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Radiological Morphometric Study of Angle of Inclination in Adult Human Femur from North India.

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ABSTRACT

Background: The femur is one of the long bones being thoroughly studied anatomically and has three parts; proximal, distal end and a long shaft. The angle between femur neck and angle with the long axis of shaft, are known as neck-shaft angle, collodiaphyseal angle, and also known as cervico-diaphyseal angle, angle of inclination, and femoral carrying angle, Neck – shaft angle is important regarding its stability, control of lateral balance, walking and facilitates hip movement. It varies with age, body structure, width of pelvis, being less in adult in persons short with limbs and in women. **Methods:** This cross-sectional study was conducted in the Department of Anatomy and department of radiology Government medical college Saharanpur, uttarprades, The antero-posterior view of pelvic radiograph taken from the Department of Radiology Government medical college Saharanpur, uttarprades.the70 samples were included in the study. **Results:** The mean right angle of inclination was 126.760±4.330 with range 1180-1350 and left angle of inclination was 128.100±5.340 with range 1180-1360. The overall angle of inclination was 127.420±4.530 with range 118.50-1350. **Conclusion:** The angle of inclination in adult human femur gives a basic structural and functional knowledge to prevent the abnormality with the help of orthopedic surgeon and society and mentian the stability, control of lateral balance, walking and facilitates hip joint movement, helpful to understand different aspect of clinical disease conditions, including changes in osteoporosis, common site of fracture, associated congenital anomalies as well as medicolegal cases.

Keywords: Angle of inclination, femur, morphometric.

1

INTRODUCTION

The femur is one of the long bones being thoroughly studied anatomically and has three parts; proximal, distal end and a long shaft. The angle between femur neck and angle with the long axis of shaft, are known as neck-shaft angle, collodiaphyseal angle, and also kown as cervico-diaphyseal angle, angle of inclination, and femoral carrying angle.[1] Neck – shaft angle is important regarding its stability, control of lateral balance, walking and facilitates hip movement. It varies with age, body structure,width of pelvis, being less in adult in persons short with limbs and in women.[2] The femur act as a brace and its bio-medical properties depend on width and length of the femoral length3.Mechanical stresses in the femoral appears to increase at three times the rate per decade of those males. With these results support to the hypo-thesis, the higher fracture rate in the elderly women is due, at least in parts, to evaluated levels of mechanical stress, resulting from a combination of greater bone loss and less compensating geometric restructuring with age.[4] Proximal femoral geometry is affected by different factors e.g. ethnicity, genetics and environmental con-ditions.[5] An increase (Coxavulga) or reduction (Coxavara) of neck shaft angle can imply pathology espe-cially hip fractures. The aged population is more prone to fracture of the femoral neck due to osteoporosis, however with an addition of the pathological neck shaft angle, the risks of the femur neck fracture is even greater.[6] After the trivial fall fractures of femoral neck are commonly seen in the elderly population. However, femoral neck fractures in adults younger than 50 years of age are uncommon and even after high-energy trauma, they account for only 2-3% of all femoral neck fractures.[7] Femoral neck fractures in young adults are usually associated with higher incidences of femoral head osteonecrosis and nonunion.[8,9] The rate of osteonecrosis reported in the literature ranges from 12-86%.[10] This devastating complication may accours due to collapse of the femoral head and

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subsequent osteoarthritis. Operative and salvage procedures such as osteotomy have high failure rates. Arthroplasty procedures are not ideal in the young patients.[11] While achieving an anatomic reduction, stable internal fixation is imperative. Other treatment variables, such as time of surgery, the role of capsulotomy and the fixation methods remain debatable. The knowledge of the treatment options and potential complications are beneficial to understanding and managing the fractures of femoral neck in young adults. Femoral shaft fractures accurse due to the result of possible multiple system injuries associated with high energy forces.[12] Fractures of the femoral diaphysis can be life-threatening on account of an open wound, fat embolism, adult respiratory distress syndrome (ARDS).[13] Or resultant multiple organ failure.[14] Major physical impairment accurse due to femoral shaft fractures, not because of disturbed fracture healing, but rather due to fracture shortening, fracture malalignment, or prolonged immobilization of the extremity by traction or casting in an attempt to maintain the femur fracture length and alignment during the early phases of healing. Even in the minor degrees of shortening and malalignment can eventuate in a limp and posttraumatic arthritis. The femoral fracture care is a art for constant balancing of the often conflicting goals of anatomic alignment and early functional rehabilitation of the limb.[15]

