Arthroplasty Today 5 (2019) 477–481

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Surgical technique

The anterior approach for conversion hip arthroplasty

Joseph S. Gondusky, MD [a,*], Jeong H. Lee, MD [b]

[a] *Jordan-Young Institute, Virginia Beach, VA, USA*
[b] *Department of Psychiatry and Neurobehavioral Science, University of Virginia Health System, Charlottesville, VA, USA*

ARTICLE INFO

Article history:
Received 16 December 2018
Received in revised form
27 April 2019
Accepted 30 April 2019
Available online 20 June 2019

Keywords:
Conversion hip arthroplasty
Anterior approach
Direct anterior approach

ABSTRACT

Conversion of prior proximal femoral fracture fixation to hip arthroplasty is a fairly common and successful procedure, necessitated by various modes of failure. The procedure is well described utilizing a posterior or anterolateral surgical approach. The anterior approach for total hip arthroplasty has gained in popularity. The approach allows for supine positioning and facilitates live fluoroscopic imaging. We present possible advantages and disadvantages, as well as the surgical technique, of conversion to total hip arthroplasty via the direct anterior approach.

Introduction

The treatment of proximal femur fractures utilizing screws, sliding hip screw (SHS) device, or a cephalomedullary nail (CMN) is a common procedure. This fixation can fail via various modes. Conversion to hemiarthroplasty or total hip arthroplasty (THA) is generally successful at decreasing pain and improving function [1,2]. Studies investigating conversion THA have utilized anterolateral or posterior surgical approaches. Compared to primary THA, these studies reveal increased operative time and estimated blood loss (EBL), increased risk of fracture, dislocation, and infection, and lower functional outcome scores [2-10]. The anterior approach (AA) has gained in popularity for primary THA. Very limited published literature examines the AA for revision THA [11-15], and none was found specifically investigating the approach for conversion THA. We review the possible advantages and disadvantages of using the AA for conversion THA, detailing the surgical technique for conversion of both an SHS device and CMN to THA.

Surgical technique

We describe here our considerations and technique for performing THA through the AA when prior surgery has been performed.

Preoperative considerations

Preoperative patient optimization and surgical planning, similar to all complex arthroplasties, ensures the greatest chance of success. It is important to note that conversion hip arthroplasty is a more technically demanding procedure than primary hip arthroplasty. The surgeon needs to be aware of their ability within the spectrum of the AA learning curve. In general, simple to complex primary AA arthroplasty should be mastered prior to performing conversion from prior hip surgery.

Standard preoperative labs and medical clearances are obtained. Preoperative images are templated. As detailed below, all methods of increased exposure must be considered. Appropriate femoral, acetabular, hardware removal and fracture fixation options must be available (Table 1).

Consideration should be given to the option of single stage vs a staged procedure. The patient should be consented for isolated hardware removal vs conversion to arthroplasty, and the rationale for this should be discussed with the patient preoperatively. This decision can be made either preoperatively or intraoperatively. Prolonged anesthesia is not optimal in the sickest of patients. In the case of either prolonged hardware removal where it is deemed in

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.artd.2019.04.011.

* Corresponding author. 5716 Cleveland Street, Suite 200, Virginia Beach, VA 23462, USA. Tel.: +1 757 490 4802.
E-mail address: josephgondusky@gmail.com

https://doi.org/10.1016/j.artd.2019.04.011

the best interest of the patient, or when significant bony defects are discovered after hardware removal, it may be best to stage the procedure. Bone defects can compromise femoral fixation, and increase risk of failure or fracture. In this case, staged reconstruction, with or without bone grafting, may be preferred. The timeframe of the second-stage surgery can be determined based on standard parameters of host health, incision healing, and bone incorporation. I prefer at least 3 months between these procedures to ensure an optimized host and bone.

Surgical considerations

A standard setup is utilized, with fracture table and technique similar to that described by Matta et al [16]. Liberally taping the abdomen improves the ability to palpate anatomy and improves femoral access. For most cases, a self-retaining retractor system is utilized (Omni-Flex; Integra LifeSciences, Plainsboro, NJ). Fluoroscopy is a useful aid, and the team should plan accordingly for more use than in primary THA. Limb length and offset are optimized during intraoperative assessment with a simple overlay [17].

