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Introduction

Successful total knee arthroplasty depends in part on re-establishment of normal lower extremity alignment, proper implant design and orientation, secure implant fixation, adequate soft tissue balancing and stability.

The NexGen® Complete Knee Solution is complete and totally integrated, with an extensive offering of cruciate retaining, cruciate substituting, and fully constrained component configurations, featuring design-specific, conforming surfaces, femoral and tibial augmentation, as well as innovative, precision instrumentation.

The NexGen CR-Flex Mobile Bearing Knee has been designed to offer both a cruciate retaining (CR) tibial bearing component as well as an ultra congruent (UC) tibial bearing component, allowing for multiple surgical situations to be addressed. Both the CR bearing and the UC bearing are compatible with the CR-Flex femoral component. If desired the CR and CRA femoral components can be used with the CR-Flex mobile articulating surfaces and tibial components. However, high flexion can only be accommodated with the use of the CR-Flex femoral component.

Cruciate Retaining

The CR-Flex mobile bearing knee is designed to accommodate a greater range of motion for appropriate patients, such as those whose cultural customs or recreational/work activities require deep flexion. The development is the result of an analysis of a knee prosthesis as it undergoes deep flexion beyond 120°. Multiple design features are incorporated to accommodate high flexion activities. For example, the interaction of the posterior condyles of the femoral component on the tibial bearing was carefully studied (Data on file at Zimmer). As a result, efforts have been made to optimize the contact area as the posterior condyles roll back to flexion angles up to 155° (Figure 1). This was addressed by thickening the posterior condyles, thereby extending the condylar radius in the sagittal plane. The posterior distal radius of the lateral condyle was extended slightly more than that of the medial condyle to further enhance natural anteroposterior rollback. Optimization of internal and external rotation at high flexion range of motion was achieved by modifying the medial surface of the lateral condyle. The height of the posterolateral condyle was decreased to reduce the tightness of the lateral retinacular ligament in high flexion.

The tibial bearing was also considered in the design. In deep flexion, the extensor mechanism experiences a high level of stress as the soft tissues are stretched and pulled tightly against the anterior tibia and distal femur. The CR-Flex mobile bearing knee is designed to help relieve these stresses through a larger, deeper anterior cutout on the tibial bearing. This cutout accommodates the extensor mechanism in deep flexion.

These design features accommodate high-flexion activities and, together with proper patient selection, surgical technique, and rehabilitation, increase the potential for greater range of motion.
Cruciate Sacrificing

A UC-Flex Mobile Bearing bearing provides an option with increased anterior constraint to accommodate knees with an absent or deficient posterior cruciate ligament. This component can be used with the CR, CRA, or the CR-Flex femoral components. The anterior lip of the UC-Flex mobile bearing provides additional constraint against anterior sliding of the femur in the absence or attenuation (anatomic or iatrogenic) of the PCL (Figure 2).

MIS Multi-Reference® 4-in-1 Instruments

Multi-Reference 4-in-1 Instruments are designed to help the surgeon accomplish the goals of total knee arthroplasty by combining optimal alignment accuracy with a simple, straight-forward technique. The instruments promote accurate cuts to help ensure secure component fixation. The femoral and tibial components are oriented perpendicular to this axis.

The multi-reference 4-in-1 instruments provide a choice of either anterior or posterior referencing techniques for making the femoral finishing cuts. The anterior referencing technique uses the anterior cortex to set the A/P position of the femoral component. The posterior condyle cut is variable. The posterior referencing technique uses the posterior condyles to set the A/P position of the femoral component. The variable cut is made anteriorly. The posterior referencing technique will help provide a consistent flexion gap. Femoral rotation is determined using the posterior condyles or epicondylar axis as a reference.

The instruments and technique assist the surgeon in restoring the center of the hip, knee, and ankle to lie on a straight line, establishing a neutral mechanical axis. Use the template overlay (available through your Zimmer representative) to help determine the angle between the anatomic axis and the mechanical axis of the femur. This angle should be reproduced intraoperatively.
Patient Selection

A common view among orthopaedic surgeons is that certain patients have greater potential for achieving higher flexion after knee replacement. Patients with good flexion preoperatively tend to get better motion postoperatively. To optimize use of the high-flexion design elements of the CR-Flex mobile bearing knee, the following criteria should be considered:

- The patient should have a need and desire to perform deep-flexion activities. This need may be dictated by cultural or social customs where practices such as frequent kneeling, sitting “cross-legged,” and squatting are common. Also, activities specific to daily living, leisure and recreation, or job performance may require high-flexion capability.

- The patient should be capable of reaching $110^\circ$ of flexion preoperatively with a reasonable probability of achieving a range of $125^\circ$ postoperatively.

- The patient should have a stable and functional posterior cruciate ligament (PCL) as well as collateral ligaments. In patients with severe deformity, consider the patient’s expectation for achieving high flexion.

- It may also be important to consider the length of time the patient has not performed high-flexion activities.

- The patient should have a thigh-calf index of less than $90^\circ$ (Figure 3).

- If the patient has an angular deformity, it should be less than $20^\circ$. Keep in mind that it is more difficult to achieve ligament balance in these patients.

The CR-Flex mobile bearing knee is designed to accommodate high flexion, and not create high flexion.

If using a minimally invasive technique, it is suggested that the patient criteria include non-obese patients with preoperative flexion greater than $90^\circ$. Patients with varus or valgus deformities greater than $15^\circ$ are typically candidates for a standard arthrotomy technique.

Please refer to the package inserts for complete product information, including contraindications, warnings, precautions, and adverse effects.

Figure 3
Thigh-calf angle
Preoperative Planning

This surgical technique helps the surgeon ensure that the distal femur will be cut perpendicular to the mechanical axis and, after soft tissue balancing, will be parallel to the resected surface of the proximal tibia.

Use the various templates to approximate the appropriate component sizes. The final sizes will be determined intraoperatively; therefore, larger and smaller sizes should be available during surgery. Plan appropriately to have a fixed bearing system available if a femoral/tibial mismatch exists.

Verify that the femoral and tibial component sizes approximated will be compatible. Check the appropriate knee implant size matching chart for component matching instructions. Mismatching may result in poor surface contact and could produce pain, decrease wear resistance, produce instability of the implant, or otherwise reduce implant life.

ℹ️ Note: If a femoral/tibial mismatch exists, a fixed bearing system should be used.

Preoperative Conditioning

To prepare the patient for surgery, it may be helpful for the patient to perform mobility exercises to prepare the ligaments and muscles for the postoperative rehabilitation protocol.
Surgical technique is an important factor to consider when attempting to maximize range of motion in total knee arthroplasty (TKA). Close attention must be paid to balancing the flexion and extension gaps, clearing posterior osteophytes, releasing the posterior capsule, and reproducing the joint line.

Although the joint line often changes as a result of a posterior cruciate substituting procedure, it is important that an attempt be made to maintain the joint line when high flexion is a priority. Depending on the degree, altering the joint line can cause patellofemoral issues and limit the degree of flexion. An elevated joint, for example, can cause tibiofemoral tightness in roll-back and thus restrict flexion.

When using the gap technique, it is possible that the joint line may be moved proximally, especially if there is a preoperative flexion contracture or if the selected femoral component is smaller than the A/P dimension of the femur. The alteration of the joint line can be minimized by accurately measuring for the femoral component size and performing a posterior capsulotomy to correct flexion contractures.

Patient Preparation

To prepare the limb for total knee arthroplasty, adequate muscle relaxation is required. This will facilitate the eversion of the patella, if desired, and minimize tension in the remaining quadriceps below the level of the tourniquet. It is imperative that the muscle relaxant be injected prior to inflation of the tourniquet. Alternatively, spinal or epidural anesthesia should produce adequate muscle relaxation.

If using a tourniquet, apply the proximal thigh tourniquet and inflate it with the knee in hyperflexion to maximize that portion of the quadriceps that is below the level of the tourniquet. This will help minimize restriction of the quadriceps and ease patellar eversion.

