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Analysis Of Functional Outcome Following Surgical Fixation For Sub Axial Cervical Spine Injuries

Dr.A.T.Mithun athiraj[1], Dr.Yeshwanth Subash[2*]
[1]Department of orthopaedics,Saveetha medical college and hospital,Saveetha institute of medical and technical science, Kanchipuram district, Tamil nadu, India
[2*]Department of orthopaedics,Saveetha medical college and hospital,Saveetha institute of medical and technical science, Kanchipuram district, Tamil nadu, India
: mithunathiraj@gmail.com[1], djyesh@rediffmail.com[2*]
*Corresponding author:
D.N.B (ORTHO),M.N.A.M.S
Professor, Department of Orthopaedics
Saveetha Medical College and Hospital,
Saveetha Institute of Medical and Technical Sciences,
Kancheepuram District,
Tamil Nadu, India
djyesh@rediffmail.com

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ABSTRACT
*Sub axial cervical spine fractures represent a significant challenge in orthopaedic and neurosurgical practice, often necessitating surgical intervention to restore stability and prevent neurological compromise. This abstract presents an outcome analysis of surgical fixation for sub-axial cervical spine fractures, focusing on the efficacy, complications, and functional outcomes associated with various surgical approaches. Using a thorough analysis of the literature and prospective analysis of clinical data, we evaluate the results of anterior, posterior as well as combined surgical methods for sub-axial cervical spine fractures. Key considerations include fracture characteristics, neurological status, patient demographics, and surgeon expertise. **A** prospective study of 15 patients with sub-axial cervical spine fractures managed surgically was conducted between March 2022 to Feb 2023 with a follow-up period of 1 year. There were 15 patients of which 10 were males and 5 were females. The most affected vertebra was C4-C5 in 6 patients. The patients had a mean age of 41.4 and varied in age from 27 to 59. The average SLIC score was 6.2 post-operatively. 1 patient died 1 month after the procedure due to. All other patients were happy with the procedure and outcome. This study therefore recommends, to achieve good results and minimize complications, early surgical stabilization of sub-axial injuries to the cervical spine had good functional results, and provided comprehensive clinical as well as radiological assessment, appropriate preoperative planning, surgical approach selection, precision in surgical techniques, and early rehabilitation program.*

KEYWORD: *sub axialcervical spine, fracture, decompression & fusion.*

INTRODUCTION:

Following trauma, dislocations,and fractures of the cervical spine are common. 1.5% to 3.5% of people who have experienced severe trauma reportedly encounter them. Cervical spine injuries are mostly caused by automobile accidents, with gunshot wounds, sports injuries, and diving into shallow water following closely behind.Traumatic cervical instability typically affects the C3–C7 range (i.e.sub axial).Deficits in the nervous system are widespread; examples include cord and root compression, subluxation, and dislocation[1]. Neurologic damage occurs in 40% of patients with fractures of the cervical spine. Dislocations of the upper cervical spine are more commonly

associated with spinal cord injuries. Cervical spine fractures are serious injuries that require immediate medical attention. The nature of the fracture and the patient's overall health will dictate the rehabilitation plan. The choice to proceed with surgical fixation when the fracture is considered serious, unstable, or may jeopardize the spinal cord's integrity. In order to stabilize subaxial cervical spine injuries and relieve persistent compression, early surgical intervention is required, as well as to maintain the cervical spine's stable architecture[2,3]. The main goals of surgical fixing are to relieve pain, stop future neurologic deterioration, and restore spinal stability. When surgical stabilization for cervical spine injuries was introduced, orthopedic therapy made great progress. It offers patients a complete answer to deal with the challenges brought on by serious neck injuries. It is a tailored response to fractures that may not respond to standard conservative treatment. Even as technology and surgical techniques continue to develop, the surgical stabilization of injuries tothe cervical spine is a testament to the commitment to improving patient outcomes and regaining functional integrity in the intricate field of spinal care [4-6].

MATERIALS AND METHOD:

Prospective research of 15 patients was presented to the emergency department at “SaveethaMedical College with sub axial cervical spine fracture.

Inclusion criteria:

- Traumatic Disc Prolapse impinging the Cord involving C3 Cervical Level to C7 Cervical Spinal Level (Lower Cervical Spine).
- Cervical spine injury with instability involving C3 Cervical Level to C7 Cervical Spinal Level (Lower Cervical Spine).
- All Patients with cord damage whether Complete or Incomplete cord lesions.
- 18 – 65 Years of both sexes

Exclusion criteria:

- Thoracolumbar spinal injuries
- Previous cervical spine injuries
- Multiple injuries that influence the function
- Medical co-morbidities eg: Malignancy, severe liver disease, Organic” brain disease

Patients were initially managed to secure their airway, breathing, and circulation following which cervical collar immobilization was done. Neurological status was assessed using the ASIA motor score.If the injury is less than eight hours old, use methylprednisolone succinate. The dosage was 30 mg/kg for the first 15 minutes, and then 5.4 mg/kg/hr IV infusion for the remaining 23 hours. Appropriate CT scans, X-rays, and MRI were done after the stabilisation of the patient. Cervical injuries were classified using Allen Ferguson classification. Surgery was scheduled after a patient's evaluation.

