Surgical Exposures in Revision Total Knee Arthroplasty

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Abstract

A well-planned operative approach to revision total knee arthroplasty is crucial to a successful outcome. Wide exposure must be achieved to allow component removal, soft-tissue balancing, management of bone loss, and reimplantation without damaging important structures. These structures include skin, the extensor mechanism, the collateral ligaments, the remaining bone stock, and neurovascular structures. Skin necrosis can be avoided by selecting the appropriate incision and dissecting deep to the fascia. Extensile exposure by dissection of scar, quadriceps snip or turndown, tibial tubercle osteotomy, or medial epicondylar osteotomy should be performed early to prevent patellar tendon disruption. In certain cases, the distal femur can be exposed circumferentially by using a quadriceps myocutaneous flap or femoral peel. Special care should be taken with the infected or ankylosed knee.

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Revision total knee arthroplasty is a challenging surgical procedure. The correct surgical approach and sound knowledge of local anatomy will allow safe exposure of the joint and successful completion of the procedure.[1]

Particular risks in the surgical exposure for revision total knee arthroplasty include wound-edge necrosis and rupture of the extensor mechanism. Both are serious complications: the former increasing the risk of periprosthetic infection due to the loss of the epithelial barrier; the latter resulting in poor long-term function and increased risk of infection.[2] Both complications must be prevented by careful planning and execution of the procedure. Other structures one must avoid damaging include the collateral ligaments at the level of the joint and the neurovascular structures in close proximity to the posterior and lateral aspects of the knee.

Patients at particular risk for wound-healing problems include those who have undergone multiple previous procedures and those with very restricted range of motion, rheumatoid arthritis, a history of corticosteroid use, or infected knees. Vasculitis can occur in patients with some polyarthropathies, such as rheumatoid arthritis, systemic lupus erythematosus, and giant-cell arteritis. A patient with one of these diseases and a history of poor wound healing may have problems with wound-edge necrosis. Patients at an increased risk of deep infection include those with renal failure, diabetes, acquired immunodeficiency syndrome complex with a CD4 count less than 200, psoriasis, rheumatoid arthritis, or systemic lupus erythematosus.

Anatomy

To be able to perform a revision knee arthroplasty without complications, the surgeon should have a thorough understanding of the local anatomy. Knowledge of the blood supply to the skin and the anatomy of the blood vessels in the knee region will help to prevent the development of wound-edge necrosis. Deep dissection has to be performed around the extensor mechanism, which needs to be identified and separated from the surrounding scar. The blood supply to the patella should be pre-

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served to prevent the late complication of patellar osteonecrosis and fragmentation. The anatomic positions and insertions of the collateral ligaments need to be recognized to allow exposure without compromise of the varus and valgus stability of the joint. The relationships to the existing anatomy of the neurovascular structures are important to understand if neurovascular injury is to be avoided.

Skin Blood Supply

The blood supply to the skin around the knee has been well described. Microanatomic study of the skin in the thigh has demonstrated that there is an anastomosis of vessels just superficial to the deep fascia (Fig. 1). Perforators through the deep fascia feed this anastomosis.[3] Blood vessels penetrate the subcutaneous fat from this layer to supply the epidermis, with little communication in the superficial layer. Therefore, wide dissection superficial to the deep fascia will compromise the blood supply to the skin, whereas dissection deep to the fascia will maintain the skin blood supply. Close parallel incisions will compromise the epidermal blood supply.

The deep perforators arise medial to the knee joint from the saphenous artery and from the descending genicular artery. Most of the perforators of the deep fascia lie on the medial side of the joint. The blood supply to the skin should not be confused with the blood supply to the patella, as there is little communication between the two. The patella is separated from the skin by the prepatellar bursa, through which few blood vessels pass.

The nerve supply to the skin is similar in distribution. Branches of the saphenous nerve traverse laterally to the anterior aspect of the joint to provide cutaneous sensation.

Patellar Blood Supply

The patella has a rich plexus of arteries surrounding it, arising from various sources (Fig. 2). These branches include the descending genicular artery, the four genicular arteries (superior medial, inferior medial, superior lateral, and inferior lateral), and the anterior tibial recurrent artery.[4-6] These form branches in front of the patella, including the transverse infrapatellar artery and the oblique prepatellar artery within the retropatellar fat pad. Some of the intraosseous blood supply to the patella penetrates from the inferior aspect of the patella.[4] The rest of the blood supply comes from penetrating vessels from the middle third of the anterior surface of the patella.

The standard midline parapatellar approach to the knee will disrupt the contribution of the three medial blood vessels to the anastomosis. At the time of the initial

