Section: Anatomy

Original Research Article

MORPHOMETRIC STUDY OF PROXIMAL END OF DRY HUMAN FEMUR IN NORTH INDIAN POPULATION AND ITS CLINICAL SIGNIFICANCE

Chawla S[1], Kumar M[2], Ashima[3], Hasan S[4], Arora N[5] Kaushik V[6], Singla M[7]

[1,6,7]*Demostrator, Department of Anatomy, SHKM GMC Nalhar, Nuh, Haryana, India.*
[2]*Associate Professor, Department of Anatomy, SHKM GMC Nalhar, Nuh, Haryana, India.*
[3,4]*Professor, Department of Anatomy, SHKM GMC Nalhar, Nuh, Haryana, India.*
[5]*Professor & Head, Department of Anatomy, SHKM GMC Nalhar, Nuh, Haryana, India.*

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Corresponding Author:
Dr. Mahesh Kumar,
Associate Professor
Department of anatomy
SHKM GMC Nalhar, Nuh, Haryana, India.
Email: 00drmahesh@gmail.com

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ABSTRACT

Background: Total hip anthroplasty is a commonly performed study these days. The hip joint is subjected to daily stress as it bears the weight of the upper body. Osteoarthritis of the hip may cause irreversible damage. Proximal geometry of the femur, like neck shaft angle and torsion, is important in designing prostheses for a specific population.

Materials and Methods: Present study was a descriptive cross sectional study on 50 Dry femora (25 right and 25 left) which were randomly obtained from the Department of Anatomy, Shaheed Hasan Khan Mewati Government Medical College, Mewat, Haryana during the period of August 2022 to December 2022. We included dried, intact and non-pathological femurs and femur with tumor, fracture, trauma and any pathological abnormality were excluded. Anthropometric instruments like Osteometric board, Digital Verneir caliper, Goniometer were used for measurements of parameters.

Results & Conclusion: The accuracy and success of the hip replacement surgery demands complete knowledge of the morphometry of the proximal femur which is highly specific among the races, region and gender.

Keywords: Femur neck length, neck shaft angle, morphometry.

INTRODUCTION

The anatomical knowledge of femur bone is important to understand different clinical disease conditions such as common site of fracture, changes in osteoporosis, associated congenital anomalies as well as medico-legal cases.[1]

The femur is the longest and strongest bone. It has upper end, shaft and lower end. The upper end consist of head, neck, greater and lesser trochanters. The shaft is almost cylindrical bowed forward. Head projecting medially from its short neck which articulate with acetabulum and form hip joint. The distal end of femur is expanded transversally and presents two condyle that articulate with tibia. The neck shaft angle of femur is formed by femoral shaft axis and femoral neck. The angle facilitate movement at hip joint to swing the limb clear of pelvis.[2]

Prevalence of hip osteoarthritis, fracture neck femur and other hip joint ailments are increasing day by day. Arthroplasty is the definite treatment for these patients.[3]The length of the femur is associated with a striding gait and its strength with the weight and muscular forces it is required to withstand.[4]

The proximal end consists of the head, neck, and greater and lesser trochanters. The spheroidal head of the femur articulates with the acetabulum of the hip bone to form the hip joint and lies within the joint capsule. The head presents a small, rough depression posteroinferior to its center, called the fovea. The femoral neck is approximately 5 cm long and connects the head to the shaft at the neck-shaft angle, which measures around 127° on average. The neck-shaft angle facilitates movement at the hip joint, enabling the limb to swing clear of the pelvis. The neck also provides a lever for the action of the muscles acting about the hip joint, which are attached to the proximal femur. The neck is laterally rotated with respect to the shaft to around 10-15°, called the angle of anteversion, which has been

found to vary between individuals and populations.[5]

It is often seen that major sources of evidence collected from crime scenes, burial grounds, sites of an explosion, and archaeological excavations are usually unknown fragmented skeletal remains. Stature estimation from such incomplete fragments of bone is a crucial step in determining the personal identity of the individual during such scientific investigations.[6,7]The neck of femur has functionally modified due to the erect posture of humans.[8]

The angle created by the longitudinal axis of the neck with the longitudinal axis of the shaft of femur bone is termed as neck shaft or collo-diaphysial angle. The neck shaft angle ranges from 115° to 140°, and an average of 126° in adults. When the angle >135°, condition is known as coxa valga. When angle <120° called as coxa vara. The collodiaphysial angle decreases with aging.[9]This angle of neck shaft allows the limb to swing clear of the pelvis during movements at the hip joint.[10] It is highest in infants decreases gradually with age,[11] and the angle is greater in males than females.[12]

