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Study and evaluation of acetabular anteversion angle in South Indian population for total hip arthroplasty

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Abstract
Aim: To determine the average acetabular antiversion angle in south Indian population, for ideal acetabular cup position in Total Hip Arthroplasty.
Background: Abnormal acetabular anteversion of the hip, has been from many years the etiogenesis of early hip wear and tear leading to osteoarthritis [1].
In this era the demand for total hip replacements has increased worldwide and in India as well. The acetabular anteversion angle plays a very important role in terms of longevity of the implant and cup positioning.
Since studies on acetabular anteversion are very few compared to western and Asian studies hence, the purpose of this study is to find out the acetabular anteversion angle for south Indian population.
Materials and Methods: A retrospective study of 250 CT scans of hips where collected from 2017 to 2020 and the mean acetabular anteversion angle was measured which was compared with Asian and western population.
Results: The average acetabular anteversion angle is 20.9±3.19 there was no statically significant difference between male and female population, as with the side, left and right side (p=0.02).
There was a significant 2 to 3 degree increase in acetabular antiversion compared to US, European and Asian studies.
Conclusion: The average acetabular anteversion angle 20.9 ±3.19 was significantly higher when compared to the western population due to the habitual cross legged sitting and squatting since childhood, hence this should be taken into consideration when designing and positioning acetabular cups during total hip arthroplasty.

Keywords: acetabular anteversion angle, total hip replacement, acetabular cup positioning

Introduction
Most of the studies regarding acetabular anteversion has been carried out in western and asian population. Few studies have been made for Indian population especially south Indian population in particular.
A definitive radiological measurement of acetabular anteversion in normal south Indian individuals is lacking. According to Lewinnek *et al.* cups with more than 25° of acetabular ante version had higher incidence of anterior dislocations [6].
Hence any change in the anteversion of acetabulum for that native hip will lead to altered biomechanics of hip joint and easy wear and tear of the implant.
This measurement will help us to determine the outcome of total hip replacement surgeries and thus create implants specific for Indian hip bone morphology. Since antversion varies with race, most of the total hip arthroplasty implants are based on western population. Previous review global literature reveals a wide range of normal FNA and AA with racial and geographic variation [2, 5]. This variation is expected to exist because of different social needs of the different races.

Material and Methods
Our study included patients with normal hips CT angiogram of lower limbs from the year 2017 to 2020 from department of radiology, after we have examined them for any hip pathology.

A total of 250 hips both right and left sides, total of 125 patients were reviewed which all skeletally mature patients were. Using the same Ct scan machine Siemens HD Edge 128 slice cuts.

Method of measurement

Line X: Horizontal line connecting two identical points on either side of the pelvis, marking the sagittal plane
Y: Line perpendicular to line X
Z: line connecting the lateral anterior and posterior margins of the acetabular component
A: Angle of acetabular anteversion, calculated between lines Y and Z.

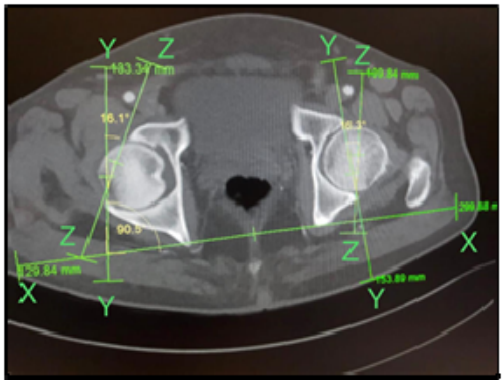

Fig 1: Lines X,Y & Z, showing horizontal plane ,vertical plane & acetabular inclination plane respectively .Between Y and Z is the acetabular angle.

Defined as: Angle of acetabular anti version is the angle between a line connecting the lateral anterior and posterior margins of the acetabular component and the sagittal plane defined as the plane perpendicular to a line connecting two identical points on either side of the pelvis [5].
Inclusion criteria, Adults who had a computed tomographic (CT) angiogram scan of the pelvis with lower limbs for pathology unrelated to the hip. Patients with complete bony fusion of the acetabulum were only included.

