Trochanteric Osteotomy and Fixation During Total Hip Arthroplasty

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Abstract

Once used routinely, trochanteric osteotomy in total hip arthroplasty now is usually limited to difficult primary and revision cases. There are three types: the standard trochanteric osteotomy and its variations, the trochanteric slide, and the extended trochanteric osteotomy. Each has unique indications, fixation techniques, and complications. Primary total hip arthroplasty procedures requiring the enhanced exposure provided by trochanteric osteotomy may be needed in patients with hip ankylosis or fusion, protrusio acetabuli, proximal femoral deformities, developmental dysplasia, or abductor muscle laxity. Trochanteric osteotomies in revision arthroplasties, primarily the extended trochanteric osteotomy, facilitate the removal of well-fixed femoral components, provide direct access to the diaphysis for distal fixation, and enhance acetabular exposure.


The use of trochanteric osteotomy in total hip arthroplasty (THA) has declined since its initial advocacy by Sir John Charnley. Routinely done in primary THA in the early 1970s, its use essentially has been abandoned in North America because of added surgery time and complications (eg, nonunion, proximal trochanteric migration, symptomatic hardware, increased blood loss). Primary THA now is generally done via a posterior, anterolateral, or direct lateral approach without the use of a trochanteric osteotomy. However, trochanteric osteotomy, the most extensile of approaches, remains a valuable tool for difficult primary and revision THAs. A trochanteric osteotomy to facilitate dislocation and exposure may be required during primary THA in patients with ankylosis or fusion, protrusio acetabuli, proximal femoral deformities, severe developmental dysplasia, or abductor muscle laxity resulting in global instability. In revision procedures, trochanteric osteotomy can facilitate hip dislocation, femoral component extraction, acetabular exposure, and access to the proximal femur. The extended trochanteric osteotomy is useful in revision cases involving the removal of well-fixed femoral components, difficult acetabular exposure, and varus remodeling of the proximal femur.

The methods of trochanteric osteotomy can be categorized into three types: the standard single-plane trochanteric osteotomy and its modifications (eg, chevron, partial, horizontal, vertical), the trochanteric slide, and the extended trochanteric osteotomy (Fig. 1). Fixation options include a variety of wire constructs; cables, with or without claws; trochanteric bolts; and cable plates with a proximal claw. Each type of trochanteric osteotomy has relatively unique indications, contraindications, and complications. Individual variations of each technique and multiple fixation methods have been developed, providing options to enhance the effectiveness of trochanteric osteotomy during THA.

Standard Trochanteric Osteotomy

Indications

Indications for the standard trochanteric osteotomy are now rare. One indication may be in cases of lax abductor musculature after THA.
with resulting secondary global instability. Generally, however, this laxity can be avoided with appropriate preoperative planning and intraoperative measures directed toward reestablishing the anatomic hip center, leg length, and offset. Despite these measures, a lax abductor mechanism occasionally can be present, with resultant instability. If adjustments in modular implants, such as offset acetabular liners, offset femoral stems, and longer neck lengths, do not provide stability without excessive lengthening (>1.5 to 2.0 cm), a standard trochanteric osteotomy can be done with distal advancement. However, a trochanteric slide may be preferable.

A second indication for the standard trochanteric osteotomy is the need for extensile acetabular exposure in complex acetabular revision, such as implantation of an antiprotrusio cage with a large flange on the ilium. This approach, with superior retraction of the abductor muscles, provides unparalleled acetabular and pelvic exposure, allows avoidance of excessive torque on the proximal femur, and prevents excessive tension on the superior gluteal neurovascular bundle. However, in most cases, these revisions can be done with the standard posterior approach supplemented with the trochanteric slide or extended trochanteric osteotomy. (The trochanteric slide can be converted to a conventional osteotomy by releasing the vastus lateralis muscle origin for additional exposure.)

A standard trochanteric osteotomy also can be helpful in revision cases in which, because of acetabular component protrusio, hip dislocation is difficult. However, in such cases, a trochanteric slide also can facilitate dislocation.

