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The progression of osteoarthritis of the hip in relation to joint biomechanics

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Several epidemiological and radiological studies provided insight into the association between hip OA and sex. These studies found a higher incidence of the hip OA in women and three major influencing factors were identified: lifestyle, the level of estrogen and genetic disposition. However, the pathogenesis of hip OA could not be fully explained by these studies and the reason of the development of hip OA is more common in women could not be answered also. Several factors seem to play a relevant role in the pathogenesis and progression of hip osteoarthritis. Among these, hip stress and biomechanical hip parameters should be considered.

Objectives:

This study investigated the potential of using joint biomechanics in native hips to identify patients who will progress to hip osteoarthritis (OA). In order to better understand the relationship of the biomechanics to the progression of hip OA, the study utilized a newly designed biomechanical measurement computer software to evaluate the stress of the hip joint. Results from this study exposed the relationship between the progression of OA and biomechanics, explained the relationship between the hip joint average stress and the prognosis OA of the hip, and explained the reason why the development of hip OA is more common in women.

Materials and Methods:

This study included 100 patients, who were treated with a THR on one hip between 1985 and 1997. The contra lateral hip that had no initial signs of osteoarthritis in the beginning was followed retrospectively for a minimum of six (average 13.2) years in order to detect degenerative changes. The stress of hip joint was calculated by our newly developed biomechanical analysis program. This study utilized the joint average stress as a predictor variable in combination with patient's sex, age, and biomechanical hip parameters such as AWZ, CE angle, CCD angle, ACM angle, joint space, lever arm ratio and Kellgren/Lawrence score to explain the relationship between the hip joint average stress and the prognosis OA of the hip, and to explain the reason of the development of hip OA is more common in women. Comparative analysis of pre-operative and follow-up results was performed using Statistical analysis software, SPSS 18.0. Analysis methods included the chi-square test (cross tabs), binomial test, independent T test, correlation and linear regression.

Results:

OA of the hip is more common in women ($p=0.03$). Women have higher hip joint stress ($p<0.01$), a shorter abductor force arm ($p<0.01$), and a bigger lever arm ratio ($p<0.01$). The body weight arm was the same between females and males ($p=0.43$).

Females have a smaller femoral head diameter ($p<0.01$), and weight were lighter than males ($p<0.01$). Females have a faster progression of hip OA ($p=0.03$). Hip joint stress: The bigger the CE was, the lower the stress was on the hip joint ($r=-0.54$, $p<0.01$). A greater AWZ and ACM resulted in a higher stress the on hip joint ($r=0.48$, $p=0.01$ and $r=0.33$, $p<0.01$ respectively). A shorter hip abductor force arm resulted in a higher hip joint stress ($r=-0.50$, $p<0.01$), while a shorter hip ratio lever arm resulted in a lower hip joint stress ($r=0.51$, $p<0.01$). The contact area and hip joint average stress were negatively correlated ($r=-0.48$, $p<0.01$). Hip joint anatomical structure: In a non-operative hip, a small femoral head had big pre-operative range of motion ($r=-0.27$, $p=0.04$). In DDH group, the larger the angle of the weight-bearing zone, the larger the change in total joint space was seen ($r=-0.29$, $p=0.02$), and the bigger AWZ angle was, the bigger change of joint space I was happened ($r=-0.26$, $p<0.05$). The Left side THR was more frequently seen ($p=0.01$). Motion of hip joint: With the narrowing of the hip joint space, the total motion of hip joint decreased ($r=0.42$, $p<0.01$).

Conclusion:

Females have a higher hip joint stress than males, it because women have a shorter abductor force arm and a bigger lever arm ratio, a wider pelvis and a smaller femoral head diameter. Females have a higher incident rate of OA of hip and a faster progression of hip OA, maybe a higher hip joint stress is the reason why females have a higher incident rate of OA of hip than males. The average joint stress as a predictor variable in combination with the biomechanical hip parameters, such as the AWZ, CE angle, ACM angle, joint space, abductor force arm and lever arm ratio can explain the prognosis OA of the hip. With the narrowing of the hip joint space, the range of hip motion was decreased.