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Research Article

Femoral Neck Anteversion: Dry Bone Measurements in Jammu

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Abstract

Objective: The femoral neck anteversion is the inclination of the axis of the femoral neck with reference to the knee axis projected on a plane, perpendicular to the shaft axis. Femoral anteversion is a physiological condition, within certain variations in degrees and differences depending on age. The wide variations in angle of anteversion of the femoral neck makes it necessary to know the angle of anteversion in a particular population. The accurate estimation of femoral neck anteversion in living subjects is not only difficult but has many shortcomings and also lacks reproducibility.

Materials and Methods: The present study was conducted on 100 dry unpaired human adult male and female femur bones from the collection of bones maintained by Postgraduate Department of Anatomy of our institute. These were used to measure the femoral neck anteversion angle by the Kingsley Olmsted method. Femora of unknown age and sex and those showing any gross deformity were excluded from the study.

Results: The mean femoral neck antiversion angle measurements of all femur bones irrespective of sex or side was 13.83o ± 3.15o whereas the mean femoral neck antiversion angle measurements of all male and all female femora were 13.69o ± 3.17o and 13.98o ± 3.11o respectively. Although the mean angle in females was more but the difference was statistically insignificant ($p > .05$).

Conclusion: Differences in various measured parameters were observed between male and female femoral neck anteversion angles however the differences in present study were observational only and were not statistically significant.

Keywords: Femoral Neck; Anteversion; Dry Bone Measurements

Introduction

The neck of the femur does not lie in the same plane as the shaft, instead is carried a bit forward as passes upwards and medially. As a result the transverse axis of the head and neck of the femur makes an angle with the transverse axis of the lower end of the bone. This angle is known as the angle of femoral torsion or the angle of anteversion [1].

Femoral anteversion is a normal physiological condition, within certain variations in degrees and differences depending on age [2]. If the axis of the neck inclines forward (anterior to the transcondylar plane), the angle of torsion is called anteversion, antetorsion or anterotation. Similarly, if it points backward (posterior to the transcondylar plane), it is called retroversion, retrotorsion or retrorotation. On the average, femoral anteversion ranges from 30-40 degrees at birth and decreases progressively throughout growth due to hereditary factors and local muscle forces and has a great importance in normal walk development [3-5]. In adults, anteversion averages between 8 and 14 degrees with an average of 8 degrees in men and 14 degrees in women [6].

To measure anteversion in living subjects there are many methods like imaging, clinical or intra-operative methods. Imaging techniques include fluoroscopy, biplane X-ray, axial X-ray, ultrasound, CT scan, Nuclear magnetic resonance and 3D remodeling. Clinical standard trochanteric prominence tests detects anteversion values slightly higher than the anteversion recorded on dried bones, this could be attributed to the overlying musculature. Intraoperative methods are most accurate and comparable to actual femoral anteversion [7]. But these techniques are not accessible in field situation. Also results of standard osteometric techniques are next best source and very close to above mentioned modern techniques. This study is an attempt to evaluate the normal femoral anteversion range in adult dry femora of Jammu population in UT of J and K India.

Materials and Methods

This cross-sectional observational study was carried out on 100 unpaired dry adult human male and female cadaveric femur bones from the collection of bones maintained by Postgraduate Department of Anatomy GMC Jammu. These were used to measure the femoral neck anteversion angle by direct measurements. Femora of unknown age and sex and those showing a significant bony or arthritic deformity or any other gross pathology were excluded from the study. The Kingsley Olmsted method [8] was followed to determine the angle of femoral torsion in our study. Dried cadaveric femur was placed on a table with the posterior surface of its condyles and greater trochanter touching a smooth horizontal surface. Retrocondylar axis was represented by the horizontal surface against which anteversion was measured with the help of the axis of the head and neck of femur. The horizontal limb of a goniometer was fixed at the edge of the experimental table. The vertical limb was held along the axis of the head and neck of the femur. The angle between two-axis was recorded as femoral anteversion angle.

Statistical Analysis

Data obtained from dry bone measurements was entered in MS Excel sheet and the results obtained were statistically analysed. The data was presented as frequency, percentage, and mean ± SD. Difference between continuous and categorical variables was analysed using student's t-test and chisquare test respectively. A p-value less than 0.05 were considered significant.

Results

Of the total 100 femora analysed half were of male and half of female group and 50% among each group belonged to right and left sides respectively. The mean femoral neck antiversion angle measurements of all femur bones irrespective of sex or side was 13.83 ± 3.15 whereas the mean femoral neck antiversion angle measurements of all male and all female femora were 13.69 ± 3.17 and 13.98 ± 3.11 respectively. Although the mean angle in females was more but the difference was statistically insignificant ($p > .05$) (Table 1). The mean femoral neck antiversion angle measurements of right and left femora in males were 13.93 ± 3.21 and 14.18 ± 3.13 degrees respectively which was slightly more on left side however the difference was found to be statistically insignificant ($p > .05$). Similarly the mean femoral neck antiversion angle of right and left femora in females was measured as 14.11 ± 2.89 and 14.53 ± 3.31 degrees respectively which again was slightly more on left side however the difference also was found to be statistically insignificant ($p > .05$) here as well (Table 2). Comparing the mean femoral neck antiversion angle measurements of right femora of both male and female sides (Table 2) it was found that it was more in females 14.11 ± 2.89 degrees however the difference was found to be statistically insignificant ($p > .05$). Similar results were observed on the left side as well where femoral neck antiversion angle measurements in left female femora was more 14.53 ± 3.31 degrees compared to that in left male femora 14.18 ± 3.13 degrees and again no statistical significance in the difference between the two was observed ($p > .05$) (Table 3).