Once the patient is drapped and prepped on the operating table, determine the landmarks for the surgical incision with the leg in extension.

Incision and Exposure

The incision may be made with the leg in extension or flexion depending on surgeon preference. The surgeon can choose a midvastus approach, a subvastus approach, or a medial parapatellar arthrotomy. Also, depending on surgeon preference, the patella can be either everted or subluxed.

The length of the incision is dependent on the size of the femoral component needed. Although the goal of a minimally invasive technique is to complete the surgery with an approximately 10 cm-14 cm incision, it may be necessary to extend the incision if visualization is inadequate. If the incision must be extended, it is advisable to extend it gradually and only to the degree necessary.

Make a slightly oblique parapatellar skin incision, beginning approximately 2 cm proximal and medial to the superior pole of the patella, and extend it approximately 10 cm to the level of the superior patellar tendon insertion at the center of the tibial tubercle (Figure 4). Be careful to avoid disruption of the tendon insertion. This will facilitate access to the vastus medialis obliquus, and allow a minimal split of the muscle. It will also improve visualization of the lateral aspect of the joint obliquely. The length of the incision should be about 50% above and 50% below the joint line. If the length of the incision is not distributed evenly relative to the joint line, it is preferable that the greater portion be distal.

Divide the subcutaneous tissue to the level of the retinaculum.
MIS Midvastus Approach

Make a medial parapatellar incision into the capsule, preserving approximately 1 cm of peritenon and capsule medial to the patellar tendon. This is important to facilitate complete capsular closure.

Split the superficial enveloping fascia of the quadriceps muscle percutaneously in a proximal direction over a length of approximately 6 cm. This will mobilize the quadriceps and allow for significantly greater lateral translation of the muscle while minimizing tension on the patellar tendon insertion.

Split the vastus medialis obliquus approximately 1.5 cm-2 cm (Figure 5).

Use blunt dissection to undermine the skin incision approximately 1 cm-2 cm around the patella.

Slightly flex the knee and remove the deep third of the fat pad. The patella can be either everted or subluxed. If everting the patella, release the lateral patellofemoral ligament to facilitate full eversion and lateral translation of the patella. Then use hand-held three-pronged or two-pronged hooks to begin to gently evert the patella. Be careful to avoid disrupting the extensor insertion. To help evert the patella, slowly flex the joint and externally rotate the tibia while applying gentle pressure. Once the patella is everted, use a standard-size Hohmann retractor or two small Hohmann retractors along the lateral flare of the tibial metaphysis to maintain the eversion of the patella and the extensor mechanism.

Note: It is imperative to maintain close observation of the patellar tendon throughout the procedure to ensure that tension on the tendon is minimized, especially if everting the patella and when positioning the patient.

Remove any large patellar osteophytes.

Release the anterior cruciate ligament, if present. Perform a subperiosteal dissection along the proximal medial and lateral tibia to the level of the tibial tendon insertion. Then perform a limited release of the lateral capsule (less than 5 mm) to help minimize tension on the extensor mechanism.
MIS Subvastus Approach

Becoming accustomed to operating through a small incision and adopting the concept of a mobile window may be facilitated by starting with a shortened medial parapatellar arthrotomy. This will help to improve visualization of the anatomy during the initial stages of becoming familiar with an MIS approach.

When comfortable with the MIS medial parapatellar approach, performing the arthrotomy through a midvastus approach will help preserve the quadriceps tendon and a portion of the medial muscular attachment. As this procedure becomes more familiar, the level of the midvastus incision should be lowered to maintain more muscle attachment.

The subvastus arthrotomy provides excellent exposure through an MIS incision. The oblique portion of the incision starts below the vastus medialis obliquus (VMO) attachment and will preserve all the medial muscle attachments, including the retinacular attachment to the medial patella. A key aspect of the subvastus approach is that it is not necessary to evert the patella. This helps avoid tearing of the muscle fibers and helps maintain muscle contraction soon after surgery.

The longitudinal incision should extend only to the point of insertion of the VMO inferiorly, not to the proximal pole. Begin the arthrotomy at the medial edge of the tubercle and extend it along the border of the retinaculum/tendon to a point on the patella corresponding to 10 o’clock on a left knee or 2 o’clock on a right knee. Then continue the incision obliquely 1 cm-2 cm just below and in line with the VMO fibers (Figure 6). Do not extend the oblique incision beyond this point as it creates further muscle invasion without providing additional exposure.

Perform a medial release according to surgeon judgment, depending on the degree of varus or valgus deformity. To facilitate a medial release, place the knee in extension with a rake retractor positioned medially to provide tension that will assist in developing this plane. For valgus deformities, consider performing a more conservative medial release to avoid over-releasing an already attenuated tissue complex.

With the knee in extension and a rake retractor positioned to place tension on the patella, remove the retropatellar fat pad. Then excise a small piece of the capsule at the junction of the longitudinal and oblique retinacular incisions. This release allows the patella to retract laterally. Undermine the suprapatellar fat pad, but do not excise it. This helps ensure that the femoral A/P measuring guide will be placed directly on bone rather than inadvertently referencing off soft tissue, which may increase the femoral size measurement.

Placement of a lateral retractor is very important for adequate retraction of the patella. With the knee extended, slip the retractor into the lateral gutter and lever it against the retinaculum at the superomedial border of the patella. As the knee is flexed, the patella is retracted laterally to provide good visualization of the joint.
MIS Medial Parapatellar Arthrotomy

Minimally invasive total knee arthroplasty can be performed with a limited medial parapatellar arthrotomy. Begin by making a 10 cm-14 cm midline skin incision from the superior aspect of the tibial tubercle to the superior border of the patella. Following subcutaneous dissection, develop medial and lateral flaps, and dissect proximally and distally to expose the extensor mechanism. This permits mobilization of the skin and subcutaneous tissue as needed during the procedure. In addition, with the knee in flexion, the incision will stretch 2 cm-4 cm due to the elasticity of the skin, allowing broader exposure.

The goal of minimally invasive surgery is to limit the surgical dissection without compromising the procedure. The medial parapatellar arthrotomy is used to expose the joint, but the proximal division of the quadriceps tendon should be limited to a length that permits only lateral subluxation of the patella without eversion (Figure 7). Incise the quadriceps tendon for a length of 2 cm-4 cm initially. If there is difficulty displacing the patella laterally or if the patellar tendon is at risk of tearing, extend the arthrotomy proximally along the quadriceps tendon until adequate exposure is achieved.

MIS Quad-Sparing™ Arthrotomy

Training available at The Zimmer Institute.
Soft Tissue Releases

The objective of this procedure should be to distribute contact stresses across the artificial joint as symmetrically as possible. This requires the creation of equal and symmetrical flexion and extension gaps.

Varus Release

To correct most fixed varus deformities (Figure 8), progressively release the tight medial structures until they reach the length of the lateral supporting structures. The extent of the release can be monitored by inserting laminar spreaders within the femorotibial joint and judging alignment with a plumb line. To facilitate the release, excise osteophytes from the medial femur and tibia. These osteophytes tent the medial capsule and ligamentous structures, and their removal can produce a minimal correction before beginning the soft tissue release. Posteromedial osteophytes may need to be removed after the proximal tibia is resected.

With the knee in extension, elevate a subperiosteal sleeve of soft tissue from the proximal medial tibia, including the deep medial collateral ligament, superficial medial collateral ligament, and insertion of the pes anserinus tendons. Continue the elevation with a periosteal elevator to free the posterior fibers. To improve exposure during the release, retract this subperiosteal sleeve using a Hohmann retractor.

Release the insertion of the semimembranosus muscle from the posteromedial tibia, and concurrently remove posterior osteophytes.

Continue the release distally on the anteromedial surface of the tibia for 8 cm-10 cm and strip the periosteum medially from the tibia. This should be sufficient for moderate deformities. For more severe deformities, continue subperiosteal stripping posteriorly and distally.

