

## RESEARCH ON ACETABULAR PARAMETERS, FEMORAL AND COMBINED ANTEVERSION ANGLES ON COMPUTED-TOMOGRAPHY SCAN

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### ABSTRACT

54 computed-tomography scans of 54 Vietnamese adults with at least 1 non-pathological hip at Hanoi Medical University Hospital are used on our research. The results are: Acetabular inclination angle:  $37.48 \pm 4.95^\circ$ ; Acetabular anteversion angle:  $17.2 \pm 5.81^\circ$ ; Femoral anteversion angle:  $12.03 \pm 7.32^\circ$ ; Combined anteversion:  $29.23 \pm 9.07^\circ$ .

**Keyword:** *Acetabulum, femoral anteversion, combined anteversion.*

### I. INTRODUCTION

Total hip arthroplasty and hemiarthroplasty have become more and more popular in treatment of hip pathology with the number of hips replacement is increasing. However, the compliance of this procedure (such as dislocation, impingement, accelerated wear, decreased lifespan of implants ...) remains an enormous challenge for surgeons to deal with. Normal morphology of hip joint in general, acetabulum, along with femoral anteversion and combined anteversion in particular plays an important role in improving preoperative planning and postoperative hip evaluation [1]. The

development of medical imaging technology allows clinical physicians to measure the hip parameters for preoperative, intraoperative and postoperative evaluation. Among the common radiographic techniques, computed-tomography scan (CT scan) is considered as reliable method to measure hip parameter pre-operatively. CT scan provides accurate information and images about the hip so that clinical surgeons are able to ensure appropriate prosthesis component and position which stabilize the prosthesis and prolong their age [2], [3]. With the aim of contributing to the data of normal morphology of acetabulum on computed-tomography (CT) scan, in addition to aid the surgeons with the reference data in clinical practice, the purpose of this study was to evaluate acetabular inclination, acetabular anteversion, femoral anteversion and combined anteversion on CT scans of Vietnamese adults.

### II. MATERIAL AND METHOD

#### 2.1. Subjects

CT scan images which started from the top of the pelvis to below the tibial tubercle and stored on Picture Archiving and Communication System (PACS) of 54 patients whose age from 25 to 96 (with mean age and SD are 61 and 16.62 respectively) with no hip pathology on at least one side at Radiology Center of Hanoi Medical University Hospital in the period from August 2018 to April 2020.

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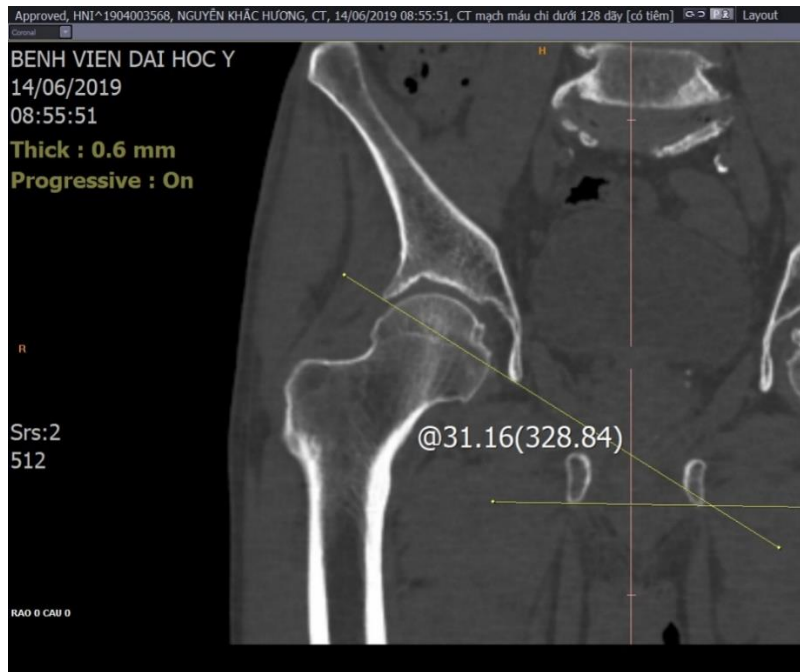
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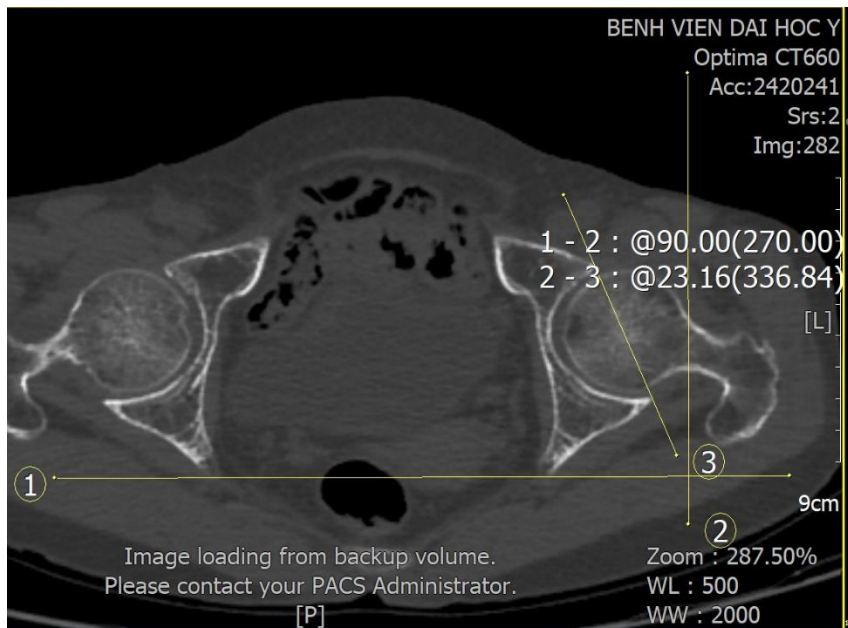


