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St. Paul's Hospital Millennium Medical College

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Department of radiology and medical radiology technology

Postgraduate study program

Magnitude and Imaging Pattern of Pelvic Bone fracture among adults who visited Addis
Ababa Burn, Emergency and Trauma centre (AaBET) with trauma cases Addis Ababa
Ethiopia

By: Shemaket Tesfaye (MD, Radiology Resident)

Addis Ababa, Ethiopia

June 2024



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Abbreviations and Acronyms

APC: Anteroposterior Compression

AO/OTA: Arbeitsgemeinschaft für Osteosynthesefragen/ Orthopedics Trauma Association

CT: Computed Tomography

DALYs: Disability Adjusted Life Year (1 DALY = loss of 1 year of healthy life)

GNP: Gross National Product

IRB: Institutional Review Board

LC: Lateral Compression

MSK: Musculoskeletal

RTA: Road Traffic Accident

SD: Standard Deviation

SPPS: Statistical Package for Social Science

USA: United States of America

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Abstract

Background: Trauma public health a public health burden resulting in increased morbidity, mortality and disability for the survivors. Of these pelvic fracture accounts approximately to 3-8 % of the overall injuries. There are several classifications systems, classification by young burgers and tiles depends on mechanism and severity of injury.

Objectives: To synthesize knowledge on the magnitude and imaging patterns of pelvic bone fracture among adults, who visited AaBET Hospital with trauma cases.

Methods: This is institution based retrospective chart review cross-sectional study and all adult patients managed at AaBET Hospital with pelvic fractures from July/2022 to December/2023 who fulfill inclusion criteria were included. The patients medical record numbers were collected from trauma and orthopedic morning registry sheets, the clinical data were reviewed from card room by using structured questionnaire. The patients CT scan /x ray images were retrieved and reviewed from PACS system by senior radiology resident and revised by MSK radiologist, with this findings Tile Classification of pelvic ring fractures were assessed for CT scans and x rays separately, the result was recorded on structured questionnaire. The collected data were be cleaned, coded and entered into Epi info 7 and exported to SPSS version 27.1 for analysis.

Results: A total of 119 patients with pelvic ring fracture were included in this study. The pelvic ring fracture was most common in male (69.7% male,30.3% female) with male to female ratio of 2.30:1 and the mean age of participants were 34.26 years with SD of 14.007. Those between 15-35 years account for 67.3%, making pelvic fractures commonly affect reproductive age group in this study. The most common mechanism of injury was road traffic accident accounting for 74.8% (89 of 119) of cases, among those involved in Road Traffic Accident 47.2% were Passengers ,44.9% were Pedestrian and 7.9% were drivers. Falling down accident account for 16.8% (20/119). Most common pelvic fracture patterns were Tile B classification accounting for 51.3% followed by Tiles A which account for 26.1% and 22.7% were Tiles C. Tile B2 most common overall accounting for 25.2% followed by tiles B1 accounting for 20.2%and Tiles C2 accounts for 14.3%.

Conclusion: In this study the magnitude of pelvic fractures was relatively high among trauma, commonly affect male and those between 15-35 years were most commonly affected. Road traffic accident was most common mechanism of injury and Tile B pattern was most common followed by Tile A pattern of pelvic fracture

1. Introduction

1.1 Background:

The pelvis bony is the entire structure formed by the two hip bones, the sacrum, and the coccyx, which is attached inferiorly to the sacrum. The paired hip bones are the large, curved bones that form the lateral and anterior aspects of the pelvis. Each adult hip bone is formed by three separate bones that fuse together during the late teenage years. These bony components are the Ilium, ischium and pubis. A pelvic fracture is a disruption of the bony structures of the Pelvis. An anatomic ring is formed by the fused bones of the ilium, ischium and pubis attached to the sacrum(1). A pelvic fracture is a break in one or more of the bones of the pelvis, which is the bony structure located at the base of the spine that connects the trunk to the lower extremities(2). Pelvic fractures can vary in severity and can be caused by high-energy trauma such as car accidents, falls from a height, or other crush injuries (3).

Pelvic fractures have presented a great challenge to orthopedic surgeons and radiologists over the years. Multiple classification system exists to attempt to standardize care. However, no consensus exists in the classification method of pelvic fracture. Classification of pelvic fracture is useful in describing injury and also to help guide both initial treatment and definitive fixation. The classification scheme of Young and Burgess and Tiles described the severity of injury by the mechanistic process involved and by grading the stability of the injury respectively. However, the most current classification method is that developed by the Arbeitsgemeinschaft für Osteosynthesefragen(AO) and Orthopedics Trauma Association(OTA) and is a composite of these two earlier methods(4).

Currently, the classification of a pelvic ring injury is based on evaluation of conventional plain radiography, specifically the AP, inlet and outlet views. Although plain radiography has been the mainstay of classifying pelvic ring disruptions, plain radiography are subject to factors, such as obesity and the presence of bowel gas or contrast media, that can impair diagnostic accuracy. In addition, accurate positioning of the X-ray tube angle to obtain proper views of the pelvis may be difficult to achieve, depending on the patients position and the technicians precision in obtaining these films. In addition, an understanding of the mechanism of injury that leads to pelvic fractures is useful to guide treatment and understand patterns of injury and cause of mortality. Identifying

the full scope of pelvic fracture patterns in older adults has gained clinical importance since the last decennium (5).

Computed tomography (CT) is the gold standard technique in the evaluation of pelvic trauma because it can quickly and accurately identify pelvic ring fractures, intra pelvic active bleeding, and lesions of other body systems. To properly guide the multidisciplinary management of the polytrauma patient and classification criterion CT is mandatory imaging(6).

Pelvic bone fracture is the most severe and life-threatening orthopedic injury with an incidence of 3–8% worldwide, and 1.5-3% of all fractures/bone injuries. The severity of pelvic bone fracture can range from simple and mostly harmless type A to life-threatening, complex type C fracture. The clinical presentation and outcomes of the pelvic fracture depend on the hemodynamic status of patients. Pelvic ring fractures typically follow high energy trauma from motor vehicular accidents, fall from a significant height and or ground level in the geriatrics and from crush injuries. Managing patients with a pelvic fracture is challenging both from the diagnostic and therapeutic perspective especially in resource-limited settings where medical facilities and infrastructure are scarce(7) and different studies done in our country, at hospitals with trauma care, shows the incidence of pelvic fracture from 1.9-11%, with RTA as a major cause of the problem(8)(9)(7).

