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Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Impact of Femoral Stem Design on Failure After Anterior Approach Total Hip Arthroplasty

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ARTICLE INFO

Article history:

Received 12 July 2017

Received in revised form

22 September 2017

Accepted 11 October 2017

Available online xxx

Keywords:

anterior approach
total hip arthroplasty
femoral loosening
aseptic loosening
stem design
complications

ABSTRACT

Background: An increased rate of complications related to femoral component failure has been described with less invasive total hip arthroplasty (THA). This study evaluated the incidence of femoral complications associated with the direct anterior approach for THA.

Methods: Retrospective review was performed of the initial 1120 consecutive patients who underwent direct anterior THA by 2 surgeons.

Results: A total of 899 patients (80.3%) had a 2-year follow-up (range, 2–8 years). Complications within 90 days occurred in 20 patients (1.8%): 10 calcar fractures, 1 greater trochanter fracture, 1 canal perforation, 3 hematomas, 2 dislocations, 2 superficial, and 1 deep infection. Nine patients (1%) underwent revision: 5 for aseptic femoral loosening (0.55%), 1 for periprosthetic joint infection, 1 for dislocation, 1 for hip flexor irritation, and 1 for a damaged polyethylene liner.

Of the 5 patients with aseptic femoral loosening, 3 had a short, mediolateral tapered stem, 1 cemented stem, and 1 S-ROM stem placed to bypass a canal perforation. There were no revisions for aseptic loosening in the collared, fully hydroxyapatite (HA)-coated compaction broached or triple tapered proximal fit and fill stem designs (70.6% of all stems). Revision rate for femoral loosening was significantly higher for tapered wedge over HA-coated, compaction broached stems ($P < .005$).

Conclusion: Pain and function improved predictably with a 0.55% rate of femoral loosening at 2-year follow-up. Among collared, fully HA-coated and triple taper fit and fill femoral stems, there were no instances of revision for aseptic loosening vs 3 in the short stem, collarless mediolateral tapered group.

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Total hip arthroplasty (THA) continues to be one of the most successful orthopedic surgical procedures performed today. There is a lack of general consensus regarding the optimal approach to perform a THA safely, with the best functional outcomes and minimal adverse events. Over the last decade, the direct anterior (DA) approach to THA has gained popularity. Proponents of the anterior approach have reported that the DA approach offers an intermuscular plane that spares the abductors and permits a faster recovery with shorter length of stay, less pain, more accurate

component positioning, decreased dislocation risk, and more accurate leg length restoration [1–9].

A prior study from our institution reported on the safety of the DA approach in the short term [10]. However, recently there has been concern about increased femoral complications in the early to mid-term postoperative periods [11–13]. Meneghini et al performed a retrospective review of 342 patients who underwent revision THA within 5 years of the index procedure. The authors found that early femoral failure secondary to loosening was 0.29 times more likely in patients who had undergone THA via the DA approach compared to the posterior approach [14]. One of the issues with this study is that the level of experience of the surgeons who performed the primary procedure could not be established nor could the number of failures during the surgeons' learning curve. Additionally, given the study design, incidence of aseptic femoral loosening could not be determined.

Eto et al [15] also examined the reasons for revision of primary THA at a tertiary care practice for revision surgery. They found a

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to <https://doi.org/10.1016/j.arth.2017.10.023>.

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<https://doi.org/10.1016/j.arth.2017.10.023>

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Table 1
Demographic Data.

Variable	Value
Number of patients	902
Mean age	67.0 (50–78)
Gender	59.3% F, 40.6% M
Mean BMI	27.0 (15.3–44.8)

F, female; M, male; BMI, body mass index.

statistically significant increase in the rate of revisions for aseptic femoral stem loosening in the DA group (30%) compared to the nonanterior (posterior, anterolateral) groups (8%).

Berend et al [16] investigated the incidence of early periprosthetic fractures associated with primary THA using the DA approach performed using fluoroscopy on a standard operating table. They found a 0.9% risk of early postoperative periprosthetic femoral fractures in their series using a cementless, single-stem design, comparable with the rate of fracture after primary, cementless THA with other approaches.

The purpose of this study is to determine the incidence of early femoral complications associated with the DA approach for THA, in a large, single-institution cohort of patients operated on by the 2 senior authors. A secondary focus of our study was to examine the effect of stem design on aseptic loosening in this cohort. To our knowledge, this is the largest single-institution cohort with at least 2-year follow-up reporting on these issues.

