Three-Year Outcomes of a Highly Porous Acetabular Shell in Primary Total Hip Arthroplasty

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Abstract: This multicenter study evaluated survivorship, functional outcomes, complications, and radiographic outcomes for patients who underwent total hip arthroplasty using a newly developed highly porous 3-dimensional titanium implant. Excellent aseptic (99.6%) and all-cause (98%) survivorship and functional outcomes were found at 3-year follow-up. This highly porous acetabular shell holds promise in total hip arthroplasty. [Orthopedics. 2018; 41(1):e154-e157.]

Cementless fixation has been used for approximately 3 decades. Cementless fixation became popular because it was thought to increase implant longevity, decrease the need for revisions when compared with cemented fixation, and preserve bone stock should a revision surgery be needed. It was established that survivorship of the implant was highly dependent on the implant’s ability to be incorporated in the patient’s native bone. Subsequently, many cementless implant designs were developed with varied clinical success. Recently, the use of highly porous titanium has increased, as these implants can successfully osseointegrate with patients’ native bone with low initial failure rates. The implants are able to achieve this because highly porous metal interfaces were specifically designed for increased biological fixation.

Several studies have reported excellent survivorship and low complication rates for patients who underwent total hip arthroplasty (THA) and received highly porous acetabular shells. However, a recent comparative cohort single-center radiographic study that compared these cups with older generation cups showed higher rates of progressive radiolucencies on anteroposterior radiographs for the highly porous cohort at 5 years of follow-up. Two other studies that investigated this type of acetabular cup reported excellent osseointegration and no progressive radiolucencies.

Because of the dichotomy of currently published literature, the authors performed a larger multicenter study. The purpose of this study was to evaluate outcomes of patients who underwent THA using a new highly porous titanium shell at minimum 3-year follow-up. Specifically, the authors assessed (1) aseptic and all-cause survivorship rates, (2) functional outcomes, (3) complications, and (4) radiographic outcomes.

Materials and Methods

Patient Selection

The authors analyzed a prospectively collected da-
tabase of primary cementless THAs performed at 12 centers as a part of a nonrandomized, postmarket, multicenter study. This yielded 255 cases in 250 patients (149 men, 101 women) who had a mean age of 63 years (range, 31-84 years) and a mean follow-up of 4 years (range, 3-4 years). Institutional review board approval was obtained prior to the start of this study.

Implant Design

The Trident Tritanium acetabular cup (Stryker Orthopaedics, Mahwah, New Jersey) and a metal-on-highly cross-linked polyethylene liner (X3; Stryker Orthopaedics) were used in all cases. The titanium acetabular cup has a repeating lattice hemispherical shell design, with a mean pore size of 546 µm, 72% porosity, and a coefficient of friction of 1.01. The shells used were hemispherical solid back (size, 44-66 mm) and cluster hole (size, 44-66 mm).

Outcomes

Preoperative records, electronic and paper medical records, discharge summaries, and image reports were analyzed to obtain patient-reported outcomes, clinical, demographic, and radiographic data. Patients were seen in clinic and reassessed at approximately 6 weeks, 1 year, 3 years, and 4 years postoperatively. During their visits, patients were asked to complete the Harris hip score (HHS), 12-Item Short Form Health Survey, Lower Extremity Activity Scale, and EuroQol-5 dimension questionnaire.

Radiographic Evaluation

During patients’ preoperative and follow-up visits, anteroposterior and frog-leg lateral radiographs were obtained. Bone fixation was assessed using the acetabular zones described by DeLee and Charnley13 and the Anderson Orthopaedic Research Institute.14 Aseptic loosening was defined as 2 mm or more of progressive radiolucencies seen on serial radiographs, which was determined by an independent radiographic reviewer (M.B.).

Data Analysis

Aseptic and all-cause Kaplan-Meier curves were used to analyze time to failure in which removal or exchange of the acetabular component due to an aseptic or septic cause was the measured endpoint.15 Effect size was analyzed according to Cohen’s criteria to determine index responsiveness. All analyses were completed using SPSS version 24 software (IBM Corporation, Armonk, New York).

RESULTS

Survivorship

The aseptic survivorship rate was 99.6% (95% confidence interval, 0.988-1.004). There was 1 case of a peri-prosthetic femoral fracture at 5 weeks postoperatively. The patient sustained a fall leading to the fracture. Nonoperative management was initially performed; however, due to nonunion, revision surgery was required. At latest, 3-month follow-up, the patient was doing well, having an HHS of 75 points.

The all-cause survivorship rate was 98% (95% confidence interval, 0.984-0.999). There were 3 cases of deep joint infection at 2 weeks, 7 weeks, and 19 months postoperatively, respectively. At postoperative week 2, one patient was admitted overnight after presenting to the emergency department with drainage at the incision site. The surgeons (T.I., J.D., D.D.) performing the revision of the acetabular shell, acetabular insert, femoral bearing head, and femoral stem noted minimal iatrogenic injury during the revision operation. At postoperative week 7, another patient presented to the clinic with incisional drainage and erythema near the surgical site and required revision of the shell, linear insert, femoral head, and stem. At postoperative month 19, a third patient presented with a chronic right total hip infection with septic loosening of the acetabular component due to a fall 2 weeks earlier. The patient underwent revision of the acetabular shell, acetabular insert, femoral bearing head, and femoral stem.

