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FUNCTIONAL OUTCOME OF ANTERIOR CERVICAL DECOMPRESSION AND FIXATION BY PLATE AND SCREWS WITH BONE GRAFT IN TRAUMATIC INCOMPLETE LOWER CERVICAL SPINAL INJURY

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ABSTRACT

Background: Acute injury to the lower cervical spine and spinal cord is one of the most common causes of severe disability and death after trauma. It is a devastating event on a personal and family level as well as tremendous financial burden to the society. To date, there is no clear consensus on the best treatment option for lower cervical fracture-dislocation. In recent years, anterior cervical decompression and fixation (ACDF) has been widely accepted. Through this study, we have assessed the functional outcome of ACDF. **Objective:** To observe the functional outcome of anterior cervical decompression and fixation by plate and screws with bone graft in traumatic incomplete lower cervical spinal injury. **Materials and Methods:** It is a prospective observational study which was performed in the Department of Orthopaedics, Dhaka Medical College Hospital (DMCH), Dhaka on 15 patients. Study period was 9 months. The primary purpose of this study was to observe the functional outcome of anterior cervical decompression and fixation (ACDF) by plate and screws with bone graft in traumatic incomplete lower cervical spinal injury. All patients with incomplete lower cervical spinal injuries attending in the Department of Orthopaedics, DMCH were included. Participants were selected by consecutive purposive sampling who met the selection criteria. Proper history was taken. Neuro-functional recovery of each patient was assessed by the American Spinal Injury Association (ASIA) impairment scale (AIS). Functional outcome was assessed using visual analog scale, Oswestry disability index and Macnab criteria. Bony fusion was determined by Bridwell fusion grading system. **Results:** The mean age was found 44.53±12.51 years with male dominancy (86.7%). Most of them are farmers (46.70%) and the most common cause is fall from height (46%). The most commonly affected level is C 5/6 (60%). Post-operatively on final follow up, ASIA grade improvement was two grade shifts in 20%, one grade shift in 66.7% and no shift in 13.7%. Minimum disability according to the Oswestry disability index, and mild pain according to visual analog scale was found at the final follow up. According to Bridwell fusion grading system, grade-I bony fusion was seen in 80% of cases. **Conclusion**: Anterior decompression, stabilization and fusion by cervical plate and screws with bone graft is an effective method which provides considerable benefit in the form of significant improvement of neurological outcome as well as yields good functional outcome.

KEYWORDS: Lower cervical spine, spinal cord, anterior cervical decompression.

INTRODUCTION

Acute injury to the spine and spinal cord is one of the most common causes of severe disability and death after trauma.[1] One third of these patients have injury that involves the cervical spine.[2] For this reason, proper evaluation and treatment of the injury to the cervical spine and spinal cord demand a systematic approach that is integrated into the overall management of the traumatized patient.

Cervical spinal trauma complicated by injury to spinal cord is a devastating event on a personal and family level as well as tremendous financial burden to the society because of its attendant morbidity, the expensive and prolonged necessary treatment regime and the patient's life long dependence on medical ancillary staff and resources.[3]

The injury can be caused by any trauma to the cervical spine that can result from motor vehicle accidents, fall from heights, sports injuries (particularly diving into shallow water), gunshot- wounds, assaults and others. A

seemingly minor injury can cause spinal cord trauma if the spine is weakened (e.g., from rheumatoid arthritis or osteoporosis). Cervical spinal injury occurs most frequently in the young male patient with an average age of 35 years.[4]

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. Spinal concussion can also occur consisting of complete or incomplete spinal cord dysfunction that is transient and generally resolves within 1 or 2 days. Approximately 40% of cervical spinal cord injury patients present with complete spinal cord injuries and 20% with either no cord or only root lesions.[5]

Recovery of function depends upon the severity of the initial injury. 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 improvement, in most of the cases, is not sufficient enough to enable these victims to ambulate and to control bowel and bladder functions and to perform detailed or intricate works.[6]

There has been a great deal of discussion as to which treatment course is most helpful in ensuring maximum neurological improvement after a cervical spinal cord injury[7]. Though conservative management was the only option in past, surgical treatment is now-a-days a practiced option because this procedure improves neurological outcome as well as reduces the length of hospital stay. This paves the way to advances in both conservative and surgical management of patients with spinal injuries.[8]

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] Surgical treatment involves decompressive surgery in the spinal cord and stabilization of unstable spine following management of patient's cardiopulmonary and general medical status.[10] Traction is also frequently applied as a decompressive method either alone or followed by surgery.[11]

The selection of an appropriate surgical approach and stabilization technique depends on type of fracture, age of the patient and expertise of the surgeon. 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 to 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.[12]

The purpose of this study is to evaluate the functional outcome of anterior cervical decompression and fixation by plate and screws with bone graft in traumatic incomplete lower cervical spinal injury to see whether it is an effective intervention for maintaining quality of life.

OBJECTIVE

General objective

To observe the functional outcome of anterior cervical decompression and fixation by plate and screws with bone graft in traumatic incomplete lower cervical spinal injury.

