

CHAPTER 7

Removal of the Femoral and Tibial Components for Revision Total Knee Arthroplasty

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The importance of implant removal in revision knee arthroplasty frequently is overlooked as the surgeon concentrates on the planned reconstructive phase of the operation.¹ However, safe and effective implant removal is important for several reasons. First, implant removal can be a time-consuming process, particularly if the surgeon is not familiar with optimal techniques or if the surgeon does not have optimal tools available for the purpose. Second, severe bone loss or bone fracture can occur during implant removal. Marked unnecessary bone loss has a substantial negative impact on the type and quality of the reconstruction that subsequently can be performed. Methods of safe implant removal have advanced dramatically over the last decade, and in most cases today, implants can be removed efficiently and with relatively little bone loss.

TOOLS FOR IMPLANT REMOVAL

Tools available for implant removal include hand instruments, power instruments, and ultrasonic instruments. In addition, certain implant-specific instruments are helpful to disassemble or extract certain implant designs.

Hand Instruments

Osteotomes Osteotomes can be used to divide implant-cement interfaces and implant-bone interfaces. Stacked osteotomes can be used to lever implants away from underlying bone or cement. When bone beneath the implant is soft, it is important to be careful that osteotomes do not crush the underlying bone. When an osteotome is used to remove cemented implants, keeping

the osteotome at the implant-cement interface rather than the cement-bone interface is preferable.

Gigli Saws Gigli saws can be used to cut beneath implants in areas that are inaccessible to power saws.² However, Gigli saws can migrate, and most surgeons have found that they tend to remove more bone than hand saws for applications such as removal of the femoral component.

Punches Punches are useful to disimpact well-fixed implants from the bone.

Power Instruments

Power Saws Power saws can very effectively divide the implant-bone interfaces of uncemented implants. Thin saw blades remove less bone, but can also wander into healthy bone.

Power Burs Thin-profile cutting burs can divide interfaces that are not easily accessible to power saws.

Metal Cutting Instruments Metal cutting instruments can cut away portions of well-fixed metal implants, thereby allowing access to otherwise inaccessible interfaces. For example, a metal cutting instrument can be used to remove a portion of a femoral or tibial component to allow access to a well-fixed underlying stem.

Ultrasonic Instruments

Ultrasonic instruments can be very useful to divide metal-cement and cement-bone interfaces. Special ultrasonic cutting tips are available that allow the metal-cement interface to be divided effectively.³⁻⁵

STRATEGIES FOR IMPLANT REMOVAL

Exposure

Adequate exposure is essential for safe implant removal. A safe path to disrupt implant interfaces must be gained and soft tissues, especially the extensor mechanism, popliteal vascular structures, and the collateral ligaments must be protected. A safe trajectory for implant extraction, particularly for the tibial component, also must be gained, while protecting the remaining bone from damage.

Loose Implants Loose implants typically can be removed with little difficulty, once adequate exposure has been achieved. As implants are removed, care should be taken that surrounding soft tissue and bony structures are not damaged. Loose, uncemented implants may have fibrous fixation that allows micromotion but does not allow easy extraction. The fibrous tissue usually can be disrupted with an osteotome, following which the loose implant is easier to remove.

Well-Fixed Cemented Implants For well-fixed cemented implants, it is desirable to remove the metal implant from the cement mantle and leave the cement mantle behind (Figure 7-1). Subsequently, the cement can be removed under direct vision with hand or power instruments, thereby minimizing bone loss. Implants with a smooth surface typically can be debonded from the underlying cement without difficulty. For implants that are well bonded to the cement, more aggressive means of cutting the implant free of the cement with saws,

FIGURE 7-1. Disrupting the cement-metal interface of a femoral component with an osteotome. The goal is to debond the implant from the cement first, then to remove remaining cement after the metal implant has been removed.



osteotomes, or ultrasonic instruments sometimes are necessary.

