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Research Article

Morphology Study of the Acetabulum Values of Indonesian Deutero Malay Sub-race Population in South Sulawesi

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Abstract

Background and Objective: The normal morphology of acetabular is an essential factor which determines the clinical results of hip surgery. No previous study has been documented regarding normal value of acetabular in Indonesian race and on how they are different with normal values of Caucasian race. This study aimed on measurement of normal acetabular morphologic values of Indonesia deutero malay sub-race population in South Sulawesi Indonesia and compare it with existing data of Caucasian morphological values. **Materials and Methods:** This cross-sectional study was performed at Wahidin Sudirohusodo Hospital in Makassar, South Sulawesi, Indonesia. A total sample of 50 acetabular images of normal Indonesian deutero malay sub-race individuals were acquired using computed tomography scanner and measurement of several parameters were done. Obtained data were collected and compared to normal values of Caucasian race from Western literatures and analyzed with independent samples t-test using Statistical Package for the Social Science (SPSS) version 18 software. The p-value of < 0.05 was considered to be significant. **Results:** The findings for acetabular values of males and females are as follows: Center-edge angle (CE) 35.04 ± 4.21 and $33.48 \pm 3.78^\circ$, acetabular index angle (AA) 9.68 ± 1.24 and $9.6 \pm 1.32^\circ$, acetabular angle of sharp 59.76 ± 7.74 and $58.08 \pm 6.35^\circ$, acetabular version (AcetAV) 21.4 ± 3.08 and $22.00 \pm 3.16^\circ$, anterior acetabular sector angle (AASA) 59.28 ± 8.90 and $58.48 \pm 8.79^\circ$ and posterior acetabular sector angle (PASA) 88.64 ± 3.8 and $91.32 \pm 4.7^\circ$. Comparison to Western results, it showed a significant difference between two groups. **Conclusion:** The acetabular morphologic values of Indonesian deutero malay sub-race population is significantly different in comparison with Western population (Caucasian). The study will provide important data for Indonesian orthopaedic surgeon during acetabular placement and also in hope for designing acetabular cup implants which better fit in the interest of Indonesian population.

Key words: Acetabular morphological values, comparative analysis, Indonesian population, Western population, hip surgery

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

An appropriate anatomical concept is one of key feature which determines a successful surgery. Regarding a total hip arthroplasty surgery, a normal morphology and orientation of acetabular is an essential knowledge which will determine the clinical results of the surgery. A malpositioned acetabular component during total hip arthroplasty can result in dislocation, limited range of motion, polyethylene wear, pelvic osteolysis and component migration. Several studies had been done regarding the parameters variation in acetabular especially the relationship between this value with the dysplasia, osteoarthritis, fracture and other diseases associated¹⁻⁴.

The normal anatomical values of acetabular may vary with age, sex and race. Thus, some surgeons prefer to use the values of native acetabulum as a guide for the design of hip joint prosthesis and placement of acetabular component during Total Hip Arthroplasty (THA). Based on the literature, there is a wide inter-individual variation in acetabular anatomy in the normal population. Some parameters are significantly different in people of different sex and race⁵⁻⁹.

The acetabular images provide the surgeon informations about native size of the acetabular, aid to determine the proper size of the acetabular cup during THA and to achieve normal acetabular alignment. Computed tomography images provide better images and more reliable measurements than the plain X-ray.

Whilst many of the hip arthroplasty implant being used in Indonesia was designed based on anatomical values of Western population, up to author's knowledge, there is still no published study regarding normal value of acetabular in Indonesian people and how are they different with normal values of Western population (Caucasian race).

This study aimed on measurement of normal acetabular morphologic values of Indonesia deuteromalay sub-race population in South Sulawesi Indonesia.

