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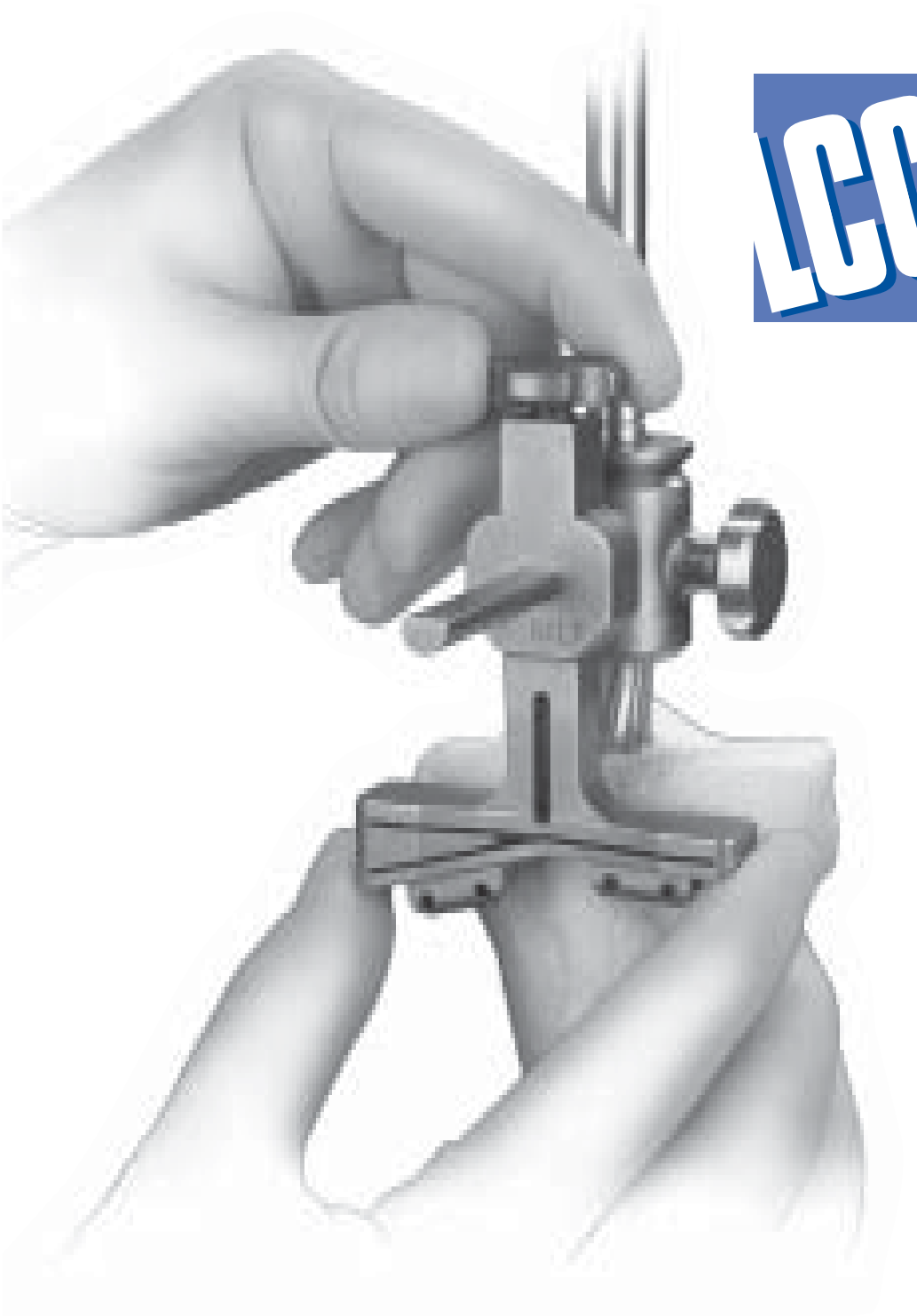

LCCK

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Revision Instrumentation Surgical Technique For *Legacy*® Knee Constrained Condylar Knee

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INTRODUCTION

Revision total knee arthroplasty can be a very challenging task for any orthopaedic surgeon.

Failure of a primary arthroplasty may have many causes, including wear, aseptic loosening, infection, osteolysis, ligamentous instability, and patellofemoral complications. One of the most important requirements in revision knee surgery is to identify the exact failure mode of the preceding arthroplasty. If this is not clearly understood, the revision is less likely to succeed. A common reason for failure in a revision total knee arthroplasty is to repeat the errors which occurred at the previous TKA.

In approaching revision procedures, the surgeon must consider the planning of the incision over a previously operated site, the condition of the soft tissue, the functionality of the extensor mechanism, the extraction of the primary prosthesis, and the preservation of bone stock. The primary goals of a revision procedure include the restoration of anatomical alignment and functional stability, the fixation of the revision implants, and the accurate reestablishment of the joint line.

Critical to achieving a successful revision surgery is the development of efficient and accurate instrumentation combined with effective surgical techniques.

This surgical technique was developed in conjunction with:

Kim C. Bertin, M.D.
Utah Orthopaedic Specialists
Latter Day Saints Hospital
Salt Lake City, UT

Kelly Vince, M.D., F.R.C.S. (C)
Associate Professor of Orthopaedic Surgery
USC Center for Arthritis and
Joint Implant Surgery,
Los Angeles, CA

Robert E. Booth, Jr., M.D.
Professor of Orthopaedic Surgery
University of Pennsylvania Health System
Chief, Department of Orthopaedic Surgery
Pennsylvania Hospital
Philadelphia, PA

Wayne G. Paprosky, M.S., F.A.C.S.
Associate Professor
Rush-Presbyterian-St. Lukes Medical Center
Chicago, IL
Staff Surgeon, Dept. of Adult Reconstruction
Central DuPage Hospital
Winfield, IL

Aaron G. Rosenberg, M.D.
Professor of Orthopaedic Surgery
Arthritis and Orthopaedic Institute
Rush Medical College
Rush-Presbyterian-St. Luke's Medical Center
Chicago, IL

Harry E. Rubash, M.D.
Chief, Department of Orthopaedics
Massachusetts General Hospital
Boston, MA

GOALS OF REVISION SURGICAL TECHNIQUE

1. Establish Tibial Platform

The first goal is to establish a prosthetic platform on solid existing tibial bone stock. This will provide a reference plane for evaluating the flexion and extension gaps.

2. Stabilize Knee in Flexion

Next, the femoral component size that will stabilize the knee in flexion is chosen and, if needed, augmentation to fit the femoral condylar bone stock is determined. Flexion and extension gaps are balanced.

3. Stabilize Knee in Extension

Finally, an acceptable position for the joint line is estimated. This will aid in the determination of the proper articulating surface thickness, distal femoral position, and femoral size that will stabilize the knee in extension.

INSTRUMENT DESIGN RATIONALE

The *NexGen* Revision Instruments are an intramedullary referencing system. All femoral and tibial cuts are based from reamers or stem extension provisionals located within the medullary canal. In this way, the instruments reference one of the remaining reliable landmarks of the diseased or badly deformed knee; usually the medullary canal. The instruments also allow the surgeon to confirm alignment using extramedullary checks throughout the procedure.

The Femoral Provisional/Cutting Guides serve double duty: as guides to perform the augmentation cuts, as well as provisionals to facilitate trial reductions before and after bone resection.

IMPLANT DESIGN RATIONALE

The *NexGen Legacy* LCCK Femoral Component is intended for use in patients who, in the surgeon's judgement, require additional prosthetic stabilization due to inadequate mediolateral, anteroposterior, and varus/valgus ligament function. The LCCK Femoral Component can also be used in conjunction with the *NexGen Legacy* LPS Articular Surface in cases where the use of a femoral augment or stem extension is needed due to poor or absent femoral bone stock, but adequate ligament stability is present. When the LCCK Femoral Component is used with an LPS Articular Surface, lesser varus/valgus constraint is provided.

The LCCK Components feature a close fit between the elevated tibial spine and the intercondylar box, partially restricting varus/valgus and rotational component movement. This close fit is designed to provide stability for patients who lack functional collateral ligaments or whose knees cannot be stabilized by the usual soft tissue releases.

To further accommodate the specific needs of each patient, three tibial base plate styles are available for use with the LCCK Femoral Component, (Precoat Stemmed, A/P Wedge, and Fluted). The LCCK Components can be used with a stemmed A/P wedge tibial base plate when anterior bone stock is compromised and a non-sloped (0˚) tibial cut is preferred or the 3 Degree Fluted tibial base plate when a 3° cut is preferred. The LCCK Components can also be used with the standard stemmed base plates when the tibial plateau allows for a 7-degree posterior slope cut.

PREOPERATIVE PLANNING

As with all revision arthroplasty, preoperative planning is essential. Estimate the size of the femoral component by templating from a true lateral x-ray of the contralateral knee. Be sure that the LCCK Stem Extension Template is centered within the femoral medullary canal. Intraoperative restoration of the appropriate A/P depth of the femur will yield the most appropriate flexion gap which can then be used to help determine the extension gap. Estimate the need for posterior femoral augmentation by overlaying the appropriate size femoral template on the lateral x-ray of the failed total knee replacement. Templating the proximal/distal position of the femoral component on an A/P x-ray is often difficult. Use the inferior pole of the patella to help determine the appropriate position of the joint line.

Templating the tibial component can yield similar information. Determine the level of bone resection and the possible need for augmentation or an offset stem by centering the tibial stem extension within the tibial canal on the A/P x-ray. Template the tibia from the lateral x-ray to assure that excessive tibial slope does not significantly change the tibial resection level. Use the lateral x-ray to initially choose between the stemmed A/P wedged, 3 degree fluted or stemmed standard tibial component design.

The Zimmer Revision Knee Arthroplasty Surgical Guidelines is strongly recommended for a more complete discussion on revision total knee arthroplasty technique. (This booklet can be ordered through Zimmer, reference catalog number 97-5224-03).

PRIMARY PROSTHESIS EXTRACTION

Remove the failed tibial and femoral components, compromising remaining bone as little as possible. Remove all cement and debride all bone surfaces down to good quality bone. Perform a synovectomy when indicated to remove cement or wear debris.

Inspect the patellar component for wear and loosening. If either is present, remove the patellar prosthesis. If the patellar component is not worn and is well fixed, decide whether the design is compatible with the *NexGen* LCCK Femoral Component. If the design is compatible, it may be more appropriate to leave the previous patellar component and avoid damage to the patellar bone. If the design is not compatible, replace the patellar component.

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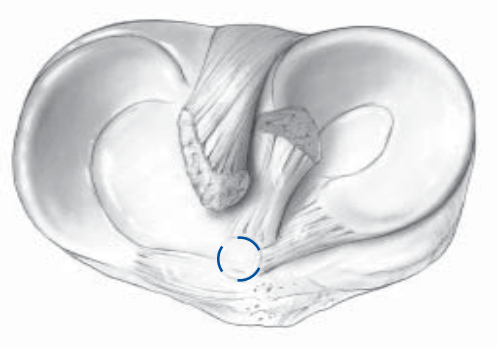
STEP ONE

DETERMINE TIBIAL PROSTHETIC PLATFORM

After removing the tibial component, remove cement and other debris. If necessary, drill a starting hole. Center the 8mm IM Drill mediolaterally. For primary arthroplasty, locate it just anterior to the insertion of the anterior cruciate ligament.



For revision arthroplasty, locate it approximately 15mm from the anterior cortex. In revision, the location of the medullary canal must be determined from preoperative radiographic planning and confirmed at the time of surgery by the location of the tibial crest. The entry point for the drill should be over the midpoint of the isthmus of the tibial canal, not necessarily the midpoint of the proximal tibial. This is particularly important if an offset stem is anticipated. With the drill properly positioned, drill the hole.

Prepare the tibial canal by using progressively larger Intramedullary Reamers beginning with the 9mm diameter reamer. Ream to a depth that allows all the reamer teeth to be buried beneath the surface of the bone. Proceed up to the diameter size that contacts the cortical bone (Fig. 1).

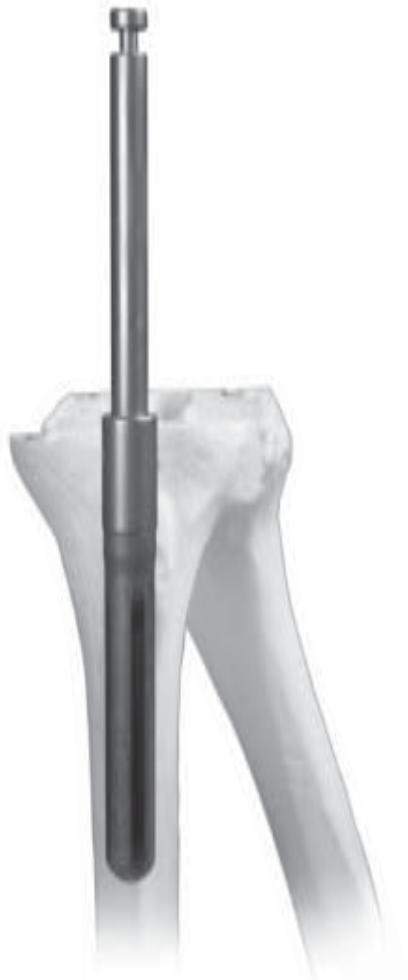
Fig. 1

The appropriate size of the final reamer should be estimated in preoperative planning and is confirmed when cortical bone contact is made.

Note: The reamers are not end cutting but, instead, have a bullet tip lead that reduces the chance of perforating the cortex of the tibial bone. Insert the first size reamer that engages cortical bone deeper than the length of tibial stem to be used. This, in turn, will allow adequate room for the next larger diameter reamers to be inserted to the final depth without the bullet tip stopping progression of the reamer.

Be sure that the reamer remains in line with the tibial shaft based on external tibial landmarks. Retained cement and/or sclerotic bone in this area will tend to deflect passage of the reamer. If this happens, remove the cement or sclerotic bone. Leave the final Intramedullary Reamer in place, or remove the reamer and attach the Straight Stem Extension Provisional that corresponds to the last reamer size used to the Stem Provisional Adapter (Fig. 2). Insert the stem provisional and adapter into the reamed canal.

