ORIGINAL ARTICLE

Femoral Neck Anteversion: Gender Wise Variation in Our Society

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ABSTRAC

Aim: To determine gender wise variation in femoral neck ante-version by anatomic method.
Methods: This Descriptive Cross Sectional study was conducted in the Anatomy Departments of three medical institutions at Peshawar, namely, 1) Khyber Medical College, Peshawar. 2) Gandahara Medical College, Peshawar 3) Khyber Girls Medical College, Peshawar from 13th August 2010 to 12th February 2011. Dry femora of 211 were studied including 189 male and 20 female type and 103 right and 108 left side bones. The angle of femoral neck ante version was determined by the Kingsley and Olmsted method by measuring the angle between the long axis of the neck of femur and the transverse retrocondylar line (in coronal plane) taken as the plane of the axis of shaft of femur.
Results: The overall mean angle calculated was 8.1±9.7, with a range of 60.5. Female type bones showed lower mean 6.6±12.2 and narrower range (46) as opposed to male bones (8.3±9.4 and range of 60.5 respectively.
Conclusion: There was a gender variation for the femoral neck ante version values in our society. The overall mean of femoral ante version determined is very different from Western, African, and most of the Asian populations and is very close to the Indian society.
Keywords: Femoral neck ante version, arthroplasty, femoral neck axis.

INTRODUCTION

The femur is one of the most investigated bones of human skeleton. The morphology of the proximal femur, especially the relationships among the head, neck, and proximal shaft, has been a subject of interest and debate in orthopedic literature dating back to at least the middle of the 19th century[1]. Because of evolutionary changes in the locomotion apparatus human femur and especially the proximal end is subjected to various kinds of mechanical forces and body loads which has given the femur complex anatomical features. There is wide variation in these anatomical features over the different social classes, variations in different ethnic groups, different geographical distribution, differences in sexes and differences even in the same individual[2-5].

A huge number of reference literatures are devoted to its anatomy, gender and racial polymorphism and age transformations[1,6] In femur the angle of femoral ante version (FNA) is one of the most studied and researched subject throughout the world since long till this date. The word “version” is referred to normal range of rotation around the longitudinal axis of a long bone. A range of more than two standard deviation errors is often taken as implying "torsion", and is considered as abnormal[7].

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MATERIAL AND METHODS

This descriptive cross sectional study was conducted in the Anatomy Departments of three medical institutions at Peshawar, namely, 1) Khyber Medical College, Peshawar. 2) Gandahara Medical College, Peshawar. 3) Khyber Girls Medical College, Peshawar from 13-08-2010 12-02-2011.

An inclusion criterion was comprised of adult dried femora extracted from dead bodies belonging to Peshawar and its surrounding villages irrespective of gender and laterality. Adult femora were selected on the basis of complete ossification of proximal and distal epiphyses and apophyses as seen with naked eyes. Femora of children and those with evidence of disease(skeletally deformed femora, having osteo-phytes on head & dysplastic head) were excluded.

Data was collected after taking approval from the heads of the concerned departments of the study setting after fully explaining the purpose and procedure of the study and seeking permission of the ethical committee. The data was collected from all the three study settings mentioned above. The dead bodies which were the source of dry femora studied belonged to Peshawar and its surrounding villages as discussed and confirmed with the heads of these departments which were identified by their physical characteristics and clothes.

Each femur was studied with respect to gender (male and female) and side (right and left) determination. The gender was determined on the basis of bone size, muscle attachment prominence and femoral head size. In males it is larger in size and has more prominent muscle attachments along with larger femoral head size as compared to the females. The side determination is straightforward with greater trochanter and intercondylar notch on the posterior aspect of the femur and the head of the femur towards the pelvis. The femoral ante version angle was measured by Kingsley and Olmsted method which is considered to be the most accurate method. In this method the femur was placed on a smooth, level, horizontal surface, so that it was rested on three points, namely, the posterior aspect of the two femoral condyles and the posterior aspect of the greater trochanter. Two smooth blocks, whose thickness was exactly the same as the thickness of the fixed arm of the goniometer up to the neutral (‘0’) mark from the horizontal surface, was then placed - one beneath the femoral condyles and the other beneath the posterior aspect of the greater trochanter. The anteroposterior width of the neck was determined at the proximal and distal ends of the neck of femur by Vernier calipers and taking half of this on both the proximal and distal points with the help of a ruler held along the mounted Vernier caliper were marked and joined to the surface of the femur, thus determining the true longitudinal axis of the femur. A 2 mm Kirschner wire was then placed along this line using clay adhesive representing the central axis of the neck. The goniometer was now mounted to measure the angle of the femoral ante version. One arm of the goniometer was along the horizontal surface and the other arm was parallel to the wire. The angle thus formed was taken as the “angle of femoral ante version”. For more accuracy two readings were taken for each femur and then their arithmetic mean was calculated.

Data collected on proforma was entered and analyzed in statistical software SPSS (version 10). The mean values, ranges and standard deviations (SD) were calculated for continuous variables like measurement of femoral ante version. Frequency and percentages were calculated for categorical variables like sex and side of femur.

