ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE

DEPARTMENT OF RADIOLOGY

RETROSPECTIVE CROSS SECTIONAL STUDY ON COMPUTED TOMOGRAPHY IMAGING ANALYSIS OF ACETABULAR FRACTURE PATTERN AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA.

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List of Abbreviations

AAU- Addis Ababa University

MSK-MUSCULOSKELETAL

RTA-Road traffic accident

MVA-Motor vehicle Accident

TASH – Tikur Anbessa Specialized Hospital

CT –Computed Tomography

MOA-Mechanism of Injury

MDCT-Multi-Detector CT

3D- Three Dimensional

2D- Three Dimensional

PACS-Picture Archiving and Communication System

SPSS- Statistical Package for Social Sciences

OPD-Out Patient Department

AP view- Antero-Posterior

ABSTRACT

Introduction: Correct recognition, description, and classification of acetabular fractures is essential for efficient patient triage and treatment. Acetabular fractures are almost universally classified by the method described by Judet et al and Letoumel over 60 years ago primarily to aid surgical planning. In the Judet and Letournel system, there are 10 acetabular fractures and fracture combinations. Although some fracture patterns are not directly accounted for in this scheme, many are subsumed into these 10 categories.CT scan is now considered a gold standard in management of acetabular fracture because it best characterizes fracture pattern, fragment size and orientation, identify marginal impaction, loose bodies and also look for articular gap.

Purpose of the study: The main objective of this study was to assess CT acetabular fracture patterns and associated injuries of all patients sustaining acetabular fracture from May 2019 to May 2020 GC in TASH, Addis Ababa, Ethiopia.

Material and methods: Institutional based retrospective cross sectional study of 89 patients with acetabular fracture was done. All patients with acetabular fracture from may -2019 to may-2020 G.C that fulfill the inclusion criteria mentioned above were studied.

The important data including age, sex, address, cause of fracture, fracture pattern classification, associated injuries and management modality were obtained from PACS, patient charts and electronic medical records. Finally, data was collected manually, coded, entered and analyzed by SPSS version 23.

Conclusion: We retrospectively assessed 89 acetabulum fractures that had been seen at TASH between May 2019 and May 2020. Majority of patients having acetabular fracture were males in their adult age group. Road traffic accident and fell down accident were causes of most acetabular fracture in TASH. Anterior column with posterior hemi transverse, T-shaped and both column fractures were the most frequent acetabular fracture patterns in their order. Associated intra-articular bony fragments and hip dislocations also noted in about 34% and 40% of cases respectively. In 8% of the cases there is also associated femoral head impaction. Femoral, pelvic and sacral bone fractures were common injuries associated with acetabular fracture. Majority of the patients had surgical management in TASH

Keywords: Acetabular fracture, CT, Judet-letournel classification system

CHAPTER ONE

Introduction

1.1 Background

The acetabulum is the socket of the hip joint and provides a stable articulation between the axial and appendicular skeleton. The stability and congruence of the acetabulum in relation to the femur is essential for normal bipedal locomotion. The column principle describes that the acetabulum is supported by the arms of an inverted "Λ". The long anterior column stretching from the pubic symphysis to the iliac crest and a shorter posterior (ileo-ischial) column from the ischial tuberosity to the greater sciatic notch (1).

Acetabular fractures are uncommon, with a reported frequency of three fractures per 100,000 trauma patients .Acetabular fractures result from either high-energy trauma or low-energy trauma in the elderly, with one meta-analysis reporting that 80.5% of acetabular fractures result from motor vehicle accidents and 10.7% result from falls (1).

Acetabular fractures are rare injuries in heterogeneous patient groups, making it difficult to develop adequately powered prospective single-center clinical trials in the USA or Europe. The incidence of acetabular fractures in the USA and Western Europe has been relatively stable over the years, with 37 pelvic fractures per 100,000 annually and only 10% of these involving the acetabulum (12).

Most acetabular fractures occur in the setting of significant trauma secondary to either a moving vehicular accident or a high-velocity acute-deceleration injury. Blunt force is exerted on the femur, is transmitted through the femoral head, and is transferred to the acetabulum. It is created when the femoral head and/or neck impact on the acetabulum. The exact type of acetabular fracture depends on the position of the hip during the trauma, the direction and magnitude of the impact force, and the quality of bone (1).

A road traffic accident is the main cause of these injuries in young adult males between 20 to 40 years of age group. It occurs in a bimodal distribution high energy trauma in younger patients (e.g., motor vehicle accidents) and low energy trauma in elderly patients (e.g., fall from standing height) (1, 13).

Acetabular fractures among elderly patients are also increasing, with recent data indicating that nearly one-quarter of acetabular fractures occur in patients who are older than 60 years of age. In this patient population, the most common fracture mechanism is falling onto the greater trochanter, which drives the femoral head anteromedially into the acetabulum, causing anterior column fracture or anterior column with posterior hemi transverse fracture, with associated medial displacement of the quadrilateral plate and damage to the articular cartilage of the femoral head (1).

The determination of the pattern of injury is key to the classification of an acetabular fracture, which, in turn, is critical to yield the highest quality orthopedic surgical treatment and therapy. Patients with high-energy acetabular fractures commonly have associated pelvic ring and lower extremity fractures. Life-threatening head, chest, and abdominal injuries are also associated with high-energy acetabular fractures (1).

Correct recognition, description, and classification of acetabular fractures are essential for efficient patient triage and treatment. Acetabular fractures are almost universally classified by the method described by Judet et al and Letoumel (2).

Accurate categorization of acetabular fractures is challenging because of the complex three-dimensional (3D) anatomy of the pelvis, the rarity of certain acetabular fracture variants, and confusing nomenclature. Judet and Letournel were disappointed with both operative and non-operative outcomes of acetabular fractures, so in the 1960s they developed standardized imaging protocols with which to classify acetabular fractures. After intensive research into the complex anatomy and radiographic landmarks of the acetabulum, they developed an acetabular fracture classification system that remains in use today (1).

In 1964, Judet et al introduced, and later slightly modified, a classification scheme for acetabular fractures that is still in use today. Before this time, acetabular fractures were poorly understood and inappropriately treated with non standardized methods. This classification was developed prior to computed tomography and was based on A/P and oblique x-rays. Currently it is the most widely used acetabular fracture classification system among radiologists and orthopedic surgeons (1).

The system is based on the orientation of the fractures and the structures involved. It is used to plan treatment and surgical approach and is most commonly used by orthopedic surgeons and radiologists.They introduced the concept of radiographic analysis of lines formed by cortical surfaces parallel to the x-ray beam on anterior-to-posterior and 45° oblique pelvic radiographs to anatomically classify acetabular fractures. This classification was used, in turn, to determine the most appropriate treatment. The four lines that are fundamental to Judet and Letournel's approach are the anterior and posterior acetabular rims (or walls) and the iliopectineal and ilioischial lines. Before that time, acetabular fractures were classified as those associated with

posterior hip dislocation and those associated with central hip dislocation. Many were treated without surgery, resulting in poor articular congruity of the hip (1).

In the Judet and Letournel system, there are 10 fractures or fracture combinations that separate walls from the acetabulum and columns from the sciatic buttress or that are transversely oriented through the acetabulum . The five elementary fracture types are posterior wall, anterior wall, posterior column, anterior column, and transverse. The five associated fracture types are combinations or partial combinations of the elementary fractures and include transverse with posterior wall, posterior column with posterior wall, T-shaped, anterior column or wall with posterior hemitransverse, and associated both columns. In general, column fractures divide the acetabulum into anterior and posterior parts, whereas transverse fractures divide it into superior and inferior parts. Although some fracture patterns are not directly accounted for in this scheme, many are subsumed into these 10 categories (based on Letournel's original work) (1).

Based on Judet and Letournel classification system most common fracture patterns in younger ages was posterior wall and transverse fracture "family" (transverse,T-shaped and transverse with posterior wall).In elderly common patterns were anterior column (e.g., quadrilateral plate fractures),anterior column with posterior hemitransverse and associated both column fractures (1).

CT scan is now considered a gold standard in management of acetabular fracture because it best characterizes fracture pattern, fragment size and orientation, identify marginal impaction, loose bodies and also look for articular gap. Evaluation of the femoral head and sacroiliac joint is also emphasized, as these structures may participate in the traumatic process. In complex acetabular fractures, 3D reformatted images, so-called "virtual imaging" of the acetabular and pelvic bones, may help conceptualize the fracture pattern and thereby aid in the planning of orthopedic surgical inter (13, 2).

Brandser and Marsh described several CT scan–based observations in the classification of acetabular fractures. The following may help in the classification of these fractures. Transverse-type fractures divide the acetabulum into top and bottom halves, as seen from the lateral perspective of the acetabulum. Column fractures divide the acetabulum into front and back halves. Isolated wall fractures do not divide the acetabulum. In other words, is the CT scan spur sign present? Only the both-column fracture causes the spur sign. Transverse-type fractures have a vertical (sagittal) CT scan orientation. Column fractures have a horizontal (coronal) orientation. Wall fractures are oriented obliquely (2).

1.2 Significance of the study

To be useful, a fracture classification must have clinical relevance, be inclusive, provide fracture-type specificity, and be easily understood by all physicians involved in the diagnosis and management of the fracture being classified. Several systems have been proposed for the classification of acetabular fractures in an attempt to better understand the lesions and predict outcome. Classification of acetabular fractures with the Judet and Letournel system is not intuitive but can be performed efficiently with careful and systematic analysis (8).

The goal of acetabular imaging is to depict the fracture and provide necessary information to the surgeon, who ultimately determines whether surgical repair is indicated and how it should be performed (31). Correct classification of acetabular fractures precedes the choice of the surgical approach and serves as the basis for preoperative planning (1).

The prognosis of acetabular lesions depends on the type of fracture, the condition of the weight-bearing part of the joint, the persistence of displaced or intra-articular fragments, and additional fractures that further destabilize the pelvis. For each of these factors, CT provides essential and often unique information. Correct classification of acetabular fractures precedes the choice of the surgical approach and serves as the basis for preoperative planning (8).

As to my knowledge, this study will be the first study to be done about acetabular fracture in Ethiopia. The study will provide the general magnitude of acetabular fracture in TASH. It is obvious that the frequency of bone fractures including acetabulum fracture is increasing with the increasing number of road traffic accident in Ethiopia.Acetabular fracture is one of the common case we encountered here in MSK imaging unit at TASH in our day to day practice. Classification of acetabular fracture based on CT patterns has paramount importance.

Knowing the proportion of acetabular fracture patterns on CT in accordance with judet-letourneal classification in TASH has importance for epidemiological study and patient management in our hospital. TASH is the only center where operative management of acetabular fracture is given at national level, so this paper will provide the general picture of the magnitude of acetabular fracture in Ethiopia.

Careful image reconstruction, analysis, and good communication between the radiologist and orthopedic surgeon allows for the best possible outcome for these complex fractures as accurate and consistent classification of acetabular fractures is essential for surgical planning. The study has several variables one of which is to assess the common cause of the acetabular fracture which have an important input for the concerned authorities and policy makers**.** In order to efficiently plan and implement the prevention, diagnosis and treatment strategy and mitigate the burden caused, one needs to properly address the magnitude of the problem.

CHAPTER TWO

2.1 Literature Review

For the patient with a traumatized acetabulum, accurate radiographic diagnosis and classification are the cornerstones of effective clinical care. Acetabular fractures are caused by high kinetic energy, and satisfactory management requires differentiation of the fracture types (1).

Acetabular and pelvic fractures occur in both men and women, but they are more common in men. A low-energy fracture results in a fracture of the acetabulum without disrupting pelvic alignment (non-displaced fracture), while a high-energy fracture may disrupt both the acetabulum and the overall alignment of the pelvic ring, and it is likely to lead to associated damage to the organs contained within the pelvis. The primary cause in younger individuals is high-energy trauma. Fractures secondary to moderate or minimal trauma are increasingly of concern in those older than 35 years (1).

The classification system of Judet and Letournel has led to improved management of such injuries. However, trauma-related acetabular fractures are often complex, with multiple fragments and secondary fracture lines. Computed tomography (CT) provides information regarding the extent of the fracture and is complementary to radiography for ascertaining the spatial arrangement of fracture fragments. Three-dimensional (3D) reconstruction of CT data can be helpful in understanding the complex fracture patterns (1).

Isolated acetabular wall fractures typically do not involve the weight-bearing articular portion of the acetabulum. Fractures of the posterior wall are more common than are those of the anterior wall because of the preponderance of posteriorly directed forces responsible for acetabular fractures. Posterior wall fractures may occur in isolation or in combination with posterior column or transverse fractures. Anterior wall fractures are rare. As the name implies, the anterior and posterior columns are involved. Isolated anterior and posterior column fractures are uncommon (1).