1.2. Statement of the Problem:

Globally, an estimated 1.2 million people die from road crash accidents, and it is the third major cause of death worldwide. Around 60% of trauma patients have injuries involving the musculoskeletal system, and more than half of hospitalized trauma patients have at least one musculoskeletal injury that could be life-threatening, like pelvic ring injuries. Apart from death, pelvic bone fracture results in disability, nerve injury and paralysis, bladder injury and difficulty of urine passage, amputation that results to, psychological trauma, and also exerts a heavy economic burden on families and society resulting from health care costs, productivity loss, and occurrence of dependency from disability, that seeks care from family members(10). Pelvic fractures occur as a result of high energy forces such as road traffic crashes, falls from heights, and older adults/ elderly are at risk of pelvic fractures from lower energy forces such as ground level falls. Pelvic fractures make up a relatively small percent of overall injuries but the mortality rate is high, between 5 and 30 percent of admitted patients with pelvic fracture especially unstable patients, have a complex life-threatening scenario that needs integrated medical interventions and

necessitates early aggressive resuscitation, proper diagnosis, classification and prompt surgical interventions(11).A better characterization of pelvic fracture is crucial to guide the decision making process for better management of patients for survival, healing, and improvement of patients, and for better clinical outcomes.

As explained above from the studies done before, pelvic fracture exerts a heavy economic burden on the society. This burden is related to health system costs incurred by society in managing the injury. Although the service of pelvic surgery is given in few hospitals in our country (Christian Sodo hospital in SNNPR and some governmental and private hospitals in Addis Ababa), there is still a burden on AaBET Hospital, since it is the center/specialty hospital of burn and emergency trauma, and the study will help us in elaboration of the incidence, causes and types of pelvic fracture determination, which will help for proper diagnosis, classification and management of pelvic fractures, and recommend all the best and applicable solutions for the hospital and future researchers.

1.3. Rationale/Justification of the study:

The burden of musculoskeletal disease in low and middle-income countries (LMIC) continues to increase mainly due to road traffic crashes (RTC). Globally, RTCs constitute over 1.35 million deaths annually, more deaths than HIV/AIDS, tuberculosis and diarrheal diseases combined, and represent the third leading cause of disability for people aged 15–44 years. Traumatic musculoskeletal injuries often necessitate orthopedic surgical treatment. However, in LMICs, even at tertiary referral centers, definitive care is not readily accessible for most of patients because of lack of quality diagnostic techniques and proper management because of no proper determination of fracture patterns accordingly with mechanism of injury and anatomically. The prevalence of pelvic fracture is assumed to be rising in recent years. The approach to evaluation and management of these pelvic fractures has also evolved in the local setup. There are tools specifically X-ray and CT scans for the evaluation of pelvic fractures and classification of pelvic fracture is useful in defining injury and also to help guide both initial treatment and definitive fixation. This study will give a baseline for further study and highlight the severity of pelvic fracture in our country. The evidence that will be produced through this study will primarily help AaBET Hospital by providing information on pelvic fracture prevalence and determination of imaging patterns. Moreover, the

finding might help policymakers to address issues related to pelvic fractures, such as working on identified causes by designing strategy

2: Literature Review

2.1. Definition, concepts and classification of pelvic fracture

Pelvic fracture is a disruption of the bony structures of the pelvis. An anatomic pelvic ring is formed by the fused bones of the Ilium, ischium and pubis attached to the sacrum. The bony pelvis is the entire structure formed by the two hip bones, the sacrum and the coccyx, which is attached inferiorly to the sacrum. The paired hip bones are large, curved bones that form the lateral and anterior aspects of the pelvis. Each adult hip bone is formed by three separate bones (ilium, ischium and pubis) that fuse together during the late teenage years (6). The stability of the pelvis ring relies on the integrity of the posterior weight-bearing sacroiliac complex and the transfer of weight bearing forces from the spine to the lower extremities. The sacro-iliac joint, found between sacrum and ilium, transmits forces from the upper limbs and spine to the hip joints and lower limbs and vice versa. This joint also acts as a shock absorber. Several muscles influence the movement and the stability of the sacro-iliac (SI) joint either through attachment to the sacrum or the ilium, or ligamentous attachment to the strong anterior and posterior SI joint ligaments. Two thirds of the joint includes the posterior superior ligamentous section and one third of the joint includes the anterior inferior synovial component (12,13).

It is important to remember that the osteoarticular structures of the pelvic ring have no inherent stability. For example, the pubic symphysis provides only 15% of pelvic stability. Indeed, pelvic stability depends mainly (ratio of 8:2) on the pelvic ligaments of the posterior tension band: anterior and posterior sacroiliac ligaments, iliolumbar ligament, sacrospinous ligament, and Sacro tuberos ligament. The iliolumbar, anterior sacroiliac, and sacrospinous ligaments guarantee rotational stability, thanks to their horizontal course. The posterior sacroiliac and Sacro tuberos ligaments ensure vertical and anteroposterior stability, due to their vertical course (6).

Plain radiography is two-dimensional imaging modalities used for osseous and soft tissue structures. Its performed as part of ATLS protocol in polytrauma scenarios. anteroposterior pelvic x ray alone has low sensitivity (50–68%) and the false negative rates are high (32%), it miss sacral and iliac wing fracture in blunt pelvic trauma. Some author suggest abandon in hemodynamically stable patient. however in patient with hemodynamic instability, patient with head injuries and suspected hid dislocation (to relocate immediately) pelvic x-ray may be obtained prior to CT scan (14).

In addition tilting of tube 45 degree cranially and caudally to obtain inlet and outlet view respectively may give additional information about sacrum SI joint and vertical displacement of hemipelvis as in vertical shear injuries which are seldom possible in acute polytrauma settings ,hence CT required for evaluation of complex trauma as well as associated injuries if needed to help surgical planning retrospective reconstruction be used to simulate above additional views (15).

Spiral CT provides information about extent, orientation of fracture fragment and understanding of complex fracture particularly when combined with 2D(MPR) or 3D multiplanar reformatted techniques which impact on management protocol in significant number of cases by enabling dictation of subtle fracture lines particularly when oriented on axial planes. The use of intravenous contrast material allows simultaneous evaluation of osseous and vascular structures within the affected area. Postoperative studies in patients with orthopedic hardware also benefit from volume-rendered imaging (16). The application of plain x ray was also studied in classification pelvic fractures. Young et in his original paper described four pattern of pelvic fractures based on plain radiography namely :lateral compression ,anteroposterior compression ,vertical shear and combined injuries (17,18).

Until recently numerus attempt to classify pelvic fracture made to aid in prompt and appropriate treatments .in 1938 Watson-Jones proposed schema based on fracture location (anterior or posterior ring). Huittenin and slatis noticed the relationship of direction of force and resulting fracture pattern, Trunkey et al. introduced the concept of stability. Location and magnitude of the applied force, either high or low energy, have been recognized as important factors responsible for pelvic injuries. Concept of vector force responsible for pelvic ring fracture introduced first systematically by Pennal et al as anteroposterior compression (AP),lateral compression(LC) and vertical shear (VS)(19).

