A PROSPECTIVE RADIOLOGICAL STUDY OF PROXIMAL FEMORAL GEOMETRY AND ITS RELATIONSHIP IN HIP FRACTURE IN SOUTH INDIAN POPULATION

Dissertation submitted to

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfillment for the award of the degree of

M.S.DEGREE BRANCH – II ORTHOPAEDIC SURGERY

Submitted by

Reg. No. 221212051

STANLEY MEDICAL COLLEGE, CHENNAI - 600 001.

APRIL - 2015

DECLARATION BY THE CANDIDATE

I hereby declare that this Dissertation titled "**A prospective Radiological Study Of Proximal Femoral Geometry and its relationship in Hip fractures in South Indian Population"** is a bonafide and genuine research work carried out by me under the guidance of **Dr.R.Selvaraj**, Professor & Head of the Department of Orthopaedics, Dept. of Orthopaedics, Govt. Stanley Medical College, Chennai.

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ABSTRACT

Only a few studies have tested the ability of proximal femur geometry parameters to discriminate between cervical hip fractures and those of the trochanter. The main objective of this study is to evaluate the geometrical difference between these two fracture types by measuring the parameters like Femoral Neck Length (FNL), Hip Axis Length (HAL), Neck Shaft Angle(NSA).

Materials and Methods: A prospective analysis was made in our hospital population of 118 patients with hip fractures (cervical fractures- 58, trochanteric fractures- 60). Study was conducted during 2013 January to 2014 August. FNL, HAL, NSA were measured from pelvic Xrays (digital) by using an advanced computer software.

Results: A significant difference was found between cervical and trochanteric fractures in HAL, especially in patients of 31- 60 years. Patients with higher HAL sustained cervical fractures. No significant difference in NSA and FNL measurements between these two patient groups.

Conclusion: The difference in the pathogenesis of cervical and trochanteric fractures can be explained by HAL and no significant difference in FNL, NSA of these patients could be appreciated in our study. A much higher standardized measurement setup is needed for evaluating the role of hip geometry in fracture patients.

Key words: bone geometry, hip fractures, population based, radiography.

TABLE OF ABBREVIATIONS

S .No.	Acronym	Abbreviation
1	IC	Intra capsular
2	EC	Extra capsular
3	FNL	Femoral Neck Length
4	HAL	Hip Axis Length
5	NSA	Neck Shaft Angle

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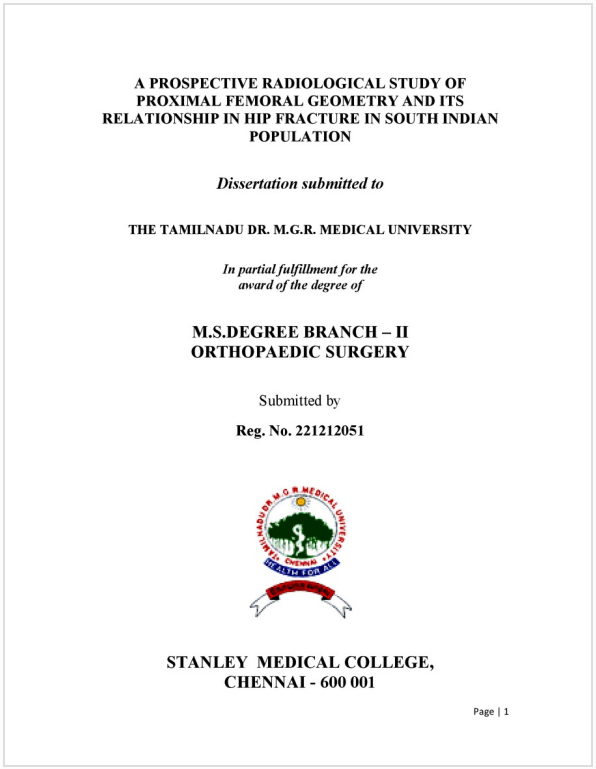

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Principal Investigator : Dr. M Ashok Kumar

Designation : PG in MS (Orthopaedics)

Department : Department of Orthopaedics
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The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 01.04.2014 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM

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INTRODUCTION

Epidemiology:

Fractures of the proximal Femur & hip occur more frequently in elderly population. Racial variations occur in the incidence. The incidence is lesser in black population [1], much commoner in White females than males [2]. Throughout the globe, these fractures are much more common in white population of North America and Europe [3].

As the life expectancy is increasing for every decade, there is a steady & substantial rise of active geriatric population in our society. So there is an exponential increase in occurrence with increase in age [4]. In elderly patient s, these fractures are one of the leading causes of increased mortality & morbidity.

It is estimated that the future incidence of hip fractures worldwide will double to 2.6 million by 2025, 4.5million by 2050 [5]. The percentage rise will be greater in men about 310% than women 240%.

In 1990, 26% of all hip fractures occurred in Asia, but this will certainly rise to 37% in 2025 and 45% in 2050 [6]. Currently, about 1/3 of world s hip fracture occurs in Asia [7]. Hagino et al reported a life

time risk of hip fractures for individuals at 50yrs of age as 5-6% for men and women about 20%.

Based on anatomical location, the fractures of proximal Femur & hip includes the neck of Femur(Intra capsular)fractures, intertrochanteric fractures(Extra capsular fractures), Subtrochanteric fractures.

Costs involved in management:

The patients who develop proximal Femoral fractures belong to very different economic strata from very rich to very poor condition. Most of our patients are unorganised labourers and they have to meet their own expenses. Government s resources are limited and it's a tough job to subsidize the whole treatment cost.

In U.S. alone there are over 250,000 hip fractures annually [9], costing approximately around 5.4billion dollars annually [10].

Risk factors:

S.no.	Modifiable
1.	Trauma
2.	Visual acuity
3.	Neuromuscular impairment
4.	Cognitive impairment
5.	Physical fitness
6.	Medications
7.	Nutritional deficiency
8.	BMD

S.no.	Non Modifiable
1.	Age
2.	Race
3.	Height
4.	Hip geometry

The most common risk factors associated with these fractures are,

1. Younger individual – high energy trauma
2. Elderly individual -they can be classified as follows,

1. Factors predisposing to increase in fall as

a	Weakness of muscles/Muscular dystrophies
B	Impairment of vision
C	Cardio vascular diseases
D	Neurological disorders
E	Gait disorders

2. Disorders causing changes in bone mass/ Metabolic disorders

A	Osteoporosis
B	Osteomalacia
C	Renal osteodystrophy

Some other factors associated are low physical activity, decreased exposure to sunlight, treatment with corticosteroids, smoking.

Difficulty in treating:

As these patients are usually senile, though the options of treatment are plenty in number, there are also high chances of failure of fixation/nonunion, since the quality of bone is usually compromised.

They face trouble in meeting out the cost of treatment & getting care for their activities of daily living.

Preventive strategy:

The current paramount and remarkable shift regarding hip fractures are as follows,

1. Prevention by aggressive screening & treatment of patients with risk for fragility fractures.

2. Standardization of centres treating hip fractures by formulating new protocols, early intervention thereby avoiding/minimizing complications.

3. Optimization of fracture reduction and new design of implant component fixation in osteoporotic bone with conceptual design changes in fixation stability and augmentation of bone implant interface.

A surprising thing to be noted here is that, even though the mechanism of injury remains the same i.e. a trivial fall usually some people are developing the fractures in neck of Femur and some in the intertrochanteric region.

So, a study was undertaken to bring some limelight in understanding the relationship between proximal Femur geometry and

fracture pattern developed in these individuals. The aim of this study was to find out whether the combination of the parameters femoral neck length, hip axis length, neck shaft angle is able to predict the occurrence of the hip fracture and its type.

AIM OF THE STUDY

To study, compare and analyse the differences in proximal femoral geometry between the patients who have sustained the neck of Femur/intra capsular and inter trochanteric/extra capsular fractures by means of radiographic measurement of the parameters i.e. the Femoral Neck Length (FNL), Hip Axis Length (HAL), Neck Shaft Angle (NSA) in South Indian population.

REVIEW OF LITERATURE

Much of the studies to understand the proximal Femoral geometry and its relationship in the fracture pattern sustained have been started in early 1990s only and the literacy in this regard is still in infancy level, leaving much more to be explored.

Etiology between proximal femoral geometry and hip fractures

1. Cummings SR, Black D et al in 1993, in his study about "Bone density at various sites for prediction of hip fractures; the study of osteoporotic fractures research group" (11), suggested in their study about the possible etiological association between the proximal femoral geometry and fracture pattern sustained.

2. Clause and Cummings et al in 1994 in their work "prediction of hip fractures from pelvic X rays- the study of Osteoporotic fractures"(12), suggested in their study that, there is a definite positive relationship between the proximal femoral geometry and the fracture pattern developed.

3. Reid et al in 1994, in their work "relationship between increase in length of hip axis in older women and increase in age specific rates of hip fractures"(13), brought about a fact that an increase/rise in Hip axis

Length(HAL) in the patients are predisposed for developing the neck of Femur fractures.

4. In 1996, Flicker, Fauker et al, concluded that the HAL plays a predominant role in predicting the individual hip fracture risks [14].

5. In 1996, Maulten CA et al , suggested that the cervical fractures seems to be more related to pelvic structure failure of the outer diameter the femoral neck to expand with age and increased acetabular bone width added to a focal bone loss [15].

6. In 2001, Jamsa et al in their study concluded that the Neck Shaft Angle (NSA), smallest outer pelvic diameter are greater in cervical fractures. Increased NSA, low femoral shaft diameter, trochanteric width, thin cortices and pelvic dimensions associates with increased fracture risks [16].

7. In 2001, Partanen J at al, concluded that Neck shaft Angle(NSA), is larger in neck of Femur fracture patients than the trochanteric fractures. They concluded that proximal Femur dimension measurements calibrated and measured from the position standardized plain X rays are useful in evaluation of hip fracture risks and fracture type [17].

8. In 2004, Pulkinnen et al, in his work of measuring the proximal femoral geometry in 74 postmenopausal women (mean age of 74 years), with 49 cervical fractures and 25 trochanteric fractures in their study group, concluded that the combination of bone mineral density and proximal femoral geometry measurements will improve the prediction of hip fractures [18].

2. Racial differences in hip fractures with respect to proximal femoral geometry:

1. In 1999, Yang and Wang SS et al , in their work " Proximal femoral dimension in the elderly Chinese women with hip fractures in Taiwan",[19],concluded that in their study that individuals with increased femoral neck length (FNL) are predisposed to proximal hip fractures on comparison with the normal subjects. But the difference between the intra capsular & extra capsular fractures is negligible according to them.

2. M.B.Mikhail et al in his study suggested that the White women have a higher rate of age specific hip fractures than Black Women. In his study conducted with 5o White Women and 50 Black women by using DEXA in whom HAL, NSA are measured. They are significantly lower in White women than

Black women ($p<0.05$ &<0.02 respectively). But NSA was not statistically significant between two groups [20].

3. Cauley et al in 1994, in their work "Racial differences in the Hip Axis Length might explain racial differences in rates of hip fractures",(22), suggested that, Hip axis Length(HAL), is an independent predictor of the fracture pattern and also confirmed in his study that those individuals with increased HAL have a higher risk for proximal femoral fractures.

3. Independent of Osteoporosis:

1. In 1996, Geusen is P in his study concluded that Hip Axis Length (HAL), is the best documented geometric parameter of the proximal femur. It is an independent predictor of hip fracture risks. Also they identified that HAL associated with the hip fracture risk is independent of age, height, weight, and femoral bone density [23].

2. In 1999, Michelloti.J suggested that Hip axis length is of interest because the individual hip fracture risk cannot be determined by bone density alone, and the Hip Axis Length appears to be an

independent risk factor easily obtained in course of bone density measurements [24].

3. In 2001, Wikin et al in his study "Bone densitometry is not a good predictor of hip fractures"[25], concluded in their study that, the parameters Hip Axis Length (HAL), Neck shaft Angle(NSA) are able to predict the risk of hip fractures and bone mineral density is not a good predictor of hip fracture.

4. In 2002, Bergot V, Bousson A, Meenier et al in their work "Hip fracture risk and proximal femur geometry", concluded in their study, that the Hip Axis Length (HAL) as a best predictor for delineating the intra & extra capsular fractures. Also they stated that, HAL is increased in the intra capsular fractures [26].

4. Differences in proximal femoral geometry results to differences in types of proximal Femur:

1. In 1999, Gnudi, Ripamonti et al in their study "Geometry of proximal Femur in the prediction of hip fractures in osteoporotic women" [27], suggested that the Hip Axis Length(HAL), Neck shaft angle(NSA), are increased in neck of Femur fractures and they are independent predictors of the

risk of developing fractures when compared to the bone mineral density.

2. In 2002, Gnudi S, Lisi et al in their study "proximal Femur geometry to detect and distinguish femoral neck fractures from trochanteric fractures in post menopausal women"(10), suggested that the Hip Axis Length(HAL), Neck shaft Angle(NSA) are much higher in intra capsular fractures than in extra capsular fractures and also concluded their study by suggesting that NSA is the best predictive parameter among the tested parameters like Hip axis length, Femoral neck length, femoral neck width [28].

3. In 2003, Brownbill RA et al, suggested that it is essential to develop some better ways to identify those people who are at risk of hip fractures. They concluded that in their work that Hip Axis Length (HAL), showed the greatest promise for enhancing the fracture risks assessment in clinical setting, followed by Neck Shaft Angle (NSA), then Femoral Neck Width (FNW). In general the longer HAL, greater NSA, increased FNW all increases the risks of fractures, though

controversies exist due to use of different subject population and measurement tools.

They concluded that the overall evidence suggests that assessing the hip geometry parameters can significantly improve the ability of identifying the people at risk of fractures, but more improvements in the development of special software for measuring is necessary. More time has to be spent in research in order to make it applicable for clinical settings [29].

4. In 2006, Pulkinnen, Eckstein F in their work i.e. the association of geometric factors and failure load level with the distribution of cervical Vs trochanteric hip fractures", concluded that the femoral neck fractures predominate in the lowest structural mechanical strength levels. But the trochanteric fractures are more common at the high failure loads. The best predictor of the fracture type across all structural strength levels was the Neck Shaft Angle (NSA) [30].

5. Michael seanpartton et al in 2006,in his work " proximal femoral geometry and hip fractures" (11),in their study

concluded that an rise/increase in Femora; neck Length(FNL) in the studied population are well predisposed to intra capsular fractures [31].

6. Reid et al in 1994, in their work "relationship between increase in length of hip axis in older women and increase in age specific rates of hip fractures"(32), brought about a fact that an increase/rise in Hip axis Length(HAL) in the patients are predisposed for developing the neck of Femur fractures.

5. Relavance of these studies for the Asian population:

1. Evans MC, Chin K et al in their work of" Differences in the hip axis and femoral neck length in premenopausal women of polynesian, Asian and European origin"[33], in 1997, suggested that an increase/rise of the FNL (femoral neck length) are less predisposed to the intra capsular fractures.

2. Nakamura et al, suggested from his work that, Japanese women have lower risk of structural failure in femoral neck, attributed primarily to shorter femoral neck and to a lesser femoral neck angle. Geometric characteristics of femoral neck in Japanese women are associated with their lower hip fracture

risk and measurement of proximal femoral geometry, combined with bone mass may provide further clinical information [21].

6. Studies not favoring any relationship between proximal femoral geometry and hip fractures:

1. In 2006, Szule P, Duboeuf F et al in their work “structural determinants of hip fractures in elderly women: re- analysis of data from EPIDOS study”, concluded in a controversial manner with the rest of the authors that the, femoral neck length and the femoral external diameter are not good in predicting the risk of hip fractures [34].

2. Panula J, P.T.Jaatinen, P.Aarnio et al in his study ”the impact of proximal femur geometry on fracture type – a comparison between cervical and trochanteric fractures with two parameters(12)” in 2008, suggested that there are no significant difference in the neck shaft angle (NSA) , Femoral Neck axis Length(FNAL), between the intra capsular and extra capsular fracture patients [35].

7. Areas of interest and future prospects:

1. Measurements from the cadaveric bone have been done by RC Siwach et al [36], the parameters like femoral head offset, femoral head diameter, femoral head position, femoral neck diameter, canal width at the level at the level of and 20mm above and below lesser trochanter, endosteal, extra cortical width at isthumus, FNAV, NSA.

   All the measurements made were compared with other Asian populations and Western population, there was a significant difference in the data. The impact of these findings on future implant design in India is required. Thus in future the implants made in India should be customised for our people.

2. Quantitative CT scan was used by Dennis M. Black et al. for measuring femoral neck structure, volumetric bone density and risk of hip fractures prediction from it. They suggested that the proximal femur structural features were definitely related with increased risk of hip fractures.

Thus CT analysis gives a good information regarding the causation of fractures of hip, thereby evaluating the risk of hip fractures and identifying the targets of therapeutic intervention.

ANATOMY OF HIP JOINT

Type: Ball and socket variety of synovial joint.

It forms the primary connection between bones of lower limb and axial skeleton of trunk and pelvis. The joint surfaces are covered with a strong but lubricated layer called articular hyaline cartilage.

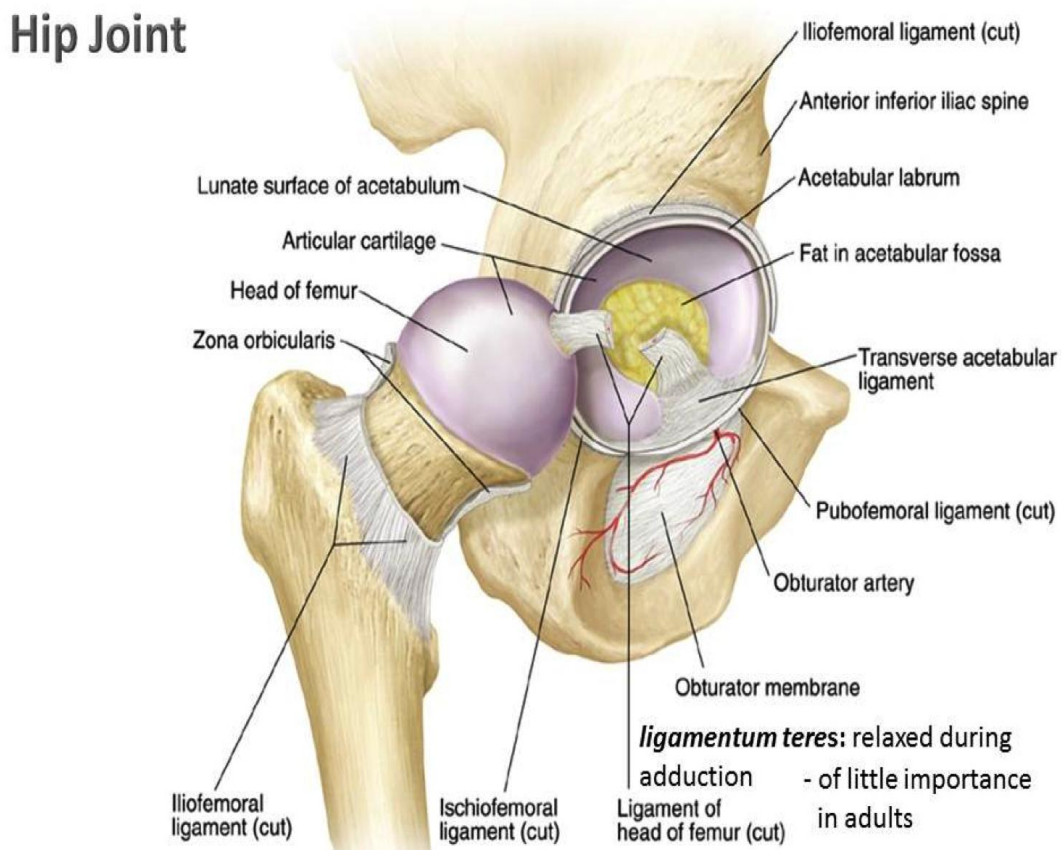
The cup like acetabulam forms at the union of 3 pelvic bones i.e. ilium, pubis, ischium. The Y shaped growth plate that separates them, i.e. the tri radiate cartilage, is fused by 14-16 yrs of age. Hip joint is a special type of ball and socket joint where the roughly spherical head is largely contained within the acetabulam and it has an average radius of 2.5cms.

