

**Study of neck shaft angle, neck length and femoral length of adult dry femur bone from Anatomy department of govt medical college, Bikaner with comparison to other studies**

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**Abstract**

Femur is the largest and strongest bone in the Human Body, the femoral neck-shaft angle (NSA) is the angle formed by the neck axis & the long axis of femur. The elongated neck shaft angle facilitates movement at hip joint enabling the limb to swing clearly. The knowledge of variations in the parameters of dry femora will help the orthopaedic surgery to diagnose various hip pathologies and in planning derotation osteotomy of femur, forensic anthropology to determine.

**Materials and Methods:** This study was done on 100 dry femur bone conducted in the Department of Anatomy, S. P. Medical College, Bikaner. The measurements of Neck shaft angle, Femoral Length and Neck Length of femur were measured and recorded.

**Result & Conclusion:** The mean neck shaft angle of femur was  $127.66 \pm 4.42^\circ$ , the mean neck length of femur was  $27.51 \pm 2.92$  mm, and the mean femoral length was  $424.64 \pm 26.6$  mm. In our study we found

that there was no significant difference between the values of all parameters on both right & left sided femur bones.

**Keywords:** Femur bone, Femoral Length, Neck Length, Neck Shaft angle

**Introduction**

Femur is the largest and strongest bone in the Human Body. It consists of proximal end, distal end & shaft. Proximal end consists of head, neck, greater and lesser trochanter, inter-trochanteric line and inter-trochanteric crest. The neck is about 5 cm long, connects the head to the shaft and is directed upward, medially and slightly forward and making an angle about  $125^\circ$  with shaft but the angle is wider in children. The elongated neck shaft angle facilitates movement at hip joint enabling the limb to swing clearly.

The femoral neck-shaft angle (NSA) is the angle formed by the neck axis & the long axis of femur. It is also known as the angle of inclination,

cervicodiaphyseal angle or caput collum diaphysis (CCD) angle<sup>2</sup>.

Normal range of Neck Shaft Angle varies from 120<sup>0</sup>–140<sup>0</sup>with an average value of 135<sup>0</sup>If neck shaft angle is less than 120<sup>0</sup> it is known as coxa vara, when this angle is greater than 140<sup>0</sup> it is called coxa valga.<sup>3</sup>

The Neck Shaft Angle is an important anatomic measurement for the evaluation of biomechanics of hip. Involvement of the proximal femur in various pathological conditions such as developmental dysplasia of hip, fibrous dysplasia, congenital coxa vara, osteoarthritis of hip changes the neck shaft angle and thereby alters the biomechanics and the gait. The neck shaft angle has an important role in gait as it clears femoral shaft off the pelvis during the swing phase.<sup>4</sup>

The knowledge of the neck shaft angle is valuable in the diagnosis and treatment of fracture of upper end of femur. The neck shaft angle can be estimated from proximal fragment of femur and required size of the length of neck can be determined to design prosthesis for the restoration of normal shaft angle. It is important to know about the proximal femoral geometry in pre-operative planning of osteotomy, arthroplasty or fracture fixation<sup>5</sup>.

It is also helpful in designing suitable implants with more accurate angulations of femur neck. Use of undersized or oversized femoral implants can lead to altered soft tissue tensioning and altered patella femoral stresses. In case of improper selection of femur implant, there may be serious problems for the patients in long run.<sup>6</sup>

The proximal end of femur varies in different ethnic groups with respect to their build, physique, habits, and genetic makeup so anthropometric dimensions described as normal for proximal end of femur for

western countries might be quite different from those encountered amongst Indians<sup>7</sup>. Indians use more of floor level activities like squatting, therefore they tend to externally rotate their hips & use them in extreme range of motion. This makes the Indian hips to be evolutionally & morphologically different from Western counterparts. Therefore the data from Western population may not be applicable to the Indian population<sup>8</sup>.

### Materials and Method

This was an observational study conducted in the Department of Anatomy, S. P. Medical College, Bikaner. The study was conducted on 100 dry femur out of which 50 were of left side and 50 were of right side. Adult femur bones taken for the study were fully ossified, not broken and not having any deformities. The 100 femora were studied for the following measurement:

1. Neck shaft angle measured by using: goniometer
2. Femoral length measured by using: osteometric board,
3. Neck length measured by using: digital vernier calliper

The neck shaft angle is formed by the axis of the neck with the axis of the shaft. The axis of the neck and axis of the shaft were measured, respectively, as the line joining the two center points on anterior surface of the neck and line joining the two center point on anterior surface of shaft. Femoral length is maximum vertical distance between upper end of the head of femur and lowest point on femoral condyles. Neck length is the distance between the base of the head and intertrochanteric line at the junction of the front of the neck with shaft. (1, 16)

