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Aetiology and Imaging Findings in Traumatic Spine Injury among Patients Attending Muhimbili Orthopedics Institute in Dar es Salaam

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Background: ***The main objective of the study was to determine etiology and imaging features of traumatic spine injury in spine injured patients attending Muhimbili orthopedics institute***
Methods: ***The study was a hospital based cross-sectional and consecutively included 87 with traumatic Spine Injury. Data was collected through a structured questionnaire. Statistical package for social science (SPSS 20) was used for data analysis.***
Results: ***Eight seven (87) patients with traumatic spine injury were studied. The age range was 4 to 81 years, with a mean age of 33 years. Males were more affected than females. Young individuals aged 16-30 years were the most affected. The commonest cause of spine trauma was motor traffic crashes. The commonest vertebral spine injury seen was compression wedge fracture (35.6%), followed by dislocation (18.4%). The most frequent spine level involved was lumbar spine (37.9%). Paraplegia (33.3%) and quadriplegia (10.3%) were the common clinical presentations. Fifty six percent of patients had associated injuries***
Conclusion: ***Traumatic spine injury is common at our settings. Young individuals below 30 years of age are most affected and the most common cause is motor traffic accident (MTA). The use of Computed Tomography (CT) in this study helped to identify several types of injuries especially injury to vertebral bodies and their effect unto neuro structures. MRI helped to identify patients with spinal cord injury which was not evident on CT.***

Key words: Spine trauma, vertebral fracture, Computed Tomography
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Introduction

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[1]. Most people with spinal cord injury (SCI)in a country such as Sierra Leone and Tanzania die within a few years of injury [1, 2]. The situation in many developing countries is comparable to what it was in Europe and North America in the 1940s [2]. Approximately 40% to 50% of spinal injuries produce a neurologic deficit, often severe and sometimes fatal [1, 4]. The neurological deficits included paraplegia, quadriplegia, or even may cause death [5, 6].

Most injuries are secondary to blunt trauma (motor vehicle accidents, falls, sports injuries), although penetrating trauma accounts for approximately 10% to 20% of the cases [1, 7]. Variations exist across regions, road traffic accidents are the main contributor to spinal cord injury in the African Region, nearly 70% of cases and the Western Pacific Region, 55% of cases. Falls are the leading cause in the South-East Asia and Eastern Mediterranean Regions accounting for 40% of cases [1].

There are approximately 1,380 new cases each year in Tanzania, but in total only 100 - 120 victims are treated in all hospitals per year. Majority of the victims are young people, from both males and females who are bread earners of their families [1, 3]. Spinal fractures represent 3% to 6% of all skeletal injuries. The average age of patients with traumatic spine lesions is 32 years at the time of injury with the majority (55%) being aged 16–30 years[6]. Approximately, half of spinal injuries occur in the cervical spine, the other half involves the thoracic, lumbar, and sacral areas. Motor traffic crashes (MTC) are the most common cause of spine trauma and account for approximately 40% of reported cases [6]. Other injuries are typically the result of falls or sporting activities [8].

Up to 47% of patients with severe spine trauma have been reported to be associated other injuries: 26% with head injuries; 24% with chest injuries; and 23% longbone injuries. Approximately 10–14% of all spinal fractures and dislocations are associated with spinal cord injury [5].

The risk of damage to the spinal cord is greater in cervical spine injuries than in the thoracic and the lumbar regions [4] occurring in about 40% of cases. Up to 17% of patients have a missed or delayed diagnosis of cervical spine injury, with a risk of permanent neurologic deficit after missed injury of 29%. In many parts of the developing world, even today Spinal Cord Injury (SCI) is neglected and poorly managed. Research is sparse and there is limited data on especially on imaging in traumatic spine injury at our settings.

