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ROLE OF STABILIZATION AND SURGICAL INTERVENTION IN CERVICAL SPINE CORD INJURY

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Table of Content

LIST OF TABLES

Page

LIST OF FIGURES

ABBREVIATIONS

ALL	Anterior longitudinal ligament
CSI	Cervical spine injury
CT	Computed tomography
GCS	Glasgow Coma Scale
HTV	Halo-thoracic vest
MRI	Magnetic resonance imaging
MVA	Motor vehicle accident
NEXUS	National Emergency X-radiography Utilization Study
PLL	Posterior longitudinal ligament
ROM	Range of motion
SCI	Spinal cord injury

INTRODUCTION

Spinal cord injury (SCI) represents an important cause of morbidity and mortality.

Estimates of the annual incidence of SCI in developed countries vary from 11.5 to 53.4 per million people [3].

The majority of victims are young males. Between the ages of 16-32 years, whose injuries are due to motor vehicles accidents, sports and recreational activities, work- related accidents and violence [1].

The financial burden of SCI to the patient, the health care system and society is high [2]. The cervical spine is the most frequently injured portion of the spinal column, in automobile accidents, especially for those occupants who do not wear shoulder and lap belts restrains.

Also the significance of another cause of cervical spine injury “diving “ is well known . These injuries tend to occur in young individuals (second to third decade) , in summer season .

A high proportion of those injuries are associated with complete neurological defect [4].

The national spinal cord injury data research Centre in Phoenix, Arizona estimates that there are 250,000 spinal cord injury victims currently living in the United States with 10,000 new injuries occurring each year [5].

To prevent a spinal cord injury, there is no argument that it is better to deal with it. As a result a comprehensive prevention is necessary.

The new generation of safety equipment such as air bags, and better laws requiring seat belt, helmets and lower speed limits, have already resulted in the reduction of catastrophic injury in developed countries.

The greatest influence on the outcome of cervical spine injury has not come from medical or surgical therapy, But from standardization and sophistication of pre hospital care afforded to accident victims across this nation.

The emergency medical services “at the scene “, first responder have played an important role in the improved outcome for multisystem trauma victims, which includes the majority of spinal cord injury.

Unfortunately all of those factors, problems, services, we try to discuss in our subject.

1ST : We have no ambulance system service to prevent pre hospital secondary spinal cord injuries .

2nd : There is no any rules of safety equipment and speed limitations .

At the end the most important problem that we have no protocol of emergency medical services regarding spinal cord injuries , so we studied and focused all factors to improve the hospital management of cervical spine injuries .

AIMS AND OBJECTIVES

1. Epidemiology of cervical spine injury in view of age, sex nature or cause of trauma and levels of cervical spine injury.

2. Degree of complications: loss of consciousness, neurological and/or respiratory involvement.

3. Role of stabilization and surgical intervention in cases with cervical spine injury.

MATERIAL AND MEDTHODS

This is a record of 49 patients who sustained and acute unstable cervical spine injuries. All were admitted to ***Al Jala Hospital*** (trauma department), Benghazi – Libya, in the period of 1st January 2010 to 31st of December 2011. The 49 patients underwent open reduction, decompression and spinal stabilization via anterior approach. The indications for surgery were spine instability or fracture with or without neurological involvement. All the patients were generally stabilized for 72 hours before surgery, anterior-posterior and lateral plain radiography with computed tomography were performed for all patients, but magnetic resonance imaging (MRI) was performed only for patients with no respiratory involvement.

The neurological assessment was assigned to all patients both preoperatively and postoperatively. All patients received low molecular weight heparin to prevent deep vein thrombosis, Diclofenac Sodium as analgesia, while methylprendisolone was given to patients with neurological deficit to reduce edema. Patients who had subluxations or dislocation of cervical spines had cranial traction was applied both preoperatively and intra-operatively. Philadelphia cervical collar was applied postoperatively to all patients for 3-6 weeks. The statistical analysis: data were analyzed using statistical package for social science (SPSS) version 18. Descriptive statistics as mean, standard deviation and median were used.

Data were presented in tables and figures by ***Microsoft Excel 2007***.

PERFORMA

Role of Stabilization and Surgical Intervention in Cervical Spine Cord Injury

Name : ………………………………………………

Age …………………………………...…………

Sex : Male (…..…..) Female (…..……)

Date of Admission : …………………………………………….…………

Date of Discharge : ………………………………………….……………

Date of Surgery : …………………………………………………………..

Mechanism of Injury : …………………………………………………….

Level of Injury : …………………………………………….……………..

Level of Conscious : Conscious (…………) Unconscious (….……..)

Neurological Involvement : +ve (………..…..) -ve (…………….)

Respiratory Involvement : +ve (………..…..) -ve (…………….)

Admission: ICU (…………) Word (…..……..) NSSR (………….)

Time of Trauma : ………………………………………………………….

Type of Surgery : …………………………………………………………

LITERATURE REVIEW

Anatomy, Biomechanics, and Instability

The cervical spine is a relatively complex anatomical structure consisting of seven slightly differing vertebra with a total of 23 articulations: two C0/1 facet joints, two C1/2 facet joints plus the odontoid process articulation with the C1 anterior arch, and two facet joints plus an intervertebral disk in each of the C2/3 to C7/Th1 segments. Movements of the cervical spine are, in addition to active stabilization by muscle contraction, also passively restricted by facet joints, anterior (ALL) and posterior (PLL) longitudinal ligaments, intervertebral disks, ligamentum flavum, facet joint capsules, and intertransverse, interspinous, and supraspinous ligmaments, as well as ligamentum nuchae. Flexion is restricted mainly by the posterior ligaments[6,7], i.e., by ligamentum flavum, by interspinous, supraspinous, and nuchal ligaments, and by facet joint capsules [8].

Extension is restricted by ALL, PLL, and the intervertebral disks [6,7]. In addition to the intervertebral disk and facet joint capsules, the frail intertransverse ligaments restrict lateral bending [7]. Rotation is restricted by the intervertebral disk and to some extent by the tensile force of all the other ligaments. Rotatory restriction by the facet joint capsule is less significant [8]. The facet joints effectively restrict anterior translator movement [6].

In the upper cervical spine, the tectorial membrane, and the cruciform and alar ligaments provide additional stability; the anterior atlantooccipital membrane is an extension of ALL.

The transverse ligament, which is the horizontal part of the cruciform ligament, is the primary ligamentous stabilizer of the C0/1 segment and prevents anterior movement of the C1 ring, allowing it to pivot around the odontoid process. The apical ligament offers no significant stability to the craniocervical junction [9]. Accessory atlanto-axial ligaments running laterally within the osseous spinal canal are common and provide additional rotational stability [10]. The main movement of the C0/1 segment is flexion-extension (average range of motion, ROM 25 ^{o}) while rotatory and lateral bending movements (10^{o} ROM each) of this segment are minor [11].

The C1/2 segment has, on average, a 20 ^{o} ROM in flexion-extension, only minor lateral bending (ROM 10 ^{o}) and an important rotatory function (ROM 80 ^{o}), contributing approximately half of the rotatory movement of the whole cervical spine.

The C2/3 segment has a 10 ^{o} flexion-extension ROM, a 20 ^{o} lateral bending ROM, and only a 6 ^{o} rotational ROM.

C3/4, C4/5, and C5/6 share similar motion characteristics: on average a 15–20 ^{o} flexion-extension ROM, a 16–22 ^{o} lateral bending ROM, and a 14 ^{o} rotational ROM. In contrast, the C6/7 and C7/Th1 segments are relatively rigid: on average a 6- 7 ^{o} flexion-extension ROM, a 8–14 ^{o} lateral bending ROM, and rotationally a 12 ^{o} ROM in C6/7 and only 4 ^{o} in C7/Th1. With advanced age, the rotation of the C1–2 segment slightly increases, while the overall cervical spine mobility in flexion-extension, lateral bending, and rotation decreases with age (12) due to degenerative changes of the spine[13]. Clinical stability of spine after biomechanical analysis of subaxial ligamentous injuries is as defined “the ability of the spine to limit its patterns of displacement under physiologic loads so as not to damage or irritate the spinal cord or the nerve roots.” [6]

This became probably the most popular definition of cervical spine stability. Their later refinement of this definition emphasized clinical symptoms in instability: “loss of ability of the spine under physiologic loads to maintain relationships in such a way that there is neither damage nor subsequent irritation to the spinal cord or nerve roots and, in addition, there is no development of incapacitating deformity or pain”. [11] cervical spines with intact anterior structures plus one posterior element, or spines with intact posterior structures plus one anterior structure remain biomechanically stable under physiological loads [6]. Any further removal of stabilizing ligaments causes a sudden increase in flexion-extension ROM.

In their study, “anterior structures” included PLL and any structures anterior to it, while “posterior structures” were those posterior to PLL. The two-column (Holdsworth 1970) [15] and three-column (Denis 1983) [14] concepts- both initially used in thoracolumbar injuries and later also used in CSI- essentially evaluate the same stabilizing structures and share similar biomechanical assumptions White also concluded that 2.7-mm horizontal displacement (3.5 mm in a radiograph, when adjusted for magnification) in a cervical spine motion segment exceeds the normal physiological limits and indicates biomechanical instability. [6]

Similarly, using adjacent motion segments as the reference, they found an angular displacement of more than 11 degrees indicating biomechanical instability.

<u>Occipitocervical junction and Upper Cervical Spine (C0–2)</u>

Fractures of the occipital condyles are relatively rare and usually neurologically uncomplicated injuries. Atlanto-occipital (C0/1) dislocations are encountered clinically only rarely [(16)], as they are associated with a very high mortality before hospitalization. Even after hospitalization they show an approximately 50% mortality. [(17)]

Atlas (C1) fractures account for 8.8% of CSI in blunt trauma. While the injury may be limited to the anterior arch (13%), posterior arch (18%), or lateral mass (21%) only, which are considered relatively stable injuries, the most common injury pattern (37%) is a comminuted fracture of both the anterior and the posterior arch. [(16)]

The most common of such comminuted injury patterns, Jefferson's fracture, is a compression fracture of C1 with bilateral fracture lines in both the anterior and posterior arches. The hallmark finding in this injury is the tendency of the lateral masses to migrate laterally.

In stable type I fractures the net displacement of the lateral masses is less than 7 mm and in unstable type II fractures-with a torn or avulsed transverse ligament-more than 7 mm .[(18)]

Magnetic resonance imaging (MRI) can show transverse ligament ruptures and avulsions more reliably and thus provide more precise information on biomechanical stability in these injuries. [19]

Atlanto-axial (C1/2) dislocations can occur in three distinct patterns: a rotatory dislocation of the facets, one anteriorly and one posteriorly, an anterior dislocation due to transverse ligament rupture or odontoid process fracture , or a posterior dislocation due to C1 anterior arch fracture or odontoid process fracture.

Fielding classified the rotatory dislocations into four types, based on severity:

type I rotatory fixation without subluxation, type II rotatory fixation with unilateral 3 to 5 mm facet dislocation, type III with bilateral facet dislocation greater than 5 mm, and type IV rotatory fixation with bilateral posterior dislocation. [20]

Type I injuries can occur within physiologic ROM without ligamentous injury, types II and III with ligamentous injuries, and type IV in conjunction with odontoid process insufficiency (fracture, rheumatoid erosions).

