

Analysis of MRI Image to Develop the Aid During the Radiological Test of Femoro Acetabular Impingement

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ABSTRACT

Background/Objectives: It is to sustain the test accuracy and improve diagnostic capability of self-developed aid in Dunn view to confirm modification of pistol grip in neck of femur that causes anterior femoro acetabular impingement.

Method/Statistical Analysis: The test was performed before and after the usage of the self-developed aid in the patients referred to the test of Dunn view (45 and 90-degree flexion) who were scheduled with hip arthroscopy. α -angle and femoral head-neck offset were measured by oblique transverse images in MRI test and statistical significance was analyzed with paired T-test.

Findings: In the MRI images and Dunn 45° and 90° images before and after ancillary device use, as a result of measuring and analyzing α -angle, it was not statistically significant at 45° ($P>0.05$), but it was found there was statistical significance in 90° ($P<0.05$). In the MRI images and Dunn 45° and 90° images before and after ancillary device use, as a result of measuring and analyzing femoral head-neck offset, it was found there was statistical significance in both 45° and 90° ($P<0.05$).

Improvements/Applications: Upon the comparison results of unidirectional image and MRI test before and after the use of the aid in this study, statistically significant outcomes were found in 45 and 90 degree of Dunn view after the use of the aid. Therefore, it is considered that they could be used as the foundation data in the image studies with Dunn view.

Keywords: *Dunn view, femoro acetabular impingement, α -angle, femoral Head-Neck offset, MRI image*

Introduction

Recently, as leisure activities through various sports have become diverse and activities have increased, the number of young and active patients who are admitted to the hospital due to excessive and unrelieved movements due to hip pain is increasing^[1].

The cause of pain in the femur and hip joints, which is the largest skeleton in the human body, is the femoral acetabulum impingement, which is considered to be the cause of hip arthritis, which is caused by a fracture of the non-lingual cartilage, which is a triangular fiber cartilage tissue between the limbus acetabuli and joint capsule^[2,3]. The anatomical mechanism of the hip is known to be caused by repeated contact of the acetabulum and femur with the proximal femur of the sphere and the osseous deformation of the femur, leading to femoroacetabular impingement^[4,5]. The anatomical

abnormalities that cause impingement between proximal femur and acetabulum include femoral head pistol grip deformation, asphericity, coxa valga, coxa vara, acetabular retroversion, and intrapelvic protrusion of the acetabulum^[6-9]. For the diagnosis of femoral acetabular impingement syndrome, general imaging studies using X-ray, computed tomography, and MR arthrography (MRA) using magnetic resonance imaging are used.

Thus, the purpose of this study was to develop an ancillary device and to investigate its applicability in general imaging studies using X-ray in the diagnosis of femoral acetabulum related hip joint diseases that are recently being studied. In addition, the developed ancillary device is used to maintain the accuracy of imaging and to reduce the radiation dose by retesting in diagnosis and follow-up of femoral acetabulum diseases. Also, there is purpose and necessity of research to contribute to the improvement of the quality of the test method by

improving the satisfaction of the test posture felt by the patient and to provide basic data in related fields.

Materials and Method

To achieve the purpose of this study, the subjects were 51 patients (29 male mean age 41.3 years, 21 female mean age 41.2 years) who were admitted and underwent femoral acetabulum test. For the study method, the study analyzed retrospectively the patients who underwent simultaneous hip joint MRI test among the patients who were followed up more than 2 times in the hip joint X-ray examination. The ancillary device and patient posture developed for image evaluation are as follows (figure1).

