ACD or ACDF in a long-term prospective randomized trial[23]. They concluded that compared to ACDF, ACD was significantly associated with less bone union, kyphosis ($p = 0.02$) and reduced level of overall gratification. However, they found that the clinical improvement was comparable and good in both groups. Likewise, Oktenoglu T et al. Found that ACDF and ACD both were similar for functional improvement and pain relief; though, ACDF was better than ACD in achieving improvements in neural foramen heigh, neck pain and disc space. Although we did not record radiographic parameters, our subgroup of patients showed an overall good improvement in pain and disability during the first 3 months of follow-up[24]. This displays that appropriately nominated patients can attain the anticipated level of pain relief and improved functioning. In another prospective non-randomized study by Bjarne L et al. Related the impacts of different techniques of fusion on pain relief, they concluded that effective pain relief was achieved in all patients, regardless of the use of the fusion technique[25]. They similarly distinguished that 49% of the patients which were operated started their routine work within six-months of the procedure, and 12% only were considered a treatment failure. The limitations of our study are a smaller sample size, shorter observation times, and a non-randomized design. They can be improved by conducting well-designed randomized, controlled trials with long-term follow-up and larger sample sizes.

CONCLUSION

Short-term results of anterior cervical decompression with or without fusion are good to excellent in pain relief and functional recovery. Both procedures are comparable in relations of length of stay in hospital and postoperative complications; however, the cost of the fusion instruments negatively affects the affordability of the patient.

