

Evaluation of femoral neck-shaft angle and its clinical significance in Telangana State

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Abstract

Background: Femoral Neck shaft angle (NSA) is the angle formed between the long axis of shaft and long axis of neck of femur. NSA of femur is an important parameter considering the biomechanics of hip joint. The clinical significance of the femoral NSA lies in the forensic science, anthropology, radiological diagnosis and orthopedic surgeries.

Objective: Objective of the study was to find out the neck shaft angle of femur and its clinical significance in Telangana population and correlate with the previous Indian study.

Materials and Methods: A total of 120 (60 right and 60 left) dry femur bones were used for measuring the neck shaft angle. Mean value and Unpaired t-test was used to compare right and left femora.

Results: The mean value of neck shaft angle was $129^{\circ} \pm 3.86^{\circ}$. It ranges between 117 to 139. The mean value of right side was 131.5° and left side was measured 132.4° . Mean NSA in male was 130.28° whereas in female 131.42° . There was no significant difference statistically between them.

Conclusion: It is important for medical practitioners to know the normal Morphometric values as well as regional variations of Femur in order to understand and treat different disorders of the Femur and hip joint. Findings of our study can be useful in designing femoral implants for south central India population for various hip joint surgeries

Keywords: Neck-shaft angle, femur bone, Right NSA, Left NSA

Introduction

The femoral neck-shaft angle (NSA) also known as caputcollum-diaphyseal (CCD) angle or inclination angle or the Mikulicz angle is the measurement of the angle formed between the oblique oriented neck with the vertical shaft of the femur and is an important anatomic measurement for the evaluation of biomechanics of hip ^[1]. This angle varies with age, sex,

race, dominant and non-dominant leg or development of femur. The neck shaft generally ranges from the angle of 115° to 140° at an average of 126° in adult ^[2].

Measurement of femoral neck-shaft angle is essential in anthropological and medico-legal practice, to radiologists, rheumatologists and orthopaedic surgeons for diagnosis and planning of treatment ^[3]. The neck shaft angle has an important role in gait as it clears femoral shaft off the pelvis during the swing phase ^[4]. The neck shaft angle in the various pathological condition of the hip and femur and also important in surgeries that involve the neck of femur, intertrochanteric fractures various osteotomies used in Perthes disease, slipped capital femoral epiphysis, during all types of osteotomies used in developmental dysplasia of hip, neuromuscular disorders of lower limb and during total Hip arthroplasty ^[5, 6]. To correctly assess the Neck-shaft angle, highly standardized anteroposterior radiographs are mandatory to avoid projectional errors of the projected NSA caused by hip rotation ^[7]. The effect of internal and external hip rotation is an over estimation of the NSA (i.e., vulgarization), while flexion does lead to an underestimation (i.e., variation) ^[8]. The NSA is one of the main diagnostic criterions that clinicians use to detect the probability of femoral neck fracture in a subject as coxa valga (More than 140° NSA) is associated with a femoral neck fracture. It also helps in designing suitable implants with more accurate angulations of the femur neck ^[9]. Since built, physique, habits and genetic makeup vary in different ethnic group, so it is possible that anthropometric dimensions of proximal end of femur for western region is different from Indian population ^[10].

Aim of the present study was planned to measure the Neck-Shaft Angle (NSA) of Femurs and its clinical relevance in Telangana population.

Materials and Methods

The present study was conducted on 120 dry human femurs bones, obtained from department of anatomy and department forensic medicine of Kakatiya Medical College, Warangal and also Government medical college, Ramagundam, Telangana. India. Femur bone with prominent pathological changes or damaged bones were excluded from the study. Neck shaft angle is defined as the angle between the long axis of shaft and the long axis of neck of femur. The angle was measured with the Instruments like linear metallic scale, ordinary measuring tape and simple protractor and the angle was noted. The measurements of neck-shaft angle of all bones were taken with both anterior and posterior views.

