Accuracy of CT-based navigation in revision THA

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Introduction: Revision total hip arthroplasty (THA) is a technically demanding procedure. Importance of preoperative planning has been emphasized and use of navigation system, especially CT-based navigation system is thought to be beneficial [2, 3]. Although the accuracy of CT-based navigation system have well been reported in primary THA [1, 4, 5], the accuracy and usefulness of its application in revision THA remains to be unknown. The purpose of this study was to evaluate the clinical accuracy of cup positioning with the use of navigation system in revision THA.

Methods: From December 2005, 30 hips (29 patients) that underwent revision THA using Stryker CT-based hip navigation system (Stryker-Leibinger, Freiburg, Germany) and Trident acetabular cup (Stryker) were the subjects of this study. The average age was 69 (40-86) years. Reason for revision THA were aseptic loosening in 21 hips, recurrent dislocation in 4 hips, post infection (two-stage revision) in 3 hips and migration of hemiarthroplasty in 2 hips. Preoperative AAOS classification of acetabular deficiencies were type I; 11 hips, type II; 3 hips, type III; 12 hips and no deficiency; 4 hips. Preoperatively, CT images of the patient were obtained and we planned the position and the size of the acetabular cup three-dimensionally on the navigation software. Intraoperatively, after removal of metal implants, surface registration of the pelvis, acetabular reaming and cup placement were performed under the navigation system according to the preoperative planning. Postoperatively, CT scanning was performed and alignment of the cup was assessed on the CT hip navigation software. The data was compared with the preoperative planning and intraoperative data. We further compared these data with those of primary THA to know whether they were comparable or not. Thirty consecutive patients who underwent primary THA using the same navigation system and whose postoperative CT were available were included and analyzed in the same way.

Results: There was no complication related to navigation procedures. The average time for the intraoperative registration was 7.7±7.7 (2-33) minutes. The average RMS was 0.68 ±0.16 (0.40-1.07) mm. The average clinical accuracy were 0.5±4 (-9-8) degrees for inclination and -0.07±5 (-14-13) degrees for anteversion. The average measurement error were 0.7±3 (-5-8) degrees for inclination and -0.7±3 (-12-5) degrees for anteversion. In primary THA group, the average time for the intraoperative registration was 5.4±3.5 (2-16) minutes. The average RMS was 0.73±0.17 (0.5-1.2) mm. The average clinical accuracy were -1.5±3 (-7-6) degrees for inclination and 1.4±6 (-13-9) degrees for anteversion. The average measurement error were 0.3±3 (-6-5) degrees for inclination and -0.8±3 (-6-8) degrees for anteversion. All these parameters were not statistically different between two groups.

Discussion: In this study, we found no differences in clinical accuracy and measurement error of the cup alignment between revision and primary THA under the use of the navigation system. In revision THA, importance of preoperative planning had been emphasized and use of navigation system, especially CT-based navigation system was thought to be advantageous [2, 3]. On the other hand, CT images of revision THA patients had an issue of metal artifacts caused by the implants [6, 7]. In this CT-based navigation system, we don't have to use the points in the acetabulum for registration. Instead, we could use extraarticular bone surface where the influence of metal artifacts was less and surface model creation was easier. In conclusion, this CT based navigation system was as effective in revision THA as in primary THA.

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