

Low Rate of Early Periprosthetic Fractures in Direct Anterior Total Hip Arthroplasty with a Triple-Tapered Wedge Stem

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ABSTRACT

Introduction: Utilization of the direct anterior approach (DAA) for total hip arthroplasty (THA) has been steadily increasing in recent years. While the DAA may offer some benefits compared to other approaches, there are still risks involved including relatively higher rates of periprosthetic femur fractures, especially when combined with cementless femoral stem use. The purpose of this study is to evaluate the early postoperative femoral complications with a short triple-wedge tapered stem used in primary THA via a DAA.

Materials and Methods: A retrospective review was conducted of the arthroplasty registry of our institution from April 2022 to August 2023 to identify patients who underwent a primary THA via a DAA with the Short Medacta Stem (SMS) (Medacta International, Castel San Pietro, Switzerland). Patients were excluded if the stem was used for a revision surgery, they were within 90 days of surgery, or they refused research consent. Inclusion criteria was met in 262 patients (302 hips). Data was collected after reviewing the chart, and reports and radiographic measurements, including Dorr type and canal fit ratios, were obtained from preoperative and postoperative radiographs, respectively.

Results: A total of 302 total hips were included, 161 patients were male (53.3%) and 141 were female (46.7%), with an average age of 66.5 years (27–88, +/- 10.7 years). Average follow up was 0.3 years (range, 0.05–1.71 years). The majority of patients had a Dorr B femur (81.7%). The Median stem size used was an 8 (range, 2–15), and 89.4% of those had a collar. Average canal fill ratio was 0.83 (range, 0.43–0.98, +/- 0.07). Overall, there were two Vancouver B2a periprosthetic femoral shaft fractures (0.66%) that required revision surgery to a modular stem. In addition, there were two Vancouver Ag greater trochanteric fractures (0.66%) with acceptable alignment that did not require revision surgery. Demographic information about the patients with femoral complications is summarized in Table I. Average age of patients with femoral complications was 69.5 years, with an average canal fit ratio of 0.88.

Conclusion: We found that the triple-wedge implant had a low rate of early femoral complication in primary THA from an anterior approach and is safe for use in THA from a DAA. More follow up is needed to evaluate continuing implant survivorship and patient outcomes.

INTRODUCTION

Total hip arthroplasty (THA) is noted to be one of the most successful surgical procedures to date and more and more often it is used in younger, active patients.¹⁻³ A current survey in 2019 of the members of the American Association of Hip and Knee Surgeons (AAHKS) found that 56.2% of respondents representing 44% of AAHKS members are using the direct anterior approach (DAA) for THA.⁴ By sparing the abductor muscles, the DAA has been increasing in popularity in recent years due to faster recovery time, improved reestablishment of limb lengths, and lower dislocation rates.⁵⁻⁹

Despite the described benefits, the risks associated with the DAA are mostly centered around femoral complications both intraoperatively and in the early postoperative period including periprosthetic fracture and femoral loosening, particularly in the early postoperative period.¹⁰ Intraoperative periprosthetic femoral fracture rates from the DAA have been reported between 1.3–2.3% and revision surgery rates related to femoral complications within one year of surgery of up to 2.1%.^{11,12}

To treat younger patients with more metabolically active bone, cementless THA stems have been developed to increase ingrowth of the components and survivorship.^{3,13,14} As of 2023, only 3.6% of primary elective THA procedures utilized a cemented stem.¹⁵ Cementless

stems have a higher fracture risk than cemented implants, and this risk can be affected by the geometry of the implant.^{16,17}

The single taper-wedge design type has the highest periprosthetic fracture rate at 1.48% reported.¹⁶ Together with the high rate of cementless stems usage, and the uptrend in DAA, there is concern that there may be an increase in femoral complications, including periprosthetic fracture. Previous studies investigating the periprosthetic fracture incidence using a triple-tapered wedge stem from a DAA found a 0.83–1.2% intraoperative fracture rate.^{18,19} Currently, there is no previously published data reporting on periprosthetic fracture rates with the use of this specific triple-taper broach-only stem. The purpose of this study was to evaluate the incidence of perioperative femoral complications with a triple-tapered wedge design used in the direct anterior THA.

MATERIALS AND METHODS

A retrospective review of our institution's arthroplasty registry from April 1, 2022 to August 31, 2023 was conducted to identify all patients who underwent a primary total hip arthroplasty from a direct anterior approach with the Short Medacta Stem (SMS; Medacata International, Castel San Pietro, Switzerland) (Fig. 1). Exclusion criteria included use of the SMS stem in revision total hip arthroplasty and lack of six-week follow up or

refusal of research consent. Inclusion criteria was met in 262 patients (302 hips).

The Medacta SMS is a proximally, porous-coated, broach-only, curved, short triple-tapered wedge design. As the size of the stem increases, the neck length (femoral offset and leg length) and anteroposterior and mediolateral size progressively increases. The SMS also features anatomical calcar curvature in the coronal plane proximally. Distally, the SMS has a medially-relieved contour to decrease contact of the implant to the calcar and a smooth, reduced tip to prevent distal fixation of the stem to potentially prevent thigh pain.