When varus malalignment is present with a flexion contracture, it may be necessary to release or transversely divide the of the posterior capsule.
**Valgus Release**

Approach the valgus knee (Figure 9) in a similar fashion to that described for the varus knee; however, to provide better visualization, the bone cuts are usually made before the ligament release.

By comparison with that of a varus release, the principle of a valgus release is to elongate the contracted lateral structures to the length of the medial structures. Though lateral osteophytes may be present and should be removed, they do not bowstring the lateral collateral ligament in the same way as osteophytes on the medial side.

This is because the distal insertion of the lateral collateral ligament into the fibular head brings the ligament away from the tibial rim.

For a valgus release, a “piecrust” technique may be preferable. This technique allows lengthening of the lateral side while preserving a continuous soft tissue sleeve, as well as, preserving the popliteus tendon, which ensures stability in flexion.

With the knee in extension and distracted with a laminar spreader, use a 15 blade to transversely cut the arcuate ligament at the joint line. **Be careful not to cut or detach the popliteus tendon.** Then use the 15 blade to pierce the iliotibial band and the lateral retinaculum in a “piecrust” fashion, both proximally above the joint and distally within the joint. Following the multiple punctures, use a laminar spreader to stretch the lateral side. This should elongate the lateral side and create a rectangular extension space. Use spacer blocks to confirm ligament balance in flexion and extension.

For more severe valgus deformities, strip the lateral femoral condyle of its soft-tissue attachments proximally for about 9 cm, and then divide the periosteum, the iliotibial tract, and the lateral intramuscular septum transversely from inside out. Be sure that any part of the lateral intramuscular septum that remains attached to the distal femur is free to slide.
Step One: Resect Proximal Tibia

If preferred the distal femoral resection can be made first. Go to page 18.

⚠️ Note: For EM/IM Surgical Technique, refer to NexGen Complete Knee Solution Extramedullary/Intramedullary Tibial Resector Surgical Technique (97-5997-02 Rev. 1).

The tibial cut is made to ensure proper posterior slope and rotation, and the resection of the tibia perpendicular to the mechanical axis. The MIS tibial cut guide assembly is designed to facilitate tibial preparation through a shorter incision and without everting the patella.

Instruments Used

• MIS tibial cut guide assembly
  – ankle clamp or spring
  – ankle bar
  – MIS distal telescoping rod
  – MIS tibial adjustable rod
  – tubercle anchor
  – tibial cut guide
• resection guide
• MIS tibial depth resection stylus
• alignment guide
• alignment rod with coupler
• osteotome
• various retractors
• kocher clamp
• hex-head screwdriver
• drill/reamer
• screw inserter/extractor
• MIS screws
Assemble the Guide

The MIS tibial cut guide assembly consists of six instruments (Figure 1a).
- tibial cut guide (left or right)
- tubercle anchor (left or right)
- MIS tibial adjustable rod
- MIS distal telescoping rod
- ankle bar
- ankle clamp or spring

Attach the ankle clamp or optional spring to the ankle bar. Then slide the ankle bar onto the dovetail at the bottom of the MIS distal telescoping rod. Turn the knob opposite the dovetail to temporarily hold the bar in place.

Arrows are etched onto both the adjustable rod and the MIS distal telescoping rod to indicate the correct orientation during assembly. With the arrows aligned, insert the adjustable rod into the distal telescoping rod (Figure 1b). Adjust the length to approximate the length of the patient’s tibia and temporarily tighten the thumb screw at the proximal end of the distal rod.

Insert the correct right or left tibial cut guide into the adjustable rod and rotate the thumb wheel counterclockwise until the threads engage. Continue to rotate the thumb wheel until the guide is approximately midway through its range of travel. This will allow the depth of the tibial resection to be adjusted after the assembly is secured to the bone via the tubercle anchor.

💡 Note: The tibial cut guide and tubercle anchor are available in left and right configurations. If the incorrect tubercle anchor is used, the cut guide will not fully retract into the adjustable rod.
Assemble the Guide (cont.)

Attach the correct right or left tubercle anchor onto the corresponding side of the adjustable rod. For a left knee, the left anchor is inserted into the right hole. For a right knee, the right anchor is inserted into the left hole. Be sure that the etched line on the side of the tubercle anchor aligns with the corresponding etched line on the anterosuperior face of the adjustable rod (Figure 1c).

Position the Guide

Place the spring arms of the ankle clamp around the ankle proximal to the malleoli and loosen the anterior knob that provides mediolateral adjustment at the ankle. If preferred, the spring may be used instead of the ankle clamp.

Loosen the knob on the proximal end of the distal telescoping rod and adjust the length of the guide until the tibial cut guide is positioned at the approximate depth of cut. With the tibial cut guide and tubercle anchor contacting the bone, move the tibial cut guide mediolaterally to align the rod with the medial third of the tibial tubercle (Figure 1d). This will usually place the proximal end of the adjustable rod so it is centered below the intercondylar eminence. The tibial cut guide will contact the tibia at an oblique angle and the low-profile portion of the cutting head will fit under the patellar tendon (Figure 1e). The tubercle anchor is shaped to fit between the patellar tendon and the base of the cutting head.

Note: Be sure that only the low-profile portion of the cutting head extends beneath the patellar tendon.

When correctly aligned, the distal telescoping rod and adjustable rod should be parallel to the tibia in the coronal and sagittal planes. To help avoid rotational malalignment of the rod, check its position from a direct anterior view, i.e., stand at the foot of the operating table.
Position the Guide (cont.)

Adjust the distal end of the MIS distal telescoping rod by moving the slide at the foot of the rod medially or laterally until the guide is aligned with the mechanical axis of the tibia. The end of the MIS distal telescoping rod should be positioned about 5 mm-10 mm medial to the midpoint between the palpable medial and lateral malleoli. The tip should point to the second toe (Figure 1f). When the proper M/L position is achieved, tighten the anterior knob to secure the MIS distal telescoping rod to the ankle bar.

Loosen the knob on the side of the distal end of the MIS distal telescoping rod. Then use the slide adjustment to align the rod in the sagittal plane so it is parallel to the anterior tibial shaft. This will create a 7° posterior tibial slope. If more or less slope is desired, use the slide adjustment to obtain the desired slope. Then tighten the knob. If there is a bulky bandage around the ankle, adjust the rod to accommodate the bandage. This will help ensure that the tibia will be cut with the proper slope.

Insert an MIS screw into the tibial tubercle through the hole in the tubercle anchor (Figure 1g). Then use the resection guide through the cutting slot to assess the slope of the cut (Figure 1h).
Set the Final Resection Level

With the tibial cut guide flush against the anteromedial edge of the tibia, insert the MIS tibial depth resection stylus into the hole on the top of the tibial cut guide. For a minimal cut, swing the 2 mm arm of the stylus over the defective tibial condyle. Adjust the tibial cut guide up or down by rotating the thumb wheel until the tip of the 2 mm stylus rests on the surface of the condyle (Figure 1i). This will position the tibial cut guide to remove 2 mm of bone below the tip of the stylus.

Alternatively, swing the 10 mm arm of the MIS tibial depth resection stylus over the least involved tibial condyle. Adjust the tibial cut guide until the tip of the 10 mm arm rests on the surface of the condyle (Figure 1j). This will position the tibial cut guide to remove 10 mm of bone below the tip of the stylus.

These two points of resection will usually not coincide. The surgeon must determine the appropriate level of resection based on patient age, bone quality, and the type of prosthetic fixation planned.

**Note:** The grooves on the stem of the tibial cut guide represent 2 mm increments.

Use the hex-head screwdriver to tighten all of the screws on the tibial assembly to maintain position.
Set the Final Resection Level (cont.)

Insert an MIS screw through the medial oblong hole on the cutting head (Figure 1k). This hole is angled to facilitate screw insertion.

Place another MIS screw through the central anterior hole on the cutting head (Figure 1l). If desired, use the alignment guide and the alignment rod with coupler to confirm alignment.

