Effect of Acetabulum Rim Recession on Anterior Rim Angle: A Cadaveric Study

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INTRODUCTION:
Femoroacetabular impingement (FAI) has been extensively studied as a source of hip pain and osteoarthritis of the hip. This disease is well characterized by two different types of impingement caused by osseous abnormalities: CAM (femur head) and pincer (acetabulum). The focus of this study is on the pincer type FAI. Despite the existing knowledge of clinical presentation of pincer FAI, the effect of acetabular rim trimming on the acetabular morphology is poorly understood.

Arthroscopic treatment of the pincer type FAI has been previously described, but these studies have only reported on the change in the acetabular center edge angle of the hip.2, 3, 4 without much additional study of the remainder of the acetabulum cavity dimensions. The purpose of the present study was to further examine the changes within the acetabulum cavity upon completion of acetabulum rim trimming for pincer type FAI.

METHODS:
Cadaver specimens with Tönnis grade 0 or 1 were included in the study. Specimens with greater than Tönnis 2, deformity, or metal implants were excluded. Eleven cadaveric hips met the study criteria and were dissected with removal of all tissue, exposing the acetabulum and femoral head. Specimens were marked 3mm from the 12 o’clock (superior) to 3 o’clock (anterior) position on the acetabulum with a digital caliper. An osteotome was used to remove the 5mm of the acetabular rim. Then, the trimmed acetabulum was smoothed out using a dremel (Bosch Tool Corp, Mount Pleasant, IL). Pre- and post-operative radiographs were taken of the anterioposterior view of the hip socket as well as the false profile.

Pre and post-op radiographs were taken of the anterioposterior (AP) and the false profile views before and after acetabulum rim trimming. The tönns angle and center edge angle were measured. The anterior rim angle was described as the angle between the line marked from the center of the femur head to the posterior inferior margin of the sourcil and the best fit line parallel to the anterior ridge of the acetabulum. This measurement is called the anterior rim angle. (Figure 1.) In addition, the anterior wall angle (angle formed by the anterior wall and a horizontal line through sourcil), along with the anterior margin ratio (distance from the anterior edge of the acetabulum to the sourcil over the distance from the center of the femur head to the sourcil) were also measured. All measurements were performed by two separate observers and averaged. Inter- and intra-observer reliability was obtained for all measurements.

RESULTS:
Each of the 11 hips included in this study underwent a rim reduction of 5 mm. The mean change in tönns angle was 3.59° (range, 0.5° to 7.60°), with p-value < 0.5. The mean change in CE angle was 7.51° (range, 5° to 12.10°), p < 0.5. The mean change in anterior margin ratio was 9.4% (range, 2.1% to 17.8%), p < 0.5. The mean pre-operative anterior rim angle was 79.66°, while the mean post-operative anterior rim angle was 84.38°. The mean change in anterior ridge angle was 4.71° ± 3.73° (range, 0.65° to 12.8°), p < 0.5. The expected post-operative increase in anterior ridge angle correlated with the reduction of the acetabular rim. The mean change in anterior wall angle was 5.5° (range, 2.1° to 9.3°), p < 0.5. The mean change in false profile CE angle was 11.90° (range, 4.7° to 27.8°), p < 0.5. The interclass correlation coefficient for radiographic measurement of the anterior ridge angle was 0.91 (95% confidence interval). Infraclass correlation coefficient for the anterior ridge angle was 0.99 for pre and post-operative anterior ridge angle. (See Table 1.)

DISCUSSION:
This study showed that a rim trimming procedure commonly used for the treatment of pincer type femoro-acetabular impingement (FAI) implements significant change on multiple measurements of the acetabular morphology. A consistent decrease of the anterior margin ratio and anterior wall angle as well as an increase of the anterior rim angle on the post-operative acetabulum were both verified: three acetabulum measurements previously unrecognized or utilized in clinical evaluation.

The data collected from the AP pelvis and false profile radiographs demonstrated acetabular dimensional changes that were comparable for all specimens. Validity of dimensional changes was confirmed through comparison to angle changes found in the literature for well studied dimensions, specifically center edge angle,4 indicating that the overall post-operative morphological change of the acetabulum is consistent with current knowledge of rim trimming procedures used in treatment of pincer type FAI.

Statistical analysis showed that measurements of both pre and post-operative data sets obtained from the two observers were statistically significant through strong interclass and intraclass correlation coefficients. The new parameters, both anterior rim angle, anterior wall angle, anterior margin ratio, can be used as a means to further examine acetabular coverage pre- and post-operatively. Much more investigation and analysis of the acetabulum anatomy is necessary to be able to fully understand the effects of rim trimming treatment on hip 3D morphology. The present study provides a foundation for a more thorough interpretation of the changes of acetabular dimensions after surgical resection.

REFERENCES: