Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 8 (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Morphometry Of Neck-Shaft Angle And Neck Length Of Femur And It's Correlations: A Cross Sectional Study

Shivani Chawla[1*], Prachi Saffar Aneja[2], Susmita Saha[3], Bhavesh Kumar[4], Yamini Sharma[5], Ruchika Yadav[6]

[1*]PhD scholar, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Budhera, Gurugram, Haryana, India- 122505.
[2]Professor and Head, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Budhera, Gurugram, Haryana, India- 122505.
[3]Professor, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Budhera, Gurugram, Haryana, India- 122505.
[4]Tutor& PhD scholar, Department of Anatomy, Parul Institute of Medical Sciences & Research, Parul University, Vadodara, Gujarat, India- 391760.
[5,6]Tutor, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Budhera, Gurugram, Haryana, India- 122505

***Corresponding Author**:
Shivani Chawla
PhD scholar, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Gurugram, Haryana, India- 122505

Cite this paper as: Shivani Chawla, Prachi Saffar Aneja, Susmita Saha, Bhavesh Kumar, Yamini Sharma, Ruchika Yadav (2025) Morphometry Of Neck-Shaft Angle And Neck Length Of Femur And It's Correlations: A Cross Sectional Study. *Journal of Neonatal Surgery*, 14 (8), 775-780

ABSTRACT

BACKGROUND: Total hip replacement is a very common procedure nowadays. The hip joint is under constant tension as it carries the weight of the upper body. Osteoarthritis does not cause any damage to the hip joint. Designing a prosthesis for a specific ethnic group requires consideration of the femoral neck-shaft angle, neck length geometry, etc.

AIM & OBJECTIVES: Study was aimed to estimate parameters of neck-shaft angle and neck length of right and left femur and correlate the above parameters among them.

MATERIALS AND METHOD: Present study was a descriptive cross sectional study on 50 Dry femurs (25 right and 25 left) which were randomly obtained from the bone bank of Department of Anatomy, FMHS, SGT University. Dry, undamaged, and non-pathological femurs were included in the study; femurs with tumours, fractures, trauma, or any other pathological abnormalities were excluded. Measurements were taken using anthropometric tools such as a goniometer, digital Verneircalliper, and osteometric board.

RESULTS: To compare the morphometric parameters in accordance of right and left femur, student 't' test was performed and it was found that comparison of all parameters of both side femur bones was not statistically significant. Second objective of this study, observed that femur length is not significantly correlated with Femur Neck Length and Neck-Shaft Angle.

CONCLUSION: These parameters can be used inaccuracy and success of the hip replacement surgery demands complete knowledge of the neck shaft angle. The values obtained were greater in western world than in present study. So, the regional variations were found among different regions of world. This study will applaud biomechanical engineers to manufacture and build the implants with accurate morphometric data to suit Indian population and for enhance surgical consequences with prevention of complications.

Keywords: Femur neck length, total hip arthroplasty, Neck shaft angle..

1. INTRODUCTION

Understanding the anatomy of the femur bone is crucial for interpreting a variety of clinical illness states, including common fracture locations, osteoporosis alterations, associated congenital deformities, and medico-legal issues[1]. The neck shaft angle of the femur is made up of the femoral neck and femoral shaft axis. By facilitating hip joint mobility, the angle enables the

limb to swing away from the pelvis[2].

Hip osteoarthritis, neck femur fractures, and other hip joint disorders are getting more prevalent every day. The best course of treatment for this patient is arthroplasty[3].The femur's strength is correlated with the weight and muscle forces it must sustain, and its length is associated with a striding gait[4].

Neck shaft or collo-diaphysial angle refers to the angle formed by the neck's longitudinal axis and the shaft of the femur bone. The neck shaft angle varies from 115° to 140°, with an average of 126° in adults. When the angle exceeds 135°, the condition is known as coxa valga. Coxa vara refersto an angle of less than 120°. Age causes a reduction of collodiaphysial angle [5]. This neck shaft angle permits the limb to swing away from the pelvis during hip joint movements[6]. It is highest in neonates and gradually declines with age[7], with males having a higher angle than females[8].Our study aimed to evaluate the parameters of neck-shaft angle and femur neck length of right and left femur and correlate the above parameters among them.

MATERIALS AND METHODS:

Study population & design- Descriptive cross - sectional study.Dry femora 50 (25 right and 25 left) which were randomly obtained from the Department of Anatomy at Faculty of Medicine &Health Sciences, SGT University, Budhera, Gurugram, Haryana.

Inclusion criteria: Cadaveric dry human femurs.

Exclusion criteria: Femur bone with visible osseous pathologies like tumors, deformities, fractures, trauma, etc

Measurement of parameters

Following parameters of proximal end of femur were measured:

Femoral Length (FL):-It is the maximum distance between the highest end of head of femur and lowest point on femoral condyle. An osteometric board was used to measure femoral length.

