

# The Functional And Neurological Outcome In Cervical Spine Injuries: A Retrospective Review

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## Abstract

**BACKGROUND:** Until recently, vertebral injuries were less commonly in cervical spine than Thoracic and lumbar region. With the decline in accidents from mining and other heavy industry and increase in Road traffic accidents, this incidences has change. At present out of significant spinal injury approx. 50% involves the cervical spine and approx. 40% of them lead to quadriplegia and approx. 10% of traumatic cord injuries have no obvious radiographic evidence of vertebral injury (SCIWORA). Aim of this retrospective case-series with 25 patients was to assess Neurological and functional outcome in Cervical Spine Injuries.

**RESULTS:** There were 10 patients with lower cervical spine fractures (C3-C7), 5 patients with upper cervical fractures, 10 patients had SCIWORA injuries. Initial ASIA scale: A:4, B:3, C:5, D:8 & E:5. 15 patients were treated conservatively with cervical tongs and orthotics. Rest of 10 patients treated operatively with anterior cervical plating. Full neurological recovery in 10 patients and 40% of patients had poor neurological outcome, which is significantly higher.

5 patients (20%) were associated with glutei sores or cranial sores. 3 patients had chest infection due to respiratory pneumonitis, 3 patients had major depression (psychological complication). Operative patients were commonly associated with cardio respiratory compromise most probably due to ascending cord edema, in 24% patients.

**CONCLUSIONS:** To conclude cervical spine injury is continuing to be fatal and paralyzing injury with poor and unpredictable neurological outcome. Final neurological outcome is depends on primary neurological damage. SCIWORA type of cervical spine injury and stable cervical spine fractures associated with good neurological outcome. Poor Neurological Outcome is associated with High velocity trauma and unstable, lower cervical spine bony injury. Functional Outcome mostly depends on final neurological outcome and can be improved with proper rehabilitation programme.

## INTRODUCTION

In general, approximately 2% to 6% of trauma patients sustain a cervical spine fracture. Of those trauma patients sustaining a spinal injury, more than half of the spinal injuries involve the cervical region. Fractures of C6 and C7 account for nearly 40 percent of cervical spine injuries after blunt trauma. 1 Because of differences in spinal canal dimensions and the mechanisms of injury, spinal cord damage is more frequently associated with lower rather than upper cervical spine fractures and dislocations.

Advances in prehospital emergent management and critical care in specialized trauma centers have improved survival from these injuries over the past few decades. In these series, Canadian C-spine rules had laid few criteria for the better approach and to improve management. 2 There were also strict rules regarding radiological clearance as per criteria

given by NEXUS (National Emergency X-ray Utilization study).<sup>3</sup> But the improvement in outcome is not been yet established. The use of steroids also standardized with NASCIS protocol III. High doses are required. Most benefit occurs in the first 8 hours, and additional effect occurs within the first 24 hours.<sup>4</sup> Three large-scale randomized clinical trials have investigated methylprednisolone in the treatment of spinal cord injury.<sup>5,6,7</sup> But steroids did not improve neural recovery in quadriplegics and their use was associated with gastrointestinal hemorrhage.

Cervical spine injuries, classified according to stability, neurological deficit, type of injury –bony or soft tissue injury (SCIWORA).but all these classification, associated with lack of reproducibility. The system of Allen et al <sup>8</sup> is the most frequently cited and used classification for subaxial cervical spine injuries. Despite this, it has not been validated,

retrospectively or prospectively, since its publication in 1982. Intraobserver and interobserver reliability has not been tested and the significance of the injury groups on treatment decision making is not yet clear.

The elements of neurological examination selected as minimum necessary assessment by the ASIA (American spine injury association) were chosen because of their reproducibility.<sup>9</sup> It constitute a minimal data set desirable in all patients with spinal injuries for accurate communication, particularly for clinical research study populations.

Final neurological outcome and ultimate functional outcome, remains the main matter of concern, whatever may be the definitive line of management. This retrospective review examines all cervical spine injuries, treated conservative or operatively, for its final neurological and functional outcome. Outcomes of these patients were compared to standard international series.

### **MATERIAL AND METHODS**

The retrospective study was performed from jan 2006 to july 2009 at orthopedics department,. G.G hospital. Jamnagar, Gujrat, India. There were 5 women and 20 men with a mean age of 61.6 years (19 to 86). Three of the patients sustained their injury following a fall, 20 from a road traffic accident, 1 from direct assault and 1 from industrial accident.

All patients admitted in trauma centre with “? Cervical spine injuries” were subjected to C-SPINE rule for emergency management. Prompt resuscitation given if required, stabilization of the injury with sand-bag, later on with haulter traction for temporary stabilization. Then patients were subjected to radiological clearance according criteria given by NEXUS. Radiological evaluation done with the plain Anteroposterior(AP) and Lateral radiographs of the obtained at the time of injury. CT scan was used in few patients, MRI were taken for all patients. Initial neurological status was assessed with ASIA Score (American Spine Injury Association).