The axis (C2) is the most frequently (23.5–23.9%) injured cervical vertebra in blunt trauma [16,21] and relatively more often in patients aged over 65. [21]

Odontoid process (dens) fractures, which account for 7.7% of CSI and are present in 11% of patients with CSI, [16] are the most common upper CSI. The stable type I [22] fractures alar ligament distractive avulsion of the odontoid tip account for 5% of odontoid fractures, and the unstable type II fractures-flexion or extension injuries with a fracture of the odontoid base for 57% of odontoid fractures.

Type III fractures account for 36% of odontoid fractures (16), are located in the area of the vertebral body, and are usually considered to be relatively stable injuries.

Hangman's fractures, i.e., traumatic spondylolisthesis of the axis account for 9.6% of axis fractures (16). As with most CSI, several classifications co-exist.

The classification proposed by Effendi (1981) has gained the widest acceptance (23), describing type I injury as a fracture through both pars interarticularis with less than a 3- mm displacement , type II injuries have more than a 3-mm displacement, and type III injuries have an additional C2/3 facet joint displacement.

All three types are believed to result from hyperextension. A later refinement of the classification (Levine and Edwards 1985) includes subtype IIA, a hyperflexion injury with mainly angular displacement due to PLL rupture. (24)

Lower Cervical Spine and Cervicothoracic Junction (C3–Th1)

Fractures of C3 and C4 are uncommon, accounting for 4.2% and 7.0% of cervical spine fractures. Fractures occur more commonly in C5 (15.0%), C6 (20.2%), and C7 (19.1%) and similarly, dislocations and subluxations occur most often in C4/5, C5/6, and C6/7 interspaces (16.4, 25.1, and 23.4% of displacements) and only rarely (3.9% of displacements) in the C7/Th1 interspace (16). Isolated injuries that do not generally need any treatment are isolated spinous and transverse process fractures, wedge compression fractures (with less than 25% compression), avulsion fractures without ligamentous injury, end plate fractures, osteophyte fractures, and trabecular fractures. [16]

Patients with spinal stenosis and intervertebral disk disease are most susceptible to Spinal cord injury without radiographic abnormality, and one-third of the patients have central cord syndrome: an incomplete SCI with motor impairment predominantly affecting the upper extremities, sensory loss below the injured level, and bladder dysfunction. [25]

Hyperflexion injuries comprise of a relatively heterogeneous group of CSI, in which the injury pattern is modified not only by the magnitude of the force, but also by co-existing additional force vectors. Hyperflexion causes compression of the anterior column structures and distraction of posterior column structures, causing posteriorly both ligamentous injuries and fractures of the spinous processes and laminae. Addition of more force or a distractive force vector increases ligamentous injury, starting posteriorly, sufficient to allow dislocation or fracture of the facet joints; this may also be unilateral, when the flexion is oblique or with a rotational force vector added. The instability criteria of White et al. (1975) are designed for evaluation of biomechanical stability in such injuries [6]. Unilateral locked facet dislocation without a fracture can be biomechanically stable, but such injuries can be considered clinically unstable, because the anatomical conditions may cause nerve root compression and injury. [26]

After reduction of the dislocation, the motion segment also becomes biomechanically Unstable [27]. Injuries of the intervertebral disk are common in both Uni- and bilateral facet dislocations. Bilateral facet dislocations are associated with extensive ligamentous disruption, frequently involving both

ALL and PLL, while in unilateral dislocations, ALL and PLL often remain intact. [26]

Compression and compression-flexion cause compression of the anterior and middle column structures and, with increasing flexion, distraction of the posterior column structures. A wedge fracture of the vertebral body, usually biomechanically stable, is the least severe of the compression-flexion injuries. More forceful compression causes a burst fracture, which frequently involves not only anterior and middle column structures, but also the posterior column. Addition of more flexion to the compression creates a flexion teardrop fracture-a compressive fracture of the vertebral body with a typical triangular fragment from the anterior-lower corner.

This injury also includes shearing across the intervertebral disk, retrolis thesis, and frequently a distractive posterior column injury that is seen as fractures or ligamentous ruptures. [28,29]

Hyperextension causes extension teardrop fracture, ALL rupture or traumatic retrolisthesis. These injuries begin as ligamentous ruptures of the anterior column and extend-with increasing hyperextension-posteriorly as intervertebral disk rupture and in severe cases as PLL, ligamentum flavum, or facet joint ruptures.

In these injuries, spinal canal stenosis, as a congenital anomaly or as a result of spondylosis, predisposes to SCI.

Great care should be taken not to confuse extension teardrop fractures with the formerly described flexion teardrop fracture, because extension teardrop-an ALL avulsion of the anterior-inferior vertebral body corner-is significantly more stable.

EPIDEMIOLOGY OF CSI AND SCI

It has been reported that the cervical spine is injured in 2.4% of blunt trauma victim [(16)]. Certain demographic factors are known to be associated with cervical spine injury; age greater than 65 years, male sex and white ethnicity[(31)].

In a cross-sectional study only one population-based study of spinal column injuries has been performed in a complete population. Hu et al. (1996) found the annual incidence of spinal fractures in Manitoba, Canada to be 640 per million, 290 per million requiring hospitalization. [(31)]

Cervical spine injuries account for 33% of the fractures, with two peaks, one in the second and third decade of the male population and another in elderly females. While accidental falls account for the greatest number of CSI, with motor vehicle accidents (MVA) second in occurrence. [(31)]

In another study, which is the largest multi – center trial to date, the most common site of injury was the atlantoaxial region, with the most commonly injured levels in the subaxial cervical spine being C6 &C7. [(16)]

One third of the injuries identified in this study were considered clinically insignificant. Despite this surprising number of clinically minor injuries, the cervical spine injuries remain the most common level for spinal cord injury (SCI), representing 55% of SCIs [(32)], the incidence of traumatic CS-FX in a general Norwegian population to be 11.8/100.000/year. A male predominance was observed , and the incidence increased with advancing age . Falls were the most common trauma mechanism, and SCI was observed in 10% of those included. The 1- and 3-months mortality rate were

7% and 9%, respectively. The incidence of open surgical fixation of CS-FX in this population is 3.1/100.000/year.

The National Emergency X-radiography Utilization Study (NEXUS), searching for clinical decision rules for cervical spine clearance (33,16,30,34,25,21) provided valuable data on CSI epidemiology in blunt trauma of 34069 patients with blunt trauma and suspected CSI, 818 (2.4%) were diagnosed with CSI.

The majority of CSI cases occur in those aged 20 to 50 Reported age distribution of CSI incidence per admission showed three distinct segments: a relatively low incidence (< 1%) in children, a plateau of 2.2% incidence in adults aged 18 to 64, and a higher 4.6% incidence per admission in those aged 65 years or more.

Those over 65 have relatively more injuries of the C1 and C2 segments, especially the odontoid process (16,21), typically sustained in a simple fall from standing height (35). The severity of head injury correlates with incidence of CSI: 1.4% in patients with Glasgow Coma Scale (GCS) score 13 to 15, 6.8% in GCS 9 to 12, and 10.2% in GCS < 8. (36)

DIAGNOSIS OF CSI

Clinical Cervical Spine Clearance

The clinical decision rules studied and validated by the NEXUS group are highly accurate for the task for which they were designed: In some patients they can rule out virtually any unstable CSI. (33,37)

The NEXUS criteria for clinical exclusion of CSI are the following: no evidence of intoxication, no posterior midline neck tenderness, no painful distracting injuries, normal level of alertness, and no focal neurologic deficit. Patients who meet all five criteria have a very low risk for CSI (99.8% negative predictive value).

The sensitivity of the decision rule is high (99.0%), but due to its low specificity (12.9%), its positive predictive value is low (2.7%). Use of the NEXUS criteria could, in theory, reduce the number of radiographic examinations of the cervical spine by approximately 20%. [37]

RADIOGRAPHY

Despite advances in computed tomography (CT) and MRI technology, plain radiography is still the fundamental primary imaging method for CSI.

In plain radiographic clearance of the cervical spine, three views including lateral, Anteroposterior, and open-mouth odontoid are the minimum requirement. [38]

Utilization of supine oblique views in addition to these three views does not significantly improve detection of CSI [39,40]. It may, however, improve diagnostic confidence [41] and more specifically the confidence of excluding fractures. [40]

Computed Tomography and Multi-Detector Computed Tomography

Helical CT is an accurate and reliable imaging modality widely used in modern emergency radiology. [42]

In cervical spine trauma, CT is both cost and time-effective, and has been recommended for screening in high-risk patients. [43,44,45]

Clinical decision rules can help to identify those blunt trauma patients at higher risk for CSI. [44,46]

Helical CT can detect CSI at a 95 to 98% sensitivity [47,48,49], and 93 to 100% specificity [48,50]. Whereas detection of mild vertebral body compression fractures and mild subluxations are known pitfalls [49], odontoid fractures are reliably detected [51,49]. 3D surface reconstruction images do not generally enhance diagnostic accuracy, but may be of value in interpretation of rotational CSI [52]. CT is unreliable in assessment of ligamentous injuries and SCI [49].

MRI

MRI has the ability to visualize soft-tissue injuries and may serve as a complement to radiography and CT. It can aid in assessment of transverse ligament injuries in Jefferson's fractures [53], of intervertebral disk and PLL integrity in type II and III hangman's fractures, ALL and intervertebral disk integrity in hyperextension injuries [54], posterior ligaments and facet joints in hyperflexion injuries [55,56], and also of post-traumatic disk herniation and hematoma [57,58].

CLASSIFICATION OF CSI

Five main classification systems for acute subaxial cervical trauma were found (Holdsworth's classification, Allen's classification, Harris' classification, the subaxial cervical spine injury classification system (SLIC) and the cervical spine injury severity score (CSISS).

The complexity of some CSIs indicates the presence of several different injury mechanisms in a single trauma. [59]

By comparing the classification systems, it is evident that older classification systems (Holdsworth, Allen et al and Harris et al) have focused on the mechanisms of injury [15,60,61] , while newer classification systems (Vaccaro et al, Moore et al) have discarded this in favor of radiological findings and, [62,63] in the case of Vaccaro et al, neurologic status. [64]

Comparisons of the classification systems show that there are clear advantages to the system presented by Vaccaro et al (SLIC scale) compared to previous systems because it may be used to guide treatment, however it has lower reliability and validity compared to the Allen and Harris systems, none of these classification systems has gained uniform acceptance among researchers or clinicians.

Assessment of spinal stability and instability are essential in conjunction with all classification systems, as choice of treatment in each specific type of CSI is based on whether the injury is considered biomechanically and clinically stable or not.

Classification by injury level to upper (C0–2) and lower (C3–7) CSI is well established, because the anatomical and biomechanical properties and thus also the type and significance of injuries-of the two uppermost cervical vertebra significantly differ from those in the third to seventh vertebra.

In most studies and also clinically, a combination of several classification methods is used concurrently. For example, the injury is described by both level and trauma mechanism followed by morphological description of the injury and finally an assessment of stability

TREATMENT OPTIONS AND CLINICAL RESULTS IN CSI

Occipitocervical Junction and Upper Cervical Spine

In neurologically uncomplicated fractures of the occipital condyles, external stabilization using a stiff collar is sufficient [64]. Because untreated and conservatively treated atlanto-occipital dislocations are often complicated by neurological deterioration, surgical internal stabilization is recommended. [65,66]

Isolated fractures of the anterior or the posterior arch of the atlas and combined anterior and posterior arch fractures with an intact transverse ligament (type I injuries) have been successfully treated with rigid collars, sternooccipitomandibular immobilizing devices, and HTV. No study has provided evidence for using one of these devices over the other. [67]

For combined anterior and posterior arch fractures with evidence of transverse ligament rupture (including type II Jefferson's fractures), HTV and surgical stabilization are the main treatment options, yet no evidence exists as to their performance relative to each other. [67]

Type I odontoid fractures are usually stable and clinically non-problematic Avulsion fractures of the odontoid process tip [68], while only limited knowledge of such injuries yet exists [69].