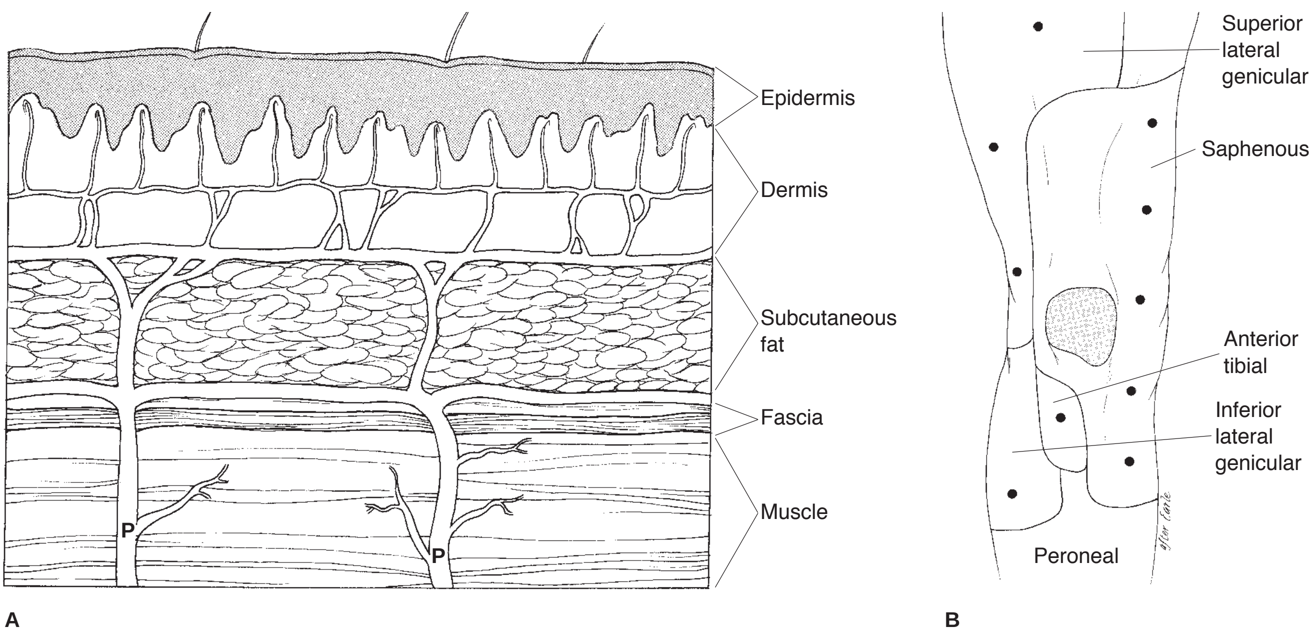


Fig. 1 **A,** Microvascular anatomy of the skin of the thigh. The vessels just superficial to the deep fascia form an anastomosis. The skin blood supply arises from this anastomosis, with little communication in the subcutaneous tissues. The deep perforators (P) supply the anastomosis above the deep fascia. **B,** Areas supplied by the deep vessels (solid circles indicate approximate position of deep perforators). Most of the blood supply comes from the medial side; therefore, using a medial incision will increase the chance of skin-edge necrosis.

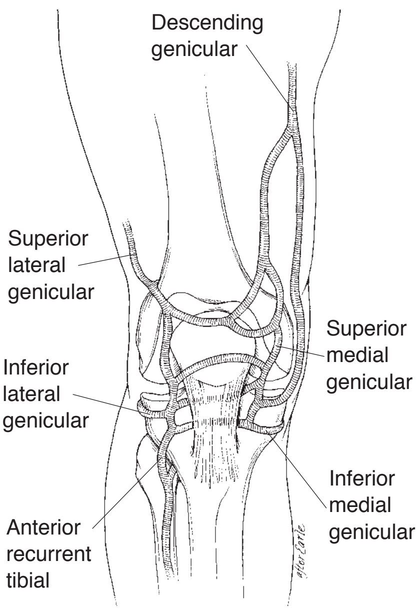


Fig. 2 Blood supply to the patella. Medial retinacular incisions will disrupt the three medial blood vessels contributing to the anastomosis around the patella. If a lateral retinacular release is added, one or both of the lateral vessels will be disrupted.

arthroplasty, the inferior lateral genicular artery will be interrupted during excision of the lateral meniscus. The superior lateral genicular artery may be divided,[7] and the branches of the recurrent anterior tibial artery may be removed during excision of the fat pad. There is an increased rate of fragmentation of the patella after total knee arthroplasty and lateral release.[8]

The superior lateral genicular artery is found deep to the synovium in the same plane as the vastus lateralis muscle. The vessels run horizontally just distal to the distal-most fibers of the muscle. Careful dissection in this zone during an internal lateral release will allow the surgeon to preserve the vessels and perhaps to prevent late fragmentation of the patella. External lateral release may not be advisable, as extensive skin dissection can cause wound-edge necrosis.

The Capsule and Posterior Cruciate and Collateral Ligaments

Although a previous total knee arthroplasty considerably alters the local anatomy, the ligamentous and capsular structures laterally, medially, and posteriorly remain relatively well preserved, and their exposure is required.[6] The medial collateral ligament runs from the medial epicondyle and inserts into the tibia approximately 2 cm distal to the joint line. The superficial medial ligament has a more distal insertion and lacks a distinct posterior border due to the insertion of fibers of the semimembranosus tendon. The semimembranosus tendon also has fibers inserting into the posterior aspect of the tibia at this level.[6] The deep collateral ligament, which inserts into the tibial joint line, is a condensation of fibers within the joint capsule and has less structural relevance. The pes anserinus and the superficial collateral ligament insert together into the tibia, forming a layer of connective tissue at this level. The lateral collateral ligament arises from the lateral epicondyle and inserts into the fibular head. It is superficial to the tendon of the popliteus and superficial to the capsule.

