Introduction

With all the advancement in the field of technology, the road traffic accidents are increasing day by day. With the modern method of treatment and awareness of healthy living, average life expectancy of Indian population has increased almost double fold 35 year to 66.09 years, (as per CIA world fact book, 19^{th} Feb 2010) resultantly in tremendous increase in osteoporotic population and osteoporotic fractures. Increasing life expectancy, sedentary life style and increasing traffic on road, lack of observing traffic rule sky scrapper buildings have resulted in increased incidence of high velocity trauma resulting remarkable increased incidence of fractures.

Before 1960, most of fracture neck of femur (intracapsular/ extracapsular) were used to manage by conservative methods. But there was a high evidence of non union, limb shortening and majority of these patient could not walk unsupported throughout the life.

The conservative management of these fractures is associated with risk of loss of reduction and malunion, nonunion, shortening etc and has a limited scope in incomplete / impacted / undisplaced fracture in children only, especially, in present era of rapidly increasing patient demand in relation to restoration of anatomy, function and cosmesis without prolonged immobilization.

The conservative management has disadvantage of long hospital stay, prolonged recumbancy, joint stiffness, malunion, delayed union and complications due to prolonged recumbancy along with social and economical problems.

After 1940, a number of implant device were developed to manage these fractures, including fixed nail plate, compression hip screw and intramedullary nail (e.g. Enderson nail, Gamma nail). Although dynamic hip screw is an established implant for fixation of these fractures but proximal femoral nailing is newer modality to treat them.

Actually **Proximal Femoral Nail** is combination of interfragmentory screw fixation (Dynamic Hip Screw) and intramedullary nail (Gamma nail, Ender's nail).

Closed proximal femoral nail overcomes the shortly coming associated with dynamic hip screw like open reduction, interference with fracture haematoma, soft tissue handling and extensive periosteal stripping which further jeopardizes vascularity of bone. Its biomechanical properties are more favourable like short lever arm, greater implant length, smaller and flexible distal ends and on additional antirotational screw in femoral neck. Moreover DHS is an eccentric device and load shearing device whereas PFN is axial and load bearing device.

Advantages of proximal femoral nail over dynamic hip screw

1. Proximal Femoral Nail is an intramedullary implant while Dynamic Hip Screw is an extramedullary implant.
2. Proximal Femoral Nail provides more biomechanical strength than Dynamic Hip Screw.
3. Patient operated with Proximal Femoral Nail can be mobilized earlier than patient with Dynamic Hip Screw.
4. It can be used when fracture intertrochanteric femur is associated with fracture shaft femur while Dynamic Hip Screw can not be used in these patients.

5. As compared to Dynamic Hip Screw, Proximal Femoral Nail is mini-invasive procedure, it minimally jeopardizes the vascularity of the bone which is already jeopardized by trauma and minimally disturbed the periosteum of bone.
6. Proximal Femoral Nail has high rotational stability.
7. Proximal Femoral Nail is a better implant in unstable type of proximal femoral fractures as compared to Dynamic Hip Screw.

Review of Literature

Intertrochanteric fractures of femur by Virtue of their great potential for union, regardless of the mode of treatment failed to draw the attention of early authors for many years. Once the impact of these injuries on the social and economic fronts was recognized, much has been published, both on the different methods of internal fixation as well as on the outcome and complications of these fractures.

Many classification systems have been devised over the past fifty years; however, since each has had a different object, none has been unanimously adopted by the orthopaedic community. Some of the systems proposed have confined themselves to a simple anatomical description of the patterns observed (Evans; Ramadier; Decoulx and Lavarde). Other, more recent, systems were designed to provide prognostic information on the prospect of achieving and maintaining reduction of the different types of fractures (Tronzo; Ender; Jensen's modification of the Evans grading; Muller et al.).

In surgical practice, it is important to know whether a fracture is stable or unstable: The answer to this question will guide the reduction technique, the type of fixation to be used, and the postoperative management. A good classification must provide information on the fracture's potential of being anatomically reduced, with good apposition of the fragments. Also, it should be possible to tell, in the light of the classification, whether a particular fracture is likely to become secondarily displaced after fixation: this information must be available before the patient is allowed to bear weight. This new approach has made it possible to develop fixation hardware whose design takes account of the biomechanical properties of fractures, in order to arrive at more dynamic modes of fixation. Finally, any classification system that aspires to universal adoption must be easy to use and reproducible.

OPERATIVE TREATMENT

Operative management, which allows early rehabilitation and offers the patient the best chance for functional recovery, is the treatment of choice for virtually all fracture intertrochanteric femur.

IMPLANT SELECTION

Two broad categories of' internal fixation devices are commonly used for intertrochanteric femoral fractures: sliding compression hip screws with side plate assemblies and intramedullary fixation devices. Sliding hip screws include traditional compression hip screws that provide compression in the intertrochanteric plane and compression plates that provide additional compression axially. lntramedullary devices include cephalomedullary nails with two screws (Recon type nails) or compression type screws (such as the Gamma or intramedullary hip screw). The intramedullary compression type screw may be short and end in the diaphyseal femur or long and end in the supracondylar region.

Condylocephalic nails, such as those designed by Ender and others, were inserted from the condyles up the medullary canal into the femoral head. Their use has been abandoned because of the associated complications, such as malunion and "backing out" of the nails,

The preferred type of device is a matter of debate. Intramedullary nails have a biomechanical advantage over standard compression hip screws because they can be inserted with less exposure of the fracture and less blood loss, although they require more fluoroscopic exposure and have been associated with fracture comminution. In addition, intramedullary nailing is a more technically demanding procedure. Goldhagen et al compared the Gamma nail to a standard compression hip screw and found no differences in surgical time, blood loss, or fluoroscopy exposure. Clinical rates of healing have been similar for the two devices, but a 3% to 6% incidence of secondary fracture of the femoral shaft at the tip of the intramedullary device has been reported. Because of this complication, the longer version of these implants is preferred that extend to the supracondylar region of the femur. The Gamma nail appears to have some advantage in certain unstable fractures, especially those in reverse obliquity and subtrochanteric extension that cannot be easily treated with standard hip compression screws.

PLATE AND SCREW DEVICES

The first successful implants were **fixed angle nail plate devices**. e.g. **Jewett nail, Holt nail**. While these devices provided stabilization of' the femoral head and neck fragment of the femoral shaft, they did not affect fracture impaction. The experience with the fixed angle nail plate devices indicated the need for device that would allow controlled fracture impaction. This gave rise to **Sliding nail plate devices** e. g. **Massie nail, Kenpugh nail**. In a retrospective study, Kyle et al. reported a lower incidence of nail breakage and fewer cases of nail penetration with a Massie Sliding nail than with a fixed angle Jewett plate for the treatment of unstable inter-trochanteric fractures. Sliding nail plate devices gave rise to **Sliding hip screw devices**. In 1955 Schumpelick and Jantzen described the use of a sliding screw. Numerous series have reported excellent result with the sliding hip screw for inter-trochanteric fracture fixation, and currently it is the most widely used device for this application. Modifications of the Sliding hip screw include the **Egger's plate** and more recently introduced two-component plate device, the

Medoff plate. Both these devices are being successfully used for the treatment of stable and unstable inter-trochanteric fractures. The **Alta expandable dome Plunger (Howmedica)** is a modified Sliding hip screw designed to improve fixation of the proximal fragment by facilitating cement intrusion into the femoral head. Although this device is demonstrably superior to the standard Sliding hip screw system in laboratory testing, improved efficacy has not been shown by clinical trials.

INTRAMEDULLARY DEVICES

Next to come in the picture were intramedullary nail devices which were claimed to be superior to nail and plate devices as they were introduced into the medullary canal along the lines of force, So that bending movements over them were considerably less than the nail and plate e.g. **Enders nails. Intramedullary Sliding hip screw** devices have recently been developed for stabilization of pertrochanteric fractures. These devices couple a sliding hip screw with a locked intramedullary nail. Hardy et al, performed a prospective randomised study comparing the use of sliding hip screw to an intramedullary hip screw for stabilization of 100 inter-trochanteric fractures in patients aged 60 years or older. Based on the results of' this study the author concluded that the routine use of the intramedullary hip screw cannot be routinely recommended for inter-trochanteric hip fracture stabilization in this age group.

Hippocrates (460BC, Greece) described in detail the splintage of fractures by using wooden appliances. But a fascinating account of external splintage was given by Alzabra, an Arabic surgeon. He used both clay gum mixtures, flour and egg white for casting materials. **Galen** (AD 130-200) first described the longitudinal traction to overcome the overriding of fracture- fragments. In 1767, **Gooch** first described the tibial and femoral functional braces. In 1800, **Albert Hoffer** described the use of traction for many types of fractures of femur. (Text book of Orthopaedics by John Ebnezar ,II edtn P – 43-45).

The first attempts at surgical treatment of femur fractures by intra-medullary technique date back to the 16th century. The conquistadors observed that the Aztecs & Incas treated non-unions of the femur by inserting wooden resinous pegs into medullary canal. As early as 1886 Bircher reported using ivory pegs as intramedullary fixation devices. In **1917 Hoglund** reported the use of bone in place of ivory. In the early part of the 20th century, Hey Groves made attempts of internal fixation with iron rods. **Rush and Rush (1939)** were first to report the use of intra-medullary pin for femur fractures.

But, before 1930, the treatment of proximal femur fractures was essentially conservative by traction until healing. It led to increased morbidity due to prolonged bed rest and it required intensive medical and nursing care (P. no-2052, Textbook of orthopaedics & **Trauma by G.S. Kulkarni** 1st Edition). The conservative treatment predisposes to respiratory tract infection, bed sore, urinary tract infection and other morbidities in elderly patients. Some times patient will not die due to trauma, but due to these bed- ridden problems. All these increase load on the hospitals; and affects family, society and ultimately nations economic growth.

Smith Peterson (1925) advocated the use of triflanged nail for internal fixation of fracture of neck femur. Thornton improved internal fixation for tronchanteric fractures by adding an adjustable side plate to **Smith-Peterson nail in 1937**. This side plate was useful to prevent coxa vara which was often followed by S-P Nail alone. Its main disadvantage was weakness at the nail-plate junction.

In **1930, Jewett** introduced Jewett nail (Fixed angle nail plate device) for internal fixation of intertrochanteric fractures. This was having a triflanged nail fixed to side plate at angle of 130^0 to 150^0. Its main disadvantages are no impaction at fracture site, penetration of nail into joint and implant breakage. All these complication were more common with unstable intertrochanteric fractures.

