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Neurosurgical Outcome of Combined Anterior-Posterior Approaches for Sub-Axial Cervical Spine Injury: A Retrospective Analysis

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Abstract

Background: Acute subaxial cervical spine injuries following trauma remain a common problem. These injuries are often associated with neurological deficits on presentation.

Individual subaxial cervical spine injuries represent a wide spectrum of damage to the anatomic structures of the neck, including fractures, ligamentous injury, and disk disruption, often with injury to the cervical spinal cord and nerve roots.

Several authors have reported series of patients treated with a combination of anterior and posterior decompression, but they did not differentiate outcomes between the anterior standalone and anterior and posterior techniques.

Aim of Study: The aim of the study to present clinical and radiological outcomes of patients who were operated by combined anterior-posterior approach for unstable subaxial cervical spine injury.

Patients and Methods: The study included the 40 patients admitted to emergency unit of Neurosurgery Department at Cairo University from 2016 to 2018 and operated with this procedure.

Results: Improvement of the neurological state occurred only in 15 patients with percentage of 37.5%. Other 25 patients showed no improvement with percentage of 62.5%.

Conclusion: Circumferential stabilization and fusion in unstable subaxial cervical spine fractures gives an opportunity for the complete posterior and anterior de-compression of the cervical cord providing good results in alignment, fusion, and neurological recovery, we could not find any absolute contraindication for a combined approach in our study.

Key Words: *Subaxial cervical spine trauma – Fracture – Ligamentous injury – Classification system.*

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Introduction

SEVERE fracture and dislocation of the cervical spine can result in devastating results such as disability or death. Although there is a controversy as to whether conservative treatment may be sufficient or surgical intervention is always necessary, in recent years, early operative treatment has gained increasing acceptance **[1]**.

Even though the subaxial cervical spine injury and severity score (SLIC) classification can provide a comprehensive assessment and important guidance in the diagnosis, treatment, and prognosis of subaxial cervical injuries, for some serious fractures and dislocations that involve both anterior and posterior structures simultaneously, various surgical techniques are still used, depending on the particular condition **[2]**.

Patients and Methods

This study is a retrospective one that included 40 patients of traumatic subaxial cervical fractures whom had been admitted and operated upon in emergency unit of Neurosurgical Department at Cairo University Hospitals between April 2018 to December 2019, for assessment of neurological outcome after combined anterior-posterior approach.

We included Patients with unstable subaxial cervical spine injury with failure in anterior, middle and posterior column and in need for anterior cord decompression and posterior stabilization whatever their age, sex or mode oftrauma. We excluded patients with Stable injury, patients who were operated by anterior or posterior approach alone, those with Co-morbid condition prevented surgery and patients with axial spine trauma (C0,C1&C2).

Prehospital Report:

Table (1): Show the scheme for prehospital report.

Mechanism	- How did injury occur?
Injury	- Primary survey Glasgow Coma Scale
Vital data	- Heart rate Blood pressure Respiratoryrate
	- Oxygen saturation
	- Temperature (if applicable)
Treatment	- Airway (airway management)
	- Breathing (oxygen administration, needle or tube thoracostomy)
	- Circulation (intravenous access established and fluids administered)
	- Extra information (medications administered, procedures performed application of neck collar and transportation)

The patients were all treated with similar emergency treatment of methylprednisolone sodium succinate (MPSS) as an initial intravenous bolus of 30mg/kg administered over a period of 15 minutes. This is followed later by a 5.4-mg/kg per hour as maintenance dose for 24 hours with difficulty in supply of it somtimes due to deficiency in our institute.

History: Age, gender, Mechanism ofinjury, Time of trauma & Pre-hospital, post-traumatic management andtransportation.

1- Clinical Findings:

2- Assessment of conscious level and assessment of airway, breathing, and hemodynamicstability, Neurological examinations. Dependingon Motor examination including: Power, Superficial & deepreflexes, Presence of sensory level, the subaxial injury classification system (SLIC) score & ASIA (American spinal injury association) impairment scale.

Patients will be diagnosed with subaxial cervical fracture with radiological investigations including X-Ray, CT, MRI, of the cervicalspine, Imaging for associated injuries (CT brain, CXR, and abdominalU/S. We evaluate type of surgery and time elapsed from accident tosurgery. All the patients operated upon by decompression of the cervical cord and fixation of the cervical spine both anterior and posterior the sametime.

Weassessed: Adequate decompression of the spinalcanal and Alignment of the vertebrae and placing of the fixation systems.

Table (2): Grades of muscle power **[3]**.

Grade	Ability to move
5	- The muscle can move the joint it crosses through a full range of motion, against gravity, and against full resistance applied by the examiner.
4	- The muscle can move the joint it crosses through a full range of motion against moderate resistance.
3	- The muscle can move the joint it crosses through a full range of motion against gravity but without any resistance.
2	- The muscle can move the joint it crosses through a full range of motion only if the part is properly positioned so that the force of gravity is eliminated.
1	- Muscle contraction is seen or identified with palpation, but it is insufficient to produce joint motion even with elmination of gravity.
0	- No muscle contraction is seen or identified with palpation paralysis.

Table (3): The subaxial injury classification system **[3,4]**.

	Points
Injury morphology:	
No abnormality	0
Compression	1
Burst	+1
Distraction	2
Translation	3
Integrity of the discoligamentous complex:	
Intact	0
Indeterminate	1
Disrupted	2
Neurologic status:	
Intact	0
Nerve root injury	1
Complete	2
Incomplete	3
Persistent cord compression	+1

Table (4): ASIA impairment scale **[3]**.

Class	Description
A	— Complete: No motor or sensory function preserved.
B	- Incomplete: Sensory but no motor function preserved below the neurologic level (includes sacral segments S4-5).
C	- Incomplete: Motor function preserved below the neurologic level (more than half of key muscles below the neurologic level have a muscle strength grade <3).
D	— Incomplete: Motor function preserved below the neurologic level (more than half of key muscles below the neurologic level have a muscle strength grade 3).
E	- Normal: Sensory & motor function normal.

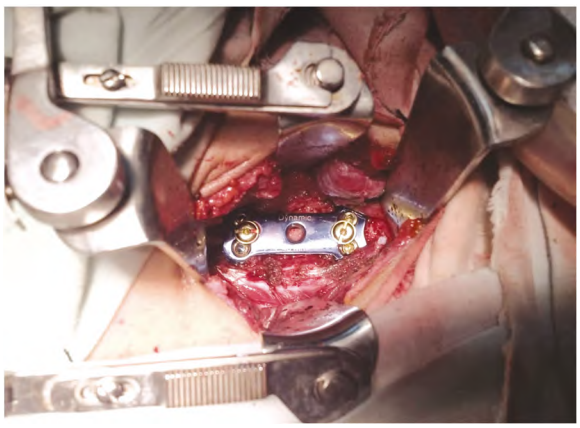

Fig. (1): Placing of bone graft obtained from the iliac crest with plate.

