Zimmer® MIS™
Natural-Knee®
Unicompartmental Intramedullary
Surgical Technique

An MIS Alternative to Total Knee Arthroplasty
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Introduction

Unicompartmental knee arthroplasty (UKA) has been shown to be a viable alternative to total knee arthroplasty for many patients with single-compartment disease. UKA has been successful even when mild to moderate (up to Grade II) chondromalacia is present in the patellofemoral joint as long as the contralateral compartment is preserved and both cruciate ligaments are functional.

The MIS™ Instruments for the Natural-Knee® Unicompartmental Knee System are designed to provide accurate, reproducible results using a minimally invasive technique. The goals of a minimally invasive surgical procedure are to:

- Facilitate the patient’s recovery
- Provide less tissue trauma
- Provide less pain
- Provide earlier mobilization
- Provide quicker rehabilitation

Combined with surgeon judgment, proper patient selection, and appropriate use of the device, this step-by-step guide to the surgical technique discusses the procedure for component selection, bone preparation, trial reduction, and component implantation. It is strongly recommended that the surgeon read the complete procedure for details, notes, and technique tips.

This technique is written for a medial compartment arthroplasty. The same technique is used for a lateral compartment arthroplasty with appropriate adjustments to reference the opposite compartment. For a lateral compartment arthroplasty, the proximity of the patella to the lateral condyle may require an extension of the incision so the patella can be adequately retracted medially.

Rationale

Instrumentation
The basic goals of unicompartmental knee arthroplasty are to improve limb alignment and function, and to reduce pain. Routinely, an effort is made to minimize disruption of the surrounding soft tissue during the procedure. The development of instruments specifically designed to be used through a smaller exposure has had a significant impact on this effort, and has enhanced the surgeon’s ability to make accurate bone cuts.

Restoration of Normal Alignment
Accurate limb alignment is described by the mechanical axis of the lower extremity, which is a straight line running from the center of the femoral head to the center of the ankle. When the center of the knee lies on or slightly lateral to this mechanical axis, the knee is said to be in neutral alignment. Unicompartmental knee disease typically reduces the joint space in the affected compartment, causing a malalignment of the joint.

Full correction of the malalignment would return the knee to neutral alignment. When establishing alignment goals for unicompartmental arthroplasty, it is particularly important to avoid overcorrection of the limb as this may increase the stress in the contralateral compartment and heighten the potential for cartilaginous breakdown. Studies of unicompartmental procedures have shown that slight undercorrection of the limb alignment correlates to long-term survivorship.\(^1\)

It is important to recognize that the methods used to adjust alignment in total knee arthroplasty (TKA) are very different from those used in unicompartmental arthroplasty. In TKA, the angle of the femoral and tibial cuts determines the postoperative varus/valgus alignment. In UKA, the angle of the cuts does not affect varus/valgus alignment. Instead, postoperative varus/valgus alignment is determined by the composite thickness of the prosthetic unicompartmental components.

In the surgical technique for the Natural-Knee Unicompartmental Knee System, the distal femoral condyle is cut at a 6° angle to the anatomic axis of the femur. The proximal tibia is cut parallel to the femoral cut, which may be perpendicular to or at an angle of up to approximately 2°-3° to the anatomic axis of the tibia, depending on patient anatomy and surgeon judgment.

Enhanced Fixation
Enhanced fixation helps stabilize the bone/implant interface and contributes to long-term arthroplasty success. Both porous and nonporous options are available on the femoral and tibial components. The porous components use Cancellous-Structured Titanium™ (CSTi™) Porous Coating while the nonporous components are grit-blasted.

The tibial component is secured with smooth pegs to help prevent stress shielding and to enhance fixation. Cementless tibial fixation is further enhanced with a titanium cancellous bone screw, which augments the component’s peripheral pegs. On the femoral component, the cruciate stem and a posterior runner contribute to component fixation as well as mediolateral and rotational stability.
Preoperative Planning

The primary objectives of preoperative planning are to choose the most appropriate implant size and to determine prosthetic placement while reestablishing joint kinematics and function. X-ray templates with 15% magnification are available for femoral and tibial component sizing to aid in meeting these objectives.