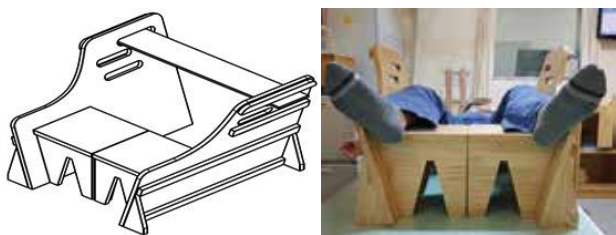


Figure 1: Self developed aid

Test Method: The images for the analysis were inspected for general radiography using X-ray, and the MRI scans were evaluated and analyzed by obtaining inclined axis upper surface (oblique transverse) that can diagnose the most sensitive femur neck form examined by Proton Density fat saturation method among Indirect MRI images performed 10 minutes after contrast agent injection.^[1]

Image Evaluation: Alpha angle and femoral head-to-neck offset were used as the best measure of the degree of circularity of the femoral head and analysis was done divided into before and after use of ancillary device. The alpha angle of the femoral acetabulum (45°, 90°) and MRI inclined axis upper surface images of the radiograph obtained by the examination were measured, and the femoral head-to-neck offset was measured on the normal image femoral acetabulum (45°, 90°) and MRI inclined axis upper surface images (figure 2), (figure 3).



Figure 2: Femoral α -angle measurement



Figure 3: Femoral offset measurement

Statistical Method: Based on MRI images before and after using ancillary device, statistical analysis was performed using the SPSS (SPSS for windows Release 22.0;SPSS, Chicago, IL) program and statistical significance level ($P < 0.05$) was determined statistically significant.

Results and Discussion

α -angle Result

Dunn 45°: In the results of α -angle measurement according to gender, in Dunn 45°, for men, it was 52.84 ± 6.69 before device use with difference of 3.08 with MRI image, and 53.02 ± 6.43 after device use with difference of 4.28 with MRI image. For women, it was 56.34 ± 5.43 before device use with difference of 5.71 with MRI image, and 56.88 ± 5.78 after device use with difference of 4.63 with MRI image. Overall, it was 52.76 ± 6.84 before device use with difference of 3.17 with MRI image, and 52.84 ± 6.72 after device use with difference of 4.41 with MRI image, and it was found that there was no statistical significance ($P > 0.05$), (Table 1).

Table 1: The result of statistical analysis of Dunn 45°, MRI (Mean \pm SD)

Division	Gender	Mean \pm SD	MRI – Dunn (Mean)	P-Value
Before device use	Male	52.84 ± 6.69	3.08	$P > 0.05$
	Female	56.34 ± 5.43	5.71	
	Overall	52.76 ± 6.84	3.17	
After device use	Male	53.02 ± 6.43	4.28	
	Female	56.88 ± 5.78	4.63	
	Overall	52.84 ± 6.72	4.41	

Dunn 90°: In the results of α -angle measurement according to gender, in Dunn 90°, for men, it was 53.74 ± 8.23 before device use with difference of 5.56 with MRI

image, and 52.86 ± 8.46 after device use with difference of 3.32 with MRI image. For women, it was 53.92 ± 7.52 before device use with difference of 5.34 with MRI image, and 52.85 ± 8.63 after device use with difference of 3.48 with MRI image. Overall, it was 53.20 ± 8.36 before device use with difference of 5.71 with MRI image, and 52.07 ± 8.24 after device use with difference of 3.15 with MRI image, and it was found that there was statistical significance ($P < 0.05$), (Table 2).

Table 2: The result of statistical analysis of Dunn 90°, MRI (Mean ± SD)

Division	Gender	Mean ± SD	MRI – Dunn (Mean)	P-Value
Before device use	Male	53.74 ± 8.23	5.56	P > 0.05
	Female	53.92 ± 7.52	5.34	
	Overall	53.20 ± 8.36	5.71	
After device use	Male	52.86 ± 8.46	3.32	
	Female	52.85 ± 8.63	3.48	
	Overall	52.07 ± 8.24	3.15	

Femoral head-neck offset Result

Dunn 45°: In the results of femoral offset measurement according to gender, in Dunn 45°, for men, it was 7.33 ± 1.48 before device use with difference of 1.13 with MRI image, and 6.44 ± 1.44 after device use with difference of 0.91 with MRI image. For women, it was 7.07 ± 1.12 before device use with difference of 1.26 with MRI image, and 6.81 ± 1.24 after device use with difference of 0.98 with MRI image. Overall, it was 7.14 ± 1.42 before device use with difference of 1.44 with MRI image, and 6.67 ± 1.48 after device use with difference of 0.94 with MRI image, and it was found that there was statistical significance ($P < 0.05$), (Table 3).

