

OUTCOME ASSESSMENT AFTER SURGICAL MANAGEMENT OF CERVICAL SPINE INJURY-RETROSPECTIVE STUDY

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Abstract

Background: Spinal cord injury (SCI) is a debilitating neurological condition with tremendous socioeconomic impact on affected individuals as well as their families and the health care system. Objective: to assess change in clinical status after surgical management of traumatic cervical spinal injury. **Materials and Methods:** This Retrospective study was conducted in 31 patients admitted to at the Neurosurgery department of DKS postgraduate and research institute, Raipur. Duration of study was from January 2020 to May 2021. **Results:** ASIA IMPARMENT SCALE grade C was the commonest finding followed by Grade D. After surgery about half of patients improved (48.4%) when graded according to ASIA and Nurick's grading. Clinical symptom which improved in most was motor power, followed by deep tendon reflexes, bladder & bowel function, tone of limbs and least improvement in sensory function. **Conclusion:** Despite an enormous amount of interest and research in SCI, the prognosis for neurologic recovery in patients with severe SCI remains poor.

INTRODUCTION

Spinal cord injury (SCI) is defined as damage to the spinal cord that temporarily or permanently causes changes in its function. SCI is divided into traumatic and non-traumatic aetiologies.^[1] Traumatic SCI occurs when an external physical impact (for example, a motor vehicle injury, fall, sports-related injury or violence) acutely damages the spinal cord, whereas non-traumatic SCI occurs when an acute or chronic disease processes, such as a tumour, infection or degenerative disc disease, generates the primary injury.

In traumatic SCI, the primary insult damages cells and initiates a complex secondary injury cascade, which cyclically produces the death of neurons and glial cells, ischaemia and inflammation. This cascade is followed by changes in the organization and structural architecture of the spinal cord, including the formation of a glial scar and cystic cavities. The glial scar and cystic cavities, in combination with poor endogenous remyelination and axonal regrowth, mean that the spinal cord has a poor intrinsic recovery potential, such that SCI causes permanent neurological deficits.

The incidence of SCI varies worldwide.^[2] Among developed regions, the incidence of traumatic SCI is higher in North America (39 cases per million individuals) than in Australia (16 cases per million

individuals) or Western Europe (15 cases per million individuals), owing to higher rates of violent crime and self-harm. By comparison, the prevalence of non-traumatic SCI has been estimated as 1,227 cases per million individuals in Canada and 364 cases per million individuals in Australia; reliable data from other countries are not available.^[3,4] The rates of occurrence varied greatly, with a 2-fold difference between the highest mortality rate in developing countries and the highest mortality rate in developed countries.^[5] The prevalence of traumatic SCI is given as ranging from 236 per million in India to 1800 per million in the USA.^[6] Traumatic SCI occurs more commonly in males (79.8%) than in females (20.2%). The age profile of individuals with a traumatic SCI has a bimodal distribution; one peak is between 15 and 29 years of age and the second, smaller but growing peak is in those >50 years of age.^[7,8]

Traffic accidents are the primary cause of all traumatic SCIs and accounted for 38% of injuries between 2010 and 2014, although this number is gradually declining. Falls are typically the second-most common cause of traumatic SCIs and accounted for 31% of injuries between 2010 and 2014, followed by sports-related injuries, which account for 10–17% of traumatic SCIs.^[8,9]

Although the survival of patients with traumatic SCI has improved over time, patients continue to have

mortality rates that exceed those of age-matched controls. The risk of mortality increases with more-severe injuries, higher injury levels (that is, cervical SCIs are associated with higher mortality than lumbar SCIs), increasing patient age, the presence of multisystem trauma and higher-energy injury mechanisms. Despite modern medical care, patients with traumatic SCI have a significantly reduced lifespan. The life expectancy after SCI for an individual 40 years of age is lowered to 23 years after C5–C8 injury, 20 years after C1–C4 injury and 8.5 years if they are ventilator dependent.^[10] The present retrospective study is designed to study the outcome assessment after surgical management of cervical spine injury.

MATERIALS AND METHODS

This Retrospective study was conducted in 30 patients admitted to at the Neurosurgery Department of DKS Postgraduate and Research Institute, Raipur with subaxial cervical SCI who underwent surgery from October 2020 to October 2021. Ethical clearance was obtained from the institutional ethical committee for the present study.

Methodology: Grading of injury was done using - American Spinal Injury Association (ASIA) Impairment Scale (AIS) grade of A through D and also Nurick's grade was noted. MRI reports were noted for confirmation of the level of injury, and to look for associated fractures, disc herniation, cord contusion, the status of posterior longitudinal ligaments and ligamentum flavum. The data was collected from patients' clinical records obtained from MRD. Follow up was done on an OPD basis or telephonically.

