COMPUTED TOMOGRAPHY PATTERNS OF CERVICAL SPINE INJURY AMONG TRAUMATIC PATIENT WHO UNDER WENT COMPUTED TOMOGRAPHY FOR CERVICAL SPINE AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA UNIVERSITY, ADDIS ABABA, ETHIOPIA.

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This is to certify that the thesis prepared by Israel Feleke entitled "RETROSPECTIVE CROSS-SECTIONAL STUDY ON COMPUTED TOMOGRAPHY PATTERNS OF CERVICAL SPINE INJURY AMONG TRAUMATIC PATIENT WHO UNDER WENT COMPUTED TOMOGRAPHY FOR CERVICAL SPINE AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA UNIVERSITY, ADDIS ABABA, ETHIOPIA." submitted in partial fulfillment of the requirements for the specialty certificate program in Radiology complies with the regulations of the University and meets the accepted standards with respect to originality and quality

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TABLE OF CONTENT

Contents Page

ABBREVIATIONS and ACRONYMS

AAU……. .Addis Ababa University

AO…….Arbeitsgemeinschaft Osteosynthesefragen

CT…….. Computed Tommography

CSI…….. ..Cervical Spine Injury

CS-FX……..Cervical Spine Fracture

ISS……Injury Severity Scoring

MVC…….Motor Vehicle Collision

OR……....Odds Ratio

Msv…….Millisilvert

SCI…….....Spinal cord injury

TASH…….Tikur Anbessa Specialized Hospital

TSF……...Traffic Safety Facts

ABSTRACT

Introduction- *Cervical spine injury was defined as a fracture or subluxation of any of cervical vertebrae which are frequently seen in association mostly with injuries secondary to blunt trauma (motor vehicle accidents, falls, sports injuries). The overall impact of SCI on the individual, and also on society at large, therefore depends on a range of factors. However there is shortage information regarding computed tomography pattern of cervical spine injury.*

Objective*: The study was aimed to assess computed tomography pattern of cervical spine injury among traumatic patients who underwent computed tomography for cervical spine injury from March 2019 to March 2020 in Tikur Ambesa Specialized Hospital.*

Methods: *Institutional based retrospective cross sectional study was conducted. The sample size for the study was 209 patient record. A structured data extraction sheet was used for data collection. The collected data was checked for completeness, edited, coded and entered into Epi Data version 3.1 and exported to SPSS version 20.00 for analysis. Descriptive analyses was done by computing proportions and summary statistics. The information was presented by using table and figures.*

Result: *209 patient recording was included making response rate of 98.1%. Out of 209 included patient record 164(78.5%) were male. Incidence of cervical spine fracture was 27 (12.9 %%). Incidence of cervical spine fracture is significantly more in male patients when compared to females patients (7:2). The maximum number 13, (48.1%) of fracture is observed in the 16-30 age group. Road traffic accident was the most common mode of trauma 116(55.5%) cases.*

Conclusion: *This study showed numbers of cervical spine fracture cases in the one year. This data demonstrated that most victims in our study are young's. A male predominance was observed, and car accident were the most frequent trauma mechanism leading to cervical spine fracture.*

Budget*: The total budget which was employed for this study is around 28,000.00 ETB.*

1. INTRODUCTION

1.1. BACKGROUND

The bony parts of the cervical spine consist of seven vertebral bodies (C1-C7) that are linked by intervertebral discs, ligaments, housing the spinal cord that sends message from the brain to control all aspect of the body. It is remarkably strong and flexible allowing the neck to move in all direction (1). Anatomically, physiologically and clinically cervical spine may be divided into two distinct areas. The first two vertebras have a different shape from the remainder; the movement taking place between them is different from that in the lower segments. Rotational movement is the primary function of the atlas and axis, three quarter of the total rotation of the cervical spine takes place between them(2).