Rapid diagnosis and treatment of fracture fragments, hematomas, or other lesions which compress the spinal cord is life saving to patients who present with an incomplete injury as may regain a large amount of useful function, or be spared the progression to complete injury. Imaging studies are essential to confirm the exact location of the injury, to assess the stability of the spine to assess spinal stenosis (canal and neural foramina), as well as compression on the spinal cord and nerve roots hence guide potential surgical decompression. Several imaging modalities can be used, but nowadays multi-detector computer tomography (MDCT) and magnetic resonance (MR) imaging are the most important imaging modalities [7]. In the developing world where CT and MRI are not readily available plain radiography is considered the first imaging modality.

The plain radiography is a 'quick way to assess the spine. May be helpful in fracture screening, and are mainly used to detect a spinal deformity. Plain radiography, even with the best possible technique, underestimate the amount of traumatic spine injury, and abnormalities may be missed. It has been shown that 23–57% of spinal fractures are missed by standard radiography compared to multi-detector (multi-slice) Computed tomography (CT) [9]. It is recommended that in severe spinal trauma CT should be the first imaging modality [10]. In the cervical spine, plain radiography detect only 60–80% of fractures; a significant number of fractures are not visible, even when three views of the spine are obtained [10, 11]. Despite of the limitation, Radiography remains appropriate in low-risk subjects, as well as in those situations where CT is not available. This study aimed at determining the causes and imaging findings of traumatic spine injury by using CT and MRI as plain radiography is limited when it comes to evaluation of the extent of vertebral fractures, spinal cord and ligamentous injuries. .

Computed tomography (CT) plays a critical role in the rapid assessment of the poly-trauma and high risk patients. It has a higher sensitivity and specificity for evaluating spine injury compared with plain film radiographs. In the cervical spine, CT detects 97–100% of fractures, but it is relatively poor in detection of purely ligamentous injuries[12]. CT screening has a higher sensitivity and specificity for evaluating cervical spine injury compared with plain film radiographs [13]. In the cervical spine, CT detects 97–100% of fractures [12]. CT has been reported recently to be the most efficient imaging tool with a sensitivity of 100%, whereas a single cross-table lateral view had a sensitivity of only 63% in detecting skeletal injuries of the cervical spine [14].

MRI is a preferred technique for the detection of soft tissue injuries due to its superior contrast resolution. It is mainly used to exclude occult injuries and to identify spinal cord abnormalities. MR imaging is the modality of choice for assessing trauma involving the intervertebral disks spinal ligaments and spinal cord injury [5, 6].

In the current study we determined the, causes, demographic and imaging findings of traumatic spine injury in patients with spine trauma attending at Muhimbili Orthopedics Institute (MOI).

Material and Methods

Formal ethics approval was obtained from the Muhimbili University of Health and Allied Sciences ethical Committee. The study was conducted at Muhimbili Orthopaedic Institute (MOI), Radiology Department. Muhimbili Orthopaedic Institute (MOI) is the largest referral and teaching hospital for Orthopaedics and Neurosurgeons in Tanzania. Its main objective is providing primary, secondary and tertiary care of preventive and curative health services in the field of Orthopaedics, Traumatology and Neurosurgery, as well as being the role model for efficient hospital management in Tanzania. The Institute is also involved in human resources development for the nation and also carries out research in these fields with a view of developing cheaper ways of treatment of patients and reducing invalidity to members of the community.

This study was a hospital based prospective descriptive cross-sectional study. The study was conducted for a period of 6 months, from July 2014 to December 2014. All patients with traumatic spine injury were consecutively included into the study. We recruited 91 patients during the study period, all had history of traumatic spine injury but 4 were excluded (3 died and 1 was referred abroad for further treatment).

The sample size was calculated from the following formula-

$$n = \frac{Z^2 \times P\ (1-P)}{E^2}$$

Where;

N = sample size

P = estimated prevalence (%) = 6%.

This was the prevalence of spine injury in trauma patients in a study done by Suraj Bajracharya et al[17]. E = error margin which is 0.05, Z = 1.96. Substituting the above mentioned values in the Formula, the size was: n = 87.

Inclusion Criteria: All patients with the diagnosis of traumatic spine injury in the during the study period were included and those who had undergone X-ray or CT or MRI.

