Case Report

Save the Greater Trochanter: A Novel Modification to the Extended Trochanteric Osteotomy

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ARTICLE INFO

Article history:
Received 4 March 2022
Received in revised form 2 May 2022
Accepted 4 May 2022
Available online xxx

Keywords:
Extended trochanteric osteotomy
Total hip revision
Femoral stem removal
Surgical technique

ABSTRACT

The extended trochanteric osteotomy is the workhorse for removal of well-fixed femoral stems during total hip revision arthroplasty. Despite its reliable performance in exposing the implants for removal and accessing the femoral canal, significant complications can occur. Though these complications are rare, trochanteric nonunion, trochanteric escape, and femoral implant subsidence can have a significant negative impact on gait mechanics and patient outcome. If access to the canal was still possible and the greater trochanter could remain in place, these complications could be minimized or possibly even eliminated. This paper describes a novel technique using a lateral cortical window just distal to the greater trochanter that allows removal of a well-fixed stem and leaves the greater trochanter intact.

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Introduction

The extended trochanteric osteotomy (ETO) is the workhorse for removal of well-fixed femoral stems during revision total hip arthroplasty (THA). Mechanical complications, implant fracture, or infection can necessitate the removal of a well-fixed stem during revision. Routine removal techniques that utilize a burr and osteotomes can lead to cortical perforations, catastrophic fracture, and significant bone loss of the proximal femur. Lerch et al reported less complications, lower rates of nonunion, lower rates of re-revision, and improved clinical outcomes in patients who had a controlled ETO during revision THA vs those who had intra-operative fractures during revision THA [1]. Fractures of the greater trochanter occur more commonly during stem removal when an ETO is not performed and cortical perforation, and ultimately stem subsidence is more common when the ETO is not performed [2–4]. Therefore, a controlled osteotomy of the proximal femur allows for removal and exposure while preserving the proximal bone stock. The survival rates for aseptic revisions using ETO have been shown to be greater than 90% [3,5].

The ETO has successfully been performed in these technically difficult situations with reportedly low nonunion rates; however, there can be significant complications. Nonunions do happen, and stem subsidence, trochanter migration, Trendelenburg gait, and dislocations can occur in 10% of cases [6,7]. These all have significant impact on gait mechanics and patient outcomes. If it is possible to gain appropriate exposure of the bone and achieve stem removal without making an osteotomy that includes the greater trochanter, it may be possible to minimize or even eliminate these complications. This paper describes a novel technique using a lateral cortical window just distal to the greater trochanter that allows removal of a well-fixed stem and leaves the greater trochanter and its muscular attachments intact.

Case history

Patient

This case report describes the procedure on a 77-year-old male who underwent his primary THA 10 years prior to the revision. Written informed consent was obtained by the patient to participate in this case report and authorize publication. He presented to the office with sudden onset of severe groin pain and difficulty ambulating. Radiographs revealed the cementless stem had catastrophic failure of the trunnion with complete dissociation of the cobalt chromium femoral head. Though the patient never complained of pain previously, radiographs of the femur showed lucencies at zone 1 and 7, lack of calcar atrophy, and pedestal formation at the tip of the stem (Fig. 1). The
acetabulum appeared to be well fixed, and revision of the femoral stem was planned.