Inclusion Criteria

1. Spinal injuries from C3-C7 managed surgically.
2. Spinal cord compression confirmed by MRI.

Exclusion Criteria

1. Patients having any associated brain, cranio-vertebral junction, thoraco lumbar injury.
2. Patients below 15 years of age.
3. Patients having hemodynamic instability (systolic bp < 85 mm hg, pulse < 40/min)
4. Associated abdominal, thoracic and grievous limb injuries.
5. Pregnant women.

Preoperative neurological status including power, sensory examination, deep tendon reflexes, bowel or bladder incontinence and tone in limbs were noted from records.

The operative decision was made as per MRI findings, level of compression and presence of any locked facets. Patients having single level disc herniation were operated using anterior approach and fixation was done with interbody fusion cage, patients who had either fracture of the vertebral body or had compression of two adjacent levels were treated by an anterior approach using cage, plate and screws fixation. The patients having more

than two levels of compression were treated by posterior decompression and fixation with lateral mass & screws.

Neurological improvement and complications at 1 week up to discharge were assessed from the available records. CT and MRI cervical spine was performed to rule out hematoma, implant dislodgement or any other pathology if any deterioration in clinical condition was found. Follow up data regarding the same was obtained telephonically (6 patients) or on an OPD basis (25 patients).

An increase in more than or equal to one grade in ASIA or Nurick's grade was considered an improvement.

Operative procedure:

Anterior Approach

The patient's head can be placed in a horseshoe headrest. Alternatively, Gardner-Wells tongs or an occipitontal traction device can be used. Anterior Cervical Discectomy or corpectomy with discectomy is done for decompression. In cases of single-level discectomy, interbody fusion cage is applied for fixation and patients having two adjacent level disc or fractured vertebral body, corpectomy was done and fixation was done using corpectomy cage, plate and screws. For fusion, bone of removed vertebral body or bone acquired through the undermining of edges was used to fill implant material.

Posterior Approach

Lateral mass screws: Generally applicable to C3–6. The lateral masses of the thoracic spine are usually too small and not strong enough for these screws. C7 is a transitional level, and lateral mass screws may sometimes be used. Occasionally even T1 may be amenable. Technique: Several methods have been promulgated with various screw entry points and trajectories. Comparing 3 techniques, there was a lower risk of nerve injury

Statistical Analysis

The results are presented in frequencies, percentages and mean \pm SD. The categorical variables were compared by using the Chi-square test. The p-value < 0.05 was considered significant. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).

RESULTS

In traumatic cervical spine patients managed surgically, mean age was found to be 40.03 \pm 11.12 with maximum patients between 41-50 years of age. In our study, there were 90.3% males and 9.7% females which showed clear predominance in male patients.

The average time duration between injury and surgery was 8.87 \pm 5.18 days. Majority of the patients had road traffic accident as cause (58.1%) while second most common cause was fall from height

(38.7%), 1 patient (3.2%) had history assault with sticks on presentation.

In this study, majority of patients presented with quadriplegia (83.9%), other presentations included isolated upper limb weakness (12.9%), single patient with quadriplegia (3.2%)

In comorbidities, 6 patients (19.4%) patients had hypertension, 2 patients(6.5%) had diabetes and 1 patient (3.2%) had both diabetes and hypertension.

Majority of the patients 17(54.8%) had no increase in tone, probably as they presented in the early days of injury, 8 patients 25.8%) had slight increase in the muscle tone and 6 patients (19.4%) had marked increase in the muscle tone.

On grading power as per the MRC grading the upper limb power was grade 0= 2 (6.5%) , grade 1= 2(6.5%) , grade 2= 7(22.6%) , grade 3=10 (32.3%) ,grade 4=7 (22.6%) and grade 5= 3 (9.7%) , and the power in lower limb was grade 0= 10(32.3%), grade 1=4(12.9%) , grade 2= 1(3.2%) , grade 3= 8(25.8%) ,grade 4= 6(19.4%) and grade 5= 2 (6.5%).

Out of 31 patients 15 (48.4%) had reduced pain and temperature sensation and 14(45.2%) patients had reduced touch sensations

Out of 31 patients, 14 patients (45.2%) had altered, either decreased/impaired sensation or hypersensitivity i.e. sensory grading of 1 and 17 patients (54.8%) had normal sensations in upper limb. However in lower limb 1 patient (3.2%) had absent sensations (grade 0), 15 patients (48.4) had altered, either decreased/impaired sensation or hypersensitivity (grade 1) and 15 patients (48.4) had normal sensations.

There were 11 patients (35.5%) with normal deep tendon reflexes and 20 patients (64.5%) with

decreased deep tendon reflexes in upper limb. In lower limb 7 patients (22.6%) with increased deep tendon reflexes, 8 patients (25.8%) had reduced DTR and 16 patients (51.6%) had normal deep tendon reflexes. The superficial reflexes were absent in 16 patients (51.6%) and it was present in (48.4%) of patients.

