



Surgical Technique **Revision Knee System**

Indications For Use

- A. Primary intervention of rheumatoid arthritis, osteoarthritis, traumatic arthritis, polyarthritis, collagen disorders, and/or avascular necrosis of the femoral condyle.
- B. Post-traumatic loss of joint configuration (particularly when there is patellofemoral erosion, dysfunction, or prior patellectomy).
- C. Failed osteotomy or unicompartmental replacements.
- D. Replacement of unsatisfactory cemented or press-fit knee components when sufficient bone stock exists.
- E. The salvage of previously failed surgical attempts if the knee can be satisfactorily balanced and stabilized at the time of surgery.
- F. Moderate valgus, varus, or flexion deformities.

Revision Knee System

Surgical Technique

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Introduction

The Consensus Revision Knee System was designed utilizing excellence in engineering, best available materials and with the advice of a diverse scientific advisory board. This has resulted in a versatile revision knee system that interfaces with the primary Consensus Knee System.

The Consensus Revision Knee System's design principle is to restore the anatomy within a multiply operated knee. This includes axial alignment kinematics as well as compensating for bone loss from removal of previously placed implants. The tibial component restores posterior slope to a value that approximates normal anatomy. The design of the intramedullary stems of both the femur and the tibia reproduce anatomy and place the components in a position to optimize extension and flexion spacing and collateral ligament function. Joint motion and stability is improved while decreasing joint compression forces.

The femoral component is based on an average normal alignment of 6° of valgus in the coronal plane. The tibial component is based on a 90° (0°) alignment to the tibial axis in the coronal plane. The posterior slope of the tibial component in the sagittal plane is fixed at 7° to approximate the average normal proximal tibia.

The Consensus Revision Knee System has been designed to allow femoral and tibial sizes to be matched as: one-size "above" through one-size "below" size-matching as shown in Table 1. This provides for size differences in femoral and tibial anatomy and protects from articulation mismatch which may result in increased UHMWPE wear.

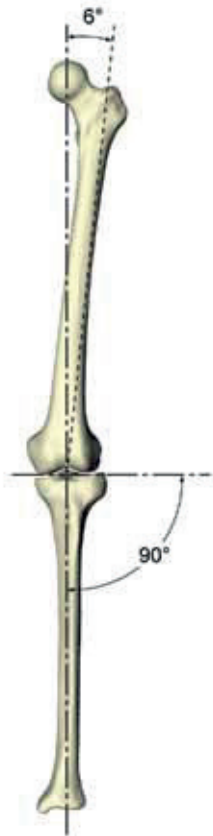


Figure 1

	Size Compatibility		
Tibial Insert	1/2	3/4	5/6
Femoral Component	1,2,3	2,3,4,5	4,5,6

Table 1

Preoperative Planning

Preoperative radiographs should include standing AP, lateral, full-length 36" AP standing, and sunrise view of the patellas (figure 2). The Consensus Revision Knee System templates show a magnification of 110 percent which will, on average, reflect implant size on standard analog radiographs. It should be noted that with digital radiography, appropriate markers need to be placed so that the magnification can be determined.

Surgical Approach

Revision knee replacement surgery should not be attempted by an orthopedist unless they are familiar experienced in revision knee replacements. The choice of incision is based on many factors including old scars, stiffness of the knee, bone quality, age and health of the patient. Therefore, these instructions will not include specific directions on the surgical approach as this should be within the expertise of the orthopedist performing revision knee surgery.

Appropriate exposure, including scar excision, debridement and removal of the components, should be done to maintain the normal anatomy and preserve as much bone stock as possible. Appropriate principles of revision surgery include atraumatic soft tissue handling, debridement of abnormal or devascularized tissues, removal of components with minimal bone loss and preparation of bony surfaces. The bone needs to be healthy, clean, free of cement, and all debris. Principles of placement of the components include restoration of the anatomic joint line, appropriate rotation of the femoral and tibial components, appropriate adjustment of the medial and lateral collateral ligaments, cementing only to clean dry bone, intrusion of cement into the clean cancellous bone limiting the cement thickness to less than 1 cm and placement of augments and bone graft where appropriate according to bone loss.