Take standing weight-bearing A/P and lateral radiographs of the affected knee, and a long standing A/P radiograph showing the center of the femoral head, the knee, and as much of the tibia as possible (preferably including the ankle). Place a skin marker, such as an EKG electrode, over the center of the femoral head for later reference.

Exposure

Place the leg in a leg holder with the knee flexed 45°. Begin the incision approximately one fingerbreadth from the medial edge of the patella, and extend it approximately 7cm-8cm to about 1cm below the joint line at the level of the tibial tubercle.

Use a subvastus approach to expose the joint, making an inverted L-shaped incision over the affected femoral condyle. Incise the synovium following the same L-shaped incision.

Use finger dissection to separate or undermine the soft tissue layers. Excise the fat pad as necessary to facilitate visualization, being careful not to cut the anterior horn of the lateral meniscus. Then incise the last fiber of the vastus medialis to free the muscle and allow lateral subluxation of the patella.

Note: It is important to avoid overcorrection. An additional radiograph while stressing the limits of the tissues may be helpful in assessing the appropriate correction.

Patient Preparation

With the patient in the supine position, test the range of hip and knee flexion. If unable to achieve 120° of knee flexion, a larger incision may be necessary to create sufficient exposure. Wrap the ankle area with an elastic wrap. Do not place bulky drapes on the distal tibia, ankle, or foot. A bulky drape in this area will make it difficult to locate the center of the ankle, and may displace the MIS Ankle Alignment Guide, which may cause inaccurate cuts.

Use a Z-retractor or bent Hohmann retractor to retract the patella laterally to expose the intercondylar notch. Reflect the soft tissue subperiosteally from the tibia along the joint line back toward, but not into, the collateral ligament.

Use another Z-retractor medially to expose the proximal tibia. Then remove the anterior horn of the meniscus.

Debride the joint and inspect it carefully. Remove all osteophytes. With medial compartment disease, osteophytes are commonly found on the lateral aspect of the medial tibial eminence and anterior to the origin of the ACL. By removing medial osteophytes, most varus deformities can be easily corrected passively. Also, remove peripheral osteophytes that interfere with the collateral ligaments and capsule. On the femur, remove intercondylar osteophytes to avoid impingement with the tibial spine or cruciate ligament. Final debridement will be performed before component implantation. Careful osteophyte removal may be important in achieving full extension.
Surgical Technique

Step One
Locate Medullary Canal

Center an 8mm (5/16-inch) drill distally on the patellar groove just anterior to both the posterior cruciate ligament and the true roof of the intercondylar notch. Holding the drill parallel to the shaft of the femur in both the A/P and lateral planes, drill the hole in the medullary canal. To help avoid contact with the medial cortex, aim the drill slightly laterally.

When withdrawing the drill from the canal, slightly toggle the drill to allow venting that will help reduce pressurization of the medullary canal during the placement of subsequent guides. Suction the canal to remove intramedullary fat.

Insert the Fluted T-handle by hand to open the medullary canal and ensure that the hole is aligned with the canal. If the T-handle is not easily inserted, reassess the orientation of the hole to ensure that it is in line with the femoral shaft. When the orientation of the hole has been confirmed, remove the Fluted T-handle.

Step Two
Prepare Femur

Cut Distal Femoral Condyle
The Distal Femoral Alignment/Saw Guide is available in four configurations: right medial, left medial, right lateral, and left lateral. The guide will remove approximately 7mm of bone and cartilage from the distal femur, which is equal to the thickness of the femoral component. When properly positioned, the guide will result in a distal femoral cut with a 6° angle from the femoral anatomic axis in the frontal plane, and in 5° of flexion to minimize the risk of patellar impingement on the anterior flange of the femoral component.