In **1950, Earnest Roll** in Germany was the first to use sliding screw and pugh and Badgley introduced sliding nail with trephne tip in U.S.A. In **1962 Massie** modified sliding nail plate device to allow collapse and impaction of the fracture fragment which led to improve results.(Text book of Orthopaedics by G.S. Kulkarni P-20-52)

In **1961, Boyd et al**, suggested that these fractures should be treated by medial displacement of the shaft femur beneath the proximal head neck fragment and valgus fixation in an effort to gain length.

One early modification to the sliding hip screw maximized fracture impaction by allowing the proximal lag screw to telescope within the plate- barrel and the plate to slide axially along the femoral shaft. To accomplish this bi-directional sliding, the plate was modified by replacing the round screw holes with slotted screw holes (Egger’s plate). In 1992, a two component plate device was introduced (Medoff plate) in which a central vertical channels constrains an internal sliding component. Both devices have been used successfully for the treatment of stable and unstable intertrochanteric fractures.

1995 Alta expandable dome plunger (Howmedica) is a modified sliding hip screw designed to improve fixation of proximal fragment by facilitating cement intrusion into femoral head.

Intramedullary nail devices were claimed to be superior to nail and plate device as they were introduced into medullary canal along the line of force, so that bending movement over them were considerably less than the nail – plate. The 1st intramedullary device for intertrochanteric fractures was Ender nail (**Ender H.G. 1970**).

Steinberg et al (1988) performed a retrospective analysis utilizing a computer assisted digital system to study the factors affecting post-operative stability. Fractures were evaluated by measuring shortening and angulation, collapse of telescoping device, migration of fixation device into femoral head. The failure rate and post-operatively stability were compared according to the type of fracture, type of operative reduction, and internal fixation device utilized. In particular, medial displacement osteotomy had no advantage over anatomic reduction in unstable fracture. The use of a fixed angle nail- plate was associated with increased failure rate.

Meena et al (1995) concluded that if an anatomical reduction was achieved by proportioned vertical and horizontal traction forces and the reduction was monitored by periodic X-ray till sound clinical and reasonable radiological union. The good functional end results could be obtained.

Gundle et al (1995) in an attempt to minimize the failure of fixation conducted a prospective study on 100 patients of unstable intertronchanteric fracture. Anatomic reduction alone rather than oteotomy together with sliding hip screw fixation has been recommended.

For sufficient slide, it is essential to use a short barrel device when using dynamic screw of 85 mm or less.

Koval K.J. Aharonoff G.B., Su ET, Zuckerman JD (1998) performed a study to access the impact of intensive rehabilitation on the outcome after proximal femoral fracture. The average duration of the stay of the hospital increased due to the rehabilitative program, but there were no difference in walking ability, place of residence, need for home assistance and independence in basic and instrumental activities at 6 and 12 months follow-up examinations between patients who had been managed by rehabilitation program and those who had not. There results raise serious questions regarding the global cost effectiveness of these programs for patients of proximal femur fracture.

Koval et al (1998) also conducted that average amount of weight placed on the injured limb is increased progressively with time in young patients but the elderly patients were allowed to bear weight as tolerated voluntarily on the injured limb.

Recently, intramedullary sliding hip screw device have been introduced for stabilization of pertronchanteric fractures. This device is a combination of Dynamic Hip Screw and intramedullary locking nail. **Hardly et al (1978)** performed a prospective randomized study comparing the use of sliding hip screw and intramedullary hip screw for stabilization of 100 intertrochanteric fractures in patients older than 60 years. The hospital and 6 months mortality rates were similar for the two treatment groups. The patients whose fractures were stabilized using the intra-medullary hip screw experienced significantly better mobility at 1 and 3 months follow-up. This difference was no longer seen at 6 and 12 months, although patients who received the intra-medullary hip screw enjoyed significantly better walking ability outside the home at all time periods. The intramedullary hip screw was associated with significantly less screw sliding and limb shortening than the sliding hip screw particularly when used to stabilize unstable fracture pattern. He concluded that routine use of the intramedullary hip screw can not be recommended for intertrochanteric hip fracture stabilization.

Boldin et al (2002) studied the results of proximal femoral nail (P.F.N.) a minimal invasive treatment of unstable proximal fractures. In 1996 the AO/ASIF developed P.F.N. as an intramedullary device for treatment of unstable per- and sub- tranchanteric femoral fracture. In a prospective study (1997-2000) they treated 55 patients having proximal femur fracture, which permitted immediate full weight bearing. The complication occurred in 12 patients with cut out of implant. In 5 patients closed reduction could not be done and open reduction with use of wire was necessary. They concluded that the P.F.N. is a good minimal invasive implant of unstable proximal femoral fractures, if closed reduction is possible, otherwise Dynamic Hip Screw with the tronchanter stabilizing plate is recommended.

Arringto ED, Davino NA (1991) reported fracture neck femur in case of intertronchanter fracture managed with Dynamic Hip Screw They concluded that this complication in patients with osteoprosis may be prevented by deeper placement of leg screw within 5 mm to 8mm of subchondral bone which may decrease the stress forces in the subcapital area of femoral neck.

Kim et al (2001) studied the failure of intertronchanteric fracture fixation with Dynamic Hip Screw. They concluded that unstable fractures and severe osteoporosis have a failure rate of more than 50%.

Haidukewych and Berry (2003) concluded that in properly selected patients, revision internal fixation with bone grafting for failed open reduction and internal fixation of intertronchateric fracture can provide high rate of union and good clinical result with a low rate of complications. They also concluded that hip arthroplasty is an effective salvage procedure after failed treatment of intertronchanteric fracture in older patients. Most of patients have good pain relief and functional improvement. Calcar replacement and long stem prosthesis is often required.

Pakat (2003) evaluated Gamma nail and dynamic condylar screw in tronchanteric fracture. Functional evaluation showed no significant differences in pain, walking ability or range of movement, but recovery was significantly earlier in Gamma nail group.

Schipper I.B., Marti R.K., Vander Werken C (2004) presented a review of 18 international papers that compared two different methods for tronchanteric fractures in prospective randomized clinical trials and concluded that sliding hip screw is superior for trochanteric (stable) fracture while intramedullary implants are superior for unstable type intertronchanteric fracture and subtronchanteric fracture.

Subtronchanteric Fracture Femur

In 1902 Hibbs suggested that reduction could be improved by bringing the distal fragment into alignment with the deviated proximal end femur when traction treatment is used, the 90^0-90^0 position is required both at hip and knee because straight longitudinal traction will not align the fracture.

Koch (1917) analysed mechanical stress on the femur during weight bearing and found out that compression forces excluded 1200 lbs per square inch in the medial subtronchateric area. Lateral tensile stresses were 20% less. But Koch's analysis did not take into account the additional effects of muscle force.

Kuntscher (1939) reported on the concept of intramedullary fixation of subtronchanteric fractures with a "Y" nail.

Operative treatment of subtronchanteric femoral fractures initially began with the surgical treatment of intertronchanteric fractures of femur with Jewett nail. From 1940 to 1960 the Jewett nail was probably the most frequent used device for internal fixation of subtronchanteric femur fractures. Failure rate of Jewett nail was 20-30 %.

The 1^{st} intramedullary device known to the used successfully was developed by Zickel in the 1967. Zickel nail was a strong, solid rectangular rod with a cross bolt engaging the femoral head. Bergman et al recommended that Zickel device for low energy trauma but preferred other form of fixation for high energy trauma because of frequent comminution.

Its main disadvantages were rotational instability and refractor after removal.

In 1970, Femoral cast bracing is popularized by **Sarminto** but with frequent poor results**. De Lee et al and Nikolic** reported on subtrochanteric fractures treated by 90^0-90^0 traction followed by fracture bracing with a hinged knee single hip spica cast. They recommended this protocol for open fractures or inoperable fractures.

In **1970, Ender nail** was introduced for treatment for subtrochanteric femoral fracture. Ender technique included low energy fracture, minimal comminution and elderly patient. Its main disadvantages were high incidence of knee pain, rotational deformity and instability.

Toridis (1969) noted the torsional stress in the subtrochanteric region an important development in regard to the current concepts of static interlocking technique to reduce the rotational shear force that may had to implant failure from cyclical loading.

Rybiki, Simonen and Weis (1972) found out that higher forces were generated with eccentrically placed devices such as plate and screw compared to centromedullary devices.

Velasco and Comfort (1978) reported that as little as 2mm reparation of medial femoral cortex would lead to medial collapse and lateral plate bending and failure of implants.

The **AO angled blade plate** introduced in the 1970 was effective if medial buttress could be restored and the plate could be used as a tension band. **Asher et al** advocated that it is to be used for non-comminuted fractures and stressed the importance of inter fragmentary compression, anatomic reduction.

In **1989, Kinast** and his associates stressed upon following for high success rate of AO blade plate.

i. Extensive pre-operative planning.

ii. Use of distractor without disturbing of medial comminution.

iii. Stable construct with interfragmentory compression.

iv. Indirect reduction

Even though, there was high rate of failure of treatment..

Sliding hip screw popularized by **Clawson and Massie in 1960s** – because of impaction at fracture site provided by this implant.

In **1980, Waddell and Kinast et al** reported failure of A.O. blade plate used in subtrochanteric fractures femur is about 20%.

In 1980, most reports noted some differences but no major advantage compared with the compression hip screw to encourage the wide spread use of Gamma nail. Shaft fracture, both intraoperatively and during rehabilitation, was a frequently reported complication.

Schatzkar and Wadell (1980) has shown that compression forces which load medial femoral cortex are considerably greater than torsional strain on lateral femoral cortex. These large stresses on subtrochanteric area make medial cortical restoration mandatory at the time of surgery to prevent cyclic loading and failure of any device used on tension side of the femur.

Tencer et al (1984) reported that interlocking centromedullary devices had greater bending stiffness had nearly normal femoral torsional stiffness and had very high axial load sustaining capacity (350-400 Lbs) of weight.

The **Russel – Taylor reconstruction Interlocking nail** was introduced in 1986 as a subtrochanteric fractures fixation device because of two-screw fixation in the femoral head, rotation is well maintained and lesser tronchanter does not have to be intact. Taylor et al reported excellent results in high-energy trauma with recon nail.

Medoff and Maes (1991) reported good results with Medoff plate (an axially dynamic side plate with sliding hip screw) for intertronchanteric fractures, but also for some high subtrochanteric fractures

Lauridsen U.B. (1995) studied the outcome of rehabilitation following hip fractures, which depends on several pre-fracture risk factors. Modern surgical techniques permit early mobilization and possible changes in surgical procedures will uncertainly influence the outcome of rehabilitation.

Dhal and Singh (1996) did a lot of work on external fixation of subtrochanteric fractures of femur. They reported union rate of 94%.

Baumgaertner et al (1998) found no significant differences between intramedullay sliding hip screw and compression hip screw even when compared in unstable fractures.