A structured designed questionnaire was used to record the information that included the aetiolology , demographic and clinical information and Imaging findings

Imaging

Conventional radiographs were obtained using a Siemens type conventional radiography, with printing on standard film and exposure was carried out in at least two incidents - anterior-posterior and profile. The variables assessed on conventional x ray included signs of fracture or dislocation, reduced vertebral height, loss of lordosis or malalignment and others that included paravertebral line distortion. Patients who had abnormal spine x-ray were referred for CT.

CT images were acquired using a sequentially device (single-slice) and a spiral machine (8 coils) using standard protocols for evaluation of the cervical spine, thoracic or lumbar and multi-planar reconstructions in sagittal and coronal, or 3D reconstructions. The variables assessed on CT images were presence of fracture or a dislocation, signs of cord compression, fragment displacement and others which included decreased disc height, malalignment or loss or exaggerated lordosis. Patients who had abnormal spine CT and neurological deficits were referred for spine MRI.

MRI images were performed by a trained Radiographer. Spine MRI was done using 1.5 T scanner, (Phillips, Achiever, Best, Eindhoven, Netherlands). The scans consisted of saggital and axial T1-weighted (repetition time/echo time (TR/TE) of 400/8 ms) and T2-weighted (TR/TE of 3,000/120 ms) turbo spin echo and STIR images. The slice thickness of 4 mm was used for both sagittal and axial images. The interslice gap of 0.4 mm used with 332 × 240 matrix and a field of view of 300 mm were used for sagittal images, and 224 × 168 matrix and a field of view of 200 mm for axial images.

The variables assessed on MR images were fracture or dislocation, cord compression, cord signal intensity change and other findings of ligamental injury, disc prolapse or herniation. The images were evaluated by the principle investigator and a senior radiologist and the final diagnosis was reached by consensus.

The statistical package for social science (SPSS) version 20 was used to for analysis. Statistical tests used for comparison of variables were Pearson chi-square and Fisher's exact test. P-value of 0.05 was considered to indicate statistically significant difference.

Results

Within a 6-months period, 87 consecutive patients with traumatic spine injury were included in the study. All patients had spine X-rays done. A total of 52 (59.8%) of them had CT spine done while 31 (35.6%) of them had MRI of the spine.

Generally motor traffic crash (MTC) was the most common cause of spine injury (44.8%), followed by fall from height (40.2%). Other causes included assault, hit by of heavy weight/object, bullet injury, and animal attack [Figure 1]. The patient ages ranged from 4 to 81 years with a mean of 33.1 years. The 16-30 years age group was most commonly affected and accounted for 38 (43.7 %) of cases. This was followed by the 31-45 years group that contributed 28 (32%) of the study population [Figure 2]. Sixty four (73.6%) patients were males.

The lumbar region was most commonly injured in 33 (37.9%) patients, followed by thoracic 31(35.6%) and cervical spine in 29(33.3%) (Table 1). On CT scan, the pattern of spine injury seen were: burst, compression and wedge fractures, fracture dislocation, dislocation, odontoid fracture, facet fracture and cord compression [Table 2]. Generally Fracture and dislocation constituted 52.2% of all of the observed spine injuries. Cord compression was seen in 29.9%. On MRI the cord signal intensity changes were seen in 26.4%, cord compression in 25.3% and others in 32.2% which constituted findings of ligamentous injury, disc prolapse or herniation, and haemangiomas [Figure 3].

Two (2%) patients presented with spine deformity, 29 (28.7%) had paraplegia, 9 (8.9%) presented with quadriplegia, gibbus and paraplegia was seen in 3 (3%), 28 (27.7%) had tender back, tender neck was recorded in 19 (n=18.8%) and urine/faecal incontinence presented in 11 (10.9%) [Figure 4]. Forty nine (56%) of our patients had associated injuries amongst which head injury was the commonest in a third (33.3%) of the cases [Table 3].Thirty two (36.8%) of the patients underwent spine surgery, while 49 (56.3%) received conservative treatment; three patients died before they could receive any kind of imaging and treatment. There was one self referral to India.