Insert the IM Rod into the canal until the stop on the rod contacts the bone. Then slide the appropriate Distal Femoral Alignment/Saw Guide over the rod until it contacts the bone. Stabilize the guide by turning the adjustable screw until it contacts the femoral condyle.

Note: The 7mm resection includes the cartilage. If there is no cartilage or if eburnated bone is present, turn the adjustable screw clockwise to move the cutting slot distally to the preferred position. If, for example, the cutting slot is moved 2mm distally, the result will be a 5mm resection. The adjustable screw provides approximately 1mm of length adjustment for each complete rotation of the screw.

Rotate the guide to allow optimal access with the saw blade, then predrill and insert a 5-inch by 1/8-inch pin through one of the two fixation holes on the side of the guide. For additional stability, insert a pin through one of the anterior holes near the cutting slot.

Check the Distal Femoral Alignment/Saw Guide to ensure that the saw blade will engage the distal femoral cortex at the meniscal abutment. If this is not clearly evident, mark the meniscal rest (junction of the tibiofemoral and patellofemoral joints) with methylene blue. Then insert the saw into the guide to determine if the blade will cut at the meniscal rest. If necessary, remove the pins and turn the adjustable screw to move the guide slightly proximally or distally to ensure a proper cut.

Using a 1mm x 2 1/4-inch Synvasive Saw Blade (11-2214) or equivalent, cut the distal femur through the cutting slot on the guide.

Remove the pins, and the Distal Femoral Alignment/Saw Guide. Leave the IM Rod in the canal to hold the patellar tendon out of the way for the remainder of the bone preparation.

If desired, use a Z-retractor on the patellar tendon to achieve better exposure.

Use a caliper to check the thickness of the resected bone fragment. Assume 1mm of bone loss due to the saw blade and 0.5mm for cartilage.

If necessary, modify the cut surface of the distal condyle so that it is completely flat. This is extremely important for the placement of subsequent guides and for proper fit of the implant. Use a saw or rongeur to smooth any bony prominences that remain and contour the peripheral edge of the femur to restore anatomic shape.
Drill Femoral Post Holes
Apply the Distal Femoral Drill Guide with the flange resting against the posterior femoral condyle. Align the guide with the axis of the cut surface of the condyle with equal bone exposed on either side of the guide.

Note: It is important to avoid the patellofemoral articulation centrally.
Impact the set pins. Then use a 1/8-inch drill bit to drill the center hole to the second calibration mark on the drill. Insert a 3-inch x 1/8-inch pin.
Use the 1/8-inch drill bit to drill the anterior and posterior post holes. Then remove the pin and use the Unicompartmental Slaphammer Extractor to remove the Distal Femoral Drill Guide.

Cut Posterior Femoral Condyle
Align the spikes on the Posterior Condyle Cutting Guide with the holes on the cut distal surface of the condyle and drive the spikes into the holes (Fig. 14). Attach the Unicompartmental Saw Capture to the cutting guide, and use an oscillating saw to resect 7mm of bone from the posterior condyle.

Note: Be careful to protect the collateral ligament during the posterior resection.
Ensure that the resected posterior surface is flat. Remove any prominences or uncut bone.
To avoid bending the spikes, use the Unicompartmental Slaphammer Extractor to remove the Posterior Condyle Cutting Guide.

Cut Posterior Chamfer
Insert the Posterior Chamfer Cutting Guide into the two anterior drill holes. Attach the Unicompartmental Saw Capture to the cutting guide, and use a reciprocating saw to cut the posterior chamfer. Ensure that the resected surface is flat. Remove any prominences or uncut bone. Then use the Unicompartmental Slaphammer Extractor to remove the Posterior Chamfer Cutting Guide.