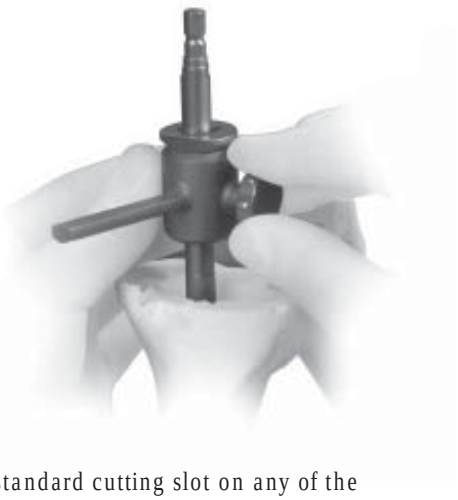
Fig. 2



Note: A shorter, possibly larger diameter, stem may be desired. Preparation for this stem is accomplished after the tibia is cut by further reaming to the shorter depth with the required diameter reamers.

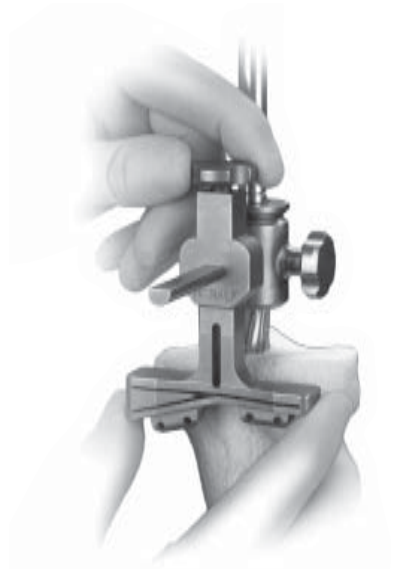
Attach the appropriate Tibial Boom to the reamer shaft (Fig. 3) or the stem provisional assembly. There are two Tibial Boom options: 0-degree and 7-degree posterior slope configurations. Use the 0-degree boom when a stemmed A/P wedged tibial base plate requiring a non-sloped (0°) tibial cut is used. Use the 3-degree boom when a 3 Degree Fluted Plate is used. Use the 7-degree boom on all other standard stemmed tibial plate options within the *NexGen* System. Be sure to direct the boom anteriorly over the medial half of the tibial tubercle.

Fig. 3



The standard cutting slot on any of the augmented tibial cutting guides can be used for a flat cut. Slide the selected tibial cutting guide onto the Tibial Boom until it contacts the anterior tibia. Then tighten the thumb screw (Fig. 4).

Fig. 4



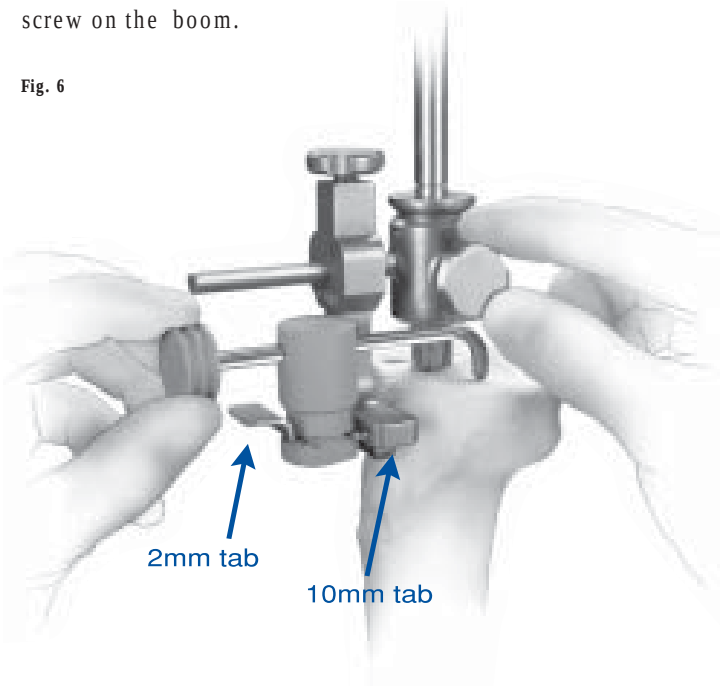
The rotation of the tibial cutting guide is important. Orient the cutting guide so it cuts directly from the front to the back of the tibia. Varus/valgus orientation is equally important. Check this by attaching the Extramedullary Arch to the Tibial Boom and tightening the thumb screw. Then insert the Alignment Rod through the arch (Fig. 5).

Fig.5

Palpate the malleoli and note the midpoint. The cutting guide should be positioned so the Alignment Rod follows the anterior tibial crest and points about 7mm-10mm medial to the midpoint between the malleoli. The tibialis anterior tendon can also be used to check the varus/valgus position of the cutting guide. The distal end of the Alignment Rod should be in line with the tendon. This will help confirm that the resected surface will be 90 degrees to the mechanical axis.

After proper rotation and varus/valgus orientation has been achieved, determine the appropriate depth of resection by taking into consideration the depth of any defects that are present. This should be a minimal resection. The purpose of this cut is to create a flat surface only. Use the Tibial Depth Resection Gauge to define where the saw cut will be made. Insert the 2mm or 10mm tab of the gauge into the cutting slot (Fig. 6) depending on which resection level has been selected. Minimal bone removal is recommended. It is not necessary to resect below all defects. Relatively small defects can be grafted and others filled with cement or augments. When the appropriate depth has been determined, tighten the thumb screw on the boom.

Fig. 6



Note: When the A/P wedge or 3 degree fluted tibial component has been chosen, the measurement for depth of resection should be taken as far posterior on the tibia as possible. This should be performed to help reestablish the joint line because the posterior slope is built into the implant and not cut into the bone.

Pin the tibial cutting guide to the tibia securely with two Headless Holding Pins. Use an oscillating saw with a 0.050-inch blade to cut through the slots (Fig. 7). Initiate the resection with the reamer or Stem Provisional Adaptor in place. Be sure that the tibial cutting guide is securely attached to the reamer or Stem Provisional Adapter during the initial cutting process. This adds further stability to the cutter.

After cutting the medial and lateral plateaus, remove the Tibial Boom and reamer or provisional assembly leaving the tibial cutting guide in place, then finish the cut.

Remove the tibial cutting guide.

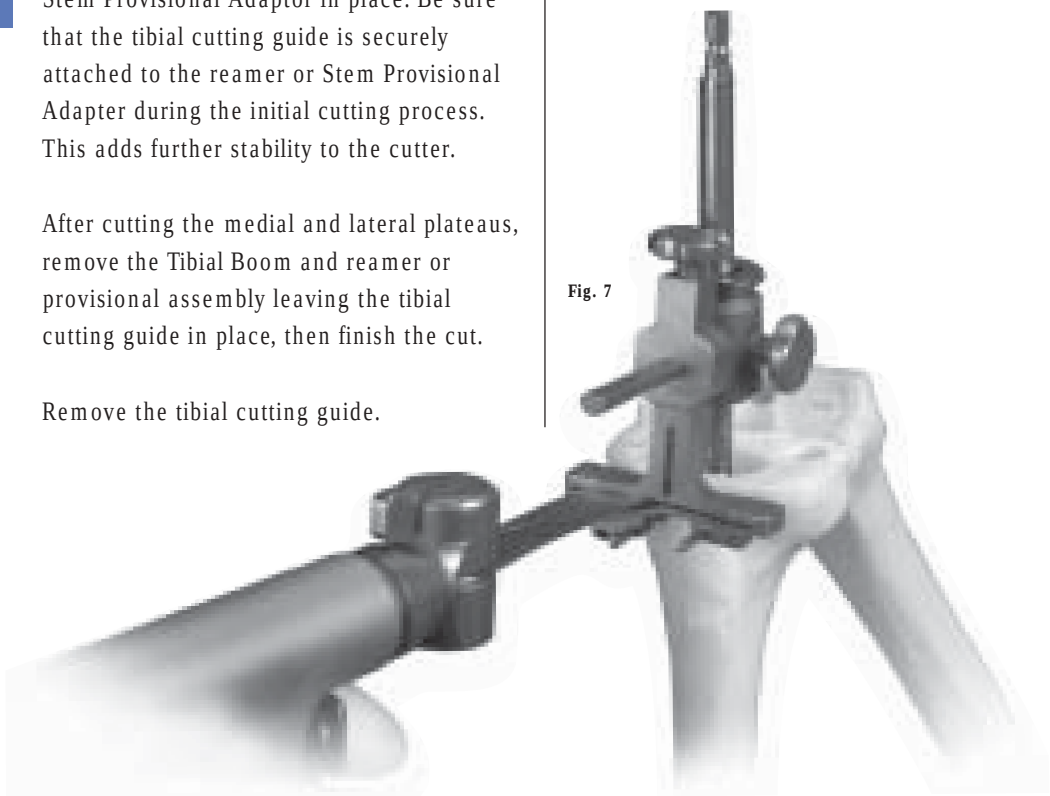


Fig. 7

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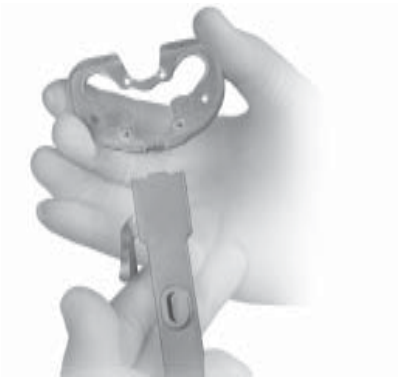
STEP TWO

FINISH THE TIBIA

Select the Stemmed Tibial Sizing Plate that provides the desired tibial coverage by placing various size plates onto the resected tibial surface. Be sure to select the appropriate style sizing plate (A/P Wedge, 3 Degree Fluted or Standard) which corresponds to the boom selected in the previous step. Attach the Tibial Provisional/Drill Guide Holding Clamp to the selected sizing plate (Fig. 8). Then use the Alignment Rod to aid in confirming varus/valgus alignment.

Fig. 8



Note: The color code designation on the Stemmed Tibial Sizing Plate should be compared to the color code designations on the anterior flange of the selected femoral provisional. At least one of the colors listed on the femoral provisional must match at least one color on the sizing plate to ensure that the components, in combination with the articular surface, will be kinematically matched. The colors must match exactly. For example, Yellow = Yellow. The striped colors are not the same as the standard colors (Yellow Striped Yellow) and should not be viewed as a match. If there is no match between the femoral provisional and sizing plate, adjust the size of the femoral provisional or the sizing plate being used to yield a match.

Reinsert the last Intramedullary Reamer or the stem provisional assembly. Place the sizing plate over the reamer shaft or stem provisional assembly and onto the prepared bone. Slide the Straight Bushing over the reamer shaft or Stem Provisional Adapter until it seats into the circular step of the sizing plate (Fig. 9). This will properly position the sizing plate relative to the tibial stem location. If the bushing will not seat in the sizing plate, check to be sure that the reamer or provisional assembly is fully inserted into the canal. Also confirm that the correct A/P Wedge (0°), 3 Degree Fluted (3°) or Standard (7°) Stemmed Tibial Sizing Plate is being used.

If the Straight Bushing allows for optimal sizing plate positioning, pin the plate with two Short-head Holding Pins. Remove the bushing, and the reamer or stem provisional assembly, leaving the sizing plate.

Note: The sizing plate must be removed prior to the reamer or stem provisional assembly if their diameter exceeds 19mm. Mark the position of the sizing plate using the pin holes or mark with methylene blue prior to removal.

If the position of the sizing plate is not optimal, continue with the "Offset Stem" procedure on page 14. If the position is satisfactory, and the tibial augmentation is necessary, proceed to the "Tibial Augmentation" procedure on page 14. If the position is satisfactory, and the tibial augmentation is not necessary, proceed to "Drilling the Stem Base" on page 15.

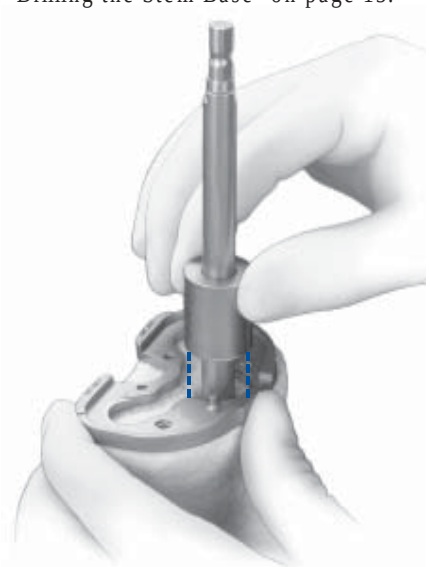
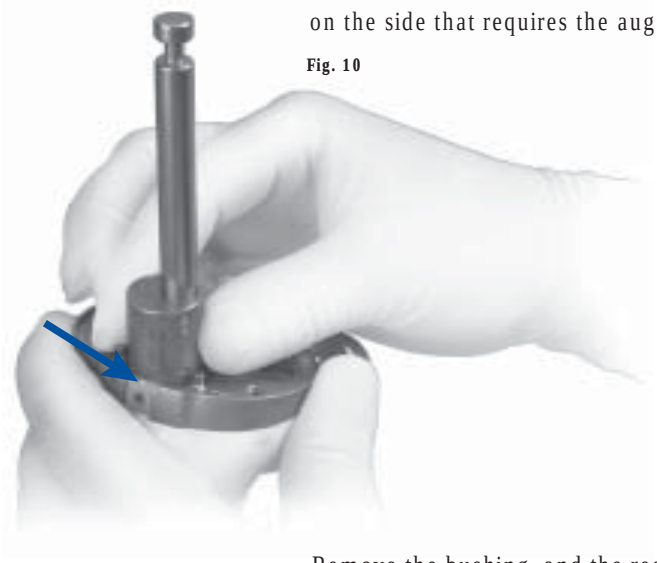


Fig. 9

OFFSET STEM

If the position of the sizing plate is not optimal, remove the Straight Bushing and slide the Offset Bushing over the reamer shaft or Stem Provisional Adapter. This will allow the plate to be shifted 4.5mm in any direction. When optimal coverage is achieved, note the position of the etched marks on the bushing relative to the etched mark on the center of the anterior portion of the sizing plate (Fig. 10). Pin the plate with two Short-Head Holding Pins. If a tibial augment will be used, do not pin the plate on the side that requires the augment.