Concept of stability was added by Tile at el, stable (vertical unstable ,rotationally stable),unstable (both vertically and rotationally unstable) (13,20).Tile modified pennal classification divided injuries unstable and stable, alphanumerical system defined by Tile is most widely used classifications. Stability is ability of pelvic ring to withstand abnormal physiologic stresses, it can be clinical or radiological stability. forty percent of the pelvic stability is provided by the anterior ring and 60% by posterior ring. Stability of the pelvis following trauma is assessed by clinical and

radiological parameters. Radiological criteria of instability are: SI displacement of 5 mm in any plane, Posterior fracture gap (rather than impaction), Avulsion of fifth lumbar transverse process, lateral border of sacrum (Sacro tuberos ligament), or ischial spine (sacrospinous ligament) (19,21).

Tile classify pelvic ring fracture in to three groups. Tile A is stable fracture without ligamentous disruption and intact soft tissues includes avulsion and transverse fracture of sacrum and coccyx.

Tile B is produced by internal and external rotation of pelvis and vertically stable rotationally unstable and there is less than 1cm rotation of hemipelvis. The external rotational forces produce 'open book' injury pattern. There is disruption of pubis symphysis associated with unilateral or bilateral SI joint disruption. The posterior SI ligaments remain intact.

Tile C fracture is produced by VS force, both vertically and rotationally instable fracture characterized by disruption of posterior SI ligaments as well as pelvic floor, this result in gross displacement of pelvis with complete disruption of both SI and Sacro tuberos ligament.

Orthopedic Trauma Association(OTA) Classification further modify the tile classification : Type A spare posterior arch with no displacement thus A-1 fracture /avulsion of innominate bone, A-2 fracture of innominate bone direct blow, A-3 transverse fracture of sacrum and coccyx. Type B partially stable incomplete disruption of posterior arch, B-1 Unilateral partial disruption of posterior arch, external rotation ("open book" injury), B-2 Unilateral, partial disruption of posterior arch, internal rotation (LC injury), B-3 Bilateral, partial lesion of posterior arch. Type C complete disruption of posterior arch, C-1 unilateral, complete disruption of posterior arch, C-2 bilateral, ipsilateral complete, contralateral incomplete, C-3 bilateral, complete disruption.

In 1986 Young et al described pelvic ring injuries among 142 patients by using AP radiography, the location and pattern of pelvic ring injuries were classified mechanistically into three groups. The author cited the necessitate of rapid accurate diagnosis and correction of deformity as part of treatment and resuscitation in pelvic injuries patient (22,23).by understating that APC result from external rotation and increased pelvic volume the authors learns early application of resuscitative splint (pelvic binder) to correct deformity and decrease intrapelvic volume, early application of traction in vertical shear injuries which reduce vertically displaced hemipelvis aid in patient resuscitations(17,22,24).

APCI injuries has no posterior instability clinically or radiologically, associated with symphyseal widening of less than 2.5cm and there are vertical fracture of pubic rami .APC II injuries is rupture of Sacro tuberos, sacrospinous, and symphyseal ligaments with intact posterior SI ligaments (open book pattern). Symphyseal diastasis of more than 2.5 cm is seen, vertical stability is maintained. APC III injuries are those associated with complete posterior ligamentous /posterior sacroiliac joint disruption. In the original description by Young et al eight of the 10 APC II injuries had widening greater than 2.5 cm at the symphysis pubis, whereas the two with widening less than 2.5 has radiologic evidence for anterior sacroiliac disruption (23,25,26).

LC injury occur when laterally based medially directed force is applied to pelvis, Various injury patterns arise depending on the area and force delivered and fracture is more common than APC injuries. In the original description by Young et al,100% of LC injuries had ramus fractures, 88% had sacral fractures, 19% had iliac wing fractures, and 19% had central hip dislocations, rami fractures are more horizontally directed. LC I injuries occurs when lateral force directed to the posterior aspect of the pelvis associated with sacral fractures of varying severities. LC II injuries result from anteriorly directed force which causes internal rotation of the anterior hemipelvis with possible external rotation of the posterior hemipelvis anterior sacroiliac joint serving as a fulcrum. The resulting posterior pelvic injury in LC II patterns may be a sacral fracture, sacroiliac ligament and joint disruption, or crescent fracture-dislocation of the ilium. LCIII injuries occurs when internal rotation of the ipsilateral hemipelvis causes injury to the contralateral hemipelvis in the form of anterior sacroiliac ligament disruption and sacrospinous and Sacro tuberos ligament injury(27)(23).

VS injuries occurs when an axially loaded force delivered to hemipelves lateral to the midline. It requires Significant force, such as being struck by falling trees on the head or upper torso or a jump or fall from height. The sacrum is driven down, relative to the iliac wing, resulting in complete ligamentous injury and disruption of the sacrospinous, Sacro tuberos, anterior, and posterior sacroiliac ligaments on the injured side. Complex patterns are a combination of any three primary patterns (APC, LC, or VS). The majority of the complex injury patterns originally described by Young et al. resulted from LC injuries being combined with AP or VS patterns(23,26).

The purpose of classifying pelvic fracture is to provide a common language to facilitate communication among medical professionals caring for the patient and, it is a means for relating clinical findings from classification to proper management and resulting in good prognosis.

Several classification schemes are currently employed and there are few studies to validate this myriads classification system. The studies show that there are moderate intra observer and interobserver agreement between tiles and young and burgess classifications. There are also interobserver variability between each classification system(28). In this studies the tile classification will be used as it is more comprehensive use and accepted by the Orthopedic Trauma Association (OTA) and Association for the Study of Internal Fixation (AO-ASIF) groups.

2.2. Epidemiology/Magnitude of Pelvic Fracture

Global burden of disease in 2004 estimated to 58.8 occurs annually worldwide, of these 4.4 million people die due to injuries and Road traffic crash constitute over 1.35 million deaths annually. For people age 5-29 years among five top cause of death is due to road traffic injuries and 1 in 3 death result from road traffic accident injuries. More deaths than HIV/AIDS, tuberculosis and diarrheal diseases combined, and represent the third leading cause of disability for people aged 15–44 years. The burden of musculoskeletal disease in low- and middle-income countries (LMIC) continues to increase mainly due to road traffic accidents(29). low- and middle-income countries account for 85% of deaths and 90% of disability adjusted life years lost annually. The major unintentional injury-related causes of DALY's lost annually include road traffic injuries and falls. World health organization (WHO) 2004 region estimates Africa DALY's 2743 per 100, 0000(29,30). Globally, in 2019, there were 178 million new fractures (an increase of 33.4% since 1990), 455 million (428–484) prevalent cases of acute or long-term symptoms of a fracture. The top three countries with Highest incidence according to this study were Australasia, central Europe, and eastern Europe. The three regions with the lowest incidence rates were southern sub-Saharan Africa, western sub-Saharan Africa, and central sub-Saharan Africa(31). Study in Zambia between 2010 and 2019 shows incidence of fracture increased by 6%.