Almost more than half of the femoral head is grasped within the acetabulam and the grip is further augmented by a ring shaped fibro cartilaginous lip, the acetabularlabrum , extending into the joint beyond equator. Acetabulam is oriented inferiorly, laterally, anteriorly while the femoral neck is directed superiorly, medially and slightly anteriorly.

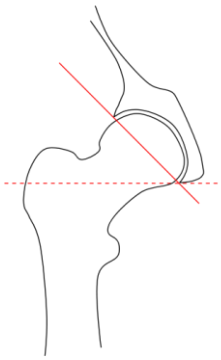
Articular surfaces:

Head of femur articulates with acetabulam of hip bone to form the hip joint. Head of Femur forms more than half of sphere and is covered with hyaline cartilage except at the fovea capitis. The acetabulam presents a horse- shoe shaped, lunate articular surface, an acetabular notch and an acetabular fossa.

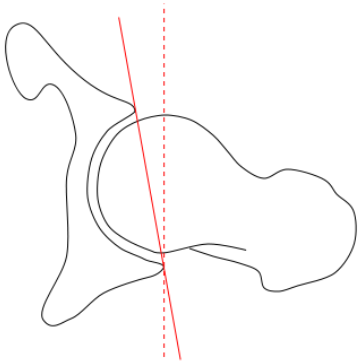
Lunate surface is covered with hyaline cartilage. Though the articular surfaces on head of femur and on acetabulam are reciprocally curved, they are not co- extensive.



Articular angles:



The transverse angle of the acetabular inlet(also known as Sharp s angle and it is generally referred as acetabular angle). It can be determined by measuring the angle between a line passing from the superior to inferior acetabular rim and horizontal plane. At birth it is about 51 deg and in adults it is 40 deg, it affects the acetabular lateral coverage of femoral head.



The sagittal angle of the acetabular inlet is an angle between a line passing from the anterior to posterior acetabular rim and the sagittal

plane. It measures around 7 deg at birth and increases to 17 deg in adults.

Wisberg s centre edge angle is an angle between a vertical line and a line from the centre of femoral head to the most lateral part of acetabulam.

The vertical- centre- anterior margin angle (VCA) is an angle formed from a vertical line (V), and a line from center of Femoral head ©, and the anterior (A) edge of dense shadow of subchondral bone slightly posterior to the anterior edge of acetabulam, as the X rays taken from the false angle, i.e. lateral view rotated 25 degrees towards becoming frontal.

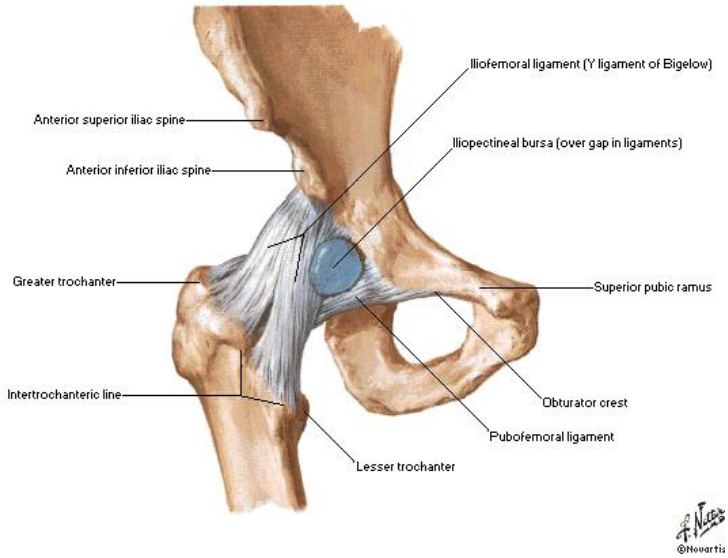
The articular cartilage angle (AC angle also K/A Hillgenreiner angle) is an angle formed parallel to the weight bearing dome, i.e. the acetabularsourcil and the horizontal plane or a line connecting the corner of the tri radiate cartilage and the lateral acetabular rim.

The hip joint is unique in having a high degree of stability as well as mobility. The stability/strength depends upon

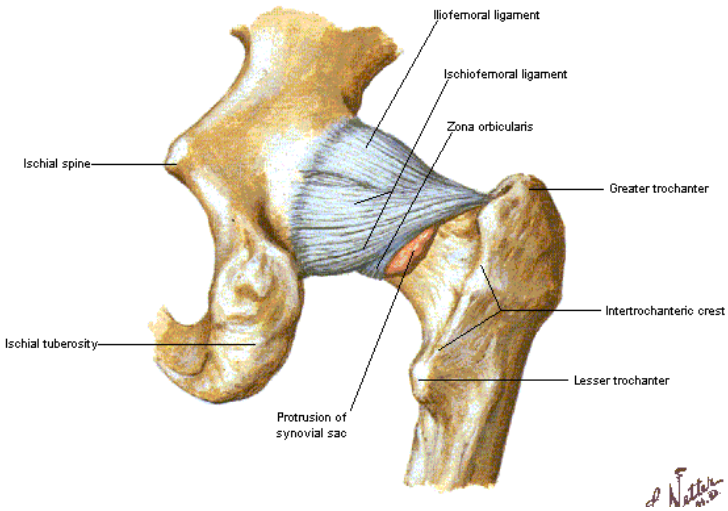
1. Depth of acetabulam and narrowing of its mouth by acetabularlabrum

2. Tension and strength of ligaments.
3. Strength of surrounding muscles.
4. Length and obliquity of neck of Femur
5. Atmospheric pressure.

Hip Joint
Anterior View



Hip Joint
Posterior View



Ligaments:

1. Fibrous capsule:

Attached on hip bone to the acetabularlabrum including the TAL and to bone above and behind the acetabulam, over the Femur on IT line in front and 1cm medial to the IT crest behind.

Capsule is made up of two types of fibers. The outer fibers are longitudinaland inner are circular called as the zona orbicularis.

2. Ilio femoral ligament/ inverted Y shaped ligament of Bigelow:

Lies anteriorly, it is one of the strongest ligament in body. It prevents trunk from falling backwards in standing posture. The ligament is triangular in shape.

Its apex is attached to the lower half of AIIS and base to the intertrochanteric line. The upper oblique and lower vertical fibers forms thick and strong bands, while middle fibers are thin and weak.

3.Pubofemoral ligament:

Supports the joint inferomedially. It s also triangular in shape. Superiorly, it is attached to iliopubic eminence, obturator crest,

obturator membrane. Inferiorly, it merges with antero inferior part of capsule with lower band of iliofemoral ligament.

4. Ischiofemoral ligament:

This is comparatively weak. It covers the joint posteriorly. Its fibers are twisted and extend from ischium to the acetabulam.

5. Ligament of Head of Femur/Round ligament/ ligamentumteres:

It is a triangular and flat ligament. Apex attached to fovea capitis, base to transverse ligament and margin of the acetabular notch. It may be very thin/absent. It transmits arteries to head of femur, from the acetabular branches of Obturator and medial circumflex femoral arteries.

6. Acetabularlabrum is a fibro cartilaginous rim attached to the margins of acetabular rim. It helps in holding head of femur in position.

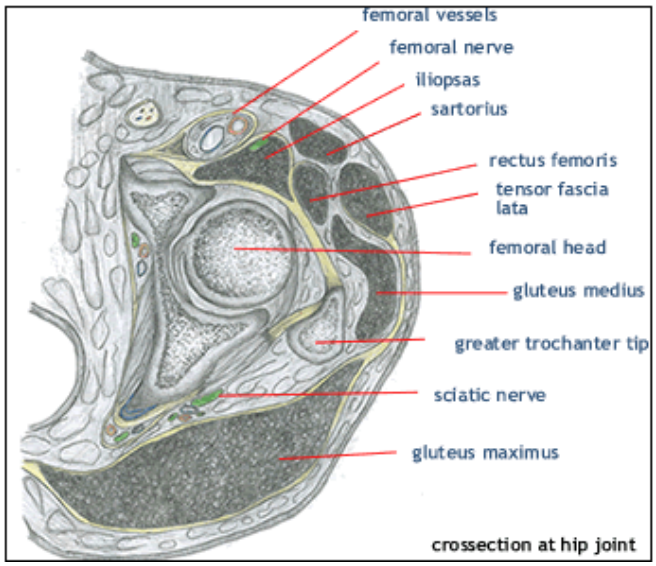
7. Transverse ligament of acetabulam(TAL):

A part of acetabularlabrum which bridges the acetabular notch.

Relations of Hip joint:

Anterior:

1. Lateral fibers of pectineus
2. Tendon of iliopsoas separated from the joint by a bursa
3. Straight head of rectus femoris
4. Femoral vein superior to Pectineus
5. Femoral Artery on tendon of Psoas.
6. Femoral nerve is groove between the Iliacus& Psoas.



Posterior relations:

The joint, from below upwards,is related to following muscles,

1. tendon of Obturatorexternus covered by Quadratusfemoris

2. Obturatorinternus and gamelli

3. Piriformis

4. Sciatic nerve

5. Gluteus maximus Muscle

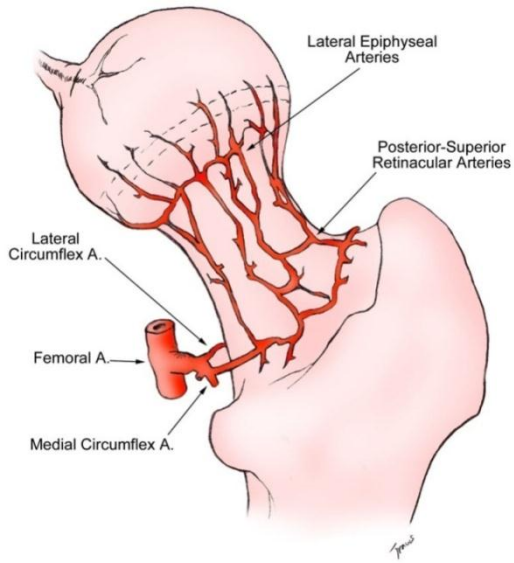
Superior relations:

Reflected head of rectus femoris covered by G,minimus, G.medius, partly by g.maximus.

Inferior relations:

Lateral fibers of Pectineus, and Obturatorexternus. In addition, Gracillis, Adductor longus, brevis, magnus, hamstring muscles.

Blood Supply:



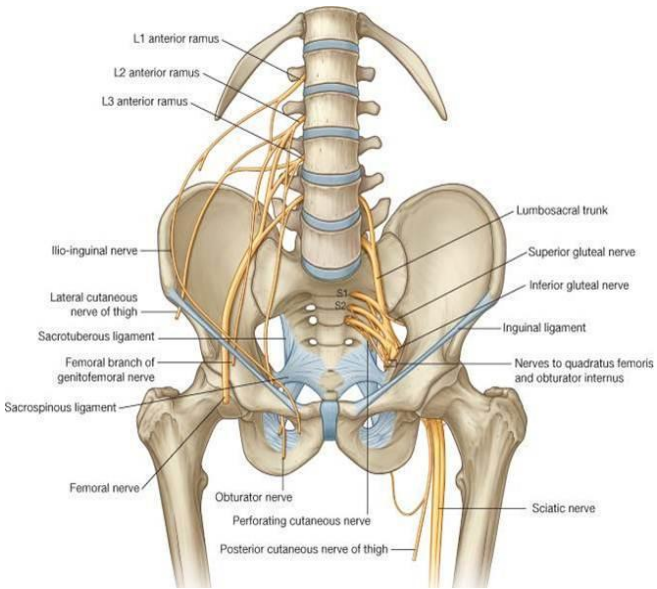
Blood supply to Hip joint is as follows,

1. Obturator artery
2. Two circumflex femoral A –Medial & lateral
3. Two gluteal A

The medial & lateral circumflex femoral A form an arterial circle around the capsular attachment on neck of Femur.

Retinacular A arise from this circle and supply the intra capsular part of neck and the greater part of head of femur. A small part of head, near the fovea capitis is supplied by acetabular branches of Obturator and medial circumflex femoral artery.

Nerve Supply:



Hip joint supplied by the Femoral nerve, anterior division of Obturator N, Accessory Obturator N, N to Quadratusfemoris, Superior gluteal nerve.

Movements at the Hip joint:

Movement	Chief m	Accessory muscles
Flexion	Psoas major, Iliacus	Pectineus, Rectus Femoris, Sartorius, add longus
Extension	G.maximus& Hamstrings	-
Adduction	Add longus,brevis,magnus	Pectineus, Gracillis
Abduction	G.Medius, G.minimus	TFL, Sartorius
Medial rotation	TFL, Ant fibers of G.Medius, G.Minimus	-
Lateral rotation	Two obturators, two gamelli, Quadratusfemoris	Piriformis, G.maximus, & Sartorius

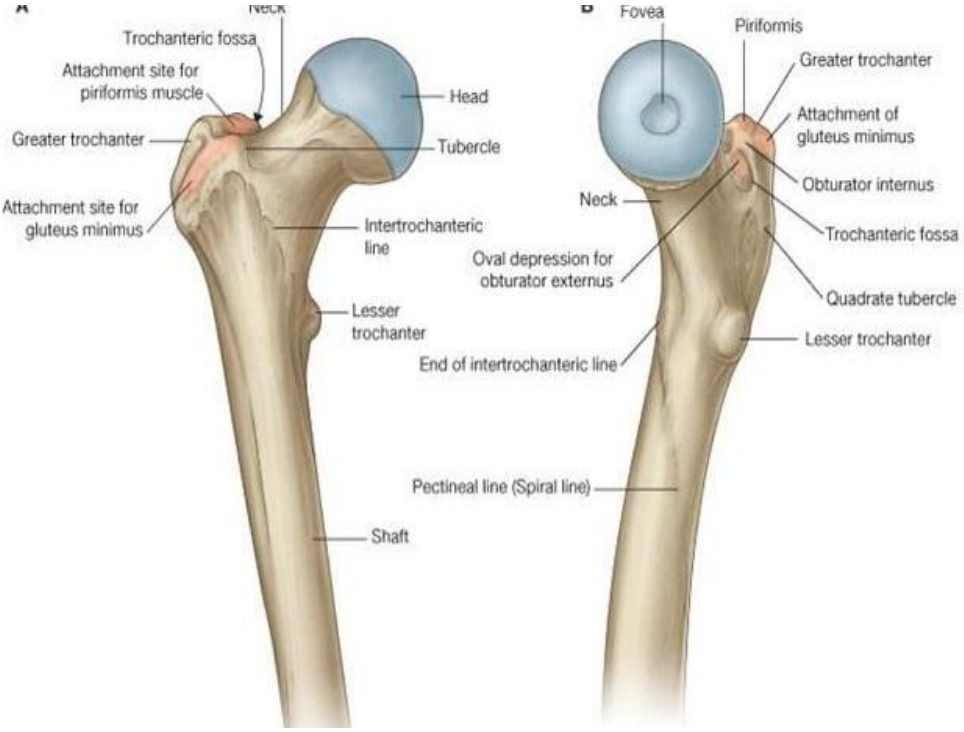
Flexion limited by contact of thigh with anterior abdominal wall. Adduction is limited by contact with opposite limb. Extension is 15 degree. Abduction is 40 degree. Adduction is 30 degree.

ANATOMY OF PROXIMAL FEMUR

The femora/thigh bone is the longest & strongest bone of human body. Just like any other long bone, it has 2 ends, the upper, lower & a shaft.

Side determination:

1. Upper end bears a rounded head whereas the lower end is widely expanded to form two large condyles.
2. The head is directed medially.
3. The cylindrical shaft is convex forwards.



Anatomical position:

Head directed medially upwards and slightly forwards.Shaft is directed obliquely downwards and medially so that the lower surface of two condyles of Femur lie in the same horizontal plane.

Upper end:

The upper end of Femur includes head, neck, greater trochanter, lesser trochanter, inter trochanteric line, intertrochanteric crest.

Head:

Head forms more than half a sphere and is directed medially upwards and slightly forwards. It articulates with acetabulam to form hip joint. A roughened pit is situated just below and behind the centre of head, this is called fovea.

Blood supply:

1. Smaller, medial part of head near fovea, is supplied by medial epiphyseal arteries, derived from the posterior division of Obturator A and from the ascending branch of the medial circumflex A. The artreries enter the acetabular

notch and then pass along the round ligament to reach head.

2. Larger, lateral part of the head is supplied by lateral epiphyseal A which are derived from the retinacular branch of MCFA.

This contributes the main supply and damageto it results in necrosis of head, following fractures of neck of femur. After epiphyseal fusion, the lateral epiphyseal A anastomoses freely with the metaphyseal vessels.

NECK:

It connects the head with the shaft and is about 3.7cm long. It makes an angle with the shaft. The Neck shaft Angle(NSA) is about 125 deg in adults. It is less in females due to their wide pelvis. The angle facilitates movements of the hip joint. It is strengthened by a thickening of bone called the calcarfemorale present along its concavity.

Neck has two borders and two surfaces.

a) Upper border- concave and horizontal, meets the shaft at greater trochanter.

b) Lower border- straight, oblique meets the shaft near lesser trochanter.

Surfaces of the neck:

a) Anterior –flat, it meets the shaft at the inter trochanteric line, entirely it is intra capsular. Articular cartilage of head may extend to this surface.

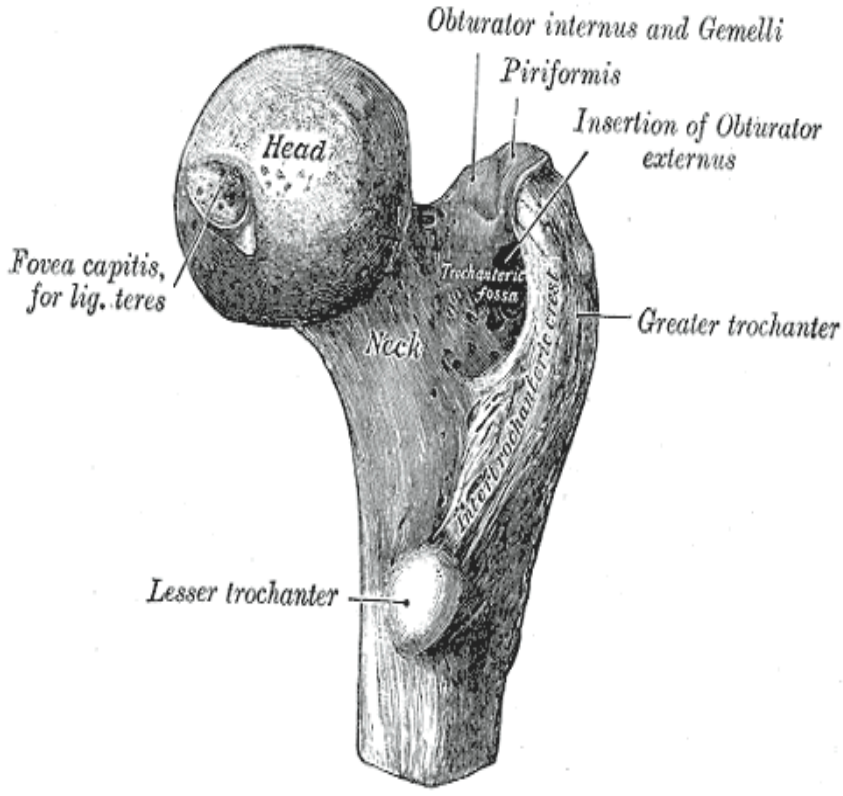
b) Posterior – Convex from above downwards and concave from side to side. It meets the shaft at the inter trochanteric crest. Only alittle more than its medial half is intra capsular. It is caused by a horizontal groove for tendons of Obturatorexternus.

The angle of femoral torsion or angle of femoral anteversion is formed between the transverse axis of upper and lower ends of Femur. It averages between 10 deg to 15 degrees.

Blood supply:

The intra capsular part of neck is supplied by retinacular arteries derived chiefly from the trochanteric anastomosis. The vessels produce longitudinal grooves and foramina directed towards the head, mainly on the anterior and postero superior surfaces. The extra capsular part of the neck is supplied by the ascending branch of the Medial circumflex artery.

Greater trochanter:



This is a large quadrangular prominence located at the upper part of the junction of neck with the shaft. The upper border of trochanter lies at the level of the centre of head.

Greater trochanter has an upper border with an apex , three surfaces, anterior, medial, lateral. The apex is inturned posterior part of posterior border. The anterior surface is rough in its lateral part. The medial surface presents a rough impression above, a deep trochanteric fossa below. The lateral surface is crossed by an oblique ridge directed downwards and forwards.