In the 1980, using radiographic and surgical data from 647 acetabular fractures, of which 582 had undergone surgical fixation, Letournel confirmed and updated his original description. He divided acetabular fractures into 10 subtypes, five elementary patterns and five associated patterns. Elementary patterns included posterior wall fractures, posterior column, anterior column, anterior wall, and transverse fracture patterns. Associated patterns include T-shaped, posterior column and posterior wall, transverse and posterior wall, anterior and hemi transverse, and fractures of both columns (2).

In a study done by Brandser and colleagues, commonly occurring acetabular fractures (90%) include the following; both-column, transverse with posterior wall, posterior wall, T-shaped and transverse. Uncommonly occurring acetabular fractures (10%) include the following; anterior column, anterior column with posterior hemi transverse, posterior column with posterior wall, Posterior column and Anterior wall (2).

In studies done by Giannoudis et al from 2005-2007 in Canada regarding the distribution of Judet and Letournel acetabular fracture categories shows five fractures (posterior wall , transverse, transverse with posterior wall, both column, and T-shaped) account for approximately 80% of all acetabular fractures despite the presence of 10 fracture types. In this study fractures that contain a posterior wall component are most common, with nearly one-half of all acetabular fractures containing a posterior wall component (1).

In a study done in Serbia, 737 patients with acetabular injuries over the period from 1989 to 1998 were analyzed. Among the study, 575 (78%) were males and the remaining 162 (22%) were females. The causes were traffic accidents in 621 (84.3%) patients, 103 (14%) fell from a height, 7 (0.9%) covered in a mine. Femur was the most frequently associated injury of all bones (occurs in 66.5% of cases). There were 176 (23.8%) fractures of the posterior wall, 23 (3.1%) fractures of the posterior column, 14 (1.9%) fractures of the anterior wall, and 29 (3.9%) fractures of the anterior column. Transverse fractures were present in 61 patients (8.3%), "T" fractures in 51 (6.9%) patients and 383 (52.1%) were combined fractures. Loose bodies within the hip joint were noted in 80 patents (10%) among them77 (96%) are visualized on CT scan (4).

In a study done to review the epidemiological aspects of acetabular fractures treated at Hamad Medical Corporation in Qatar from 103 patients who presented to level I trauma centre from 2008 to 2010 with a diagnosis of acetabular fracture. Males (93.2%) predominated. The mean age at injury time was 36 years, and the most common cause of injury was motor vehicle collisions (49.5%). Injuries were mostly primary acetabular fractures (73.6%) in comparison to (26.4%) for associated fractures. They used the Letournel system for classifying 87 displaced and nondisplaced fractures. The remaining 16 (15%)fractures were not classified either because it cannot be classified using the Letournel system.The posterior wall fractures were the most common in 26 cases (25.2%) with a high incidence of the anterior column (18.4%) and anterior wall (10.7%) fractures. Post-traumatic sciatic nerve palsy (7%) that was present at the time of injury. Associated posterior hip dislocation occurred in 21.3% of cases (10).

In a study done Fernandes Dias etal by retrospectively analyzing 73 acetabulum fractures that had been treated at National Institute of Traumatology and Orthopedics (INTO), Rio de Janeiro, Brazil between March 2006 and November 2008. Among the 73 patients, 56 (76.8%) were male and 17 (23.2%) were female. The mean age was 39.6 ± 3.8 years (minimum of 12 and a maximum of 89 years). Regarding the trauma mechanism, 43 cases (59%) were due to vehicle accidents, 14 (19%) were due to accidents involving motorcycles, six (8.2%) involved pedestrians who were run over, nine (12.4%) were due to falls, and one (1.4%) occurred on a ship. The time that elapsed between the injury and the surgical treatment was a mean of 16.4 ± 1.1 days (minimum of one and a maximum of 64 days). Forty cases (55%) were on the right side and 33 (45%) were on the left side. Twenty-two patients (30%) presented associated fractures, among which there were eight cases (36.3%) of lesions of the pelvic ring, five (22.5%) of the femur, and four (17.2%) of the tibia. Posterior column fractures were the most frequent types (20).

A research done by Mauffrey, Cyril et al with the topic of the epidemiology and injury patterns of acetabular fractures from 2005 to 2012 for one Chinese center and from 2008 to 2012 for one United States of America center. Total of 661 patients from China and 212 patients from the USA with acetabular fractures are studied. Among them 77 % were males and 23 % were females. The lower mean age of patients with acetabular fractures in china (40±13years) and the mean age of US patients (44±16) were seen. Motor vehicle accidents were responsible for 54% in China and 61% in the USA as a cause of acetabular injury. Falling from height causes 32 % of injury in China and 24% in the USA. Posterior wall (32% in USA and 30 % in China), both columns (17% in USA, 21% in china) and transverse posterior wall (14% in USA, 10% in china) are the top three commonest patterns. About 13% acetabular fractures in the USA and 9% in China are not classified to one of fracture patterns (11).

In St John's Medical College & Hospital, Bangalore, India 68 cases with acetabular fracture from 1995 to 2000 were evaluated. Among the study 59 were male and 9 were female patients. The average age of the patients treated non-operatively was 38 years (range 17 - 68 years) and in the operative group it was 34 years (25 - 55 years).In 45 cases the mechanism of injuries was motor vehicle accidents, out of which 17 were two wheeler (motorcycle) and 28 four wheeler injuries and 23 cases fell from a height. Fractures were classified and treated based on diagnostic and therapeutic criteria of Judet & Letournel. Among them around 32% have posterior wall fracture and 22% have posterior column fracture. Posterior wall fracture is the commonest type of fracture acetabulum (17).

A research done by Raffaele Pascarella et al 2009, 373 cases of acetabular fracture between January 1, 1997 and December 31, 2007 were observed. One hundred twenty-seven cases presented a dislocation (32%): 5 anterior, 13 central, and 109 posterior (90%). In 45 cases (12%), after reduction of the dislocation, 2 anterior and 43 posterior intra-articular fragments were observed (21).

A research done in Brazil evaluates a total 609 patients who were treated for fracture acetabulum with modified stoppa approach. There were 427 males (70%) and 139 females (30%) and age varies between 10–88 years (mean age 49.3 years)**.** Mode of injury was evaluated in 271 patients. Road traffic accident was the most common mode in 129 (47%) patients followed by fall from height in 108 (39%) patients, industrial accident in six patients; crush injury in three patients and sports injury in one patient. In 456 patients were classified according to Judet and Letournel classification. There were 128 associated both column, 89 anterior column with posterior hemi-transverse, 84 anterior column, 54 T -type, 53 transverse, 29 transverse with posterior wall, 13 anterior column, three anterior column with wall, two anterior wall and one posterior column fractures (9).

CHAPTER THREE
Objectives

3.1 General Objective

To determine acetabular fracture patterns and associated injuries in patients visiting TASH from May 2019 to May 2020 G C.

3.2 Specific objective

A, to assess the common acetabular fracture patterns (based on judet letournel classification) in TASH

B, to assess the common associated injuries occurring with acetabular fracture

C. to assess causes of acetabular fracture in patients visiting TASH

D. to assess the socio-demographic data of patients sustaining acetabular fracture

CHAPTER FOUR

Methods and Materials

4.1 Study area and period

The study was conducted in Addis Ababa TASH from May 2019 to May 2020 GC which is located in the nation's capital Addis Ababa. It is the largest referral hospital as well as a main teaching hospital, which was built in 1972 GC. The hospital provides a tertiary level referral treatment with over 900 beds and is open 24hrs for emergency services (14, 16).

4.2 Study design

Hospital based descriptive retrospective cross sectional study was conducted

4.3 Source Population & Study Population

4.3.1 Source Population

All patients that were sent for pelvic CT in TAH

4.3.2 Study Population

All Patients who had an acetabular fracture on Pelvic CT

4.4 Inclusion and exclusion criteria

4.4.1 Inclusion Criteria

- Patients that have acetabular fracture on pelvic CT scan in our study period

4.4.2 Exclusion criteria

- Known acetabular fracture patients who have follow up imaging at TASH after internal fixation.
- Those patients having pelvic CT which is technically poor for interpretation.
- Patients with pelvic ring fracture which has associated fracture line extension towards the adjacent acetabulum.

4.5 Sampling technique and sample size

All patients with acetabular fracture from may -2019 to may-2020 G.C that fulfill the inclusion criteria mentioned above were studied**.**

4.6 Study Variables

The independent variables included in this study were grossly divided into 3 categories based on the source or type of information: patient-level demographics, mechanism of injury and imaging findings. Patient-level demographic variables are age at diagnosis, sex, and residence area. Mechanism of injury includes the immediate cause of injury, specific type of motor if it is RTA as well as the status of the patient during the incident.

Imaging finding variables includes acetabular fracture pattern, hip dislocation, femoral head impaction fracture, intra-articular bony fragments and other associated injuries.

4.7 Study Instrument

A well structured questionnaire for data collection was developed from similar studies and utilized for data collection

4.8 Data collection

Data was collected by reviewing pelvic CT image reports on PACS which is reported by MSK imaging consultant radiologists. Other important study variables were collected from patient's charts and electronic medical records (I-care).

4.9 Operational Definition

Fracture- is a discontinuity in the bone resulting from mechanical forces that exceed the bone's ability to withstand them.

Acetabulum- is a cup-shaped socket of hip bone with anterior and posterior walls in which femur head fits. It has anterior and posterior columns.

Anterior column- extends from iliac crest to symphysis pubis and includes the anterior border of the iliac wing, the pelvic brim, the anterior superior iliac spine, the anterior inferior iliac spine, the anterior wall of the acetabulum, and the superior pubic ramus.

Posterior column- extends from superior gluteal notch to ischial tuberosity and includes only the ischial portion of the innominate bone, including the greater and lesser sciatic notches, the posterior wall of the acetabulum, and the ischial tuberosity.

Acetabular dome-the superior weight-bearing portion of the acetabulum at the junction of the anterior and posterior columns, including contributions from each.

Sciatic buttress-is a strut of bone in which the anterior and posterior columns connect to the axial skeleton.

The quadrilateral plate- is a flat thin bone which is forming the medial wall of the acetabulum.

Transverse acetabular fractures- divide the acetabulum into superior (ie, iliac) and inferior (i.e.ischiopubic) fragments.

T-shaped fractures- are transverse fractures with an inferiorly directed stem, which may run vertically through the inferior pubic ramus or through the ischium.

The spur sign- is a pathognomonic sign of both column acetabular fracture seen on the obturator oblique x- ray view and CT. It represents a strut of bone extending from the sacroiliac joint like spur like appearance as fracture of both columns disconnects this piece of bone from the acetabulum.

Posterior hip dislocation - The femoral head is totally displaced and positioned supero-lateral to the acetabulum, with the hip in flexion, internal rotation and adduction position.

Anterior hip dislocation- the femoral head is totally displaced and positioned inferomedial to the acetabulum, with the hip in marked external rotation.

Central hip dislocation -the femoral head dislocated centrally towards the pelvis usually with acetabular bone fracture.

Femoral head impaction_ is trauma to the articular cartilage and subchondral bone of the femoral head during hip dislocation .Femoral head will have depression or notching on CT imaging.

A road traffic accident - is defined as an accident involving at least one vehicle on a road open to public traffic in which at least one person is injured or killed

Passenger- is one who travels in a vehicle but who does not operate it.

A pedestrian- is a person travelling on foot, whether walking or running rather than travelling in a vehicle.

A **motor vehicle**-is a self-propelled vehicle, commonly wheeled, that does not operate on rails and is used for the transportation of people or cargo.

4.10 Data Processing and Analysis

Data was analyzed using SPSS version 23.0 and descriptive statistics such as frequency distribution, mean, standard deviation and percentages were calculated. Finally the result was described using texts, Pie charts, Bar graphs and tables.

4.11 Ethical considerations

The information obtained from patients medical records as well as imaging reports of the patients was kept confidential & Permission was obtained from research & ethics committee

CHAPTER FIVE

Results

5.1 Socio-demographic characteristics

Among the 89 patients, 74 (83.1%) were male and 15 (16.9%) were female (Figure 1). The mean age was 33.2 years with standard deviation of 11.9 (see table 1 below).

