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Functional Outcome of Anterior Cervical Discectomy and Fusion with Taper Titanium Cage for Cervical Spondylosis

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Abstract

This cross sectional observational study included 63 patients receiving Anterior Cervical Discectomy and Fusion (ACDF) with taper titanium cage was conducted at Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh. The study period was between 1st July 2015 to 30th June 2018.

Objectives: Assessment of technical success in achieving anterior cervical fusion with taper titanium cage; To see the functional outcome of surgery in relation to duration of symptoms and age of the patient.

Results: The clinical information and relevant imaging of 63 consecutive patients, 54 male and 9 female, was reviewed at 1 year after surgery. All surgery was performed at not more than 2 levels, by one surgeon. After anterior discectomy alone, or combined with posterior vertebral body margin osteophytectomy, taper titanium cage was inserted at each level with smashed autologous bone graft. All surgery was completed without cervical plating. Functional outcome was assessed by Visual Analog Scale (VAS), Oswestry Disability Index (ODI) and Odom's criteria. In 63 patients, the functional outcome was excellent to good (94.1%) when duration of symptoms less than 6 months and outcome was excellent to good (94.4%) when the age less than 50 years. The overall result of surgery was excellent to good (90.4%) in Odom's criteria and the overall result of surgery was <40% range of disability (95.2%) in Oswestry Questionnaire. This study tends to confirm the expected outcome related to young age and short duration of symptoms. Patients with technically successful fusions were less likely to have postoperative neck pain. ACDF with fusion of taper titanium cage is a safe and effective procedure for cervical spondylosis in our country. In this series no major operative complications have occurred.

Keywords: Spondylosis; ACDF; Titanium cage; Functional outcome

Introduction

Cervical spondylosis is a common degenerative condition of the cervical spine. It is most likely caused by age related changes and commonly occurs at the level C5/6, C6/7 and C4/5. The degenerative changes of the facet joints, hypertrophy of the ligamentum flavum and ossification of the posterior longitudinal ligament contribute to symptoms like altered walking ability perceived as poor balance, weakness, heaviness or numbness in the legs and a painful stiff neck with variable degrees of radicular arm pain. The indication of surgery is in patients who have intractable pain, progressive symptoms, or weakness that fails to improve with conservative therapy. Anterior Cervical Discectomy and Fusion (ACDF) is the most common neck surgery performed by neurosurgeons and spine surgeons. It generally involves removing nearly the entire disc, which must be replaced with taper titanium cage with smashed local autogenous bone and mended (fused) together to maintain stability. Anterior Cervical Discectomy and Fusion (ACDF) is the gold standard treatment for surgical management of cervical radiculopathy refractory to non-operative measures. It is a procedure of low morbidity and the success rates are high. This is in part attributed to the very high fusion rate, particularly for single level procedures [1].

A variety of implants are available for ACDF. Surgeons can choose from a variety of interbody devices including those manufactured from titanium, Polyetherthylketone (PEEK) and allograft structural bone [2]. An ACDF has several typical advantages: Direct access to the disc and less post operative pain. The insertion of cage with local smashed autologous bone into the evacuated disc space serves to prevent disc space collapse and promote growing together of the two vertebrae into a single unit, which is called "fusion". The use of Taper Titanium cage has the advantages of shorter operation time, maintenance of intervertebral disc height and lordotic angle, maintenance of the patency of the intervertebral foramen, Titanium cage is packed with local autogenous bone which eliminates the morbidity of donor site and infection risk associated with a second surgical site. Complications, although rare, arise from time to time. Dysphagia and transient hoarseness can be anticipated in the immediate post-operative period but generally resolve quickly [2,3]. Longer-term problems include pseudo arthrosis, Adjacent Segment

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Disease (ASD), Adjacent Level Ossification (ALO) and subsidence of the construct [3,4].

Objectives

1) Assessment of technical success in achieving anterior cervical fusion with taper titanium cage; 2) To see the functional outcome of surgery in relation to duration of symptoms and age of the patient.