Cervical spine injury was defined as a fracture or subluxation of any of cervical vertabrea which are frequently seen in association mostly with injuries secondary to blunt trauma (motor vehicle accidents, falls, sports injuries), although penetrating trauma accounts for approximately 10% to 20% of the cases(3).These injuries, which exist on a spectrum from minor avulsion fractures to significant fractures in association with spinal instability and spinal cord injury (SCI), can exert an enormous direct financial toll on the health care system. The even greater significance of these injuries is because of the indirect losses including time off work and lost productivity, especially in young patients who sustain complete SCIs(4, 5).

According to the data from world health organization injuries are the main health problem of our time which is associated with technological process, motorization, road traffic accidents and life style change. The overall impact of SCI on the individual, and also on society at large, therefore depends on a range of factors, including, the age at which the injury occurs (whether early or late in a person's productive life), the extent of the injury, the availability and timing of resources and services, the environment in which the person lives(3).

Trauma to the spine is devastating but when associated with spinal cord injury is life threatening especially in low income countries where there is limited availability of quality assistive devices such as wheelchairs, medical and rehabilitation services and also opportunities to participate in all areas of personal and social life are constrained(6). Failure to diagnose unstable fractures or

ligamentous injuries in the cervical spine can result in irreversible devastating neurologic consequences. CT scan is now the gold standard for the assessment of cervical spine injuries, and is 100% accurate in diagnosing bony injury. By examining the computed tomography of injuries arising from this regional-specific setting, it is believed that more favorable treatment outcomes can be obtained through efficient imaging and injury management, with either non-operative or operative management(7).

1.2. STATEMENT OF THE PROBLEM

Globally the report related to trauma-related spinal fractures shows annual incidence rate varies from 0.019% to 0.088%, and for spinal cord injury, from 35 to 53 per million people. Between 19% and 51% of cases of spinal trauma involve injuries to the cervical spine(8). Patients with cervical spine injuries are a high-risk group, with the highest reported early mortality rate in spinal trauma, as these injuries may be associated with spinal cord injury(9).

Spinal injuries specifically those involving cervical region are often feared because of their association with paralysis and death. "one having a crushed vertebra of his neck, he is unconscious of his two arms and legs and he is speechless – an ailment not to be treated. In addition someone with C4 or higher lesions may require a ventilator to breathe because the lesion directly interferes with autonomic control.(10). And also quadriplegia due to spinal cord injury is a hazardous consequence of trauma to the cervical spine, involving numerous functional, psychosocial, and economic ramifications. The even greater significance of these injuries is because of the indirect losses including time off work and lost productivity, especially in young patients who sustain complete SCIs(11, 12).

Several study suggested that the most frequent risk factors of cervical spine injury was road traffic accident, cases followed by fall from height. In younger age group (<45 year) road traffic accident was the common mechanism while in elder age group (>46 year) it was fall from height(13, 14). The study conducted in Ethiopia also showed that fall from height and Road traffic collisions were the main cause of spine and spinal cord injuries in 36.4% and 32.9% of the patients respectively(15).

Study revealed that incidence of cervical spine injury showed an increment as age of the victims increases. In addition the incidence high in factors like male patient, lower socioeconomic or

educational status, high-risk behaviors, and have all been postulated as potential risk factors for spinal fracture(13, 16). The epidemiology of spinal injuries and cervical spine fractures, in particular, remain incompletely explored. A recent search of the literature reveals that no prior investigation has attempted to quantify the incidence of cervical spine fractures or characterize risk factors for injuries. In addition there is no study conducted regarding incidence of cervical spine injury in Ethiopia. Therefore this study is aimed to assess computed tomography pattern of cervical spine injury among traumatic patient who underwent CT for cervical spine injury evaluation in 2020.

1.3. Significance of the study

The study findings will be used by health institution to obtain an optimum outcome of treatment, health care teams should be well trained in caring for these injured patients with current spinal precaution protocols and treatments. In addition the study aims to identify computed tomography pattern of spine trauma, type, site and severity of fracture. The finding of this study will also help policy makers and planners to set their target with interventions in the study area. It may also help as baseline for another study.

1.4. Objective

1.4.1. General Objective

To assess computed tomography pattern of cervical spine injury among traumatic patients who underwent computed tomography for cervical spine injury from March 2019 to March 2020 in Tikur Ambesa Specialized Hospital.

