IN VIVO HIP JOINT CONTACT DISTRIBUTION IN NORMAL AND DYSPLASTIC HUMAN HIPS

Keisuke Akiyama[1], Takashi Sakai[2], Junichiro Koyanagi[3], Hideki Yoshikawa[2], Kazuomi Sugamoto[4]

[1] Department of Orthopaedic Surgery, Osaka Kosei Nenkin Hospital, Japan; [2] Department of Orthopaedic Surgery, Osaka University Graduate School of Medicine, Japan; [3] Department of Orthopaedic Surgery, Osaka General Medical Center, Japan; [4] Department of Orthopaedic Biomaterial Science, Osaka University Graduate School of Medicine, Japan

Introduction

Our objectives were to clarify the three-dimensional articular contact areas of the *in vivo* normal hip joint and acetabular dysplasia with specific positions using magnetic resonance imaging (MRI), voxel-based registration (VBR), and proximity mapping.

Methods

Forty-two normal hips and 24 dysplastic hips were examined. MRI was performed at four different positions: neutral; 45º flexion; 15º extension; and the Patrick position. Femur and pelvis were separately extracted at the neutral position and superimposed over the images of each different position using VBR [Akiyama K, 2011]. The inferred cartilage contact was shown as proximity difference mapping using VBR and proximity mapping [Akiyama K, 2012]. The area where the femoral head approached the acetabular surface with the largest translation values was investigated. Generalized estimating equations were used for comparison, and multiple linear regression analyses were performed. A significance level of 5% was set for all comparisons ($p<0.05$).

Results

Proximity difference mapping showed the most approaching point tended to be located at either the anterior or posteroinferior lunate surface, anterosuperior region, and posteroinferior edge from neutral to 45° flexion, 15° extension, and Patrick position, respectively (*Figure 1*). Multiple linear regression analyses showed the variables retained in each of the models explained 5.9%, 10.1% and 18.3% (adjusted R^2) of the variability of the approaching distance in 45° flexion, 15° extension and Patrick position, respectively. Acetabular sphericity and age explained the variation of translation values from neutral to 45° flexion (β=0.272, p=0.027) and 15° extension (β=0.338, p=0.005), respectively. The translation value from neutral to Patrick position was independently correlated with femoral head sphericity (β=0.260, p=0.024) and acetabular sphericity (β=0.351, p=0.003).

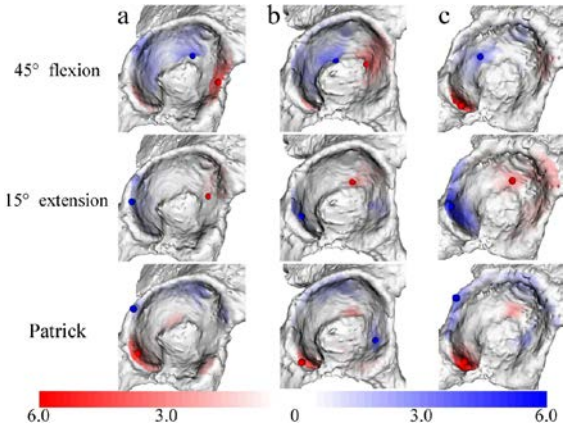

Figure 1: Proximity difference mapping from neutral to 45° flexion, 15° extension, and Patrick position in (a) normal male hip, (b) normal female hip, and (c) dysplastic hip. The area was colored red and blue where the femoral head approached and separated from the acetabulum from neutral to another position, respectively, according to the color scale. The areas with the deepest color were marked with balls. The color scale is in millimeters.

Discussion

This technique using subject-specific models revealed the contact area of the hip joint in healthy individuals and dysplastic patients. These results can be used for analyzing disease progression in the dysplastic hip.

References

Akiyama K *et al*, Osteoarthritis Cartilage, 19:700-710, 2011.

Akiyama K *et al*, Osteoarthritis Cartilage, 20: 296-304, 2012.