Pelvic bone fracture is the most severe and life-threatening orthopedic injury with an incidence of 3–8% of all fracture, the incidence in polytrauma patients range from 23-30%(32). The incidence of pelvic trauma is increasing due to the high number of traffic collisions involving pedestrians, motorcyclists, cyclists, as well as work and sport accidents(14). Pelvic injuries are commonly seen

in patients came with polytrauma and ranges from minor lacerations to major fractures that are devastating and complex. Injury to pelvic region accounts for around 10% of all the blunt trauma admissions(21) and different institution-based studies done reported that, the incidence of pelvic bone fractures ranges from 20 to 37 per 100,000-person-years populations worldwide(33)(11).

A cohort study done in USA shows, population adjusted incidence of pelvic fracture increased from 27.24 to 34.30 per 100, 000 populations, with the incidence higher in older adults(34).

Trauma Care Tertiary Hospital institution based systematic reviews done in India, Bangladesh and England/whales, shows that the prevalence of pelvic fracture to be between 2.4 to 8%, with lateral compression the most common pattern of pelvic fracture, and the incidence of the case to be high in older adults and increasing with age(35)(36)(37).

Multicentric cohort retrospective studies done two center Germany and Qatar) prevalence of 11% and 13% respectively. The mean age was (32 ± 14 in Qatar and 57.4 ± 21.6 in the German center), most common in male ((88% in Qatar and 55% in the German center). mechanisms of injury were road traffic accident in 59% of all cases, followed by fall from height (33%) in both centers. In unstable cases, the frequent mechanism of injury was Motor vehicle collusion (41%) followed by falls (35%) and pedestrian hit by vehicle (24%). Tile A (60%) was most frequently observed, followed by Tile B (30%) and Tile C (10%)(21). Prospective observational study done in India shows 74.6% were male, mean age was 37 with greater than 80% were below 50 years. Most common mechanism of injury was vehicle accidents comprising 77.3% of the cases, falls from heights 21.3%, and fall of heavy objects 1.3%, Most of the fractures were LC types (37.3%), followed by APC types (33.3%)(37). Similarly study done in Brazil shows mean age of 37 years ,57% were male , regarding mechanism of injuries 25.7% Car/truck accident, Motorcycle accident (19.6%), Fall from own height (25.7%) ,Fall from height >1m (6%) ,Horse fall/saddle trauma (7.5%) and Tractor accident (3%) .Regarding pattern of fracture Tile A most common 61% followed by Tile B(28.7%) and Tile C (16.7%)(38). Retrospective Netherlands study on 136 patients shows that 19% were female ,81% were male with mean age of 39 years ,65 of patients have Tile B type fracture with Tile A and Tile C account for 23 and 48 of patients respectively and similarly study done in Cameron shows mean age 39 with Tile B most common pattern of injury (39)(40).

In Nigeria 17 years of retrospective studies done ,shows majorities were male (42/56),mean age was 35 +14SD,MVA is most common cause (69.9%) .Tile calcification was used and Type A,B and C were found in 45.3%,32% and 22.6% of patients respectively (41). The cohort study on 129 patients done in South Africa show 51 were male 48 female MVC (50.3%) were most common mechanism of injury followed by pedestrian motor collision (37.9%) and Tile B(70%) is most common pattern of fractures (42).In study done in Kenya found that majority of patients with pelvic fractures were male with a mean age of 36 years. The main mechanism of injury was motor vehicle accidents (60.9%). The main Tiles fracture type was type B(43).

The study done in Tikur Anbesa specialized hospital, Ethiopia, including 230 patients in injury characteristics and road traffic accidents, majority of patients were males (71.7%). The mean age was 32.15 (SD 14.38) years within the range of 14-80 years. The main mechanism of injury was motor vehicle accidents (pedestrian) 36.1 % and pelvic fracture was seen in 5.1 % of patients but no study on the patterns of pelvic fracture done (44).

In Ethiopia retrospective cross-sectional study among 64 pelvic fracture patients in Bahirdar, Tibebe Ghion Specialized Hospital shows that Pelvic fracture was common among males with a ratio of 7:1 and young population (15–35 years). Moreover, most patients with pelvic fracture have Tile A fracture (56.3%,) Tile C in 20 (31.3%), and Tile B in 8 (12.5%) patients. The road traffic accident was the most common cause of pelvic fracture in 56.3%, followed by fall down accident (28.1%), and bullet injury (12.5%)(45) .Different studies in Ethiopia reveal that, the incidence of pelvic fracture to be between 2-11.4% (7,9)(39),with the most common cause of RTA and fall down injuries as mechanism of injuries but the pattern of fractures were not included in the studies, which affects the proper diagnosis and management modalities.

2.3. Causes/mechanism and risk factors of Pelvic fracture

Blunt traumatic injuries, with high energy RTA like motor vehicle collisions (cars and motorcycles), pedestrian and bicycles hit by vehicles, and falls from height are the main mechanisms of pelvic injuries. But still, low energy trauma may lead to pelvic fracture among the elderly. Different studies show that, causes/mechanism for pelvic fractures ,road traffic crashes (RTCs) as the most common mechanism of injury with an incidence of 62.9% followed by falls(30.6%)(46). From these studies, older adults are at higher risk of pelvic fractures, the same as that of osteoporosis (advanced age, prior pelvic fracture and others).

In this study the magnitude and the imaging patterns of pelvic bone ring fracture, mechanism of injuries, the agreement between CT and pelvic X-ray on Tiles classification of pelvic ring fracture were described.

3. Objectives of the study

3.1. General Objective

- To synthesize knowledge on magnitude and imaging patterns of pelvic fracture among adults, who visited AaBET Hospital, with trauma cases.

3.2. Specific Objectives

- To determine magnitude and patterns of pelvic ring fractures
- To evaluate the mechanism of injury in pelvic fractures
- To assess severity of pelvic ring fracture based on Tiles classifications
- To evaluate CT and x ray agreement on Tile classification

4. Methodology

4.1. Study Setting/area: This study was conducted in Addis Ababa Burn, Emergency and Trauma (AaBET) hospital. AaBET Hospital is the first dedicated Emergency and Trauma hospital with 250 -beds and 12 ICU -beds. AaBET hospital is an affiliated hospital of St. Paul's hospital millennium medical college, it's both teaching and public referral hospital. The hospital offers diagnosis and treatment for approximately 36,650 patients per year. The emergency department sees in average 10,379 injured patients in a year. The hospital provides services in emergency and critical care, orthopedics, neurosurgery, general surgery and burn.