MATERIALS AND METHODS

This study is a cross-sectional study comparative performed at Wahidin Sudirohusodo Hospital, Makassar, South Sulawesi, Indonesia, from December, 2016 to March, 2017 with a total sample of 50 acetabular images of Indonesian individual using computed-tomography scanner (CT-scanner). The inclusion criterias were adult Indonesian male or female with deuteromalay sub-race, 25-49 years old, normal hip and body mass index (BMI) ≤ 25 . Subjects with hip disorder, neurological deficit and gait abnormality, were

excluded. Informed consent was obtained from each subject and the study was approved by Ethical Committee of Hasanuddin University.

Acetabular images were obtained using CT scanner machine (General Electric Company, Wiscounsins, USA). The CT scan was done in supine position with hip and knee fully extended and the lower limbs secured to the table with straps. The foot was stabilized with a specially designed wooden frame while taking the cuts. The limbs were kept in identical position and were parallel to the CT machine. The thickness of each CT cut was 5 mm.

Parameters measured were central edge angle (CE), acetabular index angle (AA), acetabular angle of sharp, acetabular version (AcetAV), anterior acetabular sector angle (AASA) and posterior acetabular sector angle (PASA).

The definition used in this study as shown below:

- **Center edge angle (CE):** The angle between line from the center femoral head to the lateral margin of acetabulum and the vertical line from center femoral head. Normal value according to Wiberg², Han *et al.*⁹ and Werner *et al.*¹⁰ was 25° (Fig. 1)
- **Acetabular index angle (AA):** The angle between pelvic horizontal line and line from lateral margin to superior fovea¹¹ (Fig. 2)
- **Acetabular angle of sharp:** The angle between the line from the tip of pelvic tear drop to the lateral margin of acetabulum and the horizontal line through the tip of pelvic tear drop. Normal value was 33-38°^{12,13} (Fig. 3)
- **Acetabular version (AcetAV):** The angle between the line perpendicular that linking posterior ischium and the line connecting anterior and posterior margin of acetabulum. Normal value was 15°-20°^{14,15} (Fig. 4)

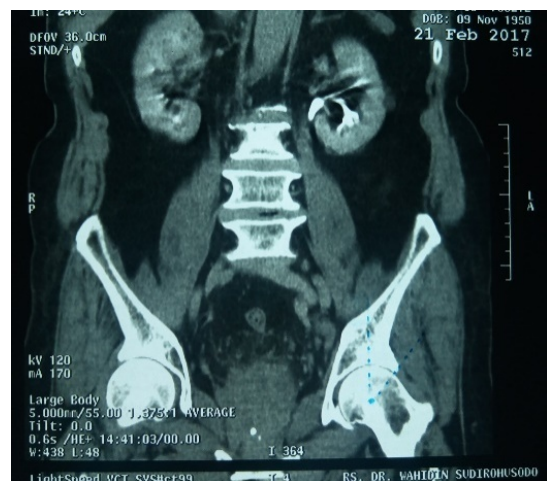


Fig. 1: Measurement of center edge angle in CT-scan image



Fig.2: Measurement of acetabular index angle in CT-scan image

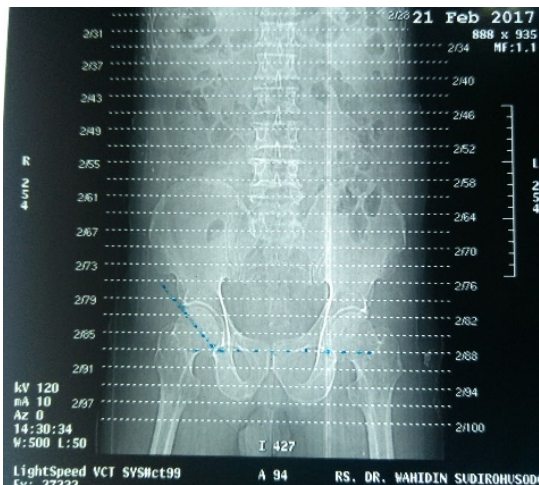


Fig. 3: Measurement of acetabular angle of sharp in CT-scan image

- Anterior acetabular sector angle (AASA):** The angle between center line of both femoral heads and line from center towards the anterior margin of acetabular. Normal value for male was 64° and female was 63° ^{16,17}



