PREVALENCE OF HIP DYSPLASIA IN ASYMPTOMATIC PATIENTS USING COMPUTED TOMOGRAPHY SCAN IN INDIAN POPULATION WITH THE ASSISTANCE OF DICOM SYSTEM

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Abstract: Timely diagnosis of acetabular dysplasia helps patients to prevent undergoing the osteoarthritis and hip replacement procedure. Though there are various diagnostic procedures available to detect hip dysplasia, but the procedures are not accurate. The present study aims to unify the single mode of diagnostic technique that helps to identify the prevalence of hip dysplasia in asymptomatic patients in the Indian population. **Materials and Methods:** 200 asymptomatic patients were subjected to with Computed tomography scan with DICOM assistance. Various diagnostic techniques like Centre edge angle, Angle of sharp, Depth to width ratio, and Tonnis angle were taken for identifying the pathology. **Results:** Among the 200 asymptomatic patients, the center edge angle has detected the hip dysplasia with 11.5% highest accuracy, followed by tonnis angle 8 % of patients and 9.5% depth to width ratio and angle of sharp detected 9.5% respectively. The female population in the present study was more affected with the hip dysplasia using the diagnostic technique center edge angle 14%, 12% angle of sharp, 10% depth to width ratio, and 10% Tonnis angle. While in the prevalence male was 9% using center edge angle, 7% with angle of sharp, 9% depth to width ratio, and 6% Tonnis angle. **Conclusion:** Based on the present data centre edge angle was found to be a desired diagnostic tool for identifying the hip dysplasia with precision. Indian ethnicity was most prone to hip-associated pathology compared to the other population like 3.3 % in the Nigerian population and 3.8% in the United Kingdom. It was thought that female population was suspectable to critically ill hip pathology and the present study proved that, but the present study found that the prevalence of hip dysplasia was highly reported when compared to the similar studies done worldwide.

Keywords: Acetabular dysplasia, Arthroplasty, acetabulum geometry, Tonnis Angle , Hip dysplasia, Teardrop acetabulum, hip pathology , Osteoporosis

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INTRODUCTION

Hip acetabular dysplasia is a serious concern that leads to several morphological changes in the hip joint. Hip dysplasia needs early diagnosis and treatment, whose failure may lead to acquired secondary osteoarthritis (Hernandez et al., 2020), in severe case the patient becomes immobile and he/she undergo Total hip arthroplasty to regain mobility.(Shi et al., 2019) Nevertheless, the worldwide incidence of hip dysplasia is up to 10 %.(Kim et al., 2019). Among the various diagnostic geometrical tools used to establish the hip dysplasia are centre edge angle, Angle of sharp, depth to width ratio, and Tonnis angle(Adanir & Zorer, 2018) and performing all the above-mentioned measurement techniques in a single patient will be time-consuming for the orthopaedician and radiologist as well. Therefore, in the present, we aim to find the best possible CT scan-based measurement tool, to identify the hip dysplasia precisely and we also assess the prevalence of hip dysplasia in male and female. However, the literature survey showed that earlier research based on X-ray geometry but the present study focussed on CT scan geometry with the assistance of DICOM in asymptotic patients

METHODOLOGY

The study was conducted at Vinayaka Mission's Kirupananda Variyar Medical College, Salem, Tamilnadu, India. A total number of 200 CT scan radiographs (100 male & 100 female) of the right and left pelvic girdle were taken by keeping the patient in supine position with both limbs in neutral rotation. With approval from the institutional ethical committee

measurements like center edge angle, Angle of sharp, Depth to width ratio, and Tonnis angle were noted. Measurements were taken using DICOM and for accuracy of the measuring process, the CT radiograph was optimized in a full-screen view, magnified to the highest resolution, and measurements were taken using DICOM software.

Inclusion criteria: Asymptomatic patients irrespective of sex, age group ranging from 20-60 years included.

Exclusion criteria: Patients with hip deformities like rheumatoid arthritis, Legg-Calve-Perthes disease, tuberculosis of the hip, tumors related to the hip like Osteosarcoma, Chondrosarcoma, Ewing's sarcoma, patients with hip replacement surgery like Total hip arthroplasty, hemi arthroplasty, revision arthroplasty, congenital anomaly, and deformities of the lower limb and spine were excluded from the study.

Acetabular teardrop: The acetabular teardrop is situated in the inferior margin of the acetabulum, medial to the lateral border of the acetabulum. The acetabular teardrop is a radiography landmark for the detection of hip dysplasia. (Huang et al., 2022)

Center edge angle: It's a measurement to estimate the super lateral coverage of the femoral head. The Center edge angle is measured by a vertical line extending to the center of the femoral head and the second angular line to the lateral end of the acetabulum.(Zhang et al., 2020) (Figure 1).

