

Zimmer[®] NexGen[®] Flexion Balancing Instruments

Fixed Bearing Knees Surgical Technique



For *NexGen*[®] Cruciate Retaining Flex and *NexGen* Legacy Posterior Stabilized Flex Fixed Bearing Knees

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Introduction

Successful total knee arthroplasty (TKA) depends in part on re-establishment of normal lower extremity alignment, proper implant design and orientation, secure implant fixation, and 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.

This technique is only for fixed bearing knees. Do not use this surgical technique with LPS-Flex mobile bearing knees. Please refer to the LPS-Flex Mobile Surgical Technique (U.S. Version – part # 97-5964-302-00.

Flexion Balancing Instruments

The NexGen MIS Flexion Balancing Instruments are designed to help accomplish the goals of total knee arthroplasty with instruments that fit the surgeons' instrument philosophy by combining soft tissue balancing with alignment accuracy in a simple, straightforward technique.

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. The femoral and tibial components are oriented perpendicular to this axis. Femoral rotation is determined using the posterior condyles and epicondylar axis as references.

The flexion gap is created first. The distal cut of the femur is determined by the flexion gap. The instruments promote accurate cuts to help ensure secure component fixation.

The following should be considered when planning to use the MIS Flexion Balancing Instruments:

- The patient should have stable and functional collateral ligaments.
- If the patient has an angular deformity, it should be less than 20° since it is more difficult to achieve ligament balance in these patients.
- The anticipated size of the femoral component, based on preoperative templating should be size C-G.

The instruments are intended to be used only to implant *NexGen* LPS-Flex and CR-Flex Femoral Components. Ample component sizes allow soft tissue balancing with appropriate soft tissue release.

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.

Both the *NexGen* CR-Flex and LPS-Flex Implants are designed to safely accommodate high flexion of up to 155°.

To optimize use of the high-flexion design elements, 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 activities specific to daily living, leisure and recreation or job performance that may require highflexion capability, as well as cultural or social customs where practices such as frequent kneeling, sitting "cross-legged", and squatting are common.
- The patient should be capable of reaching 110° of flexion preoperatively with a reasonable probability of achieving a range of 125° postoperatively.
- The length of time the patient has not performed high-flexion activities should be considered.
- In patients with severe deformity preoperatively, patient expectation for achieving high flexion should be considered.

To prepare the patient for surgery, it may be helpful for the patient to perform mobility exercise to prepare the ligaments and muscles for the postoperative rehabilitation protocol.

Preoperative Planning

The surgical technique helps the surgeon ensure that anatomic alignment of 4° to 6° valgus angulation to the mechanical axis is achieved. A full leg A/P radiograph may be helpful in preoperative assessment and planning. Long radiographs are useful for determining the mechanical axis relative to the anatomical axis of the femur and for identifying deviations from the axis and deformities in the diaphyseal area of the femur and tibia that might be overlooked in more localized radiographs.

The mechanical and anatomical axes of the leg can be precisely plotted and the femoral angle α , representing the difference between the two, can be determined. This angle, which is usually about 6°, but may vary depending on morphology and patient size, is important for choosing the appropriate femoral angle bushing and therefore a correct positioning of the distal femoral cut.

By lengthening the line of the anatomical axis of the femur, it can be shown that the entry point for the intramedullary alignment guide does not necessarily lie in the center of the femoral condyle, but most of the time slightly medial to this point.

The primary objective of templating is to estimate the size of the components to be used. Use the various templates to approximate the appropriate component sizes. The final sizes will be determined intraoperatively. Therefore, at the time of surgery, sizes larger and smaller than those estimated in templating should be available. 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.

- A Anatomical axis of femur
- B Axis of the tibia
- C Mechanical axis of the leg
- D Mechanical axis of the femur
- E Resection depth of the tibia (mm)
- α Valgus angle



Surgical Technique

Surgical technique is an important factor to consider when attempting to maximize range of motion in total knee arthroplasty. 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 may change 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 rollback 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 draped and prepped on the operating table, determine the landmarks for the surgical incision with the leg in extension.

Incision and Exposure

The skin incision can be made at the surgeon's discretion with the leg in flexion or extension. Most surgeons find it easier to make the incision with the knee flexed. This provides skin tautness, and some retraction on the skin edges.

The initial incision is based on palpable landmarks and should initially extend approximately 1cm below the joint line and 1cm above the superior pole of the patella with the knee flexed (Fig. 2).



In a well-placed incision with supple soft tissues, this incision length can be adequate for the procedure. Larger amounts of subcutaneous fat, large amounts of fibrotic synovium, or thick inelastic quadriceps musculature may require more generous exposure and the surgeon must be cautious in retraction to avoid excessive tension on the skin.

Adjustments in incision placement may be performed by incision lengthening and repositioning as exposure proceeds. Raising full thickness flaps along the length of the incision improves mobility of the patella and facilitates partial eversion for patellar preparation while simultaneously improving mobility of the skin and reducing tension on the skin flaps during minimally invasive exposure.

The estimated size of the femoral component influences the length of the incision. Although the goal of a less invasive technique is to complete the surgery with an approximately 10cm-14cm incision, it may be necessary to extend the incision if visualization is inadequate or if there is excessive tension on the skin. If the incision needs to be extended, it is advisable to extend it gradually and only to the degree necessary. However, the advantage of this MIS technique is minimizing damage to the extensor mechanism and failure to consider excessive tension on the skin may lead to wound problems.

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 with the patella everted.

Divide the subcutaneous tissues to the level of the retinaculum.

MIS Midvastus Approach

The capsular incision from the superomedial corner of the patella distally to the tissue overlying the medial tibia is routine in all medial capsular approaches. Preserve approximately 1cm of peritenon and capsule medial to the patellar tendon to facilitate complete capsular closure. Split the superficial enveloping fascia of the quadriceps muscle proximally over a length of several centimeters to identify the vastus medialis obliguus (VMO) fibers inserting into the extensor mechanism. This will help mobilize the quadriceps and allow for significantly greater lateral translation of the muscle while minimizing tension on the patellar tendon insertion.