Postoperative treatment:

Antibiotics, methylprednisolone sodium succinate (MPSS) with its maintenance dose (5.4-mg/kg per hour), gastric protecting drugs, IV fluids and neurotrophic drugs were routinely used for all the patients.

Follow-up and outcome:

a- Postoperatively patients were admitted to the ICU to take care of the respiration and its pattern, if diaphragmatic pattern was noticed mechanical ventilation was required.

b- Full neurological examination was held to all patients to detect improvement or deterioration of the neurological condition postoperative.

c- X-ray and CT scan of the cervical spine were performed to detect adequate decompression of the spinal canal and alignment of the vertebrae and placing of the fixation systems.

d- Physiotherapy started to the weak muscles.

e- Neurological outcome was assessed by JOA scale and Nurick grade table.

f- Visual analogue scale used to evaluate neck pain.

g- The follow-up period was from 3 months to 1 year.

h- We measured the cervical curvature index (CCI) as described to evaluate the stability of the cervical spine, and to predict the occurrence of adjacent segment disease after cervical surgery **[5]**.

Table (5): JOA scale **[6]**.

Scale for clinical evaluation of myelopathy-Japanese Orthopedic Association (JOA): 0 to 17 points	Points
I- Motor function of the upper limb:	
- Impossible to eat with cutlery or to button shirt	0
- Possible to eat with cutlery, impossible to button shirt	1
- Possible to button shirt, with great difficulty	2
- Possible to button shirt, with difficulty	3
- Normal	4
II- Motor function of the lower limb:	
- Impossible to walk	0
- Needs cane or assistance on flat surface	1
- Needs assistance on stairs	2
- Walks unaided, but slowly	3
- Normal	4
III- Sensory function:	
Upper limb:	
- Apparent sensory disorder	0
- Minimal sensory disorder	1
- Normal	2
Lower limb:	
- Apparent sensory disorder	0
- Minimal sensory disorder	1
- Normal	2
Trunk:	
- Apparent sensiry disorder	0
- Minimal sensory disorder	1
- Normal	2
IV- Bladder function:	
- Urinary retention or incontinence	0
- Sensation of retention, loss of slight flow	1
- Urinary retention and/or increase in urinary frequency	2
- Normal	3

Table (6): Nurick grade **[6]**.

Grading	Nurick clinical scale
Grade 0	- Signs and symptoms of root involvement but without evidence of spinal cord disease.
Grade 1	- Signs of spinal cord diseases but no difficulity walking.
Grade 2	- Slight difficulty in walking which does not prevent full-time employment.
Grade 3	- Extreme difficulty in walking that requires assistance and prevents full-time employment and occupation.
Grade 4	- Able to walk only with someone else's help or with the aid of a walker.
Grade 5	- Chairbound or bedridden.

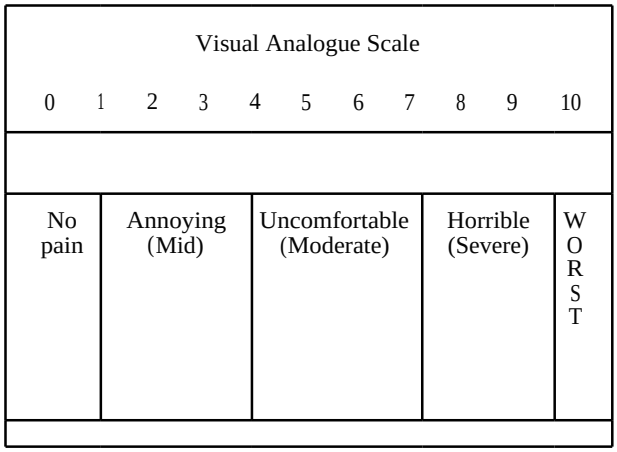

Fig. (2): Visual analogue score (VAS).

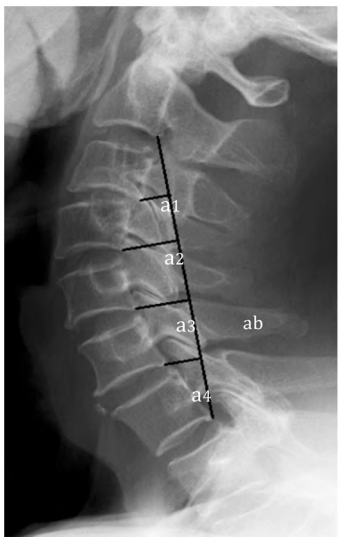

Fig. (3): Calculation of CCI. "ab" was the line connecting posterior inferior edge of the C2 and C7 vertebral body. "a1" to "a4" respectively represented the vertical distance from posterior inferior edge of the C3- C6 to "ab." CCI = [(a1 + a2 + a3 + a4)/ab] X 100%. **[5]**.

Results

The data collected from 40 cases of traumatic subaxial cervical fractures in this study were evaluated. The study included 40 patients, 30 males with percentage of 75% and 10 females with percentage of 25%. Their age ranges between 17 and 65 years with a mean age of 32.45 years.

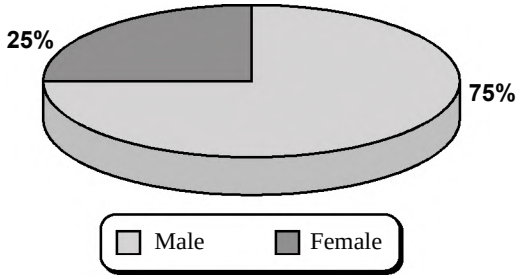

Fig. (4): Male to female ratio.

Mechanism of injury was fall from height (FFH) in 60%, road traffic accidents (RTA) in 30% and isolated head trauma (IHT) in 10% of cases.

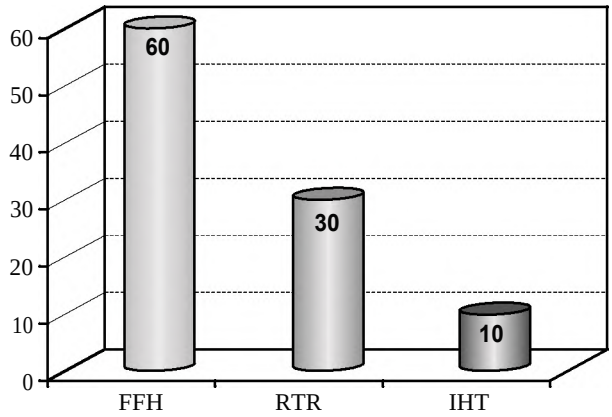

Fig. (5): Modes of injuries.