Lesser trochanter:

It is a conical eminence. It is directed medially and backwards from the junction of posteroinferior part of neck with the shaft.

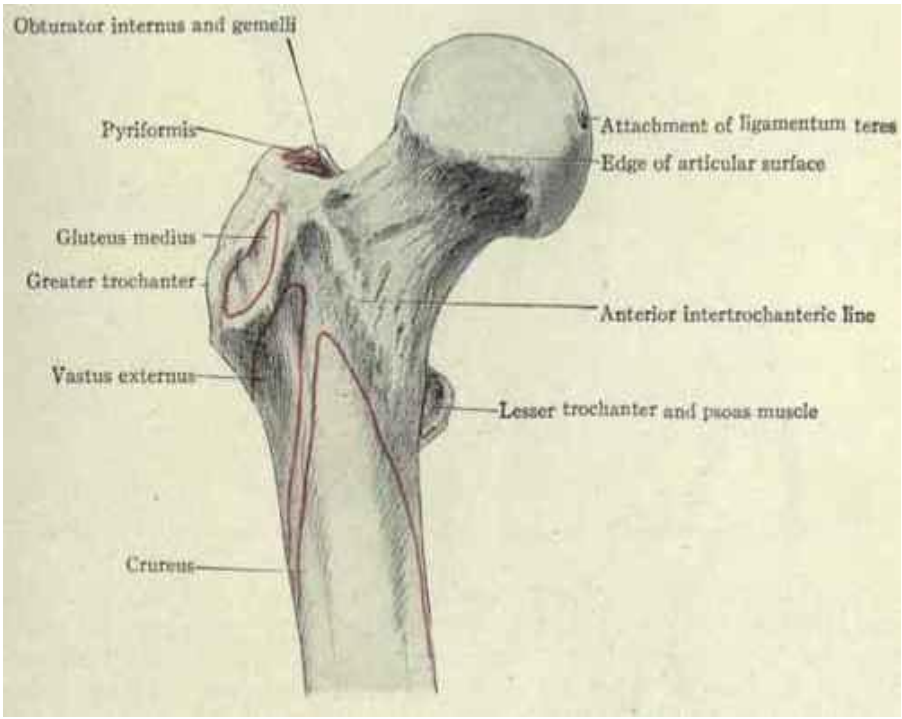
Intertrochanteric line:

It marks the junction of the anterior surface of the neck with shaft of Femur. It is a prominent roughened ridge which begins above, at the anterosuperior angle of greater trochanter as a tubercle and is continuous below the spiral line, in front of lesser trochanter. The spiral line winds around the shaft below the lesser trochanter to reach the posterior surface of shaft.

Intertrochanteric crest:

It marks the junction of the posterior surface of the neck with shaft of femur. It is a smooth rounded ridge.

Attachments on Femur:



Fovea on head of Femur provides attachment to the ligament of the head of femur or the round ligament or the ligamentumteres.

Attachments on the greater trochanter are as follows,

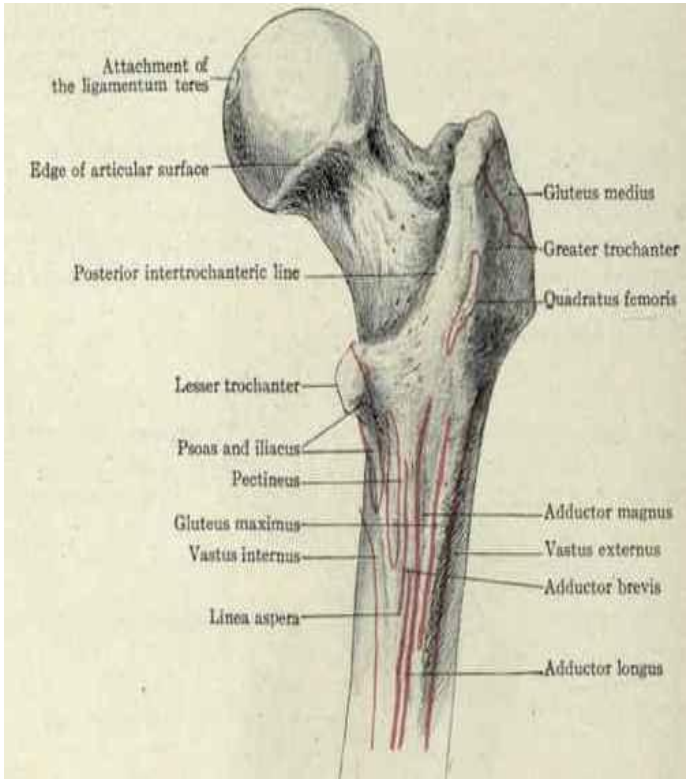
1. Piriformis is inserted on the apex.

2. G.Minimus inserted into the rough lateral part of anterior surface.

3. O.internus and the two gamelli are inserted into the upper rough impression on the medial surface.

4. The obturatorexternus is inserted into the trochanteric fossa.

5. G.medius is inserted into the ridge on lateral surface. The trochanteric bursa of gluteus mediusliesin front of ridge and the trochanteric bursa of gluteus maximus lies behind the ridge.



Attachments on lesser trochanter are

1. Psoas Major inserted on the apex and medial part of rough anterior surface.

2. The Iliacus is inserted on the anterior surface of base of the trochanter and on the area below it.

3. The smooth posterior surface of the lesser trochanter is covered by a bursa that lies deep to the upper horizontal fibers of adductor magnus.

Attachments on the inter trochanteric line are

1. Attachment to capsular ligament of the hip joint.

2. Attachment to upper band of iliofemoral ligament in its upper part.

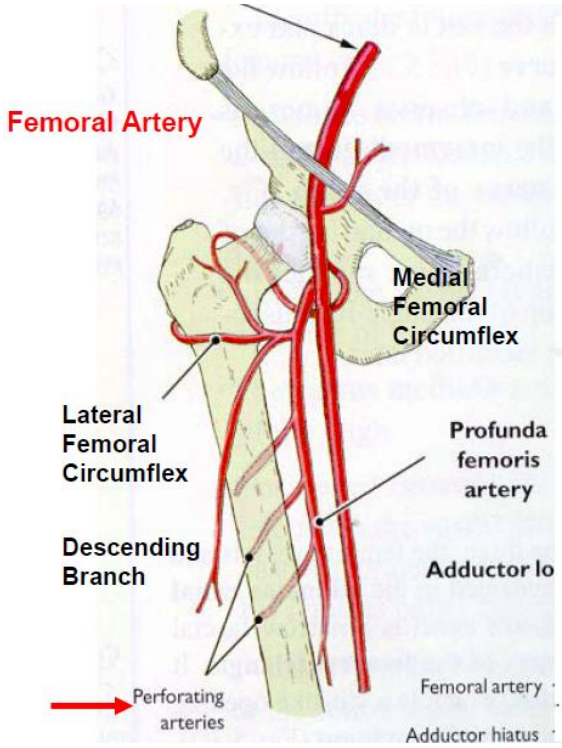
3. Attachment to the lower band of iliofemoral ligament in its lower part.

4. Origin to the highest fibers of the v lateralis from upper end

5. Origin to the highest fibers of V,medialis from the lower end of line.

6. Quadratus tubercle receives the insertion of Quadratusfemoris.

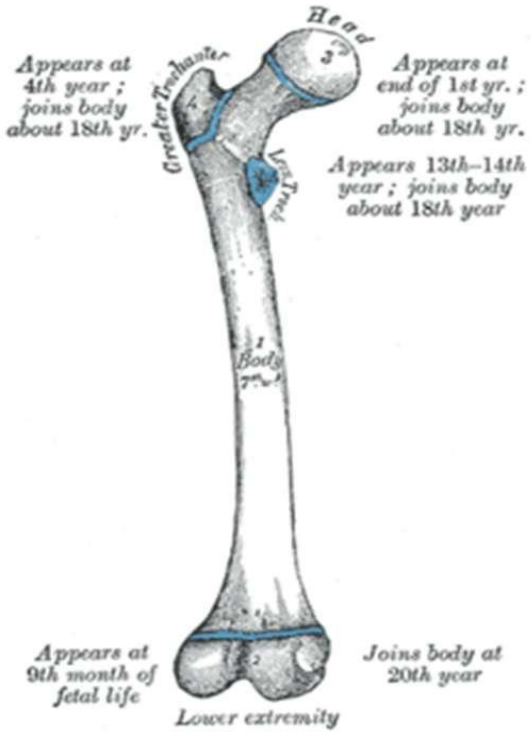
Nutrient artery to femur:



It is derived from the second perforating artery. If it is absent, it is replaced by two nutrient arteries derived from the first and third perforating artery.

On the medial side of lineaaspera, the nutrient foramen is located upwards.

Ossification:



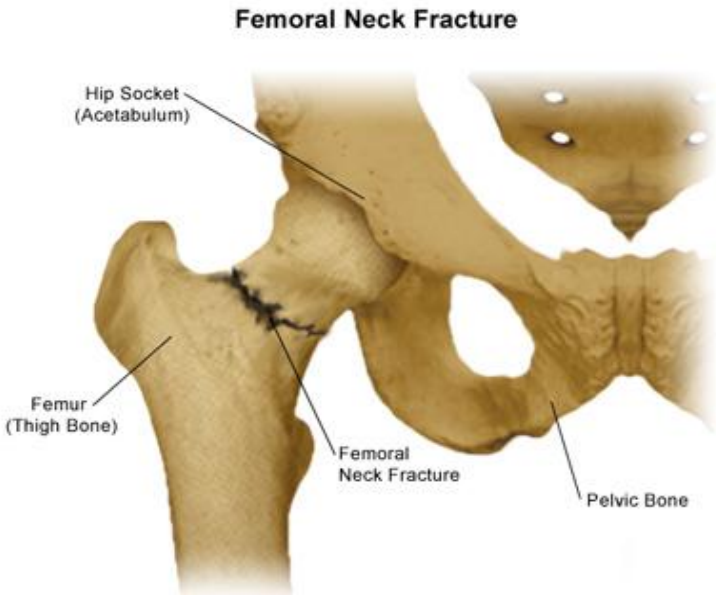
Femur ossifies from one primary centre and four secondary centres. Primary centre for shaft appears in 7th week of intra uterine life. Secondary centre appears, one for the lower end at the end of 9thmon of intra uterine life, one for head during the first six months of life, one for the greater trochanter during the fourth year and one for the lesser trochanter during the 12th year.

There are 3 epiphyses at upper and one epiphysis at lower end. The upper epiphysis, the lesser trochanter followed by greater trochanter and head in that order. All these structures are fused with shaft at about 18 yrs. The lower epiphysis fuses by 20th year.

NECK OF FEMUR/INTRA CAPSULAR FRACTURES

Mechanism of injury:

A trivial fall in elderly individuals especially females, are predisposed to develop these fractures. The femoral neck is relatively weaker immediately just below the articular surface.



The proximal and supero lateral area of the neck and head of femur are those areas where bone loss is higher than rest of the areas and those results are confirmed by quantitative Computed Tomography.

In case of the younger patients, these fractures are usually caused by high velocity trauma.

These fractures occurs as isolated in majority of individuals, yet they may be accompanied by the fractures in upper limb i.e. proximal Humerus/ distal radius or in the lower limb, i.e. They may be associated with ipsilateral shaft of Femur fractures.

Many medical co-morbid conditions like diabetes mellitus, angina/myocardial infarction, paralytic disorders, epilepsy, stroke can be associated, which requires prompt treatment and each has its own impact in the post operative recovery and rehabilitation.

History and physical examination:

A history of trivial fall will be associated in the history in elderly. In younger individuals, a high velocity automobile collisions or a repetitive physical activity causing stress fractures are much more common.

Those females with a triad of anorexia, osteoporosis, amenorrohoea, are more predisposed to develop the neck of femur fractures.

Risk factors predisposing to neck of Femur fractures

1. Corticosteroid treatment
2. Rheumatoid arthritis
3. Chronic kidney disease
4. Endocrine disorders especially involving parathyroid gland
5. Ilicit alcohol and drug abuse.

All these factors can cause decreased bone mineral density and thereby making the individuals more susceptible to neck of femur fractures.

On physical examination:

In an undisplaced neck of femur fracture, there will be no obvious deformity and they will have severe pain on movements. In displaced fracture neck of femur, the lower limb involved is classically externally rotated and shortened with painful movements.

Examine for any bed sores/pressure sores as they may increase the chance of wound infection and thereby the mobilization of patient during the post operative period is impeded.

Pre operatively, for all these patients skeletal traction is applied, so as to reduce the pain, and thereby reducing the fracture, maintaining the traction obtained.

But many studies have raised the question about its worthiness, so many centres have even abandoned the traction for neck of femur fractures.

Imaging and diagnostic modality:

Plain ray AP view with traction and internal rotation of 15 degree will be sufficient in giving much information.

Lateral views will provide information about its displacement but the patients will experience excruciating pain.

If X rays are not informative /inconclusive, MRI will be the procedure of choice, as it rules out the other soft tissues that may be a causative factor of pain.

Dual energy Xray Absorptiometry has a definitive role in identifying the osteoporotic individuals.

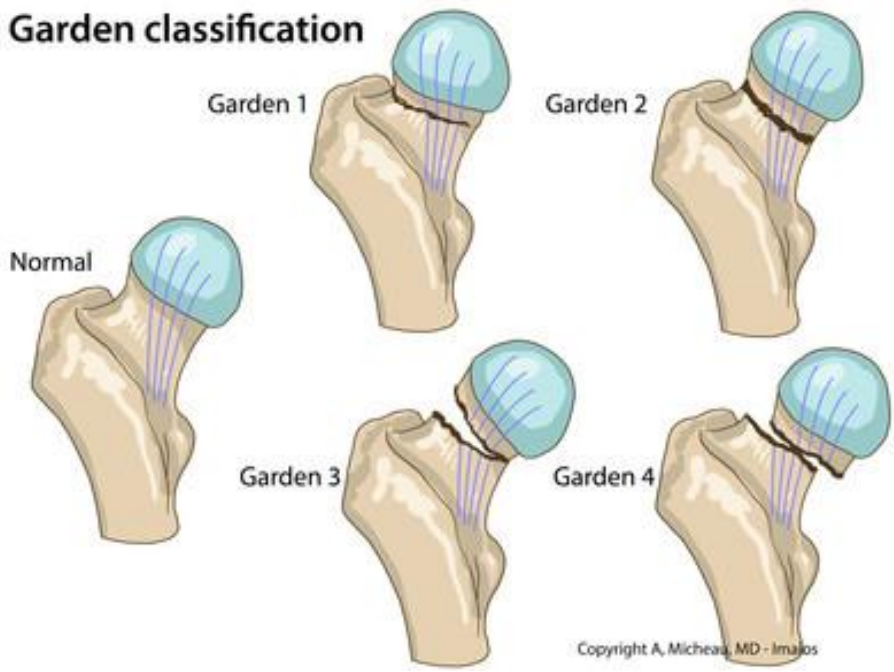
X rays for other parts of the body, if associated injuries are present.

Classification of Femoral Neck fractures:

Garden classification:

Most commonly used, it consists of four groups. The classification is based on the degree of displacement based on an AP view of pelvis, where the relationship between trabecular lines in the acetabulam compared with the femoral head.

The trabecular lines in femoral head normally correlates with that of acetabulam.



Type I:

Incomplete fracture. Valgus impacted sub capital.

Type II:

Complete, undisplaced

Trabecular lines of head are collinear with those in acetabulam and neck of Femur.

Type III:

Complete, incompletely displaced

Head in Varus and the head has not completely lost contact with femoral neck.

The trabecular lines are angulated.

Type IV:

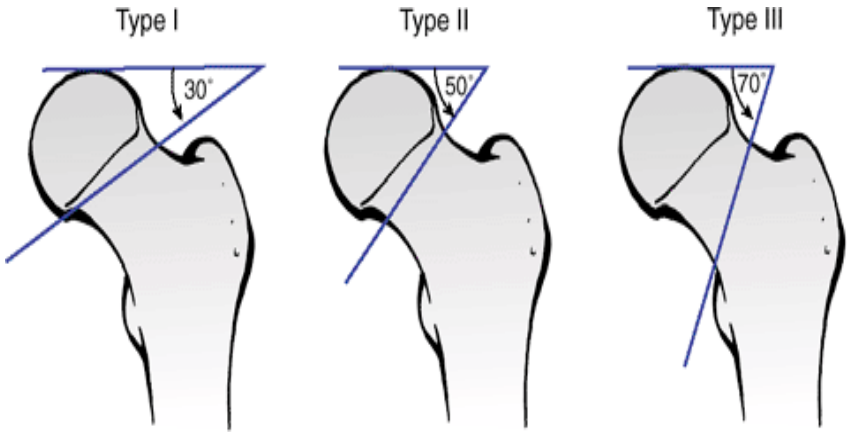
Complete fracture and usually it is completely displaced.

Neck and head will loose the contact completely.

Trabecular lines of acetabulam and haed are collinear, but alignment lost with neck.

Pauwels classification:

This classification is based upon the angle/plane of fracture in femoral neck.



Type I : less than 30 degree

Type II : 30-50 degree

Type III: >70 degree

The classification is based on whether the fracture plane is vertical/ oblique/transverse, three types are created.

This classification was considered to be predicting the fixation failure outcomes, but many studies have proven it as inconclusive. It was said that, the instability increases as the angle is increasing.

AO/OTA classification:

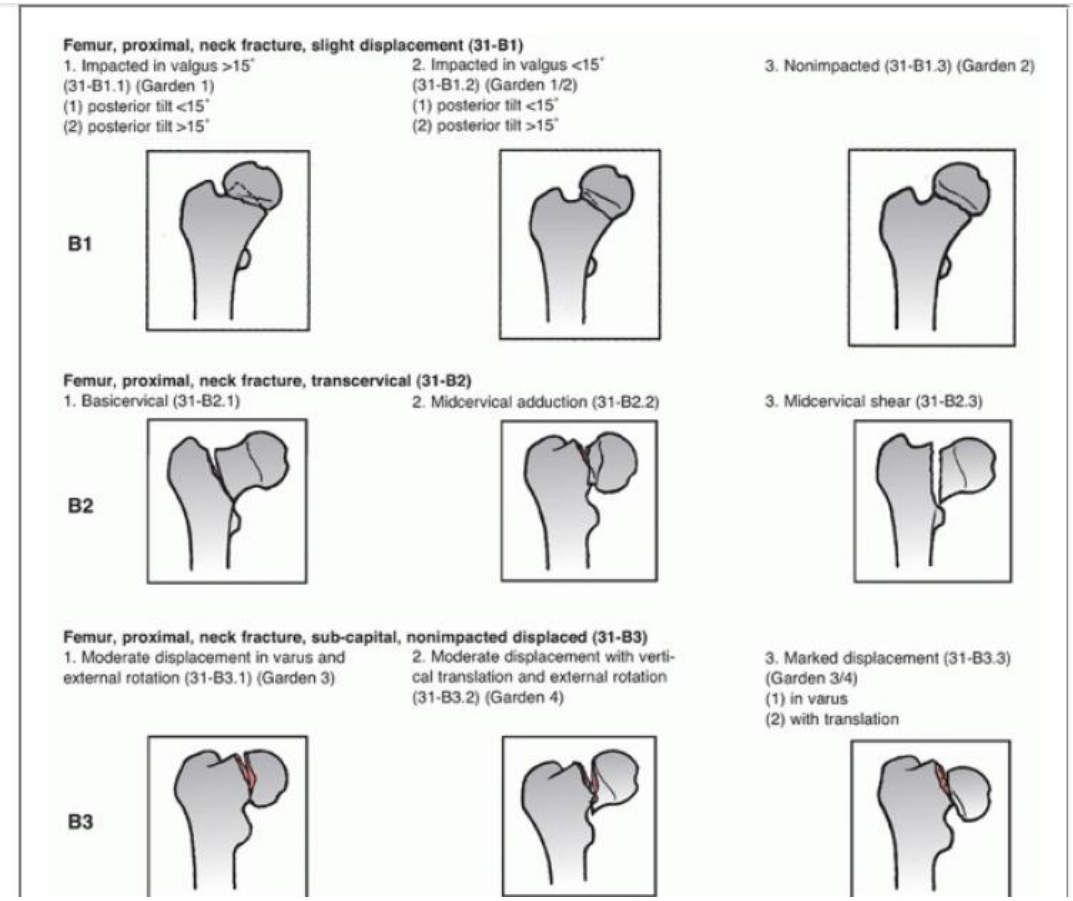
Not popular as it is complex. This is an alphanumeric system based on the bone involved, location of fracture and fracture morphology.