Femoral Neck Length (FNL):-It is the distance between the base of the femoral head and the intertrochanteric line where the shaft and neck meet. Femoral neck was measured with the help of digital vernier caliper (Fig 1)..

Fig 1: Showing the measurement of femoral Neck Length (FNL)

Neck Shaft Angle (NSA):-The axis of the neck and the axis of the shaft combine to generate the neck shaft angle. A goniometer was used to measure NSA. The line connecting the two centre points on the neck and the two centre points on the shaft forms the axis of the neck and the shaft, respectively. (Fig 2).

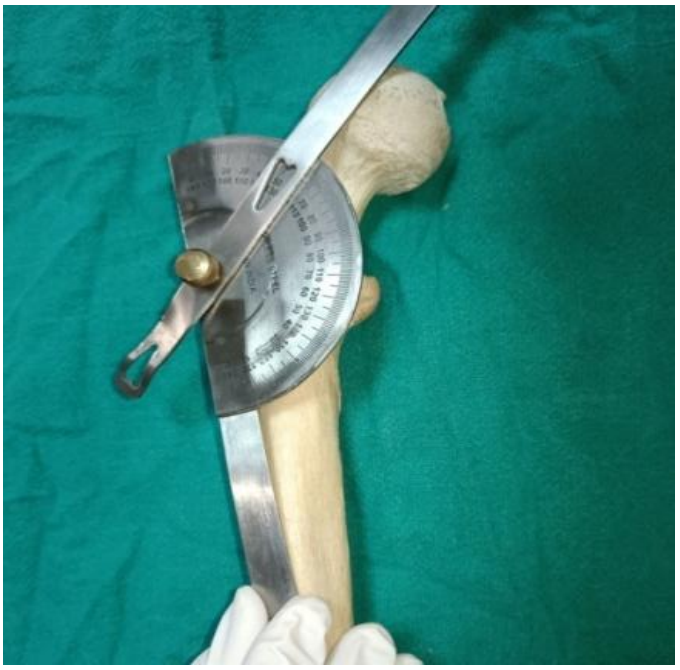


Fig 2: Showing the measurement of Neck Shaft Angle (NSA)

STATISTICS: Discriptive analysis, Student t- test and pearson correlation coefficient were perfomed with the help of Statistical package for the Social sciences SPSS software (Version 21.0). The mean and standard deviation was calculated. Student t test was used to compare the means and p value <0.05 was considered as statistically significant. Pearson correlation analysis between the femur length and other femoral parameters and p value <0.05 was considered as statistically significant. The graphs and tables were created in Microsoft Excel and Microsoft Word 2007.

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

* Correlation is significant at the 0.05 level (2-tailed).

RESULTS: In present observational study, the mean femur length and femur neck length showed 41.46±0.53 and 28.17±0.48 for total bones while the mean of neck shaft angle was 124.04±0.47. The level of significance of side difference between the means done by student 't' test. Since there was no significant side difference in parameter of right and left femora (Table/fig. 3).

Side of femur		N	Mean	SD	Total (Bones)	p-value
FL (cm)	Right	41.61	0.52	0.10383	41.46±0.53	0.083
	Left	41.3368	0.51916	0.10383		
FNL (mm)	Right	28.1904	0.48735	0.09747	28.17±0.48	0.855
	Left	28.1652	0.47991	0.09598		
NSA (°)	Right	124.0896	0.47881	0.09576	124.04±0.47	0.495
	Left	123.9964	0.47916	0.09583		

Table/Fig 3:Descricptive analysis of morphometric parameters of right and left femur (n=50).

FL: Femur length, FNL: Femur neck length, NSA: Neck shaft angle, FND: Femur neck diameter. It was found that comparison of all parameters of both sided femur bone was not statistically significant.

		FL (cm)	FNL (mm)	NSA (°)
FL (cm)	PC	1	0.138	-0.116

	Sig. (2-tailed)		0.339	0.424
	N	50	50	50
FNL (mm)	PC	0.138	1	0.173
	Sig. (2-tailed)	0.339		0.231
	N	50	50	50
NSA (°)	PC	-0.116	0.173	1
	Sig. (2-tailed)	0.424	0.231	
	N	50	50	50

Table/Fig4: PC:Pearson correlation, FL: Femur length, FNL: Femur neck length, NSA: Neck shaft angle.