Methods

This cross sectional observational study included 63 patients receiving Anterior Cervical Discectomy and Fusion (ACDF) with titanium cage was conducted at Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh. The study period was between 1st July 2015 to 30th June 2018. The purposive sampling technique was taken per inclusion and exclusion criteria. We have included the patients with cervical disc prolapse not responding to conservative treatment, patients with progressive neurological deficits and patients with compressive cervical myelopathy and supported with MRI. We excluded the patients with Ossified Posterior Longitudinal Ligament (OPLL), patients who were medically unfit for general anaesthesia, recurrent cases, and patients with pathology of cervical spine other than degenerative disc disease. The clinical information and relevant imaging of 63 consecutive patients, 54 male and 9 female, were reviewed at 1 year after surgery. All surgery were performed at not more than 2 levels, by one surgeon. After anterior discectomy alone, or combined with posterior vertebral body margin osteophytectomy, taper titanium cage was inserted at each level with smashed autologous bone graft. All surgery were completed without cervical plating. Functional outcome was assessed by Visual Analog Scale (VAS) [5], Oswestry Disability Index (ODI) [6] and Odom's criteria [7].

Outcome (Odom's criteria)

Excellent	Complete neurological recovery & went back to their previous work
Good	Neurological recovery with some deficit (spasticity, focal deficit), went back to their job but had to modify their work
Fair	Neurological status improved to a degree but unable to perform their normal daily activities
Poor	a) Did not improve or b) Deteriorated

For statistical analysis, all data was anonymized and entered into a Microsoft Excel spreadsheet. T-tests and Chi-square were utilized for categorical data assessment. The values P <0.05 were considered significant. Data analysis was conducted using the SPSS software package, version 16.0.

Results

Table I, Table II, Table III, Table IV, Table V, In 63 patients, the functional outcome was excellent to good (94.1%) when duration of symptoms was less than 6 months and outcome was excellent to good (94.4%) when the age was less than 50 years. The overall result of surgery was excellent to good (90.4%) in odom's criteria and the overall result of surgery was <40% range of disability (95.2%) in Oswestry Questionnaire [6] Table VI.

Clinical Improvement-Change in baseline Oswestry Disability Index (ODI) at the time of discharge and at 1 year. [Time Frame: 1 year] Table VII, Table VIII.

Clinical Improvement-Change in Baseline Visual Analogue Score (VAS) for Pain [Time Frame: 1 year].

Table I: Demographic characteristics of the study population (N=63).

Age		
Mean age=39 years	Youngest 24 years	Oldest 62 years
	<50yrs=71.4%	>50yrs=28.6%
Sex		
Male	54	85.7%
Female	9	14.3%
Smoking		
Smoker	Non-Smoker	
45 (71.4%)	18 (28.6%)	
Level involved		
Levels	n	%
C3/4	6	4.35
C4/5	12	17.39
C5/6	45	47.82
C6/7	12	28.98

Table II: Relationship between duration of symptoms & outcome of surgery.

Duration of symptoms	Excellent to good (%, N)	Fair & poor (%, N)	N
<6 months	94.1% (48)	5.9% (03)	51
>6 months	75% (09)	25% (03)	12

Table III: Relation between age of the patients & outcome of surgery.

Age	Excellent to good (% N)	Fair & Poor (%, N)	N
<50 years	94.4% (51)	5.6% (03)	54
>50 years	66.7% (06)	33.3% (03)	9

Table IV: Overall result of Surgery.

Outcome	No. of patients (N)	Percentage (%)
Excellent	24	38.1
Good	33	52.3
Fair	6	9.6
Poor	0	0
Total	63	100

Table V: Overall outcome of surgery (Oswestry Questionnaire).

Score ranges	Number of patients	percentage
0% to 20% moderate disability	36	57.1
41%-60% severe disability	24	38.1
61%-80% severe disability	03	4.8
61%-80% Crippled	00	00
81%-100% bed-bound	00	00

Discussion

Cervical degenerative disease, or cervical spondylosis, is an age-related change affecting the cervical spinal column. Radiographic evidence of cervical spondylosis can be found in 85% of individuals over sixty years of age [1]. Certain occupations and activities that place increased loads on the head may have a predisposition for cervical degenerative disease. Cervical spondylotic myelopathy is

Table VI: Changes in ODI scores before, after the surgery and during follow up visits.