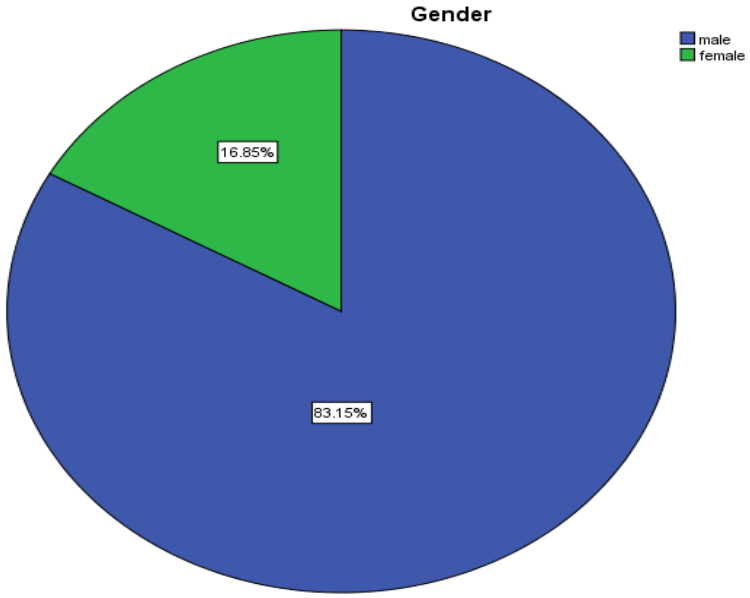


Figure 1: Gender distribution of acetabular fracture patients at TASH from May 2019-2020

Stastics	value
Mean	33.28
median	30
Std. Deviation	11.877
Minimum	17
Maximum	75
Range	58

Table 1: Distribution according to age in years

When we see the address of patients in the study by regional states and city administrations of Ethiopia, 21 (23.6%) patients were from Oromia region, 16 (18%) were from Addis Ababa and 18 (20.2%) of them were from Amhara region (See figure 2 below)

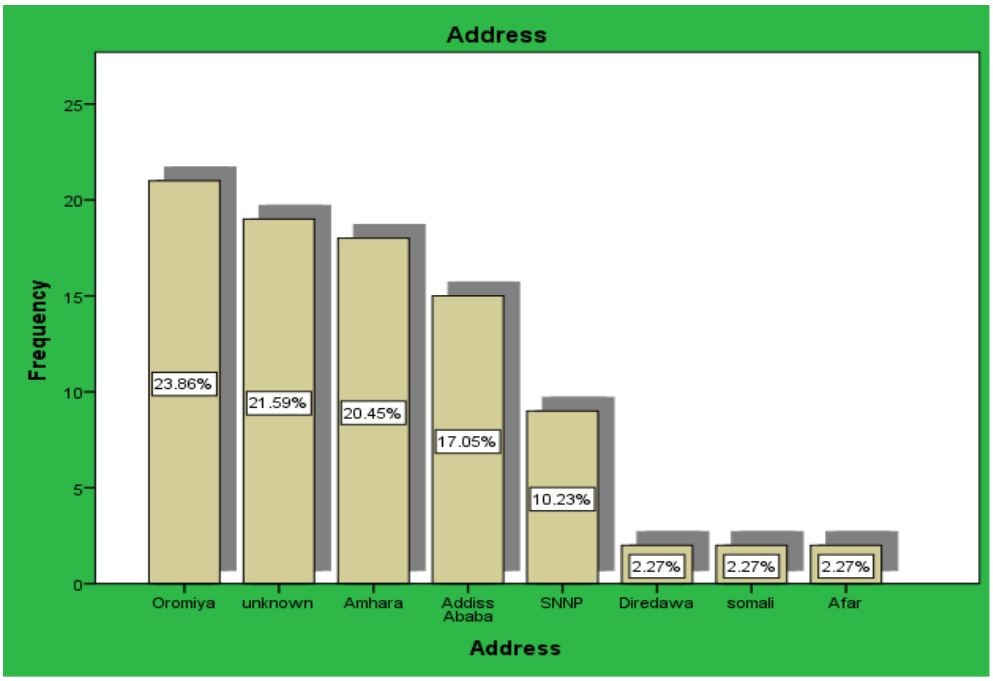


Figure 2: Distribution of acetabular fracture patients at TASH by their address from May 2019-2020.

5.2 Mechanism of injury

Regarding the trauma mechanism, 64 cases (71.9%) were due to motor vehicle accidents (RTA).Among traffic victims most are passengers. The other causes of acetabular fractures are fell down accident in 14 (15.7%) patients, bullet injury in 3 patient and stick injury in one patient (see figure 3, 4 and table 2 below).

Among the cases, 81(91%) of the patients with acetabular fracture have direct trauma to the hip and the remaining 5(5%) have indirect trauma (the trauma is upon the knee). In around 85(95%) of patients the chief complaints during presentation at emergency OPD was hip pain and difficulty of movement and almost all fully studied patients have stable vital signs during presentation (see Figure 5 and table 3 below).

Patients arrived at TASH from the range one day up to 50 days with average day of arrival around 6 days.

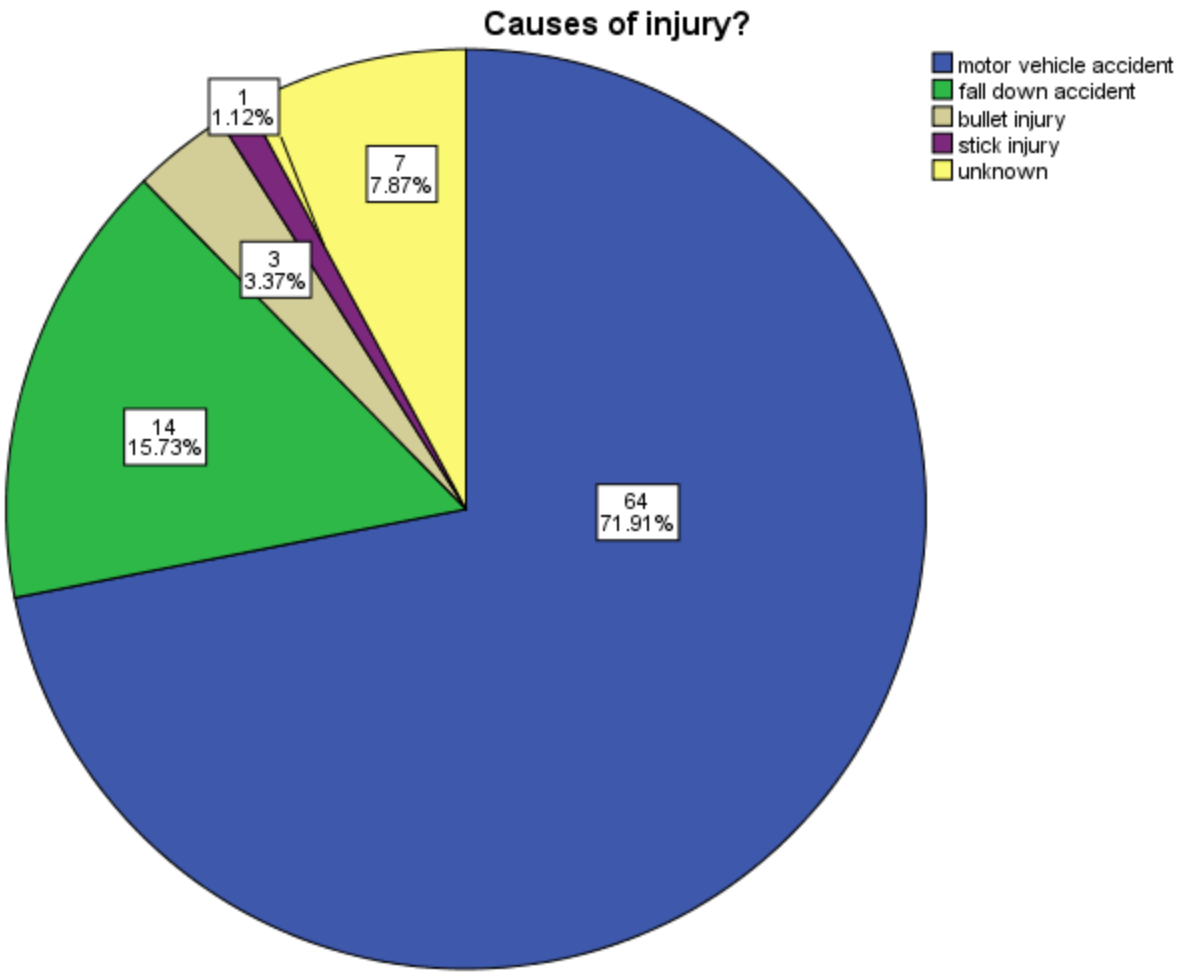


Figure 3: Causes of acetabular fracture in patients visiting TASH from May 2019-2020(unknown-those patients in which their chart is missing).

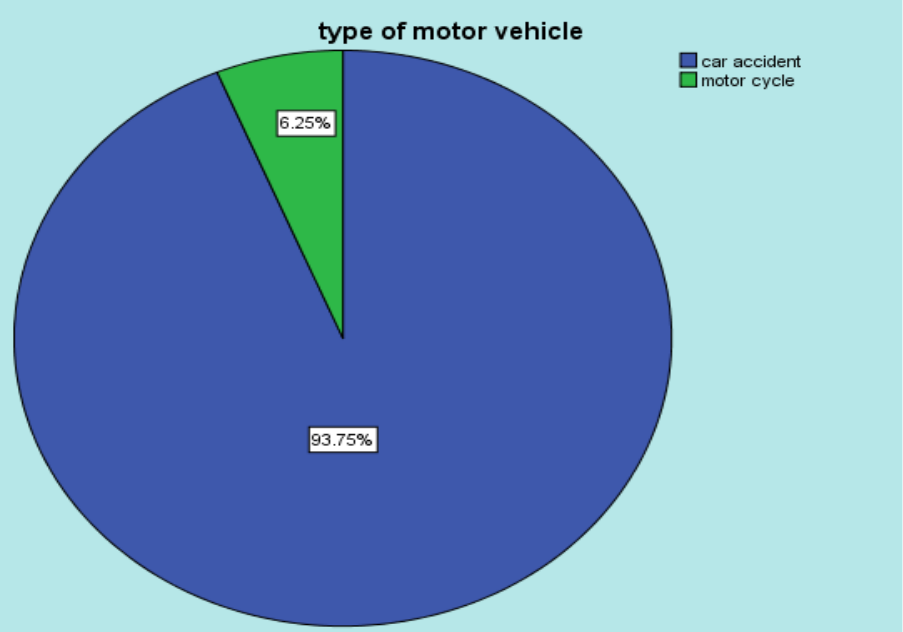


Figure 4: Causes of acetabular fracture in patients visiting TASH from May 2019-2020.

		Frequency	Valid Percent
	passenger	37	57.8
	pedestrian	16	25.0
	driver	11	17.2
	Total	64	100.0
Total		97	

Table 2: Status of the victim during the vehicle accident in patients sustaining acetabular fracture visiting TASH from May 2019-2020.

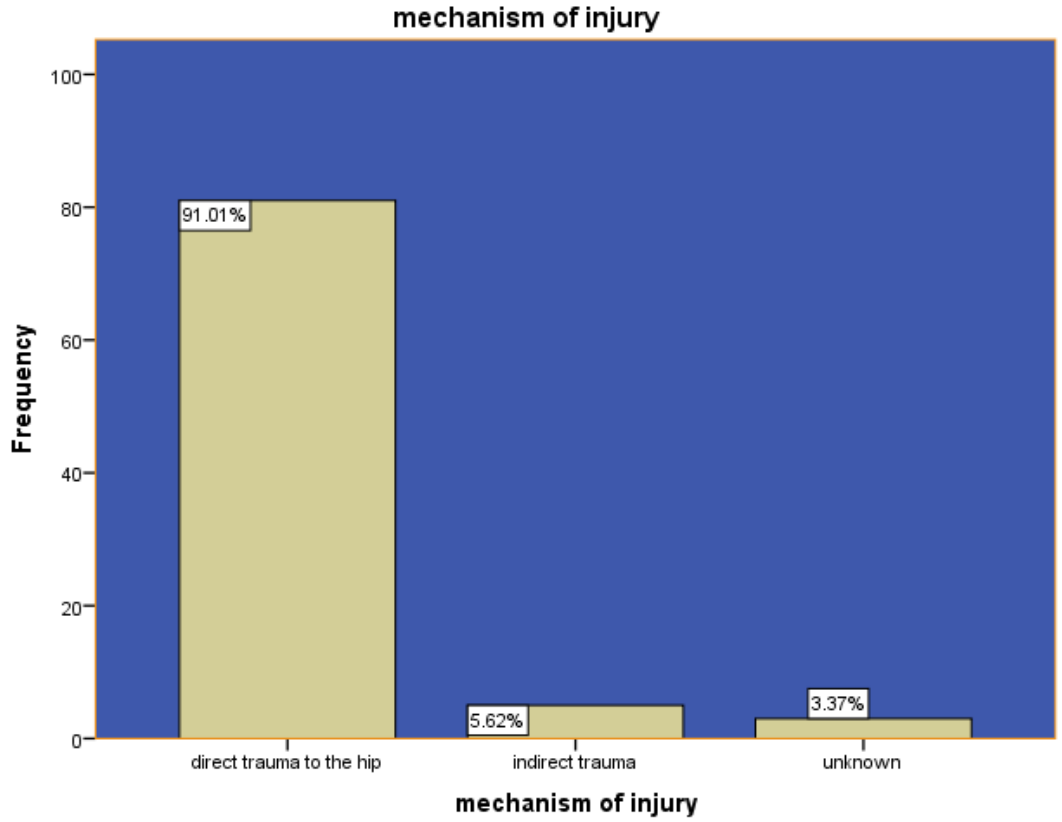


Figure 5: Mechanism of injury in patients sustaining acetabular fracture in TASH from May 2019-2020 (unknown- those patients in whom their chart is missing)

Chief complaints	Frequency		Valid Percent
Hip pain and difficulty of movement	85		95.5
bleeding	2		2.2
other	1		1.1
Unknown (missed charts)	1		1.1
Total	89		100.0

Table 3: Chief Complaints of the acetabular fracture patients visiting TASH from May 2019-2020.

