www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 71.58
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v6i5.181

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Original Article

Study of Neck-Shaft Angle of Adult Femur in Relation to Sex and Bilateral Asymmetry in Population of Bihar

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Abstract

Background: *The femoral neck shaft angle (NSA) is an angle between the long axis of shaft and long axis of neck of femur. It is formed between the obliquely oriented neck of femur with the vertical shaft of femur. Measurement of femoral neck shaft angle is an important parameter for evaluation of biomechanics of hip joint. Variation in neck-shaft angle has been noted among different age, sex and ethnicity. Though, more detail studies are required to significantly establish the variation among different sex. The normal range of neck-shaft angle varies from 120˚– 145˚ with an average value of 135˚[1,2]. Although, it is stated in various literature that neck shaft angle is lower in females, that ranges between 119˚ – 137˚[3]. Objective of this study was to find out the neck shaft angle of femur among adult population of Bihar in relation to sex and side and its comparison with previous studies*

Materials and Methods: *Present study was conducted on 62 dry skeletal collections of human femora collected from Osteology section of different medical colleges of Bihar from October 2016 to February 2017. The femoral neck shaft angle was measured by hand-held 360˚ goniometer.*

Results: *Neck-shaft angle was measured in 62 dry skeletons of femur. Among which, 33 were determined as male and 29 were determined as female. Out of 62 femurs, 32 were of right side and 30 were of left side. The results of present study are neck shaft angle of femur was 136.55˚ ± 5.23mm. Male femoral neck shaft angle was 140˚ ± 1.27mm and female femoral neck shaft angle was 132.62˚ ± 5.26mm. Neck shaft angle of right femur was 136.78˚ ± 5.16mm and, that of left femur was 136.3˚ ± 5.38mm. A significant difference in male and female neck shaft angle was found. However, no any statistically significant difference in right and left mean neck shaft angle was observed.*

Conclusions: *Female neck shaft angle was lower than male neck shaft angle. A considerable difference was measured in neck-shaft angle among, male and female viz. Male NSA > Female NSA. However, the NSA findings for bilateral asymmetry showed no statistically significant difference for the sample size studied.*

Keywords: *Neck-shaft angle, Femur, Angle of inclination, caput-collum-diaphyseal (CCD) angle, Mikulicz angle.*

Introduction

The femur is the longest and strongest bone of the body that lies in the thigh. It measures about 45 cm in length in an average man i.e. approximately one fourth of the entire height of an individual. It has upper (proximal) end, a cylindrical shaft and a lower (distal) end. The upper end possesses head, neck, and two large projections.

The head of the femur is spherical and articulates with the acetabulum of the pelvic bone, forming ball and socket joint. The neck of femur is a cylindrical strut of bone that connects the head to the shaft of the femur. The femoral neck is approximately 5 cm long, narrowest in its mid part and widest laterally, and connects the head to the shaft at an average angle 127°[4]. It is directed superomedially from the shaft at an angle of approximately 125˚, and projects slightly forward. This wide angle is known as angle of inclination. The orientation of the neck relative to the shaft increases the range of movement which enables the lower limb to move clear off the pelvis.

The neck shaft angle varies with age, stature and width of pelvis. When this angle is >135˚, condition is known as coxa valga. When angle is <120˚, it is known as coxa vara[5].

The femoral neck-shaft angle is defined as the angle between the long axis of neck and long axis of shaft of femur. It is also known as angle of inclination or caput-collum-diaphyseal (CCD) angle or Mikulicz angle. It is measurement of the angle formed between oblique oriented neck with the vertical shaft and is an important anatomic measurement for the evaluation of biomechanics of hip[6]. The neck-shaft angle has an important role in gait as it clears shaft off the pelvis in swing phase[7].

The knowledge of the neck-shaft angle is valuable in the diagnosis and treatment of various pathological conditions of hip and femur including fracture neck of femur, inter-trochanteric fractures and various osteotomies. In fractures, the proximal fragment of femur is used for estimation of neck-shaft angle and the required length of prosthesis can be designed for proper restoration of neck shaft angle.

Methods

The present study was conducted on 62 dry femora from population of Bihar. Dried femur bones were obtained from department of anatomy and department of forensic medicine of Darbhanga Medical College, Darbhanga, Bihar and also from different medical colleges of Bihar from October 2016 to February 2017. Femur bone specimen with obvious deformities (such as Paget's disease or remodelled fracture of neck) and immature skeleton lacking epiphyseal fusion were excluded. Side (right or left) and sex of bones were also determined.

Neck-shaft angle was measured by marking long axis of shaft and long axis of neck. The longitudinal axis of neck was drawn by taking two points, one at the centre of head and other at the mid-point of narrowest part of neck and, then joining the two points. This line represents the long axis of neck.

The longitudinal axis of shaft was drawn by taking two mid points of shaft, one at the upper and other at the lower end of shaft and, then joining these two points. The line thus formed represents the long axis of shaft. Which when extended upwards intersects the long axis of neck and, the angle thus formed is the neck-shaft angle (NSA) of femur. All measurement of NSA were taken on the dried femora using a hand-held 360˚ goniometer.

