"A DIAPHYSEAL FITTING MODULAR BIPOLAR PROSTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT -A PROSPECTIVE STUDY"

Submitted by

Dr. HARISH ARUNMOZHIDEVAN

Dissertation submitted to The

BLDE (DEEMED TO BE UNIVERSITY) Vijayapura, Karnataka.

In partial fulfilment of the requirement for the degree of

MASTER OF SURGERY IN ORTHOPAEDICS

UNDER THE GUIDANCE OF

Dr. SANTOSH S NANDI

MS ORTHOPAEDICS

PROFESSOR AND HOD

DEPARTMENT OF ORTHOPAEDICS

B.L.D.E (DEEMED TO BE UNIVERSITY)

SHRI B.M PATIL MEDICAL COLLEGE HOSPITAL

& RESEARCH CENTER, VIJAYAPURA, KARNATAKA-586103

2025

B. L. D. E. (DEEMED TO BE UNIVERSITY)

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA.

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I hereby declare that this dissertation which is entitled **"A DIAPHYSEAL FITTING MODULAR BIPOLAR PROSTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT -A PROSPECTIVE STUDY"** is a Bonafide and genuine research work carried by me under the guidance of **DR. SANTOSH S NANDI** MBBS, M.S, Professor and HOD, Department of Orthopaedics at BLDE (Deemed to be University) Shri B. M. Patil Medical College Hospital and Research Centre, Vijayapura.

Date: 25/03/2025 **Dr. HARISH ARUNMOZHIDEVAN**

Place: Vijayapura

B. L. D. E. (DEEMED TO BE UNIVERSITY)

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA.

CERTIFICATE BY THE GUIDE

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Date: 25/03/2025

Place: Vijayapura

Dr. SANTOSH S NANDI,
(MS ORTHOPAEDICS)
Professor and HOD,
Department of Orthopaedics,
B. L. D. E. (Deemed to be University)
Shri B.M Patil Medical College Hospital and Research Centre, Vijayapura

B. L. D. E. (DEEMED TO BE UNIVERSITY)

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA.

ENDORSEMENT BY THE HEAD OF THE DEPARTMENT

This is to certify that the dissertation entitled **"A DIAPHYSEAL FITTING MODULAR BIPOLAR PROSTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT - A PROSPECTIVE STUDY"** is a Bonafide research work done **by Dr. HARISH ARUNMOZHIDEVAN** under the guidance of **Dr. SANTOSH S NANDI**, MBBS, MS, Professor and HOD, Department of Orthopaedics at BLDE (Deemed to be University) Shri. B. M. Patil Medical College Hospital and Research Centre, Vijayapura.

Date: 25/03/2025

Place: Vijayapura

DR. SANTOSH S NANDI,
(MS ORTHOPAEDICS)
Professor & HOD
Department of Orthopaedics,
B. L. D. E. (Deemed to be University)
Shri B. M. Patil Medical College Hospital &
Research Centre, Vijayapura

B. L. D. E. (DEEMED TO BE UNIVERSITY)
SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA.

ENDORSEMENT BY THE PRINCIPAL

This is to certify that the dissertation entitled **"A DIAPHYSEAL FITTING MODULAR BIPOLAR PROSTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT - A PROSPECTIVE STUDY"** is a Bonafide research work done by **Dr. HARISH ARUNMOZHIDEVAN** under the guidance of **DR. SANTOSH S NANDI**,

MBBS, MS, Professor, Department of Orthopaedics at BLDE (Deemed to be University) Shri. B. M. Patil Medical College Hospital and Research Centre, Vijayapura

Date: 25/03/2025

Place: Vijayapura

DR. ARAVIND PATIL,
Principal,
B. L. D. E. (Deemed to be University)
Shri B. M. Patil Medical College Hospital &
Research Centre, Vijayapura

B. L. D. E. (DEEMED TO BE UNIVERSITY)
SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPURA.

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Date: 25/03/2025 **Dr. HARISH ARUNMOZHIDEVAN**

Place: Vijayapura

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Date: 25/03/2025 **DR HARISH ARUNMOZHIDEVAN**

Place: Vijayapura

ABSTRACT

Introduction

Intertrochanteric fractures are those occurring in the region extending from the extracapsular basilar neck region to the region along the lesser trochanter. A proximal femur or hip fracture remains the most common reason for an elderly person to be admitted to an acute orthopaedic ward. An estimated 2.1 million hip fractures occurred worldwide in 2021.

Assuming there is no age-specific increase, this number is predicted to rise to 2.6 million by 2025 and 4.5 million by 2050. Estimations that include an age-specific increase give predicted values of between 7.3 and 21.3 million by 2050.The total numbers of hip fractures continue to increase as life expectancy continues to increase.

The aim of our study was to evaluate the increasing both morbidity and mortality functional outcome of diaphyseal long stem bipolar prothesis in comminuted trochanteric fractures of femur in elderly patients using Harris Hip Score

Methodology

Patients admitted in Department of Orthopedics in B.L.D.E. (DEEMED TO BE UNIVERSITY) Shri B.M.Patil Medical College, Hospital and Research Centre, Vijayapura with the diagnosis of comminuted trochanteric fracture. The patients will be informed about the study in all respects and informed written consent would be obtained. Patient will be assessed post operatively at 6 weeks, 3 months, 6 months o The period of study will be from MARCH 2023- MARCH 2025.To maintain statistical power, the sample size was increased by 22.5% to allow for a 22.5% dropout rate.

Results

This study evaluated 31 elderly patients (mean age: 75.81±9.311 years) with comminuted trochanteric femur fractures treated with a diaphyseal fitting modular bipolar prosthesis. Most patients were aged 61-80 years (71%), with a higher proportion of females (64.5%). Self-falls were the primary injury cause (87.1%). Functional outcomes, assessed using the Harris Hip Score (HHS), showed a mean score of 85.19±4.377, with 64.5% achieving "GOOD," 22.6% "EXCELLENT," and 12.9% "FAIR" outcomes. Complications were minimal: 87.1% had none, 9.7% had leg length discrepancy (LLD), and 3.2% had periprosthetic fracture (PPF). The prosthesis demonstrated favorable results with low complication rates.

Conclusion

In conclusion, the use of a **diaphyseal fitting modular bipolar prosthesis** in elderly patients with comminuted trochanteric femur fractures is associated with **good to excellent functional outcomes** and a **low rate of complications**. The results of this study support the use of this surgical method as a viable option for the management of these challenging fractures in elderly patients

Keywords

- Comminuted Intertrochanteric Fracture Fumer
- Diaphyseal Fitting Modular Bipolar Hemiarthroplasty
- Elderly Patients
- Harris Hip Score
- Longstem Hemiarthroplasty

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INTRODUCTION

One of the most common fractures in the elderly is an intertrochanteric femur fracture, which encompasses the region between the extracapsular basilar neck region to the area along the lesser trochanter. The frequency of these fractures is rising as people live longer. [1] Although the use of more recent internal fixation techniques improves outcomes, they are linked to high rates of morbidity and mortality because they need protracted immobility. [2] Significant morbidity and mortality are linked to these fractures. Within a year following a fracture, 15% to 20% of patients pass away. [3,4]

It should come as no surprise that as the population's average life expectancy and associated osteoporosis have rised dramatically over the past few years in frequency of proximal femur fractures. They rank second only to the spine in terms of osteoporosis-related fractures. “An estimated 1.66 million hip fractures occurred globally in 1990; by 2050, this number is predicted to rise to 6.26 million annually, with intertrochanteric fractures accounting for a significant portion of these cases”[8].

High energy traumas, such car crashes, and other traumatic accidents, are typically the cause of intertrochanteric fractures in younger people. A minor fall, however, causes 90% of intertrochanteric fractures in elderly.

“Cummings et al. claim that neither age-related osteoporosis nor the increasing frequency of falls with age can sufficiently account for the exponential increase in the incidence of hip fractures with aging. They postulated that a hip fracture could result from a fall if four factors were correlated:

a) The faller must be positioned so that they strike close to hip.
b) There must be no efficacy in the protective responses.
c) Local soft tissues must absorb less energy than necessary to prevent fracture.

d) The proximal femur must be subjected to more fall energy than it is capable of handling”[5]

This idea mostly pertains to hip fracture prevention techniques. Extracapsular hip fractures are more likely to cause a fall with a rotational component. [6]

The population most frequently impacted by osteoporosis is the elderly. Early and adequate fixation is essential to preventing recumbency-related issues like respiratory infections, bedsores, and deep vein thrombosis and enabling these patients to resume active living activities as soon as feasible.

The unstable form of intertrochanteric fractures present greater challenges in terms of prognosis and treatment. One of the main causes of these fractures' bad outcomes is osteoporosis and challenging anatomical reduction. [7–9] Additionally, a prolonged period of immobilization is advised for these older individuals with comminuted osteoporotic fractures, which may exacerbate issues associated to recumbency. Therefore, managing these fractures requires extra attention. Treatment goals include preventing hip deformity, early patient mobilization, firm fixation, and stable anatomical reduction.

For INTERTROCHANTERIC FEMUR FRACTURES, the current therapeutic options include:

1) Conservative

2) Internal fixation and close reduction with D.H.S.

3) Use TFN for Close Reduction and Internal Fixation

4) Hemiarthroplasty

5) Arthroplasty Total Hip

6) Ender's nail

7) External fixation

Prior to Horowitz's 1960 discovery that conservative approaches had greater death rates than surgical approaches, conservative treatments were the preferred course of treatment.[10] Higher death rates and comorbidities, including decubitus ulcers, pneumonia, UTIs, and thromboembolic problems, were the outcomes of conservative approaches.

Conservative methods are now only recommended for older patients with illnesses that represent an unreasonable risk of death from anesthesia or surgery, as well as non-ambulatory individuals who have minimal discomfort after an injury. These methods have been abandoned, and new techniques for achieving reduction and having stable fixation or the option of a prosthesis have also emerged.

Hemiarthroplasty for intertrochanteric fractures was first documented in 1973. Rosenfeld was the first to develop it; he documented the surgical procedure, reported a good functional outcome, and made a prosthetic to replace the head and neck in cases of trochanteric fractures. According to studies, hemiarthroplasty has produced positive outcomes for unstable IT fractures.[11,12] Hemiarthroplasty was previously only thought of as a salvage operation for issues like failed pinning.[13] Acetabular wear, protrusion, loosening, and dislocation were among the issues with unipolar implants that led to the first development of bipolar hemiarthroplasties. However, because it permits early mobilization and complete weight bearing, it is currently being explored as a main treatment for comminuted unstable type IT fractures in the elderly.

For unstable type IT fractures, hemiarthroplasty is an effective treatment choice. Patient's quality of life can be improved, and mortality and complication rates can be decreased. Consequently, unstable IT fractures have drawn a lot of attention, and more study and care for older patients with unstable IT fractures are needed.

AIMS AND OBJECTIVES

To study the functional results of comminuted trochanteric femur fractures treated with Diaphyseal Fitting Modular Bipolar Prosthesis and to use Harris Hip Score to make it easier for older patients to mobilize, bear weight, and recover quickly.

REVIEW OF LITERATURE:

- Prior to 1930, conservative methods such as Russell traction, skeleton traction, counterpoised suspension, and well leg traction were used to treat intertrochanteric fractures. The Dutch developed the Balkan frame during the 1903 Balkan War, and it was very helpful in treating fractures by traction and suspension. The prognosis was completely changed when internal fixation procedures were later developed.
- As early as 1973, hemiarthroplasty for intertrochanteric fractures was described. Rosenfeld described the surgical procedure, created a prosthetic for replacing the head and neck in cases with trochanteric fractures, and reported a positive functional result. Since then, a lot of research has been conducted on the application of hemiarthroplasty, particularly in cases of comminuted IT fractures. This is a chronological overview of the history of intertrochanteric fractures and the changes in their management. Even while hip fractures had been recognized since Hippocrates' time, the French surgeon Ambrose Parre[16] first reported their occurrence in 1600 AD.
- In 1897 Nicolausen employed a body cast to support the steel spike that poked through the skin.
- In 1900 Davis used standard wood screws.
- In 1909 The metallic traction, which Steinmann invented, turned out to be a more successful method of applying traction.
- In 1927 The traction mechanism was designed by Wilkie
- In 1930s Lag screw devices have been used in place of nails, according to Henry, Littman, Henderson [20, and others.
- In 1931 Smith Peterson [21] employed the triflanged nail, which is still commonly used today and is composed of non-electrolytic material. The design was robust enough for patient movement and managed rotational stability.

- In 1932 Concurrently with Westcott in the United States, Sven Johansson [22] in Sweden created the method for radiographically controlled Smith-Peterson nail insertion without arthrotomy.
- In 1934 Independent reports by King and Henderson documented the use of K wires for short-term stabilization of these fractures. [23]
- In 1937, In order to properly secure the Smith-Peterson nail to the shaft, Thornton [24] added a side plate.
- In1938,Using a cannulated drilling and insertion technique, GodoyMoreira created the sliding compression.
- In 1940 Intertrochanteric fracture complications, such as nonunion, varus deformity, extended hospitalization, and joint stiffness, were published by Austin T. Moore.
- In 1940 The fragment was affected by Goody Moresia's employment of the cannulated stud bolt screw.
- In 1941 The fixed angle nail plate, originally biflanged and then triflanged, was created by E. L. Jewett [26] and is still utilized for intertrochanteric fractures. Before nail insertion, a stable reduction (anatomical or non-anatomical) is necessary to avoid this problem since they do not permit controlled collapse and impaction at the fracture site without penetration of the femoral head.
- In 1944 Moore Austin Blade and plate with several pins were introduced to support proximal fragments in all quadrants and stop rotations.
- In 1947 McLaughlin produced variable angled nail plate, which allows angle to be adjusted by a sliding arrangement without requiring the plate to be bent in order to change the angle while connecting to SP nails. Numerous bolts and washers are used to connect the two components. Their biggest drawback is that they are weak at the nail

plate junction, which causes the bolt to occasionally unscrew itself, reducing and losing fixation.

- In 1949 In order to distinguish between stable and unstable intertrochanteric fractures, Merwyn Evans developed a classification system. He added that internal fixation has a higher likelihood of early mobilization and lower rates of morbidity. In Boyd and Griffin [28] developed a categorization system for intertrochanteric fractures and introduced the trochanteric buttress plate in the same year. The 1940s saw the start of the mechanical analysis of hip fracture fixation when Inman realized the size of the hip forces and Eggers realized how compression affected healing.[29]
- In 1952 In his published research, Jewett suggested using a 135 degree fixed nail plate device to treat all hip fractures.
- In 1956 “Taylor and Neufeld proposed the need for implants with sufficient fatigue life and the importance of steady decreases in the analysis of implant failures.”[30].
- “Between 1955 and 1958 According to Pugh and Massie, the use of sliding with a nail plate device to lessen medial penetration of the femoral head and early fatigue failure was effective.”[31]
- In 1956, “In partnership with K. Clawson of Seattle and McKenzie of Scotland, the Richards Manufacturing Company of Memphis, Tennessee, produced the first sliding compression hip screw that was commercially available in the United States.”[32] Among their alterations were a forged side plate with adjustable lengths and angles and a blunt-tipped cannulated screw design. For improved rotational stability, there was a key slot.
- In 1989 A study by Haentjens et al. found that in situations of comminuted unstable intertrochanteric fractures, bipolar prosthesis had a better prognosis than internal fixation.

- In 1959 second significant advancement in internal fixation systems for intertrochanteric fractures was the sliding compression screw device, which was created by Clawson DK of the USA with assistance from Richards Manufacturing Company.
- In 1963, A Jewett nail plate with a 150 degree angle was introduced by Sarmeinto [34] for intertrochanteric fractures.
- In 1964 Dimon and Hughston suggested the medial displacement technique, which is easier to use, to create stability.
- In 1964 "Weismann et al. were fixing the lesser trochanter to achieve anatomical reduction, but Wardie (1967) noted that it is difficult, time-consuming, and frequently unsuccessful to reduce and fixate the displaced lesser trochanter fragment to the femoral shaft in order to provide a stable buttress for reduction to proximal fragment."
- In 1964, After making multiple modifications to Richard's screws, Clawson [35] reported that this device was used to treat 67 intertrochanteric fractures. He emphasized that the barrel must not cross the fracture line and that insertion required extreme precision.
- In 1967, Trochanteric osteotomy, medial distal fragment displacement, and fixation with a short Jewett nail plate were described by Joseph Dimon and Jack Hughston.
- In 1970, Ender used an image intensifier to present a novel classification of condylocephalic nailing and intertrochanteric fractures.
- In 1970 "Singh developed the technique for assessing the degree of osteoporosis by analyzing the proximal femur's trabecular pattern on x-rays. This is crucial since bone quality affects both fracture stability and proximal fragment fixation."
- In 1973, "The sliding compression screw plate was utilized for unstable trochanteric fractures by Kevin Harrington and J.O. Johnson"[38], who compared it to the Jewett Nail

Plate. According to their findings, stability is provided by the decrease rather than the device.

- In 1973 Good outcomes were reported by Rosenfeld, Schwartz, and Alter when using the Leinbach prosthesis.
- In 1974 Tronzo asserted that he was the first to treat intertrochanteric fractures with a long, prosthesis with a straight stem.
- "Stern and Goldstein used the Leinbach prosthesis to treat 22 intertrochanteric fractures in 1977. They found that early ambulation and a return to pre-fracture state were definitely beneficial."
- "A 1987 study by Green et al. and Stern et al. revealed a number of comminuted intertrochanteric fractures treated with Leinbach prosthesis, which were recommended in 1986 for elderly patients with comminuted fractures."
- In 1989 "Haentjens et al. [33] conducted the first comparison of internal fixation and hemiarthroplasty, demonstrating a notable decrease in the frequency of pressure sores and pneumonia in patients having prosthetic replacement."
- A study on application of external fixators for treatment of intertrochanteric fractures was published in 1991 by Anil Dhal, Mathew Varghese, and V.B. Bhasin of Maulana Azad Medical College in New Delhi. The benefits of this approach, which is currently being evaluated, included the greatest economy, preservation of the fracture hematoma, minimal surgical trauma, negligible blood loss, early ambulation, short hospital stay, and removal as an outpatient procedure.
- In 1991 According to Broos et al.internal fixation and hemiarthroplasty had similar rates of operating duration, blood loss, and mortality, with a slightly larger proportion of prosthesis recipients (73% versus 63%) reporting no pain. For both groups, the functional outcome was similar.

- In 1995 except for the replacement group's increased transfusion requirement, Stappaerts et al. could not find any differences between groups.
- In 2002 “Rodop et al. discovered that, according to the Harris hip-scoring system, 14 of the 37 elderly patients who underwent primary bipolar hemiarthroplasty for unstable intertrochanteric fractures had good (37%) and 17 had excellent (45%) outcomes after a year.”
- In 2005 Hemiarthroplasty, successful treatment for older patients with the unstable intertrochanteric fractures, according to Liang et al.'s study on the subject. In addition to providing early rehabilitation, it can lessen complications, lower mortality, enhance the quality of life for patients, lighten the strain on their families, and improve living conditions.
- In 2005 A cemented bipolar hip hemiarthroplasty was used to treat 39 consecutive patients with unstable intertrochanteric fractures for a study by Grimsrud et al. According to their findings, the fractures can be fixed using a normal femoral stem and trochanter circlage cabling.
- In 2005 “Kesmezacar et al. reported that after an average of 13 and 6 months, the surgical mortality rates for patients treated with internal fixation and endoprosthesis were 34.2% and 48.8%, respectively.”
- In 2005 a prospective research, Kim et al.compared intramedullary nailing with calcar replacement prosthesis in two groups of 29 patients.
- In 2006 “Hemiarthroplasty and internal fixation were evaluated by Kayali et al. who concluded that the clinical outcomes of the two groups were comparable. Compared to individuals undergoing internal fixation, hemiarthroplasty patients were permitted to bear their entire weight considerably quicker.”

- “Primary hemiarthroplasty provides a stable, painless, and mobile joint with a tolerable risk of complications for elderly patients with unstable osteoporotic intertrochanteric fractures, according to KH Sancheti's 2010 research.”
- “Coxo-femoral bypass was proposed by Kumaravel Shanmugasundaram in 2015 as a cemented bipolar hemiarthroplasty therapy for unstable intertrochanteric fractures.”
- **Femoral Replacement Arthroplasty**

There have been numerous significant advancements in the early history of femoral replacement arthroplasty: In 1919, Pierre Delbet in France replaced the femoral head with a reinforced rubber prosthetic. One of the first initiatives was to replace the femoral head. Ernest W. Hey-Groves used ivory for prosthetic replacement arthroplasty in England in 1927. He also described enlarging the acetabular socket to accommodate the femoral implant.

Their implant was improved by 1952 to include a fenestrated stem that permitted bone ingrowth. “The Judet brothers, Robert and Jean, employed an acrylic prosthesis in 1948, but it ended up being unpopular and prone to wear.” In 1950, Frederick Roeck Thompson created a prosthesis based on Vitallium that featured a vertically intramedullary stem and a flared collar behind the skull. “The Moore stem, named for Austin Moore, is the first widely used arthroplasty product used to treat femoral neck fractures in the elderly. From rubber and ivory in the 1910s and 1920s to metallic implants in the 1940s and 1950s, early femoral replacement arthroplasty advanced thanks to significant inventions by Delbet, HeyGroves, Bohlman, Moore, Thompson, and others.”

