

International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2022; 8(1): 396-399
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www.orthopaper.com
Received: 09-11-2021
Accepted: 11-12-2021

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Anterior Cervical Discectomy and Fusion (ACDF) with Stabilization by cervical locking plate and screw in traumatic sub-axial incomplete cervical spine injury: Early experience

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DOI: <https://doi.org/10.22271/ortho.2022.v8.i1f.3046>

Abstract

Introduction: Cervical spine injuries represent 2 to 6% of adult blunt trauma, and one third of all spinal injuries. Anterior approach of operative management of cervical spinal injury with incomplete neurological lesion has least analyzed in our settings, the present study has been designed to evaluate the outcome of ACDF and stabilization by cervical plate and screw for managing traumatic cervical spine injury with incomplete neurological deficit.

Methods: This study was conducted at NITOR, Dhaka, from July 2016 to June 2018. Twenty available patients meeting the inclusion & exclusion criteria were included. All cases were properly evaluated pre-operatively and underwent ACDF & stabilization with cervical plate and screws. Follow up was done for 5 to 12 months. The final assessment was done by ASIA impairment scale, MRC grading, Bridewell fusion grade, Denis work & pain scale and modified Odom's criteria.

Results: Highest number of patients 10 (50%) were in ASIA grade B, 7(35.0%) patients were in ASIA grade D and 3(15.0%) patients were in ASIA grade C on admission. But in last follow up, highest number of patients were in ASIA grade E (45%). The ASIA grade has improved 1 grade in 55% cases. Bridewell fusion grade showed anterior fusion grade I in 55% of cases, grade II in 45% cases. 60% of cases were in W2 group of Denis work scale after last follow up. Early post-operative complications were dysphagia (20%), respiratory distress (5%) and neck pain (20%). Late post-operative complications were neck pain (10%), donor site pain (5%) and bed sore (5%). According to modified Odom's criteria, 65% of the cases were found excellent.

Conclusion: On the basis of the results in this study, it can be said that anterior cervical decompression, stabilization and fusion by bone graft of the patients who have traumatic unstable cervical spine injury with incomplete neurological lesion will provide effective benefit.

Keywords: Cervical spine injury, incomplete neurological deficit, ACDF

Introduction

The cervical spine is functionally the most important region of the spine. But it is difficult to assess because of its complex anatomy, biomechanics and the complex mechanism of injury of spinal trauma. So careful assessment of the region is vital as any error will have devastating consequences for the patients. Cervical spinal injury occurs most frequently in the young male patient with an average age of 35 years [1]. Cervical spinal cord injury may be complete, resulting in quadriplegia and incomplete resulting in anterior cord syndrome, central cord syndrome, Brown-Sequard syndrome, and specific nerve root injury. Approximately 40% of cervical spinal cord injury patients presents with complete spinal cord injuries and 20% with either no cord or only root lesions [2]. Cervical spine dislocation is not an uncommon phenomenon. It carries a double threat as it also damage neural tissues as well. Unilateral facet dislocation usually results from flexion and rotation of the cervical spine. The most common site is C5-6. Patient may present with an isolated nerve root injury or an incomplete neurological deficit. The injury may be purely ligamentous causing dislocation. In less than 50% of patients, closed reduction is not successful [3]. Those who sustain a complete spinal cord injury are unlikely to regain functions below the level of injury. Incomplete injuries usually show some degree of improvement over time, but in most of the cases improvement is

not sufficient enough to enable these victims to ambulate and to control bowel and bladder functions and to perform detail or intricate works [4].

Surgical treatment involves decompressive surgery in the spinal cord and stabilization of the unstable spine following management of patient’s cardiopulmonary and general medical status [5, 6]. Traction is also frequently applied as a decompressive method either alone or followed by surgery [7, 8]. The treatment of cervical spine fractures and dislocation also has several goals, which includes reduction of deformity and stabilization, minimizing neurological injury and early rehabilitation [9].

