ORIGINAL RESEARCH PAPER

Anatomy

A COMPARATIVE STUDY OF NECK SHAFT ANGLE OF FEMUR IN CENTRAL INDIAN POPULATION

Vivek Kumar — Phd Scholar, Department Of Anatomy, RKDF Medical College Hospital & Research Center, Bhopal (M.P.).

Vivekanand Murlidhar Gajbhiye* — Professor & Head RKDF Medical College Hospital & Research Center, Bhopal (M.P.). *Corresponding Author

ABSTRACT

BACKGROUND: In the fields of forensics, anthropology, orthopaedics, and human kinematics, the thigh bone femur is widely studied. The clinical significance of the femoral neck shaft angle lies in the diagnosis, treatment and monitoring of femoral neck fractures, trochanteric fractures, slipped upper femoral epiphysis, and hip developmental dysplasia. **OBJECTIVE:** The present study was conducted to compare the NSA disparity between femurs on both sides and to compare the NSA with the Western and Indian population sizes of different regions. This research therefore leads to Indian data on these parameters. **MATERIALS AND METHODS:** A total of 150 (75 right and 75 left) dry femur were used for measuring the neck shaft angle. Unpaired t-test was used to compare right and left femora. **RESULTS:** The mean value of neck shaft angle was 126.04±5.05°. It ranges between 1130 to 1360. The mean value of right side was 125.92±4.9° and left side was measured 127.43±5.2°. There was no significant correlation between right and left neck shaft angle. **CONCLUSION:** The mean left femoral neck shaft angle was higher than the right femoral shaft in the present analysis, but the values were not statistically important. The angle of the neck shaft was lower than most studies in the Western population, but it was similar to most other studies in India. In the Indian population, geographical variations in the angle of the neck shaft also occur. In the field of orthopaedic surgery and anthropometry, this research will be of benefit.

INTRODUCTION

In forensics, anthropology, orthopaedics and human kinematics, the thigh bone femur is widely studied. In order to design and produce intramedullary fixators and identify the axes for orthopaedic surgery, the joint studies in orthopaedic research include proximal femur morphometric analysis[1]. The femoral neck is the major functional alteration after human erect bipedal posture is achieved. Many authors have investigated the angle of the neck shaft, including Hasimoto M[2], Humphrey WH[3], Kate BR[4], Parson PG[5], Singh PI[6] and Siwach RC[7]. The neck shaft angle of the femur is clinically relevant in the diagnosis, care and follow-up of femoral neck fractures, trochanteric fractures, and developmental dysplasia of the hip. The hip joint femoral mobility depends on the angle of the neck shaft since it holds the neck and head more perpendicular in the neutral position to the acetabulum. The longer the femoral neck or the greater the angle of the neck shaft, the greater the bending movement that operates on the femoral neck, the greater the risk of femoral fracture[8]. The lower angle of the neck shaft may result in greater chances of trochanteric pain syndrome (GTPS) in females[9,10] and is said to be predisposed to stress fractures[11]. One of the significant diagnostic criteria used to diagnose femoral neck fracture is the main discrepancy in the NSA[10]. The popular implants used for the surgical treatment of proximal femoral fracture are those intended for the western population, where biomechanical and constitutional factors differ from those of the Indian population[12]. According to Siwach and Noble PC, in the case of complete hip arthroplasty, the design and dimensions of the femoral portion should conform to the anatomy of the femur[7, 13]. Siwach et al contrasted the femoral parameters with those of regions in the Western region[7]. They indicated that the implants were overweight and their angles and orientations were not up to the mark, which could possibly lead to problems such as splintering and fractures[7].

OBJECTIVE

The present study was conducted to compare the NSA disparity between femurs on both sides and to compare the NSA with the Western and Indian population sizes of different regions. This research therefore leads to Indian data on these parameters.