1.4.2. Specific Objective

To determine magnitude of Cervical spine Fracture

To identify pattern of Cervical spine Fracture

To assess cause Cervical spine Fracture

2. LITERATURE REVIEW

2.1. Socio-demographic characteristic

AGE

A Retrospective Cross-sectional Observational Study conducted on Epidemiology of Distribution and Patterns of Blunt Traumatic Cervical Spine Injury in Odisha, India showed a steady increase in incidence of cervical spine fracture from 15 to 60 year old and maximum cases observed in the age group 76-90 year(13). The study from Norway also found the relative incidence of CS-fx increased significantly with age and median age was 56 yr(17). In contrast the study from Los Angeles showed most common age group with cervical fracture was 20-30 yr (18.1%) followed by 30-40 yr (17.3%). Another study observed seventy-five per cent of the CSI involved a young population aged less than 50 years and nearly 30% were in the third decade with 16% each in 2nd and 4th decades(18, 19).

SEX

Cross sectional study from Norway revealed that incidence CSI is , 68% male and 32% female, (2:1)(17). The study from Canada also found male gender constituted 66% of their study population. A Retrospective Cross-sectional Observational Study conducted on Epidemiology of Distribution and Patterns of Blunt Traumatic Cervical Spine Injury in Odisha, India, indicated that the incidence of cervical spine fracture is significantly more in male in compare to females(9). Systematic review from developing countries showed Males comprised 82.8% (95% CI: 80.3–85.2) of all SCIs with a mean age of 32.4 years (95% CI: 29.7 35.2)(20). Study from Ethiopia on Pattern of Spine and spinal cord injuries in Tikur Anbessa Hospital showed statistically significant male predominance (84.9 %)(p, 0.0001).

2.2. Incidence of CSI

Cross sectional study conducted on epidemiology and risk Factors of cervical Spine Injury during Heating Season in Hebei Medical University, Shijiazhuan, China(n=106) in the Patients with Cervical Trauma, showed that Thirty-one patients (29.2%) sustained cervical cord injury with cervical fractures/dislocations(21). A Retrospective Cross-sectional Observational Study conducted on Epidemiology of Distribution and Patterns of Blunt Traumatic Cervical Spine

Injury in Odisha, India, indicated that 10.6% of patients presented with head injury have cervical spine fracture(13).

Another study on distribution and Patterns of Blunt Traumatic Cervical Spine Injury showed radiographic cervical spine injury in 2.4% of blunt trauma patients(18). The study from Tempere University on head Injuries and the risk of concurrent cervical spine Fractures observed that cervical spine fracture was found in 6.6% of their study population(22). The study from Melbourne also showed incident of cervical spine injuries in blunt major trauma patients is14% of those 92% are fractures and/or cord injury and 14% are ligamentous and or soft tissue injuries(23).Study in in developing countries indicates that cervical spine was involved (14.5.0%)in spinal cord injury(15).

Cause of Cervical Spine Injury

A Retrospective Cross-sectional Observational Study conducted on Epidemiology of Distribution and Patterns of Blunt Traumatic Cervical Spine Injury in Odisha, India, indicated that the most common mode of trauma causing cervical spine fracture was road traffic accident seen (57.3%) cases followed by fall from height (23.5%)(10). Another study showed trauma mechanisms were fall from height as the most common mechanism of trauma in 60% followed by motorized vehicle accidents in 21%, bicycling in 8%, diving in 4% and others in 7%(17).

Cross sectional Study from Canada also observed traffic accidents accounting for 71%, followed by pedestrian trauma in 10%, sport injuries in 7% and 5% each by fall and work related trauma. They also found the commonest cause of SCI was MVC (74%). However, only 28% of MVC had a SCI while 32% of fall and industrial accidents had an associated SCI(19). In addition study from Iran showed that, motor vehicle collisions were the most frequent trauma mechanism leading to cervical spine injury, with falls the second most frequent(24). Langston T. Holly et al have also observed the most common mechanism of injury was MVA (29.3%), followed by automobile versus pedestrian accidents (20.6%), falls (16.6%) and assaults (10.7%)(25).