Vajanto I, Kuokkanen H, Niskanen R, Hapala J, Korkala O, (1998) reported that the most common general complication was thromboembolism after treatment of proximal femoral fractures. Sufficient antithrombosis prophylaxis is continued at least during the whole convalescence period at the hospital. The development of postoperative care and rehabilitation program is perhaps the most important factor today, in order to reduce complication in general.

Weire K, Schwal E . (2001) concluded that the incidence of fractures in per- and subtrochanteric fractures is high in the elderly and early stabilization is required for immediate weight- bearing. Older patients with poor bone quality limited compliance and strength, and instability for partial weight bearing benefit from intra- medullary stabilization of these fractures. The choice of implant depends on the degree of instability in the individual fracture type.

Verettas D.A., Galanis B, Kazakos, Hatziyianna Kis A, Kotsios E (2002) retrospectively studies the epidemiology and the results of treatment of fractures of proximal femur in patients aged 50 or under. There were high rate of complications attributed to a valgus malalignment and to the use of bulky implant, early collapse of the fracture and inability of the implant to withstand the strain before osseous union (in case of subtrochanteric fractures). Further more, intramedullary fixation of subtrochanteric fractures should be preferred to the sliding screw and side plate.

Parker MJ, Handoll HH (2004) conducted a study to compare all cephalocondylic intramedullary nail with extra-medullary implant for the surgical treatment of extra capsular hip fractures in adults and concluded that there is lower complication rate of the S.H.S. (sliding hip screw) in compassion with intra-medularry nails. S.H.S. is superior for tronchanteric fracture (stable type) and intramedullary nail is preferred in case of subtrochanteric fracture and reverse oblique fracture.

Schipper I.B., Steyrberg EW, Lastelein RM, Vander Heijde FH, Kerver A.J., Vanvugt A.B. (2004) compared intra- operative use complications and out come of proximal femoral nail with Gamma nail in a prospective clinical study and concluded that intra- operative blood loss was lower with P.F.N. post- operatively, more lateral protrusion of the hip screws of P.F.N. compared with the Gamma nail was documented. Most local complications were related to suboptimal reduction of the fracture or positioning of the implant. Functional outcome and consolidation were equal with both implants. Generally, the results of treatment of unstable subtrochanteric fractures were comparable for P.F.N. and Gamma nail. The pitfalls and complications were similar and mainly surgeon, or fracture related rather than implant related.

CLASSIFICATION

Numerous classification system have been devised, but non has been unanimously adopted as a fracture classification system is only of value, if it gives an idea of treatment option and permits a more accurate prognosis. The classification should predict the stability, since stability is the keystone of selection of proper treatment and good prognosis. Most of classifications are based on posteriomedial fragment, which decides the stability of the fractures.

INTERTROCHANTERIC FRACTURE

1. Evan's classification – (1949) based on stability of fracture pattern.

    a. **Stable intertrochanteric fracture**:- A stable intertrochanteric fracture is one when reduced has cortical contact without a gap medially and posteriorly. Medial cortex of proximal fragment and distal fragment are not communited. This contact prevent displacement into varus retroversion of proximal fragment of fracture when patient put his weight on that limb.

    b. Unstable intertrochanteric fracture:- There is communition of posteromedial cortex. The displaced lesser trochanter fragment and its size is a key to decide the instability of inter trochanteric fracture.

Similarly intertrochanteric fracture with reversed obliquity in which there is inherent tendency of medial displacement of distal fragment secondary to pull by adductor muscle are unstable injury.

2. **Boyd and Griffin Classification (1949):-**

    a. Type I :- Fracture that extend along the intertrochanteric line from greater trochanter to lesser trochanter.

    b. Type II :- Comminuted fracture, main fracture along intertrochanteric line with multiple fracture in cortex.

    c. Type III:- Communited fracture basically subtrochanteric with at least one fracture line passing across the proximal end of shaft just distal part of the lesser trochanter.

    d. Type IV :- Communited multiplaner fracture extending into proximal shaft of femur.

A.O. CLASSIFICATION:

A1. Pertrochanteric fracture: - Simple fracture (two part fracture with typical oblique fracture line)

A.1.1 The fracture line runs along the intertrochanteric line.

A.1.2 It passes through the greater trochanteric.

A.1.3 : It passes below the lesser trochanter.

A2. Pertrochanteric fracture :- Multi fragmentary fracture (commminution with postermedial fragment).

A.2.1 Medial cortex is broken at level with one intermediate fragment.

A.2.2 With several intermediate fragments on medial side.

A.2.3 With medial border of the fracture extending more than 1 cm below the L.T.

A.3 The fracture line extends from below greater trochanter to above the lesser trochanter.

A.3.1 Simple oblique fracture.

A.3.2 Simple transverse fracture.

A.3.3 Multi fragmentary fracture..

SUBTROCHANTERIC FRACTURE

Several classification of Subtrochanteric fracture have been suggested.

1. **Fielding and managliato** :- (1966) depending upon the side of fracture in the Subtrochanteric area.

   Type I :- Fracture at the level of L.T.

   Type II :_ Fracture in between 2.5 cm to 5.0 cm from L.T.

   Type III :_ Fracture in between 5.0 cm to 7.5 cm from L.T.

2. **Seinsheimers Classification :- (1978)**

   Depending upon No. of major fragment and location and shape of fragment.

   Type I :- Non displaced fracture or one with < 2cm of displacement.

Type II :- Two part fracture.

a. Transverse fractures.
b. Spiral configuration with L.T. attached to proximal segment.
c. Spiral configuration with L.T. attached to distal segment.

Type III :- Three part of fracture

a. Spiral configuration with L.T as a part of third fragment.
b. Spiral configuration with IIIrd part a butterfly fragment on the lateral cortex.

Type IV :- Communited fracture with 4 or more fragment from the lateral cortex.

Type V :- Subtrochanteric configuration.

3. Russel- Taylor Classification

Depending upon involvement of pyriformis fossa and L.T. in subtrochanteric region.

Type I :- Fracture does not extend into pyriformis fossa.

Type 1A :-Comminution a fracture line extend from below L.T. to femoral isthmus.

Type I B :- Fracture line and comminution involve area of L.T. to isthmus.

Type II :-

Type II A :- pyriformis fossa is fractured but L.T. is intact.

Type II B :- pyriformis fossa & L.T. both are fractured.

Aims & Objectives

- Evaluation of results following close/open reduction and internal fixation with Proximal Femoral Nail in fracture of proximal femur.
- Evaluation of result following open reduction and internal fixation with Dynamic Hip Screw in fractures of proximal femur.
- Comparative evaluation of results of Proximal Femoral Nail and Dynamic Hip Screw in proximal femoral fractures.

Material & Methods

Present study was conducted in the Department of Orthopaedic Surgery, Maharani Laxmi Bai Medical College and Hospital Jhansi, during the period between December 2008 and August 2010.

Cases of traumatic fractures managed operatively by internal fixation over the period between December 2008 to February 2010 were sorted and observed from the admission upto discharge and thereafter each was invited through the agency of post or personal visit. Sixty five patients of intertrochanteric fracture femur admitted out of which twenty one patients didn't gave the consent for surgery and forty four patient were managed operatively by internal fixation, in department of Orthopaedics, MLB Medical College, Jhansi. All the operatively managed patients were observed from admission to operative intervention and discharge thereafter they were identified and invited for follow up to participate in the study but only 35 patients of intertrochanteric fractures, irrespective of age, sex, open/compound, simple/communited were included in the study who turned up. The cases were evaluated clinically and radiologically, findings were recorded in the proforma and patients were given first aid by skin/skeletal traction in Thomas knee splint till the definitive management. Patient were divided in group I and II at random basis, patients of group I were managed by open reduction and internal fixation with DHS whereas patients of group II were managed by close/open reduction with PFN. Cases were followed and evaluated at 6 weeks interval for 6 months, the results were evaluated observed and recorded radiologically and functionally as per criterias laid down by Harris.

The exclusion criteria being :

1) Associated fracture shaft femur
2) Associated injuries like head injuries.
3) The patients who could not be followed for at least 6 months
4) Patients unfit for surgery or who did not gave consent for surgery.

Each selected case participated in the study by filling up a specially designed questionnaire.

The questionnaire as filled by the patient along with the findings of physical examination, radiological evaluation and other necessary information as obtained from the hospital records were grouped together and evaluation done on the basis of the functional hip joint evaluation system - The Harris Hip Score. Additionally, in view of the Indian context, a number of other parameters significant to the daily Indian lifestyle, such as ability to squat and sit cross legged, etc. have also been considered and included as parameters of the study.

PREOPERATIVE ASSESSMENT -

The patients of' trochanteric fractures, admitted during the course of study were allocated for fixation with an extramedullary implant or an intramedullary nail. Fracture patterns were classified as Type I, II, III, IV (Boyd & Griffin)

Operative steps and instruments and implants

Dynamic Hip Screw

Instruments [Implants]

1. Barrel plate 135°
2. Lag screw
3. 4.5 cortical screws

Special instruments

1. DHS angle guide
2. Guide wire
3. Adjustable combination calibrated triple reamer
4. Adjustable calibrated tap
5. T. Handle with coupling for use with angle guide
6. Barrel guide
7. Impactor with plastic tip
8. T wrench
9. Coupling screw for DHS removal.

General Instrument

1. Drill
2. Drill bit (3.2mm)

3. Drill guide
4. Bone tap (4.5 mm)
5. Bone tap sleeve
6. Osteotome
7. Cortical screw (4.5mm)
8. Hexagonal screw driver

Operative steps

1. Close reduction will be done under suitable anaesthesia (general/spinal anesthesia) on a fracture table by standard technique in supine position, position of fragments is confirmed by AP and lateral view with use of C-arm or X-ray imaging.

2. Operative part is painted and drapped, fracture site will be exposed by standard lateral approach.

3. An incision over the lateral side of thigh was made beginning at the distal edge of the greater trochanter.

4. A guide pin is inserted through the lateral cortex of femur and drill through the trochanter, neck and head.

5. A hole is drilled with 4.8mm drill bit and an adjustable angle guide was set at 135° in the lateral cortex of femur, with the help of an angle guide, a guide wire is inserted in the just center of the neck, position of the guide pin is confirmed by AP an lateral roentgenogram.

6. Length of dynamic hip screw will be calculated by measuring the length of guide pin pretending beyond the lateral cortex of femur.