Exclusion criteria

1. Young patients of paediatric age group or patients with incomplete fusion of the acetabulum,
2. Patients with hip pathology as evident clinically with gait abnormality and or pain or restriction of hip motions
3. Patients with bony pathology of the pelvis and femur including fractures or deformities.
4. Previous surgical fractures with hardware in situ
5. Any patients with metabolic bone disease.

Fig 2: Showing left sided severe arthritis with extensive osteophytes

All the CT scans were evaluated by two of us orthopaedic surgeons and with help of a radiologist for any abnormalities in the soft tissue muscle plane and bone window cuts. As in the above fig 2 we can see a arthritic left hip joint wherein we cannot measure the angle of anteversion and hence was excluded.

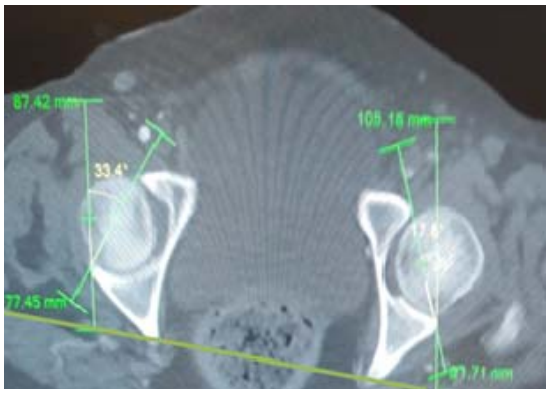

Fig 3: Shows a soft tissue mass which increased the angle of ante version

This case (fig 3) was also excluded from this study, due to soft tissue mass which increased the angle of acetabular anteversion to 33.4 degrees on the left hip.

Results

Our work sheet was tabulated for 250 hips (125 patients) with normal hip morphology. CT angiograms of these patients were studied with the help of orthopaedicans and one radiologist.

Table 1: Demographic

No of Patients		250
Sex	Male	138 (61%)
	Female	112 (39%)
Mean Age		54.43±12.78 (24-82)
Side	Left	129 (52%)
	Right	121 (48%)
Mean Antieversion Angle		20.9°±3.19 (15.10-31.20)

*mean ± standard deviation (Min-Max)

This Table 1 shows the demographic pattern of my study 132 male and 112 female cases. Average anteversion angle in the population sample of 250 is 20.9° with std and range respectively ±3.19 (15.10-31.20).

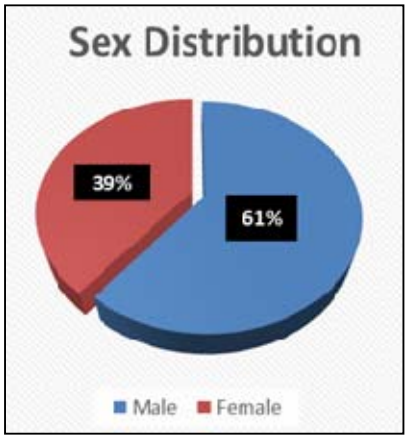

Fig 4: Sex Distribution

Table 2: Average Antiversion angles seen in male and female.

Sex	N	Mean Age	P value
Male	132	57.1± 11.4 (24-80)	0.01
Female	112	50.4 ±13.8 (26-82)	

The average anteversion angles seen for male and female sexes for the population of this study P value 0.01 is not significant.

Table 3: Average Antiversion angles seen in male and female.

Sex	N	Mean Antiversion Angle	P value
Male	132	20.3°±3.34 (15.1-31.2)	0.02
Female	112	21.2°±2.8 (15.4-31.05)	

**Significant level is 0.05
*** CI is 95%

A 0.9 degree increase in mean acetabular anteversion angle in females (21.2°±3.34) compared to male population (20.3°±2.8) P value being 0.02 which is not significant Confidence interval (Cl is 95%.)

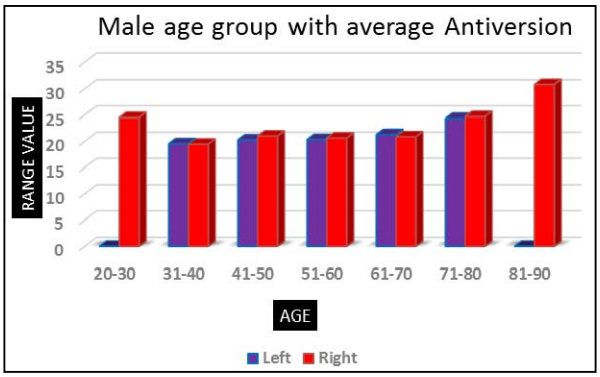

Fig 5: Showing average acetabular anteversion in males with regards to age.