Well-Fixed Uncemented Implants For well-fixed uncemented implants, the implant-bone interface should be divided before extraction is attempted, otherwise substantial bone loss can result if the bone is pulled away with the implant. The bone-implant interface is best divided sharply with a power saw, Gigli saw, osteotomes, or thin high-speed cutting tools.

Order of Implant Removal An orderly process of implant removal reduces the likelihood of associated complications. In most cases the preferred sequence of implant removal, after gaining knee exposure, is: (A) removal of the tibial polyethylene insert; (B) removal of the femoral component; (C) removal of the tibial component; and (D) removal of the patellar component. This order of implant removal provides successively better exposure for removal of each subsequent implant. Removal of the tibial insert facilitates exposure of the femoral component because knee flexion is easier, and removal of the femoral component provides better access to the posterior aspect of the tibial component, facilitating its safe removal.

METHODS TO REMOVE EACH IMPLANT

Removal of the Tibial Polyethylene Insert

The tibial polyethylene insert, whether modular or non-modular, usually can be disengaged from the underlying metal tibial tray. Removal of the tibial polyethylene insert creates a space that allows easier exposure of the remaining implants and sometimes can reduce the amount of dissection required to gain access to the tibial and femoral components. Removal of the polyethylene insert of most modular knees (and even nonmodular knees) can be achieved by levering the tibial insert out of the tray with an osteotome. Many manufacturers also have implant-specific tools to remove the modular polyethylene from the tibial tray. The surgeon should be aware that special screws or pins may secure the tibial insert to the tray; having manufacturer-specific screwdrivers or pin-grasping instruments available is helpful. When difficulty is encountered removing the tibial polyethylene from the tray, an osteotome or saw can be used to divide the tibial polyethylene, after which it can be removed from the metal tray.

Removal of the Femoral Component

Removal of the femoral component begins by dividing the implant-cement interface (for cemented implants) or

the implant-bone interface (for uncemented implants). For cemented implants, the best instruments are osteotomes or ultrasonic instruments, and for uncemented implants the best instruments are power saws, thin osteotomes, or thin high-speed cutting instruments. The anterior flange interface, distal interface, and chamfer interfaces usually all can be accessed without difficulty. Fixation pegs at the distal interface may impede access to a small central part of that interface. Narrow osteotomes or saws can be used to work along the chamfer interfaces or in the narrow spaces between fixation pegs of the distal interface. It is best to work from both the medial and lateral sides of the implant separately; this reduces the distance that the sharp instruments travel while out of sight beneath the implant, and thus reduces the likelihood of the instrument wandering away from the implant and creating excessive bone loss. The posterior condylar interfaces are hardest to access, but often there is osteolysis or little fixation at this interface. Dividing this interface is best done with special angled osteotomes, a thin saw, or a Gigli saw. Once the implant interfaces are divided, the femoral component may be removed with a company-specific or generic extractor that grasps the femoral implant and allows extraction with a slap hammer. Alternatively the implant can be tapped off of the femur gently using a metal punch against the anterior flange of the implant.

Posterior stabilized implants with a closed posterior cam box present interfaces that are difficult to access. Special care needs to be taken to remove these implants gently to avoid fracturing a condyle away from the femur.