7. Guide pin is drilled into acetabulum.

8. Reaming is done, bone is taped. Lag screw will be inserted with the help of T wrench.

9. Hip screw plate was attached offer removing the guide pin.

10. Compression screw threaded into distal end of lag screw shaft and tightened.

11. Before completion of tightening, traction will be released on leg.

12. Final position of lag screw is confirmed with the help of AP and lateral roentgenogram.

13. Wound will be closed in layers after putting a close section drainage system.

Proximal Femoral Nail

Instruments

1. Proximal femoral nail 125°, 130°, 135°, 140°

2. Zig and Tomy bar

3. Lag Screw and antirotation screw

    a. Sleeve and trochor

    b. Drill bit

    c. Guide wire

4. Distal screw (4.5 mm)
5. Guide wire and awl
6. Hexagonal screw driver , spanner and mallet
7. Screw length gauge and depth gauge (for proximal bolt)
8. Nail locking bolt
9. T Handle and cannulated drill
10. Cannulated hand reamer toper (for proximal reaming)
11. Pointer (for proximal screw)
12. Extractor set

Operative steps

The **Proximal Femoral Nail** is inserted using a ‘closed’ technique under image intensifier control. The patient is positioned on the traction table, and the fracture is reduced with the leg adducted. About 6 cm long incision is made just proximal to the greater trochanter, which is entered using a curved awl. The entry point is just lateral to the tip of the trochanter. A guide wire is introduced into the femoral shaft, and flexible reamers are used to the appropriate size. A nail, 1 to 1.5 mm smaller than the final reamer, is selected. Open reduction was performed only in cases where closed reduction failed or was grossly unacceptable.

The nail is inserted by hand. Using the appropriate jig, a guide wire is passed into the neck, and the position checked. The lateral cortex of the femur and the neck are reamed with a triple reamer and a screw is then inserted. A set - screw in the top of the nail controls rotation. This is tightened, and then loosened by half a turn to allow sliding. Finally the fracture site is compressed.

Preoperatively, the time taken to position the patient and to reduce the fracture (setting-up time) were noted. Operating time, and any operative difficulties, preoperative blood loss, postoperative wound drainage and the amount of blood transfused were recorded. Haemoglobin levels before and at 48 hours after surgery, delay in wound healing or infection, and any other complications were also noted, as were duration of hospital stay, and the type of accommodation to which the patients were discharged.

Postoperative radiographs were assessed for fracture reduction and for the position of the screw within the head. This was assessed on both the anteroposterior and the lateral radiographs.

Patients were to followed up clinically and radio logically for at least six months. Level of accommodation, ability to walk, and incidence of pain were noted. Any change in screw position was recorded, as were fracture union, sliding of the screw, shortening of the femur, and any complications relating to the fixation.

FUNCTIONAL EVALUATION (HIP JOINT EVALUATION SYSTEM BY HARRIS-1969)

The Harris score evaluates patients on the basis of four criteria namely pain, function, motion and absence of deformity.

Pain and functional capacity constitute the major concern for patients operated in the region of hip and are accordingly assigned the heaviest weight age. Correction of deformity and joint motion, the other two criteria assume lesser importance from the rehabilitative point of view and are hence given a lesser score.

Based on this reasoning out of a maximum possible 100 points used to assess the functional results of patients the following division of scores is practiced for different components:

Pain	44
Function	47
Range of motion	5
Absence of deformity	4
Total	**100**

Pain

The gradation of pain because of its subjective nature are inevitably imperfect, but the following gradation have been accepted.

Pain (44 possible points)	
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 concessions to pain. Some limitation of ordinary activity or work. May require occasional pain relieving medicine stronger than aspirin.	20
Marked pain, serious limitation of activities	10
Totally disabled, crippled, pain in bed, bedridden	0
Total Score for Pain	**44**

Function

Function is assessed under two heads, one being the activities of daily life, the other being gait. Activities of daily life are assigned a total of 14 possible points and include the following:

Activities of Daily Life (14 possible points)	
1. Stairs	
a. Normally without using a railing	4
b. Normally using a railing	2
c. If any manner	1
2. Shoes and Socks	
a. With ease	4
b. With difficulty	2
c. Unable	0
3. Sitting	
a. Comfortable in ordinary chair for one hour	5
b. On a high chair for one-half hour	3
c. Unable to sit comfortably in any chair	0
4. Enter public transportation	1
Total Score For Activitis Of Daily Life	**14**

Gait is assessed under three parameters namely the degree of limp, distance that can be walked and support required to cover the above mentioned distance. Because the support needed and amount of limp was affected by the distance walked in certain cases, scores were assigned only after the patient had walked the required distance. A total 33 points were assigned to gait, each of the constituting parameter receiving an equal share of 11 points.

Gait (33 possible points)	
1) Limp	
a. None	11
b. Slight	8
c. Moderate	5
d. Severe	0
2) Support	
a. None	11
b. Single Cane for long walk	5
c. One crutch	3
d. Two canes	2
e. Two crutches	0
f. Not able to walk	0
3) Distance walked	
a. Unlimited	11
b. Six blocks	8
c. Two or three blocks	5
d. Indoors only	2
e. Bed and chair	0
Total points for gait	**33**

Motion : derives its significance only by affecting function. Because function has been included as a separate criteria, motion by itself, is given a minor emphasis, and a maximum possible score of only five points out of 100 has been ascribed to it.

Each are of motion has been ascribed on Index factor. To determine the rating of motion the number of degrees of motion in each designation are is multiplied by the corresponding index. Factor and the point score for each individual arc is calculated.

The sum of the point, scores for the individual arcs is then multiplied by a factor of 0.05 to obtain the number of points for the overall the range of motion.

Motion (5 possible points)			
Motion	**Arc of motion**	**index factor**	**Maximum possible Score for individual arcs**
Flexion	0- 45°	1.0	45
	45 -90°	0.6	27
	90-110°	0.3	6
	110-130°	0.0	0
Abduction	0-15°	0.8	12.0
	15-20°	0.3	1.5
	20-45°	0.0	0
External rotation	0-15+0	0.4	6
In extension	Over 15°	0.0	0
Internal rotation in extension	Any	0.0	0
Adduction	0-15°	0.2	3
	Over 15°	0.0	0
Extension	Any	-0.0	0
Total Score			**100.5**
Total points for motion = Total score x 0.05			**5**

Absence of Deformity : Finally four points have been ascribed for the absence of significant deformity. Any deformity exceeding the fol1owing range of acceptable deformities constitutes a significant deformity and eliminates the four possible points.

Absence of deformity (4 possible points) (given if the patients demonstrates)	
A. Less than 30° fixed flexion contracture	Acceptable
B. Less than 10° fixed adduction	Acceptable
C. Less than 10° fixed internal rotation in extension	Acceptable
D. Limb length discrepancy less than 3.2 centimeters	Acceptable
Total score for absence of Deformity	**4**

Total score was summarized in a functional chart depicted below.

HARRIS SCORE ON FOLLOW UP

Pain	Function								Motion	Deformity
	Gait			Activities						
	Limp	Support used	Distance walked	Stairs	Shoes	Sitting	Enter pub. transport	Total		
44	47								5	4

The total for Harris score was thus calculated and patients were grouped into three categories on the bases of following criteria:

Total Harris Score	**Rating**
80 - 100	Excellent
50 - 80	Good
< 50	Poor

In view of the Indian contest : two other parameters not enlisted under the Harris's functional criteria were also assessed. These included the ability to squat and to sit cross – legged.

Squatting	**Cross legged sitting**
Able to squat	Able to sit cross legged
Unable to squat	Not able to sit cross legged

RADIOLOGICAL EVALUATION

Roentgenograms taken in the preoperative period, immediate postoperative period and over the longest available follow up were used to assess several parameters namely

- **Quality of bone** with regards to evidence of osteoporosis.
- **Neck shaft angle** of normal side and affected side were measured and compared preoperatively to determine the amount of coxa vara present. Post operatively the angle was measured and compared to the normal side to assess the correction achieved. Again the neck shaft angle was determined at follow up to assess any variation in the angle. Neck shaft angle difference of more than 5° with that in the normal side was taken to constitute a deformity.
- **Quality of reconstruction of posteromedial cortex.**
- **Evidence of radiological union:** This was assessed in terms of presence or absence of signs of radiological union.
- **Implant used and any evidence of implant failure:** Implant failure was assessed under five categories as detailed below:

○ No failure	○ Breakage of plate
○ Loosening of screw	○ Breakage of screw
○ Cut through of screw	

To reflect on the possible existence of compounding factors and the role of such factors in altering the functional results, certain additional parameters were also included in the study. These included-

- ***The age, sex and occupation of patient.***
- ***Mode of injury and the duration between trauma and surgery.***
- **Wound healing and evidence of any infection at the** operative site, in the immediate postoperative period of there after.

Detailed overleaf is the assessment form and questionnaire as recorded for each case participating in the current study.

ASSESSMENT FORM AND QUESTIONNAIRE

1.	Name	
2.	Age/Sex	
3.	Occupation	
4.	Mode of Injury ▪ Simple Fall ▪ RTA	▪ Fall from height
5.	Type of Fracture (Boyd & Griffin) ▪ Type I ▪ Type II	▪ Type Ill ▪ Type IV
6.	Duration between Injury & Surgery	
7.	Implant used	
8.	Reconstruction of Medial Pillar ▪ Adequate	▪ Inadequate
9.	Primary Bone grafting	10. Blood loss during surgery
11.	Duration of current follow up	
12.	Infection ▪ No Infection ▪ Superficial infection	▪ Deep seated infection ▪ Sinus formation

13.	Wound healing ▪ Wound healing normal	▪ Wound healing inadequate
14.	Clinical Union ▪ Clinical union present	▪ No clinical union
15.	Quality of Bone (Evidence of Osteoporosis) ▪ Present	▪ Not present
16.	Neck Shaft Angle I. Normal Side II. At current follow up Coxavara deformity ▪ Neck shaft angle equal to normal side or a difference of <5 degrees ▪ Neck shaft angle difference of >5 degrees	
17.	Associated medical illness	
18.	Radiological Union ▪ Radiological signs of union present ▪ Radiological signs of union absent	
19.	Implant Failure ▪ No failure ▪ Breakage of Plate ▪ Breakage of Screw	▪ Loosening of Screw ▪ Cut through of Screw

EVALUATION OF PATIENTS IN ACCORDANCE WITH HARRIS HIP SCORE

1. Pain (44 Possible Points)

None or ignores it	44	▪
Sight. Occasional, no compromise	40	▪
Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin	30	▪
Moderate pain, tolerable but makes concessions to pain, some limitation of ordinary activity or work. May require occasional pain medicine stronger than aspirin	20	▪
Marked pain, serious limitation or activities	10	▪
Totally disabled, crippled, pain in bed, bedridden	0	▪
Total Score for Pain		

