Study Of Femoral Neck Anteversion Of Adult Dry Femora In Gujarat Region

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Abstract : The purpose of this study was to estimate the average angle of femoral neck anteversion in an Indian population. Unpaired 92 dry femurs, 50 of female (27 right and 23 left) and 42 of male (22 right and 20 left) devoid of any gross pathology were used to measure the femoral neck angle (FNA) from Department of Anatomy, Govt. Medical College, Bhavnagar in year 2005. They were evaluated by the Kingsley Olmsted method, and the data were statistically analyzed. In female femoral neck anteversion range form –8.3° to +30.4° with a mean of 16.4° on left and 10.5° on right sides. In male femoral neck anteversion range from –13.7° to +25.6° with a mean of 14.3° on right and 7.2° on left sides. The female femora showed about 2.7° more anteversion than the male femora. The average left-sided femora showed about 6.4° more anteversion than the right-sided femora.

Key words : Femoral neck anteversion, Neck head axis, Transcondylar plane, Femur, Angle

INTRODUCTION: The femoral neck anteversion (FNA) can be defined as the angle formed by the femoral condyles plane (bicondylar plane) and a plane passing through the center of the neck and femoral head[1,2] (Figure-1). If the axis of the neck inclines forward to transcondylar plane the angle of torsion is called anteversion, if it points posterior to the transcondylar plane it is called retroversion and if the axis of neck is in the same line of transcondylar plane it is known as neutral version (Figure-2).

The FNA is first identifiable at 7 weeks of gestation[3] when it has been reported to be –10°. This gradually increases with gestational age and is reported to be 0° at the third month, +12° just after the fourth month, and +24.4° at birth[4]. It changes throughout by detorsion in childhood and adolescence until the adult average angle of +12° is reached[5,6].

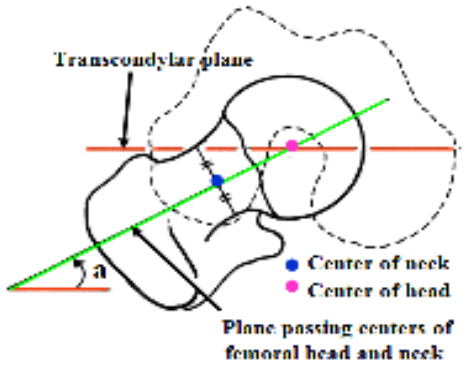

Figure-1 Shows angle of femoral neck anteversion – a

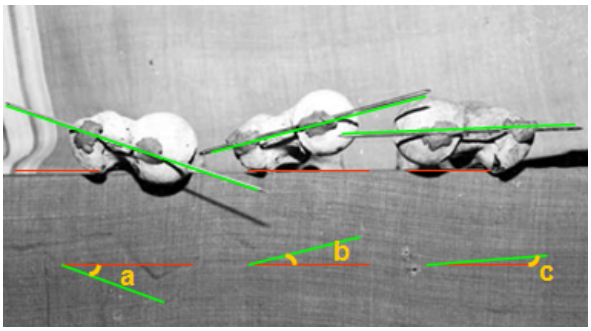

Figure-2 Femur retroversion = a (-13.7°), Normal anteversion = b (9.6°), Neutral version = c (–1° to 1°) in three specimens

The average adult femoral anteversion has been documented to range between 7°-16° in multiple skeletal surveys[4,7,8] whereas Le Damany (1903)[6] quoted it to range from –25 to +37 degrees. It is multifactoral result of evolution, heredity, fetal development, intrauterine position, and mechanical forces. Abnormal FNA sometimes can be associated with many clinical problems ranging from harmless intoeing gait in the early childhood, which could be a reason for parents concern for children future, to disabling osteoarthritis of the hip and the knee in the adults.

The present study is an attempt to evaluate the normal anteversion range in adult Indian femora and to compare values of angle in male and female as well as with other population.

