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Revision Arthroplasty

Outcomes of Custom Flange Acetabular Components in Revision Total Hip Arthroplasty and Predictors of Failure

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ABSTRACT

Background: Custom triflange acetabular components (CTAC) have become more popular in the treatment of Paprosky type IIIB defects with an average survivorship of 80% at 4 years. Many studies report survivorship of CTAC, but radiographic parameters of CTAC success or failure have not been previously reported. The purpose of the study was to assess radiographic and patient factors predictive of failure in CTAC.
Methods: A retrospective review of 63 patients with >24 months of follow-up was completed. Continuous and categorical variables were compared between failed vs successful CTAC using Wilcoxon rank-sum test and Fisher exact test, respectively.
Results: The failure rate of the CTAC was 13.5% over an average follow-up of 4.32 years (±2.94). Patients had a mean of 2 revisions (range, 0-11) before CTAC implantation. Compared with the contralateral hip center of rotation, the failed CTAC group tended to lateralize the hip center by a mean of 18.29 mm (±11.90 mm) compared to a mean of 9.86 mm (±11.89) in the intact group, although this did not reach statistical significance ($P = .1029$). The Western Ontario and McMaster Universities Osteoarthritis Index function score improved from 38.94 (±14.23) to 71.35 (±21.96) at most recent follow-up ($P = .0002$). The Western Ontario and MacMaster Universities Osteoarthritis Index scores were not significantly different between intact and failed CTAC groups.
Conclusions: CTAC tends to lateralize the hip center by approximately 1 cm, and there is a trend toward nearly 2 cm of lateralization in the small subset of failed CTAC. Future efforts should focus on medializing the hip center in CTAC to improve ingrowth and survivorship.

Cementless acetabular components have been the gold standard in revision total hip arthroplasty (THA) with excellent results [1]. Yet, extensive bone loss and massive acetabular defects still arise in revision THA and constitute some of the greatest challenges to the arthroplasty surgeon [2,3]. Acetabular bone defects can be complicated by pelvic discontinuity in which there is separation of the pubis and ischium from the ilium compromising implant fixation [4]. Jumbo cups have been very successful in Paprosky type I and II defects [5–8]. Reconstruction of Paprosky type III defects, particularly with discontinuity, have yielded more inconsistent results [9–11]. Historically, antiprotrusio cages that span the ischium and ilium have been preferred over jumbo cups for type III defects. Cages have good results with studies reporting long-term prosthetic survival rates as high as 93% [12–15]. However, cage failures tended to be in the Paprosky type IIIB classification, in which there is superior medial migration leading to disruption of the anterior column and pelvic discontinuity. In these situations, the rim defect is typically greater than 50% and less than 40% of viable host bone available [4]. Using acetabular allografts with cemented cups within a population with IIIB defects, Paprosky et al noted the mean migration of 1.5 cm in nearly all 17 cups and a dislocation rate of 35%. The mean follow-up was 31 months, and there were 3 failures secondary to sepsis in 2 patients and graft resorption and migration in one. An additional 2 patients required irrigation and debridement for wound infections and another patient required revision to a constrained liner for persistent

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instability [16]. Berry and Muller similarly reported a 29% failure rate of cages in type IIIB defects [17]. Component fracture and limp also occurred frequently in patients treated with cages. Custom triflange acetabular components (CTAC) have become more popular in the treatment of Paprosky type IIIB defects with an average survivorship of 80% at 4 years [18–20]. The contemporary alternative to the CTAC is the jumbo cup with porous metal augments [10]. Although several series have reported the survivorship of CTAC, radiographic parameters predictive of CTAC success or failure have not been previously reported. In addition, patient-reported outcome measures (PROM) of CTAC are also under-reported. The purpose of the study was 2-fold: to assess the outcome of CTAC using validated PROM and to determine radiographic factors predictive of CTAC failure.

Materials and Methods

A retrospective review of 63 patients with preoperative and postoperative radiographs was completed from a cohort of 75 patients who had undergone CTAC reconstruction over the study period. When stratified into intact and failed groups, an additional 11 patients were excluded for lack of radiographic follow-up.

Patient demographics, health status, and implant specifics were collected from hospital chart review. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores served as our PROM and were obtained by querying the prospective institutional registry. The PROM were collected at discrete intervals: baseline and postoperatively at 6 weeks, 3 months, 6 months, 1 year, 2 years, and 5 years. In addition, patients were contacted by telephone to complete the PROM if they were nearing one of the intervals. Radiographic images were retrieved from and measured by the diagnostic imaging software Sectra PACS (Linköping, Sweden).

CTAC failure was defined as revision or removal of the implant. Radiographic failure was defined as >3 mm continuous lucency around the implant or >5 mm displacement on subsequent radiographs. Reoperations for instability, periprosthetic fracture, or wound complications were recorded but considered successes if the patient retained the CTAC implant.