The long axis of neck was drawn by taking two points, one at the center of head and other at the upper end of the midpoint of the narrowest part of the neck. Then joined the two points, this line represents the axis of the neck. Long axis of shaft was drawn by taking two mid-points of shaft, one at the upper end of shaft and other at the lower end of shaft, the two points were joined and same line was extended at the upper end to cut the long axis of neck. The angle at the meeting point of the two threads is determined using a transparent protractor and the value is recorded.



Fig 1: Femur Neck shaft angle (NSA)

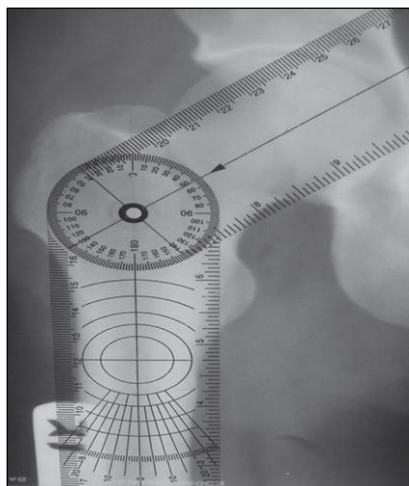


Fig 2: Measurement of the Right femoral neck shaft angle

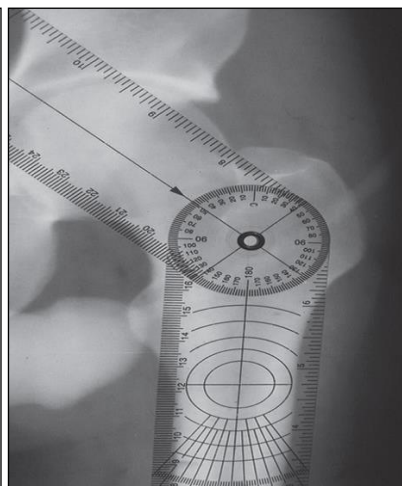


Fig 3: Measurement of the left femoral neck shaft angle

Results

In this study, neck shaft angle was measured and recorded in 120 femur bones. Among 120 femurs, 72 were classified as male and 48 were female. The minimum angle measured was 117° and maximum angle was 139° . The mean neck shaft of all femurs was $129^{\circ} \pm 3.86$. The mean neck shaft angle in male was $130^{\circ}.28$ and in female was $131^{\circ}.42$. Neck shaft angle was slightly greater in female bones than male bones. The mean right-side neck shaft angle was 126.8 ± 3.68 and mean left side was 126.2 ± 3.82 . The mean neck shaft angle for total population was 128.60 .

Table 1: Mean femoral neck shaft angle distribution of according to side

Side of femur	Maximum NSA	Minimum NSA	Total	P-Value
Mean NSA (Right)	131.8	130.6	131.5	0.82
Mean NSA (Left)	132.7	131.3	132.4	

Table 2: Mean femoral neck shaft angle distribution according to gender

Gender	Mean NSA	Maximum NSA	Minimum NSA	P-Value
Male	$130^{\circ}.28$	138°	117°	0.0614
Female	$131^{\circ}.42$	139°	119°	
Total	$130^{\circ}.38$	138°	118°	

Table 3: Comparison of neck shaft angle with previous Indian studies

Authors	Year	Population	Method	Mean NSA
Sinha RR <i>et al.</i> ^[11]	2017	Bihar	Dry bones	130.82
TR Deshmukhet <i>al.</i> ^[12]	2010	Vidarbha	X- ray	131.5
Amithet <i>al.</i> ^[13]	2017	Mangalore	Dry bones	122.2
Aparna <i>et al.</i> ^[14]	2017	Andhra Pradesh	Dry bones	121
Radha Pujari <i>et al.</i> ^[15]	2015	Raichur	Dry bones	127.5
Aruna N <i>et al.</i> ^[16]	2019	Kolar	Dry bones	128.5
Present study	2022	Telangana	Dry bones	130.38

Table 4: Comparison of Right and Left neck shaft angle with previous Indian studies

Authors	Year	Population	RightNSA	LeftNSA
Dhivyaet <i>al.</i> ^[17]	2015	South Indian	132.66	135.02

