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FREQUENCY OF BONE FRACTURES DETECTED BY PLAIN RADIOGRAPHY AND KEEPING CT AS GOLD STANDARD

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ABSTRACT

Background: The main cause of bone fracture is traffic accidents are (72.2%), falls (11.6%), blunt injuries are (7.7%) and others (5.8%)). About 84 patients were included in our studies. Out of which 21 (25.0%) were females and 63(75.0%) were males.

Objective: The objective of this study is to evaluate the frequency of bone fractures detected by plain radiography and keeping CT as gold standard.

Methodology: In our cross-sectional study all the patients with fracture undergoing CT and X-Ray were included. Patients with bone surgery were excluded as well as patients who declined to give consent and those who were uncooperative were all excluded. X-ray performed for all the fractures and the complex one sent to CT. The consent form was obtained by patients in this study. We reviewed our data of patients who underwent CT and X-ray. CT (Toshiba 64) was performed from the exact area of fracture and images reconstructed at 3mm and for reporting 5mm for filming. X-ray performed according to the appropriate range of kVp and mAs. All findings of CT were considered by the advice of consultant radiologist. Data was represented with means of standard deviation of frequency and percentage where appropriate. Chi square testing was used to compare CT and X-ray qualitative data. Data was entered into IBM SPSS Statistics 24.0. P-value <0.05 considered the significant.

Results: In our study 84 patients were included. Out of which 21 (25.0%) were females and 63 (75.0%) were males and the standard deviation was 0.436. There causes of fracture were 18(21.4%) injury, 8(9.5%) were compression fractures, 54(64.3%) RTA, 2(2.4%) pathologic fractures and 1(1.2%) was sports injury fracture and the standard deviation was .997.

Conclusion: Our study concluded that the bone fractures are more common in males than females. The most common cause of bone fractures is RTA (Road Traffic Accidents). Study also concludes that most common type of bone fracture is Transverse bone fracture. CT was more efficient in detecting bone fractures than plain radiography because more fractures were detected on CT than plain radiography.

Keywords: Non-enhanced CT, X- ray, Bone fracture, Road Traffic Accidents

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INTRODUCTION

A bone fracture is defined as a medical condition in which there is a break in the continuity of the bone. It is a typical bone ailment which occurs when the bone is not able to withstand outside force like direct hit, twisting injuries and falls.[1].Bone fracture is a common problem due to pressure, accident and osteoporosis. Many people suffer from bone fractures worldwide[2]. The International Osteoporosis Foundation reported that, worldwide, women have a 30%–40% lifetime risk of getting osteoporotic fractures while men have a lower risk of 13%[3]. Reasons of injuries are traffic accidents (72.2%), falls (11.6%), blunt injuries (7.7%) and others (5.8%)[4].Long bones may suffer from different types of fractures. In the first type known as Greenstick fracture, one side of the bone is broken while the other is bent. A Spiral fracture occurs when the bone is twisted apart. Another fracture type is the Comminuted fracture which occurs when the bone is crushed or break away. A Transverse fracture is characterized by a horizontal fracture[5]. Longitudinal fractures are defined as fractures running parallel to the bone. Mixed fractures are defined as comminuted fractures or those with both longitudinal and transverse components. Petrous fractures of skull are defined as all fractures extending to the petrous apex or the otic capsule, or both. Non-petrous fractures are simply defined as fractures not involving the petrous apex or the otic capsule. Skull fractures are seen in 23% to 66% of patients treated for head trauma with 18% to 22% of these fractures involving the temporal bone.[6] Petrous temporal bone fractures divided into four subcategories; longitudinal (67.4% of the case), transverse (8.7%), oblique (10.9%) and mixed or comminuted (13%). Many temporal bone fractures are missed on the conventional x-rays and only High-Resolution CT provides excellent sensitivity for temporal bone fractures. Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and x-rays are examples of such modalities which help physicians in detecting different types of bone fractures. X-ray images or Radiographs are among the first line investigations to detect fractures of bones as well as other organs of the human body. Instead of its few limitations, they are commonly used in bone fracture detection due to their low cost, high speed, wide availability and ease of use. Long bone fractures can be easily detected with x ray images[7].The x-rays output image is a shadow-like image, while CT and MRI images give better quality images for bone fracture than x-ray images[8]. Instead of its few limitations, they are commonly used in bone fracture detection due to their low cost, high speed, wide availability and ease of use. Long bone fractures can be easily detected with x ray images. Proximal tibia fractures are not adequately visualized on conventional radiography. CT scan contributes significantly in management of proximal tibia fractures especially in Schatzker's type 1 and type 4.[9] Carpus fractures account for 50% of all fractures in upper extremity. Computed tomography for the diagnosis of these fractures has been shown to be superior to radiographic results. CT has greater sensitivity to carpus fractures and is more precise in the evaluation of displacement and joint involvement of distal radius fractures.[10] Cervical spine fractures especially anterior instability of C5 on C6 are missed on plain radiography and are seen only by CT. CT is more sensitive than plain radiography in detecting fractures involving the sacrum, quadrilateral surface, acetabular roof, and posterior acetabular lip. Sensitivity of both examinations for abnormalities of the sacroiliac joint was relatively poor, but examinations are highly specific[11]. In a study conducted in 2006, it showed that out of 238 patients coming with foot pain, seven people with metatarsal base fractures and five people with toes fractures of phalangeal bones were still difficult to detect on plain radiography even on the second review.[12] Conventional AP-view X-rays and a high-quality axillary view are useful for primary diagnosis of the fracture, and they often do not always clearly show the appropriate bony structures such as the glenoid and humeral head. For example, CT's thin slices technology and additional 3D imagery always provide a clear overview of the fractured region.[13] Half of spine fractures are being ultimately discovered by CT The use of helical CT for the initial evaluation of suspected cervical trauma. It offers two advantages, allows faster exclusion of injuries and it detects more fractures and important injuries that were missed by X-ray radiography[14]. Radiation doses for plain radiography for different regions are given as; for chest 0.02 mSV, for abdomen 0.7 mSV, for pelvis 0.7 mSV, for skull 0.03 mSV, for thoracic spine 0.4 mSV, for lumbar spine is 0.7 mSV. Radiation exposure doses at CT for different regions are given as; for chest 7.8 mSV, for abdomen 7.6 mSV, for pelvis 7.1 mSV for skull 1.8 mSV, for thoracic spine 4.9 mSV, for lumbar spine 3.3 mSV[15]. We need Medical imaging in Medical emergency. On urgent bases so for that, we should have an idea to select a modality for a particular fracture by virtue of its type, site and extension. This will help us not to scan the patient on both modalities.