Femoral neck designated as 3-1 ,

B1- undisplaced

B2- transcervical

B3- subcapital.



Treatment

Based on classification,

In an undisplaced femoral neck fractures internal fixation by cannulatedcancellous screws.

In displaced femoral neck fractures

1. Reduction and internal fixation by cannulatedcancellous screws.
2. Hemi arthroplasty –AMP, Thompsons , Bipolar prosthesis.
3. Arthroplasty .

INTERTROCHANTERIC FRACTURES /EXTRA CAPSULAR FRACTURES

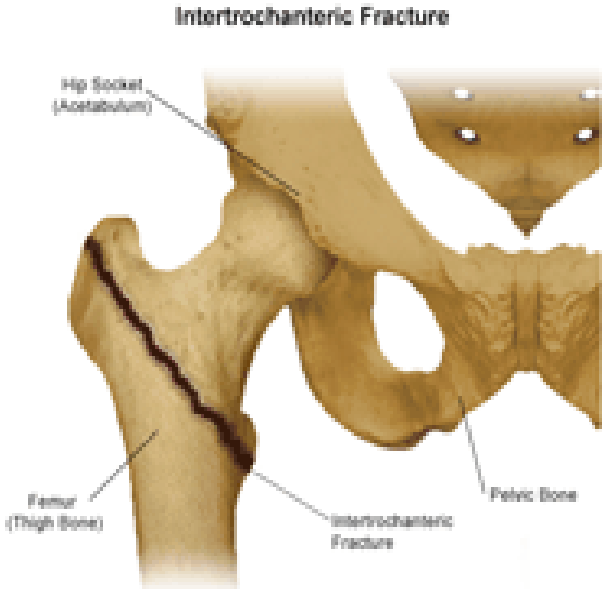
Mechanism of injury:

Low energy fall in elderly individuals and higher energy trauma in younger individuals predisposed to IT fractures.

Associated injuries:

In elderly patients fractures of upper limb like proximal humerus/ distal radius may occur.

In younger patients, because of high energy involved it may be associated with pelvic fractures, head injury, ipsilateral extremity trauma.



History and clinical examination;

A history of injury of fall and pain localized over the proximal thigh and it is severely increased on movements.

The limb will be shortened and externally rotated and the lateral border of foot may be in touch with the ground as the lateral border of foot may be in touch with the ground as the capsule is completely torn.

Risk factors for these group are corticosteroid treatment, chronic kidney diseases, alcohol and drug abuse, also included are protein calorie malnutrition, vit D deficiency disorders.

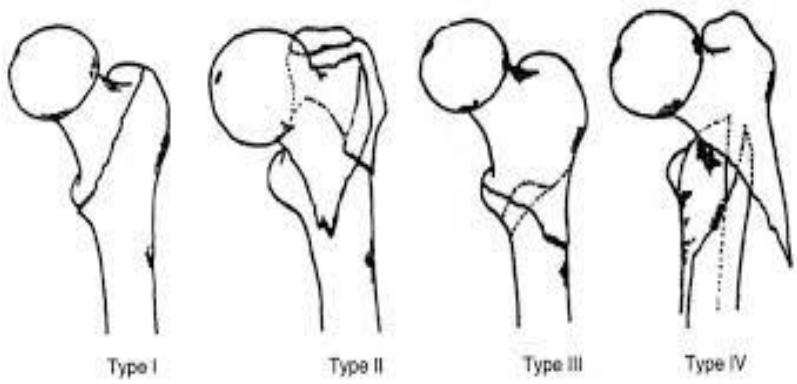
Imaging:

1. X ray pelvis with both Hips –Antero posterior view- traction and internal rotation of 15 degrees.

2. If required CT/MRI may be taken.

Classification:

Boyd & Griffin classification:



It predicts the difficulty of achieving, securing, maintaining the reduction in to four groups.

Type 1:

Stable, a fracture line extending from the lesser trochanter to greater trochanter.

Type II:

Comminuted and unstable.

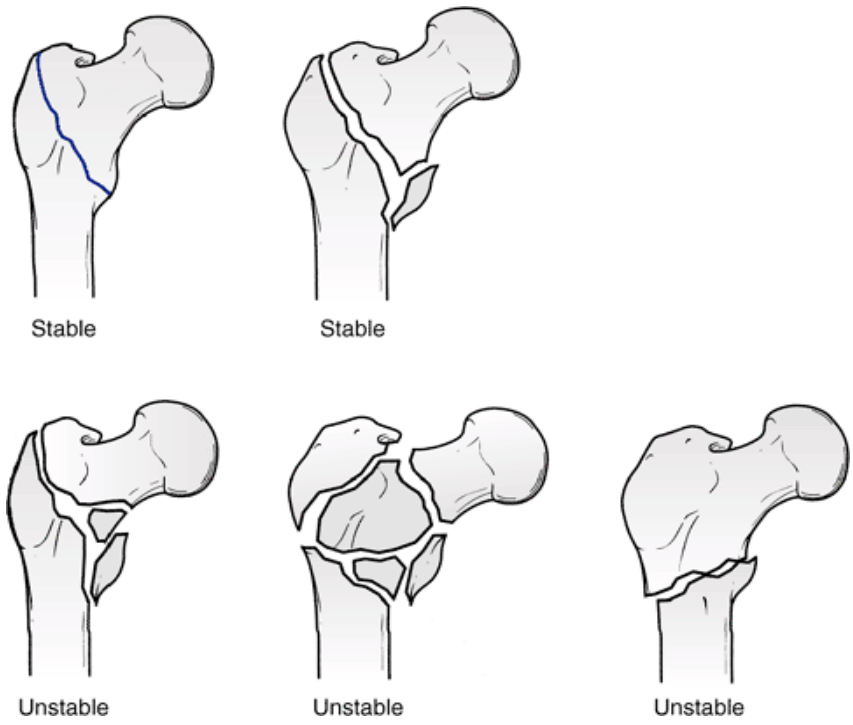
Type III:

Reverse oblique i.e. subtrochanteric extension into lateral shaft at the level or just below lesser trochanter.

Type IV:

IT fracture with sub trochanteric extension and lying in more than one plane.

Evans classification:



Type I:

Stable, intact medial cortex, either undisplaced/ displaced but anatomically reduced to stability.

Type 2:

Anteromedial cortex destruction.

Unstable – displaced and fixed in an unreduced position, reverse obliquity.

Orthopaedic and Trauma Classification :

Classified into three groups and each group divided into sub groups based on obliquity of fracture line and degree of comminution.

Group I :

Simple 2 part fractures, with typical oblique fracture line extending from the Greater trochanter to medial cortex.

Lateral cortex remains intact.

Group 2:

Unstable, comminuted fractures with a postero medial fragment. Intactness of the lateral cortex remains stable.

Group 3:

Both the medial and lateral cortices have extension of fracture line and this includes the reverse obliquity fractures.

Treatment:

1. Non operative – only in the elderly patients with medical co-morbidities.

2. Operative:

Options available are plenty and each have its own advantage and dis advantage.

a) Sliding hip screws

b) Hybrid locking plates

c) Cephalomedullary nails

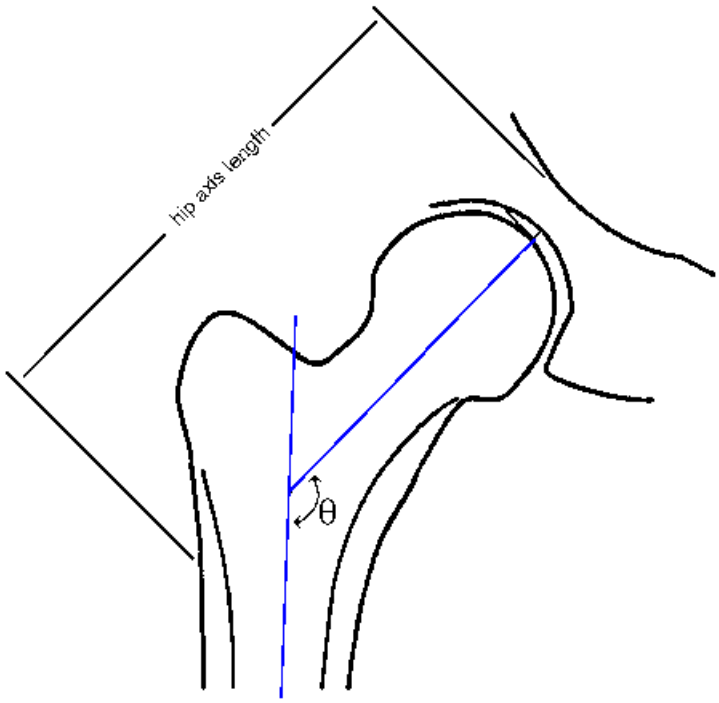
d) External fixation

e) Arthroplasty

Depending upon the age and the fracture patterns the implant is selected.

DEFINITIONS

Hip axis length:

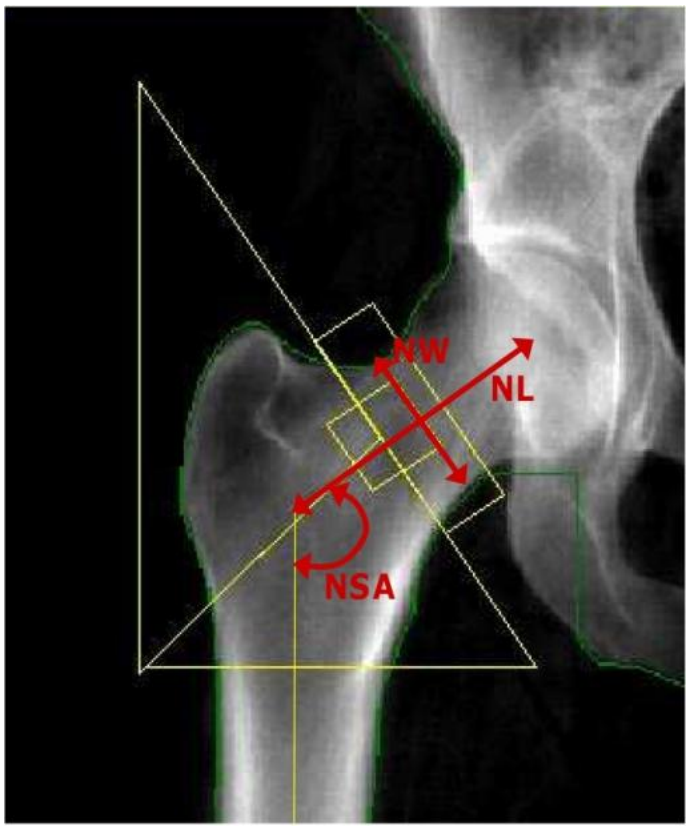


It is defined as the distance along the femoral neck axis from base of trochanter to pelvic brim.

It is an independent predictor of hip fractures risk , regardless of age, height, weight, femoral bone density.

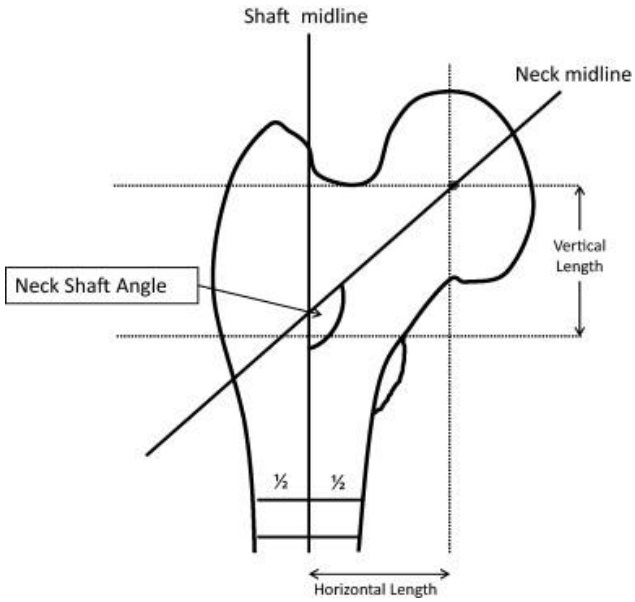
FEMORAL NECK AXIS LENGTH:

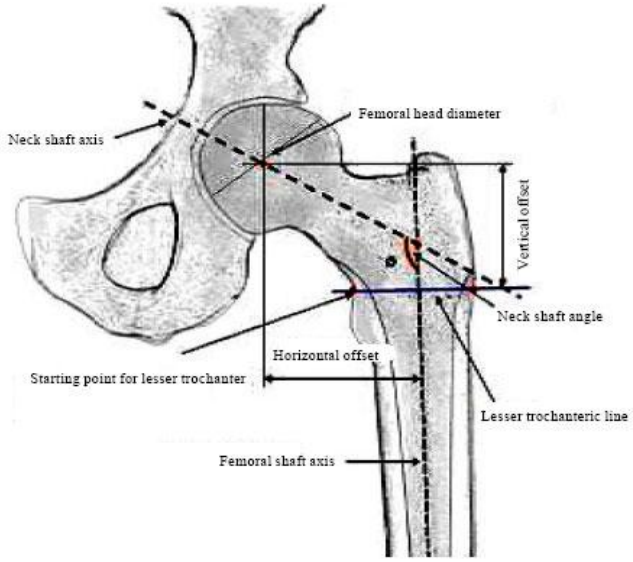
It is defined as the length between the medialborder of the base of greater trochanter to the femoral head.



NECK SHAFT ANGLE:

It is defined as the angle between the anatomical axis of the femoral shaft and the neck of the femur.





This figure elicits all the parameters of measurement in the proximal femur.

MATERIALS AND METHODS

Study subjects:

This is a prospective comparative case study of 118 patients who suffered from the proximal hip fractures, from a period of January 2013 to August 2014. Of these patients, 58 had intra capsular fractures and 60 patients had extra capsular fractures.

Inclusion criteria:

All the skeletally mature adults, who have sustained hip fractures, are eligible.

Exclusion criteria:

1. Patients with poly trauma
2. Patients with malignant disease
3. Patients with pathological fractures.
4. Patients on medications which are known to affect the bone metabolism.
5. Patients who are aged less than 18 years.
6. Patients with pelvic obliquity.
7. Patients with Sr. Calcium level <10mg/dl.

From all the patients, an informed consent was obtained after completely explaining the procedure. The study protocol was approved by the institutional ethical committee.

MATERIALS AND METHODS

All those patients with proximal hip fractures who attended the out-patient department and the trauma ward of the Stanley Medical College, between the period of January 2013 to August 2014 were considered for the study.

Based on the initial Xrays presented they were classified into two distinct groups based on the pattern of fracture they have sustained. Thus the two groups are the Neck of femur / intracapsular fractures and the other one is the inter trochanteric fractures /extracapsular fractures.

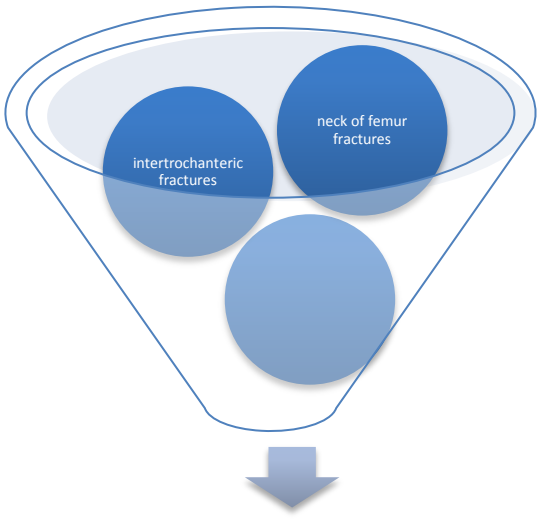
Those patients who were skeletally immature(<18yrs) are not accounted for the study. All the adults who had fracture in proximal femoral region are subjected to the basic investigations like complete blood count, ESR, mantoux, chest X ray for evaluation.

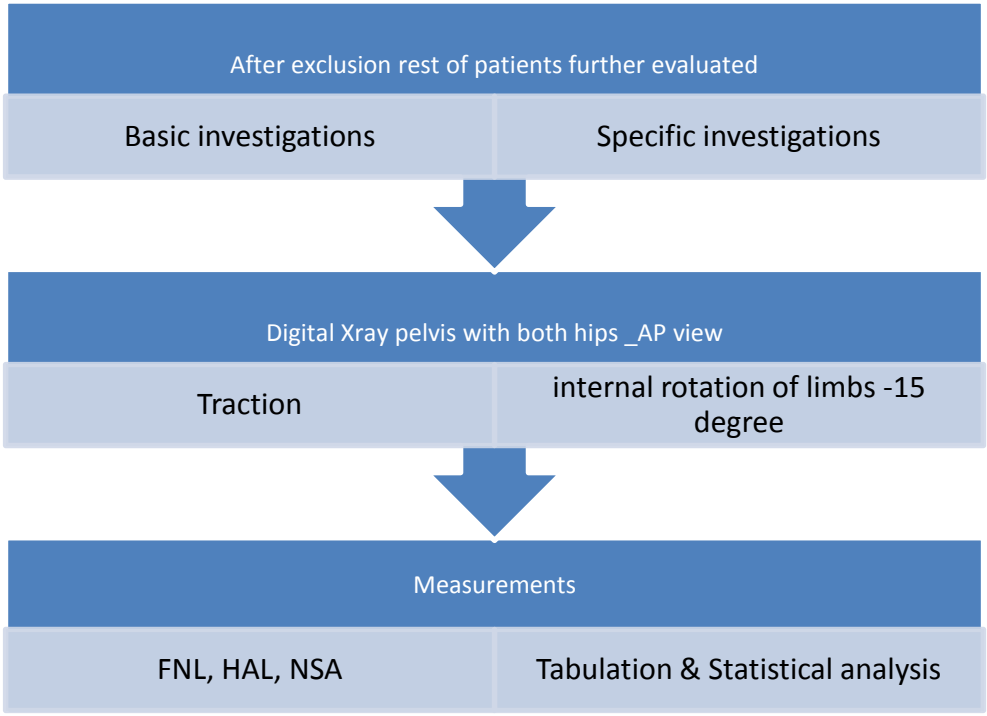
The individuals on steroids treatment for any medical ailments were excluded. The persons who turned to be Mantoux positive were excluded from the study. In some individuals there were metastatic

lesions in the chest x ray and they are not included in the study further. In some other patients who are suffering from the congenital anomalies and the paralytic disorders like polio were not included further for the study.

All those patients who presented to the trauma ward were evaluated for associated injuries. Those patients who had head injury/ pneumo or hemothorax or pelvic fractures or the fractures involving the skeletal extremities are not included.

Now all the remaining patients who were screened out were considered for the rest of the study. These patients were subjected to digital X ray pelvis with both hips antero posterior view with traction and internal rotation of limbs by 15 degree.





Positioning of the patient:

The patient will be in supine position while taking these X rays with their arms adducted and their forearm over the chest. In all these Xray films, when taken, the distance between the source and the cassette is kept at a constant distance of 100 cms, to avoid the magnification errors while measuring the parameters.


SID DIST
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Once the film has been taken, the measurement of FNL, HAL, NSA was done for every patient from the opposite uninvolved limb, in the central radiology console of the Radiology Department of Stanley medical college. To avoid the inter observer variability all these measurements have been done by the same observer who had received a orientation class about using the software.

The digital X rays taken have a standard magnification of 10%. So from each of the value measured, 10% of the value from original have been adjusted and noted. Every individual s parameters had been noted in a sequential manner.

The measurement of these parameters were made directly from the dedicated "MEDPACS" software solution directly from the computer, by means of the measurement tools provided in it. None of the values have been measured from the printed films.