**Observation**

In the present study 100 dry femur bones from department of anatomy studied out of which 50 femur bones were of left side and 50 were of right side. The mean neck shaft angle of femur was  $127.66 \pm 4.42^\circ$  the left side was  $128.20 \pm 4.13^\circ$  and right side was  $127.12 \pm 4.58^\circ$ . The maximum neck shaft angle was  $138^\circ$  and minimum was  $115^\circ$ . The mean neck length of femur was  $27.51 \pm 2.92$  mm, the left side was  $27.54 \pm 2.66$  mm and right side was  $27.48 \pm 3.19$  mm. The maximum neck length was 34.95mm and minimum was 20.27mm. The mean femoral length was  $424.64 \pm 26.6$  mm, the left side was  $427.52 \pm 25.9$  mm and right side was  $421.76 \pm 27.16$  mm. The maximum femoral length was 485mm and minimum was 325 mm.

Table 1: The data obtained on different parameters were tabulated as follows:

Parameters		Number	Mean $\pm$ SD
Neck shaft angle	Total	100	$127.66 \pm 4.42^\circ$
	Left	50	$128.20 \pm 4.13^\circ$
	Right	50	$127.12 \pm 4.58^\circ$
Neck length	Total	100	$27.51 \pm 2.92$ mm
	Left	50	$27.54 \pm 2.66$ mm
	Right	50	$27.48 \pm 3.19$ mm
Femoral length	Total	100	$424.64 \pm 26.60$ m
	Left	50	$427.52 \pm 25.99$ m
	Right	50	$421.76 \pm 27.16$ m

**Discussion**

The present observation study was conducted at Department of Anatomy, S.P. Medical College, Bikaner, after obtaining permission from institutional

ethical committee. The study included 100 adult dry femur bones, which were studied for their neck shaft angle, neck length and femoral length.

**Neck shaft angle-**

Our study results were compared with the studies of Vaishnani H et al (2019)<sup>19</sup> in Gujarat Dhivya S et al (2017)<sup>14</sup> in Tamilnadu Gujar S et al (2013)<sup>1</sup> in Gujrat, Khan S et al (2014)<sup>5</sup> in davanger, Verma M et al (2017)<sup>16</sup> in New Delhi, Rajendran HSR et al (2020)<sup>22</sup> in Chennai Ziyan T et al (2002)<sup>12</sup> in Turkey, Desousa E et al (2010)<sup>13</sup> in Brazilian, Adhikar RK et al (2017)<sup>17</sup> in Nepal. In these studies the mean value of neck shaft angle was more than the mean value observed in the present study done in Bikaner, Rajasthan. while Sundar G et al (2018)<sup>15</sup> In Karnataka Chaudhary PN et al (2020)<sup>18</sup> in Belagavi, Ozandac S et al (2015)<sup>20</sup> in Adana, Desliva V J et al (2003)<sup>21</sup> in Brazilian, observed values less than our study, for neck shaft angle of femur (table no.2).

Table 2: Comparison between the value of mean neck shaft angle (left and right) femur bone with previous Indian and other foreign studies

Author's/place	Mean $\pm$ SD (degree)	
	Left	Right
Vaishnani H et al (2019) <sup>19</sup> Gujarat	$137.6 \pm 4.91^\circ$	$136.2 \pm 5.1^\circ$
Dhivya S et al (2015) <sup>14</sup> Tamilnadu	$132.66^\circ$	$135.02^\circ$
Gujar et al (2013) <sup>1</sup> Gujarat	$136.6 \pm 5.45^\circ$	$136 \pm 6.68^\circ$
Khan S et al (2014) <sup>5</sup> Davangere	$136.9^\circ$	$137.3^\circ$
Verma M et al (2017) <sup>16</sup> New Delhi	$130.3 \pm 3.87^\circ$	$127.57 \pm 4.66^\circ$
Sundar G et al	$125.82^\circ$	$126.26^\circ$

(2018) <sup>15</sup> Karnataka		
Chaudhary PN et al (2020) <sup>18</sup> Belagavi	127.64°	126.78°
Rajendran HSR et al(2020) <sup>22</sup> Chennai	147.06±3.54°	145.46±4.62°
Ozandac S et al(2015) <sup>20</sup> Adana	122.2	121.1
Ziyan T et al (2002) <sup>12</sup> Turkey	128.7	127.6
Desliva V J et al (2003) <sup>21</sup> Brazilian	122.55±4.5	125.61±6.6
Desousa E et al (2010) <sup>13</sup> Brazilian	131.8±5.3.2	132±7.20
Adhikar RK et al (2017) <sup>17</sup> Nepal	128.12±3.66	129.84±5.22
Present study	128.20±4.13°	127.12±4.45°