2. Function (47 Possible Points)

Gait (33 possible)		
1. Limp		
a. None	11	▪
b. Slight	8	▪
c. Moderate	5	▪
d. Severe	0	▪
2. Support		
a. None	11	▪
b. Single Cane for long walk	5	▪
c. One crutch	3	▪
d. Two canes	2	▪
e. Two crutches	0	▪
f. Not able to walk	0	▪
3. Distance walked		
a. Unlimited	11	▪
b. Six blocks	8	▪
c. Two or three blocks	5	▪
d. Indoors only	2	▪
e. Bed and Chair	0	▪
B. Activities (14 Possible)		
1. Stairs		
a. Normally without using a railing	4	▪
b. Normally using a railing	2	▪
c. In any manner	1	▪
2. Shoes and Socks		
a. With ease	4	▪
b. With difficulty	2	▪
c. Unable	0	▪
3. Sitting		
a. Comfortably in ordinary chair for one hour	5	▪
b. On high chair for one-half-hour	3	▪
c. Unable to sit comfortable in any chair	0	▪
4. Enter public transportation	1	▪
Total Score for Function		

3. Absence of Deformity (4 Possible Points)

(Given if the patient demonstrates)

A. Less than 30	▪
B. Less than 10°	▪
C. Less than 10° fixed internal rotation in extension	▪
D. Limb length discrepancy less than 3.2 centimeters	▪
Total Score for Absence of Deformity	▪

4. Range Of Motion (Index Values Are Determined by Multiplying the Degrees of Motion Possible in Each Arc by the Appropriate Index)

Movement	**Range of Motion**		**Index Value**
A. Flexion	0 - 45degrees x 1.0 45 - 90 degrees x 0.6 90 - 110 degrees x 0.3	▪ ▪ ▪	
B. Abduction	0 - 15 degrees x 0.8 15 -20 degrees x 0.3 Over 20 degrees x 0.0	▪ ▪ ▪	
C. External rotation in extension	0 -15 degrees x 0.4 Over 15 degrees x 0.0	▪ ▪	
D. Internal rotation in extension	0 - 15 degrees x 0.4 Over 15 degrees x 0.0	▪ ▪	
E. Adduction	0 5 degrees x 0.2 Over I 5 degrees x 0.0	▪ ▪	
The sum of the index values The sum of the index values x 0.05			

Total score for Motion			

Harris Score on Follow Up

Pain	**Function**								**Motion**	**Deformity**
	Gait			Activities						
	Limp	Support used	Distance walked	Stairs	Shoes	Sitting	Enter pub. transport	Total		
Total Harris Score										
Overall Rating										

STATISTICAL ANALYSIS

Statistical Analysis done on 'MSTAT' Statistical Analysis Software; Chi Square, Z test, 't' test have been used to test the significance of data. Values are represented in Mean ± SD and N (%).

Observations

The study was conducted on sixty five patients of proximal femoral fracture attending out patient/casuality department of MLB Medical College, Jhansi, between December 2008 to February 2010. twenty one patients did not gave consent or were unfit for surgery, rest forty four patients II were divided in two groups I and II of twenty two patients each, patients of group I were treated by open reduction and internal fixation with DHS and patient of group II were treated by open/close reduction and internal fixation with PFN. Patient were followed up for at least six months were the observations are based on the study of thirty five patients those could be followed for six months or more.

Table no. 1 : Age Distribution of patients in two groups

Age (in yrs)	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
21-30	2	10.00	3	20.00	5	14.29
31-40	2	10.00	2	13.33	4	11.43
41-50	4	20.00	4	26.67	8	22.86
51-60	5	25.00	2	13.35	7	20
61-70	5	25.00	3	20.00	8	22.86
71-80	1	5.00	1	6.67	2	5.71
81-90	1	5.00	0	0.00	1	2.85
Total	20	100.00	15	100.00	35	100.00

χ^2=6.18, p=0.62(NS)

There is no significant difference in age distribution of two groups.

In total patients χ^2 32.59, p<0.001, maximum number of patients in the group of 41-50 (22.86%) and 61-70 (22.86%), than in 51-60 (17.14%). Minimum 81-90 (2.85%).

Table no. 2 : Sex Distribution of patients in two groups

Sex	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Male	12	60.00	12	80.00	24	68.60
Female	8	40.00	3	20.00	11	31.40
Total	20	100.00	15	100.00	35	100.00

χ^2=3.18, p=0.07 (NS)

There is no significant difference in age distribution of two groups.

In total Z=4.06, p<0.001. Number of male patient are significantly higher than female patients.

Table no. 3 : Mode of injury in two groups

Mode	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Simple fall	9	45.0	4	26.67	13	37.14
RTA	7	35.0	9	60.0	16	45.72
Fall from height	4	20.0	2	13.33	6	17.14
Total	20	100.00	15	100.00	35	100.00

χ^2=4.62, p0.12 (NS)

There is no significant difference in mode of injury in two groups.

In total χ^2=7.07, $p<0.05$, RTA is most common cause of injury (45.72%) followed by simple fall (37.14%) and fall from height is minimum (17.14%).

Table no. 4 : Comparison of types of fracture (Boyd & Griffin) in two groups

Type of fracture (Boyd & Griffin)	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
I	3	15.0	1	6.67	4	11.43
II	3	15.0	2	13.37	5	14.29
III	5	25.0	5	33.33	10	28.57
IV	9	45.0	7	46.67	16	45.71
Total	20	100.00	15	100.00	35	100.00

χ^2=0.76, p=0.85 (NS)

Type IV is the most common fracture encountered. There is no significant difference in type of fracture in two groups.

Table no. 5 : Duration of injury at the time of surgery in two groups

Days	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
0-15	12	60.0	10	66.67	22	62.86
16-30	7	32.0	3	20.0	10	28358
31-45	0	0.0	0	0.0	0	0.00
46-60	0	0.0	1	6.67	1	2.85
61-75	0	0.0	0	0.0	0	0.00
76-90	1	5.0	1	6.67	2	5.71
Total	20	100.00	15	100.00	35	100.00

χ^2=4.59, p=0.47(NS)

There is no significant difference in duration of injury at time of surgery in two groups.

In the total patients χ^2=212.86, p=0.001 (significant). Duration of injury at the time of surgery differ significantly. In 62.86% patients, surgery was performed within 15 days of injury. In 28.58% patients surgery was performed between 16-30 days.

Table no. 6 : Implant used in two groups

	Total	
	Number	**Percentage**
Dynamic Hip Screw	20	57.14
Proximal Femoral Nail	15	42.86
Total	35	100

Table no. 7 : Comparison of blood loss in two groups

The preoperative loss of blood in DHS group ranged from 150ml to 600ml (mean – 268.0ml) whereas in PFN group the range was 80ml to 600ml (mean 158.33ml).

	Group I Dynamic Hip Screw	**Group II Proximal Femoral Nail**
N	20	15
Mean blood loss (in ml)	268.0 ml	158.33 ml
S.D.	18.00	21.51

T=26.18, $p<0.001$

There is comparatively more blood loss in patients managed by DHS as compared to patients of PFN group.

Table no. 8 : Need for Bone Grafting in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
With graft	5	25.0	2	13.33	7	20.0
Without graft	15	75.0	13	86.67	28	80.0
Total	20	100.00	15	100.00	35	100.00

χ^2=1.89, p=0.16

Need for bone grafting is higher in group I than group II (p=0.16)

In total Z=7.78, p<0.001. Number of patients requiring bone graft is significantly lower than those not requiring it.

Table no. 9 : Radiological Union in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Non union	1	5.0	0	0.0	1	2.85
Union	14	95.0	15	100	34	93.15
Total	20	100.00	15	100.00	35	100.00

Fisher Exact test, p=0.57

Union is satisfactory in both groups but relatively higher in group II as compared to group I (p=0.57).

In total Z=11.49, p=0.001. Number of cases with union are significantly higher than cases presenting with non union.

Table no. 10 : Comparison of variation in neck shaft angle in two groups

	Group I Dynamic Hip Screw				Group II Proximal Femoral Nail			
	Postoperative		Variation of follow up		Postoperative		Variation of follow up	
	No.	%	No.	%	No.	%	No.	%
Maintained	18	90.0	19	95.0	13	86.67	15	100
Varus	1	5.0	1	5.0	1	6.67	0	0
Valgus	1	5.0	0	0	1	6.67	0	0
Total	20	100	20	100	15	100	15	100

Only one case which was managed by dynamic hip screw had a varus collapse on follow up. No patient managed by PFN presented with any variation in neck shall angle at follow up.

Table no. 11 : Comparison of Shortening in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Z	p
	No.	%	No.	%		
No shortening	17	85.0	13	86.67	0.62	0.52 (NS)
Shortening <3.2cm	3	12.0	2	13.37	0.62	0.52 (NS)
Shortening >3 2cm	0	0	0	0		
Total	20	100.00	15	100.00		

χ^2=0.38, p=0.55 (NS)

Total incidence of shortening is 15%. No patient is present with shortening > 3.2 cm.

Incidence of shortening (≤3.2 cm) is slightly higher in group I than II (p=0.52).

Table no. 12 : Duration of start of weight bearing after surgery

Days	Group I Dynamic Hip Screw	%	Group II Proximal Femoral Nail	%	Total
1	4	20	5	33.34	9
3	3	15	3	20.00	6
7	4	20	2	13.33	6
15	7	35	3	20.00	10
30	2	10	2	13.33	4
Total	20	100	15	100	35

Early weight bearing start in group II as compare to group I.

Table no. 13 : Comparison of Squatting and Crossed leg sitting (CLS) in two groups

	Group I Dynamic Hip Screw				Group II Proximal Femoral Nail				Total	
	Present		Absent		Present		Absent			
	No.	%	No.	%	No.	%	No.	%	No.	%
Squatting	16	80	4	20	13	86.67	2	13.33	29	82.86
CLS	16	80	4	20	13	86.67	2	13.33	29	82.86

Comparison of I vs II Squatting χ^2=1.29, p=0.26

CLS χ^2=1.29, p=0.26

About 17.14 of total patients were unable to squat or sit cross legged on follow up. Incidence of such patients was still lower in Proximal Femoral Nail group.

Table no. 14 : External Rotation Deformity in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Present	1	5.0	0	0	1	2.86
Absent	19	95.0	15	100	34	97.14
Total	20	100.00	15	100.00	35	100.00

Fisher Exact test, $p=0.32$

1 patients (5%) of Dynamic Hip Screw group developed external rotational deformity whereas no patient of Proximal Femoral Nail group was found to have this deformity ($p=0.32$).

In total $Z=10.66$, $p<0.001$. Significantly lower percentage of patient presented with external rotation deformity.