A relative contraindication to the standard trochanteric osteotomy is its use with the direct lateral (Hardinge) approach because the abductor mechanism has, in part, been released from the greater trochanter before the osteotomy. This makes subsequent osteotomy and abductor muscle repair difficult. Therefore, if a trochanteric osteotomy is anticipated, a posterior approach is preferred.

**Figure 1** The paths of the standard trochanteric osteotomy (A), the trochanteric slide (B), and the extended trochanteric osteotomy (C). Note that the trochanteric slide and the extended trochanteric osteotomy incorporate the origin of the vastus lateralis muscle, but the standard osteotomy does not.

**Figure 2** The standard, single-plane trochanteric osteotomy.
rotatory forces in the anteroposterior plane that are provided by the abductors with the hip in flexion.5

Initially, a variety of monofilament wire constructs were used, as recommended by Charnley.1 Variations of wire constructs using two, three, or four wires have since been described.4,6,9 Nonunion rates with wire fixation range from 1% to 25%.5 The different types of wire fixation techniques and large number of patient variables in each series make it difficult to identify the superiority of one technique over another.

Jensen and Harris6 reported a 99% union rate using a three-wire technique (796/804 cases). This method has been modified to a four-wire technique involving two vertical wires and one or two transverse wires (16- or 18-gauge stainless steel)2 (Fig. 3). Each of the two vertical wires is placed through a separate drill hole in the lateral femoral cortex, exiting approximately 1 to 2 cm distal to the cut surface. The holes can be drilled farther distally if advancement of the trochanteric fragment is desired. After the prosthetic insertion, two additional transverse wires are placed around the proximal femur through drill holes in the lesser trochanter. Six holes are then drilled in the trochanteric fragment from the cut surface: two are placed proximally (for the anterior and posterior vertical wires) and four are placed just distal to the previously drilled holes (for the two transverse wires). The wires are then threaded and the osteotomy fragment is returned to its bed or advanced distally. The two vertical wires are tensioned first, followed by the transverse wires.2 Wire mesh can be used to capture small or osteoporotic trochanteric fragments, making fixation more reliable.

Although this technique provides secure fixation, it is technically difficult. Additionally, the presence of intramedullary wires can interfere with insertion of a cementless femoral component, resulting in malpositioning or wire breakage. This technique also is difficult to do after the femoral component has been implanted, as in the case of unexpected abductor muscle laxity and instability. Although there is little published information about bone grafting with trochanteric osteotomy,10 autologous bone grafting is generally used in cases of nonunion or a deficient trochanteric bed. The graft can be obtained locally with femoral reamings or from the iliac crest.

**Complications**

The most common complication is nonunion; other reported complications include trochanteric bursitis and heterotopic ossification (HO). The incidence of trochanteric nonunion with all types of fixation ranges from 0.5% to 38%.5 Nonunion of the trochanter can result in hip pain, abductor muscle insufficiency, and instability. However, these symptoms can be multifactorial, and the nonunion should be confirmed as the causative factor before initiating treatment. Symptomatic nonunion generally requires revision of internal fixation and autologous bone grafting. In some cases, it may be necessary to subperiostally elevate the abductors from the ilium to sufficiently mobilize the fragment.11 Asymptomatic trochanteric nonunion does not require intervention.

Lateral hip pain after trochanteric osteotomy often is attributed to prominent trochanteric hardware. However, pain relief after hardware removal is unpredictable, with fewer than half of patients achieving relief of symptoms.12 A trial injection of local anesthetic should be attempted before surgical intervention, and the patient should be thoroughly informed about the possibility that the procedure will not result in pain relief.

The relation between trochanteric osteotomy and HO is unclear. The transtrochanteric approach has been reported to increase the incidence and severity of clinically significant HO compared with a posterior approach without osteotomy.13 However, Morrey et al14 found no statistically significant difference in the development of HO when comparing the anterolateral, transtrochanteric, and posterior approaches. Because the evidence is inconclusive, selection of approach should not be affected by the issue of HO. The use of prophylaxis to prevent heterotopic bone in high-risk patients should be considered regardless of approach.