Data Collection:

1. Patient demographics including age, gender, mechanism of injury, and comorbidities were recorded.
2. Fracture characteristics such as level of fracture (C1, C2, C3, etc.), fracture type (e.g., odontoid fracture, vertebral body fracture), and degree of displacement were documented.
3. Treatment modalities including conservative management, and surgical fixation (e.g., anterior cervical discectomy as well as fusion, posterior cervical fusion), along with complications were noted.
4. Postoperative complications such as infection, neurological deficits, hardware failure, nonunion, and malunion were recorded.
5. Functional outcomes were assessed using validated scoring systems such as the VAS (Visual Analog Scale) &NDI (Neck Disability Index) for the pain.

Radiographic Evaluation:

1. Preoperative as well as postoperative radiographs, MRI (Magnetic Resonance Imaging), and CT (Computed Tomography) scans have been reviewed to assess fracture patterns, displacement, alignment, and the presence of associated injuries (e.g., spinal cord compression).
2. Radiographic parameters including cervical alignment, fusion status, and presence of hardware-related

complications were measured and compared between preoperative and postoperative images.

Statistical Analysis:
1. Descriptive statistics were used to summarize patient demographics, fracture characteristics, treatment modalities, and outcomes.
2. Comparative analysis between treatment groups (conservative vs. surgical) was conducted utilizingproper statistical tests such as the Chi-square test for categorical variables.
3.p-value of less than 0.05 is found to be satisfactory.

Surgical Technique for Cervical Spine Fracture Fixation:

Preoperative Preparation:
1. Confirm patient identity, surgical site, and consent.
2. Position the patient supine on a radiolucent table, with the head secured in a Mayfield or Gardner-Wells traction device.
3. Administer general anesthesia and neuromonitoring as appropriate.
4. Drape and prep the surgical site in a sterile fashion, ensuring retrievalof the entire cervical spine.

Exposure:
1. A standard midline incision is made over the affected cervical levels, typically from the occiput's base to the desired level.
2. The subcutaneous tissue is dissected, and the paraspinal muscles are gently retracted laterally to expose the spinous processes and laminae.

Decompression (if needed):
1. If there is evidence of spinal cord compression or neurologic deficits, laminectomy or laminoplasty may be performed to decompress the neural elements.
2. Use high-speed drills and Kerrison rongeurs to remove the laminae and open the spinal canal.

Reduction and Fixation:
1. Confirm the level of the fracture using fluoroscopy.
2. Reduce the fracture by applying longitudinal traction and gentle manipulation of the cervical spine.
3. Select the appropriate instrumentation for stabilization, which may include:
- Anterior cervical plate fixation: A small anterior incision is made, and a cervical plate is secured to the vertebral bodies using screws.
- Posterior instrumentation: Pedicle screws, lateral mass screws, or hooks are placed bilaterally using fluoroscopic guidance.
4. Rods or plates are then connected to the screws or hooks to provide stability.
5. Interspinous or interfacet spacers may be used to restore vertebral height and alignment.
6. Bone graft or bone graft substitutes might be packed into the decorticated bone surfaces that promote fusion.

Closure:
1. Irrigate the surgical site with a saline solution to remove debris.
2. Close the deep tissues meticulously to prevent hematoma formation and infection.
3. Close the subcutaneous tissue and skin with absorbable sutures or staples.
4. Apply a sterile dressing over the incision site.
Postoperative Care:
1. Transfer the patient to the recovery room for close monitoring of neurologic status and vital signs.
2. Initiate early mobilization and physical therapy to prevent complications such as stiffness and muscle atrophy.
3. Provide prophylactic antibiotics and anticoagulation as per institutional protocol.

4. Arrange for appropriate follow-up imaging and clinical assessments to monitor fusion and hardware integrity.

This surgical technique provides a general overview of the steps involved in cervical spine fracture fixation. Surgeons may modify the approach and technique based on individual patient factors, fracture characteristics, and their own experience and preference. Close attention to detail and careful execution of each step are crucial to achieve optimal outcomes for patients undergoing this procedure.