Type II odontoid fractures are unstable, often failing to unite by conservative treatment [69]. The optimal treatment—external stabilization or surgery—and indications for early surgery are controversial. [70]

Main treatment options include HTV for all type II fractures [71], for non-displaced fractures only [72,73], and primary surgical treatment. [74,75,76]

Treatment by cervical brace alone provides insufficient stability and produces lower osseous union rates than does HTV [77]. While HTV provides an immobilization superior to that of a soft collar, a Miami J collar, or a Minerva brace [78]. It cannot completely immobilize the cervical spine; it allows some movement, especially in the upper cervical spine. [79]

Surgical treatment, meaning either posterior fusion with bone grafting and wires [80], posterior atlanto-axial screw fixation, [81] or anterior screw fixation, is effective but technically demanding and is associated with complications [76,82]. It is well accepted that surgical treatment is preferable for patients for whom conservative treatment cannot be undertaken or conservative treatment has failed.

In type III fractures, surgical treatment is generally unnecessary, as most heal well by conservative treatment such as HTV or Minerva cast. [68,83,77,70]

A cervical collar may, however, provide insufficient immobilization for some type III fractures. [84]

Most hangman's fractures, being most commonly type I, heal by conservative treatment with a rigid cervical collar or a HTV.

Surgical stabilization, either posterior or anterior, is an option in cases with severe dislocation or angulation, i.e., type II, IIA, and III injuries. [70]

Lower Cervical Spine And Cervicothoracic Junction

A relatively safe and efficient way of reducing cervical spine displacements in awake patients is skull traction with progressively increasing weights-without general anesthesia [85,86]. Patients with unilateral facet dislocations should be initially treated with initial halo traction in an attempt to obtain reduction. [87]

They also recommended HTV in neurologically intact patients in whom closed reduction was successful. In contrast, Hadley et al. (1992) concluded that facet dislocations without apparent fracture do not respond well to conservative treatment. [88]

Surgical treatment of cervical spine dislocations allows earlier mobilization of the patient and shortens the primary hospital stay. [89]

In posterior internal stabilization (Omeis et al. 2004) [90], numerous fixation methods have been used successfully: interspinous or interlaminar fixation such as Rogers interspinous wiring [91], Bohlmann's modification of the Rogers wiring with addition of bone grafting and triple-wires [92], the interspinous Daab plate [93], and interspinous or sublaminar wiring with multistrand cables. [94]

Other methods are direct fixation of lateral masses with plates and screws(95), and various instrumentation utilizing rods and screws. [96,97]

Triple-wire fixation and direct fixation of lateral masses with plates are biomechanically equally stable [98], but lateral mass fixation with screws and rods may be even more efficient in preventing pseudoarthrosis. [97]

Posterior fixation can stabilize one- and two-column posterior injuries, but without additional anterior stabilization these are insufficient for three-column injuries. [99]

The era of anterior instrumentation began when Bohler (1967) reported the use of anterior plate fixation in cervical spine fractures.

Screw loosening in such instrumentation occurs in approximately 5% of cases 100 Anterior plates can stabilize not only compressive flexion and extension injuries, but also distractive flexion injuries (dislocations and fracture dislocations), by either non-locking [101], or locking cervical spine plates. [102]

RESULTS

Table 1: Distribution of patients according to age**.**

Age /year	No.	%
≤20	5	10.2
21 – 25	9	18.4
26 - 30	7	14.3
31 - 35	5	10.2
36 - 40	2	4.1
41 - 45	6	12.2
46 – 50	7	14.3
≥50	8	16.3
Total	**49**	**100**

Table 1 showed the distribution of patients had cervical spine injury to the age, it ranges from age of 18 years to 77 years, the mean was 36.9 years, standard deviation = 13.9 years and median was 33 years.

It is obvious that more than half of them (53.1%) were ≤ 35 years.

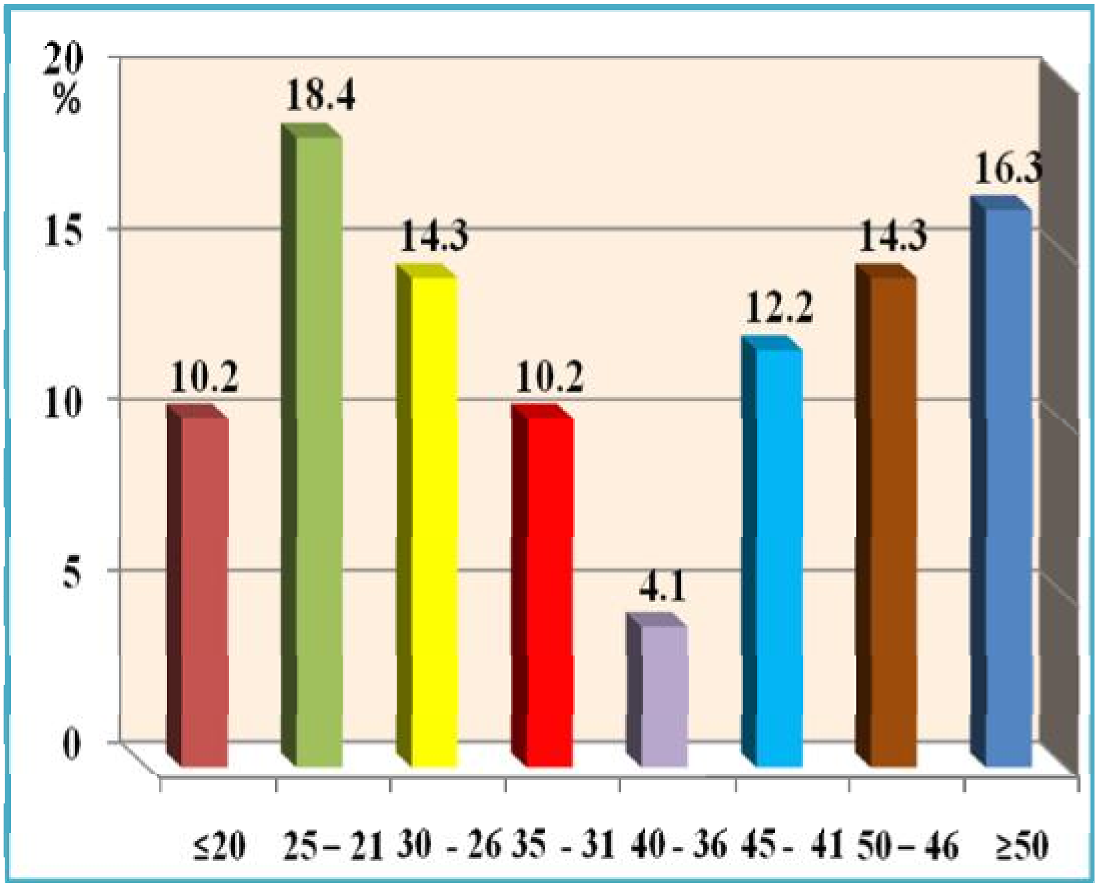

Fig. 1 : **Distribution of Patients According to Age.**

Table 2 : Distribution of patients according to the sex.

Sex	**No.**	**%**
Male	39	79.6
Female	10	20.4
Total	**49**	**100**

Table 2 showed that most of our patients in this study were men (79.6%) and 10 were women. This may be due to the type of activities resulting in such type of injury which are more practiced by men than women like diving.

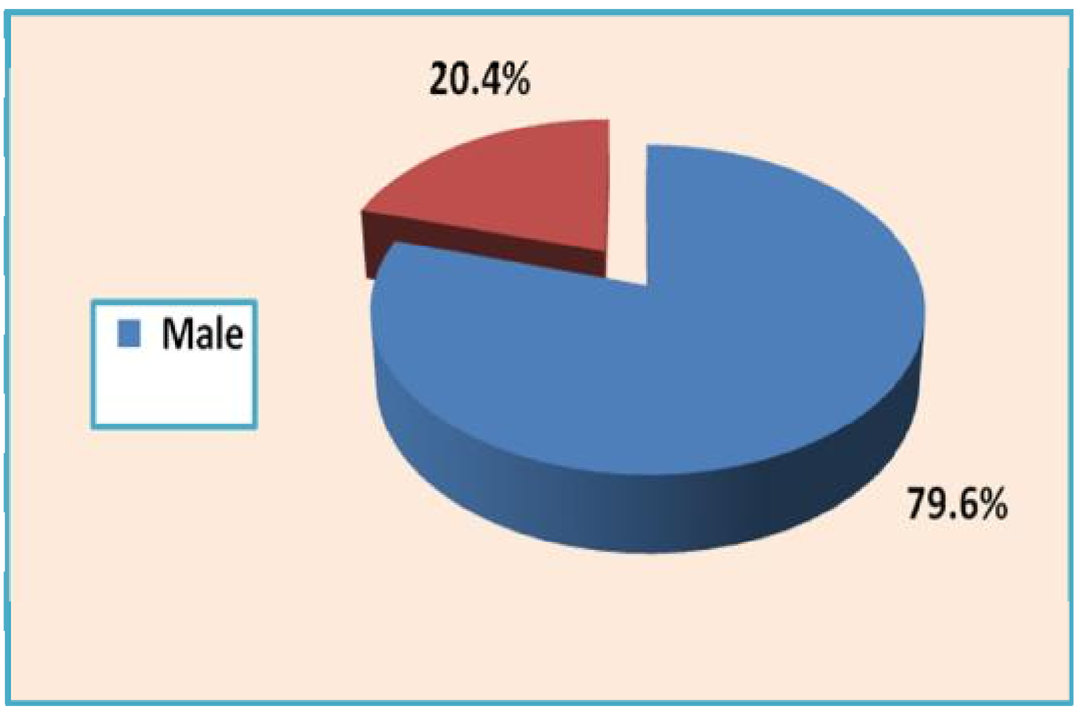

Fig. 2 : **Distribution of Patients According to the Sex.**

Table 3 : Distribution of patients according to the department admitted to.

Department	No.	%
ICU	16	32.7
Word	25	51
NSSR	8	16.3
Total	**49**	**100**

Table 3 describes that about half of our patients were admitted to the general word of the department and those were of good general condition while near 1/3 rd. (32.7%) were of critical general condition and needed to be admitted to the intensive care unit (ICU) , but 8 patients (16.3%) were kept in observation room of Neurosurgery department (NSSR), for a while before surgery and then transferred postoperative to the word.