**Modifications of the Standard Trochanteric Osteotomy**

Modifications of the standard trochanteric osteotomy were developed to address the shortcomings of the standard, single-plane osteotomy by increasing stability, decreasing nonunion, and providing greater effectiveness in revision cases. These
variations include the chevron, partial, horizontal, and vertical osteotomies (Figs. 4-7). The chevron and partial osteotomies were created for use in primary arthroplasties, whereas the horizontal and vertical osteotomies were designed for revision procedures.2

The chevron, or biplane, osteotomy was developed to improve intrinsic stability of the osteotomy and reduce the incidence of trochanteric nonunion. The geometry of the cut provides inherent stability with resistance to rotation and anteroposterior displacement (Fig. 4). The chevron osteotomy can be done using either an osteotome or an oscillating saw to create a fragment with a concave, chevron-shaped medial surface. Alternatively, a Steinmann pin can be placed from the anticipated exit site distal-laterally to the proximal-medial aspect of the greater trochanter. A Gigli saw then can be passed superiorly around the greater trochanter proximal to the Steinmann pin. The saw can be used to cut distally and laterally, with the pin as the apex of the osteotomy, thereby creating a biplane osteotomy.7 Fixation options are the same as for the standard trochanteric osteotomy.

The partial, or oblique, osteotomy was devised to provide a more extensile approach to the hip when using the direct lateral approach, as well as to provide bone-to-bone healing for reattachment of the anterior abductors (Fig. 5). The advantage of this osteotomy is preservation of the continuity of the gluteus medius and vastus lateralis muscles.15 The posterior half of the trochanter and the attached posterior gluteus medius and short external rotators remain intact. In rare cases when the aponeurosis between the gluteus medius and the anterior vastus lateralis muscles over the trochanter is excessively thin, a small wafer of bone can be elevated with these attachments to improve closure. Closure is gener-

![Figure 4](image-url)  
**Figure 4** A, The two limbs of the osteotomy should be directed at the center to converge at a 120° to 130° angle. B, Trochanteric fragment with a concave, chevron-shaped medial surface. (Adapted with permission from McGann WA: Surgical approaches, in Callaghan JJ, Rosenberg AG, Rubash HE [eds]: *The Adult Hip*. Philadelphia, PA: Lippincott-Raven, 1998, p 697.)

![Figure 5](image-url)  
**Figure 5** A, The partial, or oblique, osteotomy (dashed line) is a modification of the direct lateral approach. B, A thin wafer of bone that contains both gluteus medius and vastus lateralis attachments is elevated with an osteotome or saw, allowing anterior retraction of this myofascial sleeve. (Adapted with permission from McGann WA: Surgical approaches, in Callaghan JJ, Rosenberg AG, Rubash HE [eds]: *The Adult Hip*. Philadelphia, PA: Lippincott-Raven, 1998, p 681.)
ally done with sutures through drill holes.

The horizontal trochanteric ostetotomy was developed to allow enhanced exposure in revision cases in which a standard trochanteric osteotomy would not preserve sufficient cancellous bed for reattachment of the trochanteric fragment because PMMA extends into the trochanter (Fig. 6). The approach and trochanteric preparation are similar to those of the standard osteotomy; however, the direction of the osteotomy is done at 70° to 90° to the femoral diaphysis as far proximal as possible on the trochanter so that the entire insertion of the gluteus medius and minimus remain on the osteotomized fragment.

**Trochanteric Slide Osteotomy**

Although English first described the trochanteric slide technique, Glassman et al championed it in its modern form for use in revision hip surgery. The advantages of this technique include the use of the intact vastus lateralis muscle origin to prevent proximal trochanteric migration. Even in cases of failed hardware and nonunion, the marked trochanteric migration seen with standard osteotomies is avoided by the tethering effect of the vastus lateralis muscle and its attachment to the distal portion of the fragment. In addition, compression is applied to the fragment because the gluteus medius and vastus lateralis muscles provide a medially directed force. It is unclear whether maintaining the vastus lateralis muscle origin improves blood supply to the fragment.