The incision starts just distal and lateral to the anterior superior iliac spine and extends toward the trochanter. It is curved proximally along the pelvic crest and distally along the lateral femur. The anterior hip capsule is debulked after an inverted T-type arthrotomy, with repair as allowable during closure. Previous incisions can be incorporated. It is helpful to demarcate the standard incision utilized in primary AATHA to determine if the location of more distal prior incisions is close enough to incorporate. SHS incisions are often incorporated as the distal extension of the approach. Percutaneous screw incisions are often more distal and lateral than the AATHA requires. These screws can be removed through a separate incision, or occasionally through the main AA incision with the aid of lateral retraction and leg internal rotation. The lateral thigh fascia is incised in line with the incision. The standard muscular plane for the AA is utilized, mobilizing the tensor fascia lata posteriorly. It is important to note that this interval may be scarred in with prior incisions in that area, and meticulous dissection can be required to facilitate exposure.

Fracture fixation hardware removal

Bony overgrowth, broken hardware, and stripped screws are the most commonly encountered hardware removal issues. Fluoroscopy aids localization and removal of hardware and is a major advantage of the AA.

Percutaneous screws can be removed, as noted, from the AATHA incision or a separate incision. A broken screw removal set should be available to remove stripped or broken screws.

Table 1
Equipment considerations for conversion hip arthroplasty via the anterior approach.

Hardware removal
• Device specific and universal removal instruments, broken screw removal set, diamond-tipped wheel or burr
Femoral preparation
• Curettes, rongeurs, osteotomes, awls, burrs
• Flexible sharp-tipped handheld and/or power reamers
• Ball-tipped guidewire and cannulated reamers
Fracture treatment
• Cables and plates
Femoral stem options
• Primary and revision, metaphyseal and/or diaphyseal engaging, modular revision, cemented, calcar-replacing (consider length required)
Cup options
• Primary, revision, dual mobility, constrained

SHS devices are similarly removed from the lateral femur, usually through an incision that is continuous with the AA. If hardware within the femoral neck cannot be removed via the lateral femur, the AA can be performed in standard fashion and a napkin-ring type neck cut made around the implant. After bone removal, which can be difficult, a burr or wheel can be utilized to cut the hardware. SHS plates can sometimes be completely overgrown with thick bone, completely obscuring any direct visualization of the implant. In these cases, bone must be meticulously removed with any combination of burrs, curettes, saws, awls, or osteotomes.

Significant bony overgrowth can also occur over the proximal CMN insertion site. Similarly, bone removal here is required to gain access and cannulate the CMN for removal. Here, burrs and curettes are most useful.

Acetabular and femoral preparation

Acetabular defects from proud hardware or poor bone related to disuse should be expected and managed. Revision cup (multihole) options, bone graft, and metal augments should be considered and available. Dislocation risk is minimized with appropriate recreation of limb length and offset, cup position, and cup/head options.

Femoral preparation is the most challenging aspect of conversion arthroplasty. Careful attention to limiting stress on the greater trochanter should be cautioned. A collapsed neck fracture with significant limb shortening can complicate exposure, and make reduction difficult. Proximal sclerotic bone will be present at the neck and metaphyseal levels. A preoperative computed tomography (CT) scan can be helpful. Sclerotic bone at the medial calcar can direct the broach posteriorly, causing a femoral perforation. Safe femoral preparation can be achieved with meticulous sclerotic bone removal, palpation of the canal with curettes or the suction tip, proper releases and elevation of the femur, and the use of fluoroscopy as required. Reaming over a cannulated guidewire can be a safe way to gain entrance. Trendelenburg positioning of the table can also help. If access is not possible after simple maneuvers, the focus should be on proximal extension, performed as described [10-13]. Most commonly, only proximal skin extension and limited proximal tensor fascia lata release from the ilium is required. Distal extension of the incision is as described [10-14]. Denervation can be avoided by elevating the posterior border of the vastus lateralis [14].