26 patient had motor power in their upper limbs (UL) after the injury with percentage of 65%, and 14 patients had zero motor power in their upper limbs with percentage of 35%.

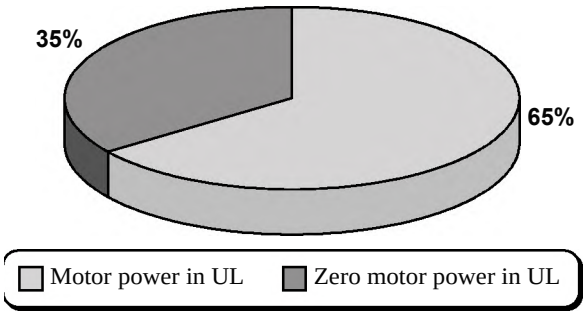

Fig. (6): Percentages of patients regarding motor power in upper limb.

34 patients had sensory level at the nipple line and sphincteric problems with percentage of 85%, the other 6 patients had no sensory affection and no sphincteric affection with percentage of 15%.

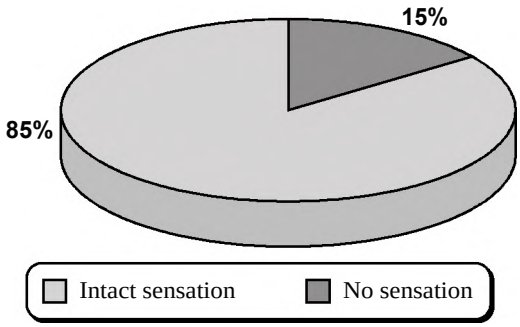

Fig. (7): Percentages of patients regarding sensation and sphincteric affection.

Regarding the type of fracture of the cervical spine, 24 patients had fracture and dislocation of the affected vertebrae with percentage of 60% other 16 patients had burst fractures of the affected vertebrae with percentage of 40%.

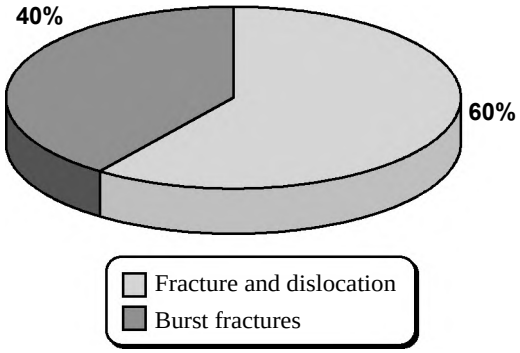

Fig. (8): Percentages of patients regarding type of cervical fracture.

We found 8 patients at level C4-5 with percentage of 20%, 8 patients at level C5 with percentage of 20%, 6 patients at level C5-6 with percentage of 15%, 6 patients at level C6-7 with percentage of 15%, two patients at level C3 with percentage of 5%, two patients at level C4 with percentage of 5%, two patients at level C3-4 with percentage of 5%, two patients at level C6 with percentage of 5%, two patients at level C7 with percentage of5% and two patients at level C7-D 1 with percentage of 5%.

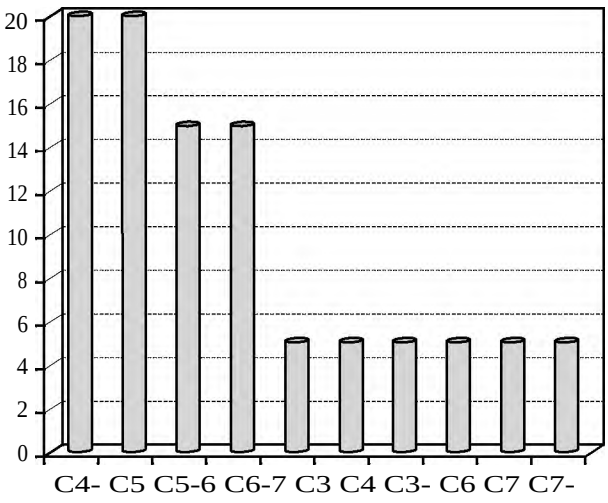

Fig. (9): Percentages of patients regarding level of injury.

Improvement of the neurological state occurred only in 17 patients with percentage of 25%, the other 23 patients showed no improvement with percentage of 75%.

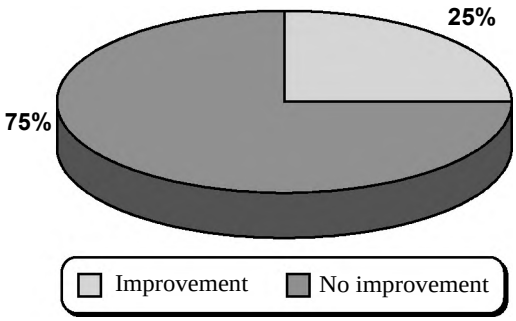

Fig. (10): Percentages of patients regarding postoperative improvement.

Table (7): Pre- and postoperative ASIA grade.

ASIA grade	Preop cases	The last follow-up ASIA grade				
		A	B	C	D	E
A	4	1	2	1		
B	8		2	2	4	
C	14			4	5	5
D	8				2	6
E	6					6

12 patients showed mild side effects such as dysphagia which was self-limited, wound discharge in two patients that improved after good dressing and wound care.

22 patients have minimal to mild neck pain, other 8 patients have moderate to severe neck pain that improved by strong analgesia.

Table (8): Summary of complications.

Complication	Patients affected	
	Number	Percentage
Adjacent segment kyphosis	1	2.5
Dysphagia	6	15
Dysphonia	1	2.5
Wound dehiscence	1	2.5
Seroma/wound discharge	2	5
Urinary retention	1	2.5

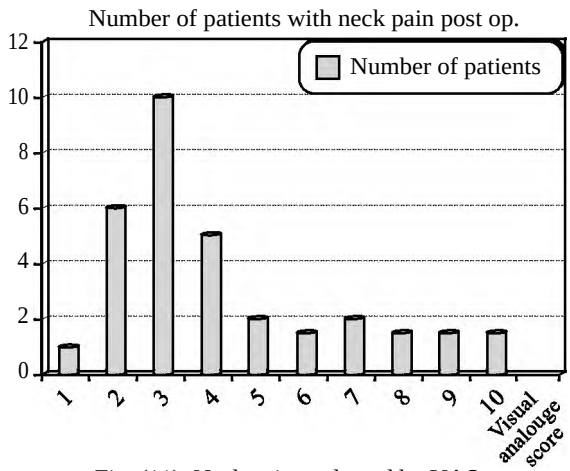

Fig. (11): Neck pain evaluated by VAS.

Table (9): Master Table.