**Indications**

Indications for use of the trochanteric slide in primary THA are similar to those for the standard osteotomy. Revision indications include some isolated acetabular revisions, protrusio acetabuli, and cemented femoral revisions (eg, impaction grafting, cemented revision component) when maintaining the integrity of the diaphyseal tube is a necessity. Contraindications include the absence of medial bone for wire or cable placement and insufficient trochanter thickness, resulting in an inadequate bed for repair and healing.

**Technique**

Generally, a straight lateral incision is used because it provides optimal access to the anterior aspect of the trochanter. This can be especially important in the fused or ankylosed hip when external rotation is not available to provide access to the anterior trochanter. The posterior border of the gluteus medius muscle is identified just cephalad to the piriformis tendon. The interval between the gluteus minimus muscle and the capsule is developed bluntly in a posterior to anterior direction, and an instrument is inserted in this plane (Fig. 8). The vastus lateralis muscle is incised along its posterior aspect 10 cm distal to the vastus ridge, leaving a 1-cm cuff of fascia posteriorly. A Homan retractor is then placed.
from posterior to anterior around the femur under the vastus lateralis. The osteotomy is initiated posteriorly with an oscillating saw, with the leg in internal rotation. The caudal extent of the osteotomy is just distal to the vastus ridge, and the proximal extent is just medial to the piriformis fossa in the interval between the gluteus minimus and capsule. It is preferable to leave the gluteus minimus attached to the osteotomy fragment to maintain abductor strength after repair. The hip then can be dislocated either anteriorly or posteriorly.

**Fixation**

Repair of the osteotomy is generally done using either two monofilament wires (16- or 18-gauge) or two cables with or without a claw construct. Drill holes can be used in the trochanteric fragment, but they are not necessary. The wires or cables are passed medially around the proximal femur and around the trochanteric fragment, taking care to pass them deep to any muscle tissue. If, as in many femoral revisions, the osteotomy fragment is prevented from seating on a bed of host bone by a prominent femoral component shoulder, the fragment should be contoured using a high-speed burr to allow apposition. With the provisional fixation in place, the hip should be taken through a range of motion to identify any impingement caused by malpositioning of the trochanter. The wires or cables are then tightened.

When fixation is difficult, such as with a thin trochanteric fragment, a cable grip system can be used. Many fixation techniques have been developed using cables, claws, or cable plates. Dall and Miles²⁰ designed a multifilament cable system with a trochanteric grip for fixation. The cable grip system provided greater resistance to displacement than did an isolated cable construct or 16-gauge wires.⁸ As with wire techniques, however, clinical results are variable, with cable fraying or breakage in up to 47% and nonunion rates ranging from 1.5% to 38%,²¹,²² Cable fragmentation can be a source of metallic debris that may cause third-body wear,²² so some surgeons have returned to wire fixation. If a cable grip system is used, the cables should be separated by 2 to 3 cm at the medial aspect of the femur with the distal cable placed distal to the lesser trochanter to avoid proximal medial migration of the trochanter. Autologous bone graft can be used to treat nonunion or when a deficient trochanteric bed exists.

**Complications**

Limited data are available on the effectiveness of the trochanteric slide osteotomy. English¹⁷ reported on 222 done for primary THAs; 120 were fixed with wires and 102 with a bolt and bone graft, with nonunion rates of 4.3% and 2.5%, respectively. Glassman et al¹⁸ reported a 10% nonunion rate of trochanteric slide osteotomies in the revision setting (9/90 cases) at a mean follow-up of 21 months. In seven of the patients with nonunion, the trochanteric fragment migrated proximally 2 to 26 mm (mean, 7.1 mm). Only one patient with a nonunion demonstrated clinically evident abductor muscle insufficiency. Of the remaining 82 patients, 23 (28%) had a Trendelenburg sign or abductor lurch.

Although many confounding factors make direct comparison difficult, the trochanteric slide seems to improve resistance to proximal

![Figure 8](image-url)

**Figure 8** The trochanteric slide osteotomy. A, Proximally, the interval is between the capsule and the gluteus minimus. Distally, the vastus lateralis origin is left intact by making the exit cut distal to the vastus tubercle. B, Once the osteotomy is complete, the trochanteric fragment and its attached proximal and distal musculature are retracted anteriorly.
migration and has a higher reported rate of union than does the standard trochanteric osteotomy. For these reasons, the trochanteric slide is generally preferred in primary and revision cases requiring a limited osteotomy.

