# Surgical Approaches in Revision Hip Replacement

*Eric L. Masterson, BSc, MCh, FRCS, Bassam A. Masri, MD, FRCSC, and Clive P. Duncan, MB, MSc, FRCSC*

## Abstract

*Revision hip arthroplasty will be performed with frequency in the future. A successful outcome depends on careful preoperative planning, and a key component of that plan is the surgical approach. The choice of the approach should be based on the indication for revision, the particular implant to be removed, the presence of acetabular or femoral bone loss, previous surgical approaches used, and the preferences and training of the surgeon. For simple revision procedures, one of the standard approaches used in primary hip arthroplasty may be adequate. More complex cases may necessitate an extended exposure or one of the techniques developed specifically for revision arthroplasty. No single approach is suitable for all revision procedures, and the surgeon must be familiar with a range of exposures if the clinical result is to be optimized.*

**J Am Acad Orthop Surg 1998;6:84-92**

Approximately 200,000 primary total hip replacements are currently being performed annually in the United States. Given a greater willingness to offer the procedure to younger patients, a population that is living longer, and the fact that implants have only a finite useful life span, there is little doubt that the number of patients coming to revision surgery will continue to increase.

Revision hip arthroplasty requires careful preoperative planning, and the choice of surgical approach is one of the most important components of this plan. An ideal approach should achieve a number of key objectives. First, it should provide satisfactory exposure of both the components to be removed, as well as any bone defects that may be present and any neurovascular structures that need to be identified and protected. Second, it should not result in uncontrolled bone or soft-tissue damage during removal of the implant. It is always preferable to perform planned, adequate incisions or osteotomies that can be adequately repaired. Third, the approach should minimize any additional soft-tissue scarring by using as much of the previous healed incisions as possible without compromising surgical exposure. Finally, the exposure should avoid unnecessary devascularization of bone. This is particularly important in revisions performed because of sepsis, as a fragment of dead bone will act as an ongoing nidus for infection.

This article is divided into three sections. The first section discusses the principal factors that will influence which surgical approach is used. The second section reviews the most commonly used approaches to the hip joint and outlines the main advantages and disadvantages of each in a revision procedure. The final section describes in detail some of the more important techniques that have been specifically developed for revision arthroplasty.

## Factors Influencing Choice of Surgical Approach

Before embarking on a revision hip arthroplasty, the surgeon should assess the case to determine whether it can be adequately managed by one of the standard approaches used in primary hip arthroplasty. If not, consideration should be given to an extended exposure. In addition, the necessity to proceed to one of the

*Dr. Masterson is a Fellow in Adult Reconstruction, Department of Orthopaedics, Vancouver Hospital and Health Sciences Centre, Vancouver, British Columbia. Dr. Masri is Clinical Assistant Professor, Department of Orthopaedics, Vancouver Hospital and Health Sciences Centre, Vancouver. Dr. Duncan is Professor and Head, Department of Orthopaedics, Vancouver Hospital and Health Sciences Centre.*

*Reprint requests: Dr. Duncan, Department of Orthopaedics, Vancouver Hospital and Health Sciences Centre, Room 3114-910, West 10th Avenue, Vancouver, BC, Canada V5Z 4E3.*

dedicated revision approaches should be recognized. Among the factors that should be considered in determining the appropriate surgical approach are the indication for the revision procedure, the type of implant used, the presence of acetabular or femoral bone loss, the influence of previous surgical incisions, and the training and preferences of the operating surgeon.

### Indications for Revision Procedure

Common indications for revision arthroplasty include aseptic loosening of one or both components, periprosthetic infection, recurrent dislocation, thigh pain, and extensive osteolysis. All but the first indication may occur in the presence of solidly fixed implants.

The hip that becomes acutely infected in the postoperative period will be most appropriately reexposed through the prior surgical incision. In the case of a chronically infected prosthesis, the surgical approach will be dictated more by the need to remove all the foreign material and dead tissue while avoiding devascularization of any bone fragments. This may necessitate special exposures to remove foreign material in inaccessible locations, such as the pelvis or femoral shaft, which will be discussed later.