Fig. 10



Remove the bushing, and the reamer or stem provisional assembly leaving the sizing plate.

Note: The sizing plate must be removed prior to the reamer or stem provisional assembly if their diameter exceeds 14mm. Mark the position of the sizing plate using the pin holes or mark with methylene blue prior to removal.

If tibial augmentation is necessary, continue with the "Tibial Augmentation" procedure. If tibial augmentation is not necessary, proceed to "Drilling the Stem Base" on page 15.

TIBIAL AUGMENTATION

If tibial augmentation is necessary, slide the appropriate Tibial Offset Boom (0° or 7°) over the reamer shaft or Stem Provisional Adapter, and the Straight or Offset Bushing (Fig. 11). The two holes on the bottom of the boom will fit over the two pegs on the top of the sizing plate. Tighten the thumb screw on the boom. Attach the appropriate tibial cutting guide, sliding it along the boom until it contacts bone. Then tighten the thumb screw.

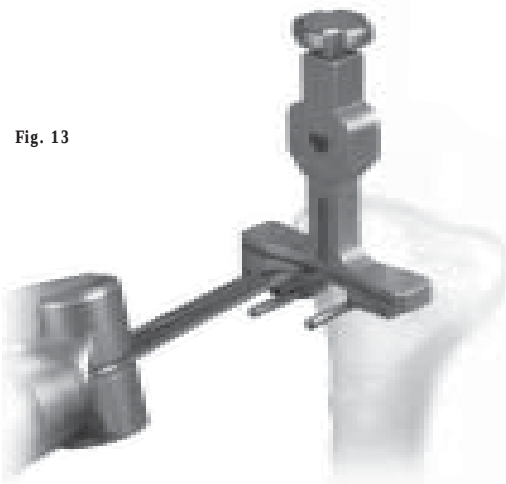
Fig. 11

Pin the tibial cutting guide to the bone with Headless Holding Pins (Fig. 12). Then use an oscillating saw to begin the augmentation cut. Remove the cutting guide, boom, bushing, sizing plate, and reamer or stem provisional assembly.

Reinsert the cutting guide over the Headless Holding Pins. If desired, insert Hex-head Holding Pins to increase the stability of the cutting guide. Then finish the cut (Fig. 13).

Fig. 12

Fig. 13



Remove the tibial cutting guide and holding pins from bone and attach the appropriate provisional augments to the sizing plate. Pin the plate to the bone with two Short-head Holding Pins. Ensure that the sizing plate remains in the proper position when pinning. Note that one of these pins can be inserted through the provisional augment.

DRILLING THE STEM BASE

Place the Cemented Stem Drill Guide on the sizing plate (Fig. 14) and drill for the tibial stem base with the Cemented Stem Drill . Drill until the engraved line on the drill is in line with the top of the drill guide (Fig. 15).

Fig. 14

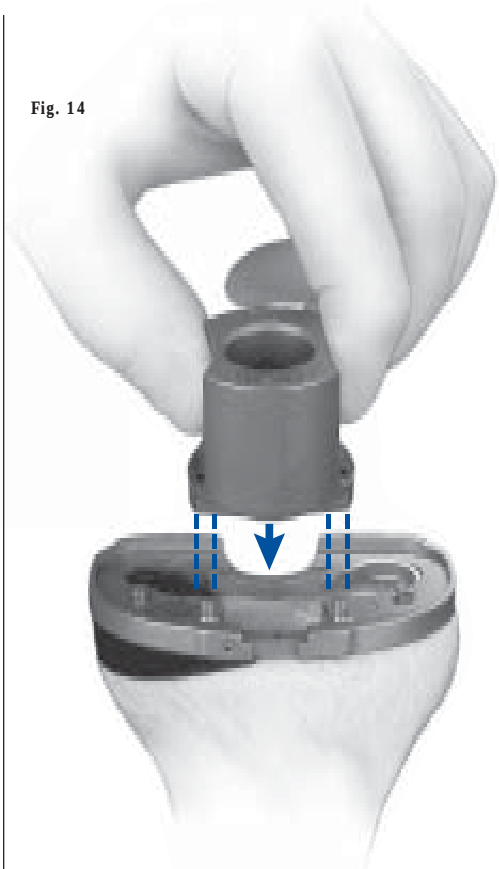
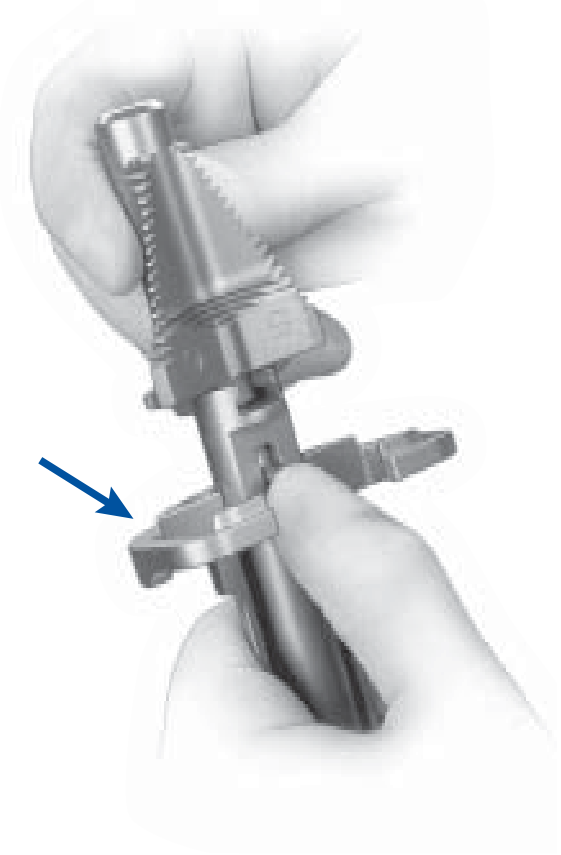


Fig. 15

Attach the proper size Tibial Broach to the Broach Impactor. The broach can be attached only from the front (Fig.16).

Note: Guide arrows are etched on the broach and impactor for additional guidance.

Fig. 16



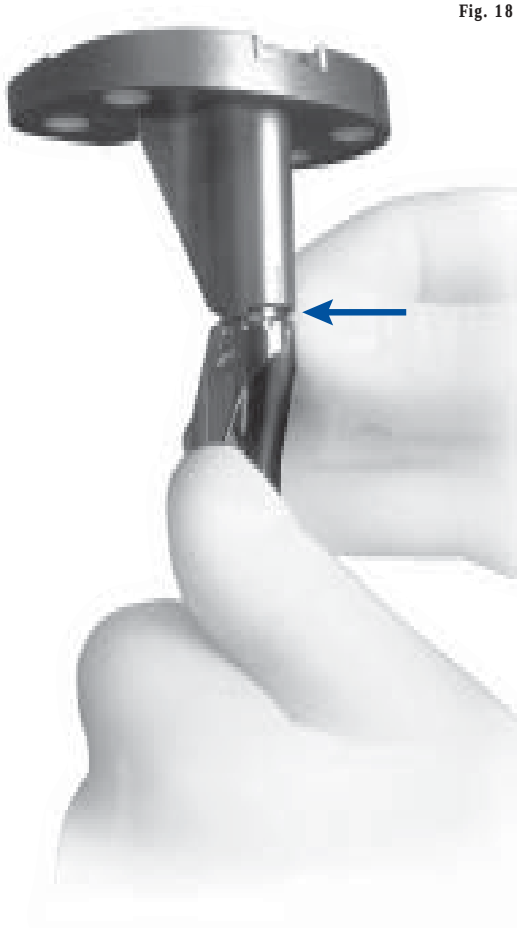
Seat the impactor on the sizing plate, over the location pegs, and impact the broach to the depth indicated by the etched groove on the shaft aligning with the impactor handle (Fig. 17). The broach has a built-in stop so it cannot be over impacted.

Fig. 17

Remove the Broach Impactor assembly and sizing plate.

Assemble the appropriate Stemmed Tibial Provisional, stem extension provisional, and augment provisional for which the bone has been prepared. For a straight stem, use the Hex-head Screwdriver to fully tighten the stem extension provisional. For an offset stem, line up the appropriate mark on the Offset Stem Extension provisional with the etch mark on the Stemmed Tibial Provisional (Fig. 18). This mark should correspond to the mark noted earlier on the Offset Bushing. Attach the stem extension provisional, but do not fully tighten the screw if an offset stem will be used.

Fig. 18



Insert the final trial prosthesis assembly into the tibia. For the offset stem, allow the Offset Stem Extension Provisional to rotate to attain an optimal position. Be sure that the provisional plate is properly positioned rotationally. Component malrotation on the cut surface of the bone can cause a misfit. Impact the tibial provisional with the Tibial Provisional Impactor (Fig. 19). Check to see that the trial prosthesis fits the cut surfaces with appropriate apposition to bone. If any undesired gaps are present, remove the trial component and adjust the bone cuts until a good intimate fit is obtained. Fully tighten the hex screw on the offset Stem Extension Provisional.

Fig. 19

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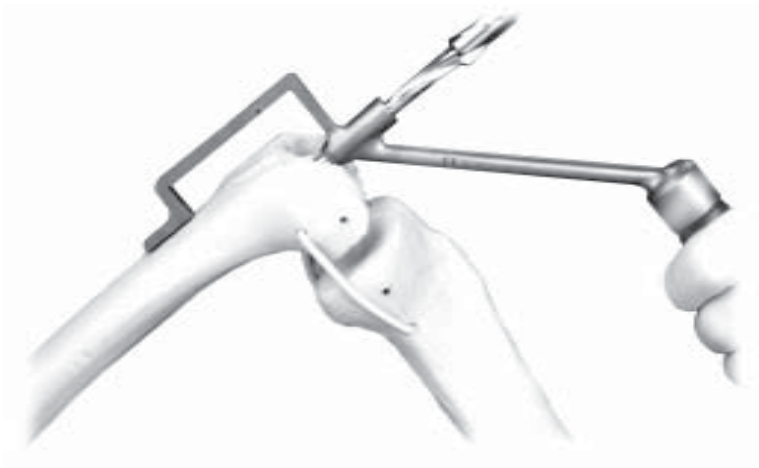
STEP THREE

PREPARE THE FEMORAL MEDULLARY CANAL

The optional IM Hole Locator may be used to find an appropriate entry point for the femoral canal. Place the outrigger of the IM Hole Locator on the anterior cortex of the distal femur. The outrigger should lie flat on the cortex and parallel to the anatomic axis of the femur. Position the drill guide portion of the hole locator in the center of the patellar sulcus.

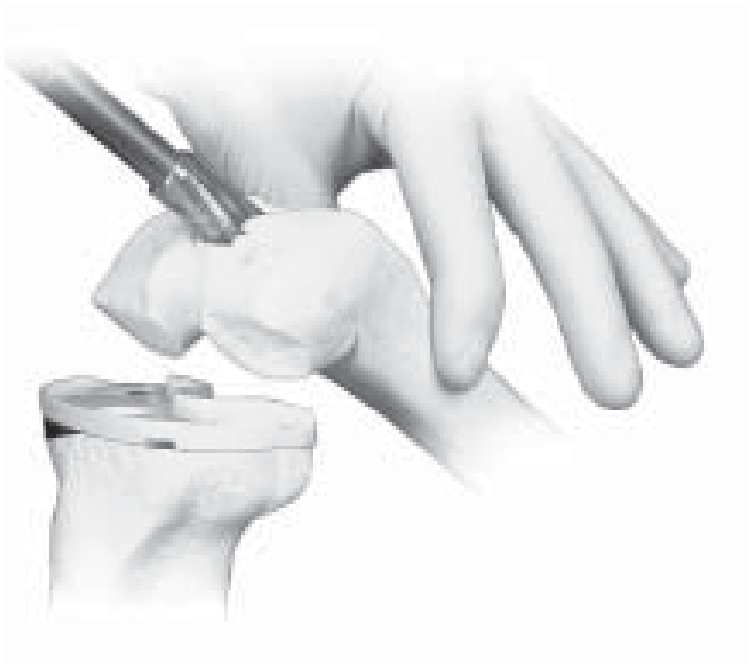
This hole location is a starting location for reaming, it is an approximate location of the stem relative to the anterior cortex. With the guide in this position, use the 8mm drill to make a hole in the medullary canal of the femur (Fig. 20). When drilling this hole, be sure to be parallel to the shaft of the femur in both the A/P and lateral projections. After the initial hole is made, remove the IM Hole Locator and use the step drill to enlarge the entrance hole.

Fig. 20



Begin with the 9mm Intramedullary Reamer and progressively ream the femoral canal (Fig. 21).

Fig. 21



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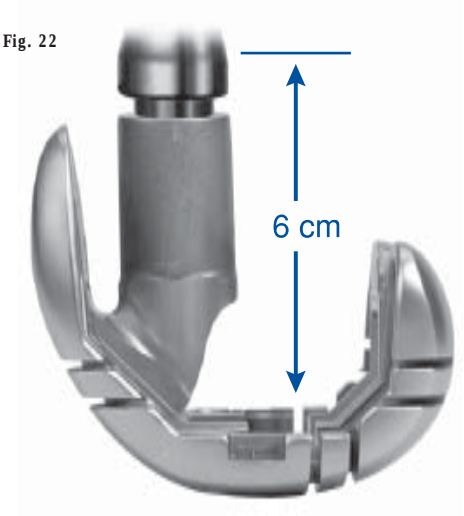
Care should be taken so that the reamer is passed in line with the center of the femoral shaft both in the A/P and M/L planes. Avoid eccentric reaming of the femoral shaft. The appropriate size of the final reamer should be estimated in preoperative planning, and is confirmed when cortical bone contact is made. Note the size of the last reamer used. To accommodate the stem base of the LCCK Femoral Component, the surgeon must ream 18mm in diameter to the depth of the stem base and stem extension shoulder, which is 6cm for the LCCK Component (Fig. 22).