Step Four
Prepare Tibia
Position MIS Tibial Assembly
The MIS tibial assembly is a smaller version of the tibial assembly used with the Natural-Knee II Primary Prosthesis. Attach the MIS Ankle Alignment Guide to the appropriate MIS Proximal Tibial Alignment Guide (Left Medial/Right Lateral or Right Medial/Left Lateral). Then slide the corresponding MIS Tibial Saw Guide superiorly onto the locating pin on the proximal end of the alignment guide. The radiused cutout on the saw guide mates with the rod of the Proximal Tibial Alignment Guide. Depress the button on the proximal guide and raise the sleeve until the collar contacts the underside of the saw guide.
Attach the ankle guide around the ankle. Place the knee in maximum flexion and position the superior portion of the proximal guide on the tibia, sliding the curved head around the patellar tendon. The guide should lie anterior to the ACL.
The posterior slope of the tibia may range from 4°-12°. The goal is to resect the tibia parallel to the joint surface in order to reproduce the posterior slope of the proximal tibia. Assess the angle of the tibial slope by placing a 5-inch by 1/8-inch pin on top or through the highest drill/pin hole of the Tibial Saw Guide. Then move the distal portion of the alignment guide anteroposteriorly until the pin rests parallel to the tibial plateau.
To adjust rotational alignment, position the proximal alignment guide at the medial third of the tubercle. Slide the alignment guide medially or laterally at the ankle to adjust the varus/valgus angle. Secure the position by
tightening the knob. The distal end of the rod should point to the anterior tibial/fibular ligament for a 2° varus tibial cut.

Thread the MIS Tibial Stylus into the superior hole on the saw guide. Then rotate the sleeve/box on the proximal alignment guide clockwise to lower the saw guide and stylus until the tip of the stylus is at the desired level for the appropriate resection. The cut will remove 7mm of bone below the tip of the stylus. One complete revolution of the nut will raise or lower the saw guide by approximately 1mm.

Use a small rake retractor to pull the skin clear from the proximal tibia and the Tibial Saw Guide. To stabilize the saw guide, predrill and insert 1/8-inch (3.2mm) pins medially and laterally through the holes marked “7”. This will set the guide for a 7mm resection. If the tibial defect is deeper, slide the saw guide off the pins and reinsert it through the holes marked “9,” “11,” or “13” for a corresponding 9mm, 11mm, or 13mm resection. Making a cut of at least 9mm will ensure that an adequate tibial articular surface thickness is used.

Loosen the thumbscrew on the stylus to remove it from the MIS Proximal Tibial Alignment Guide. Then depress the button and lower the sleeve to allow the alignment guide assembly to be lifted off the Tibial Saw Guide.

Make Sagittal Tibial Cut
Use methylene blue to mark the location of the sagittal cut as close to the ACL as possible. If desired, use the Tibial Sizer/Drill Guide as a reference for marking the resection line.

Using this reference line and the lines on the Tibial Saw Guide, make the vertical cut. This cut will serve as a reference point for the width of the horizontal proximal cut.

Make Proximal Tibial Cut
Place a saw blade or osteotome into the sagittal cut to help prevent undercutting the tibial spine when making the horizontal cut. Attach the Unicompartamental Saw Capture to the Tibial Saw Guide. Make the proximal tibial cut, being careful to avoid undercutting the medial tibial eminence. Then assure that a perfectly flat surface has been created by removing the saw capture and sighting along the superior surface of the saw guide, or by placing another saw guide or flat instrument on the surface of the bone cut.

Slide the Tibial Saw Guide off the headless pins, and remove any posterior horn of the meniscus that remains.

Size Tibia and Drill Tibial Screw Hole
Use the Tibial Sizer/Drill Guides to select the size that best covers the tibial surface area without any overhang. This will determine the size of the Tibial Base Plate Provisional and the final tibial base plate component. The A/P dimension is the most critical; there is more room for adjustment in the M/L plane.

Use a caliper to measure the thickness of the resected tibial fragment to ensure evenness of the cut. Then compare the fragment to the selected size Tibial Base Plate Provisional to ensure the best tibial coverage.

Using the selected size Tibial Sizer/Drill Guide, drill the central screw hole to the first calibration mark on the drill bit. If preferred, this hole can be drilled through the Tibial Base Plate Provisional. It is not necessary to drill peripheral holes for the tibial pegs.