Femoral implant selection

Femoral stem choice is similar in consideration to all hip arthroplasties [1-3,9], with the caveat that the AA can make long femoral stems more difficult. The standard goal of stable femoral fixation is paramount. In general, a primary uncemented stem is my preferred stem when it is long enough and robust enough for fixation. This is generally the case with simple screw removal. Longer uncemented implants, either metaphyseal or diaphyseal engaging, are preferred when distal bypass of stress risers is deemed necessary. The extent of distal bypass required is debatable, in general 2 cortical diameters are preferred, but this really depends on the location and extent of implant engagement, host bone quality, and the significance of the stress riser. Modular femoral stems are rarely necessary in these scenarios, but can be useful for more significant proximal femoral defects where distal engagement is required. This situation would most commonly be seen in conversion THA with prior CMN and/or chronic infection, and should be suspected based on preoperative radiographs. Uncemented stems are generally preferred. Multiple bony defects make for cementing difficulties, but cementing is very reasonable in many cases. Defects can be occluded prior to or during cementation with bone, a gloved finger, or other manner to allow for appropriate pressurization.

Intraoperative fracture management

Nondisplaced trochanteric fractures with an intact musculotendinous sleeve, if stable under fluoroscopic stress, may not require fixation. If required, fixation is with standard devices. Suture, cable claws, or claw/plates can be applied. Wire passage can be aided significantly by incision extension as required, as well as aggressive femoral rotation. Diaphyseal fractures can be treated most commonly by cerclage or cerclage/locking plate combination, with stem revision if indicated. Distal extension of the incision is required. The AA is extensile distally, affording complete access to the lateral femur. Fluoroscopy aids visualization of fracture reduction and hardware placement.

Closure

Closure is straightforward. After capsular closure, the lateral fascia is closed, allowing the muscular interval to re-appose. The deep subcutaneous fat is tacked down to the fascia in order to avoid seroma formation. Standard multimodal pain control and venous thromboembolism prophylaxis are employed. Postoperative dislocation precautions are individualized in conversion scenarios, based on suspected risk. In many conversion cases via the AA, chronic collapse and dense scar make for relatively constrained articulations, for which no formal precautions are ordered. In some cases, such as when very aggressive capsulectomy is required for access, cup options are optimized for stability and more formal precautions may be instituted.

Case 1

This patient is an 81-year-old male, 5′8″, and 104 kg, with primarily central/abdominal obesity and body mass index (BMI) of 35. Medical history is significant for diabetes mellitus DM, prostate cancer, gout, former tobacco use, and chronic kidney disease 3 (American Society of Anesthesiologists III). He underwent SHS fixation of an intertrochanteric femur fracture elsewhere. On initial presentation 15 months after open reduction internal fixation, he had severe hip pain, with 2-3 block walking tolerance. Aseptic vs septic nonunion was considered (Fig. 1a). CT scan, infectious labs, and aspiration were performed. The CT scan revealed a nonunion (Fig. 1b), with labs and aspiration negative for infection, supporting aseptic nonunion as the etiology for the patient's pain. With progressive discomfort and decreased ambulatory capacity, conversion occurred 20 months after original open reduction internal fixation.

Operative time was 215 minutes, primarily due to the mass of sclerotic proximal femoral bone that required meticulous removal for safe canal entrance. EBL was 800 cc. A collared, metaphyseal/diaphyseal engaging, uncemented stem was utilized (Corail Revision; DePuy Synthes, Warsaw, IN). Preoperative hematocrit (HCT) was 34.8. Postoperative day (POD) #1 HCT was 27.3. He did not require transfusion postoperatively, with asymptomatic anemia and HCT that trended to 22.8 on the day of discharge, POD # 4. He was allowed 50% weight bearing initially and made slow progress with a rolling walker. Weight bearing of 50% was planned for 6 weeks, primarily to decrease the risk of possible trochanteric fracture given the large overlying trochanteric bone, the stress seen in a large male with BMI 35, and the bone compromise from the lateral hole at the SHS site. He transferred to an skilled nursing facility at discharge. On clinic follow-up he progressed in ambulatory capacity, utilizing a cane while in crowds but no assistive device otherwise at follow-up 12 months postoperative (Fig. 1c).