**Extended Trochanteric Osteotomy**

The extended trochanteric osteotomy is useful for revision THA because it facilitates both femoral component extraction and reimplantation and enhances acetabular exposure. This osteotomy also is occasionally useful for primary THA in a patient with proximal femoral deformity or intrasosseous hardware that extends into the diaphyseal region. However, the extended trochanteric osteotomy limits femoral component options to those that rely on diaphyseal fixation.

A technique attributed to Wagner (an extended anterior trochanteric osteotomy in which the anterior half of the abductors was reflected in continuity with the anterior third of the proximal femur) was modified by Younger et al into an extended lateral trochanteric osteotomy in which all of the abductors are reflected with the lateral third of the proximal femur. In 1991, Cameron reported the use of this osteotomy in revision THA in two patients. Peters et al used a modified form of the osteotomy in 21 patients; all united by 6 months. Younger et al reported a 100% union rate by 3 months, with proximal migration >2 mm in 20 extended trochanteric osteotomies done for femoral revision (mean follow-up, 18 months). There were no fractures of the trochanteric fragment. Chen et al reported on 46 extended trochanteric osteotomies with a 98% union rate and two fractures of the trochanteric fragment, neither of which required revision surgery.

**Indications**

Indications for the extended trochanteric osteotomy include femoral revision of well-fixed cemented or cementless components, femoral revision with difficult cement removal, varus remodeling of the proximal femur, and the need for enhanced acetabular exposure. The osteotomy also greatly facilitates removal of cement through direct visualization in routine revisions. Removal of well-fixed proximally coated femoral components is aided by the use of flexible osteotomes or a Gigli saw passed medially around the prosthesis if the geometry permits. A well-fixed, extensively coated prosthesis can be extracted by sectioning the prosthesis at the junction of the tapered and cylindrical portions and using trephines distally. Acetabular exposure also can be greatly enhanced by retracting the osteotomy fragment anteriorly and the proximal femur posteriorly. Varus remodeling (ie, apex lateral bowing) of the proximal femur secondary to the presence of a failed femoral component makes eccentric reaming and cortical perforation difficult to avoid in the absence of an osteotomy because the reamers can pass through the lateral cortex at the apex of this deformity. With the aid of the extended trochanteric osteotomy, direct access to the diaphysis is provided, which allows straight reaming of the diaphysis for revision stem insertion. The extended trochanteric osteotomy requires use of a femoral component designed to obtain fixation in the femur distal to the osteotomy.

Relative contraindications include impaction grafting or femoral revisions in which the prosthesis will be fixed with cement. Although some preliminary biomechanical data imply that impaction grafting may be a sound construct after this osteotomy, the limited clinical data indicate a higher nonunion rate in these patients. Although it is possible to place a cemented revision stem after this osteotomy, cement extrusion into the osteotomy site is difficult to avoid and can prevent union.

**Technique**

The length of the osteotomy is planned preoperatively as that which will provide adequate component exposure and maintain at least 5 cm of isthmic diaphyseal cortex for revision component fixation. Generally, the osteotomy should be at least 10 cm long, measured from the tip of the greater trochanter, to allow secure fixation of the fragment to the medial femoral cortex. Femoral component revision osteotomies are typically 12 to 15 cm long.

The extended trochanteric osteotomy is usually done through a posterolateral approach. It may be done at any time during the procedure—before or after dislocation or after stem removal. The easiest time is after the stem has been removed; however, this is often not possible, so the osteotomy is usually done after dislocation but before stem removal. When dislocation is difficult, the extended trochanteric osteotomy provides excellent exposure and can be helpful in managing dislocation in the stiff hip.