Measurements:

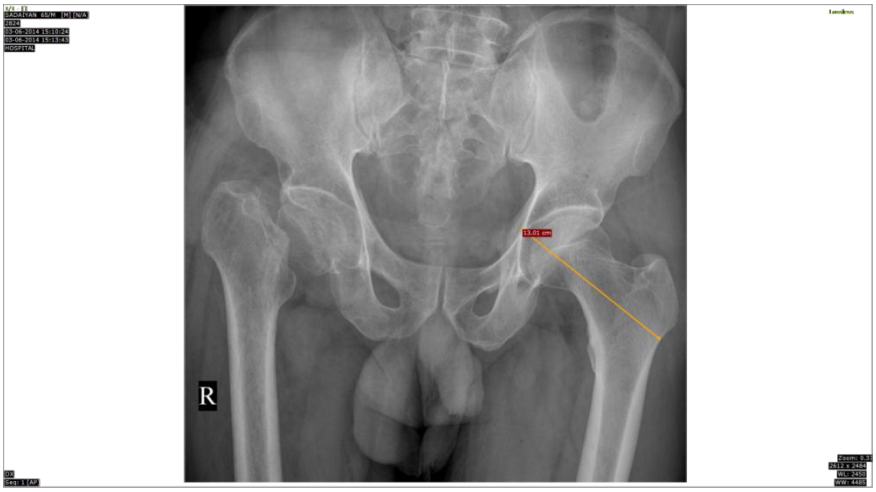
In every patient s Xray the radiological ID provided by the Department have been noted. All these measurements were made from the contralateral uninvolved sound hip joint.

The hip axis length is the distance between the lateral edge of the trochanter and the inner table of the pelvis. On drawing the line through the software, equal distance between the axis of neck and either side of the neck was maintained. It is measured in centimetres.

FNL is a component of HAL and it is measured from the medial flare i.e. an imaginary line connecting from the superior border of lesser trochanter to greater trochanter medial aspect to the flare of femoral head.

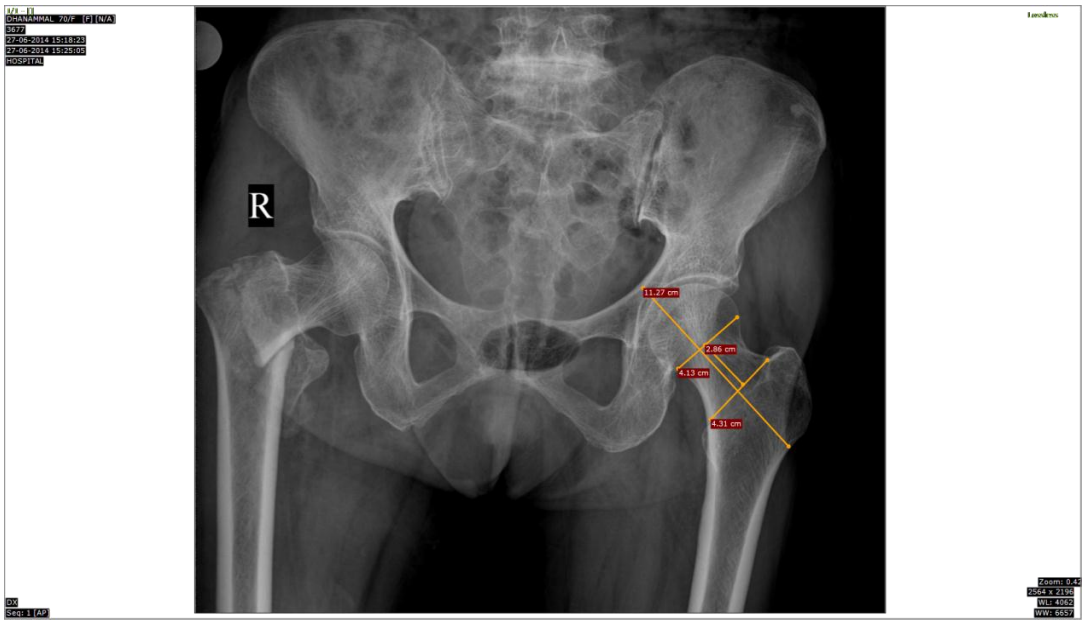
The NSA measured by means of drawing a line along the anatomical axis of the Femur and a line passing through the axis of neck. It is measured in degrees.

Measurement of HAL:



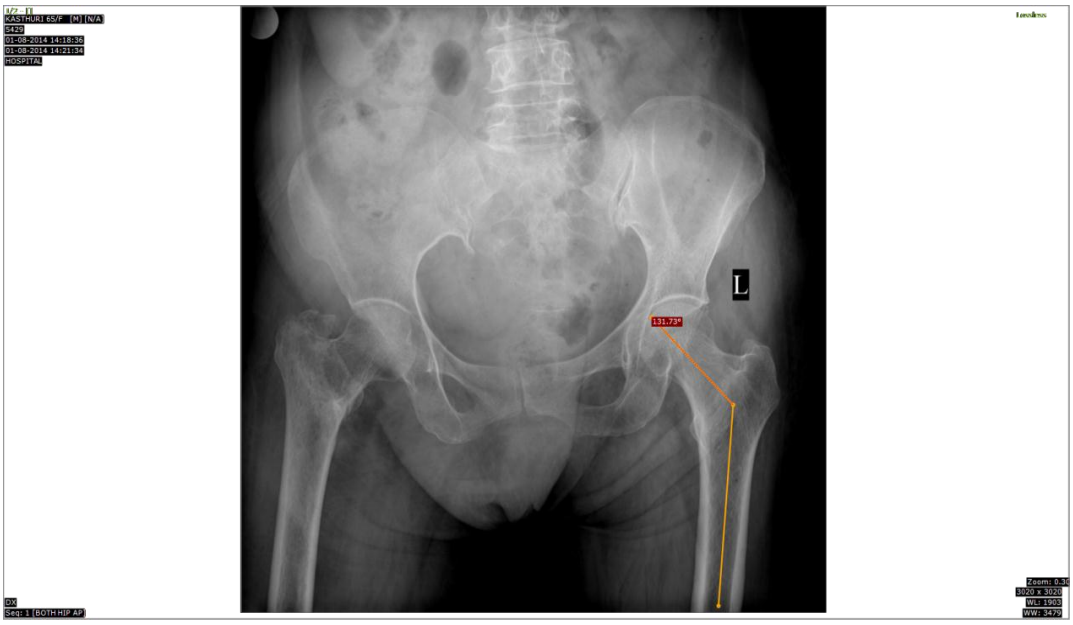
Measurement of the femoral neck length:

It is defined as the distance between the two perpendicular lines which transects the hip axis length one at the level of the trochanter and the other one at the level of head flare.



Measurement of the neck shaft angle:

The anatomical axis of the femur is defined for each xray. It is defined as the line passing through the centre of the shaft of Femur from the superior end to the inferior pole. The other line accounted here is the axis of the neck of femur. So the angle formed at the intersection of these two lines forms the neck shaft angle.



This modality of measurement had been done for every individual.

All the patient s parameters were then tabulated by means of classifying them into groups based on the age. These are then matched and their age groups of other type of fracture. For comparison, students T test of individual variables have been utilized.

Statistical analysis:

The statistical analysis was performed with SPSS, Social Package statistical software (version 16,SPSS, Chicago, Illionis, USA). Pearson s linear coefficients were calculated between the variable. Student s t test of independent variables was utilized to compare the two different groups with the parameters measured, i.e. FNL, HAL, NSA. A stepwise

multiple linear regression analysis was carried out to find the relationship between the measured parameters and the fracture pattern sustained. The criteria for stepwise analysis to continue the iteration , until the limit of P = 0.05 was reached.

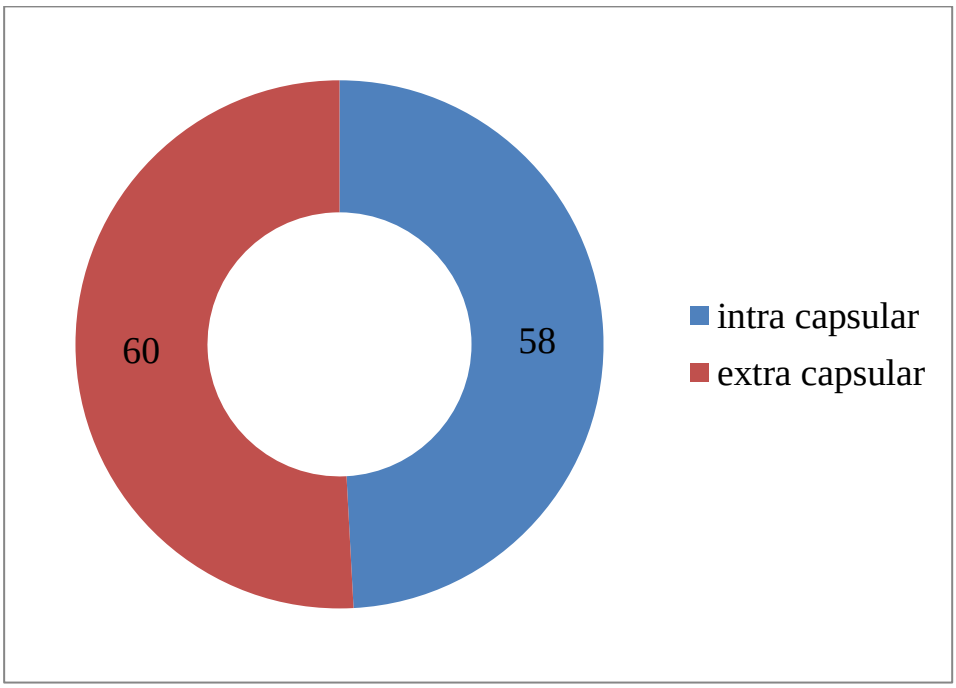
The sensitivity and specificity of each model was tested by calculating the area under the receiver operating characteristic curve, using the SPSS statistical software. Statistical comparison between the areas under curves was also performed.

OBSERVATION & RESULTS

Table 1:

Total number of patients:

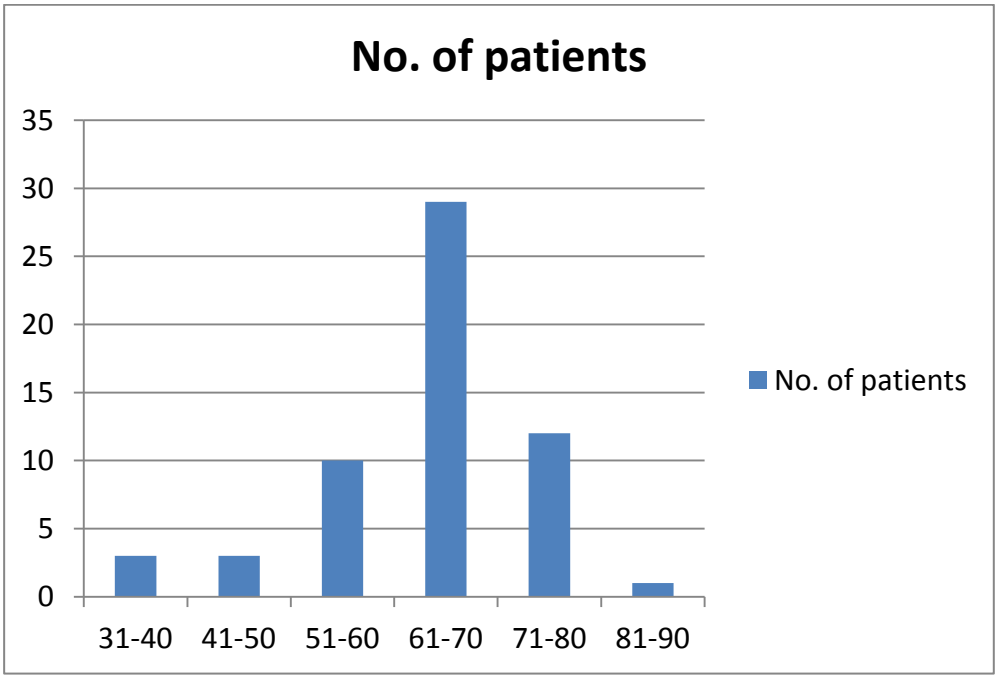
S.No.	Type of fracture	Nos.	Total
1	Intra capsular	58	
2	Extra capsular	60	
			118



Intra capsular fractures age wise distribution

Table -2:

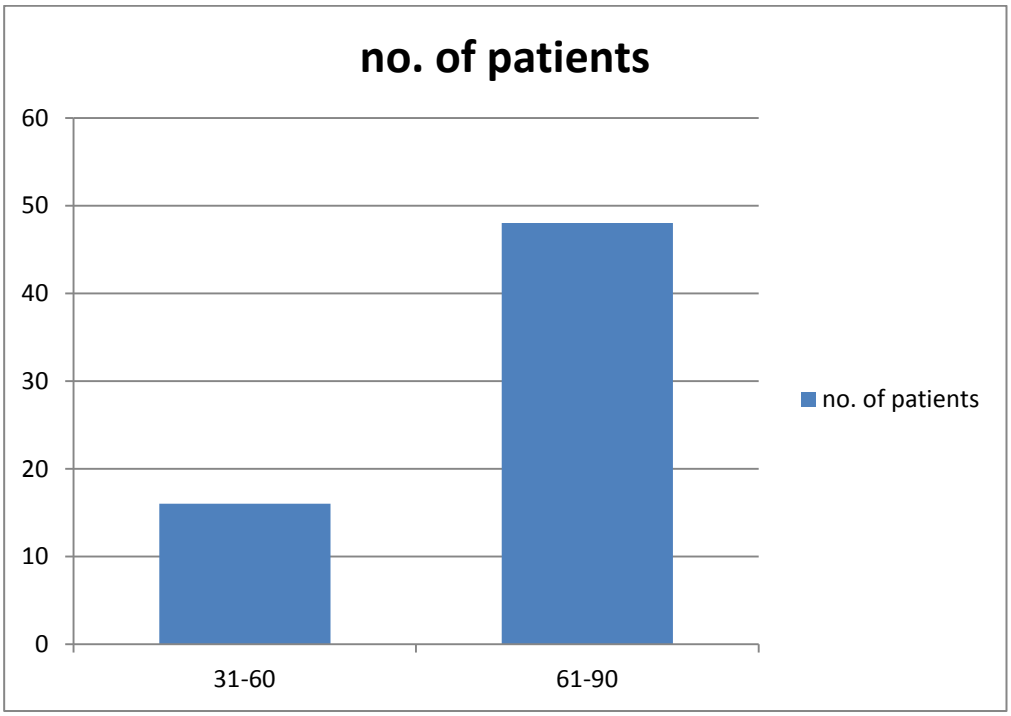
S. no.	Age group	Nos.	Total
1	31-40	3	
2	41-50	3	
3	51-60	10	
4	61-70	29	
5	71-80	12	
6	81-90	1	
			58



The above group of patients is divided into two groups as younger (31-60) & older (61-90) for comparison and to understand the etiology.

Table 3

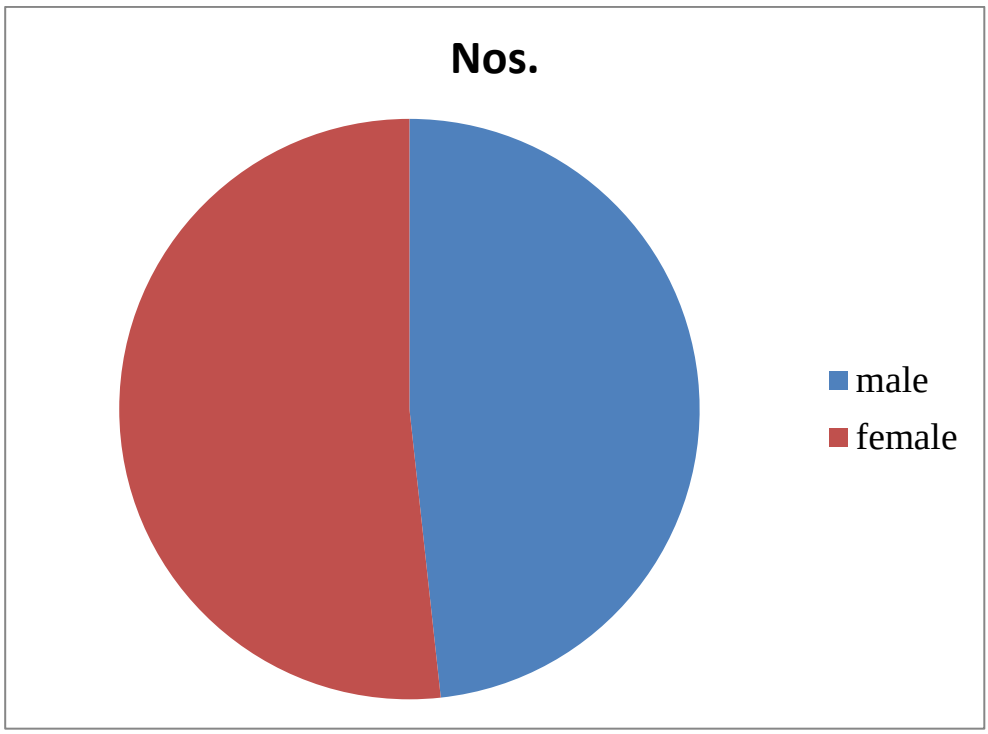
S. no.	Age group	Nos.	Total
1	31-60	16	
2	61-90	42	
			58



Sex distribution of patients

Table 4

S.no.	Sex	Nos.	Total
1	Male	28	
2	Female	30	
			58



Extra capsular fractures

Total no. of Patients

Table 5

S. no.	Age group	Nos.	Total
1	31-40	2	
2	41-50	15	
3	51-60	21	
4	61-70	18	
5	71-80	3	
6	81-90	1	
			60

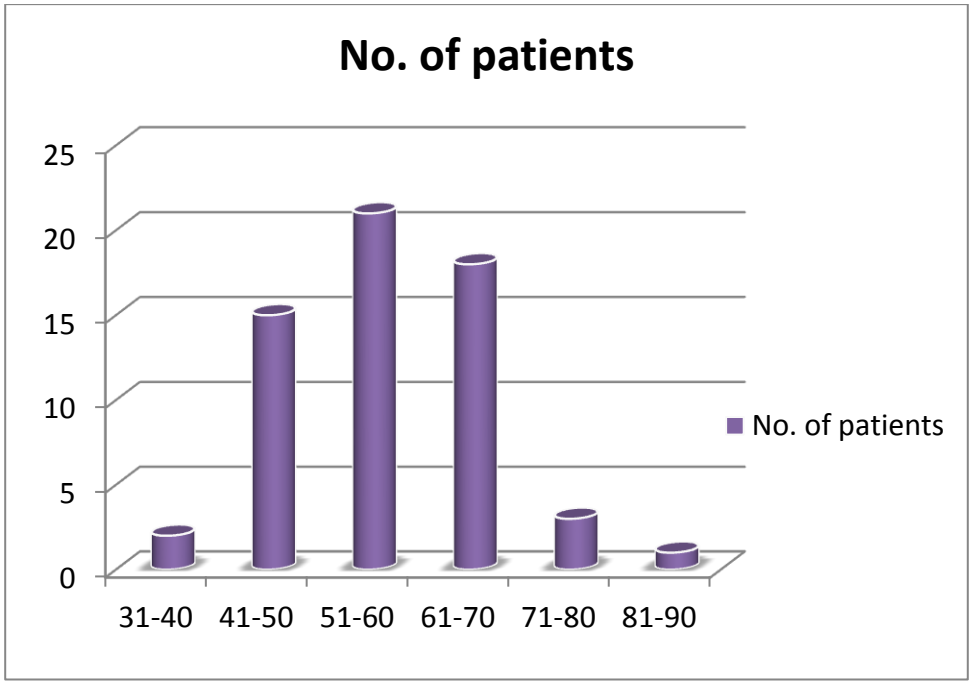
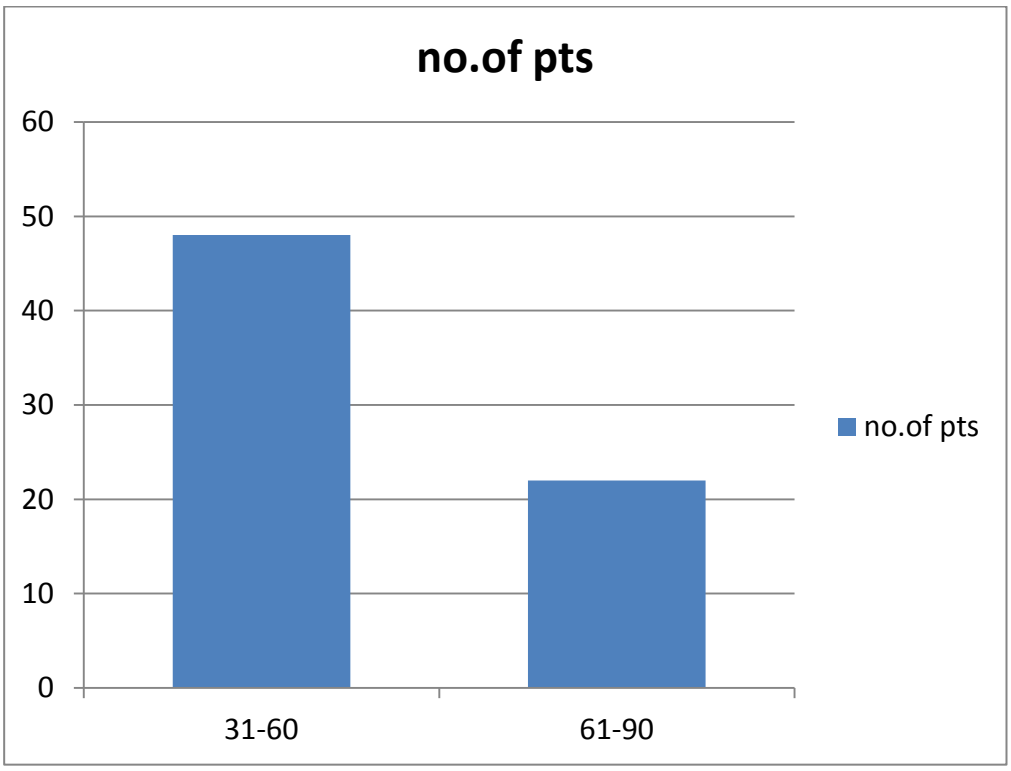