Case 2

This patient is an 81-year-old female, small-framed at 4′11″, 62 kg, and BMI of 27. Medical history is significant for diabetes mellitus, prior cerebrovascular accident with residual right upper and lower extremity weakness, anemia with HCT of 27, and chronic kidney disease 3 (American Society of Anesthesiologists III). She underwent CMN fixation of a basilar femoral neck fracture elsewhere. On initial presentation 2 years and 7 months out, she had severe hip pain at 7/10, night pain, and difficulty sleeping. She performed limited ambulation with a walker with discomfort with baseline weakness of the right lower extremity after cerebrovascular accident. She progressed from limited walker use to essentially bedridden, with increased collapse radiographically (Fig. 2a). She was diagnosed with postcollapse avascular necrosis vs arthritis and proud hardware. Due to her bedridden status and after considering the significant risks in this medically frail woman, all parties felt conversion was reasonable. She underwent conversion 2 years and 10 months after CMN fixation.

Operative time was 162 minutes. A similar stem was utilized. EBL was 350 cc, too little for available autotransfusion. Postoperative day 1 HCT was 23.0. She received 2u packed red blood cells postoperatively, 1 on POD #2 and 1 on POD #5. She was made weight bearing as tolerated utilizing a rolling walker, with slow

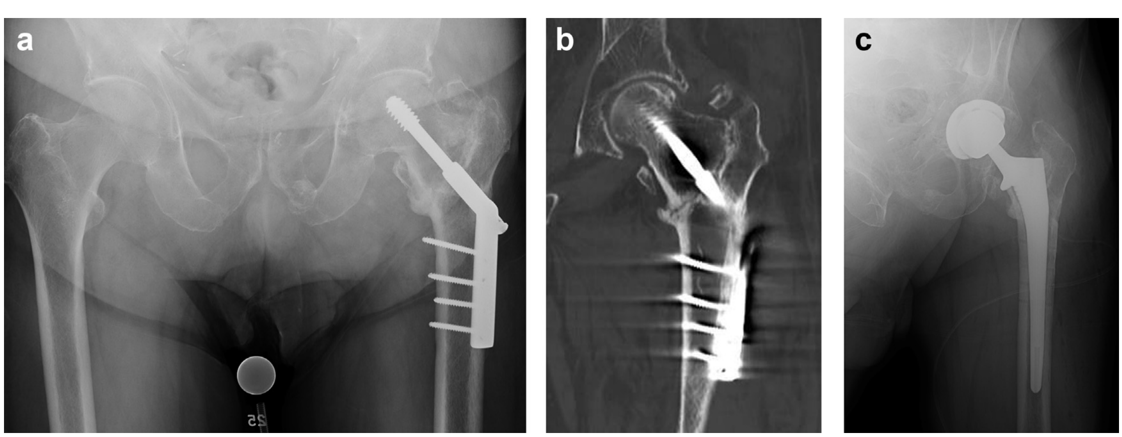

Figure 1. (a) Preoperative sliding hip screw device in place with intertrochanteric nonunion, significant hypertrophic bone, and altered proximal femoral anatomy (anteroposterior radiograph). (b) Preoperative CT image revealing intertrochanteric fracture nonunion (coronal image). (c) Postoperative radiograph after conversion to total hip arthroplasty (anteroposterior radiograph).