Specific objectives

- To find out the neurological outcome using ASIA impairment scale.
- To see the functional outcome using VAS, ODI and Macnab criteria.
- To assess the radiological outcome using Bridwell fusion grading system.

METHODOLOGY

Study design: Prospective observational study. (Short term follow-up study)

Place of study: Department of Orthopaedics, Dhaka Medical College Hospital (DMCH); Bangladesh Spine and Orthopaedic Hospital, Dhaka.

Study period: July 2020 to March 2021.

Study population: All patients with incomplete lower cervical spinal injuries attending in the Department of Orthopaedics, DMCH and Bangladesh Spine and Orthopedic Hospital, Dhaka.

Sample size: 15 patients were available and included in the study

Sampling method: Non-probability purposive sampling

Selection criteria

Inclusion criteria

i. Lower cervical (C3-C7) spinal injury
ii. Incomplete lower cervical (C3-C7) spinal cord lesion
iii. Single level injury
iv. Age: 15-55 years

Exclusion criteria

i. Associated head injury
ii. Associated polytrauma
iii. Multi-segmental cervical instability

Data collection

Data were collected using a structured questionnaire (research instrument) which contained all the variables of interest according to fixation by plate and screws with bone graft in traumatic incomplete lower cervical spinal injury.

Procedures of collecting data

Patients who met the selection criteria were included in the study. Written consent was taken from the patient. Detailed history was taken and clinical examination was

done systematically. A pre-set data form was filled up for every patient. Patients with associated head injury, polytrauma and multi- segmental cervical instability were excluded to obtain a more homogenous sample.

Data analysis

Data was analyzed by SPSS (Statistical Package for Social Sciences) version 26. Descriptive statistics was analyzed to calculate the frequency, percentage, mean and standard deviation of observed data. 2-sample t test and Chi- square test were applied in order to test the hypothesis for comparison of data presented in categorical scale. Level of significance was set at 0.05 and p-value< 0.05 was considered as statistically significant. Important tables, charts and diagrams were prepared on the basis of findings relevant to risk factors, impairments and disability.

RESULTS

Table I: Age distribution of the study population (n=15).

Age in years	Number	Percentage
15-25 years	01	6.7
26-35 years	07	46.7
36-45 years	04	26.7
46-55 years	03	20.0
Total	15	100.0
Mean ±SD	44.53 (±12.51)	Range 15-55 years

Table I showing the age range of patients was 15 to 55 years, with a mean age of 44.53 (±12.51) years. The highest number of patients 7 (46.7 %) was observed in the 36-45 years range.

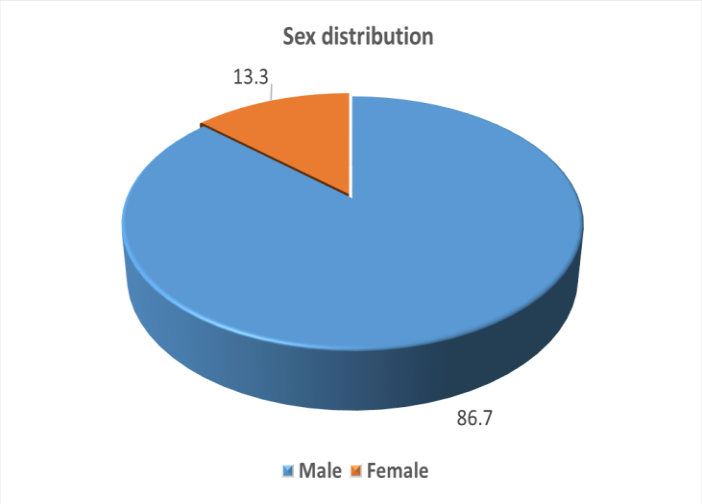

Figure 1: Gender distribution of the study patients (n=15).

Figure-1 showing the male population in the study constituted 13 (86.7%) while the female made up the remaining 2 (13.3%) with a male-female ratio of 6.5:1.

Table II: Occupational status of the study population (n=15).

Occupational status	Number	Percentage
Farmer	07	46.7
Driver	01	6.7
Service holder	01	6.7
Labor	04	26.7
House wife	01	6.7
Student	01	6.7
Total	15	100.0

Table II shows that the most commonly affected people were farmers 7 (46.7%).

Table III: Causes of injury of the study population (n=15).

Causes of injury	Number	Percentage
Fall from height	07	46.7
RTA	03	20.0
Fall with load on head	05	33.3
Total	15	100.0

Table III shows that the most common cause of injury was fall from height in 7 patients (46.7%).

Table IV: Comparison of neurological status (ASIA grade) between pre-operative with post-operative period.

Pre-operative	Post-operative ASIA grade (After 6 months follow up)				Total	p-value
	B	C	D	E		
B	1	2	1	0	4	
C	0	0	5	3	8	0.04s
D	0	0	1	2	3	
Total	1	2	7	5	15	

s= p-value is statistically significant (<0.05) Statistical analysis is done by Chi-square test

Table V: Comparison of VAS score between pre-operative and post-operative period.