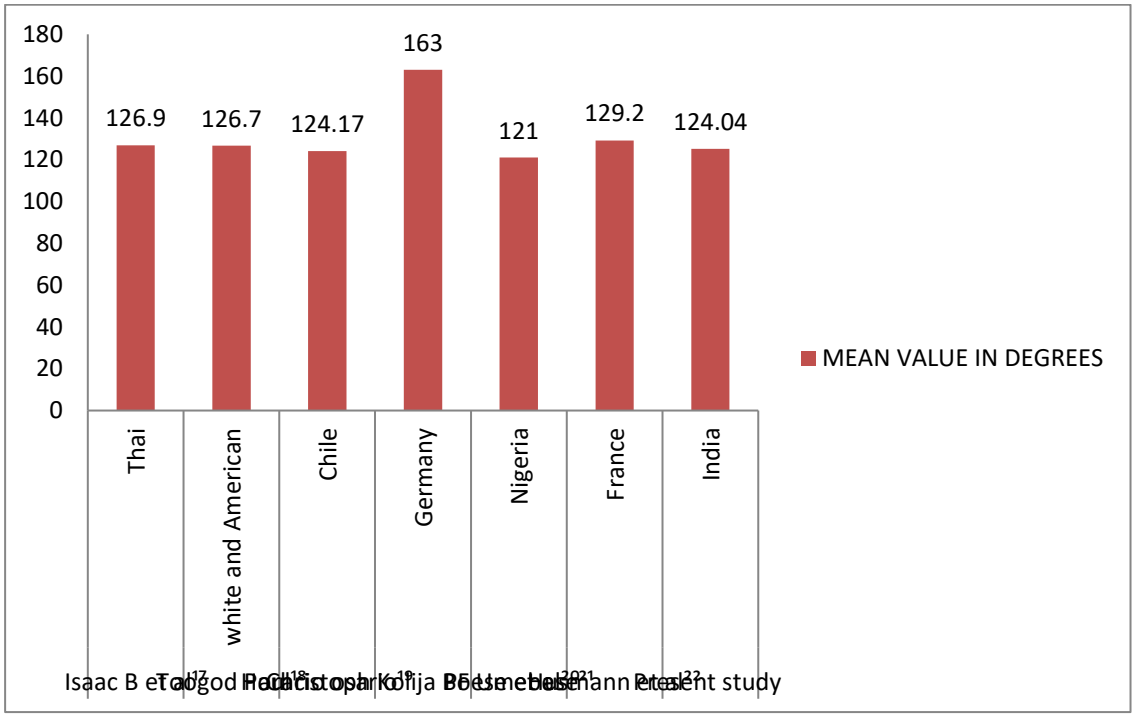
It was observed that femur length was not significantly correlated with FNL, NSA.It was observed that femur length was not significantly correlated with FNL, NSA.

2. DISCUSSION

Over 80,000 hip joint replacements are performed globally each year, a significant increase over the last several years[9]. By 2030, it is anticipated that the overall number of hip arthroplasties would have increased by 174%[10]. Over the past ten years, between 100 and 2500 hip arthroplasties have been carried out annually in India[11]. The number of fractures that occur globally each year is expected to reach 6.26 million by 2050[12].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[13]. The mean femur length of our study found 41.46±0.53. The mean femur length in Gupta M. study was found to be 42.11±2.91 cm. 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 and 42.82±2.87 cm, respectively[14,15].

In this study, the mean neck length of femur was 28.19 and 28.16 mm in right and left respectively. The Chaudhary[16] et alstudy from karnatka and Sundar[9] et alfrom South India found that the neck length of femur 28.8±3.3 and 28.8±4.0 for right and left femur and 28.8 and 31.8mm for right and left femur respectively.



Graph/Fig5: Showing the comparison of Neck Shaft Angle in various studies, population and region.

Implant	Value in Degrees
Dynamic hip screw (DHS)	125-155
Commonly used DHS	135
Condylar blade plate	95-130
Commonly used condylar blade plate	95-110
Present study	124.04

Table/Fig6: Showing comparison of NECK SHAFT ANGLE with commonly used implants[23]

The neck-shaft angle is reduced with age. In early infancy it is about 150°, in adults it is about 125° and in elderly about 120°. The clinical importance of neck-shaft angle of femur lies in the diagnosis, treatment and follow up the fractures of neck of femur. The neck-shaftangle is increased in dislocation of hip congenital subluxation, cerebral palsy, poliomyelitis and idiopathic scoliosis and decreased in posttraumatic coxavara due to malunited neck of femur and inter trochantric fracture and morphometry of neck-shaft angle varies in different regions due to climate, diet, heredity and other geographical factors related to lifestyle[23].

3. CONCLUSION

Neck-shaft angle plays very crucial role for better comprehension of clinical and pathological state of hip joint and its replacement.