Angle of Sharp: The angle of sharp is another measurement to estimate the inclination of the acetabulum. However, the angle of sharp is also used to analyze the dysplastic hip. The angle of sharp is measured by a transverse reference line connecting the acetabular teardrop of the right and left side and another line extending from the lateral edge of the acetabulum to the teardrop. The angle of sharp ≥45º is considered Hip dysplasia.(Tannast et al., 2015) (Figure 2).

Depth to width ratio: Depth to width ratio was first measured by Heyman and Herndon method (Price & Joesph, 2011). Acetabular width is measured by a line extending from the superolateral end of the acetabulum to the pelvic teardrop (Figure 3). The depth is calculated by a perpendicular line from the center of the width line.(Welton et al., 2018)

Tonnis angle: It is measured as an angle, line connecting the acetabular roof sourcil and extending to the lateral end of the acetabulum. (Figure 4).

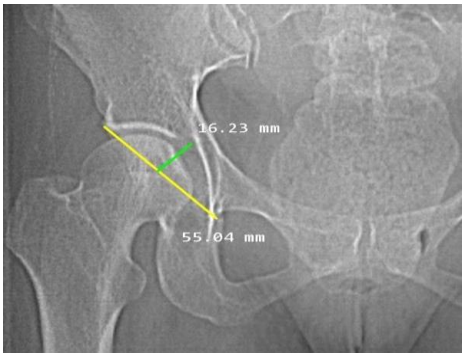

Figure 1. CT Radiograph showing Center edge angle

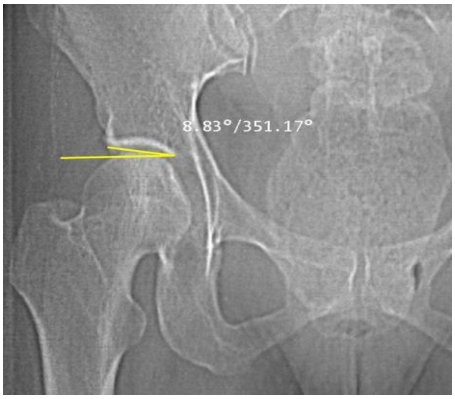

Figure 2. CT Radiograph showing the Angle of sharp

Figure 3. CT Radiograph showing the Acetabulum Depth to width ratio

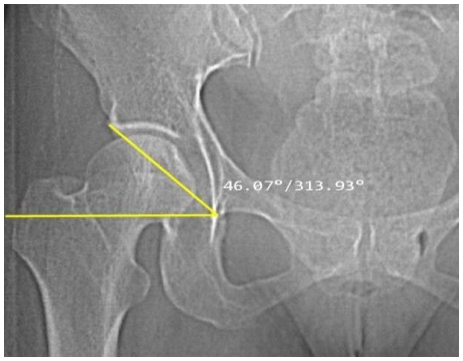

Figure 4. CT Radiograph showing the Acetabulum Tonnis Angle

RESULTS

We have analyzed two hundred asymptomatic patients whose normal mean geometry of acetabulum with center edge in angle male (32.8º ± 4.5), female (35.04 º±3.8), Angle of sharp in male (41.2 º±3.9) female (35.4 º±4.0), Depth to Width ratio in male (0.36±0.07), female (0.32 ±0.03), while in Tonnis angle male (5.4 º±2.4) female (5.6 º±5.02) (Table 1). The p-value of male and female with the center edge angle was *p* 0.3 proved to be statistically significant. However, the pearson's coefficient with

angle of sharp, depth to width ratio, and tonnis angle was not statistically significant *p* 0.14. The statistical significant was not in angle of sharp, depth to width ratio and tonnis angle was due to less number of hip dysplasia detection.

Table 1: Normal mean acetabular geometry comparison of male and female sexes

Sex	Center edge angle	Angle of Sharp	Acetabulum depth to width ratio	Tonnis angle
Male N=100	32.8 °±4.5	41.2 °±3.9	0.36±0.07	5.4 °±2.4
Female N= 100	35.04 °±3.8	35.4 °±4.0	0.32 ±0.03	5.6 °±5.02
P value	0.3	0.14	0.14	0.14

The values are in mean, ± Standard deviation

DISCUSSION

Hip dysplasia is a major cause of concern due to the development of secondary osteoarthritis and long-term dysplasia it may lead the patient to undergo expensive total hip replacement surgery. Here we have analyzed two hundred asymptomatic patients and all the samples were thoroughly scanned with various diagnostic tools like Center edge angle, angle of sharp, tonnis angle, and depth to width ratio. There were 100 male patients, to whom we have detected 31 hip dysplasia, in that center edge angle 9 hip dysplasia patients, angle of sharp 7 hip dysplasia patients, depth to width ratio 9 and tonnis angle 6 hip dysplasia patients. While in female a total of 46 patients were positive with hip dysplasia among them 14 patients were detected from center edge angle with more accuracy, 12 had hip dysplasia with angle of sharp , 9 with depth to width ratio, and tonnis angle (Engesæter et al., 2013) (Table 2)

Table 2: Prevalence of Hip Dysplasia in 200 asymptomatic patients.