Materials and Methods

This study was a case review of 20 consecutive patients with traumatic sub-axial incomplete cervical spine injury who underwent instrumentation at a single level and anterior cervical decompression and fusion with autogenous tricortical iliac crest graft and stabilization was done by cervical plate and screw (titanium). The study was carried out from July 2016 to June 2018 in National Institute of Traumatology and orthopedic Rehabilitation (NITOR), Dhaka. Average follow up period was 9 months with inclusion criteria were unstable sub-axial cervical spine injury with or without fracture and incomplete spinal cord injury from 15 to 75 years ages of both sex. Exclusion criteria were C 1-2 injury, complete spinal cord injury, posterior column injury and associated head injury. During the initial phase level and degree of Neurological injury was assed using ASIA impairment scale and MRC grading.

Operative and post-operative record with X-ray and MRI were maintained. Radiographic assessment was performed preoperatively immediately after Surgery and 3,6,9 and 12 months post operatively (Figure 1).

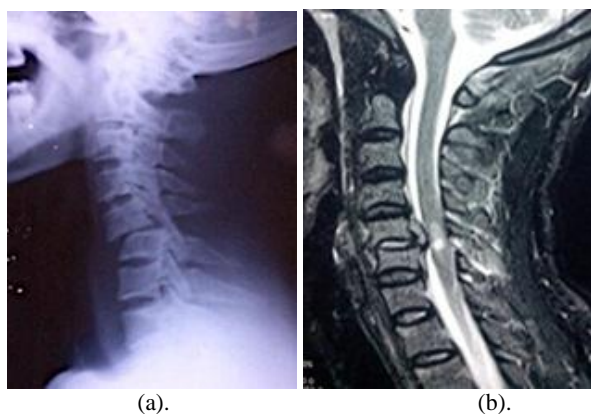


Fig 1: Preoperative X-ray showing C5/C6 dislocation (a) and preoperative MRI (b).

We assessed working capability and pain status according to Denis work and pain scale, Muscle power clinically according to MRC grading, bony fusion radiologically by Birdewell criteria and neurological outcome by ASIA impairment scale and over all functional outcomes with Modified Odom’s criteria (Table 1). We focused on operating room time, hospital stay, intra and post operative complications. Outcome and time to return to normal activities including work. Patients were discharged with soft collar for 2 months (average) and began range of motion exercise as shortly as pain subsided. The technique used was a modification of the procedure as originally described by Smith and Robison [10]. Briefly a transverse right sided cervical incision was used for exposure.

Results

In this study, the age range of patients was from 21-70 years, with mean age of 38 ± 13.24 years. Majority of the patients in this case series were in the third decade, age group of 21-30 (40%) years. Male population constituted 90% of total cases, while the female made up the remaining 10%. This series showed subluxation in 12 cases (60%), Fracture-dislocation in 2 cases(10%), compression fracture in 2cases(10%),burst fracture3(15%)&other comprises 1 cases(5%). In this study, mean hospital stay was 29.85 ± 8.65days (range 15-45 days).

Table 1: Demographic data of the patients (N=20)

Age	Mean±SD	38 ± 13.24 Years
Gender	Male: Female	9:1
Occupation	Heavy worker	14 (70%)
	Sedentary worker	6 (30%)

The result of bony fusion by this anterior cervical plating showed 11 (55%) cases showed grade I fusion and 9 (45%) showed grade II fusion at their last follow up (Figure 2).

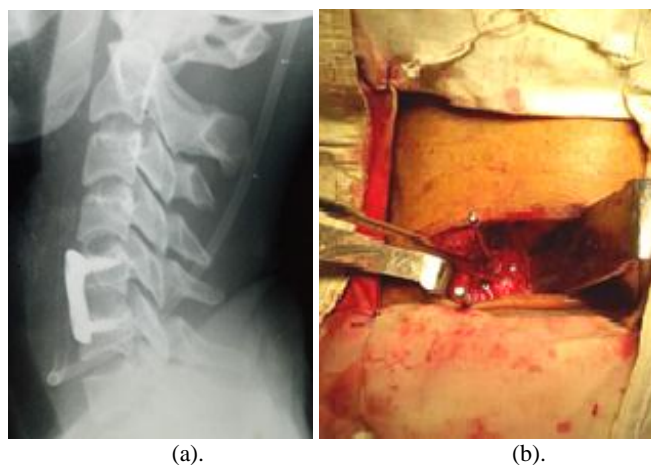


Fig 2: Postoperative X-ray with plate & screw (a) and per-operative picture.

