

Finite element analysis of mechanical stress of the hip joint in patients with posterior pelvic inclination

著者	佐久間 大輔
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論 文 要 旨

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氏名 佐久間 大輔

Abnormal mechanical loading is a main external factor affecting the development of osteoarthritis (OA). Excessive posterior pelvic inclination may decrease the loading area of the acetabulum, increasing mechanical stress to the articular surface and resulting in hip OA. However, exactly how much posterior pelvic inclination produces an excessive load on the articular surface remains unknown. The present study investigated the mechanical stress of 27 hips in 19 women [unilateral (right or left) hip joints of 11 women and bilateral (right and left) hip joints of 8 women were analyzed] with or without acetabular dysplasia by finite element analysis. Patient - specific finite element models were constructed from computed tomography data obtained in the supine position. The posterior pelvic inclination in the models was changed from 0 to 30 degrees in five - degree increments. The association between equivalent stress in the hip joint and the pelvic inclination or acetabular dysplasia was analyzed. The equivalent stress for the femoral head in the original position was 0.97 MPa (0.91 - 1.01) in normal hip joints and 1.18 MPa (1.00 - 1.28) in hips with acetabular dysplasia ($P=0.023$). The equivalent stress significantly increased at >25 degrees of posterior inclination. In normal hips, when the pelvic posterior inclination was increased by 25 and 30 degrees, the equivalent stress was 1.21 (1.11 - 1.35) and 1.24 (1.20 - 1.47) MPa, respectively ($P=0.029$ and 0.010, respectively). The mechanical stress of normal hip joints serially increased as the posterior pelvic inclination increased, reaching a level almost equivalent to that of hip joints with acetabular dysplasia at 25 degrees of posterior inclination. On the whole, the present study demonstrates that posterior pelvic inclination may be a mechanical factor affecting the development of OA in patients without acetabular dysplasia, particularly when the posterior inclination exceeds 25 degrees.