This served as the basis for contemporary total hip replacement. Arthroplasty 84: Complete Replacement Surgically replacing the acetabulum (hip socket) and the femoral head with prosthetic parts is known as complete replacement arthroplasty or total hip replacement. Particularly for older patients, this method seeks to improve joint function, lessen discomfort, and enable early weight-bearing and walking. Patients with severe hip joint deterioration can now expect better results because to the introduction of complete hip replacement, a major achievement in orthopedic surgery. 85 Historical Development Thompson and Austin Moore. The prosthesis that Austin Moore and Thompson created have been widely utilized for hip replacements in older, inactive patients over the past forty years.

Early weight-bearing and ambulation were made possible by these prostheses, which produced satisfying results. The continual friction of the metallic prosthesis allowed for early weight-bearing and ambulation, but it also destroyed acetabular cartilage all way down to the subchondral bone. In severe cases, this resulted in proximal migration of the prosthesis and acetabular erosion in addition to discomfort. Presenting Bipolar Prosthetics With the introduction of the bipolar prosthesis, the long-term issues with the Moore and Thompson prostheses were addressed. Among the main advancements and benefits of bipolar prosthesis are: Giliberty and Bateman, James E. (1974): 86 • To address the long-term issues with previous endoprostheses, James E. Bateman and Giliberty first developed the bipolar prosthesis system.

- Other Versions: • Monk Duo Pleet (1976): Monk introduced it. • The Hastings Bipolar Prosthesis was created by Biotechnic in France. INOR, an Indian company, manufactures bipolar endoprostheses. The Design and Function The two-layer movement mechanism of the bipolar prosthesis is intended to minimize acetabular erosion and stem loosening as well as frictional stresses: 1. Inner Lower Friction Bearing: o "An Ultra High Molecular Weight Polyethylene (UHMWPE) insert articulates with a small metallic head to provide a reduced friction surface for joint motion." 2. Outer Shell: The polyethylene insert is covered by the outer shell, which articulates with the acetabulum and is composed of stainless steel or Vitallium. 3. Frictional Differential: Requiring less torque and causing less wear, the differential friction between the two planes of motion guarantees that the majority of motion takes place at the inner bearing. An eccentric axis is incorporated into the design for the polyethylene and metallic cups. This keeps the head from hitting the cup edge, which may shatter and dislocate the polyethylene-bearing insert, and permits the metallic cup to spin laterally under stress. Pros 1. Decreased Frictional Stresses: o The main goal of the bipolar prosthesis is to lessen frictional stresses, which will lessen stem loosening and acetabular erosion. 2. Shock Absorption: o The UHMWPE insert has shock-absorbing properties that make the prostheses last longer by lowering impact loads on the acetabulum during weight-bearing activities. 3. Better Range of Motion: o By avoiding impingement and lowering the chance of dislocation, the bipolar prosthesis's design permits a wider range of motion.

ANATOMY OF PROXIMAL FEMUR

The femur, the body's longest and strongest bone, has two ends and a shaft like all other long bones. It articulates with the patella and tibia at its lower end and the hip bone at its upper end. The greater and lesser trochanters, head, and neck make form the femur's upper end. The hip joint is made up of the head and acetabulum articulating together. Multiaxial ball and socket synovial joints include hip joints.

The lower leg can swing out from the pelvis and the hip joint can move more freely in this arrangement. The femur's upper and lower ends' transverse axes form the anteversion angle. The measurement is about fifteen degrees.

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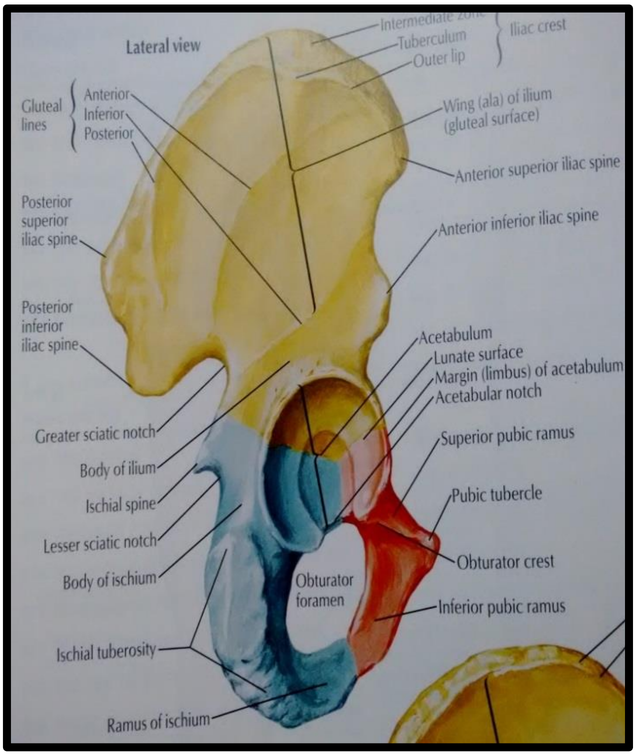


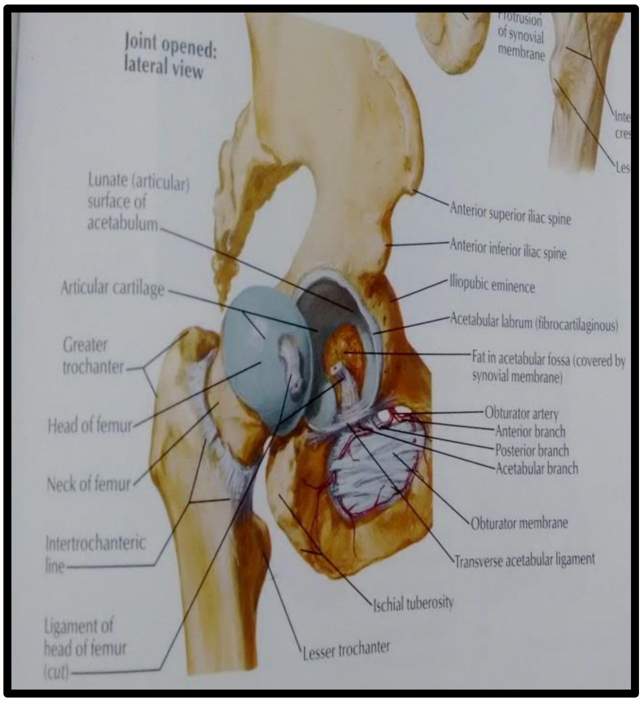


Figure: Anatomy of Proximal Femur

Head of the Femur

Enclosed by the acetabular labrum, this is fully intracapular and directly lateral to its greatest diameter. The sphere is more than half complete. For articulation with the acetabulum, it is angled forward, medially, and upward. A little fovea, or roughened pit, is located directly behind and beneath its smooth surface. The ligament teres can be attached more easily thanks to the fovea. Following its attachment to the anterior aspect of the head's inferomedial area, the femoral artery is separated by the articular capsule and the psoas tendon.

Neck

The neck is 5 cm long, form an angle with the femur shaft of between 125° and 140°. This arrangement permits the lower limbs to freely move away from the pelvis and improves hip joint mobility. The neck's front side is flattened, and the intertrochanteric line—a noticeable rough ridge—defines how it connects to shaft. Intertrochanteric crest at point where it joins the shaft marks the transverse axis of the convex back surface. The entire anterior aspect of the neck is enclosed within the joint capsule by the capsular ligament, which extends laterally to the intertrochanteric line on this side.

"On the other hand, the intertrochanteric crest on the posterior surface is not covered by the capsular ligament. The encapsulation extends only little beyond the medial part of the neck. When the femur rises and advances inside, its neck tilts forward, causing it to not line up in the same plane as the shaft. Thus, the angle of femoral torsion is created when the transverse axis of the femoral head and the transverse axis at the lower end of the bone form an angle. Head, neck, and greater trochanter are not aligned within a single coronal plane; the head is positioned more towards the front and inside relative to the greater trochanter. This positioning is known as anteversion of the neck of the femur, which is about 10-15 degrees."

Greater Trochanter

At upper part of junction where neck and shaft meet, there is a broad, quadrilateral projection known as the epiphyseal structure. The line that follows the body's axis is perpendicular to the line that connects the greater trochanter's tip with the femoral head's center. It is where muscles like the gluteus medius, obturator externus, obturator internus, gamelli, and piriformis attach.

Lesser Trochanter

The psoas major muscle attaches to this conical projection, which is positioned posteromedially, at the place where the shaft and posterior inferior part of the neck meet. At its base and in the areas beneath it, the iliacus muscle attaches to anterior surface.

Intertrochanteric Line

The intertrochanteric line denotes the point where the anterior surface of the neck and the shaft of the femur meet. Beginning with a tubercle in the upper and medial region of the greater trochanter's anterior side, it is a conspicuous rough ridge that extends downward and medially. Although it reaches the lower border of the neck at the same level, it remains in advance of the lesser trochanter. It often has a second tubercle toward its lower end and continues as the spiral line. The intertrochanteric line marks the lateral border of the capsular ligament of the hip joint. The tubercle mentioned earlier is part of the iliofemoral ligament's upper section, to which the upper band of the ligament is attached, while the lower band is attached to the lower section. While the upper portion of the vastus lateralis starts at the upper end of the line, the tallest fibers of the vastus medialis emerge from the lower end.

Intertrochanteric crest

"This structure denotes the point where the femur shaft and the posterior surface of the neck meet. It is a rounded, smooth ridge that starts at the greater trochanter's posterior superior angle and travels inward and downward to the lesser trochanter. It has a modest, rounded protrusion known as the quadrate tubercle just above its middle. The quadratus femoris and the top border of the adductor magnus divide it from the gluteus maximus, which covers the portion of the trochanteric crest above this tubercle. The quadratus insertion site is provided by the tubercle and a section of the neighboring bone beneath it." [10]

Acetabulum

On the side of the innominate bone, the acetabulum is essentially a hemispherical chamber that is oriented laterally, downward, and forward. When standing upright, "the weight of the trunk is transferred to the femur via the articular lunate surface, which is the widest part of the cup-shaped structure's sides. Three bones make up the acetabulum: the ischium forms the floor of the acetabular fossa and contributes slightly more than the lower and posterior two-fifths of the articular surface, the pubis forms the upper and anterior fifth of the articular surface, and the ilium completes the remaining portion of the articular surface."[10]

The fibrous capsule

The capsule is strong, thick cover that connects transverse acetabular ligament and obturator foramen's edge above acetabulum margin, around 5 to 6 mm past the acetabular labrum and across from the acetabular notch. “It surrounds the femur's neck and is attached to the trochanteric line in front, the base of the neck above, the neck behind, approximately 1.25 cm above the intertrochanteric crest, and the lower portion of the neck close to the lesser trochanter below. Numerous fibers are reflected upward along the neck as longitudinal bands termed retinaculae from its anterior attachment on the femoral neck. These bands contain blood vessels that nourish the bone's head and neck.”

Calcar Femoral

According to “Harty (1957) and Griffin (1982), this structure is made up of a dense vertical bone plate that spreads laterally towards the greater trochanter from the postero-medial region of the femoral shaft beneath the lesser trochanter. It reinforces the femoral neck posteroinferiorly and is thickest medially. This component helps maintain the neck shaft angle and is essential for transferring weight from the head to the shaft.”[42]

Gravity and muscular activity place the greatest amount of stress on the greater trochanter and neck, which are primarily made up of calcar femorale bone, in cases of intertrochanteric fractures. If the calcar femorale remains intact, the fracture can stay stable during reduction; however, if it is compromised, the fracture may become unstable post-reduction, resulting in coxavara.

The Ligaments

- “Iliofemoral Ligament (Ligament of Bigelow)

  The thickest and strongest component of the articular capsule, this ligament is situated in front of the joint. It is joined proximally to the ilium surface immediately lateral to the spine and to the lower portion of the anterior inferior iliac spine. It enlarges distally to join the femur's intertrochanteric line. It has the appearance of an inverted Y since the edges are thicker than the center. Only the interosseous sacroiliac ligament is stronger than the iliofemoral ligament, which is more than 0.5 cm thick. It is rarely torn during hip joint dislocation because rupture necessitates a tension of 250–750 lb. This gives surgeons leverage to realign the femoral head into the acetabulum. When standing erect, the line that connects the centers of the two hip joints is somewhat ahead of the vertical line that passes through the center of gravity of the body. In order to maintain an upright posture without requiring muscular effort at the hip joints, the iliofemoral ligaments assist in counteracting the body's propensity to fall backward on these joints.

- Pubofemoral ligament

The base of this triangle ligament is connected to the iliopectineal eminence and the superior ramus of the pubis, while the apex connects below to the lower portion of the intertrochanteric line. It limits both abduction and extension..

- Ischiofemoral ligament

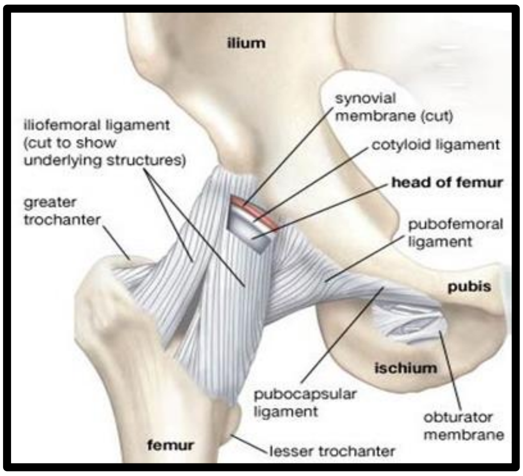
This spiral ligament attaches to the body of the ischium close to the acetabular edge. Limiting extension, its fibers join to the greater trochanter laterally and upward..

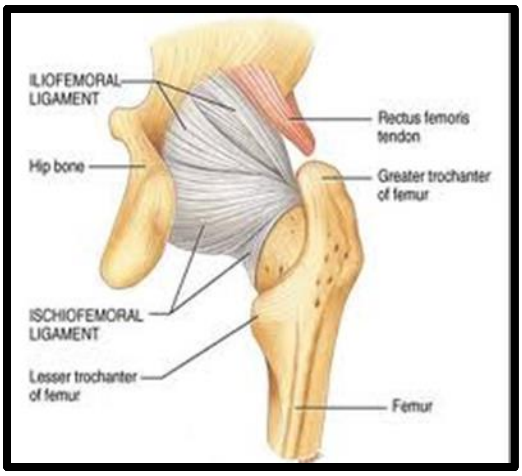
- Transverse acetabular ligament

The acetabular labrum forms this ligament, which bridges the acetabular notch by attaching to the bottom borders of the labrum on either side. It turns the notch into a tunnel that lets nerves and blood vessels pass through the joint.

- Ligamentum teres or ligament of the head of the femur

Encased in a synovial membrane, this ligament is a comparatively weak ring of connective tissue. The broad, flattened end attaches to the transverse ligament and the surrounding edges of the acetabular fossa, while the narrow, cylindrical end inserts into the pit on the femoral head. It has blood arteries that supply the femur's head and neck. the femur's head and neck”[32]





Figure

The hip capsule, its thickenings and ligaments as visualized from anteriorly and posteriorly.

BLOOD SUPPLY OF PROXIMAL FEMUR

"The blood supply to the upper femoral area, as described by Crock, is categorized into several groups:

- An extracapsular arterial ring is located at the base of the femoral neck
- The surface of the femoral neck is home to the arterial ring's ascending cervical branches.
- A subsynovial arterial ring along with the artery of ligamentum teres.
- A substantial branch from the medial circumflex femoral artery and a branch from the lateral circumflex femoral artery at the front make up the extracapsular arterial ring..
- The retinacular vessels' ascending cervical artery ascends in anterior, posterior, medial, and lateral groups along the femoral neck's surface."[41]

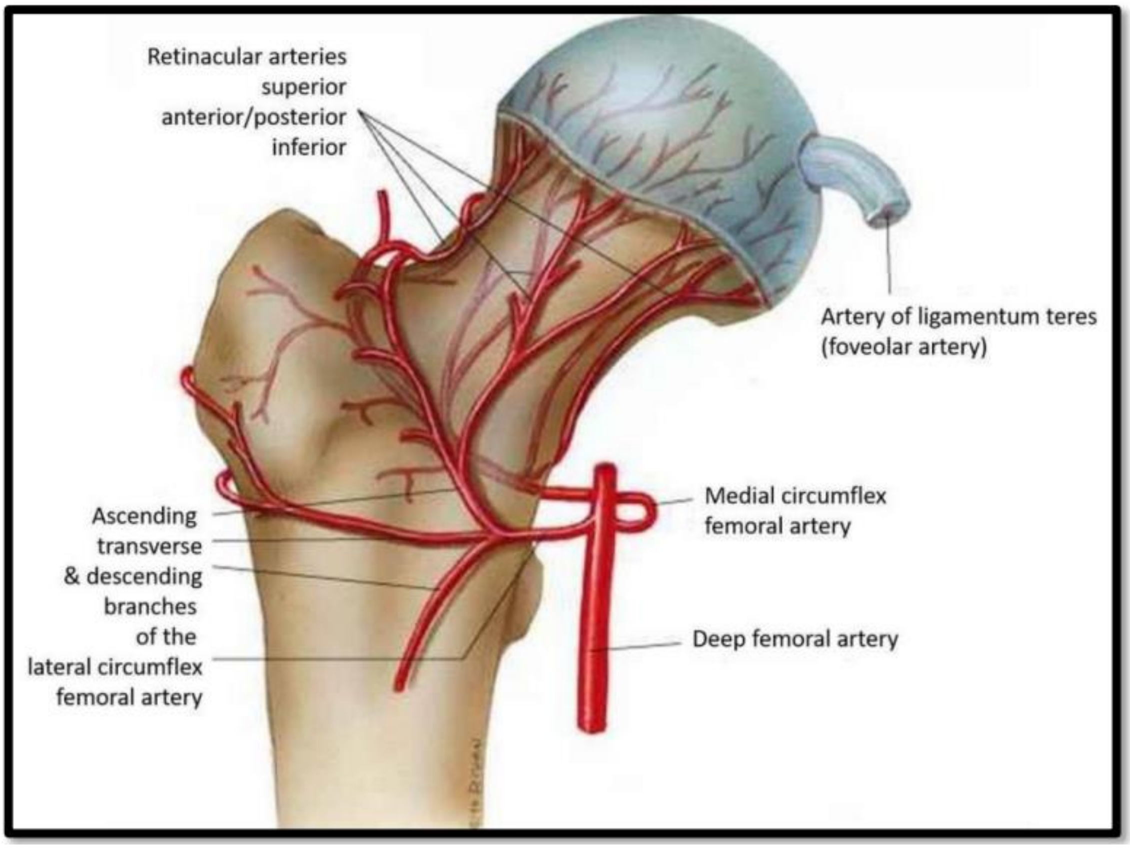


Figure: Blood supply to the Head and Neck of Femur

"The lateral set of arteries is particularly crucial because of its close proximity to the femoral neck, which puts them at risk of injury during femoral neck fractures. As the ascending cervical arteries approach the articular margin of the femoral head, they produce a new network of vessels known as the intracapsular sub-synovial arterial ring. The most significant of this set of epiphyseal arteries that enter the femoral head are the lateral epiphyseal arteries, which supply the lateral weight-bearing area of the femoral head."[31]

<u>Ossification of upper end of femur</u>

One primary center and four secondary centers are involved in the ossification process of the femur's upper end. In the seventh week of intrauterine development, the femoral shaft's main center appears. The secondary centers include one for the greater trochanter in the fourth year, one for the lesser trochanter in the twelfth year, and one for the lower end toward the end of the ninth month of intrauterine life. By the end of the first year, the femoral head's secondary ossification center begins to form.

One epiphysis is located at the lower end of the femur, whereas three are located at the higher end. Around age 18, the upper epiphyses—the head, greater trochanter, and lesser trochanter, in that order—fuse with the shaft, and by age 20, the lower epiphyses do the same.

Trabecular pattern of proximal femur

"The cancellous bone that makes up the proximal femur's trabecular structure exhibits two different trabeculae groups: tension and compression.

The trabeculae can be categorized into five groups:.

1. Primary compressive group.
2. Secondary compressive group.
3. Greater trochanteric group.
4. Primary tensile group.
5. Secondary tensile group.

The primary compressive, secondary compressive, and tensile trabeculae in the femoral neck comprise an area that includes the Ward's triangle, a structurally weak area."[37]

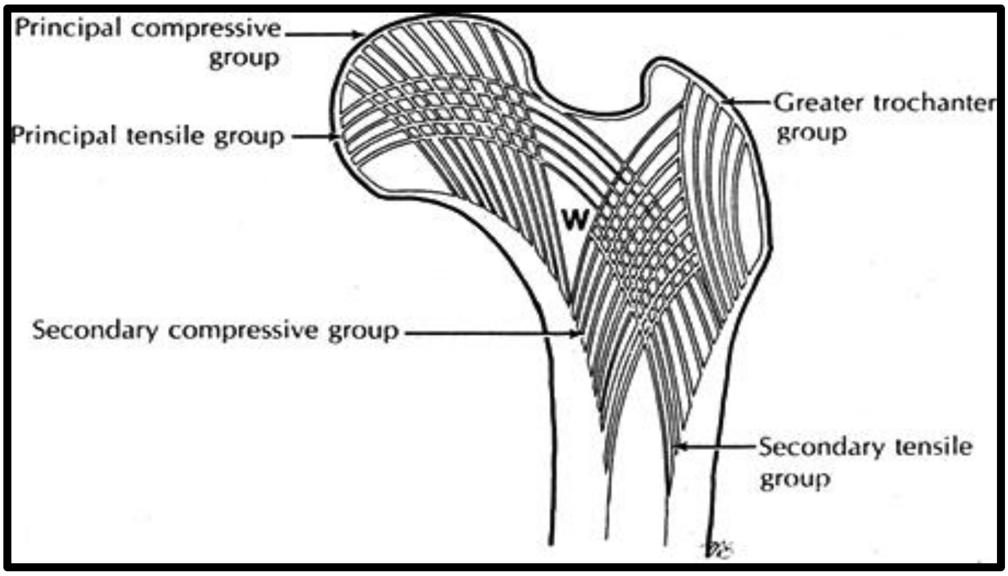


Figure :

Major trabecular groups of proximal femur

INDEX OF OSTEOPENIA

SINGH AND MAINI INDEX:

"To assess the quantity of bone visible in radiology, Singh and Maini created a graded system with six categories.