No.	History			Clinical findings			Radiological findings			Type of the fracture
	Age	Sex	Mechanism of injury	Motor power at upper limbs	Motor power at lower limbs	Sensory level	Sphincters	Level of cervical fractures	Associated Cord contusion	
1	17	M	Fall	3	0	Nipple line	Incontinent	C4-C5	Yes	Fracture dislocation
2	55	M	RTA	FMP	FMP	Pain at neck and RT upper limb	Continent	C5-C6	Yes	Fracture dislocation
3	20	M	Fall	3	0	Nipple line	Incontinent	C4	Yes	Burst fracture
4	50	M	RTA	0	0	Nipple line	Incontinent	C4-C5	Yes	Fracture dislocation
5	21	M	RTA	0	0	Nipple line	Incontinent	C5	Yes	Burst fracture
6	26	M	RTA	0	0	Nipple line	Incontinent	C5-C6	Yes	Fracture dislocation
7	50	F	Fall	0	0	Nipple line	Incontinent	C5	Yes	Burst fracture
8	22	M	Fall	3	0	Nipple line	Incontinent	C6-C7	Yes	Fracture dislocation
9	27	M	RTA	3	0	Nipple line	Incontinent	C6-C7	Yes	Fracture dislocation
10	21	M	Head trauma	Rt 4 Lt 3	Rt 4 Lt 3	No sensory level	Continent	C3	No	Burst fracture
11	40	F	Fall	0	0	Nipple line	Incontinent	C4 -C5	Yes	Fracture dislocation
12	29	M	Fall	3	0	Nipple line	Incontinent	C7	Yes	Burst fracture
13	24	M	RTA	0	0	Nipple line	Incontinent	C5-C6	Yes	Fracture dislocation
14	20	M	Fall	3	0	Nipple line	Incontinent	C6	Yes	Burst fracture
15	22	M	Fall	4	2	Nipple line	Incontinent	C6 -C7	Yes	Fracture dislocation
16	53	F	Fall	Rt 2 Lt 0	Rt 2 Lt 0	Nipple line	Incontinent	C3-C4	Yes	Fracture dislocation
17	25	F	Fall	0	0	Nipple line	Incontinent	C5	Yes	Burst fracture
18	56	M	Fall	FMP except HG3	0	Nipple line	Incontinent	C7-D1	Yes	Fracture dislocation
19	50	M	Head trauma	Rt 2 Lt FMP	FMP	No sensory level	Continent	C5	No	Burst fracture
20	21	F	Fall	Rt 2 Lt 4	Rt 2 Lt 4	Nipple line	Incontinent	C4-C5	Yes	Fracture dislocation
21	33	F	RTA	FMP	FMP	No sensory level	Continent	C7	No	Burst fracture
22	24	F	Fall	FMP	FMP	No sensory level	Continent	C3	No	Burst fracture
23	50	F	Fall	3	Rt 3 Lt 2	Nipple line	Incontinent	C4-C5	Yes	Fracture dislocation
24	44	F	RTA	FMP	FMP	No sensory level	Continent	C6	No	Burst fracture
25	30	F	Fall	3	4	No sensory level	Continent	C4-C5	Yes	Fracture dislocation
26	32	M	RTA	FMP	0	Nipple line	Incontinent	C6	Yes	Burst fracture
27	22	M	Fall	3	0	Nipple line	Incontinent	C6	Yes	Burst fracture
28	27	M	Fall	3	0	Nipple line	Incontinent	C7	Yes	Burst fracture
29	34	M	Head trauma	FMP	FMP	No sensory level	Continent	C3-C4	No	Fracture dislocation
30	33	M	Fall	2	FMP	No sensory level	Continent	C4-C5	Yes	Fracture dislocation

Table (9): Count.

No.	History			Clinical findings				Radiological findings		Type of the fracture
	Age	Sex	Mechanism of injury	Motor power at upper limbs	Motor power at lower limbs	Sensory level	Sphincters	Level of cervical fractures	Associated Cord contusion	
31	32	M	RTA	FMP	FMP	No sensory level	Continent	C7-D1	No	Fracture dislocation
32	40	M	RTA	FMP	FMP	No sensory level	Continent	C6-C7	No	Fracture dislocation
33	45	M	Fall	3	3	No sensory level	Continent	C4-C5	No	Fracture dislocation
34	38	M	Fall	2	3	Nipple line	Incontinent	C3	Yes	Burst fracture
35	33	M	Fall	3	1	Nipple line	Incontinent	C6-C7	Yes	Fracture dislocation
36	25	M	Head trauma	FMP	FMP	No sensory level	Continent	C5	No	Burst fracture
37	26	M	Fall	FMP	FMP	No sensory level	Continent	C7	No	Burst fracture
38	30	M	Fall	0	0	Nipple line	Incontinent	C6	Yes	Burst fracture
39	33	M	Fall	FMP	FMP	No sensory level	Continent	C5-C6	No	Fracture dislocation
40	35	M	RTA	3	4	Nipple line	Incontinent	C6	Yes	Burst fracture

Preoperative imaging:

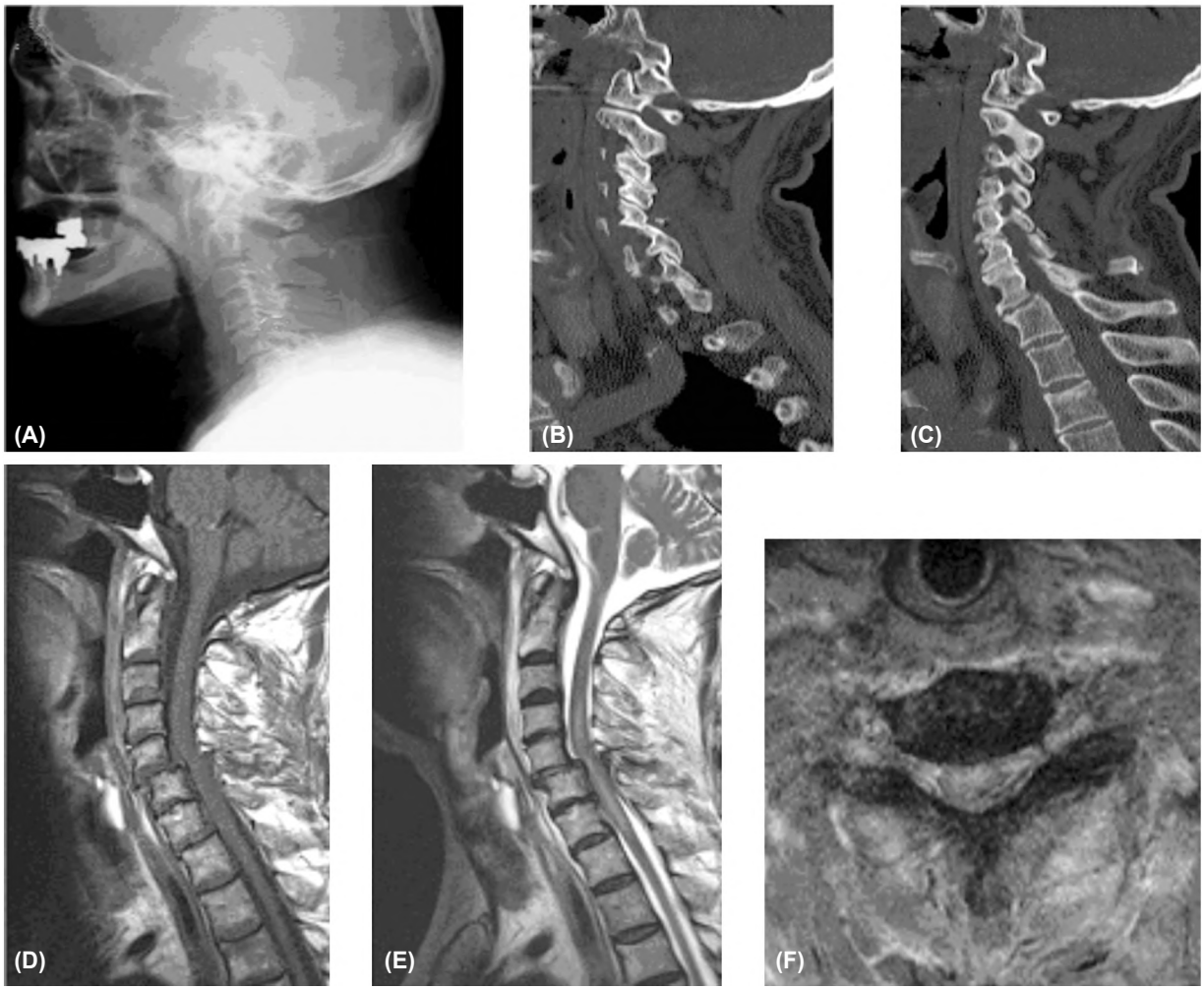

Fig. (12): Preoperative imaging of a case.
(A): X-ray was done revealing spondylolisthesis of C5 over C6.
(B): Sagittal CT scan of the cervical spine revealed dislocation of facets bilaterally.
(C): Axial CT scan of the cervical spine revealed dislocation of facets bilaterally.
(E&F): MRI of cervical spine revealed high signal intensity in T2 opposite C5 and C6.

Postoperative imaging:

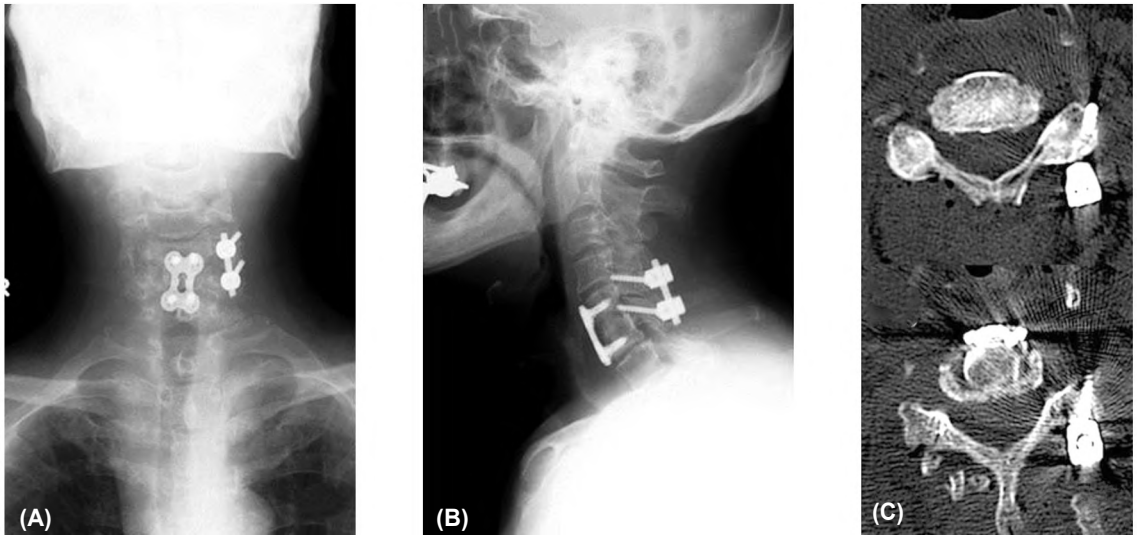

Fig. (13): Postoperative imaging of same case.
(A): X-ray anterior-posterior view showing that lateral mass screws on the left side were used for fixation.
(B): X-ray lateral view showing that lateral mass screws on the left side were used for fixation.
(C): Axial CT scan of C5-C6 showing that half of the C5 to C6 facet joint was resected on the right side, and one quarter of the C5 to C6 facet joint was resected on the left side. Lateral mass screws on the left side were used for fixation, but on the right side were not used for fixation because most of the lateral bone mass was resected.

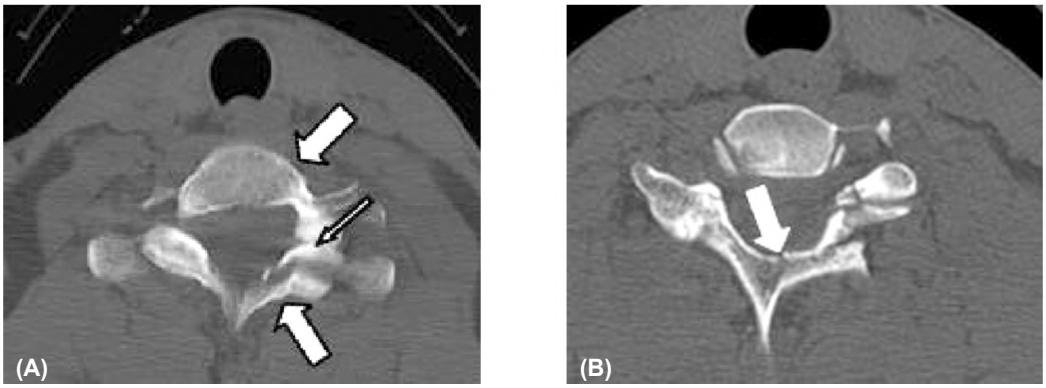

Fig. (14): CT-scan demonstrating a left fracture-dislocation C7-T1 (small arrow in upper image), the two large arrows point to the vertebral body and to the lamina.