Table 4: Male age group

Male age group distribution by Antiversion angles		
Age group	**Left**	**Right**
20-30	0	24.5
31-40	19.53	19.45
41-50	20.26	21.01
51-60	20.33	20.63
61-70	21.28	20.87
71-80	24.33	24.69
81-90	0	26.83

Key point: Male age distribution by age group and their anteversion angle in both side. Age group 81-90 Right side is having 27.83 the highest anteversion angle and age group 31-40 having the lowest anteversion angle seen in both side. Else in left side the age group 71-80 having the anteversion 24.33.

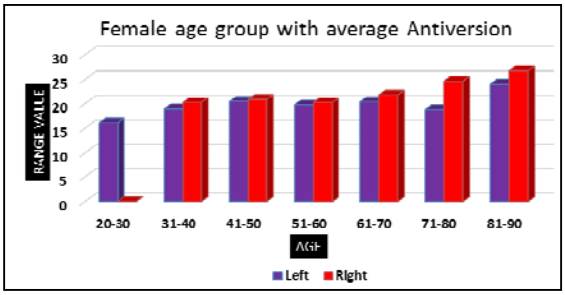

Fig 6: Showing average acetabular anteversion in females with regards to age.

Table 5: Male age group

Female age group distribution by Antiversion angels.		
Age group	**Left**	**Right**
20-30	16.03	0
31-40	18.89	20.26
41-50	20.44	20.87
51-60	19.74	20.24
61-70	20.35	21.79
71-80	18.7	24.62
81-90	24	25.75

Key point: Female age distribution by age group and their anteversion angle in both side. Age group with 81-90 in both side having highest anteversion angle and age group 51-60 having the lowest anteversion angle seen in right and in left the age group 20-30 seen the lowest anteversion angle.

Table 6: Male and Female antiversion angle by their side.

Sex	Left	Right
Male	19.4± 3.2 (15.1-29.8)	21.4± 3.5 (15.5-31.2)
Female	21.2± 2.4 (15.3.1-25.9)	21.2± 3 (16.8-31.05)

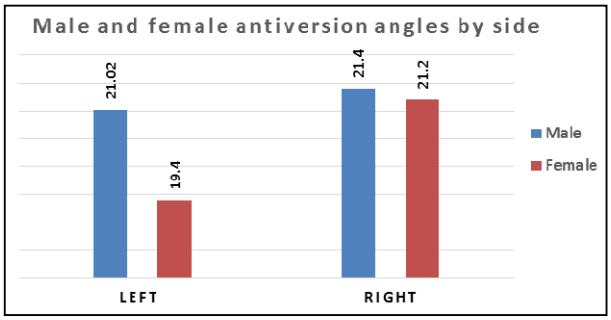

Fig 7: Acetabular anteversion angle male vs female with regards to dexterity

Key Point: Fig 7 shown the comparative analysis between left and right side of male and female group.

We can seen the left side anteversion angle in high in male and less in female population

Correlation Analysis between Age and antiversion angle

The CORR Procedure

2 Variables:	AGE	ACETABULAR ANTIVERSION

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
AGE	250	54.43205	12.78291	13608	24.00000	82.00000	AGE
ACETABULAR ANTIVERSION	250	20.86952	3.18546	5217	15.10000	31.20000	ACETABULAR ANTIVERSION

Pearson Correlation Coefficients, N = 250
Prob > |r| under H0: Rho=0

	AGE	ACETABULAR ANTIVERSION
AGE AGE	1.00000	0.40616 <.0001
ACETABULAR ANTIVERSION ACETABULAR ANTIVERSION	0.40616 <.0001	1.00000