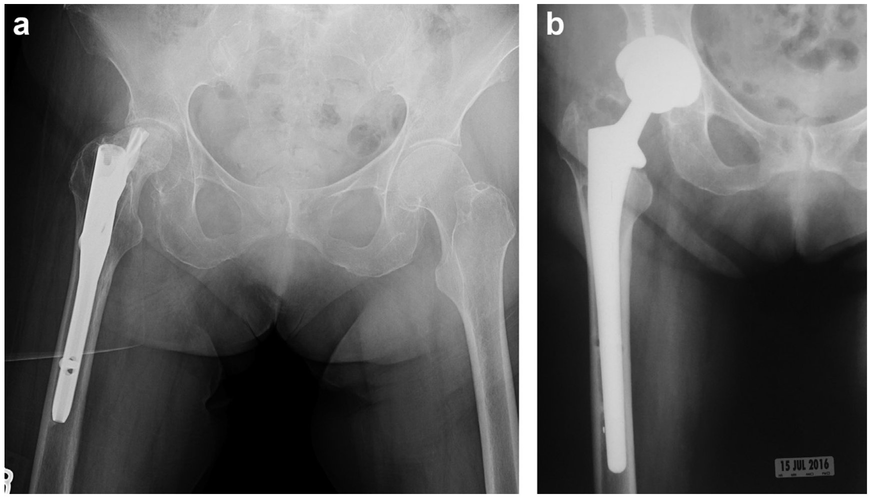

Figure 2. (a) Preoperative cephalomedullary nail in place with femoral head collapse, proud proximal device, and massive external rotation (anteroposterior radiograph). (b) Postoperative radiograph after conversion to total hip arthroplasty (anteroposterior radiograph).

progress, ambulating 40 feet on POD #3. Urinary retention required management with prolonged catheter usage, this resolved without issue. She was discharged on POD #6 to a skilled nursing facility. On clinic follow-up POD #18 she denied any pain and noted she was "walking better than I have in 2 years." She progressed to ambulation with a walker at 4 months postoperative (Fig. 2b). She continues to do well at final follow-up 2 years postoperative, continuing with walker ambulation due to her stroke history, but pain free from the hip, and continuing care in the office for her symptomatic shoulder arthritis.

Discussion

When proximal femoral fracture fixation fails, conversion to hemiarthroplasty or THA is an option that is most commonly successful [1,2]. Conversion arthroplasty studies utilizing posterior or anterolateral approaches reveal significant rates of complication [2-9] (Table 2). Complication rates are highest with conversion from a CMN [4,8]. Those studies that differentiate neck fracture from intertrochanteric fracture note increased complication with the latter, as would be predicted [2,6]. Versus primary surgery, conversion is associated with increased operative time, blood loss, fracture, dislocation, infection, and lower functional outcome scores [10].

Table 2
Study data regarding conversion hip arthroplasty.

Pui et al [8]	• 11.7% overall complication rate for conversion from SHS • 41.9% overall complication rate for conversion from CMN • 4 fractures in 60 SHS conversions • 3 fractures in 31 CMN conversions
Khurana et al [7]	• Patients converted from both femoral and acetabular fractures • 39% overall complication rate • 12.5% required revision at a mean of 3.5 years postop
Exaltacion et al [5]	• 9 of 20 conversions from SHS with trochanteric nonunion
Zhang et al [9]	• Posterior approach conversion from an SHS • 47% overall complication rate • 32% sustained a greater trochanteric fracture • 3 of 16 conversions to THA dislocated
Archibeck et al [2]	• 4 of 39 (10.3%) periprosthetic fracture rate in conversions from intertrochanteric fracture • 4.9% dislocation rate

The AA for primary THA has been well described [16,18]. The authors are unaware of any study that presents data for conversion THA via the AA. Advantages of the approach for conversion THA can only be extrapolated from data in primary series and expert opinion [19-22]. In my experience, the advantages (for an experienced AA surgeon) include the supine positioning, as well as the ease of fluoroscopy use and leg manipulation if a table is used. This can help facilitate hardware removal, cup and femoral preparation, and recreation of limb length and offset. No data on conversion AATHA dislocation rate and early recovery exist, but this could present an advantage as well, as has been shown in some primary AATHA series [19-22]. Disadvantages with the AA in these scenarios to consider are possible difficulty addressing abductor tendon pathology and periprosthetic fracture. The surgeon should also factor in expected operative time, blood loss, skin issues, and his or her experience to individualize and optimize the planned approach based on the patient's physiologic status, anatomical factors, and the operative environment.

Summary

Conversion of proximal femoral fracture fixation to hip arthroplasty can be performed utilizing the AA. Studies to date have utilized alternative approaches. This case presentation highlights the surgical technique for conversion of both an SHS device and a CMN to THA using the anterior approach. Possible advantages and disadvantages of the approach for conversion are presented. Additional studies are required to determine the role of the approach in conversion THA.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.artd.2019.04.011.

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