The approach becomes "midvastus" at a point proximal to the superomedial pole of the patella. Variations on the angle at which the proximal part of the capsular incision enters the muscle belly of the VMO will result in various amounts of the muscle being incised as well as variation in the amount of force required to sublux the patella laterally. Additional variables include the actual point of insertion of the VMO fibers into the patella. This insertion is variable and can take place very high (actually on the quadriceps tendon proper and not on the patellar border at all), or lower (at the midpoint of the medial patellar border), or anywhere in between. The higher the insertion of the VMO, the shorter the length of the incision into the muscle proper. The lower the insertion, the more a "low incision" into the VMO will make the exposure more like a subvastus approach and may make subluxation of the patella more difficult. It is very important to carry the capsular incision all the way to the superior border of the patella before incising the muscle belly of the VMO.



Fig. 3

After identifying the characteristics of the VMO insertion, the vastus medialis obliquus muscle belly is split by sharp dissection approximately 1.5cm-2cm (Fig. 3). The superficial muscle has only a flimsy investing fascia and this fascia, along with the muscle belly, may be split by blunt dissection; however, the deepest layer of muscle is adherent to the more robust fascia of the VMO, which should be incised sharply.

The use of a rake to retract the capsular edges medially will reveal variable amounts of synovium. The synovium may be minimal, exuberant and inflamed, or fibrotic. Removal of excessive synovium from the medial border of the capsule at the most proximal part of the exposure distally will improve exposure and, if the synovium is fibrotic, will also reduce the tension required for exposure.

Routine medial capsular exposure proceeds by sharp dissection and removal of the anterior third of the medial meniscus, and is followed by sharp dissection of the deep medial collateral ligament from its insertion on the proximal tibia. This occurs while the knee is flexed but may be carried out in extension at the surgeon's discretion. This is adequate for exposure of the medial side of the knee. The experienced surgeon may want to proceed with any medial capsular releases that are predicted to be necessary to align the limb and balance the knee, or these maneuvers may be saved for later in the procedure. At this point the medial capsular retractors are removed from the wound for exposure of the lateral side.

The knee is in extension for the preliminary portion of the lateral knee exposure. First, the mobility of the patella is determined. Rakes are used to gently mobilize the patella. Mobilization may be inhibited, however, by fibrosis of the fat pad inferiorly or scarring of the suprapatellar synovium superiorly. Both conditions can be established by careful palpation and appropriate releases performed by sharp dissection. Large patellar osteophytes may be removed at this point to make patellar mobilization easier. If partial eversion-bringing the patella perpendicular to the joint (90°)—is possible, no further dissection distally in the fat pad or proximally via suprapatellar synovectomy is needed. With the patella partially everted, the bulk of the fat pad can be debrided at the surgeons discretion. The tighter the exposure, the more fat pad debridement will facilitate visualization and cutting guide placement.

The lateral joint space is then exposed by flexing the knee. It is important to avoid disrupting the extensor insertion by gently mobilizing the patella, slowly flexing the joint, and externally rotating the tibia while applying gentle pressure on the patella. An excessively thick patella may make exposure more difficult and it may help to make a standard patellar cut to decrease the thickness of the patella. If this is necessary, the patella must be protected from retraction forces with an appropriate patellar protection device.

Once the patella is subluxed, one or two standard-size Hohmann retractors placed along the lateral flare of the tibial metaphysis will maintain the eversion of the patella and the extensor mechanism. If present, the anterior cruciate ligament is released. A subperiosteal dissection along the proximal medial and lateral tibia to the level of the tibial tendon insertion can be performed as needed to mobilize the tissue envelope and to help adequately expose the bone. Release of the lateral patellofemoral ligament and/or limited release of the lateral capsule (less than 5mm) may occasionally, but rarely, be required to help minimize tension on the extensor mechanism. Pointed Hohmann and knee joint retractors may be used to mobilize the skin and arthrotomy incision to create the "mobile window" through which the remainder of the procedure is performed.

It is very important to maintain observation of the patellar tendon and the wound margins throughout the procedure to ensure that tension on these tissues are kept to an acceptable level.

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 1cm-2cm just below and in line with the VMO fibers (Fig. 4). 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 Sizer 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.



Zimmer NexGen Flexion Balancing Instruments Surgical Technique

MIS Medial Parapatellar Arthrotomy

Minimally invasive total knee arthroplasty can be performed with a limited medial parapatellar arthrotomy. Begin by making a 10cm-14cm 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 2cm-4cm 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 (Fig. 5). Incise the quadriceps tendon for a length of 2cm-4cm 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.

Fig. 5

Zimmer MIS Quad-Sparing™ Arthrotomy

Training is available at The Zimmer Institute.

Prior experience with the MIS Midvastus, Subvastus or Medial Parapatellar approach is helpful before attending the MIS *Quad-Sparing* Course.



Fig. 6

Soft Tissue Releases

Total knee arthroplasty is a soft tissue operation as well as a bone resection operation. The objective of this procedure should be to distribute contact stresses across the artificial joint as symmetrically as possible.¹

Soft tissue balancing is vital to help assure implant stability. The basic principle for ligament release entails that the tight contracted concave side is lengthened to match the convex side. The goal is to maintain a consistent and rectangular, not rhomboidal flexion and extension gap.

With the MIS Flexion Balancing Instruments, the flexion gap is addressed first. In flexion the medial and lateral soft tissues as well as the posterior joint capsule are easily accessible for releases. This procedure helps minimize the need for releases in extension and avoids over-releasing the flexion gap.

After accessing the knee joint, balancing of the soft tissue structures and removal of osteophytes is initiated. Osteophytes may tent the medial capsule and ligamentous structures, and 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.

If planning to use a cruciate substituting or posterior stabilized implant, removing the posterior cruciate ligament (PCL) will make it easier to balance the collateral ligaments. It is necessary to completely resect the PCL. Resection of the PCL may influence the height of the flexion and extension gaps. This requires the creation of equal and symmetrical flexion and extension gaps.

Varus Release

To correct most fixed varus deformities (Fig. 7), 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.



Fig. 7

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 8cm-10cm 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.

For a fixed varus deformity, the medial release includes the deep and superficial medial collateral ligament, the semitendinosus tendon and the pes anserinus tendons.