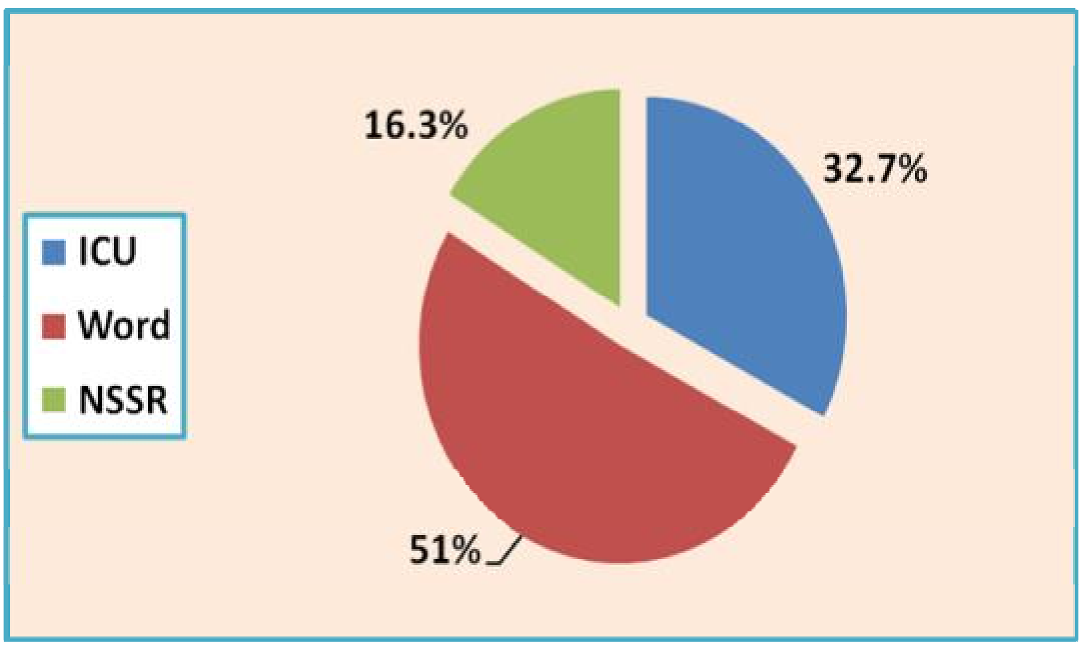

Fig. 3 : **Distribution of Patients According to the Department Admitted**

Table 4 : Distribution of patients according to level of conscious.

Level of Conscious	**No.**	**%**
Conscious	46	93.9
Unconscious	3	6.1
Total	**49**	**100**

Table 4 showed that most of our patients were conscious (93.9%) on admission and only 3 patients were admitted unconscious usually because of associated head trauma.

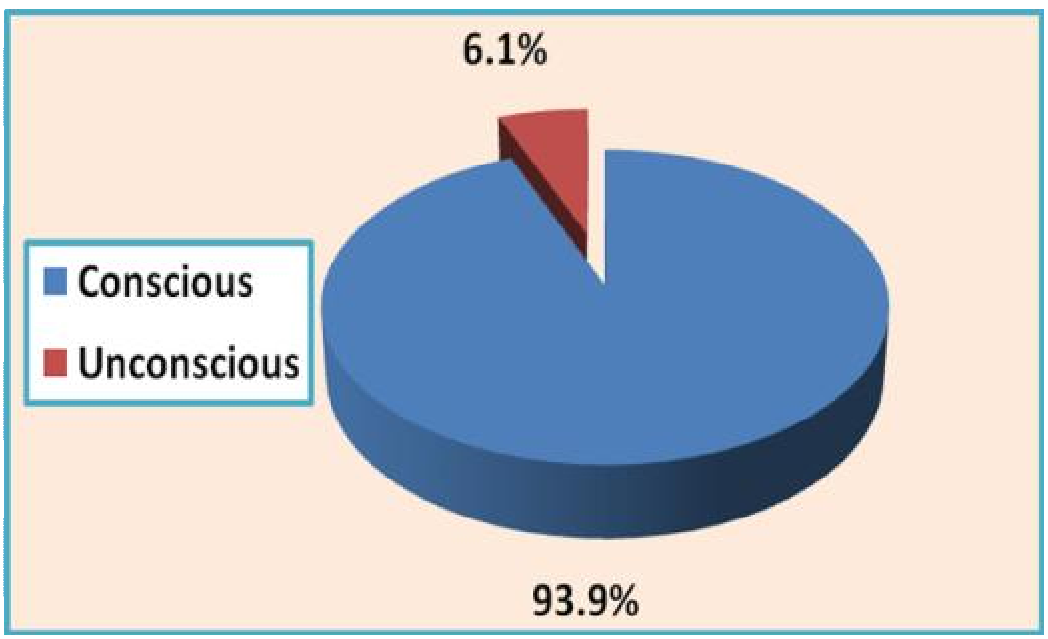

Fig. 4 : **Distribution of Patients According to Level of Conscious**

Table 5 : Distribution of patients according to the months.

Months	**No.**	**%**
January	4	8.2
February	5	10.2
March	3	6.1
April	4	8.2
May	3	6.1
June	4	8.2
July	7	14.3
August	3	6.1
September	9	18.4
October	1	2
November	3	6.1
Dec.	3	6.1
Total	**49**	**100**

Table 5 revealed that the cervical spine injuries occurred more in July and September may be because of holiday seasons in Benghazi.

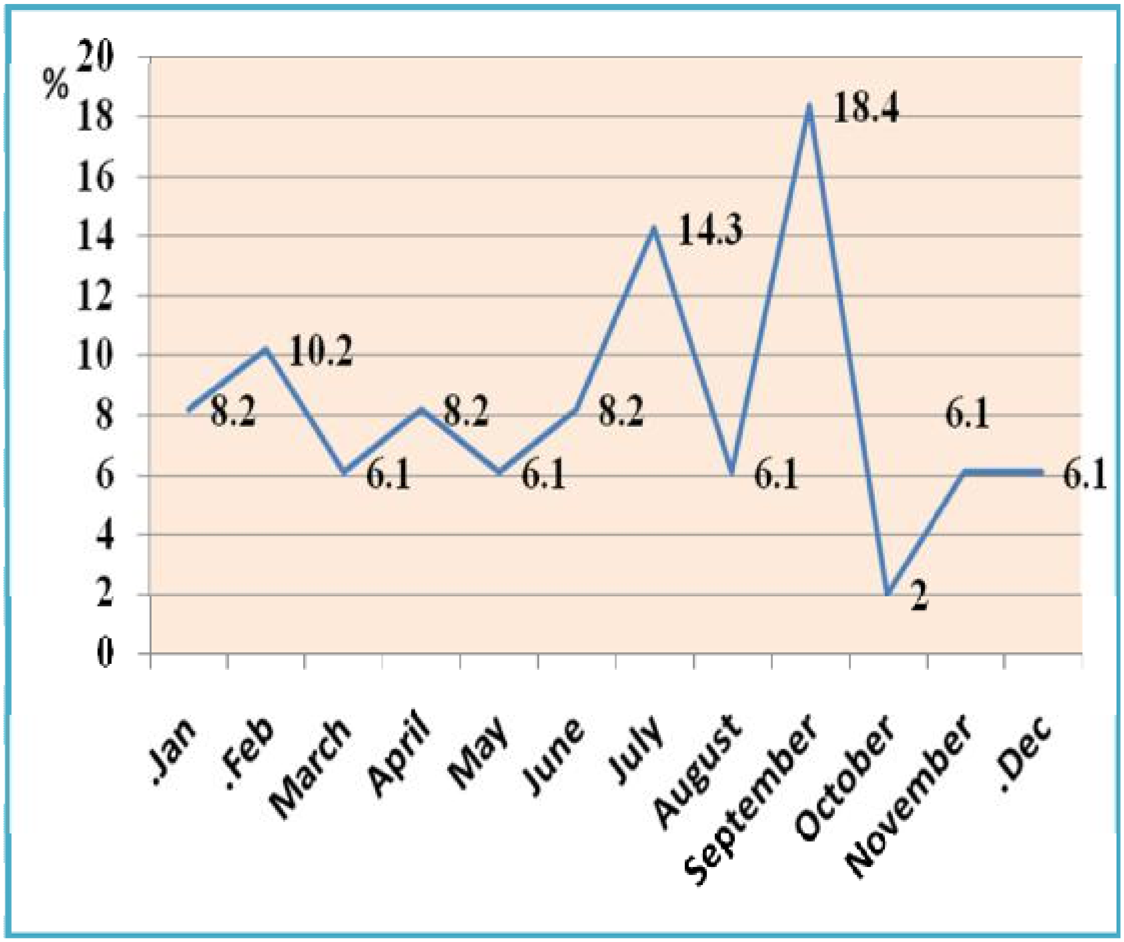

Fig. 5: **Distribution of Patients According to the Months**

Table 6: Distribution of patients according to the seasons .

Seasons	No.	%
Spring	10	20.4
Summer	14	28.6
Autumn	13	26.5
Winter	12	24.5
Total	**49**	**100**

Table 6 described again that the cervical spine injuries occurred in Summer and Autumn (55.1%). This explains that the injuries occurred more on the holiday seasons in Benghazi.

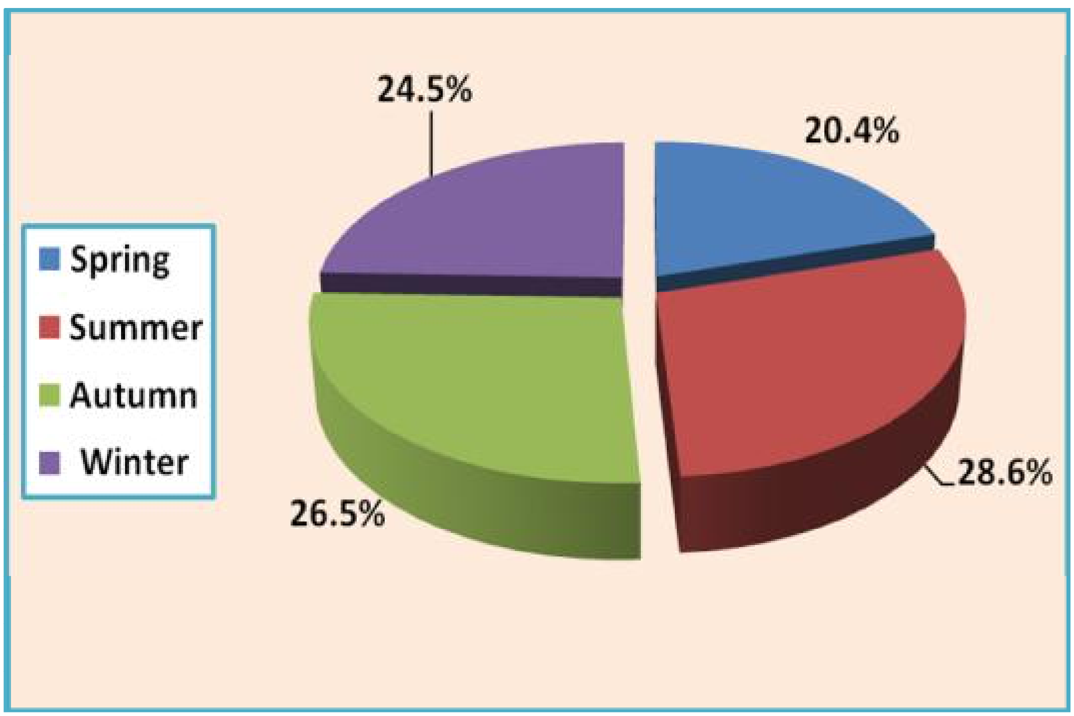

Fig. 6 : **Distribution of Patients According to the Seasons**

Table 7 : Distribution of patients according to cause of injury.

Cause of Injury	No.	%
RTA	32	65.4
Fall down	8	16.3
Diving	7	14.3
Bomb explosion	1	2
Hanging	1	2
Total	**49**	**100**

Table 7 showed that the most common cause of trauma was the road traffic accidents (65.4%), then the falling down (16.3%) and diving (14.3%) while hanging was reported in one case and bomb explosion in another one case.

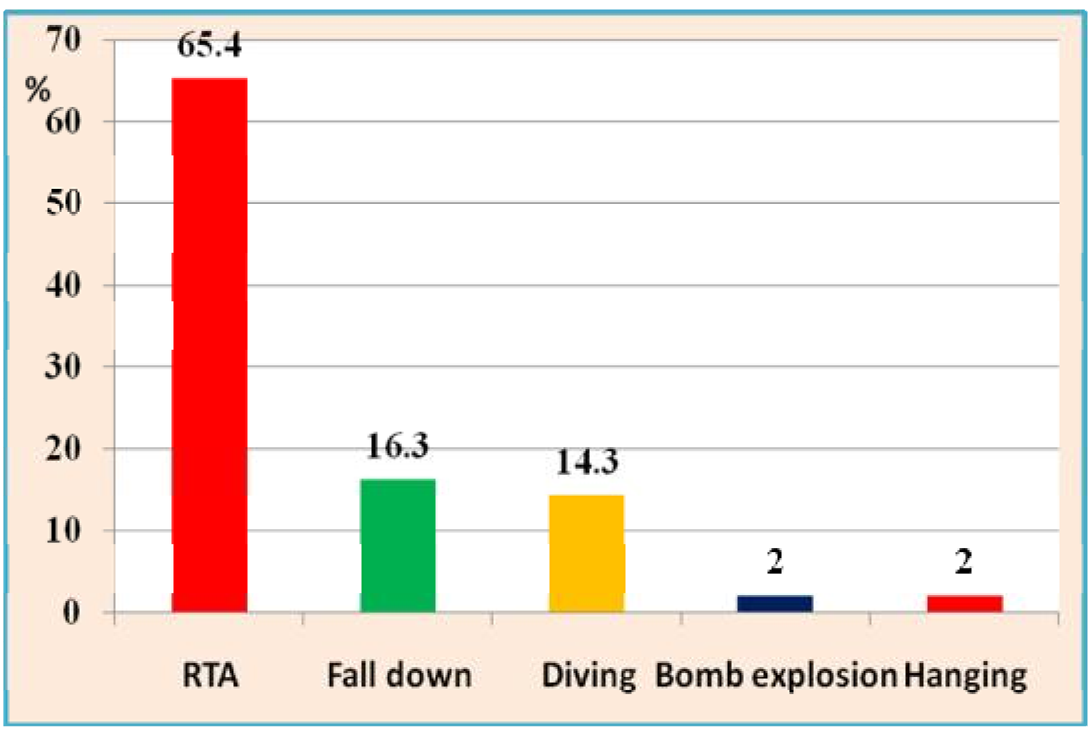

Fig.7 : **Distribution of Patients According to cause of Injury**

Table 8 : Distribution of patients according to age and cause of injury.

Age/years	Cause of injury									
	RTA		Fall down		Diving		Others		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
≤ 20	1	3.1	0	0	4	57.1	0	0	5	10.2
21 – 25	5	15.6	0	0	3	42.9	1	50	9	18.4
26 - 30	6	18.8	0	0	0	0	1	50	7	14.3
31 - 35	5	15.6	0	0	0	0	0	0	5	10.2
36 – 40	2	6.2	0	0	0	0	0	0	2	4.1
41 - 45	6	18.8	0	0	0	0	0	0	6	12.2
46 – 50	6	18.8	1	12.5	0	0	0	0	7	14.3
≥ 50	1	3.1	7	87.5	0	0	0	0	8	16.3
Total	**32**	**100**	**8**	**100**	**7**	**100**	**2**	**100**	**49**	**100**

Table 8 found the relations between the age and the cause of trauma in 49 Patients with cervical spine injuries. It revealed that road traffic accident was an important cause of CSI In both young and middle age groups (≤ 50 years). While falling down was an important cause for CSI in patients > 50 years of age. Diving was an obvious cause of trauma in patients ≤ 25 years.

Table 9 : Distribution of patients according to cause of injury and sex.

Cause of injury	**Sex**					
	Male		**Female**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
RTA	24	61.6	8	80	32	65.4
Fall down	7	17.9	1	10	8	16.3
Diving	7	17.9	0	0	7	14.3
Others	1	2.6	1	10	2	4
Total	**39**	**100**	**10**	**100**	**49**	**100**

Table 9 was revealing the relation between the patient gender and the cause of trauma leading to CSI. It is clear that 80% of women had the injury because of RTA, one hanging and one falling down, since diving is not a hoppy of women in our community.

Regarding men, RTA again was the most common cause of trauma (61.6%) followed by falling and diving (17.9% each).

Table 10 : Distribution of patients according to type of injury.

Type of injury	**No.**	**%**
Fracture	33	67.4
Sublaxation	15	30.6
Dislocation	1	2
Total	**49**	**100**

Table 10 presented that the nature or type of injury among 49 patients of this study. Cervical spine factures was the most common type of injury in 67.4% of cases, then subluxations in 30.6% of them while dislocation was diagnosed in one case.

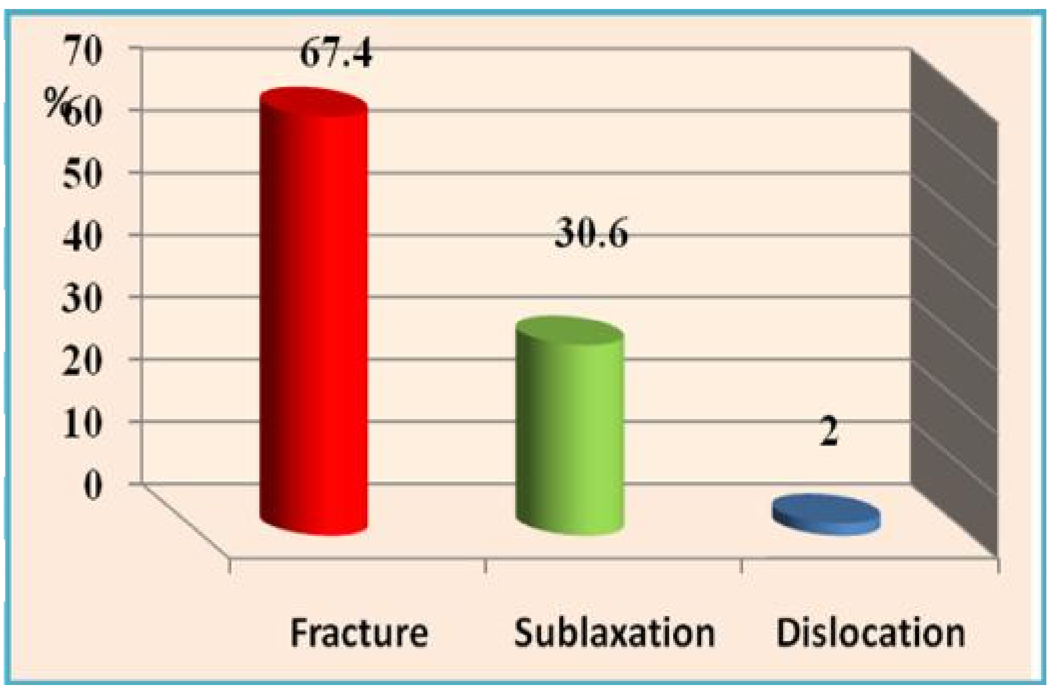

Fig. 8 : **Distribution of Patients According to Type of Injury**

Table 11 : Distribution of patients according to cause of injury and type of injury.

Cause of injury	Type of injury							
	Fracture		**Sublaxation**		**Dislocation**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
RTA	25	78.1	7	21.9	0	0	32	100
Fall down	2	25	6	75	0	0	8	100
Diving	4	57.1	2	28.6	1	14.3	7	100
Others	2	100	0	0	0	0	2	100
Total	**33**	**67.4**	**15**	**30.6**	**1**	**2**	**49**	**100**

Table 11 found the relation between the cause of trauma and the nature or type of injury. It is clear that RTA was an important cause of cervical spine fracture in 78% of patients, while falling down was an important cause of cervical spine sublaxation (75%) but diving may result in fractures (57%) or sublaxation (28.6%). Hanging and bomb explosions both were the cause of cervical spine fractures..

Table 12 : Distribution of patients according to level of injury .

Level of injury	No.	%
C2	14	28.6
C2- C3	2	4.1
C3	1	2
C3 -4	2	4.1
C4	4	8.2
C4 –C5	5	10.2
C5	8	16.3
C5 –C6	8	16.3
C6	2	4.1
C6 – C7	2	4.1
C7	**1**	**2**
Total	**49**	**100**

Table 12 revealed that the most frequent cervical spine level was C2 in (28.6%) of cases, followed by C5: 8 cases (16.3%) and C5-C6 : 8 cases (16.3%) then C4 or C4-C5 levels (8.2% % 10.2%).

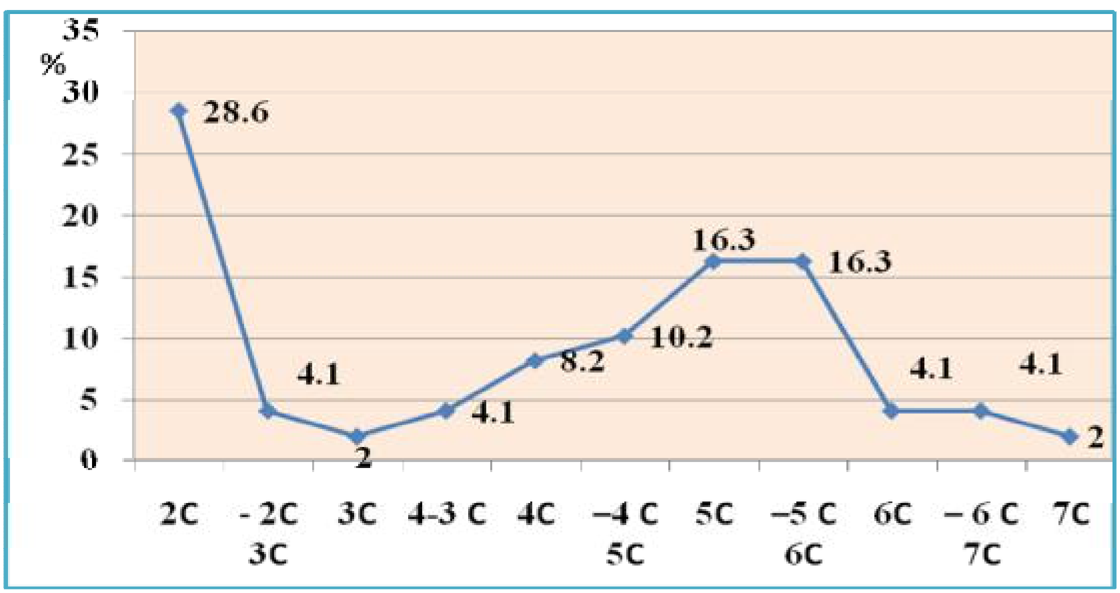

Fig. 9 : **Distribution of Patients According to Level of Injury**

Table 13 : Distribution of patients according to level of injury and type of injury.