All surgeries were performed by one of two fellowship-trained arthroplasty surgeons via the direct anterior approach, and a standard operating room table was utilized. All patients underwent preoperative templating to estimate component size using a digital picture archive viewing system (PACS).

The surgeon followed the manufacturer's recommended technique: the canal was localized, and broaching followed in a sequential manner until stable fixation was achieved. Trailing was then performed to ensure hip stability, range of motion, and restoration of leg length. Intraoperative fluoroscopy was used to assess acetabular cup positioning, femoral canal stem fit, and leg length and offset. The broach was then removed and the final stem was impacted. Collared stems were used in all cases where the collar contacted the calcar. In cases with a lower

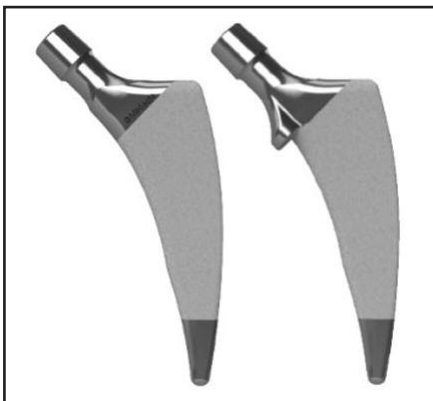


Figure 1. Image of the Short Medacta Stem (SMS) without a collar on the left and with a collar on the right. Features include plasma spray titanium and hydroxyapatite porous coating proximally with a smooth polished tip distally.

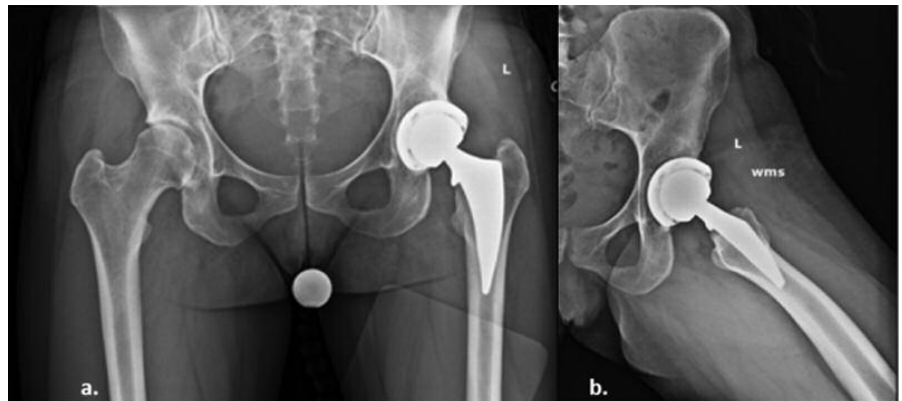


Figure 2. Example of an AP pelvis (a) and frog-leg lateral hip radiograph (b) of the Medacta SMS at the six-week postoperative visit.

neck cut, in which the collar would not contact the calcar, a collarless stem was chosen.

Postoperatively, patients were permitted to bear weight as tolerated on the operative extremity. A written home exercise program was provided and formal postoperative physical therapy was not routinely utilized. Patients followed up in the office at six weeks and then annually thereafter unless there were any concerns or complications.

Clinical notes were used to obtain data, including patient age, body mass index (BMI), gender, surgical laterality, Dorr classification, canal fit ratio, and complications. Operative reports were reviewed for surgical approach, implant data, and complications. All six-week and most recent postoperative radiographs were evaluated (Fig. 2a and b). Canal fit ratios were calculated by measuring the width of the stem at the midpoint of the lesser trochanter divided by the width of metaphyseal bone at the same level.

RESULTS

Of the 310 total hip arthroplasties (271 patients) that were initially included, eight patients were lost to follow up for a total of 302 hips (263 patients). The average follow up was 109 days (0.30 years), (range, 2–623 days or 1.71 years). Mean patient age was 66.5 years (range,

27–88, +/- 10.7 years). The average patient BMI was 35.1kg/m² (range, 18–57, +/- 8.2kg/m²), and 161 patients were male (53.3%) and 141 were female (46.7%). Surgical laterality was right in 148 hips (49.0%).

The median SMS stem size used was an 8 (range, 2–15). There were 51 hips classified as Dorr A (16.9%), 247 as Dorr B (81.8%), and 4 as Dorr C (1.3%). A collared SMS was used in 270 hips (89.4%). The average canal fit ratios postoperatively were 0.83. A total of four periprosthetic femur fractures were observed in this study (1.32%), two were detected postoperatively (0.66%) and required revision total hip arthroplasty and two were found intraoperatively and treated conservatively without weight-bearing restrictions. Three of the hips in the periprosthetic fracture group were Dorr B and one was a Dorr C. Summary of the periprosthetic fracture demographics are seen in Table I.