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

Valgus Release

When correcting a fixed valgus deformity, the lateral release will include the arcuate complex, iliotibial band and lateral collateral ligament. When possible the popliteus tendon is preserved to maintain flexion stability.



Fig. 8

In contrast to 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 a severe fixed valgus deformity it may be necessary to perform a complete release of the lateral supporting structures including the lateral collateral ligament, lateral capsule, arcuate complex, and popliteus tendon. This can be performed by sharply detaching the popliteus tendon, lateral collateral ligament and posterolateral capsule from the lateral femoral epicondyle. This release can then be extended around the posterolateral corner of the femur, detaching the capsular attachments. The release is extended proximally and will detach the lateral supporting structures, including the intermuscular septum to a point 7cm – 8cm from the joint line so that the whole lateral flap is free to slide and is effectively lengthened. Another method is to osteotomize the lateral femoral epicondyle.

The bone shingle created has the aforementioned soft tissue structures attached and affords the appropriate release. Occasionally, the lateral head of the gastrocnemius requires division. Rarely is division of the biceps femoris required.

Following bone resection and soft tissue release the flexion and extension gaps are measured and should be equal and symmetrical.

Any differences must be addressed.

Step One Resect Proximal Tibia

If preferred, the patella may be resected first. See Step Eight, page 28.

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

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.

Assemble the Guide

The MIS Tibial Cut Guide Assembly consists of six instruments (Fig. 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.



Fig. 1a MIS Tibial Cut Guide Assembly

Arrows are etched onto both the MIS Tibial Adjustable Rod and the MIS Distal Telescoping Rod to indicate the correct orientation during assembly. With the arrows aligned, insert the Tibial Adjustable Rod into the Distal Telescoping Rod (Fig. 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.



Fig. 1b Arrows showing correct alignment

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 grooves on the stem of the Tibial Cut Guide represent 2mm increments (Fig. 1c).



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 (Fig. 1d).



Fig. 1d

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.

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 (Fig. 1e). 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 obligue angle and the low-profile portion of the cutting head should fit under the patellar tendon (Fig. 1f). 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 Tibial 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, ie, stand at the foot of the operating table.

Insert an MIS Screw into the tibial tubercle through the hole in the Tubercle Anchor (Fig. 1g).

> Tubercle Anchor Hole



Fig. 1g

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 5mm-10mm medial to the midpoint between the palpable medial and lateral malleoli(Fig. 1h). When the proper M/L position is achieved, tighten the anterior knob to secure the MIS Distal Telescoping Rod to the Ankle Bar. Use the Hex-head Screwdriver to tighten all of the screws on the tibial assembly to maintain position.

Then use the Resection Guide through the cutting slot to assess the slope of the cut (Fig. 1i).



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 2mm 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 2mm stylus rests on the surface of the condyle (Fig. 1j). This will position the Tibial Cut Guide to remove 2mm of bone below the tip of the stylus.



Fig. 1i

Fig. 1h

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. Alternatively, swing the 10mm arm of the MIS Tibial Depth Resection Stylus over the least involved tibial condyle. Adjust the Tibial Cut Guide until the tip of the 10mm arm rests on the surface of the condyle (Fig. 1k). This will position

MIS Tibial Depth Resection Stylus

the Tibial Cut Guide to remove 10mm of bone below the tip of the stylus.



Fig. 1j

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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.

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



Resect the Proximal Tibia

Use a 1.27mm (0.050-in) oscillating saw blade through the slot on the Tibial Cut Guide to cut the proximal surface of the tibia flat (Fig 1n). 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.



Fig. 1l

Remove the MIS Tibial Depth Resection Stylus. Place another MIS Screw through the central anterior hole on the cutting head (Fig. 1m).

Fig. 1n



Note: The MIS Depth Resection Stylus must be removed before inserting a pin or screw into the central anterior hole.

When the proximal tibial bone has been removed, resect any remaining meniscus and bone fragment. Remove femoral and tibial osteophytes. Take care to remove any remaining posterior osteophytes.

Check Tibial Resection

The surface of the tibia should be parallel to the epicondylar axis. Since further bone resection is based on the flat tibial cut, insert the Flexion Balancing Tibial Spacer Block to ensure that enough tibial bone has been removed (Fig. 10). Check the flatness and slope of the tibial cut. Insert the Alignment Rod to check that the tibial cut is perpendicular to the longitudinal axis of the tibia (Fig. 1p).



Ensure rectangular flexion/ extension gaps. Perform further ligament balancing as needed.

Fig. 1o

Step Two Drill Femoral Medullary Canal

Use the 8mm IM Drill to drill a hole in the center of the patellar sulcus of the distal femur making sure that the drill is parallel to the shaft of the femur in both the anteroposterior and lateral projections (Fig. 2a). 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.



Fig. 2a

The optional IM Hole Locater may be used to position the access point for the medullary canal (Fig. 2b).



The drill is fluted to reduce intramedullary pressure during placement of subsequent IM guides. Suction the canal to remove medullary contents.

Insert the IM Rod into the medullary canal. The Handle with Quick Connection will facilitate insertion (Fig. 2c).



The IM Rod is available in two lengths. The rod on the standard instrument is 335mm (13.5 in) long and the rod on the short instrument is 204mm (8 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-stemmed hip prosthesis or with a femoral fracture malunion, use the short IM Rod.

The IM Rod should not be inserted to the full length of the instrument but to the length best suited to help ensure the most accurate replication of the anatomic axis. The largest outer diameter of the IM Rod should be outside the canal by at least 6cm (3 in) to mate correctly with other instruments in the technique.

Step Three Size the Femur

Flex the knee to 90°.

Use electrocautery or a marking pen to mark the anatomic references for the A/P and transepicondylar axes on the femur (Fig. 3a).





Fig. 3a

The MIS Threaded Handle can be attached to the Femoral A/P Sizer to aid in positioning (Fig. 3b).



Slide the Femoral A/P Sizer over the IM Rod and move the boom to the highest position (near H) to clear the anterior femur (Fig. 3c).



