"FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURES TREATED WITH PROXIMAL FEMORAL NAIL - A ONE YEAR HOSPITAL BASED - PROSPECTIVE STUDY"

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LIST OF ABBREVIATIONS

AO	-	Arbeitsgemeinschaft fur Osteosynthesefragen
AP	-	Antero- Posterior
ASIF	-	Association for Study of Internal Fixation
DCS	-	Dynamic Compression Screw
DHS	-	Dynamic Hip Screw
FWB	-	Full Weight Bearing
NWB	-	Non Weight Bearing
PA	-	Postero—Anterior
PFN	-	Proximal Femoral Nail
POD	-	Post Operative Day
PWB	-	Partial Weight Bearing
FWB	-	Full weight bearing
SD	-	Standard Deviation ·
TFL	-	Tensor Fascia Lata
IT	-	Intertrochanteric Fracture
ORIF	-	Open Reduction and Internal Fracture
GT	-	Greater Tuberosity
LFA	-	Lateral circumflex femoral artery
IM	-	Intramedullary
ATLS	-	Advanced Trauma Life Support
TLC	-	Total Leucocyte Count
ZE	-	Z Effect
MHHS	-	Modified Harris Hip Score
PTT	-	Principal tensile trabeculae

ABSTRACT

TITLE: "FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURES TREATED WITH PROXIMAL FEMORAL NAIL - A ONE YEAR HOSPITAL BASED - PROSPECTIVE STUDY"

INTRODUCTION:

Intertrochanteric fractures are among the most prevalent fractures in today's orthopaedic care. The damage is induced by high impact trauma in young persons, whereas the majority of fractures in the elderly are osteoporotic and triggered by a modest fall. Many treatment options are an available. The goal of the treatment of these fractures is stable fixation, which allows early mobilization of the patient. Choice of treatment remains with the surgeons. Leg shortening, medialization of the fragment distal to fracture are common in unstable intertrochanteric fractures. Intramedullary implants were developed as a result of this. This implants get the benefits of being an intra medullary fixation device, having a smaller lever arm that results in reduced tensile pressure upon that implant, having a short operational duration, minimal soft tissue resection, and early ambulation.

AIMS AND OBJECTIVES:

To Assess the Functional Outcome of intertrochanteric fractures treated with proximal femoral nail on the basis of Modified Harris Hip Score.

MATERIALS AND METHODS:

A One year hospital based prospective study was conducted in the department of orthopaedics, KLEs Dr.Prabhakar Kore Hospital and MRC, Belagavi.

30 Patients with Intertrochanteric fractures who met our inclusion criteria were selected. Clinical and radiological assessment of the patients was done in detail. Routine blood investigations were done. X-rays of pelvis with bilateral

hip were taken. Fractures were classified by AO Classification. Detailed informed consent obtained. When closed reduction was not possible, open reduction was done. Both short and long proximal femur nail were used depending upon the needs. The research was conducted to analyse the functional outcome of an intertrochanteric femur fracture based on the observation of the modified Harris hip score.

RESULTS:

In our study, mean age of the patient was 55.90 yrs. IT fracture patients were classified according to AO Classification as follows-A2.2 11(36.67%) patients, A1.3 7(23.33%) patients, A3.1 5(16.67%) patients, A1.2 3(10%) patients, A1.1 2(6.67%)patients, A3.2 3(3.33%) patients, A2.1(3.33%) patients. In our study 15 (50%) patient had excellent outcome, 10 (33.33 %) patient had good outcome, 1 (3.33%) patient had fair outcome, 4(13.33%) patient had poor outcome. 5 complications were noted in our study, 2(6.67%) were infection, 2(6.67%) were Reverse Z effect and 1(3.33%) was DVT.

CONCLUSION:

Proximal femur nail has widened the indication of intra medullary nailing for more complex fractures of the proximal femur. By doing closed reduction, it offers minimal soft tissue damage, preserves the fracture hematoma, decreased blood loss and reduces the operating time. Though complications were reported, still it holds good, with good surgical hands because the procedure is technically demanding and needs a steep learning curve.

KEY WORDS: Intertrochanteric fractures; Proximal Femoral Nail; Modified Harris Hip Score

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INTRODUCTION

Intertrochanteric fractures are among the most prevalent fractures in today's orthopaedic care. Intertrochanteric fractures are life-threatening injuries that mostly impact the elderly, but are now affecting a younger population as well. The damage is induced by high impact trauma in young persons, whereas the majority of fractures in the elderly are osteoporotic and triggered by a modest fall. [1].

Conservative procedures may be used to treat these fractures, but the end result due to prolonged immobilization is mansion and other complications. As a result, internal fixation surgery would be the best choice [2].

Leg shortening, medialization of the fragment distal to fracture are common in unstable intertrochanteric fractures. Intramedullary implants were developed as a result of this. This implants get the benefits of being an intra - medullary fixation device, having a smaller lever arm that results in reduced tensile pressure upon that implant, having a short operational duration, minimal soft tissue resection, and early ambulation.

Intertrochanteric fractures extend from the trochanteric line to the lesser trochanter and a little below. The most unstable fractures include grades 3 and 4, which involve the subtrochanteric extension. Such fractures are known for having a greater proportion of unsatisfactory post-operative results. Most of these fractures were treated with ORIF. Several internal fixation methods have been proposed, however because of the significant risk of problems like non - union and implant failure. Only lately have these fractures been effectively treated because to a greater knowledge of biology, reduction procedures, and improved implants like Gamma nail, Proximal femoral nail.

AIMS AND OBJECTIVES:

To Assess the Functional Outcome of Intertrochanteric fractures treated with Proximal femoral fracture on the basis of Modified Harris Hip Score.

REVIEW OF LITERATURE

Sir Astley Cooper separated proximal femur fractures into Intra capsular and extra capsular in 1851 [4].

Hugh Owen Thomas was a renowned nineteenth-century British orthopaedic surgeon. He was the one who came up with the Thomas splint. Even today, its significance is well understood. In the treatment of fractures, he was a true believer in the concept of continuous immobilisation [4]. Prior to the invention of radiography, Allis identified the challenge of treating intertrochanteric fractures with traction, which eventually resulted in varus deformity and nonunion in 1891. Intertrochanteric fractures were first treated surgically in 1949 by Boyd and Griffin [5].

ASIF produced the AO blade plates in 1959. They recommended that the system be successful, that it serve as a tension band, and that it be followed by the prompt restoration of an intact medial cortical buttress [6].

Klemm and Schellman, as well as Grosse, Kempf, and Lafforgue, first developed intramedullary nailing guidelines for stable subtrochanteric femoral fractures with only proximally locked nails in 1972. The majority of broad series, on the other hand, record postoperative shortening due to unrecognised, nondisplaced cortical fractures or an overestimation of fracture stability [8].

Seinsheimer proposed a new classification of subtrochanteric fractures in 1978 to differentiate between various types of fractures that need different treatment methods and have different prognoses [9].

Tenur and Johnson in 1984 did a comparision study of biomechanics in different intertrochanteric fracture stabilization methods [10].

Enders nailing for femoral peritrochanteric fractures was researched by MC Harper and T Walsh in 1985, and they discovered that it was relatively successful for the management stable and unstable fractures unless the patient's mobilization could be delayed [11].

Kinast demonstrated blade plate fixation of IT fractures using a closed reduction method over ORIF in 1989 [12].

Senter et al. showed the evidence of medial cortex reconstruction in IT fracture in 1990 [4].

In the system, an axial compression screw is used to facilitate compression along femoral shaft axis. Dynamic axial compression continues as the fracture settles after surgery [13].

The use of gamma nail to fix unstable IT fractures was first described by S.C Halder in 1992. Even in comminuted fractures, the data demonstrated that fracture union was acceptable with hardly any loss of position [14].

In 1992, Leung et al conducted a randomised research in elderly patients comparing gamma nails and DHS and discovered that, while both had comparable final outcomes, gamma nails had shorter screening time, decreased blood loss, and quicker rehabilitation [15].

Rosenblum et al. released a paper on gamma nail biomechanical evaluation in 1992. The gamma nail was shown to carry decreasing load to the calcar while lowering stability of the fracture [16].

Kapila et al. conclude that PFN gives great clinical outcomes in the treatment of stable as well as unstable IT fractures with both a firm knowledge of biomechanics and accurate instrumentation, and skill [17].

Parker et al. discovered a mobility hip score that can predict mortality risk following hip fracture in 1993, and suggested that it can be used regularly in the evaluation of patients with hip fracture [18].

Blatter was the first to use DCS fixation for fracture of peritrochanteric region, which he did in 1994 [19].

Jose et al. concluded that PFN offers steady fixation as well as faster mobilisation with bony union in complex IT fractures, which would include communicated fractures in osteoporotic females and reverse oblique types of fractures [20].

Cole treated IT fractures by intra-medullary nailing as well as fixation using lag-screw in 1994, while Hopman researched osteosynthesis of proximal femoral fractures using an unreamed AO femoral intramedullary nail [21].

Vanderschof researched the risk factors for pertrochanteric fractures in 1995, including age, fracture pattern, and fracture level [22].

The AO/ASIF invented PFN in 1996 for the management of unstable IT fractures [23].

Intramedullary hip screws, compression hip screws and plates for IT fractures were compared by Hardy et.al in 1998. They found early weight bearing in comminuted fractures with a subtrochanteric extension or a reverse oblique pattern, as well as decreased limb shortening. Intraoperative shaft fracture, cortical hypertrophy, and mid-thigh pain with an intramedullary hip screw were all recorded as complications. Nailing is only recommended for fractures that are unstable [24].

Domingo et al. used a proximal femoral nail to treat trochanteric fractures in 2001. The overall results were comparable to other fracture systems in their analysis, and the number of complications observed was satisfactory [25].Christian Boldin et al in 2003, concluded that if closed reduction is necessary then PFN is a successful mini-invasive method for unstable IT fractures [26].

Ramakrishnan et al. presented their results regarding long PFN for difficult IT fractures in 2003, indicating that it is a secure implant that requires required posteromedial restoration to avoid mechanical failure [27].

In 2004, Steinberg et al. studied the biomechanical qualities of the PFN and discovered that it is secure and can give excellent support to the bone [28].

In 2005, Menezes et al. suggested the PFN for the treatment of unstable IT fractures, stating decreased rates of shaft fractures as well as a decrease in failures of fixation while using it [29].

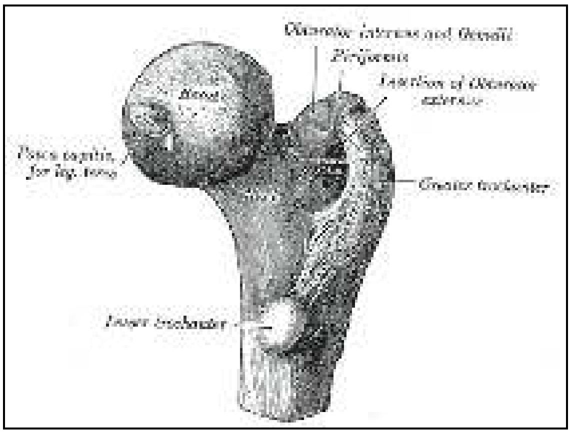
ANATOMY

The femur (longest and strongest bone) is cylindrical for the most of its length [31].

The Head (caput femoris)

The femoral head is globular in shape and is directed superiorly, medially, and slightly anteriorly. The ligamentus teres is attached to the fovea capitus femoris. The neck is a flattened structure that links the head to the body and forms a broad angle that opens towards medial side. During childhood, the angle tends to be wider and gets narrower as the child grows. The neck of the femur forms a 125-130 degree angle with the shaft in an adult. The amount of forward projection varies widely, but ranges between 12 degree and 14 degree.

The calcar femorale provide strength and support to the neck of femur in posterior and inferior directions, according to Harty and Griffin [32].



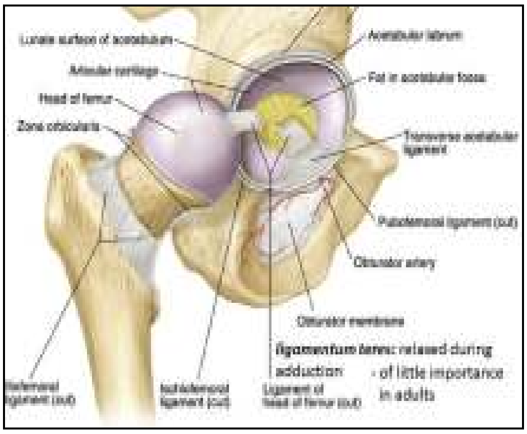


Figure 1: Anatomy of head of femur [53] **Figure 2: Anatomy of hip joint [54]**

The Trochanters:

The Trochanters are prominent structures that provide attachments to abductor group of muscles.

The lateral surface is quadrilateral in shape with rough margins marked with a diagonal impression. A triangular surface present above the impression, often rough for a portion of the same muscle's tendon, occasionally smooth for a bursae interposition between the tendon and the bone.

The trochanteric fossa (digital fossa) is a deep depression at the base of the medial surface, significantly smaller than the lateral surface, provides attachment to the tendon of obturator externus.

Lesser Trochanter (LT) has a conical shape and varies in size depending on the subject. Three well-defined boundaries extend from its apex, two of which are visible above.

Psoas major muscles are attached into the rough margins of lesser trochanter. The inferior border of LT is in continuation with the linea aspera .

The femoral tubercle is a variable-sized protrusion located at the juncture of the proximal portion of neck and the greator trochanter (GT). The intertrochanteric line (spiral line of the femur) runs obliquely downward and medially and wraps around the medial surface, under the LT.

The Body or Shaft (corpus femoris):

The cylindrical body is somewhat large over the proximal region is wider from front to rear. It is reinforced by the linea aspera, a prominent longitudinal ridge.

