

Journal of Nobel Medical College

Available Online: www.nepjol.info, www.nobelmedicalcollege.com.np
Volume 6, Number 1, Issue 10, January-June 2017, 44-47

Original Article

Comparative Study of Angle of Inclination and Neck Length of Dry Femur

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Received: 5th March, 2017; Revised after peer-review: 18th April, 2017; Accepted: 17th May, 2017

Abstract

Background

The angle of inclination of the femur is the angle formed between long axis of neck of femur and long axis of the shaft of femur. The average angle of inclination (neck–shaft angle) is 126°, ranging from 115° to 140° in the adult population. As with the angle of inclination of the humerus, the angle of inclination of the femur varies among individuals and also from side to side. The aim of this study was to determine the Angle of inclination and neck length of Femur.

Material & Methods

A total of 50 dry femora (25right and 25 left) of nobel medical college was cross sectionally studied with random sampling without knowing the sex & age of bone. The angle formed between long axis of neck and long axis of the shaft of femur was measured with the help of goniometer. The neck length was measured with the help of sliding calliper.

Results

The mean angle of inclination was 128.98 ± 4.55 degrees, on the right side was 129.84 ± 5.22 degrees and on the left side was 128.12 ± 3.66 degrees. The difference in the mean angle of inclination of right and the left side was found to be statistically insignificant (p value > 0.05). The mean neck length femur was 2.93 ± 0.24 cm, right femur was 3.06 ± 0.19 cm and left femur was 2.80 ± 0.21 cm. The difference in the mean neck length of the right and the left side was found to be statistically insignificant (p value > 0.05).

Conclusion

The Angle of Inclination of Femur and neck length of femur in present study had no remarkable dissimilarity with the results observed in the studies conducted in Nepal and neighbouring countries. In the study there was no statistical significant difference between the neck-shaft angle and neck length of femur of right and left side of the femur but there was positive correlation between angle of inclination and neck length of femur.

Key words:

Angle of Inclination (Neck shaft angle), femur, Goniometer, Neck length, Sliding caliper

Introduction:

The longest and strongest bone in the human body is femur, which transmits

body weight from the hip bone to the tibia in standing position. The femur has a shaft and two ends, superior and inferior. The

superior end of the femur has a head, neck, and two trochanters (greater and lesser). The femoral neck is approximately 5 cm long, neck is narrowest in its mid part and widest laterally [1]. The neck of femur connects to the shaft of femur at an average angle of 126° (angle of inclination, neck–shaft angle) ranging from 115° to 140° in the adult population [2]. As with the angle of inclination of the humerus, the angle of inclination of the femur varies not only among individuals but also from side to side. The angle of inclination in women is smaller than it is in men, due to the greater width of the female pelvis. The Angle of inclination of the femur is important regarding its stability, control of lateral balance, walking and facilitates hip movement. The angle of inclination of the femur changes across the life span, being substantially greater in infancy and childhood and gradually declining to about 120 in the normal elderly person[2]. A pathologic increase in the angle of inclination is called coxa valga, and pathologic decrease is called coxa vara. The clinical importance of the angle of inclination of femur lies in the diagnosis , treatment and follow up of fractures of the neck of femur, trochanteric fractures , slipped upper femoral epiphysis , development dysplasia of the hip and neuromuscular disorders of the lower extremity. The knowledge of normal angle of inclination of femur may be of great value in evaluation of patient with known or assumed pathological conditions and in correctional osteotomy in case of femoral fractures. The angle of inclination can be estimated from a proximal femoral fragment and the required size of the length of the neck can be determined to design the prostheses for the restoration of normal angle of inclination. The knowledge of the angle of inclination is a valuable aid in the diagnosis and treatment of the fractures of upper end of femur.

Materials and Methods:

This was a cross sectional study where dry femora were obtained from the department of human anatomy of Nobel Medical College by random sampling whose sex & age were not determined/ were unknown. Damaged, incomplete and unossified bones were excluded. Only the intact bones which were fully ossified were included in the study. A total of 50 dry femora (25 right & 25 left) were selected using simple random sampling method & were studied from 5th September 2014 to 7th October 2016. The angle of inclination of femur is defined as the angle formed between long axis of neck of femur and long axis of the shaft of femur.

After labelling the bones with numbers, 50 femora were studied for measurements of the angle of inclination and neck length of the femur

1. The long axis of neck of femur was drawn through the midpoint of narrowest part the neck.
2. The long axis of the shaft of femur was drawn through the midpoint of narrowest part of the shaft.
3. The angle formed between the long axis of neck and long axis of shaft of femur was measured by goniometer.
4. The neck length of femur was measured with the help of sliding calliper.

Data were collected and analysis was done using SPSS version 16.0.