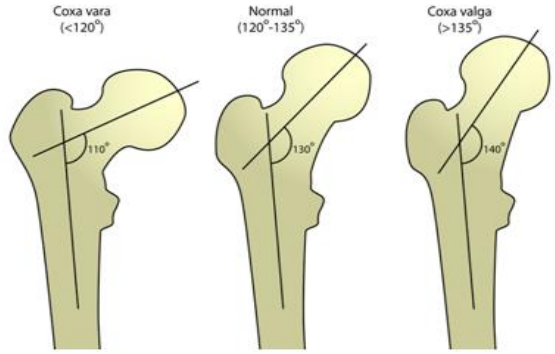

Figure 1: Shows the angle of inclination of adult human femur

The data are collected from anatomical study of femur bone serves helpful to understand different aspect of clinical disease conditions, including changes in osteoporosis, common site of fracture, associated congenital anomalies as well as medicolegal cases. The femur is the longest & strongest bone in the body. Its length is associated with a striding gait, its strength with the weight and muscular forces which it must withstand. Its shaft is almost cylindrical. It has a proximal rounded articular head projecting medially from its short neck. The femoral neck length is approximately 5cm long & connects the head to shaft at an average angle of 135o .This angle facilitates movements at the hip joint, enabling the limb to swing clear of the pelvis.[16] The neck shaft angle varies with age, stature & width of pelvis. When this angle >135o, condition is known as coxa valga. When angle <120o, it is known as coxa vara.[17] The angle of femoral neck is reduce with aging. In early infancy the neck shaft angle is about 150o, in childhood 140o, in adult about 125o and in elderly about 120o.[18]

The neck-shaft angle and angle of inclination also known as collo-diaphyseal angle (CDA) of femur is defined as the angle made by the long axis of shaft and the long axis of the upper anterior column. The angle is widest at birth and diminishes steadily until the adult condition is reached. It is less in female than in male, owing to the increased breadth of the lesser pelvis and greater obliquity of the shaft of the femur.[19]

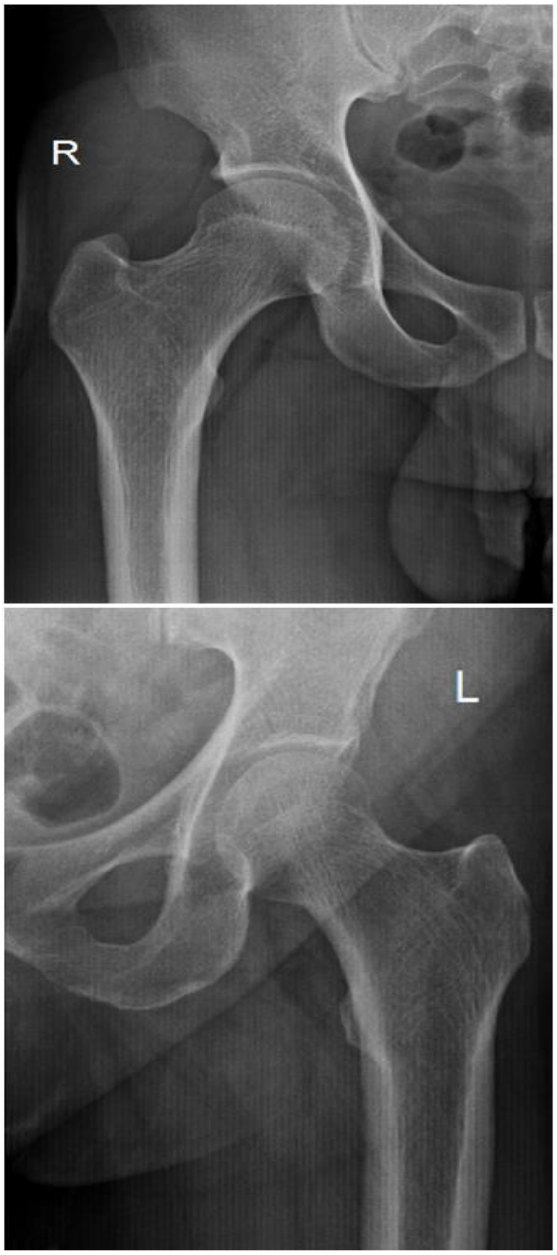

Figure 2 A & B: In X-ray the imaginary line Shows the angle of inclination in adult right and left human femur with articulation of acetabulum.

Aims and Objectiv

To determine the morphometric parameters as for angle of inclination in human adult femur and to find out any variation in the angle of inclination.

MATERIALS & METHODS

This cross-sectional study was conducted in the Department of Anatomy and department of radiology Government medical college Saharanpur, uttarprades, Ethical approval was given by the Institutional ethical committee and consent will be taken to the patients, The antero-posterior view of pelvic radiograph taken from the Department of Radiology Government medical college Saharanpur, uttarprades and than After taking the X-ray film, marked the inclined line on X-ray film along the long axis of the neck of femur and long axis of shaft of femur. Then the angle between long axis of neck of femur and long axis of shaft of femur was measured, The 70 samples of male and female, right and left femur were included in this study. The duration of study was May 2017 to august 2018 (15 month).