*Image 1.* A sample of acetabular inclination

**2.2. Method**

- Acetabular inclination is determined on coronal slice contains femoral head center. Acetabular anteversion is in which the distance between acetabular anterior margin and posterior margin is greatest. Femoral

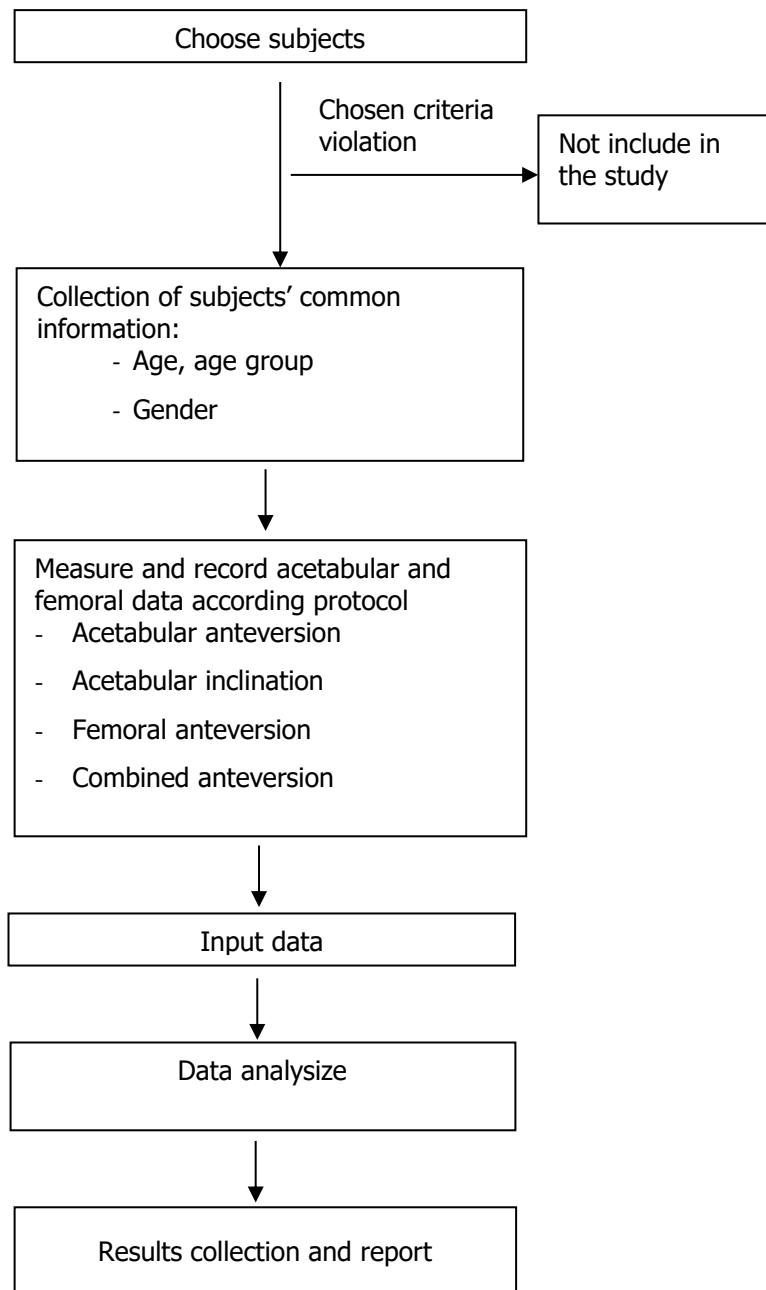
anteversion is measured by determined by single-sliced axial method. Combined anteversion is calculated by the sum of acetabular anteversion and femoral anteversion.