**Neck length of femur-**

Our study results were compared with the studies of Vaishnani H et al (2019)<sup>19</sup> in Gujarat Dhivya S et al (2017)<sup>14</sup> in Tamilnadu Gujar S et al (2013)<sup>1</sup> in Gujrat, Khan S et al (2014)<sup>5</sup> in davanger, Verma M et al (2017)<sup>16</sup> in New Delhi, Ziyan T et al (2002)<sup>12</sup> in Turkey, Desousa E et al (2010)<sup>13</sup> in Brazilian, Adhikar RK et al (2017)<sup>17</sup> in Nepal, Chaudhary PN et al (2020)<sup>18</sup> in Belagavi. In these studies the mean value of neck length was more than the mean value observed in the present study done in Bikaner, Rajasthan. While Ozandac S et al (2015)<sup>20</sup> in Adana, Desliva V J et al (2003)<sup>21</sup> in Brazilian, observed values were less than our study, for neck length of femur (table no.3).

Table 3: Comparison between the value of mean neck length of left and right femur bone with previous Indian other foreign studies

Author's/place	Mean ± SD (mm)	
	Left	Right
Vaishnani H et al(2019) <sup>19</sup> Gujarat	36.7	39.8
Dhivya S et al(2015) <sup>14</sup> Tamilnadu	31.6	29.8
Gujar et al (2013) <sup>1</sup> Gujarat	34.2±3.62	34.5±4
Khan S et al (2014) <sup>5</sup> Davangere	36.4±4.3	36.1±4.1
Verma M et al (2017) <sup>16</sup> New Delhi	44.66±6.98	44.83±9.09
Sundar G et al (2018) <sup>15</sup> Karnataka	28.8	31.8
Jha S et al (2016) <sup>23</sup> Jharkhand	29.3±3.1	29.1±2.6
Chaudhary PN et al (2020) <sup>18</sup> Belagavi	28.8±4	28.8±3.3
Ozandac S et al(2015) <sup>20</sup> Adana	22.5±4.4	22.2±3
Ziyan T et al (2002) <sup>12</sup> Turkey	30.6	30.7
Desliva V J et al (2003) <sup>21</sup> Brazilian	23.3±3.6	22.3±3.3
Desousa E et al (2010) <sup>13</sup> Brazilian	30.5±4.1	30.1±4.3
Adhikar RK et al (2017) <sup>17</sup> Nepal	28±0.21	30.6±0.19
Present study	27.54±2.66	27.48±3.19

### Femoral length

Our study results were compared with the studies of Vaishnani H et al (2019)<sup>19</sup> in Gujarat Gujar S et al (2013)<sup>1</sup> in Gujrat, Khan S et al (2014)<sup>5</sup>in davanger, Verma M et al (2017)<sup>16</sup> in New Delhi, Ozandac S et al(2015)<sup>20</sup> In Adana, in these studies the mean value of femoral length was more than the mean value observed in the present study done in Bikaner, Rajasthan. While Dhivya S et al (2017)<sup>14</sup> in Tamilnadu, Chaudhary PN et al (2020)<sup>18</sup> in Belagavi, Desliva V J et al (2003)<sup>21</sup> in Brazilian, observed values were less than our study for femoral length(table no.4).

Table 4: Comparison between the mean value of femoral length of left and right femur bone with previous Indian and other foreign studies

Author's/place	Mean ± SD (mm)	
	Left	Right
Vaishnani H et al(2019) <sup>19</sup> Gujarat	433.8±26.14	436.2±27.91
Dhivya S et al (2015) <sup>14</sup> Tamilnadu	418.8	412.9
Gujar et al (2013) <sup>1</sup> Gujarat	436.5±25.31	439.9±25.98
Khan S et al (2014) <sup>5</sup> Davangere	445.8±26.12	446.6±26.66
Verma M et al (2017) <sup>16</sup> New Delhi	427±29.12	429.4±27.69
Sundar G et al (2018) <sup>15</sup> Karnataka	451.3	452.8
Chaudhary PN et al(2020) <sup>18</sup> Belagavi	416.4±29.3	409.4±31.8
Rajendran HSR et al (2020) <sup>22</sup> Chennai	437.7±32.9	430±29.8
Ozandac S et al(2015) <sup>20</sup> Adana	431.3±26.2	429.5±35

Ziyan T et al (2002) <sup>12</sup> Turkey	428.4±24.9	416.8±68.6
Desliva V J et al (2003) <sup>21</sup> Brazilian	409.8±26.5	409±28.2
Present study	427.52±25.99	421.76±27.16

### Conclusion

In our study we found that there was no significant difference between the values of all parameters on both right & left sided femur bones. On comparing the results of the study with results of some Indian studies and those done in other countries, we found that some studies showed a value more than our study and some showed a value less than our study for different parameters hence we come to a conclusion that the values of neck shaft angle, neck length, femoral length, showed regional variation.

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