Navigated vs. non-navigated acetabular component positioning

LEE JH[1], JOHNSON SH[2], MACAULAY WB[1], GELLER JA[1]

[1]*Department of Orthopaedic Surgery, New York Presbyterian Hospital at Columbia University, New York City, USA*
[2]*Columbia University College of Physicians and Surgeons, Columbia University, New York City, USA*

shj2110@columbia.edu

Introduction: Imageless navigation has been shown to increase the surgeon's ability to place the acetabular component within the "safe zone, " as defined by Lewinnek.[1-3] Accurate placement of the acetabular component is crucial for adequate stability of the construct, longevity of the implant, and surgical outcomes.[3-11] In this series we analyzed the abduction angle of our acetabular cups placed by conventional techniques and compared them with our initial experience using an imageless navigation system. Our hypothesis was that, even in the early adoption period of using a surgical navigation system, acetabular component placement would be closer to ideal values.

Methods: 68 unilateral total hip replacements were utilized for the study. All of the navigated hips performed from 10/27/2010 to 1/11/2012 were used in the study and in order to obtain appropriate statistical power, fifty-one randomly selected non-navigated total hip replacements were used as a comparison group. One surgeon performed all of the navigated cases and two surgeons performed all of the non-navigated surgeries. All three surgeons are fellowship-trained in adult reconstruction and have practices dedicated to adult reconstuction in the same academic medical center. The same components were used in all cases (Zimmer Trilogy with either a titanium fiber metal backing or a porous tantalum backing) and the Zimmer Orthosoft Imageless navigation was used for all of the navigated surgeries. In all cases, a posterolateral approach was utilized. For the navigated cases, before the patient was placed in the lateral position, an initial supine step was required for placement of the pelvic array and registration of the pelvic plane. For each case, we measured the abduction angle of the acetabular component, as measured on an AP pelvis X-ray. The abduction angle was determined by establishing a horizontal line connecting the "teardrops" and the line across the face of the acetabular component. The person taking the measurement was blinded as to whether the case was a navigated or non-navigated case. Three measurements were taken for each case and an average of the three measurements was the number used for the abduction angle. If there was a wide discrepancy between any of the three numbers the measurements were re-done. A student's t-test was used to compare the abduction angles with significance set at $p = 0.05$.

Results: Using navigation, 94.1% (16/17) of acetabular components were found to be within Lewinnek's "safe zone", compared to 84.3% (43/51) of non-navigated components. Furthermore, using 45 degrees as the ideal angle of abduction it was found that acetabular components placed using navigation were oriented significantly closer to the ideal angle than for non-navigated components (absolute mean degrees from ideal for navigated: $3.44^\circ \pm 2.89^\circ$, vs. non-navigated: $6.24^\circ \pm 4.61^\circ$, where $p= 0.0221$)

Discussion: We have shown that an Imageless navigation system allows for more reliable placement of the acetabular component. This is particularly interesting since these cases represent the first use of a hip navigation system at our medical center. Limitations of the study include the fact the study was not randomized (only one surgeon used the navigation) as well as the fact that we only measured abduction and not anteversion. Nevertheless, our results are interesting in that we show more reliable abduction measurements with the use of an imageless navigation system. Our early success with this navigation system has encouraged us to continue its use at our institution and further studies are currently underway including randomization, additional measurements (including anteversion) and clinical outcomes.

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