Correlation between anteverision of the cup, pelvic inclination angle and polyethylene wear after total hip arthroplasty

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INTRODUCTION:
Polyethylene wear contributes to periprosthetic osteoradion and results in loosening after total hip arthroplasty (THA). The amount of polyethylene wear has been shown to be affected by acetabular cup anteverision, and cup anteverision is affected by pelvic tilt. While many studies have investigated the relationship between pelvic tilt and cup angle, none have examined the relationship between pelvic tilt and polyethylene wear. The purpose of this study was to examine the correlation between cup anteverision and the pelvic inclination angle (PIA), and also the effects of pelvic tilt on polyethylene wear.

METHODS:
A total of 50 hips which were treated by THA between 2001 and 2005 and followed up for a minimum of 5 years were enrolled in this study. There were 45 women and 5 men, and the mean age at the time of surgery was 64.3 ± 8.4 years. The diagnosis was osteoarthritis in 42 hips (84%) and osteonecrosis in 8 hips (16%). All cases were treated by cementless THA (Secure Fit®, Super Secure Fit®, Trident AD Cup®: Stryker; Versys Fibermetal midcoat®, Trilogy Cup®: Zimmer). Highly cross-linked polyethylene liners (Crossfire®: Stryker; Longevity®: Zimmer) were used for all patients. All patients were treated with 26mm cobalt-chrome heads.

In radiographic evaluation, anteverision of the cup was measured according to the Lewinnek4 procedure (Fig. 1). PIA was calculated by using the longitudinal axis length (H) on antero-posterior radiographs of the pelvis and the equation θ = arcsin(H/D). D was substituted for the average of the pelvic foramen distance (165mm for women or 157mm for men), as suggested by Kitajima5(Fig. 2). Each item was measured in supine and standing position, and the differences in measurements between supine and standing were defined as Δanteversion and ΔPIA.

**Fig 1** Anteverision=arcsin(D1/D2+5°) **Fig 2** 0 = arcsin(H/D)

D : 165mm for women, 157mm for men

Polyethylene wear was measured using the Roman free software V1.70, which applies a digital equivalent of the manual Livermore method using the compass and ruler function of the software. The variation of the head center after THA and at the final follow-up was defined as polyethylene wear (mm). To obtain the annual wear rate (mm/year), we divided the amount of wear by the length of follow-up period (years). Coefficients were calculated between Δanteversion and ΔPIA. Also, correlation coefficients were calculated between Δanteversion or ΔPIA and wear rate, and between PIA and wear rate and standing positions. Finally, coefficients were calculated between Δanteversion and ΔPIA.

The data was analyzed by the Pearson product-moment correlation coefficient and simple regression analysis. The difference was considered to be significant when the p-value was less than 0.05.

RESULTS:
Postoperatively, the mean anteverision was 20.1 ± 9.8° in supine position and 25.7 ± 10.5° in standing position, and this difference was significant (p<0.05). The mean PIA was 25.7 ± 8.6° in supine position and 20.1 ± 6.4° in standing position, and this difference was also significant (p<0.05). The mean polyethylene wear rate was 0.081mm/yr. There was a negative correlation between Δanteversion and ΔPIA (r=−0.54, p=0.0004) (Fig 3-a). There was a negative correlation between the wear rate and PIA in supine and standing positions (r=0.367; p=0.007; r=0.398; p=0.004, respectively) (Fig. 3-b). There was a negative correlation between the wear rate and ΔPIA (r-value -0.319; p-value 0.02) (Fig. 3-c, Table). There was a positive correlation between the wear rate and anteversion in supine and standing positions (r=0.508; p=0.0001; r=0.551; p=0.0001, respectively) (Fig. 3-e, Table). There was a positive correlation between the wear rate and Δanteversion (r=0.301; p=0.018) (Fig. 3-f, Table).

**Table. Factors which correlated with wear rate after THA by simple regression**

<table>
<thead>
<tr>
<th>Position</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine</td>
<td>0.551</td>
<td>0.0001</td>
</tr>
<tr>
<td>Standing</td>
<td>0.551</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

DISCUSSION:
This study revealed a correlation between Δanteversion and ΔPIA. The pelvis tilted posteriorly in standing position more than in supine position; furthermore, anteverision tended to be greater in standing position than in supine position. A correlation was also observed between the amount of polyethylene wear and Δanteversion or ΔPIA. These results might indicate that polyethylene wear would be increased in cases with large amount of change in PIA between standing and supine positions.

The present study suggested that to reduce polyethylene wear, careful attention must be given to not only the implantation of the acetabular component, but also to the pelvic inclination.

REFERENCES:

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