RESULTS:

15 patients withsub axial cervical spine fractures managed surgically were studied between April 2022 to May 2023 in our study. Ten men and five women participated in our study.The patients' average age group was 41.4yrs with a range of 27 to 59. Eight patients had injuries from traffic accidents, while seven patients had injuries from falls from a height.The most affected site was the C4-C5 vertebra in 6 patients, the C5-C6 vertebra in 4 patients, and C6-C7 in 5 patients. The mean SLIC score was 6.2 ranging from 5 to 8. The mean neck disability index pre procedure and post procedure was 26.8 and 13.5 respectively. The mean visual analogue score post procedure was 2.2. All patients were managed by decompression and fusion at the affected level. One patient experienced an infection that cleared up after receiving antibiotics and 1 patient died 1 month after the surgery due to acute respiratory distress syndrome. There were no patients lost to follow-up.

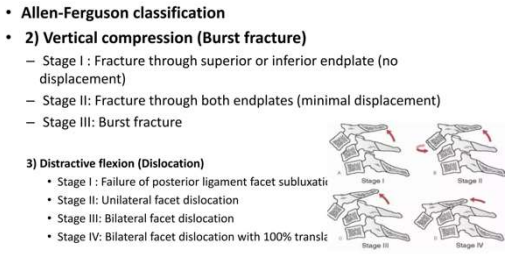

FIG-1: ALLEN FERGUSON CLASSIFICATION SYSTEM

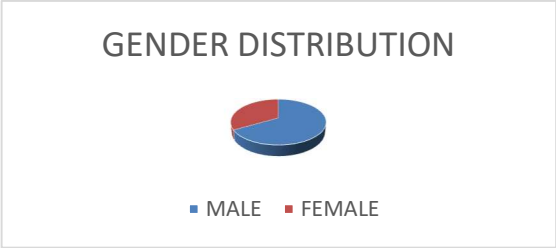

FIG-2: GENDER DISTRIBUTION

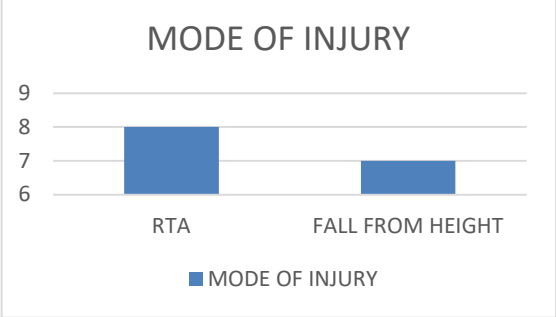

FIG-3: MODE OF INJURY

DISCUSSION:

As sub-axial cervical spine fractures can result in spinal instability, neurological impairment, and permanent disability, they provide a serious challenge to orthopedic and neurosurgical practices. Recent developments in surgical fixation methods for sub-axial cervical spine fractures are the main topic of discussion here, with an emphasis on treatment outcomes and factors to consider. Restoring spine alignment, protecting neurological function, and averting long-term consequences like deformity and instability are among the objectives of surgical intervention [7,8]. Conventional methods include posterior fixation with lateral mass screws or pedicle screws and anterior cervical fusion and discectomy continue to be cornerstones of care [9]. Still, there are other ways to achieve stable fixation with motion preservation and less adjacent segment degeneration, such as anterior cervical corpectomy as well as fusion, which are more recent methods [10,11]. Based on fracture morphology, patient anatomy, and surgical objectives, biomechanical testing offers important insights into the stability, load-sharing properties, and failure modes of various implant configurations. These insights help identify the best fixation solutions [12]. Optimizing outcomes for sub-axial cervical spine fractures requires customizing treatment algorithms based on unique patient features and fracture characteristics. Treatment choices are influenced by the patient's age, bone quality, neurological condition, and any related traumas. Older patients and those with several comorbidities typically benefit from less intrusive procedures to reduce perioperative risks. Like our study's 35% of patients, Zubia et al.'s series of 214 patients from 2003 to 2007 revealed 31percent of patients having injuries to the cervical spine, with C5–C6 being the most common level [13]. Among the 273 patients in their series with full cord damage, Ducker et al. found 34% death at the one-year mark; this figure is higher when compared to our study's 25% [14].Paramore et al. found a correlation between instrumentation issues and plate length, reporting hardware failure in 22% of patients. However, there were no plating-related problems in our trial, such as implant failure or screw pull-out [15].