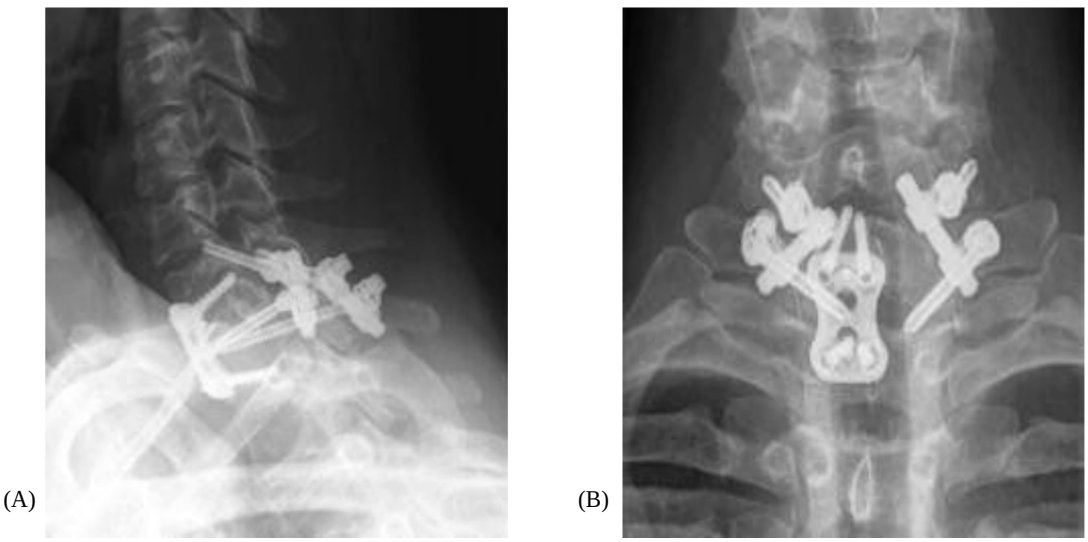

Fig. (15): Postoperative X-ray lateral (A) and AP (B) views after reduction of case showed in figure 10, combined fusion and insertion of a tricortical bone graft into the disc space C7-T 1.

Discussion

In this study, 40 patients with traumatic subaxial cervical spine injury were operated with anterior cervical decompression reduction and posterior fixation approach as the surgical corridor, with follow-up from 3 months to 1 year.

The age distribution of patients presenting with lower cervical spine and spinal cord injuries is bimodal. Injuries in persons aged 15-24 years are usually the result of high-energy trauma, such as motor vehicle accidents, accidents resulting from sporting activities, or acts of violence.

Injuries in persons older than 55 years usually result from low-energy trauma, such as falls from the standing position. Studies suggested that age-associated cervical spondylosis narrows the spinal canal and predisposes the cervical cord to injury at this level [7].

The surgical management of fracture dislocation of the sub axial cervical spine is based on decompression of the impaired neural elements and restoration of the normal spinal arch with stabilization [8].

In this study, the road traffic accidents were the most common mode of trauma accounting for admission. Of 40 patients, 16 of our patients experienced RTAs (30%). Such injuries are often associated with neurological deficit from complete cord injury to radiculopathy. Road traffic accidents also were the commonest mode of trauma in many studies [2,8,9].

Considering the injury level, 75% of injuries were around the C5 and C7 level. Also, in many studies, >50% of injuries are located between C5 and C7.

Of 40 patients, 34 sustained complete cord injury, whereas 6 had incomplete cord injuries.

All patients in our study presented with neck pain and spinous tenderness and exhibited significant compression of the spinal cord anteriorly and posteriorly at multiple levels. The indication for surgical intervention was undoubted. We sought both to improve the patient's baseline symptoms and to prevent further damage to the spinal cord.

A study advised that medical management involves treating the multiple traumas and, more specifically, treating concomitant neurologic injury, use of steroids for neurologic injury has become standard to prevent secondary causes of spinal cord damage, such as release of toxic peroxidases, and to minimize associated local edema. Steroids are thought to help stabilize neural membranes, to prevent uncontrolled intracellular calcium influx, to decrease lysosomal enzyme action, and to diminish swelling and inflammation [9].

Also mentioned that prophylaxis for deep vein thrombosis (DVT) and pulmonary embolism is of particular concern in the neurologically compromised patient. Rates for DVT in complete injuries range from 30-90%; DVT warrants medical and/or mechanicaltreatment. This may include low molecular weight heparin, oral warfarin (Coumadin), intermittent compression devices for the lower extremities, or vena cava filters [10].

We classified such injuries using the classification system developed by Allen et al., to understand the mechanism of injury and plan the treatment [4].

This classification considers the severity and mechanism of injury, which helps determine an appropriate plan of management, although the system was based (in 1982) on X-ray alone, wherein posterior arch fractures and disco-ligamentous injuries can be missed and, this was mentioned previously by Aarabietalin their paper at 2013 [3].

Moreover, no injury classification system has currently achieved universal use, and despite technological advances, classification and treatment of subaxial cervical spine injuries remain controversial [11].

Several other classification systems have been proposed, such as the sub axial cervical spine injury classification system and AO spine classification group.

We performed CT and MRI of all patients because CT scan detects 97%-100% of fractures, and MRI is useful in assessing the intervertebral disc status and ligamentous structures and plan the management particularly for extruded disc, initially requiring anterior decompression.

The median VAS score for neck pain was 4.5 (range 0-10).

Furthermore, 32/40 (80%) patients had VAS scores 3, 640 (5%) had VAS sores 4-6 and 2/40 (5%) had VAS scores 7 No s gnificant association was observed between the surgical approach and neck pain.

These injuries need to be addressed surgically with the aim of reversing and preventing deterio-

ration of neurological damage, achieving spinal reduction, stabilization, and early mobilization.

The use of anterior fusion alone was associated with the development of kyphotic deformity and graft dislodgement, most likely as a result of co-existing posterior ligamentous and osseous injury, hence performing the combined anterior decompression and fixation and the posterior fixation for further stabilization of dislocated cervical spine had a fewer short and long term complications **[12]**.

Spontaneous loosening of the plate or screws in up to 17% of patients after only anterior cervical plate fixation even after a short duration of follow-up had been reported **[13]**.

A combined single staged anterior and posterior approach for acute surgical management permitting early restoration of anatomic alignment and decompression while optimizing the environment for neurological recovery **[8]**.