All trabeculae are present in young, healthy people, and according to Singh's scale, these bones are given a 6.

Strong cancellous bone across the femur's head and neck gives any fixation device a secure hold.

In grade 5, The absence of the trabecular pattern in Ward's triangle

In grade 4, A decrease in secondary trabeculae

In grade 3, the greater trochanter is traversed by the major tensile trabeculae, which are absent.

In grade 2, primary tensile trabeculae are entirely absent.

In grade 1, the primary compressive trabeculae are noticeably thinned.

Grades 6, 5, and 4 bones are regarded as variations of normal bone for clinical evaluation, however grades 3, 2, and 1 bones show reduced strength and could be categorized as osteopenic.

The degree of osteopenia is closely linked to the risk of problems after fixation.

Since osteopenia cannot be assessed in a fractured bone, the initial radiographic evaluation should include the opposite hip that is intact, ideally with 15 degrees of internal rotation."[30]

Movement of the hip joint; "Muscles contributing to the movements:

- The range of flexibility is 0-90 degrees when the knee is extended and 0-130 degrees when it is flexed.
- The iliacus and psoas major are the main muscles engaged in early flexion from a fully extended position, with rectus femoris, sartorius, pectineus, and adductor longus making modest contributions.
- When the thigh is extended against resistance, the gluteus maximus and hamstrings are activated (0-100 to 150 degrees).
- The gluteus medius and gluteus minimus are the main muscles responsible for abduction (0–45 degrees), with sartorius, tensor fascia lata, and piriformis providing supplementary support.
- The adductor fibers of the adductor magnus, adductor longus, and adductor brevis are primarily responsible for adduction (0–40 degrees), with the pectineus and gracilis contributing only slightly.

- The anterior fibers of the gluteus minimus, gluteus medius, and tensor fascia lata are mostly responsible for medial rotation (0–30 degrees), with adductors contributing just somewhat.
- The quadratus femoris, obturator internus, obturator externus, superior gemellus, and inferior gemellus are the main muscles involved in lateral rotation (0–40 degrees); gluteus maximus, sartorius, and piriformis play a smaller role.
- Circumduction is the combination of all the aforementioned movements.

It is noteworthy that lateral rotators are stronger than medial rotators, and extensor muscles are typically stronger than the flexor group."[29]

.

Muscular Forces:

A mass of powerful muscles surrounds the top end of the femur.

The situation becomes more complicated and the stress level might rise significantly when the muscular forces required for single-leg support are taken into account. In contrast, under some circumstances, some muscles, like tensor fascia lata, may function to partially oppose bending forces. In healthy hip, strong psoas muscle performs flexion and rotation, while the gluteal muscles help with abduction. The adductor and hamstring muscles act to offset these stresses. These pressures become imbalanced in a subtrochanteric fracture, giving rise to the characteristic deformity Proimson describes in terms of abduction, rotation, and flexion. After surgery, the fixation device is affected by the same muscle forces.

According to research, even when the patient is at rest, these pressures can place a substantial strain on the femoral head, which Koch's studies demonstrate causes stress in the subtrochanteric region.Rydell demonstrated that even stretching or flexing the hip muscles while in bed caused the same amount of strain on the femoral head as walking slowly without the use of crutches.

MUSCLES AROUND HIP

"The sartorius and the four major quadriceps femoris muscles—rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius—are located in the anterior compartment of the thigh.

The femoral nerve supplies innervation to each of these muscles. Furthermore, the iliacus and psoas major muscles' terminal segments, which originate from the posterior abdominal wall, reach into the top half of the anterior compartment. As the main flexors at the hip, these muscles are innervated by branches that originate directly from the anterior rami of L1 to L3 (psoas major) or from the femoral nerve (iliacus) as it descends along the abdominal wall.

The gracilis, pectineus, adductor longus, adductor magnus, and obturator externus are the six muscles that make up the medial compartment of the thigh.

All of these are innervated by the obturator nerve alone, with the exception of the pectineus, which receives dual nerve supply from the femoral and, on occasion, the obturator nerve, and the adductor magnus, which receives innervation from both the obturator and sciatic (tibial) nerves.

With the exception of the obturator externus, all of these muscles generally adduct the thigh at the hip joint; the adductor longus and magnus can also rotate medially.

At the hip joint, the obturator externus serves as a lateral rotator of the thigh. Three lengthy muscles, referred to as the "hamstrings," are located in the posterior compartment of the thigh: the biceps femoris, semitendinosus, and semimembranosus."[36]

"A. Muscles in Front of the thigh

Muscle	Origin	Insertion	Nerve Supply	Action
Psoas Major	Lateral Surfaces of T12- L5 vertebrae and discs between them; transverse processes of all lumbar vertebrae	Lesser trochanter of femur	Ventral rami of lumbar nerves (L1, L2, & L3)	Flexion of the hip joint
Iliacus	Iliac crest, iliac fossa, ala of sacrum, and anterior surface of the sacroiliac ligament	Tendon of psoas major, lesser trochanter	Femoral nerve (L2 & L3)	Flexion of the hip joint
Tensor Fasciae Latae	Anterior superior iliac spine and anterior part of iliac crest	The iliotibial tract that attaches to the lateral condyle of the tibia	Superior gluteal nerve (L4 & L5)	Abducts, medially rotates, and flexes the hip; helps to keep the knee extended

Sartorius	Anterior superior iliac spine	The superior part of the medial surface of the tibia	Femoral nerve (L2 & L3)	Flexes, abducts, and laterally rotates the hip joint; flexes the knee joint
Rectus Femoris	Anterior inferior iliac spine and ilium superior to acetabulum	The base of the patella and a patellar ligament to the tibial tuberosity	Femoral nerve (L2, L3 & L4)	Extension of knee joint; steadies hip joint and helps in flexion of the thigh
Vastus Lateralis	Greater trochanter and lateral lip of linea aspera of femur	Base of patella and by a patellar ligament to tibial tuberosity	Femoral nerve (L2, L3 & L4)	Extension of knee joint
Vastus Medialis	Intertrochanteric line and medial lip of linea aspera of femur	Base of patella and by a patellar ligament to tibial tuberosity	Femoral nerve (L2, L3 & L4)	Extension of knee joint

Vastus Intermedius	Anterior and lateral surfaces of the shaft of the femur	Base of patella and by a patellar ligament to tibial tuberosity	Femoral nerve (L2, L3 & L4)	Extension of knee joint

."[36]

"B. MUSCLES OF THE GLUTEAL REGION

Muscle	**Origin**	**Insertion**	**Nerve Supply**	**Action**
Gluteus Maximus	The surface of ilium posterior to the posterior gluteal line, dorsal surface of sacrum and coccyx, sacrotuberous ligament	Most fibers end in an iliotibial tract that inserts into the lateral condyle of the tibia; some fibers insert on the gluteal tuberosity of the femur	Inferior gluteal nerve (L5, S1 & S2)	Extension and lateral rotation of the hip. Steadies hip and assists in raising trunk from a flexed position

Gluteus Medius	The external surface of ilium between anterior and posterior gluteal lines	Lateral surface of greater trochanter of femur	Superior gluteal nerve (L5 & S1)	Abduction and medial rotation of the hip. Steadies pelvis on lower limb when opposite leg is raised
Gluteus Minimus	The external surface of ilium between anterior and inferior gluteal lines	Anterior surface of greater trochanter of femur	Superior gluteal nerve (L5 & S1)	Abduction and medial rotation of the hip. Steadies pelvis on lower limb when opposite leg is raised
Obturator internus	The anterior surface of sacrum and sacrotuberous ligament	Superior border of greater trochanter of femur	Nerve to obturator internus (L5 & S1)	External rotation of the hip

Superior Gemellus	Pelvic surface of obturator membrane and surrounding bones	Medial surface of greater trochanter ofthe femur	Nerve to obturator internus (L5 & S1)	External rotation of the hip
Inferior Gemellus	Pelvic surface of obturator membrane and surrounding bones	Medial surface of greater trochanter ofthe femur	Nerve to quadratus femoris (L5 & S1)	External rotation of the hip
Quadratus Femoris	Lateral border of ischial tuberosity	Quadrate tubercle on intertrochanteric crest of femur and are inferior to it	Nerve to quadratus femoris (L5 & S1)	External rotation of the hip

.”[36]

“C. Muscles Posterior to the Hip

Muscle	Origin	Insertion	Nerve Supply	Action
Semitendinosus	Ischial tuberosity	The medial surface of the superior part of the tibia	Tibial division of sciatic nerve (L5, S1 & S2)	Extension of the hip; flexion of the knee and medial rotation of the knee
Semimembranosus	Ischial tuberosity	Posterior part of medial condyle of tibia	Sciatic nerve (L5, S1 & S2)	Extension of the hip; flexion of the knee and medial rotation of the knee
Biceps Femoris	Ischial tuberosity; linea aspera and lateral supracondylar line of femur	The lateral side ofhead of fibula	Sciatic nerve (L5, S1 & S2)	Extension of the hip; flexion of knee and lateral rotation of theknee

.”[36]

"D. Medial Hip Muscles

Muscle	**Origin**	**Insertion**	**Nerve Supply**	**Action**
Pectineus	Superior ramus of pubis	The pectineal line of the femur, just inferior to lesser trochanter	Femoral nerve (L2 & L3); may eceive a branch from obturator nerve	Adducts, flexes, and medially rotates the hip
Adductor Longus	The body of the pubis inferior to the pubic crest	The middle third of the linea aspera of the femur	Anterior branch of obturator nerve (L2, L3 & L4)	Adducts the hip
Adductor Brevis	Body and inferior ramus of pubis	Pectineal line and proximal part of linea aspera of femur	Obturator nerve (L2, L3 & L4)	Adducts the hip and to some extent flexes it

Adductor Magnus	Inferior ramus of pubis, ramus of ischium. Adductor part from ischial tuberosity	Adductor part: gluteal tuberosity, linea aspera, medial supracondylar line. Hamstring part: adductor tubercle of femur	Adductor part: obturator nerve (L2, L3 & L4). Hamstring part: tibial part of the sciatic nerve (L4)	Adducts the hip. The adductor part also flexes the hip, and the hamstring part extends it
Gracilis	Body and inferior ramus of pubis	The superior part of medial surface of the tibia	Obturator nerve (L2 & L3)	Adducts the hip, flexes the knee, and helps to rotate it medially
Obturator Externus	Margins of obturator foramen and obturator membrane	Trochanteric fossa of femur	Obturator nerve (L3 & L4)	Laterally rotates the hip and steadies the head of the femur in the acetabulum

.”[36]

BIOMECHANICS OF HIP JOINT

"As a ball and socket joint, the hip joint functions. The femur's head and neck experience pressure pressures at an angle of 165 to 170 degrees when it bears weight, regardless of the pelvic position. Trabeculae in the medial part of the femoral neck are well developed and follow the force's trajectory upward via the supero-medial portion of the femoral head. These trabeculae are similar to pressure trabeculae that proceed medially and upward toward the sacroiliac joint from the acetabulum. Normally, the cartilaginous epiphyseal plate is oriented perpendicular to the forces that are reacting.

The proximal femoral area is subjected to axial, torsional, and bending forces during routine activities. This area is subject to eccentric loading because of its distinct shape. The greater trochanter's enormous size, increased peripheral material, and wide cortical surface counteract these loads.

Forces acting on hip joint -

- Body weight
- Joint reaction force
- Bending stress
- Shear stress
- Torque transmitted by shaft

The primary stresses in the proximal femoral area result from

- Abductor muscle force
- Hip joint reaction force

Axial compression loads are applied along the femoral neck by the gluteus medius muscle, and forces are applied to the hip joint by the combination of muscular strength and body weight. The hip joint reaction force, on the other hand, is exerted to the hip joint in the opposite direction but with an equal magnitude. The medial cortex, often known as "Adam's

Arch," is a highly stressed region of the body located one to three inches below the lesser trochanter. This is where the majority of the femur's primary compressive stresses are located. The lateral cortex experiences tensile tension."

Biomechanical Contribution of muscles

Certain abnormalities in fracture fragments are caused by the biomechanical contributions of muscles. Distal piece is adducted by powerful adductor muscles, while proximal fragment is flexed by the iliacus and psoas major muscles. All extended muscles eventually contract, causing a shortening that eventually pushes fracture pieces aside.

We will now investigate the biomechanical aspects of proximal femoral fractures after gaining a grasp of the biomechanical aspects of anatomy.

Cortical and compact cancellous bone make up the intertrochanteric and subtrochanteric zones. Because bone has a non-homogeneous structure and a complex stress arrangement, fractures usually happen along the route of least resistance. Compared to normal walking, the forces generated during disordered activities are substantially higher. Fractures may occur if these stresses are greater than bone's ability to withstand them.

Usually, a combination of compression, bending, torsion, and shear loads results in fractures. The two most important of these forces are bending and compression. Compression strengthens long bones more than stress does. Fatigue fractures can result from repeated loads that are less than the bone's tensile strength. Every stress has the potential to harm the bone structure in tiny ways, and these flaws may eventually combine to become fractures. The degree of energy absorption determines whether a fracture is comminuted or simple.

Trochanteric fractures:

Loads acting parallel to and perpendicular to the fracture line cause trochanteric fractures. Together, these two different directional forces create compression and shear stresses throughout the fracture site. “The femoral head tends to move downward in reference to the femoral shaft due to shear forces acting parallel to the fracture line. The femoral head is compressed against the femoral neck by compression forces acting perpendicularly. Fracture pieces are brought together by this compression, which makes it easier for them to mechanically interlock. Because the distance between the line of action from the hip joint load and the fracture line is longer in intertrochanteric fractures, the bending impact from joint load is more noticeable. The proximal piece bends in a varus direction as a result.”

When two-part fractures are undisplaced, the gluteus medius muscle's tension is still present, which helps the fracture stay stable throughout realignment. The gluteus medius' compressive action is eliminated if both trochanters are separated. “During internal or external rotation of the limb, the axial rotation force on the femoral shaft becomes a crucial factor that can jeopardize fixation, even though the shear force acting on the fracture is not the dominant force.”

PLANE OF FORCES ON HIP JOINT

“When standing, the center of gravity is situated behind the hip joint's axis. I. A view of the pelvis is obtained from the height of the sacral ala to the upper border of the symphysis pubis. The center of gravity is shown at X. II, and the acetabulum's contour is marked. In front of the S2 vertebrae is the center of gravity, or X, albeit it is not fixed and changes as the upper body moves in relation to the pelvis. In addition to forces in the coronal plane that tend to rotate and bend the prosthetic stem, there are rotatory and posterior bending forces involved because the hip joints are located distally and anteriorly to X.

shows the stem's torsion and offsets in both the vertical and horizontal directions. 1. The stem is pushed medially by the pressures operating on the hip in the coronal plane. 2. The forces in the sagittal plane, especially during lifting motions or when the hip is flexed, work to deflect the stem posteriorly. When combined, they cause the stem to torsion. The head and offset of the femur: A longer neck segment length (I) of the femoral component results in a higher lever arm or moment of force that can bend or break the component at a given angle between the neck and femoral shaft.”

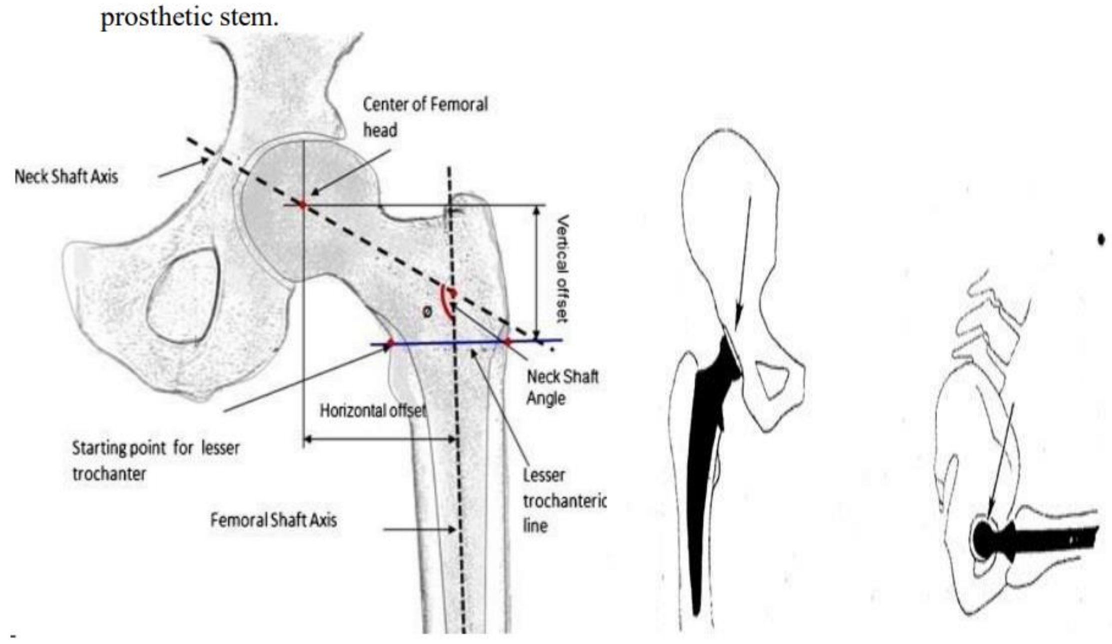


Fig 5. Vertical and horizontal offset and torsion on the stem

IMPLICATION OF FRACTURE ANATOMY

A fracture's stability is directly impacted by the degree of comminution. By increasing compression and shear resistance, a lower degree of comminution helps to increase resistance against deforming forces. The magnitude of bending and shear loads is also influenced by the neck shaft angle and the femoral neck's length. Strains placed on fracture site increase with neck shaft angle, leading to less stable fixation. Therefore, the resistance offered against deforming pressures is inversely correlated with the degree of comminution in a fracture.

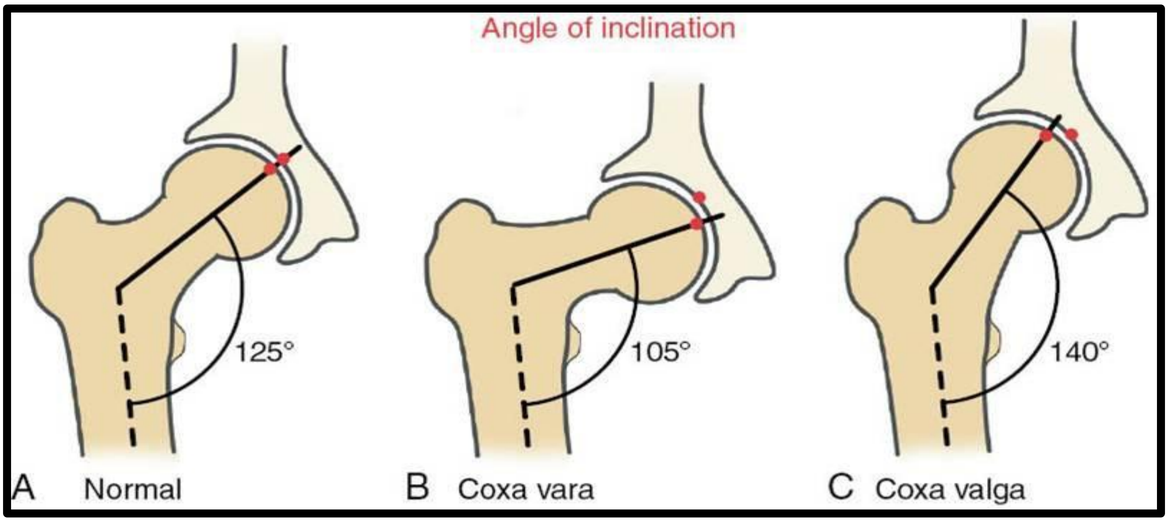


Figure:

Femoral Neck-shaft Angle

<u>“Main fragments of an unstable intertrochanteric fracture are:</u>

- Proximal neck fragment
- Greater trochanteric fragment
- Lesser trochanteric fragment
- Proximal femoral shaft fragment”

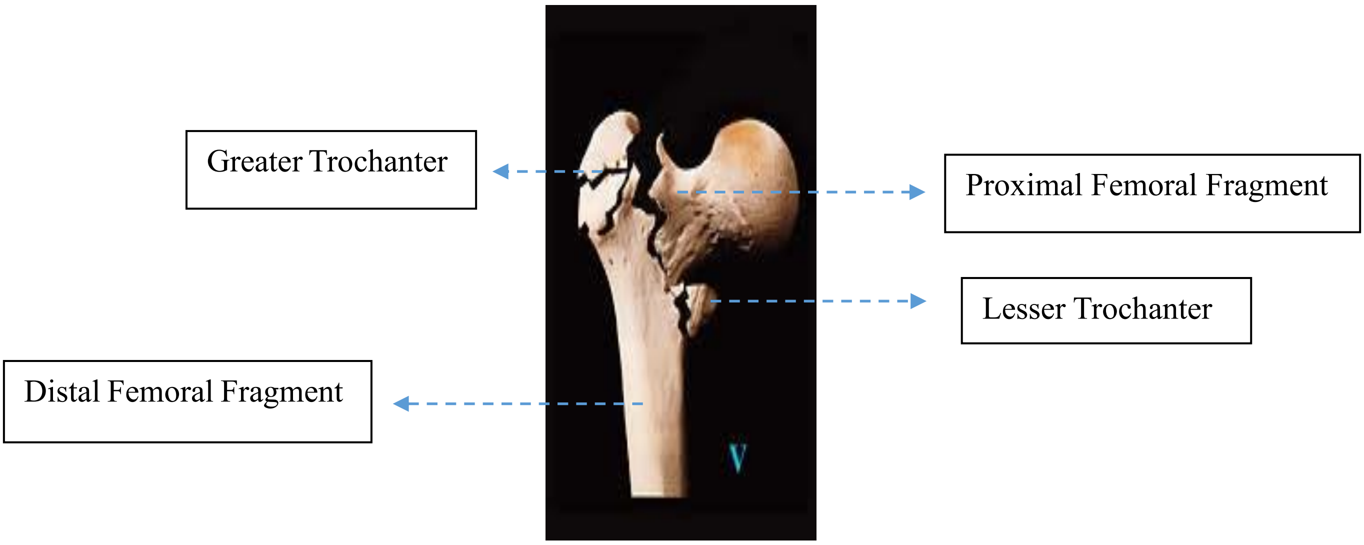


Figure:

Main Fragments of Comminuted Inter-trochanteric Fracture [120]

“A posterior and posteromedial wall defect is included in the insufficiency caused by an unstable intertrochanteric fracture. From the proximal femoral shaft, the delicate lateral wall protrudes. The intertrochanteric fracture becomes a subtrochanteric fracture when it happens in this lateral wall.