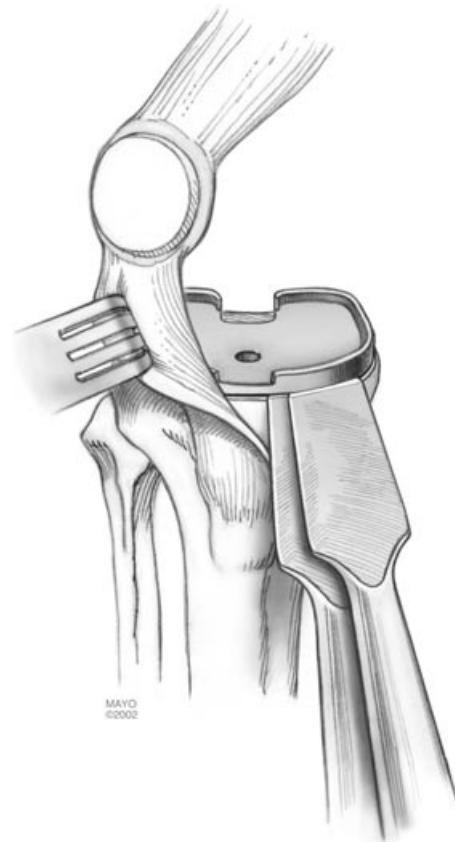
Removal of the Tibial Component

Most tibial components can be removed by passing a saw or osteotome beneath the tibial tray, then levering the tibial component away from underlying bone. As is the case for femoral components, cemented implants usually can be removed by passing an osteotome between the implant and the cement. When the metal implant is roughened, porous coated or precoated, the cement may not readily separate from the metal. In this circumstance the cement can be divided with a saw or ultrasonic instruments to facilitate implant removal. Uncemented implants usually can be removed by dividing the bone-implant interface with a saw. When pegs, central stems, or keels prevent the surgeon from passing instruments from anterior to posterior, to divide posterior interfaces of the tibial implant, good medial exposure with external tibial rotation often allows instruments to be passed in a medial to lateral direction posterior to the pegs or keel. Care should be taken to protect soft tissues in the popliteal fossa area.

Once the proximal tibial interface is divided the tibial implant usually can be removed by using stacked osteotomes (Figure 7-2) to lever the tibial implant out of the tibia or by using a manufacturer specific or generic tibial implant extractor to pull the implant out of the tibia. During this process, the knee needs to be hyperflexed and the tibia translated anteriorly to avoid impingement of the tibial tray against the femoral condyle during extraction. The surgeon needs to be careful to avoid avulsion of the patellar tendon insertion at the tibial tubercle during this exposure. When extraction is difficult, a punch can be inserted beneath the tibial tray to drive it out of the tibia with a hammer. To gain purchase on the tray with a punch, a small medial or lateral hole in the tibial metaphyseal bone may be made that allows the punch to be directed perpendicularly against the tibial tray (Figure 7-3).

The surgeon should be cautious not to exert excessive force when trying to remove a tibial tray with a well-fixed keel or stem. At times the interface between the stem and the tibia needs to be accessed directly and divided before

FIGURE 7-2. Stacked osteotomes are used to lever a tibial component away from the bone. Care must be taken to avoid crushing underlying bone. The broadest osteotome is placed nearest the bone.



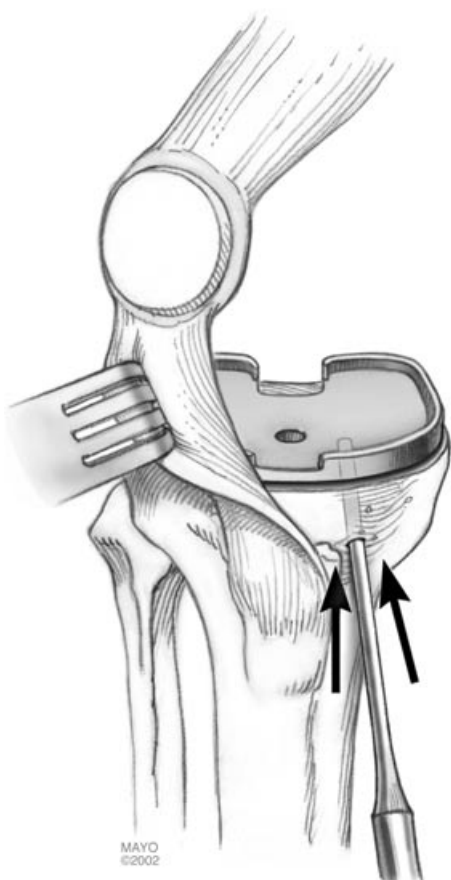


FIGURE 7-3. A punch used to disimpact a tibial component through a small hole drilled in the metaphysis.

the tray is removed. This technique is discussed in the following section.