Table 3: The result of statistical analysis of Dunn 45°, MRI (Mean ± SD,mm)

Division	Gender	Mean ± SD	MRI – Dunn (Mean)	P-Value
Before device use	Male	7.33 ± 1.48	1.13	P > 0.05
	Female	7.07 ± 1.12	1.26	
	Overall	7.14 ± 1.42	1.14	
After device use	Male	6.44 ± 1.44	0.91	
	Female	6.81 ± 1.24	0.98	
	Overall	6.67 ± 1.48	0.94	

Dunn 90°: In the results of femoral offset measurement according to gender, in Dunn 90°, for men, it was 7.68 ± 1.56 before device use with difference of 1.37 with MRI image, and 6.02 ± 1.29 after device use with difference of 0.79 with MRI image. For women, it was 7.18 ± 2.13 before device use with difference of 1.56 with MRI image, and 6.29 ± 1.21 after device use with difference of 0.84 with MRI image. Overall, it was 7.84 ± 1.42 before device use with difference of 1.66 with MRI image, and 6.38 ± 1.32 after device use with difference of 0.83 with MRI image, and it was found that there was statistical significance ($P < 0.05$) (Table 4).

Table 4: The result of statistical analysis of Dunn 90°, MRI (Mean ± SD,mm)

Division	Gender	Mean ± SD	MRI – Dunn (Mean)	P-Value
Before device use	Male	7.68 ± 1.56	1.37	P > 0.05
	Female	7.18 ± 2.13	1.56	
	Overall	7.84 ± 1.42	1.66	
After device use	Male	6.02 ± 1.29	0.79	
	Female	6.29 ± 1.12	0.84	
	Overall	6.38 ± 1.32	0.83	

Despite the many diagnostic methods, in femoroacetabular impingement, general imaging with X-ray is still the primary and basic method. For this, Meyer et al reported that Dunn 45° flexion view was the most sensitive of the 6 radiographic tests (Hip AP, Dunn 45°, 90° flexion, cross-table/15° internal rotation, cross-table/15° neutral rotation, cross-table/15° external rotation) used to evaluate the femur head and asphericity of the neck (Hip AP, Dunn 45°, 90° flexion, cross-table/15° internal rotation, cross-table/15° neutral rotation, cross-table/15° external rotation) [10], and Kim et al reported that Dunn 90° flexion view was most useful when compared with MRI of Hip AP, Dunn (45°, 90°), Frog leg view, and Trans Lateral view, through comparative analysis [11]. In this study, MRI images were compared according to the use of ancillary devices, where it was found to be useful in Dunn 90°, and the ancillary device was used to supplement the inconvenience of unstable posture in patients where it was not possible to fix the tibia during the examination.

Conclusion

This study was performed to evaluate the image of Dunn view test using a self-developed device in 51 hip

joint patients (29 male, 21 female) with femoroacetabular impingement and the results are as follows.

First, in measuring and analyzing the α -angle in MRI image, it was not statistically significant at 45° ($P>0.05$), and there was statistical significance at 90° ($P<0.05$)

Second, in measuring and analyzing the femoral head-neck offset in MRI image, it was statistically significant at both 45° and 90° ($P<0.05$).

In the results of the study, using a self-made ancillary device in Dunn view examination, it showed in the diagnosis of femoroacetabular impingement of the Cam type, that it is possible to improve diagnostic ability in general radiography and to provide accurate and consistent diagnostic value images in the follow-up examination which can be helpful to make an accurate diagnosis in the patient observation process and at the same time to improve the satisfaction of the test posture felt by the patient.

Therefore, it is expected that the results of this study will be utilized to provide basic data for accurate and efficient patient posture in Dunn view examination.

Ethical Clearance: Not required

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Conflict of Interest: Nil

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