MATERIAL AND METHODS

In our cross-sectional study, all the patients with fracture undergoing CT and X-Ray were included. Patients with bone surgery were excluded, as well as patients who declined to give consent and those who were uncooperative were all excluded. X-Ray performed for all the fractures and the complex one sent to CT. In this study informed consent was obtained from patients. We reviewed our data of patients who underwent CT and X-ray. CT (Toshiba 64) was performed from the exact area of fracture and images reconstructed at 3mm and for reporting 5mm for filming. X-ray performed according to the appropriate range of kVp and mAs. All findings of CT were considered by the advice of consultant radiologist. Data was represented with means of standard deviation of frequency and percentage where appropriate. Chi square test was used for the comparison of qualitative data of CT and X-ray. Data was entered into IBM SPSS Statistics 24.0. P-value <0.05 was considered significant.

RESULTS

About 84 patients were included in our studies. Out of which 21 (25.0%) were females and 63 (75.0%) were males and the standard deviation was 0.436 (Table-1) shows the percentage and (Graph-1) shows the frequency of the gender.

Fracture Site

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Distal Phalanges	1	1.2	1.2	1.2
	Ulna	6	7.1	7.1	8.3
	Middle Humerus	5	6.0	6.0	14.3
	Radius	4	4.8	4.8	19.0
	Hip bone	4	4.8	4.8	23.8
	LI	1	1.2	1.2	25.0
	Femur	4	4.8	4.8	29.8
	Sternum	1	1.2	1.2	31.0
	Transverse L2	1	1.2	1.2	32.1
	Tibia	8	9.5	9.5	44.0
	Skull bone	13	15.5	15.5	59.5
	Scapular Fracture	1	1.2	1.2	60.7
	Occipital Fracture	1	1.2	1.2	61.9
	Right Parietal	3	3.6	3.6	65.5
	Temporal bone	8	9.5	9.5	75.0
	Frontal bone	5	6.0	6.0	82.1
	Distal middle phalangx	1	1.2	1.2	91.7

	Ankle joint	2	2.4	2.4	94.0
	Pelvic Fracture	1	1.2	1.2	95.2
	Knee joint	2	2.4	2.4	97.6
	Distal fibula	2	2.4	2.4	100.0
	Total	84	100.0	100.0	

Table-1: Shows the frequency of site of fractures present in the study.