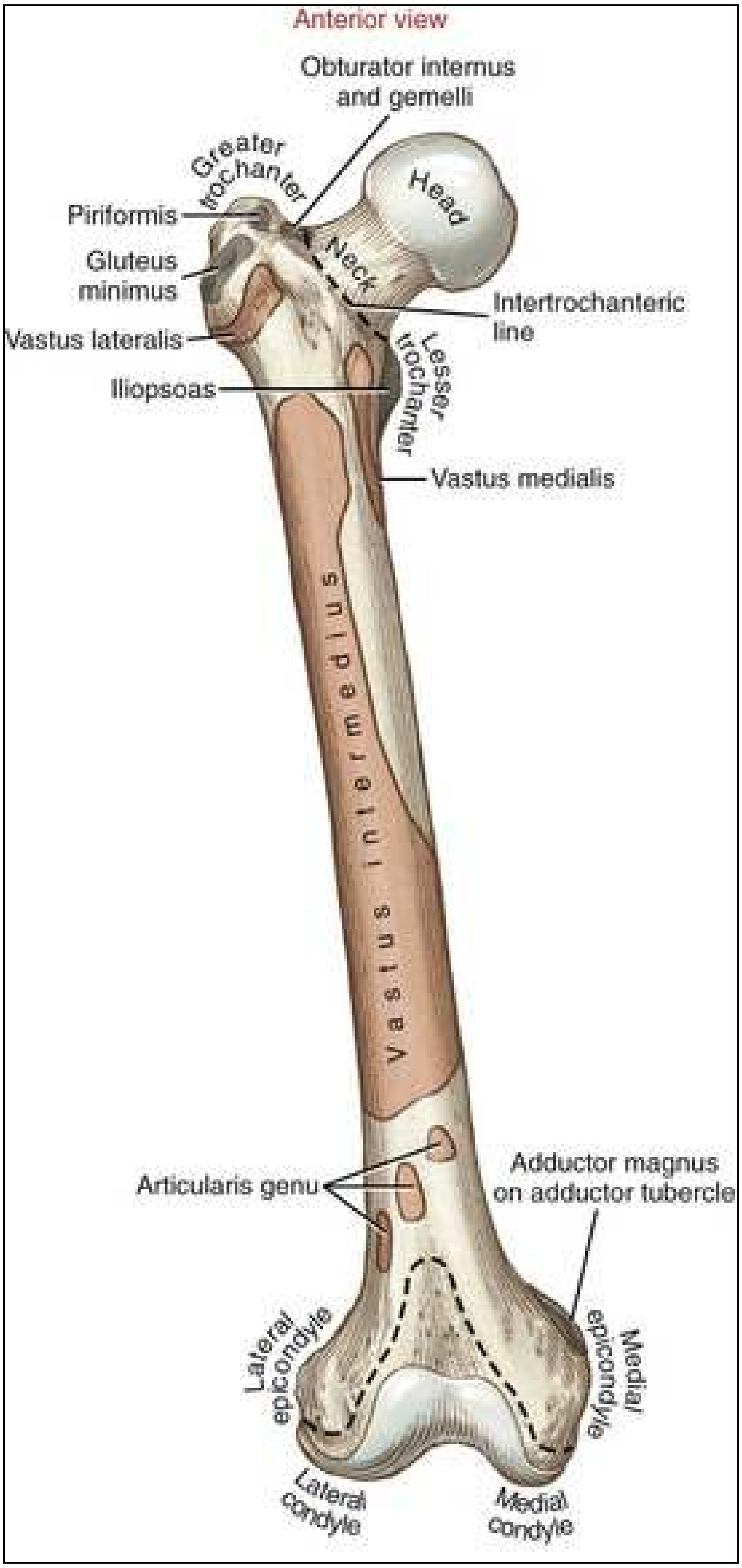


Figure 3: Muscular attachments of anterior femur [55]

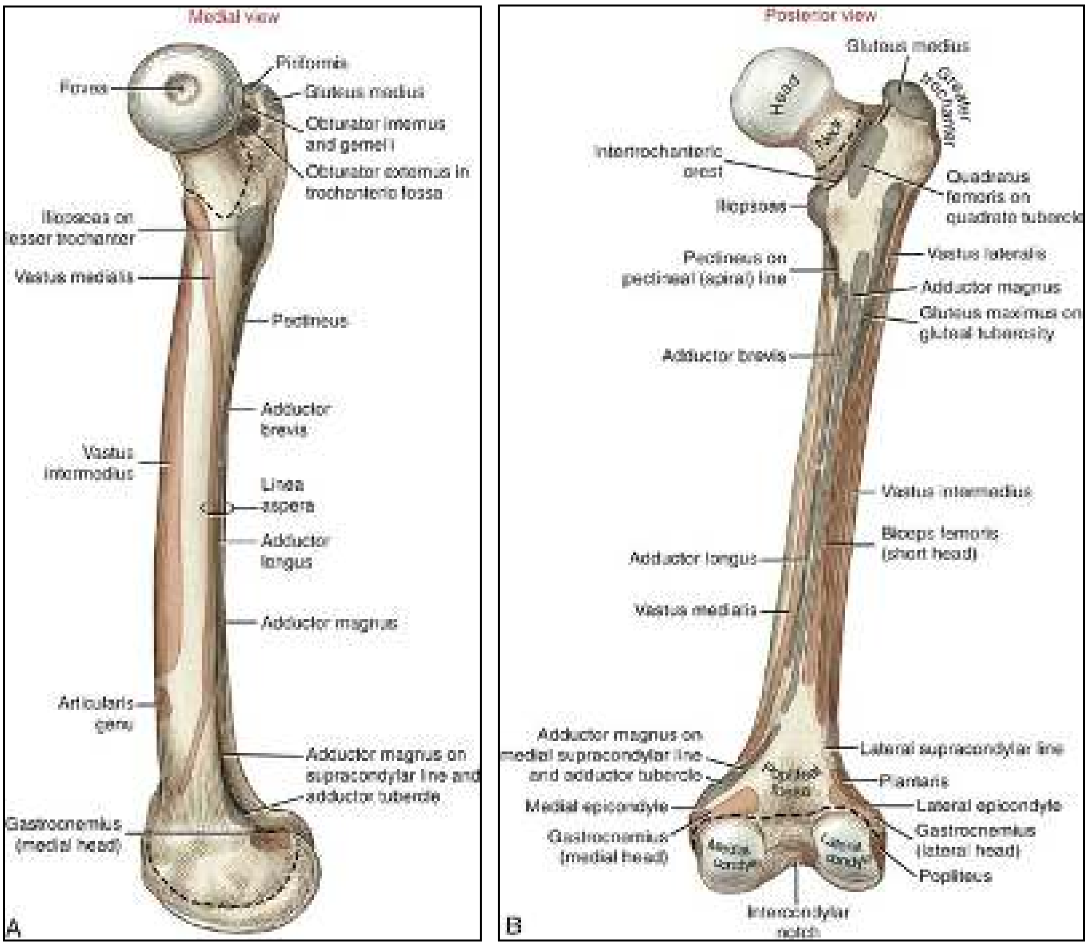


Figure 4: Medial (A) and posterior (B) Aspect of femur [56]

Ossification: Five centres make up the femur: located in the shaft, head, GT, LT and distal femur. Around the seventh week of pregnancy, ossification starts the body and swiftly extends superiorly and inferiorly.

The epiphyses centres form in the inferior end of the femur during the 9th month of life, Head is formed at the end of the1st year, the GT during the end of 4th year, and the LT between the 13th and 14th year. The epiphyses join the body in the reverse sequence in which they appear, with the LT joining first, followed by the GT, head and last to involve is the distal extremity.

Inner Architecture of the Upper Femur:

Ward described the trabecular process inside the femoral head in 1838 [33]. In upper femur's these are organised into two distinct structures. Compressive and tensile, which refer to the femur's maximum and minimum stress lines in terms of location. The width and distribution of the trabeculae vary with the intensity of the peak stresses at various places in the upper femur.

COMPRESSION GROUP:

1) Primary compressive:

These extend slightly radially upwards to the anterior surface of the femur head.

2) Secondary compressive:

Curve 45 degrees away from the shaft, then outward and upward to intersect the trabeculae in the opposite direction.

TENSILE GROUP:

1) **Greater trochanteric group:**

It grows vertically upwards from the upper part of the shaft.

2) **Principal tensile group:**

Cross the femur's straight axis

3) **Secondary tensile group:**

These emerge from a 30-40 degree angle lower in the shaft, cross the neck of the femur in almost parallel curved lines, and intersect with the principal compressive group at right angle.

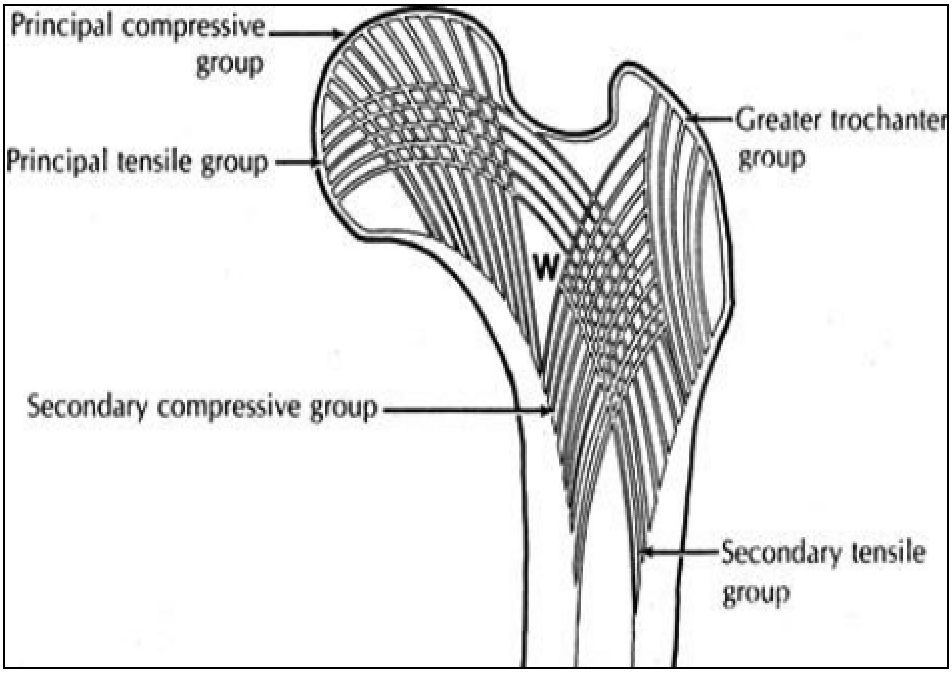


Figure 5: Trabecular network of proximal femur [57]

Blood supply of femur [1]:

Trueta and Harrison's work has been used to describe adult vessels (1953). Because the circulatory pattern produced at the time of the growth process is not replaced at adulthood but rather endures through the entire life, the arrangement of the vessels is both in the epiphyseal as well as the metaphysial regions. Crook's definition appears to be more correct because it is built on 3 plane analysis, which offers anatomic nomenclature standardisation.

The arteries of proximal femur were divided into 3 groups by Crook:

1) **Extracapsular arterial ring**
2) **Ascending cervical arteries**
3) **Arteries of the round ligament.**

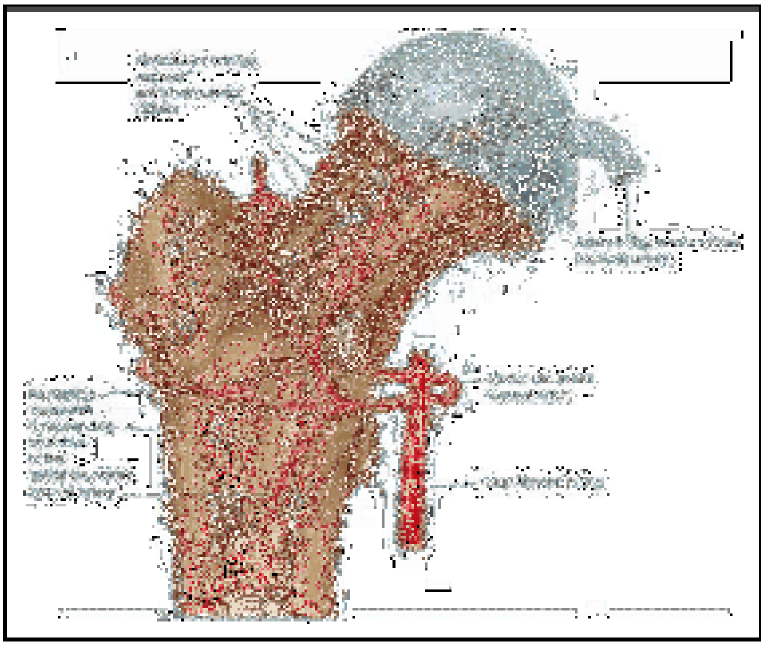


Figure 6: Blood supply of proximal femur [58]

A broad segment of the medial circumtlex femoral artery forms the extracapsular arterial ring posteriorly whereas lateral circumflex femoral artery (LCFA) forms anteriorly.

Extracapular arterial ring gives the ascending cervical root.They travel underneath capsule and anteriorly enter the hip joint capsule at IT line. The artery of ligamentum teres often referred as the MCFA is the main branch of obturator vessel.

Singh index is a simple and inexpensive method. The SI score can be used to determine apparent bone density as well as trabecular pattern of the femoral neck [59]. X-rays are ranked from 6 to 1.

Grade 6 :	The radiographic picture clearly shows all trabecular types. The top of the femur appears to be entirely covered in cancellous bone.
Grade 5:	Principal tensile trabecular (PTT) is highlighted. Ward's triangle is clearly visible.
Grade 4 :	Although the PTT have been decreased (significantly).
Grade 3 :	The PPT has a split in their continuity.
Grade 2 :	Only the primary compressive trabeculae may be seen clearly; rest are absorbed.
Grade 1 :	The primary compressive trabeculae have also diminished and are no longer evident.

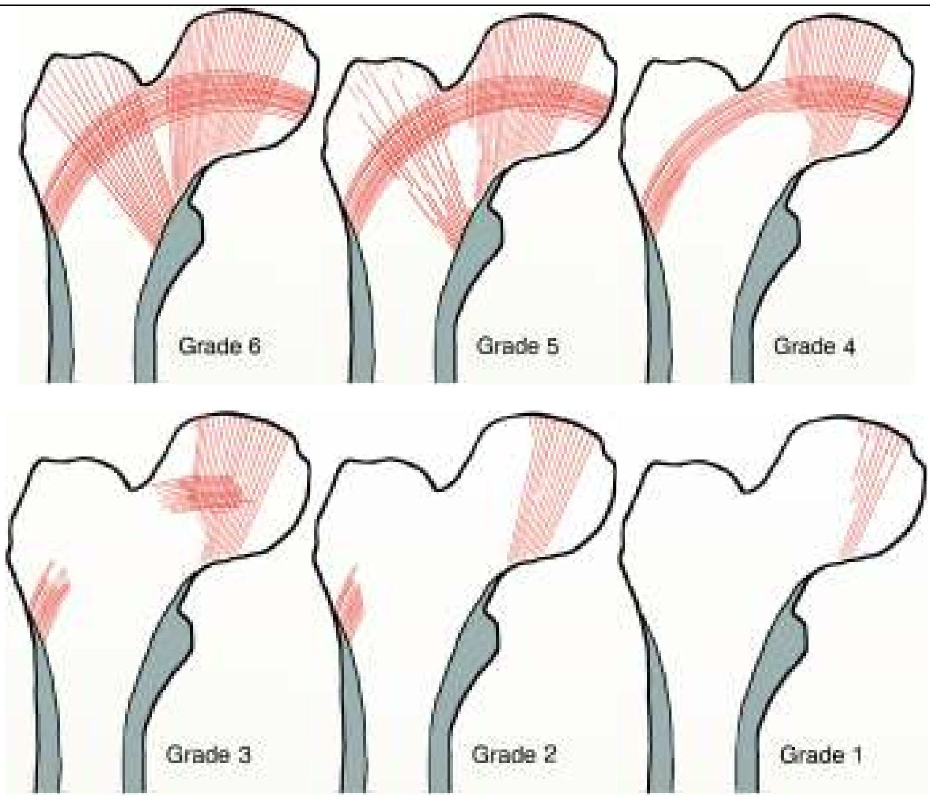


Figure 7: Six grades of singh index [60]

MOVEMENTS [31]

Flexion: Range:120- 130

Psoas major and iliacus are the main muscles. Pectinius, rectus femoris and other accessory muscles.

Extension: Range: 10 - 12°.

Gluteus maximus are the most important muscles.

Adduction: Range: 30-40°.

The primary muscles are the adductor longus, brevis, and magnus.

Abduction: Range: 40 — 50°.

The gluteus medius and gluteus minimus are the primary muscles.

TFL, sartorius is accessory muscles.

Medial rotation: Range: 30-40°.

TFL, anterior fibres of gluteus medius and gluteus minimus are the main muscles.

Lateral rotation: Range: 40-50°.

2 gemelli, 2 obturators, quadratus femoris are the chief muscles.

BIOMECHANICS

Cortical and compact cancellous bone are mainly involved in extracapsular fractures (intertrochanteric and subtrochanteric fractures) [35]. The amount of energy absorbed by the bone determines whether the fracture is simple or has a much more widely comminuted appearance. In compression, bone is stronger than in tension. Each load damages the osseous structure on a microscopic level, causing small cracks to merge into a single large crack.

If these micro fractures do not heal, failure will result. Powerful muscles encircle the proximal femur.