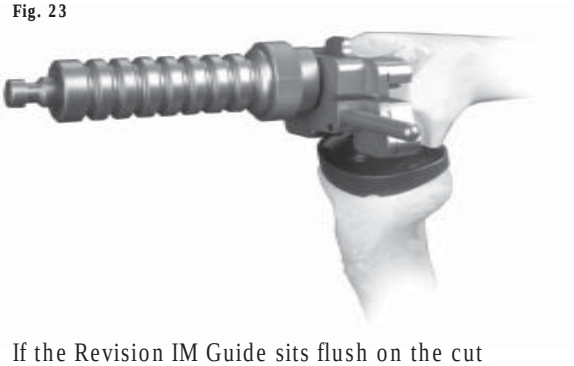
Fig. 22



If cortical bone contact is made before an 18mm-diameter reamer is used, continue reaming to 18mm to accommodate the Femoral Provisional/Cutting Guide stem base. Alternatively, the 18mm Femoral Stem Drill can be used to complete the canal preparation necessary to accommodate the stem housing.

If this is a revision and the previous femoral components have been removed, the valgus angle must be checked. To check the valgus angle attach the Standard Revision Cut Block to the Revision IM Guide. Then attach a Straight Stem Extension Provisional, which corresponds to the last diameter reamer used, to the guide. Be sure that the Revision IM Guide is set for “Left” or “Right” depending on the side of the surgery. Insert the Revision IM Guide into the femoral canal (Fig 23).

Fig. 23



If the Revision IM Guide sits flush on the cut distal femur, 6 degrees of valgus alignment exists between the orientation of the medullary canal and the distal cut. Proceed to Step Four—Evaluate Femoral Size. If not, recutting the distal femur may be necessary. Refer to Appendix B—Resecting the Distal Femur.

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STEP FOUR

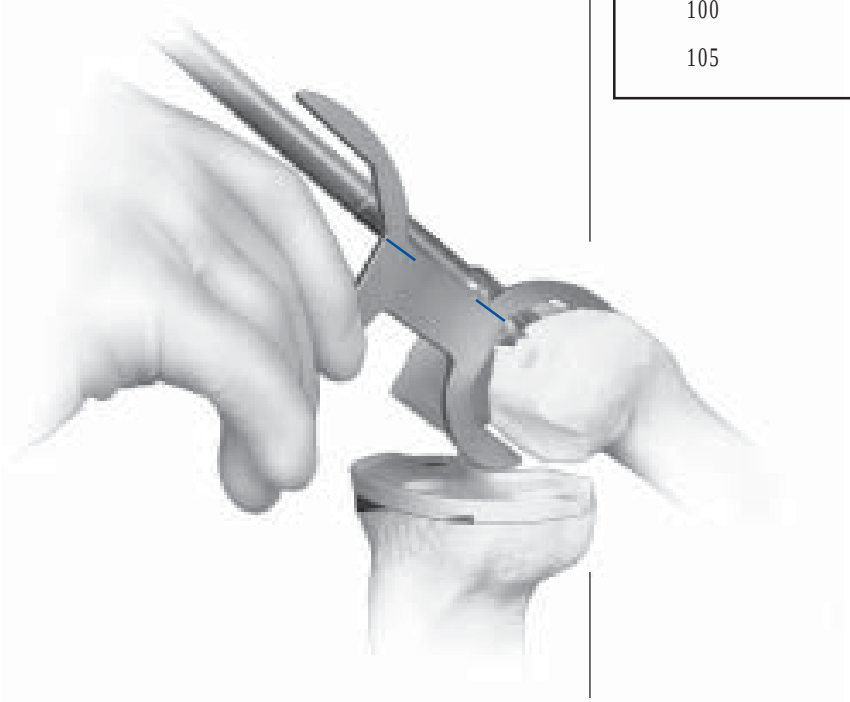
EVALUATE FEMORAL SIZE

There are several ways to estimate the appropriate femoral size. The following techniques should be used in conjunction with templating as discussed in the Preoperative Planning section, to determine an approximate femoral size. The final size will ultimately be selected during Step Six—Establish Flexion Gap and Stability.

Femoral Sizing Templates

Reinsert the final Intramedullary Reamer, or attach the Stem Extension Provisional that corresponds to the last reamer size used to the Stem Provisional Adapter. Insert the stem provisional assembly or reamer into the femoral canal. Center the etched line of the various sizes of Femoral Sizing Templates on the shaft of the reamer or adapter until the appropriate size is found (Fig. 24).

Fig. 24



Previous Prosthesis

Measure the size of the revised previous prosthesis.

Epicondylar Width

The epicondylar width of the femur also aids in selecting the appropriate femoral size. Measure the width of the epicondyles and use the following chart to determine the appropriate size.

NexGen FEMORAL COMPONENT SIZE RELATED TO THE TRANSEPICONDYLAR WIDTH

Transepicondylar Width (mm)	Female Size	Male Size
75	C	–
80	D	C
85	E	D
90	F	E
95	G	F
100	H	G
105	–	H

The femoral component must be chosen to stabilize the arthroplasty with the knee in flexion, without regard to the available distal femoral bone. Selecting the femoral component to fit the existing bone may undersize the femoral component and can create a large flexion gap which may be unequal to the extension gap or, if balanced, may lead to undesirable proximal displacement of the joint line.

Note: After estimating the femoral size, one can assemble that size of LCCK Femoral Provisional/Cutting Guide with the Stem Extension Provisional that corresponds with the diameter and depth of the last reamer used. Seat the femoral assembly on the existing bone. If the components will not seat, use a rongeur to carefully remove any anterior or posterior bone that is preventing insertion. Take care not to over resect at this point.

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STEP FIVE

ESTABLISH FEMORAL ROTATION

Attach the Femoral Base Guide Flange to the Femoral Stem Base/Cutting Block that corresponds to the femoral component size chosen. Be sure that the proper “Right” or “Left” indication is facing toward you on the cutting block. Tighten the thumb screw to secure the flange to the cutting block. Slide the block and flange over the reamer or Stem Provisional Adapter. The cutting block should be flush against the distal femur and the flange should rest on the anterior femoral cortex (Fig. 27).

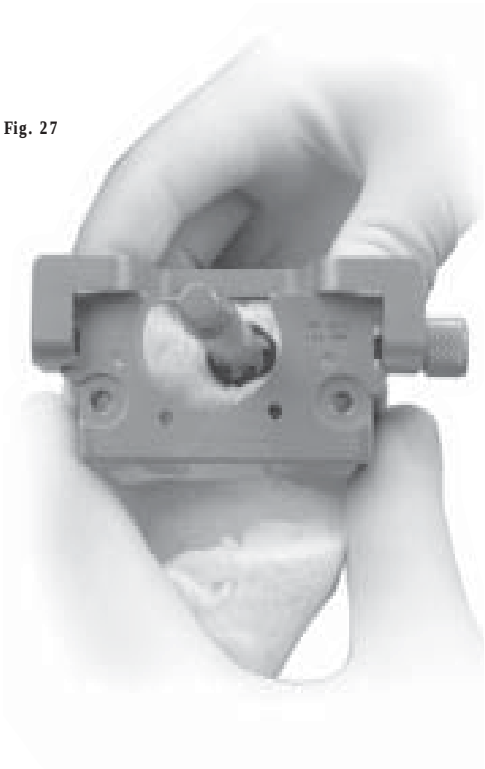


Fig. 27

Slide the 9mm-10mm Femoral Guide Bushing over the reamer shaft or adapter until it seats into the circular step of the Femoral Stem Base/Cutting Block (Fig. 28).

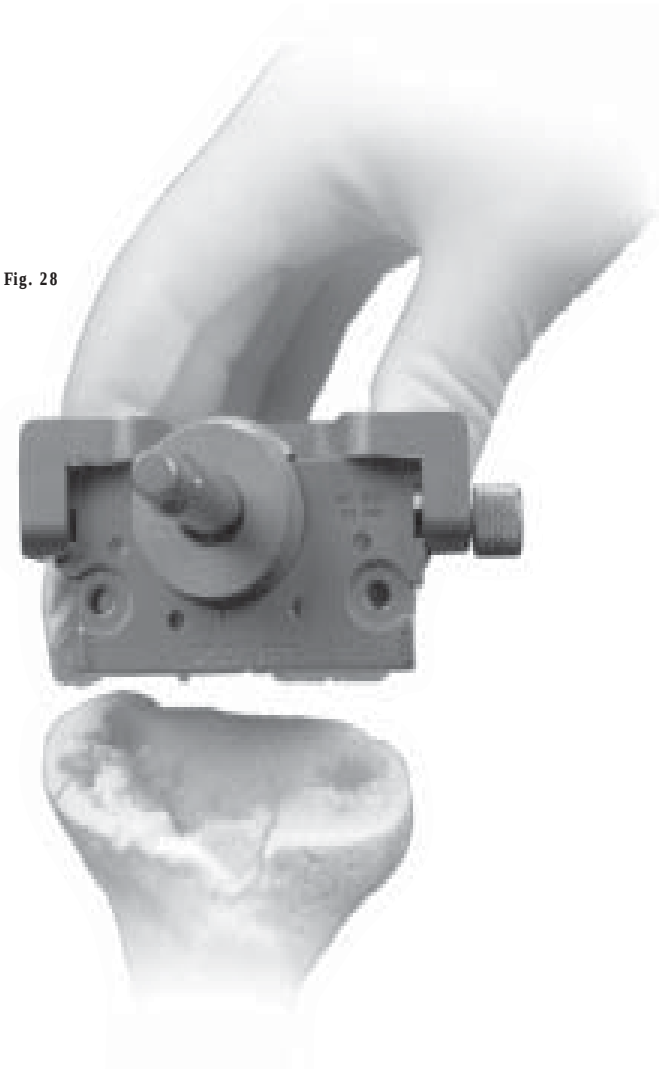


Fig. 28

A collar inside the cutting block serves as a stop to indicate when the bushing is fully seated. The numbers on the bushing should be facing up; the straight bushings are keyed so they can only fit into the guide one way.

Attach the Revision Rotational Alignment Guide to the posterior edge of the Femoral Stem Base/Cutting Block by inserting the pegs on the alignment guide into the holes on the face of the cutting block. To achieve the proper external rotation of the Femoral Stem Base/Cutting Block, and the prosthesis, the handles of the alignment guide should be in line with the transepicondylar axis (Fig. 29). If the Femoral Base Guide Flange prevents the appropriate rotational adjustment, remove the flange. Then align the handles with the transepicondylar axis (Fig. 30).

Fig. 29

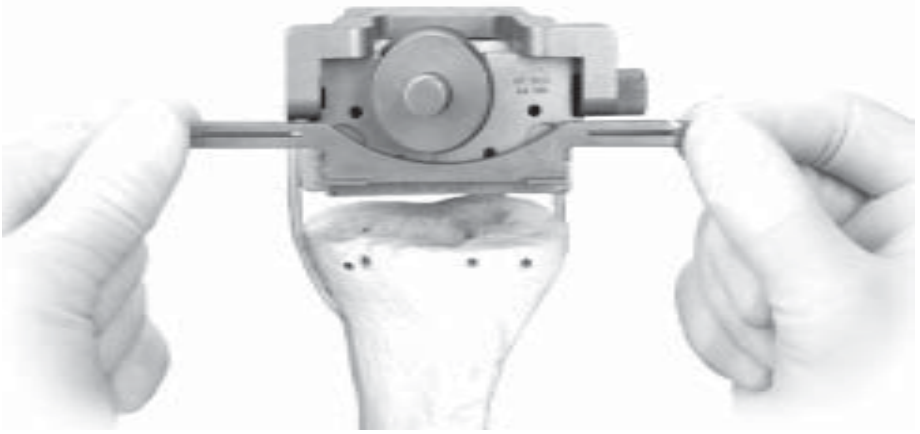
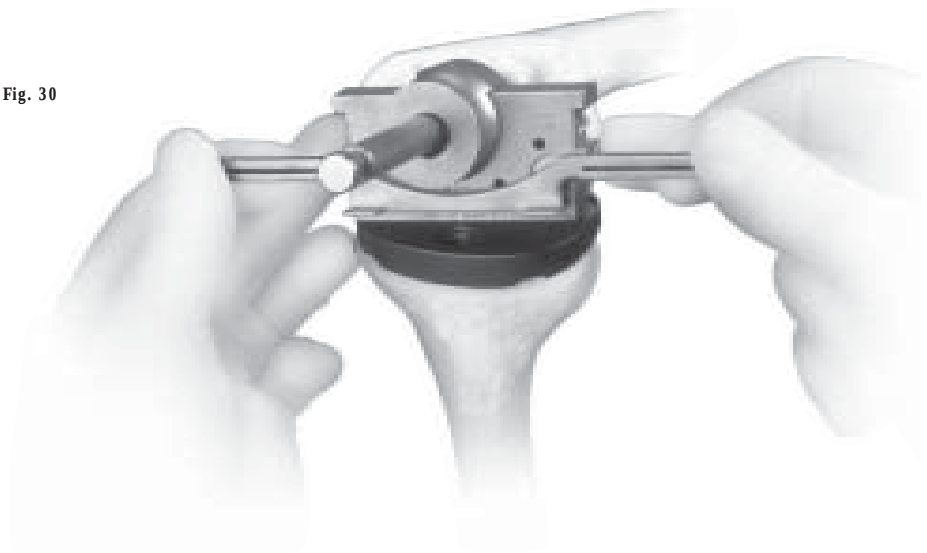


Fig. 30

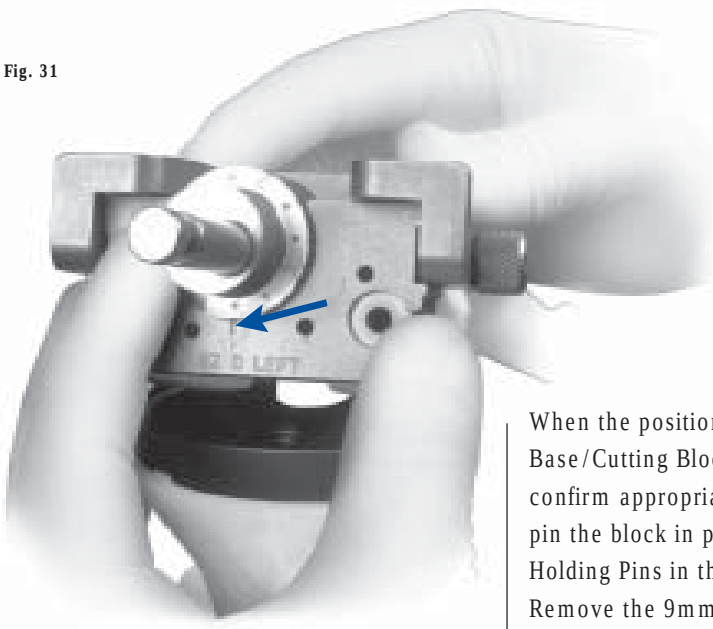


Component Placement

It is important to optimize the A/P and M/L position of the Femoral Stem Base/Cutting Block on the distal femur. If it appears that the prosthesis will not be properly positioned on the distal femur, an offset stem should be used. To prepare for the offset stem, use the Femoral Offset Bushing in place of the 9mm-10mm Femoral Guide Bushing. Insert the Femoral Offset Bushing with the numbers facing out. The offset bushing is not keyed to the Femoral Stem Base/Cutting Block. Rotate the bushing within the guide until an optimal position is found.