Level of injury	Type of injury							
	Fracture		**Sublaxation**		**Dislocation**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
C2	14	42.5	0	0	0	0	14	28.6
C2 - C3	1	3	1	6.7	0	0	2	4.1
C3	1	3	0	0	0	0	1	2
C3 - C4	0	0	2	13.3	0	0	2	4.1
C4	4	12.1	0	0	0	0	4	8.2
C4 - C5	0	0	4	26.7	1	100	5	10.2
C5	8	24.2	0	0	0	0	8	16.3
C5 - C6	2	6.1	6	40	0	0	8	16.3
C6	2	6.1	0	0	0	0	2	4.1
C6 - C7	0	0	2	13.3	0	0	2	4.1
C7	1	3	0	0	0	0	1	2
Total	**33**	**100**	**15**	**100**	**1**	**100**	**49**	**100**

Table 13 presents the nature of trauma to the level of cervical spines. It is obvious that fractures were seen in large number of cervical spine but mostly at level C2 (42.5%) level C5: (24.2%) and levels C6 or C5-C6 (12.2%).

Table 14 : Distribution of patients according to level of injury and cause of injury

Level of injury	Cause of injury									
	RTA		Fall down		Diving		Others		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
C2	12	37.5	0	0	1	14.3	1	50	14	28.6
C2- C3	1	3.1	1	12.5	0	0	0	0	2	4.1
C3	1	3.1	0	0	0	0	0	0	1	2
C3 -4	2	6.3	0	0	0	0	0	0	2	4.1
C4	3	9.4	1	12.5	0	0	0	0	4	8.2
C4 –C5	1	3.1	1	12.5	3	42.8	0	0	5	10.2
C5	6	18.8	0	0	2	28.6	0		8	16.3
C5 –C6	4	12.5	4	50	0	0	0	0	8	16.3
C6	1	3.1	0	0	0	0	1	50	2	4.1
C6 – C7	1	3.1	1	12.5	0	0	0	0	2	4.1
C7	0	0	0	0	1	14.3	0	0	1	2
Total	**32**	**100**	**8**	**100**	**7**	**100**	**2**	**100**	**49**	**100**

Table 14 found the relation between the cause of injury and the level of cervical spine involved RTA was the cause of trauma at almost all levels of cervical spines mostly C2, C5 and C5-C6, while falling down was the cause of injury at levels of C4 or C4-C5; C6-C7 but mostly at the levels of C5-C6 on the other hand diving was the cause of trauma at the cervical spine levels C4-C5 more than other levels.

Table 15 : Distribution of patients according to neurological involvement.

Neurological Involvement	**No.**	**%**
Yes	22	44.9
No	27	55.1
Total	**49**	**100**

Table 15 revealed that 22 patients out of 49 cervical spine injured cases were diagnosed to have neurological involvement (44.9%).

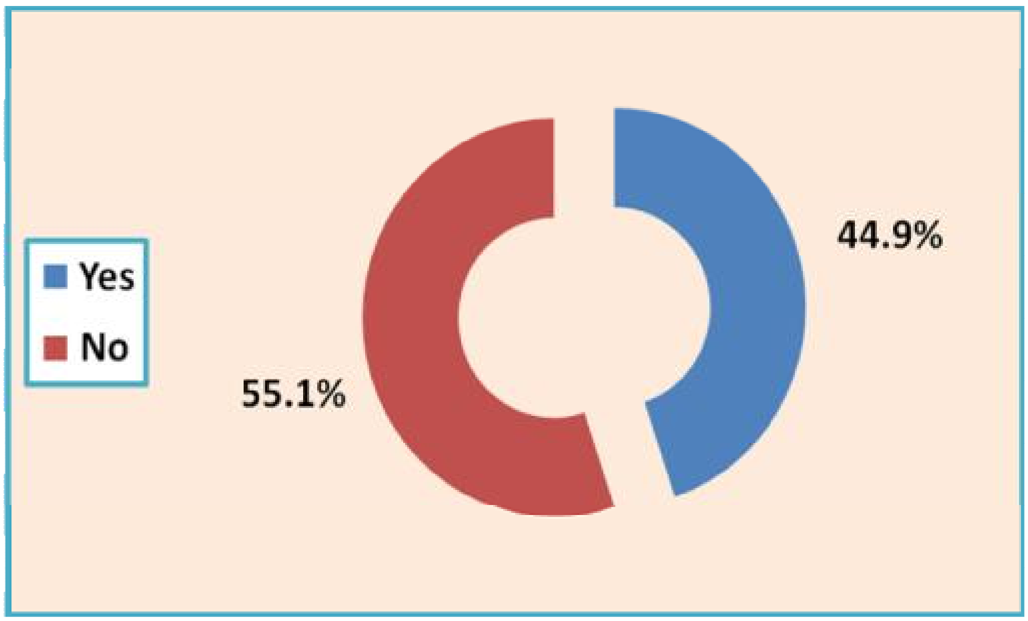

Fig. 10 : **Distribution of Patients According to Neurological Involvement**

Table 16 : Distribution of patients according to neurological involvement.

Type of neurological Involvement	No.	%
Quadriplegic	18	81.8
Central cord syndrome	3	13.6
Others	1	4.6
Total	**22**	**100**

Table 16 showed that out of the 22 neurologically involved cases 18 had quadriplegia (81.8%) with complete loss of muscle power at upper and lower limbs, loss of bowel and bladder functions.

The central cord syndrome with weakness of upper limbs more than that of lower limbs was diagnosed in 3 cases, one case had weakness only at the upper limbs with normal lower limbs (UL: 3/5 & LL : 5/5).

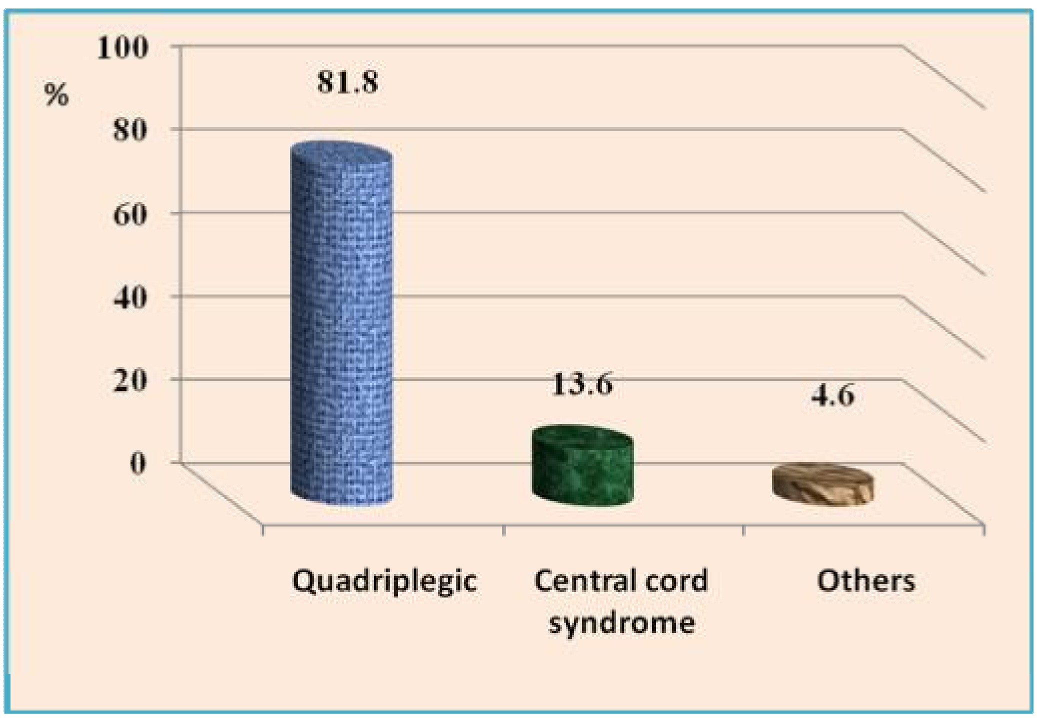

Fig. 11 : **Distribution of Patients According to Neurological Involvement**

Table 17 : Distribution of patients according to causes of quadriplegia.

Causes of Quadriplegia	**No.**	**%**
RTA	10	55.6
Diving	5	27.8
Fall down	3	16.7
Total	**18**	**100**

Table 17 showed the relation between quadriplegic patients and the cause of trauma. It is clear that more than half of our quadriplegic cases were occurred because of RTA (55.6%) and more than 1/4th of them because of diving (27.8%) while falling down was the least cause of quadriplegia (16.7%).

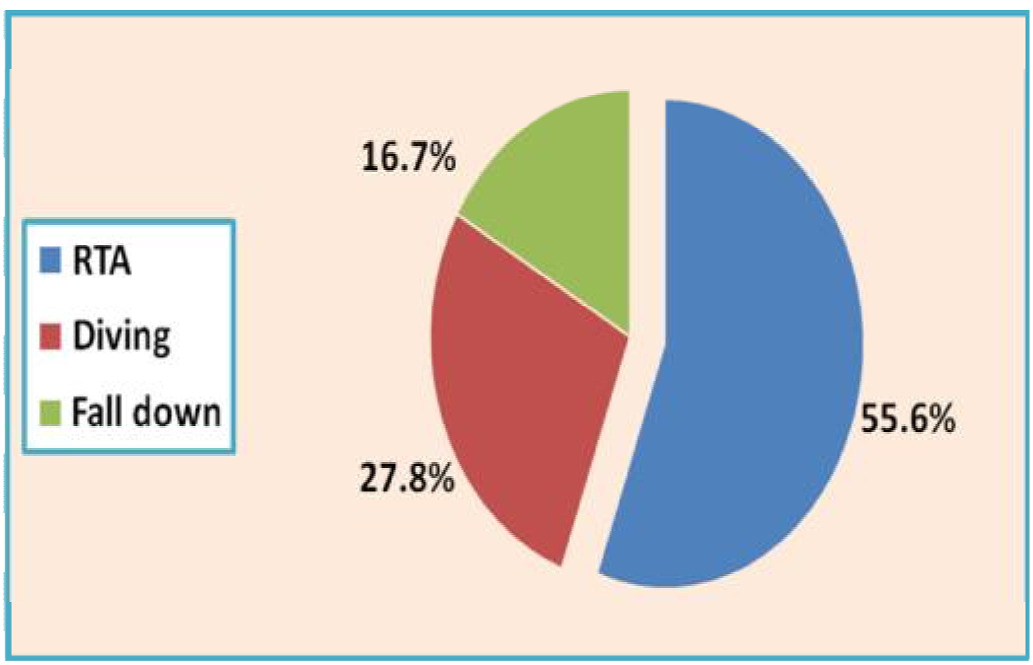

Fig. 12 : **Distribution of Patients According to Causes of Quadriplegia**

Table 18: Distribution of patients according to level of injury and neurological involvement.

Level of injury	Neurological involvement					
	Yes		No		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
C2	0	0	14	51.9	14	28.6
C2- C3	0	0	2	7.4	2	4.1
C3	0	0	1	3.7	1	2
C3 -4	2	9.1	0	0	2	4.1
C4	2	9.1	2	7.4	4	8.2
C4 –C5	5	22.7	0	0	5	10.2
C5	5	22.7	3	11.1	8	16.3
C5 –C6	6	27.4	2	7.4	8	16.3
C6	0	0	2	7.4	2	4.1
C6 – C7	1	4.5	1	3.7	2	4.1
C7	1	4.5	0	0	1	2
Total	**22**	**100**	**27**	**100**	**49**	**100**

Table 18 found the relation between the neurological involvement in this study and the level of cervical spine injured. It is obvious that C2 level trauma had no neurological involvement (14 patients: 28.6%) but the neurological involvement occurs more among patients who had C4-C5, C5 or C5-C6 cervical spine injury.