Definitive line of treatment was decided by team of orthopedics surgeon. Conservative line of treatment includes skull traction or cervical orthotics, according to indication. Others were surgically treated according to surgical indications including irreducible and unstable fractures with significant neurological deficit.

Cranial traction was applied pre- and intra-operatively; steroids were administrated preoperatively in some patients.

Open reduction, decompression, and spinal stabilization were performed via anterior approach based on the location of injury. An anterior (left-side Robinson) approach was performed in anterior and middle column injuries with bony and neurological compromise.

Most patients were anatomically reduced using Anterior cervical plates. The intraoperative variables studied from OT records like, operative time, estimated blood loss, no. of units of blood transfused and other complication related to implants. Anesthesia will be decided by consultant anesthetist. The surgeon were well experienced with the approach, implant, and IITV Anteroposterior(AP) and lateral view were adequacy of reduction and location of screws in vertebral body.

Post operatively all patients were shifted to surgical ICU according to protocol for observation for at least for 48 hrs, all patients were given prophylactic preoperative antibiotics and post operative antibiotics(Third generation cephalosporin),for 72 hrs. The incidence of any postoperative complications and hospital stay were recorded.

All patients had a 12-month minimum clinical follow-up, with a average of 15 months. At the most recent follow-up, neurological outcome was evaluated with ASIA score by the treating surgeon and recorded. Patients were evaluated in clinic or contacted by mail or telephone and asked for ultimate function analysis.

### **RESULTS**

In our study, Cervical spine injuries are more commonly associated with young active peoples (<35 yrs: 15, 35-60 yrs: 4,>60 yrs: 6). Mean age is 33.2, which is significantly higher. Males are more common to cervical spine injuries in our study. RTA (80%) are most common mode of injury, presently Industrial accidents are becoming less common. All patients were followed clinically for a minimum of 2 years and average follow-up at final examination was 15 months.

Most of fractures (15 patients: 60%) are stable. Neurological damages are more associated with unstable fractures (10 patients). Most of the injuries are associated with incomplete neurological deficit (16 patients). Lower cervical spines are more vulnerable to injury, associated with 10 patients and 5 patients had upper cervical spine injuries. Rest 10 patients (40%) had SCIWORA (spinal cord injury without obvious radiological abnormality).

**Figure 1**

TABLE: 1. Initial Neurological status

	No. of pts.	%
<b>Initial neurological status</b>		
FND	7	28
Paraplegia	6	24
Quadriplegia	7	28
Normal	5	20
<b>Initial ASIA Scale</b>		
A	4	16
B	3	12
C	5	20
D	8	32
E	5	20

In our study, we used ASIA Score (American spine injury Association) for assessing initial neurological status, and it also becomes the standard baseline measurement for the final assessment of patients after definitive management and during follow-up. In our study there were more than 50% patients associated with motor score less than 50 and sensory score less than 112.

In our study, most of injuries were treated conservatively (15 patients:60%), only the unstable and unreduced fractures(10 patients) were treated operatively. Skull traction (CFT: crutch field tongs) were used for conservative treatment IN 10 patients, Skull traction will accomplish reduction and maintain it in a high proportion of injuries. It is comfortable and greatly facilitates nursing care. Cervical orthotics (Philadelphia collar) was used only in 5 patients, having SCIWORA type of injury with nearly normal neurology.

**Figure 2**

TABLE: 2. Final neurological recovery assessment

	No. of pts	%
Full	10	40
Partial	7	28
None	3	12
Worsening	-	-
Death	5	20
Total	25	100

In our study, Final neurological assessment was based on comparing scores according to ASIA Score assessment, and 60% of the patients had poor neurological outcome which quite noticeable.

**Figure 3**

TABLE: 3. Functional outcome

	No. of pts.	%
Normal	10	40
Able to perform activities with residual weakness	4	16
Crutch walking	3	12
Wheel chair mobilized	2	8
Bed ridden	1	4
Death	5	20
Total	25	100

Patients were evaluated in clinic or contacted by mail or telephone and asked for ultimate function analysis. Functional outcome was assessed with activity level and rehabilitation status of the patient with questionnaire set as for paraplegic patients. More than 50% (56%) of patients were occupationally rehabilitate and rest of them socially rehabilitated with proper rehabilitation programme.