On admission, most of the cases (n=9, 45%) scored 4 in Denis pain scale (Table 2). Among them, 5 (25%) improved to score 1, 3 (15%) improved to 2 and 1 (5%) improved to 3. Four (20%) cases scored 3. All of them scored 1 in last follow up. Seven (35%) cases scored 5. Among them, 3 (15%) improved to score 1, 1 (5%) improved to score 2 and 3 (15%) improved to score 3. The mean score on admission was 4.15±0.75 which improved to 1.6±0.82 on last follow up. The p value was less than 0.005. So, there was significant improvement regarding pain statuses of the cases at last follow up.

Table 2: Pain status of the cases (Denis Pain Scale) (N=20)

Grade	On Admission	On Last Follow Up
	n (%)	n (%)
P1	0 (0%)	12 (60%)
P2	1 (0%)	4 (20%)
P3	4 (20%)	4 (20%)
P4	9 (45%)	0 (0%)
P5	7 (35%)	0 (0%)

Working capabilities of all the patients in this study were categorized according to Denis work scale. [11] The highest number of patients was found in grade W2, 12(60%). In grade W4 number of patient were 4(20%). One (5%) patient showed grade W1, 1(5%) patient showed grade W3 and 2(10%) patients showed grade W5 (Table 3).

Table 3: Working capability at last follow up (Denis Work Scale) (N=20)

Denis work scale	n (%)
W1	1 (5%)
W2	12 (60%)
W3	1 (5%)
W4	4 (20%)
W5	2 (10%)
Total	20 (100%)

Among the early post-operative complication, temporary dysphagia was highest in 4 (20%) patients. Next common complication was neck pain in 4 (20%) patients followed by respiratory problem in 1(5%) patient. Among the late post-operative complication neck pain were highest in 2(10%) patients followed by donor site pain in 1(5%) patient & only one (5%) patient developed bed sore.

According to ASIA impairment scale majority of the patients were occupied in ASIA grade B (50%) on admission. Out of them, 2 (10%) remained in same grade. Three (15%) cases improved 1 grade and 5 (25%) cases improved 2 grade. Three (15%) cases were in ASIA grade C on admission. Among them, 1 (5%) improved 1 grade and 2 (10%) improved 2 grade. The remaining 7 (35%) were in ASIA grade D on admission and all of them improved 1 grade on last follow up (Table 4)

Table 4: Neurological status according to ASIA Grade (N=20)

AIS on Admission		AIS on Last Follow Up			
ASIA Grade	n (%)	B	C	D	E
B	10 (50%)	2	3	5	0
C	3 (15%)	0	0	1	2
D	7 (35%)	0	0	0	7

On admission, most of the cases (n=10, 50%) scored 0 in MRC grading. Three (15%) cases scored 2 and 7 (35%) scored 3 with a mean score 1.35 ± 1.42 . At last follow up, 8 cases (40%) scored 5 and 8 cases (40%) scored 3. Two (10%) scored 0 and 2 (10%) scored 4 with a mean score 3.6 ± 1.54 . The p value is less than 0.05. So, there was significant improvement regarding MRC grading for muscle power of the cases at last follow up.

On last follow up, functional assessment was done according to modified Odom's criteria. Out of 20, 13 (65%) were excellent, 1 (5%) was good, 4 (20%) were fair and only 2 (10%) were poor (Table 5). The result strongly favors the improved outcome of this operative management. There was no dysphonia, pseudoarthrosis or deformity due to graft subsidence, graft dislodgment, plate loosening or breakage, screw migration or misdisplacement.

Table 5: Functional outcome according to Modified Odom's criteria (N=20)

Modified Odom's Criteria	n (%)
Excellent	13 (65%)
Good	1 (5%)
Fair	4 (20%)
Poor	2 (10%)
Total	20 (100%)

Discussion

The treatment of lower cervical spinal injuries was not yet been standardized in past decade. But it has been improved a lot from the last decade. Improvement of various facilities like proper implants, surgeon's skill, newer technique and

improved operative facilities now a day has made the treatment option of cervical spine injury much more standardized ever before in Bangladesh.

In this study, the cases were carefully selected for surgery and the surgical procedure was selected on the basis of available local facilities and the paying capability of the patients.

Goal of any form of treatment are to obtain a painless, balance stable spine with optimum neurological function and maximum spine mobility. The treatment of cervical spine fractures and dislocation has also several goals including reduction of deformity and stabilization, minimizing neurological injury and early rehabilitation^[9].