Table no. 15 : Comparison of Infection in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Present	1	5.0	0	0	1	2.86
Absent	19	95.0	15	100	34	97.14
Total	20	100.00	15	100.00	35	100.00

$\chi^2=1.54$, $p=0.21$

1 patient (5%) of group I presented with infection whereas no patient of group II presented with infection ($p=0.21$).

In total $Z=11.16$, $p<0.001$. Number of patients presenting with infection is significantly lower.

Table no. 16 : Comparison of Implant Failure in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Failure	1	5	0	0	1	2.85
Non failure	19	95	15	100	34	97.15
Total	20	100.00	15	100.00	35	100.00

Fisher Exact test, p=0.57

Incidence of implant failure is higher in group I than group II (p 0.57). Only one patient in our study had implant Failure who was managed by Proximal Femoral Nail fixation.

In total Z=11.49, p<0.001. There is very little incidence of implant failure.

Table no. 17 : Comparison of Results in two groups

	Group I Dynamic Hip Screw		Group II Proximal Femoral Nail		Total	
	No.	%	No.	%	No.	%
Excellent	17	85.0	13	86.67	30	85.72
Good	2	10.0	2	13.33	4	11.42
Poor	1	5.0	0	0	1	2.86
Total	20	100.00	15	100.00	35	100.00

χ^2=0.76, p=0.68

85.0% patients in group I have excellent Harris Hip Score in comparison to 86.87% patients with excellent score in group II (p=0.68)

5% poor result is seen in group I as compared to 0% in group II.

In total χ^2=97.02, $p<0.001$ (significant). No. of patients who had excellent score on follow up is significantly higher than patients with good and poor score.

Discussion

Fractures of intertrochanteric femur have been recognized as a major challenge by the Orthopaedic community, not solely for achieving fractures union, but for restoration of optimal function in the shortest possible time that to with minimal complications. The aim of management accordingly has drifted to achieving early mobilization, rapid rehabilitation and quick return of individuals to premorbid home and work environment as a functionally and psychologically independent unit.

Operative treatment in the form of internal fixation permits early rehabilitation and offers the best chance of functional recovery, and hence has become the treatment of choice for virtually all fractures in the trochanteric region. Amongst the various types of implants available i.e. fixed nail plate devices, sliding nail/screw plate and intramedullary devices, the compression hip screw is most commonly used but recently techniques of closed intramedullary nailing have gained popularity.

In this study an attempt was made to survey, evaluate, document and quantify our success in the management of such individuals by using PFN and DHS implants and compare the result in these two groups. The study was conducted on sixty five patients of proximal femoral fracture attending out patient/casuality department of MLB Medical College, Jhansi, between December 2008 to February 2010. twenty one patients did not gave consent or were unfit for surgery, rest forty four patients II were divided in two groups I and II of twenty two patients each, patients of group I were treated by open reduction and internal fixation with DHS and patient of group II were treated by open/close reduction and internal fixation with PFN. Patient were followed up for at least six months were the observations are based on the study of thirty five patients those could be followed for six months or more. These patients were evaluated for assessment of epidemiological, clinical, functional, rehabilitative outcomes and complications.

In our study sixty five percent of cases belonged to age group between 40—70 years, with a distribution of 22.86%, 17% and 23% in 4^{th}, 5^{th} and 6^{th} decades respectively. There is no significant difference in age distribution of' two groups. The increase in incidence of intertrochanteric fractures with advancing age has been demonstrated in a number of studies. Gallaghar et al (1980) reported an eight fold increase in trochanteric fractures in men over 80 years and women over 50 years of age.

Average age reported by other workers is as follows :

Name of the worker	**Age in years**
Cleaveland and Thompson, 1947	76.0
Murray and Frew, 1949	62.5
Byod and Griffith, 1949	69.7
Scott, 1951	73.3
Evans 1951 –	
Males	62.6
Females	74.3
Wade and Campbell (1959)	72.0
Sarmiento, 1963	71.9
Gupta, RC, 1974	51.2

We found a male preponderance in our patients with males accounting for 68% of cases and females for the remaining 32% constituting a male to female ratio of about 2:1. This clearly reflected the preference and better acceptance of surgery by males and higher incidence of trochanteric fractures of femur in male population due to their more active lifestyles. David G. Lovelle found trochanteric fractures more common in women than men by a margin of three to one. Melton J.L., Ilistrup DM, Riggs BL et al (1982) released a study titled ‘fifty years trend in Hip fracture incidence’ and reported a female to male ratio of 1.8:1. This variation is probably because our study measured the male female ratio amongst operated fractures that reported for follow up and not the actual sex incidence for all trochanteric fractures.

Ratio of males : females in other series is given below :-

Series	Males	Females
Boyd and Griffith (1949)	74	226
Murray and Frew 1949	56	46
Scott (1951)	35	65
Robey 1956	46	53
Clawson 1957	75	102

The most common mode of injury emerged as the road traffic accident followed by simple fall on ground, 40% patients sustained trauma as a result of road traffic accident. The simple fall accounted for 42 percent the total cases included in the study. Significantly, all hundred percent of cases of trochanteric fractures resulting from a simple fall occurred in patients more than forty years of age. This may be attributed to the following factors as enumerated by Cummings and Nevitt in 1994. Inadequate protective reflexes, to reduce energy of fall below a certain critical threshold. Inadequate local shock absorbers e.g. muscle and fat around hip. inadequate bone strength at the hip on account of osteoporosis or osteomalacia.

Young patients with intertrochanteric fractures sustained trauma either as a result of road traffic accident or fall from height, there by reflecting the requirement of high velocity trauma to cause fracture in the young. Keneth J. Koval and Joseph D. Zuckerman (1996) observed that 90% of hip fractures in the elderly result from a simple fall. Hip fractures in young adults were observed to result most often with high energy trauma such as motor vehicular accidents or a fall from height.

The delay in surgery was attributed to two major reasons. The first was the time lag between injury and hospitalization. The second reason for delay was time lag between hospitalization and surgery. This was attributed to poor general condition of the patient towards fitness for anaesthesia and surgery as well as high workload and working condition in government hospital.

91.44% of patients were operated within one month of sustaining injury. 62.8% of these were operated within 15 days and 28.5% between 16 to 30 days.

All fractures were classified in accordance with the Boyd and Griffin’s classification into four fracture types and the relative incidence of each type was calculated. Type IV fractures emerged as the most common fracture type in our study with 45.7% of cases, while type I, type II and type III fractures accounted for 11.43%, 14.29% and 28.57% of cases respectively. This also correlated with the finding of Jacobs and coworker (1980) that incidence of comminuted usable intertrochanteric fractures is increasing.

None of the patients with either type I or type II fracture configuration, had a Harris score of less than 80. Out of eight patients with scores less than eighty under the Harris evaluation system, three patients had a type III fracture while the remaining five had type IV Fractures. Thus, type IV fractures carried significantly poorer prognosis in terms of functional outcome in relation to other fracture types. Unfortunately these also emerged as the most common fracture type, in our study. Boyd & Griffin (1949) observed that type III and IV fracture were the most difficult to manage. In our study we found PFN nails to he more useful in management of type Ill and type IV fractures,

About 80% of fractures fixed by PFN nails were type III and type IV whereas 70% of fractures fixed by DHS implants belonged to this type.

There was comparatively less blood loss in patients managed by proximal femoral nail than in patients managed by Dynamic hip screw. This is attributed to smaller exposure required for PFN, exception being where open reduction was mandatory, shorter operating time.

Bone grafting was performed amongest five cases of DHS group and in 2 cases of PFN group in our study. In one DHS and all 2 PFN cases where surgery was delayed by more than thirty days grafting was done with the intent of promoting union. In remaining four cases grafting was performed as a primary procedure to buttress the posteromedial cortex and enhance stability. Four cases, which underwent bone grafting, had Harris scores in excess of eighty showing excellent functional results. Three cases where grafting was performed had Harris scores of less than eighty. This was attributed to other associated factors namely a long interval between trauma and surgery, development of postoperative infection and nonunion with fixation failure.

Nonunion was observed in one case (2.85%) during the course of this study. This was an unstable type IV Boyd and Griffin fracture pattern in an osteoporotic patient managed by DHS. Altner PC (Orthop Rev. 1982) studied reasons of failure in treatment of trochanteric fractures and observed nonunion in less than 2% of his patients. The incidence of nonunion was observed to be highest in unstable fracture patterns.

Implant failure in the form of cut out in the Richard screw from the femoral head was observed in one case. This was associated with varus collapse of the neck shaft angle and nonunion at the fracture site. Baumgaertner M.R Chvostoski (1995) reported the incidence of fixation failure to be as high as 20% in unstable fracture patterns. Osteoporosis was found to be the most important predisposing factor for this complication.

Thromboembolic complications were not observed in any of our eases. Also no patient was put on anti-thrombosis prophylaxis in the postoperative period. This was contrary to the study by Vajanto I, Kuokkanen H. Niskanen R. Haapala J, Korkala O in 1998, who observed thromboembolic phenomenon as one of their most common general complications and recommended sufficient anti-thrombosis prophylaxis during convalescence period at the hospital.

No case developed subcapital femoral neck fracture. Arrington ED, Davino Na in 1999 observed this devastating complication in patients with osteoporosis and recommended deeper placement of dynamic hip compression screw to within 5 mm to 8 mm of subchondral bone, to decrease stress forces in the subcapital femoral neck.

The neck shaft angle of normal side and affected side were measured and compared preoperatively to determine the amount of coxa vara present.

Post operatively the angle was measured and compared to the normal side to assess the correction achieved. Again the neck shaft angle was determined at follow up to assess any variation from immediate postoperative. Five patients presented with varus deformity.

Out of five patients with coxa vara deformity at follow up three were managed by dynamic hip screws. Four out of five patients had coxa vara deformity due to inadequate reduction and failure to maintain neck shaft angle peroperatively. All four patients had Harris functional scores in the excellent categories. One patient developed varus deformity during the follow up period after adequate peroperative maintainance of neck shaft angle. This was attributed to migration of screw within the femoral head. The same patient had a poor Harris score of 35.2.

Two patients presented with valgus deformities at post op. In both cases the valgus malalignment was due to inaccurate reduction of fracture fragments peroperatively. None of the cases showed any variation in the neck shaft angle from that in the immediate postoperative period. One patient had excellent functional result at six months. The other case was operated after a time lag of 25 days, fracture was fixed in external rotation and patient had a Harris score between 50 to 80.

Union is satisfactory in both groups but relatively higher in group II as compared to group I. Non union was observed in one case 92.85%) during the course of this study. This was an unstable type IV Boyd and Griffith fracture patter in an osteoporotic patient managed by dynamic hip screw. The incidence of nonunion was observed to be highest in unstable fracture patterns.

Only one case which was managed by dynamic hip screw had a varus collapse on follow up. No patient managed by proximal femoral nail presented with any variation in neck shaft angle at follow up.