The posterior capsule inserts into the femur above the condyles and deep to the medial and lateral heads of the gastrocnemius. The capsule can be stripped off the back of the femur at this level. Just anterior to the capsule, the posterior cruciate ligament arises from the intercondylar notch of the femur on the medial side and descends posteriorly and laterally to insert on the posterior aspect of the tibia. The posterior cruciate ligament has two bands, the anterior band being broader and tight in flexion. Release of the anterior band off the femur can increase the flexion gap without complete disruption of the ligament. The insertion is approximately 13 mm wide and 20 mm long on the proximal posterior cortex of the tibia.

Retained osteophytes or cement over the posterior tibia can result in tightness of the posterior cruciate ligament in flexion and an apparently decreased flexion gap. Above the joint line in the normal knee, some fibers of the posterior cruciate ligament join the lateral meniscus, and fibers also contribute to the posterior aspect of the medial meniscus. These fibers will have been removed with the meniscus at the primary procedure. During revision knee replacement, the posterior cruciate ligament is commonly removed or defunctioned. Care should be taken during dissection of the posterior cruciate ligament not to penetrate the posterior capsule and damage the popliteal contents.

Nerves and Blood Vessels

The popliteal artery starts at the adductor hiatus and lies immediately posterior to the capsule. The genicular arteries tether the popliteal artery to the posterior aspect of the capsule, so that dissection or division of the capsule must be performed very carefully. Subperiosteal elevation of the capsule off the femur or on the tibia may be safer. The tibial nerve lies superficial to the artery and hence is less likely to be damaged. The popliteal vein lies between the tibial nerve and the popliteal artery. Flexion of the knee does not protect the popliteal artery, as it still remains closely related to the posterior capsule.[9]

The peroneal nerve is more at risk than the tibial nerve from traction, compression, and direct laceration. It lies on the lateral aspect of the joint, running just behind the biceps tendon to its insertion on the fibular head.[1] Its medial relationships are with the lateral head of the gastrocnemius and the soleus muscle. It is less at risk from dissection around the back of the joint than from lateral release or exposure. It lies superficial to the lateral collateral ligament. It is most at risk during release of the biceps tendon, which should therefore be avoided.

Preoperative Assessment

Careful preoperative assessment and planning can avert most of the complications associated with revision total knee arthroplasty. The history should include inquiry about previous wound-healing problems, history of nerve injury, and weakness of knee extension suggestive of extensor mechanism disruption. If the knee is stiff, specific questioning should focus on the duration of loss of range of motion. These factors in particular may have a profound effect on the approach used. Corticosteroid use and any events suggestive of infection (such as prolonged wound drainage) are also important features in the history.

The past medical history should include inquiry about systemic diseases, such as diabetes, rheumatoid arthritis, and osteoporosis. Systematic inquiry should also include information about peripheral vascular function, which will be useful not only in identifying the origin of the pain but also in estimating the risk of wound necrosis and postoperative limb ischemia.[10]

On examination, very close attention should be paid to the position and shape of the scars. The general health of the skin and the capillary return at the wound edges should be inspected. Local cicatrix formation or hemosiderin staining at the wound edge is suggestive of previous wound-healing problems. The alignment of the limb is examined with the patient standing, and stability is assessed in both flexion and extension. Subluxation and positional dislocation of the prosthesis can be examined and documented with fluoroscopy.

Range of motion, flexion deformity, and extensor lag should be carefully recorded. A knee with an extensor lag suggests extensor mechanism disruption, associated with poor long-term function and an increased risk of wound breakdown. A stiff knee is at risk for patellar tendon avulsion during exposure. Lack of mobility of the patella in the coronal plane indicates scarring of the extensor mechanism. An infected knee has extensive scar formation, increasing the stiffness of the soft tissues and increasing the risk of patellar tendon avulsion.[11]

Distal examination includes inspection of peripheral vascular and neurologic function. A vascular surgeon should assess preoperatively any patient with compromised circulation. Poor venous return may compromise the wound edge, leading to tissue ischemia due to venous engorgement.

Preoperative consultation by a plastic surgeon should be sought if difficulties with closure or wound breakdown are anticipated. In some cases, a flap may be created before the revision procedure to prevent wound breakdown. A sham incision down to the level of the capsule has been advocated. It serves two purposes: First, if wound breakdown ensues, a periprosthetic infection will be avoided, as the capsule has not been breached. Second, the sham incision will promote collateral circulation within the skin, increasing the chances of survival of the skin flaps. In some cases, tissue expansion can be used to increase the amount of skin available for repair either for revision knee replacement or for knee fusion.[12]

Preoperative radiographs should include an anteroposterior view of both extremities and lateral, skyline, and notch views of the affected knee. These films will allow determination of the length and fixation of each component of the prosthesis and the required extent of the exposure. The 36-inch anteroposterior view is useful for delineating the mechanical axis of the femur and illustrating malalignment of the femur or tibia. The intended bone cuts should be drawn on the film before the procedure. A high-riding patella is suggestive of a patellar tendon rupture.

The tourniquet cuff should be positioned as high as possible on the thigh. The tourniquet should be inflated after preparation of the skin and draping to allow more operating time in a dry field.