Systematic review from developing countries showed motor vehicle collisions were found to be the causative mechanism in 41.4% of patients also study in Ethiopia revealed Fall from height ($P<0.001$) and Road traffic collisions were the main cause of spine and spinal cord injuries in 36.4% and 32.9% of the patients respectively(15, 20).

Level of Cervical spine involved

A Retrospective Cross-sectional Observational Study conducted on Epidemiology of Distribution and Patterns of Blunt Traumatic Cervical Spine Injury in Odisha, India, indicated Complete CSI was seen in patient with C4 level injury .Similar to this study the study from Canada also observed SCI in 57% of C4 and 24% of C6 level spinal trauma(19).

The study from Norway observed high CS-fx (C0-C2) and subaxial fractures in 35% and 65% of fractures respectively and combination of both in 5.3% of cases(17).While the study from India showed high cervical spine fracture (C0-C2) in 36.4% and subaxial fractures (C3-C7) in 63.6% of fractures and both types in 5.9% of patients. The median age for patients with C0-C2 fractures was 63 yr (54% were males) and that for subaxial fracture was 44 yr (68% were males)(13).

Systematic review on Epidemiology of Traumatic Spinal Cord Injury in Developing Countries Complete SCIs were found to be more common than incomplete injuries (complete SCI: 56.5%; 95% CI: 47.6–65.3; incomplete SCI: 43.0%; 95% CI: 34.1–52.0)(20).

DISLOCATION AND SUBLUXATION

Report from Los Angeles showed that studied dislocations and subluxations most commonly at C5-C6 interface (25.1%) followed by C6-C7 (23.3%) while least common at atlanto-occipital joint (2.1%)(18). Similar to this a retrospective cross-sectional observational study conducted on Epidemiology of Distribution and Patterns of Blunt Traumatic Cervical Spine Injury in Odisha, India, indicated dislocations and subluxations most commonly at C5-C6 interface (25.5%) followed by C6-C7 (23.5%) while least common at atlanto-occipital joint (1.9%)(13).

3. STUDY AREA AND PERIOD

The study was conducted at Addis Ababa University College of health science, Tikur Ambessa specialized Hospital. TASH is the largest hospital found in nation's capital city Addis Ababa. It is the largest referral center of the country and the main teaching hospital. The hospital provides a tertiary level referral treatment with over 900 beds and is open 24hrs for emergency services. The study was conducted from September 16 to 30.

3.1. Study Design

Retrospective cross sectional study design was conducted.

3.2. Source Population

All traumatic patients who underwent Computed tomography for spinal cord injury was considered as source population.

3.3. Study population

All traumatic patients who underwent Computed tomography for Cervical spine injury was selected.

3.4. Inclusion and Exclusion Criteria

3.4.1. Inclusion Criteria

All patients evaluated for cervical spine injury was included

3.4.2. Exclusion criteria

Patients imaged for non-traumatic cervical pathology was excluded.

Incomplete patient record and unclear image also was excluded.

3.5. Sample size determination and sampling technique

The actual sample size was calculated using single population proportion formula

$$n = \frac{Z@/2P(1-P)}{d^2}$$

Where P= incidence of cervical spine injury from previously conducted study which is 14% (13).

d =the margin error between the sample and the population is 5%.

Z α/2= critical value at 95% confidence level of certainty (1.96).

The calculated sample size (n) $= (\frac{1.96)^2 * 0.14(1-0.14)}{(0.05)^2} = 185$

Adding 15% non-respondent the total sample size is 213.

3.6. Data collection instrument and procedure

3.6.1. Data collection tool

Data was collected using structured data extraction sheet from Picture Archive Communication System. Patient information like Socio-demographic characteristics such as age sex, distance of residential area from the TAH and causes of injuries was included. Patient's image and the CT reports was reviewed and findings recorded in the data extraction sheet.

3.6.2. Data collection procedure

Before data collection, two days training was given data collectors by the principal investigator (PI). The data was collected for fifteen days.