Number of patients presenting with infection is significantly lower in group II than in group I. One patient (5%) of group I presented with infection whereas no patient of group II presented with infection. This may be attributed to low immunity status of patient as the patient was of asthenic built and belonging to low socioeconomic status, more soft tissue exposure as compared to patients of group II and more surgical exposure time as compared to patients of group II.

Total incidence of shortening is 15%. No patient presented with shortening >3.2cm. Incidence of shortening is slightly higher in patients of group I managed by DHS than in patients of group II managed by PFN.

One patients (5%) of dynamic hip screw developed external rotational deformity whereas no patient of proximal femoral nail group was found to have this deformity.

Functional outcome of patients was evaluated by Harris hip Score evaluation score. In DHS group, 17 patients had a Harris hip score ranging between 80 and 100 and constituted 5% of all cases. One patient demonstrated a poor score of 35.2 accounting for 5%. Four patients had scores ranging between 50 and 80 accounting for 10% of all cases. In PFN group 13 patients had excellent Harris hip score which constituted 86.67%. 2 patients had good Harris Hip Score which constituted 13.33%. about 17.14% of total patients were unable to squat or sit cross legged on follow up. Incidence of such patients was higher in patients managed by DHS than in PFN.

Placement of Screw

Position: The internal fixation device should be placed in that part of the head and neck where quality of hone is best. Placement of' screw within the fernoral head and neck should be central. It may be placed slightly inferior and posterior but never in the anterior or superior aspect.

Depth of Insertion: The depth to which lag screw is inserted within the femoral head is critical for maximal purchase on the proximal fragment.

Screw should be inserted within 1 cm of subchondral bone for optimum purchase. In cases with osteoporosis deeper placement of Richard screw / lag screw to within 5 mm to 8 mm of subchondral bone is recommended.

Tip apex distance by Baurngaertner et al is an important index to ascertain the adequacy of depth of placement of screw. The sum of distances from the apex of femoral head to the tip of lag screw on both anteroposterior and lateral roentgenogram should be less than 25 mm.

A central position of screw is probably optimal for pertrochanteric fractures (Mushollard and Gunn 1972, Wolfgang et al. 1982, Davis et al., 1990). The screw of intramedullary nail proved more likely to go up the central axis of the femoral neck, and to give a better screw position. This may be because the entry point of the guide wire into the neck is controlled by the position of the nail within the medulla, close to the base of the neck, a point which is less variable than an entry point on the lateral cortex.

Summary

With all the advancement in the field of technology, the road traffic accidents are increasing day by day. With the modern method of treatment and awareness of healthy living, average life expectancy of Indian population has increased almost double fold 35 year to 64 year, resultantly in tremendous increase in osteoporotic population and osteoporotic fractures. Increasing life expectancy, sedentary life style and increasing traffic on road, busy life style, lack of observing traffic rule result remarkable increase incidence of fractures. The incidence of femur fractures is more than other of all fractures, proximal femoral fracture contribute higher in percentage.

Intertrochanteric fractures of femur by Virtue of their great potential for union, regardless of the mode of treatment failed to draw the attention of early authors for many years. Once the impact of these injuries on the social and economic fronts was recognized, much has been published, both on the different methods of internal fixation as well as on the outcome and complications of these fractures.

Present study was conducted in the Department of Orthopaedic Surgery, Maharani Laxmi Bai Medical College and Hospital Jhansi, during the period between December 2008 and August 2010.

Forty four patients of trochanteric fractures managed operatively by internal fixation with Dynamic Hip Screw and Proximal Femoral Nail during the course of the study were sorted and each was followed for at least 6 months, among them only thirty five patients turned up for follow up for 6 months or more and those patients were omitted from study who could not be followed for at least 6 months.

Follow up of all patients in both groups were carried out regularly with clinical and radiological assessment at successful visits till the patients achieved maximum possible functions of the injured limb. The data thus collected from patients of these two groups was analysed , evaluated, compared with each other .. **observation can be summarized as follows-**

1. There is no significant in age distribution in two groups. 65% of cases belongs to age group between 40-70 years.
2. We found male preponderance in our patients with male accounting for 68% of cases and females for remaining 32% constituting a male to female ratio of about 2:1.
3. Most common mode of injury in young patients is the road traffic accident while most common mode of injury in old patients is the simple fall.
4. The delay in surgery was attributed to two major reason, the first was the time lag between injury and hospitalization. The second reason for delay was time lag between hospitalization and surgery. This was due to poor general condition of the patient and high workload with the hospital.

   Majority of patients were operated within one month of sustained injury.
5. According to Boyd and Griffin's classification type 4 fractures emerged as the most common fracture type in our study. About 80% of fractures fixed by proximal Femoral Nail were type 3 and 4 where as 70% of fractures fixed by Dynamic Hip Screw implants belongs to this type.

6. There is comparatively less blood loss in patients managed by proximal femoral nail as compared to patients of Dynamic Hip Screw group.

7. Need for bone grafting is higher in group I than group II.

   In total number of patients requiring bone graft is significantly lower.

8. Union is satisfactory in both groups but relatively higher in group II as compared to group I. Nonunion was observed in one case (2.85%) during the course of this study. This was an unstable type IV Boyd and Griffin fracture pattern in an osteoporotic patient managed by Dynamic Hip Screw . The incidence of nonunion was observed to be highest in unstable fracture patterns.

9. Number of patients presenting with infection is significantly lower.

   1 patient (5%) of group I presented with infection whereas no patient of group II presented with infection.

10. Only one case which was managed by dynamic hip screw had a varus collapse on follow up. No patient managed by Proximal Femoral Nail presented with any variation in neck shaft angle at follow up.

11. Incidence of implant failure is higher in group I than group II. Only one patient in our study had implant Failure who was managed by Proximal Femoral Nail fixation.

12. 1 patients (5%) of Dynamic Hip Screw group developed external rotational deformity whereas no patient of Proximal Femoral Nail group was found to have this deformity.

13. Total incidence of shortening is 15%. No patient is present with shortening > 3.2 cm. Incidence of shortening (≤3.2 cm) is slightly higher in group I than II.

14. About 17.14 % of total patients were unable to squat or sit cross legged on follow up. Incidence of such patients was still lower in Proximal Femoral Nail group

15. Number of patients who had excellent Harris Hip score on follow up is significantly higher than patients with good and poor score. 85.0% patients in group I have excellent Harris Hip Score in comparison to 86.87% patients with excellent score in group II. 5% poor result is seen in group I as compared to 0% in group II.

Taking the anatomical or near anatomical fracture union and restoration of the patient to his or her prefracture ambulatory status at the earliest possible and avoiding all problems of recumbency, the overall quality of results were better with internal fixation with Proximal Femoral Nail as compared to internal fixation with Dynamic Hip Screw.

Conclusion

Operative management which allows early rehabilitation and offers to the patient the best chances for functional recovery is the treatment of choice for virtually all trochanteric fractures. The preferred type of implant is still a matter of debate.

The claimed advantage with Proximal femoral nail is that a smaller exposure is required than for a sliding screw, it may therefore be associated with lesser blood loss, shorter operating time and less morbidity. There may also be mechanical advantages, because the shaft fixation is nearer to the centre of rotation of the hip, giving a shorter lever arm and a lower bending movement on the device (Kaufer, 1980). In osteoporotic bones Proximal femoral nail fixation carries definitive advantage over Dynamic Hip Screw fixation devices.

We aimed to evaluate whether these theoretical advantages could be proved in practice, by a comparison of the results of Proximal Femoral Nail and Dynamic Hip Screw implants.

We found that in type III and type IV fractures Proximal Femoral Nail implants have better results as compared to Dynamic Hip Screw implants. To achieve stability good reduction is essential. The fracture should be internally fixed only once good medial cortical contact is seen on anteroposterior view and good posterior contact is seen on lateral view. In cases with intramedullary fixation closed reduction is attempted. Open reduction is done only in cases where closed reduction failed or was grossly unacceptable. Bone grafting to buttress the posteromedial cortex is recommended where good medial and posterior contact is not achievable by reduction.

Malrotation and deformity after trochanteric fracture fixation is usually a result of improper fixation of fracture fragments in rotation at time of surgery. In fractures managed by closed intramedullary nailing, incidence of malrotation deformity is found to be lower.

A central position of screw is probably optimal for pertrochanteric fractures. We found that screw of Proximal Femoral Nail proved more likely to go up the central axis of the femoral neck. This is in coherence with findings of previous studies.

Non-union of trochanteric fracture although is a rare entity but most of non-unions follow unsuccessful operative stabilization with subsequent varus collapse and screw cut out through femoral head or due to an osseous gap secondary to inadequate fracture impaction. Only one patient in our study who was managed by dynamic hip screw had a varus collapse resulting in non union. However, no case in Proximal Femoral Nail group had such failure.

Infection in the postoperative period is an important independent predictor of functional outcome irrespective of adequacy of internal fixation and radiological union. Adequate antibiotic coverage and sterile stitch line dressings deserve special attention. Incidence of infection was found to be lesser in Proximal Femoral Nail group.

In our study, the mean blood loss was comparatively less in patients managed by Proximal Femoral Nail fixation.

We did not encountered any secondary femoral fracture in patients managed by Proximal femoral nails though this is one of common complication reported in some previous studies.

In our study we found that Proximal femoral nails prove to be more useful in difficult fractures with a subtrochanteric extension or reversed obliquity and for high subtrochanteric fractures, where other forms of fixation are less satisfactory. We obtained a more central position of the lag screw with Proximal femoral nails as compared to Richard screw in Dynamic Hip Screw implant. The mean blood loss was lesser with intramedullary implants and incidence of wound infection was also lower so early ambulation was achieved. We did not come across any secondary femoral fractures with Proximal femoral nails as reported in some previous case studies. However, the rate of union was similar in two groups.

Bibliography

1. Altner PC, Reasons for failure in treatment of intertrochanteric fracture. Orthop Rev 1982; 11:117.
2. Arrington ED, Davino NA, Subcapital femoral neck fracture after closed reduction and internal fixation intertrochanteric hip fracture: a case report and review of the literature. Am J Orthop 1999 Sep; 28(9): 517-21.
3. Asher, M.A:Rockwood compression fixation of subtrochanteric fracture Clin Ortho 17: 202-208. 1976.
4. Baumagaertner MR, Chrostowski JH, Levy RN, intertrochanteric hip fracture In: Bronwer BD, Levine AM, Jupiter JB, et al eds, Skeletal trauma , vol,2, Philadelphia: WB saunders, 1992; 1833-1881.
5. Baumagaetner MR, Curtin SL, Lindskog DM, et al. The value of the tip apex distance in predicting failure of fixation of peritronchanteric fractures to the hip. J Bone Joint Surg; 1995; 77A:1058-1064.
6. Bergman G.D. et al. Subtrochanteric fracture of femur fixation using the Zickel nail J.B.J.S. 69A:1032-40;1987.
7. Boldin et al (2003): The proximal femoral nail (P.F.N.)- a minimal invasive treatment of unstable proximal femoral fractures. Actar Orthop Scand 2003, 74 (1);53-58.
8. Boyd HB, Griffin LL. Classifications and treatment of trochanteric fracture. Arch Surg 1949; 58:853-866.