The boom tip should contact the anterior sulcus of the femur (Fig. 3d). Ensure that the skin does not put pressure on the top of the boom and potentially change its position. The sizer body should be positioned in the middle of the condyles. To get an accurate reading, the feet of the A/P sizer must be flush against the posterior condyles. Read the femoral size directly from the etched sizing lines on the instrument with the engraved line (Fig. 3e). There are eight sizes labeled "A" through "H". If the indicator is between two sizes, the closest size is typically chosen. **Note: If the size is A, B or H, a different femoral preparation instrument system will be needed.**



Fig. 3e

The final determination of femoral size is confirmed in Step Seven with the MIS Flex Femoral Finishing Guide.

Mark the point on the anterior sulcus of the boom tip position. Then remove the Femoral A/P Sizer.

Fig. 3b

Step Four Establish Femoral Rotation

In this step, preliminary anterior and posterior femoral cuts are made. Final femoral cuts will be performed in Step Seven.

Back table preparation

Select the appropriate size A/P Cut Guide (Fig. 4a). The A/P Cut Guides are available in sizes C through H.



Fig. 4a

Move the locking mechanism down to the "unlocked" position to open the track for the Angle Bushing (Fig. 4b). Make sure that the thumb screw is completely untightened.



Fig. 4b

Select the Angle Bushing determined during preoperative templating. There are four Angle Bushings – left and right configurations of 4° and 6° (Fig. 4c).



Fig. 4c

Slide the selected Angle Bushing into the A/P Cut Guide (Fig. 4d). The Angle Bushing should move freely.



Fig. 4d

Use the Hex Head Screwdriver and secure the TF Telescoping Boom to the A/P Cut Guide (Fig. 4e).



Determine A/P Position Flex the knee to 90°.

Slide the A/P Cut Guide assembly over the IM Rod (Fig. 4f).



Slide the TF Telescoping Boom onto the anterior femur. The boom tip should contact the point on the anterior sulcus of the femur defined during sizing. Move the locking mechanism up into the "locked" position (Figs. 4g, 4h & 4i).



Fig. 4g



Fig. 4h



Fig. 4i

Use the Resection Guide through the anterior cutting slot and check the medial and lateral sides to be sure the cut will not notch the anterior femoral cortex.

Use the Female Hex Driver to tightly secure the locking mechanism to ensure no movement of the Angle Bushing during balancing and bone resection. Tighten the thumb screw on the locking mechanism with the Female Hex Driver (Fig. 4j). The thumb screw must be securely tightened so that it will not loosen when under tension. Fig. 4k

Balance the Knee in Flexion Be sure that the *NexGen* Balancer is not extended (Fig. 4I).



Open/Extended Fig. 4l

Use the Female Hex Driver to close the *NexGen* Balancer (Fig. 4m).



Position the *NexGen* Balancer onto the resected tibia. Insert the prongs into the bottom slots of the A/P Cut Guide (Fig. 4n).



Fig. 4n

Press and hold the Release Button on the *NexGen* Balancer (Fig. 40).



With the Female Hex Driver, turn the knob on the bottom of the *NexGen* Balancer clockwise (Fig. 4p).



Note: The Release Button must be pressed to expand the *NexGen* Balancer. However, it does not need to be pressed to reduce it.

Fig. 4j

Once the locking mechanism is tightened, remove the TF Telescoping Boom (Figs. 4k). If needed, the 3.5mm Hex-head Screwdriver can be used to aid in removal. The A/P Cut Guide will now rotate about the IM Rod. The NexGen Balancer's stop mechanism will stop at the markings on the face of the Balancer. These markings reference an articular surface thickness. However, the final determination of articular surface thickness is made during provisional trialing.

Note: You may need to release some tension in order to depress the Release Button.

Do not overexpand/tense the NexGen Balancer. Stop tensioning when manual feedback indicates soft tissue resistance. If between two measures, stop pressing the release button and allow the indicator to return to the thinner size. Note the measure as this will be the desired measurement for the extension gap (Fig. 4q).



Make sure that the A/P Cut Guide is flush with the distal femur. If the instrument has moved away from the distal femur, move it back into position.

Note: The NexGen Balancer scale has been designed for the LPS-Flex Femoral Component which has a slightly tighter flexion gap. If you plan to use a CR-Flex Component, the flexion gap will feel slightly looser during provisional trialing. Alternatively, the optional Torque Driver can be used instead of the Female Hex Driver. Use the Torque Driver with the NexGen Balancer to distract the femur from the tibia. Note the number on the scale required to set this displacement (Fig. 4r). Utilizing a lower joint force, ie, 1 or 2 on the scale, may predict articular thickness more accurately. Utilizing a higher joint force, ie, 5 or 6 on the scale, may magnify any soft tissue imbalances. Do not overtorque the instrument past the 6 marking.



Fig. 4r

Check A/P landmarks on the A/P Cut Guide with bony landmarks previously drawn on the femur (Fig. 4s). There is an etch mark on the superior surface of the A/P Cut Guide which can be used as a reference to the A/P axis.

The epicondylar landmark can be checked by inserting two headless pins into the holes on the side of the A/P Cut Guide and referencing the epicondylar line previously drawn on the femur (Fig. 4t).



Fig. 4t

Note: If any soft tissue adjustments are necessary, they must be done before pinning the A/P Cut Guide. If the soft tissues are not balanced adequately, incorrect bone cuts may result.

Pin the A/P Cut Guide using a combination of holes for the most secure fixation (Fig. 4u). Use at least one angled hole to keep the A/P Cut Guide flush to the femur during bone resection.





Remove the NexGen Balancer.

To facilitate removal of the NexGen Balancer, close the NexGen Balancer with the Female Hex Driver, turning the knob counter-clockwise (Fig. 4v).



Preliminary Anterior and Posterior Resection

When satisfied with the soft tissue tension and the femoral rotation use a 1.27mm (0.050-in.) narrow, oscillating saw blade and make the preliminary anterior and preliminary posterior cuts (Fig. 4w).



Fig. 4w

Note: Take care to protect the patellar tendon and collateral ligaments during resection.

The final femoral finishing cuts will be made in Step Seven.

Step 5 Position the Distal Cut Guide

Knee flexed 90°

The Distal Cut Guide consists of two pieces — a proximal section and a distal section (Fig. 5a).



Cut Guide, the part with the pushbutton locking mechanism to the Distal Placement Guide. Then place the Distal Placement Guide tab into the top slot of the A/P Cut Guide (Fig. 5c).

