

# ACCURACY OF COMBINED ANTEVERSION IN THE COMBINED ANTEVERSION TECHNIQUE WITH IMAGE-FREE NAVIGATED TOTAL HIP ARTHROPLASTY

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## INTRODUCTION

In recent literatures dealing with optimization of prosthetic alignment in total hip arthroplasty (THA), the concept of combined anteversion (CA), which is the sum of acetabular anteversion (AV) and femoral antetorsion (AT), has been addressed. Widmer attempted to determine the optimal CA using a computer simulation study<sup>1)</sup>. He proposed the “new safe zone” for the CA value to achieve essential range of motion while avoiding prosthetic impingement. On the other hand, Dorr described the combined anteversion technique (CA technique) to determine both cup and stem alignment during THA procedure<sup>2,3)</sup>. He proposed the so-called “stem-first” procedure for the CA technique in which the stem is set first, and cup alignment is determined to consider the target CA value. In our recent clinical practice, we have been using an image-free THA navigation system (OrthoPilot THA Pro; B/BRAUN-Aesculap, Germany) to achieve improved overall alignment with both stem and cup<sup>4)</sup>. In the present study, the femur was prepared first with the target angle corresponding to the native femoral AT, and the cup AV was decided considering the CA calculated with Widmer’s formula ( $37.3^\circ = \text{cup AV} + 0.7 \text{ stem AT}$ ) using an image-free navigation system. The purpose of this study was to evaluate the accuracy of CA by using the CA technique with image-free navigated THA.

## MATERIALS AND METHODS

From February 2013 to December 2014, 50 hips underwent primary THA with the CA technique using OrthoPilot THA Pro. All included patients underwent preoperative CT examination to measure the native femoral AT. The native femoral AT was defined as the angle formed between the proximal femoral neck axis and the tangential line connecting the bilateral posterior femoral condylar margin on axial CT images. All hips were implanted with a cementless cup (Plasma cup; B/ Braun-Aesculap, Germany) and a cementless stem (Bicontact; B/Braun-Aesculap, Germany). In the CA technique, the femur was prepared first and the target angle of the AT value was basically determined by the amount of the individual native femoral AT angle. After the femur was prepared, the cup AV was decided based on Widmer’s formula (aiming at the optimal Widmer’s CA of  $37.3^\circ$ ). The stem AT in patients with a native femoral AT of more than  $53^\circ$  or less than  $0^\circ$  was not targeted at the native angle and those subjects were excluded from the study. All included patients underwent postoperative CT examination, and the prosthetic alignment was assessed using the 3D-Template system (Zed Hip, LEXI).

## RESULTS

In the assessment of accuracy of the navigation systems in 50 consecutive THA’s, comparison of intraoperative navigation value and postoperative CT evaluation indicated that the absolute

discrepancy of cup inclination, AV, and stem AT was  $3.0^\circ \pm 2.6^\circ$ ,  $4.5^\circ \pm 3.5^\circ$  and  $5.9^\circ \pm 4.3^\circ$  respectively. In the assessment of the cup AV with postoperative CT evaluation, the measured values averaged  $20.7^\circ \pm 6.2^\circ$  while AT values for the stem averaged  $20.9^\circ \pm 10.6^\circ$ . Distribution of AT values showed large SD. By contrast, the average Widmer's CA values (cup AV + 0.7 stem AT) were  $35.2^\circ \pm 5.7^\circ$ . In the assessment of overall alignment, the Widmer's CA values were within  $37^\circ \pm 5^\circ$  in 40 hips and  $37^\circ \pm 10^\circ$  in 46 hips.

parameter	Pre-operative CT evaluation (native femoral AT)	Intra-operative navigation	Post-operative CT evaluation
Cup anteversion		17.6±5.3 (6-28)	20.7±6.2 (6-33)
Cup inclination		39.3±2.8 (33-43)	38.1±3.5 (30-44)
Stem anteversion	20.1±2.6 (4-45)	15.5±9.7 (0-40)	20.9±10.6 (4-46)
Widmer's combined anteversion			35.3±5.7 (22.8-55.1)

Table 1: Summary of the results

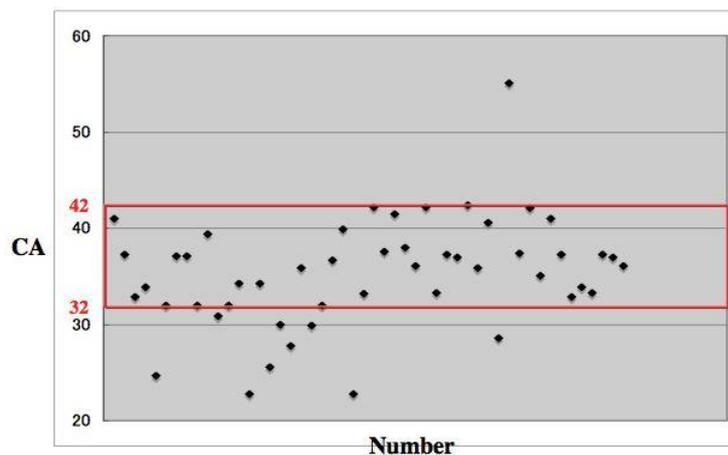


Figure1: Scatter potting of postoperative CA value. Red square is indicated the range of within  $37^\circ \pm 5^\circ$

## DISCUSSION

Wide variability of postoperative femoral AT has been reported <sup>5,6</sup>. In regards to the individual difference in the native femoral AT, stem AT cannot be well controlled by depending on the anatomy of the proximal femur during cementless THA. It could be difficult to adjust the target for the optimal CA value in the cup-first technique due to the

individual variation of the native femoral AT <sup>2,3,7</sup>). The present study proposed that confirming stem AT prior to cup placement could be important to achieve the appropriate CA value. CA technique with image-free navigated THA could effectively achieve accurate and consistent control of the CA value, and thus is expected to further improve the surgical outcome.

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## DISCLOSURES

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