Statistical Analysis

Continuous variables including WOMAC scores of both the failed and successful CTAC groups were summarized by means with standard deviations and the groups were compared using the Wilcoxon rank-sum test. Categorical data of the two groups were presented as frequencies and percentages then compared by chi-square or Fisher's exact tests.

Radiographic Review

All patients had preoperative and postoperative radiographs reviewed using electronic tools on local PACS by a single observer (BTB). The most recent standing anteroposterior (AP) pelvis radiograph of adequate quality taken before the triflange THA revision was used as the “preoperative” film. The first postoperative film used for measurement was the standing AP pelvis radiograph taken at the 6-week clinic visit. The most recent AP pelvis radiograph was also reviewed to determine the radiographic outcome of the CTAC.

Hip height on both sides was measured as a perpendicular from a line connecting the bottom of the ischial tuberosities to the center of the native or prosthetic femoral head using a best-fit circle technique (Fig. 1). Although the preferred method for measurement of pelvic obliquity is the radiographic teardrop, this landmark was consistently absent or distorted in this patient population and therefore the bottom of the ischial tuberosities was used. The difference between the hip heights was recorded: positive values indicated femoral center of rotation (COR) on the hip of interest was more superior than the control hip, and a negative difference in hip height indicated that the femoral COR was more caudal on the CTAC side. The difference in hip height was measured between the preoperative and post-CTAC radiographs. Hip offset was determined by drawing a vertical line through the center of the pubic symphysis, then drawing a perpendicular line from this pelvis bisector to the center of the femoral head using a best-fit circle technique (Fig. 1). The length of the perpendicular line was recorded as the hip's offset. When calculating change in offset between the preoperative and post-CTAC radiographs, a positive value indicated that the CTAC had lateralized the femoral COR and thereby increased the offset; conversely, a negative value indicated that the CTAC medialized the femoral COR. Postoperative films were used to determine the number of ischial screws, presence of a pubic flange, constrained liner, greater trochanter periprosthetic fractures, or whether a femoral revision was required (Fig. 2). These CTAC characteristics were confirmed by the patient's operative report. The most recent AP pelvis radiograph was used to determine the presence of the original CTAC, the presence of screw fracture, or radiographic evidence of loosening. Loosening of the triflange device was measured by radiolucency >3 mm or displacement >5 mm. Finally, heterotopic ossification was recorded using the Booker scale.

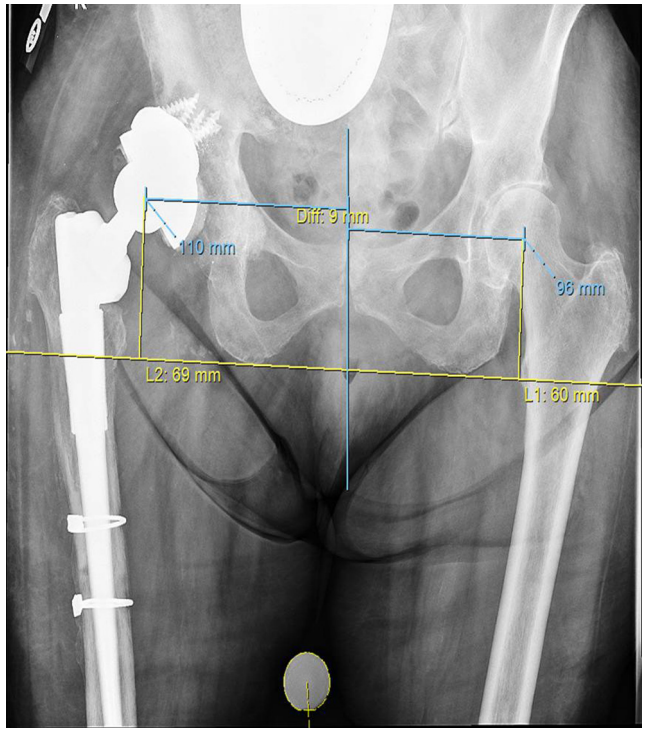

Fig. 1. Preoperative anteroposterior (AP) pelvis radiograph demonstrating the measurement of hip height and offset. First, a line was drawn connecting the inferior-most aspect of the ischial tuberosities. The hip height was then measured as a vertical perpendicular from the initial line to the center of the native or prosthetic head. The difference in hip height was compared between the prosthetic hip and uninvolved contralateral side. Positive hip height distance indicates that the involved side was more cranial. With respect to hip offset, a vertical line was drawn through the center of the pubic symphysis. The hip offset was measured as a perpendicular distance from the vertical line to the center of the femoral head (prosthetic or native). Positive hip offset indicates that the involved hip center of rotation was more lateral than the uninvolved contralateral side.