10-Year Experience With Short Stem Total Hip Arthroplasty

GABRIELA VON LEWINSKI, MD; THILO FLOERKEMEIER, MD

Abstract

Since 1998, short stem total hip arthroplasty (THA) has been performed at the authors’ institution. Currently, 30% of THAs are performed with short stems. This article reports on complications that required revision of a short stem THA. Between September 2005 and February 2012, a total of 1953 Metha short stem THAs were performed; of these, 38 required revision due to mechanical complications. In 12 cases, the modular titanium neck adapter failed. In 19 cases, aseptic implant loosening occurred; of these, 11 cases were due to major stem subsidence. In 2 cases, via falsa (cortical penetration) implantation occurred. In 5 cases, periprosthetic fractures led to revision. This corresponds to an aseptic total revision rate of 1.3% for 26 short stems and 1.9% including the cases of all 38 documented revision cases. Thirty-four cases were revised with cementless standard hip stems, 2 cases were revised with short stems, and 2 cases were revised with long revision stems. Undersizing was analyzed in 58% of aseptic revisions. Fifty-four percent of revisions were performed in male patients—23% with osteonecrosis of the femoral head, and 7% with short hip stems positioned in varus in coxa vara deformities. Seventy-two percent of revisions after marked early stem subsidence and position change into valgus were performed in female patients. Dysplastic hips with coxa valga did not show elevated revision rates. No revisions were performed for dislocation or femoral thigh pain. Short stem THA with the Metha implant is a bone-preserving option for various indications in select patient groups.

The authors are from the Department of Orthopaedic Surgery, Hanover Medical School, Hanover, Germany.

Dr. von Lewinski received a grant, payment for lectures, and payment for travel expenses from B. Braun Aesculap. Dr. Floerkemeier receives payment for lectures from B. Braun Aesculap.

Correspondence should be addressed to: Gabriela von Lewinski, MD, Department of Orthopaedic Surgery, Hannover Medical School, Anna-von-Borries-Str, 1-7, 30625 Hannover, Germany (Gabriela.lewinski@ddh-gruppe.de).
doi: 10.3928/01477447-20150215-57
Short stem total hip arthroplasty (THA) is an established procedure. Studies of short stem THA have shown a less pronounced loss in bone mineral density around the proximal femur,\(^1\) good short-term results in patients with femoral head osteonecrosis,\(^2\) and good mid-term results in young patients who require THA.\(^3\) Such femoral implant components present a bone-preserving alternative to standard length stems and offer the opportunity for revision with a standard length stem if needed. Studies have investigated the migration patterns of short hip stems with radiostereometric analysis,\(^4\) the influence of resection height to the proximal load transfer,\(^5\) finite element analysis of short stems,\(^6\) and biomechanical comparisons to standard stems.\(^7\)

Since 2005, the Metha short stem (Aesculap AG, Tuttingen, Germany) has been used at the authors’ institution; more than 2,000 cases have been performed using an anterolateral (30%) or transgluteal approach (70%). As the implant range of modular and nonmodular components changed over the years, 190 short stems with a modular titanium neck adapter were implanted in 2005 and 2006, and 380 short stems with modular cobalt-chromium neck adapters were implanted since 2007. Since 2008, the majority of implanted short hip stems used nonmodular monoblock components, with the total number of such THAs being more than 1,500. The femoral component design, shape, and instrumentation have remained unchanged since 2004.

The percentage of short stem THAs increased from 10% during the first year of introduction to more than 30% in 2009. Based on positive clinical experiences, cementless short stem THAs currently account for approximately one third of primary cementless THAs performed at the authors’ institution (Figure 1).

For all short stem THAs that required revision, a detailed case analysis was performed to learn from femoral component failures. Such analysis of adverse events in short stem THA is an effective tool to identify risk factors, possible contraindications, and surgery-related aspects. In cases of implant revision, the reason for failure and any strategy to avoid such cases in the future is mandatory when a new implant concept is introduced. This should lead to a better understanding of the limitations for short stem THA and improved preoperative assessment of indications and differentiation for standard and short stem THA in each patient. The purpose of this study was to analyze the revisions that occurred with the Metha short stem at the authors’ institution.