The CORR Procedure

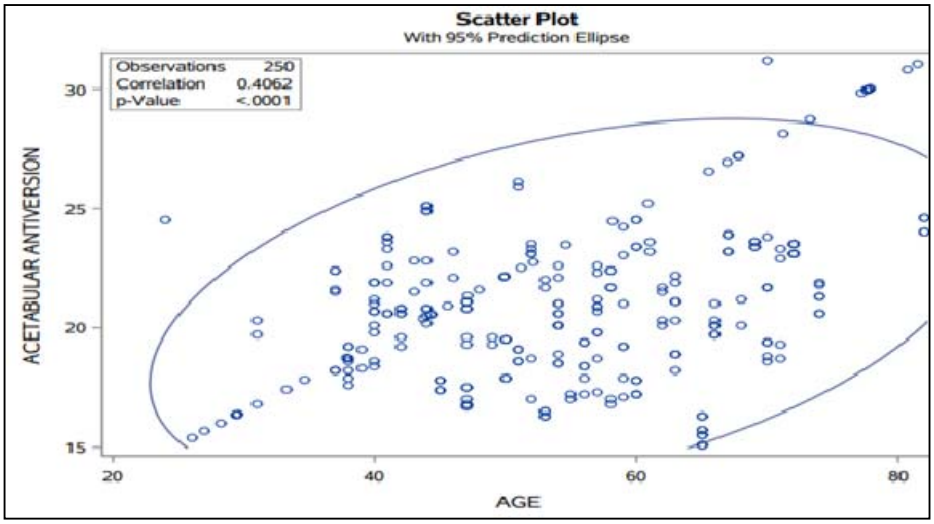

Fig 8: Showing a scatterd plot of age vs acetabular anteversion showing positive correlation

There is a Positive correlation seen (=0.40) between age and anteversion angles with significant p value (Fig 8)

Table 7: Average mean Antiversion angle countrywise

Average mean Antiversion angle countrywise	
India (our study)	20.9®± 2.8
Asia	19.2®±3.11
Australia	18.2®±2.8
UK	17.3®±3.16
USA	16.7®±2.3

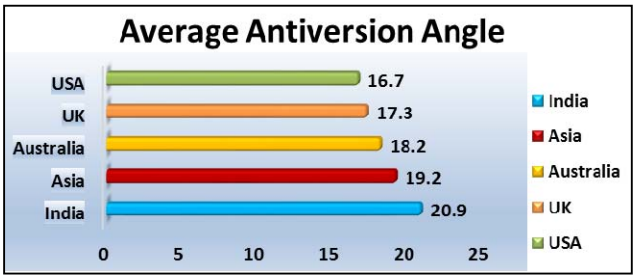

Fig 9: Comparison of our acetabular anteversion with other country registry data.

Average anteversion angel seen among different country India (south Indian population) having higher average acetabular antiversion angle.

Discussion

Acetabular cup placement in THA can be difficult and optimal placement is required to prevent chronic instability, accelerated wear, implant migration [11].

Hence acetabular anteversion angle plays a important role in cup positioning

In our study it is of importance to note that our south Indian mean anteversion angle is 20.9 ±, placing the version guide at an angle of 20 or 21 degrees will mimic the native ante version with better anatomic cup positioning.

Using CT based calculation, an exact reference plane can be defined and such reference provides highly accurate information of the cup position [7].

In the present study, we obtained CT-scans with the patient in supine position to measure the version of the acetabulam.

We had a 1to 2 degrees of Intra- and interobserver errors have been reported respectively between two orthopaedic surgeons and radiologist.

In our study we derived at a mean acetabular ant version angle of 20.9±3.19 (mean + standard deviation) with the angle being 1degree less in females as compared to males, however this is not statistically significant.

Acetabular anteversion increased with age especially in age group more than 70 years and above.

When we compared our study in south Indian population with other registry data analysis of western and Asian population and found that our study population had an increased acetabular anteversion angle of 2 degrees more.

We can attribute the increased anteversion to our cross legged sitting and squatting since childhood mostly in south Indian population.

Conclusion

Many studies have been done in western population on acetabular antiversion

Very few in Indian population and this study is the only study on south Indian population with a significantly large sample size of 250 patients (125 hips).

This average mean anteversion angle of 20.9±3.19 will help the surgeon as an indicator and guide when using the version guide gig in total hip arthroplasty in order to have a near perfect anatomical cup placement which is a key step in THR. Thus this will improve the longitivity and decrease the wear on the implant.

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