The Femoral Offset Bushing allows the guide, and the prosthesis, to be shifted 4.5mm from the center of the canal in any direction. If the Femoral Base Guide Flange prevents appropriate placement, remove the flange. The necessity for anterior bone resection will result, but be careful not to notch the anterior cortex. Note the orientation of the Femoral Offset Bushing by observing the numbers and marks on the bushing relative to the etched line on the posterior face of the Femoral Stem Base/Cutting Block (Fig. 31). This reference will be needed later in the procedure.

Fig. 31



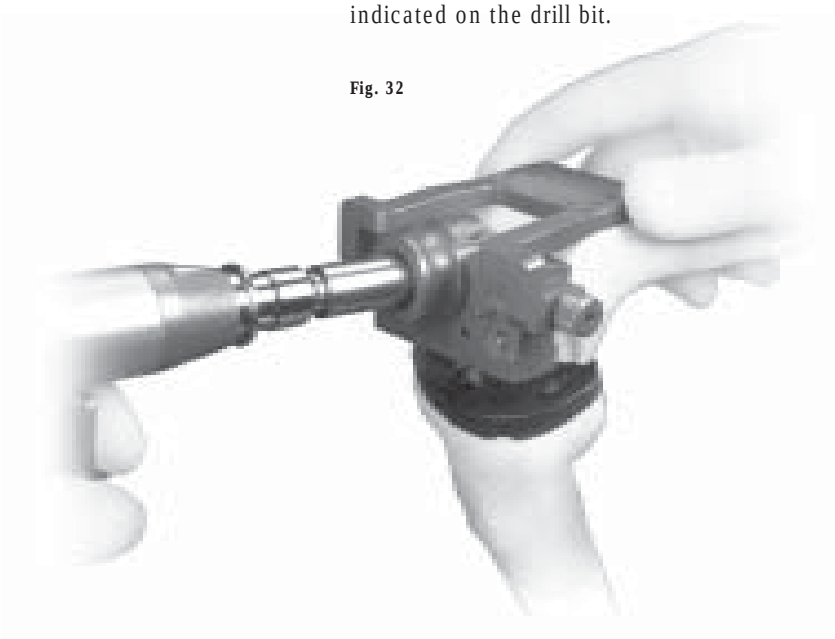
When the position of the Femoral Stem Base/Cutting Block has been established, confirm appropriate external rotation and pin the block in place with two Headless Holding Pins in the upper two holes. Remove the 9mm-10mm Femoral Guide Bushing or Femoral Offset Bushing. Remove the Intramedullary Reamer or, the stem provisional assembly with the Femoral Extractor. Attach the extractor at the slot indicated for the Femoral Finishing Guide.

LCCK

Insert the 16mm-18mm Femoral Guide Bushing into the cutting block.

Attach the Femoral Stem Drill to a drill/reamer and drill through the bushing (Fig. 32). Drill to the second engraved line for an LCCK Femoral Component. The depth is indicated on the drill bit.

Fig. 32



Anterior and posterior clean-up cuts may be necessary due to optimal femoral guide rotation and placement from previous steps.

Remove the Femoral Base Guide Flange by loosening the thumb screw if it has not already been removed in a previous step. For the posterior cut, the Posterior Saw Guide Attachment can be assembled to the hole on the posterior edge of the cutting block. The instrument is marked to indicate the side that must face the bone. Be sure the thumb screw is fully tightened. Use an oscillating saw to cut the anterior and posterior condyles (Fig. 33, 34, or 35).

Remove the Femoral Stem Base/Cutting Block leaving the headless pins in place.

Fig. 33

Fig. 34

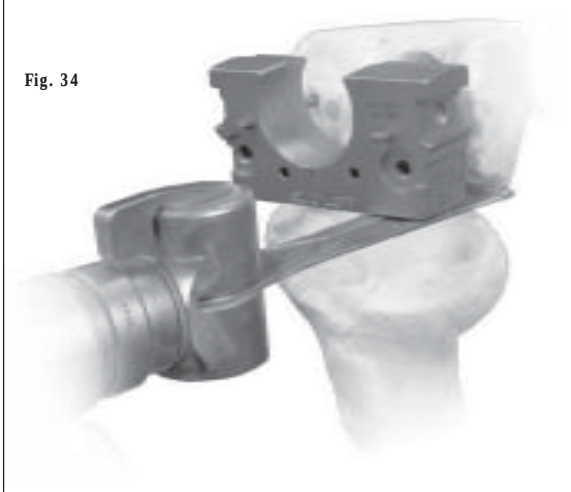
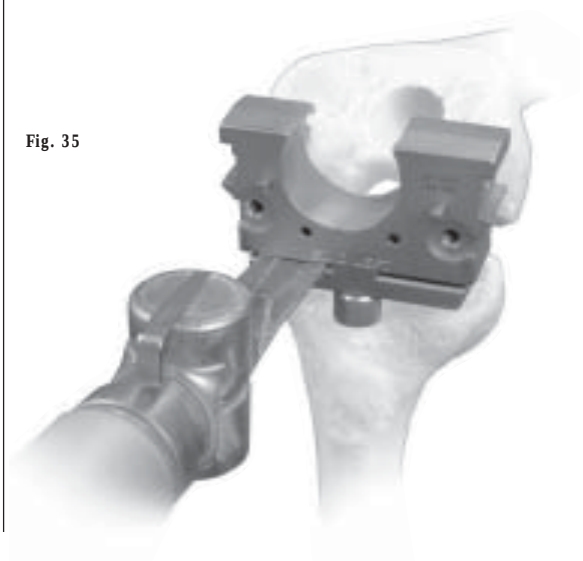


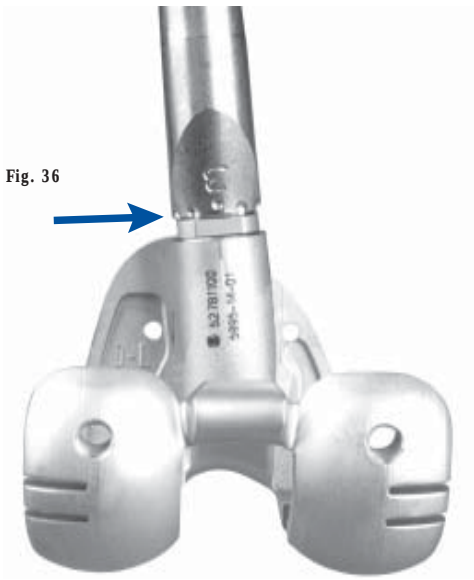
Fig. 35



When using a straight stem, insert the appropriate size Straight Stem Extension Provisional into the appropriate size Femoral Provisional/Cutting Guide.

When using an offset stem, fully thread the Offset Stem Locknut onto the appropriate size Offset Stem Extension Provisional. Then back thread the locknut until it engages only the first thread. Thread the offset provisional onto the appropriate size Femoral Provisional/Cutting Guide (Fig. 36). Rotate the Offset Stem Extension Provisional to the position noted earlier on the Offset Bushing. The posterior mark on the stem base of the femoral provisional should be lined up with the appropriate mark on the Femoral Offset Stem Extension Provisional. Use the Offset Stem Wrench to tighten the locknut against the cutting guide stem.

Fig. 36



With the knee in flexion, insert the provisional/cutting guide assembly onto the distal femur. The cutting guide will fit over the headless pins (Fig. 37). Seat the femoral assembly on the existing bone. If the components will not seat, use a rongeur to carefully remove any anterior or posterior bone that is preventing insertion. Be careful not to over resect at this point.

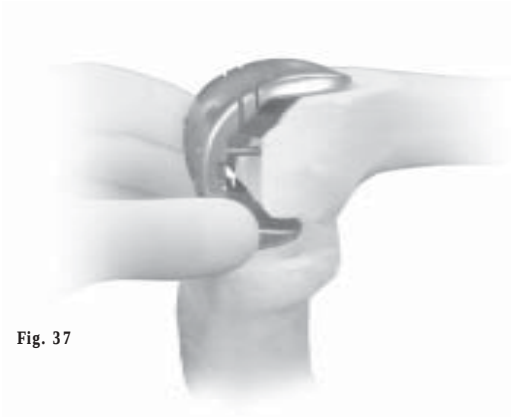
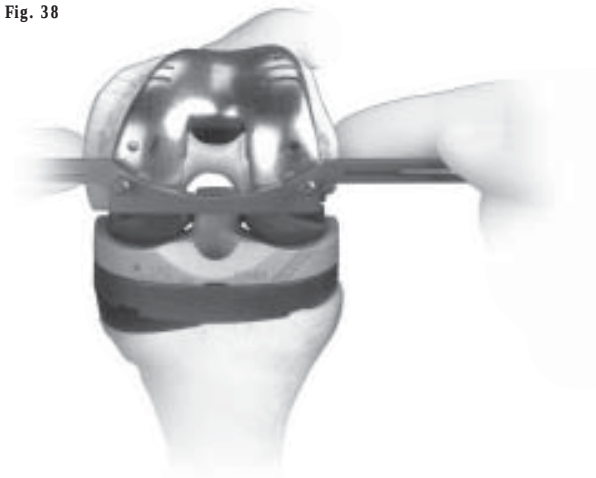


Fig. 37

Insert the tabs of the Revision Rotational Alignment Guide into the posterior augment resection slots of the femoral provisional (Fig. 38). The handles of the alignment guide should line up with the transepicondylar axis. The guide may also be used to reference the tibial plateau to confirm a symmetrical gap in flexion.

Fig. 38



If additional adjustments to the amount of external rotation are neccessary, return to the beginning of this section

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STEP SIX

ESTABLISH FLEXION GAP AND STABILITY

Determine the ability of the selected Femoral Provisional/Cutting Guide to fill the flexion gap and create stability in flexion.

Make an early assessment of the need for posterior augmentation through the posterior augment cutting slots in the cutting guide. If a gap larger than 10mm exists, consider choosing the next smaller femoral component.

Note: The Posterior Augment Provisionals may be inserted into the femoral provisional to provide added stability in flexion.

Begin by inserting the thinnest LPS Articular Surface Provisional of the color indicated on the tibial plate and femoral provisionals. (The LCCK Articular Surface Provisional cannot be used because the intercondylar box cut has not yet been made.) Evaluate the stability in flexion (Fig. 39).

Fig. 39

If the thinnest articular surface cannot be inserted, one of two solutions should be explored. First, the femoral provisional can be downsized. Each femoral component size is 4mm different in the A/P dimension. The selection of the next smallest component will result in an additional 4mm in flexion space. If this does not allow the thinnest Articular Surface Provisional to be inserted, then the tibial plateau will have to be lowered. Use the 2mm Tibial Recutter to obtain an additional 2mm in both flexion and extension spaces. If the tibia has additional bone resected then it will be necessary to follow this by repeating Step Two—Finish the Tibia.

Insert progressively thicker Articular Surface Provisionals until adequate stability is obtained. If the knee is still loose in flexion after trialing the thickest articular surface, consider one of the following options: Augment the tibial component, adding 5mm or 10mm blocks to the medial and lateral sides, or select the next larger femoral component. There may be minor asymmetry between the medial and lateral sides. This asymmetry will be addressed in Step Seven—Establish Extension Gap and Stability.

STEP SEVEN

ESTABLISH EXTENSION GAP AND STABILITY

After achieving appropriate stability in flexion, leave the final LPS Articular Surface Provisional in place and bring the knee to full extension. Assess the overall limb alignment. Bring the Femoral Provisional/Cutting Guide out to meet the tibial Articular Surface Provisional and create stability in extension.

Note: The Distal Augment Provisionals may be used as spacers to create added stability in extension. (Fig. 40)

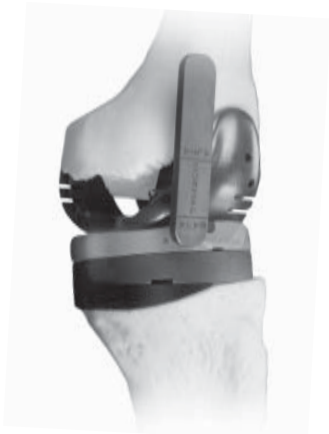
Fig. 40

Joint Line

Assess the joint line. The true joint line in the average knee, in full extension, can be approximated by referencing several landmarks. These landmarks include: one finger breadth distal to the inferior pole of the patella; one finger breadth above the fibular head; 12mm -16mm distal to the femoral PCL attachment; and 30mm distal to the epicondyles.

If desired, use the Patella Joint Line Gauge to assess the position of the patella. With the tabs of the gauge positioned in the two slots on the anterior flange of the Femoral Provisional/Cutting Guide, the inferior pole of the patellar component should fall between the two "Normal" marks on the gauge (Fig. 41).

Fig. 41



The epicondyles also provide a starting point for distal positioning of the femoral component. The distal joint line averages 30mm from the epicondyles (Fig. 42). This is very similar to the average distance to the posterior joint line and this distance may be used to check femoral component size.

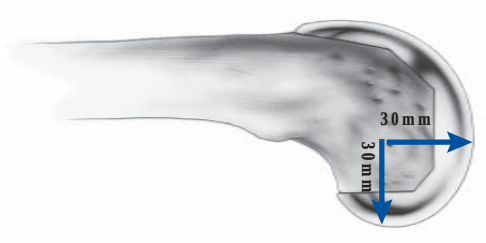


Fig. 42

Avoid hyperextension. If hyperextension exists, move the femoral trial more distally. Evaluate the resultant space between the femoral component and distal femur. If the gap exceeds the maximum augment available, 10mm, then evaluate the next smaller femoral component size. This will allow the use of a thicker articular surface and will necessitate a return to Step Six—Establish Flexion Gap and Stability, to reassess the flexion gap.