When planning revision for recurrent dislocation, one needs to consider the soft-tissue tethers that lend stability to the joint. The direction of instability should be determined from the history and from examination during closed reduction of the components. This will help to determine whether preservation of the anterior or the posterior soft-tissue envelope is more important during exposure.

The extent of any surgical exposure for removal of implants causing thigh pain or associated with osteolysis will depend on whether the components are cemented and whether they are solidly fixed.

### Type of Implant

The particular design of the acetabular component will not usually influence the surgical approach, as good circumferential visualization is required for the removal of both cemented and noncemented designs. More extensive exposure of the outer table of the ilium is required if a reconstruction cage with a prominent flange is to be removed or inserted or if allograft reconstruction of a superolateral or posterior column deficiency is necessary.

When revising a loose cemented femoral component, attention should be paid to the presence of solidly bonded cement in the femoral canal after the prosthesis has been successfully extracted from above. A long column of cement may remain distal to the position of the original component, especially if an intramedullary cement restricter was not used at the index procedure. The need to remove this cement should be determined in the preoperative planning on the basis of the presence or absence of infection and the type of revision prosthesis to be used. If removal of solidly fixed distal cement is considered necessary, serious consideration should be given to an additional procedure to improve visualization of the distal cement, as the risk of damage to the femur is considerable when an attempt is made to remove solid distal cement from above. (These procedures will be discussed in more detail in the section "Special Exposures in Revision Hip Arthroplasty.")

Removal of osseointegrated cementless stems requires a familiarity with the particular stem design. The surgeon should be aware of the extent and location of porous coating or fiber-metal pads, the modularity of the prosthesis, the presence or absence of a collar, and the level at which the metaphyseal flare of the prosthesis joins the more tubular distal part. Some stems are best extracted with the aid of metal-cutting equipment to remove a prominent collar or to divide the component at the base of the metaphyseal flare via a small cortical window.[1]

When removing solid cementless stems, an extended trochanteric osteotomy down to the distal extent of the porous coating is recommended, as this reduces the extent of damage to the femoral bone stock. Even when the stem does not appear solidly osseointegrated on preoperative radiographs, the extended trochanteric osteotomy can be very useful, as the component is often retained by tenacious fibrous ingrowth. The technical aspects of cementless stem removal are beyond the scope of this article, but have been nicely summarized elsewhere.[2]

Another stem-design factor can cause particular difficulty during revision unless it is recognized preoperatively. Cemented stems that have been precoated with methylmethacrylate are designed to achieve a very rigid bond with the cement mantle. When solidly fixed, these stems are usually impossible to knock out from above, as they will not debond from the cement. Removal of a solidly fixed precoated stem usually requires extensive visualization of the cement mantle, which is most conveniently achieved with an extended trochanteric osteotomy.

### Influence of Acetabular or Femoral Bone Loss

Failed hip replacements may be associated with considerable loss of bone stock as a result of osteolysis, component migration, previous surgery, or the effects of stress shielding of the femur by the implant. The surgical exposure must be adequate to allow these areas of bone deficiency to be dealt with successfully.

Acetabular bone loss is conveniently categorized into segmental, cavitary, and combined defects.[3,4] Severe combined defects may be associated with a dissociation between the proximal and distal halves of the hemipelvis. Of the commonly used surgical approaches, the widest exposure of the acetabulum is provided by a classic trochanteric osteotomy with proximal retraction of the trochanteric fragment and the attached abductor muscles. This is particularly appropriate when the femur has been medialized as a result of migration of the acetabular component into the pelvis. Particular attention should be paid to the sciatic nerve in these instances, as the medial migration of the femur can render it very superficial. Trochanteric osteotomy provides the widest exposure of the superolateral rim of the acetabulum when this is required for the purpose of placing a reconstruction cage or a bulk allograft. Similar exposure can be achieved with use of the trochanteric slide.[5]

In general, anterolateral approaches to the hip should be reserved for simple revisions. These approaches are nonextensile, as they cannot be converted to a trochanteric osteotomy without compromising the blood supply of the trochanteric fragment. If a trochanteric osteotomy is likely to be necessary, it should be performed before the anterior one to two thirds of the abductors have been unnecessarily detached. The posterior approach is certainly more versatile, as it allows ready extension of the exposure to a classic trochanteric osteotomy or a trochanteric slide if one is struggling to achieve adequate visualization of the acetabulum.