Figure 2

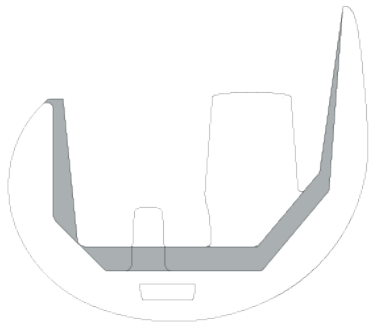


Figure 3

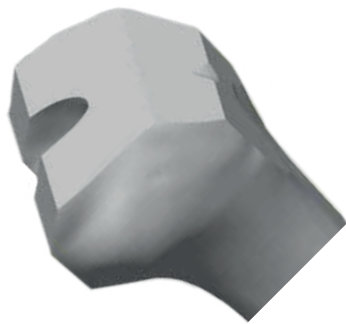


Figure 4



Figure 5

Femoral Preparation

The component metal thickness has been increased to make up for the bone loss from the removal of an average primary component (Figure 3). Thicknesses have been calculated to be appropriate when a component can be removed with minimal bone loss and should result in the metal replacing the previous bone-cement composite from the index arthroplasty. Therefore, as the bone cuts are made on the patella, femur and tibia, take great care to remove only what bone is necessary so that the components can be sized and placed. A desirable technique to remove the index components is to disrupt the interface between the cement and the metal rather than the cement and the bone. The cement can be removed after the metal/polyethylene components are removed with minimal loss of healthy bone.

The cutting block and alignment guides are designed to achieve the appropriate cuts with removal of a minimal amount of healthy bone stock (figure 4). It is recommended that minimal cuts first be attempted, then the cutting blocks can be backed down to remove additional bone if needed to achieve stable bony fixation of the new components. Fluid irrigation should be used during bone cuts as the blades can cause thermal damage to normal bone structures. The bone thickness of the patella should be maintained and protected while working on the femur and the tibia. In some instances it may be appropriate to leave the old patella component in place to provide some protection during retraction of the patella; therefore, the suggested sequence is addressing the femoral cuts followed by the tibial cuts and the patella last.

The femoral alignment guide is an intramedullary instrument and needs to be centered in the medullary canal. Determine the general marrow space by using the 5/16ths drill. The center of the marrow space in the distal femur is located just medial, 4 or 5 mm, and towards the top of the normal intercondylar notch (figure 5). This will not be well defined in revision surgery and it may be necessary to use a rolling motion to



T-handle



IM Rod



Femoral Reamer



Femoral Cutting Guide



Alignment Tower

develop an appropriate canal position as the drill bit progresses up the marrow space. Suction and irrigation can be used to prevent compression of the marrow.

Next, use the intramedullary **T-handle** to make sure the hole is within the marrow space (Figure 6). Pass this up the marrow space slowly to allow any marrow to extrude along the longitudinal fins. If the rod is clearly in the center of the distal femoral canal, and the drill hole is appropriate, then proceed to the distal femoral cutting jig. Otherwise, re-drill the femur until the intramedullary T-handle can be passed appropriately in the center of the canal.

Distal Femoral Cut

Place the smallest distal **Femoral Reamer** on the T-handle (Figure 7). This can be used to hand ream the distal femur which will provide important information. The feel of the reamer will give an indication of the appropriate diameter and the appropriate length needed for the femoral stem. If the reamer is clearly loose and not engaging the intramedullary cortical bone then proceed to the next sized intramedullary reamer. Increase the size of the reamer until a reasonable firmness is achieved. This determines the appropriate size and length of the stem. Note that it is best to do this using the hand reaming technique with modest firmness as often the bone adjacent to failed knee replacements is osteoporotic and soft. Remove the T-handle and leave the **Femoral Reamer** in place, slide the appropriate size bushing into the distal **Femoral Cutting Guide** and over the selected reamer in the femoral canal (Figure 8). Adjust the cutting jig to the appropriate lower extremity (left or right). The distal cut is fixed at 6° of valgus in the coronal plane compared to the axis of the distal femur. It should be emphasized that the appropriate fit of the distal femoral hand reamer needs to be carefully selected as this is the reference to the 6° valgus cut.