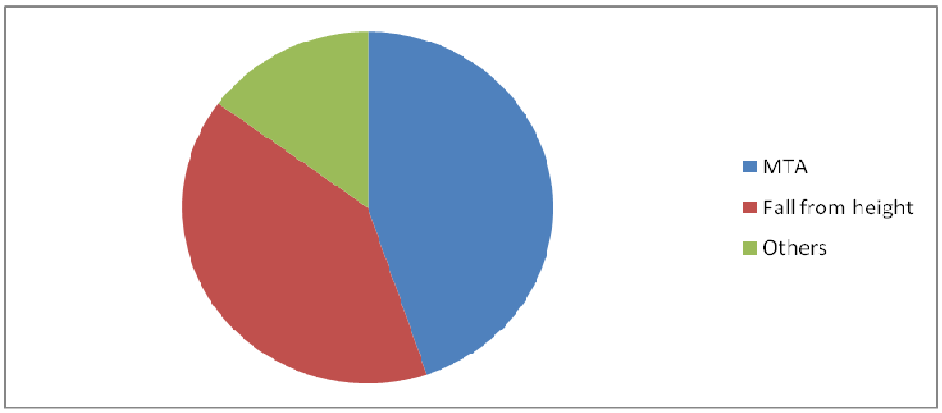

Fig. 1. Percentage Distribution of causes of traumatic spine Injury
N.B: Others included causes like assault, fall of heavy weight, bullet injury. One patient was attacked by a buffalo

Table 1. Frequency distribution of Traumatic spine injury by spine level

Radiological level	Frequency	Percent
Cervical	29	33.3
Thoracic	31	35.6
Lumbar	33	37.9

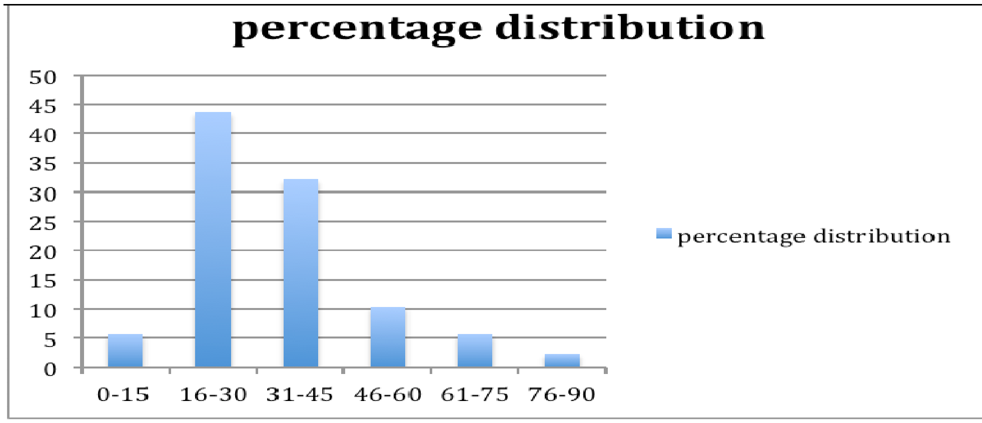

Figure 2. Percentage Distribution of spine injury by age

Table 2. Frequency distribution of Fractures and dislocation in patients with traumatic spine injury

Fracture type/Dislocation	Frequency	Percent
Burst	15	17.2
Compression wedge	31	35.6
Fracture dislocation	13	14.9
Dislocation	16	18.4
Odontoid fracture	4	4.6
Facet fracture	5	5.7
Others*	27	31.0