The femur may also be affected by a range of bone defects, including ectasia, stenosis, malalignment from previous fracture or osteotomy, and segmental, cavitary, and combined deficiencies.[6] In general, there should be a low threshold for comprehensive exposure of the femur in revision hip replacement. In a matter of a few minutes, the femur can be viewed directly by anterior mobilization of the vastus lateralis, and unwanted damage can be avoided.

### Influence of Previous Surgical Incisions

Prior incisions should be used when possible to avoid undesirable and unnecessary railroad-track incisions, with the attendant risks of wound-edge necrosis. This is not always possible, as there is a tendency for laterally placed hip incisions to migrate with time. Nonetheless, considerable skin laxity is often present, which allows a less than ideally placed healed incision to be used provided care is taken to make the correct fascial incision.

The deep dissection is also sometimes best performed along the route of the previous exposure. A nonunited greater trochanter may provide an obvious route to the hip joint. Similarly, a poorly healed anterolateral approach may be most appropriately reused, rather than dissecting the remaining normal tissues.

### Surgical Training and Preferences

Every surgeon who performs primary hip arthroplasties will extol the virtues of his or her particular routine surgical approach. Usually, this approach will be the one to which the surgeon was most widely exposed during residency or fellowship training. It will also often be the approach that he or she is most likely to use in a revision procedure. However, it is important to stress that no one surgical approach is the most appropriate for all revision hip arthroplasties. The revision arthroplasty surgeon should be conversant with the full gamut of surgical approaches to the hip joint so that the most appropriate one can be used.

## Common Surgical Approaches to The Hip

Classification of the various surgical approaches to the hip joint is difficult and can be confusing. There is little argument that the Langenbeck and Moore approaches can be safely considered as posterior approaches because they use posterior skin incisions, remain posterior to the gluteus medius, and dislocate the hip posteriorly. Similarly, the Smith-Petersen and Watson-Jones approaches are certainly anterior, as the skin incisions, relationship to the hip abductors, and capsular incisions are predominantly anterior. However, there are a number of surgical approaches to the hip that defy convenient categorization because it is not clear whether one is referring to the skin incision, the relationship to the hip abductors, or the direction of dislocation of the hip joint. For the sake of simplicity, the approaches will be described as “anterior” when they remain in front of the abductor muscles, “transgluteal” when the approach involves detaching some or all of the abductors from the greater trochanter, “transtrochanteric” when the trochanter is osteotomized, and “posterior” when access is obtained by remaining posterior to the abductors.

**Anterior Approaches**

The Smith-Petersen approach to the hip develops the plane between the tensor fascia lata (superior gluteal nerve) and the sartorius (femoral nerve). It was popularized during the era of mold arthroplasty and is now most commonly used in surgery for congenital hip dislocation or acetabular dysplasia. It provides excellent exposure of the anterior column and the medial wall of the acetabulum and is sometimes used for exposure of acetabular fractures, either by itself or combined with a posterior approach. It may occasionally be useful as an adjunct to another approach to facilitate reconstruction of the anterior column or to access infected cement. It provides unsatisfactory access to the posterior column of the acetabulum and to the femoral medullary canal and is unsuitable as an approach for primary or revision total hip arthroplasty, except as an occasional adjunct to another approach. Particular anatomic structures at risk with this approach include the lateral femoral cutaneous nerve and the ascending branch of the lateral circumflex femoral artery.