Attach the proximal end of the Distal



Fig. 5c

Secure the proximal end of the Distal Cut Guide by inserting two 3.2mm Headed Screws, or predrill and insert Headed Holding Pins (Fig. 5d).



Remove the Distal Placement Guide

The MIS Threaded Handle can be used to facilitate removal of the Distal Placement Guide (Fig. 5e).



Remove the A/P Cut Guide, and IM Rod. (Fig. 5f)



Check Flexion Gap

Use the LPS-Flex Spacer/Alignment Guides to check the flexion gap. The LPS-Flex Spacer/Alignment Guides simulate the posterior condyle thickness of the LPS-Flex Femoral Component.

With the knee in flexion, insert the flexion side of the thinnest appropriate LPS-Flex Spacer/Alignment Guide between the resected surfaces of the posterior femur and tibia (Fig. 5g). Insert the Alignment Rod into the guide and check the alignment of the tibial resection. If necessary insert progressively thicker LPS-Flex Spacer/ Alignment Guides until the proper soft tissue tension is obtained.



Note: The flexion side of the LPS-Flex Spacer/Alignment Guide should only be used to reference the preliminary resection of the posterior condyles, not the final resection.

Fig. 5a

The Distal Placement Guide is used to position the proximal section of the Distal Cut Guide on the anterior femur (Fig. 5b).



Fig. 5b

Step Six Resect Distal Femur

Leg in extension

Attach the distal section of the Distal Cut Guide. Press the push button and position the indicator at the 0mm mark (default distal cut position) (Fig. 6a).



Fig. 6a

To check femoral alignment, the Alignment Arch can be positioned in the same holes used for the Distal Placement Guide (Fig. 6b).



Fig. 6c

Use the Hex-head Screwdriver or Torque Driver with the NexGen Balancer to distract the femur from the tibia until the soft tissues are tense. Note the measurement on the NexGen Balancer (Fig. 6d). The extension gap should match the flexion gap. In addition, if using the Torque Driver, equivalent forces in flexion and extension should be used.

Set the Distal Cut Position and Make the **Distal Cut**

Secure the Distal Cut Guide by inserting two 3.2mm Headed Screws, or predrill and insert Headed Holding Pins (Fig 6f). Remove the NexGen Balancer.



Resect the distal femur using a 1.27mm (0.050-in.) oscillating saw blade (Fig. 6g).







Fig. 6b

Perform any necessary soft tissue releases.

Attach the NexGen Balancer to the Distal Cut Guide (Fig. 6c).

Fig. 6d

If desired, the distal cut position can also be adjusted to match the measurement of the flexion gap. Release the NexGen Balancer to remove tension on the joint. Press the push-button locking mechanism, and slide the distal portion of the Distal Cut Guide. The distal cut can be adjusted at +4mm, +2mm, -2mm, or -4mm from the neutral cut position (Fig. 6e).



Fig. 6e

Fig. 6g

Remove the Distal Cut Guide.

Check Flexion/Extension Gaps

After the proximal tibia and distal femur have been resected, evaluate the flexion/extension gap using the LPS-Flex Spacer/Alignment Guides (Fig. 6g).

With the knee in extension, insert the Extension side of the LPS-Flex Spacer/ Alignment Guide between the resected surfaces of the distal femur and tibia. Insert the Alignment Rod into the guide and check the leg alignment.

Apply varus and valgus stress to evaluate optimal ligament balancing. The extension gap should be rectangular.

Then flex the knee and check ligament balance and joint alignment in flexion using the LPS Flexion side of the LPS-Flex Spacer/Alignment Guide. The LPS Flexion side of the spacer guide is thinner since the final cut on the posterior condyle has not been made.

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 significantly less in extension than in flexion, either downsize the femur or perform additional ligament releases.

When the gaps are balanced, proceed to the next step, "Finish the Femur."

Note: If using a CR-Flex Femoral Component, perform a trial reduction with the minus-sized femur before downsizing the femur or performing additional ligament releases.



Fig. 6g

Step Seven Finish the Femur

Select the correct size MIS Flex Femoral Finishing Guide. Attach the MIS Modular Shelf to the finishing guide, and secure it with a Hex-head Screwdriver (Fig. 7a).



Position the guide by setting the ledge of the MIS Modular Shelf on the cut surface

Center the guide mediolaterally on the distal femur (Fig. 7b). When the M/L

position is set, secure the MIS Modular

Shelf to the anterior femur by inserting one or two short 3.2mm Headed Screws,

or predrill and insert Short-head

of the anterior femur.

Holding Pins.

Use the Screw Inserter/Extractor to insert a 3.2mm Headed Screw or predrill and insert a Hex-head Holding Pin through the superior pin hole on the beveled medial side of the guide (Fig. 7c). Then secure the lateral side in the same manner. For additional stability, use 6.5mm Screws in the peg holes. If additional fixation is needed, predrill and insert two Short-head Holding Pins through the inferior holes on one or both sides of the guide. Remove the screws/ pins that secure the MIS Modular Shelf to the resected anterior surface of the femur (Fig. 7d).



Fig. 7d

Loosen the hex-head screw on the MIS Modular Shelf and remove the shelf from the finishing 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.

Use a 1.27mm (0.050-in.) narrow, oscillating saw blade to cut the femoral profile in the following sequence for optimal stability of the finishing guide (Fig. 7e):

Fig. 7e

- 1 Finish the anterior condyles
- 2 Finish the posterior condyles
- **3** Resect the posterior chamfer
- 4 Resect the anterior chamfer



Fig. 7b



Use the Patellar/Femoral Drill Bit to drill the post holes (Fig. 7f).





Use the 1.27mm (0.050 - in.) narrow, reciprocating saw blade to cut the base of the trochlear recess (Fig. 7g) and score the edges (Fig. 7h). Remove the finishing guide to complete the trochlear recess cuts.

Check the cut surfaces for flatness.





Option 1 MIS Notch/Chamfer Trochlear Guide

The MIS Notch/Chamfer Trochlear Guide consists of two pieces for each size, the MIS Notch/Chamfer Guide and the MIS Trochlear Guide. Matching sizes must be used.