Well-fixed, all-polyethylene implants can be removed easily by using a saw to cut through the inferior aspect of the tray at the bone-cement interface, thereby providing the surgeon with direct access to remaining cement and the keel. The keel can be removed by using a thin bur to cut the cement-implant interface.

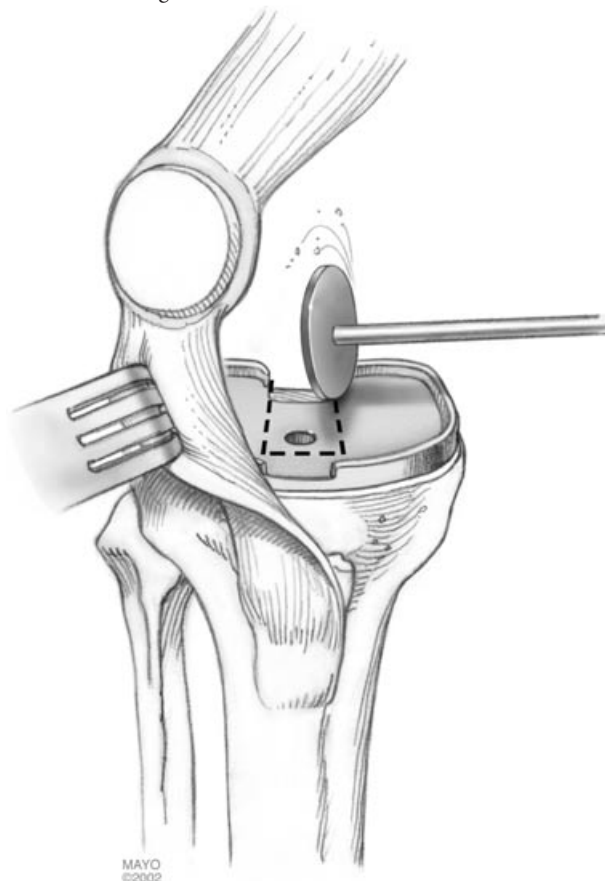
Removal of Implants with Stems

Uncemented Stems Most implants with uncemented stems can be extracted using the same methods discussed previously for condylar implants. Most long uncemented knee implant stems are smooth or fluted with smooth surfaces and are not biologically fixed in the metaphysis or diaphysis. Therefore, once the condylar interfaces are divided, the implant with the stem attached can be driven out of the bone. Well-fixed roughened or porous stems are more difficult to remove. Thin high-speed cutting tools can be used to divide the metal-bone interface, or trephines designed to remove well-fixed total hip arthro-

plasty stems can be used to cut the stem free of bone. Initial removal of the condylar portion of the implant, discussed below, may be required to access the stem.

Cemented Stems Well-fixed implants with cemented stems can be very difficult to remove⁶ and require an individualized approach that depends on the specific design and patient anatomy. Usually the interfaces of the condylar portion of the tibial or femoral implant are divided and then the implant—with stem attached—is driven out of the remaining cement. When this is not possible, sometimes the condylar portion of the implant can be disassembled from the stem, allowing the stem to be accessed separately. Alternatively, metal cutting instruments can be used to cut the stem, or a portion of the femoral or tibial implant, thereby allowing direct access to the stem (Figure 7-4). Once direct access to the stem has been gained, thin high-speed cutting tools or ultrasonic instruments can be used to divide the cement interface, allowing stem extraction. Some stems have manufacturer-specific threaded

FIGURE 7-4. Gaining access to a well-fixed tibial stem by cutting the metal tray of the tibial component. After the tray is removed, the interface along the stem can be divided.



holes in the accessible end that help the surgeon gain purchase for extraction. On rare occasions, an osteotomy of the femur or extended tibial tubercle osteotomy may be needed to remove a very well-fixed stemmed implant.

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