5.3 Imaging findings

Almost all patients had non-contrast pelvic CT with multiplanar reconstructions. Among the study, the fracture involves the right acetabulum in 34 patients (38.2%) and left acetabulum in 46 patients (51.7%) while in 9 patients (10.1%) it involves both acetabulum.

According to the Judet and Letournel classification: 19 cases (19.6%) could be classified as Anterior column with posterior hemitransverse, 15 (15.5%) as both column fracture, 16(16.5%) as T-shaped fracture, 14(14.4%) as posterior wall, 13 (13.4%) as anterior wall, 8(8.2%) as anterior column, 3(3.1%) as transverse, one patient as transverse with posterior wall fractures.
In 7 patients (7.2%), the acetabular fracture pattern cannot be categorized in one of the judet-letournel classification patterns (see figure 6 and table 4 below)

In 89 acetabular fracture patients, 33 of them (34%) have associated intra-articular bony fragments (see figure below).

In proportion the occurrence of intra-articular bone fragments is common in posterior wall, T-shaped fracture and anterior wall/column + posterior hemitransverse fracture patterns (see table 5 below).

Among the study, 39 patients (40.2%) have associated hip dislocation. T-shaped fracture, posterior wall and anterior wall/column + posterior hemi transverse fracture patterns are commonly associated with hip dislocation in their order (see table 6 below)**.**Posterior hip dislocation seen in 22 cases (63.7%), central dislocation in 9(26.5%) and anterior dislocation in the remaining 3 cases (8.8%) (See figure 8 below).

In 8 patients (8%) there is associated femoral head marginal impaction (see figure 9 below)

Among 89 patients with acetabular fracture, 62 patients (63.9%) have other associated injuries in addition to acetabular fracture (see figure 9 below),among which there were 18 cases (29 %) of fractures s of the femoral bone, 10 (16.1 %) pelvic bone, 8 (13 %) of the sacral fracture, 4 (6.5%) of the tibia, 4 (6.5%) of the ankle, 4(6.5%) of the vertebrae,4 (6.5%) sciatic nerve palsy and 3(4.8%) patellar knee joint fracture dislocation (see figure 10 below**).**

Acetabular fracture pattern	Frequency	Percent	Valid Percent	Cumulative Percent
posterior wall	14	14.4	14.4	14.4
anterior wall	13	13.4	13.4	27.8
anterior column	8	8.2	8.2	36.1
posterior column	1	1.0	1.0	37.1
transverse	3	3.1	3.1	40.2
transverse + posterior wall fractures	1	1.0	1.0	41.2
T-shaped fracture	16	16.5	16.5	57.7
Anterior wall/column + posterior hemitransverse fracture	19	19.6	19.6	77.3
Associated both-column fracture	15	15.5	15.5	92.8
other	7	7.2	7.2	100.0
Total	97	100.0	100.0	

Table 4, Acetabular fracture pattern based on Judet and letournel classification system among patients visiting TASH from May 2019-2020 (Other-those acetabular fracture patterns which cannot be categorized in one of Judet-Letournel classification).

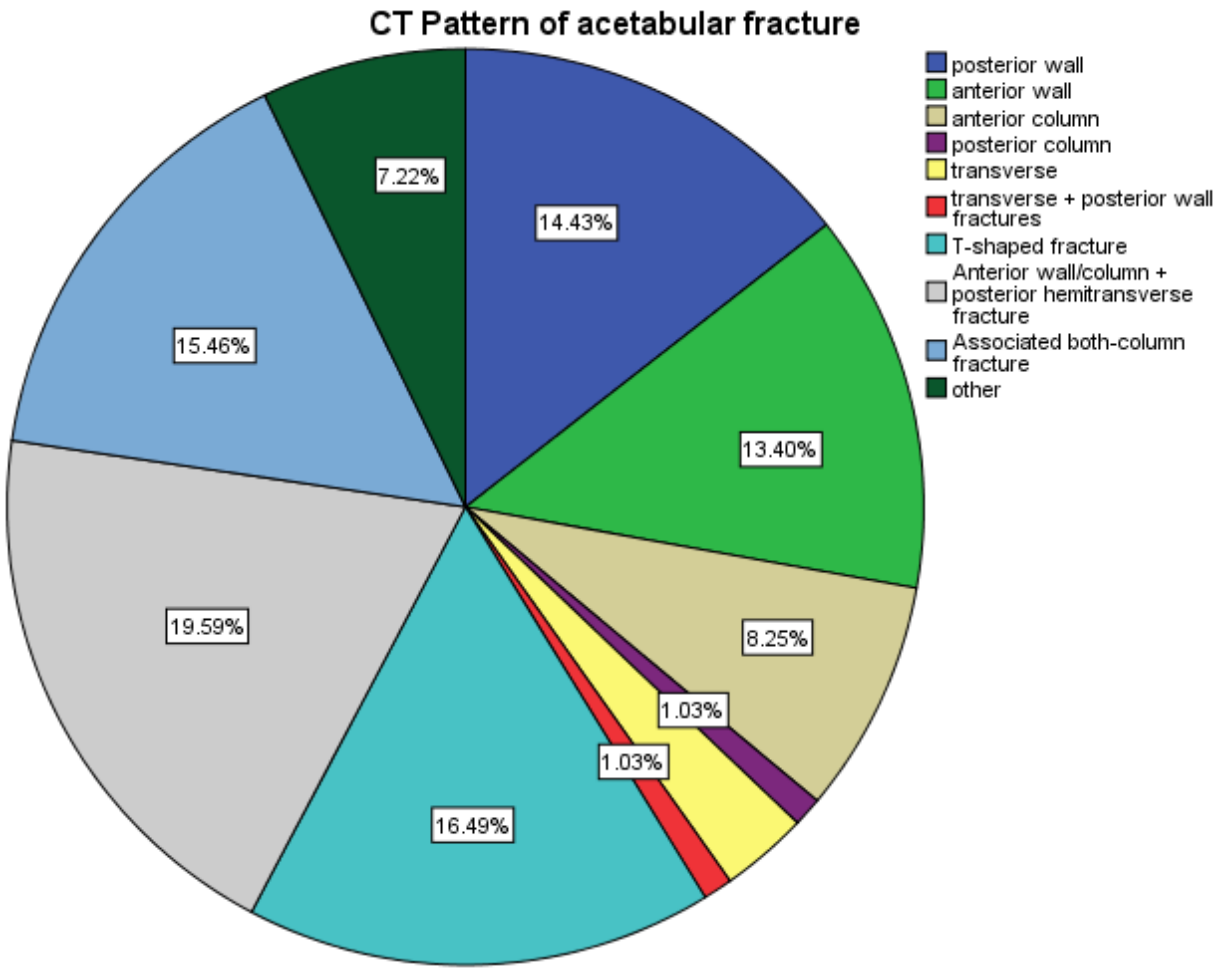


Figure 6: Acetabular fracture pattern based on the Judet and Letournel classification among patients visiting TASH from May 2019-2020 (Other-those acetabular fracture patterns which cannot be categorized in one of Judet-Letournel classification).

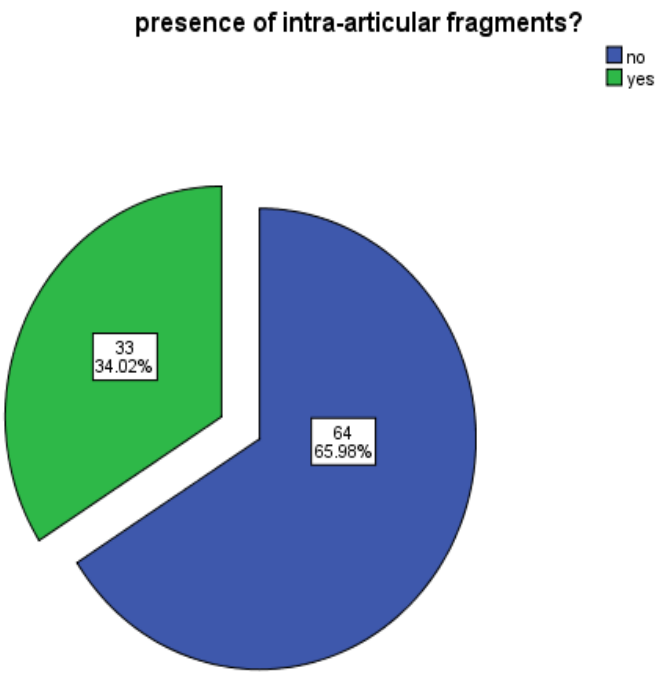


Figure 7: the occurrence of intra-articular bony fragments among patients with acetabular fracture visiting TASH from May 2019-2020.

CT Pattern of acetabular fracture	presence of intra-articular bony fragments?		Total
	no	yes	
posterior wall	4	10	14
anterior wall	9	4	13
anterior column	8	0	8
posterior column	1	0	1
transverse	3	0	3
transverse + posterior wall fractures	1	0	1
T-shaped fracture	9	7	16
Anterior wall/column + posterior hemitransverse fracture	13	6	19
Associated both-column fracture	13	2	15
other	3	4	7
Total	64	33	97

Table 5: Cross tabulation of the co- occurrence intra-articular bony fragments with different acetabular fracture patterns among patients visiting TASH from May 2019-2020.

Acetabular fracture pattern	presence of hip joint dislocation			Total
	no	yes	unknown	
posterior wall	3	8	3	14
anterior wall	8	3	2	13
anterior column	6	0	2	8
posterior column	0	1	0	1
transverse	1	0	2	3
transverse + posterior wall fractures	0	1	0	1
T-shaped fracture	4	10	2	16
Anterior wall/column + posterior hemitransverse fracture	8	6	4	18
Associated both-column fracture	5	6	4	15
other	3	3	1	7
Total	38	38	20	96

Table 6: Cross tabulation between the occurrence of associated hip dislocation and acetabular fracture pattern among patients visiting TASH from May 2019-2020

