Direct anterior approach for femoral component revision: Surgical technique for extended trochanteric osteotomy and anterior cortical window

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ABSTRACT

Objective: Direct anterior approach (DAA) is becoming a popular option for both primary and revision total hip arthroplasty (THA). Adequate exposure is crucial in the setting of revision THA. The purpose of this article is to describe two different techniques for expanded femoral exposure through the DAA, the anterior extended trochanteric osteotomy and anterior cortical window.

Methods: Extensile exposure were carried out in cadavers, using the contralateral hip as a control. The exposure and technical viability were assessed.

Results: It was demonstrated that both extensile techniques can be carried out safely.

Conclusions: Extensile exposures including femoral osteotomies can be safely carried out for revision THA via DAA.

1. Introduction

The demand for primary total hip arthroplasty (THA) has been growing steadily over the last decade, which an associated increase in the prevalence of revision THA.¹ It is estimated that revision THA rates will increase by 137% with 97,000 cases per year by 2030 in the United States of America and this is thought to be related to the increased performed THA in younger and active patients as well as the increase in life patient life expectancy.^{2,3}

Different revision techniques have been described throughout the literature to revise a well-fixed femoral implant, including extended femoral osteotomies (ETO). These techniques have traditionally been performed through posterior or lateral approach. Recently, use of the direct anterior (DA) approach for revision THA has increased, and as such there is a need for extensile exposure techniques that can be utilized through this approach.

Multiple studies have shown the potential advantages of DA approach, including reduced blood loss, faster rehabilitation, decreased perioperative pain, better postoperative strength, lower rate of dislocation, less soft tissue injury and lower risk of heterotrophic ossification.^{4–9}

In general, a surgical approach must be extensile in order to

accommodate the numerous surgical challenges and various exposure techniques required in both primary and revision scenarios. Several articles have described different techniques to create an extensile DA approach, including vastus lateralis (VL) split, extension of the DA incision in an S-shape posteriorly or using the femoral inter-bundle technique.^{10–13} Though these techniques aid in visualization, one the most significant challenges in THA revision is the removal of a well fixed stem. Removal of a well fixed stem can be potentiated by greater access to the bone-metal interface, which can be achieved through either ETO or anterior cortical window.

Currently there is no clear description of these techniques through a DA approach in the literature. Therefore, the purpose of this paper is to describe the surgical techniques for ETO and anterior cortical window through a DA approach in a cadaveric setting. Moreover, we believe that although both the anterior window and the ETO can be done via the DAA, the anterior window can be done with greater ease compared to ETO.

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Fig. 1. A&B. Saw used to create the longitudinal cut along the lateral aspect of the femur. C. Distal cut done from mid-femur to the lateral cortex. D. Osteotome used to open the osteotomy site. E. The final look for the ETO. F. Exposure of the lateral, anterior and posterior aspect of the femoral implant.

2. Surgical technique

2.1. Set up

Patient is placed supine either on the traction table or a standard operative table that allow flexion through the hip in order to increase exposure to the femur.^{14–16} In this paper we used the traction table and the following descriptions will continue accordingly. The following techniques were done on eight cadavers, so in total sixteen hips, eight hips for each approach.

2.2. Incision and surgical approach

The incision's starting point is located two cm distally and two cm laterally to the anterior superior iliac spine (ASIS) and carried out distally toward the lateral boarder of the patella. The incision in revision cases may be extended as needed. Superficially, the interval between the TFL and sartorius is utilized. The lateral femoral cutaneous nerve is identified and protected when possible. TFL fascia is then incised longitudinally and lifted with kochers and the medial muscle fibers are swept bluntly off the fascia from distal to proximal. A deep blunt Hohman is then placed on the superior aspect of the femoral neck. A deep Charnley retractor is then placed to retract the TFL laterally and the sartorius medially. Metzenbaum scissors are then used for dissection to identify the ascending branch of the lateral femoral circumflex vessels, which are then cauterized. The hip capsule is then identified, cleared of any adipose tissue, and a capsulectomy is performed to provide adequate visualization. Exposure of the acetabulum will not be

described here since it is beyond the scope of this paper.

2.3. Femoral exposure

A gel bump is placed under the pelvis at the level of the ASIS in order to increase hip extension. A blunt bone hook is used to lift the femur up while externally rotating and adducting the femur in order to expose and release the posterior capsule and external rotators for proper femoral elevation. Once the femur is exposed the incision can be extended distally and posteriorly toward the midline of the femur. TFL is reflected posteriorly and the vastus lateralis is split in line with its fibers as far as needed. Care should be taken to identify the perforating vessels and cauterizing them. It is often useful to leave a cuff of the VL tendon attached to the vastus ridge for closure.