3.7. Study variable

3.7.1. Dependent variable

CT pattern of cervical spine injury

3.7.2. Independent variable

Socio demographic characteristics

Cause of injury

3.8. Operational definition

CSI was defined as a fracture or subluxation of any of the cervical vertebrae.

Road traffic accident (RTA) is an incident on a way or street open to public traffic, resulting in one or more persons being injured or killed and involving at least one moving vehicle.

Motor vehicle collision, , also called traffic collision occurs when a vehicle collides with another vehicle, pedestrian, animal, road debris, or other stationary obstruction, such as a tree, pole or building.

3.9. Data quality control

Two day training was given for data collectors regarding the objective of the study, data collection tool, ways of data collection, checking the completeness of data collection. Proper coding and categorization of data was maintained for the quality of the data to be analyzed. All data was checked for completeness, accuracy, clarity and consistency by principal investigator and supervisors before data entry in to software. Simple frequencies and cross tabulation was done for missing values and variables.

3.10. Data Processing and Analysis

The collected data was checked for completeness, cleaned, edited, coded and entered into Epi data version 3.1 to minimize logical errors and design skipping patterns. Then, the data was exported to SPSS window version 20 for analysis. Descriptive analysis was done by computing proportions and summary statistics. Then the information was presented by using simple frequencies, summary measures, tables and figures.

3.11. Ethical Consideration

Ethical clearance was obtained from departments' research and ethics committee. Any piece of information was kept confidential by keeping anonymity of the study subjects. A formal letter of permission and support was written to radiology department. Then informed, voluntary, written and signed consent was obtained from the radiology department head.

4. RESULT

Among the trauma patients who undergone cervical spine computed tomography 209 patient recording was included making response rate of 98.1%. Out of 209 included patient record 164(78.5%) were male and 105 (50.2%) from urban areas. The mean age of study participant was 32.99((±15SD). Road traffic accident was the most common mode of trauma which accounts for 116(55.5%) followed by motor vehicle accident which accounts for around 28(13.3%) (Table1).

TABLE1: Socio demographic characteristics of poly traumatic patient record that underwent Cervical spine computed tomography 2020.

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE (%)
Age	<15	14	6.7
	16-30	105	105
	31-45	45	4.5
	46-60	35	16.7
	61-75	8	3.8
	>76	2	1
Sex	Male	164	78.5
	Female	45	21.5
Residence	Urban	105	50.2
	Rural	104	49.8