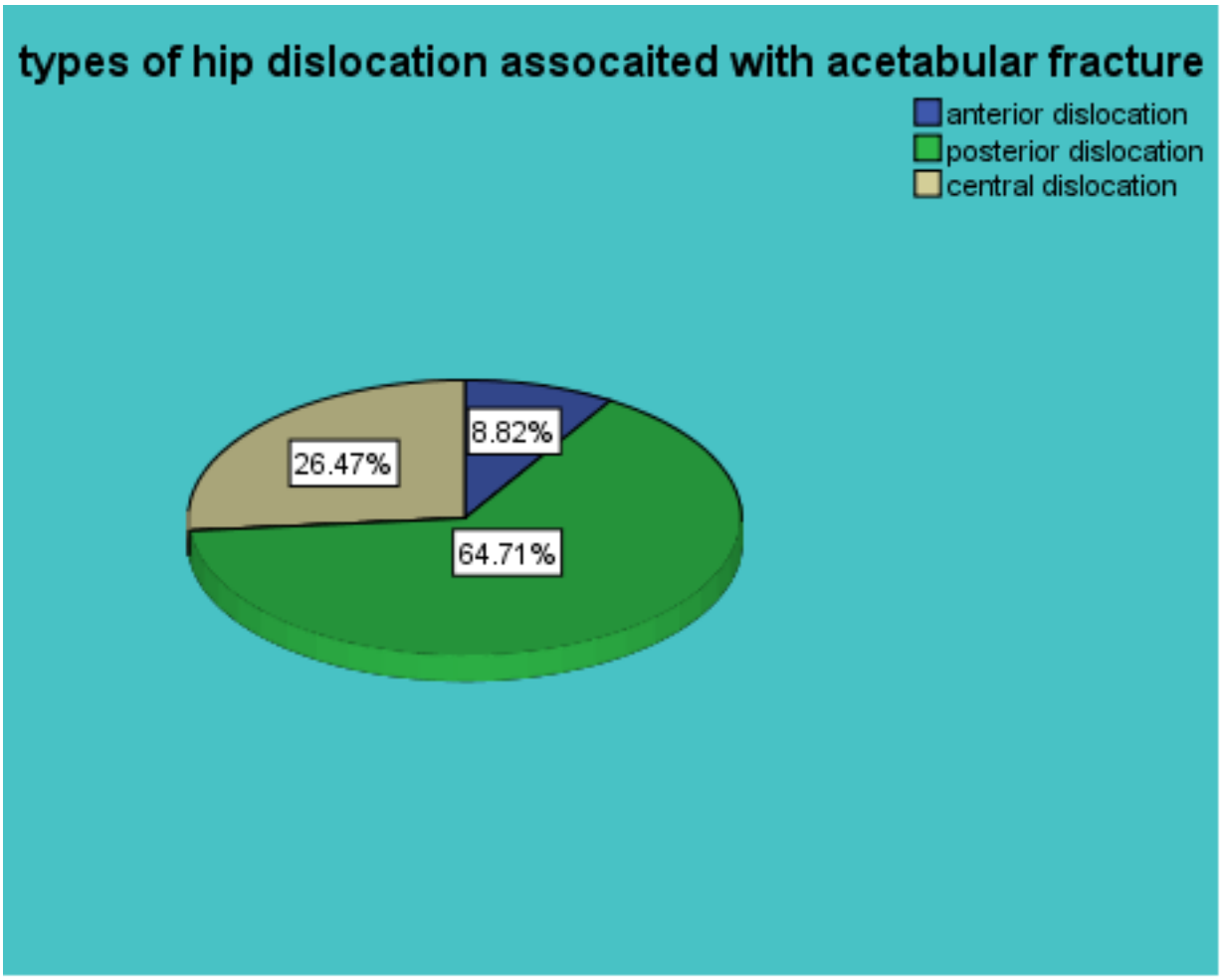


Figure 8: Types of hip dislocation that occur among patients with acetabular fracture visiting TASH from May 2019-2020.

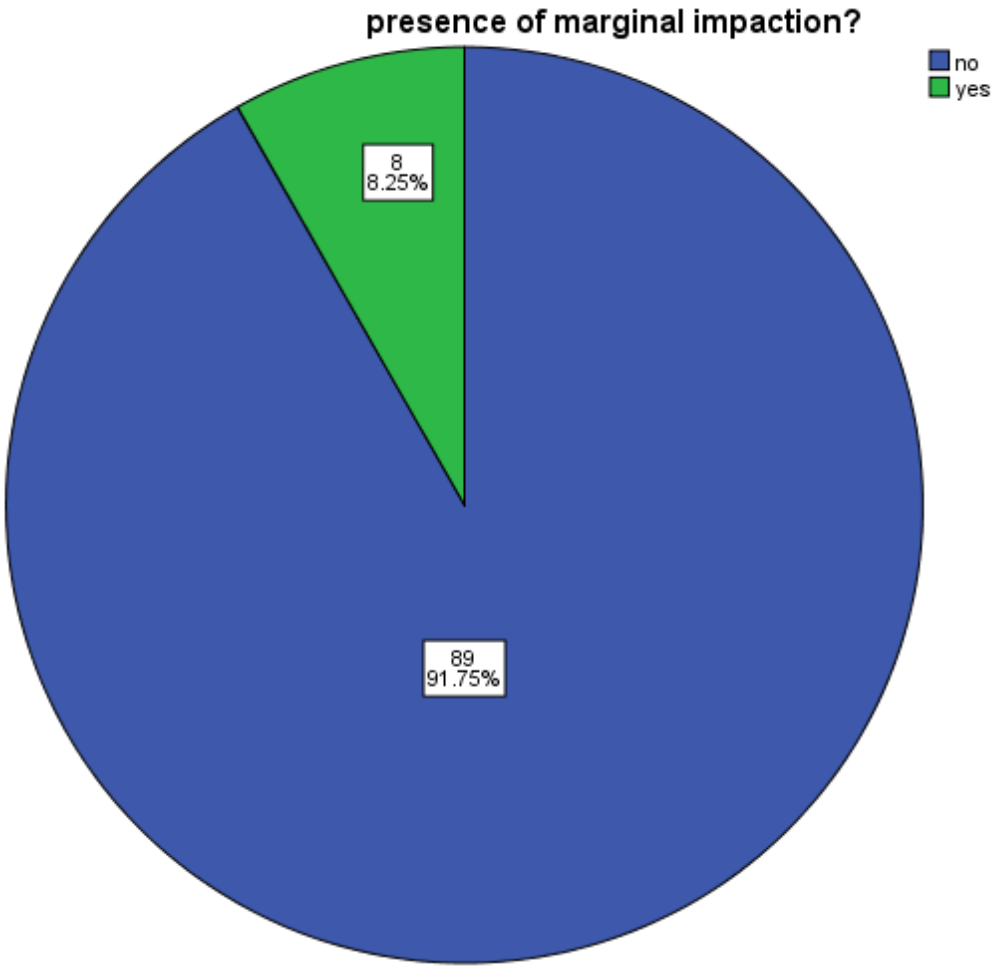


Figure 9: Presence of femoral bone marginal impaction among patients with acetabular fracture visiting TASH from May 2019-2020.

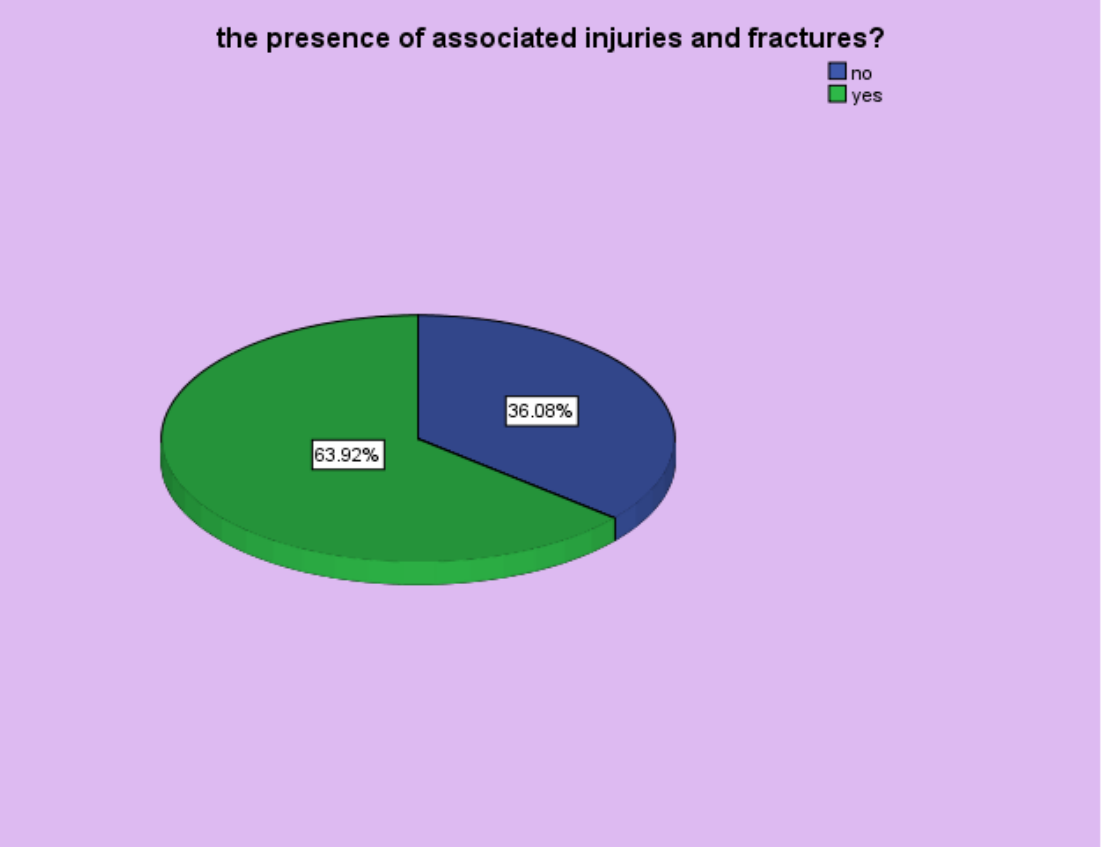


Figure 10: The magnitude of associated traumatic injuries that occur among patients with acetabular fracture visiting TASH from May 2019-2020.

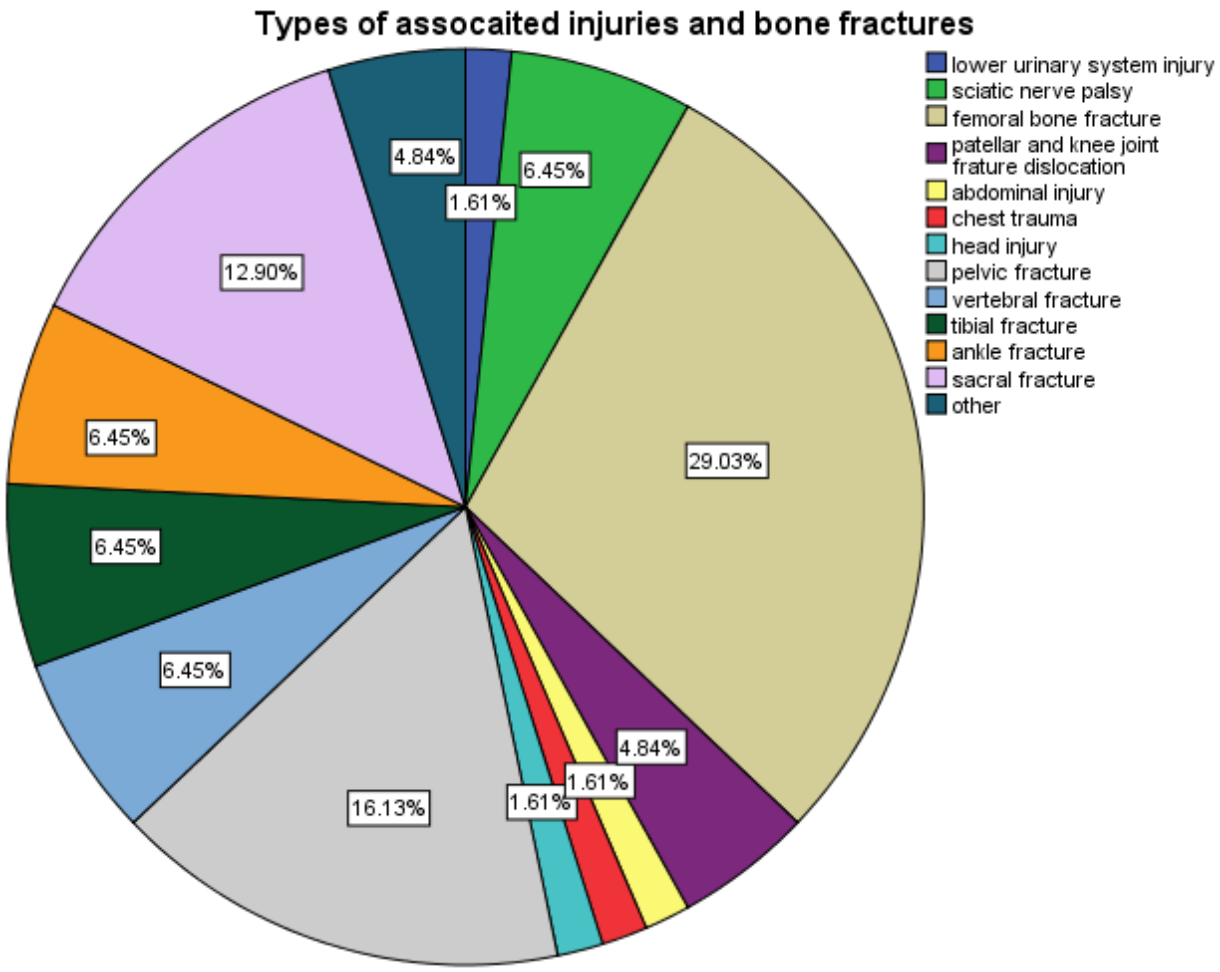


Figure 11: Types of associated traumatic injuries that occur among patients with acetabular fracture visiting TASH from May 2019-2020.