After fracture impaction and fracture spike interdigitation, rotational and varus stability are improved by the lateral wall's lateral support for the compression of the proximal fragment. The proximal neck fracture fragment will collapse if the lateral wall is weakened since it will not have any lateral support.“

The bone must offer sufficient support in order to treat intertrochanteric fractures since more support results in less strain on the implant. Because the implant bears a greater load than the bone can sustain, comminuted fractures put more strain on it. When there are intertrochanteric fractures, the hip joint's bending forces cause the implant to bear a greater weight.

Fixation devices are placed according to configuration of fracture fragments, with proximal fixation positioned within the femoral head, mid-segment secured in the intertrochanteric area, and distal fixation attached to the lateral trochanteric wall in Dynamic Hip Screw (DHS) or in the intramedullary space as seen with Proximal Femoral Nail (PFN). Maintaining reduction across these three segments is vital for ensuring unhindered bone healing.

Number, size, form, position, and displacement of intertrochanteric fracture fragments have been subject of clinical attention. A major factor in fixation failure can be comminution that impacts the posteromedial cortex. Multiple fragments with posteromedial cortical comminution are considered unstable fractures because they are more likely to shift in varus and retroversion. On the other hand, stable fractures are those that do not exhibit posteromedial cortical comminution and for which anatomical reduction is still possible.

A number of circumstances can lead to unstable fractures, including reverse oblique fractures, when the tension from the adductor muscle causes the shaft to significantly shift. The greater trochanter's involvement in comminution further raises the possibility of medial displacement. The proximal and distal fragments in this case do not come into touch because of either comminution or extensive medial and posterior displacement. The posteromedial wall develops a deficiency if the lesser trochanter is damaged. Varus collapse is caused by this medial flaw, while retroversion displacement is caused by the posterior wall defect.

CLASSIFICATIONS

A useful classification serves as a clear reference for prognosis and treatment in addition to identifying the fracture pattern. There have been several attempts to classify these fractures. The challenge in classifying these fractures lies in their frequent comminuted and complicated nature.

Numerous classifications for fractures exist.

1. "TRONZO CLASSIFICATION
2. BOYD AND GRIFFIN CLASSIFICATION.
3. EVANS CLASSIFICATION.
4. JENSENS AND MICHAELSEN CLASSIFICATION.
5. KYLE CLASSIFICATION.
6. A.O. CLASSIFICATION."

1. TRONZO CLASSIFICATION:

"Tronzo categorized intertrochanteric fractures into five types based on the reduction potential associated with each type. He proposed a specific reduction method for each type.

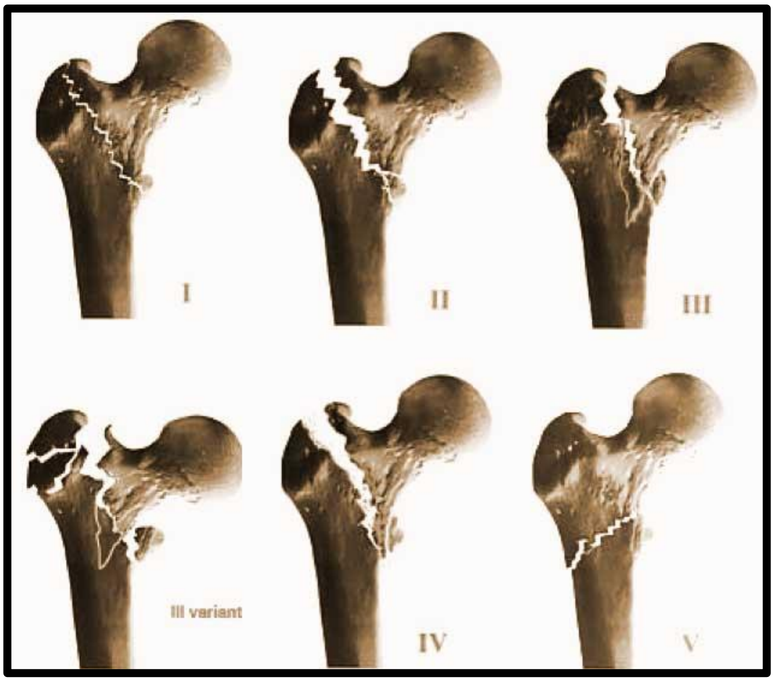
I) An incomplete intertrochanteric fracture involves only the greater trochanter and the ilio-psoas tendons may still be attached, potentially hindering reduction efforts.

II) An uncomminuted trochanteric fracture, which may or may not have slight displacement, retains an intact posterior wall and generally has a smaller fragment of the lesser trochanter. In these fractures, both the lesser and greater trochanters are fractured.

III) A big lesser trochanter fragment and the neck spike extending into the shaft fragment are characteristics of a comminuted posterior wall. This kind is similar to a variety of kind III, except in this instance, the greater trochanter is totally broken, even though the neck fragment's beak telescopes or enters into the shaft fragment.

IV) The neck spike is pushed outward from the shaft when the posterior wall is comminuted without the two primary segments telescoping. There is considerable comminution as a result of the medial side losing the majority of the posterior wall.

V) The greater trochanter may or may not be linked to the neck fragment in a reverse oblique trochanteric fracture, with displacement taking place in the shaft. The posterior wall is typically not extensively comminuted, but its peculiar oblique shape is what causes its instability. ”[28



Tronzo classification for intertrochanteric fractures

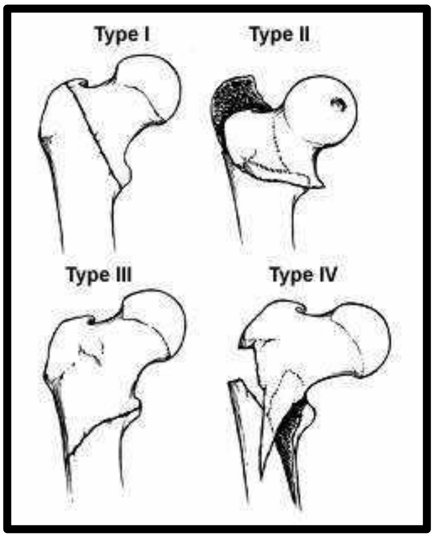
2. **“BOYD AND GRIFFIN CLASSIFICATION”:**

I. “Fractures that run from the larger to the lesser trochanter along the intertrochanteric line usually require simple reduction and are easily maintained, producing good results.

II. Comminuted fractures are characterized by several cortical fractures in addition to the main fracture, which follows the intertrochanteric line. Different levels of comminution, from mild to severe, might make the reduction process more difficult.

III. At least one fracture from the proximal end of the shaft, either at or just below the lesser trochanter, is typically present in fractures categorized as subtrochanteric. Because these fractures are more difficult to minimize, there will be more difficulties during surgery and the healing process.

IV. On normal anteroposterior radiographs, fractures in the proximal shaft and trochanteric area may be difficult to see because they include at least two planes, usually the sagittal plane. Two-plane fixation is required when using open reduction and internal fixation. ”[28]

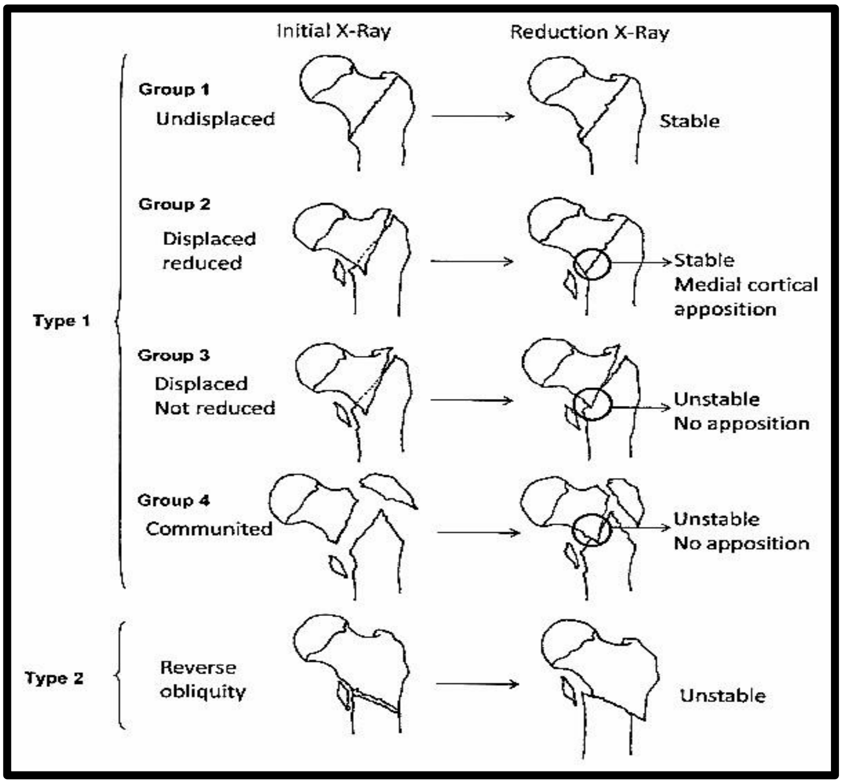


Boyd & Griffin classification of intertrochanteric fractures.

3. EVANS CLASSIFICATION:

"The two main categories into which Evans classified intertrochanteric fractures were stable and unstable. He also separated unstable fractures into those that can be stabilized by anatomical or near-anatomical reduction and those that rely on anatomical reduction to establish stability.

1) The fracture line rises and projects outwards from the lesser trochanter.
2) In reverse obliquity fractures, the primary fracture line extends outward and descends from the lesser trochanter. These fractures often lead to medial displacement of the shaft due to the traction of the adductor muscles." [27]



Evans classification of intertochanteric fractures.

4. JENSENS AND MICHAELSEN CLASSIFICATION:

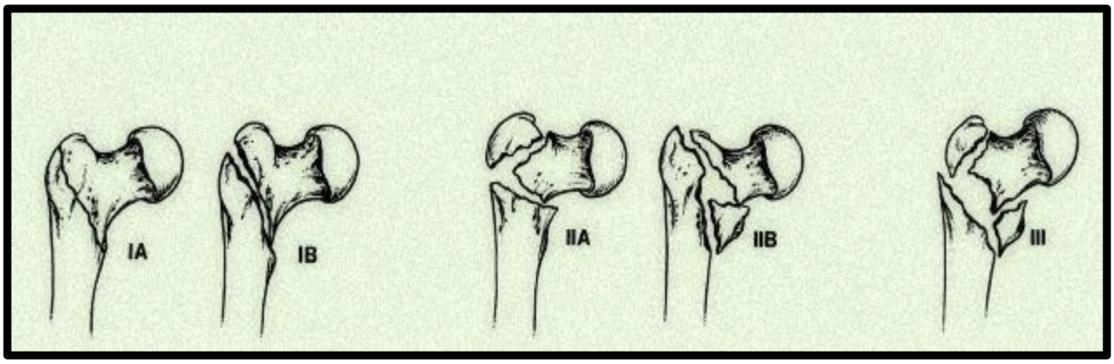
“1A) A two-part stable fracture that is undisplaced.

1B) A two-part stable fracture that is displaced.

2A) A three-part fracture with a separate greater trochanteric fragment, stable if medial cortex apposition is achieved during reduction.

2B) A three-part fracture involving a lesser trochanteric fragment, which is relatively unstable.

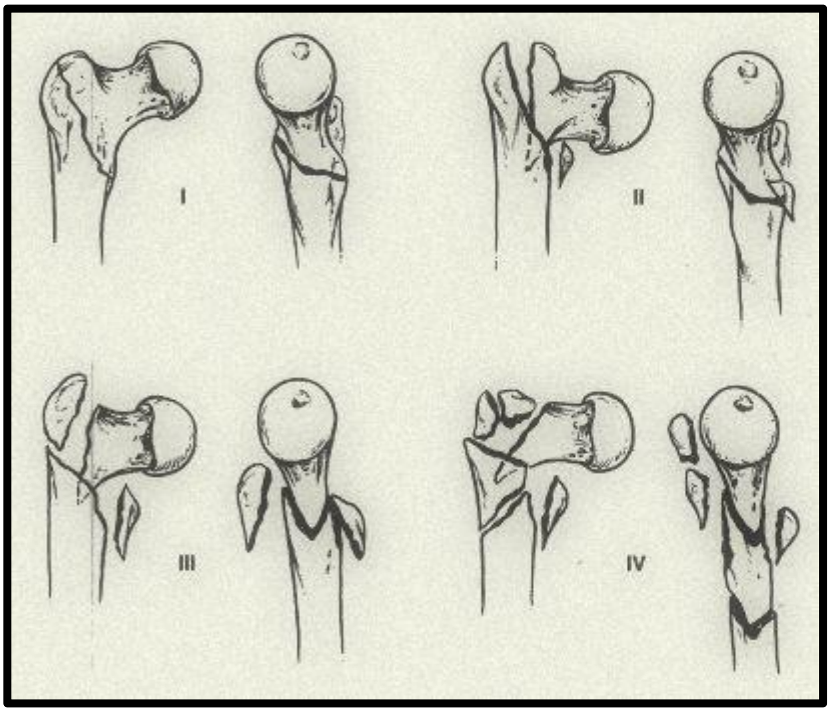
3) A four-part unstable fracture that contains fragments from both trochanters. ”[28]



JENSENS AND MICHAELSEN CLASSIFICATION

5. **KYLES CLASSIFICATION:**

1. "An undisplaced fracture consisting of two parts that is stable.
2. Stable fractures that preserve a considerable portion of the posteromedial cortex but have been shifted into varus with a smaller lesser trochanteric fragment.
3. A four-part unstable fracture with a larger trochanteric fragment and posteromedial cortical comminution that is displaced into varus.
4. An unstable fracture similar to type 3 that extends into the subtrochanteric region"[28]



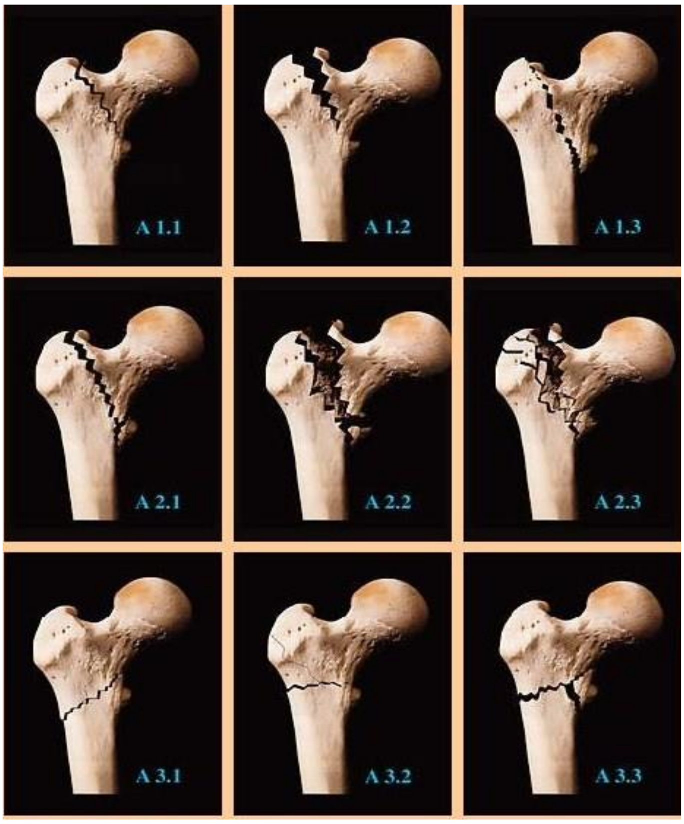
Kyles classification

6. A.O. CLASSIFICATION:

"The AO group classified trochanteric fractures into the following categories:

1) A1 fractures are classified as uncomminuted.
2) A2 fractures are classified as comminuted.
3) A3 fractures involve subtrochanteric extension or reverse obliquity.

A1.1 to A2.1 are typically regarded as stable, whereas A2.2 to A3.3 are viewed as unstable."[28]



A.O. classification

In our current series, we utilized the AO classification.

The criteria for assessing fracture instability include:

1. Four part fractures.
2. Posteromedial wall comminution.
3. Reverse oblique fractures.

4. Fractures with beak inside the canal.

Consequently, AO types A2.3 to A3.3 are categorized as unstable and were part of our study.

7. DORR CLASSIFICATION

"The Dorr classification system is a method that surgeons utilize to decide whether to use cemented or cementless femoral components in total hip arthroplasty, depending on the overall quality of proximal femur's bone.

Implant Type: Choosing the right type of implant is critical, as the final classification relies on the ratio that assesses bone quality. The ratio is computed as follows; canal diameter = 10 cm below the lesser trochanter's midportion ÷ inner canal diameter at the lesser trochanter's midportion.

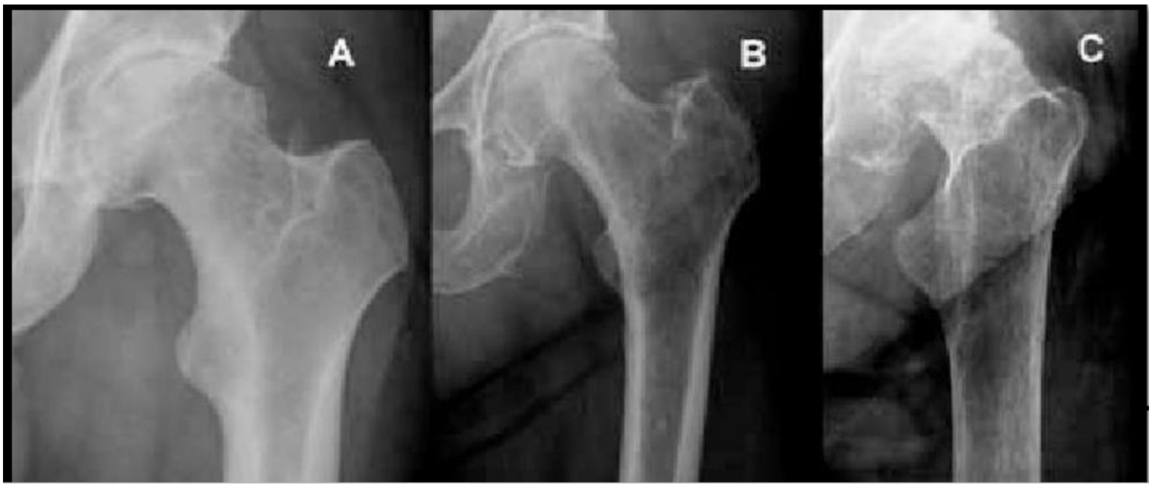
Explanation of Dorr Classification Types •

Type A (< 0.5): Signifies good bone quality with visible thick cortices on both anteroposterior (AP) and lateral X-rays. This category is optimal for fixation of uncemented femoral components. This type resembles a champagne flute shape. The thick cortices provide robust support and a narrow medullary canal, making this type ideal for uncemented prostheses due to its good bone quality and ability to ensure stable fixation.

Type B (0.5 to 0.75): Denotes intermediate bone quality, showing some thinning of the posterior cortex on lateral X-rays. This category is generally appropriate for uncemented femoral component fixation. This type is characterized as normal, having features that lie between Type A and Type C. The cortices are thinner than in Type A but still offer sufficient support. The medullary canal is broader, accommodating both cemented and uncemented prostheses.

Type C (> 0.75): Represents poor-quality bone, with significant cortical thinning evident on AP and lateral X-rays. Due to the reduced bone stock, this type typically requires cemented femoral component fixation. This type resembles a stovepipe shape, exhibiting fragile cortices and a large medullary canal. The poor bone quality necessitates frequent use of cemented prostheses for stable fixation.