**Materials and Methods**

Since the Metha short stem THA was first performed, all revisions were documented. Patient age, gender, body mass index (BMI), and preoperative indication for the index surgery were reviewed. When such stem revisions became necessary, implant selection at index surgery was reassessed in detail. Radiographic
documentation was evaluated regarding sizing of the implant and its relation to bone quality and individual patient anatomy, as well as osteotomy level and primary implant position. Preoperative planning was reassessed and compared directly with the postoperative results. Operative details and events also were reviewed. All aspects that might have led to revision as well as the types of femoral revision implants were documented.

RESULTS
From 2005 through 2013, a total of 1953 patients underwent short stem THA; of these, 45 THAs required revision. Seven revisions were performed because of infection, and 38 revisions were performed because of mechanical complications (Figure 2). The first revision was performed in September 2005, and the last revision was performed in February 2012. Failure of the modular titanium neck adapter required revision in 12 patients. Aseptic implant loosening required revision in 19 patients; of these, major stem subsidence occurred in 11 patients. Two cases required revision due to via falsa implantation. Five periprosthetic fractures led to revision. There were no dislocations or revisions due to thigh pain.

Based on the total number of 190 modular stem components with titanium neck adapters implanted during 2005 and 2006, the 12 modular titanium neck failures correspond to a rate of 6.3%, with an average time to failure of 57.7 months (minimum and maximum of 19.5 and 88.3 months, respectively). Excluding these failures of 12 modular neck adapters, the average time to implant revision for the remaining 26 revision cases was 8.9 months (minimum and maximum of 0.4 and 28.5 months, respectively). The revision rate of short hip stems implanted since 2005 and revised through 2013 was 1.9%, including all 38 documented revision cases of 1953 implantations, and 1.3% without the 12 failures of the modular titanium neck adapter of the first implantation series. Thirty-four cases were revised with cementless standard hip stems, 2 short stems, and 2 long revision stems.

The yearly number of revisions excluding modular titanium neck adapter fractures ranged between zero and 1.9% during the 9-year period (Table). Twenty of the 26 short stem revisions were necessary within the first year after the index THA. Five of the remaining 6 revisions occurred within the second year. Aseptic loosening of the short hip stem was differentiated into cases with marked postoperative subsidence >10 mm and a group of implants with lesser subsidence. For aseptic loosening, 11 of 19 cases were identified as undersized. The patients with subsidence >10 mm showed a valgus position after subsidence, whereas the patients who demonstrated loosening with less subsidence failed into a varus position.

Twenty-three percent (6 of 26) of revisions occurred in patients with osteonecrosis of the femoral head. Other indications such as dysplastic hips with a coxa valga did not show an elevated revision rate, but 7% of revised hips were in patients with a short hip stem positioned in varus for coxa vara deformity.
Although a higher percentage of women underwent THA with a short stem, 54% of the patients who required revision were men. Also, in the group of titanium neck failures, 10 of 12 patients were men. In patients with loosening into varus position, the percentage of men with coxa vara was 88% (7 of 8). In contrast, for patients in the subsidence or valgus group represented, 73% were women. Within this group, 45% of patients had osteonecrosis of the femoral head and 45% of patients had a high BMI (≥35) as well.

Of 5 periprosthetic fractures, 1 fracture occurred in a patient with osteonecrosis of the femoral head. Two fractures occurred after more than 2 years and were linked to trauma. One fracture was associated with an immediate postoperative failure and was believed to be the result of an intraoperative femoral fissure that was not diagnosed. Intraoperative unstable small fissures typically are treated with a wire cerclage. Cases of a rotationally stable rasp are only treated with partial load bearing, and revision following this has not occurred. Two revisions were necessary for unrecognized via falsa positions, with one lateral and one dorsolateral cortical penetration of the short stem.

**Case Examples**

The following case examples show typical failure situations that can be prevented by systematic intraoperative assessment of implant size and position. Undersizing is the most common complication; cortical contact inside the neck must be observed. It is helpful to check the lateral view intraoperatively. Cancellous stem fixation should be avoided as this could give an impression of a nonexisting primary stability.

To follow the Metha short stem anchoring concept, it is essential to have a lateral neck support inside the closed femoral neck osteotomy. This support must be assessed during surgery and is influenced by stem sizing and depth of implantation.

**High Osteotomy and Undersizing.** A high osteotomy can lead to a varus and undersized position of the stem (Figures 3-5). Each osteotomy level requires a dedicated position and sizing. Ensured primary stability is essential for similar reconstructions.