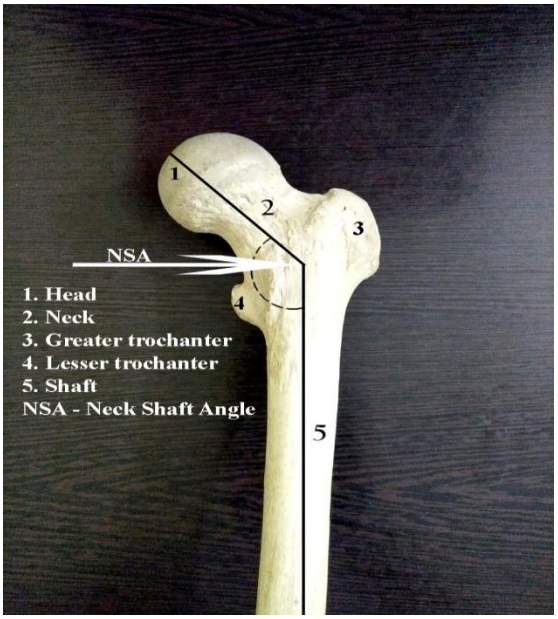

Figure.1: Neck-shaft angle (NSA) of femur

Results

In this study, NSA was measured, recorded and compared in 62 dry femurs. Among which, 34 were determined as male and 28 were determined as female. Out of which, Right femur was 32 and left femur was 30. The minimum angle measured was 120˚ and maximum angle was 142˚. The mean NSA of all femur was 136˚.55 ± 5.23. The mean NSA In male was 140˚ ± 1.27, and in female mean NSA was 132˚.62 ± 5.27. The mean right side neck shaft angle was 136.78˚± 5.16 .The mean left side neck shaft angle was 136.3˚ ± 5.38. Neck shaft angle was slightly lower in female bones in comparison to male bones.

Table 1: Showing Result of Neck Shaft Angle

	N	Minimum	Maximum	Mean	Std. deviation
Neck shaft angle	**62**	120˚	142˚	136˚.55	5.23

Table 2: Comparison of Mean and Standard Deviation of Neck Shaft Angle between Male and Male.

	Sex	N	Mean	Std. deviation
Neck shaft angle	**Male**	33	140˚	1.27
	Female	29	132˚.62	5.27

Table 3: Comparison of m Mean and Standard Deviation of Neck Shaft Angle of Right and Left femur

	Side	N	Mean	Std. deviation
Neck shaft angle	**Right**	32	136.78˚	5.16
	Left	30	136.3˚	5.38

Discussion

The neck-shaft angle in a new born is nearly equal to the adult. The average being 126.5˚ and range being 106˚-151˚. The neck-shaft angle is widest at birth and diminishes gradually until the age of 10 years[8], it is smaller in females. The neck is laterally rotated with respect to the shaft (angle of anteversion) some 10˚-15˚, although values of this angle vary between individuals and between populations (Eckhoff et al. 1994). There is racial and gender difference, smaller in females in comparison to males. The difference in mean femoral length in between populations may possibly be a result of factors affecting bone morphology such as genetic constitution, diet, nutrition status, environment and physical activity[9].

In this study, the mean neck shaft angle is 136.55 ± 5.23, the mean of right femur neck shaft angle is 136.78˚ ± 5.16 and, the mean of left femur neck shaft angle is 136.3˚± 5.38. The neck shaft angle of present study relates closely to study done by Subhas Gujar, in their study the average neck shaft angle was 136.2°[10]. My result is also in agreement with Shaik Hussain Saheb, in their study mean neck shaft angle was 137.1°[11]. The study done by KC Saikia in population of Guwahati using CT scan was 139.5 [12], which is similar to my results. The study done by TR Deshmukh in Vidarbha using X-ray was 131.5[13]. In Ravichandran et al study, the neck shaft angel was 126.55°[14], which is lower but, similar to my study. In the study done by RC Siwach in 2003 among people of Rohtak using dry bones, the neck shaft angle was 123.5°[15], which is very low as compared to this study. [Table: 4]

Table: 4. Comparison of Neck Shaft Angle of Present Study with Previous Studies

Author	Year	Sample size	Population	Method	Neck shaft angle	Standard deviation
RC Siwach	2003	150	Rohtak	Dry bones	123.5	4.3
KC Saikia	2008	92	Guwahati	CT scans	139.5	7.5
TR Deshmukh	2010	77	Vidarbha	X-rays	131.5	----
Subhas Gujar	2013	250	Central Gujarat	Dry bones	136.2	6.0
Shaik hussain Saheb	2014	250	South India	Dry bones	137.1	----
Present study	2017	62	Bihar	Dry bones	136.54	5.23

Conclusion

In this study, the sample size had neck shaft angle ranging from 120˚ to 142˚ with a mean of 136.55˚. A significant difference between male and female neck shaft angle of femur was observed. But, right and left side of neck shaft angle showed no significant variation. Orthopaedists and Radiologists use the normal range and means of neck shaft angle in the diagnosis and treatment of various diseases of hip. Neck shaft angle is useful in proper design and fit of prosthetic implants or functional replacements used in the management of congenital pathologies, missing limb as well as fracture management of proximal femur. Measurements of the present study may be helpful for orthopaedic surgeons, radiologists, anthropologists and anatomists.

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