Before preparing the skin, an indelible marking pen is used to mark previous incisions, which may not be visible after the application of occlusive drapes. Drawing transverse lines across the incision will allow correct wound-edge alignment at the time of closure. Landmarks, such as the tibial tubercle, the patella, the patellar tendon, and the head of the fibula, should then be outlined.[5]

Extracapsular Approach

The skin incision should be selected carefully. Because the fascial perforators arise from the medial side, the most lateral incision giving appropriate exposure should be used.[13] A number of skin incisions have been described; however, in the revision case, the approach is usually predetermined by the previous incisions. In some cases, a new incision may be made if the previous skin incisions prevent reasonable access to the joint. Transverse scars should be crossed perpendicular to the scar, with minimal compromise to the junction zone.[7]

The skin incision should end medial to the tibial tubercle. If the old scar is over the tubercle, this scar should be used; however, deep dissection should be performed carefully, as the patellar tendon lies immediately under the skin at this level and may be damaged. Extension of the incision beyond the distal end of the scar may assist in this dissection.

Skin flaps should be kept as thick as possible.[3] Undermining may be required to reach the joint or for an extensile exposure of the joint. It is often difficult to correctly identify the tissue planes within the scar; however, this can be facilitated by extending the incision proximally beyond the level of the scar. The deep fascia can be visualized, and the dissection can be extended distally. All dissection should be kept deep to the deep fascia to preserve the skin blood supply.[3] Surgical soft-tissue handling should be careful, with minimal pressure on the skin edges by forceps and self-retaining retractors. Sharp dissection is used. Any vessels seen during the dissection should be cauterized, as a wound hematoma can compromise local tissue blood supply and can be the initiating event of wound breakdown.

Capsular Approaches

A number of deep approaches can be used to access the joint (Fig. 3). The capsular incision can be made lateral or medial to the patella. All of these capsular approaches are accessible from all incisions, but ideally the skin incision requiring the least amount of undermining should be used.[14]

Medial Approaches

Once through the skin, the extensor mechanism is exposed. The medial border of the patella, the quadriceps tendon, the patellar tendon, and the tibial tubercle are clearly identified.

Three approaches can be used at this level: the medial parapatellar (either standard or Insall) approach, the von Langenbeck approach, and the subvastus approach. With the midline approach, described by Insall,[7] the medial third of the quadriceps tendon is divided from the lateral two thirds longitudinally. The capsule is peeled off the medial third of the patella by subperiosteal dissection, and the capsule is entered just medial to the patellar tendon. The standard medial parapatellar approach uses the same proximal and distal dissections as described by Insall, but at the level of the patella, the dissection is carried medial through the capsule and lateral to the fibers of the vastus medialis.[15,16]

The von Langenbeck approach is carried down through the fibers of the vastus medialis. This approach is not recommended, as the pull of the vastus medialis is interrupted, increasing the chances of patellar subluxation or dislocation.[14]

The subvastus approach uses the same distal interval as the other medial approaches, but the dissection plane lies medial to the vastus medialis. The vastus medialis is dissected clear of the medial intermuscular septum and is elevated laterally. Dissection is continued up the intermuscular septum until the patella can be everted.[17]

The subvastus approach should be chosen cautiously for revision knee surgery because a tibial tubercle osteotomy is the only way of extending the approach. Also, it is difficult to evert the patella without undue tension on the insertion of the patellar tendon. Therefore, its

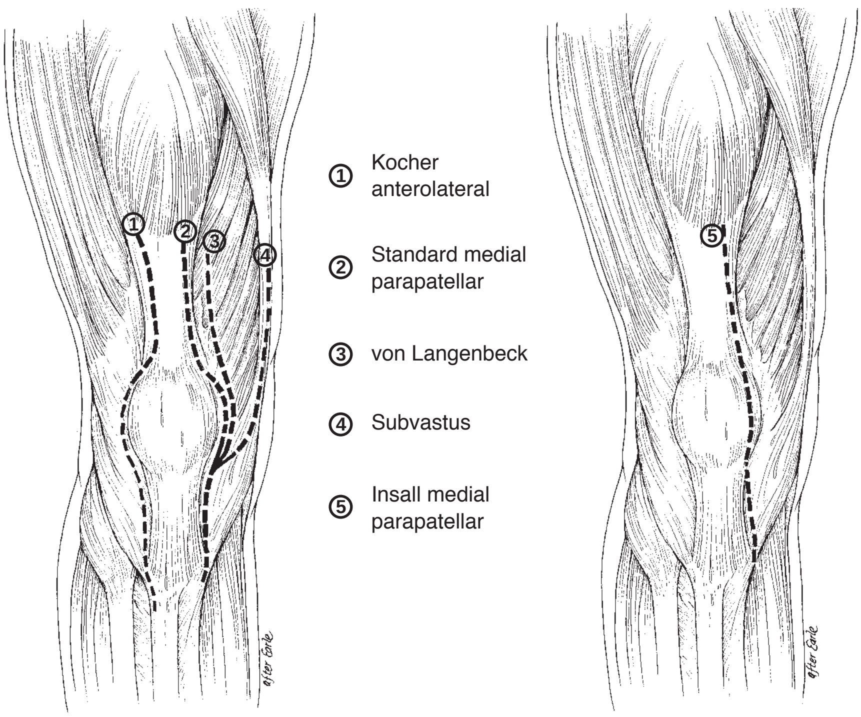


Fig. 3 Capsular incisions used for revision total knee arthroplasty. All can be reached from any skin incision by subfascial dissection, but this should be kept to a minimum to prevent skin necrosis.

use is not recommended for most revision total knee arthroplasties.