Resect the Proximal Tibia

Use a 1.27 mm (0.050 in) oscillating saw blade through the slot on the tibial cut guide to cut the proximal surface of the tibia flat (Figure 1m). After cutting through the medial side and as far as possible into the lateral side, remove the cut guide assembly. Extend the knee and retract soft tissue on the lateral side. Then use an osteotome to complete the cut.

Note: Be careful to avoid cutting the patellar tendon when cutting the lateral side.

Use a kocher clamp to remove the tibial bone fragment. Then trim any remaining bone spikes on the posterior and lateral aspects of the resected tibial surface.
**Step Two: Establish Femoral Alignment**

Use the 8 mm IM drill w/step to drill a hole in the center of the patellar sulcus of the distal femur (Figure 2a) making sure that the drill is parallel to the shaft of the femur in both the anteroposterior and lateral projections. The hole should be approximately one-half to one centimeter anterior to the origin of the posterior cruciate ligament. Medial or lateral displacement of the hole may be needed according to preoperative templating of the A/P radiograph.

The step on the drill will enlarge the entrance hole on the femur to 12 mm. Suction the canal to remove medullary contents.

The adjustable IM alignment guide is available with two intramedullary rod lengths. The rod on the standard instrument is 229 mm (9 in) long and the rod on the short instrument is 165 mm (6.5 in). Choose the length best suited to the length of the patient’s leg which will provide the most accurate reproduction of the anatomic axis. If the femoral anatomy has been altered, as in a femur with a long-stem hip prosthesis or with a femoral fracture malunion, use the short adjustable IM alignment guide and use the extramedullary alignment technique.

>Note: It is preferable to use the longest intramedullary rod to guarantee the most accurate replication of the anatomic axis.

Set the adjustable IM alignment guide to the proper valgus angle as determined by preoperative radiographs. Check to ensure that the proper “Right” or “Left” indication (Figure 2b) is used and engage the lock mechanism (Figure 2c).
Step Two: Establish Femoral Alignment (cont.)

The standard cut plate must be attached to the adjustable IM alignment guide for a standard distal femoral resection (Figure 2d).

Use a hex-head screwdriver to tighten the plate (Figure 2e) on the guide prior to use. The screws must be loosened and the plate removed for sterilization.

If preferred, remove the Standard Cut Plate if a significant flexion contracture exists. This will allow for an additional 3 mm of distal femoral bone resection (Figure 2f).

Note: The mini micro cut plate can be used when templating has indicated that a micro implant is likely. When the mini micro cut plate is attached to the MIS adjustable IM alignment guide, one millimeter (1 mm) less bone is removed. However, if a significant flexion contracture exists and no plate is attached, an additional 4 mm will be removed compared to the distal femoral cut when the mini micro cut plate is attached. For less bone resection, adjustments can be made using the +2 mm/-2 mm holes on the mini distal cut guide.

Insert the IM guide into the hole in the distal femur. If the epicondyles are visible, the epicondylar axis may be used as a guide in setting the orientation of the adjustable IM alignment guide. If desired, add the threaded handles to the guide and position the handles relative to the epicondyles. This does not set rotation of the femoral component, but keeps the distal cut oriented to the final component rotation.

Once the proper orientation is achieved, impact the IM guide until it seats on the most prominent condyle. After impacting, check to ensure that the valgus setting has not changed. Ensure that the guide is contacting at least one distal condyle. This will set the proper distal femoral resection.

Optional Technique: An extramedullary alignment arch and alignment rod can be used to confirm the alignment. If this is anticipated, identify the center of the femoral head before draping. If extramedullary alignment will be the only mode of alignment, use a palpable radiopaque marker in combination with an A/P x-ray film to ensure proper location of the femoral head.
Step Three: Cut the Distal Femur

While the adjustable IM alignment guide is being inserted by the surgeon, the scrub nurse should attach the mini distal femoral cutting guide to the 0° distal placement guide (Figure 3a). A 3° distal placement guide is available which will resect the femur in 3° of flexion.

Ensure that the attachment screw is tight.

Insert the distal placement guide with the cutting guide into the adjustable IM alignment guide until the cutting guide rests on the anterior femoral cortex (Figure 3b). The mini distal femoral cutting guide is designed to help avoid soft tissue impingement.
Step Three: Cut the Distal Femur
(cont.)

Using the 3.2 mm drill bit, drill holes through the two standard pin holes marked “0” in the anterior surface of the mini distal femoral cutting guide, and place headless holding pins through the holes (Figure 3c).

Additional 2 mm adjustments may be made by using the sets of holes marked -4, -2, +2, and +4. The markings on the cutting guide indicate, in millimeters, the amount of bone resection each will yield relative to the standard distal resection set by the adjustable IM alignment guide and standard cut plate.

If more fixation is needed, use two 3.2 mm headed screws (Figure 3d) or predrill and insert two hex-head holding pins in the small oblique holes on the mini distal femoral cutting guide, or silver spring pins may be used in the large oblique holes.
Step Three: Cut the Distal Femur (cont.)

Completely loosen the attachment screw (Figure 3e) in the distal placement guide. Then use the slaphammer extractor to remove the IM alignment guide and the distal placement guide.

Cut the distal femur through the cutting slot in the cutting guide using a 1.27 mm (0.050 in.) oscillating saw blade (Figure 3f). Then remove the cutting guide.

Check the flatness of the distal femoral cut with a flat surface. If necessary, modify the distal femoral surface so that it is completely flat. This is extremely important since this cut guides the placement of all subsequent guides and to help assure proper fit of the implant.
Step Four: Check Extension Gap

After the proximal tibia and distal femur have been resected, the extension gap is evaluated using spacer blocks or a tensioning device.

Drop the alignment rod with coupler into the spacer/alignment guide. Check the flatness, slope and alignment of the tibial cut.

Apply varus and valgus stress for optimal ligament balancing. Ligament releases should be performed until the extension gap is rectangular.

When the extension gap is balanced, proceed to size femur, establish external rotation and finish the femoral cuts.

Position the knee in full extension.

Use the spacer/alignment guides or MIS spacer/alignment guides to check the extension gap, insert the thinnest appropriate spacer/alignment guide between the resected surfaces of the femur and tibia. (Figure 4a). If necessary insert progressively thicker spacer/alignment guides until the proper soft tissue tension is obtained.
Step Five: Size Femur and Establish External Rotation

Flex the knee to 90°. Attach the MIS threaded handle to the medial side of the mini A/P sizing guide, and place the guide flat onto the smoothly cut distal femur (Figure 5a). Apply the guide so that the flat surface of the mini A/P sizing guide is flush against the resected surface of the distal femur and the feet of the mini A/P sizing guide are flush against the posterior condyles.

Slide the body of the mini A/P sizing guide along the shaft to the level of the medullary canal. Position the guide mediolaterally, and check the position by looking through both windows of the guide to ensure that the medullary canal is not visible through either.

Note: Remove any osteophytes that interfere with instrument positioning.

While holding the mini A/P sizing guide in place, secure the guide to the resected distal femur using a short 3.2 mm (⅛ inch) headed screw or predrill and insert a short-head holding pin into the lateral hole in the lower portion of the guide. Then remove the threaded handle and insert a 3.2 mm (⅛ inch) headed screw or predrill and insert a short-head holding pin into the medial hole in the lower portion of the guide. Do not over tighten or the anterior portion will not slide on the distal femur. Note: Remove the threaded handle before using the screw inserter/extractor.

Slightly extend the knee and retract soft tissues to expose the anterior femoral cortex. Clear any soft tissue from the anterior cortex. Ensure that the leg is in less than 90° of flexion (70°-80°). This will decrease the tension of the patellar tendon to facilitate placement of the guide.
Step Five: Size Femur and Establish External Rotation (cont.)

Attach the MIS telescoping locking boom to the mini A/P sizing guide. Ensure that the skin does not put pressure on the top of the boom and potentially change its position. The position of the boom dictates the exit point of the anterior bone cut and the ultimate position of the femoral component. When the boom is appropriately positioned, lock it by turning the knurled knob (Figure 5b).