The osteotomy is initiated along the posterior aspect of the anterior proximal femur (Fig. 9). The posterior extension of the linea aspera is exposed by partial elevation of the vastus lateralis muscle and release of the gluteus maximus insertion subperiosteally. An oscillating saw or high-speed pencil-tip Burr can be used. Although a thin saw removes less bone, the high-speed cutting instrument allows the surgeon to make rounded distal corners, thus reducing the stress risers of sharp corners. The initial cut is made from the posterior aspect of the greater trochanter and continues distally along the posterior femur to the preoperatively determined distance (ie, 10 to 15 cm) from the tip of the...
greater trochanter. The transverse portion is then cut to include approximately one third of the femoral diaphyseal circumference with minimal elevation of the vastus lateralis muscle. The distal anterior portion of the osteotomy is initiated 1 to 2 cm proximal to the transverse osteotomy. The proximal extent of the anterior limb is then cut by passing the saw, burr, or osteotome from posterior to anterior between the prosthetic neck and the medial trochanter and cutting the proximal 1 to 2 cm. A 0.25-in straight osteotome is used to score the anticipated anterior extension of the osteotomy from distal to proximal, deep to the vastus lateralis. Alternatively, drill holes can be made through the muscle anteriorly. With a series of broad, curved osteotomes inserted in the posterior limb of the osteotomy, the fragment is carefully elevated, exposing the underlying femoral component or cement mantle.

It is important to release the anterior proximal soft tissue and remaining capsule from the osteotomy fragment. This release prevents anterior tethering of the proximal fragment that can lead to fracture and allows the fragment to be posteriorly positioned during reattachment. The proximal femoral shaft can be retracted in an anterior, posterior, or distal direction for acetabular exposure. To minimize the risk of fracture with cemented femoral component extraction, the cement adherent to the trochanteric fragment is left in place until just before repair of the osteotomy.

Although a posterior approach is preferred when an extended trochanteric osteotomy is anticipated, the extended osteotomy can be done after a direct lateral or anterolateral approach. In addition, if the anterior bow of the femur prohibits insertion of a straight femoral component, an anterior extended trochanteric osteotomy that includes osteotomy of the anterior third of the femur in continuity with the anterior abductors can be used.

After addressing the acetabulum, the new stem is inserted before the osteotomy is reduced. Generally, a cementless revision stem (nonmodular or modular) with at least 4 cm of distal fixation is used. Hip stability is assessed with the osteotomy still open. After stability is ensured and the acetabular and femoral components are in place, including the liner and femoral head, the extended trochanteric osteotomy is reattached. At the time of osteot-
omy repair, the medial surface of the trochanteric fragment often requires sculpting with a high-speed burr to accommodate the lateral profile of the revision femoral component.

**Fixation**

Fixation of the extended trochanteric osteotomy can be less troublesome than that of the standard trochanteric osteotomy or the trochanteric slide. The osteotomy fragment is reapproximated back into its bed in the lateral femur. A common error is to reapproximate the fragment too anteriorly, which can result in anterior impingement and thus posterior hip dislocation. Relative reapproximation of the osteotomy fragment can be aided by abducting the leg and internally rotating the femur during osteotomy repair. The posterior limb of the osteotomy should be reapproximated, leaving any longitudinal gap anteriorly. Occasionally, because of varus remodeling of the proximal femur, the medial aspect of the proximal femur will not be adjacent to the femoral prosthesis. In such instances, the transverse portion of the osteotomy can be completed circumferentially, making the medial aspect a third free piece. The free medial fragment and the trochanteric fragment then can be reduced to the prosthesis. However, this can make appropriate positioning of the trochanteric fragment more difficult because the rotational reference of the medial piece is no longer fixed.

Once reduced, two to four wires or cables are passed around the diaphysis and trochanteric fragment (Fig. 10). Both cables and wires have been used successfully. Although controversy exists about which is better, cable offers improved tensile strength and resistance to fatigue. It is critically important to pass the wires or cables in a submuscular fashion so as not to injure the vascular supply to the osteotomy site or inadvertently entrap neurovascular structures. The cables are generally passed in a posterior to anterior direction to avoid inadvertently incarcerating the sciatic nerve. The proximal cable or wire is placed on the calcari just proximal to the lesser trochanter if bone is available to support the cable medially. This cable should not rest on the prosthesis; therefore, if calcari bone is absent, only two cables may be used, or an allograft can be applied medially. The second cable is placed just distal to the lesser trochanter, and one additional cable is placed 2 to 3 cm proximal to the transverse portion of the osteotomy. Additional cables can be used depending on the length of the osteotomy. The distal cable is generally secured tightly, the middle one not quite as tightly, and the proximal cable even more loosely. This sequence of graduated tightening is done to avoid fracture of the osteotomy at its most tenuous portion, just distal to the vastus tubercle. Once fixation is secured, range of motion is tested again to ensure stability without impingement.

