Redefining the Acetabular Component Safe Zone for Posterior Approach Total Hip Arthroplasty

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Introduction: Proper orientation of the acetabular component is an important factor in patients undergoing total hip arthroplasty (THA), particularly as malpositioning has been a recognized cause of hip instability. The safe zone (SZ) for acetabular cup placement is considered to be 30-50° abduction and 5-25° anteversion. This study sought to investigate the effect of acetabular component orientation on the rate of hip dislocation. We hypothesized that a poorly aligned acetabular component will result in increased dislocation events.

Methods: After IRB approval, a consecutive cohort of 1572 primary THA cases was prospectively followed through our center’s patient registry. All utilized a metal or ceramic head and polyethylene liner and were performed utilizing a posterior approach. After excluding incomplete data sets and patients lost to follow up or death, 1209 cases were monitored through an average follow-up of 4.2 years, with minimum follow-up of 6 months. Five fellowship trained orthopaedic surgeons performed all procedures at a single institution. Component position was retrospectively measured using a validated computer-assisted method on routine pelvis radiographs by two independent blinded reviewers. Dislocation events were recorded and correlated with acetabular cup orientation.

Results: Average cup abduction was 42.8°±7.7° and anteversion was 13.4°±7.4°. 773 (63.9%) cups were within the SZ and 436 (36.1%) were malpositioned. The 41 cases sustaining dislocations had an average abduction of 43.9° and anteversion of 12.4°. Twenty (47.5%) of the dislocated hips were within the SZ and 21 (52.5%) were malpositioned. Cup position was an independent risk factor for dislocation (OR 1.91, 95% CI 1.02-3.56). Twenty-three dislocation cases showed less than 10° anteversion and this was also an independent risk factor for dislocation (OR 2.34, 95% CI 1.25-4.40). Modifying the anteversion SZ limits to 10-25° revealed 10 (24.4%) dislocations inside the new safe zone, versus 31 (75.6%) dislocations in malpositioned cups. Cup position outside this new safe zone was the greatest risk factor for dislocation (OR 2.63, 95% CI 1.28-5.41). Postoperatively, 18 patients (44% dislocations) dislocated within 30 days, 26 patients (63% dislocations) dislocated within the first 3 months, and 35 patients (83% dislocations) dislocated in the first year. Figure 1 shows a scatter plot depicting the cup position for all patients, and the SZ limits are marked on each axis with dislocation cases circled (the dotted line indicates the new recommended lower limit for the anteversion SZ based on this study using a posterior approach to the hip). Figure 2 shows a Kaplan-Meier survival curve of all dislocations indicating time from surgery at which dislocation occurred.

Discussion: In our study population, THA dislocations occurred at higher frequency when the acetabular cup was not accurately positioned in the SZ of 30-50° abduction and 5-25° anteversion. The data suggest...
that modifying the anteversion $SZ$ to 10-25° limits will further decrease the likelihood of dislocation. The majority of dislocation events occur within 3 months of surgery, and dislocation after 1 year is less common. A combination of additional factors including femoral offset, quality of the hip abductor complex, and leg length must also be considered to influence hip stability.

**Significance:** Hip dislocation events may be minimized by orienting the acetabular component inside a safe zone of 10-25° anteversion and 30-50° abduction, when using a posterior approach.