Femur	FNA Male (mean ± SD) n = 50	FNA Female (mean ± SD) n = 50	P-value
Right and Left (Both)	13.69° ± 3.17°	13.98° ± 3.11°	0.645

Table 1: comparison of angle of Anteversion in males and females.

Femur	FNA Male (mean ± SD) n = 50	FNA Female (mean ± SD) n = 50	P-value
Right	13.93° ± 3.21°	14.11° ± 2.89°	0.835
Left	14.18° ± 3.13°	14.53° ± 3.31°	0.703

Table 2: Comparison of right and left angle of Anteversion in males and females.

Femur	FNA Right (mean ± SD) n = 50	FNA Left (mean ± SD) n = 50	p-value
Male	13.93° ± 3.21°	14.18° ± 3.13°	0.782
Female	14.11° ± 2.89°	14.53° ± 3.31°	0.635

Table 3: Comparison of angle of Anteversion in males and females on right and left sides.

Discussion

Femoral neck anteversion angles with a lot of variations have been reported in studies from many parts of the world.

Multiple number of methods are available to measure the femoral neck anteversion like physical examination, radiology, CT, MRI, ultrasound and dry bone measurements.

In the present study, dry bone measurements were used to assess femoral neck anteversion. The mean femoral neck anteversion angle of all bones both male and female including both right and left sides was measured and a value of 14.70° ± 2.26° was obtained.

Similar results also were reported in other studies as well. Siwach RC and Dahiya S [9]. did measurements of 150 dry bones and observed a mean femoral neck anteversion angle value of 13.68° ± 7.92° whereas Vipin sharma., *et al*. [10]. measured 93 dry femora and reported a value of 14.57° ± 2.67°. However Saikia KC., *et al.* [11] did measurements in 92 CT scans and found a value of 20.4° ± 8.6° whereas Vipin sharma., *et al*. reported a value of 14.70° ± 2.26° using digital radiography in 89 cases. The difference observed could be attributed to the two different methods of measurement used in these studies. Variable results were reported in other studies as well. Saikia KC., *et al*. studied 92 CT scans in Guhati and reported a value of 20.4° ± 8.6° while as Maheshwari AV., *et al.* [12] and Jain AK., *et al*. [12] measured femoral neck anteversion angles in 172 and 72 CT scans respectively in Delhi and found a value of 8.0° ± 4.7° and 7.4° ± 4.6° respectively. Toogood PA., *et al*. [13] also did measurements on 375 dry femora and reported a value of 9.73° (14.63° to 35.90°) whileas Umebese PF., *et al.* [14] studied 118 X-ray and reported a value of 28° ± 5°. Yun HH., *et al*. [15] analysed 112 CT scans and found that mean femoral neck anteversion angle was 9.0° ± 8.1°.

Variations observed in femoral neck anteversion angle value in above mentioned studies could be due to different races, different methods of measurement used and use of different anatomical landmarks while doing the measurements.

Femoral neck anteversion angle is known to show sexual dimorphism with males having a slightly less femoral anteversion than females. In the present study also we observed the same as the value of anteversion angle was found to be higher in the female bones however it had no statistical significance. Similar results were also obtained by [13,17,18].

We also observed a slightly higher value of femoral neck anteversion angle on right sided bones in both male and female femora although the difference was statistically insignificant.

Similar results were also reported by jain AK., *et al*. [13] and Srimathi T., *et al*. [18] in their studies.

Deviations of femoral neck anteversion angle from normal can clinically present as minor postural problem in children like in toeing to crippling hip osteoarthritis in adults. Conditions like external tibial torsion, flat foot etc. are related with increased femoral anteversion angle whereas diseases like rickets, chondrodystrophy etc. are related with decreased anteversion angle. Thus accurate measurement of femoral neck anteversion angle is not only essential for diagnosis of the disease conditions but also must for planning any definitive deformity corrective procedure like femoral or acetabular osteotomy [19-21].

The present study employed smaller number of hip bones, so it is advisable to carry out similar studies on more number of hip bones for its theoretical and practical value in the coming years.

Conclusion

Variations in the values of femoral neck anteversion measurements have been reported in literature from all over the world and therefore, analysis of anteversion of the femoral neck in a population assumes importance.

In the current study differences in various measured parameters were observed between male and female femoral neck an-

teversion angles which also varied from those observed in other racial and ethenic groups. The differences in present study were observational only and were not statistically significant. The observations however were consistent with the observations concluded by other authors in their studies as well.

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Conflict of Interest

None declared.

Ethical Approval

Not required.

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