Mechanism of injury

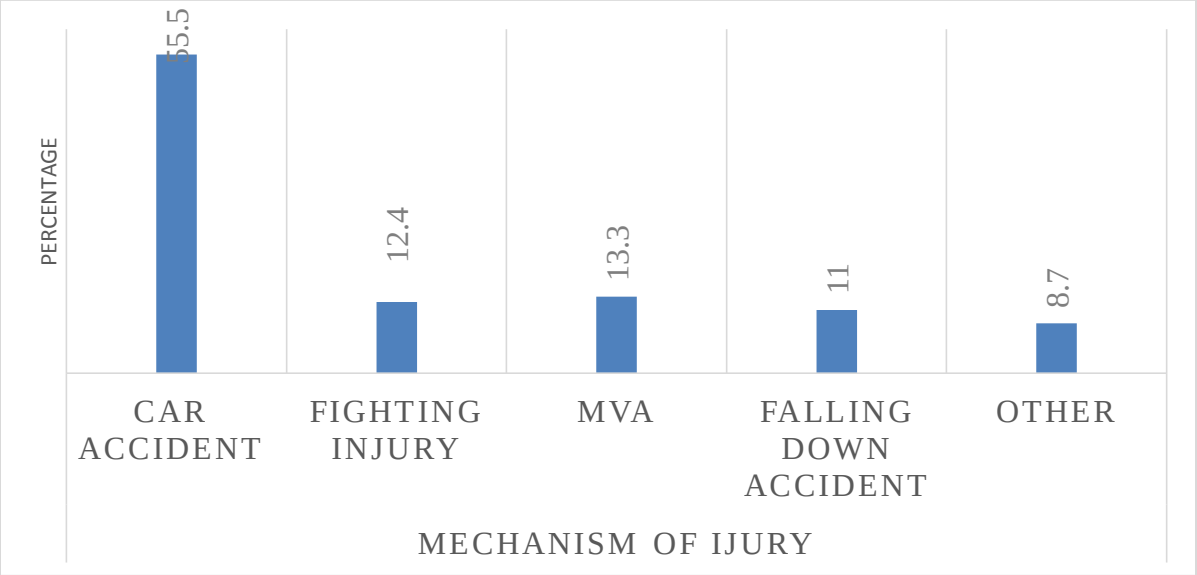
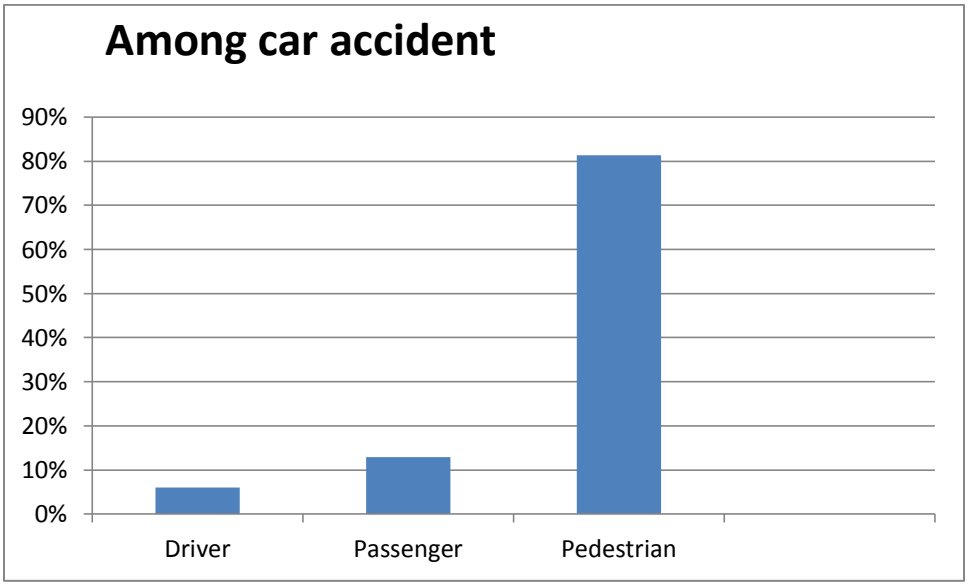


Figure 1: Mechanism of injury among patient who underwent Cervical spine CT at TASH from 2019-2020

Among car accident



Cervical Spine fracture

Out of the total 209 patient who undergone Cervical spine Computed tomography incidence of cervical spine fracture was 27 (12.9%%). Incidence of cervical spine fracture is significantly more in male patients when compared to females patients (77.7% vs 22% of total cervical spine fracture). The maximum number 13, (48.1%) of fracture is observed in the 16-30 age group.

Table 2: Distribution of CSI fracture with age and Car accident among poly traumatic patient record who underwent cervical spine computed tomography 2020.

Age	**Car accident**			**CS Fx**
	Driver	**Passenger**	**Pedestrian**	
<15	-	-	10	-
16-30	5	9	45	13
31-45	2	4	22	3
46-60	-	2	15	3
61-75	-	0	2	6
76-90	7	15	94	2

Pattern of Cervical spine Fracture

Out of 209 patient record evaluated C1 fracture accounts 7(3.3%) three of them on posterior arch. On the other hand odontoid dens fracture accounts for 6(2.8%), of which three of them are at the upper parts and three at the lower part. Regarding C3-C7 14(6.7%) had vertebral body fracture (Table3).

Table 3: Pattern of Cervical spine injury among poly traumatic patient record who underwent Cervical spine computed tomography 2020.