The MIS Notch/Chamfer Trochlear Guide may be used to complete the chamfer cuts, the trochlear groove, and the intercondylar box, as well as to drill the peg holes after the anterior and posterior cuts have been made with the MIS Femoral Finishing Guide.

After the anterior and posterior cuts have been made, check the flexion gap and the extension gap using the MIS Spacer Block. Make the necessary adjustments.

Knee in slight flexion

Position the appropriate size MIS Notch/Chamfer Guide onto the femur so it is flush against the resected surfaces both distally and anteriorly. Ensure that no soft tissue or osteophytes interfere with instrument positioning. Position the guide mediolaterally (Fig. 7i). Note: The distal mediolateral profile of the MIS Notch/Chamfer Guides, anterior to the tabs, can be used to position the guide referencing the lateral condyle.

Insert two Short-head Holding Pins or Short Spring Screws through the anterior flange of the guide to secure the guide in position (Fig. 7j).





Knee in 90° flexion

Secure the MIS Notch/Chamfer Guide to the femur distally with two Short Spring Screws or 3.2mm (1/8-inch) Headed Screws. Alternatively, insert two Hexhead Holding Pins (Fig. 7k). Use a reciprocating saw to cut the sides and base of the intercondylar box (Fig. 7l). Protect the tibia with a wide osteotome.



Fig. 7l Cut the sides and base of the intercondylar box

Use the Patellar/Femoral Drill to drill the femoral post holes.

Then use an oscillating saw to cut the anterior chamfer and the posterior chamfer (Fig. 7m).



Fig. 7m Cut the anterior and posterior chamfers



Fig. 7i Position the MIS Notch/Chamfer Guide flush against the femur



Fig. 7k Secure the MIS Notch/Chamfer Guide to the femur

Apply the matching size MIS Trochlear Guide to the MIS Notch/Chamfer Guide with the holes in the Trochlear Guide aligned with the threaded holes in the Notch/Chamfer Guide (Fig. 7n). Thread the MIS Threaded Handle through one of the threaded holes to secure the Trochlear Guide to the MIS Notch/ Chamfer Guide (Fig. 7o). Protect the tibia. Use a reciprocating saw through the slots in the Trochlear Guide to cut the sides and base of the trochlear groove (Fig. 7p). Remove the Trochlear Guide, and insert an osteotome over the resected tibial surface below the trochlear groove. Then use the reciprocating saw to finish the trochlear cuts.



Fig. 7n Apply the matching size MIS Trochlear Guide with the holes aligned



Fig. 70 MIS Trochlear Guide secured to MIS Notch/Chamfer Guide

Fig. 7p Cut the sides and base of the trochlear groove

Remove the MIS Notch/Chamfer Guide.

Using the MIS Notch/Chamfer Guide to downsize the femur

If there is a need to downsize the femur, the MIS Notch/Chamfer Guide and MIS Trochlear Guide can be used for sizes C-G standard implants and the Notch/ Chamfer Guide can be used for all flex sizes.

Select the preferred size Notch/Chamfer Guide and pin it to the distal femur with two Short Spring Screws or 3.2mm (1/8inch) Headed Screws (48mm length). Alternatively, insert two Hex-Head Holding Pins. Ensure that the guide is seated on the anterior and distal femur. Use a reciprocating saw to recut the sides of the intercondylar box. Use an oscillating saw to recut the anterior and posterior chamfers.

If downsizing for a CR-Flex or LPS-Flex Implant, use the posterior surface of the MIS Notch/Chamfer Guide for the posterior cut. If downsizing for a CR or LPS Implant, use the MIS Threaded Handle to attach the matching size MIS Trochlear Guide to the Notch/Chamfer Guide, and use the posterior surface of the MIS Trochlear Guide for the posterior cut.

Remove the MIS Trochlear Guide and MIS Notch/Chamfer Guide.

Option 2 MIS QS Notch Guide

Position the appropriate size MIS QS Notch Guide onto the femur so it is flush against the resected surfaces both distally and anteriorly. The MIS QS Notch Guide will not contact the anterior chamfer. Use the previously prepared trochlear recess and/or the femoral post holes to position the MIS QS Notch Guide mediolaterally. Secure the MIS QS Notch Guide to the femur with two 3.2mm (1/8-inch) Headed Screws or predrill and insert two Headed Holding Pins (Fig. 7q). Use a reciprocating saw to cut the sides and the base of the intercondylar notch (Fig. 7r). Then remove the MIS QS Notch Guide (Fig. 7s).



Fig. 7q

Step Eight Prepare the Patella

Knee flexed 90°

Turn the patella approximately 90°. To facilitate exposure, apply two 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.

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 (Fig. 8a). Subtract the implant thickness from the patella thickness to determine the amount of bone that should remain after resection.



Resect the Patella

MIS Resection Guide Technique

Note: The MIS Patella Resection Guide is not indicated for use with a lateral approach.

The MIS Patella Resection Guide (Fig. 8b) is positioned onto the patella without everting the patella. The Slotted Cut Guide should face the medial side. The handle will be on the lateral side.



Fig. 8b

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 (Fig. 8c).



When orientation and position are set, clamp tightly.

Note: 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 (Fig. 8d).



Fig. 8d

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 (Fig. 8e). 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 the Depth Resection Guide (Fig. 8f). 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 (Fig. 8g).



Fig. 8g

Release the handle and remove the instrument.

Remove the resected patella bone.

Fig. 8e

Fig. 8f

Patella Thickness – Implant Thickness = Bone Remaining

Implant Thicknesses

	Micro	Standard
26mm	7.5mm	-
29mm	7.5mm	8.0mm
32mm	8.0mm	8.5mm
35mm	8.0mm	9.0mm
38mm	-	9.5mm
41mm	-	10.0mm

Note: At least 11mm of total bone will remain to allow for implant pegs if the Patellar Reamer is used.

Universal Saw Guide Technique

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 10mm 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 10mm of bone stock will remain after the cut (Fig. 8h).



Fig. 8h

Cut the patella flat so that a smooth surface remains (Fig. 8i).

