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Study of Neck Shaft Angle of Femur on Bones–Original Report

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Abstract

The present study was done in department of anatomy in different sexes to evaluate the variations in the neck shaft angle of femur which helps to understand clinical relevance's in biomechanics of the hip joint. Determination of the angle also has great value in treatment of different pathological conditions of hip and femur. The present study was done on 50 femoral bones of different ages and sex. Several parameters of femoral neck geometry were studied and analysed, among parameters studied 31 were men, and 19 women.

Keywords: Different sex; Neck shaft angle; Biomechanics; Congenital conditions; 50 femoral bones

Introduction

Femur

The femur is the longest and strongest bone in the human body. Its length is associated with a striding gait, its strength with the weight and muscular forces. Proximally the femur consists of a head, neck, greater and lesser trochanters.

Its shaft is almost cylindrical along most of its length and bowed forward, the proximal rounded articular head projecting medially from its short neck which articulates with acetabulum and form hip joint.

The distal end of the femur is widely expanded as a bearing surface for transmission of weight to the tibia, it is wider and more substantial, and presents a double condyle that articulates with the tibia. Since the tibia and fibula descend vertically from the knees, the ankles are also in the line of body weight in standing or walking.

Materials and Methods

The following materials were collected for the present study.

1. 50 femoral bones from the Department of Anatomy
2. Osteometric Board from the Department of Forensic Medicine
3. Calipers, scale, sketch pen, lead pencil etc.
4. Goniometry

Table 1: The neck shaft angles and lengths of femora, measurements by sexing of femora.

Sl. No.	Oblique Length mm	Trochanteric length (oblique) Mm	Vertical Diameter of head mm	Bicondylar width (mm)	Sex	Neck shaft angle
1	450	420	40	74	F	134°
2	465	436	49	91	M	118°
3	450	430	45	88	M	124°
4	443	424	35	72	F	127°
5	460	435	40	85	M	137°
6	438	424	45	87	M	113°
7	410	376	42	76	F	130°
8	401	384	34	74	F	125°
9	451	446	43	80	M	124°
10	372	352	41	70	F	126°

11	414	384	43	81	F	130°
12	402	385	38	69	F	129°
13	402	382	40	78	F	125°
14	445	433	45	84	M	133°
15	393	385	36	73	F	123°
16	480	455	46	86	M	127°
17	410	386	45	79	F	132°
18	440	424	40	84	M	132°
19	427	410	37	79	F	147°
20	462	442	42	87	M	128°
21	460	431	47	79	M	132°
22	524	494	46	88	M	137°
23	404	390	40	65	F	119°
24	436	415	46	78	M	123°
25	523	491	50	91	M	142°
26	488	459	45	88	M	130°
27	424	400	40	77	F	130°
28	461	430	40	78	M	126°
29	455	425	42	82	M	132°
30	447	423	46	80	M	134°
31	456	424	44	81	M	132°
32	454	436	45	80	M	121°
33	434	420	44	80	M	123°
34	452	429	51	85	M	130°
35	442	429	45	70	M	128°
36	460	433	44	77	M	129°
37	430	409	39	82	F	116°
38	426	398	40	65	F	131°
39	434	410	44	78	F	122°
40	445	421	41	86	F	134°
41	450	419	49	90	M	131°
42	460	435	40	81	M	130°
43	459	425	46	78	M	125°
44	476	454	43	85	M	125°
45	442	418	44	84	M	120°
46	473	460	47	82	F	116°
47	434	404	42	77	F	125°
48	472	453	50	79	M	124°
49	445	432	45	83	M	126°

50	367	352	36	60	F	128°

Table 2: Comparison of neck shaft angle between male and female with mean and standard deviation.

Specimens	Bones	Minimum°	Maximum°	Mean	Standard deviation	Standard Error Mean
Male	31	113	142	127.483	6.2822	0.79785
Female	19	115	147	127.526	5.22332	0.84733

Observations

1. The femora were differentiated into male and female; the following measurements are taken and recorded.

- Vertical diameter of head.
- Bicondylar width
- Trochanteric oblique length
- Oblique length of femur.