		ODI	*P* value
Preoperatively		42.4 ± 8.6	
Postoperatively	At the time of discharge	25.7 ± 3.9	<0.01
	At 1 year	12.2 ± 3.4	<0.01

Table VII: VAS neck scores before, after the surgery and at follow up.

		VAS Neck pain	*P* value
Preoperatively		6.7 ± 1.4	
Postoperatively	At the time of discharge	3.4 ± 2.3	<0.01
	At 1 year	2.3 ± 1.2	<0.01

Table VIII: VAS arm pain scores before, after the surgery and at follow up.

		VAS Arm pain	*P* value
Preoperatively		6.9 ± 1.3	
Postoperatively	At the time of discharge	4.1 ± 1.2	<0.001
	At 1 year	2.0 ± 0.8	<0.001

the most frequent cause of spinal cord dysfunction in individuals older than 55 years in the US and worldwide. Parthiban, Singhania & Ramani PS defined the prevalence of cervical spondylotic myelopathy using radiographic evidence. In males, the prevalence was 13% in the third decade, increasing to nearly 100% by the age 70 years. In females, the prevalence ranged from 5% in the fourth decade to 96% in women older than 70 years [8]. In this study, the mean age was 39 years and 71.4% patients were below 50 years. In another studies, cervical degenerative disc disease is most commonly reported in middle-age group (35–55 years) [9,10]. In our study, 85.7% were male. The other studies are similar to ours where males are more prone to develop cervical degenerative disc disease [11,12]. Higher incidence of spondylosis changes in population with increasing age and in males was reported by Sasaki et al. [13] Higher incidence of cervical degenerative disc disease in males was also reported by Hukuda and Kojima [14]. Indian studies have also reported that age and gender are important risk factors for having cervical spondylosis. The most frequently levels for cervical disc herniation to occur are C4/5, C5/6, and C6/7 [1,2]. However, in our study, majority of the patients (47.82%) had degenerative disc disease at C5–6 level.

Smoking is an important risk factor for cervical disc degeneration and can also affect the postoperative outcome [15]. This study found that patients who were smokers had cervical disc degeneration (with or without myelopathy) more frequently and at younger age than those who did not smoke [16]. Smoking increases the rate of perioperative complications such as infection, adjacent segment disease, and dysphagia [15,17]. Smoking adversely affects bony fusion and increases the chances of pseudoarthrosis [15-17]. Thus, it is mandatory to know the smoking habit of the patient with cervical disc degeneration before surgery. In our study, 71.4% patients had smoking habit.

In the last century, ACDF was applied for the treatment of cervical spondylosis with satisfactory results in many patients. It is now considered the gold standard for the treatment of degenerative cervical diseases. ACDF (anterior cervical discectomy and fusion) has become the most common approach, since 1958 introduced by Robinson and Smith in patients affected by cervical disc disease like cervical spondylosis. It is a primary procedure performed as anterior cervical discectomy of the herniated disc with endplate and fusion of vertebral bodies for standard stabilization [4]. In the past several decades, epidemiological data has suggested a rapidly increasing number of ACDF procedures performed on increasingly elderly patients. This study has explained that ACDF leads to significant improvements in Quality-of-Life (QOL) [18]. So quality of life is the most important measures to check the outcome of surgery. Until now, cervical degenerative disc disease that causes radiculopathy/myelopathy has been successfully managed via ACDF for the last five decades with the satisfactory outcomes of ACDF. When it comes to radiculopathy most of patients are conservatively treated; but if surgery is required, then the most common procedure is ACDF and the most common discs involved are C6 and C7 [19,20]. There are also some complications related to ACDF as a recent study reported an overall revision rate of 15% in patients who underwent ACDF for radiculopathy or myelopathy [18,21].

ACD and fusion with bone graft harvested from the iliac crest is associated with significant patient morbidity related specifically to the graft harvest. Historically, the iliac crest was the donor site of choice due to the volume of bone available and the ease of access for bone harvesting. Though some studies suggest that the rate of complications is higher for iliac crest harvesting for ACD procedures [22,23]. In our study, we used local autologous bone harvesting instead of iliac crest harvesting which eliminates the morbidity of the donor site.

