

Evaluation of acetabular component alignment change during screw fixation using navigation system

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Introduction: The cementless acetabular component fixed with several screws is one of the most widely used approaches in THA. The screws achieve fixation based on their initial bony purchase, and these screws rely on contact pressure and the resultant friction between the screw head and the cup to control translation and angulation of the prosthesis. However, intraoperative change of the acetabular component alignment during screw fixation should be hardly detected. Acetabular component alignment can be assessed using computer-assisted navigation systems with realtime adjustments for component position. The purpose of the current study was to evaluate intraoperative change of acetabular component alignment during screw fixation using navigation system.

Patients & Methods: Primary THAs were performed in 51 hips using CT based fluoroscopic matching navigation system (VectorVision, BrainLAB). The patients were 13 men and 38 women with a mean age of 62.4 years (range, 47-78 years) at operation. The diagnoses for THA included osteoarthritis (40 hips), osteonecrosis (5 hips), rapidly destructive coxopathy (RDC) (4 hips), and dislocated hips (2 hips). Intraoperative acetabular component inclination and anteversion were measured at the time of press-fit, and after screw fixation using the cup verification function in the system. Mean of the absolute difference between at the time of press-fit and after screw fixation was evaluated as intraoperative change of acetabular component. In addition, stability of acetabular component was assessed radiographically. The central-edge angle of the acetabular component, and the distance from the center of the femoral head to the interteardrop line as a horizontal and vertical reference on the postoperative radiograph with the patients in supine position was measured. The number of screws was also investigated.

Results: Mean inclination and anteversion at the time of press-fit were $41.0^\circ \pm 3.7^\circ$ and $14.0^\circ \pm 8.6^\circ$, respectively. Mean inclination and anteversion after screw fixation were $41.5^\circ \pm 4.8^\circ$ for inclination and $13.9^\circ \pm 8.8^\circ$ for anteversion. Mean intraoperative change of acetabular component was $1.8^\circ \pm 1.8^\circ$ for inclination and $2.1^\circ \pm 2.1^\circ$ for anteversion. The use number of the screw was an average of 1.58 (1 to 4). There was no correlation between the change of both inclination and anteversion and age, number of screws and radiographycal measurements. The intraoperative change acetabular component inclination in patients with dislocated hips was significantly greater than patients with hip OA and RDC ($p < 0.05$).

Discussion: The cementless acetabular cup fixed with multiple screws is one of the most popular approaches in THA, and many studies have shown that bone screws are very helpful aids for cup fixation. The multiple-screw fixation could have an effect on micromotion of the acetabular component. However, the change of acetabular alignment during inserting screws has not been clearly reported.

The current study showed mean intraoperative change of acetabular component was 1.8° for inclination and 2.1° for anteversion. Maximum change of acetabular component was 5° for inclination and 13° for anteversion. These findings suggest that the alignment of acetabular component could change during screw fixation, and the change might cause malalignment of the acetabular component, and could increase the risks of impingement, dislocation, and accelerated wear.

We also hypothesized that bone quality could affect stability of acetabular component. However, there was no correlation between the change of acetabular alignment and age, number of screws and radiographycal measurements in this series. These findings suggest that press-fit fixation of acetabular component should be more important.

In conclusion, navigation can show potential to help quantify intraoperative acetabular component alignment change during screw fixation and potentially reduce the risk for malposition of acetabular components.