Fracture Type					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Comminuted	9	10.7	10.7	10.7
	non Displace	9	10.7	10.7	21.4
	Transverse Fracture	13	15.5	15.5	36.9
	Oblique fractures	8	9.5	9.5	46.4
	Mixed fractures	8	9.5	9.5	56.0
	Compound fractures	4	4.8	4.8	63.1
	Greenstick fractures	1	1.2	1.2	64.3
	Displace trans frct	3	3.6	3.6	67.9
	Linear fracture	7	8.3	8.3	76.2
	Depressed fracture	8	9.5	9.5	85.7
	Hairline fracture	4	4.8	4.8	90.5
	Melleolus fracture	3	3.6	3.6	98.8
	Complex fracture	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

Table-2: Shows the percentage of types of fractures present in the study.

DISCUSSION

A bone fracture is defined as a medical condition in which there is a break in the continuity of the bone. It is a typical bone ailment which occurs when the bone is not able to withstand outside force like direct hit, twisting

injuries and falls. Bone fracture is a common problem due to pressure, accident and osteoporosis. Kun Hwang et.al., did retrospective study of 2,094 cases which include 1,673 males and 421 females, aged 1–97 years (mean age= 30.6 years) with facial bone fractures. There was a significant male predominance in all age groups and the overall ratio of males to females was 3.98:1. The results of their study were same as our study because in Kun Hwang et.al., study, there were more males than females as our study describes. In our study, 84 patients with bone fractures were examined out of which 63(75%) were males and 21(25%) were females. Out of 84 patients, x-ray was able to detect fractures in 40 patients, while 44 were detected on CT scan.[16]

Causes of fractures are road traffic accidents (72.2%), falls (11.6%), blunt injuries (7.7%) and others (5.8%). Adeyinka Abiodun study of 236 patients with cranial and mid-facial fractures. RTA was more common in males than females. Motor-vehicle was the most common cause of RTA in the present study (66.9%). More passengers were involved in the motor vehicle (87.3%) and motorcycle (52.0%) accidents than their corresponding drivers, and they were predominantly males. Majority of the patients involved in pedestrian road traffic accident (PRTA) were motor vehicle victims (93.3%). The results of our studies are same with the study done by Adeyinka Abiodun et.al., as in our study there were 64.3% cases of RTA which was the most common cause of fractures.[17]

Dennis Lee et.al., did a retrospective study of all patients with a diagnosis of temporal bone fractures, seventy-two children ranging from 6 months to 14 years of age were included in this study. The classification of fracture patterns was longitudinal, 6%; transverse, 54%; oblique, 10%; squamous, 27%; and other, 3%. The results of our studies are same with the study done by Dennis Lee as in our study transverse fracture ratio is more than other fracures.[18]

Spencer Kriss et. al., did study of 47 children with 57 abusive skull fractures and 47 children with 54 accidental skull fractures were evaluated. The patients were 1–36 months old. Fifty-one abusive skull fractures (89%) terminated in contact with a cranial suture; 35 of the 51 (69%) touched two or more sutures, and 12 touched three or more sutures. Forty-two of the 54 (78%) accidental skull fractures contacted a suture; only 3 of the 42 (7%). The sagittal (23%), coronal (21%), temporal-squamous (12%), and metopic (1%) sutures. The results of our studies are same with the study done by Spencer Kriss et.al., as in our study there were 15.5% cases of skull fractures.[19]

Kathryn Stevens et.al., study of 45 subjects at 6 months, 18 fractures were shown on CT scans, but only 12 were detected on radiographs and six, on MR images. At 12 months, 20 subchondral fractures were detected on CT scans, but only 17 were seen on radiographs and 11, on MR images. Compared with CT, MR imaging has a sensitivity and specificity of 38% and 100%, and unenhanced radiography has a sensitivity and specificity of 71% and 97%, respectively. The results of our studies are same with the study done by Kathryn Stevens et.al., as in our study there was CT reveals more fractures than unenhanced radiography or MR imaging.[20]

Conclusion:

Our study concludes that bone fractures are more common in males than females. The most common cause of bone fractures is RTA (Road Traffic Accidents). study also concludes that most common type of bone fracture is Transverse bone fracture and bone fractured were detected on both CT and X-ray radiography.