In present study, the mean in neck shaft angle of right and left femur was 124.04°, in right femora 124.08° and in left femora it was 123.99° ($p > 0.05$). So, there was no significant difference between mean of right and left femora. The values were compared with the previous reported literature and the values were compared with different dimensions of commonly used implants in the field of orthopaedics. The values obtained showed greater in western world than present study. So the regional variations were found among different regions of world. This study will applaud biomechanical engineers to manufacture and build the implants with accurate morphometric data to suit Indian population and for enhance surgical consequences with prevention of complications.

REFERENCES

[1] Krishan Kant Choudhary, Margaret Roshni Dhan, Neck Shaft Angle of Femur and Its Clinical Implications, JMSCR, 2020;8(1):971-974.

[2] Subhash Gujar, Sanjay Vikani, Jigna Parmar, K V Bondre. A correlation between femoral neck shaft angle to femoral neck length. IJAR;2013:04(05).

[3] Minakshi Verma, Sheetal Joshi et al, Morphometry of Proximal Femur in Indian Population, Journal of Clinical and Diagnostic Research. 2017;11(2):01-04.

[4] Mayank Gupta, Deepa Devdas et al Morphometric Analysis of the Proximal Femur With Its Clinical Correlation in Eastern Uttar Pradesh Region, Cureus, 2020; 14(9): e28780.

[5] Sundar G & Sangeetha V. Morphometric study of human femur. Ind Jr of Med Research and Pharma Sciences. 2018;5(3):52-55.

[6] Peter E L, Pavani Marapaka. Examination evaluation and statistical analysis of human femoral anthropometry in Hyderabad and Secunderabad regions, India. Ind Jr of Clin Anat and Phy. 2016;3(4);427-432.

[7] Shakil Mohamad Khan, Shaik Hussain Saheb. Study on neck shaft angle and femoral length of south Indian femurs. Int J Anat Res. 2014;2(4):633-635.

[8] Mahesh Vemavarapu, Jyothinath Kothapalli, Vijayendranath, Kulkarni. Estimation of collo-diaphyseal angle of femur by Martin's dioptrograph: a comparative study. Int J Anat Res 2016;4(1):1772- 1776.

[9] Granger C, Schutte HD, Bigger SB, Kennedy JM, Latour RA. Failure analysis [12] of composite femoral component for hip arthroplasty. J Rehab Res Develop. 2003;40:131-46.

[10] Kurtz S, Ong K et al Projections of primary and revision hip and knee arthroplasty in the United States frm 2005 to 2030. I Bone Joint Surg Sm.2007, 89:780-785.

[11] Vaidya SV, Jogani AD et a: India joining the world of hip and knee registries: present status- A leap forward. Indian J Orthop. 2021, 55:46-55.

[12] Cooper C, Compaion G et al, 3rd: Hip fractures in the ederly: a world wide projection. Osteoporos Int. 1992, 2:285-289.

[13] Giard j: femoral head diameter considerations for primary total hip arthropasty. OrthopTraumatol Surg res. 2015,101:25-29.

[14] Kulkarni M, Naik A M, Shetty CB, Paruthikunnan SM, Rao SK, CT based measurement of anatomical dimensions of femur and its relevance in nail designs for proximal femoral fractures. J Orthop. 2020;20:63–69.

[15] Verma M, Joshi S, Tuli A, Raheja S, Jain P, Srivastava P, Morphometry of proximal femur in Indian population.. J Clin Diagn Res. 2017;11:01-04.

[16] Chaudhary PN, Shirol VS, Virupaxi RD. A morphometric study of femoral length, anterior neck length, and neck-shaft angle in dry femora: A cross-sectional study. Indian J Health Sci Biomed Res 2017;10:331-4.

[17] Issac V, Prasad J, et al. Prediction of the femoral neck-shaft angle from the length of the femoral neck. Clin Anat. 1997;12:444-50.

[18] Toogood PA, Skalak A. Cooperman proximal femoral anatomy in the North-eastern region population. Clin OrthopRelat Res. 2009;467:867-85.

[19] Horacio O, Karl S. Proximal femoral epiphysis anatomy in Chilean population. Orthopaedic and forensic aspects. Int Jour of morphology. 2012;30(1):258-62.

[20] Kolja BC The modified femoral neck-shaft angle: age and sex-dependent reference values and reliability analysis. Journal of Biomedical research International. 2006; 86475627:7.

[21] Umebese PF, Adeyekun A, Moin M. Radiological assessment of femoral neck-shaft and anteversion angles in adult Nigerian HIPS. Niger Postgrad Med J. 2005 Jun;12(2):106-9.

[22] Husmann O, Rubin PJ, Leyvraz PF, et al. Three- dimensional morphology of the proximal femur J Arthroplasty, 1997;10:318-23.

[23] Suresh NM, Sunitha R, et al. morphometric study of femoral neck-shaft angle in Kolar population and its clinical significance. Indian Anat., 2019;8(3):226-232...