5.4 Patient management

Among 89 acetabular fracture patients, 50 patients have surgical management and the remaining 23 patients managed non-operatively (see the table below).In 13 patients the management modality is unknown and the remaining three patients were referred to the facilities with good set up.

Mode of management		Frequency	Percent
	non operative	23	25.8
	operative with internal fixation	50	56
	referral	3	3.3
	unknown	13	14.6
	Total	89	100.0

Table 7: Mode of management among patients sustaining acetabular fracture visiting TASH from May 2019-2020 (unknown- those patients in which their chart is missing).

Discussion

Judet-Letournel revolutionized the treatment of fractures of the acetabulum through developing better comprehension of this type of injury and rationalizing the surgical approach. The number of acetabular fractures in developed/industrialized countries is low and possibly decreasing but the incidence of acetabular fractures is on a rise in the developing world due to suboptimal roads and traffic (1).

Our study showed a total of 89 patients over 12 months and majority is males with a female to male ratio of 1:4.9. Most of the patients are adult age groups in which the mean age at the time of injury was 33 year. RTA accounts for 72% of the patients as cause of acetabular fracture. Fall down accident being the second most common cause of injury.

Since the most common cause of acetabular fracture is RTA and fall down accidents, males in their adult age group who participate more in outdoor activities are more susceptible to fracture.

As stated in the descriptions above among the 89 cases the top five commonest fracture patterns are anterior wall/column with posterior hemi transverse fracture, T-shaped fracture, associated column fracture, posterior wall and anterior wall in their order. These account for around 80% of the acetabular fracture patterns.

Posterior wall fractures involve the posterior acetabular rim, which includes the posterior articular surface. The fracture may separate one or multiple fragments, with comminution having implications for prognosis (1) (Fig 15).

Posterior column fractures involve the posterior portion of the acetabulum, disconnecting it from the sciatic buttress. The fracture runs from the greater sciatic notch through the acetabulum and the obturator foramen and into the ischiopubic ramus. Posterior column fractures are very unstable, and the femoral head may be dislocated or subluxated(1) (Fig 16).

Transverse acetabular fractures divide the acetabulum into superior (ie, iliac) and inferior (ie, ischiopubic) fragments. The fracture line involves both columns, but a portion of each column remains connected to the sciatic buttress, a characteristic that differentiates a transverse fracture pattern from an associated both-column fracture pattern(1) (Fig 13).

T-shaped fractures are transverse fractures with an inferiorly directed stem, which may run vertically through the inferior pubic ramus or through the ischium(Fig 14). Posterior column with anterior hemitransverse fractures and transverse with anterior wall fractures are considered T-shaped fractures (1).

Associated both-column fractures are unique in that the entire weight-bearing portion of the acetabulum is disconnected from the sciatic buttress. The two columns are separated from each other, with the two dominant fractures nearly perpendicular to each other (1) (Fig 11).

The anterior component of anterior with posterior hemitransverse fractures may be an anterior wall or an anterior column fracture. A low or very low anterior column fracture with a posterior hemi transverse fracture is similar to a T-shaped fracture; however, the anterior component rises anteriorly in an anterior column with posterior hemitransverse fracture (Fig 12). The anterior column or wall with posterior hemitransverse fracture is a common fracture pattern in elderly patients (1).

Transverse with posterior wall, posterior column and transverse and anterior column fractures are the rarest patterns which account for around 12%.In our study, the frequency of complex acetabular fractures are much common than elementary acetabular fractures

In a similar study done in India by Rajkumar S Amaravati et al 2005(17), 68 cases with acetabular fracture from 1995 to 2000 were evaluated. Female to male ratio was 1:6.5 and the average age of the patients was 34 years (range 17 - 68 years). In 45(66%) cases the mechanism of injuries was motor vehicle accidents and 23 (33%) cases fell from a height. Among them around 32% have posterior wall fracture and 22% have posterior column fracture. On comparison, grossly the magnitude of the acetabular fracture is lower compared to our setup but the distribution in sex, age and mechanism of the injures corroborates our study. Anterior wall/column posterior hemi transverse fracture and T-shaped fracture are the commonest pattern and posterior column is one of the rarest patterns in the study in research done by Rajkumar S

Amaravati et al 2005(17),so the frequency of the acetabular fracture patterns doesn't not fit our study.

A research done by Mauffrey, Cyril et al, 2014 (11). The mean age of patients with acetabular fractures in china (40±13years) and the mean age of US patients (44±16) were seen and it was associated mostly with high energy mechanisms. Posterior wall acetabular fractures were the most common type of fractures seen in both countries, accounting for 30% in China and 32% in the USA, followed by both column fractures 21% and 17%, respectively. The mean age is more older in this study and also regarding the proportion of the pattern of acetabular fracture posterior wall and associated both column fractures are the 3rd and 4th most common patterns in our study which doesn't support this research.

In a study by Brander et al 1998 (2), regarding the distribution of of Judet and Letournel acetabular fracture, both-column, transverse with posterior wall, posterior wall, T-shaped and transverse accounts for more than 90% of acetabular fractures .In the same study uncommonly occurring acetabular fractures (10%) include; anterior column, anterior column with posterior hemitransverse, posterior column with posterior wall, posterior column and anterior wall. Other studies done by Giannoudis et al (1) from 2005-2007 in Canada also shows five fractures (posterior wall, transverse, transverse with posterior wall, both column, and T-shaped) account for approximately 80% of all acetabular fractures.

The frequency of most acetabular fracture patterns supports our study but the magnitude of transverse, transverse with posterior column and anterior column with posterior hemi transverse fracture patterns is different from our study.

The study also showed that around 34% of patients with acetabular fracture have associated intra-articular bony fragments. Associated hip dislocation also noted in around 40% of patients with acetabular fracture, the majority (65%) being posterior hip dislocation. Acetabular fracture, especially posterior wall are commonly associated with femoral head dislocation. A research done by Raffaele Pascarella et al in2009 (21) shows 32% of acetabular fracture cases have associated dislocation (90% being posterior hip dislocation) and 12% have intra-articular bony fragments (98% in those with posterior dislocation).

Intra-articular fragments are common in acetabular fracture–dislocation and are significant in patient management. The presence of the fragments in the hip joint may prevent complete reduction of the dislocation. Surgery should be performed early to reduce the risk of aseptic necrosis of the femoral head. Therefore, computed tomography scans are always indicated in

fracture-dislocations pre- and postoperatively to check that all intra-articular fragments have been removed and the fracture has been reduced (19).

In comparison the magnitude of the occurrence of hip dislocation and intra-articular bony fragments appears less than our study.

Among the total cases 36% were isolated acetabular fracture while around 64% have associated different types of injuries and fractures. The commonest associated fractures are femoral bone fracture, pelvic fracture and sacral fractures accounting for 29%, 16 % and 13% respectively. In around 6.5 % there is also associated sciatic nerve palsy.

In a research done by analyzing 73 acetabulum fractures by Marcus Vinicius Fernandes Dias etal. 2010(20), twenty-two patients (30%) presented associated fractures, among which there were eight cases (36.3%) of lesions of the pelvic ring, five (22.5%) of the femur, and four (17.2%) of the tibia. The magnitude of the presence of associated injuries was markedly less than our study but femoral and pelvic fractures predominate in the list of associated injuries in both studies. Otherwise, the age, sex distribution and mechanism of injury in this study are more or less comparable but the posterior column is the most common fracture which is different compared to our study.

A study was done to review the epidemiological aspects of 103 acetabular fracture patients by Ahmed M etal.2018 (10) in Qatar. Males (93.2%) predominated. The mean age at injury time was 36 years, and the most common cause of injury was motor vehicle collisions (49.5%). Injuries were mostly primary acetabular fractures (73.6%) in comparison to (26.4%) for associated fractures. The posterior wall fractures were the most common in 26 cases (25.2%) with a high incidence of the anterior column (18.4%) and anterior wall (10.7%) fractures. 12% fractures cannot be classified using the Letournel system.

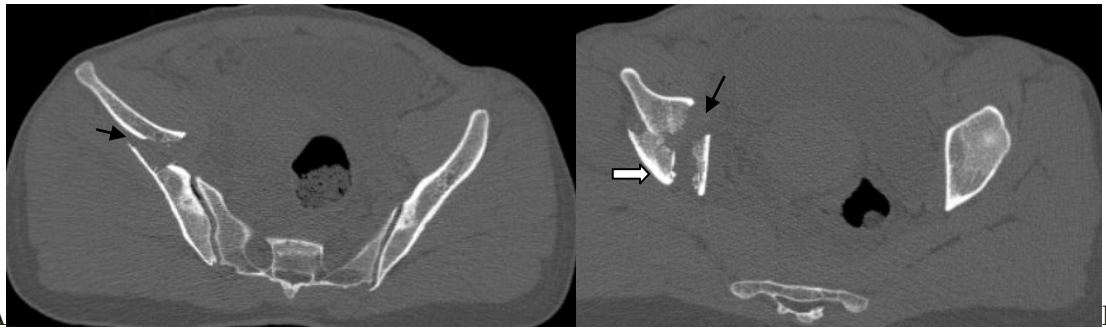
Post-traumatic sciatic nerve palsy (7%) that was present at the time of injury. Associated posterior hip dislocation occurred in 21.3% of cases. The age and sex distribution and magnitude of associated sciatic nerve palsy is more or less comparable with our study. The frequency of mechanism of injury, acetabular fracture pattern, associated injuries and of hip dislocations is different from our study.

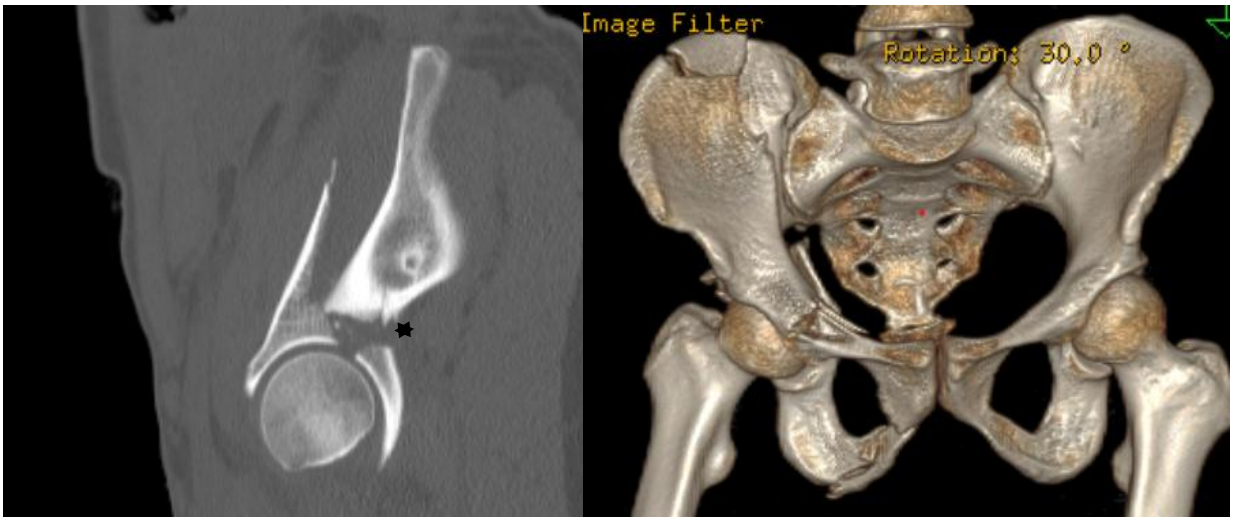
In a research done by Senohradski K, Karovic etal.2001 (4), the distribution of sex, age and mechanism of injury corroborates our study. Similar to our study, femur fracture is also the most common associated injury that occurs with acetabular fracture. The frequency of acetabular fracture pattern and the magnitude of the occurrence of intra-articular fragments don’t fit with our study.

Regarding patient management, around 50 patients (56%) have operative management with internal fixation and the remaining 23(26%) are managed non-operatively.

A research done in Brazil who evaluates a total 609 patients who were treated for fracture acetabulum with modified stoppa approach, shows both column fracture and anterior column with posterior hemi transverse are the most common fracture patterns (9) .The results in this research supports our study regarding distribution of acetabular fracture pattern as well as socio-demographic data and mode of injury.