There were 5 patients with fracture of vertebral body, maximum was fracture of C7 (n=3, 9.7%), 1 patient of C4 fracture (3.2%), 1 of C5 (3.2%). Majority of the patients had no fracture.

Patients found to have cord contusion in single were most common (n=17 54.8%), 6 patients (19.4%) had cord contusion of 2 levels and 4(12.9%) had contusion up to 3 levels. 4 patients (12.9%) had no contusion at any level.

In 31 operated traumatic cervical spine injury patients 15 patients (48.4%) had no disc, 11 patients (35.5%) had compression due to disc in single level and 5 patients (16.1%) had multiple level compression due to disc.

Out of 31 patients 22 patients (71.0%) received instrumentation Cage, plate, screws, in 7 patients (22.6%) interbody fusion cage was used and 2 patients (6.5%) had lateral mass screws.

Most of the patients were operated through anterior approach (93.5%) including procedures like anterior cervical discectomy and fusion using interbody fusion cage and corpectomy and fusion using cage, plate and screws. 6.5% of the patients were operated through posterior approach as they had more than two levels of compression and fixation was done with lateral mass screws

Table 1: Distribution of patients according to Impairment grading (pre-operative)

Impairment grading	No.(n=31)	%
AIS		
A	1	3.2
B	3	9.7
C	17	54.8
D	10	32.3
Nurick's		
1	2	6.5
2	1	3.2
3	3	9.7
4	9	29.0
5	16	51.6

Most of the patients in the study presented with ASIA IMPARMENT SCALE grade C (54.8%). Grade D AIS patient were second most common (32.3%).

On recording their Nurick's grade most patients were of nurick's grade 5 (51.6%) i.e. either they were chair bound or bedridden. There were 2 patients (6.1%) of grade 1, 1 (3.2%) of grade 2, 3 (9.7%) of grade 3 and 9 patients (29%) of grade 4.

Table 2: Distribution of patients according to Impairment grading-AIS

Impairment grading-AIS	Pre		1 week		1 month		6 months	
	No.	%	No.	%	No.	%	No.	%
A	1	3.2	1	3.2	1	3.2	1	3.2
B	3	9.7	3	9.7	3	9.7	3	9.7
C	17	54.8	17	54.8	11	35.5	10	32.3
D	10	32.3	10	32.3	14	45.2	7	22.6
E	0	0.0	0	0.0	2	6.5	10	32.3

Improvement in ASIA grade was tracked down for 1 week, 1 month and 6 months. Single patient (3.2%) in grade A, AIS grade B (n=3, 9.7%) showed no improvement. Number in patients with AIS grade C showed decline in number from 17 (54.8%) to 10 (32.3%). AIS grade D patients increase in number from 10 (32.3%) to 14 (45.2%) in 1 month but the number decreased in 6 months as they improved to grade E. There were no grade E patients at the beginning, but at 1 month there were 2 patients (6.5%) and 10 patients (32.3%) at the end of 6 months.

Table 3: Distribution of patients according to Impairment grading-Nurick

Impairment grading-Nurick	Pre		1 week		1 month		6 months	
	No.	%	No.	%	No.	%	No.	%
0	0	0.0	0	0.0	2	6.5	4	12.9
1	2	6.5	2	6.5	1	3.2	2	6.5
2	1	3.2	2	6.5	2	6.5	6	19.4
3	3	9.7	2	6.5	6	19.4	5	16.1
4	9	29.0	9	29.0	9	29.0	3	9.7
5	16	51.6	16	51.6	11	35.5	11	35.5

Improvement was noted in Nurick's grade of patients over 6 months where at presentation there were no patients in grade 0 (i.e. no walking difficulty or cord signs). There were 2 patients (6.5%) with grade 1, 1 patient (3.2%) with grade 2, 3 patients (9.7%) with grade 3, 9 patients (29%) grade 4 and 16 patients (51.6%) who were either chair bound or bedbound with Nurick's grade 5. At 6 months there were 4 patients (12.9%) without any walking difficulty (grade 0), 2 patients (6.5%) with grade 1, 6 patients (19.4%) grade 2, 5 patients (19.4%) with grade 3, 3 patients (9.7%) with grade 4, and number of chair bound or bedridden i.e. grade 5 patients decreased to 11 (35.5%)

Out of 31 patients, 17 patients (54.8%) had abnormality in bladder and bowel control which

improved in 6 patients post operatively and at the end of 6 months there were only 11 patients (35.5%) patients who had abnormal bladder and bowel control.

Improvement in tone of limb was noted (grade 0 being normal), there were 17 patients (54.8%) with normal tone i.e. grade 0 and after 6 months it was 74.2% (n=23). Increase in tone was also noted to grade 3 in 1 patient and grade 4 in 1 patient which could be due presence of cord contusion.

