

Visualization of acetabulum and cup overhang after THA using a radar chart

Sakura Kuniyoshi¹, Satoshi Nakasone¹, Takahiro Igei¹, Masamichi Onaga¹, Fumiya Washizaki¹, Kotaro Nishida¹
¹Department of orthopedic surgery, Graduate School of Medicine, University of the Ryukyus
Email of Presenting Author : sakusakurai318@gmail.com

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INTRODUCTION:

Iliopsoas impingement syndrome (IPI) is one of the major causes of groin pain after total hip arthroplasty (THA), which is in most cases, caused by irritation between iliopsoas tendon complex and anterior aspect of the acetabular component. However, we sometimes encounter with post THA patients with hip pain without cup overhang in X ray and CT. We hypothesized that detection of cup overhang by X ray and CT is limited. The objective of this study is to visualize the entire circumference of acetabulum and cup by using our radar chart method, which was reported by Igei et al., and reveal cup overhang in unvalued areas.

METHODS:

This retrospective study was approved by our Institutional Review Board. 98 patients (100 hips) who underwent primary THA through direct anterior approach during April 2014 to March 2020 were included, and were divided into two groups according to groin pain; pain positive / negative group: 9 patients (9 hips) / 89 patients (91 hips) respectively. The axis was created with a crossing plane passing through the center of acetabulum cup and is parallel to the functional pelvic plane (FPP) from post operative CT. Twenty-four radial planes were reconstructed by rotating the plane along the axis in increments of 15 degrees using three-dimensional analysis software. Angle of edge of the acetabulum cup (ACA) and acetabulum rim (ARA) were measured in each radial plane using Image J (National Institutes of Health, MD), and were described as a clock using a radar chart. We defined the cephalic point of the edge of the cup and rim where the plane was parallel to the FPP and passed through the center of the acetabular cup as 0:00. We defined the superior location of the two as 0:00, the anterior location as 3:00, the inferior location as 6:00, and the posterior location as 9:00 (Figure 1). ACA and ARA were compared in each group to investigate the difference in the area of cup overhang between the two groups. Statistical analyses were performed with JMP software version 15.0 (SAS Institute, Cary). Paired t-test was used to compare ACA and ARA at each location. The percentages of hips with component overhang in both groups in each area were compared using Chi-squared test. *P* value of < 0.05 was considered significant.

RESULTS:

Evaluation of cup overhang and acetabulum coverage using a radar chart enabled us to get full image of the two relationships easily. In both groups, ACA was significantly larger than ARA in posterior and superior area of the acetabulum, indicating cup overhang in the two areas. In pain negative group, ARA was significantly larger than ACA in 2:00 to 4:30, indicating adequate acetabulum coverage in anterior area (Figure 2). In pain positive group, ACA was significantly larger than ARA in 1:30 to 2:00, indicating cup overhang in partial aspect of anterior area (Figure 3). The ratio of patients with cup overhang in 1:00 to 2:00, and in 9:00 was significantly higher in pain positive group.

DISCUSSION:

In previous studies, cup overhang in anterior area of acetabulum was considered as the risk of IPI, and was evaluated by axial CT which could be expressed as 3:00 in the radar chart. Consistent with these studies, pain positive group showed cup overhang in anterior area and pain negative group showed adequate acetabulum coverage in the area. In particular, the ratio of hips with cup overhang was significantly higher in 1:00 to 2:00 where we assume the iliopsoas tendon is located at, thus special attention might be required in the area during surgery. Furthermore, radar chart allowed the visualization of cup overhang in superior and posterior areas as well. Gluteus minimus was located at superior area, but considering the origin and insertion of the muscle, cup impingement at abduction was unlikely to occur, so the overhang in the area may not be a clinical problem. The ratio of hips with cup overhang in 9:00 was significantly higher in pain positive group, where the external rotator muscles and conjoint tendons were located at. But since irritation between those tendons and cup only occur with the combination of hip flexion and external/ internal rotation, which is not a frequent move in our daily activities, symptoms are less likely to be noticeable. Relation between pain and posterior cup overhang still remains uncertain, and further research for the assessment is required.

There are some limitations to this retrospective study: although we evaluated CT using metal artifact reducing algorithm, influence from artifacts could not be ignored. Our study evaluated angles, so the numerical value cannot be simply compared with previous reports, which could be taken as another limitation. However, evaluating angles instead of lengths made comparison between patients with different acetabulum size possible, which could be taken as an advantage as well. ACA and ARA were measured by a single rater.

SIGNIFICANCE/CLINICAL RELEVANCE: Post operative groin pain is a considerable problem which leads to decrease in quality of life in patients, which must be solved. Evaluation using radar chart enabled us to evaluate the entire circumference of cup overhang and acetabulum coverage easily, and may be a useful diagnostic tool for those patients.

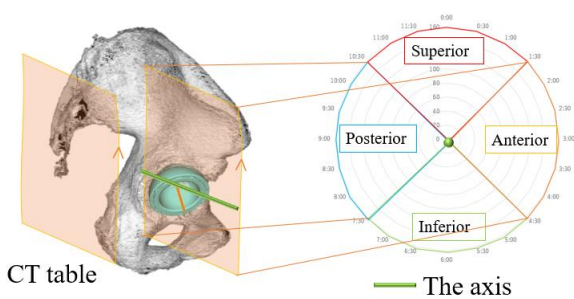


Fig. 1

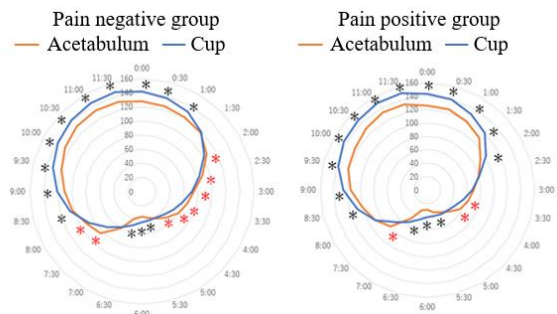


Fig. 2

Fig. 3