Midwest Orthopaedics at RUSH
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Computed Tomography (CT) Analysis Of Femoral Head Translation: A Cadaveric Investigation

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Background

- The hip joint is a ball and socket type with mainly rotational motion. A series of cadaveric studies have shown it undergoes translation possibly as a result of the asphericity of the femoral head and acetabulum.[1,2]
- According to a study by Safran MR et al, excision of soft tissues around the hip joint affects hip translation and excessive hip translation subsequently may lead to osteoarthritis.[3]

Purpose

The purpose of this study was to:

- Determine the three-dimensional (3D) translation of the hip joint at different hip positions in a cadaveric model and determine if there are differences based on 3D morphology.
- To observe the effect of soft tissues on hip translation.

Methods.

- 4 male fresh-frozen bilateral cadaveric specimens with no prior hip or acetabular surgery were selected for this study. Each was mounted onto a custom-made CT compatible positioner.

- Hip was fixed in a series of positions simulating physiologic hip motions: neutral resting position, 45 degrees of flexion (Flex45), 90 degrees of flexion (Flex 90), flexion adduction internal rotation (FADIR), and flexion abduction external rotation (FABER).

- A 3-D CT was conducted in each position.

Methods

- Following the initial CT, the hip was dissected down to the capsuloligamentous structures and rescanned in each of the 5 positions.

- Translation was measured in the mediolateral, craniocaudal, and anteroposterior directions compared to a reference neutral position.

- Analysis was done using a validated, high precision 3D-3D registration technique. Alpha angle, lateral center edge angle (LCEA), and Tonnis angle were measured to correlate translation to commonly employed radiologic variables.

Results

- The mean alpha angle, LCEA, and Tonnis angles were 48.8±11.1°, 30.7 ±5.1°, and 9.4±3.9° respectively. Factoring in all planes of motion, the average translation in the Flex45 position was 1.0±0.21mm. The average translation in the Flex 90 position was 1.33±0.32.
- The average translation in the FADIR and FABER positions were 1.32±0.21 and 1.45±0.15, respectively.
- The average total translation did not change significantly with the soft tissues removed to the level of the hip capsule except for the FADIR position, which demonstrated a significant increase in total translation (1.49±0.56; p=0.05). Hips with larger alpha angles were associated with increased total translation in Flex45 position (r=0.8; p=0.03) and the FADIR position (r=0.79; p=0.02).

Results

- Increasing alpha angle was associated with increased anterior translation of the femoral head in the FADIR position (r=0.85; p=0.008).

- Increased LCEA was associated with decreased total translation in the Flex45 position (r=0.9; p=0.006) and the FADIR position (r=0.75; p=0.03).

- Changes in Tonnis angle were not associated with changes in total femoral head translation.

Conclusion

- This study demonstrates that in intact hip specimens, femoral head translation occurs as the hip moves through a physiologic range of motion as well as during impingement positions.

- Preliminary results suggest that cam-type impingement (hip with increased alpha angles) may increase femoral head translation, whereas overcoverage (hips with increased LCEA) may decrease femoral head translation.

References

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