9. Browner B. Jupiter J, Levine A Russel- Taylor classifications of subtrochanteric fracture 1998;2:1891-197.

10. Campbells operative orthopaedics. 9th ed 1998.2181-2223.

11. Choneka J et al. Biomechanical comparison of sliding hip screw and the done plunger J.B.J.S. 1995; 77B:277-83.

12. Cleveland M, Bosworth DM, Thompson FR, et al. A ten year analysis of intertrochanteric fracture of femur. J Bone Joint Surg 1959; 41A : 1399-1408.

13. Cummings SR, Nevitt MC. Non- skeletal determinants of fractures: the potiential importance of mechanics of falls. Osteoporosis Int 1994; suppl1: S67-70.

14. Dhal. A : Singh, S.S. Biological fixation of subtrochanteric fracture by ext. fixation 27:723-731, 1996.

15. Ender H.G. treatment of pertrochanteric and subtrochanteric fractures of the femur with Ender’s pin in the hip proceeding of hip society CV Mosby St. Louis 187, 1978.

16. Evans E. The treatment of trochanteric fractures of the femur J.B.J.S. 1949; 3113:190-203.

17. Fielding J.W. subtrochanteric fracture 1966; 122:55-567.

18. Gallangher JC, Melton LJ, Riggs BL et al. Epidemiology of fractures of the proximal femur in Rochester, Minnesota. Clin Orthop 1980; 150:163-171.

19. Ganz R and Thomas RJ (1979) trochanteric fractures of the femur clin. Orthop 138:30-40.

20. Gundle R, Gargan MF simpwon AH. How to minimize failures of fixation of unstable intertrochanteric fracture. Injury 1995 femoral neck and pertochanteric femoral fractures. Unfallchirurgic 1996 Apr; 22 (2) :74-84.

21. Harri's W.H. J.B.. J.S.Am 51:537-755,1969.

22. H. Banon et al./ Injury J. care injured 33 (2002) 401-405.

23. Haidukewych GJ, Berry DJ, Hip artroplasty for salvage of failed treatment of intertrochanteric hip fractures. J. Bone Joint Surg Am. 2003 May; 85-A (5):899-904.

24. Haidukewych GJ, Berry DJ, Salvage of failed internal fixation of intertrochanteric hip fractures. Clin Orthop. 2003 July;(412): 184-8.

25. Hardy D. Descamps P et al use of an intramedullary hip screw compared with a compression hip screw with a plate for intertrochanteric fracture J.B.J.S. 1998; 80A 618- 630.

26. Hibbs, R.A. The management of the tendency of the upper fragment to tilt forward in fracture of the upper 3rd of femur. N.Y. med J. 75: 177-179, 1902.

27. Hoerer D, Volpin G, Stein H, Results of early and delayed surgical fixation of hip fracture in the elderly: a comparative retrospective study. Bull Hosp Jt Dis 1993 spring; 53 (1); 29-33.

28. Hoffman P.(1994) change in the management pf per-subtrochanteric femoral fractures A.K. tuelle trakmatol; 24(1):1-5.

29. Hoffmann P Change in the management of pre-subtrochanteric femoral fractures- a retrospective 10-year analysis. Aktuelle Truamatol 1994 Feb; 24 (1): 1-5.

30. Hoglund EJ, New intramedullary bone implant surgery. Cyneoil obstrets 1917;24:243.

31. Hunghston JC (1984) unstable intertrochanteric fracture of the hip. J.B.J.S. 46A:1145.

32. Hunter GA. The results of operative treatment of trochanteric fracture of the femur. Injury 1975; 6:202-205.

33. Jensen JS, Bagger J. Long-term social prognosis after hip fractures Acta Orthop Scand 1982 Feb; 53 (1): 97-101.

34. Kaufer H. et al. Stable fixation of intertrochanteric fracture : a biomechanical evaluation. J.B.J.S; 1974; 56A: 899-907.

35. Kuntscher, G , Daver Bruch and umbanzone. Bruns Beitrage Klin Chir 169:558,1939.

36. Kim W Y et al (2001): Failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to preoperative fracture stabilization osteoposis Int. orthop ; 25 (6):300-362.

37. Kim Wy, Han Ch, park JI Kim JY failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to preoperative fracture stability and osteoporosis. Int ortop 2001;25(6):360-2.

38. Kinast C et al. Subtrochanteric fractures of femur; results of treatment with 95 condylar blace plate. Clin orthop 1989; 28:122-130.

39. Koch, J.C. laws of bone architecture Am J, Anat 21: 173- 298, 1917.

40. Koval KJ Sala SA., Kummer FJ, Kuckerman JD postoperative weight bearing after a fracture of the femoral neck or an

intertrochanteric fracture. J bone Joint Surg Am 1998 Mar; 80(3): 352-6.

41. Koval KJ, Aharonoff GB, Su et Zuckeman JD. Effect of acute impatient rehabilitation on outcome after fracture of the femoral neck or intertrochanteric fracture J Bone Joint Surg Am 1998 Mar; 80; (3): 357-64.

42. Kuntscher, G. Dawer Bruch and Umban Zone . Bruns Beitrage Klin Chir 169:558,1939.

43. Kyle RF, Gustilo RB Premer RF. Analysis of six hundred and twenty two intertrochanteric hip fracture. J Bone Joint Surg, 1979; 61 A (2): 216-221.

44. Lauridsen UB Rehabilitation after trochanteric femoral fractures. Ugeskr Laeger 1995 Jan 30; 157(5):565-7).

45. Mariani EM, Rand JA, Nonunion of intertrochanteric fracture of the femur following open reduction and internal fixation: results of second attempt to gain union. Clin Orthop 1987; 218:81-89.

46. Medoff, R.J. A new device for the fixation of unstable peritrochanteric fracture of the hip J.B.J.S. Am 73: 1192-1199, 1991.

47. Meena RC, Udawat MP Jain N, A ten years analysis of 500 intertrochanteric fracture of the femur with impression to residual deformity and shorting. Indian J Med Sci 1995 Jun; 49(6): 135-8.

48. Melton JL, Ilstrum DM, Riggs BL, et at. Fifty year trend in hip fracture incidence. Clin Orthop 1982 ;162:144-149.

49. Pakat J. Andren (2003) unstable subtrochanteric fracture – gamma nail versus dynamic condylar screw SCIOT 2004;2821-24.

50. Pugh WL (1955): A self adjusting nail for fracture about the hip joint J.B.J.S.- 37A , 1085-1093.

51. Rockwood and Green Fractures in adults 5th 2001;1635-1663.

52. Rush L.V. Rush HL, technique for longitudinal pin fixation of certain fracture of the femur J.B. J.S, 1939;21:619.

53. Ry bicki EF, Simonen FA, on the mechanical analysis of stress in the femur.

54. Schatzkar J: The femur primges- venlag, 1987.

55. Seinsheimer F III, subtrochanteric fracture of the femur J.B.J.S. 1978; 60A: 300- 306 device for the proximal part of the femur J.B. J.S. 1976; 58A: 866-82.

56. Simmermacher RKJ. Bosch A.M. Vander Werken Proximal femoral nail: a new device of the treatment of unstable proximal femoral fractures injury 1999; 50:327-52.

57. Steinberg GG, Desai SS, Kornwitz NA, Sulvan TJ. The intertrochanteric hip fracture. A retrospective analysis, Orthopedics 1988 Feb; 11(2): 265-73.

58. Tencer A.F. et al : A biomechanical comparission of various methods of stabilization of subtrochanteric fractures of the femurJ. Orthop Res. 2:297, 1984.

59. Toridis T.G. stress analysis of the femur of Biomech 21163-174,1969.

60. Vajanto I, Kuokkanen H, Niskanen R, Haapala J, Korkala O, Complications after treatment of proximal femoral fractures. Ann Chir Gynaecol 1998;87(1):49-52.

61. Velasco RV and comfort TH: Analysis of treatment problems in subtrochanteric fractures of the femur J. trauma 18:513,1978.

62. Verettas DA. Galanis B, Kazakos K hatziyiannakis A, Kotosis E Fractures of the proximal part of the femur in patients under 50 years of age injury 2002 Jan; 33(1); 41-5.

63. Waddel JP subtrochanteric fracture of the femur J. Trauma 1979;A: 585-592.

64. Weise K, Schwab E, Stabilization in treatment of pre- and subtrochanteric fractures of the proximal femur Chirurg 2001 Nov; 72 (11): 1277-82.

65. Wissing H, Peterson T, Doht A Risk and prognosis of hip para-articular fractures. A comparison of treatment results of femoral neck and petrochanteric femoral fractures. Unfallchirurgin 1996 Apr; 22(2); 74-84.

66. Wolgang GL. Bryant MH. Oneil JP Treatment of intertrochanteric fractures of the femur using sliding screw plate fixation. Clin Orthop. 1982; 163:148-58.

67. Zickel RE. An intramedullary fixation device for the proximal part of the femur J.B.J.S. 1976;58A.866-872.

68. Zuckerman JD. Hip fracture. N Engl J Med 1996; 334:1519-1525.

69. Klinger HM, Baums MH, Eckert M, and Neugebauer R A comparative study of unstable per- and intertrochanteric fractures fixed with proximal femoral nail (PFN) and the dynamic hip screw (DHS) with trochanteric butt-press plate (TBPP). Zentralblatt fur Chirurgie 130(4):301-6, 2005 Aug.

70. Klinger H M; Baums M H; Eckert M; Neugebauer R A comparative study of unstable per- and intertrochanteric femoral fractures treated with dynamic hip screw (DHS) and trochanteric butt-press plate vs. proximal femoral nail(PFN)] Zentralblatt für Chirurgie 2005;130(4):301-6.

71. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Cochrane Database Syst Rev. 2005;(4):CD000093.

72. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Pertrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail. A randomised study comparing post-operative rehabilitation.J.Bone Joint surg. Br. 2005 jan; 87(1) :76-81.

73. Stefan Hajdu and Vilmos Vécsei, Intramedullary Stabilization of Proximal Femoral Fractures ,European Journal of Trauma and Emergency Surgery Volume 33, Number 2 / April, 2007