Fig. 4: Measurement of acetabular version in CT-scan image

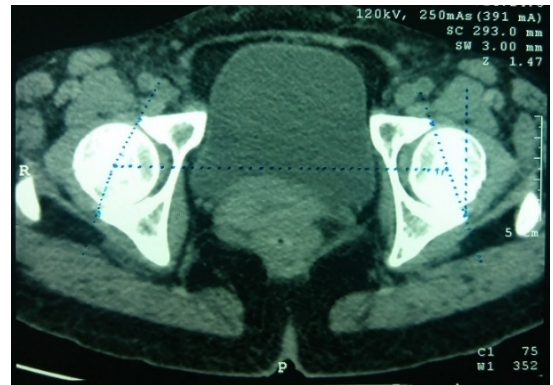


Fig.5: Measurement of anterior and posterior acetabular sector angle in CT-scan image

- Posterior acetabular sector angle (PASA):** The angle between center line of both femoral heads and line from center towards the posterior margin of acetabular. Normal value for male was 102° and female was 105° ^{17,18} (Fig. 5)

RESULTS

A total of 50 subjects who meet the inclusion and exclusion criterias were measured in this study. The samples were divided according to gender with total of 25 males (50%) and 25 females (50%).

The findings for mean and range acetabular values of males and females are as follows: Center-edge angle (CE) 35.04 ± 4.21 and $33.48 \pm 3.78^\circ$, acetabular index angle (AA) 9.68 ± 1.24 and $9.6 \pm 1.32^\circ$, acetabular angle of sharp