RESULTS

Out of 211 femora, majority were of male type 189 (89.6%) and right and left side distribution was almost equal i.e., 103(48.8%) and 108(51.2%) respectively. (Table 2 and 3). The mean FNA of the total sample was 8.1±9.7 (Table 1). Significant difference was observed for the mean and standard deviation of male (8.3±9.4) and female bones (6.6±12.2) (Table 3). The female type of bones had a significantly narrower range (46 as opposed to 60.5) but higher value of standard deviation (partly because of lower number in the sample). The extremes of FNA value belonged more to the male type femora (Table 4). The study showed that almost 70% of the male type femora had FNA between 0 and 20 degrees and 91 bones (43%) showed FNA from 5 to 15 and almost 50% showed the value of FNA between 3 and 15.

Table 1: Cumulative Results for FNA[*]

	FNA
N[a]	211
Minimum	-27.0
Maximum	33.5
Mean	8.1
SD**	9.7
Range	60.5

Table 2: Sex wise distribution of the femora (n=211)

Gender	Frequency	%age
Male	189	89.6
Female	22	10.4

Table 3: Gender wise analysis for FNA[*]

	Male	Female
N[a]	189	22
Mean	8.3	6.6
SD**	9.4	12.2
Minimum	-27.00	-19.00
Maximum	33.50	27.00
Range	60.50	46.50

a= number of femora studied [*]*Femoral neck anteversion*
***Standard deviation*

Table 4: Gender wise distribution of FNA*

FNA*	Male (N [a])	Female (N [a])
< -10	5	2
-10 to -2	31	4
-1 to 1	6	0
2 to 5	24	3
6 to 10	45	5
11 to 15	32	3
16 to 20°	32	2
> 20	14	3

a= number of femora studied [*]*Femoral neck anteversion*
***Standard deviation*

Table 5: Comparison of gender varation in FNA of the present study with other studies

Author	Year	N[a]	Sex (M/F)	Mean FNA[*]-angle	SD**
Nagar[2]	2000	182	104/94	16.9	0.29
Jain et al[5]	2005	300	240/60	8.1	6.6
Mishra[3]	2009	344	262/82	8.5	-
Schachar[14]	2009	155	97/58	1.7	-
Kingsley[9]	1948	630	380/250	325/305	8.0
Wagner[17]	1927	956	499/457	485/471	11.7
Rokade[15]	2009	144	89/55	8.68	6.37
Present study	*2011*	*211*	*189/22*	*8.1*	*9.7*

**standard deviation* *a= number of femora studied*

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, various pathologies of the hip and the whole lower extremity 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. Hence estimation of anteversion on dry bone is still considered the most accurate method[8].

As we have adopted the same method for measurement which was adopted by Kingsley and Olmsted, it is better to compare our results with those of the mentioned authors. The mean value calculated for female femora by Kingsley was higher than the males and the range was almost the same for both sexes. This is in contrast to the present study. More femora belonged to the retroversion group in the present study (20.8%) as compared to the Kingsley and Olmsted study (14.5%)[9]. Further there is more clustering about the mean in the Kingsley study (more than 26% lying in the range of 5 to 10 degrees) in contrast to the present study (23.7%). This may be because of the larger sample size as compared to the present study as well. One other difference is the higher value for female femora (8.11) as compared to males (7.97°). Higher FNA values for female have been determined by a number of other authors. Maheshwari and colleagues[10] and Jain et al[5] have calculated it higher for females as compared to males with the help of CT scan. Similarly Aitkinson et al has found it higher for female against the males (8 vs. 7)[11].

Extremes of negative and positive values have been documented in these studies along with the present study. When comparing the various studies, the divergence among the results is striking. This may partly be due to differences between the methods of measurement, partly to differences between races, ages and sexes. Therefore, the great variability in the size of the FNA angle of the full-grown human femur may be considered as a proven fact thus making it extremely difficult to determine just what can be considered normal. This is why some authors take the 15-20 degrees as the average[12], some take 12 degrees as the average[13] and similarly various authors have taken the normal average value ranging from 11.9 to 25 for the Western society[9].

Gender variation is a fact which is reflected from nearly all the studies done on FNA and some of which are exemplified here (Table 5) and proved by the present study.

Majority of the studies have shown a relatively larger degree of FNA for females as compared to males in both the Western data and the Asian data including the Indian studies (Table 5). But comparing with another Asian study with which he compared his own results having significantly larger sample, his results can be justified as both had similar results. The results in Caucasians males the FNA mean was 14(4-36), females 16(7-28). In Hong Kong Chinese the FNA mean in males was 14(4-36) and 16 in females (7-28)[16].

Smaller sample size, non availability of paired femora and rarity of the female type femora were the limitations of the present study. Because of cultural trends the heirless female dead bodies are very rarely available for donation to anatomy museums through out the country. If a reasonably large female sample size would have been available, the results might have been different for the population.

CONCLUSION

There was a gender variation for the femoral neck ante version values in our society. The overall mean of femoral ante version determined is very different from Western, African, and most of the Asian populations and is very close to the Indian society.

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