4.2. Study period: Data were collected from May -June/2024 and all adult patients' pelvic fractures managed AaBET hospital from July/2022-December/2023 were included in the study

4.3. Study design: Institution based retrospective chart review cross- sectional study design was conducted at AaBET hospital to meet study objectives.

4.4. Study Population:

4.4.1 Source population: Adult Patients who visited AaBET hospital from July/2022 to December/2023.

4.4.2 Study Population: All adult patients treated at AaBET specialty hospital with pelvic fracture cases having imaging (CT scan and Xray) from July /2022 to December/2023.

4.5. Sample Size: All adult patients with pelvic fractures having imaging and fulfilling inclusions criteria, managed at AaBET hospital from July/2022 to December/2023 were included in the study during study periods to describe mechanism of injury and imaging patterns pelvic fracture, while all adult patients with trauma having fracture were included to determine magnitudes for pelvic fractures.

4.6. Sampling Procedures: Patient medical record numbers and trauma registry numbers were used to review patient sociodemographic data and patients CT scan and x rays images by the using nonrandom convenient sampling technique.

4.7 Inclusion and exclusion criteria:

4.7.1 Inclusion criteria

- All adult patients >14 years of age with trauma cases and having imaging

4.7.2. Exclusion criteria

- Patients with pelvic fracture whose clinical data and chart could not retrieved.
- Patients whose chart is retrieved but no relevant clinical information available

4.8. Measurement:

4.8.1 Study Variables:

Independent variables:

- Age
- Gender
- Mechanism of injuries
 - pedestrian
 - passengers
 - driver
 - falling down accident
 - bullet injury

Dependent variables:

- Patterns of pelvic fracture

4.8.2 Instruments:

4.9. Data Collection and Procedures: Relevant clinical information's, such as socio-demographic data, mechanism of injury and patterns of pelvic bone fracture had been filled on questionnaire with reading findings of CT by senior radiology resident and radiologist from the Picture Archive and Communication System (PACS). Data were collected retrospectively by the principal investigator from patient record charts.

4.10. Operational Definition:

Pelvic fracture classification: Depends on Tile's classification which is widely used in most of literatures, and classified as(41)

Tiles Type A: stable

A1: Avulsion Fractures- Pelvic ring not involved.

A2: Iliac wing fractures or. Stable minimally displaced anterior arch fractures.

A3: Transverse fractures of the sacrum or coccyx.

Tiles Type B: Partially Stable, vertically stable but rotationally unstable

B1: - disruption of the anterior pelvic arch through the symphysis pubis or through the rami

B2:- Anterior and posterior arch fractures.

B3: Bilateral open book (vertically oriented pubic rami fracture), bilateral lateral compression (horizontally oriented pubic rami fracture) or combined.

Tiles Type C: unstable both rotationally and vertically, due to complete disruption of the anterior arch, posterior arch, and pelvic floor.

C1: -Unilaterally unstable

C2: -Unstable in one side and partially stable in the other side.

C3: -Bilaterally unstable.

Anterior Arch: anterior to the acetabulum

Posterior Arch (Sacroiliac complex): posterior to the acetabulum

Stability: is the ability of pelvic ring to withstand physiologic forces without abnormal deformation.

Clinically instability: is determined by pelvic compression and distraction test.

Radiological instability: sacroiliac joint displacement of 5 mm in any plane, posterior fracture gap (rather than impaction), and avulsion of fifth lumbar transverse process, lateral border of sacrum (Sacro tuberos ligament), or ischial spine (sacrospinous ligament).

4.11. Data Quality Control and Management:

The data were collected by principal investigator by reviewing chart of patient and CT scan and X rays images of patients with case by case consultation to senior MSK radiologist. Data quality and consistency were checked by doing a supervision, follow-up and summarization done every day after data collection by investigator.

4.12. Data Analysis Plan and Procedures:

Collected data were grouped accordingly for the socio-demographic data, mechanisms of injury and fracture patterns. The grouped data were cleaned and coded, entered into Epi info version 7 and sent to SPSS version 27.1 for analysis. Any logical and consistency error identified during data entry was corrected after revision of the original completed questionnaire. Cleaned and coded data was analyzed by SPSS version 27.1 to generate result in frequency, table and figures for different variables.

4.13. Ethical Consideration:

The data collection was undertaken after obtaining permission from ethical committee of St. Paul Millennium Medical College Ethical Review Board (ERB) office. Approval from IRB was obtained and formal letter were written from radiology department to the card archive before commencing the data collection process. Information from patients' medical chart and radiology diagnostic results will be used only for the purpose of this study and confidentiality will be kept and maintained during data collection and dissemination of the results by excluding their names.

4.14. Dissemination of plan:

The finding will be defended and the report will be submitted to St. Paul Millennium Medical College and AaBET hospital after finalization of the analysis and interpretation of the result. The findings of this study will be communicated to department of radiology and orthopedics through printing the result. Publications will be made in the Ethiopian Journal of Health Sciences if study will be considered.

5.Result

5.1 socio demographic characteristics of study participants

Total of 119 patients were included in this study during study period. the majority of participants 83 (69.7%) were male and 36(30.3%) were female with male to female ratio of 2.30:1. Regarding the age of the patients the mean age of 34.26 with standard deviation of 14.007.

The most commonly affected age group by pelvic fracture was between 26-35 age years (46, 38.7%) followed by between 15-25 years (34, 28.6%), the minimum age in this study was 15 years with maximum age of 85 years, the least affected age group being 65 and above. The age group between 36-45 and 46-55 years of age account for 18.5% and 4.2% respectively. 7.6% of patients were between 56-65 years of age.

Genders	Frequency	Percentage
Male	83	69.7
Female	36	30.6
Total	119	100

Table 5.1 Frequency and percentage of gender of pelvic ring fractures patients in AaBET ,Addis Ababa Ethiopia 2024