Read the femoral size directly from the guide between the engraved lines on the sizing tower (Figure 5c). There are eight sizes labeled “A” through “H”. With the breadth of sizes available, if the indicator is between two sizes, the size closest to the indicator is typically chosen.

If a posterior referencing technique is preferred, remove the mini A/P sizing guide and go to page 27, “STEP SIX Finish the Femur - Posterior Referencing”. If a blended technique is preferred, proceed to set external rotation and make final determination of posterior resection using the Posterior Referencing option.
Step Five: Size Femur and Establish External Rotation (cont.)

There are four external rotation plates: 0°/3° Left, 0°/3° Right, 5°/7° Left, and 5°/7° Right. Choose the external rotation plate that provides the desired external rotation for the appropriate knee. The 0° option can be used when positioning will be determined by the A/P axis or the epicondylar axis. Use the 3° option for varus knees. Use the 5° option for knees with a valgus deformity from 10° to 13°.

Attach the selected plate to the mini A/P sizing guide (Figure 5d).

Use a 3.2 mm drill to drill through the two holes that correspond to the desired external rotation. Position two headless holding pins, and impact them into the guide (Figure 5e). Leave the head of the pin proud. If preferred, the MIS headless screws may be used.

Note: Do not impact the headless holding pins flush with the external rotation plate.

Careful attention should be taken when placing the headless pins into the appropriate external rotation plate as these pins also set the A/P placement for the MIS femoral finishing guide in the next step of the procedure. It is important to monitor the location of the anterior boom on the anterior cortex of the femur to ensure the anterior cut will not notch the femur. Positioning the anterior boom on the “high” part of the femur by lateralizing the location of the boom can often lessen the likelihood of notching the femur.

Unlock and rotate the boom of the guide medially until it clears the medial condyle. Then remove the guide, but leave the two headless holding pins. These pins will establish the A/P position and rotational alignment of the femoral finishing guide.
Step Six: Finish the Femur

Option One
Posterior Referencing Technique

Option Two
Anterior Referencing Technique, page 31

Option One: Posterior Referencing Technique

Select the appropriate size MIS femoral finishing guide (silver-colored) or MIS flex femoral finishing guide (gold-colored) as determined by the measurement from the A/P sizing guide. Additional bone is removed from the posterior condyles when using the flex finishing guide. Attach the posterior reference/rotation guide to the selected femoral finishing guide (Figure 6a).

Lock the femoral position locator on the rotation guide to the zero position (Figure 6b). This zero setting ensures that, when the feet are flush with the posterior condyles, the amount of posterior bone resection will average 10 mm when using the standard MIS femoral finishing guides, and approximately 12 mm when using the MIS flex femoral finishing guides.

Technique Tip: If between sizes and you don’t want to go to larger size, you may shift the femoral cutting block 2 mm anterior using the +2 mm setting to reduce chance of notching the femur.
Option One: Posterior Referencing Technique (cont.)

Place the finishing guide on the distal femur, bringing the feet of the rotation guide flush against the posterior condyles of the femur (Figure 6c).

Set the rotation of the finishing guide parallel to the epicondylar axis. Check the rotation of the guide by reading the angle indicated by the posterior reference/rotation guide. The epicondylar line is rotated externally 0°-8°, (4°±4°), relative to the posterior condyles. The external rotation angle can also be set relative to the posterior condyles, lining up the degrees desired.

Remove any lateral osteophytes that may interfere with guide placement. Position the MIS femoral finishing guide mediolaterally. The width of the MIS femoral finishing guide replicates the width of the NexGen CR and CRA femoral component. The width of the MIS flex femoral finishing guide replicates the width of the NexGen CR-Flex femoral component. Lateralization of the femoral component is desired.

When the proper rotation and the mediolateral and anteroposterior position are achieved, secure the finishing guide to the distal femur. Use the screw inserter/extractor to insert a 3.2 mm headed screw or predrill and insert a hex-head holding pin through the superior pinhole on the beveled medial side of the femoral finishing guide (Figure 6d). Then secure the lateral side in the same manner.
Option One: Posterior Referencing Technique (cont.)

For additional fixation, drill the post holes using the patellar/femoral drill bit (Figure 6e). Then insert 6.5 mm x 35 mm periarticular bone screws through the post holes.

If desired, predrill and insert two short-head holding pins through the inferior holes on one or both sides of the guide.

Use the resection guide through the anterior cutting slot of the finishing guide, and check the medial and lateral sides to be sure the cut will not notch the anterior femoral cortex (Figure 6f).

Alternatively, the MIS locking boom attachment can be attached to the face of the femoral finishing guide. Use the MIS locking boom or telescoping locking boom to check the location of the anterior cut and determine if notching will occur (Figure 6g). The boom tip indicates where the anterior femoral cut will exit the bone.
Option One: Posterior Referencing Technique (cont.)

Use a 1.27 mm (0.050 in.) narrow, oscillating saw blade to cut the femoral profile in the following sequence for optimal stability of the finishing guide (Figure 6h):

1. Anterior condyles
2. Posterior condyles
3. Posterior chamfer
4. Anterior chamfers

Use the patellar/femoral drill bit to drill the post holes if not done previously.

Use the 1.27 mm (0.050 in.) narrow, reciprocating saw blade to cut the base of the trochlear recess (Figure 6i) and score the edges (Figure 6j). Remove the finishing guide to complete the trochlear recess cuts and complete any remaining bone cuts.
Option Two: Anterior Referencing Technique

Select the correct size MIS femoral finishing guide (silver colored) or MIS flex femoral finishing guide (gold colored) as determined by the measurement from the A/P sizing guide. An additional 2 mm (approximately) of bone is removed from the posterior condyles when using the flex femoral finishing guide.

Place the finishing guide onto the distal femur, over the headless pins (Figure 6k). This determines the A/P position and rotation of the guide. Remove any lateral osteophytes that may interfere with guide placement. Position the finishing guide mediolaterally by sliding it on the headless pins. The width of the MIS femoral finishing guide replicates the width of the NexGen CR and CRA femoral component. The width of the MIS flex femoral finishing guide replicates the width of the NexGen CR-Flex femoral component. Lateralization of the femoral component is desired.

When the proper rotation and the mediolateral and anteroposterior position are achieved, secure the finishing guide to the distal femur. Use the screw inserter/extractor to insert a 3.2 mm headed screw or predrill and insert a hex-head holding pin through the superior pinhole on the beveled medial side of the femoral finishing guide (Figure 6l). Then secure the lateral side in the same manner.

For additional fixation, drill the post holes using the patellar/femoral drill bit (Figure 6m). Then insert 6.5 mm x 35 mm periarticular bone screws through the post holes.
Option Two: Anterior Referencing Technique (cont.)

If desired, predrill and insert two short-head holding pins through the inferior holes on one or both sides of the guide.

Use the resection guide through the anterior cutting slot of the finishing guide, and check the medial and lateral sides to be sure the cut will not notch the anterior femoral cortex (Figure 6n).

Alternatively, the MIS locking boom attachment can be attached to the face of the femoral finishing guide. Use the MIS locking boom or telescoping locking boom to check the location of the anterior cut and determine if notching will occur (Figure 6o). The boom tip indicates where the anterior femoral cut will exit the bone.

Remove the headless holding pins from the femoral finishing guide (Figure 6p) with the headless pin puller.
**Option Two: Anterior Referencing Technique (cont.)**

Use a 1.27 mm (0.050 in.) narrow, oscillating saw blade to cut the femoral profile in the following sequence for optimal stability of the finishing guide (Figure 6q):

1. Anterior condyles
2. Posterior condyles
3. Posterior chamfer
4. Anterior chamfers

Use the patellar/femoral drill bit to drill the post holes if not done previously.

Use the 1.27 mm (0.050 in.) narrow, reciprocating saw blade to cut the base of the trochlear recess (Figure 6r) and score the edges (Figure 6s). Remove the finishing guide to complete the trochlear recess cuts and complete any remaining bone cuts.
Surgeon Notes and Tips

- Although a sequence of femoral cuts has been provided, the cuts may be made in any sequence. It is recommended for the surgeon to complete the cuts in a consistent sequence to help ensure that all cuts are performed. However, the peg holes should be drilled prior to assembling the MIS trochlear guide.

