

## Morphometric Measurement of Anteversion of Femur in South Indian Populations

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### Abstract

**Introduction:** The measurement of angle of anteversion is important in orthopedic surgery for hip replacement and to gain the normal activities of that joint. It is also important factor to increase the longevity of joint. **Methods:** Adult femora available in the anatomy department of different Medical College in costal Andhra Pradesh including G S L Medical College was used as study sample to get exact idea of femoral anteversion, any significant difference between right and left sided femora in South Indian population and to compare them with previous study. Goniometer and Vernier calliper were used to measure all the parameters. Values were analyzed by using statistical software (SPSS programmed, version-17). **Results:** The anteversion of present study was about  $18.78^{\circ}$ . Significant differences between left sided and right sided anteversion was observed. Anteversion on right side is  $19.45 \pm 5.64$  and on left side  $18.45 \pm 4.30$ . The p value is 0.048 which is  $< 0.05$ . **Conclusion:** The present study is an attempt to evaluate the angle of anteversion among the South Indian Population to determine the bilateral asymmetry and to compare it with the anteversion of other races like Caucasian, Negroes etc as stated in different literatures that might be helpful for orthopedic surgeon in hip replacement therapy.

**Keywords:** Anteversion; Femoral Neck; Racial Difference.

### Introduction

Femur is the longest bone of human body. Neck is rotated laterally in respect of the shaft of femur to form angle of anteversion (according to Gray's anatomy) [1]. The femoral neck anteversion (FNA) is thought to result from medial rotation of the limb bud in intra uterine life [2]. Its value is about  $10-15^{\circ}$  although some racial variations are observed in previous study. The value of anteversion also depends upon the axis which has been used for study. Nagar M et al [3] described in his study the

value of anteversion in the Indian (i.e.  $16.4^{\circ}$  in males and  $15.94^{\circ}$  in female) is less than African population ( $19$  degree) by using same retrocondylar axis. Farrally et al (1985) reported Indian average anteversion is probably higher than Caucasian and Oriental values but lower than African figures [4]. Hoagland F.T. [5] reported femora from cadavers of Caucasians, the anteversion angle averaged  $7.0^{\circ}$  in males (range,  $-2^{\circ}$  to  $35^{\circ}$ ) and  $10.0^{\circ}$  in females (range,  $-2^{\circ}$  to  $25^{\circ}$ ) by using transcondylar plane. Using similar techniques on cadavers of Hong Kong Chinese, they found that the average anteversion in males was  $14.0^{\circ}$  (range  $4^{\circ}$  to  $36^{\circ}$ ) and  $16.0^{\circ}$  in females (range,  $7^{\circ}$  to  $28^{\circ}$ ). This racial variation of femoral anteversion is an important implication for assessment in correction of anteversion in orthopedic setting in different racial groups. The measurement of angle of anteversion is important in orthopedic surgery for hip replacement and to gain the normal activities of that joint. It is also important factor to increase the longevity of joint.

The present study is an attempt to evaluate the angle of anteversion in South Indian Population to determine the bilateral asymmetry and to compare it with the anteversion of other races like Caucasian,

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Negroes etc as stated in different literatures that might be helpful for orthopedic surgeon in hip replacement therapy.

**Materials and Methods**

The angle of anteversion can be measured by various methods. For example biplane radiography, CT scan is used to determine anteversion. Clinically FNA is measured by trochanteric prominence angle test (TPAT) or Craig test [6]. The present study is morphological study and the angle of anteversion was measured according to the guidelines given by Nagar M et al [3].

Goniometer and Vernier calliper were used to measure all the parameters to get exact idea regarding anteversion in South Indian population and to determine any significant difference between right and left sided femora in South Indian population. Values were analyzed by using statistical software (SPSS programmed, version-17).

*Sample Size and Sampling Design*

Adult femora available in the anatomy department of different medical college in costal Andhra Pradesh including G S L medical college was used as study

sample. Written permission from the competent authorities was obtained for inclusion of femora from other institutions. All together 220 adult femora were final sample size for the study. Only intact adult femora were taken after the determination of side. Sex determination was excluded from study.

**Result Analysis and Observation**

Analysis of values shows that out of 220 femora, 110 measurements of each case for right and left sided angles of anteversion give average values (means) as 19.45° and 18.11° respectively. The mean difference for same parameter between right and left side is 1.35cm [ Table 1].

Pair t test were used to determine p and t values for present study. After analyzing, It was found that p values for anteversion is <0.05 which are statistically significant. Value for t and p are -1.99 and 0.048 for anteversion [Table 2].

The angle of anteversion of present study is 18.78 degree (average) while in Asian population showed 14° for male and 16° for female. The value of anteversion is 7° in male and 10° in female among Caucasian [Table 3].

**Table 1:** Measurements of anteversion in dry adult femora

Parameters	Mean	Std. Deviation	Std. Error of mean
Angle of anteversion (degree ) n-220	18.78	5.09	0.34
Angle of anteversion of left femora (degree ) Number- 110	18.11	4.39	0.42
Angle of anteversion of right femora (degree ) Number- 110	19.45	5.64	0.54

**Table 2:** Statistical comparison of angle of anteversion between right and left side

Variable	Angle of anteversion
Mean+-SD (right side)	19.45+/-5.64
Mean+- SD(left side)	18.11+/-4.39
t-value	1.99
p value(2-tailed level of significance)	0.048
Significance	Significant

**Table 3:** Comparison between present studies with previous studies of India and outside India

Different Study	Anteversion (Degree)
RC Siwach, S Dahiya Nagar M et al	0-36(average)13.6 Male11.32(left),21.23(right), Female11.02(left),20.87(right)
Caucasian	
Male	7°
Female	10°
Asian	
Male	14°
Female	16°
Present study(irrespective of sex)	18.78°

## Discussion

The knowledge of the normal proximal geometry is required in selection of patient for prosthesis and pre operative planning of hip replacement and for anthropological studies. Proximal end of femur is also important to design the implants which are suitable for Indian population to give maximum functional end result. The present study was conducted to see the anteversion of femur in South Indian population.

Most of the books of Anatomy quoted an average anteversion angle were about 10-15°. Not many Indian studies were available with respect to the dimensions of proximal femur. R.C. Siwach [7] (2003) worked on 75 pairs of femora and reported the value of anteversion 13.68°. Nagar M. et al [3] reported in their study anteversion was about 15.94° in female & 16.4 degree in male. P.C. Kingsley et al [8] and Braselio [9] observed in their study average value of anteversion 8.021° and 11.32+/-0.3 degree respectively.

The present study was carried out on 220 femora and anteversion of present study was about 18.78°. The result of present study almost was similar to Nagar M. et al study but greatly varies from study of P.C. Kinseley [8].

The present study also found significant differences between left sided and right sided anteversion. Anteversion on right side is 19.45+/-5.64 and on left side 18.45+/-4.30. The p value is 0.048 which is <0.05. Similar significant findings were also reported by Nagar M. et al and Oetra Braselio [9] in their studies. Greater right side anteversion has been documented by Le Damany [10], Kingsley et al, and Yoshioka et al, [11] in Caucasians, Oriental & African population.

P.C. Kingsley [8] et al reported that retroversion was a frequent finding in adult although in present study no retroversion was observed. Similar findings were reported R.C.Siwach [7] and Nagar M et al [3] in their study.

## Conclusion

Femoral anteversion values of South Indian population are almost similar to other regions of

India. There are significant statistical differences between right and left sided anteversion. Therefore this study will enlighten orthopedic surgeon and the biomechanical engineer to design the implants suitable for Indian population.

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