**Technique**

This surgery was performed via a direct lateral approach; however, any approach that can access the proximal and lateral aspect of the femur can be utilized. The basic preparation is the same as the ETO as described by MacDonald et al [5]. After dislocation of the hip and removal of the femoral head, the proximal femur was cleared of debris to visualize the entire proximal bone-implant interface. A 2-mm burr and flexible osteotomes were used to remove any points of fixation proximally between the implant and the bone (Fig. 2). As these devices are passed distally, great care is necessary to ensure no perforation of the cortical bone. An extraction device was placed on the stem, yet the implant would not release. It was decided to perform the osteotomy. The borders of the osteotomy were identified. A diagram with dimensions is shown marked on a saw bones femur (Fig. 3a). The proximal aspect is just distal to vastus ridge ensuring 2 cm of bone is not disrupted proximally. The distal aspect was measured 6 cm distal to the proximal cut—this was determined based on the porous coating of the stem. It is important that the osteotomy extends beyond the porous coating of the stem so as to allow for release of distal spot welds into the stem. The anterior cut was made at the lateral edge of the implant, and the posterior cut was made internally after the anterior cut was made. The anterior cut was made with the oscillating saw. The proximal and distal cuts were made with a pencil tip burr, and the posterior cut was made through the anterior cut to score the inner cortex. Osteotomes were used to lever out the fragment, leaving the greater trochanter completely intact (Fig. 3b). This was performed similarly to the standard ETO, but the proximal extent was stopped at the vastus ridge.

The osteotomized fragment was levered posteriorly, and the stem was visualized (Fig. 4). The flexible osteotome was passed proximally through the osteotomy and around the implant and then used in a sawing fashion moving distally until it passes the distal aspect of the porous coating (Fig. 5). The extraction handle was attached to the implant, and the stem was removed with ease and without any appreciable bone loss (Figs. 6 and 7). The osteotomy fragment was then secured in anatomic position with 2 cables (Fig. 8). If there was appreciable osteoporosis or lysis, consideration of placing a cable distal to the osteotomy would be reasonable to prevent a distal fracture, though it was not necessary for this case. The femur was then prepared in routine fashion with a modular stem. The wound was closed in routine fashion. Postoperative radiographs show anatomic position of the osteotomized fragment and the greater trochanter intact (Fig. 9a). The patient performed 50% weight-bearing for the first 4 weeks and then advanced as tolerated. This limitation was more for the style of femoral implant than for protection of the osteotomized fragment. He progressed without difficulty and ambulated without a limp, and his radiographs at 1 year revealed complete healing of the osteotomy and no stem subsidence (Fig. 9b).
Discussion

This case study shows a novel technical modification to obtain all the potential benefits of performing a standard ETO without risking dysfunction of the greater trochanter itself. Dysfunction can be secondary to nonunion, ETO fragment migration, stem subsidence, and dislocation. By preserving the greater trochanter and the attachment of the gluteus medius, there is no damage to this area. Therefore, there is likely improved ability to tension the soft tissues and limping may be diminished. Also, keeping the proximal bone stock may allow for improved fit of the proximal portion of a modular or nonmodular revision stem.

A limp or Trendelenburg gait after ETO for revision THA occurs in 9%-18.5% [6,7]. Due to the nature of the biomechanics of the gluteus medius muscle, there are forces on the ETO fragment pulling proximally and anteriorly. This may be a direct reason for nonunion and fragment migration. Nonunion has been reported as high as 20% [4], but most studies range between 1.4% and 8.9% [5,8,9]. Wronka et al [4] and Drexler et al [10] have reported 0% ETO nonunion rate on aseptic cases though Wronka notes 6% were not completely healed. Migration of the ETO fragment has been shown in 0%-8% though Leon noted a decreased risk of migration as long as osteotomy length was a minimum of 10 cm [2,8,11,12]. Based on the lack of distracting forces present on the fragment in this presented technique, it is possible to have less or no migration and nonunions. With nonunion and migration of the ETO fragment, stem fixation and soft tissue tensioning may be affected. Malahias reported a 7.1% incidence of stem subsidence in a metaanalysis of 19 articles including 1478 patients after femoral stem revision using an ETO [13]. However, Abdelsamie looked specifically at revision THA using a porous coated cylindrical modular stem and found an 85% rate of...