- If the MIS femoral finishing guide is used, the flexion gap should equal the extension gap.

- If the MIS flex femoral finishing guide is used, then the flexion gap will be approximately 2 mm greater.

- An oscillating saw with a narrow blade may also be used, or a reciprocating blade may be used to cut the sides and a chisel or osteotome used to cut the base of the notch.

- Remember that the incision can be moved both medial-to-lateral and superior-to-inferior as needed to gain optimal exposure.

- To facilitate the use of the mobile window, when resecting on the medial side, use retraction on the medial side while relaxing the lateral side. Likewise, when resecting on the lateral side, use retraction on the lateral side while relaxing the medial side.
Step Seven: Check Flexion Gap

*Knee in 90° flexion.* Use the spacer/alignment guides or MIS spacer/alignment guides to check ligament balance and joint alignment in flexion. Insert the alignment rod with coupler into the guide and check the alignment of the tibial resection (Figure 7a). Then check ligament balance. If necessary insert progressively thicker spacer blocks until the proper soft tissue tension is obtained. When using the MIS flex femoral finishing guide, the flexion gap will be greater than the extension gap. Position the CR-Flex spacer block adapter on top of the spacer block to simulate the CR-Flex component posterior condyle dimension for sizes C-G.

⚠️ *Note:* Do not use the LPS-Flex spacer block adapter since it simulates the LPS-Flex component posterior condyle dimension and will result in inaccurate representation of the CR-Flex flexion gap.

Balance Flexion/Extension Gaps

*Knee in extension.* Attach the alignment rod to the alignment rod with coupler. Check ligament balance and limb alignment in extension.

If the tension is significantly greater in extension than in flexion, re-cut the distal femur using the appropriate instrumentation. This will enlarge the extension space.

If the tension is tighter in flexion than in extension, either use a minus-size femur or perform additional ligament releases.
Note: If using the headless pins or small-head holding pins, predrill using the 3.2 mm bone screw drill.

After preparing the tibia, select the appropriate size MIS CR-Flex mobile broach plate (Figure 8a).

Base the selection first on achieving good mediolateral coverage, and then on anteroposterior coverage.

Verify that the femoral and tibial component sizes will be compatible. If there is a femoral/tibial mismatch, consider using the fixed bearing system.

Assemble the CR-Flex mobile broach and trialing plates. Position the trialing plate onto the broach plate (Figure 8b) so that the peg on the under side of the trialing plate mates with the anterior hole on the proximal surface of the broach plate. Snap the plates together tightly (Figures 8c & 8d). **Note:** If the plates are not tightly snapped, it will interfere with trialing.
Step Eight: Prepare the Tibia (cont.)

Attach the MIS sizing plate handle to the broach and trialing plate assembly (Figure 8e). The handle should be inserted on the medial side of the broach plate to provide clearance for the patella. Extend the lever on the handle and engage the tabs on the handle with the grooves on the broach plate by positioning the lever lateral to the dovetail, and clamp the lever to secure.

Ensure that the broach and trialing plate assembly is positioned as far posteriorly as possible on the lateral side without overhanging the tibia. This position may leave some bone exposed on the posteromedial tibia when the plate lines up with the posterolateral cortex.

It is recommended to use one hole on the top broach plate face and one anterior oblique hole on the opposite side if additional plate stability is needed.

Insert a small head holding pin into the lateral pin hole on the top face of the broach plate (Figure 8f).

Only the small head holding pins may be used through the top face of the broach plate. This pin will allow the bearing provisional to rotate on the assembled broach and trialing plate.
Step Eight: Prepare the Tibia (cont.)

A short-head pin or MIS screw is inserted into the medial anterior oblique hole on the broach plate (Figure 8g).

When using the anterior oblique pin holes, pay special attention to the posterior aspect of the sizing plate to ensure lift-off does not occur from over tightening/seating.

In extension, apply a valgus stress to view or palpate the lateral side of the tibia to check broach plate fit laterally.

Note: The anterior peg holes in the top face of the broach plate are used to locate the broach impactor. Do not use these holes to pin the plate on the resected tibia (Figure 8h).

Note: Do not pin through the anterior oblique hole and top face hole on the same side. In this arrangement, the pins may interfere, on smaller sizes.

Be sure that the component is properly positioned rotationally. Broach plate rotation and varus/valgus alignment can be checked by inserting the alignment rod through the hole or slot in the handle of the MIS sizing plate handle (Figure 8i). There are two options available for use of the alignment rod:

- Slot – check varus/valgus and rotational alignment (distal end of rod should point to second metatarsal)
- Round hole – check slope of tibial cut
Step Nine: Perform Trial Reduction

In this step, a trial reduction is performed to check component position, patellar tracking, ROM, and joint stability.

Check the size matching chart for component matching instructions.

The broach and trialing plate assembly is in place.

*Knee in 70°-90° flexion.* Attach the bearing provisional onto the broach and trialing plate assembly (Figure 9a).

**Note:** If femoral provisional is inserted first, it may be difficult to insert the bearing provisional onto the broach plate.

Place the collateral retractor laterally, an Army-Navy retractor anteriorly, and a rake retractor on the meniscal bed medially.

Insert the femoral provisional. Be sure that soft tissue is not trapped beneath the provisional component. Translate the femoral provisional laterally until the lateral peg of the provisional aligns with the drill hole in the lateral femoral condyle. Push the provisional in place beginning laterally, then medially.

*Knee in extension.* Check to ensure that the femoral provisional is flush against the resected surface on the medial condyle. Then retract the lateral side and check to make sure it is flush on the lateral side. The femoral provisional should be centered mediolaterally on the distal femur.

With the provisionals in place, perform a trial reduction. Check ligament stability in extension and in 30°, 60°, 90°, and 120° flexion. Check for motion between the tray and the baseplate.

**Note:** The anterior oblique pins on the broach plate may limit the rotation of the bearing provisional. If this occurs, perform a trial range of motion using the tibial plate provisional with the bearing provisional.
Step Nine: Perform Trial Reduction (cont.)

Attempt to distract the joint in flexion to ensure that it will not distract. If the bearing provisional lifts off anteriorly during flexion, check the resected bone surfaces and remove any bony protrusions. If this lift-off occurs and the resected bone surface is smooth, consider using a minus size femoral component or perform an additional release of the posterior cruciate ligament. Flex and extend the knee again with the provisionals in place to ensure that proper soft tissue balancing is complete.

Note: During the trial reduction, observe the relative position of the femoral provisional on the tibial bearing provisional by using the lines on both provisionals. The lines can be used to determine if posterior rollback is occurring, whether the PCL is functional, and if the femoral component will contact the tibial bearing in the proper location. If the PCL is properly balanced, the femoral provisional should sit near the anterior or center lines on the tibial bearing provisional in extension and near the posterior line in flexion.

If the femoral provisional sits posterior to the lines, the PCL may be too tight or the bearing may be too thick. If the femoral provisional sits anterior to the lines, the PCL may be too loose or the bearing may be too thin.

Note: If the posterior cruciate ligament is absent or deficient, the UC-Flex mobile bearing should be used.

When component position, ROM, and joint stability have been confirmed, remove all provisional components.
Step Ten: Finish the Tibia
MIS CR-Flex Mobile Tibial Component Preparation

Remove the bearing provisional and trialing plate, leaving the broach plate in place on the tibia.

Insert the M/G® uni poly remover or a small osteotome between the CR-Flex mobile broach and trialing plates to facilitate removal (Figure 10a).

*Knee flexed to 90°.*

**Technique Tip** – When encountering unusually hard, sclerotic bone on the proximal tibia, it is recommended to pre-drill the tibia prior to broaching. Attach the MIS threaded handle to the MIS drill bushing and position on the broach plate (Figure 10b). Hold the MIS drill bushing in place while drilling to ensure it remains in full contact with the broach plate. Using the cemented drill, drill half the distance to the engraved line on the cemented drill (Figure 10c). This depth will prepare for the length of the keel.

