Anterior Instability Due To the Posterior Pelvic Tilt in Total Hip Arthroplasty

INTRODUCTION:
Posterior pelvic tilt in elderly patients due to the lumbopelvic kyphosis, or the patients with ankylosing spondylitis results in the excessive anteversion of the acetabular component and sometimes leads to the anterior instability after total hip arthroplasty (THA) (Fig.1). Large changes of the acetabular anteversion in between prone and standing position may mislead surgeons about the implant placement. The purpose of this study was to conduct the quantitative evaluation of the effects of pelvic tilt (PT) on the range of motion (ROM) of the hip after THA.

METHODS:

THA Model
We established a THA model based on that described by Amstutz et al.1. Cementless THA (Japan Medical Material, Osaka, Japan) was implanted into a synthetic replica of unilateral pelvis and proximal femur (Sawbones, Vashon, WA) with head diameter 28mm and with neck length +3mm. The anteversion of acetabular component and ROM of the hip can be finely adjusted in according to the radiographic definition described by Murray1. (Fig. 2).

Measurement
The anterior pelvic plane (APP), defined by anterior superior iliac spine and pubic symphysis, was used as the reference for PT. PT was varied from -90° (anterior tilt) up to 40° (posterior tilt) with a 10° increment. The acetabular anteversion was varied from -10° (10° retroversion) to 30° with a 10° increment, and the inclination (abduction) angle of the acetabular component was increased from 35° to 55° with a 10° increment. To evaluate joint stability, we measured ROM at which impingement occurred prior to dislocation. In addition, we recorded the site where impingement occurred. The range of external rotation at 0° extension (ER) was measured by the built-in goniometer. All measurements were repeated 3 times.

RESULTS:

Posterior PT and anterior instability
ER decreased in a posterior PT-dependent manner. In the case with 20° acetabular anteversion, The decrease of ER was linear and the rate was approximately 0.94° per degree of PT (R^2=0.995) (Fig. 3). The site of impingement was the bony impingement between the great trochanter and ischium up to 20° posterior PT. It changed to the implant impingement between the neck and liner at more than 20° posterior PT.

Effects of acetabular anteversion on anterior instability
In the case with 40° posterior PT, the less acetabular anteversion led to the more ER in the range between 30° and 10° of acetabular anteversion (Fig 4). The rate was approximately 1.4° per degree of acetabular anteversion (R^2=0.998). The delayed implant impingement contributed to this improvement. However, the bony impingement occurred prior to the implant impingement at less than 10° acetabular anteversion. Thus, the further improvement of ER by the decreased acetabular anteversion was not observed.

Effects of acetabular inclination on ER
The inclination of the acetabular component showed small effects on ER. ER improved from 5° to 8° by changing the inclination from 35° to 55° at 40° posterior PT.

Conclusions:
Our study showed that the so-called anatomical position of acetabular component resulted in anterior instability in the patients with excessive posterior pelvic tilt. Preoperative evaluation of the pelvic tilt with the standing position is necessary for these cases. Technically, less anteversion of the acetabular component improved ER, however, 10° of acetabular anteversion or under resulted in posterior bony impingement and could not improve the anterior instability.

References

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