Complications with the anterior approach include vertebral artery injury (0.3%), esophageal injury (0.2–0.4%), wound infection (0.2–1.4%), and dysphagia (28–57%) [18]. Hoarseness after the anterior cervical spine surgery has been reported to be a consequence of RLN (Recurrent Laryngeal Nerve) palsy [24]. Right RLN leaves the vagus nerve and loops under subclavian artery, while the left RLN leaves vagus nerve at the mediastinum and passes over the aorta. After branching from vagus nerve, right nerve does not go into the tracheoesophageal groove until it approaches the cricothyroid joint, whereas left RLN ascends within the tracheoesophageal groove. Right RLN was thought to be easily injured by right side approach of the anterior cervical spine surgery, because it might cross the operative field [24,25]. However, the incidence of postoperative hoarseness does not differ by the side of approach. The overall incidence of RLN palsy had been reported to be 2–3% [24]. But recent prospective study showed that the incidence of hoarseness and subclinical laryngoscopic vocal code paralysis was 8.3%, 15.9% at 3–7 days, and 2.5%, 10.8% at 3 months after surgery, respectively. Dysphagia is often observed after the anterior cervical spine surgery with an incidence of 2–60% [26]. The incidence has been lower in the reports by surgeons (neurosurgeons and orthopedic surgeons) and higher in those by otolaryngologists. But, recent cohort study by orthopedic surgeons revealed that dysphagia was observed in 54% of patients at 1 year and 14% at 2 years after the anterior cervical spine surgery [27]. Risk factors were female gender, prolonged operative time, revision surgeries, multilevel surgeries, and the use of bone morphogenetic protein [26,27].

In our study, the surgical incisions were healed without

complications. All patients had pain relief. No graft fracture, sliding or resorption was observed. Five patients in ACDF experienced temporary hoarseness. Twelve patients in our study reported dysphagia, which disappeared within 2 weeks after surgery. Adjacent level degeneration was observed in 2 patients in this study.

The functional outcome was assessed by Visual Analog Scale (VAS), Oswestry Disability Index (ODI) and Odom's criteria. The clinical improvement was measured at changes in baseline Visual Analogue Score (VAS) [5] for Pain [Time Frame: 12 months]. Patients were asked to complete the VAS to measure their pain prior to surgery in the preoperative waiting area. Scores at the time of discharge and 12 months follow up visits compared to baseline. Also the clinical improvement was measured at changes in baseline Oswestry Disability Index (ODI) [6] [Time Frame: 12 months]. ODI survey scores at the time of discharge and at 12 month follow up visits compared to baseline. VAS neck and arm pain scores were decreased significantly after surgery (P <0.01). ODI scores were also significantly decreased after the surgery (P <0.01).

In our study, the functional outcome was excellent to good (94.1%) when duration of symptoms was less than 6 months and outcome was excellent to good (94.4%) when the age was less than 50 years. The overall result of surgery was excellent to good (90.4%) in odom's criteria and the overall result of surgery was <40% range of disability (95.2%) in Oswestry Questionnaire. Among the two studies of Smith & Robinson, outcome obtained as excellent in 64.2%, good in 14.25, fair in 14.2%, and poor in 7.1% cases in one study. The other study showed outcome was excellent in 45.5%, good in 27.2%, fair in 21.8% and poor in 5.5% cases and 50% of cases required re-operation for non-union in this series [4]. Rosenorn et al. Showed outcome excellent in 41.3%, good in 27.5%, fair in 6.2% and poor in 24.1% cases [28]. But the recent study shows when performed with fusion, Anterior Cervical Discectomy (ACD) yields good to excellent results in almost 90% of patients when no other level of spondylosis is present. When adjacent levels of spondylosis were demonstrated, only 60% of patients had good to excellent results [29,30]. A study shows after successful ACDF, 50% of individuals may return to full employment, 40% to light employment and 10% may remain disabled [31].

Conclusion

This study tends to confirm the expected outcome related to young age and short duration of symptoms. The taper titanium cage for ACDF could effectively restore the cervical physiological curvature, cause few complications, and lead to satisfactory outcomes. Local autogenous bone eliminates the morbidity of the donor site.

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