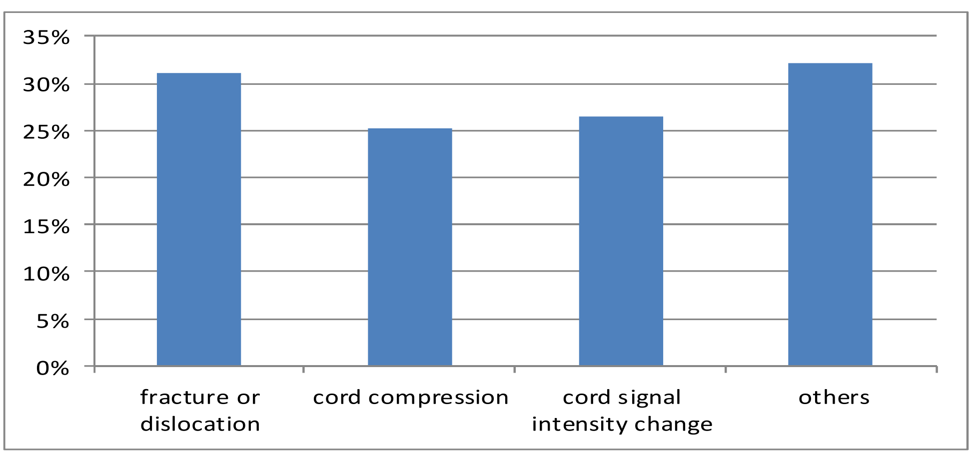

Figure 3. Frequency distribution of MRI findings in patients with traumatic spine injury

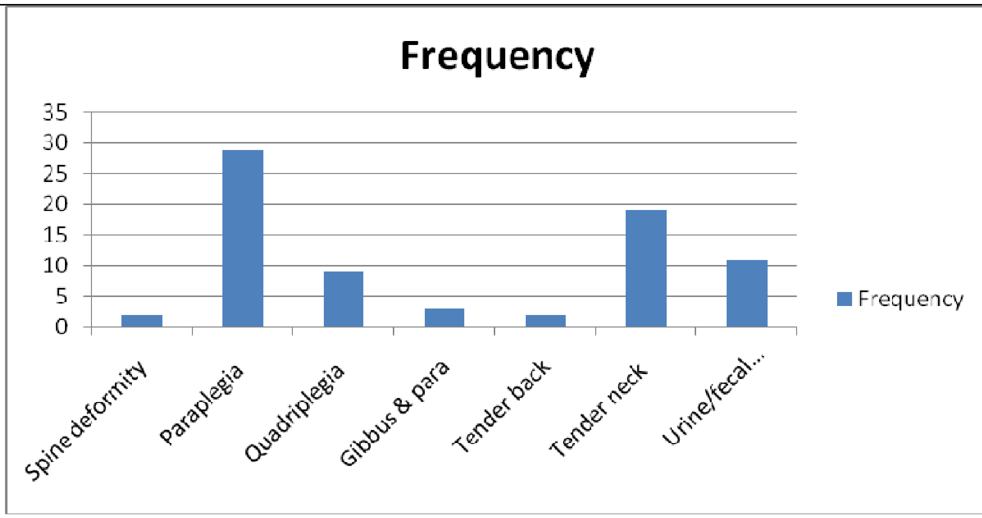

Figure 4. Frequency distribution of clinical findings in patients with traumatic spine injury

Table 3. Frequency Distribution of Associated Injuries

Associated injury	Frequency	Percent
Yes	49	56.3
No	38	43.7
Associated injury	**Frequency**	**Percent**
Head injury	29	33.3
Pelvic injury	8	9.2
Extremity injury	8	9.2
Chest injury	4	4.6
Total	49	56.3

Discussion

Traumatic spine injury is one of the major contributors of disability in the population. It leads to a major impact on people's lives. The sudden onset of spine trauma is tragic and has a profound impact on the individuals and their families. The role of radiological diagnostic examinations is to provide accurate anatomic details that can help in patient management. Several imaging studies can be used radiologically to diagnose and characterize spine injury where CT scans are very sensitive and can identify even subtle fractures. MRI is best used to study the extent of damage to the spinal cord [6]. As compared with radiographic film, CT offers superior quality visualization of the fractures, of the evaluation of cervico-thoracic and cranio-cervical junctions [10, 15]. Hence we determined causes, demographic and imaging findings of traumatic spine injury by using CT and MRI.