		Frequency	**Percentage**
CSFx(n=27)	**C1**	**5**	**22.2**
	C2	**7**	**25.9**
	C3	**2**	**7**
	C4	**3**	**11.1**
	C5	**5**	**22.2**
	C6	**2**	**7**
	C7	**3**	**11.1**
Odontoid dens fracture			
	Upper part	2	1.0
	Odontoid with extension to body of C2	3	1.4
C3-C7 and T1	Vertebral body fracture	12	5.9.
	Displaced	4	1.9
	Anterior wedging	5	2.4
	Disruption of posterior cortex	3	1.4
	Retropulsion of fractured segment	3	1.4
	Kyphosis	4	1.9
	Listhesis	4	1.9
	Decreased intervertebral space	6	2.9
	Disc herniation	3	1.4
	Multiple site injuries	3	1.4

5. DISCUSSION

In this study among 209 traumatic patients who underwent Cervical spine CT we observed 27(12.9%) of patients have cervical spine fractures. This finding is consistent with the finding from the study conducted in India which showed that 10.6% of patients presented with cervical spine injury have cervical spine fracture (13). The finding from this study is higher than the study from North eastern Ohio on incidental findings in the Cervical Spine at CT for trauma evaluation which showed 7% of patients had a fracture of the cervical spine (16).In addition the study from India on mechanism and patterns of cervical spine fractures also showed fractures of cervical spine were noted in 36 (76.5%) patients (28). This difference resulted probably due to countries status of development, study stetting and the difference in sample size.

In our study we observed that the incidence of cervical spine fracture is significantly more in male patients when compared to female's patients with the ratio 7:2. Similar results were reported from the study conducted in India that incidence of cervical spine fracture is significantly more in male in compare to females (2.2:1)(13). In addition the study from Norway showed that 68% male and 32% female, (2:1) have cervical spine fracture (17).Also the study from Canada also found male gender constituted 66% of their study population (19). This may be due to the engagement of the male gender in more hazardous vocations and the fact that males constitute more vehicle riders than female.

In this study we observed that incidence of cervical spine fracture maximum cases from 15 to 60 years old. The study from New York reported consistent finding that most common age group with cervical fracture was 20-30 year (18.1%) followed by 30-40 year (17.3%) (18). And also the study from Canada observed seventy-five per cent of the CSI involved a young population aged less than 50 years and nearly 30% were in the third decade with 16% each in 2nd and 4th decades(19). This is probably in developing countries the youngest population is high and involve in vehicles riding and daily labour work activities.

This study showed that most common mode of trauma causing cervical spine fracture was road traffic accident seen (55.5%) cases followed by motor vehicle accident (13.3%). Similar finding reported from India that the most common mode of trauma causing cervical spine fracture was road traffic accident seen (57.3%) (13). In addition study from Nigeria found road traffic

accidents were most numerous (50%)(26). This shows that nowadays road traffic accident is highly contributing to many traumatic causes.

We observed high cervical spine fracture in 37% and sub axial fracture in 63% of fracture and both type in 1.5% of patients. Study rom Norway observed high CS-fx (C0-C2) and sub-axial fractures in 35% and 65% of fractures respectively and combination of both in 5.3% of cases. In this study we found maximum number of fractures are in C2 vertebra (25.9%) followed by C5 (22.4%) cases. Similar to us study from Norway had indicated most common site of fracture at C2 (23.3%) and also Cothren et al reported C2 spine fractures were noted in 15% patients(17, 27).

Odontoid dens fracture was found in five of patients with C2 fracture ad type three odontoid fracture was common .This study is supported with the study from New Delhi that Odontoid fractures were present in five of the six patients with C2 fractures and Type III odontoid fracture was most common pattern in four patients(28).

CONCLUSION AND RECOMMENDATION

Conclusion: This study showed numbers of cervical spine fracture cases in the one year. This data demonstrated that most victims in our region are young's. A male predominance was observed, and road traffic accidents were the most frequent trauma mechanism leading to cervical spine injury, with falls the second most frequent. The rate of Cervical spine fracture in our study was 12.9% of all cases.

Recommendation: It is known that road traffic accident is common now a days and contributing factors to devastating trauma especially cervical spine fracture which might lead to irreversible complication in human's life even to death. Therefore driver should focus on how to save the life of others while driving. And legal body should act on enforcing traffic law to save the life of others.

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