Methods

After institutional review board approval was obtained, we performed a retrospective review of 1120 consecutive patients who underwent a THA procedure using the DA hip approach between May 2007 and December 2011 at our institution. In 2007, the surgical team converted to using the DA approach for THA. This study includes patients in the learning curve for the 2 fellowship-trained senior surgeons (RSG, SLB) and is inclusive of every patient who underwent an anterior approach on an orthopedic (Hana, Mizuho OSI; Union City, CA) fracture table at our institution. Demographic data including age, gender, and body mass index (BMI) were recorded for each patient (Table 1). The duration of surgery, amount of intraoperative blood loss, blood transfusions, and length of hospital stay were also documented. All perioperative and postoperative medical and surgical complications were noted.

Patients were seen for follow-up at regular intervals including 6 weeks, 12 weeks, 6 months, 12 months, and 24 months, and then biennially after that. Harris hip score evaluation was obtained from each patient at 24 months in addition to subjective satisfaction level. 899 (80%) patients were available with a minimum 2-year clinical follow-up. The remaining patients were lost to follow-up. Standing weight-bearing anteroposterior pelvic radiographs were obtained at 6 weeks, 3 months, 12 months, and biennially thereafter. Also, 899 (80%) patients had postoperative radiographs taken at 2 years for evaluation of acetabular cup positioning and femoral loosening.

Surgical Technique

Patients undergoing a DA THA received appropriate prophylactic antibiotics and received spinal anesthesia when applicable. All patients received deep venous thrombosis prophylaxis according to their risk stratification. Patients were placed in the supine position using an orthopedic (Hana, Mizuho OSI) fracture table to allow controlled hyperextension and adduction of the operative

extremity. A DA approach to the hip was used for implantation of components as described by Matta et al [3]. The ascending branch of the lateral femoral circumflex artery was identified and cauterized. A capsulotomy was performed in all cases and repaired at the end of the procedure.

The femoral component was uncemented in 886 (98.2%) cases. In descending frequency, the femoral stems used were Corail (DePuy, Warsaw, IN), Anthology (Smith & Nephew, Memphis, TN), Tri-Lock (DePuy, Warsaw, IN), Summit (DePuy, Warsaw, IN), Accolade (Stryker, Mahwah, NJ), Profemur (Wright Medical, Memphis, TN), Fitmore (Zimmer, Warsaw, IN), Taperloc (Biomet, Warsaw, IN), ML Taper Kinectiv (Zimmer, Warsaw, IN), S-ROM (DePuy, Warsaw, IN), and Synergy (Smith & Nephew, Memphis, TN) (Table 2). Stem choice was based on bone quality and morphology from preoperative radiographs. Tapered stems were thought to be beneficial in cases of Dorr type A bone where there was concern about fully hydroxyapatite (HA)-coated compaction broach stems potting in the diaphysis and preventing metaphyseal engagement, due to metaphyseal-diaphyseal geometry mismatch between the stem and proximal femur. Based on this theoretical benefit, tapered wedge stems were initially used with high frequency in Dorr A bone. However, over time surgeons migrated away from these tapered wedge stems toward HA-coated stems due to concerns regarding ingrowth. The distribution of bone quality over the entire cohort was 19% Dorr A, 80% Dorr B, and 1% Dorr C. In Dorr A bone, tapered wedge stems were used in 24% of patients, HA-coated compaction broach stems were used in 66% of patients, and fit and fill stems were used in 8% of patients. In Dorr B bone, tapered wedge stems were used in 25% of patients and HA-coated compaction broach stems were used in 68% of patients. In Dorr C bone, HA-coated compaction broach stems were used in 50% of patients, fit and fill stems were used in 17% of patients, and cemented stems in 33% of patients. All acetabular components were uncemented and placed under fluoroscopic guidance. A femoral hook (Mizuho OSI, Union City, CA) was used to elevate the femur during femoral preparation in external rotation, extension, and adduction positioning. Appropriate capsular and musculotendinous releases were performed as needed to allow exposure of the proximal femur. Final component sizing, offset, and leg length were again verified using intraoperative fluoroscopy.

A reservoir suction drain was inserted submuscularly and discontinued within 24 hours in most of the cases. An absorbable running barbed suture was used in the subcuticular layer in addition to a topical skin glue. Physical therapy started the day of surgery. Patients were allowed to weight bear as tolerated after surgery, even with an intraoperatively identified calcaneal fracture that was treated with cerclage cabling. Anterior hip precautions were enforced for 6 weeks.

Statistics

On the entire cohort of 902 hips, descriptive statistics were calculated for demographics, surgical procedure variables, and Harris hip scores. Kaplan-Meier survival analysis was used to estimate device survivorship with revision of any component for any reason as the end point. For all learning curve comparisons, demographic variables that differed significantly were included as covariates. When comparing postoperative Harris hip scores, the preoperative score and years postoperative were also included as covariates. Statistical tests were performed with SAS (v9.3, NC). All *P* values less than .05 were considered to be statistically significant. All statistical tests were 2-sided. Proportion *z* test was performed to evaluate the differences in rate of loosening by stem type for statistical significance.

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