Anterolateral Capsular Approach

The anterolateral capsular approach was first described by Kocher. The incision is carried down just lateral to the quadriceps mechanism proximally, around the lateral aspect of the patella (similar to a lateral retinacular release), and lateral to the patellar tendon.[15]

This approach can be difficult to use, as the patella may not be easily everted medially. The approach is potentially extensile, but with considerable undermining of the skin and potential devascularization of the patella. It may have a role to play in patients with severe fixed valgus deformity.

Development of the Soft-Tissue Sleeve

Once deep to the capsule and within the joint, the exposure should be extended to allow access to all sides of both the tibial and femoral components. Knee flexion up to 110 degrees or more is required to allow extraction and reinsertion of the components.

In most cases of knee revision, the capsular incision alone will not allow sufficient flexion to expose the joint. Considerable soft-tissue dissection must be performed first. If the dissection fails to allow adequate exposure, an extensile exposure should be used, as described below.

After the capsular incision has been performed, the medial and lateral gutters of the knee are developed.[13] Scarring of the quadriceps mechanism to the anteromedial and anterolateral aspects of the femur prevents flexion. This scar should be dissected off the femur to allow mobilization of the knee (Fig. 4). The scar restricts the exposure, as it is not pliable and can be very thick, particularly in infected tissue. Care should be taken to dissect to, but not including, the collateral ligaments, except in cases of ankylosis or chronic knee dislocation. The medial collateral ligament may be dissected off the tibia or femur as part of a soft-tissue flap, with the dissection plane being kept close to bone. The proximal end of the lateral collateral ligament may be similarly dissected as part of a femoral peel.

The scar is normally stiff and has considerable bulk, particularly deep to the extensor mechanism, and can prevent eversion of the patella. The patellar tendon should be dissected from its insertion to a minimal extent only, with great care and with constant attention to that point thereafter, so that traumatic avulsion can be anticipated and avoided by using another technique. Delayed avulsion is a risk if the release was liberal. As much scar as possible should be excised by sharp dissection without damage to the extensor mechanism or collateral ligaments.[18]

The plane between the scar and normal tissue can be identified at the level of the patella by removing the meniscus of scar around the patellar component. Proximally, a plane can usually be found between the shiny, organized fibers of the deep surface of the quadriceps tendon and the scar. A similar plane can be found distally deep to the patellar tendon by very careful sharp dissection.

The tibia is also exposed by sharp dissection. The upper end of the insertion of the patellar tendon should be identified, and any scar proximal and lateral to the insertion should be excised.

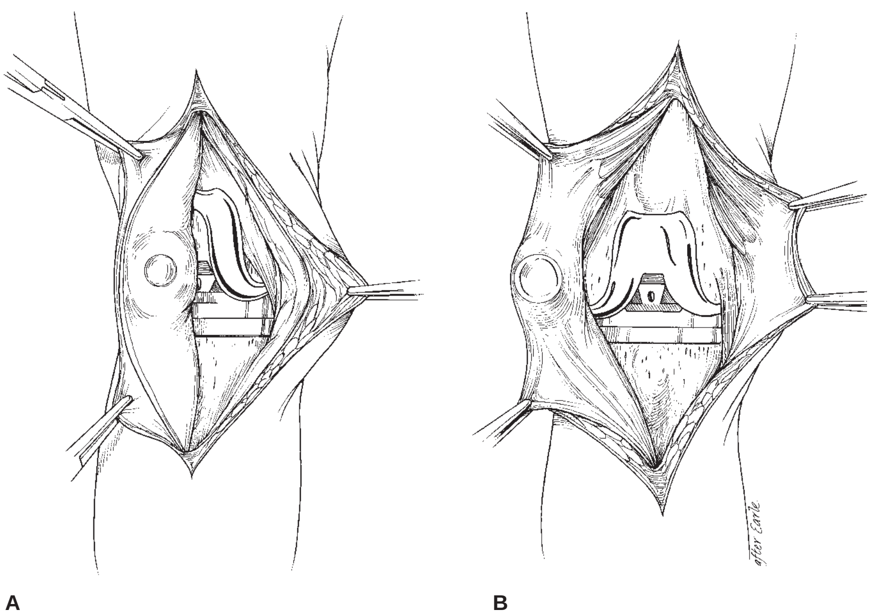


Fig. 4 **A,** Appearance of the knee after exposure with the scar intact. **B,** Complete exposure is achieved by dissecting out both femoral gutters and removing the nonpliable scar from the deep surface of the extensor mechanism. After full exposure, the distal femur should be visible to the level of the periosteum, and the undersurface of the quadriceps muscles can be seen. The collateral ligaments can be dissected as part of a flap off the femur or tibia, but should not be divided transversely at any level.

The rest of the exposure of the proximal tibia is performed by dissection of the superficial medial collateral ligament off its proximal insertion by subperiosteal dissection. The dissection is carried around the medial aspect of the tibia to the level of the insertion of the semimembranosus tendon in the midcoronal plane.[5] As the dissection is carried around the medial aspect of the tibia, external rotation facilitates exposure while relaxing tension on the patellar tendon attachment, allowing flexion of the knee and decreasing the risk of tendon avulsion.