DISCUSSION

Although literature exists for other triple-tapered wedge stems, this study is the first to look at early results of the Medacta SMS implant. The early results with the use of the Medacta SMS triple-tapered wedge stem via the direct anterior approach demonstrated a very low rate of periprosthetic fracture requiring

revision (0.66%). The authors from this institution have previously published studies regarding DAA and with different tapered stems reporting 0, 0.83, and 0.9% periprosthetic fracture rates.^{18,20,21}

Cementless stems have a higher periprosthetic fracture rate compared to cemented stems due to the tight fit required for adequate stable fixation prior to bony ingrowth of the implant.²² Each stem design has advantages and disadvantages. Based on a 2011 study, cementless femoral stem designs are categorized into six distinct types: 1) single-wedge, 2) double-wedge, metaphyseal filling, 3) smooth tapered, 4) cylindrical, 5) modular, and 6) anatomic.²² A study investigating the results of different femoral stem designs and THA failure from a DAA found a rate of early femoral complications of 1.1%, most of which were fractures.²³ A systematic review of periprosthetic femoral fractures during THA demonstrated that single- and double-wedge stems had the highest rate of periprosthetic fractures at 1.48% and 3.42%.²⁴ The authors of this study have demonstrated a 0.83% periprosthetic fracture rate from the DAA using a single-tapered wedge stem.¹⁸ The results of this study demonstrate a lower periprosthetic fracture rate when compared to other THA stems in the literature.

The DAA for THA has been on the rise as mentioned previously, as many

Table I
Summary of patients with femoral complications

Age	Sex	Dorr Classification	Canal Fit Ratio	Collar (Y/N)	Fracture Type (Vancouver Classification)	Notes	Treatment
55	M	B	N/A	N	B2a	Noted 6 weeks postoperatively with sudden inability to bear weight	Revision to modular stem
81	M	B	0.80	Y	Ag	-	Weight bearing as tolerated, stable fracture with appropriate alignment, no revision of implants required
87	F	B	0.96	Y	B2a	Noted 6 weeks postoperatively with sudden inability to bear weight	Revision to modular stem
55	F	C	0.89	Y	Ag	Avulsion of greater trochanter during approach, prior to femoral preparation	Weight bearing as tolerated, stable fracture with appropriate alignment, no revision of implants required

adopters claim better acetabular exposure than other described approaches. However, drawbacks include more difficult femoral exposure and, as a result, higher periprosthetic fracture rates as well as a recognized learning curve. Prior studies found a decrease in femoral fractures after the surgeon performed at least 62 cases, and at least 50 cases were performed before a decline in overall complications.²⁵⁻²⁷ The surgeons in this study are fellowship trained and are beyond the learning curve.

In this study, a total of four patients had femoral periprosthetic fractures; however, only two of them required a femoral revision/open reduction internal fixation. Previous investigations of predictive factors for Vancouver B type periprosthetic femoral fractures from the DAA included increased modifiable and nonmodifiable variables including medical comorbidities, advanced age, right-sided procedures, Dorr B & C class, and greater stem canal fill. The authors also noted that more than 85% of Vancouver B fractures occurred within six weeks of surgery.²⁶ Both the Vancouver B2a fractures were Dorr B and one patient was advanced age and had a canal-fill ratio of 0.96. The other two patients with periprosthetic femur fractures had avulsions of the greater trochanter prior to broaching the femur, meaning the fractures were likely due to the approach rather than the stem itself; both had an otherwise stable stem and were allowed to bear weight to tolerance.

The need for femoral stems to preserve bone stock for future revisions is important as the age of the average THA patient declines and lifetime risk for revisions increases.²² An investigation comparing short-stem THA and different international arthroplasty registries found comparable revision rates of 3.4–4.8% at 10 years for the Australian and Dutch registries.²⁸ One study showed an eight-year stem survivorship between 97.7–99.2% with a proximally coated tapered wedge stem.²⁹ Regarding midterm survivorship, short metaphyseal loading cementless stems were found to have a component survivorship of 98.6% at a mean follow up of 12.1 years in a systematic review.¹³

This study has several limitations. The first limitation is the short follow-up term; however, the nature of this study is to present early results and postoperative periprosthetic fractures. Long-term follow up and reporting outcomes in these

patients is recommended in the future. Next, this study was performed at a high-volume center with fellowship-trained arthroplasty surgeons who are beyond the DAA learning curve, and therefore this data may not be generalizable. Another limitation is the volume of patients included in the study. This was a single institution study, and future direction could include collaborating with other centers to increase the power of the study.

CONCLUSION

This triple-wedge broach-only implant demonstrated low rates of early perioperative femoral complications in primary THA via a direct anterior approach and low rates of early periprosthetic fracture rates requiring revision surgery. The authors will continue to monitor the longer-term survival and patient outcomes with this implant. **STI**

AUTHORS' DISCLOSURES

Dr. Crawford and Dr. Berend have received research support from Zimmer Biomet, Total Joint Orthopaedics, Firstkind, and Parvizi Surgical Innovation. Dr. Crawford is a consultant for Depuy and Medacta, and Dr. Keith Berend is a consultant for Medacta.

All other authors have no conflicts of interest to disclose.

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