2. The neck-shaft angles of 50 femora were measured and recorded.

Discussion

The neck-shaft angle of femur **(Table 1)** was measured by marking axis of shaft and axis of neck. The axis of the neck was drawn by taking two points, one at the centre of the head and other at the end of the midpoint of the narrowest part of the neck (highest constriction at the neck), the two points were joined, and thus the line drawn represents the axis of the neck. Then the axis of shaft was marked by taking two mid points, one at the upper end of shaft, and the other at the lower end of the shaft, the two points were joined and the same line was extended at the upper end as such, to cut the axis of the neck. The angle was then measured, using a goniometer and the angle was noted down **(Table 2)**.

Olav Reileras et al. [1] measured the neck-shaft angle of femur by taking neck axis as the line drawn from the centre of the femoral head to the centre of the femoral neck at the narrowest part of neck. The long axis of femur is defined as the line drawn from the middle of the femoral condyles to the middle of the greater trochanter in two planes; this corresponds to the ideal axis. In 1980 Henriksson elaborated a method for the determination of anatomical angles from Roentgenograms using a computer technique, by which the mid axis of the femoral neck is defined as a line through the centre of the head and geometrical centre of neck i.e., the intersection of shaft and long axis of the elliptical cross section of the femoral neck [2].

In the year 1967 Dr. B R Kate measured the angle and the axis of the neck was marked at two points and long pin fixed along with it transferred on paper [3]. The shaft was traced on paper and axis drawn. The angulation was studied extensively by many workers and conclusions were drawn. Regarding its valuations due to age, sex and race, Charpy [4], Humphry [5], Parsons [6], Pearson [7] and Pike et al. [8] measured this angle and mentioned its value, ranging from 125° to 131.47°. It was found to be different in different races and at different age. The findings pertaining to sex were inconsistent. However, it was described as greater in females than males or no sexual difference at all.

The angle in the new born is nearly equal to the adult. The average angle being 126.5° and range being between 106°–151°, according to Kate [9].

Angulation renders stability during weight transmission. Mechanically the width of the pelvis should not influence the angle of the neck even to the slightest degree [10].

The femur with a long neck is associated with high neck-shaft angle and the short neck is associated with the low angle. The necks above the average length have on each side a wider angle by 2° than average necks or those below average [11]

Sitaram Rao [12] measured angles taken at random. It was 132° to 205° and the average neck-shaft angle was found to be 127.7°. D Reikeras et al. [13] observed the neck shaft angle about 127.7°.

Lofgran [14] stated that the mean value of the femoral neck angle in the female was 125.1° and male 125.2° being almost same in both the sexes.

The femoral neck angle was determined by D. Reikeras, et al. [13] and there was no significant difference in the angle between the sexes. The mean values of the male and female neck angles were 128.3° and 127° respectively.

According to Martin [15] who made studies on the female subjects of the Japanese, French, Negroes, Egyptians and Bantu mentioned greater angles in females being 127.1° to 128° over their male counterparts being 124.3° to 128°.

Reikeras et al. [16] showed that anteversion of the femoral neck may be a predisposing factor because of difficulty in adapting the femoral head to the acetabulum. They also raised the hypothesis that increased anteversion may be secondary to the degenerative process of osteoarthritis.

Anteversion is an anterior component of the cervicodiaphyseal angle. This angle is oriented to a position that provides greater advantage for resisting the forces that act on the joint, and it also enables a mechanical influence to allow a large joint range of motion [17].

Giunti et al. [18] observed that the anteversion angle was significantly greater in the group with osteoarthritis than in the control group, and that the increase was also proportional to the severity of the arthrosis.

Conclusion

According to-my study of the neck-shaft angle, the following conclusions were made:

1. The neck-shaft angle of femur is measured in 50 normal femora, 31 were classified as male and 19 as female.
2. The average angle is found in male 127.48° and in females 127.52°. The difference between the angles of both the sexes is 0.2° and it is negligible. There is not much difference in the angle of male and female, being slightly more in the females.
3. The present study may be useful in the department of orthopaedics to diagnose various pathologies of hip and femur, and also helpful in forensic anthropology for determining racial variations.

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