If full extension is not possible, either move the femoral trial more proximally or use a thinner tibial Articular Surface Provisional. Another option is to perform a posterior capsule release. If a thinner tibial articular surface is used, it may be necessary to use the next larger femoral size and return to Step Six—Establish Flexion Gap and Stability.

Balance Soft Tissues

While the knee is in extension, perform necessary ligament releases to achieve symmetric and adequate tension. In rare cases, ligament advances may be appropriate. Ligament release should be performed in a manner which is conceptually similar to that in primary arthroplasty. Selectively release the ligaments on the concave or contracted side of the knee until symmetric ligament balance or tension is observed on the medial and lateral sides of the knee with the limb in neutral mechanical alignment. In revision surgery, however, the specific ligamentous structures which may be identified in the primary total knee are likely to be scarred fibrous tissue sleeves that are more difficult to identify and/or release. In general, they are more amenable to treatment as medial or lateral sleeves of undifferentiated ligamentous tissue.

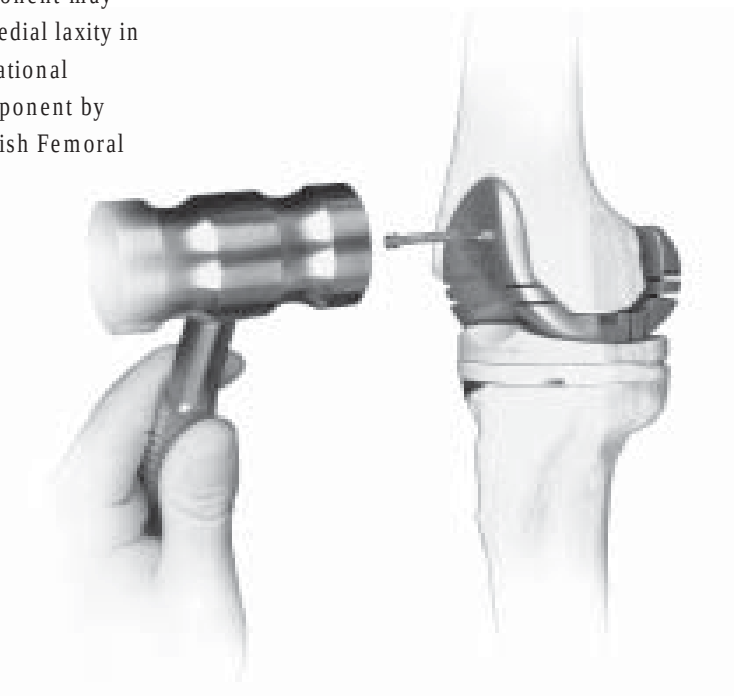
If the knee is well balanced in extension but has significant imbalance in flexion, there may be a rotational problem with the femoral component. Internal or excessive external rotation of this component may cause substantial lateral or medial laxity in flexion. If so, evaluate the rotational alignment of the femoral component by returning to Step Five—Establish Femoral Rotation.

If the femoral component rotation is appropriate, the joint line has been reestablished, and the Articular Surface Provisional height is appropriate, the knee should be stable in both flexion and extension. If it is not stable, there is a mismatch between the extension and flexion gaps. Understanding how the size and position of the components affect the flexion and extension gaps is essential to problem solving in total knee arthroplasty. These principles are thoroughly reviewed in Appendix C of this technique under the heading **"BALANCING FLEXION/EXTENSION GAPS."**

When the extension gap has been balanced with the previously determined flexion gap, and the limb alignment and joint line have been judged to be accurate, pin the Femoral Provisional/Cutting Guide anteriorly using the Short-head Holding Pins (Fig. 43).

Perform a trial range of motion and confirm that the soft tissue tension, balance, and joint line are appropriate.

Fig. 43



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STEP EIGHT

MAKE FEMORAL AUGMENT CUTS

Insert the Posterior Femoral Retractor to protect the posterior capsule, and tibial bone or provisional. Make any necessary posterior or distal augment cuts through the cutting slots in the Femoral Provisional/Cutting Guide (Fig. 44, 45). Use a 0.050-inch thick reciprocating saw blade. A 0.050-inch thick oscillating blade may also be used. Begin the cuts with the cutting guide in place, then remove the guide, the Short-head Holding Pins, and the Headless Holding Pins to complete the cuts. Once the augment cuts have been made, remove the retractor.

Note: It may be necessary to remove the femoral provisional cutting guide to complete any distal augment cuts. When removing the femoral augment provisionals from any instrument, use the ball-nose screwdriver to push the peg of the augment from the opposite side.

Fig. 44

Fig. 45

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STEP NINE

PREPARE FOR THE LCCK BOX

Remove the Short-head Holding Pins from the anterior flange of the LCCK Femoral Provisional/Cutting Guide. Leave the two headless pins distally or reinsert the pins if they were previously removed. These pins will serve to provide rotational alignment for the LCCK Notch/Chamfer Guide.

Note: One headless pin will also provide sufficient rotational alignment.

Remove the LCCK Femoral Provisional/Cutting Guide and Stem Extension Provisional (Fig. 46). Remove the Stem Extension Provisional from the Femoral Provisional/Cutting Guide and insert it into the Stem Extension Bushing (Fig. 47). When using an offset stem, fully thread the Offset Stem Locknut onto the appropriate size offset Stem Extension Provisional. Then back thread the locknut until it engages only the first thread. Thread the offset provisional onto the Stem Extension Bushing and rotate the Offset Stem Extension Provisional so that the appropriate number, noted earlier on the Offset Bushing, is lined up with the mark on the bushing.

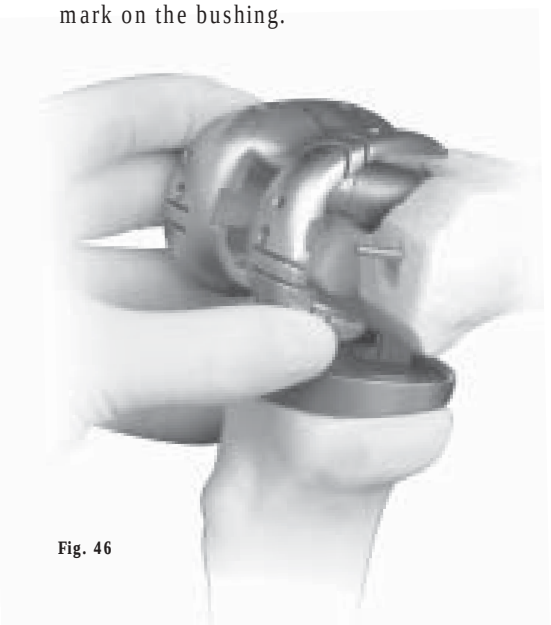


Fig. 46

Fig. 47

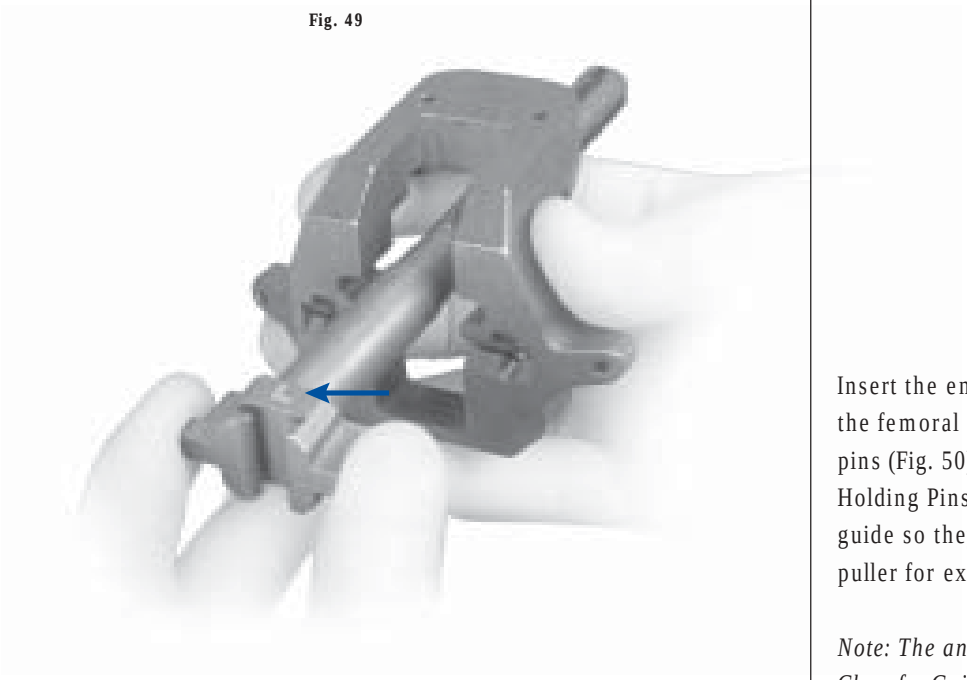
Use the Offset Stem Wrench to tighten the locknut against the Stem Extension Bushing. Attach any necessary Distal Augment Provisionals to the LCCK Notch/Chamfer Guide. These provisionals should correspond to the augment cuts that were made in Step Eight — Make Femoral Augment Cuts (Fig. 48).

Fig. 48

LCCK

Insert the stem/bushing combination into the LCCK Notch/Chamfer Guide (Fig. 49). The bushing is etched with “R” and “L” for right and left knees. Ensure that the proper “R” or “L” designation is showing anteriorly.

Fig. 49



Insert the entire notch guide assembly into the femoral canal and onto the headless pins (Fig. 50). Be sure that the Headless Holding Pins protrude beyond the face of the guide so they can be grasped with a pin puller for extraction.

Note: The anterior flange of the LCCK Notch/Chamfer Guide is not designed to sit flush with the anterior femoral bone.

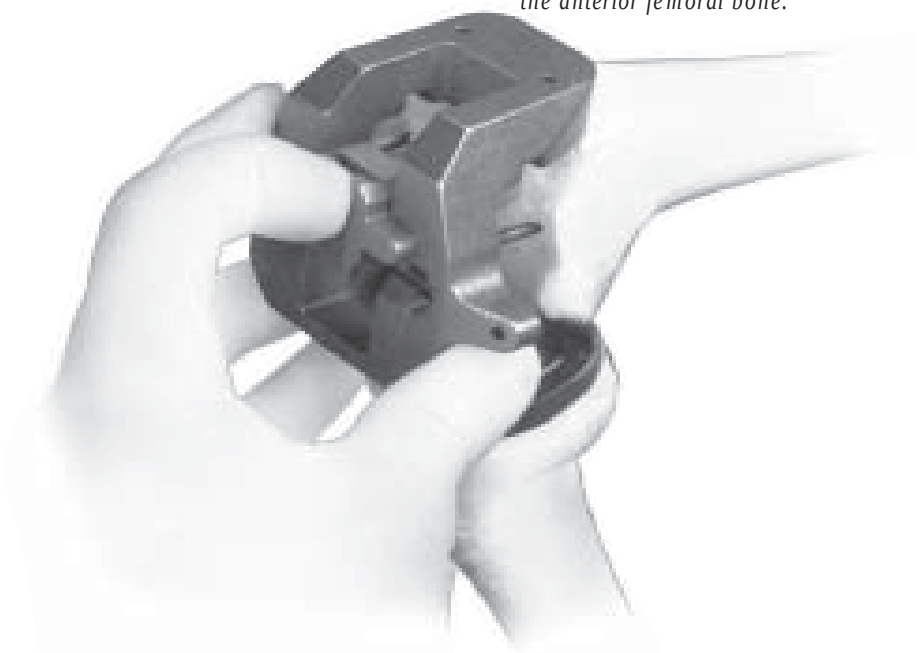


Fig. 50

Insert Hex-head Holding Pins through the anterior or distal tab holes in the guide (Fig. 51).

Once the notch guide is secured, remove the Stem Extension Bushing and the Stem Extension Provisional by pulling the assembly out of the guide. The Femoral Extractor may be used.

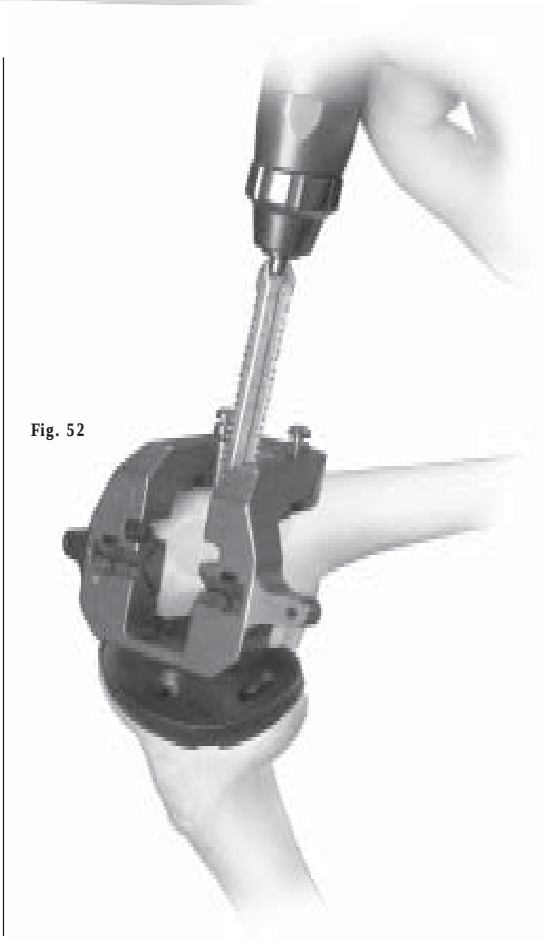
Fig. 51

Note: If a Straight Stem Extension Provisional larger than 22mm in diameter or an Offset Stem Extension Provisional larger than 17mm in diameter is used, the notch guide will have to be removed in order to pull out the bushing and stem provisional.

Use a reciprocating or narrow oscillating saw blade to cut the sides and base of the LCCK box (Fig. 52).

Note: The base cut will angle proximally as it goes posteriorly. This angled cut accommodates the spine on the LCCK Articular Surface Component.