The Watson-Jones approach uses the plane between the tensor fascia lata and the gluteus medius to access the anterior hip capsule. This approach was originally described for the treatment of femoral neck fractures but was later adopted for total hip arthroplasty. The approach provides rapid exposure of the joint in primary hip arthroplasty but has some disadvantages in revision surgery. Proximal dissection is limited by the risk of damaging the innervation of the tensor fascia lata, which restricts acetabular exposure. The proximal femoral shaft can be accessed only by extensive muscle stripping and devascularization, which limits its usefulness in infected revisions. Adequate access to the femoral medullary canal may result in damage to the substance of the gluteus medius unless care is taken to divide (and subsequently repair) the anterior fibers of the gluteus medius tendon. Furthermore, this approach provides poor access to the posterior column of the acetabulum and is not recommended if access to this area is required. For these reasons, this approach should be reserved for simple revisions; if more complex reconstruction is necessary, consideration should be given to an alternative approach.

**Transgluteal Approaches**

There are a number of soft-tissue approaches to the hip in which portions of the gluteus medius are detached from the greater trochanter in functional continuity with the vastus lateralis. McFarland and Osborne[7] were the first to describe such an approach. They detached the gluteus medius in its entirety but maintained the periosteal tissue overlying the greater trochanter in continuity with the vastus lateralis, thus providing the potential for better postoperative abductor function. The approach was later modified by Hardinge,[8] who stressed the advantages of preserving the attachment of the thick posterior part of the gluteus medius tendon to the greater trochanter and therefore detached only the anterior half of the tendon.

Various modifications of this basic approach have been reported more recently.[9-13] These approaches all provide more or less similar exposure of the hip joint. They avoid both the problems of trochanteric reattachment associated with the transtrochanteric approach and the higher dislocation rates associated with a posterior approach to the hip and are therefore popular for primary hip arthroplasty. In the context of revision hip surgery, they provide adequate exposure to the joint provided there is a reasonable soft-tissue interval between the femur and the pelvis. Where protrusio acetabuli exists, an osteotomy of the greater trochanter or a posterior approach may be more appropriate.

Potential drawbacks of the Hardinge approach in revision surgery include difficulty in achieving wide exposure of the posterior column (unless a supplementary subfascial plane passing behind the femur and posterior border of the gluteus medius and minimus is developed), inability to adjust abductor muscle tension, difficulty with advancement and secure attachment of the abductors if lengthening of more than 1 cm is accomplished, increased incidence of prolonged abductor weakness, the potential for damage to the superior gluteal neurovascular bundle, and a reported higher incidence of heterotopic bone formation.[14] Because of the inability to adjust the abductor muscle tension, this approach is unsuitable when the need for more than 1 cm of lengthening is anticipated. The risk of prolonged abductor weakness is related partly to damage to the inferior branches of the superior gluteal nerve[15] and partly to avulsion of the tendon repair.[16] The superior gluteal nerve passes approximately 4 cm above the tip of the greater trochanter. Every effort should be made to avoid splitting the gluteus medius muscle fibers above this point.

**Transtrochanteric Approaches**

The transtrochanteric approach as a means of providing access to the hip for primary total hip arthroplasty was popularized by Charnley. Although still popular, it is probably being used less today because of concerns about reattachment of the trochanteric fragment. These concerns are particularly valid in the revision setting, when the trochanteric bed is commonly deficient or absent. However, this approach affords excellent circumferential exposure to the acetabulum and unimpaired access to the proximal femoral medullary canal. The improved exposure thus provided is deemed by many to justify the difficulties of trochanteric reattachment.[17,18] These difficulties can be reduced by careful reattachment techniques, and very low rates of trochanteric nonunion can be achieved.[19] Techniques for trochanteric reattachment have been clearly described by McGrory et al.[20]

Trochanteric osteotomy should be regarded as the surgical approach of choice when substantial lengthening or shortening of the limb is required, as the approach permits appropriate adjustment of abductor muscle tension by altering the position of reattachment of the trochanteric fragment.