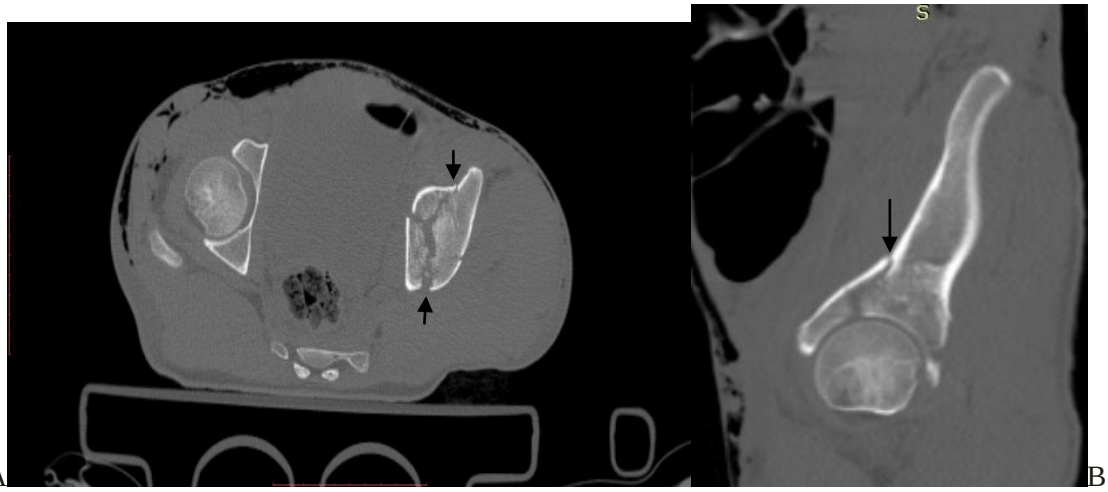
One thing which is observed in our study is the correlation between the socio-demographic data and mechanism of injury is in agreement with the literature reviews detailed above. The frequency of the acetabular fracture patterns, the frequency of intra-articular fragments as well as the common types of associated injuries has some difference as compared to the literature. This may be attributed to inter-personal or inter-institutional difference in image interpretation. Thd other issue was almost all literatures about acetabular fracture imaging detailed above have long period of study with large study population. This will also account for discrepancies in different imaging variables mentioned above.

A  B



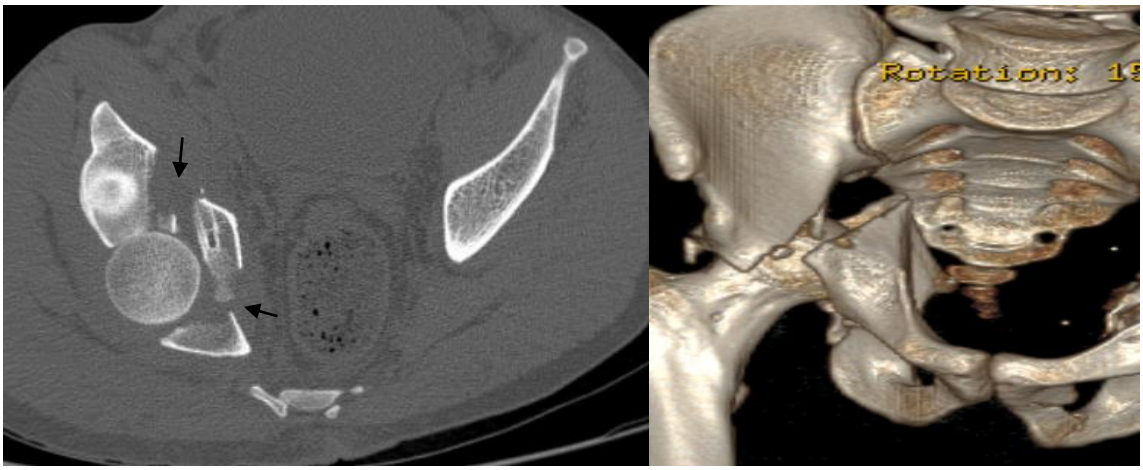
C D

Fig 12, Right both-column acetabular fracture. Axial (A and B),sagittal(C) and 3-D CT reconstruction(D) Pelvic computed tomography (CT) scan of a 35 years old female patient shows coronal fracture(small arrow) beginning superiorly at the iliac wing and extending to the acetabular roof with associated sagittal fracture line(large arrow) involving the right acetabular columns which separate them from sciatic buttress(double arrow head). There is also an ipsilateral bi-rami fracture (C). CT Spur sign (white block arrow)



A B

Fig 13.Left Anterior column with posterior hemi transverse acetabular fracture .Axial (A) and sagittal (B) pelvic CT scan of 20 years old male patient sustained RTA shows coronal fracture line(large arrow) involving the left acetabular anterior column with associated fracture extension to the acetabular roof. Associated sagittal fracture line (small arrow) involving the left acetabulum also noted. Associated subcutaneous emphysema also noted



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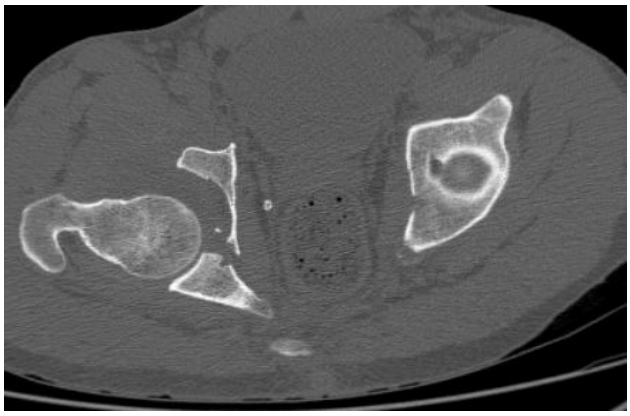
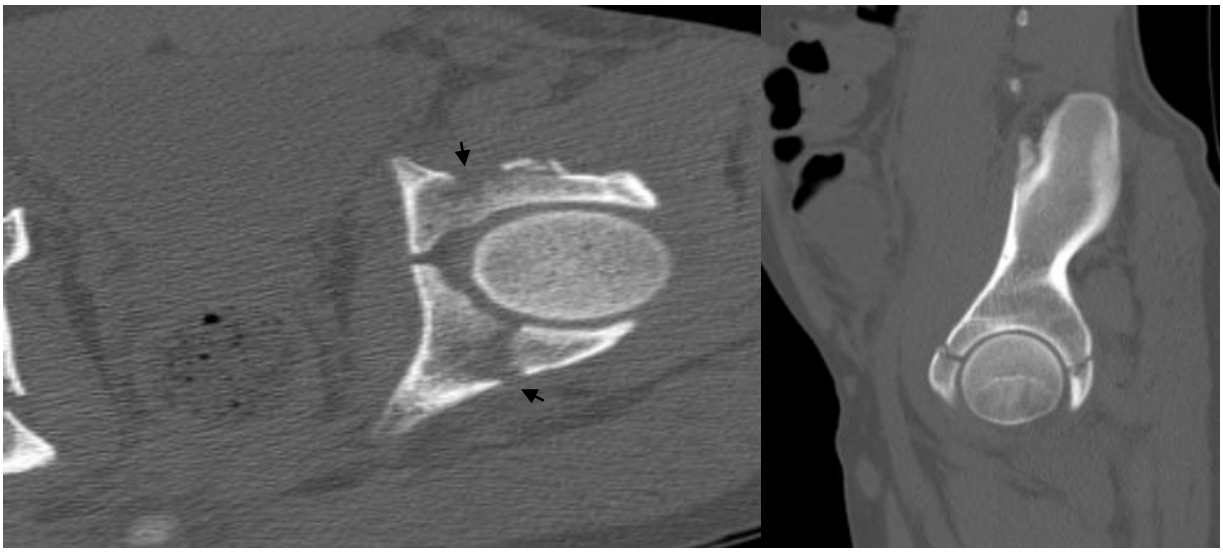


C

Fig 14, Right transverse acetabular fracture. Axial (A and C),and 3-D CT reconstruction(B) Pelvic computed tomography (CT) scan of a 28 years old male patient Computed tomography (CT) scan shows the vertically oriented transverse fracture (arrows) of the left acetabulum is well depicted on CT scans. Posterior right hip dislocation and intra-articular bony fragments (C) also noted.



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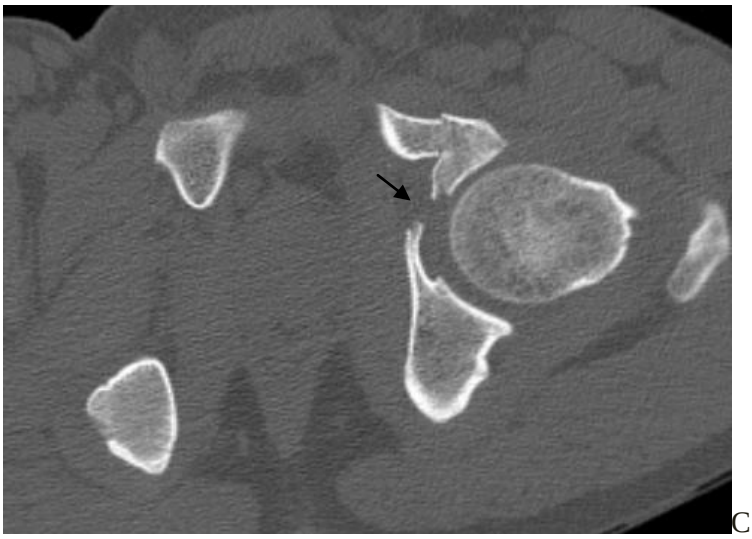
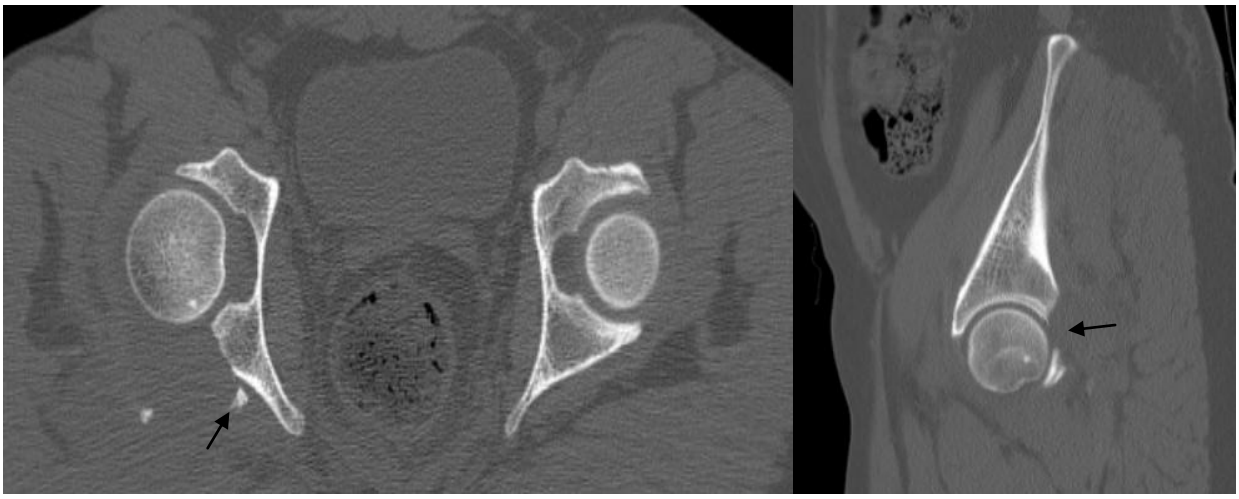


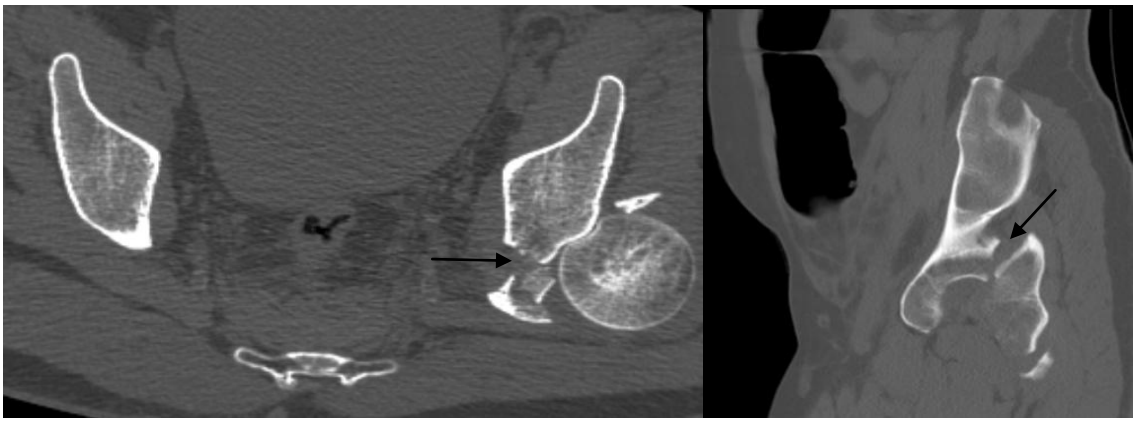
C

Fig 15. Left T-shaped acetabular fracture. Axial (A and C),and sagittal(B) Pelvic computed tomography (CT) scan of a 28 years old male shows the vertically oriented transverse fracture (small arrow) of the left acetabulum with fracture line extension to the ipsilateral inferior pubic ramus(arrow).