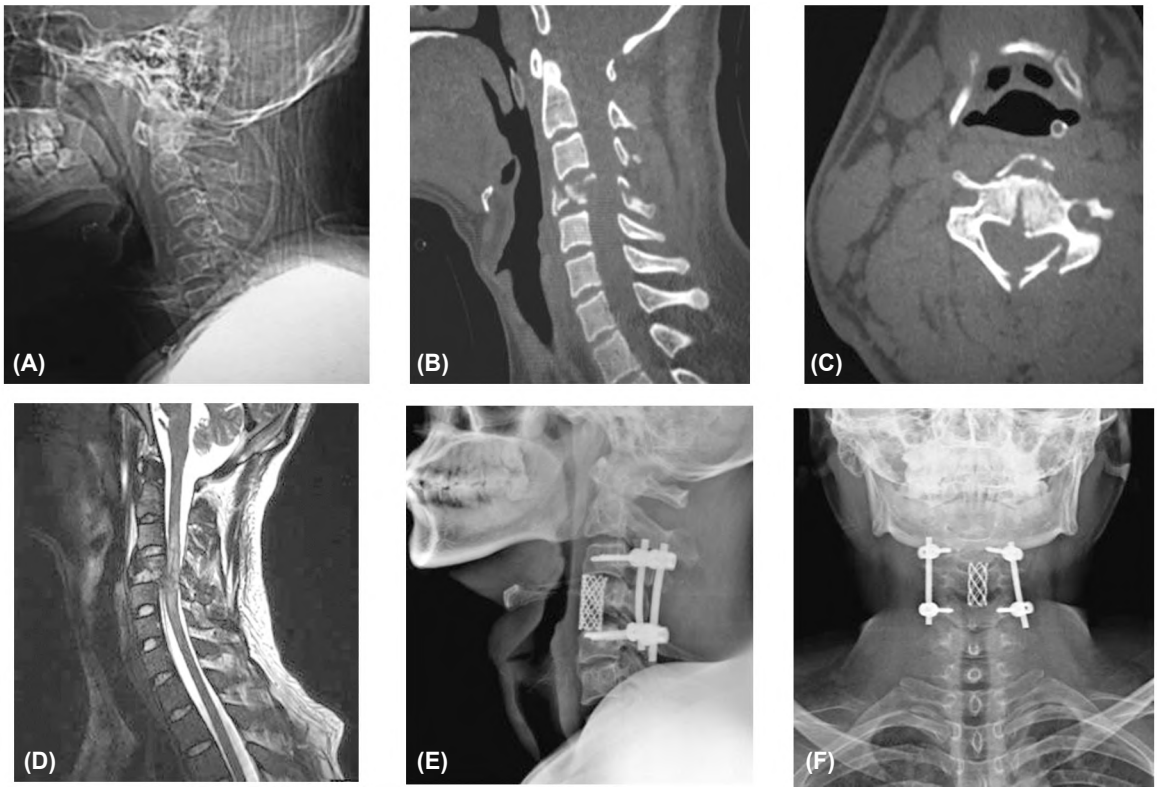

Fig. (16): Preoperative (A) Plain X-ray film, (B) Axial CT, (C) Sagittal CT, and (D) Sagittal T2-weighted image showed C4 vertebra burst fracture with facets locked, the disc had been ruptured and the spinal cord was injured. Postoperative (E,F) Plain X-ray films show that the posterior pedicle screw fixation and ACCF of C4 were completed simultaneously.

The use of anterior fusion alone was associated with the development of kyphotic deformity and graft dislodgement, most likely as a result of co-existing posterior ligamentous and osseous injury, hence it is better to perform the combined anterior decompression and fixation and the posterior fixation for further stabilization of dislocated cervical spine.

Bilateral facet dislocations are more commonly associated with a neurological deficit. These injuries are thought to represent a sequela of pathology with disruption of various osseous and ligamentous structures.

In the presence of both anterior and posterior ligamentous and bony disruption combined technique provides far greater stabilization than either procedure performed alone.

Apart from traumatic spondylolistheses, Vaccaro et al., have also advocated circumferential fusion for complete dislocations with unsatisfactory anterior reduction, in flexion-extension and rotation injuries associated with complete spinal cord injury, in order to favor functional rehabilitation from orthosis **[2]**.

Combined stabilization in patients with posterior ligamentous disruption or facet fracture and simultaneous anterior compression by a herniated disc was proposed, so we followed that in our study and, anterior procedure was performed first to relieve the cord compression, also in multiple level

of burst fracture, combined procedure is necessary **[14]**.

In our study, first anterior fixation was usually performed using plate over bone graft taken from iliac crest followed by posterior fixation that performed by lateral mass rods and screws for very rigid fixation along with fusion, and 15 patients (37.5%) showed improvement of the neurological condition.

Lateral mass screws were used at the level C7. Indeed, transpedicular screws are associated with an increased risk of injury to the major neurovascular structures, including the spinal cord, nerve roots, and the vertebral artery, especially at the cervical level.

In addition, at the C7 level the shoulder girdles may obstruct a clear intra-operative radiographic view of the pedicles, making the procedure even more difficult. In contrast, pedicle screws were used at the T1 level **[15]**.

Compared with the cervical spine, the transverse processes of the thoracic spine are considerably weaker. Consequently, lateral mass screws are less favorable at this level. Since the diameter of the pedicles increases to a mean width of 7.8mm at T1, pedicle screws are preferable **[16]**.

We used different types of implants for posterior stabilization as per the surgeon's choice, indications, and cost constraints.

We noticed that the most common type was flexion distraction injury, wherein the injury initially originates in the posterior elements and travels to the anterior elements of the cervical spine, making it unstable antero-posteriorly. Hence, a posterior tension band was necessary for stabilization to prevent distraction of posterior elements and to increase stability of anterior implant and cage during flexion motion of the cervical spine. This allows early mobilization of the patient.

We used lateral mass fixation as wiring techniques are not useful in laminar and spinous process fractures.

A retrospective survey analysis of surgical approach in treatment of lower cervical distraction-flexion was conducted and found that combined approach is recommended for the treatment of bilateral dislocation, which is in line with our findings **[17]**.

Regarding operative time and intraoperative blood loss in our study the median duration of surgery was 240 minutes, the median volume of intraoperative blood loss was 200cc.

The recovery of neurological injury was examined by comparing the difference in pre-operative ASIA grade and JOA scores of motor and sensory function in our study.

No neurological worsening occurred; neurological function in patients with incomplete spinal cord injury was restored to varying degrees, yet symptoms of nerve root irritation had disappeared. Considering our result and previous reports and study an effective reduction decompression and internal fixation system for lower cervical distraction-flexion relieve neurological deterioration, provide immediate stabilization, enhance bony fusion, and correct the spine deformity **[2]**.

Sagittal alignment in the cervical spine is an important factor that should be considered in choosing the approach. Cervical injuries generally result the loss of the normal physiologic lordosis, and cervical spine is more prone to kyphosis **[14]**.