Once the T-handled intramedullary jig has been placed, the reference plate should be against the distal femoral bone. Remove the prominent areas of bone against the reference plate with an

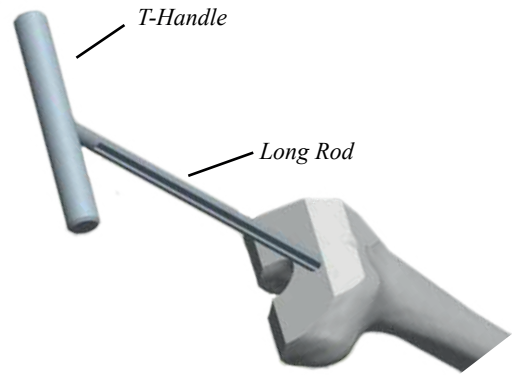


Figure 6

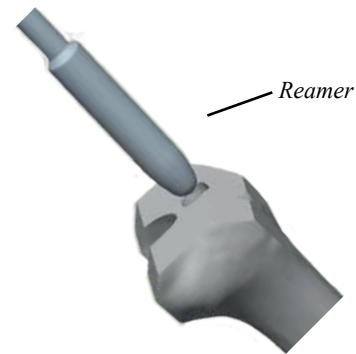


Figure 7

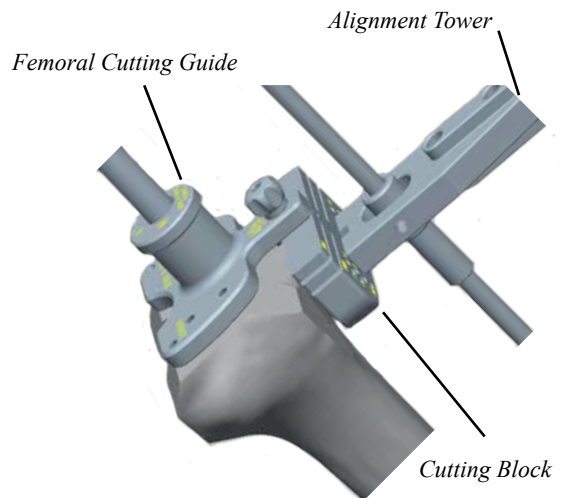


Figure 8

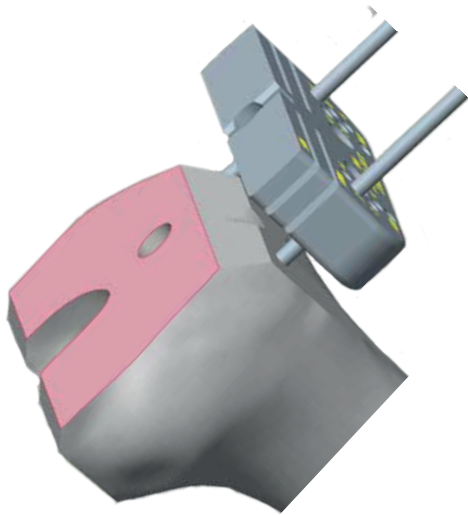


Figure 9

oscillating saw to achieve a uniform apposition of the alignment plate to the healthy bone of the distal femur. Preserve as much healthy bone as possible.

Once this is in place the rotation needs to be adjusted. Possible references include the posterior condylar cuts from the previous surgery if they are an accurate representation of rotation. The epicondyles can also be used to determine distal rotation. It should be noted that if rotation of the femur is used to determine appropriate component rotation, this should be checked on the normal extremity as well as the operated extremity prior to draping.

If needed, the distal **Femoral Alignment Guide** can be fixed to the femur by first drilling through the guide hole in the alignment plate and then placing a smooth pin through this drill hole. It should be noted that errors can be created by impacting a pin through the guide hole without first drilling the hole. Place the cutting block onto the distal femoral alignment plate.