At this time, the knee can be flexed up, and eversion of the patella can be attempted. Special attention must be paid to the patellar tendon insertion. If the tendon seems tight, an extensile approach is indicated. Extensile measures should be performed early to prevent patellar tendon avulsion. If the knee can be flexed to 110 degrees with the patella everted or displaced laterally with minimal tension on the patellar tendon, the procedure can be continued without any further exposure.

Extensile Exposures

Quadriceps Snip

The quadriceps snip is a frequently used technique for extensile exposure. It has the advantage of causing minimal risk to the extensor mechanism, and no postoperative immobilization is required. It should be used with caution in very stiff knees, as it may not give adequate exposure; instead, a more extensive exposure technique should be used.

The quadriceps snip is used when the standard medial parapatellar approach fails to give adequate exposure to the joint, and a small amount of additional exposure is required. At the apical end of the standard incision, the rectus tendon is divided in an oblique manner in a superior and lateral direction (Fig. 5).[19] The patella is everted, and the knee is flexed while carefully observing the patellar tendon insertion. If the patella cannot be everted, a lateral release and excision of any additional scar may assist in the exposure. A lateral release may be extended into a Coonse-Adams approach, recognizing that the patellar blood supply may be affected by the exposure. Alternatively, the patella may be displaced laterally to allow exposure.

In one study,[19] extensor mechanism function was not impaired in a review of 16 patients who underwent the quadriceps snip. All had immediate postoperative physiotherapy and good return of function.

Patellar Turndown

Because the traditional Coonse-Adams approach cannot be extended from a standard midline parapatellar incision, the approach has been modified by Insall[20] into the patellar turndown as an extension of the parapatellar incision. The knee is approached in a standard medial parapatellar manner. If adequate exposure cannot be achieved, a second incision is made in the extensor mechanism 45 degrees to the proximal end of the parapatellar incision (Fig. 6).

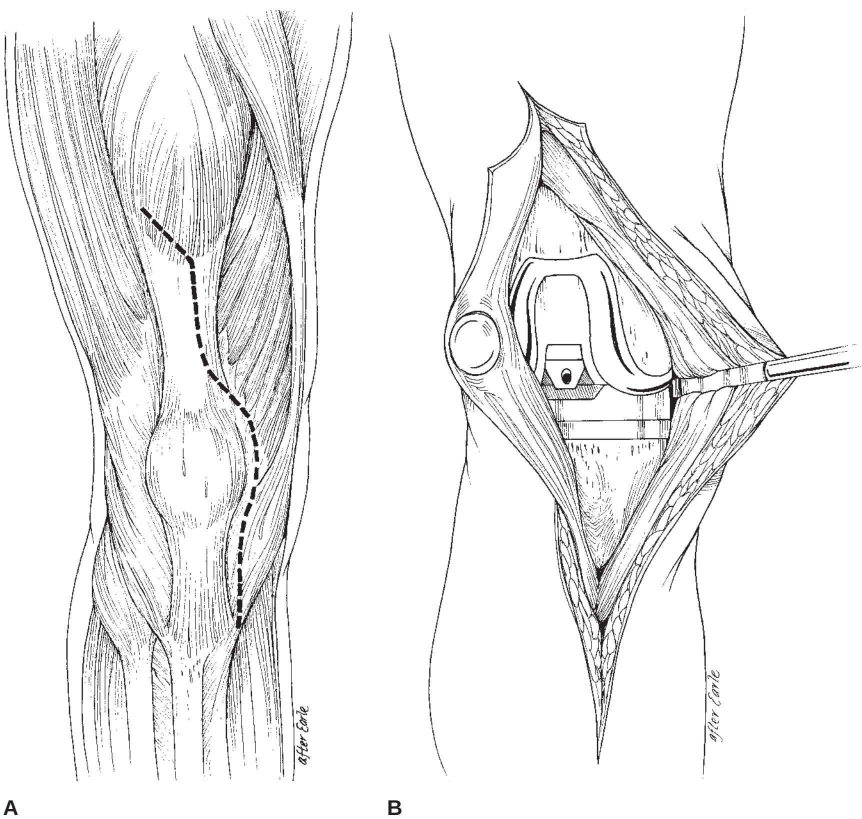
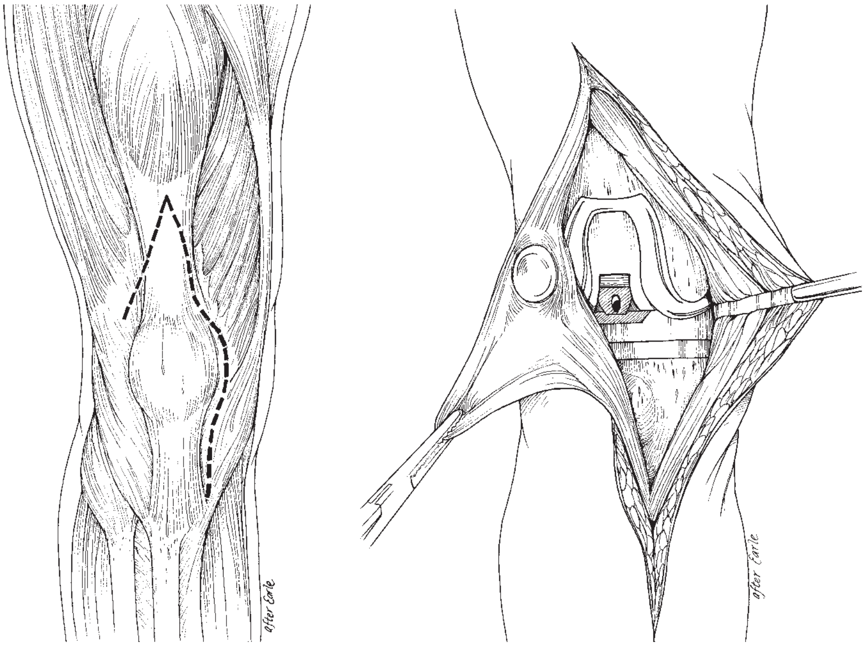