Table 19 : Distribution of patients according to respiratory involvement .

Respiratory involvement	**No.**	**%**
Yes	13	26.5
No	36	73.5
Total	**49**	**100**

Table 19 showed that 13 patients (26.5%) had respiratory complications and those all were with neurological involvement 12 (92.3%) were discharged alive and one died (7.7%).

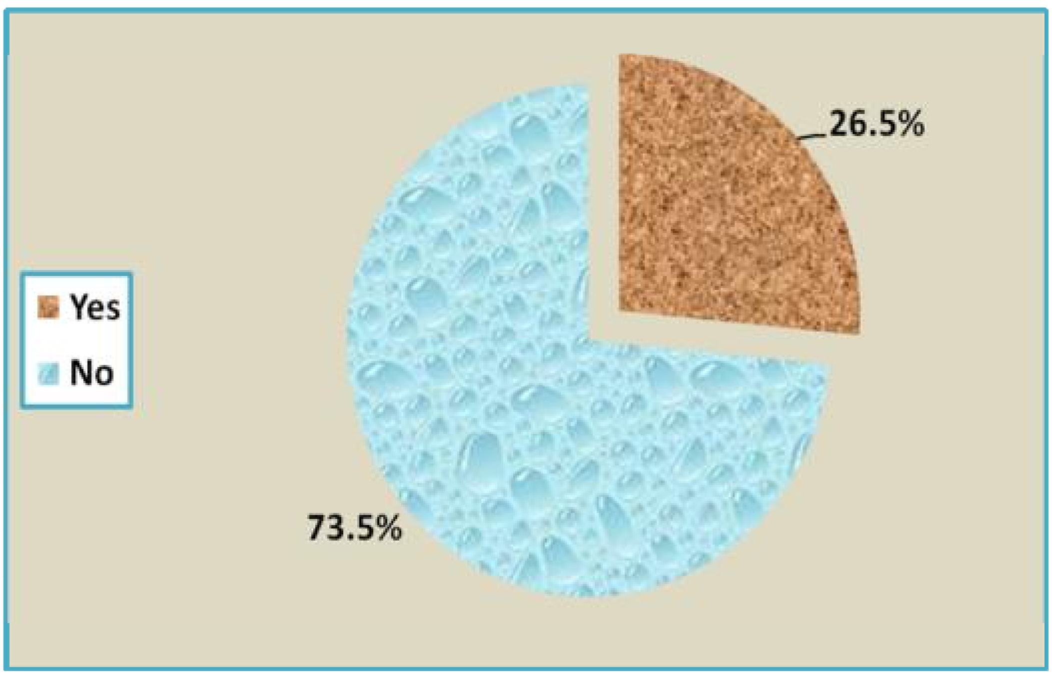

Fig. 13 : **Distribution of Patients According to Respiratory Involvement**

Table 20 : Distribution of patients according to level of injury and respiratory involvement.

Level of injury	Respiratory involvement					
	Yes		No		Total	
	No.	%	No.	%	No.	%
C2	0	0	14	38.8	14	28.6
C2- C3	0	0	2	5.6	2	4.1
C3	0	0	1	2.8	1	2
C3 - C4	2	15.4	0	0	2	4.1
C4	2	15.4	2	5.6	4	8.2
C4 - C5	2	15.4	3	8.3	5	10.2
C5	2	15.4	6	16.7	8	16.3
C5 - C6	4	30.7	4	11	8	16.3
C6	0	0	2	5.6	2	4.1
C6 - C7	1	7.7	1	2.8	2	4.1
C7	0	0	1	2.8	1	2
Total	**13**	**100**	**36**	**100**	**49**	**100**

Table 20 describes the relation between the level of cervical spine injury and the respiratory involvement. It is obvious that the spine level of C5-C6 was the most affected area among patients of respiratory involvement followed by: C3-C4, C4, C4-C5 and C5.

Table 21 : Type of surgery performed for 49 patients with cervical spine injury

Type of Surgery	No.	%
Anterior Odonoid screws fixation	10	20.4
Discectomy, bone graft or cage and fixation	19	38.7
Corpectomy and fixation	20	40.9
Total	**49**	**100**

Table 21 describes the type surgery that performed for 49 patient of cervical spine surgery corpoectomy and fixation for fracture spine was done in 20 cases (40.9%) while discectomy and fixation had performed in another 19 cases (38.7%). For dens fracture type II anterior odontoid screws fixation was performed for 10 cases (20.4%).

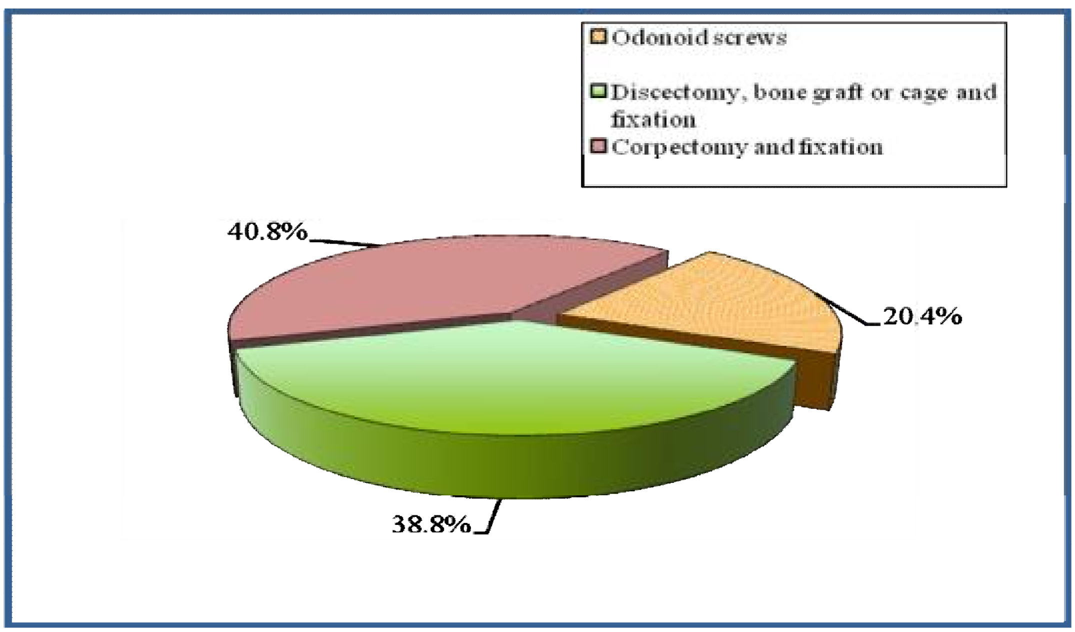

Fig. 14 : **Type of Surgery Performed for 49 Patients with Cervical Spine injury**

Table 22 **:** Condition of patients at discharge.

Condition at discharge	No.	%
Good	27	55.1
With neurological problems	21	42.9
Died	1	2
Total	**49**	**100**

Table 22 showed that more than half of our patients discharged well with no neurological deficits while 21 of them were discharged home with same neurological deficit three patients with central cord syndrome improved shortly after discharge. One patient died at hospital.

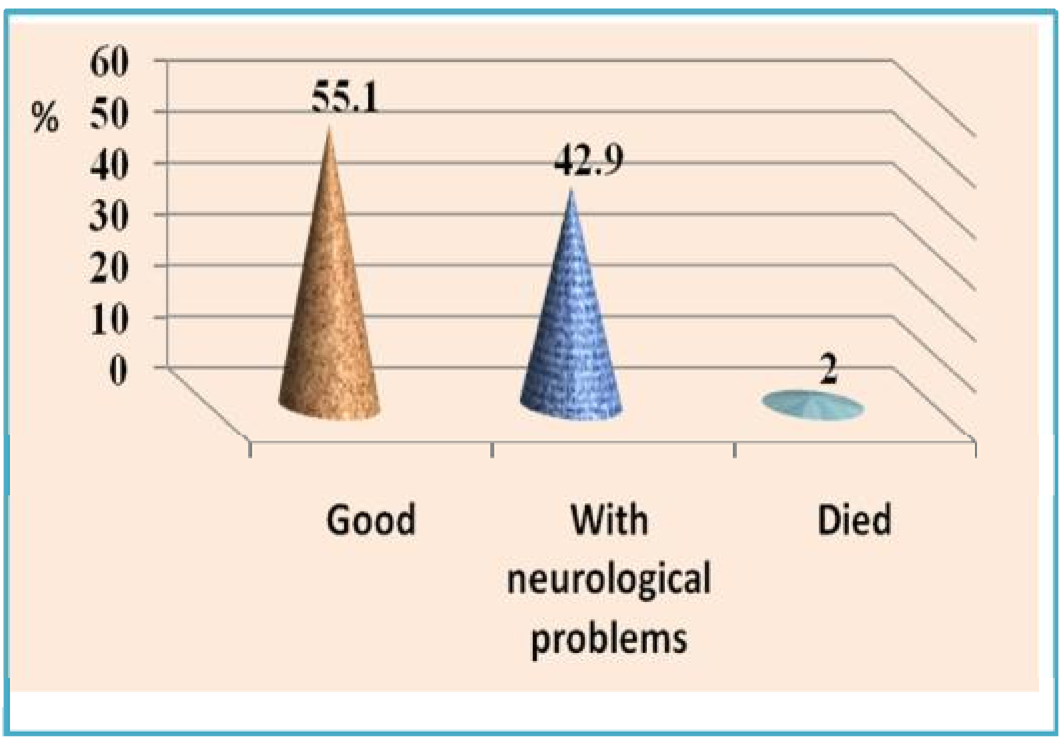

Fig. 15 : **Condition of Patients at Discharge**

Table 23 : Distribution of patients according to duration of hospital stay.

Duration of Hospital Stay/ Days	No.	%
1 – 7	33	67.3
> 7	16	32.7
Total	**49**	**100**

Table 23 describes the total hospital stay of our patients, since most of them were kept in hospital for ≤ 7 days (67.3%) and near 1/3rd were kept for more than that the mean of hospital stay 6.4 days, minimum 3 days and maximum was 12 days.

