Accuracy of Component Positioning in 2330 Total Hip Arthroplasties: A Comparative Analysis by Surgical Technique and Mode of Guidance.

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INTRODUCTION

Lewinnek et al described a safe zone of acetabular component placement in Total Hip Arthroplasty (THA) to reduce complications. This safe zone is between 10-30 degrees of version and 30-50 degrees of inclination[1]. Callanan et al. reports only 53% of acetabular cups were within Lewinnek's Safe Zone of optimal cup placement (62% within the abduction safe zone, 79% within the version safe zone). Callanan et al proposed a modified safe zone with a reduced range of acetabular inclination of 30-45 degrees to eliminate the steeper or more inclinated cups[2]. Robotic assisted surgery has shown more accurate acetabular component placement in a single surgeon study. Domb et al saw 100% of acetabular components within the Lewinnek safe zone compared to 80% of manual cases. When using the Callanan modified safe zone 92% versus 62% when comparing robotic assisted results to manual cases[3]. This study compares the accuracy of cup placement in the safe zones described by Lewinnek et al. and Callanan et al., leg length discrepancy (LLD) and global offset (GO) measurement in THA using five different surgical techniques performed by six different surgeons.

METHODS

Between June 2008 and April 2014, 2330 THRs were performed by six different surgeons. Surgical Techniques included robotic assisted anterior approach, robotic assisted posterior approach (MAKO Surgical Corp. Fort Lauderdale, FL), fluoroscopic guided anterior approach, navigation guided anterior approach (BrainLAB, Heimstetten, Germany) and radiographic guided posterior approach. Post-operative radiographic images were retrospectively reviewed and measured using TraumaCad® software to determine cup placement, LLD, and GOD. For a subset of one hundred cases, radiographic measurements were performed by two different blinded observers. Intraobserver and interobserver correlation and reliability were calculated ($r>0.82$ and $p<0.001$).

RESULTS

One Thousand, nine hundred-eighty patients met the inclusion and exclusion criteria. Ninety-three (4.69%) patients underwent robotic-assisted THA anterior approach, 135 (6.8%) had robotic-assisted THA posterior approach, 942 (47.5%) patients underwent fluoroscopic guided THA anterior approach, 708 (35.7%) had THA without guidance using

posterior approach, 43 (2.1%) patients underwent navigation-guided anterior approach and 59 (2.9%) patients underwent radiographic-guided posterior approach THAs. Robotic guidance groups had a significantly greater percentage of hips in the Lewinnek's and Callanan's safe zone ($p < 0.005$). Between robotic guidance groups, the group with posterior approach has more cups placed in the Lewinnek's and Callanan's safe zone ($p < 0.005$). The frequency of hips within the Lewinnek's safe zone was significantly greater in the navigation guided group, compared to the other groups except robotic guided ($p < 0.05$). Sixty-four (3.2%) of our cases were with LLD greater than or equal to 10mm, five of those cases were (8.5%) in the group treated with x-ray guidance. ($p < 0.05$). The mean GOD for the overall cohort was 4.0mm ± 0.4mm ($p < 0.0001$). Mean ages of patients in the treatment groups were significantly different ($p < 0.0001$).

CONCLUSION

Robotic assisted surgery was more consistent than the other techniques in placing the acetabular cup into the Lewinnek and Callanan safe zone. The use of robotic assitance in hip arthroplasty surgery is more accurate fulfilling the goals needed to actual hip arthroplasty. De Palma et al., analyzed the financial impact of a dislocated THA in patients with primary hemiarthroplasty (HA), THA and revision surgery (RTHA), finding 87 (18 HA, 44 THA and 25 RTHA) dislocated within six weeks of the primary operation[4]. An early dislocation increased the cost of HA, THA and RTHA by 472%, 342% and 352%, respectively. An average of 22.5% of revision THAs are secondary to instability of the primary implant[5]. This increase in accuracy may results in fewer revisions and therefore a decreased financial burden for healthcare. Long term follow-up is required to determine clinical impact of increased accuracy.

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DISCLOSURE

Jennifer Christopher is an employee of Stryker Corp.

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