Figure: Dorr Types A, B, and C Proximal Femoral Morphology The Dorr classification is an essential instrument. In total hip arthroplasty (THA), a key responsibility for an orthopedic surgeon is to select the appropriate prostheses in line with the degree of bone quality. ”[28]



MANAGEMENT OF TROCHANTERIC FRACTURES

“Watson-Jones indicate that a fracture through the intertrochanteric line of the upper femur, as well as peritrochanteric fractures, tend to heal effectively regardless of the treatment applied because the extensive fractured surfaces have a rich blood supply and usually don’t exhibit significant displacement. However, if appropriate precautions are not implemented, the fracture may heal in a position of coxa vara, leading to limb shortening and restricted hip movement. Additionally, since these fractures typically occur in elderly patients, the dangers of prolonged immobility and bed rest become a concern. Therefore, treatment should be designed to promote healing without deformity while also facilitating early mobilization. Trochanteric fractures can be treated in one of two methods..

1) Conservative or Non-operative method.
2) Operative method.”

“CONSERVATIVE MANGEMENT :

‘Two strong men will suffice by making extensions and counterextension’ by Hippocrates in 350 BC.

It's unclear why non-surgical treatment is preferred for intertrochanteric fractures.

Conservative treatment includes:

a. A patient who is near death
b. A patient who has already experienced a fracture.
c. A patient who is comfortable with the fracture but is unable to walk.
d. If open reduction is insufficient to stabilize the fracture
e. A patient with co-existing conditions where the risks associated with anesthesia and surgery significantly exceed the advantages of surgical intervention and fixation.”

“Conservative Treatment Regimes Include :

- Basic support with cushions.
- Bracing the contralateral limb,
- Buck's traction.
- Skeletal traction applied to the lower femur or upper tibia.
- Well-leg traction.
- Russell’s balanced traction.
- Plaster spica for immobilization.”

Buck’s Traction: (1861)

This is lower limb's application of skin traction. Comfort and effectiveness are increased since traction force is dispersed over large region of the skin. Traction should only be used on the part of the limb beneath the fracture site for treating fractures.

The results of applying skin traction to elderly people with thin, delicate, and inelastic skin can frequently be highly distressing. Furthermore, controlling the limb's lateral rotation while skin traction is difficult. Therefore, skeletal traction is typically preferred for treating the intertrochanteric fractures, which frequently occur in the older patients.

“Skeletal Traction: Fritz Steinmann: (1907)

He described a method that involves inserting two pins into the femoral condyles to apply skeletal traction through the femur. Soon after he first proposed the two-pin method, he improved the "through and through" technique with the Steinmann pins in 1916. These sturdy stainless-steel pins come in a range of lengths and have a diameter of 3 to 5 mm.

Austrian inventor Bohler created a particular stirrup that fastens to the Steinmann pin. Without turning the pin inside the bone, the Bohler stirrup makes it possible to change the direction of the traction.

Denham created a pin that resembled the Steinmann pin but included a short, elevated threaded segment that was very useful for treating osteoporotic or cancellous bone in older people.

Well-Leg Traction:

Roger Anderson explained a traction technique in 1932 in which the wounded leg received skeletal traction while the "well" leg produced counter-traction.

Russell’s Balanced Traction

In 1924, Melbourne's Hamilton Russell introduced it. This type of balanced traction is simple and easy to understand. The fundamental idea is to apply two forces at the knee, which will produce a pull that nearly matches the axis of the femur.

One of two essentially distinct approaches can be used for non-operative treatment of intertrochanteric fractures.

1) Early Mobilization:

As with the post-surgery procedure, patients are deployed immediately in this approach. Every day, they are sat in a chair and given analgesics. They start walking with crutches if their physical condition improves. Fracture pain after a few days is rarely more severe than wound pain after open reduction, according to Shaftan and colleagues. Additionally, they stressed that the healing of the fracture was not impeded by their non-operative therapy method. Nonetheless, this method accepts a certain amount of external rotation, shortening, and varus deformity.

2) Traction:

For ten to twelve weeks, Aufranc recommended skeletal traction in balanced suspension. The leg is kept in abduction, which makes it simpler to reduce and maintain the typical head-neck angle. The patient is then made mobile and allowed to bear some weight until the fracture heals completely.

Aufranc and his colleagues observed that partial weight bearing might be necessary for up to 6 months before achieving good fracture stability and that varus displacement could happen as late as 3 to 4 months post-fracture.

When using conservative techniques, especially those that call for prolonged traction, care must be taken to avoid secondary problems such thromboembolic illness, pressure sores on the sacrum and heels, pneumonia, urinary tract infections, and foot equinus contractures."[21]

OPERATIVE MANAGEMENT :

"Surgery using an internal fixation technique is the recommended course of treatment for intertrochanteric fractures.

The objectives are

- Achieving stable fixation and anatomical realignment, which causes the fracture to heal.
- Enabling the patient to be mobilized promptly.
- As soon as feasible, returning the patient to their pre-operative state.

Kaufer, Matthews, and Sonstegard have identified the factors that influence the strength of the fracture fragment-implant assembly.

The factors are

- .Fracture Geometry.
- Reduction.
- Bone Quality
- Implant Placement
- Implant Design.

In order to guarantee a consistently reduced and internally fixed intertrochanteric fracture, the surgeon can control the quality of reduction as well as the implant's selection and placement, even though the quality of bone and fracture geometry cannot be changed.

Surgical Techniques :

Patients with intertrochanteric fractures in the 19th century were typically kept in bed for long periods of time until they healed or, more often, passed away.

Plate and Screw Devices:

Fixed Angle Nail Plate devices (Jewett and Holt nails) were the first effective implants for intertrochanteric fractures. These devices consisted of a triflanged nail that was affixed to a plate at an angle of 130 to 150 degrees.

These devices did not stop fracture impaction, but they did stabilize the femoral head and neck fragment against the femoral shaft. The nail's point accidentally penetrated the hip joint through the top portion of the femoral head as a result of the fracture fragments collapsing. Additional technical problems with these devices were difficulties fitting the side plate correctly to the shaft of the femur or insufficiently securing the grip in the cancellous bone of the femoral head. Still, unstable fractures tended to heal in a varus shape, resulting in fractured side plates, bent or broken nails, and screws that broke or pulled out of the femoral shaft.

These solutions were used to develop the Sliding Nail Plate devices. Screw threads on the hip nail to improve grip in the femoral head's porous bone, a blunt screw tip to lower the chance of head penetration, and a sliding mechanism that permits fracture collapse and impaction while maintaining the neck-shaft angle and controlling rotation. The tongue-in-groove barrel collar strengthens the nail-plate interface and aids in rotation control. By enabling the proximal lag screw to move inside the plate barrel and the plate to glide axially down the femoral shaft, an early switch to a sliding hip screw increased fracture impaction. Egger's plate, which was modified to employ slotted screw holes rather than round holes, allowed for this bi-directional sliding.

Due to the frequent occurrence of nail cut-out and head penetration, the sliding screw plate was proposed by Schumpelick (1955) and Jantzen P.M., designed by Ernst Pohl of Kiel. In 1945, a screw that provided dynamic compression at the fracture site was designed by Virgin and Mac Ausland

Richards screw: Introduced in 1945, the Richards screw is a dynamic compression screw that was refined by Callender in 1960 and manufactured by the Richards Company, earning it its name.

Thus, the sliding screw plate, combined with the Richards screw, enables a bidirectional sliding mechanism at the fracture site.

The Medoff Plate is a two-component plate system that was recently introduced. It has an internal sliding component and a central vertical channel. In an effort to streamline the process and improve its biomechanical soundness, Kulkarni G.S. [42] created the Miraj Screw, a modified version of Richard's hip screw.

1) As with the original design, the modification incorporates a longer lag screw with coarse threads at the proximal end and threaded distal end. A nut that passes over the distal end instead of putting itself into it is used to generate compression. This modification streamlines the process.
2) The barrel's distal end cannot become trapped thanks to the tapering distal shaft thread junction design.
3) The screw and barrel of the conventional device no longer have the key and slot mechanism that stops the fragment from rotating.

Some researchers have suggested using polymethyl methacrylate (PMMA) to improve fixation and stability for unstable intertrochanteric fractures in individuals with severe osteoporosis.

Intramedullary Devices:

Lezius was the first to treat intertrochanteric fractures from the medial aspect intramedullarily in 1950. He placed the nail at the point where the proximal and middle thirds of the femur meet.

The insertion location was moved by Kuntscher in 1964 to the medial femoral condyle, where the cortex is thinner and less soft tissue exposure is necessary. Even though the results were remarkable, there were issues with the nail's stiffness, big diameter, and need for a guide wire.

To continue reduction of these fractures, Ender advocated in 1970 for the use of Ender's Nails, a series of flexible nails placed directly above the adductor tubercle. Image intensification is used to introduce these devices in a backward manner.

The benefits of this approach include:

- An incision made far from the fracture site lowers the risk of infection and bleeding.
- Minimal exposure of soft tissues, which makes surgery easier and shortens the time needed for both the procedure and the anesthesia.
- Intramedullary placement that maintains the typical neck shaft angle while permitting fracture impaction during weight-bearing.
- They have fewer bending moments than plate and screw devices because they are located near the femur's mechanical axis.

Nevertheless, they have been connected to a significant number of problems, including

- Rotational deformity.
- Proximal migration of the nails through the femoral head.
- Withdrawal of the nail, leading to knee pain and stiffness.

Intertrochanteric fractures have also been fixed with other intramedullary devices, such as the Russell Taylor Reconstruction Nail, Proximal Femoral Nail, Trochanteric Femoral Nail, Gamma Nail, and Intramedullary Hip Screw. It is possible to use the Trochanteric Gamma Nail, the second generation of interlocking nails, without going into the subtrochanteric area. When weight is applied, the Gamma Nail, an intramedullary device, receives less force since it is positioned more medially than standard sliding compression hip screws and plates. By moving the patient's weight closer to the Calcar, the gadget increases the mechanical strength.

There is very little blood loss and the surgery takes very little time. The Intramedullary Hip Screw is a combination of a locked intramedullary nail and a sliding hip screw.

This design offers a number of possible advantages. —

- The intramedullary fixation, as opposed to a sliding hip screw, is thought to provide more effective load transmission because of its placement.
- It is expected that the intramedullary device's reduced lever arm will lessen the implant's tensile strain, reducing the chance of failure..
- Its sliding hip screw preserves the advantage of controlled fracture impaction..
- It is also hypothesized to necessitate less soft tissue dissection and a shorter operating time.

However, at the device tip or close to the distal locking screw, these devices may result in late femoral fractures.

When dealing with unstable intertrochanteric fractures, reverse obliquity, or subtrochanteric involvement, the Russell Taylor Reconstruction Nail is advised.

Prosthetic Replacement:

For intertrochanteric fractures, prosthetic replacement has not gained widespread approval. There is a lack of clarity regarding the criteria for choosing to replace a main prosthetic. The primary candidates for prosthetic replacement, according to numerous experts, are older, fragile patients who have a comminuted, unstable intertrochanteric fracture in highly osteoporotic bone.

Kenneth J. Koval [73] states that the following are indications for primary prosthetic replacement:

- A complete hip replacement is the better option for patients with ipsilateral degenerative hip disease.

- If significant comminution and low bone quality prevent an attempted open reduction and internal fixation from being effective, the treatment should be stopped and a hemiarthroplasty performed instead.

Primary prosthetic replacement carries a higher risk of morbidity and potential consequences, including prosthesis dislocation, and is a more extensive and intrusive procedure than internal fixation. Apart from that, the prosthesis is very expensive. Prosthetic replacement is therefore a viable option for certain patients with comminuted unstable fractures or those with intertrochanteric non-union and fixation failures.

It is simple, secure, and economical to treat intertrochanteric fractures using external fixators. It is the recommended approach for older individuals who are at high risk.

Realigning the fracture on a fracture table is usually followed by the percutaneous insertion of two or three 6.5mm cancellous Shanz pins into the femoral neck under imaging guidance. Additionally, three or more preloaded 4.5mm cortical Shanz pins are inserted transversely into the shaft percutaneously. Following that, universal clamps are used to secure these pins to the tubular rods.

Local anesthetic can be used to facilitate the simple application and removal of the external fixator. On the first postoperative day, patients can start mobilizing using crutches. The advantages of external fixation are –

- Short operative time.
- Minimal blood loss.
- Early mobilization.

The complications with external fixation are

- Pin tract infection
- Varus collapse at the fracture site

- Pin breakage
- Proximal pin migration."[12]

TREATING UNSTABLE TYPE

Unstable intertrochanteric fracture:

The Stable fracture patterns enable for attainment and maintenance of a reduction because the posteromedial cortex either stays intact or exhibits little comminution. On the other hand, the posteromedial cortex shows more noticeable comminution in unstable fracture patterns. Because the femoral shaft may medially shift, the reverse obliquity pattern is inherently unstable. (Source: Court Brown C, Heckman JD, Bucholz R W, et al.)

With osteosynthesis, stable fractures may usually be treated with consistent results. It can be difficult to manage unstable intertrochanteric fractures, though.

The Problem with unstable type :

As a general guideline, the primary goal for surgeons is to preserve the patient's own bones. This goal becomes challenging in cases of comminuted intertrochanteric fractures when using internal fixation. Osteoporosis and difficulties in achieving anatomical reduction, such as instability, are significant factors contributing to less than optimal results. "A lengthy period of immobilization is frequently advised for older patients with unstable osteoporotic fractures, despite the fact that this might result in problems such as deep vein thrombosis, pneumonia, bedsores, and atelectasis.

The weak anchoring of the internal fixation device due to osteoporosis and fracture comminution raises the likelihood of internal fixation failures, including screw cutout and bone fragment displacement. In situations of severe osteoporosis and significant comminution at the fracture site, dependence on internal fixation devices for early full weight-bearing is not feasible. These patients often struggle to follow partial weight-bearing protocols, leading them to place full weight on the operated limb, which results in mechanical failures.

In the past, there were significant rates of cutout and fracture displacement in the fixed nail plate systems used for these fractures. Following its successful introduction, a sliding hip screw was adopted as the main fixation technique for these fractures. Nonetheless, issues including head perforations, excessive sliding that shortens the plate, plate pullout, and plate breakage have continued, especially in cases of comminuted intertrochanteric fractures. Therefore, the stability of the fracture, bone strength, and rehabilitation timing all affect the end results in cases with intertrochanteric fractures.

Intramedullary interlocking devices have produced improved results in situations of unstable intertrochanteric fractures and have been shown to reduce the occurrence of cut-outs in osteoporotic bones. However, it is yet unclear how intramedullary implants can be used to treat severely comminuted, osteoporotic, and unstable intertrochanteric fractures.

Compared to internal fixation, cemented bipolar hemiarthroplasty is a more effective treatment for these fractures. A stable and mobile hip is the result of cemented hemiarthroplasty, which also helps with early ambulation and shortens hospital stays. By starting weight-bearing earlier than with other treatment modalities, problems from extended recumbency can be reduced. The purpose of this study is to compare hip hemiarthroplasty and TFN for the treatment of unstable intertrochanteric fractures."[19]

MATERIALS AND METHODS

SOURCES OF DATA

- “Patients admitted in Department of Orthopaedics in B.L.D.E. (DEEMED TO BE UNIVERSITY) Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapura” with the diagnosis of comminuted trochanteric fracture.
- The patients will be fully informed about the trial, and their written consent will be sought.
- Patient will be assessed post operatively at 6 weeks, 3 months, 6 months
- The period of study will be from MARCH 2023- MARCH 2025.

STUDY SUBJECTS

- “Patients admitted in Department of Orthopedics in B.L.D.E (Deemed To Be University) Shri B.M Patil’s Medical College, Hospital and Research Centre,” with diagnosis of comminuted trochanteric fracture.

INCLUSION CRITERIA

- Trochanteric fracture classified as “Comminuted fracture according to Boyd and Griffin classification (type II, III, IV).”
- Closed fractures
- Patients with pathological fracture including osteoporosis

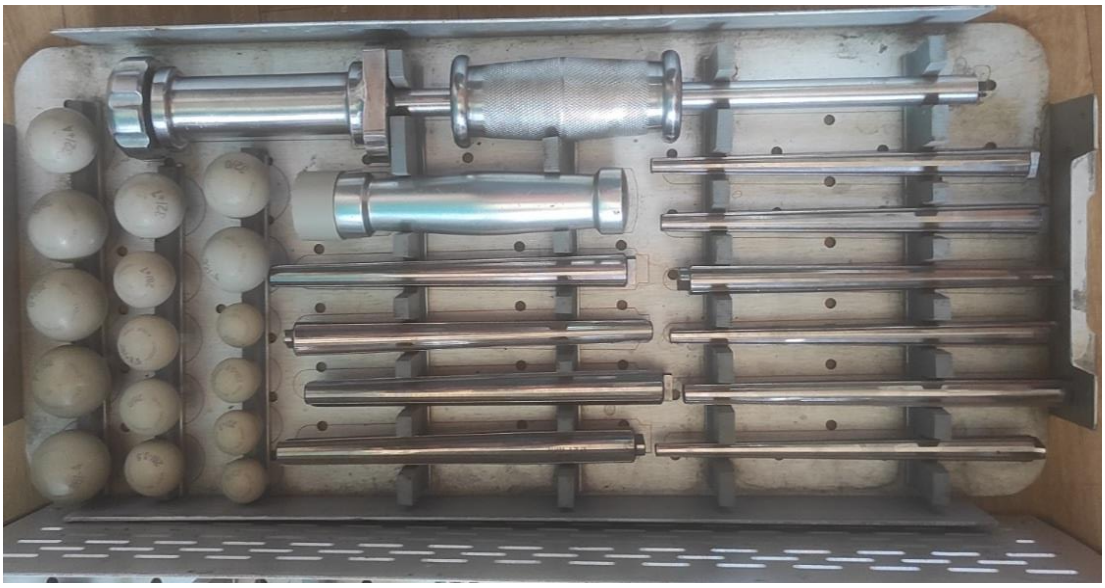
EXCLUSION CRITERIA

- Compound trochanteric fracture
- Poly trauma patient who cannot be mobilized
- Active infection of hip joint

INSTRUMENTS

Apart from standard surgical instruments, the following tools are required:



Diaphyseal Fitting Modular Bipolar Femoral Stem

THE BIPOLAR PROSTHESIS

The bipolar design was created to minimize metal-on-cartilage movement and friction, which is intended to lessen acetabular wear and erosion, a proposed factor in postoperative discomfort. Simultaneously, modern modular stem designs were introduced alongside the bipolar head design. Various studies have reported favorable outcomes for bipolar prostheses when used in conjunction with cement. However, cadaveric and radiographic investigations showed that motion primarily occurs at the outer bearing, especially under load (such as during walking), which diminishes the chances of protecting the acetabular cartilage..

OPERATIVE PROTOCOL:

As for antibiotics, one dose of injectable Cefuroxime 1.5 gm and Injection Amikacin 500 mg was administered the before surgery.

This was followed by intravenous Injection Cefuroxime 750 mg every 8 hours and Injection Amikacin 500 mg intravenously every 12 hours.

Both antibiotics were given for a duration of 3 to 5 days.

Additionally, an oral 2nd generation cephalosporin was prescribed for a period of 7 to 10 days..

ANAESTHESIA

Based on patient's overall health condition, either General or Spinal/Epidural anesthesia was administered.

OPERATIVE TECHNIQUE

All procedures were performed using the Southern approach.

PREOPERATIVE PLANNING:

Patient assessment involved a comprehensive medical history and physical examination, which can be challenging in many elderly or frail individuals. A detailed medical history and review of systems provide critical information that affects the timing of surgery or the selection of anesthesia type. “On physical examination, the injured leg typically appeared shortened, externally rotated, and painful upon movement. The evaluation included the examination for other typical insufficiency fractures, such as those of the distal radius, pelvis, or spine, as well as fall-related traumatic conditions like subdural hematoma. Assessment for distal neurovascular deficits was also performed.

Laboratory evaluations encompassed a complete blood count, serum electrolyte analysis, as well as a blood sample for typing and cross-matching, alongside chest X-rays and an electrocardiogram. Sufficient anteroposterior (AP) radiographs of the hip and proximal femur were taken with the limb fully internally rotated to facilitate surgical planning, while preoperative templating was carried out. This templating involved the utilization of plastic overlay templates provided by the prosthesis manufacturer. Careful preoperative templating reduced much of the uncertainty during surgery and shortened the operative duration by minimizing repetitive steps. It assisted in choosing the type of implant that offered the best fit for the femur, restoring equal limb lengths and femoral offset.”

Shaving and preparation were performed the night prior to the surgery.

➢ POSITIONING AND DRAPING

- The patient was placed in the lateral decubitus posture with the afflicted side on top following the onset of anesthesia. We used padding on all bone prominences.