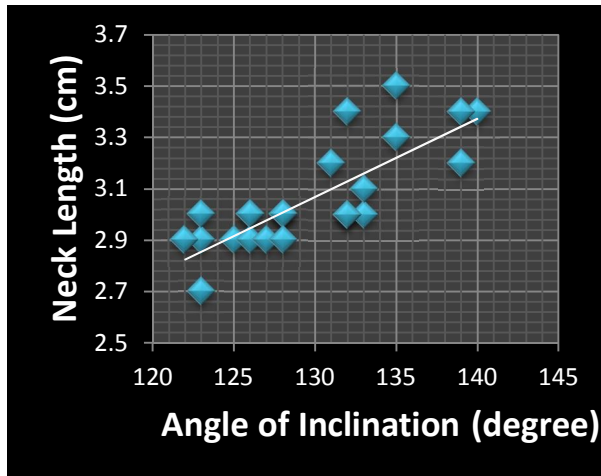
Results:

In results of present study, the mean angle of inclination was 128.98 ± 4.55 degrees, on the right side 129.84 ± 5.22 degrees and on the left side 128.12 ± 3.66 degrees. The difference in the mean angle of inclination of right and the left side of femur was found NOT to be statistically significant (p value > 0.05). The mean neck length of femur was 2.93 ± 0.24 cm, on the right

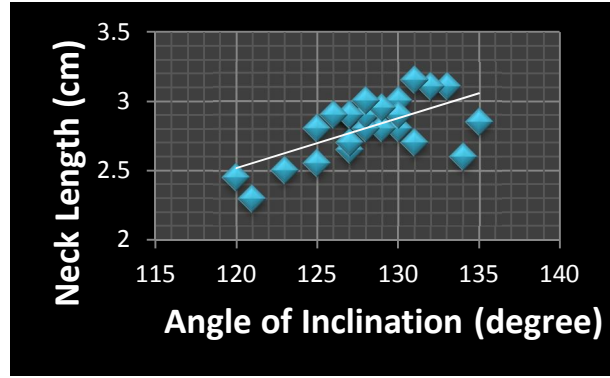
femur $3.06 \pm 0.199\text{cm}$ and on the left femur $2.80 \pm 0.211\text{cm}$. The difference in the mean neck length of femur of the right and the left side was found NOT to be statistically significant ($p \text{ value} > 0.05$). The correlation between angle of inclination and neck length of femur was found statistically significant ($p \text{ value} < 0.05$).

Table 1: Showing the result of Femoral Angle of Inclination and Neck length.

Parameter		Number	Mean \pm SD	Range
Angle of Inclination	Total	50	$128.98^\circ \pm 4.55^\circ$	$120^\circ - 140^\circ$
	Right	25	$129.84^\circ \pm 5.22^\circ$	$123^\circ - 140^\circ$
	Left	25	$128.12^\circ \pm 3.66^\circ$	$120^\circ - 135^\circ$
Neck length	Total	50	$2.93 \pm 0.24\text{cm}$	$2.3 - 3.5\text{cm}$
	Right	25	$3.06 \pm 0.19\text{cm}$	$2.7 - 3.5\text{cm}$
	Left	25	$2.80 \pm 0.21\text{cm}$	$2.3 - 3.15\text{cm}$



Graph 1: Correlation between right side Angle of inclination and neck length of femur: increased angle of inclination with increase in neck length.



Graph 2: Correlation between left side Angle of inclination and neck length of femur: increased angle of inclination with increase in neck length.

Discussion:

In the present study the mean angle of inclination was $128.98^\circ \pm 4.55^\circ$, on the right side $129.84^\circ \pm 5.22^\circ$ and on the left side $128.12^\circ \pm 3.66^\circ$. Which falls under the range of 115° to 140° in the adult population given by Moore et al[3]. This was very similar to the earlier study in Nepal by Anusuya Shrestha(2015) who found mean angle of inclination for the right femora $129.92^\circ \pm 6.12^\circ$ and for the left femora $127.36^\circ \pm 5.59^\circ$ [4]. In another study in the neighboring countries, by Issac (1997) in South Indian population the mean neck shaft angle was on the right side 126.9° and on the left side 126.5° [5]. Our results are also in agreement with study of Ravichandran et al, which was 126.55° [7]. The values obtained in the present study are low as compared to the mean values of right and left showed by Gujar et al [6], which has the mean value of 136.6° of right and 136° of left side respectively. The mean femur neck length of present study was $2.93 \pm 0.24\text{cm}$, on the right side $3.06 \pm 0.19\text{cm}$ and on the left side $2.80 \pm 0.21\text{cm}$. The value obtained was closer to the study done by Issac (2003) in South Indian population, 28.6mm for right side and 28.1mm for the left side [5]. Da Silva (2003) found mean neck length for the right femora $22.3 \pm 3.3 \text{ mm}$ and for the left femora $23.5 \pm 3.6 \text{ mm}$ in the Brazilian

population [8]. Subhsh Gujar (2013) found mean neck length for the right femora 34.5 ± 4.0 mm and for the left femora 34.2 ± 3.62 mm in Gujarat (India) [6]. The neck length values obtained in present study are low as compare to the study done by Gujar et al.

Table 2: Femoral Angle of Inclination in different populations

Authors	Population	Side	Angle of Inclination
Present study	Nepali	Right	129.84°
		Left	128.12°
Shrestha A et al	Nepali	Right	129.92°
		Left	127.36°
Isaac et al	South Indian	Right	126.9°
		Left	126.5°
De Sousa [9]	Brazil	Right	131.8°
		Left	132.1°
Gujar et al	Indian	Right	136.6°
		Left	136°

Conclusion

The Angle of Inclination of Femur and neck length of femur in present study had no remarkable dissimilarity with the angles observed in the studies conducted in Nepal and neighbouring countries. There was no any significant difference between angle of inclination of femur of right and left side of the Nepalese population. But there was positive correlation between angle of inclination and neck length of femur.

Accurate acquaintance of femoral neck length and angle is important in knowing, understanding and treating pathologic conditions in the hip joint. The limitation of our study was small sample size, more femoral neck length and angle of inclination would be needed to achieve greater precision in such an analysis.

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