Parameters	Male N=100	Female N=100	Percentage of male and female with hip dysplasia
Center edge angle < 20	9% (N=9)	14% (N=14)	11.5%
Angle of sharp ≥45	7% (N=7)	12% (N=12)	9.5%
Acetabulum depth to width ratio	9% (N=9)	10% (N=10)	9.5%
Tonnis angle	6%(N= 6)	10% (N=10)	8%
Total	31	46	

Various studies have reported that hip dysplasia was more recurrent in female than in the male population (Engesæter et al., 2013; Umer et al., 2009). In present study, all the four diagnostic tools reported higher incidence of hip dysplasia in female population compared to male population with a similar study done by Kim CH et al 2019 which showed high incidence of hip dysplasia in female while measuring with angle of sharp and tonnis angle . The prevalence of hip dysplasia in female of the present study reported a maximum 11.5 % with center edge angle, which was marginally lower than the similar study done among the Japanese population 11.6% ((Engesæter et al., 2013; Umer et al., 2009) (Table 3).

Table 3: Review of previous studies on hip dysplasia using Center edge angle

Worldwide	Modality	Cut off value	Number of Hip	Prevalence
Japanese (13)	X ray	25	2603	Male 4% Female 4 %
Singaporean (14)	X ray	25	522	7.3% (male & female)
Mimura(15)	CT scan	20	104	11.5% (both)
Korean (3)	X ray	20	400	15%(both)
Present study	CT scan	20	**200**	Male 9% & female 14%

However, the present study of center edge angle was comparable to Mimura et al 2017 with 11.5% using the CT scan, and the cut-off value is the same as the present study. (Mimura et al., 2017) (Table 3). While in the male the hip dysplasia detection showed maximum of 9 % with center edge angle, depth to width ratio. Whereas the Tonnis angle and angle of sharp detected the least hip dysplasia 9% and 6% respectively. in the present study, we found that high incidence of hip dysplasia in male among the Indian population compared to similar studies related to male worldwide.(Ali-Gombe et al., 1996) Furthermore, most of the researchers kept the center edge angle cut-off value as 25, which detected higher dysplasia. While in our study we kept the cut-off value to minimum of 20, which still detected more hip dysplasia in the study population. The study present is unique due to the usage of CT scan images with the aid of software assistance DICOM (Digital imaging communications in medicine), the accuracy of CT scan DICOM measurement is highly precise and the error margin was very minimal.(Fowler et al., 2011) Therefore, the present study has detected high number of hip dysplasia. Furthermore, most of the studies limited were to plain anterio posterior X-ray radiographs and the measurements were done using normal scales and other geometric devices like X-ray bisecting angle tool, baseline 180-degree X-ray tool, and goniometer(Inoue et al., 2000; Yoshimura et al., 1998). Furthermore, the prevalence of hip dysplasia in Indian population especially in female may be due following reasons to lack of calcium, vitamin D levels, morphological variation of femur and acetabulum, wider pelvic brim, ligaments laxity and life style modification.

CONCLUSION

In Conclusion, our study showed a higher prevalence of hip dysplasia in female and male patients. Our study reported a higher incidence of hip dysplasia in male Indian population compared to other similar studies done worldwide.

Furthermore, the center edge angle is a valuable tool in identifying borderline hip dysplasia and chronic hip dysplasia. The software-driven measuring tool will enhance the accuracy of the diagnostic results than the manual method, and also clinicians can consider the cut off range of 20 for center edge angle which will potentially be the unified single tool to identify and predicting the hip dysplasia in early stage and center edge angle can also be used as one of the geometrical tools that help orthopaedician to counsel pre-operative THA surgery. Besides, invasive procedure is not the only option in hip dysplasia treatment, if the pathology detected in early stages of prognosis. Various redhibitory exercise like iliotibial band stretch, seated stretch rotation, hamstring stretch exercise, abductor strengthening, hip internal & external rotation exercise can prevent the patient undergo the invasive procedure.

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