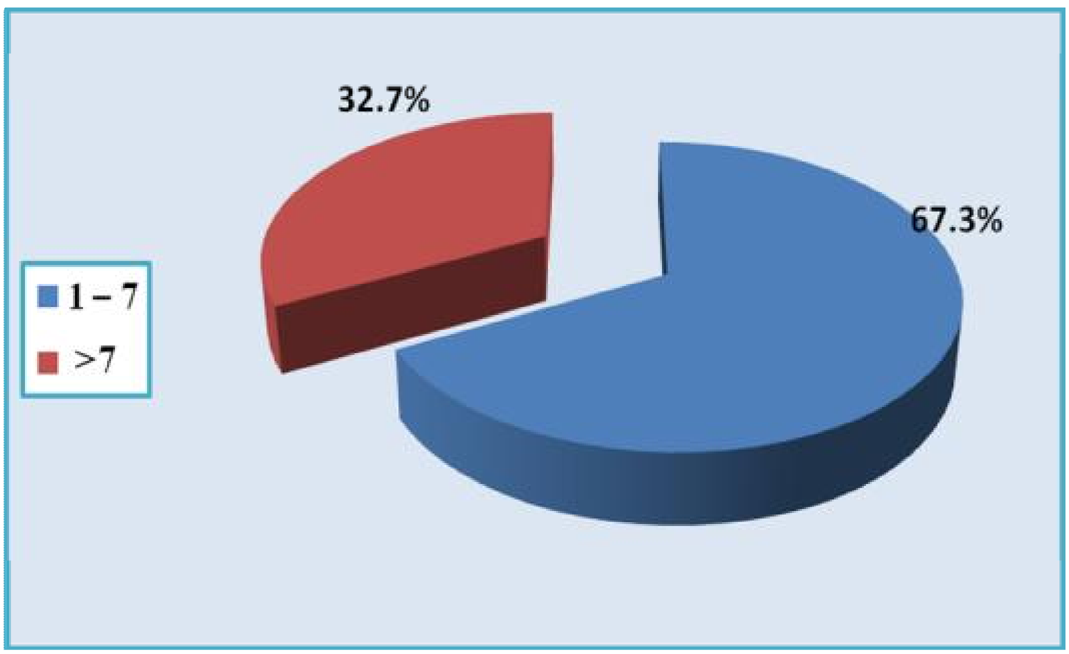

Fig. 16 : **Distribution of Patients According to Duration of Hospital Stay**

30 year male Libyan Neurosurgeon doctor admitted with H/O R.T.A. He was complaining of neck pain and inability to move his limbs O/E: Tone hypotonia in upper and lower limbs, Power of upper and lower limbs were 0/5, Hyporeflexia in upper and lower limbs, sensation up to C5 dermatome.
Anterior cervical corpoectomy and fixation done



Preoperative Preoperative Postoperative

32 year female patient was admitted with H/O R.T.A.
She complains of neck pain and inability to move his limbs and loss of sensation
O/E Tone hypotonia in upper and lower limbs, Power of upper and lower limbs were 0/5, Hyporeflexia in upper and lower limbs, sensation up to C5 dermatome
CT cervical reveals C5-C6 sublaxation

Cranial skull traction applied preoperatively

Anterior cervical discectomy and fixation done for her

Preoperative

Postoperative

24 year male patient was admitted with H/O R.T.A.
He was complaining of neck pain

Patient was conscious, No respiratory involvement, and No neurological deficit

Anterior odontoid screw fixation done for him

Preoperative

Intraoperative

Intraoperative

Postoperative

Postoperative

Postoperative

<u>SUMMARY</u>

1. The mean age of patients had cervical spine injury is 36.9 years with standard deviation = 13.9 years. The youngest 18 years and oldest 77 years - ***Table 1***.

2. Males are a higher risk of cervical spine injury (79.6%) in this study - ***Table 2***.

3. Most of patients were admitted to the word and most of them were conscious - ***Table 3&4.***

4. Most injuries of cervical spines had occurred at Summer and Autumn (between July and September) – ***Table 5&6***.

5. Most of this crisis had occurred due to RTA (65.4%), other causes were fall down and diving - ***Table 7***.

6. Both young and middle age groups were at risk of cervical spine injury due to RTA. In young age group $\leq$ 25 years diving was an additional important cause of trauma, in the other hand falling down was seen to be an important cause of trauma among old age group - ***Table 8***.

7. RTA was an important cause of cervical spine injury in both men and women. Diving as a cause of cervical spine trauma not seen among women – ***Table 9***.

8. Cervical spine fractures was the most frequent type of injury in this study (67.4%), followed by subluxations in 30.6% of cases while dislocations was seen only in one case – ***Table 10***.

9. The cervical spine fractures was seen more among patients who had RTA (78.1) while fall down was the cause of most cases of cervical spine subluxations (75%) - ***Table 11***.

10. The most common level of cervical spine injury was C2 followed by C5 or C5 & C6 – ***Table 12***.

11. Fractures of cervical spines occurs more at level C2 but can occurs at other levels as well, C5 was the second common cause of fracture but subluxations was occurred more at the levels C5-C6 and C4-C5 - ***Table 13***.

12. Neurological involvement was seen in 44.9% of patients had cervical spine injury. Quadriplegia was the most common clinical form of neurological involvement (81.8%) the cause of this kind of trauma was mostly RTA (55.6%) - ***Table 15,16 & 17***.

13. Neurological involvement was mostly because of injuries at cervical spine levels – C4-C5, C5, C5-C6 - ***Table 18.***

14. Respiratory involvement was seen in 13 patients (26.5%) 12 of them (92.3%) were improved. It occurs more when the injury involving spines of levels C4, C4-C5, C5 and C5-C6 – ***Table 19&20***.

15. Corpoectomy and fixation was performed to 20 patients while discectomy and fixation was performed for 19 patients, but odontoid screws fixations was performed only for 10 patients (20.4%) whom diagnosed to have type II dense fractures of cervical spines *Table 21*.

16. Hospital stay was variable but mostly patients were discharged within a week of surgery, the least stay 3 days and the maximum stay was 12 days – ***Table 23***.

DISCUSSION

This study was designed to find out the epidemiology of cervical spine injuries in view of patients age, gender, cause of trauma, type of injury, level of spine affected and neurological with or without respiratory complications associated with such type of trauma.

In our study the patients age were ranging from 18-77 years with mean 36.9 years and medium 33 years. It also showed the predominance of males (79.6%) with motor car accidents being the commonest cause of injury (65.4%) followed by falling (16.34%) and diving (14.3%) the most common type of injury was fracture in 67.4% of cases followed by subluxations (30.6%) and one dislocation. Vashdev Chandwani et al 2010 [(103)] had reported almost the same mean age of 36.4years in a study included 36 men and 5 women with trauma caused mostly by RTAs (46.3%). Recently Kamravan et al 2014 [(104)] had also reported a mean age near to that in our study (37.2 years) with predominance of males (male: female ratio = 3 : 1), also the concluded that the car accidents were the leading cause of cervical spine injury. On the other hand Hasler RM et la 2012 [(105)] concluded that the mean age of cervical spine injury in a multicenter study was higher than that of our patients with median 47.2 years, 60.2% were males and road traffic accidents with falls were important predictive factors for fracture or dislocations of cervical spine injuries among their patients . also Adeou and his associates from Nigeria [(106)] had reported that higher age group with mean 41.8 years were at higher risk for cervical spine injuries that obtained by road traffic injuries in all cases included in their study, the commonest was ondontoid peg and hangman fractures.

Falling down was the 2nd cause of trauma in this study (16.3%), it noticed to occur more among elderly patients (≥ 50 years) causing subluxations or fractures of cervical spine. Falling from a height had also reported in 14.3% of patients had cervical spine trauma in a study of Vashdev Chandwani et al. (104)

In other studies like that of Sidong Kang and his associates (107), fall was the commonest cause of cervical spine injury in 75.5% of their cases.

Fredo et al (108) also had reported that falling was the commonest cause of injury in their series (60%) with mean age group higher than that of our study 56 years.

The 3rd cause of cervical spine injury in our study was diving (14.3%) that occurred only among males and of young ages ≥25 years.

T. Noguchi (109) had concluded that lack of skills and misjudgment to the depth of water in diving activity were the cause of cervical spine injuries in 35 cases included in his study (32 males and 3 female), most of them were young, less than 30 years (88.6%).

Korres and his colleagues (110) had reported cervical spine injury because of diving in 2.6% of their cases, mostly occur in May and September resulting in fractures mostly at the level of C5 and C6 compared to our study the cases had occurred mostly in July and September (summer and autumn) and mostly at levels of C4-C5 and C5 cervical spines.

Most frequency of injuries in this study had occurred at cervical spine levels. C2 (28.6%) C5 alone (16.3%) or C5-C6 (16.3%) followed by C4 or C4-C5. Others had reported that fractures most often occur at C6 and C7 while dislocations often occur between C5-C6 and C6-C7. [111,112]

Kocis and his associated [113] earlier also reported that the commonest cervical spine levels had injured were C5th and C6-C7 among 363 patients studied for cervical spine injuries that seen more among young and middle age groups with predominance of car accidents as a cause of trauma.

Neurological involvement in our study was diagnosed in 22 patients (44.9%) all of them had trauma at levels of C3 to C7 (mostly C4-C5 and C6). Quadriplegia was the commonest form of neurological involvement (81.8%) while central cord syndrome seen in 3 patients (13.6%). Fredo et al (2012) had reported that 79% of their patients with cervical spine injury had no neurological deficits, 8% had incomplete spinal cord injury while 2% were diagnosed to have complete spinal cord injury (quadriplegia) [108]. This shows that we had a higher incidence of quadriplegia may be due to lack of pre-hospital management.

The respiratory involvement among our patients was detected in 13 patients (26.5%). It is well known that the extent of respiratory complication in cervical spine injury depends on the level of cord injury and degree of motor impairment [114]. Total long capacity and static lung volume are reduced according to the level of cervical spine cord injury[115]. Devivo MJ et al [116] had concluded that respiratory complications are the important causes of morbidity and mortality in both phases of cervical spine injury.

Surgery was performed after 72 hours in all patients in this study. It is well known that the golden standard time of decompressing within 6 to

72 hours, much of controversy continuous over the timing of surgery after cervical spine injury. [117,118,119]

Recent studies suggest that decompression within 48 hours result in improved neurological outcome without increase in systemic complications. [120]

Though other had concluded that no significant neurological benefit between early or late surgery for cervical spinal cord injury. [119]

In this study :

- The type of surgery applied was according to the type of injury : in C2 dens fracture anterior adontoid screw fixation was applied and for solitary cervical vertebral fractures corpectomy with fixation was performed while in cervical sublaxations discectomy and fixation was performed.
- Vaccaro Alexacler et al [119] had performed almost similar operations on their patients of both early or late intervention: anterior cervical discectomy and fusion was done for 9 patients in both groups, anterior corpoectomy and fusion in 20 cases in both groups and posterior approach was added to the rest of patients in their both groups (33 cases).

The hospital stay of our patients was ranging from 3 to 12 days, mostly discharged well to follow rehabilitation center outside the hospital, Sidong Yang et al [5] had reported an average hospital stay of 13.3 days in total patients and 13.6 days in cord injury patients this may be because of most of their patients were old and from the rural region.

CONCLUSION

1. The diagnosis of the cervical spine injuries in our study was based on the medical history and clinical examination followed by x-ray images in 3 basic projections and CT scan.
2. All of our patients had stabilized for 72 hours before surgery that performed through anterior approach which allow us to carry out decompression, graft and plate insertion under direct visual control.
3. Cervical spine injury had occurred more among young and middle age groups with male predominance.
4. Road traffic accidents was the commonest cause of trauma followed by falling down and diving.
5. The type of injury was fractures mostly followed by sublaxation.
6. Elderly $\geq$50 years at higher risk for subluxations of cervical spines because of fall down mostly.
7. Diving was the cause of cervical spine injury in young male patients $\leq$25 year affected lower cervical spines.
8. The most affected spine regions were C2 , C5 and C5-C6 then C4 with C4-C5.
9. Quadriplegia the commonest form of neurological involvement because of lesions of lower cervical spines mostly C4-C5 and C6.
10. The respiratory involvement was seen with patients who had lower cervical spine injuries below C2.

RECOMMENDATIONS

1. This study calls for further studies with larger groups and multicenter to evaluate the proper clinical approaches to this group of patients by emergency physicians.

2. Asking for a well develop and updated pre-hospital management to those patients including education to the populations with availability of well-equipped ambulances throughout the country.

3. Prevention for the type of injury is very important particularly the risk of road traffic injuries that can be reduced by speed control and using of car seat belt.

4. Attention should be targeted towards the elderly people above 50 years who need careful public health and family care.

5. Diving needs a lots of education to get good skills.

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