In a typical hip, the strong gluteal muscles (maximus,minimus,medius) causes abduction of the hip joint whereas the psoas muscle are the main flexor that are attached at the LT. Adductor and hamstrings counteract these powers.

In a sub-trochanteric fracture, the muscular pull is unequal, and the unhindered muscular movement leads to characteristic abduction (caused by the gluteus muscles), external rotation (caused by short external rotators), and flexion deformity (caused by psoas major) [36].

Following surgery, the fixation system is subjected to the same muscle forces. Even when the patient is in bed, the above mentioned forces cause stress in the subtrochanteric region, as Koch has shown.

Trydell found that simply flexing or stretching the hip in bed exerted similar pressure on the head of the femur as did walking slowly [37].

DEFINATION AND MECHANISM OF INJURY OF INTERTROCHANTERIC FRACTURES

Defination:

IT femur fractures are those that occur in the proximal femur between the intertrochanteric line, or base of the neck, and the lesser trochanter distally.

Figure 8: Anatomy of the proximal femur [61]

Mechanisms of Injury:

One of three mechanisms may cause intertrochanteric region fractures. These fractures in the elderly are normally due to trivial trauma. Bad vision, reduced muscle strength all contribute to an increased risk of falling as people get older. The age-related loss of muscle mass around the hip could explain why hip fractures become more common as people get older [38]. Although the muscles that envelope the hip may secure it, contraction of these muscles during a fall can enhance the risk of hip fracture.

Commination, soft tissue trauma, including the possibility of an open wound, and the presence of other injuries are all common concerns [39].

The third mechanism is mild trauma, which occurs when the proximal femur fractures as a result of neoplasia, most commonly metastatic cancer. The neoplastic mechanism must also be assessed and managed in such pathological subtrochanteric fractures.

Biomechanical Studies:

The creation of improved implants and drastic improvements in treatment modalities have resulted from detail knowledge of the biomechanics of IT fractures.Koch looked at the mechanical stress on the femur during weight bearing and discovered that in a 200-pound individual, compression stress in the medial trochanteric region reaches 1200 lb per square inch, while lateral tensile stress measured around 20% less at 900 lb/in square [40].

CLASSIFICATION OF INTERTROCHANTERIC FRACTURES

Intertrochanteric fractures have been classified using a variety of classification schemes. The majority of them aid in recovery preparation and have prognostic value. The following are some of them:

1. **Boyd and Griffin classification (1949) [5]:**

These are divided into four types-

Type 1: In this type, Fractures runs from the GT to LT along the intertrochanteric axis. Reduction is usually straightforward and easy to manage.

TYPE 2: Comminuted fractures with multiple fractures in the cortex and the primary fracture line along the IT axis.

Type 3: There is an extension of fracture line below the LT into the subtrochanteric region.

Type 4: IT fractures in minimum two different planes, in which one plane being sagittal and are difficult to interpret in AP view of x-ray.

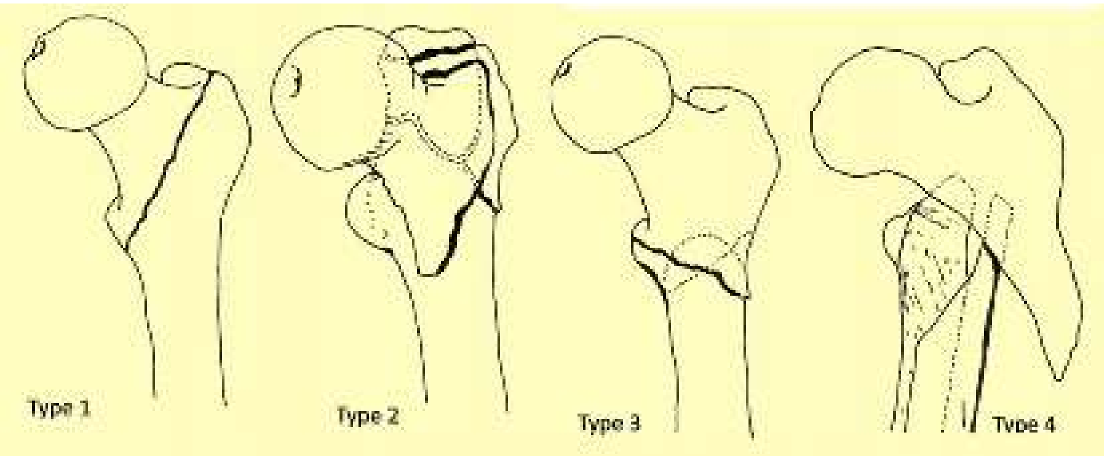


Figure 9: Boyds and griffith classification [62]

2. **Evans classification [32]:-**

Type 1: From the lesser trochanter, the fracture stretches superiorly and laterally.

Type 2: The reverse obliquity type of fracture, in which the fracture line extends laterally and posteriorly and the posteromedial cortical continuity is not maintained.

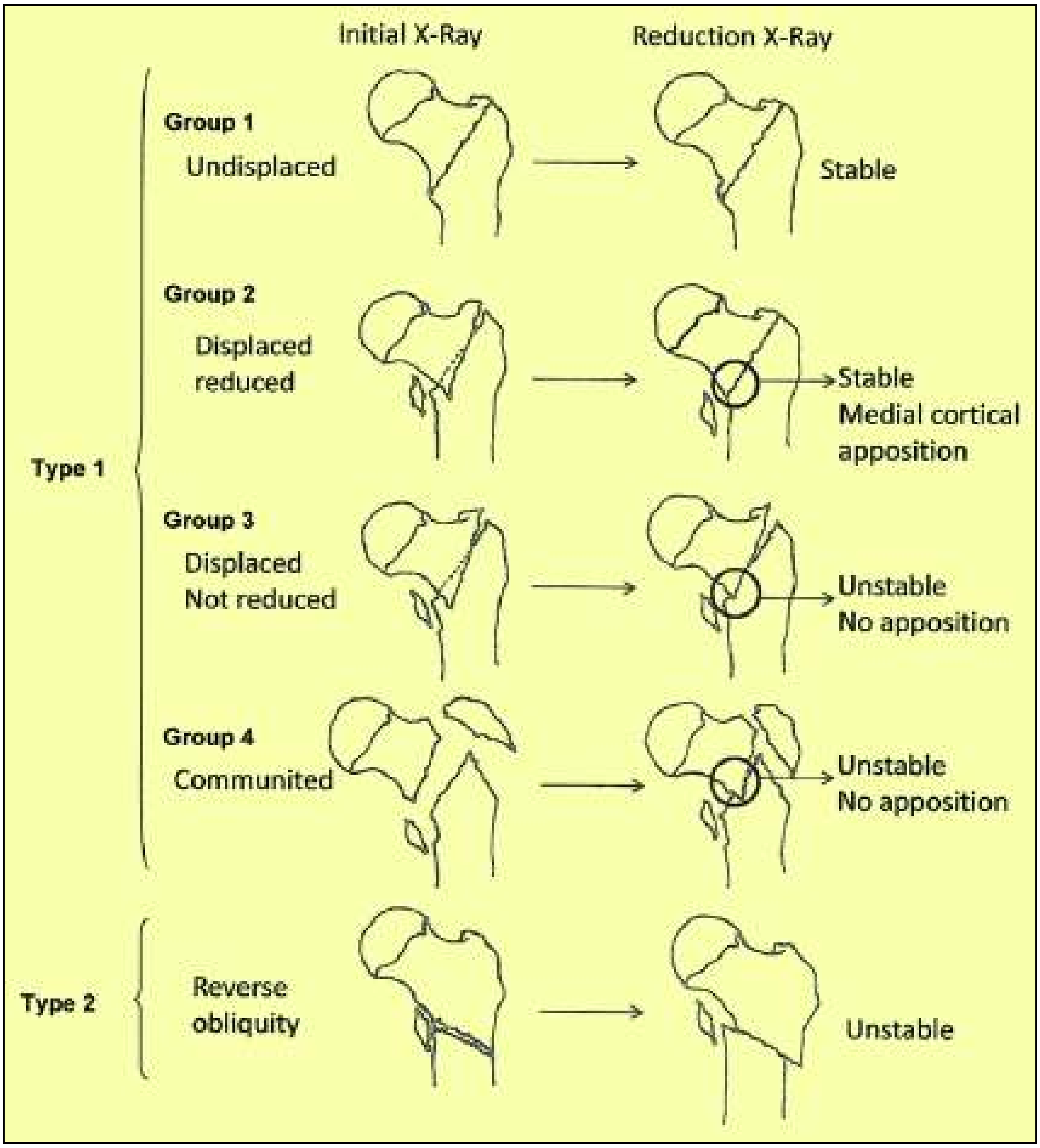


Figure 10: Evans classification [62]

3. **AO Classification** [33]

A- Femur, Proximal IT	A1-Pertrochanteric (simple)	A1.1-Along IT line A1.2-Through GT A1.3-Below LT
	A2-Pertrochanteric (multifragmentary)	A2.1-1 intermediate fragment A2.2-several intermediate fragments A2.3 extending segment (> 1 cm) below LT
	A3- IT	A 3.1- oblique pattern(Simple) A 3.2- Transverse pattern (Simple) A 3.3- Multifragmentary pattern

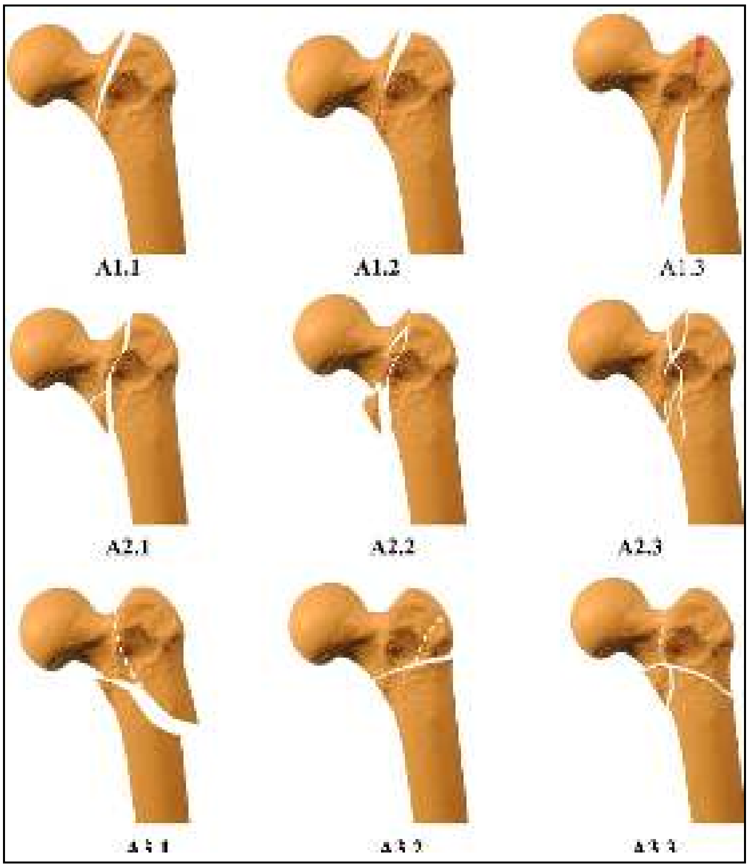


Figure 11: AO Classification [63]

MANAGEMENT OF INTERTROCHANTERIC FRACTURES [3]

"Fractures occurring along intertrochanteric line of the proximal end of femur, including peritrochanteric fractures, unite easily regardless of intervention because the wide fractured surfaces are abundantly supplied with blood and that there is rarely wide displacement," according to Watson Jones [5]. Furthermore, this fracture occurs in older patients who are vulnerable to the risks of extended immobility and recumbency. As a result, care should be designed to promote union without deformity while also allowing mobilization.

CLINICAL DIAGNOSIS:

Clinical characteristics such as tenderness, swelling, crepitus, inability to bear weight, as well as an externally rotated lower limb must be used to diagnose the patient. Open fractures may occur and indicate serious soft tissue or bone injury. Injury to the same extremity, as well as injuries elsewhere in the body, should be presumed. The patient should be treated for hypovolemic shock if there is a serious haemorrhage within the thigh.

RADIOLOGICAL DIAGNOSIS:

Antero-posterior x-ray of pelvis and lateral view of the involved hip are used to accurately determine the level of fracture. Before making a treatment decision, an X-ray is used to assess the presence or severity of osteoporosis in older patients. DEXA is the investigation of choice for osteoporosis.

TREATMENT:

It's difficult to treat an IT fracture extending to subtrochanteric region. Malunion, delayed and nonunion complicate the treatment of these fractures. Following this fracture, Allisin recognised complications of angular deformity, as well as rotational mal alignment in 1981. He explained the underlying cause of these deformities using muscular force analysis. In Grade one and two intertrochanteric fractures, cortical bone vascularity and healing surfaces have been less than cancellous bone surfaces.

Because of the rising prevalence of IT fractures that are expected, much attention has been focused on the management of these fractures [30].

These fractures are said to have a greater risk of complications than other forms of femur fractures. Malunion as well as mortality rates have been estimated to be as high as 40%. Cardio-respiratory, thromboembolic phenomena are all systemic disorders due to the symptoms of injury and immobilisation in the elderly. Early fixation failure, late union, delayed fixation failure and hardware complications are all examples of local complications [43].

OPERATIVE MANAGEMENT

Since ORIF preserves anatomy and enable for faster mobilisation in IT fractures with subtrochanteric extension, it becomes the choice of treatment if healthy osteosynthesis can be obtained at the time of surgery. Internal fixation is difficult to achieve due to comminution. This necessitates more secure internal fixation in order to prevent implant failure.

The following factors are used to determine adequate postoperative fracture stability:

1. Quality of bone,
2. Fracture geometry,
3. Device positioning,
4. Reduction of the fracture segment.

I) "EXTRAMEDULLARY DEVICES":

Fixed angle nail plates:

Treatment with these plates has yielded mixed results. Hamson and Tullos showed an 88 percent union average after performing a single case. They realised that implant failure was caused by nonunion, not the other way around.

Because of the Jewett nail's varus angulation, acetabulum penetration, and implant failure, it was no longer recommended for use in subtrochanteric fractures. In cases of comminuted subtrochanteric fractures, Waddell also used Jewett angle plates or McLaughlin types [40].

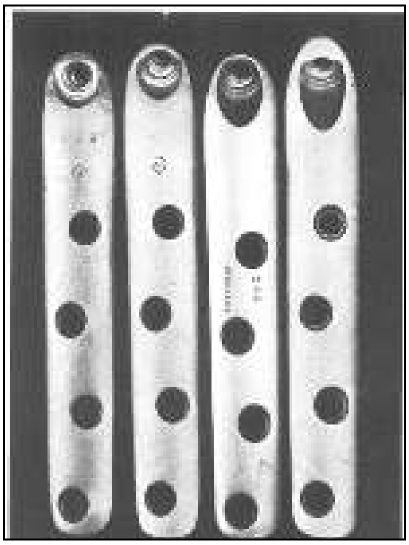


Figure 12: Jewett hip nail plates [64]

AO BLADE PLATE:

The AO Blade plate was suggested by schatzker and Wadell in selective intertrochanteric fractures. They assume it is ideal for fractures in pertrochanteric regions.

Velasco and Comfort advocated for AO blade plate in transverse fractures and large multiple fractures.

Kinast and colleagues unveiled a string of fractures of per trochanteric and sub trochanteric operated with 95- degree angle plate in 1989.

According to the authors, soft tissue preservation using indirect reduction and plate pretensioning would result in a quicker healing period, decreased non-union incidence, and low infection rate. They also indicated that if this indirect form of reduction is used, bone grafting of these fractures might be unnecessary [7].