A technique of trochanteric osteotomy in which the risk of proximal displacement of the trochanter is minimized was originally described by Mercati et al and has more recently been popularized by Glassman et al.[5] The approach, which is known as the trochanteric slide, involves a trochanteric osteotomy that is performed from behind. The gluteus medius and vastus lateralis remain attached to the trochanteric fragment, thus effectively creating a digastric muscle. The opposing pull of the two muscles helps to prevent postoperative avulsion of the greater trochanter. This approach affords excellent exposure of the acetabulum and can be continued distally to provide exposure of the entire femoral shaft if necessary. In the revision setting, the lower risk of trochanteric avulsion from an often poor trochanteric bed is particularly attractive.

#### Posterior Approaches

The posterior approach to the hip as described by Langenbeck and popularized by Moore[21] and by Marcy and Fletcher[22] is also commonly used in primary total hip arthroplasty. Detachment of the abductors from the greater trochanter as part of the approach was advocated by Kocher and by Gibson but is not widely practiced. Advocates of the posterior approach point to the minimal disturbance of the abductor mechanism, the ease of exposure, and the lower rates of heterotopic ossification compared with the Hardinge approach or one of its modifications. The main disadvantage is a higher rate of postoperative dislocation. This is due partly to the loss of the posterior joint capsule and short external rotators and partly to a tendency to place the acetabular component in insufficient anteversion because of insufficient anterior retraction of the femur.

In the revision setting, this approach allows good circumferential exposure of the acetabulum and excellent visualization of the sciatic nerve. The posterior column is particularly well visualized should plating or grafting of a pelvic discontinuity be required. A further advantage is the ease with which it can be extended distally by using the trochanteric slide or extended trochanteric osteotomy techniques or simply a soft-tissue approach to the femoral shaft, as advocated by Henry.

## Special Exposures in Revision Hip Arthroplasty

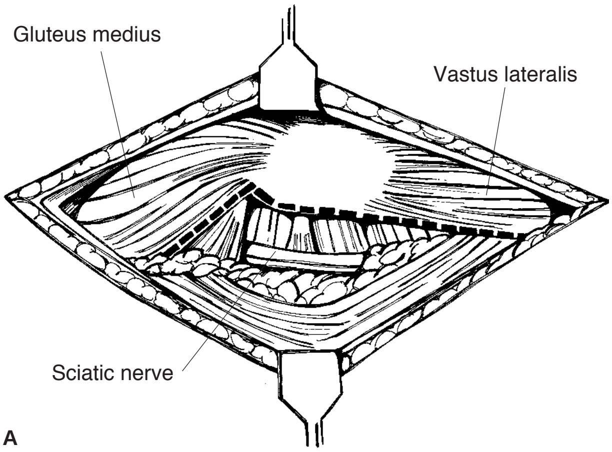
#### Osteotomies to Access the Femoral Shaft

Attempts to remove a solidly bioingrown stem, extensive cement, or a broken stem from the proximal end of the femur can result in serious damage to the remaining bone stock and can jeopardize the revision procedure. There are several techniques that permit adequate controlled access to the femoral medullary canal while allowing stable repair.

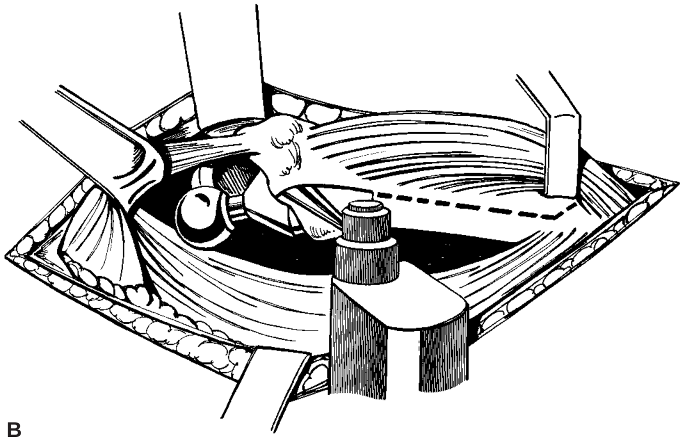
The extended trochanteric osteotomy described by Younger et al[23] is an extremely useful technique in revision of both cemented and noncemented stems. A posterior approach to the hip is extended distally over the posterior aspect of the greater trochanter and along the posterior fascia overlying the vastus lateralis (Fig. 1, A). The vastus lateralis is reflected forward from the intermuscular septum, and perforating vessels are ligated or cauterized. The posterolateral femoral shaft is thus exposed, permitting a long oblique osteotomy that is performed with an oscillating saw blade or with multiple holes (Fig. 1, B). The saw blade should pass through both cortices, and the distal end of the osteotomy should be rounded. This results in detachment of the proximal lateral femur in continuity with the greater trochanter.