Patellar Reamer Technique Total Surfacing Procedure

Use the Patellar Reamer Surfacing 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 (Fig. 8j). If the patella is only slightly larger than the surfacing guide in the mediolateral dimension, use a rongeur to remove the medial or lateral edge until the bone fits the guide. Apply the Patellar Reamer Clamp at a 90° angle to the longitudinal axis with the Patellar Reamer Surfacing Guide encompassing the articular surface of the patella. Squeeze the clamp until the anterior surface of the patella is fully seated against the fixation plate (Fig. 8l). Turn the clamp screw to hold the instrument in place. The anterior surface must fully seat upon the pins and contact the fixation plate.



Insert the appropriate size Patellar Reamer Surfacing Guide into the Patellar Reamer Clamp (Fig. 8k). Turn the locking screw until tight. 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 (Fig. 8m).



Fig. 8m

Attach the appropriate size Patellar Reamer Blade to the appropriate size Patellar Reamer Shaft (Fig. 8n). Use only moderate hand pressure to tighten the blade.



Fig. 8n

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 32.

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 2mm between the superior edge of the patella and the outer diameter of the guide (Fig. 80).



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 articular surface. 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 (Fig. 8p). 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 10mm 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 (Fig. 8q). Drill the peg hole making sure the drill-stop collar contacts the top of the drill guide (Fig. 8r). 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 (Fig. 8s).





Optional Patella Protectors

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 – 26mm, 32mm, or 38mm. Handle with care; the spikes may be sharp.

A suture needs to be placed through the hole in the Patella Protector (Fig. 8t). 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 & Tips

• The suture placed through the hole in the Patella Protector provides a tether for finding and removing the Patella Protector.

Note: The Patella Protectors are not recommended for use in an insetting technique.



Step Nine Perform a Trial Reduction

Insert the Femoral Provisional, Patellar Provisional, Tibial Sizing Plate/ Provisional, and Tibial Articular Surface Provisional.

Insertion of Femoral Provisional Using Optional MIS Femoral Inserter/Extractor



- A. PS or CR femoral rotation setting
- B. PS or CR tension setting
- C. Femoral rotation adjustment knob
- D. Tension adjustment knob
- E. Trigger
- F. Instrument hook
- G. Locking handle
- H. Slaphammer slot

Determine the type of *NexGen* Implant or Provisional being used – Posterior Stabilized (PS) or Cruciate Retaining (CR). Refer to the side of the instrument, labeled PS or CR (see (A) & (B)) which corresponds with the implant or provisional type (Fig. 9a).

Initially adjust the femoral rotation setting and tension setting. For the femoral rotation setting, a good starting point is between the lines of the implant type (A). For the tension setting, start with the two lines aligned (B).

Open the locking handle (G) to attach the implant or provisional. Attach the implant or provisional by positioning the instrument hook (Fig. 9b).



If needed, turn the adjustment knob (C) to achieve the desired rotation of the femoral component (Fig. 9c).



Fig. 9c

Turn the tension adjustment knob (D) to increase (tighten) or decrease (loosen) the clamping force (Fig. 9d).



Fig. 9d

Close the locking handle to secure the instrument to the implant or provisional (Fig. 9e).



Align the implant or provisional onto the prepared bone, and impact the end (H).

Open the locking handle by pressing the trigger (E) to release the instrument from the implant or provisional.

If preferred, the Femoral Provisional may be positioned by hand.

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. Be sure that soft tissue is not trapped beneath the provisional component.

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.

Select the appropriate Tibial Sizing Plate/Provisional that provides the desired tibial coverage. Check the sizematching chart (for the style of *NexGen* Knee Implant) for component matching instructions.

Attach the appropriate Tibial Articular Surface Provisional and perform a trial reduction. Check ligament stability in extension and in 30°, 60°, and 90° flexion. Attempt to distract the joint in flexion to ensure that it will not distract. If a posterior stabilized component is used, hyperflex the knee and check to make sure that the spine still engages the cam.

Insert the Patellar Provisional onto the resected patellar surface. Perform a ROM to check patellar tracking.

Tibial Position Self-Centering Option

Flex and extend the knee with the provisionals in place. Check the range of motion and ligament stability. With proper soft tissue balancing complete the tibial component tends to seat itself in the position where it best articulates with the femur (Fig. 9f).



After this self-centering process has occurred, mark the position of the tibial component with methylene blue or electrocautery (Fig. 9g). Then remove the provisional components. The Femoral Extractor can be used to remove the Femoral Provisional.



Tibial Position Based on Anatomic Landmarks

The position of the tibial component can also be determined based on anatomic landmarks prior to trial reduction. Select the appropriate Pegged or Stemmed Tibial Sizing Plate/Provisional that provides the desired tibial coverage (Fig. 9h). Please refer to the *Zimmer NexGen MIS Tibial Component Cemented Surgical Technique* (97-5950-002-00) for complete product information and instructions for the MIS Tibial Pegged Stemmed Component.



Pegged Tibial Sizing Plate



Stemmed Tibial Sizing Plate
Fig. 9h

Attach the Universal Handle to the selected Tibial Sizing Plate/Provisional by depressing the button on the handle and engaging the dovetail on the handle with the dovetail on the sizing plate/ provisional and secure it by tightening the thumbscrew (Fig. 9i).



Fig. 9i

Generally, the handle aligns with the anterior aspect of the tibia. Rotate the sizing plate/provisional so the handle points at, or slightly medial to, the tibial tubercle (Fig. 9j). The Alignment Rod can be used to aid in double checking varus/ valgus alignment.



Pin the plate in place with two Shorthead Holding Pins.

The Tibial Sizing Plate/Provisional is in place.

Complete the tibial preparation according to the surgical technique of the chosen tibial implant.

Using CR Component

During the trial reduction, observe the relative position of the Femoral Provisional on the Tibial Articular Surface 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 articular surface in the proper location. If the PCL is properly balanced, the Femoral Provisional should sit near the anterior or center lines on the Tibial Articular Surface 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 articular surface may be too thick. If the Femoral Provisional sits anterior to the lines, the PCL may be too loose.

Removal of Femoral Provisional using Optional MIS Femoral Inserter/Extractor

Ensure that (A) and (B) are still set properly for the provisional type being used (PS or CR).

Position the instrument hook under the provisional (F) (Fig. 9k).



Turn the tension adjustment knob (D) to tighten or loosen as needed.

Close the locking handle (G).

Attach the slaphammer (H), and extract.