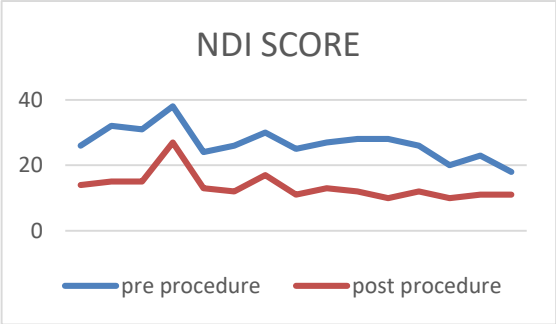

FIG:4- NECK DISABILITY INDEX SCORE PLOT

CONCLUSION:

In conclusion, one of the most important components of orthopedic and neurosurgery care for sub-axial cervical spine fractures is surgical fixation, which aims to restore spinal stability, avoid neurological impairments, and promote early mobilization. This article has emphasized the significance of careful patient selection, meticulous surgical technique, and appropriate implant selection in achieving favorable outcomes for patients with sub-axial fractures of the cervical spine through a thorough literature review and analysis of clinical data. The surgical stabilization of sub-axial cervical spine fractures can result in complications such as degeneration of the surrounding segment, hardware failure, and neurological impairment. To reduce problems and maximize functional outcomes, careful postoperative monitoring and adherence to rehabilitation guidelines are crucial. After surgical surgery, we were able to achieve a good functional outcome in our study. In summary, the functional outcome of early surgical stabilization of sub-axial injuries to the cervical spine was good. However, to achieve good results and minimize complications, it is necessary to provide detailed clinical as well as radiological assessment, proper preoperative planning, surgical approach selection, precision in surgical techniques, and an

early rehabilitation program.

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S.NO	AGE	SEX	MODE OF INJURY	DIAGNOSIS	ALLEN FERGUSON CLASSIFICATION	SLIC	PROCEDURE DONE	NDI SCORE(PRE PROCEDURE)	NDI SCORE(POST PROCEDURE)	VAS(POST PROC)	COMPLICATION
1	29	M	FALL FROM HEIGHT	C4-C5 FRACTURE DISLOCATION	II	6	C4-C5 ANT CERVICAL DECOMPRESSION & FUSION	26	14	3	
2	35	M	RTA	C5-C6 FRACTURE DISLOCATION	II	6	C5-C6 ANT CERVICAL DECOMPRESSION & FUSION	32	15	2	
3	44	M	FALL FROM HEIGHT	C6-C7 FRACTURE DISLOCATION	II	7	C6-C7 ANT CERVICAL DECOMPRESSION & FUSION	31	15	3	
4	29	M	FALL FROM HEIGHT	C4-C5 FRACTURE DISLOCATION	III	5	C4-C5 ANT CERVICAL DECOMPRESSION & FUSION	38	27	2	DIED AFTER 1 MONTH
5	52	M	RTA	C6-C7 FRACTURE DISLOCATION	II	8	C6-C7 ANT CERVICAL DECOMPRESSION & FUSION	24	13	2	
6	38	F	FALL FROM HEIGHT	C4-C5 FRACTURE SUBLUXATION	III	5	C4-C5 ANT CERVICAL DECOMPRESSION & FUSION	26	12	3	
7	51	M	FALL FROM HEIGHT	C5-C6 SUBLUXATION WITH DISC PROLAPSE	III	6	C5-C6 ANT CERVICAL DECOMPRESSION & FUSION	30	17	3	
8	41	M	RTA	C4-C5 FRACTURE DISLOCATION	II	5	C4-C5 ANT CERVICAL DECOMPRESSION & FUSION	25	11	2	
9	27	F	RTA	C5-C6 FRACTURE SUBLUXATION	III	7	C5-C6 ANT CERVICAL DECOMPRESSION & FUSION	27	13	1	SUPERFICIAL INFECTION
10	36	F	FALL FROM HEIGHT	C6-C7 FRACTURE DISLOCATION	II	7	C6-C7 ANT CERVICAL DECOMPRESSION & FUSION	28	12	2	
11	40	M	RTA	C4-C5 FRACTURE DISLOCATION	III	8	C4-C5 ANT CERVICAL DECOMPRESSION & FUSION	28	10	3	
12	54	M	RTA	C6-C7 FRACTURE DISLOCATION	II	5	C6-C7 ANT CERVICAL DECOMPRESSION & FUSION	26	12	2	
13	57	F	FALL FROM HEIGHT	C5-C6 SUBLUXATION WITH DISC PROLAPSE	II	6	C5-C6 ANT CERVICAL DECOMPRESSION & FUSION	20	10	1	
14	30	M	RTA	C5-C6 FRACTURE DISLOCATION	III	5	C5-C6 ANT CERVICAL DECOMPRESSION & FUSION	23	11	3	
15	59	F	RTA	C4-C5 FRACTURE DISLOCATION	III	8	C4-C5 ANT CERVICAL DECOMPRESSION & FUSION	18	11	2	