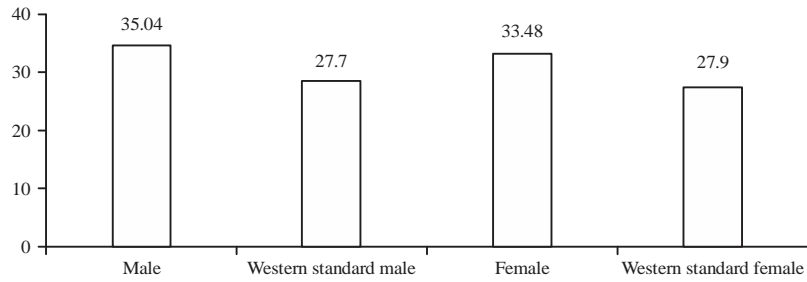


Fig. 6: Comparison of centre edge angle

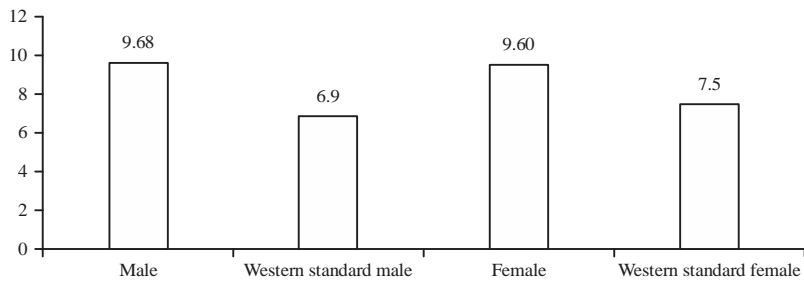


Fig. 7: Comparison of acetabular angle

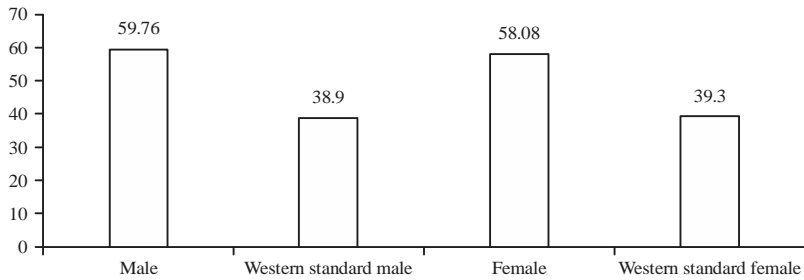


Fig. 8: Comparison of sharp angle

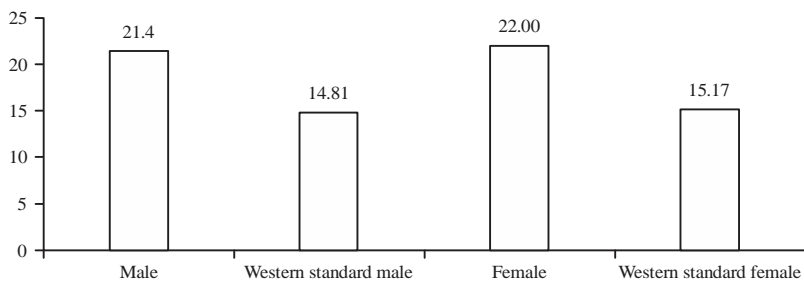


Fig. 9: Comparison of acetabular version

59.76±7.74 and 58.08±6.35°, acetabular version (AcetAV) 21.4±3.08 and 22.00±3.16°, anterior acetabular sector angle (AASA) 59.28±8.90 and 58.48±8.79° and posterior acetabular sector angle (PASA) 88.64±3.8 and 91.32±4.7°.

The comparison between study results and Western values are shown in Fig. 6-11. The study shows that the centre-edge angle, acetabular angle, angle of Sharp and acetabular version of Indonesian deuteromalay sub-race are

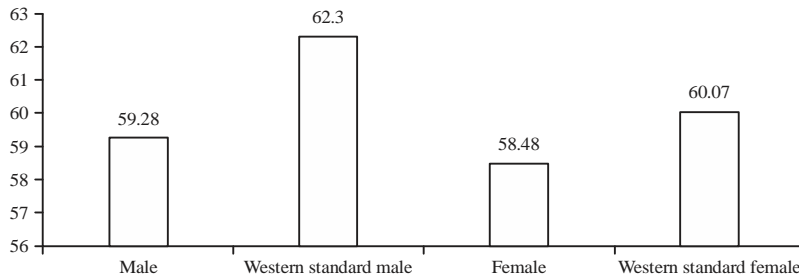


Fig. 10: Comparison of anterior acetabular sector angle

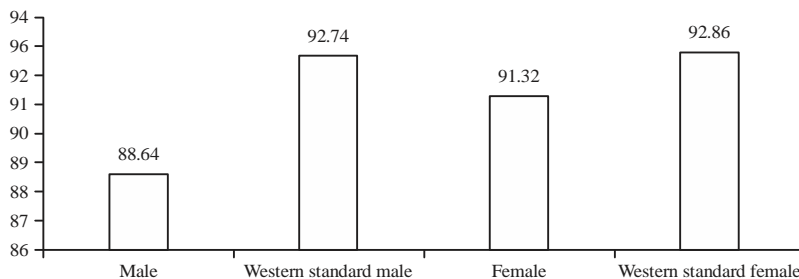


Fig. 11: Comparison of posterior acetabular sector angle

higher if compared to Western values, in both gender group. In contrary, the results of anterior and posterior acetabular sector angle of Indonesian deuterio malay sub-race are lower if compared to Western values.

DISCUSSION

These results regarding the normal acetabular values of Indonesian males and females found that there are one standard deviation differences between Indonesian deuterio malay sub-race and Caucasian race.

Computed tomography has been widely used in the assessment of acetabular morphology, a practical approach to determine acetabular deformity^{5,11}.

Several studies reveal clinical significances of acetabular measurement to acetabular reconstructive surgery. However, the range of normal acetabular variation may differ between races¹⁹⁻²³.

