Malposition of a Custom Flanged Acetabular Component does not Associate with Implant Survivorship

Daniel A. Driscoll[1], Troy Bornes[1], Michael Alexander Malahias[2], Joseph D Lipman[2], Timothy M Wright[3], Mathias P G Bostrom[2], Peter Keyes Sculco
[1]Hospital for Special Surgery, [2]Hospital For Special Surgery, [3]Hosp for Special Surgery

INTRODUCTION: Custom flanged acetabular components (CFACs) are patient-specific three-dimensional printed implants used in complex acetabular revision. Although they are designed to be placed in a specific position within the acetabulum, accurate CFAC placement can be difficult due to surgical exposure, screw position, and bone loss. Few studies to date have evaluated the impact of CFAC positioning on rates of aseptic loosening and survivorship. The objectives of this study were to (1) determine the accuracy of CFAC placement relative to the preoperatively planned position, (2) evaluate postoperative CFAC hip center compared to the native hip center, and (3) determine if degree of CFAC malpositioning was associated with CFAC migration or revision. migrated, and revised components.

METHODS: This retrospective single-center study included 96 acetabular revisions using a CFAC in 91 patients with a mean age of 62.4 ± 12.5 years between 2004 and 2017. The earliest postoperative radiograph was used to measure the distance between actual CFAC position following implantation and the position proposed during preoperative planning. Distance between CFAC position and the Ranawat hip center (RHC) was also measured. Aseptic failure was identified as either radiographic failure or revision involving CFAC removal for treatment of aseptic loosening. Independent t-tests were performed to evaluate whether there was a significant difference in the distance metrics for well-fixed versus failed CFACs. Independent t-test was also performed to determine if increased distance of the final construct from the planned position was associated with aseptic loosening.

RESULTS: Mean follow-up was 6.48 ± 3.32 years. There were 21 radiographic failures and 13 cases requiring re-revision. Mean distance between the actual CFAC position and planned CFAC position was 7.0 ± 5.8 mm for cases that did not require re-revision and 7.7 ± 4.9 mm for cases that did require re-revision (p = 0.68; Table 1). 60% of all cases were placed greater than 5mm away from the planned CFAC position (Figure 1). CFAC position was 21.0 ± 10.1 mm away from RHC for survived cases and 23.0 ± 9.0 mm away from RHC for removed cases (p = 0.57; Table 2). 87% of all cases were placed more than 10mm away from the RHC (Figure 2). The position of all implanted CFACs was lateral relative to the RHC on radiograph (18.3 ± 8.7 mm).

DISCUSSION AND CONCLUSION: In this retrospective evaluation of 96 acetabular revisions using a CFAC, the majority of CFACs were placed at least 5mm outside of the planned position and at least 10mm away from the native acetabular center of rotation based on the Ranawat Triangle. Interestingly, neither metric was associated with an increased risk of component failure. At mid-term follow-up, CFACs appear to be less sensitive to malposition as long as peripheral and inferior fixation is adequate. In addition, use of the Ranawat hip center for CFAC positioning may not be ideal in all CFAC cases given that there is a risk of insufficient offset and subsequent impingement. Further research will help to best identify ideal positioning for CFACs and predictors of failure for these implants.

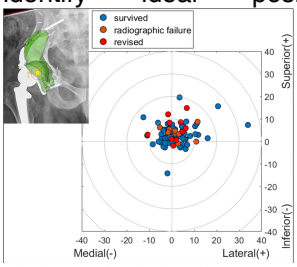

Figure 1. The distances of survived, radiographic failure, and revised custom flanged acetabular components (CFACs) relative to their respective planned positions (0, 0) in the lateral-medial and superior-inferior planes. Blue points represent well-fixed/survived components, orange points represent radiographic failures, and red points represent CFACs that were revised.

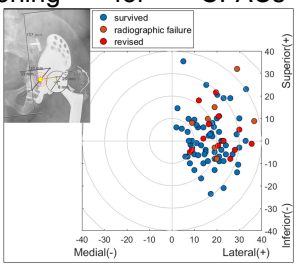

Figure 2. The distances of survived, radiographic failure, and revised custom flanged acetabular components (CFACs) relative to their respective anatomic reference (0, 0) in the lateral-medial and superior-inferior planes. Blue points represent well-fixed/survived components, orange points represent radiographic failures, and red points represent CFACs that were revised.

Table 1. Mean Differences in Actual Positions of Custom Flanged Acetabular Components Relative to Preoperative Plan

	Survived [N = 66]	Revised [N = 10]	Revised or Radiographic Failure [N = 19]	All Cases [N = 85]
Superior Distance Relative to Plan (mm)	1.6 ± 7.1	1.1 ± 5.1	1.8 ± 5.2	1.7 ± 6.7
Lateral Distance Relative to Plan (mm)	3.0 ± 4.6	5.6 ± 5.3	4.8 ± 4.3	3.4 ± 4.6
Total Distance Relative to Plan (mm)	7.0 ± 5.8	7.7 ± 4.9	7.2 ± 4.3	7.1 ± 5.5

Note: 11 patients were excluded from analysis relative to plan as a preoperative plan was not available.

Table 2. Mean Differences in Actual Positions of Custom Flanged Acetabular Components Relative to Ranawat Hip Center (RHC)

	Survived [N = 70]	Revised [N = 13]	Revised or Radiographic Failure [N = 21]	All Cases [N = 91]
Superior Distance Relative to RHC (mm)	1.0 ± 17.1	1.0 ± 9.1	4.9 ± 10.4	1.9 ± 11.8
Lateral Distance Relative to RHC (mm)	17.7 ± 8.9	20.2 ± 8.3	20.3 ± 8.2	18.3 ± 8.7
Total Distance Relative to RHC (mm)	21.0 ± 10.1	22.0 ± 8.0	23.0 ± 9.0	21.0 ± 9.8

Note: 5 patients were excluded from analysis relative to RHC as inadequate postoperative radiograph lacked full pelvic height (necessary to identify RHC).