Figure 3. A saw bones replica of the proximal femur (a). The proximal border (blue arrow) of the osteotomy is just distal to vastus ridge and leaving at least 2 cm of proximal bone. The distal border (yellow arrow) is measured 6 cm distally from the proximal border (based on the porous coating of this stem). The anterior border (black arrow) connects the proximal and distal borders along the lateral edge of the stem. Intraoperative photograph (b) after the anterior cut was made with the oscillating saw and the proximal and distal cuts were made with a pencil tip burr. The posterior cut was made passing the saw through the anterior cut to score the inner cortex. Osteotomes were used to lever out the fragment.

Figure 4. The osteotomized fragment (white arrow) is retracted posteriorly. The greater trochanter (blue arrow) is completely intact. The implant (black arrow) and distal aspect of the porous coating is visualized within the femoral canal.

Figure 5. The Gigli saw (white arrow) is passed through the osteotomy site up and over the neck of the stem (blue arrow). It may be necessary to use a burr or osteotome through the osteotomy site directed proximally if there is any obstruction to passing the Gigli saw. The saw is then passed back and forth moving distally around stem until all bony ingrowth/outgrowth is released.
subsidence when ETO was performed in a small series of patients. They saw a significantly lower rate with use of a tapered-modular fluted stem [14]. Stem subsidence, migration, and nonunion of the ETO fragment can all lead to shortening of the abductor mechanism with resultant poor soft tissue tensioning. This leads directly to weakness and limping but secondarily may lead to dislocation. Obviously, dislocation is multifactorial, but reported rates of dislocation after ETO range from 3% to 9% [10,15]. This new technique may minimize the risk for osteotomy fragment migration and hip dislocation. Further study is necessary to evaluate if this new technique can reduce these complications.

There are other reports regarding a cortical window to remove femoral implants. Historically, Moreland and Jinnah described making a cortical window distally at the site of a fractured Charnley stem to remove the broken fragment [16]. More recently, Koksal et al described a small series of patients where a cortical window was made to remove the distal portion of broken stems [17]. Kim et al [18] and Park et al [19] described making an anterior femoral cortical window to remove well-fixed stems. However, this required bone removal the entire length of the stem with poor ability to reach the posterior aspect of the stem. It also required toe-touch weight-bearing for 8 weeks postoperatively, whereas our patient was restricted to only 50% weight-bearing for 4 weeks. Based on the type and fit of the revision stem, it is possible that no restriction would be necessary with this novel technique. Obviously, the anterior cortical window technique would require an anterior-based approach, whereas this novel technique utilizing a lateral cortical window could be performed with any approach to the hip.

This novel technique could be performed for the removal of well-fixed cementless primary tapered, fit and fill, and revision stems. This lateral window technique could also be utilized to extract distal cement during removal of cemented implants or broken cemented or cementless implants while protecting the greater trochanter. Extending the osteotomy distally should not be an issue for longer implants as long as there is enough remaining bone at the isthmus for the revision stem to purchase. However, it may not be appropriate for all cases. A 2-cm bridge of proximal bone above the vastus ridge was utilized in this case. If there is proximal bone loss and the proximal cut leaves a bridge of bone that is too narrow, then the greater trochanter could fracture. In these cases, the osteotomy could be started more distally. Also, in cases where increased stress would be placed directly on the greater trochanter during removal or reimplantation, the standard

Figure 6. Stem removed with no appreciable bone attachment.

Figure 7. Proximal femur after stem removal. The osteotomy site (black arrow) and greater trochanter (blue arrow) are intact and without damage.

Figure 8. Proximal femur after osteotomy repair with 2 metallic cables (blue arrows).
ETO may be necessary to avoid fracture of the greater trochanter. This requires further study.

Summary

This modification to the ETO by performing a lateral cortical window distal to the greater trochanter allows for all the benefits of the ETO without the risks as it preserves the greater trochanter and avoids the proximal distracting force on the osteotomized fragment by the abductor muscles.

Conflict of interest

The authors declare that there are no conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2019.12.004.

Informed patient consent

The author(s) confirm that informed consent has been obtained from the involved patient(s) or if appropriate from the parent, guardian, power of attorney of the involved patient(s); and, they have given approval for this information to be published in this article

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