Table 6

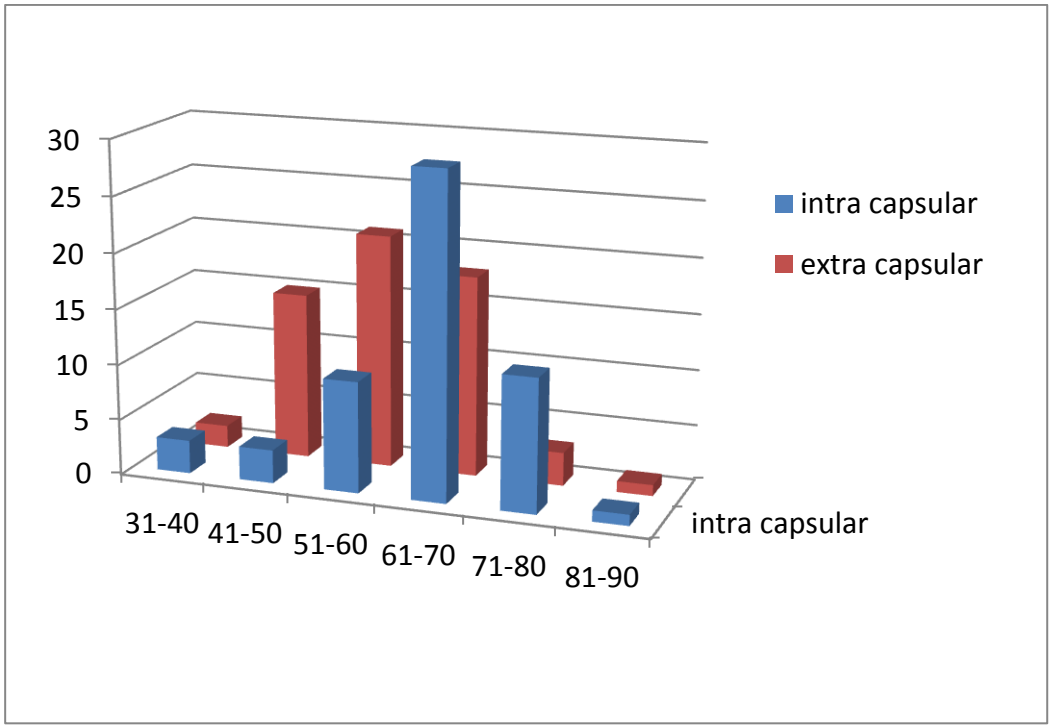
S. no.	Age group	Nos.	Total
1	31-60	48	
2	61-90	12	
			60



Sex distribution of patients

Table 7

S.no.	Sex	Nos.	Total
1	Male	45	
2	Female	15	
			60



Mean of NSA in intracapsular fractures:

Age	Mean value(IC)	Mean value (EC)
31-40	131.42	126.78
41-50	122.94	123.87
51-60	138.73	124.71
61-70	124.813	124.82
71-80	124.76	124.19
81-90	123.13	123.47

Age	Mean -IC	Mean- EC
31-60	131.03	125.12
61-90	124.23	124.16

COMPARISION OF FEMORAL NECK LENGTH OF THE INTRA AND EXTRA CAPSULAR FRACTURES

Age group	Frequency	Percentage
31-40	5	4.2
41-50	18	15.3
51-60	31	26.3
61-70	47	39.8
71-80	15	12.7
81-90	2	1.7
Total	118	100.0

Test of FNL values between IC and EC group

Group Statistics

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	58	2.5459	.41119	0.997	Not significant
	EC	60	2.5456	.43966		

Test of FNL values between IC and EC among age group 31-60

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	16	2.5907	.36791		Not significant
	EC	38	2.5059	.38532	0.458	

Test of FNL values between IC and EC among age group 61-90

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	42	2.5288	.42948		Not significant
	EC	22	2.6141	.52320	0.487	

Test of FNL values between IC and EC among age group 31-40

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	3	2.7087	.36830	0.891	Not significant
	EC	2	2.7500	.07071		

Test of FNL values between IC and EC among age group 41-50

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	3	2.2867	.47290	0.363	Not significant
	EC	15	2.4967	.33440		

Test of FNL values between IC and EC among age group 51-60

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	10	2.6465	.32687		Not significant
	EC	21	2.4893	.43569	0.321	

Test of FNL values between IC and EC among age group 61-70

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	29	2.4783	.37236	0.181	Not significant
	EC	18	2.6472	.47610		

Test of FNL values between IC and EC among age group 71-80

	Grp	N	Mean	Std. Deviation	P-value	Results
FNL_cms	IC	12	2.6241	.55547		Not significant
	EC	3	2.6167	.86904	0.990	

COMPARISON OF HIP AXIS LENGTH OF INTRACAPSULAR FRACTURES WITH EXTRA CAPSULAR FRACTURES

Test of HAL values between IC and EC

Group Statistics

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	58	11.3801	1.14537	0.374	NS (Not Significant)
	EC	60	11.2108	.89712		

Test of HAL values between IC and EC among age group 31-60

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	16	11.8881	1.07745	0.007	**significant**
	EC	38	11.0919	.89799		

Test of HAL values between IC and EC among age group 61-90

Group Statistics

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	42	11.1866	1.12251	0.408	NS
	EC	22	11.4161	.87786		

Test of HAL values between IC and EC among age group 31-40

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	3	12.5100	1.04360		NS
	EC	2	11.9700	.89095	0.594	

Test of HAL values between IC and EC among age group 41-50

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	3	11.4433	1.40657	0.516	NS
	EC	15	10.9649	1.09591		

Test of HAL values between IC and EC among age group 51-60

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	10	11.8350	1.02721	0.028	**Significant**
	EC	21	11.0990	.72261		

Test of HAL values between IC and EC among age group 61-70

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	29	11.1630	1.09424	0.256	NS
	EC	18	11.5050	.79218		

Test of HAL values between IC and EC among age group 71-80

	Grp	N	Mean	Std. Deviation	P-value	Result
HAL_cms	IC	12	11.1417	1.22838		NS
	EC	3	11.4633	1.08039	0.686	

COMPARISON OF NECK SHAFT ANGLE OF INTRA CAPSULAR AND EXTRA CAPSULAR FRACTURES

Test of NSA values between IC and EC

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	58	124.96E2	4.16166		NS
	EC	60	124.60E2	2.63994	0.583	

Test of NSA values between IC and EC among age group 31-60

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	16	125.74E2	4.05093		NS
	EC	38	124.59E2	2.52954	0.213	

Test of NSA values between IC and EC among age group 61-90

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	42	124.66E2	4.21309	0.973	NS
	EC	22	124.63E2	2.88194		

Test of NSA values between IC and EC among age group 31-40

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	3	131.43E2	5.74332	0.393	NS
	EC	2	126.78E2	3.50018		

Test of NSA values between IC and EC among age group 41-50

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	3	122.95E2	3.78783		NS
	EC	15	124.15E2	2.83101	0.531	

Test of NSA values between IC and EC among age group 51-60

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	10	124.86E2	1.61264		NS
	EC	21	124.70E2	2.23056	0.832	

Test of NSA values between IC and EC among age group 61-70

	Grp	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	29	124.76E2	4.50033	0.885	NS
	EC	18	124.93E2	2.77715		

Test of NSA values between IC and EC among age group 71-80

	Group	N	Mean	Std. Deviation	P-value	Result
NSA_deg	IC	12	124.30E2	3.76701		NS
	EC	3	124.19E2	3.51510	0.964	

SPSS Version 16- package was used for statistical analysis. Statistical tool.

T-test for two independent samples was employed .

In our study, the test of Hip Axis Length (HAL), among the age group of 51- 60 with p value of 0.028 is significant and also on comparison of the two groups as older and younger the HAL in the age group of 31 -60 is significant with p value of 0.007 on comparison between IC and EC fractures.

The Intra capsular fractures in the 51 -60 age group had a mean of 11.8350 with standard deviation of 1.0271 and the extra capsular fractures had a lesser mean of 11.0990 with standard deviation of 0.72661.

Fracture type	Mean value	Standard deviation
Intra capsular	11.8350	1.0271
Extra capsular	11.0990	0.72261

Similarly in the age group of 31- 60yrs the intra capsular fractures had a mean of 11.8881 and standard deviation of 1.07745 and

the extra capsular fractures had a mean of 11.0919 with a std. deviation of 0.89799.

Fracture type	Mean value	Standard deviation
Intra capsular	11.8881	1.07745
Extra capsular	11.0919	0.89799

Thus in our study**, the HAL is increased in the intracapsular/ femoral neckfractures on comparison with extra capsular fractures**. As most of the literature says the HAL had been an independent risk factor and thus increased in the neck of femur fractures.

Femoral Neck Length

Fracture type	Mean value	Standard deviation
Intra capsular	2.5459	0.4119
Extra capsular	2.5456	0.43966

Statistically, in our study FNL has no difference between the two fracture groups.

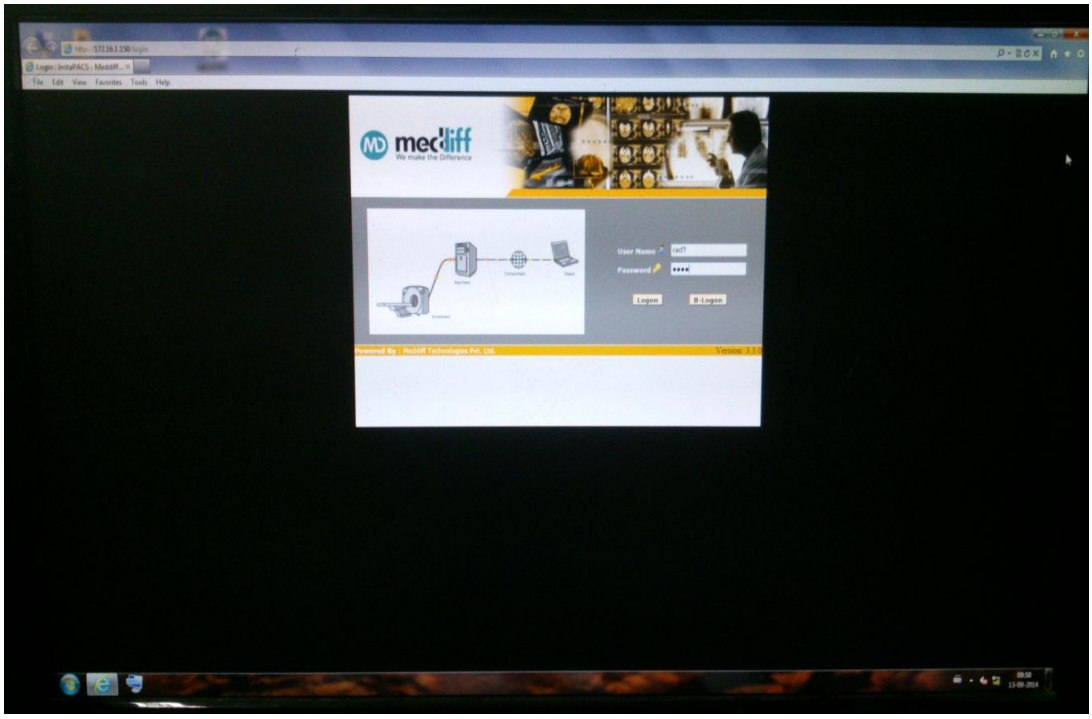
Neck Shaft Angle

Fracture type	Mean value	Standard deviation
Intra capsular	124.96	4.1616
Extra capsular	124.60	2.6938

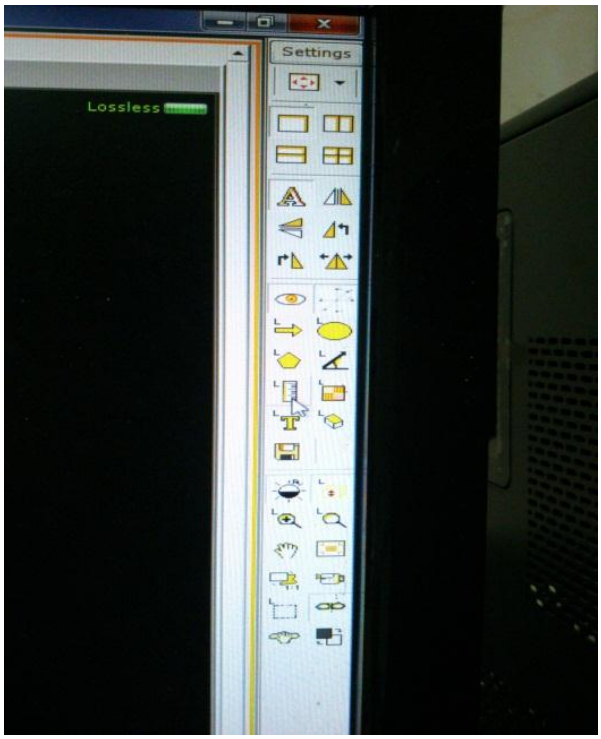
Statistically, in our study NSA has no difference between the two fracture groups.

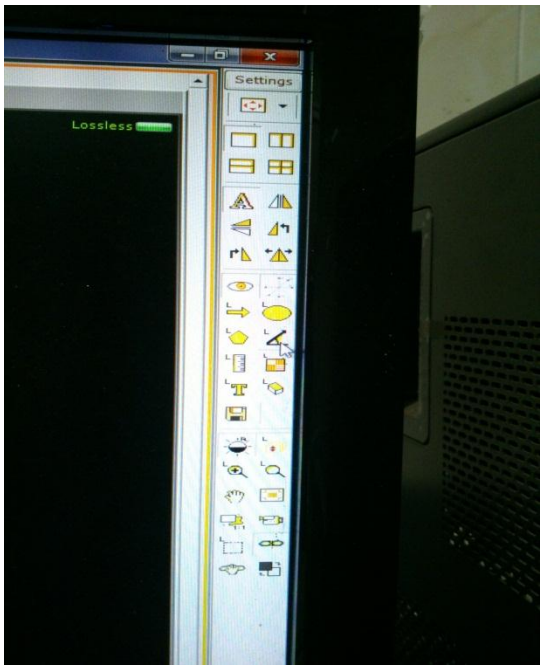
ILLUSTRATIONS

The software used is shown below,



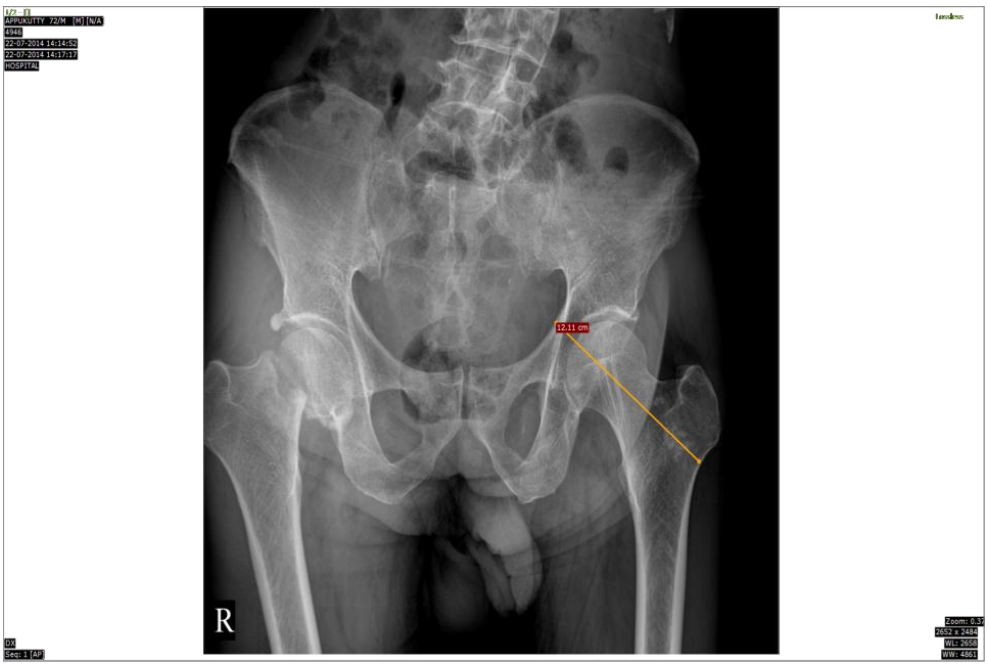
The measurement tool,



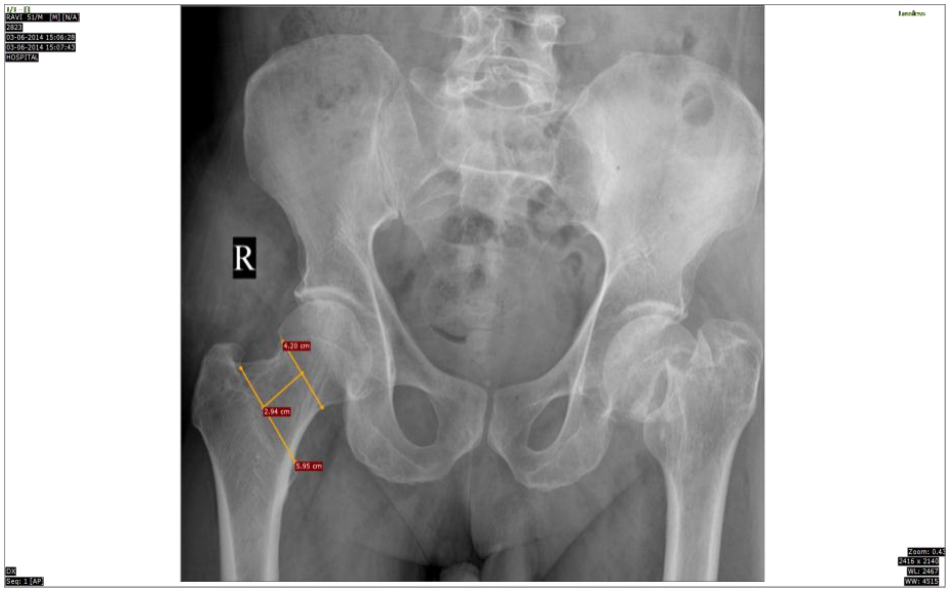


Illustrated pictures of measurement:

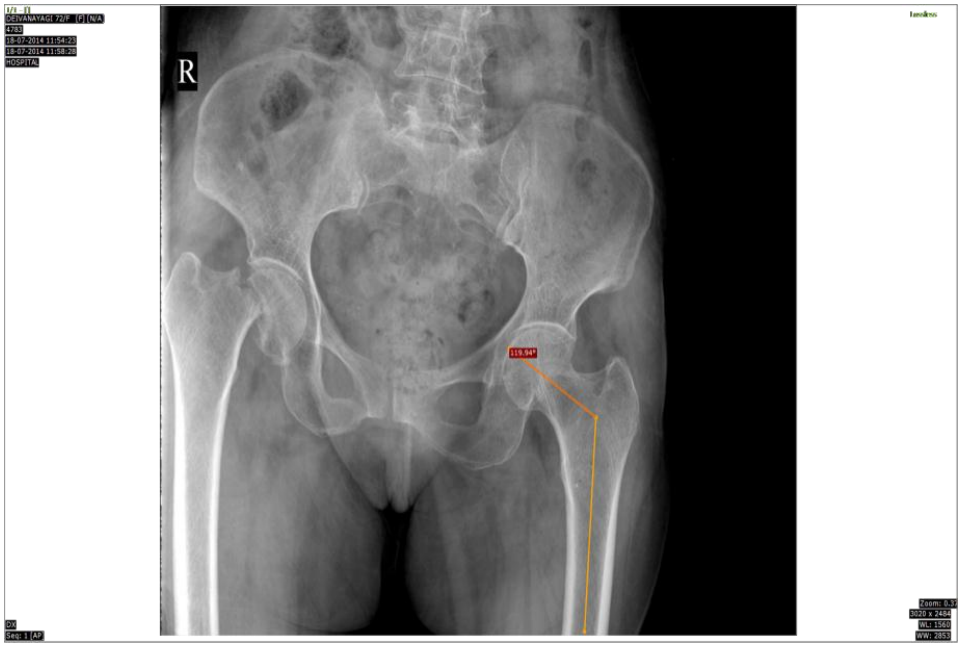
1. HAL



2.FNL



3.NSA

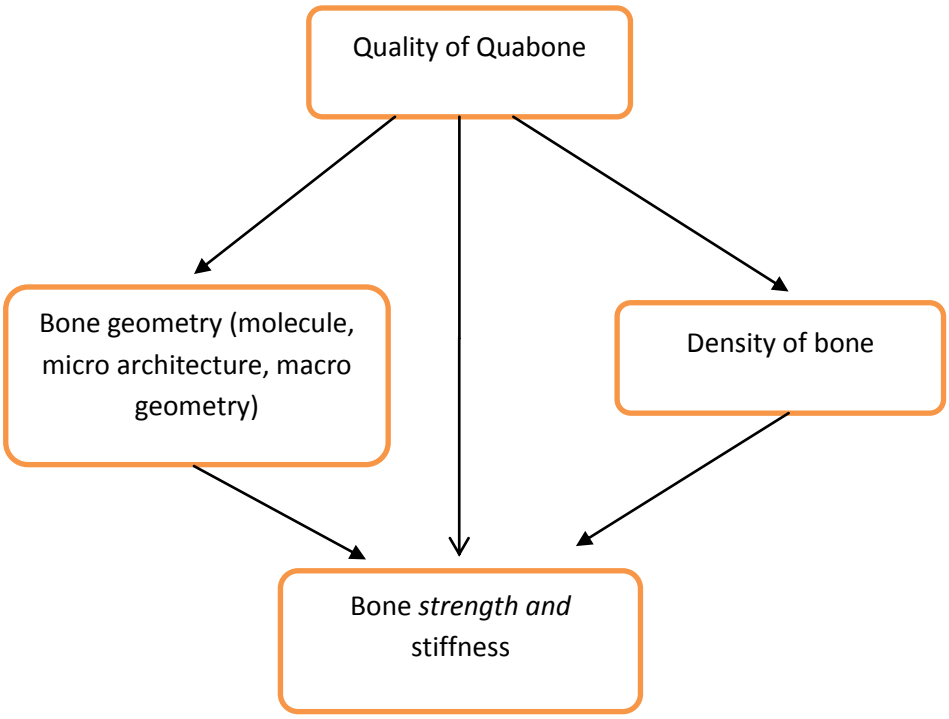


DISCUSSION

Bone geometry has been shown to be important for the evaluation of risk of fractures in an individual especially in the proximal Femur. Biomechanically , at the tissue level the mechanical properties of bone are determined by both material quality and bone structure i.e. strength of bone is influenced by both the material of which the fracture is composed and also the distribution and organization of the material content.

Some of the functions of bone are mechanical support, soft tissue protection and acting as the sites of attachment and origin and the most important part of Calcium metabolism i.e maintaining the homeostasis of Calcium in the body. Thus for providing the sufficient strength and stress on loading or reception of stress the bone has got specific bio mechanical properties.

Thus a significant role is played by the geometrical configuration and the bio material characteristics in providing the ample strength and stress. The calcified matrix within the bone determine the bone density.



Thus the hip structure anatomy seems to be an important determinant in predicting the risk of hip fractures (38). It has been suggested that cervical fractures are much related to pelvic geometry/anatomy of hip joint and trochanteric fractures to the osteoporosis in the trabecular compartment of neck and trochanteric region [39].

The size, shape and structure of bone are the components of so called “bone quality” [43]. In selecting the parameters, we regarded the proximal Femur as a cantilever and assumed that the angle, length are most critical. Of these, the HAL, FNL, NSA were considered to be the most reliable measures to be determined in our study.

Our study results on comparison with others,

Study	HAL		P values
	Cervical (cm)	**trochanteric(cm)**	
Duboeuff et al	9.42 N=42	9.25 N=24	>0.001
Michael et al	13.88 N=50	13.39 N=50	>0.001
Our study	11.88 N=58	11.09 N=60	>0.001

Thus the p value is significant and thereby , there exists an association between the hip fractures and the geometrical structure. HAL had been shown to predict the hip fractures independent of age, BMD [40]. As each SD increase in HAL it is associated with 1.8 times the risk of hip fractures [41], this effect is being independent of bone mass.

On comparing the NSA and FNL with others,

Partanen J et al	**N**	**NSA(degrees)**	**FNL (cms)**
Cervical #	46	135.7	2.6
trochanteric #	24	130.03	2.6

Pannula J et al	**N**	**NSA(degrees)**
Cervical #	266	133.2 +/-6
Trochanteric #	162	132.4 +/-6.4

Michael J et al	N	FNL(cms)
Cervical #	50	3.23
Trochanteric #	50	2.755

Our study	**N**	**NSA(degrees)**	**FNL (cms)**
Cervical #	58	124.96	2.5459
Trochanteric #	60	124.60	2.5456

Thus there is no statistical significance between these two populations, as compared with other studies.

NSA was found to be significantly higher in patients with IC fractures than EC fractures in a study by Partanen et al [44]. His study material consists of 46 cervical and 24 trochanteric fractures. Like our study FNL between the two types of fractures is not significant.

A wider NSA was detected by Gnudi et al in a cross sectional study involving 88 cervical, 93 trochanteric fractures involving menopausal women over 69 yrs of age. But unlike our study, all the measurements were taken from DEXA scan. Yet the reason for differences in NSA between intra and extra capsular fracture could not be explained by the patient [45].

Xray pelvis with both hips – antero posterior view had been taken in a study group involving 23 cervical , 20 trochanteric fractures with 119 controls by Michelotti et al [45]. As in our study, there was no difference in NSA/FNAL between the two fracture groups [46].

FNL just like other proximal femoral dimensions highly depends on height of the individual [47], Bergot et al also observed that the FNL was independent of age as in our material although we did not measured the height of the patients at all.

Thus from our study we are not able to detect any difference between the intra and extra capsular fractures by means of the parameters i.e. NSA, FNL. So the difference in the mechanism between the cervical and trochanteric fractures were not confirmed in our study, by means of these two parameters alone.

In one of the studies made with 114 post menopausal women, (49 cervical, 25 trochanteric fractures and 40 controls), the combination of NSA with more geometrical parameters along with BMD improved the accuracy in assessing the fracture type. Here NSA was found to be elevated in cervical fractures than in controls, but there was no major difference in the trochanteric group compared with the controls [48]. As in our study, there was no significant difference between cervical, trochanteric fractures by means of FNL measurements.

But this study differ from ours in way it has been carried out by means of including controls, whereas in our study there are no controls/ only patients have participated in the study and no normal subjects.

In general, age related changes in bone geometry attempt to preserve the strength of bone as a whole [49].

A gender difference was noted in a study by Pulkinnen et al [50], where intra capsular fractures were significantly higher in women (74%), than in men (49%), this finding differs from our study as there are more male patients in both the groups, than the females. Yet their study was experimental, comprised of 140 cadavers whose femorae were radiographed. They concluded from their study that NSA as the best predictor of the type of hip fracture. In that same study, FNL importance could not be established.

There exists very limited evidence, that there exists a relationship between age and various hip geometry parameters [51].

The ability of a bone to resist a fracture depends on the amount of bone, spatial distribution of bone mass (micro architecture anatomy) and the intrinsic properties of materials forming the bone [52]. In our study, there exists no correlation between the age and NSA/FNL in fractured hips regardless of the type of fracture. Thus the age related changes typically occurs mostly in the internal structure of bone and not in the gross anatomy of proximal femur.

There is an another study by Sievannen [53] et al, who suggested that , there have been remarkable alterations in the proximal femur macro anatomy within past 1000 years. In their study, they compared

the medieval hip anatomy with contemporary hip anatomy and thy suggested that femoral neck axis has become larger and its cross section has become proportionately smaller and oval shaped. All these changes remarkably increases the risk of hip fractures especially when osteoporosis co exists.

Although FNL is a component of HAL, its role in prediction of risks of hip fractures is not clear/inconclusive. HAL measurements increases on adduction of hip because of inner shape of pelvis [42], which should be avoided by means of standardization of the position of patient on subjecting to X ray.

CONCLUSION

Thus in our study, the HAL is significantly different between the intra capsular and extra capsular fractures especially more in individuals of 51-60 years. But in our study, we didn't found any significant differences in the Femoral Neck length and the Neck Shaft Angle of these fractures.

Advantages of the study:

1. It s based on our population.

2. Considerable size of the material.

Limitations of study:

1. Though the measurements were made from advanced computer software yet Xrays are just two dimensional and much more accurate correlation between these fractures can be found by CT scans which are 3 dimensional and much higher accuracy in calibration will be possible.

2. Addition of Bone Mineral Density(BMD), will provide more limelight in predicting the risk and thereby difference in these two types.

3. Consideration of more parameters like Femoral neck Width (FNW), ratio of Femoral Neck Length to Femoral Neck Width, Femoral Head Width, Cortices thickness of the shaft at the level of trochanters will be much more productive.

4. Measurement of height, weight will give more accuracy.

5. Magnification error – but it loosed much of its effect in the study as we just compare the differences between the two types of fractures. But the magnitude of errors is probably of equal size in both the groups.

Thus I conclude from our Study that, the Hip Axis Length (HAL), is an independent predictor of the risk of hip fractures. It can be used as a screening tool in the patients to predict and there by forewarn about their susceptibility to hip fractures and educating about the ways to avoid the risk factors predisposing the hip fractures.

BIBLIOGRAPHY

1. Solmon L. Osteoporosis and fractures of femoral neck in south African Bantu. J Bone J surgery 1968;503;2-13.
2. Pirrtola M, Vahlborg T, Isoaho R et al –incidence of fractures and changes over time among the aged in Finnish municipality ; a population based 12yrs follow up. Aging ClinExp res 2007;19 (4); 269- 276.
3. Kannus P, parkrurari J, Seivanen H et al. epidemiology of hip fractures. Bone 1996, 18 (1 supp), 575-635.
4. Efflors, Gulberg B, Alexander E et al – methodology of Medosmulticentric study of hip fracture incidence. Validity and relevance consideration. Bone 1993; 14;s 45-49.
5. Gukberg B, Johnell O, Kanis JA, world wide projections of hip fractures. OsteoporosInt 1997; 7 (5) – 407- 413.
6. Melton LJ, 3rd , Keaons AE, Atkinson EJ, et al, secular trends in hip fracture incidence and recurrence. OsteoporosInt 2009, 20 (5), 687- 694.
7. Xu ling, Lu aimin, Zhao Xihe et al very low rates of hip fractures.

8. Hagino.H, Furkawa K, Fujiwara S et al. recent trends in the incidence and life time risk of hip fractures in Cotton; Japan, Osteoporosint 2009, 20 (4),;543-548.

9. Praemer A, Furner S, Rice DP, Musculoskeletal condition in U.S. Park ridge II – American Academy of Orthopaedic Surgeons 1992.

10. Hip fracture outcomes, in people aged fifty and over. Background Paper, Office of technology assessment. Washington D.C.; GPO;1994 Pub No. OTA –BD H -120.

11. Cummings SR, Black D, Nevitt MC ***et al.*** Bone density at various sites for prediction of hip fractures. The Study of Osteoporotic Fractures Research Group. *Lancet* 1993 ;341 ;72-75.

12. Clause and Cummings et al. prediction of hip fractures from pelvic X rays – the study of osteoporotic fractures. Journal of Bone & Mineral research Vol -9, issue 5 ,671-n677, May 1994.

13. Reid IR, Chin K, Evans MC, Jones JG. Relationship between increase in length of hip axis in older women between 1950s and 1990s and increase in age specific rates of hip fracture. *BMJ* 1994 ; 309 : 508-509.

14. Flicker L, Faulken KG, Hopper J.L., Green R.M., Kaymacki B, Nowson C.A., Young D, Wark J.D.,; determinants of hip axis length in women aged 10-89 years; a twin study: Bone 1996; 18(1),;41-45.

15. Gnudi S, Malavolta N, testi D, Vicoconti M 2004 et al, differences in proximal femur geometry distinguish vertebral from femoral neck fractures in osteoporotic women Br J Radiol 77; 219-223.

16-17 Jamsa T, Jalovara P et al: influence of upper femur and pelvic geometry on the risk and type of fractures. J Bone Miner Res 2001; 16 (8),: 1540-1546

18. Pulkkinen P, Partanen J, Jalovaara P, Jämsä T: Combination of bone mineral density and upper femur geometry improves the prediction of hip fracture. OsteoporosInt 2004;15(4):274–280

19. Yang RS, Wang SS, Liu TK. Proximal femoral dimension in the elderly Chinese women with hip fractures in Taiwan. *OsteoporosInt*1999 ; 10 : 109-114

20. M.B. Mikhail, Dr.A.N. Vasuvani, J.F. Aloia – racial differences in femoral dimensions and their relationship to hip fractures ,osteoporosis int 1996, Vol 6 issue 1, pp 22-24.

21. T. Nakamura, C.H. turner, T. Yoshikawa, M.Peacock , do variations in hip geometry explain differnces in hip fracture risk between Japanese and White Americans? Jounal of Bone and mineral Research, vol 9 – issue 7, July 1994, 1071- 1076.

22. .S.R. Cummings, J.A. Cauley, L Palermo et al. Racial differences in Hip Axis Length might expalain differences in rates of hip fractures. Osteoporosis int 1994, 4, 226-229.

23. Geusen P; geometric characteristics of the proximal Femur and hip fractures risk. OsteoporosINt 1996; 6 suppl 3: 27-30.

24. Michellotti J, Clark J et al. : Femoral neck length and hip fracture risk, Jbone Miner Res 1999; 14(10), 1714 -1720.

25. **Wilkin TJ, Devasenan D, Dequeker J, Luyten FP.** Bone densitometry is not a good predictor of hip fracture. *BMJ* 2001 ; 323 : 795-799.

26. Bergot C, Bousson V, Meunier A, Laval-Jeantet M, Laredo JD: Hip fracture risk and proximal femur geometry from DXA scans. OsteoporosInt 2002;13(7):542–550.

27. Ripamonti C, Gnudi S, Lisi.L, Fini M et al. Proximal Femur Geometry to detect and distinguish femoral neck fractures from trochanteric fractures in post menopausal women. OsteoporosInt (2002), 13: 69- 73.

28. Gnudi S, Ripamonti C, Lisi L, Fini M, Giardino R, Giavaresi G: Proximal femur geometry to detect and distinguish femoral neck fractures from trochanteric fractures in postmenopausal women. OsteoporosInt 2002;13(1):69–73.

29. Brownbill RA, Ilich JZ: Hip geometry and its role in fracture: what do we know so far? CurrOsteoporos Rep 2003;1(1):25– 13

30. Pulkkinen P, Eckstein F, Lochmüller EM, Kuhn V, Jämsä T: Association of geometric factors and failure load level with the distribution of cervical vs. trochanteric hip fractures. J Bone Miner Res 2006;21(6):895–901.

31. Michael sean Patton, Robert Andre et al. proximal femoral geometry and hip fractures. Actaorthop. Belg, 2006, 72, 51-54.

32. Reid IR, Chin K, Evans MC, Jones JG. Relationship between increase in length of hip axis in older women between 1950s and 1990s and increase in age specific rates of hip fracture. *BMJ* 1994; 309 : 508-509.

33. Chin K, Evans MC, Cornish J ***et al.*** Differences in hip axis and femoral neck length in premenopausal women of Polynesian, Asian and European origin. *Osteoporos Int*1997

34. Szulc P, Duboeuf F, Schott AM, Dargent-Molina P, Meunier PJ, Delmas PD: Structural determinants of hip fracture in elderly women: re-analysis of the data from the EPIDOS study. Osteoporos Int 2006;17(2):231–236.

35. Pannula .J, P.T.Jaatinen, P.Aarino, S.-L. Kivela et al. the impact of proximal Femur geometry on fracture type –A comparison between cervical and trochanteric fractures with two parameters. Scandinavian Journal of Surgery 97: 1,2008.

36. R.C. Siwach , S.Dahiya Anthropometric study of Proximal femur geometry and its clinical application, , IJO – 2003, vol 37, issue 4 pg 247- 251.

37. Dennis H Black, Mary L Bousexin, Lynn M Marshall, Steven Cummings, Proximal Femoral structure and prediction of hip fracture in Men. A large prospective study using QCT, Journal of Bone and Mineral Research vol 23 issue 8, 1326- 1333. Aug 2008.

38. Szulc P, Duboeuf F, Schott AM, Dargent-Molina P, Meunier PJ, Delmas PD: Structural determinants of hip fracture in elderly women: re-analysis of the data from the EPIDOS study. Osteoporos Int 2006;17(2):231–23

39. Mautalen CA, Vega EM, Einhorn TA: Are the etiologies of cervical and trochanteric hip fractures different? Bone 1996; 18(3 Suppl):133S–137S.

40. Center JR, Nguyen TV, Pocock NA, Noakes KA, Kelly PJ, Eisman JA, Sambrook PN: Femoral neck axis length, height loss and risk of hip fracture in males and females. Osteoporos Int 1998;8(1):75–81.

41. Flicker L, Faulkner KG, Hopper JL, Green RM, Kaymacki B, Nowson CA, Young D, Wark JD: Determinants of hip axis length in women aged 10–89 years: a twin study. Bone 1996; 18(1): 41–45.

42. Michelotti J, Clark J: Femoral neck length and hip fracture risk. J Bone Miner Res 1999;14(10):1714–1720 43. Bouxsein M: Biomechanics of age-related fractures. In: Marcus R FD, Kelsey J, editor. Osteoporosis 2 ed. San Diego: Academic Press; 2001. p. 509–534.

44. Partanen J, Jämsä T, Jalovaara P: Influence of the upper femur and pelvic geometry on the risk and type of hip fractures. J Bone Miner Res 2001;16(8):1540–1546.

45. Gnudi S, Ripamonti C, Lisi L, Fini M, Giardino R, Giavaresi G: Proximal femur geometry to detect and distinguish femoral neck fractures from trochanteric fractures in postmenopausal women. OsteoporosInt 2002;13(1):69–73.

46. Michelotti J, Clark J: Femoral neck length and hip fracture risk. J Bone Miner Res 1999;14(10):1714–1720

47. Bergot C, Bousson V, Meunier A, Laval-Jeantet M, Laredo JD: Hip fracture risk and proximal femur geometry from DXA scans. OsteoporosInt 2002;13(7):542–550.

48. Pulkkinen P, Partanen J, Jalovaara P, Jämsä T: Combination of bone mineral density and upper femur geometry improves the prediction of hip fracture. OsteoporosInt 2004;15(4):274–280.