**: Note:** Make sure detents are engaged and bushing remains in full contact with the sizing plate during drilling.
MIS CR-Flex Mobile Tibial Component Preparation (cont.)

Assemble the proper size MIS cemented broach to the MIS tibial broach impactor (Figure 10d).

Seat the MIS tibial broach Impactor assembly in the corresponding broach plate holes (Figure 10e).

During broaching, make sure that the broach handle remains flush against the broach plate and in full contact with the broach plate and that the broach handle does not toggle during impaction.
MIS CR-Flex Mobile Tibial Component Preparation (cont.)

The orientation of the broach handle is important to ensure proper and complete broaching, resulting in full seating of the tibial implant on the bone (Figure 10f).

Impact the MIS tibial broach impactor assembly with care to prevent fracture of the tibia.

Caution: During impaction, take care not to move the broach handle anteriorly.

Broaching is complete when the impactor knob is fully seated against the MIS broach impactor. Impact until the instrument bottoms out on the handle stop (Figure 10g).

Remove the tibial broach impactor assembly and MIS tibial sizing plate (Figure 10h).

- Impact the under surface of the impaction head in the center of the anterior portion of the collar beneath the impaction head.
- Maintain a vertical impact direction in order to extract the broach straight out of the bone and avoid disruption of the broach preparation. Vertical extraction will also reduce stress on the instrument.

Warning: DO NOT extract with mallet blows on either the medial or lateral side of the under surface of the impaction head.

DO NOT attempt to extract the broach with a horizontal or angled blow on any side of the MIS broach impactor handle.
MIS CR-Flex Mobile Tibial Component Preparation (cont.)

The tibial bone plug may not be fully removed by the hollow broach. Use a Kocher or small rongeur to fully remove remaining bone (Figure 10i).

With the femoral provisional in place, position the knee in an appropriate flexion angle to insert the tibial plate provisional. Insert the tibial plate provisional into the broached tibia by hand (Figure 10j). Use the correct size CR-Flex mobile tibial plate provisional to ensure proper fit before implanting the final components.
MIS CR-Flex Mobile Tibial Component Preparation
(cont.)

Place the tibial impactor onto the provisional and impact until completely seated. Check to see that the trial prosthesis fits the cut surfaces with appropriate position to bone and appropriate cortical bone coverage. If any undesired gaps are present, remove the trial component and adjust the bone cuts until an intimate fit is obtained. The MIS threaded handle can be used to facilitate provisional removal.

Assemble the trialing plate on top of the tibial provisional (Figure 10k).

Slide the bearing provisional onto the trialing plate (Figure 10l).

With all the provisional components in place, perform a complete range of motion. Observe patellar tracking and tilt. If necessary, perform a lateral retinacular release.

Use the M/G uni poly removal tool or a small osteotome to remove the trialing plate from the tibial plate provisional (Figure 10m).
Step Eleven: Finish the Patella

💡 Note: It is not necessary to resurface the patella. If the surgeon prefers, the patella may be resurfaced. The geometry, depth, and length of the patella groove on the CR-Flex femoral component accommodates the unresurfaced patella.

In this step, the resection of the articulating surface of the patella is completed, and the appropriate hole(s) are drilled for the selected patellar component.

*Knee in extension.* Turn the patella approximately 90°. To facilitate exposure, apply towel clips to the nonarticular proximal and distal aspects of the patella, and apply gentle thumb pressure on the dorsal side of the patella. Sharply dissect through the prepatellar bursa to expose the anterior surface of the patella. This will provide exposure for affixing the anterior surface into the patellar clamp.

Total Surfacing Procedure

**Option One**
MIS patella resection guide

**Option Two**
Universal saw guide

**Option Three**
Patella reamer surfacing guides
Remove all osteophytes and synovial insertions from around the patella. Be careful not to damage tendon insertions on the bone. Use the patellar caliper to measure the thickness of the patella (Figure 11a). Subtract the implant thickness from the patella thickness to determine the amount of bone that should remain after resection.

**Patella Thickness – Implant Thickness**

= Bone Remaining

**Implant Thicknesses**

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**Note:** At least 11 mm of total bone needs to remain to allow for implant pegs if the patella reamer is used.
Option One: MIS Patella Resection Guide

Warning: MIS patella resection guide should not be used with a lateral approach.

*Knee in extension.* The MIS patella resection guide (Figure 11b) is positioned onto the patella without evert ing the patella. The slotted cut guide should face the medial side. The handle will be on the lateral side.

Set the mediolateral position of the guide so that the patella ridge sits in the deepest part of the “v-shape” on the posterior clamp.

Use the engraved lines to visualize the position of the patella by looking through the underside of the instrument (Figure 11d).

When orientation and position are set, clamp tightly.

 gợi ý: Take care to avoid any tilting of the patella relative to the cut slot.

**Determine the pre-cut patella thickness.** Read the scale on the central plunger at the base of the scale, above the “PRE CUT” arrow (Figure 11e).
Option One: MIS Patella Resection Guide (cont.)

Determine amount of bone to remain after resection. Using the quick-release buttons on the side of the cut guide, slide the cut guide up or down until the desired amount of bone remaining is indicated on the measurement scale. Read the measurement between the engraved lines (Figure 11f). This scale indicates the thickness of the bone that will remain after resecting the posterior patella.

Note: When releasing the buttons at the desired resection level be sure both buttons withdraw and lock fully. If they do not engage the posts fully, the cut guide may become loose during cutting.

Check resection depth and orientation with resection guide (Figure 11g). If the resection depth and orientation do not appear accurate, release the handle ratchet and reapply.

Place an osteotome or retractor behind the patella to help protect the other joint surfaces and soft tissues. Then use an oscillating saw to complete the patella resection (Figure 11h).

Release the handle and remove the instrument.

Remove the resected posterior bone.

A patella protector can be used to protect the patella during subsequent bone cuts.
Option Two: Universal Saw Guide

Apply the universal patellar saw guide in line with the patellar tendon. Push the patella up between the jaws of the saw guide. Level the patella within the saw guide jaws and use the thumbscrew to tighten the guide.

The amount to be resected across the top of the saw guide jaws should be approximately the same on all sides. Check to be sure that the 10 mm gauge does not rotate beneath the anterior surface of the patella. If the gauge hits the anterior surface of the patella as it is rotated, this indicates that at least 10 mm of bone stock will remain after the cut (Figure 11i).

Cut the patella flat so that a smooth surface remains (Figure 11j).
Option Three: Patellar Reamer Surfacing Guide

Use the patellar reamer surfing guides as templates to determine the appropriate size guide and reamer. Choose the guide which fits snugly around the patella, using the smallest guide possible (Figure 11k). If the patella is only slightly larger than the surfing guide in the mediolateral dimension, use a rongeur to remove the medial or lateral edge until the bone fits the guide.

Insert the appropriate size patellar reamer surfing guide into the patella reamer clamp (Figure 11l). Turn the locking screw until tight.

Apply the patellar reamer clamp at a 90° angle to the longitudinal axis with the patellar reamer surfing guide encompassing the bearing of the patella. Squeeze the clamp until the anterior surface of the patella is fully seated against the fixation plate (Figure 11m). Turn the clamp screw to hold the instrument in place. The anterior surface must fully seat upon the pins and contact the fixation plate.
Option Three: Patellar Reamer Surfacing Guide (cont.)

Turn the depth gauge wing on the patellar reamer clamp to the proper indication for the correct amount of bone that is to remain after reaming (Figure 11n).

Attach the appropriate size patellar reamer blade to the appropriate size patellar reamer shaft. Use only moderate hand pressure to tighten the blade.

Note: Patella reamers that use the pilot drill can also be used.