Fig. 52



LCCK

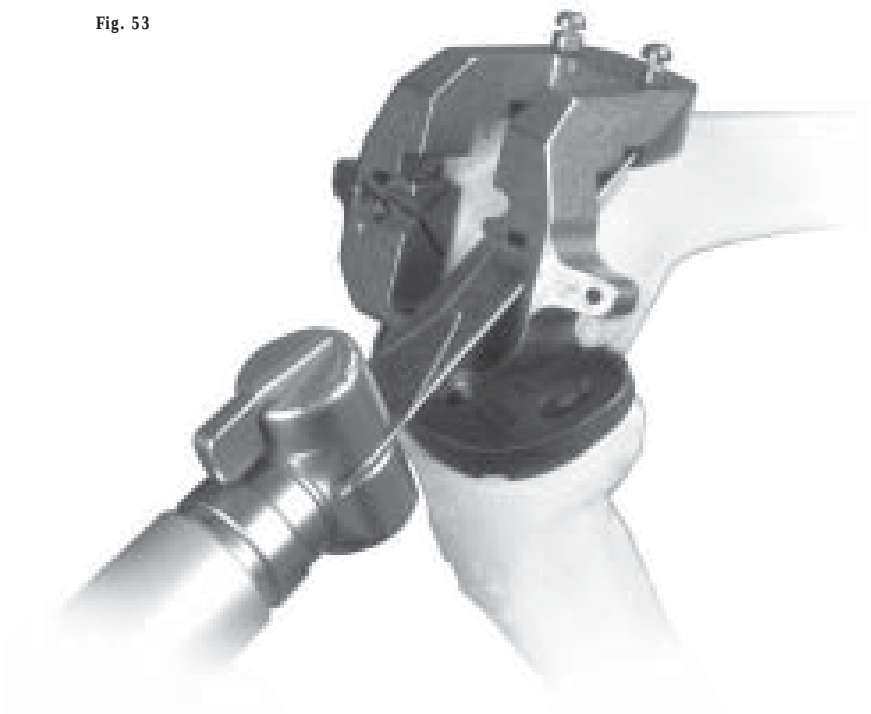
Then use an oscillating saw to cut the anterior and posterior chamfers, if necessary. (Fig. 53).

Note: For sizes C and D, if snap-in distal augments have been used, care must be taken to avoid the peg if it enters the slot with the saw blade.

Remove the holding pins and the Notch/ Chamfer Guide.

Note: When removing the femoral augment provisionals from any instrument, use the ball-nose screwdriver to push the peg of the augment from the opposite side.

Fig. 53



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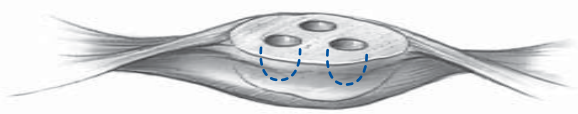
STEP TEN

PREPARE THE PATELLA

It is not always necessary to revise the patellar component. A well-fixed component from the same system should be left. A reasonably compatible, well-fixed, all-polyethylene component should also be left. If the component is loose or found to be incompatible, determine if there is enough bone remaining to implant a new patellar component. Sufficient bone must remain to ensure that the pegs from the new prosthesis do not protrude through the anterior surface (Fig. 54). The *NexGen* Patellar Component requires a minimum of 11mm of remaining bone to allow for the implant pegs. If inadequate bone remains, trim the surface and leave the residual bone.

Fig. 54



If the decision is made to replace the primary patellar component, either prepare the patella peg holes for a *NexGen* Patellar Component by centering the appropriate Patellar Drill Guide over the patella or follow detailed instructions included with revision patella devices. It may be necessary to rotate the guide to avoid the peg holes from the previous patellar component. Holding the guide firmly in place, drill the three peg holes using the Patellar/Femoral Drill Bit.

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STEP ELEVEN

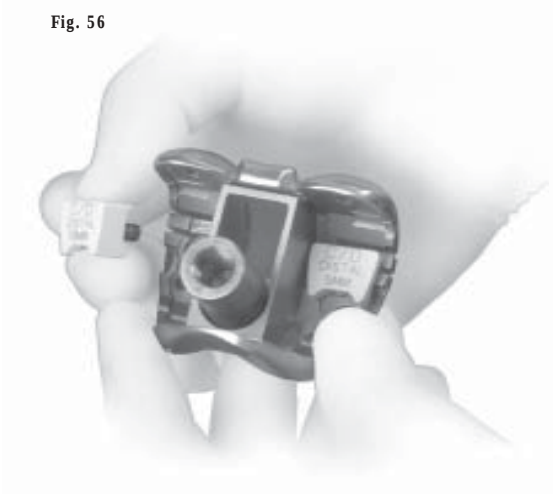
PERFORM TRIAL REDUCTION

Slide the appropriate size Modular Box Provisional onto the LCCK Femoral Provisional/Cutting Guide (Fig. 55).

Fig. 55

Attach the appropriate Posterior Augment Provisionals, then the Distal Augment Provisionals (Fig. 56). The augment provisionals simply snap into place. They will help secure the Modular Box Provisional to the femoral provisional.

Fig. 56



If distal femoral augmentation is not necessary, use a Femoral Augment Provisional Screw to secure the box (Fig. 57).

Fig. 57

Note: The Modular Box Provisional is angled to match the bone cut. The provisional box does not match the femoral implant.

If necessary utilize any appropriate anterior augment.

Assemble the Stem Extension Provisional to the Femoral Provisional/Cutting Guide (Fig. 58). Insert the femoral provisional assembly onto the bone to check for proper fit.

Fig. 58

Insert the correct size and style of Stemmed Tibial Provisional with the selected tibial augment provisional and Stem Extension Provisional. Attach the proper height and style of Articular Surface Provisional onto the tibial provisional.

LCCK

When implanting an LCCK Femoral Component, insert the LPS Articular Surface Provisional. If more constraint is needed, remove the LPS Provisional and insert the LCCK Articular Surface Provisional. For either the LPS or LCCK Articular Surface provisional, insert the locking screw through the articular surface and tighten with the Hex-head Screwdriver, if desired (Fig. 59).

Fig. 59

Remember that at least one color designation on the tibial provisional must match one of the color designations listed on the femoral provisional, and this color should be the same color of the articular surface family being used. If a three-of-a-kind color match is not obtainable, the incorrect tibial size has been selected and another tray size and articular surface family should be selected.

Check the range of motion and joint stability (Fig. 60).

Fig. 60

Perform any necessary soft tissue releases. Then, remove all provisionals.

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STEP TWELVE

COMPONENT IMPLANTATION

After the implants have been chosen, make one last check to ensure that the femoral, tibial, and articular surface components match. There are colored squares on each box. There should be a three-of-a-kind color match. If there is, the components are matched.

FEMORAL COMPONENT PREPARATION

Stem Extension

The locking mechanism between the femoral implant and the stem extension implant is a combination of a Morse-type taper and two set screws. Remove the stem extension locking screw from the stem extension and discard. The stem extension screw is not used with the femoral component.

Check to ensure that the set screws have not migrated into the femoral stem base taper prior to inserting the stem extension. Insert the stem extension into the base of the femoral component. When using the offset stem extension, use the stem location referenced earlier and line up that stem location number with the etched line on the posterior stem base housing. The stem extension should be "snug" in the femoral component base. If toggle exists, back out one or both of the set screws one half turn. When a "snug" fit is achieved, wrap the femoral component in a cloth and place it on a surgical cart. While protecting the stem extension, **strike it solidly one time** with a two-pound mallet.

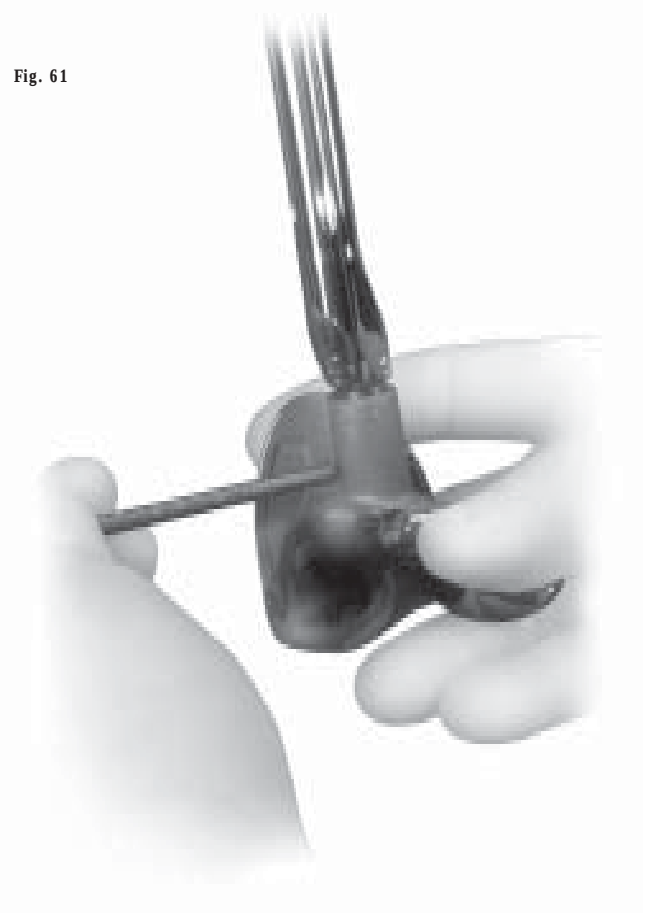
Note: Hitting the stem more than once may loosen the taper connection.

After seating the Morse-type taper, tighten the two set screws located in the base of the femoral component. Use the Femoral Set Screw Hex Driver and apply moderate torque to tighten each of the two set screws (Fig. 61).

Note: The Femoral Set Screw Hex Driver is designed to limit the amount of torque which can be applied to the set screws. ***Torque by hand only***.

It is recommended that a stem extension always be used with an LCCK Femoral Component. If, in the surgeon's opinion, a stem is not needed, then the set screws should be removed before implanting the femoral component.

Fig. 61



AUGMENTS

The locking mechanism between the femoral implant and the femoral augment implant is a single fixation screw (except the anterior augment which is cemented only). The fixation screw is packaged with the augment.

A special ball-nose style Femoral Augment Screwdriver (5987-89) was designed to attach the posterior lateral augment because the anterior flange prevents straight alignment of the screwdriver. The same screwdriver can be used on all the other femoral augments as well, although the standard Hex-head Screwdriver may be preferred for attaching the distal femoral augments.

Augments may also be cemented in place and are precoated for enhanced cement fixation. If augments are to be cemented, apply cement between the augment and femoral component, around the sides of each augment, and to the rails of the femoral component. Use the Femoral Augment Holding Clamp Head with the Augment Assembly Clamp to achieve intimate contact between the augment and the femoral component until the cement is cured.

When using multiple augments, the order in which they are positioned is important. The distal femoral augments must be positioned first, followed by the posterior femoral augments, and then the anterior femoral augment.

Note: Posterior-only and distal-only augments are not to be used in combination with other distal or posterior augments.

TIBIAL COMPONENT PREPARATION

Tibial augments are designed to be secured to the tibial plate with screws or bone cement. Screws provide automatic alignment on the tibial tray and immediate attachment of the augment. As with the stem extensions, the augment screws are packaged with the augment. If cement is used to attach the augment, use the Augment Assembly Clamp to stabilize the augment while the cement is curing. All augments are PMMA precoated to enhance fixation to the bone cement.

There are two techniques for inserting the tibial articular surface onto the tibial plate. The recommended method is to assemble and tighten the articular surface, tibial plate, and stem extension on the back table. The alternative method is to insert the articular surface intraoperatively, after the tibial plate has been cemented.

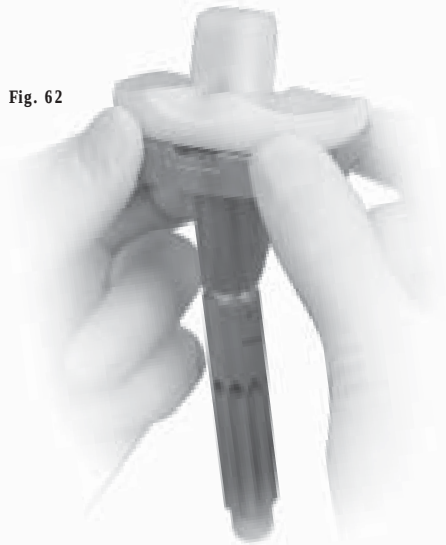
"Back Table" Technique

Remove the locking screw from the stem extension implant and discard. The locking screw that will be used is packaged with the LCCK Articular Surface Implant. Insert the stem extension implant into the base of the tibial plate implant. When using an offset stem extension, use the stem location referenced earlier and line up that stem location number with the etched line on the posterior stem base housing. Wrap the tibial component in a cloth and place it on a surgical cart. While protecting the stem extension, **strike it solidly one time** with a two-pound mallet.

Note: Hitting the stem more than once may loosen the taper connection.

By hand, assemble the LCCK Articular Surface onto the implant tray applying downward and posterior force (Fig. 62).

Fig. 62



Insert the locking screw packaged with the LCCK Articular Surface, and hand tighten with the 4.5mm Hex Driver Bit (Fig. 63). Leave the driver bit set in the screw head.