Gujar Set <i>et al.</i> ^[18]	2013	Indian	136.6	136.6
Khan and Saheb <i>et al.</i> ^[19]	2014	South Indian	137.3	136.9
Choudhary <i>et al.</i> ^[20]	2020	Bihar	133.63	134.34
Agrawa <i>et al.</i> ^[21]	2022	Raipur	133.8	132.8
Present study	2022	Telangana	131.5	132.4

Table 5: Comparison of neck shaft angle in male and female with previous Indian studies

Authors	Year	Population	NSA in Male	NSA in Female
Bagaria <i>et al.</i> ^[22]	2012	South Indian	127.7	126.6
Pathak SK <i>et al.</i> ^[23]	2016	Gujarat	129.26	126.62
Roy <i>et al.</i> ^[24]	2014	Eastern Indian	131.0	130.37
Rajeev V Joshi, <i>et al.</i> ^[25]	2021	Madhya Pradesh	128.0	128.0
Rani Nallathamby, <i>et al.</i> ^[26]	2013	South Indian	132.3	132.8
Gattu PK <i>et al.</i> ^[27]	2018	Kerala	127.48	127.52
Present study	2022	Telangana	130.28	131.42

Discussion

Variations in neck shaft angle have been found in different studies and this can be attributed to varying level of activity, genetics, race, diet and lifestyle. Despite lot of research in the anatomic and biomechanical factors which influence the modality of treatment of orthopedics conditions, consideration of neck shaft angle has been critically importance in assessment of hip biomechanics and preoperative planning and templating of hip surgeries.

In this study, the mean neck-shaft angle of femur bones was observed 130.38 which falls under the range given by most of the studies (117 to 140),

Almost similar findings of mean NSA have been reported in many previous studies in the our country and neighboring Countries, Sinha RR *et al.* ^[11] TR Deshmukhet *et al.* ^[12] Aruna Net *et al.* ^[16] Verma *et al.* ^[28] and Shrestha Aet *et al.* ^[29], conducted in Kathmandu, Nepal, whereas quite lower value of NSA reported by Nadia Ahmad *et al.* ^[30], Mukherjee, *et al.* ^[31] Sharma & Lal *et al.* ^[32] and Siwahet *et al.* ^[33] and very high value of mean NSA as reported by Rajendran *et al.* ^[34], GO *et al.* ^[35] and Ahmed Zaghlouet *et al.* ^[36].

Present study shows no significant difference of neck shaft angle between right and left femur bone as p-value is greater than 0.05. The angles with right and left femur bones are measured with mean angles 131.5 and 132.4 Respectively. These values are low as compared to the mean values of right and left NSA showed by Gujar S *et al.* ^[18], khan & sahib *et al.* ^[19] which has presented the mean value of 136.6 and 137.0 respectively. Concordance finding was reported by Choudhary *et al.* ^[20] and Agrawal *et al.* ^[21]. Many other Indian studies observed quite lower value of mean NSA of right and left femur like: Aparna *et al.* ^[14], Mukherjee, *et al.* ^[31] and Bharathi *et al.* ^[37].

In our study the mean neck shaft angle for males were 130.28 degree and for females were 131.42 degree, statistically no significant difference ($P > 0.05$) slightly higher value of NSA as observed in female as compared to the male, our finding was comparable with the Sinha RR *et al.* ^[11] and Rani Nallathamby *et al.* ^[26] also find little higher value of mean NSA in female, dissimilar to that many studies like Adekoya Cole *et al.* ^[38], Pathak SK *et al.* ^[23], Roy *et al.* ^[24] reported male has higher value of mean NSA than female.

Conclusion

The present study was analysed NSA of dry femur bones belonging to south Indian population. The neck shaft angle of adult femur bone of Telangana people was found quite similar to other regions of India. Mean NSA was little higher in female and left side femur bones, but there is no significant difference statistically. Evaluation of NSA play critical role

in the field of orthopaedic surgery and Anthropometry.

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