2.4. Extended trochanteric osteotomy

The extended trochanteric osteotomy (ETO) is an osteotomy that is performed on the lateral aspect of the femur in order to adequately exposure and remove a distally well fixed femoral stem. It was first described by Younger et al.¹³ The osteotomy is carried distally from the greater trochanter while maintain an intact musculo-osseous sleeve to preserve bone fragment blood supply. The length of the osteotomy site is determined preoperatively based on the length of the stem to be removed and the location of the femoral isthmus. Various techniques have been described that achieve adequate fixation of the osteotomy and promote union.

Fig. 2. A&B. Exposure of the anterior and medial aspect of the femoral shaft. C. Saw is then used to make a horizontal cut into the anterior femoral cortex D. Distal cut done from mid-Femur cortex to the medial cortex. E. Medial cortex osteotomy. F. The final look of the anterior cortical window. G. Exposure of the anterior and medial aspect of the femoral implant.

2.5. Technique

The femoral cortex is well exposed as previously described. The length of the longitudinal cut of the osteotomy is planned according to preoperative templating. A prophylactic cable is placed just distal to the intended osteotomy to prevent distal fracture propagation. A saw is used to cut the anterolateral aspect of the femur down to the posterior cortex (Fig. 1A & B). The distal aspect of the osteotomy is turned laterally, finishing in the mid-coronal plane (Fig. 1C). Finally, osteotomes are used to slowly open the osteotomy in a controlled fashion (Fig. 1D). With the fragment displaced, the anterior, lateral and posterior aspects of the implant can be seen (Fig. 1E&F). Traditional implant removal techniques can then be used to remove the implant. Once the new implant is placed the osteotomy is closed and fixed with cerclage cables.

2.6. Anterior cortical window

Another technique used to improve femoral implant exposure and removal involves creating an anterior cortical window in the proximal femur, allowing greater exposure of the anterior and medial aspects of the implant. This is usually performed with the hip reduced. The VL is exposed and released from its origin proximally to approximately 5 cm distally and reflected medially in order to expose the anterior femoral cortex (Fig. 2A&B). A saw is then used to make longitudinal cut in the anterior femoral cortex (Fig. 2C). The osteotomy is then turned medially (Fig. 2D&E). A prophylactic cable is placed just distal to the intended osteotomy to prevent any distal fracture propagation. Osteotomes are then used to mobilize the anterior bony fragment medially, providing access to the femoral component (Fig. 2F&G). Once exposed, traditional implant removal techniques can be used to remove the

implant and once the new implant is placed the osteotomy can be fixed using cerclage wires around the proximal femur.

3. Discussion

The direct anterior approach has not historically been used for THA revision. As patient demand for less invasive surgery increases and instrumentation has improved, surgeon interest in the DA approach for both primary and revision THA has increased significantly. Moreover, the DA approach has been shown to cause less soft tissue trauma, allow faster postoperative recovery, lead to less postoperative pain, and is associated with less complications including thromboembolic risks and instability.^{17,18} With experience, surgeons have become increasingly comfortable using this approach for both primary and revision cases.

The DA approach provides excellent exposure of the acetabulum, with the ability to visualize the entire acetabulum, acetabular columns and the iliac wing when employing proximal exposure techniques. With the use of the extensile distal approach described here, adequate exposure of the femoral shaft is permitted, making this a safe and efficient approach for revision THA.

The main concern for many surgeons when using the DA approach for revision THA is the need to revise a well fixed femoral stem. In this paper we described two techniques that can be utilized through a DA approach in order to safely and efficiently remove a well fixed stem. The direct anterior ETO is a variation of a very familiar technique often done through posterior or lateral approach. This technique offers the advantage of fully exposing a distally well fixed or cemented implant, allowing for use of common implant extraction techniques. However, the ETO requires more surgical time and soft tissue dissection to complete. Furthermore, Nobel et al.,¹⁹ demonstrated that there was 73% reduction in mean torque to failure in the osteotomized specimen and that did not improve even after repairing the osteotomy fragment. Regardless, this technique can be extremely useful for distally fixed cementless or fully cemented stem removal. The anterior cortical window technique provides the advantage of less femoral bone disruption, less soft tissue dissection, and a potentially less biomechanically compromised construct when compared to the ETO. However, access to the distal and lateral aspect of the implant can be more challenging with this technique. Nevertheless, this technique can be used for proximally coated cementless stems, loose cemented stems, or other situations that do not require distal stem exposure.

In conclusion, DA approach provides some potential advantages when compared to other approaches to the hip and can be considered a safe and efficient approach for THA revision. All standard techniques for implant removal and osteosynthesis can be performed safely through a DA approach. The techniques described here provide reliable access to the femur and femoral components, ultimately allowing for safe and efficient femoral implant retrieval and placement of revision femoral components.

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Declaration of competing interest

The Authors declare that there is no conflict of interest.

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