Improvement in sensory grade of upper limb in patients undergoing surgery, the sensation was impaired in 15 (48.4%) of the patients at presentation, which improved in 5 patients (16.1%) and patients (32.3%) patients had impaired sensation at 6 months post-operatively.

Table 4: Distribution of patients according to improvement/changes in sensory grading U/L

	No.(n=31)	%
At presentation		
1	15	48.4
2	16	51.6
1 WEEK		
1	13	41.9
2	18	58.1
1 MONTH		
1	10	32.3
2	21	67.7
6 MONTHS		
1	10	32.3
2	21	67.7

Change in sensory grade was noted in lower limb in which 1 patient (3.2%) had absent sensations, 15 patients (48.4%) had impaired sensations. Improvement was seen in 1 month which remained same upto 6 months as impaired sensation in 13 (41.9%) and normal sensations in 18 patients (58.1%).

Improvement in power of upper was noted, with 2 (6.5%) grade 0, 1 (3.2) grade 1, 7 patients (22.6%) with grade 2, 10 patients (32.3%) with grade 3, 8 patients (25.8%) with grade 4 and 3 patients (9.7%) with grade 5 power at presentation. After 6 months post-operatively there were 2 patients (6.4%) with grade 0, 1 patient (3.2%) with grade 1, 5 patients (16.1%) with grade 2, 6 patients (19.4%) with grade

3, 10 patients (32.3%) with grade 4 and 7 patients (22.6%) with grade 5 power.

At the starting point of study, only 16 patients (51.6%) patients had normal deep tendon reflexes in lower limb. Improvement in this sign was noted mainly from 1 month (n=24 77.4%) and similar number at the end of 6 months.

DISCUSSION

In the current study, the majority of the patients had road traffic accidents as the cause (58.1%). Fredø HL, et al.^[11] found in their study that 60% of cervical spine trauma patients had motorized vehicle accidents as the mechanism of injury. In addition, in

a recent big series from India by H. S. Chhabra et al.^[12], road traffic accidents were found to be the leading cause of SCI closely followed by falls.

In this study, the majority of patients presented with quadriplegia (83.9%) whereas in a study done by Wills SJ et al.^[13], Quadriplegia was found to be the most common neurological deficit (23.3%).

In this study, there were 5 patients with fracture of the vertebral body, maximum was fracture of C7 (n=3, 9.7%) whereas C2 and C5-7 were the most commonly affected levels in the study done by Hege LinnerudFredø et al.^[11]

The posterior approach, which includes laminectomy, laminoplasty with instrumentation and fusion, or laminoplasty without fusion, can be used in all types of cervical spinal canal stenosis.^[14] In their meta-analysis, Luo et al.^[15] discovered that there is no clear indication for each approach and no difference in late clinical outcomes, despite the anterior approach having better postoperative neurological outcomes. There was no difference in recovery between anterior and posterior surgery in many studies.^[15]

Most of the patients were operated through an anterior approach (93.5%) , 6.5% of the patients were operated through posterior approach. In the study by Ma et al (2015).^[16], surgical methods contained simple anterior approach alone, posterior approach alone, and combined posterior-anterior or anterior-posterior approach.

Most of the patients presented with ASIA IMPAIRMENT SCALE grade C (54.8%). Grade D AIS patients were second most common (32.3%). In the study by Ma et al.^[16], the assessment of their neurological function states showed 6 patients (24%) were in American Spinal Injury Association (ASIA) A grade, 1 (4%) in ASIA B grade, 3 (12%) in ASIA C grade, 12 (48%) in ASIA D grade, and 3 (12%) in ASIA E grade.

Single patient (3.2%) in grade A, AIS grade B (n=3, 9.7%) showed no improvement. The number of patients with AIS grade C showed a decline in number from 17 (54.8%) to 10 (32.3%). AIS grade D patients increase in number from 10 (32.3%) to 14 (45.2%) in 1 month but the number decreased in 6 months as they improved to grade E. Sekhar and Srinivas et al.^[17] reported that no improvement was noted in patients with ASIA grade A. Srinivas et al.^[18] observed that no improvement was noted in patients with ASIA Grade A. Maximum improvement was noted in the ASIA Grade D group (83.3%).

Overall 29% of the patients had improvement in the power of the lower limb. Lal Rehman et al. found improvement of power in 42% of patients.^[19]

CONCLUSION

ASIA IMPARMENT SCALE grade C was the commonest finding followed by Grade D. After surgery about half of patients improved (48.4%)

when graded according to ASIA and Nurick's grading. Clinical symptom which improved in most was motor power, followed by deep tendon reflexes, bladder & bowel function, tone of limbs and least improvement in sensory function. Decrement was noted in bulk and tone of few patients.

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