Pre-operative Post-operative VAS score				Total	p-value
VAS score	No pain	Mild	Moderate		
Mild	2	0	0	2	0.04s
Moderate	5	2	0	7	
Severe	0	4	2	6	
Total	7	6	2	15	

s= p-value is statistically significant (<0.05) Statistical analysis is done by Chi-square test.
Table V shows operation improves the functional outcome (VAS score) significantly (p-value is 0.04).

Table VI: Comparison of mean VAS score between pre-operative and post-operative period.

	Pre-operative Mean±SD	Post-operative Mean±SD	p-value
VAS score Range (min – max)	6.06±1.38 3-8	1.63±1.60 0-4	<0.001s

s= p-value is statistically significant (<0.05) Statistical analysis is done by Chi-square test.
Table VI shows that mean pre-operative VAS score was 6.06 (±1.38) and at last follow-up, it was 1.63 (±1.60) with significant p-value (<0.001).

Table VII: Comparison of ODI score between pre-operative and post operative period.

Pre-operative	Post-operative ODI score			Total	P value
ODI score	Minimum	Moderate	Severe		
Severe	5	1	0	6	
Crippled	5	0	1	6	0.02^{S}
Bed bound	0	2	1	3	
Total	10	3	2	15	

s= p-value is statistically significant (<0.05) Statistical analysis is done by Chi-square test.
Table VII shows operation improves the functional outcome (ODI score) significantly (p-value is 0.02).

Table VIII: Comparison of mean ODI score between pre-operative and post-operative period.

	Pre-operative Mean±SD	Post-operative Mean±SD	p-value
ODI score Range (min – max)	68.80±14.11 50-88	20.67±14.27 06-50	0.03s

Table VIII shows that mean pre-operative ODI score was 68.80 ± (14.11) and at last follow-up, it was 20.67 (±14.27) with significant p-value.

DISCUSSION

In this study, the age range of patients was 15 to 55 years, with a mean age of 44.53±12.51 years. The highest number of patients 7 (46.7 %) was observed in the 4th decade and the lowest number of patients 1 (6.66%) was observed in the 3rd decade. Hossain and Khundkar (2013) showed the mean age was 47.44[13]. A study conducted by Koller *et al.* (2009), showed that mean age at injury was 42.4±18.7 years with range of 16-70 years[14]. Gao *et al.* (2015) reported a mean age of 41.5 years, range 21-72 years. In the present series, middle-age people are the main victim as they are the working group of people.[15]

The male population in the study constituted 13 (86.67%) while the female made up the remaining 2 (13.33%) with a male-female ratio of 6.5:1. A study conducted by Hoque *et al.* (1999) at CRP, Bangladesh showed male predominance (M: F =7.5:1) and Rahman *et al.* (2017) showed that among 2184 patients 86.8% (n=1897) were male and 13.1% (n=287) were female.[16,17]

In this series, the most common cause of injury was fall from height 7 (46.66%) where as RTA 3 (20.00%), fall with load on head 4 (26.67%), fall of heavy object on head 1(6.66%). Rahman *et al.* (2017) showed that among 2184 spinal injury patients 992 (45.4%) due to fall from height and 567 (25.9%) due to road traffic accidents.[17]

In our study, the distribution of patients' neurological status on admission, 8 were in ASIA grade C (53.33%), 4 were ASIA grade B (26.66%) and 3 were ASIA grade D (20%). On follow-up, neurological status improved in 13 patients (87%) and 2 patients (13%) remained the same. Lee *et al.* (2016) achieved 86% improvement neurologically using the ASIA impairment scale.[18] Rob *et al.* (2016) obtained a 91.7% improvement in neurological status. These results are comparable.[13]

Next to it was the ASIA grade improvement. In this study, one grade shift of ASIA grade improvement was noted in 10 (66.7 %) patients. Next, two grade shift of ASIA grade improvement was in 3(20%) patients followed by no shift of ASIA grade improvement in 2

(13 %) patients. Overall ASIA grade improvement was in 87%.

In this series, improvement of pain status was measured by Visual Analog Scale (VAS). The pre-operative VAS was 6.06 (±1.38) and at last follow-up, it was 1.63 (±1.60). The p-value was <0.001 which is statistically significant. In an initial series of Rizzi *et al*. (2016) the improvement of the VAS score was 07.18 ± 01.09 to 01.92 ± 0.91 which is comparable to this study.[19] In this study, improvement of disability measured by Oswestry Disability Index (ODI) was 68.80 (±14.11) to 20.67 (±14.27) at last follow-up, here also p-value is <0.05 which is statistically significant. There were very little works done where ODI was assessed in cervical injury. But lumbar injuries were assessed in many previous works.

In this study, overall results were classified according to Macnab criteria for characterizing outcomes after surgery (Macnab 1971) as excellent, good, fair and poor.[20] Seven (46.67%) patients were found good in final follow up and 4 (26.67%) patients were found excellent.

CONCLUSION

On the basis of the results in this present study, it can be concluded that anterior cervical decompression, stabilization and fusion by cervical plate and screws with bone graft of the patients who have traumatic lower cervical spinal injury with incomplete neurological lesion provides considerable benefit in the form of significant improvement of neurological outcome as well as yields good functional outcome.

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