Positioning & Draping

- The leg on the downside was cushioned and fastened to the bed using straps or tape. Steps were taken to position the pelvis in a directly lateral orientation.
- The hip and leg were thoroughly cleaned and coated with an antiseptic solution from above the iliac crest down to the toes, and draping was applied to ensure proper exposure both posteriorly and proximally. Sterile drapes along with hip u drape were

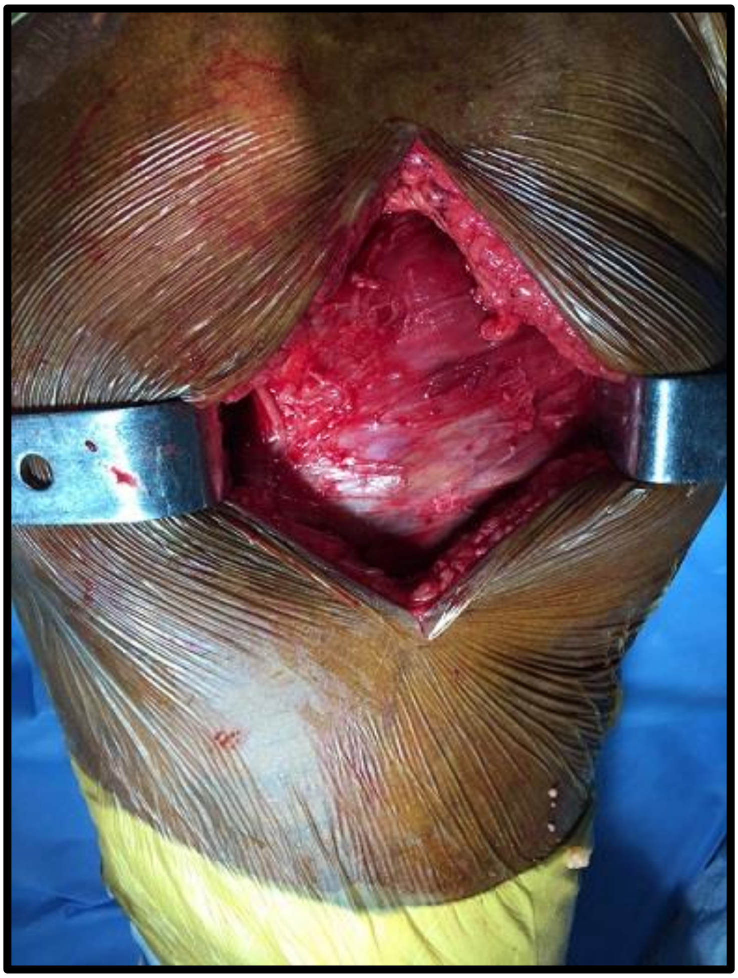
arranged in such a way that the anterior superior iliac spine could be easily felt as a landmark. A stockinet covered the leg up to the mid-thigh and was secured with Io-ban.

INCISION:

- A longitudinal incision was created that extended about 8 cm down the femur shaft, beginning 5 cm above the greater trochanter and going over the middle of the greater trochanter tip.

INCISION

- To realign the gluteus maximus posteriorly and the tensor fascia lata anteriorly, the fat and deep fascia are cut parallel to the skin incision.



- Fracture line of greater trochanter is located by palpation, and a pathway is created for accessing the fracture site.
- On the superior aspect of the capsule, a T-shaped incision is created. The posterior capsule and short external rotators need to be cut.

- Femoral head along with the neck is removed using a head extractor. The ligamentum teres connected to the fovea is severed. All soft tissues are cleared from the acetabulum.

Femoral Head

- Femoral head sizer is utilized to measure femoral head.

Femoral head sizer used to measure the femoral head.

- Starting with the smallest size broach, a tiny tapered reamer is used to identify the medullary canal. In relation to the axis of the flexed tibia, the broaches are inserted at an anteversion angle of 10 to 15 degrees.

- Progressively the larger broaches are used to excise the cancellous bone in proximal shaft of the femur, and the largest broach that can be inserted comfortably in the proximal femur is used. The final broach is countersunk slightly below the provisional femoral neck cut. Trial reduction is conducted with trial stems.

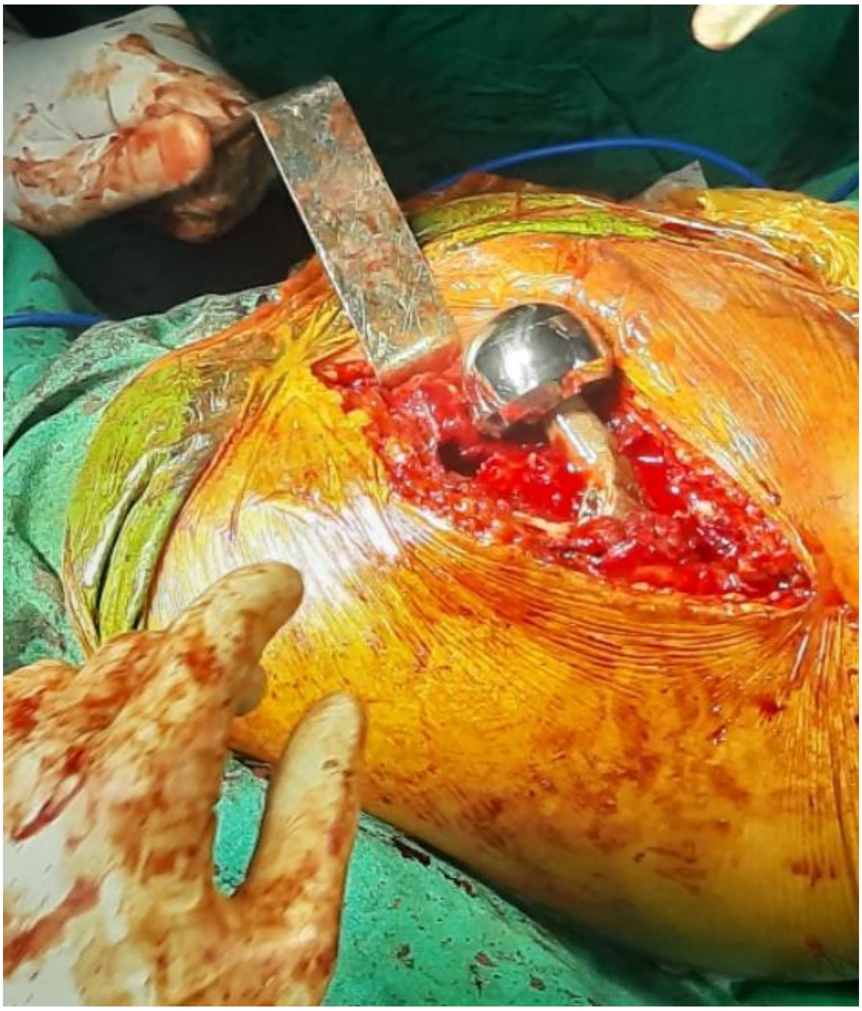
Insertion of Broaches

Trial reduction with trial stems.

- Limb length is assessed, and range of motion and stability of hemiarthroplasty are evaluated with trial components. The depth of the component insertion is determined when limb lengths equalize, and a bony landmark is marked as a reference for prosthesis insertion. The hip is dislocated once final component sizes are selected, and limb length and stability are evaluated. Exposure of the proximal femur is restored.
- Femoral canal is occluded about 2 cm distal to where stem tip is expected by placing a cement restrictor to enable cement pressurization and prevent distal extrusion into femoral diaphysis.

Insertion of Diaphyseal Fitting Femoral Stem

- The appropriate head size is then inserted into the femoral stem.



Appropriate head size insert to femoral stem

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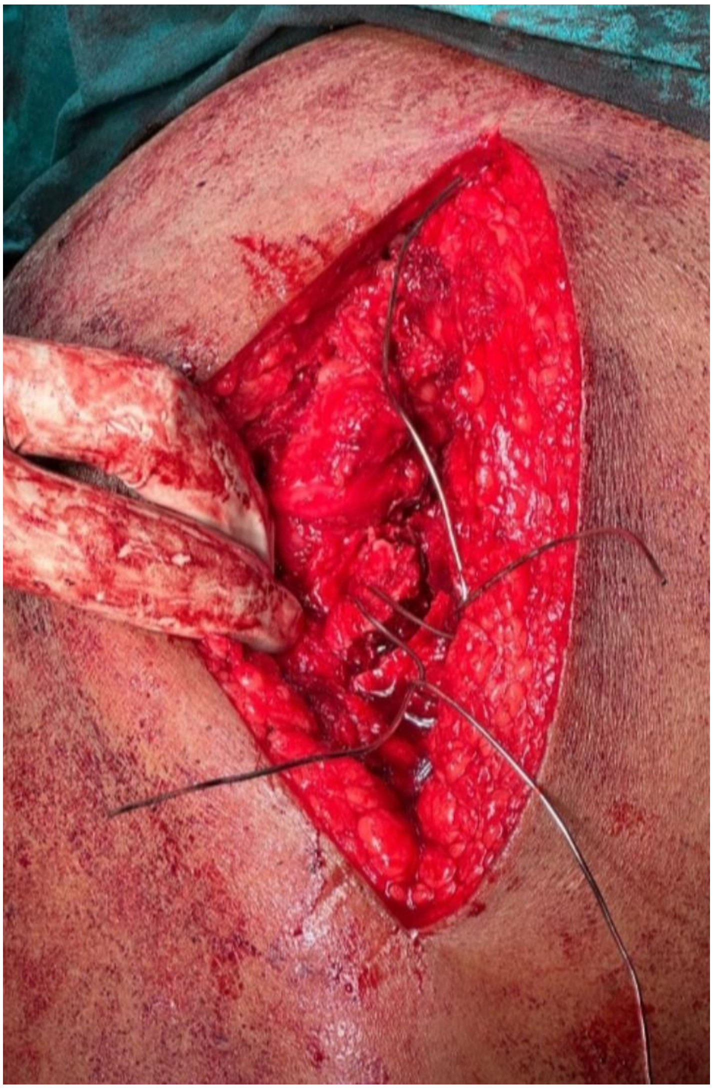
- Finally, the reduction is performed.
- The limb length and the stability of the prosthesis are verified.

Reduction done



Tension Band Wiring

- Soft tissue and skin closure is accomplished after placing a Romovac suction drain beneath the fascia. The drain will be removed once the output is less than 20 ml per day.

POST-OPERATIVE PROTOCOL

- “X-rays of the operated patient were obtained in pevic with both hip in anteroposterior views after the surgery.
- A haemogram and serum electrolytes were assessed immediately after the procedure and again 24 hours later.
- The limb is positioned in abduction with a pillow placed between to avoid adduction and internal rotation.
- Dressings were changed on day 2 during the drain removal and again on day 5.
- Supine static quadriceps exercises and ankle pumps were initiated on the day of surgery, while sitting quadriceps exercises commenced on the first postoperative day.
- Full weight-bearing was allowed starting on the first postoperative day.
- Suture removal was done alternately and completely on the 10th and 12th days after surgery. Discharge took place on the 12th day following the operation.
- Postoperative follow-ups were conducted at 6 weeks, 3 months, and 6 months. At each follow-up appointment, the patients were assessed both radiologically and clinically. Functional outcomes were measured using the Harris hip score.
- Radiographs were taken at each follow-up to check for any signs of dislocation or loosening of the prosthesis.
- Rehabilitation lasted for up to 1 year and included lifestyle modifications like avoiding squatting, sitting cross-legged, or climbing high steps, along with gait training.”