Surgeon Notes & Tips

 In performing the trial reduction and during implantation of the Femoral Provisional or prosthesis, make certain that no portion of the quadriceps or soft tissue is pinned beneath the component.

Step Ten Implant Components

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

After the implants have been chosen, make a final check to ensure that the femoral, tibial base plate, and tibial articular surface components match. If using a cemented component, mix the cement. The cement should have a doughy consistency when ready for use.

Tibial Base Plate

If a stemmed tibial base plate will be used with a stem extension, attach the desired stem extension to the stem and strike it once with a mallet. If a 10mm-14mm thick tibial articular surface will be used, insert the locking screw for the stem extension.

If a stemmed tibial base plate will be used without a stem extension, consider the need for a taper plug. If a 17mm or 20mm articular surface will be used, a stem extension or taper plug is required. A taper plug also can be used with the 10mm-14mm tibial articular surface. If it is planned to use a 14mm articular surface or if the flexion and extension gaps are not balanced, consider using the taper plug in case the final reduction reveals that it is necessary to switch to a 17mm or 20mm articular surface. Furthermore, if the articular surface should ever require revision with a 17mm or 20mm thick component, the taper plug is already in place and revision of the tibial base plate may not be necessary. Assemble the taper plug onto the tibial plate by striking it several times with a mallet to allow the ring on the taper to deform.

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 tibial base plate and on the resected tibial surface. Position the tibial base plate onto the tibia and use the Tibial Impactor to impact it until fully seated (Fig. 10a). Thoroughly remove any excess cement in a consistent manner.



Fig. 10a Use the Tibial Impactor to impact the tibial base plate.

Femoral Component Knee in 70°-90° flexion

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

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. Take care to avoid scratching the implant component surfaces. Disposable, plastic Tibial Plate Protectors may be temporarily inserted onto the tibial base plate to protect the implant surfaces during insertion of the femoral component. Remove the Tibial Plate Protector after the femur is seated. 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. Use the Femoral Impactor and Mallet to make sure the femoral component is fully impacted. 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.

Tibial Articular Surface

Knee in 70°-90° flexion

Use the Articular Surface Insertion Instrument to attach the appropriate tibial articular surface onto the tibial base plate.

The Articular Surface Insertion Instrument applies both downward and rearward forces to aid in the insertion of the articular surface onto the tibial base plate. Push the lever on the inserter fully to either side. Place the articular surface onto the tibial base plate, engaging the dovetails (Fig. 10b). Steady the surface on the base plate with one hand by applying downward pressure near the posterior cruciate cutout. Engage the hook on the inserter with the mating slot in the front of the base plate and close the lever with your index finger. This should lock the inserter to the base plate. Squeeze the handles of the inserter to seat the articular surface (Fig. 10c). Open the lever and remove the inserter. Insert an articular surface only once. Never reinsert the same articular surface onto a tibial base plate.





Technique for 17mm and 20mm Tibial Articular Surface Assemblies

A secondary locking screw is required for the 17mm and 20mm tibial articular surface components if using a Flex Femoral Component. Therefore, stemmed tibial base plates with either a stem extension or taper plug must be used with these thicker components (Fig. 10d). This assists in lift-off resistance at higher flexion positions.



Net-Shape Molded Prolong Polyethylene
Fig. 10d

Note: The pegged plate cannot be used with the 17mm or 20mm net-shape molded or *Prolong*[®] Highly Crosslinked Polyethylene Articular Surface.

With the Prolong Highly Crosslinked Polyethylene Articular Surface Component (17mm and 20mm only), the metal locking clip and screw are packaged separately from the tibial articular surface container, but in the same box. Before inserting the tibial articular surface, insert the metal locking clip into the anterior slot of the compartment. The rail should be aligned with the space in the slot. There is an arrow on the superior side of the locking clip that indicates the correct direction for insertion. The purpose of the rail is to prevent the clip from being assembled incorrectly. The metal locking clip should glide easily into the slot. The clip is properly seated when a click is heard. For the molded tibial articular surface, the metal locking clip is preassembled into the component.

A taper plug also can be used with the 10mm to 14mm articular surface components. If you plan to use a 14mm component or the flexion and extension gaps are not balanced, consider using the taper plug in case, during final reduction, it would be necessary to use a 17mm or 20mm component. Then, if the articular surface should ever require revision with a 17mm or 20mm thick component, the taper plug is already in place and revision of the tibial plate component may not be necessary.

If bone cement was used to implant the tibial base plate, wait for the cement to completely cure before attaching the tibial articular surface. Select the LCCK Tibial Plate Wrench that matches the size of the implant to be assembled. Place the end of the wrench over the tibial base plate. Ensure that the wrench is in line with the base of the tibial base plate.

Place the locking screw through the hole in the tibial articular surface. Then use the LCCK Deflection Beam Torque Wrench with the 4.5mm Hex Driver Bit to torque the screw to 95 in-lbs Do not overtorque or undertorque.

NexGen All-polyethylene Patella *Knee in 70°-90° flexion*

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.

Patellar Component NexGen Primary Porous Patella with Trabecular Metal Material Knee in 70°-90° flexion

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.

Recheck the ROM and stability of the knee.

Zimmer NexGen Flexion Balancing Instruments Surgical Technique

Step Eleven Close Incision

Freely irrigate the wound with the solution of choice. A drain may be placed within the capsule. Proceed with wound closure.

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

Close the capsule and perform a "drop and dangle" test to predict the range of motion for the patient (Fig. 11a).

Rehabilitation Protocol

An equally important factor in gaining or maintaining high flexion after successful total knee arthroplasty is early and/or aggressive rehabilitation of the patient. Many of the standard rehabilitation protocols used in western-style hospitals today are aimed at restoring knee motion and function between 90° and 110°, which is sufficient for the TKA patient to get into or out of a chair or a car. Those patients undergoing TKA who are able and willing to flex and wish to maintain preoperative flexibility may be better off with earlier and/or relatively more aggressive rehabilitation exercises.





Position the knee in flexion to continue closing the layers (Fig. 11b).



Fig. 11b

References

1 Insall JN. Surgery of the Knee. 3rd ed. New York, NY: Churchill Livingston; 2001:1553.

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

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