Dynamic hip screw:

Pertrochanteric fractures are adequately healed with a DHS, according to biomechanical and clinical reports. Newer designs have better fatigue characteristics as well as loss of fixation is most likely due to the screw backing out, rather than the plate breaking, as was the case with older designs.

By using compression hip screw, Waddell registered good results in 21 of 24 pertrochanteric as well as subtrochanteric fractures. The value of medial buttress reconstitution is not diminished by the increased strength of the slide plate.

Burman and colleagues documented 38 successive pertrochanteric as well as subtrochanteric fractures treated with DHS. They seemed to have decreased non-union rates, implant failures and also varus displacement using these methods [14].

Bigger sliding hip screws have lesser penetration of acetabulum as well as femoral head due to presence of a blunt nose. In intertrochanteric fractures where medialization of shaft as well as fracture impaction is likely, Schatzker and Waddell suggested using a sliding compression hip screw. They proposed that AO side plate fixation is safer for low fractures when the medial cortex can be reconstructed. However, complications remain a frequent occurrence. The need for extensive dissection, fixation of the lateral wall with side plate, and unstable comminuted pertrochanteric fractures fixation, all of which contribute to delayed mobilization [44].

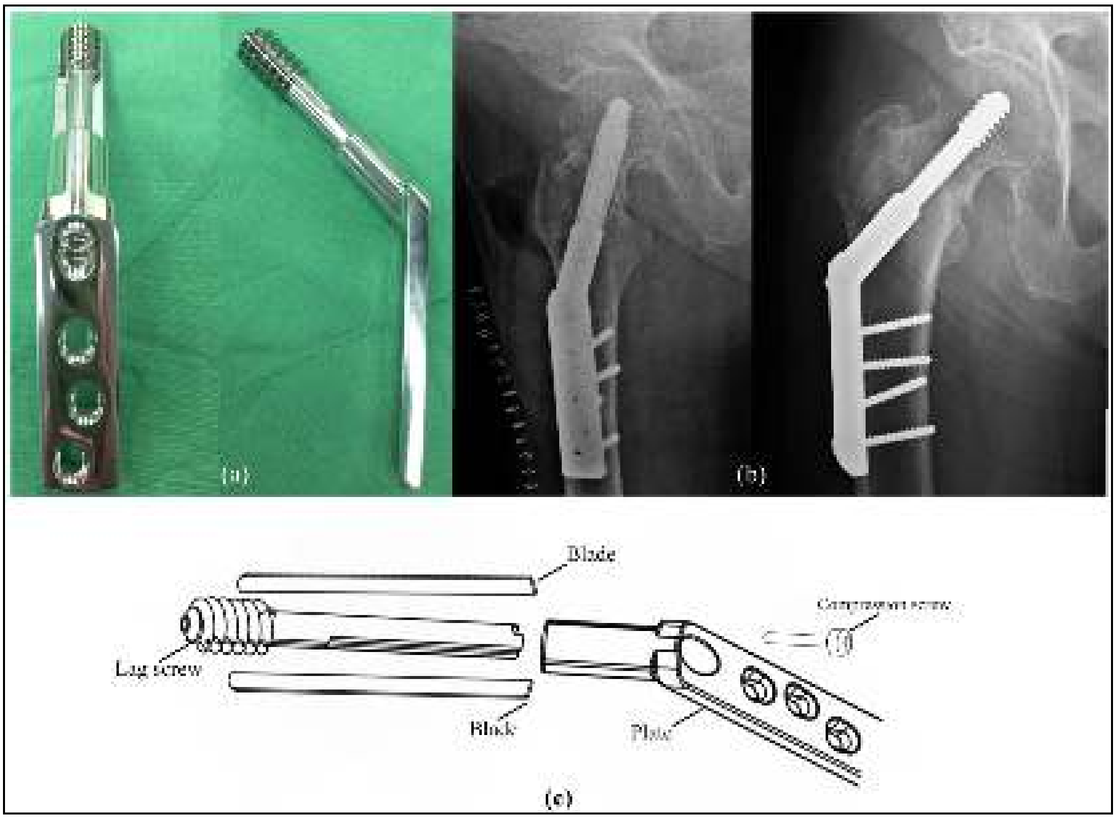


Figure 13: Dynamic hip screw [65]

Medoff's Axial Compression Screw:

Medoff has created a system that uses a sliding device to permit axial compression across the metaphyseal region A barreled plate is attached to the body of the femur with screws pointing in two different directions [45].

Figure 14: Medoff axial compression plate [66]

CONDYLOCEPHALIC NAILING:

Enders pins:

It is a closed and minimally invasive procedure. Furthermore, nail orientation is mechanically effective, allowing for early weight bearing in pertrochanteric fractures. Painful inflammation, nail migration proximally and distally, penetration into hip joint have all been identified as complications.

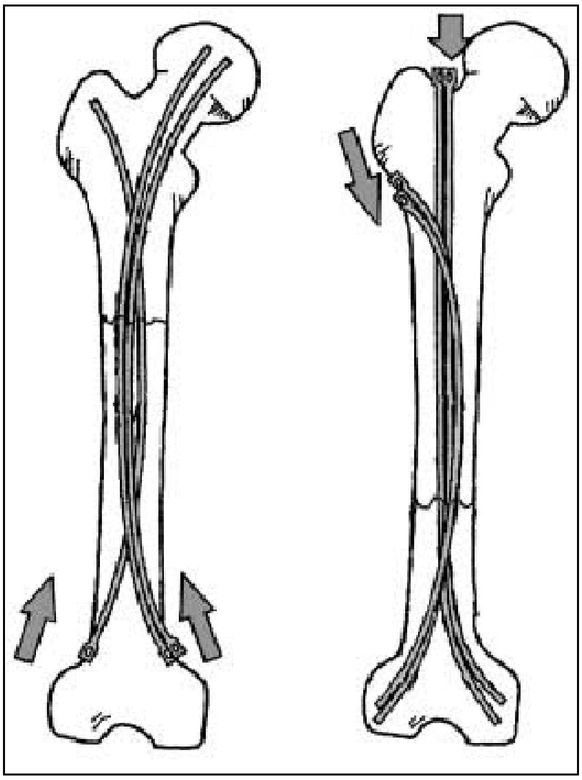


Figure 15: Enders nails [67]

Zickel Nail:

In the early l960s, Zickel created the first intramedullary device. Throughout the 1970s and early 1980s, this was one of the most effective devices for pertrochanteric as well as subtrochanteric fractures. The success rate were high in a series of fractures of peritrochanteric and subtrochanteric region treated with the Zickel nail as well as telescopic screw along with early bone grafting at Helmepin Country Medical Center. The current version features a tapered medullary rod with a wide upper diameter (17 mm) and stem widths of 11, 13, or 15 mm. The triflanged nail is passed into a tunnel in the proximal portion of the rod that is at an inclination of 125 degrees with respect to the stem. The procedure has many drawbacks, including an open operating technique and a current design that lacks a compression mechanism for neck of femur portion of the implant as well as distal locking capability. Intra-operative comminution of the greater trochanter, rotational as well as varus deformity was previously reported [20].

Russel Taylor Reconstruction Nail:

Guidelines for nailing in cases of femoral fractures were first established by Klemn and Schellman, Grosse, Kempf, and Lafforgue. Unlocked nails are used to treat stable isthmus fractures, proximally locked nails are used to treat fractures close to the isthmus, and one or two distally locked screws are used to treat more distal fractures. While these recommendations have yielded excellent results, most large series record postoperative shortening due to unrecognised undisplaced cortical fractures. With static interlocking, almost all pertrochanteric fractures can be united, and rotation and length are better regulated.

The diameters of Russell Taylor reconstruction femoral nails are 9, 10, and 11 mm. The upper diameter of 8cm of the nail is enlarged to 15mm [21].

Figure 16: Russel Taylor Reconstruction Nail [68]

Uniflex Nail:

This nail has two proximal holes that are angled to provide insertion for a lag screw. Pathological subtrochanteric fractures were commonly treated with this implant. It has many of the benefits and drawbacks of other commonly used interlocking nails. Although used in narrow femurs, its uniform diameter loses its intensity in the proximal portion [21].

Interlocking Nails (Grosse Kempf, AO):

Introduction of highly specialised intramedullary (IM) nails, such as this one, allows for the placing both superior and inferior screws, as well as rotational stability. This implant is useful in IT fractures that occur just under the LT and do not encompass the GT. The ability to place such devices while preventing exposure of the fracture hematoma and avoiding additional de-vascularization of fracture fragments has improved fracture union [21].

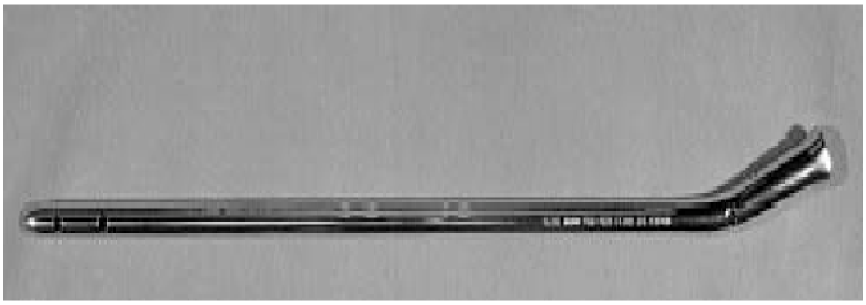


Figure 17: Grosse Kempf nail [69]

AP Gamma Locking Nail:

Halder invented this novel IM system for the treatment of unstable IT fractures. Patient body mass is transmitted more nearer to the calcar, when compared to the sliding hip screw. As a result, mechanical strength is increased. With this implant, surgery time and blood loss are reduced to a minimum. Implant failure cases reported by Halder were none, and zero cases of nonunion have been observed with this implant. A small number of patients have developed Coxa vara. Despite the positive results, some cases of screw backing out of the femoral head have been recorded by the authors [8]. According to Davis and colleagues, another benefit of the Gamma nail is that it can be inserted without opening the fracture site [14].

For fractures of intertrochanteric region extending to subtrochanteric area and with reverse obliquity component, Bridle and co-workers suggested Gamma nail [46]. K S Leung observed an intra-operative lateral cortex fracture with the Gamma nail, as well as a post-operative stress fracture of the femoral shaft, similar to Bridle et al. and Halder 1992 [15].

These intramedullary approaches of treating intertrochanteric fractures necessitate a great deal of operative experience, as well as costly equipment and image intensification. Because of the high rate of complications associated with their use, these devices have lost popularity.

Figure 18: Gamma nail [70]

Proximal Femoral Nail:

AO/ASIF introduced proximal femoral nail (PFN) in 1996 as an IM device for management of unstable IT fractures [23]. PFN has several advantages like less blood loss,less soft tissue dissection,decreased moment arm,inserted by closed methods [47].

Addition to the benefits of an intramedullary implanted nail, it has a number of other advantages. It does not need pre-drilling has low stress concentration between implant and the bone surface [47].

The Gamma nail, which is currently used as an IM device, has a failure percentage of up to 10% and has a long learning curve [48]. To prevent these failures, the AO/ASIF developed anti-rotational head screw in the proximal femoral nail design.

Gotze et al. discovered that PFN can withstand maximum stress among all devices, when it was subjected to tension ability of osteosynthesis in cases of unstable subtrochanteric as well as pertrochanteric fractures in1998.

In a clinical multicenter analysis, Simmermacher et al found that technical failures of the PFN occurred in 5% of cases due to poor reduction of fracture fragment, mal-rotation, or incorrect screw selection. In 0.6 percent of cases, the neck screw was cut out [23].

In contrast to the Gamma nail, Christian Boldin et al found no femoral shaft fracture and no implant crack. This is due to the nail's tapered narrow tip, which inhibits tension focus [26].

Harris and Ralune D discovered that the blade plate group had a 24 percent fixation failure rate in an analysis of IT fractures operated with a PFN versus a 95-degree angle plate [49].

The best treatment for these fractures is operative treatment along with internal fixation.

The following are the objectives of surgical management:

- Rigid fixation
- Faster mobilization
- As soon as possible, the patient should return to his or her pre-surgery condition.

Figure 19: Proximal femoral nail [71]

Advantages of Intramedullary Devices:

The following are some of the benefits of using this implant:

- In order to avoid blood loss and septicaemia, the incision is made far from the fractured bone.
- Very little soft tissue seperation simplifies the procedure and cuts surgical time.
- Intramedullary positioning allows for early weight bearing.

They've been linked to complications like-

- Proximal nail migration
- Backing out causing knee pain and stiffness.
- Rotational deformity.

MATERIALS AND METHODS

CLINICAL MATERIALS

From January to December 2019, this study was conducted at KLE's Dr. Prabhakar Kore Hospital and Medical Research Center in Belgaum.During this period, adult patients with IT fractures were classified on the basis of Arbeitsgemeinschaft fur Osteosynthesefragen (AO) classification, and 30 cases are selected based on inclusion and exclusion criteria

The research was conducted to analyse the functional outcome of an intertrochanteric femur fracture based on the observation of the modified Harris hip score (MHHS).

DATA COLLECTION:

Patients with IT fracture from A1 to A3 (AO Classification) were recorded in a proforma created specifically for the research. Patients were discharged after treatment and were seen at the OPD basis at regular follow ups for examining the patient’s outcome as well as radiological evaluation.

MANAGEMENT OF PATIENTS:

Patients with these fractures were assessed first in the emergency department according to the advanced trauma life support (ATLS) protocol. The fracture was stabilized using skin traction. The patients were given a detailed preoperative evaluation, which included the following-

1. The patient's general condition
2. Clinical assessment
3. Radiological evaluation

Clinical examination:

a) Inspection
b) Palpation
c) Measurements
d) Movements
e) Associated injuries

INVESTIGATIONS:

- Hemoglobin %, Total leucocyte count (TLC) counts, and all necessary blood tests.
- Renal function test (RFT), Liver function test (LFT) Random blood sugar (RBS).
- Viral markers, Electrocardiogram (ECG), as required, based on the risk factors.
- Echocardiography

X Rays

- Antero-posterior view (AP) of pelvis along with bilateral hip joint
- Lateral views of hip joint along with the respective femur (Full length)
- PA view of the chest

All of the patients with diagnosed IT fracture on the basis of roentgenogram were shifted to orthopaedic wards along with traction of 2 kg, which varied for each patient's. Pain killers and if skin abrasions present then antibiotics were administered as required. Related injuries were assessed and treated at the same time. Patients underwent surgery on elective basis.

INCLUSION CRITERIA:

Patients who voluntarily agreed to take part in the research.

1) IT fractures
2) More than18 years of age

EXCLUSION CRITERIA:

1) Open injury
2) Pathological fractures
3) Peri-prosthetic fractures
4) Fractures before physeal closure

Sample size formula:

The minimum sample size formula based on prevalence rate is

$$N=z\alpha 2p\ (1-p)/d2$$

Where P is the percentage of prevalence and d is the percentage likely difference in the prevalence. zα is linked with the level of significance. For 5% level of the significance zα = 1.96.

Ref:

With P = 89% and d = 15% of P = 13.35%, the sample size is 21.

During the follow up few cases are likely to be missed. Hence the sample size will be raised to 30.

PRE-OPERATIVE PLANNING:

1) Measure the width of the femoral canal in AP view to determine the nail diameter.
2) On the AP view, the length of the hip screws as well as distal locking bolts.
3) The angle of the neck shaft.

PROXIMAL FEMORAL NAIL - IMPLANT DETAILS:

Derotation screw / lag screw of diameters 6.5mm and 8mm respectively were used, and 4.9 mm of distal locking bolts comprised the proximal femoral implant. The use of an end cap was optional.

The nail is constructed of titanium alloy or 316L stainless steel.

PFN Instrumentation Set

The nail comes in the below sizes.

