A PROSPECTIVE CONTROLLED STUDY ON RANGE OF MOTION IN ANTERIOR FEMOROACETABULAR IMPINGEMENT

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INTRODUCTION:
Femoroacetabular impingement (FAI) is a pathomechanical concept of the hip where any loss of clearance between the femoral head/neck and/or the acetabular rim compromise the range of motion (ROM) causing significant prearthrotic joint alterations in young and active adults.

Substantial errors in clinical measurement of ROM can occur if the examiner fails to recognize individual pelvic tilt or rotation which is difficult to control and which can vary considerably in supine position. Therefore, a more accurate analysis of ROM is mandatory based on anatomical defined reference coordinate systems.

The purpose of this study was to detect (1) the ROM pattern in hips with FAI in comparison to a normal group; (2) the specific impingement zones for these two groups; (3) the most sensitive ROM pattern for identifying FAI; (4) the effect of quantified surgical debridement on the resulting ROM.

METHODS:
After institutional review board approval, a prospective controlled study was conducted by means of a previously developed and validated CT-based computerized method for three-dimensional assessment of FAI. The data of a consecutive series of 28 hips with anterior FAI and a cohort of 33 normal hips were investigated. The FAI group was subdivided into a cam, pincer, and a combined subgroup.

Two established reference coordinate systems were used to define the neutral orientation; the anterior pelvic plane for the pelvis and the femoral axis for the femur.

Internal rotation was studied in 5°-increments through ranges between 70-110° of flexion and -20-20° of adduction, corresponding to the clinical impingement detection test. The localization of each possible combination and its impingement point within this interval was quantified and anatomically referenced.

To calculate the most specific ROM pattern for clinical determination of FAI, the differences between the two sets of ROM were calculated and the maximum was considered to represent that pattern.

The resection depth of acetabular segment to be trimmed was quantified in millimeters (mm). The extension of the segmented segment was chosen individually according to the detected impingement zones.

Femoral offset-creation is quantified with mm-stepwise removal of the non-spherical portion of the femoral neck.

RESULTS:

Hips with FAI had a significantly decreased pure flexion, internal rotation and abduction, but there were no differences in adduction, external rotation or extension (Table 1). The impingement-free ROM was significantly less for the FAI group for all combinations of flexion, internal rotation and abduction (Fig. 1). The impingement zones were localized in the anterosuperior quadrant of the acetabulum, without any significant differences between the FAI and the normal group or within the three subtypes of FAI.

The optimal ROM to detect FAI was at 100° of flexion, and 20° of abduction where the difference in internal rotation reached 15.7° between the two groups.

**Parameter** | **Normal hips** | **FAI (preop.)** | **FAI (postop.)**
---|---|---|---
Flexion | 122.0 ± 16.3 | 105.2 ± 12.2* | 125.4 ± 9.7
Extension | 56.5 ± 20.1 | 61.1 ± 31.8 | 71.1 ± 26.4
Abduction | 63.3 ± 10.9 | 51.7 ± 12.2* | 63.6 ± 7.5
Adduction | 32.7 ± 12.3 | 34.6 ± 12.3 | 35.8 ± 15.3
Int. rot. | 35.2 ± 6.9 | 11.1 ± 6.9* | 35.8 ± 15.3
Ext. rot. | 102.5 ± 14.2 | 83.0 ± 33.7 | 93.9 ± 32.7

Table 1: Range of motion in degrees for normal hips and for hips with FAI (statistically significant).

The mean improvement of internal rotation after segmental rim trimming/femoral head-neck offset creation was 5.6°/8.8°, respectively, and 14°for a combined treatment.

**DISCUSSION:**
The presented method represents a novel approach to a pathoanatomical problem of the hip that has not studied extensively so far with a sophisticated anatomically based computer program. It helps the surgeon to define the severity of impingement and guide him in decision making of the appropriate treatment option. This method is the basis for future steps where navigated surgical instruments will allow executing intraoperatively the previously planned osteoplasties, potentially with less-invasive techniques. In addition, the reference values for the normal group can be used as a guideline for other applications, e.g. hip arthroplasty.

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