MATERIALS AND METHODS

A total of 150 (75 right and 75 left) normal adult dry femora without any gross deformities or damage obtained from the anatomy department of various colleges of Madhya Pradesh and this analysis was performed at RKDF Medical College Hospital & Research Center, Bhopal (M.P.). No measurement was made of sex and bone age. The femoral neck shaft angle: first, the neck axis was calculated by a thread dividing the anterior surface of the neck into two equal upper and lower halves. The axis of the shaft was outlined with the same thread in the mid-sagittal plane over the anterior surface of the shaft and the angle was determined by a Goniometer (**Figure-1**).
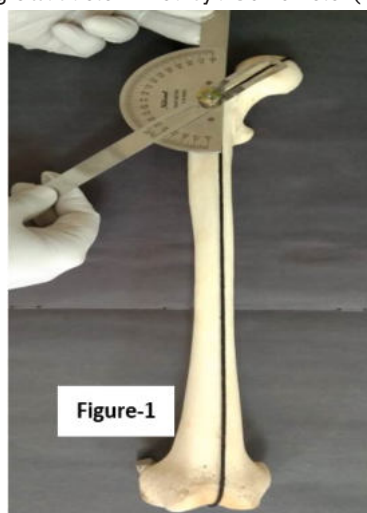

Figure-1

The findings obtained after the dry femora NSA calculation were tabulated and SPSS (version 20.0) was used to perform statistical analysis. For comparison of right and left femora, the unpaired t-test was used. For NSA, the mean value obtained was 126.04°. The mean value of NSA in the right femur was 125.92° and 127.43° on the left side with a standard deviation of 4.9° and 5.2°, respectively. The NSA range lies between 113° and 136°. No substantial lateral difference between the right and left femora was found. There was no substantial difference between the right and left side of the unpaired t-test in both NSA (P>0.05) findings.

Table-1. Showing the results of parameters (n=150 femurs)

Parameter		Right side	Left side	Total (n=150)	P-value
NSA in degrees	Mean ±SD	125.92±4.90	127.43±5.20	126.04±5.050	P>0.05
	Range	1130-1350	1190-1360	1130-1360	

DISCUSSION

In the present analysis, the mean neck shaft angle is 126.04°. Our findings among western workers were comparable to the results of authors who studied the British population, i.e. Parsons et al (126.3°), Reikeras O et al (127.7°) for the population of Norway, Otsianyi et al (127.56°) for Nairobi and Da Silva et al (122.55° on the right and 125.61° on the left). The mean NSA of the current study was lower than most studies in the West. Whereas Umebese PF et al (121°) recorded lower values for the Nigerian population; Rubin et al (122.9°) reported lower values for the French population, Macho (121.9°) for the South African population, and Noble (124.7°) for the American population (Table 2).

Table-2. Comparison of NSA with Western studies (T-Total, M-male, F-female, R-right, L-left)

Authors	Year	Region	Mean (degree)
Parsons et al[5]	1924	British	126.3°±5.1°
Hoaglund FT et al [19]	1980	England Chinese	136.0° 135°
Reikeras O et al[20]	1982	Norwegian	127.7°±7.6°
Noble et al[13]	1988	American	124.7°±7.4°
Rubin et al[21]	1992	French	122.9°±7.6°
Da Silva et al[14]	2003	Brazilian	Right-122.55°± 4.9° left-125.61°± 6.6°
Bulandra AM et al[22]	2003	Poland	140.48°±6.95°
Umebese PF et al[30]	2005	Nigerian	121°±6°
Toogood PA et al[23]	2008	American	129.2°±6.2°
Otsianyi[8]	2011	Nairobi	127.56°±3.75°
Present study	2019	Central India	Total-126.04°±5.05° Right -125.92°±4.9° Left- 127.43°±5.2°

In the central Indian area (Table 3), the current research was conducted and the mean NSA 126.04° is comparable to most other Indian studies. Whereas KC Saikia et al[15] reported an average neck shaft angle of 139.5° from the population of the north-east, Shakil M khan et al[16] reported 137.1° from the region of southern India, and Subhash Gurjar et al[17] reported 136.3° from the region of western India, higher values were all reported from the present analysis. In the Punjab area, author Kaur P et al[18] recorded a lower NSA value of 121.39° on the right side and 121° on the left side, which is comparatively less than the current analysis.