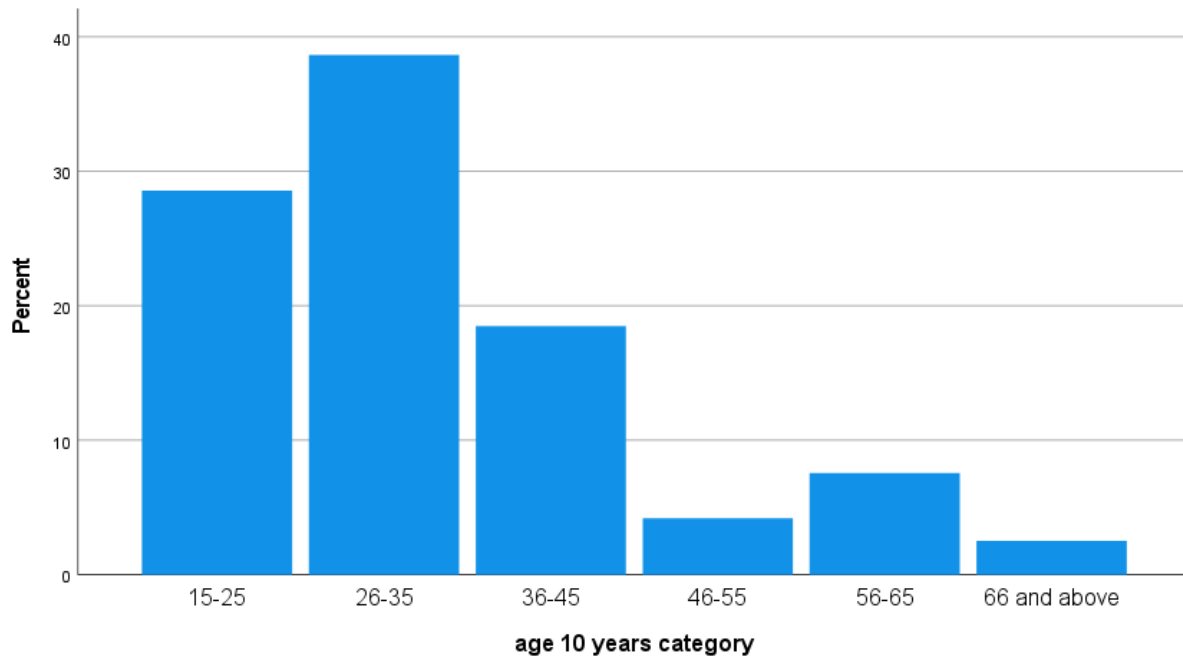


Figure 5.1 Age category distribution of patients with pelvic ring fractures in AaBET, Addis Ababa, Ethiopia 2024

5.2. Magnitude of Pelvic Fractures

During the study period from July 2022 to December 2023 total of 4479 patient with trauma having fractures and fulfilling inclusion criteria managed at AaBET hospital identified and there were 119 patients with pelvic fractures, four patients with pelvic fractures for whom charts were lost from chart room not included in the study. These gives the prevalence of pelvic fractures 2.65%.

5.3 Mechanism of Injury of Pelvic Ring Fractures

The most common mechanism of injury was Road terrific accident accounting for 74.8% (89 of 119) of cases followed by falling down accident which account for 16.8% (20/119). Among those involved in Road Traffic Accident 47.2% were Passengers ,44.9% were Pedestrian and 7.9% were drivers. Bullets injury account for 4.2%. The others mechanism of injuries occurred in five patients including house falling on them (three patients), two patients were injured by tree falling on them.

Table 5.2 : mechanism of injuries in pelvic fractures among adult in AaBET hospital
Addis Ababa ,Ethiopia 2024

mechanism of injury

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Road traffic accident	89	74.8	74.8	74.8
	Falling down accident	20	16.8	16.8	91.6
	bullet injury	5	4.2	4.2	95.8
	others	5	4.2	4.2	100.0
	Total	119	100.0	100.0	

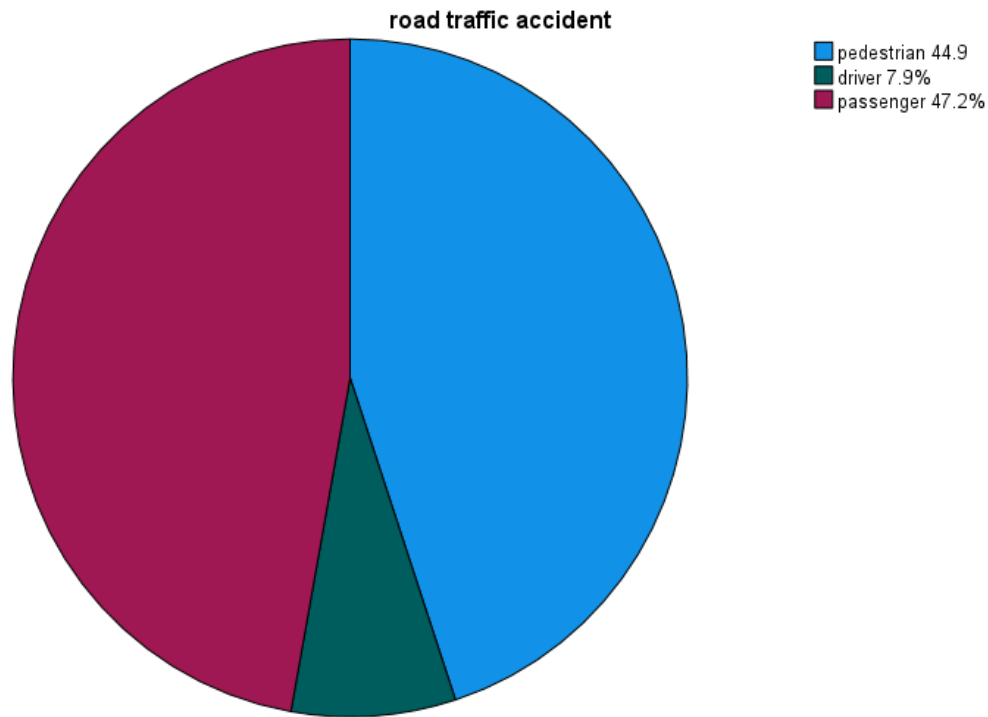
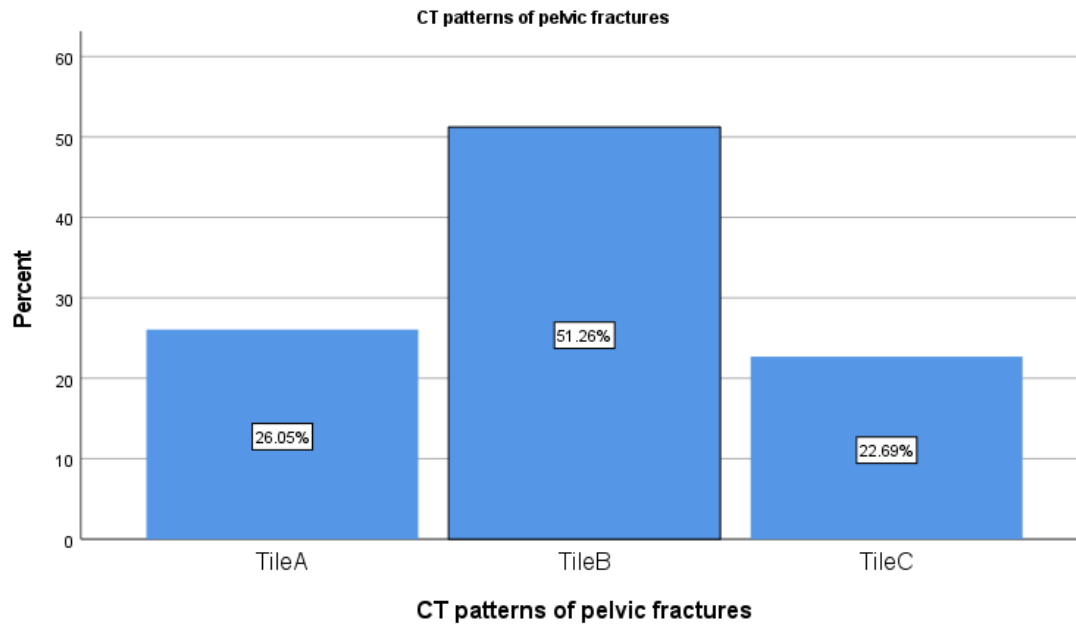