Conservative line of treatment is routinely associated with common complication like decubitus ulcer/pressure sores, in our study 5 patients (20%) were associated with glutei sores or cranial sores. 3 patients had chest infection due to respiratory pneumonitis, 3 patients had major depression (psychological complication). Whereas, operative patients were commonly associated with cardio respiratory compromise most probably due to ascending cord edema, 24% of patients in our study had such complication.

**DISCUSSION**

Cervical spine injuries, primarily occurs in high velocity trauma especially by road traffic accidents in young active males. Amongst them lower cervical spine bony injury specifically more Common. There are plenty of methods described in literature for management of cervical spine fractures.

The majority of cervical spine fractures can be treated nonoperatively. The most common method of nonoperative treatment is immobilization in a cervical orthosis An x-ray study demonstrated that the NecLoc collars better than Miami J and Miami J better than the Philadelphia and Apsen collars.10 Despite these detected x-ray differences, the clinical superiority of one device over another has yet to be demonstrated. Up to 38% of patients had developed skin complications with prolonged use.11

Other nonoperative method is cervical traction. Varying rates of success have been documented with the use of CFT (crutch field tongs) and halo vest fixator for various types of subaxial cervical injuries.12,13,14,15 Despite this, halo vest immobilization remains a viable, minimally invasive method

of stabilization of unstable cervical spine injuries for patients who might otherwise have contraindications to open surgical methods. Halo fixators are the best nonoperative method amongst the available. 16 various complications have been reported with use of the traction devices. Pin site infection can occur in 6% to 20% of cases .17,18 Pressure sores can develop in 4% to 11% of patients. 19

The optimal time to perform surgery, particularly in patients with neurological deficits, still remains unclear. In the only randomized, prospective, controlled trial found in the literature, surgery performed for cervical spinal cord injuries less than 72 hours versus more than 5 days from the injury demonstrated no significant difference in motor scores at final follow-up.20 Supportively, other nonrandomized prospective studies have demonstrated that surgery performed within 8 hours or within 24 hours from injury did not result in a better neurologic outcomes.21,22

Moerman et al 23 reviewed their results with one- or two-level fusions stabilized with an anterior cervical plate in 22 patients with lower cervical fractures or dislocations. At 1-year follow-up, solid fusion was documented in all cases with acceptable alignment. Garvey et al 24 found equally good results in 14 patients treated with anterior Cervical plate fixation and fusion for subaxial cervical fractures and dislocations. At an average follow-up of 30 months, no cases of fixation failure had been observed. Goffin et al 25 reported 5- to 9-year follow-up results in 25 patients treated with anterior fusion and plating for cervical fractures and dislocations. Fusion was demonstrated in all cases by 1 year; plate fracture occurred in one case. Laus et al 26 treated 32 lower cervical fractures or dislocations with anterior surgery. Fusion was achieved in all patients by an average of 4.5 months. Neurologic recovery of one to three Frankel grades was observed in the 14 patients with an incomplete spinal cord injury and no change in those with complete spinal cord injury or no neurologic deficit. Randle et al 27 also documented their results with the Cervical plate with traumatic cervical injuries; all patients achieved solid fusion by 6 months follow-up.

Brodke et al 28 compared anterior and posterior surgery for unstable cervical spine fractures with spinal cord injury. Neurologic recovery was comparable in both groups. A 90% fusion rate was achieved with anterior surgery, and 100% percent with posterior fusion; there were no differences in complaints of pain or maintenance of alignment.

I have compared my observation with some of standard well

recognized international studies.

J.Baldauf et al 29 Griesfswald University,Germany. Retrospective study of 26 patients of cervical spine injuries treated in their institute during year 1993-2006

Graham Nelson and Nkosama et al 30 Department of orthopaedics surgery, University of Pretoria, South Africa. Retrospective study of 17 patients of cervical spine injury treated in their hospital for 3 years.

Mean average age in our study is 33.2(22-65 years), which is comparable to Graham’s series and Baldauf’s series. Male to female ratio of my series (M:F=6.9:1) is comparable to both the series. RTA is major mode of injury (67%) in our study which is again comparable to both series.

60% fractures are stable in our study, 60% of all injury are belongs to lower cervical spine, SCIWORA type of cervical spine injury is around 33 % , 67% of patients had complete neurological deficit, which is comparable to both series. In our study, unstable fractures and lower cervical spine, are associated with poor neurological outcome, again to both series.

15 patients out of 25 patients had significant neurological deficit, 7 patients had paraplegia and 2 patients had quadriplegia. On comparison, Final neurological outcome to primary neurological damage, Poor neurological outcome correlated with initial neurological status in my studies, in spite of different line of treatment.

**COMPARISION OF FINAL RESULTS**

**Figure 4**

	<b>Our study</b>	<b>Baldauf's series</b>	<b>Graham's series</b>
<b>Full</b>	40%	38%	71%
<b>Partial</b>	30%	27%	6%
<b>None</b>	13%	23%	23%
<b>Worsening</b>	-	-	-
<b>Death</b>	27%	12%	-

I have compared my final neurological outcome with mode of injury,initial neurological status, type of neurological injury, stability of fracture and definitive management.