The osteotomy is easier to perform if the prosthesis can first be removed from above. If this is not possible and the shoulder of the prosthesis prevents access to the anterior cortex, an osteotome can be introduced through the muscle anteriorly. The length of the osteotomy should be determined during preoperative planning to ensure that the full extent of the porous coating of the component or the retained cement can be readily accessed (Fig. 1, C). Care should be taken not to strip the long trochanteric fragment of its muscle attachments, thereby depriving it of a blood supply.

An additional indication for this approach is the noncemented revision in a femur with varus bowing. The osteotomy is performed as far




A



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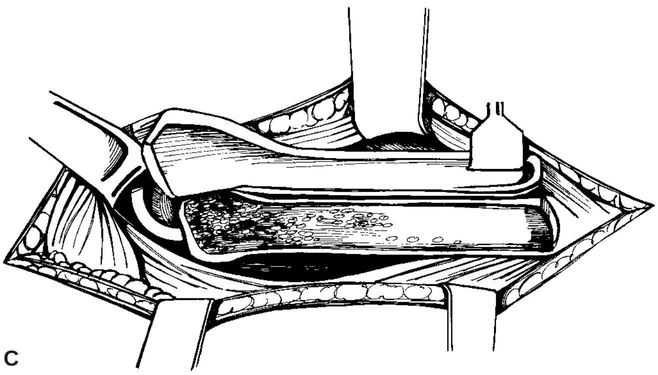

C

**Fig. 1** The extended trochanteric osteotomy. **A,** Initial exposure is provided by identifying the posterior border of the gluteus medius proximally and the posterior border of the vastus muscles distally. **B,** Detachment of the posterior capsule, external rotators, and gluteus maximus, coupled with posterior dislocation and removal of the stem, will facilitate the osteotomy. Retention of the stem will be necessary in some cases (as illustrated in this diagram). With use of an oscillating saw or high-speed burr, the proximal lateral femur is detached as far distally as necessary, as determined during preoperative planning. **C,** The proximal lateral fragment is hinged forward, with the gluteus and vastus muscles attached, to expose the femoral medullary canal, after which the stem and cement are removed.

as the apex of the deformity, thus permitting the use of any regular diaphyseal locking implant. The osteotomy fragment is then reduced, and any gaping that occurs as a result of the correction is accepted. Alternatively, the medial cortex can be drawn laterally to the proximal stem after its junction with the femoral shaft has been weakened with a few drill holes.

When the proximal femur is so badly damaged that it cannot be salvaged, revision must include replacement of the proximal femur with a prosthesis, an allograft, or a combination of both. In these situations, the level of division of the proximal femoral remnant should be determined, and the transverse osteotomy should then be carried out. The proximal remnant is split longitudinally and opened while retaining its blood supply via soft-tissue attachments. This remnant is used to embrace the proximal femoral replacement and the junction between allograft and host bone. This technique provides the best means of attaching the greater trochanteric remnant and the abductors to the prosthesis or allograft when the proximal femur is severely deficient.

Occasionally, it may be appropriate to intentionally transect the femoral shaft during a revision procedure.[24] This technique is well suited to revision procedures in which the proximal femur is malaligned as a result of a periprosthetic fracture or remodeling around a loose prosthesis. It permits easy access to the medullary canal for removal of cement and realignment of the femoral shaft. Fixation is easier to achieve with a noncemented revision stem, as the osteotomy makes it difficult to achieve a good cement technique. If the osteotomy is performed obliquely or with step cutting, supplementary fixation can be achieved with the use of supplementary cerclage wires or cables.

