

Validation of patient specific templates in total hip arthroplasty

SAKAI T¹, MURASE T¹, HANADA T², KITADA M³, NISHII T⁴, TAKAO M¹, YOSHIKAWA H¹, SUGANO N⁴

¹*Department of Orthopaedic Surgery, Osaka University Graduate School of Medicine, Suita, Japan*

²*Nakashima Medical, Okayama, Japan*

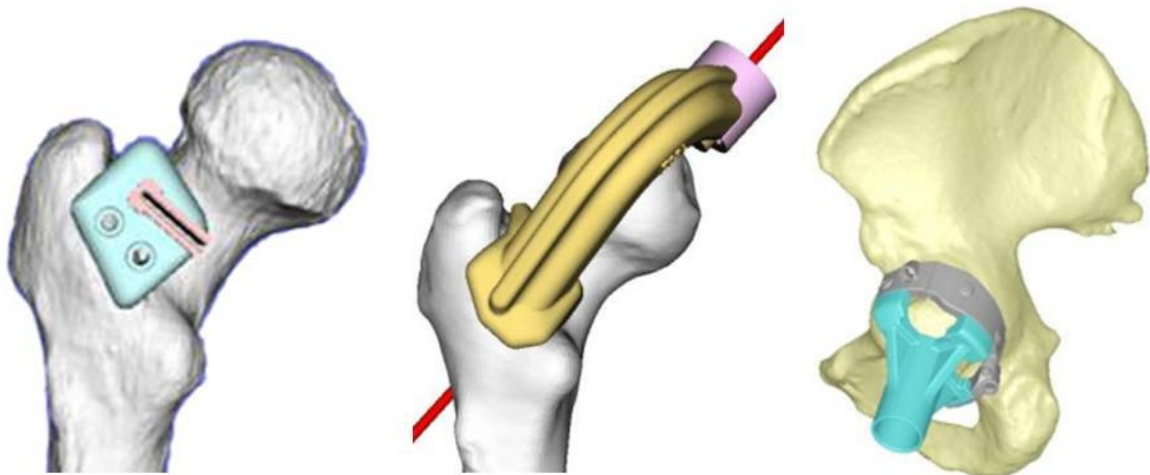
³*Department of Orthopaedic Surgery, Kyowakai Hospital, Suita, Japan*

⁴*Department of Orthopaedic Medical Engineering, Osaka University Graduate School of Medicine, Suita, Japan*

tsakai-osk@umin.ac.jp

Introduction: The absolute error of femoral template for insertion of guide pin in resurfacing hip arthroplasty (RHA) [1, 2] and acetabular template for component fixation in total hip arthroplasty (THA) [3, 4] has been reported in comparison between the preoperative planning and the postoperative computed tomography (CT). However, there has been no report about the absolute error between the preoperative planning and template fitting, or template fitting and final implantation in THA. In order to elucidate validation of patient specific templates in THA, we performed experimental study using fresh cadaver samples.

Methods: Neck cut template for the femoral neck in THA, femoral template for guide pin insertion in RHA, and acetabular template in THA were made based on the preoperative planning from the preoperative CT data of eight fresh cadaver samples (Figure 1). We used posterolateral approach. After setting acetabular template and inserting a femoral guide pin using femoral template for RHA, first CT was imaged for validation assessment between the preoperative planning and template setting. After acetabular component and stem were implanted, second CT was imaged for validation assessment between the preoperative planning and final implantation.



Results: The absolute error between the preoperative planning and template setting of the femoral neck template was $1.6 \pm 1.9^\circ$ for the neck-shaft angle, $0.7 \pm 0.7^\circ$ for the flexion angle, and 0.8 ± 0.5 mm for the neck cut level. That of the acetabular template was $3.4 \pm 3.8^\circ$ for the inclination angle and $3.6 \pm 4.3^\circ$ for the anteversion. The absolute error between the preoperative planning and final implantation of the femoral guide pin insertion was $2.6 \pm 3.9^\circ$ for the stem-shaft angle, $2.4 \pm 2.3^\circ$ for the anteversion, and 3.7 ± 2.6 mm for the femoral insertion point. That of the femoral neck template was $3.6 \pm 5.2^\circ$ for the neck-shaft angle, $4.2 \pm 4.6^\circ$ for the flexion angle, and 0.9 ± 0.8 mm for the neck cut level. That of the acetabular template was $6.7 \pm 5.6^\circ$ for the inclination angle and $8.4 \pm 4.8^\circ$ for the anteversion.

Discussion: The absolute errors between the preoperative planning and template setting of the femoral neck template and acetabular template were elucidated. The validation of the femoral neck template was first reported and the absolute error was acceptable. Concerning the femoral guide pin in RHA, the absolute error between the preoperative planning and final implantation in the present study was comparable with other reports; 0.6 - 4.2° for the stem-shaft angle and 0.4 – 8.2° for the anteversion in clinical situation [1, 2]. Concerning the acetabular template, the absolute error between the preoperative planning and final implantation in the present study was worse than other reports; 0.7 – 5.5° for the inclination angle and 1.0 – 6.4° for the anteversion in clinical situation [3, 4]. The differences of the errors may depend on the design of the acetabular template.

Conclusion: Neck cut template and acetabular template in THA showed errors in both procedure of template setting and cup implantation. The absolute errors of femoral template for guide pin in RHA was acceptable.

References

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