Table- 3. Comparison of NSA with Indian studies (T-Total, M-male, F-female, R-right, L-left)

Authors	Year	Population	NSA
Isaac B et al[24]	1997	Vellore	126.7°
Siwach RC et al[7]	2003	Rohtak	123°±4.3°
Saikia KC et al1[15]	2008	Guwahati	139.5°±7.5°
Deshmukh TR et al[25]	2010	Vidarbha	131.5°
Ravichandran D et al[12]	2011	Chennai	126.55°
Rawal et al et al[26]	2012	Indian	124.42°±5.49°
Kaur P et al[18]	2013	Ludhiana	L-121°±2.44° R-121.39°±2.46°
Subhash gujar et al[17]	2013	Gujarat	T-136.3±6° L-136.6±5.45° R-136±6.68°
Santanu B et al[27]	2014	Kolkata	R-125.12±2.22° L-124.96±1.93°
Shakil M. khan et al[16]	2014	Karnataka	T-137.1°, R-137.3 L-136.9°

Roy et al[28]	2014	Eastern Indian	T-130.57±3.0° M-131.0 (L-130.99±3.77°; R-130.89±3.61°) F-130.37°, (L:130.2±2.56°; R-129.93°±3.82°)
Lakshmi V et al[29]	2016	Rajasthan	124.95°±6.09°
Present Study	2019	Madhya Pradesh	126.04°±5.05°

CONCLUSION

Given the above-mentioned significance of the femoral angle of the neck shaft, this analysis was carried out using anatomical methods to examine the angle and its variations with respect to the hand. The mean neck shaft angle value for the left femora was higher than that of the right femora in the present sample, but the values were not statistically significant. The NSA was smaller than most Western studies, but it was close to most other Indian studies as well. NSA was comparably higher than our studies in a few Indian studies. There are also regional NSA differences in the Indian population. In the field of orthopaedic surgery and anthropometry, this research will be of benefit.