Figure 5.2: Road traffic accident in pelvic fractures among adults in AaBET hospital, Addis Ababa, Ethiopia 2024

5.4 CT Patterns of Pelvic Ring Fractures (Tiles classification)

This study includes total of 119 patients with pelvic ring fracture, B Tile classification was most common accounting for 51.3% followed by Tiles A classifications which account for 26.1% and Tiles C classification account for 22.7% making it least common. Tiles B2 classification is most common types accounting for 49.2% of B Tiles classification and 25.2% of all classes. Tiles A second mass common classification account for 26.1% and Tiles C classification is least common classifications in this study. The second most common CT patterns in this study was Tiles B1 accounting for 20.2% followed by Tiles C2 patterns accounting for 14.3% of all Tiles classifications.



Figures 5.3: CT patterns of pelvic ring fractures Tiles classification among adults in AaBET Hospital, Addis Ababa .Ethiopia 2024

Table 5.3: CT patterns of pelvic fractures Tiles classification among adult in AaBET hospital Addis Ababa Ethiopia 2024

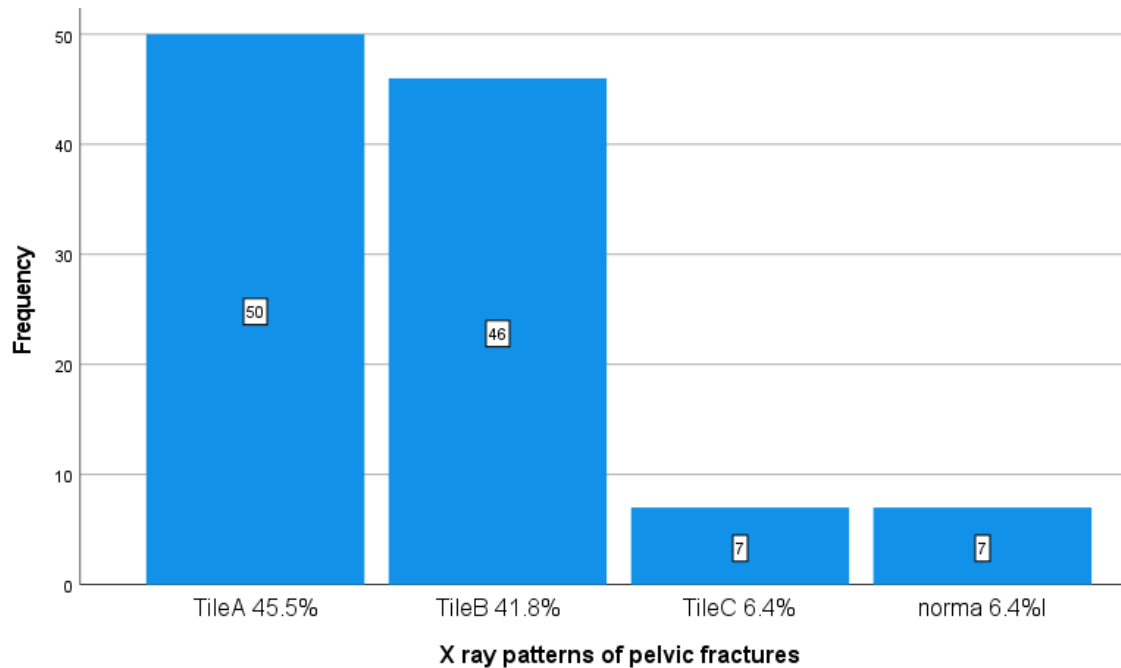
Valid	Frequency	Percent	Valid percent	Cumulative percent
TileA1	6.0	5.0	19.4	19.4
TileA2	11	9.2	35.5	54.8
TileA3	14	11.8	45.2	100
TilesB1	24	20.2	39.3	39.3
TilesB2	30	25.2	49.2	88.5
TilesB3	7	5.9	11.5	100
TilesC1	7	5.9	25.9	25.9
TilesC2	17	14.3	63	88.9
TilesC3	3	2.5	11.1	

5.5 X ray patterns of pelvic rings fractures (Tile classification)

out of 119 total of pelvic fracture cases only 110 cases were found to have pelvic X ray (AP, inlet and outlet) during study periods. Out of this Tiles A accounts for 45.5% followed by Tile B which account for 41.8%. Tiles A2 and B1 were most common patterns of each accounting for 18.5% over all cases of x ray evaluated .Out of 110 cases 5.9% (7 patients) x rays were normal. Tiles A1 accounts for 12.6%. Tiles C1 and A3 accounts for 5.9% and 16.8% respectively. The least X-ray Tiles pattern of pelvic ring fracture was found to be C2 accounting to only 0.8%. In this study no B3 and C3 Tiles pattern were found.

Table 5.4: X ray patterns of pelvic ring fractures Tile classification among adults in AaBET hospital Addis Ababa, Ethiopia 2024

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TileA1	15	12.6	26.3	26.3
	TileA2	22	18.5	38.6	64.9
	TileA3	20	16.8	35.1	100.0
	TileB1	22	18.5	57.9	57.90
	TileB2	16.00	13.40	42.10	
	TileC1	7.00	5.90	87.5	87.50
	TileC2	1.00	.80	12.50	100.00
	Normal	7.00	5.90	6.40	
Total		110	100.0		



Figures 5.4: X ray patterns of pelvic ring fractures among adults in AaBET hospital, Addis Ababa, Ethiopia 2024

5.6 Mechanism of injury and Pattern of Pelvic Fracture

There was no significant relationship between mechanism of injury and pattern of pelvic ring fracture (likelihood p value = 0.556). see table 5.5 for cross tabulation

Table 5.5 mechanism of injury versus patterns of pelvic fractures among adult AaBET hospital, Addis Ababa, Ethiopia 2024

		mechanism of injury				Total
		RTA	fallind down accident	bullet injury	others	
CT patterns of pelvic fractures	TileA	23	6	1	1	31
	TileB	45	10	3	3	61
	TileC	21	4	1	1	27
Total		89	20	5	5	119