A single supplemental allograft strut can be used to span the distal extent of the osteotomy with an attenuated or fractured osteotomy fragment. However, with the high osteotomy union rate reported without allografts (98% to 100%), allografts typically are not used. Chen et al\textsuperscript{26} found the time to bridging callus to be prolonged in cases in which strut allografts were used to supplement repair of the osteotomy. In addition, autologous bone or allograft is not typically needed to graft osteolytic lesions or gaps between the proximal femur and the prosthesis because these areas remodel with time.

Release of the contracted anterior capsule or scar tissue is done if these tissues impair reattachment or if external rotation is markedly limited. The release is done by developing the plane between the capsule and the more superficial gluteus medius and minimus muscles, starting at the anterior border of the gluteus medius. A capsular scissors then can be passed in an anterior-to-posterior direction, with care taken

![Figure 10](image-url)

**Figure 10** A, Preoperative posteroanterior radiograph of a loose total hip arthroplasty. B, Eight weeks after revision, with evidence of healing of the extended trochanteric osteotomy. C, Two years after revision, with remodeling of the osteotomy site.
to avoid injury to the overlying musculature. Alternatively, this release can be done from within the hip joint, releasing the anterior tethering structures with electrocautery.

Postoperatively, the patient is treated with touch-down weight bearing and no active abduction for 6 weeks. Abduction orthoses are not routinely used except in patients at high risk for dislocation. After 6 weeks, the patient progresses to weight bearing as tolerated, and active abduction and progressive ambulation are initiated.

Complications
Little has been reported about the complications of the extended trochanteric osteotomy. However, nonunion and proximal migration, the major complications of standard and sliding osteotomies, are largely avoided with the extended osteotomy. Four published series report union rates of 98% to 100%.23-26 Two nonunions have been reported with the use of this osteotomy in conjunction with impaction grafting.28

Intraoperative and postoperative fractures of the osteotomy fragment can occur. The base of the greater trochanter distal to the vastus tubercle is the area most susceptible to fracture. This is also the location that is often attenuated by the lateral profile of the previously failed femoral component. Intraoperative measures to avoid fracture include release of the anterior capsular and scar tissues from the proximal trochanteric fragment to increase its mobility, gentle exposure of the acetabulum with broad retractors, and delayed removal of retained cement on the trochanteric fragment. If an intraoperative fracture of the osteotomy fragment occurs, fixation with a trochanteric claw or plate is recommended. In cases of marked attenuation of the cortex in this region, prophylactic fixation with a claw or plate construct may be warranted.

Another potential complication of the extended trochanteric osteotomy is vascular injury with the use of proximal cerclage cables or wires. Attention to detail is critical in the placement of these fixation devices.

Summary
The use of trochanteric osteotomies dates to the inception of the THA procedure. Initially implemented as a routine part of the exposure, trochanteric osteotomies are now selectively used for difficult primary and revision THAs. Trochanteric osteotomies can be classified into three categories: the standard trochanteric osteotomy and its variations, the trochanteric slide, and the extended trochanteric osteotomy. The standard, single-plane osteotomy and its variations are rarely done in North America but can be used in cases that require trochanteric advancement to improve stability or in those that require extensive exposure of the acetabulum. The trochanteric slide, which preserves the vastus lateralis muscle origin, has largely taken the place of the standard osteotomy in difficult primary THAs that require enhanced exposure. The extended trochanteric osteotomy is valuable in some primary THAs and many revision THAs because it facilitates removal of well-fixed cemented or cementless femoral components, provides direct access to the diaphysis for central reaming, enhances acetabular exposure, and has a low rate of nonunion and complications.

References