### Femoral Cortical Windows and Controlled Perforations

Bone cement in the proximal metaphysis is usually easily removed from above under direct vision. Farther distally, direct visualization of the bone-cement interface becomes progressively more difficult, and the risk of cortical perforation with manual or power instruments increases. In these situations, it is preferable to perform a controlled perforation of the proximal shaft to permit direct visualization of the position of instruments within the canal, allow light into the medullary canal, and enable debris to be more effectively irrigated. Sydney and Mallory[25] reported a series of revision procedures in which one or more 9-mm drill holes were made in the anterior femur after subperiosteal mobilization of the vastus lateralis. They emphasized the importance of leaving two full diameters between adjacent perforations to prevent cumulative stress risers. A similar anterior perforation has been reported to be a useful means of aiding removal of a broken femoral stem.[26]

Occasionally, it is possible to remove all the cement apart from a solid distal cement plug. If it is necessary to remove this plug (e.g., in the presence of infection), a cortical window can provide ready access. This is conveniently approached by using what has been referred to by the senior author (C.P.D.) as the "pencil box" osteotomy. The vastus lateralis is mobilized off the lateral intermuscular septum, exposing the posterolateral aspect of the femoral shaft (Fig. 2, A). With use of an oscillating saw, a window representing about one third of the shaft circumference is created in the lateral femoral shaft. The window should be oval rather than square in outline to reduce the risk of fracture from an acute angle. Great care should be taken to ensure that the vastus lateralis remains attached to the window fragment, as this represents the periosteal blood supply. The window fragment can then be easily retracted to provide access to the cement plug (Fig. 2, B). After removal of the necessary material, the window is closed with cerclage wires or cables.

## Exposure for Extensive Acetabular Reconstructions

In rare instances, very extensive exposure of the acetabulum may be favored for massive acetabular allografts, management of pelvic discontinuity, or certain tumor resections, although total acetabular allografts and stabilization of hemipelvic discontinuity can usually be adequately handled via one of the more commonly used approaches. When it is considered necessary to provide very extensive access to both the anterior and posterior columns, one must choose between a triradiate approach and a two-incision approach (posterior and ilioinguinal or iliofemoral). The triradiate approach combines the posterior, transtrochanteric, and anterior exposures. The anterior limb may be extended into an ilioinguinal approach. The skin incision can cause problems with skin necrosis when scars from previous surgery are present and when the superior angle is not sufficiently large. Comprehensive descriptions of the ilioinguinal approach can be found in the literature pertaining to the surgical management of acetabular fractures.[27]

## Exposure of Intrapelvic Prostheses or Cement

Serious injuries to the pelvic viscera as a result of revision hip replacement surgery have been described.[28,29] In removal of an intrapelvic acetabular component