Results Vs mechanism of injury

**Figure 5**

Final neurological status	RTA	Fall	Industry	Assaulted	Total
Full	10	-	-	-	10
Partial	5	-	1	1	7
None	2	1	-	-	3
Death	3	2	-	-	5
Total	20	3	1	1	25

Results Vs Initial neurological status

**Figure 6**

Final neurological status	FND	Paraplegia	Quadriplegia	Normal	Total
Full	3	1	1	5	10
Partial	2	2	3	-	7
None	2	-	1	-	3
Death	-	3	2	-	5
Total	7	6	7	5	25

Results Vs Type of injury

**Figure 7**

Final neurological status	SCIWORA injury	Upper cervical spine injury	Lower cervical spine injury	Total
Full	8	1	1	10
Partial	1	2	4	7
None	-	1	2	3
Death	1	1	3	5
Total	10	5	10	25

Results Vs stability of fractures

**Figure 8**

Final neurological status	Stable fractures	Unstable fractures	Total
Full	8	2	10
Partial	5	2	7
None	2	1	3
Death	1	4	5
Total	15	10	25

Results Vs definitive management

**Figure 9**

Final neurological status	Conservative	Operative	Total
Full	7	3	10
Partial	4	3	7
None	3	-	3
Death	1	4	5
Total	15	10	25

Results Vs Initial ASIA Scale

**Figure 10**

Final neurological status	A	B	C	D	E	Total
Full	-	-	-	-	-	10
Partial	-	1	1	-	-	7
None	1	-	-	-	-	3
Death	2	-	-	-	-	5
Total	4	3	5	8	5	25

One major limitation of our study is small sample size. In spite of that fact from above comparison we can able to conclude few things. Road traffic accident remains major mode of trauma, but it does not have impact on final neurological status. SCIWORA type of injury and stable fractures are associated with good neurological recovery. Initial neurological status is consistently comparable with final neurological status. Operative patients are associated with higher mortality rate, but again it may be associated with primary level of surgical ICU setup at our institute.

In spite of the fact that more than 40% had poor neurological outcome, about 56% of the patients had neurological deficit initially were associated with good functional outcome ultimately. They were all occupationally rehabilitate and rest of them socially rehabilitated with good quality rehabilitation programme. So, functional outcome does depends on neurological outcome but can be improved with good rehabilitation programme.

**CONCLUSION**

To conclude cervical spine injury is continuing to be fatal and paralyzing injury with poor and unpredictable neurological outcome. Results can be improved with proper clinical approach and aggressive rehabilitation programme.

1. Final neurological outcome is depends on primary neurological damage
2. SCIWORA type of cervical spine injury and stable cervical spine fractures associated with good neurological outcome.
3. Poor Neurological Outcome is associated with High velocity trauma and unstable, lower cervical spine bony injury.
4. Functional Outcome mostly depends on final neurological outcome and can be improved with proper rehabilitation programme.

In addition to above conclusion, we draw out few preferences for better management of cervical spine injuries,

from our study.

- a. For the dangerous period between the time of injury and definitive treatment, and while being moved about during definitive treatment, the patient should be recumbent, at all times, on a firm stretcher or bed. An adjustable traction neck brace should be worn during these times, applied in the long axis of the spine in the neutral position.
- b. Skull traction is the best proved means of protecting the cord during definitive treatment of cervical-spine injuries.
- c. Skull traction will accomplish reduction and maintain it in a high proportion of injuries. It is comfortable and greatly facilitates nursing care.
- d. Complete reduction is ideal; satisfactory reductions may include those in which there is less than 0.3 centimeter of decrease in the anteroposterior diameter of the vertebral canal.
- e. Internal fixation and surgical fusion provide reliable stabilization of the injured vertebrae. They appear to protect the cord against attrition in patients with a vertebral canal diameter of less than normal.
- f. The treatment of cervical-spine injuries is highly specialized; technical errors in its treatment may be fatal. A trained and experienced operating team is essential.

As with most of spine surgery, controversy remains about various aspects of treatment of lower cervical spine injuries. Likewise, controversy about the optimal surgical treatment of these injuries will continue, because many still feel that anterior surgery alone is doomed to fail. This controversy represents, in our opinion, because of the lack of understanding of the natural history of such injuries and usable, reproducible, and reliable injury description system, upon which a prognostic and treatment-influencing classification system can be built. Further study requires in such fields along with advances in better stabilization methods, whether they be minimally invasive or motion sparing for better management of cervical spine injuries.

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