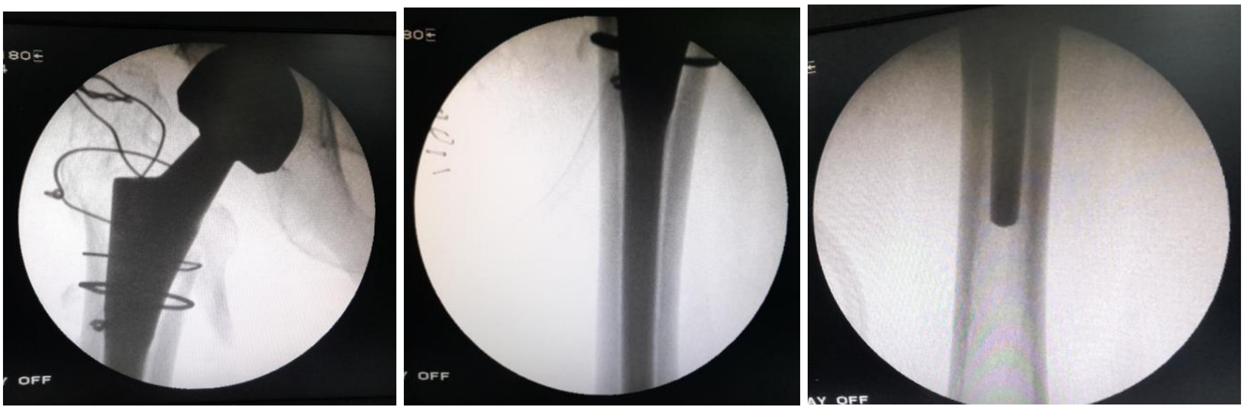
Sitting Quadriceps Exercise

Full Weight Bearing

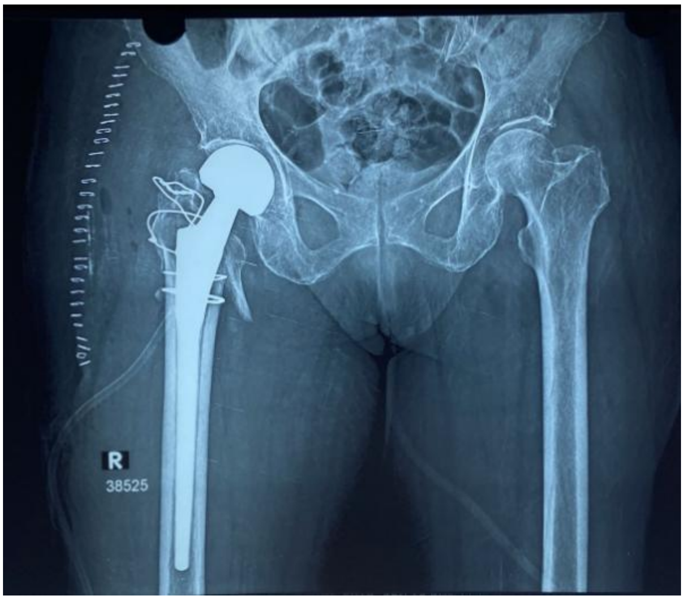
Case Radiograph

Case 1

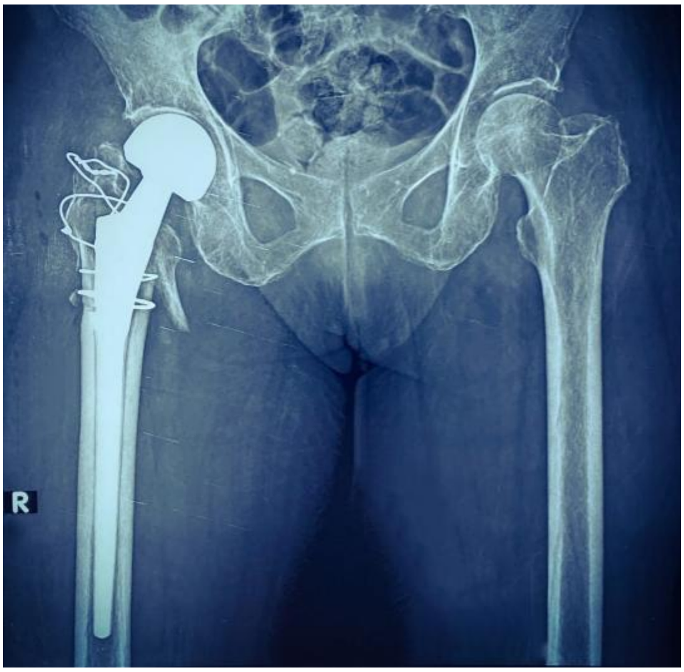
Preoperative



Intraoperative image intensifier



Postoperative X-Ray POD-1



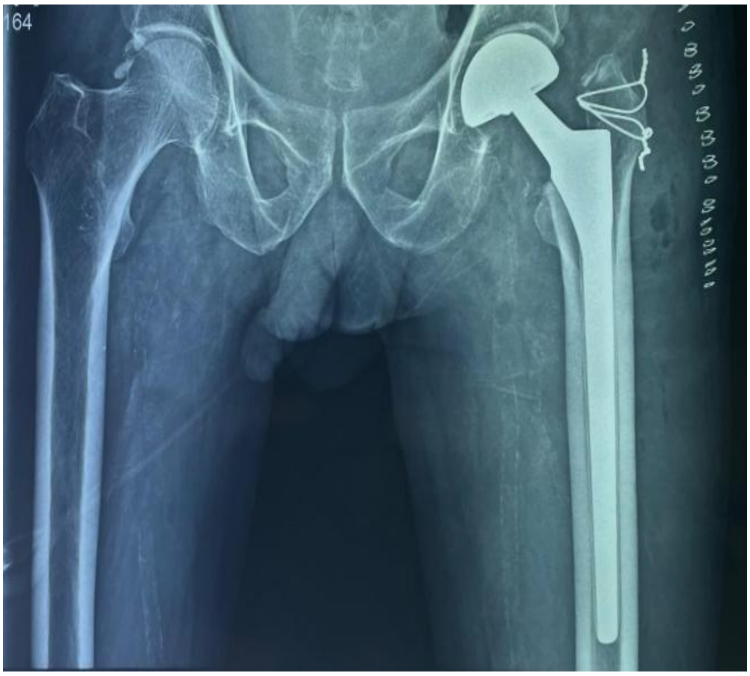
Follow up X-Ray 6 Weeks

Follow up X-Ray 3 Months

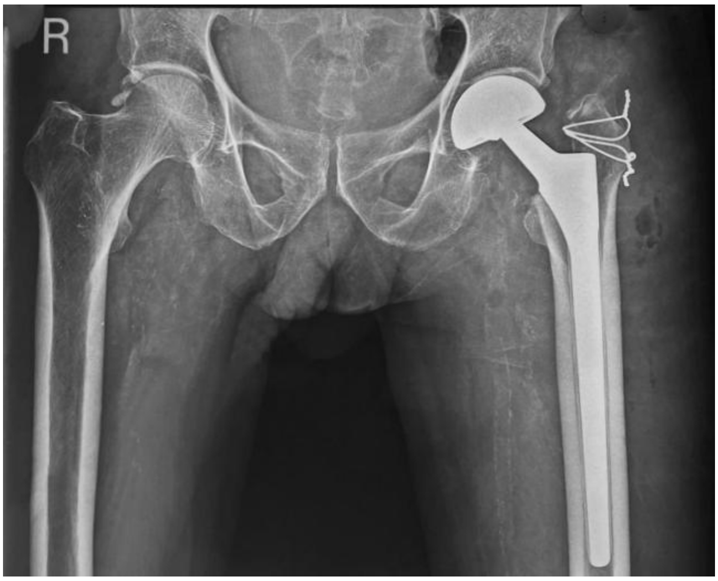
Follow up X-Ray 6 Months

Case 2

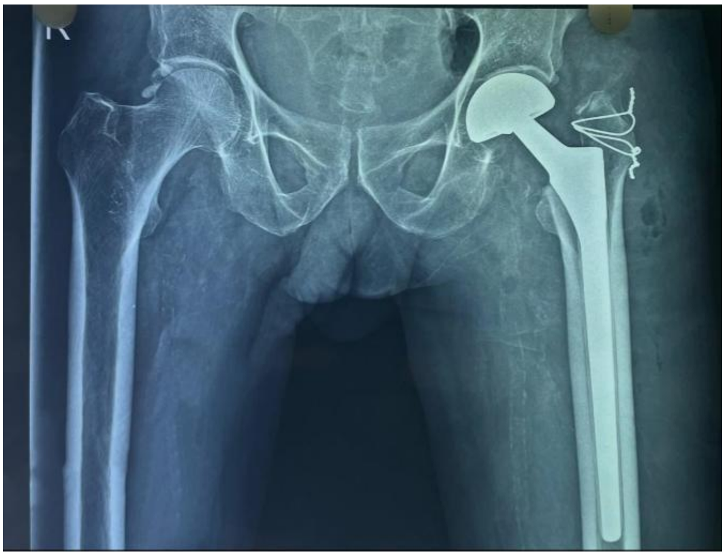
Preoperative



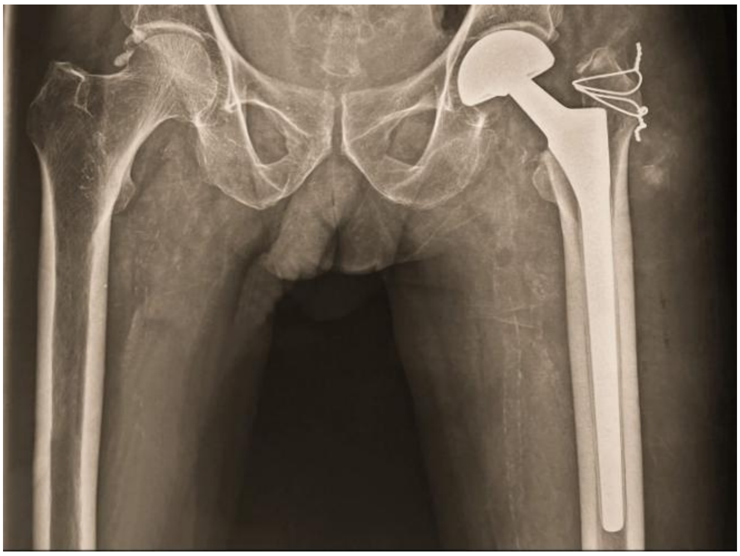
Postoperative X-Ray POD-1



Follow up X-Ray 6 Weeks



Follow up X-Ray 3 Months

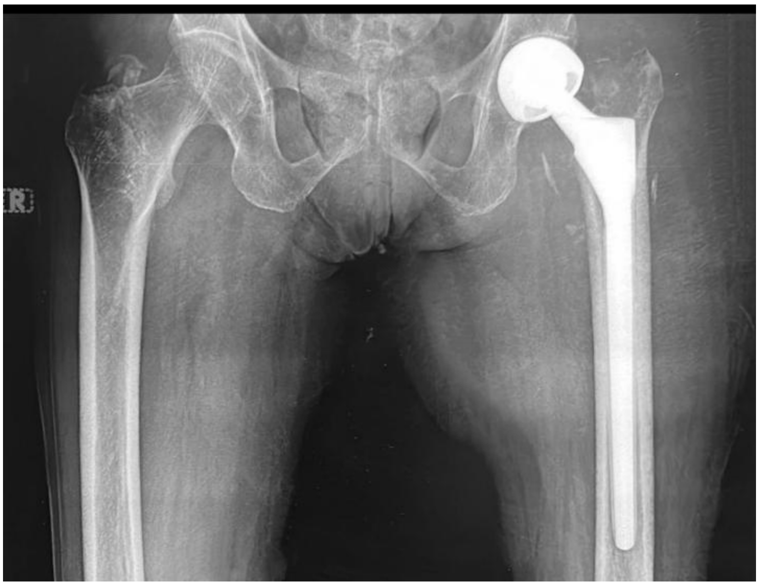


Follow up X-Ray 6 Months

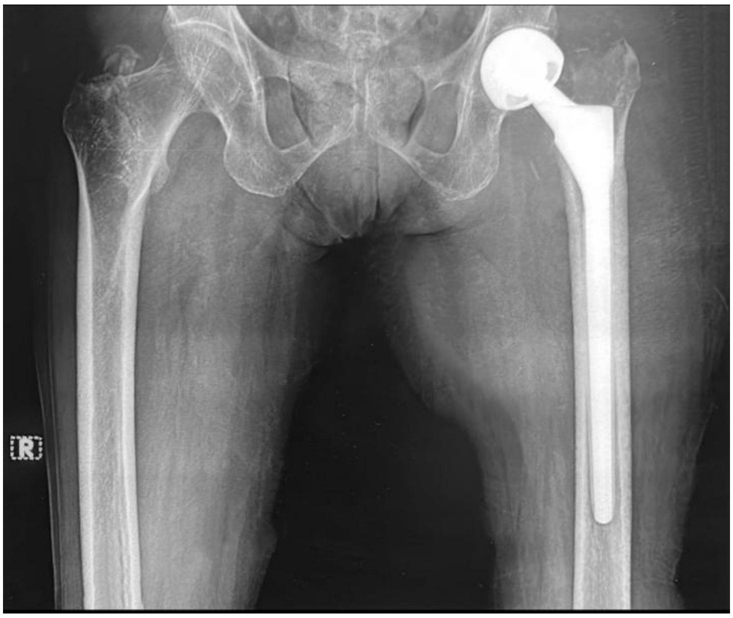
Case 3

Preoperative

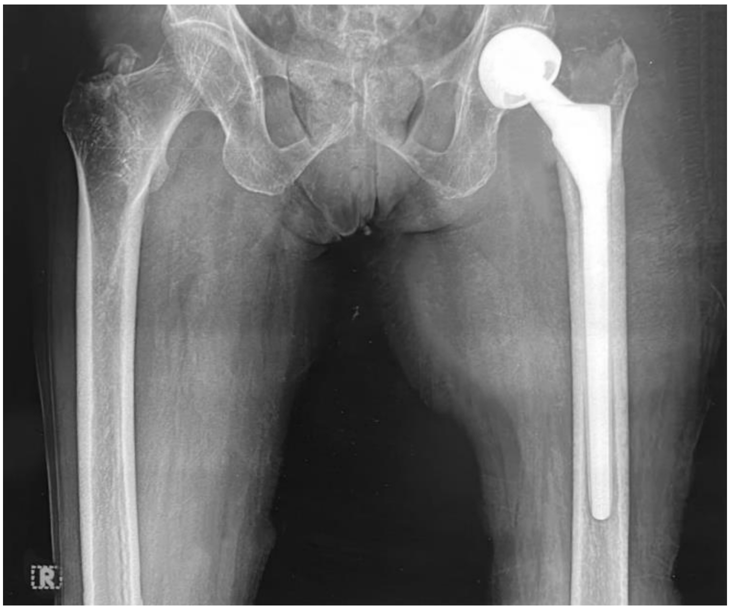
Postoperative X-Ray POD-1



Follow up X-Ray 6 Weeks

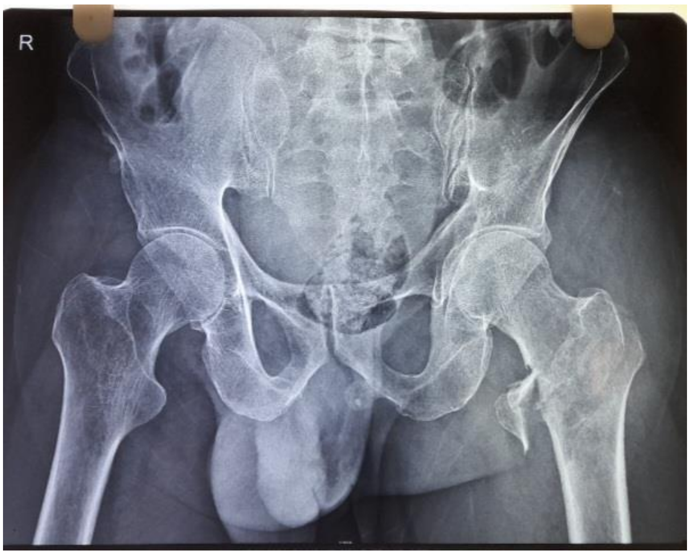


Follow up X-Ray 3 Months

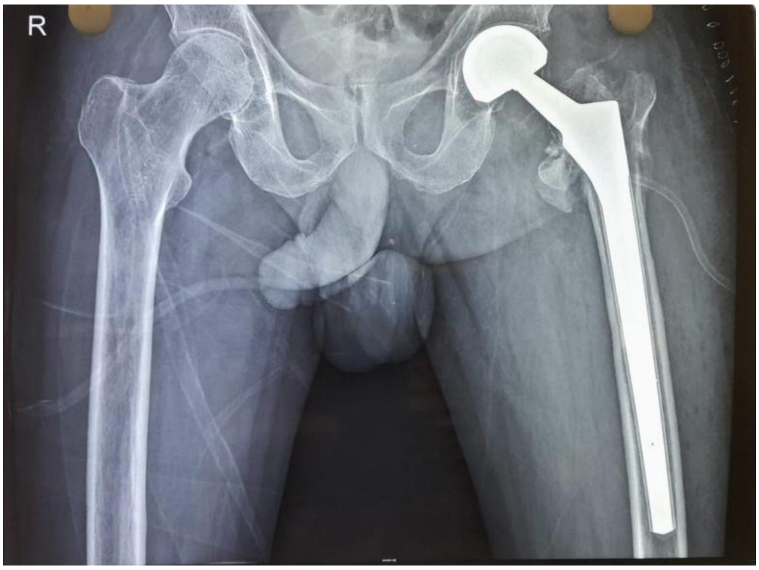


Follow up X-Ray 6 Months

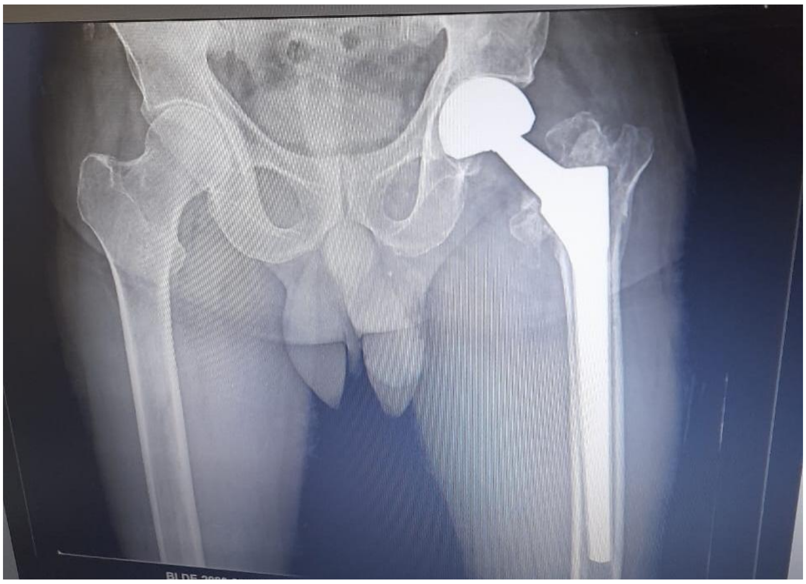
Case 4



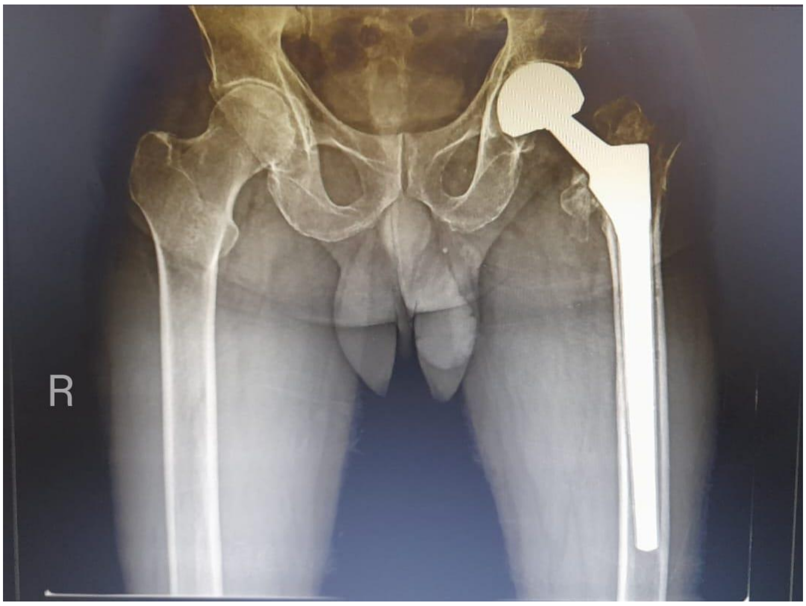
Preoperative



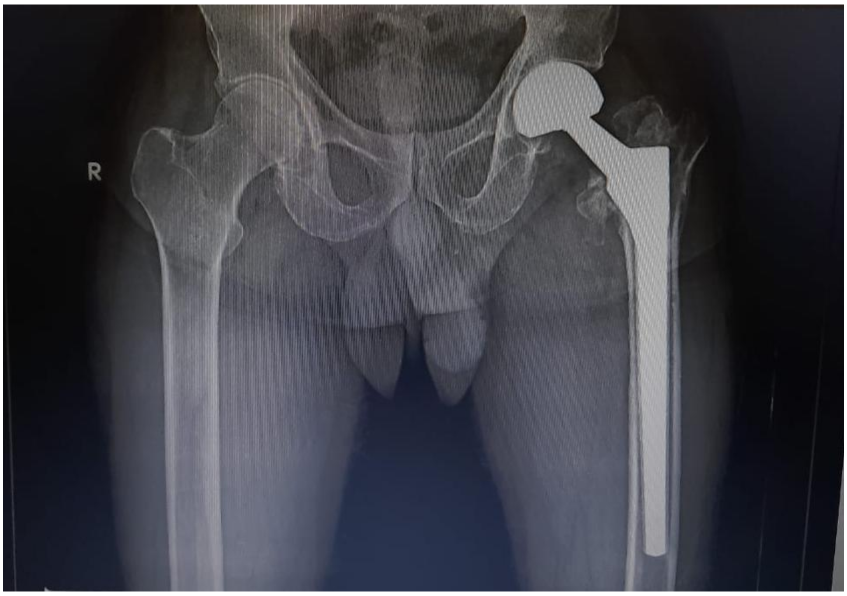
Postoperative X-Ray POD-1



Follow up X-Ray 6 Weeks



Follow up X-Ray 3 Months



Follow up X-Ray 6 Months

SAMPLE SIZE:

With anticipated Proportion of graded as fair of Harris Hip score in Trochanteric fracture 10% (ref) , the study would require a sample size of 24 patients with 95**%** level of confidence and 4% absolute precision,

"Formula used

- **$n = \frac{z^2 p*q}{d^2}$**

Where Z= Z statistic at α level of significance

d^2= Absolute error

P= Proportion rate

q= 100-p"

Statistical Analysis

- "The data obtained will be entered in a Microsoft Excel sheet, and statistical analysis will be performed using statistical package for the social sciences (Verson 20)."
- Results will be presented as Mean ± SD,Median and interquartile range, frequency, percentages and diagrams.

Accounting for Dropouts:

To ensure both statistical power and precision in our research, we plan to recruit additional participants to accommodate potential dropouts.

Step 1: Calculate the Dropout Rate

Dropout rate = (31 - 24) / 31 = 7/31 = 0.225 or 22.5%

Step 2: Adjust the sample size Formula:

Adjusted sample size = Initial sample size / (1 - dropout rate)

Adjusted sample size = 24 / (1 - 0.225)

= 24/ 0.775

= 31

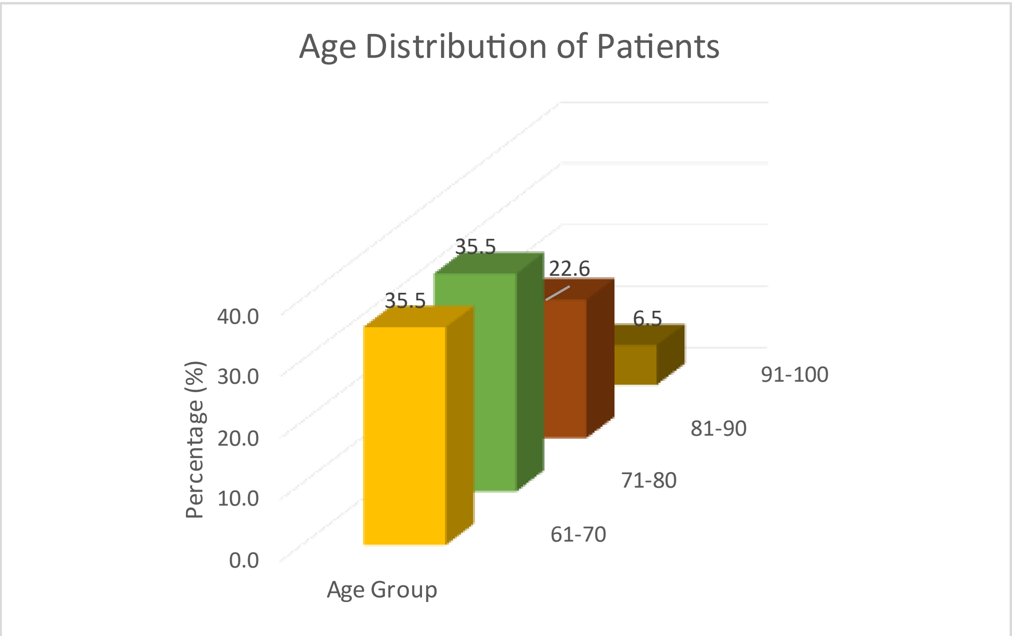
By raising our sample size from 24 to 31, we are factoring in a possible dropout rate of 22.5%. This strategy guarantees that we should have enough data from at least 24 to 31 patients by the study's conclusion, thereby preserving the statistical validity of our investigation.

RESULTS

Table 1: Age Distribution of Patients

Age Group	***Frequency (n)***	***Percentage (%)***
61-70	11	35.5
71-80	11	35.5
81-90	7	22.6
91-100	2	6.5
Total	***31***	***100.00%***
Statistic	***Value***	
Min & Max Age	*63 years & 94 years*	
Mean ± SD	*75.81 years ± 9.311 years*	

Figure: **Age Distribution of Patients**

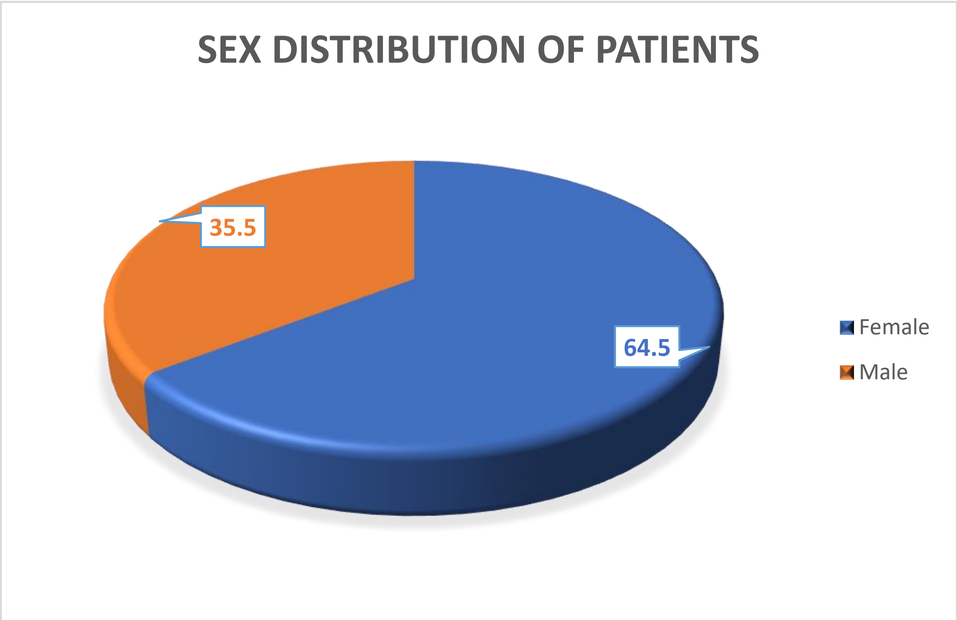


The age distribution among study participants (n = 31) shows that a majority fall within the 61-80 years age range (71%), with the next largest group being those aged 81-90 years (22.6%). The smallest representation belongs to the 91-100 age group. The average age of participants is 75.81 years (SD=9.311), with ages ranging from 63 to 94 years. Baseline age data is crucial for understanding the context and generalizability of this study, as it reflects a typical elderly population with femoral fractures.

Table 2: Sex Distribution of Patients

Category	Frequency	Percentage
Male	11	35.5%
Female	20	64.5%

Figure: **Sex Distribution of Patients**

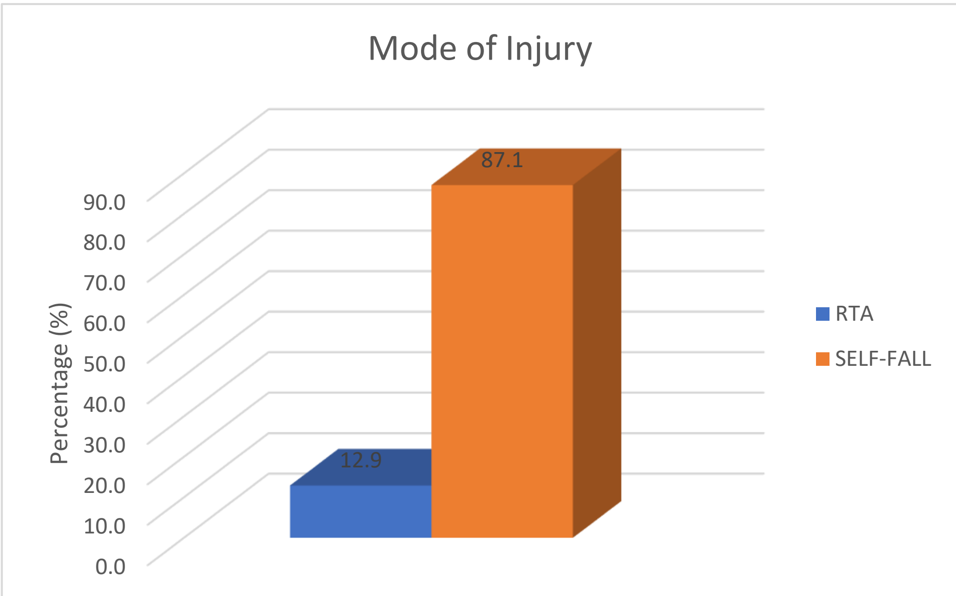


In terms of sex distribution, female patients comprise 64.5% of the study population, while male patients account for 35.3%.

Table 3: Mode of Injury Distribution

Mode of Injury	Frequency	Percentage
Self-Fall	27	87.1%
RTA	4	12.9%

Figure: **Mode of Injury Distribution**

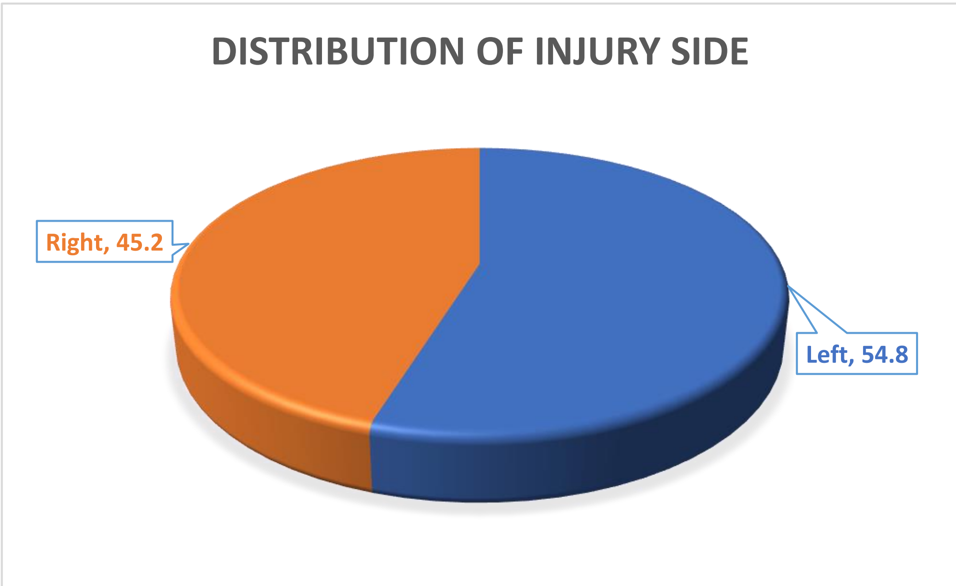


The mode of injury and its distribution can be summarized, where self-falls constitute the majority of injuries (87.1%), compared to road traffic accidents (RTA) at 12.9%

<u>Table 4: Distribution of Injury Side</u>

Side	Frequency	Percentage
Right	14	45.2%
Left	17	54.8%

Figure: **Distribution of Injury Side**



Regarding the side of the injury, the distribution is fairly even, with 45.2% of injuries occurring on right (R) side and 54.8% on left (L).