Inclusion Criteria

Patients with the age between 20 to 70 year, normal hip joint, with ought any trauma,

Exclusion criteria: - Age below the 20 year and above the 70 year, having osteoporosis, tuberculosis, heart disease

RESULTS

Table 1: Shows the distribution of angle of inclination. The mean right angle of inclination was 126.760±4.330 with range 1180-1350 and left angle of inclination was 128.100±5.340 with range 1180-1360. The overall angle of inclination was 127.420±4.530 with range 118.50-1350.

Side	Angle of inclination (0) (Mean±SD)	Range
Right	126.760±4.330	1180-1350
Left	128.100±5.340	1180-1360
Both	127.420±4.530	118.50-1350

Table 2: Shows the comparison of right side angle of inclination with age. The right side of angle of inclination was higher in the age group of 20-30 (127.520±4.300) than 41-50 (127.170±3.730), 31-40 (126.780±3.930) and >50 (125.130±5.190). However, the difference was statistically not significant (p>0.05).

Age in years	Right side angle of inclination (0) (Mean±SD)
20-30	127.520±4.300
31-40	126.780±3.930
41-50	127.170±3.730
>50	125.130±5.190
ANOVA p-value	0.40

Table 3: Shows the comparison of left side angle of inclination with age. The left side of angle of inclination was higher in the age group of 31-40 (129.080±5.730) than 41-50 (128.750±5.240), 20-30 (127.400±5.150) and >50 (125.930±5.180). However, the difference was statistically not significant (p>0.05).

Age in years	Left side angle of inclination (0) (Mean±SD)
20-30	127.400±5.150
31-40	129.080±5.730
41-50	128.750±5.240
>50	125.930±5.180
ANOVA p-value	0.35

Table 4: Shows the correlation among side of angle of inclination. There was significant (p=0.0001) positive correlation between left and right side of angle of inclination (r=0.75, p=0.0001).

		Right Angle	Left Angle	Both
Right Angle	Pearson Correlation	1.00	0.75**	0.92**
	p-value		0.0001	0.0001
Left Angle	Pearson Correlation	0.75**	1.00	0.94**
	p-value	0.0001		0.0001
Both	Pearson Correlation	0.92**	0.94**	1.00
	p-value	0.0001	0.0001	

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

About one third of the cases were between 20-30 years (35.7%) followed by 31-40 (25.7%), >50 (21.4%) and 41-50 (17.1%) years. The mean age of the cases was 39.01 ±1 (4.79) years. More than half (52.9%) of the cases were males. In a study (Akbar and Kalimullah, 2015),[20] out of the total of 91 cases, 55 (60.4%) were male and 36 (39.6%) were female with mean age 58.24 (6.49).

The angle is widest in infancy, and becomes lessened during growth, so that at puberty it forms a gentle curve from the axis of the body of the bone. In the adult, the neck forms an angle of about 125° with the body, but this varies in inverse proportion to the development of the pelvis and the stature. The angle decreases during the period of growth, but after full growth has been attained it does not usually undergo any change, even in old age; it varies considerably in different persons of the same age.

In the female, in consequence of the increased width of the pelvis, the neck of the femur forms more nearly a right angle with the body than it does in the male. It is smaller in short than in long bones, and when the pelvis is wide. In addition to projecting upward and medial ward from the body of the femur, the neck also projects somewhat forward; the amount of this forward projection is extremely variable, but on an average is from 12° to 14°.

In the present study, the mean right angle of inclination was 126.760±4.330 with range 1180-1350 and left angle of inclination was 128.100±5.340 with range 1180-1360. The overall

angle of inclination was 127.420±4.530 with range 118.50-1350. The results of this study is in agreement with the study by Hartel et al (2016) ,[21] in whcih the calculated median angle of inclination was 122.2° (range 100.1–146.2°, IQR 117.9–125.6°). Akbar and Kalimullah (2015)20 showed that the mean neck – shaft angle of both sides of female population were significantly higher than male (rig-ht side p = 0.009, left side (p = 0.05). The mean left neck – shaft angle of the total population was higher than right side (p = 0.05).

CONCLUSION

The angle of inclination in adult human femur gives a basic structural and functional knowledge to prevent the abnormality with the help of orthopedic surgeon and society and mentian the stability, This method allows three-dimensional evaluation of the anatomical structure of the hip joint and may be useful in predicting progression of coxarthrosis by measuring the femoral neck shaft and anteversion angles, control of lateral balance, walking and facilitates hip joint movement, helpful to understand different aspect of clinical disease conditions, including changes in osteoporosis, common site of fracture, associated congenital anomalies as well as medicolegal cases.

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