MATERIALS AND METHODS: Unpaired 92 dry femurs, 50 of female (27 right and 23 left) and 42 of male (22 right and 20 left) devoid of any gross pathology were used to measure the femoral neck angle (FNA). The angle of anteversion was measured by Kingsley Olmsted method[9] after placing the specimen at the edge of a glass horizontal surface so that the condyles of the inferior end rest on the surface. The horizontal limb of a goniometer was fixed at the edge of the experimental table. The vertical limb was held parallel along the axis of the head and neck of the femur. The horizontal surface represents the retrocondylar axis and the plane of reference against which the anteversion is measured with the help of the axis of head and neck of the femur. The angle subtended was recorded (Figure-1)

All measurements were repeated twice by two independent observers to identify any intra and inter-observer variability of these techniques. Data collected was tabulated according to gender and sides and statistically analyzed.

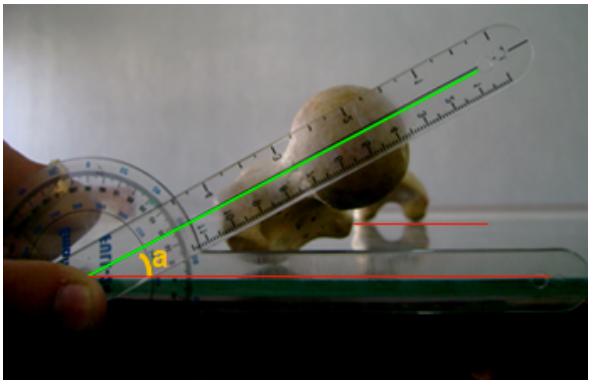

Figure-3 Shows Kingsley Olmsted method of measurement of angle of femoral neck anteversion

RESULTS: Cross sectional study of unpaired 92 adult unpaired dry femurs was conducted, out of them 50 femurs are of female & 42 femurs are of female.

Average anteversion in males was 14.3° ± 0.38° and 21.23° ± 0.39° on the left and right sides respectively. In the female femora, the average anteversion recorded was 11.02° ± 0.34° and 20.87° ± 0.36° on the left and right sides respectively (Table 1).

Retroversion was observed in 5 bones (6.5%). Neutral or almost neutral version (–1° to +1°) was found in 5 bones (5.4%) (Figure-2). 20.5% of the bones were in the range of 0°–10°, while between 10°–15° there were 33.6% of bones. 36.9% of bones were above 15° (Table-2) (Figure-4).

Table-1 Average angle of anteversion in 92 dry adult femora

	FNA Left	FNA	FNA average
	Female femora		
Mean±SD	*16.4° ± 8.2°	10.5° ± 5.7°	13.6° ± 16.8°
	Male femora		
Mean±SD	*14.3° ± 8.3°	7.2° ± 8.5°	10.9° ± 14.7°
	Total female and male femora		
Mean±SD	15.4° ± 15.0°	9.0° ± 7.9°	12.4° ± 18.0°

