Is Femoral Head to Acetabular Cup Ratio Associated with Dislocation after Total Hip Arthroplasty?

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INTRODUCTION:

Dislocation remains a common reason for revision total hip arthroplasty (THA). Large femoral heads and dual mobility bearings have been developed to improve stability; however, it remains unknown if the head size alone or a ratio of head size to acetabular cup size matters most for the purposes of stability. The purpose of this study was to investigate if there is an optimal ratio of femoral head to acetabular cup size to reduce the risk of dislocation. We hypothesized that a ratio closer to 1 would be associated with lower dislocation rates.

METHODS:

A retrospective cohort study was conducted. Between 2016-2019, 3,155 patients underwent primary THA via a direct anterior, direct lateral, or posterior approach. Demographic, radiographic, and implant data was recorded. Head/cup ratio was calculated by dividing femoral head size by acetabular cup size. All patients were at least two years from the date of surgery at the time of analysis. Univariate analysis and logistic regression was conducted.

RESULTS:

Overall age was 64 ± 11 years. Females comprised 51% of the cohort and BMI was 29.2 ± 5.2. Mean Charlson Comorbidity Index (CCI) was 3.4 ± 2.6). In total, 1.9% of patients underwent bilateral THA. Mean femoral head size was 33.7 ±2.8 mm. The most common head sizes were 36 mm (50%) followed by 32 mm (40%). Some 91% of heads were 32 mm or larger, 51% were 36 or larger, and 1% were 40 mm. Cup sizes ranged from 42 to 62 mm. Mean head/cup ratio was 0.64 ±0.05 (Table 1). Overall, females had a greater head to cup ratio compared to males (0.64 +/- 0.06 vs. 0.62 +/- 0.06)(p<0.001). Thirty-six patients (1.1%) sustained a dislocation at a median of 51 days following surgery (quartile 1: 29 days; quartile 3: 315 days). Logistic regression adjusting for age, sex, BMI, and surgical approach demonstrated that head/cup ratio was not associated with increased risk of dislocation (p=0.728)(Table 2). Posterior approach increased odds of dislocation by 4.2 times (p=0.026). Female gender increased risk by 74% (p=0.001).

DISCUSSION AND CONCLUSION:

Our results demonstrate that head to cup ratio is not associated with increased risk for dislocation following primary THA when controlling for age, sex, BMI, and surgical approach. We did find that posterior approach was associated with a higher risk along with female sex, which has been shown in prior literature. These findings suggest that a complex relationship exists with multiple patient and surgical variables such as implant positioning, soft tissue tensioning, spinopelvic factors etc. contributing to risk of dislocation, rather than solely an optimal head/cup ratio. Further investigation is needed to better define groups benefiting from specialized implants such as large-diameter or dual mobility heads.

Table 1. Demographics and Implant Sizes

	No Dislocation (n=3119)	Dislocation (n=36)	p-value
Age	64.4 +/- 11.2	61.4 +/- 14.3	*0.303*
Female	1583 (50.8%)	28 (77.8%)	***0.002***
BMI	29.2 +/- 5.2	30.0 +/- 7.2	*0.582*
CCI	3.4 +/- 1.6	3.0 +/- 2.1	*0.193*
ASA III/IV	1027 (39.0%)	10 (37.0%)	*0.992*
Bilateral	61 (1.9%)	0 (0.0%)	*0.999*
Head Size (mm)	33.7 +/- 2.8	33.7 +/- 3.7	*0.670*
Acetabular Size (mm)	53.0 +/- 3.3	52.5 +/- 4.0	*0.216*
Head to Cup Ratio	0.64 +/- 0.05	0.64 +/- 0.05	*0.317*

Reported as mean +/- standard deviation or n (%)

Table 2. Logistic Regression for Dislocation

Variable	OR (95% CI)	p-value
Ratio	0.34 (0.0 – 169.7)	*0.728*
Approach		
Anterior	Reference	
Lateral	0.6 (0.3 – 1.3)	***0.220***
Posterior	4.2 (0.96 – 13.2)	***0.026***
Age	0.98 (0.95 – 1.00)	***0.079***
Male sex	0.3 (0.1 – 0.6)	***0.001***
BMI	1.03 (0.97 – 1.09)	*0.391*

OR=odds ratio, CI=confidence interval, BMI=body mass index. OR for BMI reported per 1 unit increase