Outcomes

At final follow-up, the mean HHS was 91 points (range, 33-100 points), the mean 12-Item Short Form Health Survey score was 48 points (range, 34-59 points), the mean Lower Extremity Activity Scale score was 11 points (range, 6-15 points), the mean EuroQol-5 dimension visual analog scale score was 85 points (range, 50-100 points), the mean EuroQol-5 dimension time trade off score was 0.9 points (range, 0.71-1 points), and the mean Short Form-6D score was 0.8 points (range, 0.5-1 points).

Operative Complications

There were 5 intraoperative complications. One patient developed a hairline acetabular fracture that was noted on postoperative radiographs. This was successfully treated nonoperatively with 20% weight bearing for 6 weeks. There were no further sequelae, and the patient was doing well at the 3-year follow-up, having an HHS of 62 points. Three patients who had poor bone quality sustained femoral fractures during broaching. These were successfully fixed with cerclage cables. All 3 patients were doing very well at final follow-up, having a mean HHS of 93 points. One patient sustained a trochanteric fracture. This was fixed, and the patient had no further sequelae. At the 3-year follow-up, this patient was doing very well, having an HHS of 94 points.

Radiographic Analysis

Radiographs were interpreted by an independent radiographic reviewer (M.B.). On radiographic evaluation at the 3-year follow-up, all acetabular and femoral components were stable. Excluding patients who underwent revision (1.6%), there were no progressive radiolucencies, loosening, or shielding of acetabular component noted at final follow-up.

DISCUSSION

Total hip implant fixation, stability, and loosening continue to be major concerns.
for adult reconstructive surgeons, as these factors often contribute to implant survivorship, outcomes, and patient satisfaction. A highly porous 3-dimensional titanium coating was developed specifically to improve initial and long-term implant fixation to achieve better outcomes. Initial reports suggest positive results with this implant type in both primary and revision cases, indicating better patient outcomes and the potential for fewer revisions. Given these favorable results, further investigation of fixation, stability, and outcomes at longer follow-up is warranted. Therefore, the current authors evaluated outcomes of patients who underwent THA using a new highly porous titanium shell at minimum 3-year follow-up. The results of this study indicated excellent outcomes, as the aseptic survivorship rate was 99.6% and the all-cause survivorship rate was 98%. Overall, patient satisfaction was high in all evaluation modalities, and only minimal complications occurred. Furthermore, no patient had radiographic evidence of implant loosening at the 3-year follow-up.

This study had some limitations, including the nonrandomization of selected patients, more than one surgeon performing the procedure, and limited follow-up. Although patients were not randomly selected and several different surgeons performed the THAs, the 12 different centers and 255 cases improve the ability to generalize the study results. Furthermore, although 3 years is not considered long-term follow-up for total hip implants, this study, at the least, provides a baseline success rate proving the feasibility of this implant type. Therefore, additional multicenter studies with larger samples and midterm (7 to 10 years) and long-term (15 to 20 years) follow-up should be conducted.

Recent studies give credence to the benefits of highly porous titanium implants in THA. Perticarini et al11 reported the 5-year mid-term clinical and radiographic outcomes of another cementless highly porous trabecular titanium cup (DELTAT-T cup; Lima Corporate, Villanova di San Daniele del Friuli, Italy) characterized by an average porosity of 65% and a mean pore diameter of 640 µm. They found a significant increase in mean HHS—from 44 points (range, 35-52; SD, 5.4) preoperatively to 96 points (range, 88-100; SD, 3.5) postoperatively. Moreover, 99.3% of the acetabular components were radiographically stable by last follow-up, and patients had a Kaplan–Meier survival rate of 99.3%. Naziri et al11 reported that the use of a highly porous titanium cup yielded no radiolucencies or cup migration for 252 patients at a minimum follow-up of 3 years. Their mean HHS improved from 53 points preoperatively to 91 points postoperatively. Most recently, Delanois et al22 conducted a minimum 5-year outcomes study of patients who underwent revision THA using a highly porous revision titanium shell. They found excellent survivorship of the acetabular component, with an aseptic survivorship rate of 97% and an all-cause survivorship rate of 91%.

CONCLUSION

The highly porous titanium-coated acetabular shells used in this study led to outstanding aseptic and all-cause survivorship, exceptional patient satisfaction and functional outcomes, only a few complications, and limited undesired radiographic findings at 3-year follow-up. On the basis of these 3-year results, additional prospective studies with longer-term follow-up should be conducted. This implant type shows great promise for further use in patients planning on undergoing THA.

REFERENCES

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