1) Length - Standard PFN 240mm, 340mm, 380mm, and 420mm Long PFN 340mm, 380mm, and 420mm
2) Diameter: 9, 10, and 11 mm
3) Angle between neck and shaft- 125^0, 130^0, 135^0

From top to bottom, nail has a 14mm proximal diameter, which increases the implant's stability and grip. A 6 degree valgus angle stops the fracture from collapsing into varus and allows insertion through the greater trochanter's tip.

It has two holes near the proximal end that form a neck shaft angle. The 8mm lag screw is inserted distally. The proximal hole is used to insert the 6.5mm derotation screw, which prevents rotation and improves stability.

The distal diameter of the nail is narrowed to 9 to 11mm, with grooves to prevent implant breakage at the tip. Distally two holes of diameter 4.9mm are present.

We used a regular short PFN with distal diameters of 9, 10, and 11 mm and proximal widths of 14 mm in our research for intertrochanteric fractures and long PFN for intertrochanteric fractures extending to subtrochanteric region. A 6.5mm proximal derotation screw and an 8mm hip screw were used, with 4.9mm bolts used for distal locking. With a 6 degree varus angulation and different neck shaft angles, the nail was universal.

OPERATIVE TECHNIQUE FOR PROXIMAL FEMORAL NAIL

ANAESTHESIA:

The majority of the cases were done under either spinal or combined epidural anaesthesia. General anaesthesia was favored in some cases.

PATIENT POSITIONING AND FRACTURE REDUCTION:

After anaesthesia was administered, the patient was placed in fracture table in a supine attitude, with the affected limb adducted and the fracture aligned under C-arm guidance with traction and internal rotation. To accommodate the image intensifier, the unaffected leg was abducted.

The patients were scrubbed, and their sections were painted and draped in the same way as they would be for a typical hip fracture fixation. Before surgery, patients were given antibiotics as a precaution.

Patients positioning on a fracture table

APPROACH:

In obese patients, the tip of GT was located through palpation or, by using an image intensifier. A 5-centimeter longitudinal incision was made proximal to the trochanter's tip. The fascia lata was opened parallel to the incision, the gluteus medius was split parallel to the fibers, and the trochanter tip was exposed.

Lateral Approach

ENTRY POINT AND INSERTION OF GUIDE WIRE:

The entry point was made on the tip (medially) of GT using a straight bone awl. The cancellous bone was pierced with an awl before the marrow was exposed. The guidewire was then passed along the same route into the marrow and directed through the fracture with a T handle under image intensification.

Entry Point

OPENING OF FEMUR:

A cannulated rigid reamer no. 14 was used for manual reaming to insert the proximal end of the proximal femoral nail.

Opening of femoral canal

Intramedullary guidewire

INSERTION OF THE NAIL:

After verifying adequate reduction, an adequate size nail was selected and manually passed through the guiding wire using gentle movements of the handle until the 8mm hip screw hole in the image intensifier aligned with the inferior aspect of the neck. Open reduction was used in situations where satisfactory reduction was not feasible. The guide wire was eventually removed.

INSERTION OF GUIDE WIRES FOR THE NECK SCREWS:

The aiming system is closely attached to the insertion handle, and the necessary guide wire sleeves are used to insert these. After a stab incision for the 8 mm neck pin, a 1.8mm guide wire was threaded through the sleeves. To prevent the guide wires from being misdirected, the sleeves were made to fit close to the lateral cortex. For the 8 mm hip screw, a guide wire was placed through the inferior pole of femoral neck and center in AP and lateral views respectively.

A second guide wire was inserted through the proximal hole to enable the 6.5mm derotation screw to be inserted.

Guidewire into the femoral neck

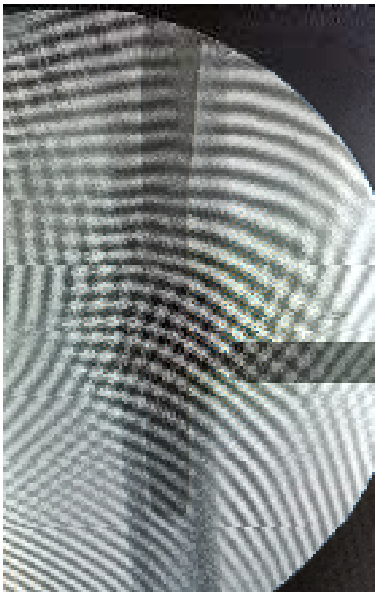
INSERTION OF HIP AND DEROTATION SCREWS:

The derotation screw was inserted first to prevent the proximal fragment from rotating when the hip screw was inserted. The 6.5mm cannulated drill was utilised up to the previously determined length. With the aid of a hexagonal cannulated screw driver, the screw length was inserted as measured previously and validated by a similar length guide wire. Before removing the guide wire, the length and location were checked using an image intensifier. The neck was opened over the guide wire to the desired length using an 8mm cannulated drill. Over the guide wire, tapping was performed. The hexagonal cannulated screw driver was used to insert the necessary 8mm hip screw. Under image intensifier, the final location was verified.

Insertion of Neck screws

DISTAL LOCKING:

4.9mm locking bolts are commonly used for distal locking. Aiming via the handle was used for the regular PFN. Until distal locking, traction was released to achieve compression at the fracture site. A stab incision through the targeting device was used to mount the drill sleeve framework. Drill holes were drilled through both cortices with a 4mm drill bit. The drill marking was used to determine the duration. The locking bolt was inserted into the sleeve and checked with an image intensifier.



Distal locking

CLOSURE:

After the fixation was completed, the wound was thoroughly washed with regular saline. If necessary, a suction drain was inserted and sterile wound closure was done. A sterile dressing was added, as well as a compression bandage.

POST-OPERATIVE REHABILITATION:

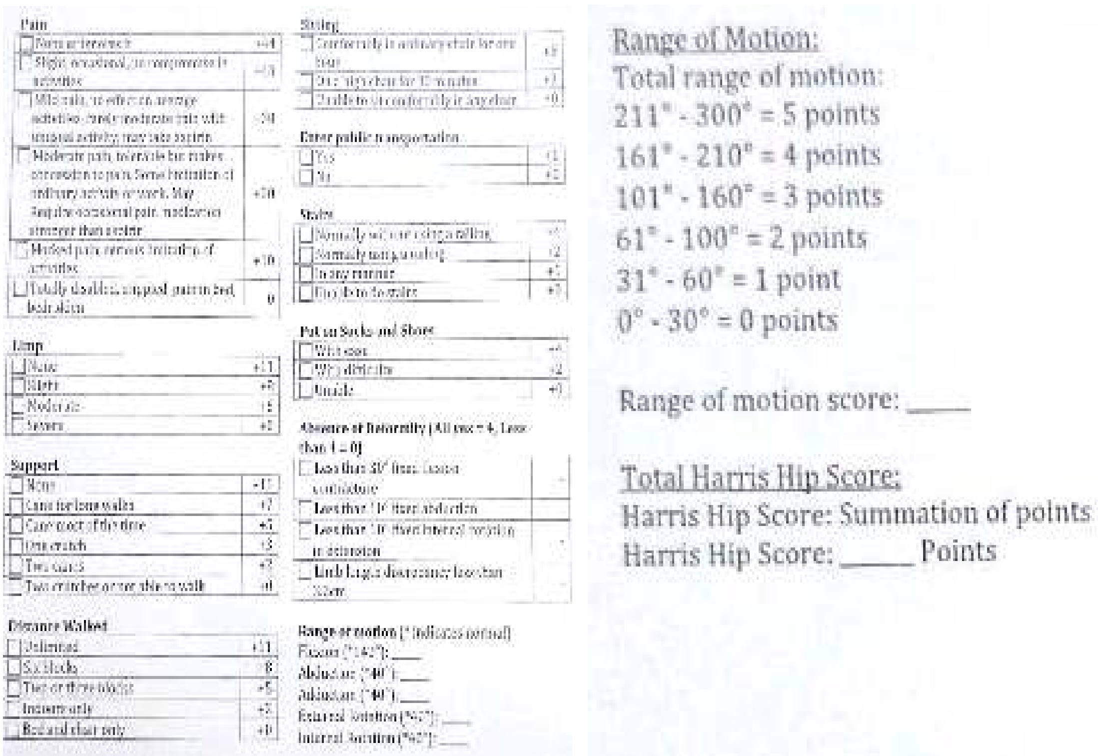
The patient's vital signs were monitored. Overnight, the foot end was elevated. Drain was monitored. Antibiotics were provided in accordance with hospital policy. Analgesics were given based on the patient's compliance. Blood transfusions were provided based on the patient's preoperative condition and intraoperative blood loss. On the third day, patients were advised to sit in bed and taught quadriceps exercises and knee mobilisation. On the 10th to 12th postoperative day, the sutures were removed. The following was the post-operative weight-bearing protocol used at our institution:

NWB- 3rd Post-operative day to 3 weeks of post-operative care.

PWB- 3 Weeks post-operative to 10 weeks post-operative.

FWB - >10 weeks post-operative / signs of radiological union.

Patients were discharged from hospital at various times based on their general health and wound status.


Pain

Limp

Support

Distance Walked

Sitting

Enter public transportation

Stairs

Put on Socks and Shoes

Range of motion

Range of Motion:
Total range of motion:
211° - 300° = 5 points
161° - 210° = 4 points
101° - 160° = 3 points
61° - 100° = 2 points
31° - 60° = 1 point
0° - 30° = 0 points

Range of motion score: _____

Total Harris Hip Score:
Harris Hip Score: Summation of points
Harris Hip Score: _____ Points

Figure 20: MHHS [40]

GRADING FOR HARRIS HIP SCORE:-

EXCELLENT: - 90-100

GOOD: -80-89

FAIR: -70-79

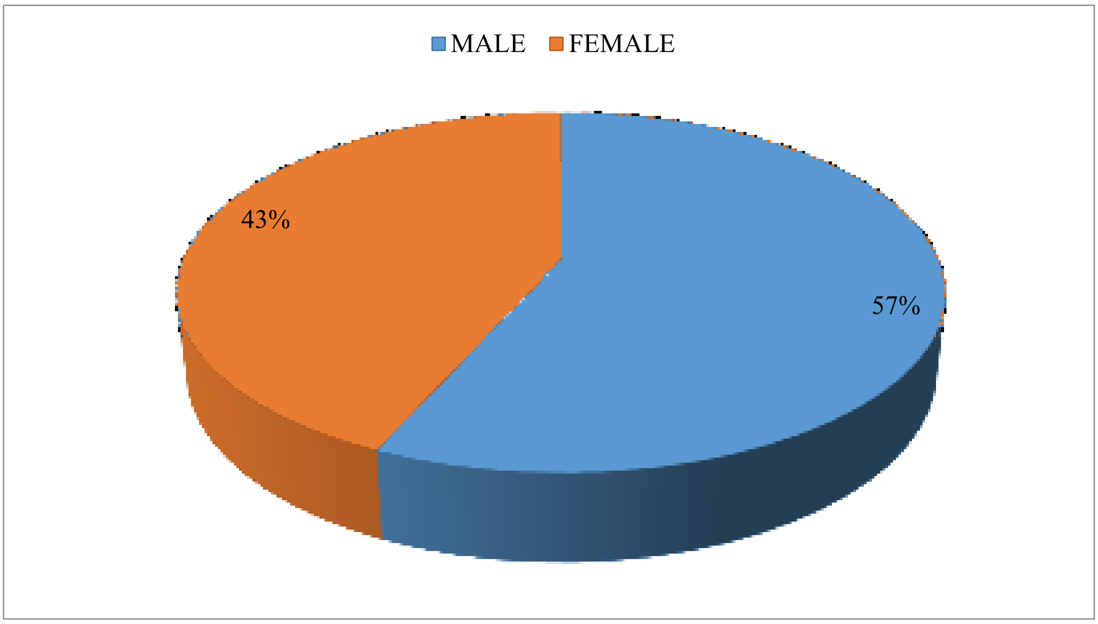
POOR:-<70

RESULTS

Table 1: Study participant were divided into two groups based on their gender

	NUMBER	PERCENTAGE
FEMALE	13	43.33
MALE	17	56.67
TOTAL	30	100

Figure 21: Pie chart showing Study participant were divided into two groups based on their gender



The overall number of patients included in the study was 30, with 17 (56.67%) male patients and 13 (43.33%) female patients.

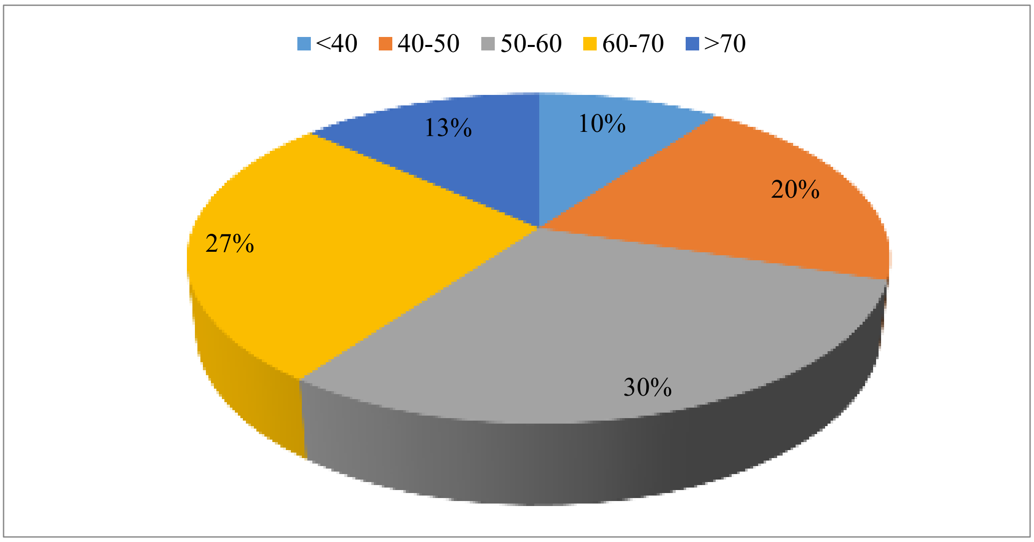
Table 2: Age distribution

AGE (YRS)	NUMBER	PERCENTAGE
< 40	3	10.00
40-50	6	20.00
50-60	9	30.00
60-70	8	26.67
≥ 70	4	13.33
TOTAL	30	100.00

AGE (YEARS)

MEAN	S.D.	MINIMUM	MAXIMUM
55.90	13.18	28	85

Figure 22: Pie chart showing age distribution

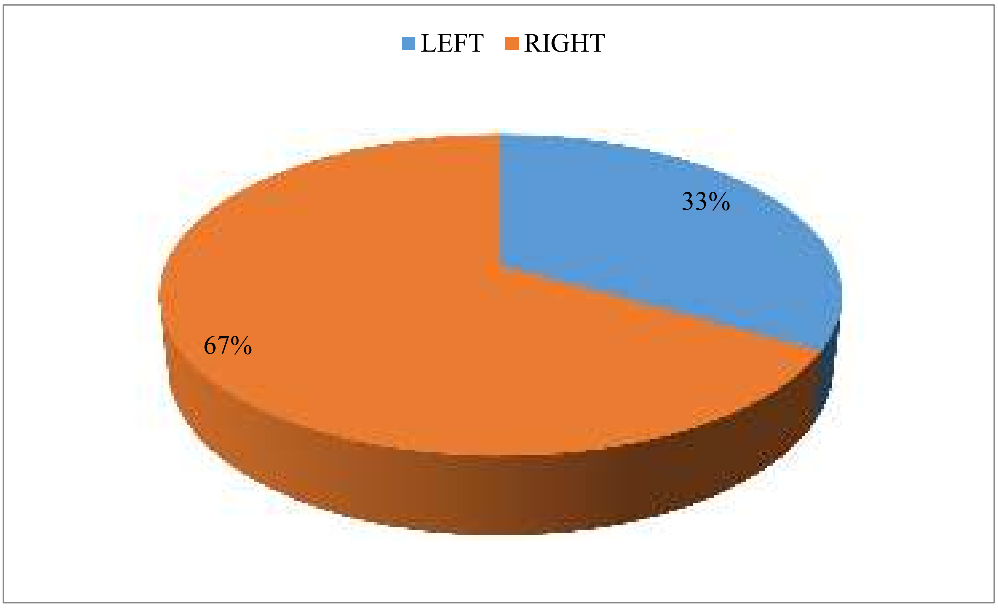


A total of 9(30%) patients belong to age group 50-60 years followed by 8(26.67%) patients between 60-70 years:6(20%) patients between 40-50 years: 4(13.33%) patients between >70 years: 3(10%) patients <40 years old.