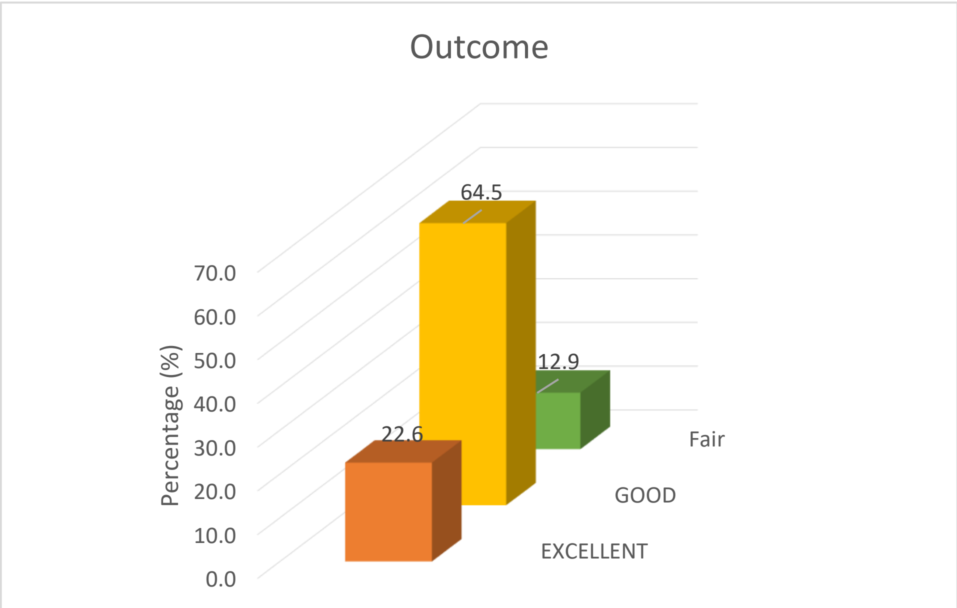
Table 5: Distribution of Study Participants by Recent HHS

Recent HHS Range	Frequency (n)	Percentage (%)
76-80	4	12.9
81-85	11	35.5
86-90	12	38.7
91-95	4	12.9
Total	**31**	**100.0**
Statistic	**Value**	
Min & Max Recent HHS	77 & 93	
Mean ± SD	85.19 ± 4.377	

Table 6: Outcome Distribution based on HARRIS HIP SCORE (HHS).

Outcome	Frequency	Percentage
EXCELLENT	7	22.6
GOOD	20	64.5
FAIR	4	12.9

Figure: **Outcome Distribution**

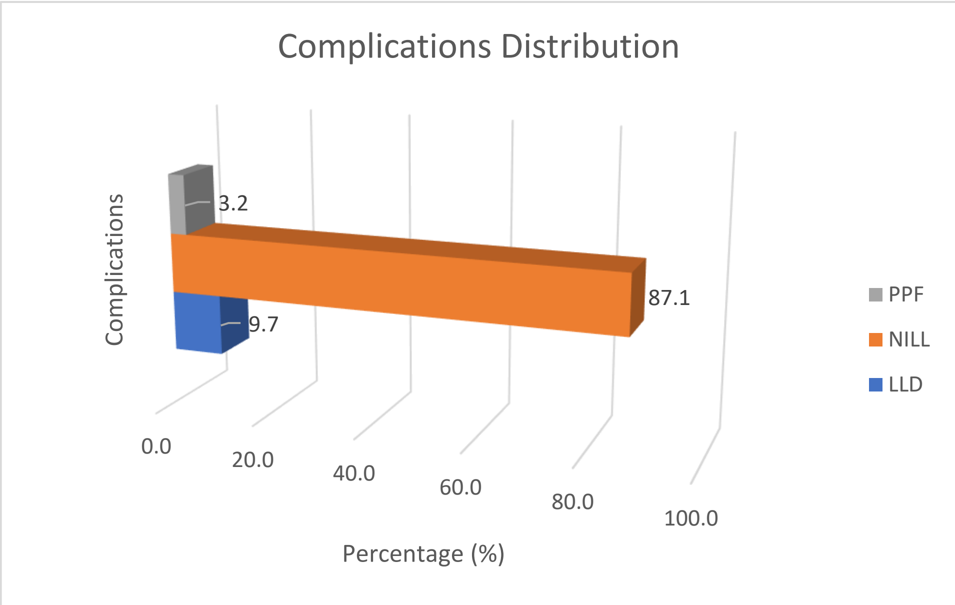


The breakdown of patient outcomes indicates that the majority, 64.5%, had a "GOOD" outcome, 22.6% achieved an "EXCELLENT" outcome, and 12.9% experienced a "FAIR" outcome.

Table 7: Complications Distribution

Complications	**Frequency**	**Percentage**
NILL	27	87.1
LLD	3	9.7
PPF	1	3.2

Figure: **Complications Distribution**



The distribution of complications among patients shows that most patients, 87.1%, were uncomplicated. Other complications included leg length discrepancy (LLD) at 9.7% and periprosthetic fracture (PPF)

Table 8: Complications and Functional Outcomes

Complications	EXCELLENT	GOOD	FAIR	Total
NIL	7	20	0	27
LLD	0	0	3	3
PPF	0	0	1	1
Total	7	20	4	31
Chi-Square Test	**Value**	**df**	**p-value**	**Association**
Pearson Chi square	31.00	4	0.001	significant

Table illustrates the distribution of functional outcomes relative to presence of complications in these patients undergoing diaphyseal fitting modular bipolar hemiarthroplasty for comminuted intertrochanteric fractures of femur. Patients without complications (NIL) (n=27), 7 achieved excellent outcomes while 20 had good outcomes. Among patients with leg length discrepancy (LLD) (n=3), there were no excellent or good outcomes, and all 3 had fair outcomes. For the single patient with a periprosthetic fracture (PPF) (n=1), there were also no excellent or good outcomes, with that patient receiving a fair outcome. In total, there are 31 patients, with 7 achieving excellent outcomes, 20 achieving good outcomes, and 4 achieving fair outcomes.

Chi-Square test yielded a value of 10.0, with 4 degrees of freedom (df) and a p-value of 0.062, suggesting no significant statistical association between complications and functional outcomes ($p > 0.05$). This indicates that the presence of complications does not have a meaningful effect on functional outcomes in patients treated with this procedure, though the p-value is close to the significance threshold.

Table 9: Post operative complications

Mortality rate	0
Pulmonary Complications	0
Urinary Tract Infections	0
Deep Vein Thrombosis	0
Cardiovascular Complications	0
Wound Infections	0
Pressure Sores	0

Post operative mortality and morbidities were nill.

Discussion

Managing comminuted trochanteric femur fractures in elderly patients presents a challenging clinical dilemma, primarily due to the weakness of the bone, a heightened risk of complications, and the need for prompt mobilization to avert additional morbidity. This research assessed the effectiveness of employing a diaphyseal fitting modular bipolar prosthesis in elderly individuals with comminuted trochanteric femur fractures. The findings indicate that this surgical approach successfully results in good to excellent functional outcomes for most patients, accompanied by a low complication rate.

Average age of study cohort was 75.81 years (SD=9.311), which is consistent with the demographic profile of older people who had femur fractures. A significant portion of the patients (71%) fell within the 61 to 80-year age range, which is consistent with existing literature showing that the likelihood of hip fractures markedly rises with age, especially among the elderly (Çiloğlu et al., 2022; Kim et al., 2018). The gender distribution revealed a higher percentage of female patients (64.5%), aligning with the established higher prevalence of osteoporosis and hip fractures among postmenopausal women (Lee et al., 2011).

The predominant cause of injury in this research was self-fall (87.1%), corroborating findings from other studies that have identified falls as the primary cause of hip fractures in elderly (Zha et al., 2019; Biçen et al., 2021). Road traffic accidents (RTA) accounted for a lesser share of injuries (12.9%), which is anticipated given the reduced mobility and lower exposure to high-energy trauma in this age demographic.

According to Harris Hip Score (HHS), functional outcomes were primarily classified as good (64.5%) or exceptional (22.6%), with just 12.9% of patients receiving a fair score. With an average HHS of 85.19 (SD=4.377), the majority of patients were able to resume hip function to a satisfactory degree. For unstable intertrochanteric fractures, these outcomes are similar to those of other trials that used modular bipolar prostheses. “In their mid-term follow-up of patients treated with cementless bipolar hemiarthroplasty, for example, Kim et al. (2018) showed similar functional results, with a mean HHS of 84.5. With a mean HHS of 86.2 in older patients with osteoporotic fractures, Lee et al. (2011) discovered that using a hydroxyapatite-coated long stem in cementless bipolar hemiarthroplasty allowed for satisfactory functional outcomes."

The complication rate found in this investigation was relatively low, with 87.1% of patients not experiencing any complications. The most frequently observed complication was leg length discrepancy (LLD) (9.7%), followed by periprosthetic fracture (PPF) (3.2%). These outcomes align with previous research that reported LLD and PPF as potential complications associated with modular bipolar hemiarthroplasty. For example, Zha et al. (2019) documented a 10.2% incidence of LLD in their study of cementless distal fixation modular stems for unstable intertrochanteric fractures. Similarly, Biçen et al. (2021) identified a 3.5% occurrence of PPF in their retrospective comparison of long-stem prostheses for intertrochanteric fractures. Notably, patients experiencing complications (LLD and PPF) exhibited poorer functional outcomes, with none reaching excellent or good results. This underscores the critical need for precise surgical techniques and diligent postoperative care to reduce complications and enhance outcomes.

The study's conclusions are consistent with those of prior investigations on the application of modular bipolar prosthesis in senior citizens with unstable intertrochanteric fractures. For example, Kim and colleagues (2018) documented mid-term survival rates of 92.3% after cementless bipolar hemiarthroplasty for unstable intertrochanteric fractures. The use of a hydroxyapatite-coated long stem in cementless bipolar hemiarthroplasty also produced favorable functional results and low rates of complications in older patients with osteoporotic fractures, according to Lee et al. (2011). This was demonstrated by a mean HHS of 86.2 at an average follow-up of 5.2 years.

Conclusion

To summarize, employing a diaphyseal fitting modular bipolar prosthesis in older individuals with comminuted trochanteric femur fractures leads to favorable to outstanding functional results along with a minimal occurrence of complications like bed sores, deep vein thrombosis, dependency and psychosocial side effect, chest infections. The findings from this research endorse this surgical method as a practical choice for treating comminuted trochanteric femur fractures in elderly patients facilitate early mobilization, early weight bearing with rapid rehabilitation with decreased morbidity and mortality.

Limitations of the study

- Less Follow-up periods.
- Low sample size.

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ANNEXURE I

B.L.D.E. (DEEMED TO BE UNIVERSITY) SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTER, VIJAYAPURA-586103

INFORMED CONSENT FOR PARTICIPATION IN DISSERTATION/RESEARCH

I, the undersigned, _______________, S/O D/O W/O ________________, aged ____years, ordinarily resident of ____________ do hereby state/declare that Dr. HARISH ARUNMOZHIDEVAN of Shri. B. M. Patil Medical College Hospital and Research Centre has examined me thoroughly on ______________ at ______________ (place) and it has been explained to me in my own language that I am suffering from ________________ disease (condition) and this disease/condition mimic following diseases. Further Dr. HARISH ARUNMOZHIDEVAN informed me that he/she is conducting dissertation/research titled "FUNCTIONAL OUTCOME OF DIAPHYSEAL FITTING MODULAR BIPOLAR PROSTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT" under the guidance of Dr SANTHOSH.S NANDI. requesting my participation in the study. Apart from routine treatment procedure, the pre-operative, operative, post-operative and follow-up observations will be utilized for the study as reference data.

The Doctor has also informed me that during the conduct of this procedure like adverse results may be encountered. Among the above complications, most of them are treatable but are not anticipated; hence there is a chance of aggravation of my condition. In rare circumstances, it may prove fatal despite the anticipated diagnosis and best treatment made available. Further Doctor has informed me that my participation in this study help in the evaluation of the results of the study, which is a useful reference to the treatment of other similar cases soon, and also I may be benefited in getting relieved of suffering or cure of the disease I am suffering.

The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by the person other than my legal hirer or me except for academic purposes.

The Doctor did inform me that though my participation is purely voluntary, based on the information given by me, I can ask for any clarification during the course of treatment/study related to diagnosis, the procedure of treatment, result of treatment, or prognosis. I have been instructed that I can withdraw from my participation in this study at any time if I want, or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Shri/Smt ____________________________ under my full conscious state of mind agree to participate in the said research/dissertation.

Signature of the patient:

Signature of Doctor:

Witness: 1.

2.

Date:

Place

ANNEXURE – II

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE,

VIJAYAPURA - 586103

PROFORMA

CASE NO. :

NAME :

AGE/SEX :

I P NO :

DATE OF ADMISSION :

DATE OF SURGERY :

DATE OF DISCHARGE :

OCCUPATION :

RESIDENCE :

Presenting complaints with duration :

History of presenting complaints :

Family History :

Personal History :

Past History :

General Physical Examination

Pallor:	present/absent
Icterus:	present/absent
Clubbing:	present/absent
Generalized lymphadenopathy:	present/absent
Built:	poor/moderate/well
Nourishment:	poor/moderate/well

Vitals

PR: RR:

BP: TEMP:

Other Systemic Examination:

Local examination:

Right/ Left Hip

Inspection:

a) Attitude/ deformity

b) Abnormal swelling

- Site
- Size
- Shape
- Extent

c) Skin

Palpation:

a) Local tenderness

b) Bony irregularity

c) Abnormal movement

d) Crepitus

e) Swelling

Movements:	Right	Left
HIP JOINT		
Flexion		
Extension		
Abduction		
Adduction		
Internal rotation		
External rotation		

Intra Operative details:

Post-Operative:

- Rehabilitation protocol as per the guidelines
- Functional outcome evaluation with:
    1. Harris scores

Harris Hip Score		
Pain (Check one) None Or ignores it (44) Slight, occasional, no compromise in activities (40) Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin (30) Moderate pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stringer than aspirin (20) Marked pain, serious limitation of activities (10) Totally disabled, crippled, pain in bed, bedridden (0) **Limp** None (11) Slight (8)		**Stairs** Normally without using a railing (4) Normally using a railing (2) In any manner (1) Unable to do stairs (0) **Put on Shoes and Socks** With ease (4) With difficulty (2) Unable (0) **Absence of Deformity (All yes = 4; Less than 4 = 0)** Less than 30^{o} fixed flexion contracture Yes No Less than 10^{o} fixed abduction Yes No Less than10^{o} fixed internal rotation in extension Yes No Limp length discrepancy less than 3.2 cm Yes No **Range of Motion (* indicates normal)** Flexion (*140 ^{o}) ___________ Abduction (*40 ^{o}) ___________ Adduction (*40 ^{o}) ___________

Moderate (5)

Severe (0)

Support

None (11)

Cane for long walks (7)

Cane most of time (5)

One crutch (3)

Two canes (2)

Two crutches or not able to walk (0)

Distance Walked

Unlimited (11)

Six blocks (8)

Two or three blocks (5)

Indoors only (2)

Bed and chair only (0)

Sitting

Comfortably in ordinary chair for one hour (5)

On a highchair for 30 minutes (3)

Unable to sit comfortably in any chair (0)

Enter public transportation

Yes (1)

No (0)

External Rotation (*40 ^{o}) ___________

Internal Rotation (*40 ^{o}) ___________

Range of Motion Scale

211 ^{o} - 300 ^{o} (5)	61 ^{o} - 100 (2)
161 ^{o} - 210 ^{o} (4)	31 ^{o} - 60 ^{o} (1)
101 ^{o} - 160 ^{o} (3)	0 ^{o} - 30 ^{o} (0)

Range of Motion Score ____________

Total Harris Hip Score _____________

Grading for the Harris Hip Score:

Successful result=post-operative increase in Harris Hip Score of > 20 points + radiographically stable implant + no additional femoral reconstruction

Or

<70 =Poor , 70 – 79= Fair, 80-89 =Good, 90 -100= Excellent

- Pain is assessed
- Functions of the limb post-operatively are assessed
- Complications like painful hip, and posterior dislocation, are evaluated

ANNEXURE III

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

Azadi Ka Amrit Mahotsav

BLDE

(DEEMED TO BE UNIVERSITY)

Declared as Deemed to be University u/s 3 of UGC Act, 1956

Accredited with 'A' Grade by NAAC (Cycle-2)

The Constituent College

SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 982/2022-23

10/4/2023

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Saturday, 18th March, 2023 at 11.30 a.m. in the CAL Laboratory, Dept. of Pharmacology,** scrutinizes the Synopsis/ Research Projects of Post Graduate Student / Under Graduate Student /Faculty members of this University /Ph.D. Student College from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "A DIAPHYSEAL FITTING MODULAR BIPOLAR PROTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT-A PROSPECTIVE STUDY".

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: DR.HARISH ARUNMOZHIDEVAN.

NAME OF THE GUIDE: DR. SANTOSH S. NANDI. PROFESSOR AND HOD, DEPT. OF ORTHOPAEDICS

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA

Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr.Akram A. Naikwadi
Member Secretary
IEC, BLDE (DU),
VIJAYAPURA

MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103. Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.

BLDE (DU): Phone: +918352-262770, Fax: +918352-263303, Website: www.bldedu.ac.in, E-mail:office@bldedu.ac.in

College: Phone: +918352-262770, Fax: +918352-263019, E-mail: bmpmc.principal@bldedu.ac.in

MASTER CHART

SI. NO	NAME	A G E	S E X	S I D E	BOYD AND GRIFFIN	AO/OTA	MODE OF INJURY	APPROACH	FOLLOW UP	RECENT HHS	COMPLICATIONS	OUTCOME
1	TARUNAKSHAMMA PATIL	78	F	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	91	NILL	EXCELLENT
2	S M KAHZI	63	M	L	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	87	NILL	GOOD
3	SANGAN BASAPPA	75	M	R	II	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	90	NILL	EXCELLENT
4	MACHINDRA PAWAR	68	M	R	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	81	NILL	GOOD
5	JAGADEVAPPA	94	M	L	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	86	NILL	GOOD
6	LAKSHMI BAI	67	F	R	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	78	LLD	FAIR
7	GANDU AVARADI	68	F	L	IV	31-A2.3	RTA	MOORE'S	6 MONTHS	85	NILL	GOOD
8	LAKSHMI BAI	70	F	L	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	87	NILL	GOOD
9	SHANKREWWA	73	F	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	89	NILL	GOOD
10	KALLAMMA BADIGER	65	F	R	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	93	NILL	EXCELLENT
11	MADIVAL	72	M	L	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	82	NILL	GOOD
12	SHARANAMMA MATH	90	F	L	IV	31-A3.3	RTA	MOORE'S	6 MONTHS	84	NILL	GOOD
13	KAMAKSHI AMMAL	85	F	L	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	87	NILL	GOOD
14	SIDLINGAYYA MASUTI	69	M	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	83	NILL	GOOD
15	SIDDARAM BANASODE	64	M	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	90	NILL	EXCELLENT
16	BASANNA S B	87	M	L	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	82	NILL	GOOD
17	TRUTI PATTANASHETTI	85	F	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	84	NILL	GOOD
18	SUMITRA JOSHI	72	F	L	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	86	NILL	GOOD
19	KAVATHI BANDIVADDAR	86	F	L	II	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	78	LLD	FAIR
20	KARTIK WALIKAR	90	M	L	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	85	NILL	GOOD
21	MAKKBEE H	85	F	L	III	31-A3.3	RTA	MOORE'S	6 MONTHS	92	NILL	EXCELLENT
22	KANTHPPA TORAVI	76	M	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	87	NILL	GOOD
23	SHENKREWWA BIRADAR	66	F	R	II	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	82	NILL	GOOD
24	NIRMALA HANDI	75	F	L	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	86	NILL	GOOD
25	RANIBAI R	75	F	L	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	90	NILL	EXCELLENT
26	GOURAMMA T	65	F	R	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	81	NILL	GOOD
27	KASAPPA MAKOD	67	M	R	IV	31-A2.3	SELF-FALL	MOORE'S	6 MONTHS	77	LLD	FAIR
28	CHENNAMMA M	94	F	L	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	83	NILL	GOOD
29	SUJNANI HALLI	78	F	L	IV	31-A2.3	RTA	MOORE'S	6 MONTHS	91	NILL	EXCELLENT
30	SHAHERA SHAIKH	72	F	R	III	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	86	NILL	GOOD
31	REKHA HIPPARAGA	76	F	L	IV	31-A3.3	SELF-FALL	MOORE'S	6 MONTHS	78	PPF	FAIR

PLAGIARISM CERTIFICATE

Dr. HARISH ARUNMOZHIDEVAN

A DIAPHYSEAL FITTING MODULAR BIPOLAR PROSTHESIS IN COMMINUTED TROCHANTERIC FEMUR FRACTURE IN ELDERLY PATIENT -A PROSPECTIVE STUDY

BLDE University

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