Comparison Of Image-free Navigation And Intraoperative Instrument (gravity guide) In Assessment Accuracy Of Femoral Stem Antetorsion In THA

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Introduction: Implant positioning is an important factor determining the outcome of total hip arthroplasty (THA), and malpositioning of the implant may lead to an increased risk for postoperative complications such as dislocation. Regarding optimal implant position to be aimed at during the THA procedure, there have been a number of studies proposing desirable range of acetabular cup alignment. However, there have been a few studies dealing with the issue of femoral stem antetorsion (AT). In our clinical experience with the use of image-free cup navigation system, stem alignment was adjusted manually based on surgeon’s perception. The clinical review of this case series showed consistent and accurate cup positioning, while the AT values averaged 23.6° ± 11.2° (range: 2° to 45°) with large variation. Consequently, sum of cup anteversion and stem AT values, combined anteversion (CA), also showed variable results.

In order to attain consistency in intraoperative stem AT adjustment, we have employed two different procedures. First, we developed a simple instrument, Gravity-guide (G-guide), for intra-operative assessment of stem AT. Secondly, navigation software was revised, and equipped with intraoperative measurement system for AT values. We have used these two methods concomitantly to control stem AT intraoperatively. In the present study, we evaluated the accuracy and effectiveness of G-guide and new navigation software as referenced to postoperative measurement results using CT examination.

Methods: From January to December 2012, 30 hips underwent primary navigated THA using OrthoPilot THApro (B. Braun Aesculap, Tuttlingen, Germany). In addition to control cup positioning, this system is capable of adjusting leg length, femoral offset, and stem AT. During surgery, AT value was determined at the time of final rasping of the femur. Additionally, the G-guide was also utilized to evaluate the AT as determined by the final rasp. In the THA procedure, we used a modified Hardinge approach with the patient at a lateral decubitus position in all cases. The G-guide consists of two parts; one attached to the lower leg and the other attached to the handle of the rasp (Fig.1). One part attached to the lower leg was utilized to ascertain perpendicularity of the lower leg axis. The other part provides the information for AT of the rasp. Intraoperative set up of this instrument system is shown in Figure 2.

In the process of preoperative planning, the femoral AT was measured on preoperative CT images for each patient. The target angle for AT of the femoral stem (range: 10° to 30°) was specifically determined for each patient according to the amount of the individual femoral AT. Postoperatively, AT was measured on CT images, and the measured angle was compared to the value obtained from intra-operative assessments as presented by OrthoPilot THApro and G-guide evaluation. Subsequently, the values obtained from these two systems (image-free navigation and G-guide) were compared in reference to the AT value as indicated by postoperative CT image examination. In comparison of stem AT value derived from postoperative CT examination and the value obtained from the G-guide system, the angle of discrepancy between posterior condylar line and femoral transepicondylar axis needs to be taken into consideration. The lower leg (tibial) axis, which is thought to be perpendicular to the transepicondylar axis, is used as reference in the G-guide system, while posterior condylar line is used as a reference to determine stem AT in CT examination. Therefore, the angle of this discrepancy (condyler twist angle) should be added to the AT value obtained from the G-guide for comparison with postoperative value measured on CT images. The AT angle calculated with this correction is indicated as “corrected intraoperative AT angle” in the following description.

Results: The mean AT values obtained from the intraoperative navigation and postoperative CT examination showed that were 18.8± 8.3° (range: 7 to 39°) and 19.3 ± 8.8° (range: 2 to 38°) respectively. There was no significant difference between the values obtained by intraoperative navigation system and post-operative CT evaluation. A discrepancy between the intraoperative and postoperative measurements was ranging from -10 to 8 degrees with absolute discrepancy value of 10 degrees or less, while the average absolute discrepancy was 3.9± 3.2°. The angle with the intra-operative G-guide evaluation was 16.2 ± 8.0° (range: 5 to 30°), and the condyler twist angle in preoperative epicondylar view was 6.6 ± 2.4° (range: 4.0 to 10.0°). Based on these results, the mean corrected intraoperative AT was 22.1 ± 7.9° (range: 10 to 38°). The mean value for corrected G-guide value was significant higher than the value indicated by navigation and postoperative CT evaluation. A discrepancy between the intra-operative and postoperative measurements was ranging from -5 to 8 degrees with absolute discrepancy value of 8 degrees or less. The average discrepancy was 4.0± 2.6°. The absolute value as well as standard deviation in the discrepancy results was smaller in the use of G-guide as compared to the navigation system.
Discussion: Determination of the stem AT is one of the critical factors influencing the outcome of THA. Conventional (manual) intra-operative adjustment may result in variability and inaccuracy. The use of both OrthoPilot THApro and G-guide was equally effective in reducing the variability of the stem AT compared to the results with manual adjustment. Additionally, this study proved the effectiveness of the G-guide system we invented in intra-operative stem AT adjustment.

Significance: This study proved the effectiveness of the G-guide system we invented in intra-operative stem AT adjustment.

Acknowledgments: non

References: S Fukunishi et al. Combined anteversion of the total hip arthroplasty implanted with image-free cup navigation and without stem navigation. Orthopedic Review 2012; 4: e33
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Fig.2