TABLE 3: Affected side to side distribution of study participants

	NUMBER	PERCENTAGE
FEMALE	13	43.33
MALE	17	56.67
TOTAL	30	100.00

Figure 23: Pie chart demonstrating the side to side distribution of study participants

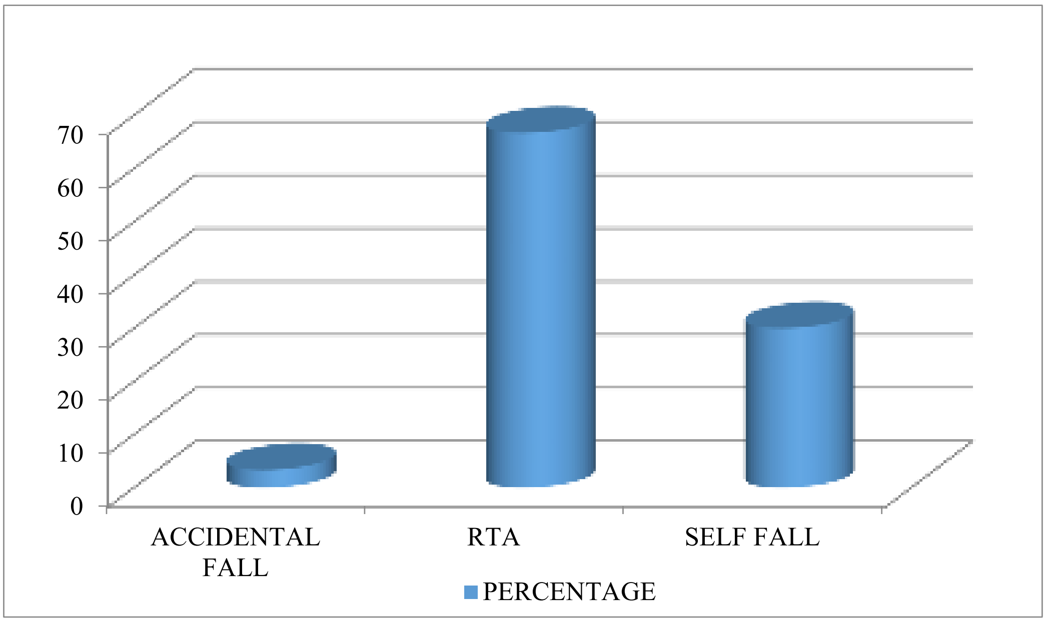


When compared to the left, a greater number of patients presented with an IT fracture on the right side. In comparison to the left side, there were 20 (66.67%) more right-sided fractures (33.33%).

Table 4: Distribution of Participants according to the mode of injury

MODE OF INJURY	NUMBER	PERCENTAGE
ACCIDENTAL FALL	1	3.33
RTA	20	66.67
SELF FALL	9	30.00
TOTAL	30	100.00

Figure 24: Bar Graph representing the mode of injury

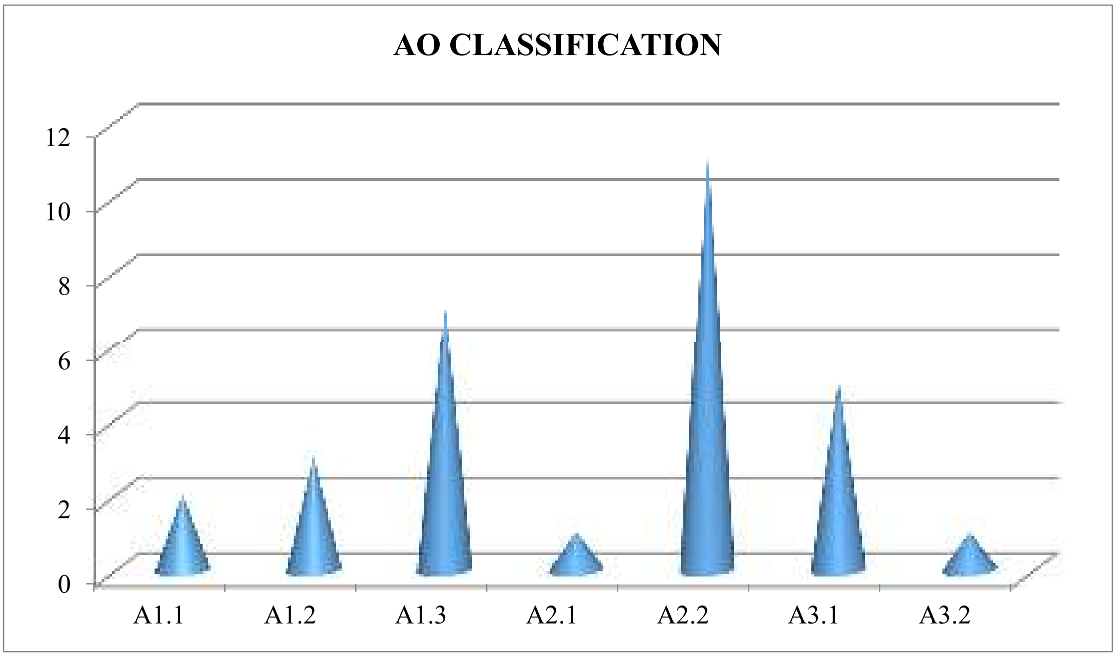


In our study 20 (66.67%) patient had a RTA, 9 (30%) patient had a history of Self fall whereas 1 (3.33%) patient.

Table 5: Distribution of the patients according to AO Classification

AO CLASSIFICATION	NUMBER	PERCENTAGE
A1.1	2	6.67
A1.2	3	10
A1.3	7	23.33
A2.1	1	3.33
A2.2	11	36.67
A3.1	5	16.67
A3.2	1	3.33
TOTAL	30	100

Figure 25: Bar graph showing case distribution based on AO Classification



In our study the IT fracture patients were classified according to AO Classification as follows-A2.2 11(36.67%) patients, A1.3 7(23.33%) patients, A3.1 5(16.67%) patients, A1.2 3(10%) patients, A1.1 2(6.67%)patients, A3.2 3(3.33%) patients, A2.1(3.33%) patients.

PARTIAL WEIGHT BEARING (IN WEEKS)

MEAN	S.D.	MINIMUM	MAXIMUM
5.57	1.98	3	13

FULL WEIGHT BEARING (IN WEEKS)

MEAN	S.D.	MINIMUM	MAXIMUM
10.34	3.03	6	19

HOSPITAL STAY (IN DAYS)

MEAN	S.D.	MINIMUM	MAXIMUM
10.07	6.05	3	27

In the following tables p value is calculated (using student's paired t test). Comparison is made with respect to the immediate previous records

NS - NOT SIGNIFICANT

S - SIGNIFICANT

VS - VERY SIGNIFICANT

HS - HIGHLY SIGNIFICANT

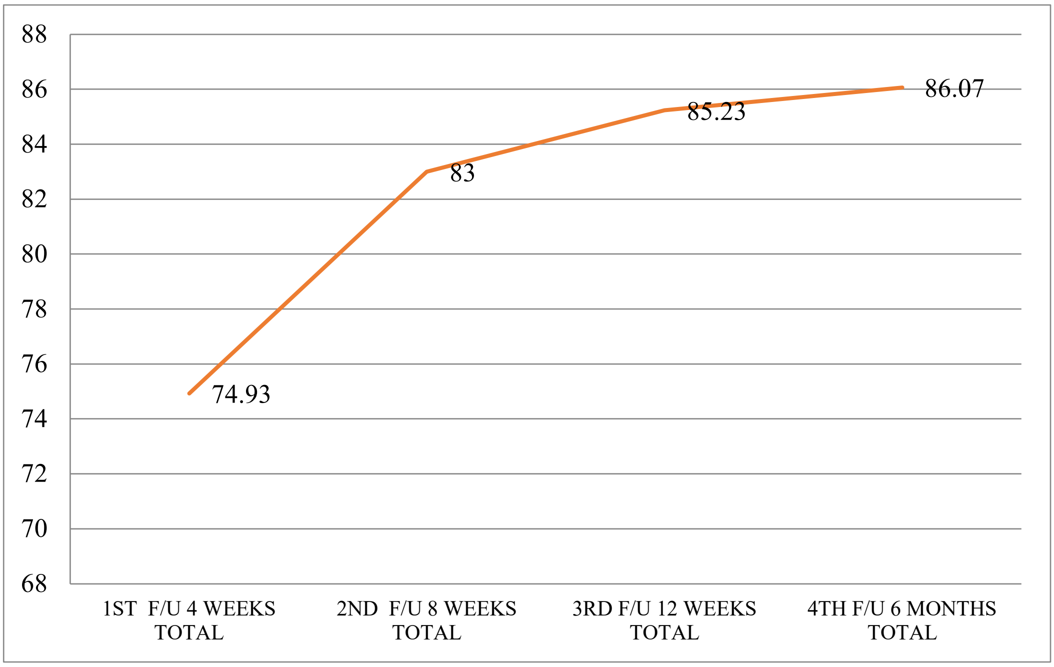
P VALUE	**INFERENCE**
--	--
0.0002	HS

MEAN MODIFIED HARRIS HIP SCORE

Table 6: Follow up of the patients months with mean MHHS

	MEAN	S.D.	MINIMUM	MAXIMUM
1ST F/U 4 WEEKS TOTAL	74.93	8.28	54	82
2ND F/U 8 WEEKS TOTAL	83.00	8.19	62	90
3RD F/U 12 WEEKS TOTAL	85.23	8.39	66	94
4TH F/U 6 MONTHS TOTAL	86.07	8.46	67	95

Figure 26: Follow up of the patients with mean MHHS

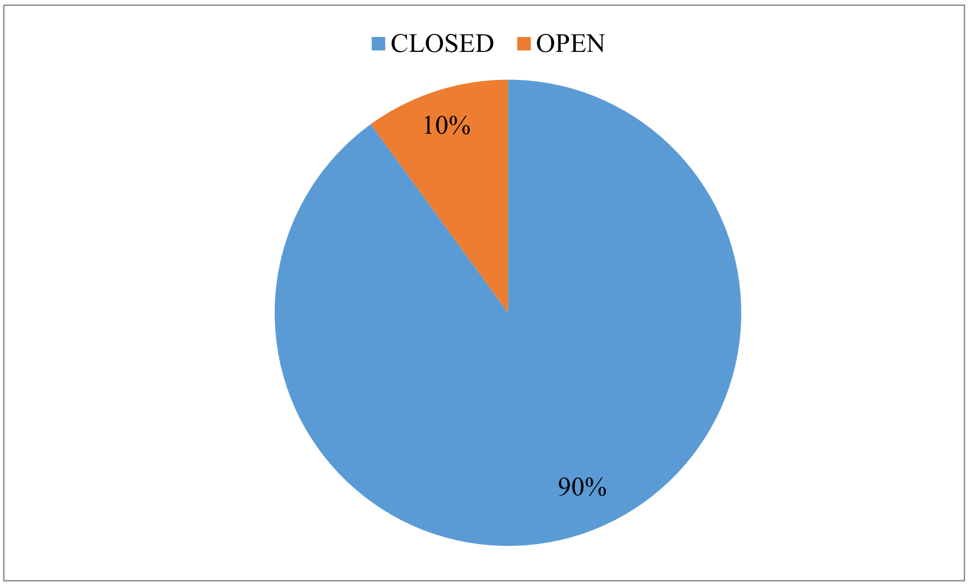


The Mean MHHS at 4 weeks (74.93±8.28), 8 weeks (83±8.19), 12 weeks (85.23±8.39), and 6 months (86.07±8.46) were noted.

Table 7: Intraoperative reduction technique

INTRA OPERATIVE REDUCTION	NUMBER	PERCENTAGE
CLOSED	27	90
OPEN	3	10
TOTAL	30	100

Figure 27: Pie chart representing intraoperative reduction technique

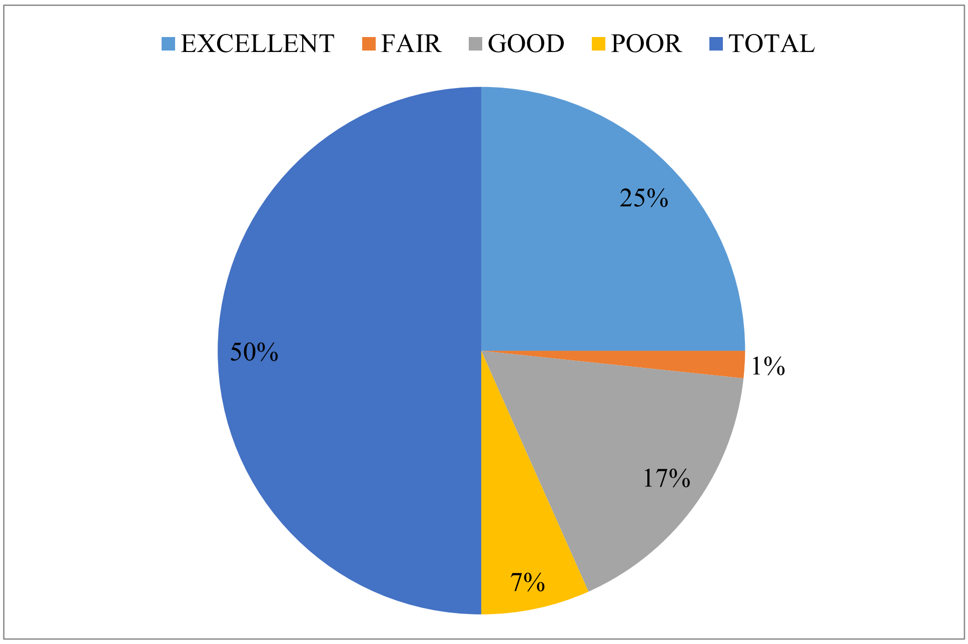


In our study we had difficulty in closed reduction in 3 (10%) patients for which open reduction was performed. 27(90%) patient underwent closed reduction.