**Step Five**
Perform Trial Reduction
With all bone surfaces prepared, perform a trial reduction with the appropriate size Femoral Provisional, Tibial Base Plate Provisional, and Tibial Articular Surface Provisional.

Position the Tibial Base Plate Provisional on the resected surface of the tibia, and impact it so the three short pegs engage the cancellous bone. The provisional should fit within the entire cortical rim without any overlap. If the all-polyethylene tibial component will be used, apply the Keel Broach over the Tibial Base Plate Provisional and impact it.

Remove the IM Rod, and retract the patellar tendon as needed. Then slide the Tibial Articular Surface Provisional onto the Tibial Base Plate Provisional and lightly impact it. Tibial Articular Surface Provisionals are available in 9mm, 11mm, and 13mm thicknesses. There is also a 7mm provisional size available for the all-poly.

Impact the correct size Femoral Provisional onto the prepared distal femur. The Femoral Provisional includes a cruciate cutter that will prepare the distal femoral surface.
to accept the cruciate stem of the femoral component. With the Femoral Provisional fully seated, use a 1/8-inch drill bit through the posterior drill hole in the provisional to create a groove for the antirotational posterior runner of the femoral component.

Check the fit of the provisional components. If necessary, perform minor trimming of bone surfaces.

Assess soft tissue balance using either the mechanical axis or the anatomic axis. If using the mechanical axis, use the preoperative x-ray with a skin marker centered over the femoral head. In unicompartmental arthroplasty, the mechanical axis should be centered over the tibial spine.

Check joint stability in full extension and in flexion. In a varus knee, a valgus stress should allow for a 1mm to 2mm opening, and should allow for the insertion of the Laxity Checker, which is 2mm thick, in both full flexion and full extension. Overstuffing should be avoided, as this will transfer stress to the contralateral compartment. For example, in a varus knee, slightly undercorrect the alignment to avoid transferring excessive stress to the lateral compartment.

After confirming that the tibial resection is correct, remove the headless pins from the anterior tibia. When stability and range of motion are satisfactory, use the Unicompartmental Slaphammer Extractor to remove the provisional components.

**Step Six**

**Implant Final Components**

Obtain the final components and implant the tibial component first.

**Technique Tip:** With the modest amount of bone removed, particularly from the tibia, there may be a sclerotic cut surface. If the resected surfaces of the tibia and/or femur are sclerotic, drill multiple holes with a small drill (2.0mm-3.2mm) to improve cement intrusion.

**Tibial Component**

If using a cemented component, apply cement. To facilitate insertion, flex the knee and externally rotate the tibia. If desired, place an opened and slightly moist sterile gauze sponge behind the tibia before implanting the components to help collect excess cement behind the tibia.

Use the Modular Tibial Impactor to impact the tibial base plate, or the All-polyethylene Tibial Impactor to impact the all-polyethylene tibial component. If using a cementless tibial base plate, insert a 40mm cancellous screw to secure it in place.

**Note:** Do not use the Modular Tibial Impactor to impact an all-polyethylene tibial component.

Remove the sterile gauze sponge slowly from behind the joint, and remove any excess cement.

**Tibial Articular Surface**

After the cement has cured, remove any remaining excess cement before the final placement of the tibial articular surface. Do not proceed with locking the final articular surface component until the cement has fully cured.

**Femoral Component**

If using the cemented component, apply cement. Engage the cruciate tip and the posterior runner of the femoral component, and impact the component carefully. Then check the final range of motion and joint stability.

**Closure**

Fashion an osteochondral plug from the resected tibial or posterior femoral fragments and insert it into the distal femoral hole to minimize bleeding. Thoroughly irrigate the knee and close in the standard manner over a suction drain. Apply a bulky, cotton roll compressive dressing. If desired, place the leg in a continuous passive motion (cpm) machine. A cold therapy machine may be used if desired. Then follow a standard knee rehabilitation protocol.

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

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