At this point examine the placement of the block and make sure it is clinically appropriate in the 6° of valgus. An outrigger can be placed on the cutting block, and with the femur in neutral position, the alignment rod can be placed to check that the mechanical axis is through the center of the hip rotation (Figure 8). Fix the cutting block to the femur by drilling through the **Cutting Guides** and then placing **Smooth Pins**. Remove the intramedullary guide and the alignment plate. (Figure 9)

Check the amount of bone that would be removed with the current placement of the block by using the **Resection Indicator**. Move the cutting block distal or proximal using the multiple holes in the cutting block to result in the appropriate cut to minimize bone loss but to produce an appropriate surface for placement of the revision femoral component. The principle is to restore the anatomic joint line. The most distal cutting surface of the cutting block is at the level of the femoral component (minimal bone removal). The -5mm cutting slot is the level



Femoral Alignment Guide



Femoral Cutting Guide



Fixation Pins
with Cutouts



Resection Indicator
(Angle Wing)



A/P Cut Block



Trial Stem



Resection Indicator
(Angle Wing)

that will accommodate the 5mm distal augment medially or laterally on the femoral component. Using an oscillating saw carefully remove the distal femoral bone using the appropriate surface of the distal femoral cutting block. Make sure that the assistant surgeon protects the soft tissue structures such as the collateral ligaments. Check the cut with a flat block and, if this is satisfactory, proceed to the chamfer cuts. If additional bone needs to be removed, then the distal femoral cutting block has multiple positions to allow 2 mm increments of additional bone cut.

Femoral Resections

The **A/P Cut Block** is based on the intramedullary space of the distal femur. This ensures the best anterior-posterior placement of the femur. The femur size can be estimated from the x-rays and the component removed. The selected size of **A/P Cut Block** is fixed to the **Trial Stem** (Figure 10). The size of the stem (length and diameter) was determined above with the hand canal reamers. Place this in position on the distal femur. Adjust the rotation as suggested above, making sure not to internally rotate the **A/P Cut Block**.

Once the surgeon feels that the block is appropriately placed, check the anterior cut with the **Resection Indicator**. Adjust the block as needed to ensure a smooth transition of the anterior femur with the femoral component. Avoid notching of the anterior femur. Fix the A/P Block to the femur by drilling and filling the block pin holes (Figure 11). Make the anterior and posterior chamfer cuts.