Table 8: Functional outcome of IT fracture using MHHS

OUTCOME	NUMBER	PERCENTAGE
EXCELLENT	15	50
FAIR	1	3.33
GOOD	10	33.33
POOR	4	13.33
TOTAL	30	100

Figure 28: Pie chart representing the functional outcome of IT fractures using MHHS

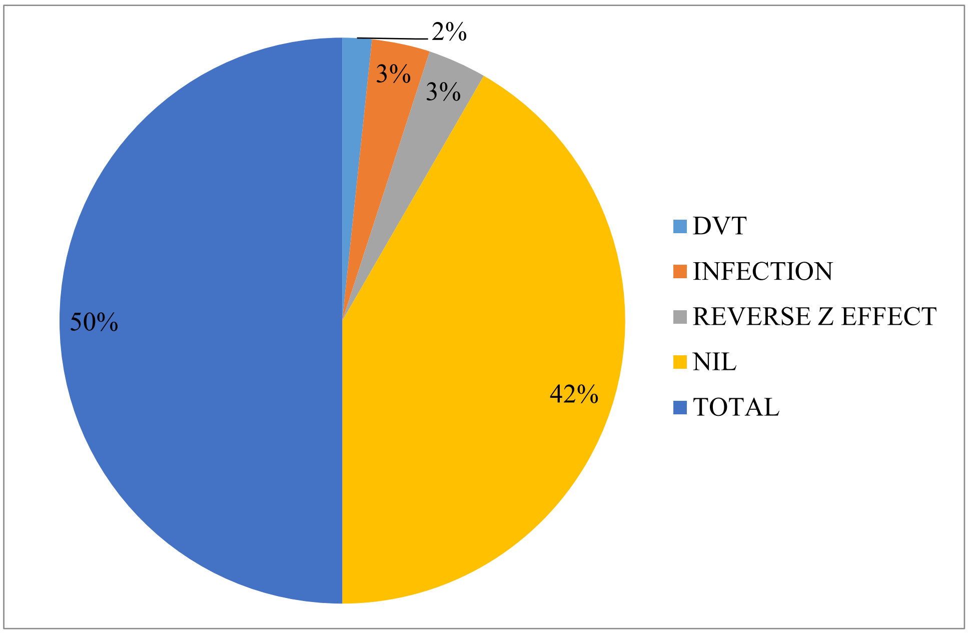


In our study 15 (50%) patient had excellent outcome, 10 (33.33 %) patient had good outcome, 1 (3.33%) patient had fair outcome, 4(13.33%) patient had poor outcome.

Table 9: Complications

COMPLICATIONS	NUMBER	PERCENTAGE
DVT	1	3.33
INFECTION	2	6.67
REVERSE Z EFFECT	2	6.67
NIL	25	83.33
TOTAL	30	100.00

Figure 29: Pie chart representing complications



5 complications were noted in our study, 2(6.67%) were infection, 2(6.67%) were Reverse Z effect and 1(3.33%) was DVT.

DISCUSSION

Trochanteric fractures are becoming more common in the recent times. These fractures are most common in elderly individuals with various medical comorbidities, and they frequently result in deterioration in the patient's functional prognosis. A high union rate with fewer sequelae should emerge from effective care of these injuries. The surgeon cannot control the quality of bone, patient compliance, or comorbidities in old age patients, but he should be able to reduce the morbidity associated with fracture by executing a correct reduction with an optimal implant while keeping implant cost in mind [72].

Fixation failure is commonly caused by instability of fracture fixation, osteoporosis, a loss of anatomic reduction, failure of implant which results in screw being cut out. PFN provides many advantages, such as reducing the moment arm, using a closed method, and preserving the hematoma present in the fracture, which is a critical factor in bone healing [73].

The stress induced on the intramedullary implants is low due to their proximity to the weight-bearing axis. PFN is currently an accepted and minimally invasive implant for proximal femoral fractures. Quality of life and function are typically essential measures for both patients and health care providers. The capacity to conduct daily activities such as walking, squatting, cross-legged sitting, and ascending stairs was satisfactory in patients who had intertrochanteric fracture fixation with PFN [74].

PFN consequences include screw-loosening collapse and subsequent varus. According to Herera et al. screw migration caused an 8 percent collapse of the fracture site. Menezes et al. found lateral femoral screw displacement in just one of 129 patients who were observed for a year. We discovered posterior screw displacement in two participants in our investigation, and both subjects exhibited varus angulations of 5 Degree – 10 Degree (varus angulations of 7 Degree – 9 degree).

Banan et al. documented diaphysial fracture over the inferior aspect of nail in 2 of 46 patients and Fogagnolo et al. in one of 47 subjects. In two cases, Tyllianakis et al. discovered implant breakage at distal locking. In three participants, Rappold et al. reported implant breakage at femoral neck level. In our study, neither a femoral shaft fracture nor an implant break was observed.

Z-effect (ZE) is defined as hip pin migration into the joint during the postoperative loading period. The reverse ZE refers to the outward displacement of an antirotation screw. Papapismos et al. observed ZE in four participants and reverse ZE in one, Tylianakis et al. observed ZE in 5 cases and reverse ZE in one, and Boldin et al. observed ZE in 3 cases and ZE in two. In our study, reverse ZE was seen in two patients. Both patients had a poor functional outcome. Both patients underwent a second operation for screw removal.

Following the use of PFN, especially if two screws are utilized for distal locking, a cortical reaction in the femur may occur, resulting in thigh pain. Hardy et al. collected the material from three of six participants with cortical hypertrophy in their series. Distal locking was achieved in our series using two locking screws, although cortical thickening was not seen [75].

Minos Tyllianakis performed closed reduction and less incision in 40 patients of proximal femur nailing for extra capsular hip fractures, whereas we did open reduction in 3 of our cases [76].

In a retrospective analysis of 30 cases that underwent surgical intervention with PFN for unstable IT fractures, Ashutosh Goswami et al observed that 74% cases demonstrated an excellent/good outcome. In our research 83% patients had excellent/good results [77].

CONCLUSION

The proximal femur nail has expanded the scope for intramedullary nailing for more challenging proximal femur fractures. Closed reduction causes less tissue injury, retains the hematoma at fracture site, decreases bleeding, and shortens surgical duration.

PFN provides a stable fracture reduction, reduces load, and enhances chances of faster mobilization. It provides better stabilization than other implants currently used to treat similar fractures.

The majority of problems are attributable to the surgeon and the instruments that are reduced by efficiently choosing the patient that is suited for the study. Due to rising frequency in young age, the treating surgeons are under more desire to restore near normal limb outcome.

Our study discovered that using PFN for the management of IT fractures provides a satisfactory functional outcome as well as benefits such as low blood loss, early weight bearing, and few problems. It is the preferred implant for IT fractures.

SUMMARY

- This was a one year hospital based prospective study. This included 30 patients.
- The Functional outcome of the patients was assessed on the basis of MHHS.
- Most commonly encountered method of injury was Vehicle accidents (66.67%) followed by self-trauma (30%).
- Majority of the patient belonged to A2.2 (36.67%) followed by A1.3 (23.33%).
- Follow up were at 4 weeks, 8 weeks, 12 weeks and 6 months.
- Results with Intramedullary nail were found to be excellent with good union rates.
- Average duration of Patients' hospitalisation was 10.07 ± 6.05 days.
- PWB was started in 5.57 ± 1.98 weeks.
- FWB was started in 10.34 ± 3.03 weeks.
- Closed reduction was done in 20 patients and 3 patients required open reduction.
- Intramedullary nail prevented significant shortening of head and neck segment in the fracture.
- The MHH score were as follows:
  1) Excellent-15 cases (50.00%)
  2) Good in 10 cases (33.33%),
  3) Fair in 1 case (3.33%)
  4) Poor in 4 cases (13.33%)
- 5 (16.67%) patients had complication in the study.

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ANNEXURE I – CONSENT FORM

INFORMED CONSENT

TITLE OF THE STUDY: "FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURE TREATED WITH PROXIMAL FEMORAL NAIL- A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY" is being conducted by ____________________ Post graduate in Orthopaedics Department at J.N. Medical College, Belgaum, Karnataka. Under guidance of ____________________, Department of Orthopaedics, J.N. Medical College, Belgaum under KLE university, Belgaum.

Respected………………,

We request you to participate in our study as you are eligible to be included. During the study you will be asked questions regarding your present and past medical history and you are supposed to answer to the best of your knowledge.

Your participation in this study is voluntary. Your decision whether or, not to participate will not affect your relationship with J.N.M.C. If you decide to participate you are free to withdraw at any point of time.

INTRODUCTION AND PURPOSE:

Intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly with porotic bones, usually due to low-energy trauma like simple falls. Problems of these fractures are (1) association with substantial morbidity and mortality, (2) malunion, (3) great financial burden to the family and (4) associated medical problem like diabetes, hypertension.

The main purpose of the current study is to; assess the functional outcome and complications of these patients with intertrochanteric hip fractures treated with intramedullary nail, with regard to functional mobility, stability and the range of movements using Modified Harris Hip Score.

PROCEDURE

If you Consent to be in this study, the relevant data is collected as per the proforma, and the final diagnosis is confirmed after correlating both clinical and radiological evidences. The subject is then posted for the proposed surgery after obtaining the fitness for surgery and the type of implant will be selected according to the fracture pattern. Patient will be discharged accordingly and would be followed up with post-operative X-rays and regular physiotherapy. The patients will be followed up at 4 weeks, 6 weeks and 12 weeks and 6 months till radiological union was seen. Radiographs will be taken in AP and Lateral views to look for signs of radiological union. At every follow up clinical examination would be done. Clinical union would be there if fracture site becomes stable and pain free. The time taken for radiological and clinical union would be noted down.

You will also be observed for any kind of complication and if present will be treated.

The advantages of intramedullary implant are :

1. A closed reduction and less soft tissue dissection, therefore more biological fixation.
2. Shorter surgical time.
3. Less blood loss.
4. Improved early patient mobility at 1 and 3 months postoperatively

Disadvantages are:

1. Thigh pain has been reported to occur in 17% of patients.
2. The rate of cutout of first-generation intramedullary nails from the femoral head has ranged from 2% to 4.3%.
3. Rotational deformity and back out of nail with resultant pain and stiffness may occur.
4. Non union
5. Intramedullary implants are associated with unique implant related complications such as:
   - i. Shaft fracture, due to stress riser effect.
   - ii. Penetration of anterior femoral cortex.
   - iii. Missed targeting of locking.
   - iv. Implant disengagement.

ALTERNATIVES:

Even if you decline the participation in study, you will get the routine line of management.

VOLUNTARY PARTICIPATION/WITHDRAWAL:

Taking part in this study is voluntary. I may choose not to take part in this study, or if I decide to take part I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive.

COSTS:

The cost to the patient of the implant, would come to around 7000/- and would be explained to the patient.

COMPENSATION:

As the subject voluntarily consents to be a part of the study, no compensation will be given.

CONFIDENTIALITY:

All information collected about the subject during the course of the study will be kept confidential to the extent permitted by the law. The code numbers will identify the subject in this research record. Information from this study may be published but the subjects identity will be confidential in any publication.

QUESTION:

If you have any questions about the rights of a research participant, you can contact **Dr ROOPA BELLAD**, Professor, Dept of Paediatrics and Chairman Ethical Committee on Human subjects, J.N Medical College Belagavi.

CONSENT TO PARTICIPATE IN RESEARCH STUDY:

I voluntarily agree to take part in this study by signing below. I may withdraw at any time. I am not giving up any of my legal rights by signing this form. My signature below indicated that I have read this entire consent form or it has been read to me, and had all my questions answered. I will be given a copy of this consent form.

Signature of the Participant or legally authorized representative.

Participant's Name	: ……………………………….
Signature	: ……………………………….
Name of the legally authorized representative	: ……………………………….
Signature	: ……………………………….
Witness's Name	: ……………………………….
Signature	: ……………………………….
Investigators name and Signature	: ……………………………….
Date and Place	: ………………………………

ANNEXURE-II PROFORMA

"FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURE TREATED WITH PROXIMAL FEMORAL NAIL- A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY"

PATIENT NO: IP NO:

NAME:

AGE: SEX:

ADDRESS:

OCCUPATION:

DOA: DOS: DOD:

CHIEF COMPLAINTS:

PRESENTING COMPLAINTS:

Pain

Swelling

Instability

Deformity

HISTORY OF PRESENT ILLNESS:

NATURE OF INJURY:

Road Traffic Accident

Self-fall

Others

MODE OF INJURY:

Direct

Indirect

DURATION SINCE INJURY:

…………days

a) History of Diabetes Mellitus, Hypertension, Asthma, Rheumatoid Arthritis, Tuberculosis and other chronic illness

Yes

No

Previous history of intertrochanteric fracture

Yes

No

Previous history of any medication received:

PERSONAL HISTORY:

Diet : Veg/ Mixed/ Non-veg

Appetite : Increased or Decreased

Habits : Smoking/ Alcohol /Tobacco chewer / others

Bowel & Bladder Habits: Normal or Abnormal

FAMILY HISTORY:

GENERAL PHYSICAL EXAMINATION:

Built : Well/Moderate/Poor

Temperature: Pulse:

Blood Pressure: Respiratory Rate:

Pallor

Cyanosis

Icterus

Clubbing

Pedal edema

Lymphadenopathy

SYSTEMIC EXAMINATION:

Cardiovascular System Examination:

Respiratory System Examination:

Per Abdomen Examination:

Central Nervous System Examination:

LOCAL EXAMINATION:

INSPECTION:

Lower Limb Involved RIGHT LEFT

Pain

Attitude

Skin: Blebs / Ecchymosis / Avulsed / Bruise

Swelling

Effusion

Deformity

PALPATION:

Tenderness

Abnormal mobility

Loss of transmitted movement's and continuity of bone

Peripheral Pulses: Dorsalis pedis / Posterior Tibial

Neurovascular Deficits: (Tingling numbness, Power)

Yes

No

Presence of any associated injury:

Yes

No

If yes specify

RANGE OF MOVEMENTS:

Hip joint movements- Flexion: Extension:

RELEVANT INVESTIGATIONS:

1. CT SCAN
2. X RAY OF HIP JOINT
3. ROUTINE INVESTIGATIONS:

BLOOD: Hb%, TLC, DLC, ESR, Platelet Count, Blood Grouping, CRP, RBS, Coagulation profile

4. HIV, HbsAg, HCV
5. URINE: albumin, sugar, microscopy.

DIAGNOSIS:

1. CT SCAN
2. X RAY OF HIP JOINT

TREATMENT:

FIRST AID: 1. YES 2. NO

Fluid Replacement

Immobilization of the Injured Limb

Analgesics

Antibiotics

DEFINITIVE TREATMENT:

Relevant Investigations and Medical Fitness for Surgery

Yes

No

Anaesthesia

General

Spinal

Combined spinal epidural anaesthesia

Antibiotic Therapy: 1. Pre-operative 2. Post-operative

Analgesics

COMPLICATIONS:

Intraoperative: 1) YES 2) NO

Postoperative

Immediate: 1) YES 2) NO

Bleeding

Infection

Neurovascular damage

Compartment syndrome

Deep vein thrombosis

Duration of stay in hospital:

Range of movement of hip joint at discharge:

Flexion Extension

Physiotherapy:

Hip joint

Ankle and active toe movements

Static quadriceps exercises

Mobilization of knee and hip

Non weight bearing crutch walking/ walker

Time of full weight bearing

Follow up:

Date:

Serial no. :

Time since surgery:

Clinical union

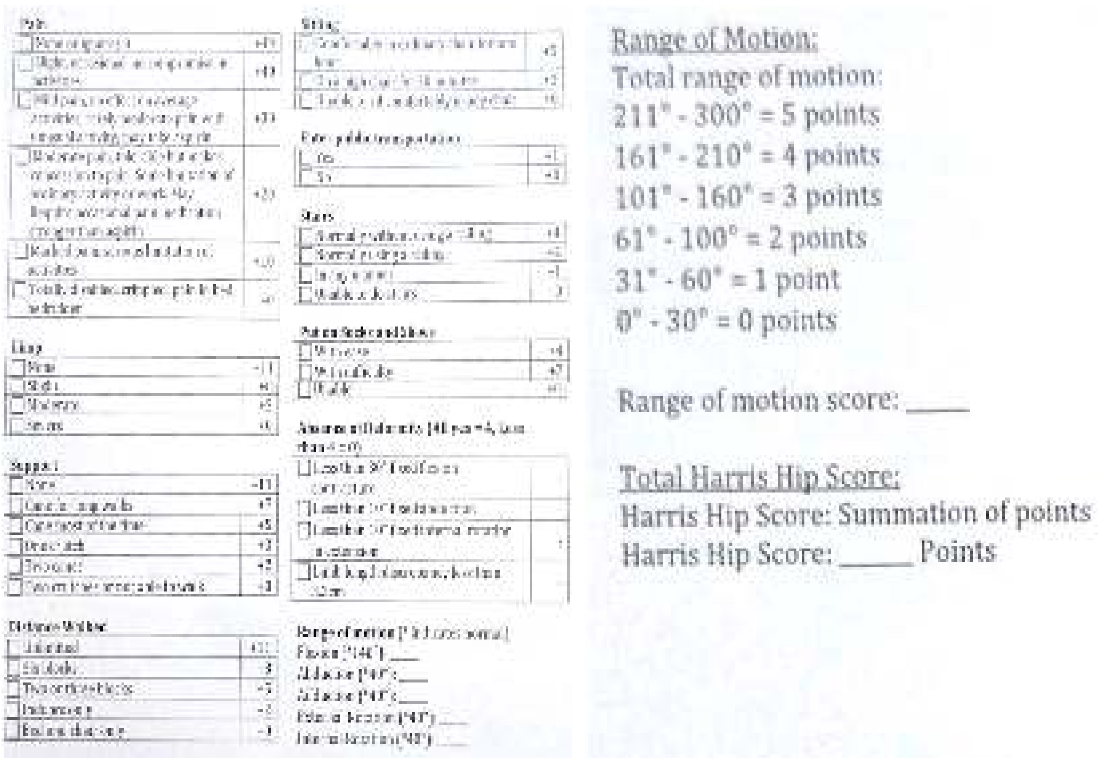
Range of movements

Final Deformity: Angulation Varus/ Valgus

Anterior / Posterior

Final Result: Excellent / Good / Fair / Poor

To be evaluated by Modified Harris Hip score-


Range of Motion:

Total range of motion:

211° - 300° = 5 points

161° - 210° = 4 points

101° - 160° = 3 points

61° - 100° = 2 points

31° - 60° = 1 point

0° - 30° = 0 points

Range of motion score: _____

Total Harris Hip Score:

Harris Hip Score: Summation of points

Harris Hip Score: _____ Points

GRADING FOR HARRIS HIP SCORE:-

EXCELLENT: - 90-100

GOOD: -80-89

FAIR: -70-79

POOR: -<70

ANNEXURE-III- ETHICAL CLEARANCE LETTER

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to- be University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)

Website: http://www.jnmc.edu
E-Mail : dome@jnmc.edu
Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/ 248. **Date: 24/12/2019**

To,
REG NO. BL0119001
PG student in Orthopaedics,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURE TREATED WITH PROXIMAL FEMORAL NAIL – A ONE YEAR HOSPITAL BASED PROSPECTIVE STUDY "**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

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ANNEXURE IV – PHOTOGRAPHS

CLINICAL CASES

CASES – PFN SERIES

CASE 1

Pre-operative x-ray **Post-operative x-ray**

6 Months Follow up

CASE 2

Pre-Operative x-ray **Post-Operative x-ray**

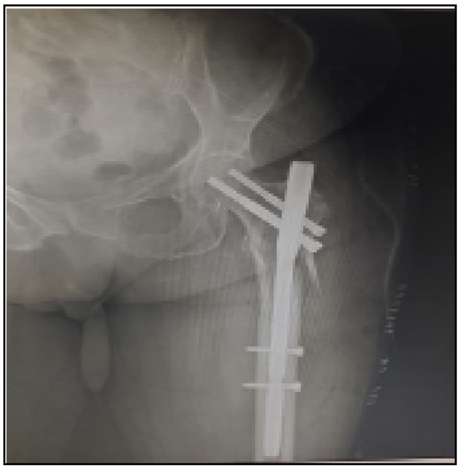
6 Months Follow up

CASE 3

Pre-operative x-ray **Post-operative x-ray**

3 Months Follow up

CASE 4



Pre-operative x-ray **Post-operative x-ray**

6 Months Follow up

COMPLICATION OF PFN

CASE 1


Pre-operative x-ray **Post-operative x-ray**

REVERSE Z EFFECT

CASE 2


REVERSE Z EFFECT

ANNEXURE-V

KEY TO MASTER CHART

M	-	Male
F	-	Female
R	-	Right
L	-	Left
RTA	-	Road Traffic Accident
O	-	Operative
P	-	Present

ANNEXURES V - MASTER CHART

SR. NO.	IP NUMBER	AGE	GENDER	OCCUPATION	DOMINANT SIDE	SIDE AFFECTED	AO CLASSIFICATION	MODE OF INJURY	DIRECT INJURY	POST-INJURY PERIOD FOR SURGERY ()	HOSPITAL STAY	MANAGEMENT	MODIFIED HARRIS HIP SCORE: 1ST F/U 4 WEEKS TOTAL	2ND F/U 8 WEEKS TOTAL	3RD F/U 12 WEEKS TOTAL	4TH F/U 6 MONTH TOTAL	OUTCOME	**SATISFACTION (/10)**	TIME TO UNION (IN WEEKS)	PARTIAL WEIGHT BEARING(IN WEEKS)	FULL WEIGHT BEARING(IN WEEKS)	COMPLICATIONS: INTRA OPERATIVE: REDUCTION	RADIATION(SECONDS)	POST OPERATIVE: IMMEDIATE: DVT	INFECTION	LATE: CHRONIC INFECTION	MALALIGNMENT	REVERSE Z EFFECT	NON-UNION
1	949337	59	F	HOUSEWIFE	R	R	A2.2	RTA	DIRECT	4	20	O	74	86	88	90	EXCELLENT	10	14.2	4	8	CLOSED	65						
2	955013	42	F	HOUSEWIFE	R	R	A1.2	SELF FALL	DIRECT	1	4	O	76	88	89	92	EXCELLENT	10	13.3	6	9	CLOSED	45						
3	9622753	39	F	HOUSEWIFE	R	R	A1.1	SELF FALL	DIRECT	4	27	O	78	89	90	91	EXCELLENT	10	12.3	5	8	CLOSED	40						
4	969675	55	F	HOUSEWIFE	R	R	A2.2	RTA	DIRECT	1	6	O	76	86	87	89	GOOD	10	14.3	3	7	CLOSED	60						
5	959734	43	F	HOUSEWIFE	R	L	A1.3	SELF FALL	DIRECT	4	25	O	80	90	91	93	EXCELLENT	10	10.2	3	6	CLOSED	48						
6	960119	63	F	SHOPKEEPER	L	L	A3.1	RTA	DIRECT	3	17	O	75	85	87	88	GOOD	10	11.6	4	8	CLOSED	74						
7	967546	44	M	FARMER	R	R	A2.2	RTA	DIRECT	2	8	O	56	65	67	67	POOR	10	15.3	7	7	CLOSED	85						
8	967973	52	M	SERVICEMAN	R	L	A2.2	RTA	DIRECT	2	6	O	76	81	83	83	GOOD	10	14.1	7	12	CLOSED	87						
9	965308	70	M	RETIRED	L	R	A1.3	ACCIDENTAL FALL	DIRECT	5	7	O	79	82	88	89	GOOD	9	12.6	6	10	CLOSED	40						
10	967234	46	F	HOUSEWIFE	R	R	A2.2	RTA	DIRECT	1	11	O	82	89	92	93	EXCELLENT	10	11.8	5	9	CLOSED	90						
11	962416	52	M	SERVICE MAN	R	L	A1.2	RTA	DIRECT	3	12	O	80	88	91	92	EXCELLENT	10	13.5	4	9	CLOSED	35						
12	970365	56	F	HOUSEWIFE	L	L	A2.2	RTA	DIRECT	1	7	O	82	89	94	94	EXCELLENT	10	12.4	5	9	CLOSED	70						
13	977656	66	F	HOUSEWIFE	R	L	A3.1	SELF FALL	DIRECT	2	11	O	80	88	90	90	EXCELLENT	10	13.6	6	10	OPEN	110		P				
14	982082	68	M	RETIRED	R	L	A2.2	RTA	DIRECT	2	15	O	82	90	94	95	EXCELLENT	9	10.5	3	7	CLOSED	70						
15	986829	38	M	FARMER	L	L	A1.3	RTA	DIRECT	2	7	O	80	87	89	90	EXCELLENT	10	11.5	4	8	CLOSED	45						
16	986287	50	M	RETIRED	R	R	A1.2	RTA	DIRECT	2	6	O	79	88	90	91	EXCELLENT	10	11.2	4	9	CLOSED	50						
17	986786	67	M	RETIRED	L	R	A1.3	RTA	DIRECT	1	7	O	75	82	83	84	GOOD	10	14.2	7	11	CLOSED	40						
18	987222	85	F	HOUSEWIFE	L	L	A2.2	SELF FALL	DIRECT	2	11	O	56	65	66	67	POOR	10	17.3	13	19	OPEN	105					P	
19	987245	55	M	SHOPOWNER	R	R	A1.3	RTA	DIRECT	2	5	O	67	77	78	79	FAIR	10	14.6	7	13	CLOSED	40	P					
20	988546	45	M	POLICE OFFICER	R	R	A2.2	RTA	DIRECT	1	7	O	78	88	90	91	EXCELLENT	10	13.6	6	14	CLOSED	50						

SR. NO.	IP NUMBER	AGE	GENDER	OCCUPATION	DOMINANT SIDE	SIDE AFFECTED	AO CLASSIFICATION	MODE OF INJURY	DIRECT INJURY	POST-INJURY PERIOD FOR SURGERY ()	HOSPITAL STAY	MANAGEMENT		MODIFIED HARRIS HIP SCORE 1ST F/U 4 WEEKS TOTAL	MODIFIED HARRIS HIP SCORE 2ND F/U 8 WEEKS TOTAL	MODIFIED HARRIS HIP SCORE 3RD F/U 12 WEEKS TOTAL	MODIFIED HARRIS HIP SCORE 4TH F/U 6 MONTH TOTAL	OUTCOME		**SATISFACTION (/10)**		TIME TO UNION (IN WEEKS)	PARTIAL WEIGHT BEARING(IN WEEKS)	FULL WEIGHT BEARING(IN WEEKS)		COMPLICATIONS INTRA OPERATIVE REDUCTION	COMPLICATIONS INTRA OPERATIVE RADIATION(SECONDS)	COMPLICATIONS POST OPERATIVE IMMEDIATE DVT	COMPLICATIONS POST OPERATIVE IMMEDIATE INFECTION	COMPLICATIONS POST OPERATIVE LATE CHRONIC INFECTION	COMPLICATIONS POST OPERATIVE LATE MALALIGNMENT	REVERSE Z EFFECT	NON-UNION
21	990267	50	M	DRIVER	R	L	A1.3	RTA	DIRECT	2	6	O		81	88	92	92	EXCELLENT		10		12.5	5	11		CLOSED	40						
22	992188	28	M	FARMER	R	R	A1.3	RTA	DIRECT	1	3	O		76	82	84	84	GOOD		10		11.6	4	9		CLOSED	40						
23	995859	80	M	RETIRED	R	R	A3.2	RTA	DIRECT	2	10	O		54	62	66	67	POOR		10		15.2	8			OPEN	100					P	
24	996919	65	M	RETIRED	L	R	A1.1	SELF FALL	DIRECT	1	8	O		75	82	84	85	GOOD		10		13.6	6	12		CLOSED	40		P				
25	996213	75	M	SHOPOWNER	L	R	A2.2	RTA	DIRECT	2	7	O		57	65	66	67	POOR		10		15.6	8	16		CLOSED	85						
26	1003739	65	M	RETIRED	R	R	A3.1	RTA	DIRECT	2	7	O		78	85	86	87	GOOD		10		14.3	6	15		CLOSED	75						
27	1008552	62	F	HOUSEWIFE	R	R	A3.1	SELF FALL	DIRECT	2	8	O		77	83	85	85	GOOD		10		15.3	5	9		CLOSED	70						
28	1003643	60	F	HOUSEWIFE	R	R	A3.1	SELF FALL	DIRECT	2	7	O		76	81	84	84	GOOD		10		14.6	5	11		CLOSED	80						
29	995667	55	F	HOUSEWIFE	R	R	A2.2	SELF FALL	DIRECT	1	7	O		82	90	92	92	EXCELLENT		10		13.4	5	10		CLOSED	85						
30	1052966	42	M	DRIVER	R	R	A2.1	RTA	DIRECT	8	20	O		81	89	91	91	EXCELLENT		10		14.4	6	14		CLOSED	85						

SR. NO.	IP NUMBER	AGE	GENDER	OCCUPATION	DOMINANT SIDE	SIDE AFFECTED	AO CLASSIFICATION	MODE OF INJURY	DIRECT INJURY	POST-INJURY PERIOD FOR SURGERY ()	HOSPITAL STAY	MANAGEMENT		MODIFIED HARRIS HIP SCORE						**SATISFACTION (/10)**		TIME TO UNION (IN WEEKS)	PARTIAL WEIGHT BEARING(IN WEEKS)	FULL WEIGHT BEARING(IN WEEKS)		COMPLICATIONS							
																										INTRA OPERATIVE		POST OPERATIVE					
																												IMMEDIATE		LATE			
														1ST F/U 4 WEEKS TOTAL	2ND F/U 8 WEEKS TOTAL	3RD F/U 12 WEEKS TOTAL	4TH F/U 6 MONTH TOTAL	OUTCOME								REDUCTION	RADIATION(SECONDS)	DVT	INFECTION	CHRONIC INFECTION	MALALIGNMENT	REVERSE Z EFFECT	NON-UNION

SR. NO.	IP NUMBER	AGE	GENDER	OCCUPATION	DOMINANT SIDE	SIDE AFFECTED	AO CLASSIFICATION	MODE OF INJURY	DIRECT INJURY	POST-INJURY PERIOD FOR SURGERY ()	HOSPITAL STAY	MANAGEMENT		MODIFIED HARRIS HIP SCORE						**SATISFACTION (/10)**		TIME TO UNION (IN WEEKS)	PARTIAL WEIGHT BEARING(IN WEEKS)	FULL WEIGHT BEARING(IN WEEKS)		COMPLICATIONS							
																										INTRA OPERATIVE		POST OPERATIVE					
																												IMMEDIATE		LATE			
														1ST F/U 4 WEEKS TOTAL	2ND F/U 8 WEEKS TOTAL	3RD F/U 12 WEEKS TOTAL	4TH F/U 6 MONTH TOTAL	OUTCOME								REDUCTION	RADIATION(SECONDS)	DVT	INFECTION	CHRONIC INFECTION	MALALIGNMENT	REVERSE Z EFFECT	NON-UNION

SR. NO.	IP NUMBER	AGE	GENDER	OCCUPATION	DOMINANT SIDE	SIDE AFFECTED	AO CLASSIFICATION	MODE OF INJURY	DIRECT INJURY	POST-INJURY PERIOD FOR SURGERY ()	HOSPITAL STAY	MANAGEMENT		MODIFIED HARRIS HIP SCORE						**SATISFACTION (/10)**		TIME TO UNION (IN WEEKS)	PARTIAL WEIGHT BEARING(IN WEEKS)	FULL WEIGHT BEARING(IN WEEKS)		COMPLICATIONS							
																										INTRA OPERATIVE		POST OPERATIVE					
																												IMMEDIATE		LATE			
														1ST F/U 4 WEEKS TOTAL	2ND F/U 8 WEEKS TOTAL	3RD F/U 12 WEEKS TOTAL	4TH F/U 6 MONTH TOTAL	OUTCOME								REDUCTION	RADIATION(SECONDS)	DVT	INFECTION	CHRONIC INFECTION	MALALIGNMENT	REVERSE Z EFFECT	NON-UNION