Fig. 5 The quadriceps snip. A standard medial parapatellar incision **(A)** is used, with further exposure of the knee being obtained by dividing the quadriceps muscle proximally, with extension of the incision laterally **(B)**. A greater degree of exposure will be obtained with a more distal and transverse cut.



A **B**

Fig. 6 The incision **(A)** and the exposure obtained **(B)** with the patellar turndown. The quadriceps tendon should be repaired with use of a nonabsorbable suture and should be protected postoperatively.

The dissection is taken distally through the tendinous insertion of the vastus lateralis and through the lateral retinaculum. The blood supply to the patella is possibly maintained through the superior lateral genicular artery and the vessels within the remaining fat pad supplying the inferior pole of the patella.[20]

At the time of the repair, the apex of the incision is repaired, as well as the medial incision. The lateral retinaculum can be left open as a lateral retinacular release. The knee is protected for 2 weeks postoperatively to allow the repair to partially heal before mobilization.[20]

Scott and Siliski[21] modified Insall's patellar turndown technique by taking the lateral limb of the incision underneath the edge of the vastus lateralis through its tendinous insertion into the retinaculum, rather than through the lateral retinaculum. The superior lateral genicular artery is preserved by using this approach. A V-Y advancement can be performed at the time of closure. The authors recommend a slightly more aggressive postoperative regimen after this exposure, with flexion up to 30 degrees in a continuous-passive-motion machine immediately after surgery. They reviewed the outcomes in seven patients and found that they were similar to those reported by Insall.[20] Ritter et al[8] do not believe that preservation of the superior lateral genicular artery makes any difference in the rate of patellar fragmentation after total knee arthroplasty.

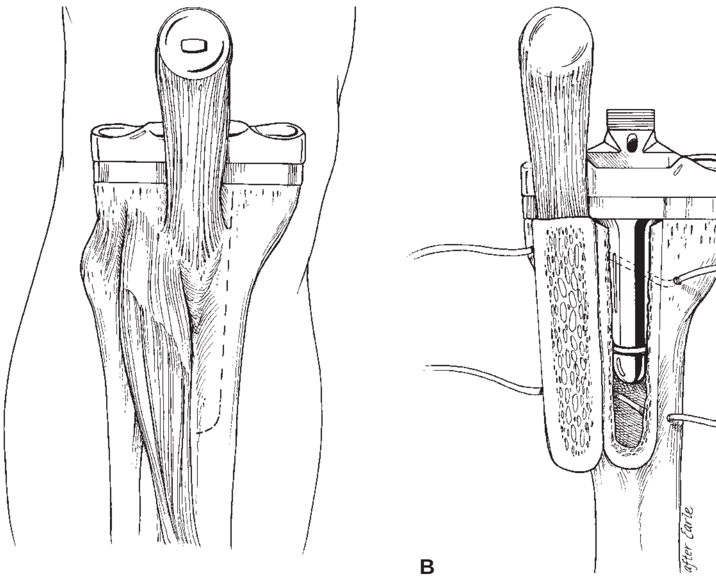
Tibial Tubercle Osteotomy

Tibial tubercle osteotomy was described for use in total knee arthroplasty by Dolin[22] in 1983. In his original description, the osteotomy was 4.5 cm long and was fixed with a screw. There was concern because of the potential of this osteotomy to escape, particularly with the use of a screw.

Whiteside[23] has since modified the procedure to use a longer osteotomy (8 to 10 cm long) with wire fixation, allowing the use of canal-occupying press-fit stems. In this technique, a standard approach is used. If the knee cannot be flexed to allow adequate exposure after release of the lateral gutters and excision of the scar, a tibial tubercle osteotomy is performed.

To perform the osteotomy, the incision is extended distally down the shaft of the tibia on the medial side (Fig. 7). The proximal 10 cm of the tibia should be exposed. The osteotomy is performed by using an oscillating saw, with the initial cut being made from medial to lateral. The end of the osteotomy should be curved rather than square to reduce the risk of tibial fracture. The proximal and distal ends of the osteotomy are completed with curved osteotomes. The cut is left incomplete on the lateral side, and curved osteotomes are used to elevate the flap with a lateral periosteal hinge. The periosteum and muscle are left attached to the lateral aspect of the osteotomy, so that the tubercle is moved laterally rather than proximally in the exposure. Two or three wires are passed around the lateral edge of the tibial tubercle and back onto the tibial crest. The wires are angled down at 45 degrees to the shaft of the tibia (proximal lateral to distal medial) to pull the osteotomy distally.