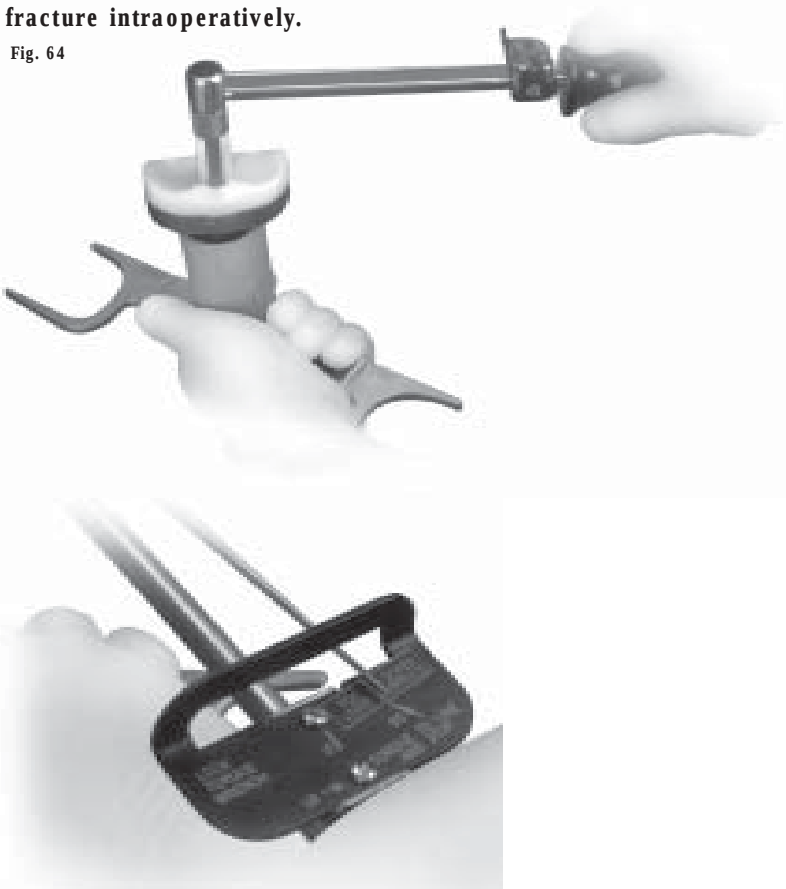
Fig. 63

Note: The articulating surface must be completely seated in the tibial tray prior to torquing the screw. The screw is not intended to pull the articular surface down into the tibial plate.

Select the LCCK Tibial Plate Wrench that has the stem extension diameter that matches that of the implant to be assembled. Insert the stem extension through the stem protector sleeve and into the hole in the wrench that corresponds to the stem extension diameter. Attach the Deflection Beam Torque Wrench to the 4.5mm Hex Driver Bit (Fig. 64). Apply 95 in. lbs. of torque with the wrench (Fig. 65).

Do not over or under torque. Under-tightening of the screw may allow the screw to loosen over time. Over-tightening may cause the screw to fracture intraoperatively.

Fig. 64



LCCK

"Intraoperative" Technique

Warning: Use of this technique risks disturbing the bone/cement/implant interface.

Remove the locking screw from the stem extension implant and set it on the back table for later use. Insert the stem extension implant into the base of the tibial plate implant. When using an offset stem extension, use the stem location referenced earlier and line up that stem location number with the etched line on the posterior stem base housing. Wrap the tibial component in a cloth and place it on a surgical cart. While protecting the stem extension, **strike it solidly one time** with a two-pound mallet.

Note: Hitting the stem more than once may loosen the taper connection.

Insert the locking screw packaged with the stem extension and hand tighten with the Hex-head Screwdriver. This will serve as a temporary screw which will be replaced upon insertion of the LCCK Articular Surface Implant.

Implant the tibial plate and stem extension.

Note: Cement must be cured prior to using this technique. If a leg holder is used, the leg should be removed, and be free to rotate. This will promote proper Tibial Plate Wrench use and help prevent loads from developing at the bone/cement/implant interface.

Remove the temporary locking screw from the stem extension. By hand, assemble the LCCK Articular Surface onto the implant tray applying downward and posterior force. Insert the locking screw packaged with the LCCK Articular Surface and hand tighten it with the 4.5mm Hex Driver Bit. Leave the driver bit set in the screw head.

Select the LCCK Tibial Plate Wrench that has the tibial plate size that matches that of the implant to be assembled. Place the end of the wrench over the tibial plate. Ensure that the wrench is in line with the base of the tibial plate. Attach the Deflection Beam Torque Wrench to the 4.5mm Hex Driver Bit, (Fig. 66). Apply 95 in. lbs. of torque with the wrench (Fig. 67).

Do not over or under torque. Under-tightening of the screw may allow the screw to loosen over time. Over-tightening may cause the screw to fracture intraoperatively.

Fig. 66

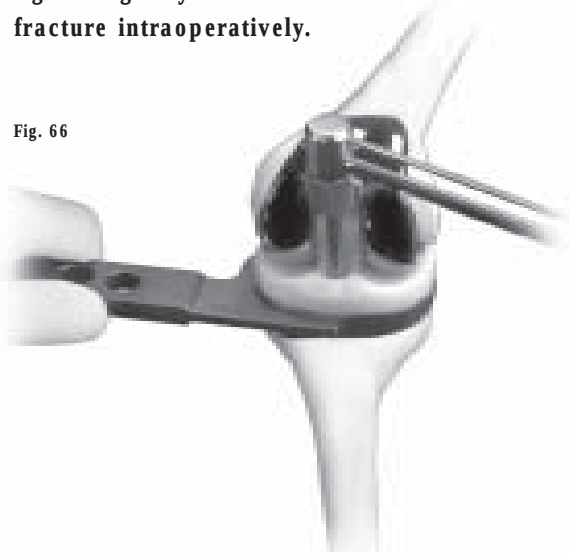


Fig. 67

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APPENDIX A

CROSSOVER TECHNIQUE

During a primary procedure, the surgeon may determine that sufficient bone loss or soft tissue instability is present to warrant a stemmed femoral component. The *NexGen* Revision Instruments allow the surgeon to convert from *NexGen* primary implants to a stemmed LCCK Implant intraoperatively. This crossover can be accomplished after the tibial preparation has been completed and all the femoral cuts have been made via any of the *NexGen* primary techniques.

STEP ONE

Attach the Femoral Base Guide Flange to the appropriate size Femoral Stem Base/Cutting Block. Be sure that the proper "Right" or "Left" indication is facing up on the cutting block. Tighten the thumb screw to secure the flange to the cutting block. Apply the assembly to the distal femur so the cutting block is flush against the distal femur and the flange rests on the anterior femoral cortex (Fig. 68). Position the assembly mediolaterally and insert two Headless Holding Pins into the cutting block, and two Hex-head Holding Pins into the flange.

Fig. 68

STEP TWO

Insert the 9mm-10mm Femoral Guide Bushing into the circular step of the Femoral Stem Base/Cutting Block. The numbers on the bushing should be facing up; however, the straight bushings are keyed so they can only fit into the guide one way. A collar inside the cutting block serves as a stop to indicate when the bushing is fully seated.

Beginning with the 9mm-10mm Femoral Guide Bushing and Intramedullary Reamer, progressively ream the femoral canal until cortical contact is made or to the stem diameter desired.

Note: Care should be taken when reaming to avoid perforating the cortex. (Fig. 69).

Fig. 69

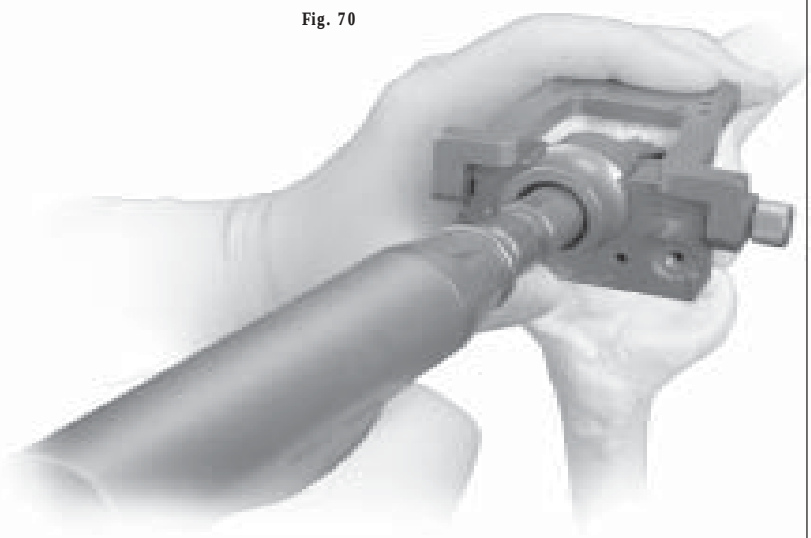
Care should be taken so that the reamer is passed in line with the center of the femoral shaft both in the A/P and M/L planes. Avoid eccentric reaming of the femoral shaft. Be sure that the reaming depth is adequate to allow for the length of the stem base on the femoral component **plus** the length of the intended stem extension.

LCCK

STEP THREE

Insert the 16mm-18mm Femoral Guide Bushing into the Femoral Stem Base/Cutting Block. Using the 18mm Femoral Stem Drill, enlarge the diameter of the canal to the second engraved line for an LCCK Femoral Component (Fig. 70). Remove the cutting block, flange, and bushing.

Fig. 70



STEP FOUR

Insert the appropriate size Straight Stem Extension Provisional into the appropriate size Femoral Provisional/Cutting Guide. Insert the provisional assembly onto the bone. Then proceed to Step Six—Establish Flexion Gap and Stability.

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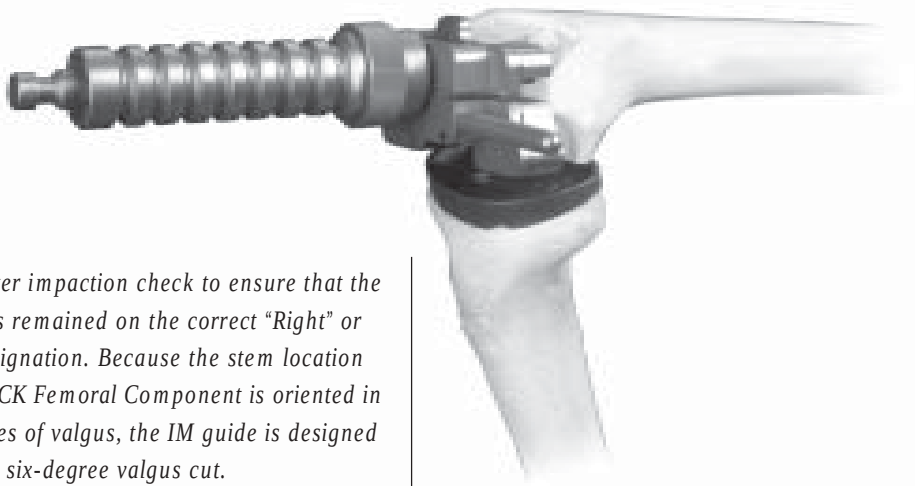
APPENDIX B

RESECTING THE DISTAL FEMUR

Attach the Standard Revision Cut Block to the Revision IM Guide. Set the revision IM Guide to either “R” or “L”. Then attach the Straight Stem Extension Provisional to the guide. Insert the stem provisional and IM guide into the femoral canal. Impact the guide onto the distal femur (Fig. 71).

Fig. 71



Note: After impaction check to ensure that the guide has remained on the correct “Right” or “Left” designation. Because the stem location of the LCCK Femoral Component is oriented in six degrees of valgus, the IM guide is designed to yield a six-degree valgus cut.

Attach the Distal Femoral Cutting Guide to the Distal Placement Guide. Turn the thumb screw on the cutting guide all the way to the left. Attach the cutting guide/placement guide assembly onto the Revision IM Guide. Turn the thumb screw until it contacts the anterior femur (Fig. 72). This will help stabilize the cutting guide. Once it has contacted bone, do not turn the screw further. Secure the Distal Femoral Cutting Guide by inserting two Headless Holding Pins through the holes marked “0” on the top of the guide. Use the Femoral Extractor to remove the Revision IM Guide and the Stem Extension Provisional.

Fig. 72

Use a 0.050-inch oscillating saw blade to make a minimal resection of the distal femur through the slot on the cutting guide (Fig. 73). Additional 2mm adjustments may be made by using the sets of holes marked -4, -2, +2, and +4. The markings on the cutting guide indicate, in millimeters, the amount of bone resection each will yield relative to the standard distal resection set by the Revision IM Guide and the Standard Revision Cut Block. Remove the Distal Femoral Cutting Guide. Then proceed to Step Four—Evaluate Femoral Size.

Fig. 73

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APPENDIX C

BALANCING

FLEXION/EXTENSION GAPS

After the flexion gap has been established and the appropriate size femoral component applied, extend the knee. A symmetrical and balanced extension gap should be created. This is sometimes difficult as it often requires elevation or lowering of the joint line. The patella helps determine the appropriate position of the joint line.

It is important to remember that adjustments to the femoral side of the arthroplasty can affect the knee in either flexion or extension, while any change to the tibia affects both flexion and extension. This is part of the rationale for reconstructing the tibial side first. The following matrix (Fig. 74) suggests the nine situations that can occur during a trial reduction in a revision knee. It is worth reviewing these options and some of their potential solutions.

Fig. 74

FLEXION \ EXTENSION	Tight	OK	Loose
Tight	1	2	3
OK	4	**5**	6
Loose	7	8	9

1. If a knee is too tight in both flexion and extension, reducing the height of the tibial articular surface may be sufficient to balance the construct.

2. If the knee is tight in flexion but acceptable in extension, two options exist. An augment may be used with the distal femur. This will drop the joint line lower, and allow the use of a thinner tibial component. Another option is to use a smaller femoral component.

3. If the joint is loose in extension and tight in flexion, augmentation of the distal femur should provide a good arthroplasty with a thinner polyethylene component if the joint line is at its proper location. Another option is to use a smaller femoral component.

4. If the joint is acceptable in flexion but tight in extension, several options exist. One is to release the posterior capsule from the femur. Another alternative is to resect more distal femoral bone. This moves the femoral component proximally on the femur at the expense of elevating the joint line.

5. Obviously, if both components are acceptable, no further modification is necessary.

6. If the joint is acceptable in flexion and loose in extension, the probable solution is augmentation of the distal femur while using the same polyethylene component. This will drop the joint line and tighten the extension gap.

7. If the joint is loose in flexion and acceptable in extension, a larger femoral component, moved slightly proximal on the femur, may suffice. If the original component size was correct, a thicker tibial articular surface and a more proximal femoral position may be necessary.

8. If the joint is loose in flexion and acceptable in extension, one may choose to accept this situation if it is only of a mild degree, particularly in a highly constrained component. Increasing the femoral size may equalize the gaps. Alternatively, moving the femoral component proximally and applying a thicker tibial articular surface will equalize the gaps.

9. If the joint is symmetrically loose in both flexion and extension, a thicker tibial articular surface will solve both problems.

Note: After applying one of these solutions, perform another trial reduction. This will identify any new problem or a variation of the initial problem that now may exist.

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

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