REFERENCES

[1] Ho-Jung Cho, Dai-Soon Kwak, and In-Beom Kim. Morphometric Evaluation of Korean Femurs by Geometric Computation: Comparisons of the Sex and the Population. BioMed Research International Volume 2015, Article ID 730538, 9pages.
[2] Hasimoto M. Ethnologic studies of Chinese. Journal of Oriental Medicine 1938;29:3234.
[3] Humphrey WH. The angle of the neck with the shaft of the femur at different periods of life and under different circumstances. J. Anat&Physio 1958; 23: 273.
[4] Kate B.R. The angle of the femoral neck in Indians. Eastern Anthropologist 1967;20:54.
[5] Parson P.G. The characteristics of the English thigh bone. J.Anat&Physio 1914; 48 : 238 267.
[6] Singh P.I, Bhasin M.L. Antropometry 1st Edn; Delhi, Educational Publishers and Booksellers ; 1968, pp 142.
[7] Siwach RC, Dahiya S. Anthropometric study of proximal femur geometry and its Clinical Application. Indian Journal of Orthopaedics 2003;37(4):247-251.
[8] Otsianyi WK., Naipanoi AP, Koech A. The femoral collodiaphyseal angle amongst selected Kenyan ethnic groups. J. Morphol. Sci., 2011, vol. 28, no. 2, p.129-131.
[9] Jiang N, Peng L, Al-Qwbani M, Xie GP, Yang QM, Chai Y, Zhang Q, Yu B. Femoral version, neck-shaft angle, and acetabularanteversion in Chinese Han population: a retrospective analysis of 466 healthy adults. Medicine (Baltimore). 2015May;94(21):891.
[10] Tian TP, Chen Y, Leow WK, Hsu W, Howe TS and Png MA. Computing Neck-Shaft Angle of Femur for X-Ray Fracture Detection. NMRC2000.
[11] OrlinFilipov. Femoral Neck Fractures – Biological Aspects And Risk Factors. Journal of IMAB - Annual Proceeding (Scientific Papers) 2014, vol. 20, issue4.
[12] Ravichandran D, Muthukumaravel N, Jaikumar R, Das H, and Rajendran M. proximal femoral geometry in Indians and its clinical applications. J. Anat. Soc. India 2011;60(1) : 6-12.
[13] Noble PC, Alexander JW, Lindahl LJ, et al. The anatomic basis of femoral component design. ClinOrthopRelat Res. 1988:148–165(235).
[14] Da Silva VJ, Oda JY, Sant'ana DMG. Anatomical aspects of the proximal femur of adults brazilians. Int. J. Morphol., 21(4):303308,2003.
[15] Saikia KC, Bhuyan S, Rongphar R. Anthropometric study of the hip joint in Northeastern region population with computed topography scan. Indian J Orthop 2008;42:260- 6.
[16] Shakil Mohamad Khan, Shaik Hussain Saheb. Study on Neck Shaft Angle and Femoral Length of South Indian Femurs. Int J Anat Res 2014,Vol2(4):633-35.
[17] Subhash Moolchand Gujar, Sanjay Vikani, Jigna Parmar, K V Bondre A study of neck shaft angle in the North- west Indian population on radiographs International Journal of Basic and Applied Medical Sciences ISSN: 2277-2103(Online).
[18] Kaur P, Mathew S and George U. A Study Of Neck Shaft Angle In The North- West Indian Population On Radiographs. International Journal of Basic and Applied Medical Sciences ISSN:2277-2103.
[19] Hoaglund FT, Low WD. Anatomy of the femoral neck and head, with comparative data from Caucasians and Hong Kong Chinese. ClinOrthopRelat Res. 1980 Oct;(152):10-6.
[20] Reikeras O, Hoiseth A, Reigstad A, et al. Femoral neck angles: a specimen study with special regard to bilateral differences. ActaOrthop Scand.1982;53:775–779.
[21] Rubin PJ, Leyvraz PF, Aubaniac JM, et al. The morphology of the proximal femur. A three-dimensional radiographic analysis. J Bone Joint Surg Br. 1992;74:28– 32.
[22] Bulandra AM, Gielecki JS, Leciejewska I, Karaszewski P, Siero□ D. Digital-image analysis of the femoral shaft/neck angle in human foetuses. Folia Morphol (Warsz). 2003Nov;62(4):415-7.
[23] Toogood PA, Skalak A, Cooperman DR. Proximal femoral anatomy in the normal human population. ClinOrthopRelat Res.2009;467:876–885.
[24] Isaac B. Neck Shaft Angle of Femur (thesis). Vellore : Tamil Nadu Dr. MGR Medical University; 1993.

[25] Deshmukh TR, Kuthe AM, Ingole DS, Takre SB. Prediction of femur bone geometry using anthropometric data of Indian population: A numerical approach. J. Med Sci 2010;10(1);12-18.

[26] Rawal B, Ribeiro R, Malhotra R, et al. Anthropometric measurements to design best-fit femoral stem for the Indian population. Indian J Orthop.2012;46:46–53.

[27] Santanu Bhattacharya, PitbaranChakraborty, Dr. Anindya Mukherjee. Correlation between neck shaft angle of femur with age and anthropometry: A radiographicstudyIndianJournalofBasicandApplied Medical Research; June 2014:Vol.-3, Issue- 3, P. 100-107.

[28] Roy S, Kundu R, Medda S, et al. Evaluation of proximal femoral geometry in plain anterior-posterior radiograph in eastern-Indian population. J ClinDiagn Res. 2014;8:C1–C3.

[29] Verma M, Gupta S, Ghulyani T, and Jaiswal P. A digital image analysis method for measuring femoral neck shaft angle and anteversion angle: A pilot study. Indian Journal of Clinical Anatomy and physiology.2016 July; 3(3):362-369.

[30] Umebese PF, Adeyekun A, Moin M. Radiological assessment of femoral neck-shaft and anteversion angles in adult Nigerian HIPS. Niger Postgrad Med J. 2005;12:106–109.