Postoperative radiological follow-up there was no mal-alignment, instrumentation failure or graft problems, of the studied patients. A potential explanation for this difference could be the interbody support provided by the graft in the anterior surgery.

In our study 15 patients (37.5%) showed favorable outcome where they could carry on normal activities and work with no care needed. 22 patients (55%) had accepted outcome where they were need occasional assistance for their daily needs. Three patients showed no improvement.

The most frequent operative complications described in the literature **[8,12,14]** were encountered among 12 patients such as dysphagia, dysphonia, wound dehiscence, seroma, and urinary retention all that have been controlled by conservative measures and all of them have improved and discharged. None of the cases showed any implant-related complications.

Bone fusion and postoperative re-alignment were obtained in all patients and maintained throughout the follow-up period.

In our study, all patients (100%) lived until discharged from the hospital, and within the follow up period there were no mortalities. We assume that the cause is unfitness of patients with spinal shock for anesthesia and surgery and postponing them till resolution of the shock or any other general condition makes the surgery unfavorable.

Conclusions:

Circumferential stabilization and fusion in unstable sub-axial cervical spine fractures with anterior column and posterior disruption gives an opportunity for the complete posterior and anterior decompression of the cervical cord in a single session of anesthesia providing good results in alignment, fusion, and neurological recovery, and we could not find any absolute contraindication for a combined approach in our study.

References

1- HARRIS M.B., REICHMANN W.M., BONO C.M., BOUCHARD K., CORBETT K.L., WARHOLIC N., SIMON J.B., SCHOENFELD A.J., MACIOLEK L., CORSELLO P., LOSINA E. and KATZ J.N.: Mortality in elderly patients after cervical spine fractures. J. Bone Joint Surg. Am., Mar. 92 (3): 567, 2010.

2- VACCARO A.R., HULBERT R.J., PATEL A.A., FISHER C., DVORAK M., LEHMAN Jr. R.A., ANDERSON P., HARROP J., ONER F.C., ARNOLD P. and FEHLINGS M.: The subaxial cervical spine injury classification system: A novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex. Spine, Oct. 1; 32 (21): 2365-74, 2007.

3- AARABI B., WALTERS B.C., DHALL S.S., GELB D.E., HURLBERT R.J., ROZZELLE C.J., RYKEN T.C., THEODORE N. and HADLEY M.N.: Subaxial cervical spine injury classification systems. Neurosurgery, Mar. 1; 72 (Suppl 3): 170-86, 2013.

4- ALLEN B.L. Jr., FERGUSON R.L. and LEHMANN T.: A mechanistic classification of closed, indirect fractures and dislocations of the lower cervical spine. Spine, 7: 1-27, 1982.

5- TAKESHITA K., MURAKAMI M., KOBAYASHI A. and NAKAMURA C.: Relationship between cervical curvature index (Ishihara) and cervical spine angle (C2--7). J. Orthop. Sci., 6 (3): 223-226, 2001.

6- MENCHETTI, PIER PAOLO MARIA, ed.: Cervical Spine: Minimally Invasive and Open Surgery. Springer, 2015.

7- LI A.E. and FISHMAN E.K.: Cervical spine trauma: Evaluation by multidetector CT and three-dimensional volume rendering. Emergency Radiology, Apr. 1; 10 (1): 34-9, 2003.

8- JOAQUIM A.F. and PATEL A.A.: Subaxial cervical spine trauma: Evaluation and surgical decision-making. Global Spine J., 4 (1): 63-70, 2014.

9- TORRETTI J.A. and SENGUPTA D.K.: Cervical spine trauma. Indian J. Orthop., 41 (4): 255-267, 2007.

10- FURLAN J.C. and FEHLINGS M.G.: Cardiovascular complications after acute spinal cord injury: Pathophysiology, diagnosis, and management. Neurosurgic Focus., 25 (5): E13, 2008.

11- MOORE T.A., VACCARO A.R. and ANDERSON P.A.: Classification of lower cervical spine injuries. Spine (Phila Pa 1976), 31 (11): S37-S61, 2006.

12- HAN Y., XIA Q., HU Y.C., ZHANG J.D., LAN J. and MA X.L.: Simultaneously Combined Anterior-Posterior Approaches for Subaxial Cervical Circumferential Reconstruction in a Sitting Position. Orthopedic Surgery, 7 (4): 371-374, 2015.

13- JOHNSON M.G., FISHER C.G., BOYD M., PITZEN T., OXLAND T.R. and DVORAK M.F.: The radiographic failure of single segment anterior cervical plate fixation in traumatic cervical flexion distraction injuries. Spine (Phila Pa 1976), 29 (24): 2815-2820, 2004.

14- SRIBNICK E.A., HOH D.J. and DHALL S.S.: Traumatic high-grade cervical dislocation: Treatment strategies and outcomes. World Neurosurg., 82 (6): 1374-1379, 2014.

15- NAKASHIMA H., YUKAWA Y., ITO K., MACHINO M., EL ZAHLAWY H. and KATO F.: Posterior approach for cervical fracture-dislocations with traumatic disc herniation. Eur. Spine J., 20 (3): 387-394, 2011.

16- SCHMIDT-ROHLFING B., NOSSEK M., KNOBE M. and DAS M.: Combined approach for a locked unilateral facet fracture-dislocation of the cervicothoracic junction. Acta. Orthop. Belg., 74 (6): 875-880, 2008.

17- NASSR A., LEE J.Y., DVORAK M.F., HARROP J.S., DAILEY A.T., SHAFFREY C.I., ARNOLD P.M., BRODKE D.S., RAMPERSAUD R., GRAUER J.N. and WINEGAR C.: Variations in surgical treatment of cervical facet dislocations. Spine, Apr. 1; 33 (7): E188-93, 2008.

إضطراب هرمونات الغدة النخامية بعد إصابات الدماغ الرضية المتوسطة والشديدة: دراسة تحليلية مستقبلية

إن إصابة المخ بالصدمات هى مشكلة صحية عامة متنامية فى جميع أنحاء العالم وهى سبب رئيسى للوفاة والإعاقة.

ويستنتج أن خلل الغدد الصماء العصبية هى واحدة من الآثار طويلة الأمد لإصابة المخ بالصدمة.

ويتم تشخيص العديد من المرضى بشكل ناقص لأن أعراض الغشاء المتوسط الخفيفة هى النامية ببطء.

من ٢٣ مريض تم إدراجهم بدراستنا التحليلية المستقبلية تبين أن ٦ مرضى بمعدل يعانون من خلل فى الغدد الصماء العصبية.

نقص هرمون النمو وهرمونات القشرة الكظرية هم الأكثر شيوعاً نقصاً من هرمونات الغدة النخامية فى المرضى وتبين أن النسبة ٨.٧٪ فى دراستنا.