Do not overtighten the blade. Insert the patellar reamer shaft into a drill/reamer. Insert the reamer assembly into the patellar reamer surfacing guide. Raise the reamer slightly off the bone and bring it up to full speed. Advance it slowly until the prominent high points are reamed off the bone. Continue reaming with moderate pressure until the step on the reamer shaft bottoms out on the depth gauge wing of the patellar reamer clamp. Remove the reamer clamp assembly.

Proceed to “Finish the Patella” on page 54.
Option Three: Patellar Reamer Surfacing Guide (cont.)

**Insetting Technique**

Use the patellar reamer insetting guides as templates to determine the appropriate size guide and reamer. Choose the guide which will allow approximately 2 mm between the superior edge of the patella and the outer diameter of the guide (Figure 11o).

Insert the appropriate size patellar reamer insetting guide into the patellar reamer clamp. Turn the locking screw until tight. Apply the patellar reamer clamp at a 90° angle to the longitudinal axis with the patellar reamer insetting guide on the bearing. Squeeze the clamp until the anterior surface of the patella is fully seated against the fixation plate. Turn the clamp screw to hold the instrument in place. The anterior surface must fully seat on the pins and contact the fixation plate.

Turn the clamp wing to the “inset” position.

Attach the appropriate size patellar reamer blade to the appropriate size patellar reamer shaft (Figure 11p). Use only moderate hand pressure to tighten the blade.

**Do not overtighten the blade.** Insert the patellar reamer shaft into a drill/reamer.

Use the patellar reamer depth stops to control the amount of bone to be removed based on the thickness of the implant chosen.

**Note:** If using a primary porous patella with Trabecular Metal™ material, all implants are 10 mm thick.

The depth gauge wing on the patellar reamer clamp can be used instead of the stops to control the amount of bone remaining, rather than the amount of bone removed.

Insert the reamer assembly into the patellar reamer insetting guide. Raise the reamer slightly off the bone and bring it up to full speed. Advance it slowly until the prominent high points are reamed off the bone. Continue reaming with moderate pressure. Remove the reamer clamp assembly.
Finish the Patella

For the NexGen Primary Porous Patella With Trabecular Metal Material

Center the appropriate patellar drill guide over the resected patella surface with the handle on the medial side of the patella and perpendicular to the tendon. Press the drill guide firmly in place so that the teeth fully engage and the drill guide sits flat on the bone surface (Figure 11q). Drill the peg hole making sure the drill stop collar contacts the top of the drill guide (Figure 11r).

Note: The primary porous patellar clamp may be used to fully seat the drill guide on hard sclerotic bone surfaces.

For the NexGen All-Polyethylene Patella

Center the appropriate patellar drill guide over the patella with the handle on the medial side of the patella and perpendicular to the tendon. Holding the drill guide firmly in place, drill the three peg holes using the patellar/femoral drill bit (Figure 11s).
Patella Protectors

Note: The patella protectors are not recommended for use in an insetting technique.

There are 3 sizes of patella protectors available to cover the patella while completing the remaining bone resections. Choose the size that best covers the patella – 26 mm, 32 mm, or 38 mm. Handle with care; the spikes may be sharp.

A suture needs to be placed through the hole in the patella protector (Figure 11t). Loosely tie a suture through the hole on the patella protector. Attach a hemostat to the end of the suture material. Leave an adequate amount of suture material to position the hemostat away from the incision.

After the initial patella cut is completed, use thumb pressure to press the patella protector against the bone. If the bone is particularly hard, apply the patellar clamp against the patella protector. Squeeze the clamp until the patella protector is fully seated against the bone.

The patella protector should be part of the instrument count before closing the wound. It is not intended for implantation. Completely remove the suture material at the end of the operation and before sending the instrument for cleaning.

Surgeon Notes and Tips

- The suture placed through the hole in the patella protector provides a tether for finding and removing the patella protector.
Step Twelve: Implant Final Components

Instruments Used

- tibial impactor
- femoral impactor
- bearing provisional
- retractors
- cement

In this step, the final components are implanted, and the tibial bearing is secured to the implanted tibial base plate.

Ensure that the appropriate left or right femoral component, MIS CR-Flex mobile tibial component, and CR/UC-Flex mobile bearing components have been selected.

After the implants have been chosen, make a final check to ensure that the size chosen for the femoral, MIS CR-Flex mobile tibial component, and CR-Flex or UC-Flex mobile bearing components are compatible.

Tibial Base Plate

*Knee in 90° flexion.* Position the PCL retractor posteriorly, the collateral soft tissue protector laterally, and the collateral retractor medially. Sublux the tibia anteriorly. Place a layer of cement on the underside of the MIS CR-Flex mobile tibial component, around the keel, on the tibial cut surface, and in the tibial canal. Position the MIS CR-Flex mobile tibial component onto the tibia and impact until fully seated.

>Note: Take care to avoid scratching the implant component surfaces during insertion.

Thoroughly remove any excess cement in a consistent manner.

Femoral Component

*Knee in 70°-90° flexion.* Place the collateral retractor laterally and an Army-Navy retractor anteriorly. After the tibial base plate component has been implanted, ensure that the tibial base plate component is not dislodged by the retractors.

Place a layer of cement on the underside of the prosthesis and in the holes drilled in the femur.

Attach the femoral impactor/extractor to the femoral component. Insert the femoral component onto the distal femur by translating the component laterally until the lateral peg aligns with the drill hole in the lateral femoral condyle. Be sure that soft tissue is not trapped beneath the implant. Use a mallet to impact the component until fully seated.

Remove the femoral impactor/extractor, and the retractors. Check the medial and lateral sides to make sure the femoral component is fully impacted. Remove any excess cement in a thorough and consistent manner.
Patellar Component if resurfacing the patella

*Knee in extension*

**NexGen All-polyethylene Patella**

Apply cement to the anterior surface and pegs of the patellar component while in a doughy consistency. Locate the drilled peg holes and use the patellar clamp to insert and secure the patella in place. Fully open the jaws of the clamp and align the teeth to the anterior surface of the patella and the plastic ring to the posterior surface of the implant. Use the clamp to apply a significant amount of pressure to the implant to fully seat the implant on the patellar surface. Then remove excess cement.

⚠️ **Note:** If the implant post begins to engage at an angle, the implant should be removed and repositioned perpendicular to the resected surface. Insert the patella again and reclamp, applying an even distribution of pressure on the patellar surface.

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**NexGen Primary Porous Patella with Trabecular Metal Material**

Locate the drilled post hole and use the primary porous patellar clamp to insert and secure the patella in place. Fully open the jaws of the clamp and align the teeth to the anterior surface of the patella and the plastic ring to the posterior surface of the implant. Use the clamp to apply a significant amount of pressure to the implant to fully seat the implant on the patellar surface.

⚠️ **Note:** If the implant post begins to engage at an angle, the implant should be removed and repositioned perpendicular to the resected surface. Insert the patella again and reclamp, applying an even distribution of pressure on the patellar surface.
Tibial Bearing Implantation

*Knee in 70°-90° flexion.* When the appropriately-sized tibial, femoral and patellar implant components have been implanted, allow the bone cement to cure. The bearing provisional may be inserted to perform another trial reduction to confirm the bearing thickness. When the desired bearing has been determined, the bearing implant may be inserted.

1. Align the bearing with the tibial baseplate utilizing an anteromedial approach at approximately 45 degrees from the medial edge of the tibia. The bearing should be parallel with the tibial component (Figures 12a & 12b).

2. Slide the medial condyle of the bearing onto the baseplate and underneath the medial femoral condyle (Figures 12c & 12d).
3. Continue to slide the bearing at a 45 degree angle until the slot in the bearing contacts the medial side of the rail on the tibial component. Apply gentle pressure in a posterolateral direction to rotate the lateral side of the bearing underneath the lateral femoral condyle (Figures 12e & 12f).

4. Proper orientation of the bearing on tibial baseplate (Figures 12g & 12h).

To remove the bearing, reverse the steps above.

Recheck the ROM and stability of the knee.

Close Incision

Freely irrigate the wound with the solution of choice. A drain may be placed intracapsularly. Then close the wound with sutures, and apply a bandage.
Notes