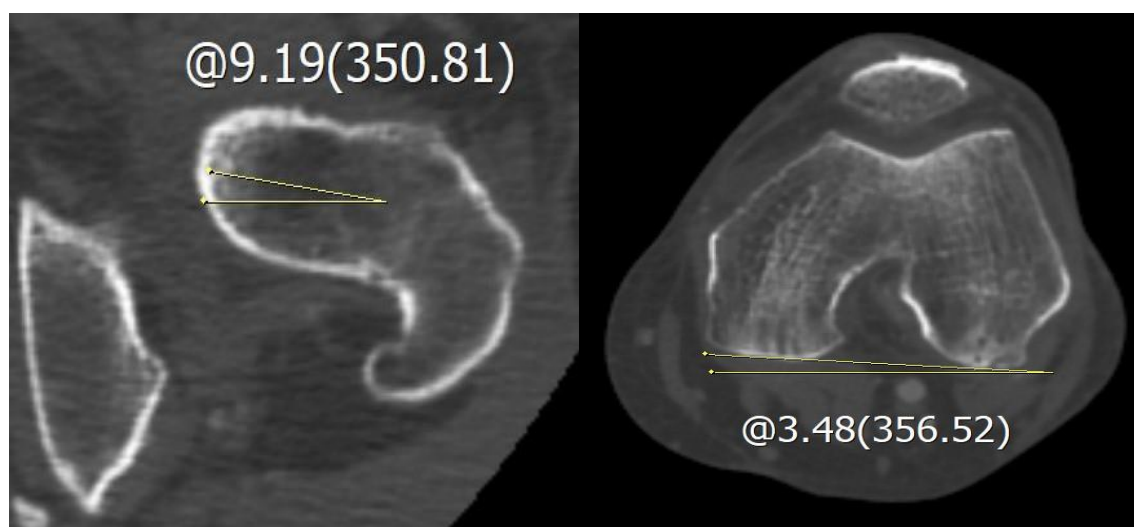
*Image 2.* A sample of acetabular anteversion

- Data of the parameters are measured on PACS, recorded on medical study records and analyzed by SPSS 20.0 and Microsoft Excel Office 2016. Normal distribution of variables is tested by Kolmogorov-Smirnov test. The comparisons between variables are

tested by t-test and paired t-test for variations with normal distribution, by Mann-Whitney-U test for variables with abnormal distribution. Spearman and Pearson correlation are used to test relations between variables (Figure 1).



*Figure 1.* Data record diagram.



*Image 3.* A sample of femoral anteversion measured by single-sliced axial method

III. RESULT AND DISCUSSION

*Table 1.* Sex-based comparison of acetabular parameters and anteversion angles

		Acetabular inclination (°)	Acetabular anteversion (°)	Femoral anteversion (°)	Combined anteversion (°)
This study	Total	37.48 ± 4.95	17.2 ± 5.81	12.03 ± 7.32	29.23 ± 9.07
	Male	36.89 ± 5.17*	16.08 ± 5.65*	10.47 ± 6.11*	26.54 ± 8.03*
	Female	39.25 ± 3.8*	20.51 ± 5.04*	16.66 ± 8.69*	37.17 ± 7.22*
Tran Trung Dung et al. [4]	Total	38.5 ± 3.9	17.2 ± 7.0	13.7 ± 10.4	30.8 ± 13.2
	Male	38.6 ± 3.8	16.3 ± 7.1	13.3 ± 11.7	29.6 ± 14.8
	Female	38.3 ± 4.3	18.7 ± 6.8	14.3 ± 7.8	33.0 ± 9.8
Aditya V. Maheshwarie t al. [5]	Total	-	19.1 ± 5.0	8.0 ± 4.7	27.1 ± 6.3
	Male	-	17.3*	7.3	24.6*
	Female	-	20.8*	8.7	29.5*
Nan Jiang et al. [6]	Total	-	18.79 ± 5.30	10.62 ± 9.02	-
	Male	-	18.27 ± 5.22*	9.31 ± 8.58*	
	Female	-	20.44 ± 5.26*	14.76 ± 9.13*	