49. Bouxsein ML, Karasik D: Bone geometry and skeletal fragility. CurrOsteoporos Rep 2006;4(2):49–56.

50. Pulkkinen P, Eckstein F, Lochmüller EM, Kuhn V, Jämsä T: Association of geometric factors and failure load level with the distribution of cervical vs. trochanteric hip fractures. J Bone Miner Res 2006;21(6):895–901.

51. Brownbill RA, Ilich JZ: Hip geometry and its role in fracture: what do we know so far? CurrOsteoporos Rep 2003;1(1):25–31.

52. Bouxsein ML, Karasik D: Bone geometry and skeletal fragility. CurrOsteoporos Rep 2006;4(2):49–56.

53. Sievänen H, Jozsa L, Pap I, Järvinen M, Järvinen TA, Kannus P, Järvinen TL Fragile external phenotype of modern human proximal femur in comparison with medieval bone. J Bone Miner Res 200;22(4):537–453.

CASE PROFORMA

Name : Case No.:

Age :

Sex :

IP/OP No :

Radiological I.D. :

Address :

Occupation :

Final Diagnosis :

D.O.A :

D.O.S :

D.O.D :

MODE OF INJURY

1. Domestic accidents :

2. Road Traffic Accidents :

3. Fall from height :

4. Miscellaneous :

MECHANISM OF TRAUMA

Direct injury :

Indirect injury :

HISTORY

1. History of present injury :
2. Duration :
3. History of previous injury if any :
4. Family history :

GENERAL EXAMINATION :

Pulse :

BP :

SYSTEMIC EXAMINATION :

1. CVS :
2. RS :
3. PA :
4. CNS :
5. Spine :
6. Pelvis :

LOCAL EXAMINATION :

1. Site of injury :
2. Deformity :
3. Wound if any :
4. Type of injury :
5. neurological complication :
6. vascular complication :

INVESTIGATIONS

Blood

Hb% :

Total Count :

Differential Count:

ESR :

Serum Calcium :

X – Ray

Pelvis with both hips – traction and internal rotation view.

MEASUREMENT DATA:

1. Hip axis length = mm
2. Femoral neck length = mm

after equilibrating,

3. adjusted Hip axis length = mm
4. adjusted Femoral neck length = mm

INFORMATION SHEET FOR THOSE WHO PLAN TO PARTICIPATE IN THIS PROJECT

NAME OF THE RESEARCH PROJECT: A prospective radiological study of proximal Femoral geometry and its relationshio in Hip fractures in South Indian population.

We welcome you and thank you for having accepted our request to consider whether you can participate in our study. This sheet contains the details of the study; the possible risks, discomfort and benefits for the participants are also given.

You can read and understand by yourself; if you wish, we are ready to read and explain the same to you.

If you do not understand anything or if you want any more details we are ready to provide the details.

Information to the participants:

What is the purpose of the study?

To know the differences in hip fractures by certain radiological measurements.

Who / where this study is being conducted?

This study is being conducted by _____ ____ Dr.M.Ashokkumar_____ a Post Graduate medical student belonging to _____ Orthopaedics_____ department under the guidance of Dr. R. Selvaraj.

Should I definitely have to take part in this study?

No. If you do not wish to participate you will not be included in this study. Also you will continue to get the medical treatment without any prejudice.

If I am participating in this study, what are my responsibilities?

You may have to follow some simple rules.

These are: co – operartion for taking aXray in particular position.

Are there any benefits for me / public?

Yes. __by better understanding between these two fracture pathologies in future people can forewarned about the risk of sustaining hip fractures.

Will there be any discomfort / risks to me?

No risks. But some discomforts may be there like giving few mls of blood for investigation, undergoing some medical examinations.

Will I be paid for the study?

No. you will not be paid.

Will my participating in this study, my personal details will be kept confidentially?

Yes, confidentiality will be maintained.

Will I be informed of this study's results and findings?

Yes, if you want you can get the details from us.

Can I withdraw from this study at any time during the study period?

Yes. You can withdraw at any time during the study period.

ஆராய்ச்சியின் பெயர்

A prospective radiological study of proximal Femoral geometry and its relationship in hip fractures in south Indian Population.

இந்த ஆராய்ச்சியை பற்றியமுக்கியமான தகவல்களை தெரிந்துகொண்டு, இதில் பங்கேற்க உங்கள் சம்மதத்தை தெரிவிக்குமாறு நாங்கள் விடுத்த வேண்டுகோளை ஏற்றுக்கொண்டமைக்கு நன்றி.இந்த ஆராய்ச்சி சம்மந்தமான தகவல்கள், இதில் பங்கு பெறுவதினால் உங்களுக்கு ஏற்படக்கூடிய அசௌகரியங்கள், பாதிப்புகள் மற்றும் நன்மைகள் அனைத்தும் இப்படிவத்தில் கொடுக்கப்பட்டிருக்கின்றன. இதை நீங்களாகவே படித்து தெரிந்து கொள்ளலாம் அல்லது நீங்கள் விருப்பப்பட்டால், நாங்கள் இதை உங்களுக்குபடித்துக்காட்டி புரியும்படி சொல்வதற்கு தயாராக இருக்கிறோம். உங்களுக்கு ஏதேனும் புரியவில்லை என்றாலும் அல்லது கூடுதல் தகவல்கள் ஏதேனும் தேவை என்றாலும் நாங்கள் உங்களுக்கு உதவ தயாராக இருக்கிறோம்.

ஆராய்ச்சியில்பங்குபெறவிரும்புபவர்களுக்கானதகவல்:

1. இந்த ஆராய்ச்சியின் நோக்கம் என்ன?

   To know the differences in hip fractures by certain radiological measurements.

2. இந்த ஆராய்ச்சி எங்குயாரால் செய்யப்படுகிறது?
   Stanleyமருத்துவமனையில்,
   _____Orthopaedics_____ மருத்துவத்துறையில் பட்ட மேற்படிப்புபடிக்கும் _Dr.M.Ashok Kumar _____ என்பவர் _____ என்கிற மருத்துவ மேலதிகாரியின் கண்காணிப்பில் இந்த ஆராய்ச்சியை செய்கிறார்.

3. இந்த ஆராய்ச்சியில்பங்கு பெறுவதற்கு என்னை தேர்ந்தெடுக்க நீங்கள் விருப்பப்படுவதன் காரணமென்ன?

   இந்த ஆராய்ச்சியில்பங்கு பெறுவதற்கு தேவையான அனைத்து தகுதிகளும் உங்களுக்குஇருக்கிறது.அதனால் இதில் பங்குபெற உங்கள் விருப்பத்தை கேட்கிறோம்.

4. இந்த ஆராய்ச்சியில் நான் கட்டாயம் பங்கு பெற வேண்டுமா?

இல்லை, இது உங்கள் விருப்பத்தை மட்டுமே பொறுத்தது. நீங்கள் விரும்பவில்லையெனில், உங்களை இந்த ஆராய்ச்சியில் ஈடுபடுத்தமாட்டார்கள். நீங்கள் இந்த ஆராய்ச்சியில்பங்கு பெறாவிட்டாலும், உங்களுக்கு கிடைக்க வேண்டியமருத்துவ உதவி, எந்த பாரபட்சமும்இல்லாமல் தொடர்ந்து கிடைக்கும்.

5. இந்த ஆராய்ச்சியில் நான் பங்கேற்க வேண்டுமானால், நான் எடுத்துக் கொள்ள வேண்டிய பொறுப்புகள் என்ன?

சில எளிய பொறுப்புகளை எடுத்துக் கொள்ள வேண்டியிருக்கும்;

6. இந்த ஆராய்ச்சியில்பங்கு பெறுவதினால் எனக்கோ, சமுதாயத்திற்கோ ஏதேனும் நன்மைகள் உண்டா?

உண்டு.

7. இந்த ஆராய்ச்சியில்பங்கு பெறுவதினால் எனக்கு ஏதேனும் அசௌகரியங்கள், பாதிப்புகள் ஏற்படுமா?

பாதிப்புகள் ஏதும் ஏற்பட வாய்ப்பில்லை.ஆனால், சில அசௌகரியங்கள் ஏற்பட வாய்ப்பிருக்கிறது.

8. இந்த ஆராய்ச்சியில்பங்கு பெறுவதற்காக எனக்கு ஏதேனும் சன்மானம்வழங்கப்படுமா?

இல்லை, சன்மானம் ஏதும் வழங்கப்பட மாட்டாது.

9. இந்த ஆராய்ச்சியில் நான் பங்கு பெறுவதையும், என்னை குறித்த விவரங்களையும் வேறு யாருக்கும் தெரியாமல்இரகசியமாக வைக்கப்படுமா?

ஆம், இரகசியமாக வைக்கப்படும்.

10. இந்த ஆராய்ச்சியின் முடிவுகள் எனக்கு தெரிவிக்கப்படுமா?

நீங்கள்விரும்பினால், எங்களிடம் பெற்றுக் கொள்ளலாம்.

11. இந்த ஆராய்ச்சியிலிருந்து, என் விருப்பத்திற்கேற்ப எந்நேரமும் நான் விலகிக் கொள்ள முடியுமா?

ஆம். உங்களுக்கு விருப்பமில்லையெனில் எந்நேரமும் விலகிக் கொள்ளலாம்.

FORM FOR GETTING INFORMED CONSENT FOR THOSE PARTICIPATING IN THE RESEARCH PROJECT

Name of the Research Project : A prospective radiological study of proximal Femoral geometry and its relationship in hip fractures in south Indian Population.

I _____ have been informed about the details of the study in own language.

I have understood the details about the study.

I know the possible risks and benefits for me, by taking part in the study.

I understand that I can withdraw from the study at any point of time and even then, I will continue to get the medical treatment as usual.

I understand that I will not get any payment for taking part in this study.

I will not object if the results of this study is getting published in any medical journals, provided my personal identity is not reviewed.

I know what I am suppose to do by taking part in this study and I assure that I will give my full co-operation for this study.

Signature/Thumb impression of the participant
(Name/Address)

_____

_____

Signature/Thumb impression of the witness (Name/Address)

_____

_____

Name & Signature of the investigator

_____

_____

ஆராய்ச்சியில்பங்குபெற ஒப்புதல் உறுதிமொழி அளிக்கும்படிவம்

ஆராய்ச்சியின் பெயர் _ A Prospective radiological study of proximal Femoral Geometry and its relationship in hip fractures in south Indian Population.

_____ என்கிற எனக்கு இந்த ஆராய்ச்சியைப் பற்றிய முழுவிவரங்களும் என் தாய்மொழியில் தரப்பட்டன.

இந்த ஆராய்ச்சியை பற்றி முழுமையாக தெரிந்து கொண்டேன்.

இதில் நான் பங்கு பெறுவதினால் எனக்கு ஏற்படக்கூடிய அசௌகரியங்கள் மற்றும் நன்மைகள்பற்றியும் தெரிந்து கொண்டேன்.

இந்த ஆராய்ச்சியிலிருந்து என் சுய விருப்பப்படி, எந்த நேரமும் விலகிக் கொள்ளமுடியும் என்றும், அதனால் இம்மருத்துவமனையில் எனக்கு கிடைக்கவேண்டியமருத்துவ உதவிகள் அனைத்தும் எந்த பாரபட்சமும் இல்லாமல் தொடர்ந்து கிடைக்கும் என்றும் தெரிந்து கொண்டேன்.

இதில் பங்குபெற எனக்கு எந்தவித சன்மானமும் தரப்பட மாட்டாது என்று புரிந்துகொண்டேன்.

இந்த ஆராய்ச்சியின் முடிவுகள், என்னைபற்றிய தனிப்பட்ட தகவல் ஏதும் தராமல் இருந்தால், மருத்துவம் சார்ந்த பத்திரிக்கைகளில் பிரசுரமாவதற்கு எதிர்ப்பு தெரிவிக்கமாட்டேன்.

இந்த ஆராய்ச்சியில் பங்குபெற நான் என்ன செய்ய வேண்டும் என்று தெரிந்து கொண்டேன்.அதன்படி முழு ஒத்துழைப்பு கொடுக்க தயாராக உள்ளேன்.

பங்கு பெறுபவரின் கையொப்பம் _____ தேதி _____

முகவரி : _____

_____

சாட்சியாளரின் கையொப்பம் _____ தேதி _____

முகவரி : _____

_____

ஆராய்ச்சியாளரின் கையொப்பம் _____ தேதி _____

INTRA CAPSULAR/NECK OF FEMUR FRACTURES

S.No.	Name	Sex	I.P. No.	age (yr)	FNL(cms)	HAL(cms)	NSA(deg)
1	Arokiasamy	M	15483	68	2.25	11.16	129.85
2	Govindhasamy	M	15485	78	2.52	11.88	129.79
3	Kalaiselvi	M	15842	48	2.16	11.52	119.85
4	Valliammal	M	15477	75	2	11.34	125.86
5	Kuppammal	F	23345	62	2.52	11.52	133.73
6	Rajammal	F	19490	70	2.88	10.53	128.87
7	Kondammal	F	2262	65	2.61	11.16	117.96
8	Valliyammal	F	19492	70	2.52	9.54	119.04
9	Padma	F	19059	65	2.43	9.81	121.65
10	Arumugam	M	19798	65	3.087	12.051	123.95
11	Ravi	M	19800	34	2.548	12.61	136.78
12	Dennis	M	19799	32	2.448	11.42	125.36
13	Valliyammal	F	19809	70	1.54	9.52	117.6
14	Hemachandran	M	20299	68	2.94	11.46	122.29
15	Yuvafenvick	M	20300	75	3.78	10.43	130.88
16	Florence	F	18700	62	2	10.34	121.44
17	Jayanathan	M	20302	65	2.34	11.6	124.52
18	Radhakrishnan	M	14008	58	2.025	11.5	122.43
19	Rajagopal	M	10159	58	2.86	11.69	124.52
20	Mani	M	22097	55	2.92	11.08	126.73
21	Maniyammal	F	18249	80	2.979	10.42	120.08
22	Noor Begam	F	23417	65	2.043	9.765	117.2
23	Krishnaveni	F	25774	67	2.07	9.9	133.61
24	Karpagam	F	22449	70	2.13	10.98	132.5
25	Ravi	M	2823	51	2.94	13.03	122.7
26	Sadaiyan	M	2824	65	3.31	13.04	118.9
27	Kannan	M	24416	63	2.4	11.31	124.82
28	Govindhan	M	25414	65	2.4	11.31	124.82
29	Mariyammal	F	26418	83	2.85	12.41	126.32
30	Krishnan	M	26514	72	2.34	9.67	123.54
31	Mathannamal	F	27614	80	1.8	9	120.18
32	Shanthi	F	26493	69	2.25	9.18	124.14
33	Padmavathi	F	28763	68	2.43	9.45	122.14
34	Srinivasan	M	29419	45	1.89	10	121.82
35	Munusamy	M	30546	75	1.89	9.72	125.45

36	Salima	F	30943	55	2.54	12.34	124.49
37	Sundari	F	31941	50	2.81	12.81	127.17
38	Thulasi	F	32946	70	2.42	12.6	125.89
39	Krishnasamy	M	32336	68	2.34	11.84	127.42
40	Bakthvachalam	M	34578	60	2.89	12.65	124.98
41	Malliga	F	34719	60	3.01	12.82	126.14
42	Vasanthakumari	F	36414	65	2.64	11.98	128.42
43	Vasavi	F	37818	62	2.98	12.78	125.42
44	Mannan	M	36519	38	3.13	13.5	132.14
45	Munnah	M	38917	58	2.54	12.1	124.82
46	Isakki	M	39416	65	2.83	11.89	124.52
47	Vasanthi	F	39517	63	2.54	11.56	127.3
48	Marappan	M	40243	65	2.34	11.42	126.42
49	Velu	M	41241	75	2.91	12.41	125.49
50	Vinayagam	M	42443	60	2.34	11.62	124.31
51	Elumalai	M	42549	73	2.8	12.2	126.32
52	Anbazhagan	M	43641	67	2.2	11.2	121.42
53	Muthayammal	F	45643	62	2.89	12.85	127.31
54	Panchavarnam	F	45949	63	2.54	11.98	124.81
55	Deivanayagi	F	44783	72	2.85	12.41	119.94
56	Uma Rani	F	43240	56	2.4	9.52	127.53
57	Appukutty	M	44946	72	2.81	12.11	124.14
58	Shantha	F	45411	80	2.81	12.11	119.94

EXTRA CAPSULAR/INTER TROCHANTERIC FRACTURES							
S.No.	Name	Sex	I.P. No.	age (yr)	FNL(cms)	HAL(cms)	NSA(deg)
1	kishore kumar	M	15478	45	2.4	12.6	120.56
2	sangan	M	15485	65	2.52	11.88	124.77
3	Muniyan	M	19485	45	2.7	12.7	125.78
4	Ravi	M	19487	37	2.8	12.6	129.26
5	Munirathnam	M	19488	45	2	11	124.72
6	Abraham	M	19048	75	1.8	10.8	124.72
7	Vasantha	F	19062	45	2.25	8.55	120.15
8	parvathi	F	19060	62	2.79	11.16	122.21
9	Rajeshwari	F	19061	65	3.87	10.53	122.05
10	Ponnusamy	M	19811	55	3.04	11.61	126.87
11	Halasingh	M	19812	78	3.53	12.71	120.44
12	Saraswathy	F	19808	50	2.31	10.65	119.66
13	Muniyammal	F	11540	83	2.01	9.675	120.58
14	Rajalakshmi	F	11554	45	2.73	9.504	125.56
15	Rani	F	12050	70	2.9	12.09	127.36
16	Mannan	M	23698	62	2.84	10.98	128.1
17	Kailash	M	24691	45	2.88	11.6	124.41
18	Sundharam	M	24694	54	2.826	11.25	127.32
19	Ravindran	M	24741	54	2.79	11.34	124.32
20	Prema	F	24786	56	2.61	10.08	129.32
21	leela	F	24821	50	2.6	10.2	126.31
22	Suresh	M	24946	46	3	11.61	126.43
23	Asirvatham	M	25041	56	3.2	11.52	126.44
24	Perumal	M	25114	55	2.79	11.52	126.5
25	Purushothaman	M	25241	52	2.88	11.34	124.32
26	Krishnasamy	M	25349	58	2.79	11.34	125.43
27	Madhivannan	M	25461	45	2.88	11.52	127.31
28	Shanmugam	M	25561	33	2.7	11.34	124.31
29	kuppan	M	25641	65	2.88	11.52	126.34
30	Krishnan	M	25621	75	2.52	10.88	127.41
31	Murugesh	M	25671	42	2.52	10.44	126.15
32	Vairam	M	28611	67	2.07	11.61	123.42
33	Perumalsamy	M	28741	56	2.16	11.52	125.61
34	Thameem	M	36781	45	2.79	11.7	128.42
35	Purushothaman	M	36882	65	2.52	11.61	124.53

36	Prathap	M	37816	54	2.88	11.79	126.61
37	Mohammad	M	38918	58	2.34	11.52	123.45
38	Kumar	M	39414	63	1.89	10.44	120.19
39	Kumudha	F	40141	69	1.8	9.54	121.59
40	Annamalai	M	42342	59	2.07	10.71	122.34
41	Hussaain	M	43411	63	2.52	11.52	124.39
42	Mannikkam	M	45461	56	2.07	10.62	126.31
43	Sardar	M	46414	45	1.98	10.44	120.41
44	Gandhiammal	F	48914	58	1.89	10.62	121.81
45	Suresh	M	47416	48	2.34	11.34	123.49
46	Punitha	F	48491	56	1.89	10.08	122.43
47	Pitchai	M	47512	63	2.34	11.52	124.32
48	Vijayan	M	49541	59	2.07	11.25	124.38
49	Pushparaj	M	49946	56	2.07	11.34	123.74
50	Shenbagam	F	50411	58	1.8	9.99	121.43
51	Saibudeen	M	51416	63	2.52	11.61	123.64
52	Dhandapani	M	52421	50	2.07	10.62	122.88
53	Kannan	M	53411	63	2.47	12.42	127.43
54	Kandhasamy	M	54614	58	2.52	11.52	126.39
55	Pachaippan	M	55611	60	2.61	9.54	121.38
56	Alagappan	M	57414	68	2.79	12.15	123.68
57	Pandiyan	M	58914	57	2.98	12.58	122.21
58	Dhannamal	F	58916	70	2.86	11.27	126.78
59	Babu	M	59194	62	3.01	12.71	126.19
60	Kasthuri	F	60411	65	3.06	12.53	131.73