5.7 CT and X ray agreement on classification of Pelvic Ring Fracture

In this study comparing 110 cases who had both Pelvic X-ray and CT scan independent classification with Tiles classification was done and there was agreement in 45.5% and no agreement in the rest 54% of cases was seen. Out of these 61 cases (54.4%), the X-ray being normal in only 7 of cases (11.5%). On statistical analysis the kappa value was 0.336 which showed poor agreement

5.8 correlation of variables

There is no significant correlation seen with in the variables in 95% confidence interval and significance level of 0.05

6. Discussion

The result of this study shows the frequency and magnitudes of pelvic fractures are relatively high particularly in young adults and adolescent age indicating severe natures of trauma in young population. This result is in keeping with study done in Qatar , UK and Germany(33)(11). The mean age of patients in this study was 34.26 with SD of 14.007 and the pelvic fractures occurs predominantly in males (69.7% male,30.3% female) with 2.3:1 male to female ratio in keeping with studies done in Brazil (mean age of 37 years ,57% were male,43% female) , study in Qatar shows mean age was 32 ± 14 SD years and most common in male (88%) .Similarly study done in Indian shows 74.6% were male, mean age was 37 with greater than 80% were below 50 years. This study is also in line with study done in Nigeria and Kenya which shows 42/56 were male with mean age was $35 + 14$ SD in Nigerian study and majority were male with mean age of 36 years in Kenyan study (21)(37)(38)(40)(43).

Similarly Study done in Ethiopia, Bahidar ,Tibebe Gihon hospital shows Pelvic fracture was common among males with Male to female ratio of 7:1 and young population (15–35 years) . Study done in Tikur Anbesa specialized hospitals also shows similar findings regarding sociodemographic distributions of pelvic fractures(males (71.7%), mean age was $32.15 + 14.38$ SD years, with the 14-80 years of age ranges) (44)(47). In contrary Germany and USA cohort study shows the incidence of pelvic fractures were higher among older age groups which possibly explained by most of population in Ethiopia are in young age groups (34). It could be also due to working habit, as male more works in the field and are more mobile than females. The study also showed the commonest age range involved was between 26-35 years 38.7% of the cases. Most of the accidents occur in the productive age groups (15-35 years) accounting 67.3% of the total pelvic ring fracture. This result is relatively similar with study done in Kenya (75%), India (73%) and Tikur Anbesa specialized hospital (69.7%). This result shows most of the affected patients are in the productive age groups which is burden for the family and the country.

The commonest mechanism of injury for pelvic ring fracture was road traffic accidents accounting for 74.8% where both pedestrians and passengers each accounted for 47.2% and 44.9% respectively followed by drivers among road traffic accidents (7.9%). This result is relatively similar with study done in Wollaita which showed passengers (45.8%), pedestrians (33.8%), and driver's (18.8%)(48). Other study done in Ethiopia Tibebe Gihon hospital shows road traffic

accident account for 56.7%. Study in Kenya showed pedestrians account for (46.5%), passengers and drivers account for 37.5%. This study is also in line with studies done in Qatar (Road traffic account for 57% followed by falling down accidents), Indian (Motor vehicle accidents account for 77.3%), and Nigerian (MVA 69.8%).

In this study fall down accident accounts for 16.8% of causes of pelvic ring fracture in keeping with similar study in Kenya. There are three cases of patients who had pelvic ring fracture after a house fell on them and another two patients who sustained trauma while cutting a tree and the tree fell on them.

The most common of pelvic fracture pattern in this study was B Tile classification accounting for 51.3% followed by Tiles A classifications which account for 26.1% and Tiles C classification account for 22.7% making it less common. Tiles B2 classification is most common types accounting for 49.2% of B Tiles classification and 25.2% of all classes. This is in accordance with Netherlands study (Tile 65/136, Tile A 23/136 and Tile 48/136). Similarly study done in Cameron shows Tile B most common pattern of injury (39)(40).

Study in south Africa also shows Tile B (70%) was most common pattern of fractures (42). In study done in Kenya found that the main Tiles fracture patterns was type B(43).

In contrary to this study studies done two center Germany and Qatar (Tile A 60%), Brazil(Tile A 61%) shows Tile A classification were most common among pelvic rings fractures(21) (37). Study in Nigeria also shows Type A,B and C were found in 45.3%,32% and 22.6% of patients respectively (41).

Tiles A second most common classification account for 26.1% and Tiles C classification is less common classifications in this study. The second most common CT patterns in this study was Tiles B1 accounting for 20.2% followed by Tiles C2 patterns accounting for 14.3% of all Tiles classifications.

n this study, the Tiles classification was made by X-ray and CT independently, there was under classification by the X-ray and the agreement was assessed and showed poor agreement with kappa value of 0.336. No similar study found which compares the agreement between X-ray and CT scan for the Tile's classification of pelvic ring fracture

7.Conclusion

According to this study the magnitudes of pelvic fracture was relatively high and the most commonly affected with pelvic ring fracture was male with M:F ratio of 2.30:1. In addition to this the commonly affected population seen was in their productive age groups (15-35 years) and most of the Victims were due to road traffic accidents and more so passengers and pedestrians. Fall down from a height accounts also significant number. In study Tile B classification is most common patterns which rotationally unstable high energy trauma This study also shows that there was under classification of pelvic ring fracture based on Tiles classification by X-ray. The CT scan may be valuable in improving the reliability of assessment of pelvic stability because of its potential ability to more clearly identify anatomical features of injury. More extensive work would be required in the future to determine how and whether these observations should be implemented clinical

8.Reccomendation

- Having consensus to use Single and consistent classification system of pelvic ring fracture.
- The stakeholder and responsible authorities should institute road safety campaign especially for pedestrians and drivers.
- Policy formulation and enforcement in road safety.
- Further study is recommended in the clinical relevance and value of X-ray in classifying pelvic ring fractures and agreement between CT scan and Xray on classification of pelvic fracture

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Annex I: Data collection instrument

CT/X ray Code _____ MRN: _____ Hospital Name: _____

1. Socio-demographic characteristics and assigned code

Age in years: _____

Sex: ☐Male ☐Female

2. Radiologic investigation done

X-ray: _____ CT-scan: _____ both: _____

3. Mechanism of Injury and who is injured

1.Road Traffic Accident

2.Faling down accidents

3.Bullet injury

4.Others

4.Road traffic accidents

1. Pedestrian

2. Driver

3 Passenger

4. Patterns of pelvic fractures (CT-scan) Tiles classification

1. Tile A: (Specify as, A1, A2, A3)

2. Tile B (Specify as, B1, B2, B3)

3. Tile C (Specify as, C1, C2, C3)

5.Patterns of pelvic fractures (X-ray) Tiles classification

1. Tile A: (Specify as, A1, A2, A3)

2. Tile B (Specify as, B1, B2, B3)

3. Tile C (Specify as, C1, C2, C3)