MATERIAL AND METHODS

Present study was a descriptive cross sectional study on 50 Dry femora (25 right and 25 left) which were randomly obtained from the Department of Anatomy, Shaheed Hasan Khan Mewati Government Medical College, Mewat, Haryana during the period of August 2022 to December 2022. We included dried, intact and non-pathological femurs were included and we excluded femur with tumor, fracture, trauma and any pathological abnormality. Anthropometric instruments like Osteometric board, Digital Verneir caliper, Goniometer were used for measurements of parameters.

Femoral Length (FL):- It is the maximum distance between the upper end of head of femur and lowest point on femoral condyle. Femoral length were measured with the help of osteometric board.

Femoral Neck Length (FNL):- It is the distance between base of femoral head and intertrochanteric line at the junction of front of neck and shaft. Femoral neck were with the help of sliding caliper.

Neck Shaft Angle (NSA):- The neck shaft angle is formed by axis of neck with the axis of shaft. NSA were measured with the help of goniometer. Axis of neck is formed by the line joining the two center point on front of neck and the axis of shaft is formed by the two center point on front of shaft.

Femoral Head Diameter (FHD):- FHD was the distance in a straight line between the upper end to the lower end of the femoral head in cranio caudal axis.

Femoral Neck Thickness (FNT):- FNT was thickness of neck of femur in antero posterior axis.

Femoral Neck Diameter (FND):- FND was the distance in a straight line from upper end to the lower end of the anatomical neck of femur in craniocaudal direction.

Femoral Head Offset (FHO):- FHO was the horizontal distance among the center of femoral head to the axis of femoral shaft.

Vertical Offset (VO):- VO was the vertical distance between proximal extent of lesser trochanter to the center of femoral head.

Discriptive analysis, Student t- test and pearson correlation coefficient were perfomed with the help of SPSS software.

Figure 1: Neck Shaft Angle (NSA)

Figure 2: femoral Neck Length (FNL)

Figure 3: Femoral Head Diameter (FHD)

Figure 4: Femoral Neck Thickness (FND) AP Axis

Figure 5: Femoral Neck Diameter (FND) in craniocaudal axis

RESULTS

Table 1

Group Statistics						
Side of femur		**N**	**Mean**	**Std. Deviation**	**Total (Bones)**	**p-value**
FEMUR LENGTH (cm)	Right	25	41.060	1.544	41.03±1.64	0.8980
	Left	25	41.000	1.750		
FEMUR NECK LENGTH(mm)	Right	25	28.183	3.708	27.41±5.37	0.3130
	Left	25	26.638	6.611		
NECK SHAFT ANGLE(°)	Right	25	124.000	4.164	125.14±4.47	0.0700
	Left	25	126.280	4.542		
FEMUR HEAD DIAMETER (mm)	Right	25	42.258	3.244	42.02±3.77	0.6540
	Left	25	41.775	4.277		
FEMUR NECK THICKNESS(mm	Right	25	24.951	2.236	24.93±2.98	0.9620
	Left	25	24.910	3.617		
FEMUR HEAD OFFSET(mm)	Right	25	45.064	4.459	45.71±4.2	0.2850
	Left	25	46.343	3.891		
VERTICAL OFFSET (mm)	Right	25	54.689	5.505	54.2±6.33	0.5890
	Left	25	53.709	7.141		
FEMUR NECK DIAMETER (mm)	Right	25	31.225	2.370	30.54±3.52	0.1660
	Left	25	29.8400	4.31000		

