Can the Pre-operative Femoral Neck Geometry Be Used to Predict Post-operative Femoral Stem Anteversion in THA Patients?

Kwan Kyu Park, M.D., Ph.D.1, Tsung-Yuan Tsai, PhD2, Dimitris Dimitriou, MD2, Harry E. Rubash, MD2, Guoan Li, Ph.D.2, Young-Min Kwon, MD2.

1Yonsei University, College of Medicine, Seoul, Korea, Republic of, 2Bioengineering Laboratory, Dept. of Orthopaedic Surgery, Massachusetts General Hospital/Harvard Medical School, Boston, MA, USA.

Disclosures: K. Park: None. T. Tsai: None. D. Dimitriou: None. H.E. Rubash: 1; MAKO/Stryker. 3B; Access MediQuip. 7; Lippincott, Williams and Wilkins. G. Li: 1; MAKO Surgical Corp, Stryker. 5; K2M, DePuy Synthes. Y. Kwon: 5; Zimmer Mako Stryker Biomet.

Introduction: Optimal femoral stem anteversion in total hip arthroplasty (THA) is an important parameter to minimize dislocation and impingement [1]. Limited information is known for the estimation of the femoral stem anteversion from the pre-operative native femoral geometry. This study investigated the relationships between the preoperative femoral anteversions and the femoral stem anteversion using CT scans and CT-based 3 dimensional models to determine whether any preoperative anteversion measurement correlates with the postoperative stem anteversion. We hypothesized that the anteversions based on the femoral neck geometry would be correlated to the postoperative femoral stem anteversion.

Methods: Pre-operative native femoral anteversions from CT scans and 3D models at different anatomical locations (CT-Head, CT-Below Head, CT-Neck, 3D-Head, and 3D-Neck) were measured in 19 THA hips with cementless proximally tapered femoral stems (Fig. 1). These 5 pre-operative parameters were compared with the post-operative femoral stem anteversion and the combined acetabular-femoral component anteversion [2].

Results: The pre-operative anteversion measurement at the femoral Neck level was correlated with the post-operative stem anteversion (r=0.761, p=0.002) among all preoperative anteversion measurements, with the narrowest ranges of the differences from the stem anteversion (-10.2°~11.0°) (Table 1). There was a significant difference between CT-Head anteversion and stem anteversion (9.6° ± 9.2° vs. 19.0° ± 9.4°, respectively, p=0.004).

Discussion: The pre-operative anteversion using the neck geometry from CT scan correlated with postoperative stem anteversion in tapered femoral stem, suggesting that the preoperative anteversion measurement based on the femoral neck geometry is a useful preoperative templating parameter for the estimation of the postoperative stem anteversion.

Significance: The pre-operative anteversions using the femoral neck geometry from CT scans can be used for the estimation of the postoperative femoral stem anteversion in THA. This information is clinically useful for surgeons in optimizing combined acetabular-femoral component version in THA patients.

Table 1. Anteversion measurement by each method and correlations with stem anteversion
<table>
<thead>
<tr>
<th></th>
<th>Anteversion (mean ± SD, ranges)</th>
<th>Difference from the Stem Anteversion* (mean ± SD, ranges)</th>
<th>r† (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT scan based</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT-Head</td>
<td>9.6° ± 9.2° (-5~24.7°)</td>
<td>-9.4° ± 9.4° (-27.4~4.1°)‡</td>
<td>0.491 (0.094)</td>
</tr>
<tr>
<td>CT-Below Head</td>
<td>14.1° ± 9.8° (-7.1~28.6°)</td>
<td>-4.8° ± 8.4° (-18.6~8.4°)</td>
<td>0.491 (0.094)</td>
</tr>
<tr>
<td>CT-Neck</td>
<td>21.3° ± 8.1° (6.0~32.8°)</td>
<td>2.3° ± 5.9° (-10.2~11.0°)</td>
<td>0.781 (&lt;0.001)</td>
</tr>
<tr>
<td>3D model based</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3D-Head</td>
<td>14.4° ± 8.9° (-2.2~26.9°)</td>
<td>-4.5° ± 8.1° (-21.0~9.1°)</td>
<td>0.613 (0.005)</td>
</tr>
<tr>
<td>3D-Neck</td>
<td>15.9° ± 10.1° (-1.5~31.0°)</td>
<td>-3.1° ± 9.9° (-20.4~14.1°)</td>
<td>0.488 (0.035)</td>
</tr>
</tbody>
</table>

*The stem Anteversion = 19.0° ± 9.4° (range, 0.4~34.1°), and negative means retroversion
†Correlations with Stem anteversion
Fig. 1 A schematic figure of the measurement of the anteversion by each method

CT Scan
- CT-Head Level
- CT-Below Head Level
- CT-Neck Level

3D Model
- 3D-Head
- 3D-Neck

ORS 2015 Annual Meeting
Poster No: 1836