Motor traffic accidents (MTA) are the main contributor to spine and spinal cord injury in the African Region, nearly 70% of cases and the Western Pacific Region, 55% of cases [1]. This observation is similar to what was observed in the current study as most of the traumatic spine injury was caused by MTA (44.8%). Other major causes include diving into shallow water, football/athletic injuries, falling objects, or fired projectiles [1, 7]. MTA is the principal cause of injury not only to spine but to all other types of injuries in African settings though in the developed world the gunshot injuries are on the rise. This can be explained by the fact that, we use frequently the cars and motorcycles daily. African infrastructures are not well-developed, heavy traffic jam and overpopulation in urban areas may be the cause of to increased incidences of MTA. Individuals below 15 and those above 60 years of age were more affected by falling from heights while the cause of spine injury in individuals aged 16 to 45 years was MTA. Individuals in the age group of 16 to 45 are the most active and reproductive age group hence they are more vulnerable. It is devastating that younger individuals are highly affected, as this is the economically active group. Injuries to the spinal column and the spinal cord are the major cause of disability, affecting predominantly the young, healthy individuals. They are the main bread earners of the family and main work force of the nation thus affecting the socio-economic growth of the country.

In the current study the most affected level of the spine was lumbar spine 33 (37.9%), followed by thoracic spine 31 (35.6%) and cervical spinal vertebrae 29 (33.3%) These findings are similar to those by Udosen et al[16]. This is contrary to what has been reported by other studies where cervical spine injuries are reported to be the most common. The observed differences between the current study could be due to different settings and study population.

In the study, the most frequent pattern seen was compression wedge fracture 31 (35.6%) This could have been due to mechanism of injury as the most common cause was MTA. Sudden downward force shatters and collapses the body of the vertebrae. The combination of flexion and compression forces typically causes an anterior *wedge* compression fracture. The anterior column is compressed, with variable involvement of the middle and posterior column. If the force is great enough, it may send bone fragments into the spinal canal, called a burst fracture.

MRI is the best modality for evaluation of soft tissues and spinal cord lesions. Twenty six percent (25%) of patients had spinal cord compression and 26% had hyperintense signal on spinal cord. The signal change signifies oedema due to spinal cord injury. None of the patient had haemorhagic spinal cord injury.

Approximately 40% to 50% of spinal injuries produce a neurologic deficit, often severe and sometimes fatal [1, 4]. In the current study 57 (65.5%) patients had neurological deficits Paraplegia and quadriplegia. Neurological deficits do occur when there is compression or injury to the neural structures. The fracture dislocations, free bone fragments, the traumatically displaced disks and burst fractures may have contributed to the observed neurological deficits in these patients. Other clinical features were tenderness in the back and neck, urine and fecal incontinence and gibbus deformity.

Up to 47% of patients with severe spine trauma have associated injuries: 26% with head injuries; 24% with chest injuries; and 23% long bone injuries [5]. In the current study the prevalence of associated injuries was higher (56%). This difference could have been contributed by a number of factors like the cause of injury and the study settings as MOI is the only public facility where there is a neurosurgery unit. The observation that head injury is the most frequent associated injury is similar to what was observed in the current study.

Conclusion

Traumatic spine injury is common at our settings. Young individuals below 30 years of age are most affected and the most common cause is motor traffic accident (MTA). Since motor traffic accidents are the commonest cause of traumatic spine injury, focus should be more on ways to reduce or prevent car accidents by sensitizing people more on road safety rules and regulations.

More than 50% of patients presents with neurological deficits indicating that the neuro-structures are frequently injured in traumatic spine injury. Almost more than a half of patients have associated injuries and the most frequent is head injury. Lumbar spine was the most affected spine level. Traumatic spine injury is frequently associated with vertebral body fractures and the most common types are compression wedge fractures. The use of Computed Tomography (CT) in this study helped to identify

several types of injuries especial injury to vertebral bodies and their effect unto neuro structures. MRI is very useful for assessing the spinal cord lesions as it shows changes of signal intensity which signifies injury to spinal cord. The use of advanced MRI techniques can be very helpful in early detection of spinal cord injury. CT and MRI should be considered to all high risk patients with traumatic spine injury.

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