REFERENCES

1. Buttermann GR. Anterior cervical discectomy and fusion outcomes over 10 years. Spine. 2018 Feb 1;43(3):207-14.
2. Nichols NM, Jamieson A, Wang M, Chou D, Mummaneni PV, Tan LA. Characterizing the fusion order and level-specific rates of arthrodesis in 3-level anterior cervical discectomy and fusion: a radiographic study. Journal of Clinical Neuroscience. 2020 Nov 1;81:328-33.
3. Muzević D, Splavski B, Boop FA, Arnautović KI. Anterior cervical discectomy with instrumented allograft fusion: lordosis restoration and comparison of functional outcomes among patients of different age groups. World neurosurgery. 2018 Jan 1;109:e233-43.
4. Karikari I, Ghogawala Z, Ropper AE, Yavin D, Gabr M, Goodwin CR, Abd-El-Barr M, Veeravagu A, Wang MC. Utility of cervical collars following cervical fusion surgery. Does it improve fusion rates or outcomes? A systematic review. World neurosurgery. 2019 Apr 1;124:423-9.
5. Davidoff CL, Rogers JM, Simons M, Davidson AS. A systematic review and meta-analysis of wound drains in non-instrumented lumbar decompression surgery. Journal of Clinical Neuroscience. 2018 Jul 1;53:55-61.
6. Burkhardt BW, Brielmaier M, Schwerdtfeger K, Oertel JM. Clinical outcome following anterior cervical discectomy and fusion with and without anterior cervical plating for the treatment of cervical disc herniation—a 25-year follow-up study. Neurosurgical review. 2018 Apr;41(2):473-82.
7. Bagga RS, Shetty AP, Sharma V, Vijayanand KS, Kanna RM, Rajasekaran S. Does preventive care bundle have an impact on surgical site infections following spine surgery? An analysis of 9607 patients. Spine Deformity. 2020 Aug;8(4):677-84.
8. Stark JR. Bone Graft Substitutes in Single or Double Level Anterior Cervical Discectomy and Fusion: A Systematic Review.
9. Nichols N, Chou D, Jamieson A, Tan LA. P13. ACDF fusion rates. The Spine Journal. 2020 Sep 1;20(9):S153-4.
10. Simsek H. Anterior cervical discectomy and fusion solely with peek cages in multilevel cervical spondylotic radiculomyelopathy: Single center clinical experience with 58 consecutive patients. Medicine Science. 2017;6(3):514-20.
11. Chen YC, Wu JC, Chang HK, Huang WC. Early discharge for anterior cervical fusion surgery: prediction of readmission and special considerations for older adults. International Journal of Environmental Research and Public Health. 2019 Jan;16(4):641.
12. Yao R, Tan T, Tee JW, Street J. Prophylaxis of surgical site infection in adult spine surgery: a systematic review. Journal of Clinical Neuroscience. 2018 Jun 1;52:5-25.
13. Ye F, Zeng Z, Wang J, Liu H, Wang H, Zheng Z. Comparison of the use of rhBMP-7 versus iliac crest autograft in single-level lumbar fusion: a meta-analysis of randomized controlled trials. Journal of Bone and Mineral Metabolism. 2018 Jan;36(1):119-27.
14. Elias A, Kyriaki P, Polychronios S, Ioannis B, Athanasios S, Ioannis P. Stand-alone anterior cervical decompression and fusion in three levels with peek cages: A possible satisfactory alternative. Journal of Neurology and Neuroscience. 2017;8(6):0-.
15. Epstein NE. Lumbar stenosis surgery: Spine surgeons not insurance companies should decide when enough is better than too much. Surgical Neurology International. 2017;8.
16. Phillips BT, Sheldon ES, Orhurhu V, Ravinsky RA, Freiser ME, Asgarzadeh M, Viswanath O, Kaye AD, Roguski M. Preoperative versus extended postoperative antimicrobial prophylaxis of surgical site infection during spinal surgery: a comprehensive systematic review and meta-analysis. Advances in therapy. 2020 Jun;37(6):2710-33.
17. Nasi D, Dobran M, Pavesi G. The efficacy of postoperative bracing after spine surgery for lumbar degenerative diseases: a systematic review. European Spine Journal. 2020 Feb;29(2):321-31.
18. Debono B, Corniola MV, Pietton R, Sabatier P, Hamel O, Tessitore E. Benefits of enhanced recovery after surgery for fusion in degenerative spine surgery: impact on outcome, length of stay, and patient satisfaction. Neurosurgical focus. 2019 Apr 1;46(4):E6.
19. Kim JS, Cheung ZB, Arvind V, Caridi J, Cho SK. Role of posterior ligamentous reinforcement in proximal junctional kyphosis: a cadaveric biomechanical study. Asian Spine Journal. 2019 Feb;13(1):68.
20. Tan T, Lee H, Huang MS, Rutges J, Marion TE, Mathew J, Fitzgerald M, Gonzalvo A, Hunn MK, Kwon BK, Dvorak MF. Prophylactic postoperative measures to minimize surgical site infections in spine surgery: systematic review and evidence summary. The Spine Journal. 2020 Mar 1;20(3):435-47.
21. Imajo Y, Taguchi T, Neo M, Otani K, Ogata T, Ozawa H, Miyakoshi N, Murakami H, Iguchi T. Surgical and general complications in 2,961 Japanese patients with cervical spondylotic myelopathy: Comparison of different age groups. Spine Surgery and Related Research. 2017 Jan 27;1(1):7-13.
22. Newcomb AG, Hostetler T, Lehrman J, Pereira BD, Wangsawatwong P, Turner JD, Kelly B. P12. Lumbosacral residual rod strains in long PSR constructs often exceed in vitro rod bending strains. The Spine Journal. 2020 Sep 1;20(9):S153.
23. Haimoto S, Schär RT, Nishimura Y, Hara M, Wakabayashi T, Ginsberg HJ. Reduction in surgical site infection with suprafascial intrawound application of vancomycin powder in instrumented posterior spinal fusion: a retrospective case-control study. Journal of Neurosurgery: Spine. 2018 Aug 1;29(2):193-8.
24. McCarthy MH, Lafage R, Smith JS, Bess S, Protopsaltis TS, Ames CP, Klineberg EO, Kim HJ, Shaffrey CI, Burton DC, Mundis Jr GM. P11. How much lumbar lordosis does a patient need to reach their age-adjusted alignment target? A formulated approach predicting successful surgical outcomes. The Spine Journal. 2020 Sep 1;20(9):S152-3.
25. Hirai T, Yoshii T, Sakai K, Inose H, Yamada T, Kato T, Kawabata S, Arai Y, Shinomiya K, Okawa A. Long-term results of a prospective study of anterior decompression with fusion and posterior decompression with laminoplasty for treatment of cervical spondylotic myelopathy. Journal of Orthopaedic Science. 2018 Jan 1;23(1):32-8.