**Aseptic Loosening.** In cases with missing primary stability, the implant has no
chance to grow in and needs to be revised early. If the stem does not subside or stabilize, pain and radiographic signs of loosening present a clear indication for revision (Figure 6).

Via Falsa. In case of a via falsa penetration of the rasp or implant through the femur, change to a standard length stem is recommended as long as the penetration is in Gruen zone 3 (Figure 7). In all other zones, there is a high potential to use still a Metha stem.

Correct Implant Positioning. The medial part is supported by the calcar region and the distal part of the implant touches the lateral cortex of the femur (Figure 8). In the axial view the implant has to follow the anteversion of the femoral neck.

DISCUSSION

When developing a new surgical method, it is mandatory to systematically analyze failures to speed the learning process and to confirm or revise indications, technique, and implants to limit patient harm as much as possible. As all surgery is linked to a certain percentage of failure in all disciplines, care must be taken to identify differences in complication rates between the established and the new operative therapy. As adverse events normally are seldom in THA, the differentiation process requires a limited number of events for the difference to become obvious or even significant. Manufacturers responsible for the technical function of instruments and implants and surgeons therefore must watch all adverse events from the beginning with concentrated attention, comparing failure rates continuously as closely as possible to established practices, optimally within the frame of a clinical study, with rigorous rules of observation.

This retrospective revision analysis of femoral complications is based on a high number of cases and a certain level of experience with short hip stems, which is indicated in one third of the primary THAs performed at the authors’ institution. Since only the revision cases treated at the authors’ institution were included in this analysis, the total number of revisions may be higher. However, the findings of the particular reasons for femoral component revision in this analysis are believed to be representative for the Metha hip implant.

Other studies have reported that implant undersizing resulted in reduced primary stability with early stem subsidence.8 In one of the first studies of Metha short-term results, Braun and Sabah9 identified risk factors as stem undersizing, varus positioning, and missing proximal lateral cortex contact within the closed neck. Via falsa stem implantations have been reported by Wittenberg et al10 in 2 of 250 cases and in a single case by Milecki et al.11

In a report of cone fractures among patients treated with the modular titanium alloy neck adapter, a combination of different parameters was identified as risk factors of implant failure immediately after occurrence of an elevated cone fracture rate, including intraoperative...
Particle contamination of the cone, connection, excessive loading due to a patient weight >100 kg or high activity level, and male gender. An additional risk was a cone adapter of 135° and 130°. Revision of well-fixed femoral short stem components could be performed with conventional standard stems. Since the modular neck adapter was changed to a cobalt-chromium material in 2007 and the availability of nonmodular stems, the majority of short stem THAs performed at the authors’ institution are the nonmodular type.

Selection of the correct femoral stem size for any individual patient is important in THA, for standard and for shorter size for any individual patient is important in THA, for standard and for shorter stems during preoperative planning. The authors’ institution are the nonmodular type.

Although a standard stem must follow the orientation of the femoral diaphysis, a short stem achieves a metaphyseal anchorage with an orientation along the antetorsion of the femoral neck. This difference might play a role in size and alignment errors that were observed initially when using this new type of implant. These errors may influence later aseptic loosening but often are linked to early implant migration, which has occurred as one of the most frequent adverse events. Preoperative templating for short stems and a detailed analysis of the individual patient anatomy in anteroposterior and lateral views can predict the correct implant size more accurately compared to preoperative templating only in the anteroposterior view.

When evaluating revisions from 2005 to 2013, a further observation emerged. In 2011, a quality management program was initiated for arthroplasty surgeries of the knee and hip. From this time point on, only surgeons with a total number of more than 50 operations of either total hip or knee arthroplasties were allowed to perform the operations. This reduced the total failure rate of all short stem implantations from 1.9% in 2010 to 1.3% in 2013. This finding emphasizes the important role of experience and training in surgery, and has shown a measurable effect on the revision rate at the authors’ institution.

**Conclusion**

The Metha short stem is a bone-preserving option for various indications and younger patient groups when following the special requirements of a short stem with regard to specific patient anatomy and biomechanics. It offers advantages when small diaphysis or dysplastic hips are being treated. The observed complication rates compare favorably with conventional THA. However, early failures due to undersizing and malpositioning seem to be more relevant in short hip stems. Special attention is needed if surgeons are not yet familiar with the technical differences compared to conventional THA.

**References**


