An Analysis of Cup Positioning in Total Hip Arthroplasty: Quality Improvement by Use of a Local Joint Registry

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Introduction
There are a variety of patient and surgical factors shown to increase post-operative complication risk for a total hip arthroplasty (THA). Patient factors that have been shown to influence surgical outcome include body mass index (BMI), age, patient gender, and primary diagnosis for the THA. Surgical factors influencing post-operative THA outcomes include performing surgeon, surgical approach, prosthetic components, acetabular cup fixation method, and orientation of the acetabular cup. While many studies have linked patient and surgical factors to unsuccessful outcomes post total hip arthroplasty (THA), no study has attempted to correlate the influence of these factors to the positioning of the acetabular cup. The purpose of this study was to determine if a correlation exists between patient and surgical factors and the anatomical position of the acetabular component.

Materials and Methods
Data for 2063 patients from 2004-2008 who underwent a primary total hip arthroplasty (THA), revision THA, or Birmingham Hip Resurfacing procedure was compiled. The post-op anteroposterior pelvis (AP) and the cross table lateral digital radiographs for each patient were obtained. The AP radiograph was measured using Hip Analysis Suite™ software to calculate the cup inclination and version angles. The version direction (+/-) was determined from the lateral radiograph using mDesk™ software. Acceptable angle ranges were defined as 30-45° for abduction, and 5-25° for version. Correlations between variables and cup abduction and version angles were determined with SPSS™ statistical software.

Results
There were 1954(95%) qualifying patients. There were 1218(62%) acetabular cups that fell within the 30-45° optimal abduction range, and 1576(87%) cups in the 5-25° optimal version range. There were 921(47%) patients that had both inclination and version angles that fell within the optimal range. Regression analysis showed that surgical approach (p<0.001), high/low volume surgeon (p<0.001), and obesity (BMI >30, p=0.01) were independent predictors for abduction and version combined analysis. Both surgical approach (p<0.001) and BMI (p=0.018) were independent predictors in the individual analysis of both abduction and version. High/low volume surgeon was significant for the independent analysis of abduction (p<0.001), but did not reach significance for the independent analysis of version (p=0.186). In the combined analysis, low volume surgeons showed a 2 fold increase (95% C.I. 1.5-2.8) in risk for cup malpositioning compared to high volume surgeons. The MIS surgical approach showed a 6 fold increase (95% C.I. 3.5-10.7) in risk for cup malpositioning compared to the posterolateral approach. Obesity (BMI>30) showed a 1.3 fold increase (95% C.I. 1.1-1.7) in risk for cup malpositioning compared to all other body mass index groups.

Discussion
Posterolateral surgical approach was superior to MIS surgical approaches for independent and combined abduction and version analysis. High volume surgeons had greater accuracy for cup positioning, specifically for achieving optimal cup abduction angle. Compared to all other body mass index categories, patients that were obese (BMI>30) displayed a greater risk for cup malpositioning for independent and combined abduction and version analysis. Further statistical analyses on patient and surgical variables and their influence on cup position at a lower volume medical center would provide a valuable data comparison.