

WHAT MORPHOLOGICAL FACTORS INFLUENCE ON HIP FLEXION RANGE OF MOTION AFTER ROTATIONAL

ACETABULAR OSTEOTOMY? - CT SIMULATION STUDY -

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INTRODUCTION

Reorientation of the acetabulum for developmental dysplasia of the hip (DDH) by rotational acetabular osteotomy (RAO) may not restore normal hip range of motion (ROM) due to the inherent deformity of the hip (Ninomiya 1989) (Nakamura 1998) and it may lead to femoro-acetabular impingement (FAI). (Myers 1999) The purpose of this study was to investigate morphological factors of the pelvis and femur influencing on simulated ROM after RAO with a fixed target for femoral head coverage.

MATERIALS AND METHODS

We retrospectively reviewed hip CT images of 52 DDH hips from 29 women with an average lateral center edge angle (CEA) of 7.9 ° (range -12° to 19°). After virtual RAO with 30° of lateral CEA and 55° of anterior CEA producing femoral head coverage similar to that of the normal hips we measured simulated flexion ROM using pelvic and femoral computer models reconstructed from the CT images. Using the CT images, acetabular anteversion, anterior acetabular sector angle, lateral CEA, pelvic sagittal inclination, femoral neck anteversion, femoral neck shaft angle (FNSA), alpha angle and the position of the anterior inferior iliac spine (AIIS) were investigated as morphological factor. To characterize the position of AIIS: when the most prominent point of the AIIS existed more distally than the cranial tip of the acetabular joint line in a lateral view of the pelvis model in supine position, the subjects were defined as AIIS-Type1; the remaining subjects were defined as Type2. The Kappa value of inter-observer reproducibility to classify AIIS was estimated. There were 10 hips with Type 1 and 42 hips with Type 2 AIIS. The Kappa value was 0.82.

Multiple regression analyses were performed to analyze the relationship between ROM and the morphological parameters including the AIIS-Type. Furthermore, we analyzed the relationship between the probability of flexion ROM being less than 110° and the factors

which influenced on flexion ROM.

RESULTS

FNSA and AIIS-Type independently influenced on simulated flexion ROM after RAO (standard regression coefficient: -0.51 and 0.37, respectively. $p < 0.001$). The multiple correlation coefficient was 0.68. Flexion ROM after RAO with a fixed femoral head coverage similar to that of the normal hips ranged from 95° to 141° with an average of $121^\circ \pm 8^\circ$. The probability of ROM being less than 110° was significantly higher in subjects with AIIS-Type 1 than in those with Type 2 (odds ratio: 13.3, $p < 0.01$). It was also significantly higher in subjects with more than 135° of FNSA than in those with less than 135° of FNSA (odds ratio: 9.5, $p < 0.05$).

DISCUSSION

This study is the first report to investigate the morphological factors of the pelvis and femur influencing on simulated flexion ROM after RAO with a fixed target for femoral head coverage. Femoral neck shaft angle and the type of AIIS influenced on flexion ROM after RAO with approximately 40° of variation in spite of a fixed target for femoral head coverage. (Steppacher 2014) (Hetsroni 2013) In conclusion, we demonstrated that a large femoral neck shaft angle and a distal positioning of AIIS were independently associated with smaller flexion ROM after RAO.

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DISCLOSURES

The authors declare no conflict of interest associated with this manuscript.

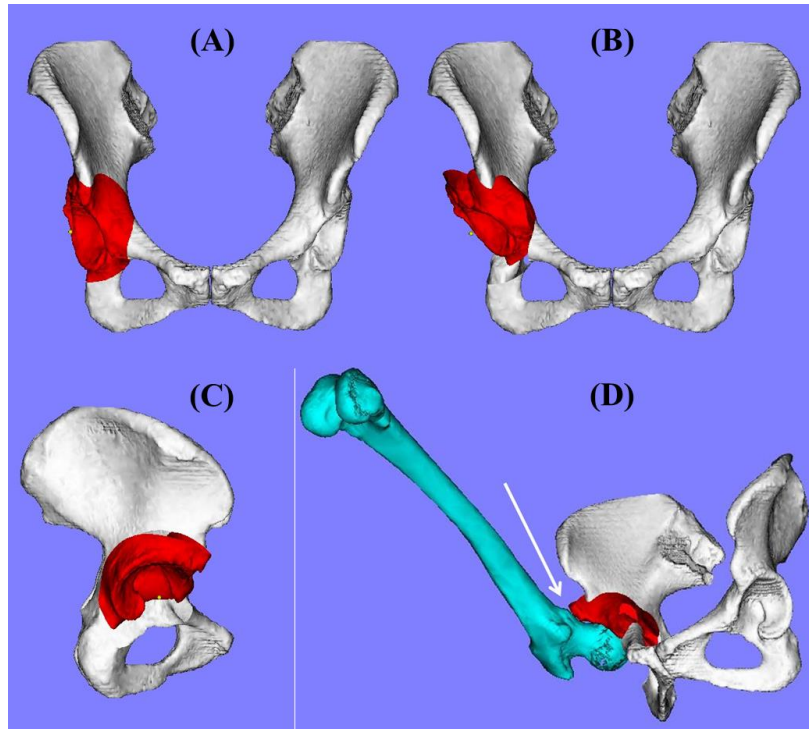


Figure1. (A) a preoperative pelvic model with the acetabulum in red cut by a 40-mm spherical radius from the hip center. (B) a pelvic model after Virtual RAO showing a lateral CE angle of 30°. (C) a pelvic model after Virtual RAO showing an anterior CE angle of 55°. (D) Simulated flexion ROM measured by collision detection of the pelvis and femur models.

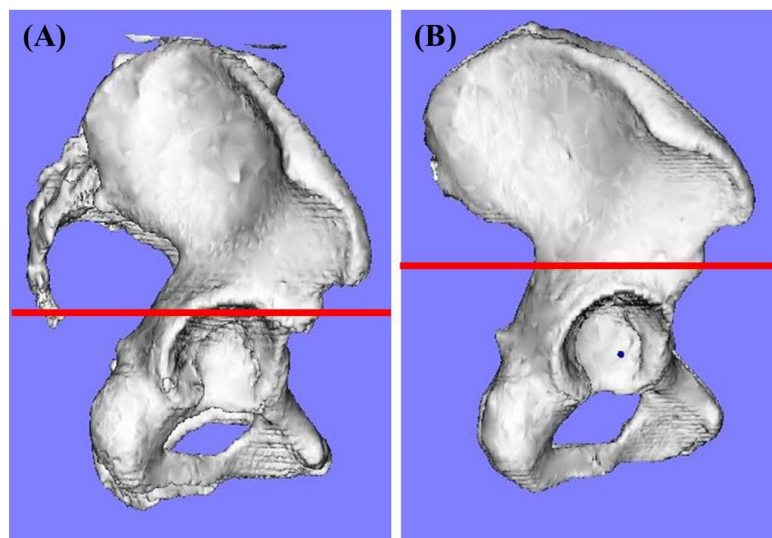


Figure2. (A) AIIS-type 1: the most prominent point of the AIIS existing more distally than the cranial tip of the acetabular joint line in a lateral view of the pelvis model in supine position. (B) AIIS-type2