Figure 10

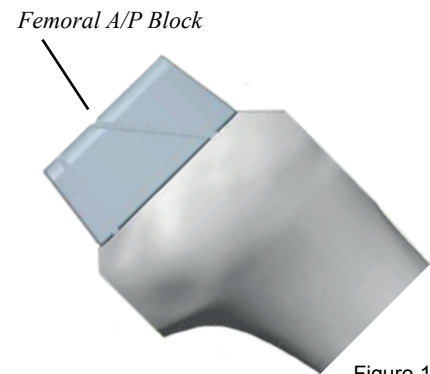


Figure 11

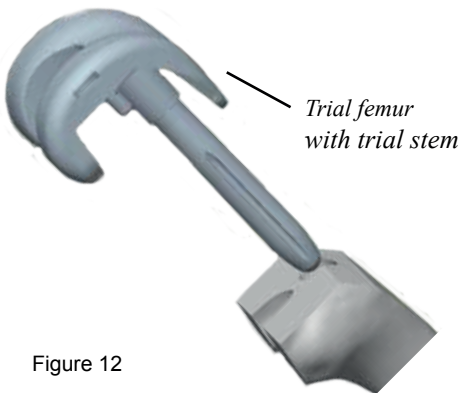


Figure 12

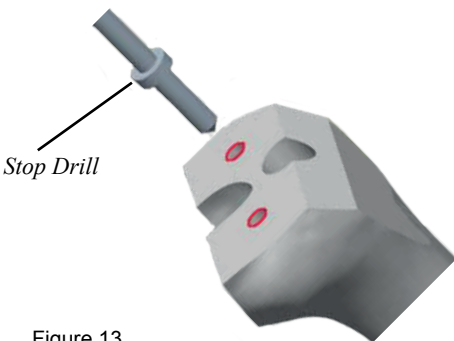


Figure 13

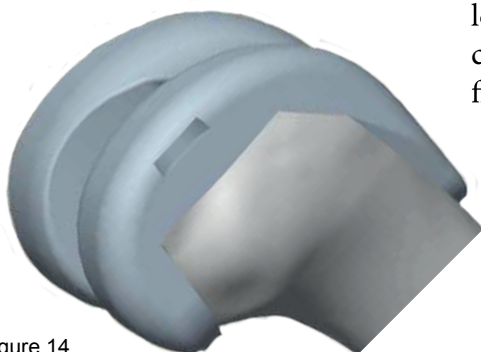


Figure 14

Trial Placement

Remove the A/P Block and fix the trial stem to the appropriate size **Trial Femur** (Figure 12). Secure augments* to the distal femur if needed. If no augments are planned, affix pegs to the femoral trial. Gently impact this onto the distal femur. Remove the trial femur and use the indentations from the pegs to drill the peg holes with the **Step Drill** (Figure 13). Also, remove a small portion of the anterior mid bone where there is a “notch” in the femoral component. Impact the trial component onto the distal femur (Figure 14). Check for appropriateness of cuts and the fit of the trial component. Make adjustments as needed. Check for residual osteophytes such that the component will fit flush to the bone and the collateral ligaments will not be obstructed. (See Table 2 for component compatibility)

Tibial Preparation

The tibial component has a built in 7° posterior slope to approximate the average posterior slope of the tibia. The principle of maintaining maximal bone contact is also important and, therefore, when resecting the proximal tibia, remove only the bone that is required in order to seat the component onto healthy bone stock. Rotation of the tibial component is based on the medial one-third of the tibial tubercle. The proximal tibial cutting guide does not have the usual spikes, pins, or other stabilizing devices, prior to locating the appropriate height of the cutting block. This is due to the fact that with revision surgery there is bony deficiency in the central portion of the proximal tibia. Therefore, the height of the cutting guide is determined by the comma feeler gauge that will allow the surgeon to place the cutting block at the level of this gauge and then subsequently fix the cutting block to the proximal tibia by drilling and filling the block guide holes with smooth pins.



Trial Femur



Step Drill

Proximal Tibial Cut

Place the revision external **Alignment Guide** on the ankle with its mid point at the middle of the ankle joint. This is generally 4 mm medial to the geometric mid point between the medial and lateral malleoli. The rotation of the external alignment jig is referenced off of the medial one-third of the tibial tubercle. Mark the medial one-third of the tibial tubercle with a marking pen. The slot in the outrigger is used to sight the marking to ensure rotational alignment. Take great care not to internally rotate the tibial component or the patella may not track accurately.

At the proximal aspect of the **Cutting Block**, place the **Resection Indicator** on top of the block and use it to place the position of the cutting block at the desired level of bony cut which generally represents the lowest area of bone to be removed. Again, it should be stated that it is important to preserve as much normal bone as possible and frank bony defects can be handled by other techniques such as increased cement mantle, bone grafting, or metal augments which are available with this revision system.

At this point the 7° posterior slope alignment needs to be achieved. Slide the distal aspect of the alignment guide along the ankle attachment until the longitudinal axis of the alignment guide is parallel to the mechanical axis of the tibia as viewed from the lateral side. The 7° posterior slope is built into the proximal aspect of the guide. Fix the **Tibial Cutting Block** by first drilling through the fixation hole and then placing at least two **Smooth Pins** (Figure 15). These two pins are generally placed at the same hole position in the block to allow adjusting of the block at 2 mm increments if needed. Remove the outrigger and then use the check reference alignment guide to make sure that the block is in the appropriate mechanical alignment regarding the medial one-third of the tibial tubercle and the center of the ankle joint (Figure 16). Place the comma feeler gauge again through the block and visually determine that the cut is appropriate to maximize retention of normal bone when making the proximal tibial cut. The proximal (top) surface references the “zero” cut and the slot just below that references the -5mm cut for the augment if needed for bony deficits. Move the cutting block up or down if needed using the multiple pin holes in the tibial cutting block.