After placement of the stem, the wires are tightened onto the shaft of the tibia. The rest of the joint is closed in the standard manner. Postoperatively, early range of motion and full weight bearing are encouraged.[23]



A B

Fig. 7 The bone cut **(A)** and the exposure achieved and wire placement for closure **(B)** for the tibial tubercle osteotomy. The osteotomy should be at least 8 cm long and should be as thick as the cortex to allow access to the tibial shaft and to prevent fracture of the osteotomized fragment. The osteotomy is performed with use of a saw from medial to lateral and can be completed with osteotomes. The osteotomy is hinged on the lateral soft tissues, which are left intact to maintain blood supply. The tibial shaft can be accessed for cement removal, which reduces tension on the extensor mechanism by displacing the tibial tubercle laterally. The osteotomy is closed by passing two wires through drill holes and is then stabilized by compression of the cortical bone. The lateral drill holes are placed more proximal than the medial drill holes to draw the osteotomy distally.

Whiteside[23] has reviewed his experience with 136 osteotomies. The mean postoperative range of motion was 93.7 degrees. No further exposure was required in any knee. Two avulsion fractures occurred but did not compromise long-term function.

Femoral Peel

The femoral peel was described by Windsor and Insall.[24] In this exposure, the joint is exposed by using the standard parapatellar approach. The dissections around the lateral and medial aspects of the femur are continued subperiosteally to include the origin of the medial and lateral collateral ligaments. The posterior capsule is stripped off the back of the femur, resulting in complete exposure of the joint and exposure of the distal femur. The femoral peel may devascularize the distal end of the femur due to the extensive soft-tissue dissection.

Medial Epicondylar Osteotomy

The medial epicondylar osteotomy was first described by Engh.[25] In this approach, the knee is approached in a routine fashion, either by paramedial incision or subvastus approach. If the exposure is tight, the superficial medial collateral ligament and the tissues superior to the medial epicondyle are raised as a flap, with the medial epicondyle as a bone fragment within the soft-tissue flap (Fig. 8). The dissection is then carried out posteriorly and laterally around the femur and tibia, and the knee is opened by externally rotating the knee into external rotation and hinging into valgus.

The joint is closed by using a screw to reattach the epicondyle. The remainder of the knee is closed as with a standard medial parapatellar approach.

Quadriceps Myocutaneous Approach

The quadriceps myocutaneous approach to the knee was first presented in 1991.[26] Initially used for tumor excision and reconstruction, the approach can also be used for revision knee replacements of unusual complexity. A chevron osteotomy of the patella was first used, but an inverted-V turndown incision of the quadriceps tendon is now favored. By maintaining the soft-tissue attachments on the distal segment, the blood supply to the patella can be maintained. This

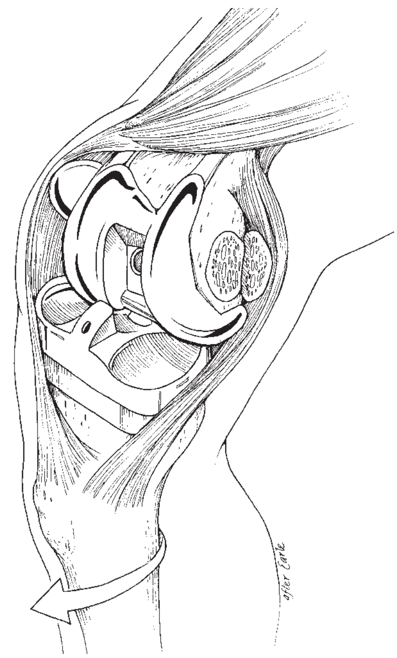


Fig. 8 The medial epicondylar osteotomy. The subvastus approach is used. The medial epicondyle is elevated off the bone with a flap of soft tissue. The flap is then elevated off the posterior aspect of the femur and tibia, staying on bone. The joint is opened hinging on the lateral soft tissues.

approach may occasionally be indicated for revision of a tumor prosthesis or revision of a total knee arthroplasty with a large distal femoral allograft.

In this approach, the distal femur is exposed by using a U-shaped myocutaneous flap based on the quadriceps muscle. The transverse limb of the incision crosses anterior to the patella, and the medial and lateral arms extend up the medial and lateral aspects of the femur. A previous paramedial skin incision can be used for the medial side of the approach. Because the quadriceps muscle is left attached to the deep fascia and skin, the superficial blood supply is maintained, and necrosis of the wound edge is not a problem. The entire distal end of the femur can be exposed with this technique. A recent review of 15 consecutive cases revealed no case of delayed wound healing, despite the magnitude of the exposure.[26]

Summary

Understanding the basic principles of exposure of the knee is essential for optimal performance of revision knee replacement. The skin incision should be carefully chosen, and skin flaps should be kept thick to prevent necrosis of the epithelium. A complete excision of the scar deep to the extensor mechanism will assist in the exposure of the joint. Knowledge of the local anatomy will allow the surgeon to avoid damage to the extensor mechanism, the collateral ligaments, and neurovascular structures. Wide exposure can be achieved by careful selection of the approach and extension of the approach early in the procedure.

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