Table 2

Correlations									
		FL (cm)	**FNL (mm)**	**NSA (°)**	**FHD (mm)**	**FNT (mm**	**FHO (mm)**	**VO (mm)**	**FND (mm)**
FEMUR LENGTH (cm)	Pearson Correlation	1	-0.029	0.050	0.490**	0.260	0.316*	0.214	0.285*
	Sig. (2-tailed)		0.842	0.731	<0.0001	0.069	0.026	0.135	0.045
	N	50	50	50	50	50	50	50	50
FEMUR NECK LENGTH(mm)	Pearson Correlation	-0.029	1	-0.136	0.515**	0.290*	0.258	0.072	0.537**
	Sig. (2-tailed)	0.842		0.346	<0.0001	0.041	0.070	0.618	<0.0001
	N	50	50	50	50	50	50	50	50
NECK SHAFT ANGLE(°)	Pearson Correlation	0.050	-0.136	1	0.079	0.060	-0.282*	0.179	-0.005
	Sig. (2-tailed)	0.731	0.346		0.584	0.681	0.047	0.213	0.972
	N	50	50	50	50	50	50	50	50
FEMUR HEAD DIAMETER (mm)	Pearson Correlation	0.490**	0.515**	0.079	1	0.578**	0.413**	0.351*	0.756**
	Sig. (2-tailed)	<0.0001	<0.0001	0.584		<0.0001	0.003	0.013	<0.0001
	N	50	50	50	50	50	50	50	50
FEMUR NECK THICKNESS (mm	Pearson Correlation	0.260	0.290*	0.060	0.578**	1	0.214	0.002	0.721**
	Sig. (2-tailed)	0.069	0.041	0.681	<0.0001		0.136	0.988	<0.0001
	N	50	50	50	50	50	50	50	50

FEMUR HEAD OFFSET(mm)	Pearson Correlation	0.316*	0.258	-0.282*	0.413**	0.214	1	0.251	0.384**
	Sig. (2-tailed)	0.026	0.070	0.047	0.003	0.136		0.078	0.006
	N	50	50	50	50	50	50	50	50
VERTICAL OFFSET (mm)	Pearson Correlation	0.214	0.072	0.179	0.351*	0.002	0.251	1	0.347*
	Sig. (2-tailed)	0.135	0.618	0.213	0.012	0.988	0.078		0.014
	N	50	50	50	50	50	50	50	50
FEMUR NECK DIAMETER(mm)	Pearson Correlation	0.285*	0.537**	-0.005	0.756**	0.721**	0.384**	0.347*	1
	Sig. (2-tailed)	0.045	<0.0001	0.972	<0.0001	<0.0001	<0.0001	0.014	
	N	50	50	50	50	50	50	50	50
**. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.05 level (2-tailed).									

DISCUSSION

There are over 80000 hip joint replacement occur annually worldwide considerably over past few years.[13] It is expected that total hip arthroplasties has been grown by 174% by the year 2030.[14] In India over the last decade around 2500 total hip arthoplasties have been performed on yearly basis.[15] Fractures occur worldwide each year will reach 6.26 million by 2050.[16] An accurate assessment of femoral head diameters with considerations of regional variations becomes indispensable for total hip replacement.[4]

The length of the femur contributes to 27% of the individual's stature. The mean femur length of our study found to be 41.03 ±1.64. the mean femur length in Gupta M. study was found to be 42.11±2.91cm. this is consistent with the findings of kulkarni M et al and Verma M et al,who observed it to be 41.95±2.85 cm respectively.[18,19]

In this study the mean neck length of femur was 28.18 and 26.638 mm in right and left respectively. The Chaudhary20 et al study from Karnataka and Sundar,[9] et al from South India found that neck length of femur 28.8 ±2.85 and 28.8±4.0 for right and left Femur and 28.8 and 31.8 for right and left femur respectively.

Present study showed the measurement of Neck shaft angle to be 125.14 ± 4.4º while the study of Skaria,[21] et al showed the measurements as the mean value of NSA of total 300 femur were found to be 128.55±6.99º. It shows the side different variations from the other studies.

Present study found the measurement of femur head diameter as 42.02±3.77 while Prasath RA and Ismail BM observed that Femur head diameter in south Indian population was 41.98±1.98 mm.

Clinical Implications

The importance of anatomical knowledge of human femur is important to understand the clinical condition of femur like changes in osteoporosis, common site of fracture, medico-legal importance, many other congenital anomalies. The neck shaft angle of femur varies with age, habits and genetic makeup in different ethnic group, so it may be possible that the anthropometric dimensions of proximal end of femur for northern group is different from that of the Indian population.

CONCLUSION

Researchers found that femur morphometry vary according to age, gender, race, regional customs and ethnicity. Skeletal parameters of Indian population are different from other regions globally. Proxiomal femur morphometry shows significant relation among European, Asian and African populations. FHO, VO, FNL and FHD are the determinable parameters hence they are responsible for designing the Hip prosthesis.

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