Using appropriate retractors, protect the soft tissue structures and use the oscillating saw to remove the proximal tibial bone. Again, irrigation is important to maintain the integrity of the remaining bone.

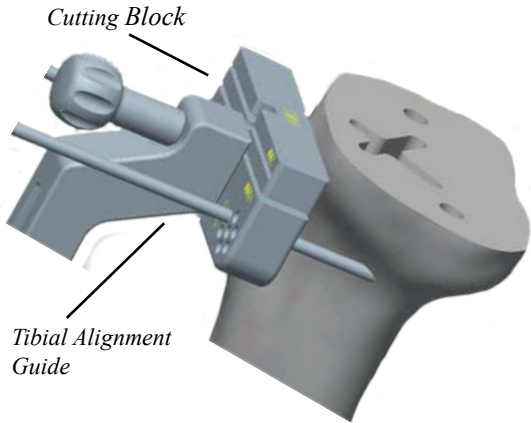


Figure 15

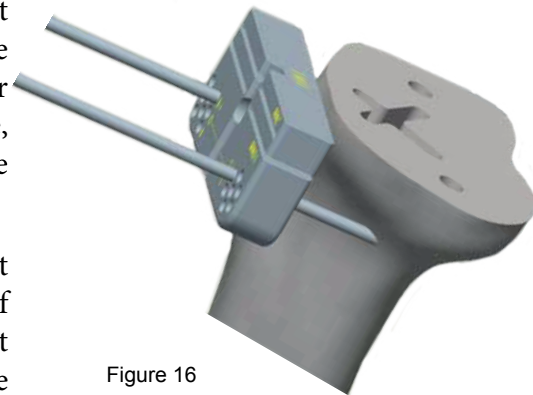


Figure 16



Tibial Alignment Guide
(Top)



Tibial Alignment Guide
(Bottom - Ankle)



Resection Indicator
(Angle Wing)



Cutting Block



Fixation Pins
with Cutouts

Trial Sizing/Reaming

Place the sizers on the proximal tibial bone. The appropriate size should be contained within the bony margins of the tibia (consult Table 2 for femur/tibia size compatibility). Place the **Tibial Sizer** in the appropriate position with regards to rotation at the medial one-third of the tibial tubercle and centered over the proximal tibial bone stock (Figure 17). Using an alignment rod in the sizer handle check the longitudinal placement of the proximal tibial cut relative to the ankle. If need be, carefully re-cut the proximal tibial surface until correct alignment is achieved. Drill and then pin the tibial sizer to the proximal tibia to stabilize this for the next step in the process.

Choose the appropriate sized bushing. Start with a reamer smaller than the anticipated final size. Assemble the **Bushing Guide** to the tibial base plate (Figure 18). Hand ream the proximal tibia taking care to do this in a gentle fashion as the bone about the loose knee replacement may be osteoporotic. Assess the stability and the length of the stem as the proximal tibia is hand reamed. Start with the smallest **Reamer** and gradually work up to larger sizes using the stability of the reamer and the depth of the reamer to determine the appropriate stem size for the revision tibial component.

Remove the tibial sizer and bushing. At this point check for retained osteophytes or other tissues that may block appropriate range of motion.