**P value paired't' test <0.0001;* Significance: All significant

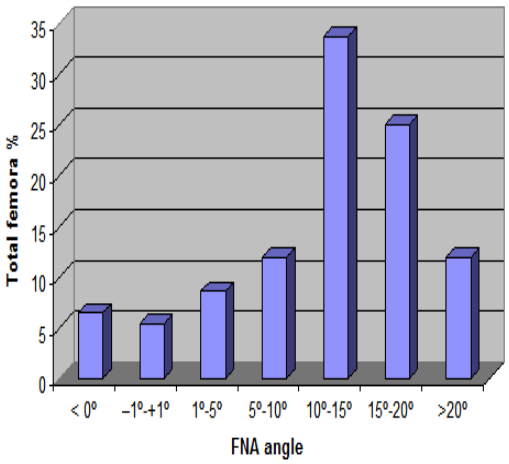

Figure-4 Distribution of FNA

Table-2 Distribution of femoral anteversion angle

Angle of Anteversion (In degree)	Female				Male				Total %
	Left		Right		Left		Right		
	No.	%	No.	%	No.	%	No.	%	
< 0	1	3.7	1	4.3	1	4.5	3	15	6.5
–1 to +1	1	3.7	1	4.3	2	9	1	5	5.4
+1 to +5	4	14.8	2	8.6	0	0	2	10	8.6
+5 to +10	3	11.1	3	13	3	13.6	2	10	11.9
+10 to +15	3	11.1	14	60.8	3	13.6	11	55	33.6
+15 to +20	11	40.7	2	8.6	9	40.9	1	5	25
>20	7	25.9	0	0	4	18.1	0	0	11.9

DISCUSSION: The knowledge of normal femoral anteversion is of extreme importance in selection of patients for prosthesis and preoperative planning for total hip replacement surgery and anthropological studies. Although newer methods using computed tomography (CT) have been shown to be ±1° accurate, there is no universal consensus for locating the

femoral neck axis and the femoral condylar axis[10]. Hence estimation of anteversion on dry bone is still considered the most accurate method.

There are few studies done in India before this study. Western studies results are not applicable in Indian population because femoral anteversion differs in both populations[11].

The mean anteversion in male bones was 7.2° and 14.3° on the left and right sides respectively averaging to about 10.9°. In females, it was 10.5° and 16.4° on the left and right side respectively averaging 13.6° in females. This significant bilateral limb asymmetry should discourage the tendency to view the lower limbs as mirror images of one another. Statistical analysis revealed sexual dimorphism in anteversion (Table-1) in Indians being greater in the females as compared to males. A statistically significant difference was found for the angle of anteversion between the male-and female-type bones and the right- and left-sided bones. The average female-type bone was about 3° higher than the average male-type bone. Parsons et al[12]. had also documented anteversion to be greater in females. Similarly, Kingsley and Olmsted9 observed a negligible difference (0.081°), and Yoshioka et al[8]. found a difference of 1° (Table-3). However, no tests of significance were done in these series. Kate BR et al[13]. done study on Indian femur found lesser average angle of anteversion as compared to present study (Table-3).

Table-3 Femoral anteversion as observed by other researchers

	Researcher	Sample size	Mean angle of anteversion in degree		
			Right	Left	Average
Western studies	Yoshioka Y et al[8]. (1987)	32	-	-	M-7 .F-8
	Kingsley PC et al[9]. (1948)	630	M-8.54, F-7.47	M-7.94, F-8.11	8.02
	Parsons FG et al[12]. (1914)	266	M-13.0, F-18.0	M-13.0, F-16.0	15.3
Indian studies	Kate BR et al[13]. (1976)	108	9.0	8.6	8.8
	Present study (2005)	92	M-7.2, F-10.5	M-14.3, F-16.4	12.4

Because Indians are more apt to participate in floor level activities, in contrast to persons in the West, our hips have to be evolutionally different from theirs. Thus, the same procedure produces a different outcome in our population. Hence a population-specific protocol and assessment criteria must be devised. A femoral component of a total hip replacement should be in an anteversion angle that closely represents the anteversion angle for the Indian population to achieve the best surgical results. In India with the increasing demand for total hip replacement, this anteversion angle becomes more significant. Therefore, our study was undertaken to ascertain the average angle of anteversion of the femoral neck in Indian subjects.

CONCLUSIONS: The average angle of anteversion obtained on dry bone was 12.4°

(SD 18.4°) by the Kingsley and Olmsted method. The angles of anteversion of the femoral neck in 8.6%, 20.5%, and 54.1% of cases were in the range of 1°–5°, 1°–10°, and 1°–15°, respectively. Altogether, 6.5% of the cases showed retroversion, 5.4% neutral version and 36.9% had anteversion of more than 15°. Statistically significant differences were found between the male and female-type bones and the right and left-sided bones. The male bone showed about 2.7° less anteversion than the female bone. The right-sided bones had about 6.4° less anteversion than the left-sided bones.

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