Anterior fixation is generally used for anterior column disorders or as an adjunct to posterior fixation for three-column injuries. Ideally approach should be least invasive. Anterior cervical approach is relatively atraumatic compared with posterior approach. Anterior approach avoids the risk of prone positioning in a traumatized cervical spine, and allows direct anterior decompression at the site of injury.

In this study gender distribution of the study cases, male population constituted 90% of total cases, while the female made up the remaining 10%. Singhal, *et al.*^[13] observed a male predominance (Male- 75.4% & Female- 24.6%). One of the major causes of male predominance is being the major working force of the society and is more constantly exposed to the external environment, which probably accounts for this discrepancy. On the other hand it may be due to the fact that the female victims might have been neglected from modern facilities due to socio-cultural economic conditions of the country.

In this series, bearing load on the head was the most common cause (40%) followed by fall from height (30%). Raja, Makhdoom & Qureshi^[12] found that fall is the most common mode of injury. Laus *et al.* (14) also found that common cause of injury was high energy trauma such as motor vehicle accidents (85%). Study in our country as well as in subcontinent showed that most common cause of injury was due to fall either bearing load in head or fall from height. It indicates that the people require more awareness about this habit of carrying load and climbing a tree to reduce chances of injury. But study in western countries showed that common cause of injury is RTA. Difference between these two studies is again due to socio-economic status of the patient. Although cervical spinal injury is associated with concomitant injuries (28%) like brain injury, extremity injury, chest injury, abdominal and pelvic injury^[14], but this study showed only one patient had Colles' fracture (5%) and one patient had fracture shaft of right humerus (5%), one patient had fracture of right fibula (5%) and one patient had rib fracture (5%). This poor percentage of other injury is due to exclusion criteria.

In this study most involved level of spine was C5/C6 (55%); next common involved level was C6-C7 (20%). Vafa *et al.*^[15] also showed that most involved level of spine is C5 (30.8%) & C6 (23.1%). Singhal *et al.*^[13] showed most common involved level is C5/C6(32.4%); next common to it was C6/C7 (21.3%). Raja, Makhdoom & Qureshi^[12] also found most common involved level was C5/C6 (32.4%); next to it was C6/C7 (24.3%). So in all series C5-C6 is the most common involved spine level. Among the per-operative complication hemorrhage was present in only 1(5%) case. The hemorrhage was mainly bony showing healing process, due to delayed surgery. No patient had recurrent laryngeal nerve injury or dural injury. In the series of McAfee, *et al.*,^[16] dura was injured in 1 (5%) case. No patient was deteriorated

after operation. Among the early post-operative complication, temporary dysphagia was highest in 4 (20%) patients. Next common complication was neck pain in 4 (20%) patients followed by respiratory problem in 1(5%) patient. Aronson, Filtzerand & Bagan^[17] had also reported temporary dysphagia (4.7%), in a series of 100 patients. So the incidence was higher than the finding of that series. It may be due to improper retraction of oesophagus & trachea. McAfee, *et al.*^[16] reported that 7 (5%) patients with respiratory problem immediately after surgery which coincide with this study. The incidence of graft extrusion was nil and similar to the series of Caspar, Barbier and Clara^[18]; Randle, *et al.*^[19]; Shoung & Lee,^[20] and Tippets & Apfelbaum^[21] using anterior cervical plates and lower than that of Smith& Robinson's study^[10]. From a neurological point of view, overall improvement was noted in 18 (90.0%) patients. Two grades shift of ASIA scale was noted in 7 (35.0%) patients & 1 grade shift of ASIA scale was noted in 11 (55.0%) patients. McAfee *et al.*^[16] observed shift of ASIA grade 1 in 76% cases & shift of ASIA grade 2 in 12% cases which is comparable to the present study.

Conclusion

The study shows that the anterior surgical decompression, fusion and stabilization by cervical plate and screws are relatively easy, safe and an effective procedure for unstable sub axial spinal injuries with good neurological and radiological outcome. It provides immediate stability to the affected area, reduces the risk of graft extrusion, avoids the need for extended post-operative external immobilization, and significantly improves pain & neurological statuses of the patients. However, in this study the sample size was small with short follow-up.

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