REFERENCES

1. Umadevi N, Geethalakshmi SN. A brief study on human bone anatomy and bone fractures. IJCES Int J Comput Eng Sci. 2011 Dec;1(3):93-104.
2. Lim SE, Xing Y, Chen Y, Leow WK, Howe TS, Png MA. Detection of femur and radius fractures in x-ray images. InProc. 2nd Int. Conf. on Advances in Medical Signal and Info. Proc 2004 Sep (Vol. 65, pp. 70-75).

3. Al-Ayyoub M, Al-Zghool D. Determining the type of long bone fractures in x-ray images. WSEAS Transactions on Information Science and Applications. 2013 Aug;10(8):261-70.
4. Ishman SL, Friedland DR. Temporal bone fractures: traditional classification and clinical relevance. The Laryngoscope. 2004 Oct;114(10):1734-41.
5. Amin Z, Sayuti R, Kahairi A, Islah W, Ahmad R. Head injury with temporal bone fracture: one year review of case incidence, causes, clinical features and outcome. Med J Malaysia. 2008 Dec 1;63(5):373-6.
6. Berlin L. CT versus radiography for initial evaluation of cervical spine trauma: what is the standard of care?. American Journal of Roentgenology. 2003 Apr;180(4):911-5.
7. Al-Ayyoub M, Hmeidi I, Rababah H. Detecting Hand Bone Fractures in X-Ray Images. J. cture detection and classification using X-Ray images. Machine Learning Research. 2018 Oct 10;3(3):49-59. Multim. Process. Technol.. 2013 Sep;4(3):155-6
8.Bandyopadhyay O, Biswas A, Bhattacharya BB. Long-bone fracture detection in digital X-ray images based on digital-geometric techniques. Computer methods and programs in biomedicine. 2016 Jan 1
9. Kumar R, Juneja J, Ramesh Sen D, Kadam S, Sahu G. Comparison between standard radiography and spiral CT with 3D reconstruction in the evaluation, classification and management of tibial plateau fractures. International Journal of Orthopaedics. 2020;6(2):789-94.
10. .Neubauer J, Benndorf M, Reidelbach C, Krauß T, Lampert F, Zajonc H, Kotter E, Langer M, Fiebich M, Goerke SM. Comparison of diagnostic accuracy of radiation dose-equivalent radiography, multidetector computed tomography and cone beam computed tomography for fractures of adult cadaveric wrists. PloS one. 2016 Oct 27;11(10):e0164859.
11. Harley JD, Mack LA, Winquist RA. CT of acetabular fractures: comparison with conventional radiography. American Journal of roentgenology. 1982 Mar 1;138(3):413-7.
12.Wenzel A, Haiter-Neto F, Frydenberg M, Kirkevang LL. Variable-resolution cone-beam computerized tomography with enhancement filtration compared with intraoral photostimulable phosphor radiography in detection of transverse root fractures in an in vitro model. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2009 Dec 1;108(6):939-45.
13. Wei CJ, Tsai WC, Tiu CM, Wu HT, Chiou HJ, Chang CY. Systematic analysis of missed extremity fractures in emergency radiology. Acta Radiologica. 2006 Jan 1;47(7):710-7
14.Dai LY, Wang XY, Jiang LS, Jiang SD, Xu HZ. Plain radiography versus computed tomography scans in the diagnosis and management of thoracolumbar burst fractures. Spine. 2008 Jul 15;33(16):E548-52.
15. ERIC J. HALL Radiobiology for the radiologist eighth edition
16.Hwang K, You SH. Analysis of facial bone fractures: An 11-year study of 2,094 patients. Indian Journal of Plastic Surgery. 2010 Jan;43(01):042-8.
17.Abiodun A, Atinuke A, Yvonne O. Computerized tomography assessment of cranial and mid-facial fractures in patients following road traffic accident in South-West Nigeria. Annals of African medicine. 2012 Jul 1;11(3):131.
18. Lee D, Honrado C, Har-El G, Goldsmith A. Pediatric temporal bone fractures. The Laryngoscope. 1998 Jun;108(6):816-21.
19. Kriss S, Morris J, Martich V. Pediatric Skull Fractures Contacting Sutures: Relevance in Abusive Head Trauma. American Journal of Roentgenology. 2021 Apr 28:1-5.
20.Stevens K, Tao C, Lee SU, Salem N, Vandevenne J, Cheng C, Neumann G, Valentin-Opran A, Lang P. Subchondral fractures in osteonecrosis of the femoral head: comparison of radiography, CT, and MR imaging. American Journal of Roentgenology. 2003 Feb;180(2):363-8.