This independent study offer acetabular morphologic data in Indonesian population, specifically for deuterio malay sub-race. In this study, the samples were divided into 2 groups based on gender. All six parametres of study were measured in both groups and further compared with Western values reference. The study showed that the centre-edge angle, acetabular angle, angle of sharp and acetabular version of Indonesian deuterio malay sub-race are higher if compared to Western values, in both gender group. In contrary, the results

of anterior and posterior acetabular sector angle of Indonesian deuterio malay sub-race were lower if compared to Western values. Despite of the differences, statistical analysis using Independent Samples T-Test shows only 5 among 6 parametres (centre-edge angle, acetabular angle, angle of sharp, acetabular version, posterior acetabular sector angle) that had significant value ($p < 0.05$), whilst the anterior acetabular sector angle was not statistically significant ($p > 0.05$).

Deuterio malay race itself spread all over Southeast Asia region. As the most populated country in Southeast Asia, Indonesia could represent the characteristic of population at Southeast Asia, more than other countries. Both Indonesia and Malaysia have a racially heterogenous population and also have rich ethnic diversity. Unfortunately, in the article, Baharuddin *et al.*⁸ did not mentioned which race/ethnic their sample population was taken from (Table 1).

Accounting Indonesia and Malaysia are close in term of genetic trait and race origin, the diversity of ethics makes risks of biased result to generalize and directly take samples as what Baharuddin *et al.*⁸ did in his study. Reference study stated that hip joint morphology may show geographical difference.

It is still imminent for Indonesian to have its own reference of acetabular normal morphologic values. There were numerous previous studies from different Asian countries (similar physical appearance) which also tried to

Table 1: Comparison of acetabular morphology in different populations⁸

Parameters (°)	Gender	Malay	Finland	India	USA
CE	Male	32.67±5.45	39.0±7.0	32.3±10.5	28.7±7.8
	Female	30.71±5.38	41.0±7.0	33.5±10.2	27.9±7.1
SA	Male	41.79±3.23	-	39.0±5.60	38.9±3.2
	Female	42.92±3.19	-	39.4±3.20	39.3±4.7
AA	Male	10.03±4.27	5.0±5.0	-	-6.9±7.1
	Female	9.87±3.83	1.0±4.0	-	-7.5±5.5
AcetAV	Male	14.81±5.45	17.0±6.0	18.0±6.10	-
	Female	15.17±4.67	23.0±7.0	18.4±6.20	-
AASA	Male	62.30±6.57	67.0±13	-	-
	Female	60.07±6.74	63.0±11	-	-
PASA	Male	92.71±6.24	103.0±11	-	-
	Female	92.86±6.34	104.0±25	-	-

determine their specific own population normal acetabular morphologic values, like Singaporean population²⁴, Chinese population²⁵, Japanese population²³ and Korean population⁹. This study already perform worldwide due to establishing the prevalence of acetabular dysplasia and designing better acetabular implant for orthopaedic surgery.

This study only performed in one centre, thus limiting further evaluation and analysis. Considering the extent of Indonesia's region and high variability of races among its people, researchers recommend a multi-centred study with specific race by using cadaveric study to provide a better result and data for clinical use.

CONCLUSION

The CT-scan is a reliable modality to obtain acetabular anatomical values. The study found that there are significant differences of normal acetabular morphologic values between Indonesian deuteromalay sub-race and Caucasian race (one standard deviation).

The author highly honored the result of the study, since Malaysian had already publish its data at 2011 by Baharuddin *et al.*⁸, it documents for the first time for Indonesian population and how it different to Western population. This data may contribute and benefit the Indonesian orthopaedic surgeon in planning hip arthroplasty surgery and as well aid in implant's manufacturer in hope for designing acetabular cup implants which better fit the interest of Indonesian population.

SIGNIFICANCE STATEMENT

This study specified the samples on deuteromalay race, which dominated the ethnics at South Sulawesi region where authors study took place. Authors hope by contributing another reference values from Indonesian subrace (which dominates Southeast Asian population), there will be consensus drawn as guidance for acetabular surgery of Asian

people in general. Up until know, most of Asian countries (and also Indonesia) still use hip implant designed based on Caucasian reference values.

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