\*Significant at the 0.05 level

Regarding of gender, acetabular parameters, femoral anteversion and combined anteversion of male is lesser than female with the 0.05 level of significant. This study’s results are different from the study of Tran Trung Dung et al., where there is no different of hip joint’s parameters between two genders. The study of Aditya V.

Maheshwari et al. indicates that there is no difference in sex-based femoral anteversion comparison while there is difference in acetabular anteversion and combined anteversion. The sex-based difference in acetabular anteversion and femoral anteversion observed in the study of Nanjiang et al.

**Table 2.** Side-based comparison of acetabular parameters and anteversion angles

		Acetabular inclination (°)	Acetabular anteversion (°)	Femoral anteversion (°)	Combined anteversion (°)
This study	Total	37.48 ± 4.95	17.2 ± 5.81	12.03 ± 7.32	29.23 ± 9.07
	Left	36.95 ± 4.87	16.79 ± 5.87	12.15 ± 7.38	28.94 ± 8.61
	Right	38.01 ± 5.03	17.59 ± 5.79	11.91 ± 7.34	29.5 ± 9.58
Aditya V. Maheshwari et al.	Total	-	19.1 ± 5.0	8.0 ± 4.7	27.1 ± 6.3
	Left	-	18.9	7.4*	27.6
	Right	-	19.2	8.7*	26.6
Nan Jiang et al.	Total	-	18.79 ± 5.30	10.62 ± 9.02	-
	Left	-	18.43 ± 5.21*	10.93 ± 9.13	-
	Right	-	19.10 ± 5.38*	10.41 ± 8.85	-

\*Significant at the 0.05 level

In term of side comparison, our study found no asymmetry in the acetabular parameters and anteversion angles. In the study of Aditya V. Maheshwari et al., there was difference in femoral anteversion between right and left hip, the difference was not found in acetabular anteversion and combined anteversion. Nanjiang et al.'s research show that there was difference in acetabular anteversion in two sides while there was no difference in femoral anteversion. The side-based difference may be result from leg dominance. The dominant lower limb, usually the right, places greater biomechanical stresses and loads to the dominant so the parameters and angle of femoral neck, head and acetabulum on the dominant side tends to be smaller than the

other side [7].

We found that combined anteversion has a positive correlation with femoral anteversion and acetabular anteversion (correlation index are 0.592 and 0.769 respectively), and there were no correlations between other couples of parameters. Leonard T. Buller et al. found correlation between femoral anteversion and acetabular inclination as well as femoral anteversion and acetabular anteversion [8]. Reikeråls. et al's study on 47 persons with normal hip joint and 39 persons with osteoarthritis found that there was no correlation between femoral anteversion and acetabular anteversion, and the existence of this correlation may contribute to the osteoarthritis of hip [9].

**Table 3.** Correlations between acetabular parameter and anteversions

<b>Parameter</b>	<b>Acetabular inclination</b>	<b>Acetabular anteversion</b>	<b>Femoral anteversion</b>	<b>Combined anteversion</b>
Acetabular inclination	1			
Acetabular anteversion	0.01	1		
Femoral anteversion	-0.66	-0.59	1	
Combined anteversion	0.592*	-0.047	0.769*	1

\*Significant at the 0.01 level

## IV. CONCLUSION

- Mean and standard deviation of femoral anteversion are  $12.03 \pm 7.32^\circ$ , age-based difference is observed between the age group under 60 and 60 and above.

- Mean and standard deviation of acetabular anteversion are  $17.2 \pm 5.81^\circ$ .

- Mean and standard deviation of acetabular inclination are  $37.48 \pm 4.95^\circ$ .

- Mean and standard deviation of combined anteversion are  $29.23 \pm 9.07^\circ$ .

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