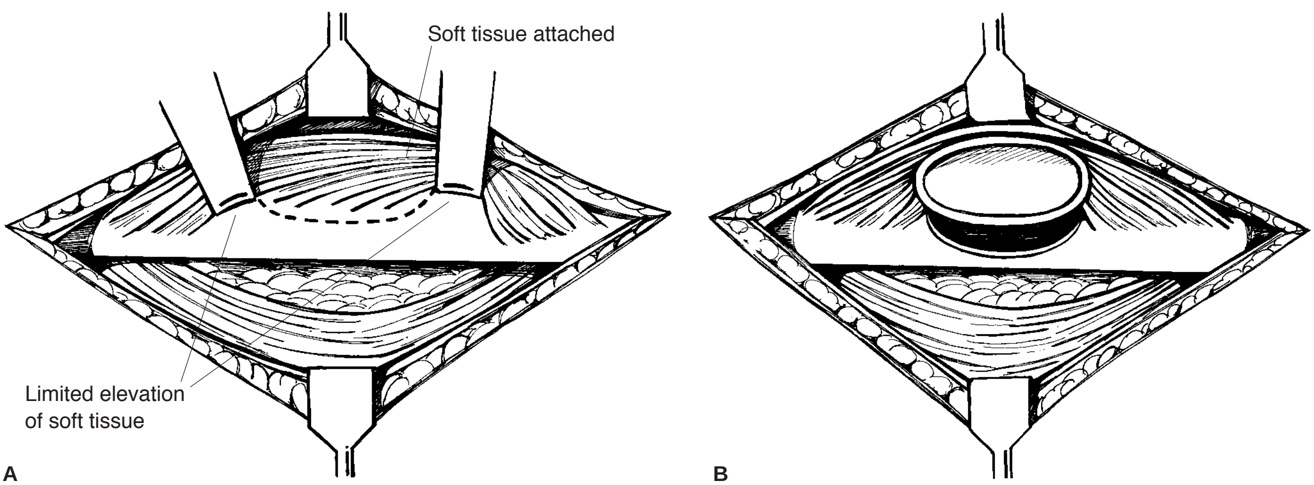


**Fig. 2** The pencil-box osteotomy. **A,** The lateral femoral cortex is exposed at the appropriate level while taking care to avoid denuding the bone of soft-tissue attachments. An oval osteotomy is produced with use of an oscillating saw or high-speed burr. **B,** The cortical window fragment is hinged forward with the attached soft tissues to provide access to the femoral medullary canal.

or infected intrapelvic cement via any of the conventional approaches to the hip, the risk of such injuries may be considerable. The vessels of the sigmoid colon, cecum, rectum, and bladder and the iliac vessels are the principal structures at risk in any penetration of the floor of the true acetabulum.[30] The risk of injury to these structures by traction on the prosthesis or cement is increased by the intense fibrous reaction that they can provoke.

Preoperative assessment by contrast studies of the iliac vessels is advisable when the protrusion is substantial and there is the possibility that the vessels are lying interposed between the acetabular component and the pelvis. Eftekhar and Nercessian[31] reported four such cases, in which the intrapelvic components were removed under direct vision with use of the lateral two windows of a modified ilioinguinal approach. Prior to this, the femoral components were removed via a separate transtrochanteric approach.

Grigoris et al[32] reported nine cases in which the intrapelvic cup was removed with use of only the lateral part of this approach (i.e., subperiosteal mobilization of the iliacus from the inner table of the pelvis). However, they recommended that a Rutherford-Morison approach be used if the preoperative angiograms reveal a false aneurysm or if the cement mass to be removed is particularly large. In these situations, it may be appropriate to seek the assistance of a general surgery colleague.

### Revision of the Acetabular Component Only

Aseptic loosening of a cemented total hip arthroplasty is more likely to occur on the acetabular side, especially when the implant has been in situ for more than 10 years.[33] Isolated acetabular component loosening also occurs in uncemented arthroplasties. This results in the need to revise an acetabular component in the presence of a solidly fixed cemented or bioingrown femoral stem. The femoral component can generally be preserved in these situations unless a nonmodular component shows evidence of damage to the surface of the femoral head or unacceptable orientation of the stem (such as retroversion).

Exposure of the acetabulum in this situation can be facilitated in a number of ways. First, the femoral head can be removed if the component is modular; the less bulky neck can be retracted more easily while taking care to protect the Morse taper from damage. Second, if the stem is lying within an intact cement mantle, it can be removed and reimplanted into the same mantle with a small quantity of liquid cement after successful revision of the acetabular side.[34] Finally, the intact femoral component can be retracted anteriorly or posteriorly after adequate mobilization of the proximal femur. Placing the femoral head in a soft-tissue pocket anterior to the acetabulum may further facilitate exposure.[35]

## Summary

No single approach is suitable for all revision total hip arthroplasty procedures, and the surgeon who takes on these cases should be at ease with a range of approaches. The appropriate surgical exposure for any given revision procedure should be determined by careful preoperative planning based on an assessment of the implant type to be removed, the extent of bone deficiencies to be reconstructed, and the presence or absence of infection. Osteotomies and soft-tissue incisions should be adequate, so that unwanted fractures and soft-tissue damage are avoided.

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