A B

Fig 16. Right posterior wall acetabular fracture. Axial (A) an sagittal(B) Pelvic computed tomography (CT) scan of a 30 years old male patient shows a comminuted fracture (arrows) of the right posterior wall.



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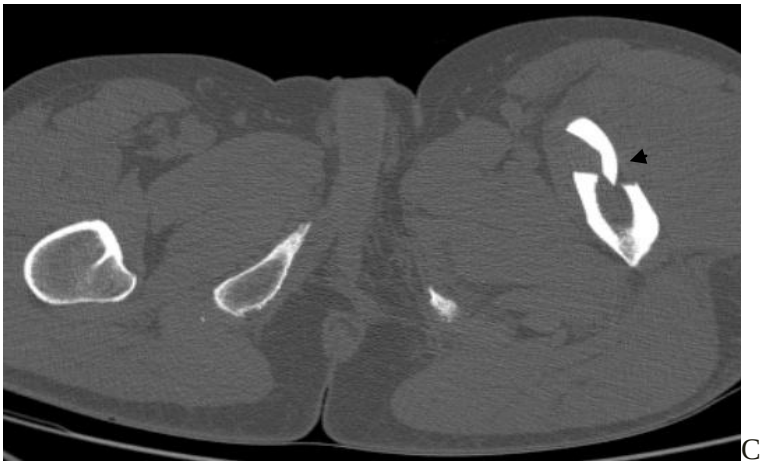
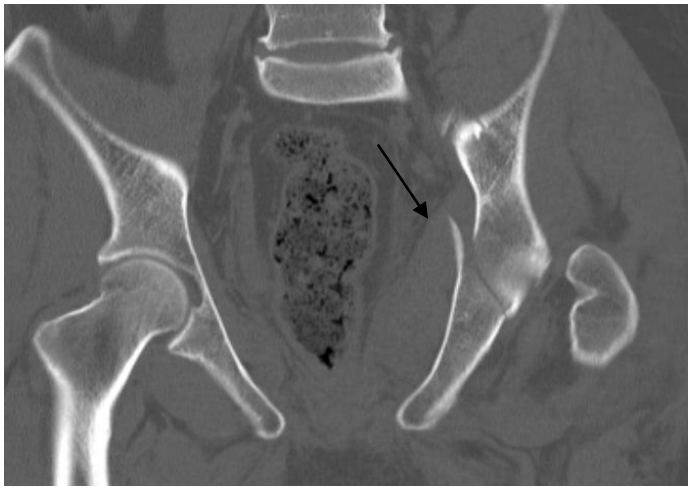


C

Fig 17. Left posterior column acetabular fracture. Axial (A and C),and sagittal (B) Pelvic computed tomography (CT) scan of a 30 years old male patient shows coronally oriented fracture (large arrow) of the left acetabulum posterior column with communited bony fragments (arrows) . Associated left posterior hip dislocation and displaced proximal femoral shaft fracture also noted (arrow head)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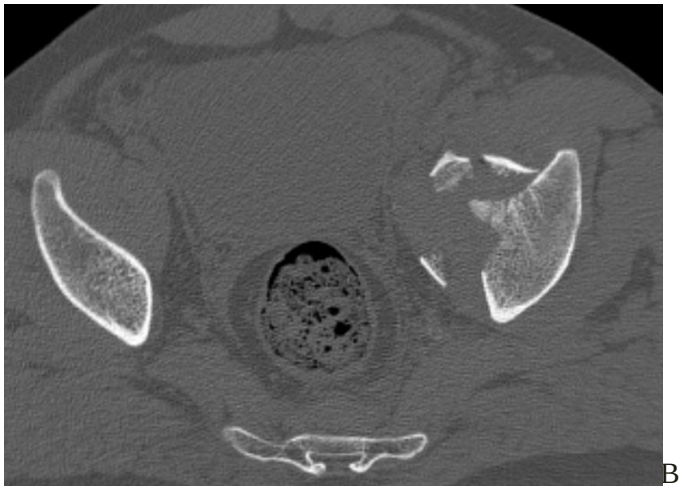
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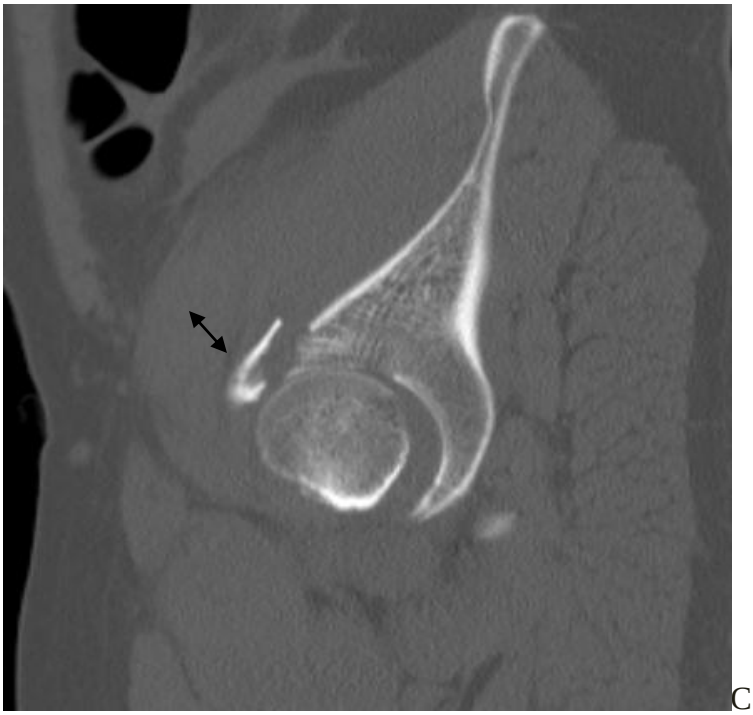
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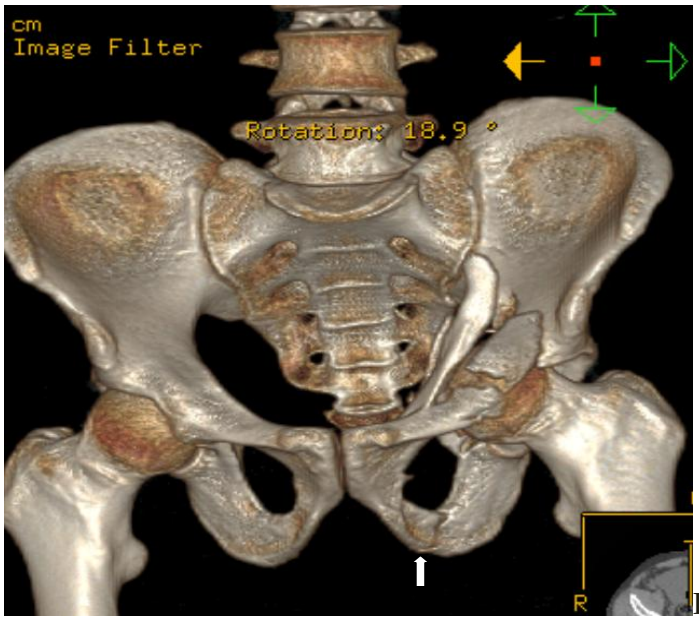

D

Fig 18. Left anterior column acetabular fracture with central hip dislocation. Coronal (A), Axial (B) , sagittal (c) and 3-D (D)Pelvic computed tomography (CT) scan of a 38 years old male patient shows oblique fracture line the left anterior column which separates it from sciatic buttress. There is also communited and displaced fracture of the quadrilateral plate (best depicted on axial and 3-D images) with central femoral head dislocation. Associated left anterior wall acetabular fracture also noted(C, double arrow).Fracture of the left superior pubic ramus at its root and left inferior pubic ramus at it mid portion (D, white arrow) also seen.

Conclusions

Majority of patients having acetabular fracture were males in their adult age group. Road traffic accident and fell down accident were causes of most acetabular fracture in TASH. Based on the judet-letournel acetabular fracture classification system associated injury patterns including anterior column with posterior hemi transverse, T-shaped and both column fracture were top three common fractures in our study with comparable proportion. Majority of patients with acetabular fracture have other associated fractures and most of the patients have surgical management in TASH.

Limitations

-In complete chart recording and poor documentation.
-Poor chart keeping
-Short study period and small study population
Failure to do inter-observer reliability for acetabular fracture pattern by providing pelvic CT image for different radiologists.

Recommendations

- Electronic medical record system should be applied to all patients

-Important patient clinical data should be properly documented by the treating physicians.

-Good interdisciplinary communication and collaboration between radiologists and orthopaedician is important for better patient management and follow up.

-This study should be conducted in wider scale for detailed/better understanding of the magnitude of acetabular fracture, its patterns and associated injuries.

-Structured reporting system should be applied in patients with acetabular fracture.

X. References

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Data collection format (Questionnaire)

CODE:	**MRN:**	**MOBILE NO:**	
PART I: SOCIO DEMOGRAPHIC CHARACTERSTICS			
No	**Questions and filters**	**Coding categories**	
101	Address	Region or city administration _____ specific address_____	
102	Age	_____ years	
103	Sex	Male. 1 female. 2	
Part II: Mechanism of injury and clinical presenantion.			
201	Motor vehicle	1. Motor vehicle (car) A.Passenger B.Pedestrian C,Driver 2. Motor cycle B.Pedestrian C,Driver	
202	Fall down accident		
203	Bullet injury		
204	Stick/stone fighting injury	Specify_____	
205	Others	Specify_____	
206	Mechanism of force In direct injury –When the injury involves the ipsilateral lower limb (at the knee,leg or foot)	1.Direct trauma to the hip 2.Indirect 3.unknown	

207	Chief complaint of the patient during presentation	1. Loss of consciousness 2. Bleeding 3. Difficulty of movement 4. Others ,specify_____	
208	Vital sign at presentation	1.stable 2.unstable	
209	Duration of the injury before hospital arrival	._____days	
PART III: CT Imaging information			
301	Location of the lesion	1. Left acetabulum 2. Right acetabulum 3. Bilateral	
302	Scanned body part	1.Pelvc CT 2.Abdominopelvic CT 3.Others-specift _____	
303	Types of CT scan study	1.Non-contrast study 2.Post- contrast study 3.both pre and post contrast	
304	CT scan done with MPR and bone algorithm and 3D-surface rendering	1.yes 2.NO	
305	Is the iliac wing above acetabulum broken?	1.Yes 2.No	
306	Is the obturator ring broken?	1.yes 2.No	
307	Is there posterior wall fracture?	1.yes 2.No	

308	What is the orientation of the major fracture line on the axial CT?	1.sagittal 2.coronal	
309	Can an intact strut of bone be followed from the sacroiliac joint to the acetabular articular surface, or is aspur sign present?	1.yes 2.No	
310	Does the fracture divide the acetabulum into superior and inferior parts ?	1.Yes 2. No	
311	Does the fracture divide the acetabulum into anterior and posterior halves?	1.Yes 2.NO	
313	Intra-articular fragments?	1. Yes 2. No	
314	A,Incongruity, including subluxation or dislocation? B.types of hip dislocation	1. Yes,specify _____ 2. No A.posterior B.anterior C.central	
315	Femoral head lesion(s)?	1. Yes, specify_____ 2. No	
316	Pattern of acetabular fracture based on the above findings	1.simple pattern A.posterior wall B.posterior column C.transverse D.anterior colum E.anterior wall 2.Complex pattern A.posterior column + posterior wall fractures B.transverse + posterior wall fractures C.T-shaped fracture	

		D.anterior wall/column + posterior hemitransverse fracture E.bilateral-column fracture 3.other unspecified patterns , to be specified in detail_____	
	Other associated injuries	1.Genitourinary injury 2.Head injury 3.Abdominal injury 4.chest injury 5.Others,specify	
317	Other associated fractures	1..Pelvic bone fracture 2.knee injury 3..Vertebral bone fracture 4..Femur fracture 5..tibial fracture 6.ankle fracture 7.foot bone fracture(tarsal,metatarsal or phalangeal) 8.others	
318	Management	1.Operative , specify _____ 2.Non-operative_____ 3.refferal 4..unknown_____	