Tibial Sizer



Bushing Guide



Reamer

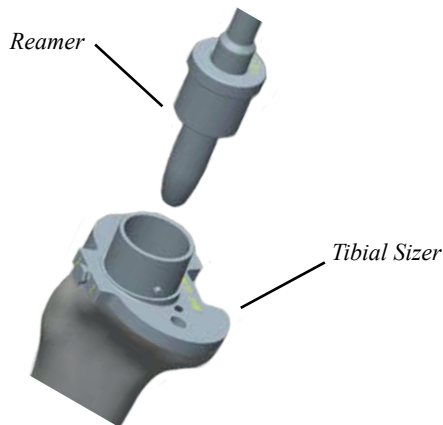


Figure 17



Figure 18

Component and Size Compatibility with CONSENSUS® RKS Femoral Component						
RKS Femoral Component	1	2	3	4	5	6
RKS Femoral Posterior Augment (5mm)	1	2	3	4	5	6
RKS Femoral Distal Augment (5mm)	1	2	3/4	3/4	5/6	5/6
KNEE Tibial Insert (congruent or ultracongruent)	0, 1/2	1/2, 3/4	1/2, 3/4	3/4, 5/6	3/4, 5/6	5/6
KNEE All Poly Tibia	1, 2	1, 2, 3	2, 3, 4	3, 4, 5	4, 5, 6	5, 6
KNEE Patella, Round, All Poly	0, 1, 2, 3	1, 2, 3	1, 2, 3	2, 3	2, 3	3
KNEE Patella, Oval, All Poly	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2
KNEE Patella, Oval, Metal Backed	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3
MBK Tibial Insert	0, 1/2	1/2, 3/4	1/2, 3/4	3/4, 5/6	3/4, 5/6	5/6

Table 2



Tibial Trial Broach/
Base Plate



Trial Peg



Trial Stem



Tibial Trial Base Plate
Handle



Stop Drill

Trial Placement

Assemble the appropriate size **Tibial Trial Broach/Base Plate** with the stem size as determined by the above hand reaming of the proximal tibia. Assemble augments*, if needed, onto the Tibial Trial Broach/Base Plate. If augments are not used, then attach **Trial Pegs** onto the Tibial Trial Broach/Base Plate. The tibial **Trial Stem** should be fully threaded onto the tibial trial broach/base plate so that the stem is well secured to the broach/base plate.

Attach the **Tibial Trial Base Plate Handle** by depressing the thumb button on the proximal aspect of the handle and then clipping it over the attachment platform over the center of the tibial trial (Figure 19). Controlling the rotation and position of the tibial trial, place this down the proximal tibial marrow space. The actual broaching of the proximal tibia occurs with placement of this tibial trial as should be apparent from the cutting surfaces underneath the tibial base plate. Therefore, as this is positioned, the rotation should be carefully adjusted. The trial broach/base plate and stem should insert into the proximal tibia with modest impaction being needed. Remove the trial broach/base plate and use the indentations of the pegs to guide the use of the **Step Drill** to make the peg holes in the proximal tibia (Figure 20). Reposition the tibial trial broach/base plate and impact it into the proximal tibia. If it is not going down smoothly, recheck for appropriateness of the size of the stem and the appropriate direction of the stem relative to the proximal tibia. After this has been lightly impacted into the appropriate position check the contact surface underneath the tibial tray (Figure 21). This should be very squarely down in all aspects and should be contained within the margins of the tibial bone in the same fashion as the tibial sizer had been as noted above, make adjustments as needed (See Table 3 for component compatibility).



Figure 19



Figure 20

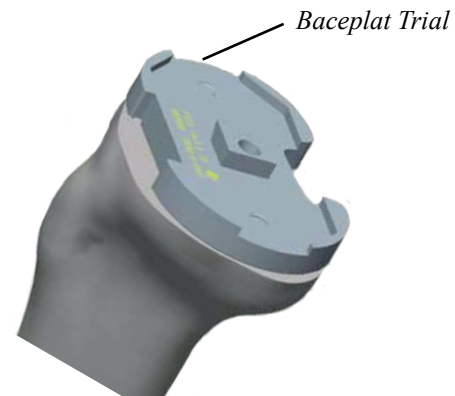


Figure 21

Table 3

Component and Size Compatibility with CONSENSUS® RKS Tibial Baseplate							
RKS Tibial Baseplate	0	1	2	3	4	5	6
RKS Tibial Augment (5mm, 10mm)	0Lat, 0Med/ 1Lat	0Med/ 1Lat, 1Med/ 2Lat	1Med/ 2Lat, 2Med/ 3Lat	2Med/ 3Lat, 3Med/ 4Lat	3Med/ 4Lat, 4Med/ 5Lat	4Med/ 5Lat, 5Med/ 6Lat	5Med/ 6Lat, 6Med
KNEE Tibial Insert (all variants)	0	1/2	1/2	3/4	3/4	5/6	5/6

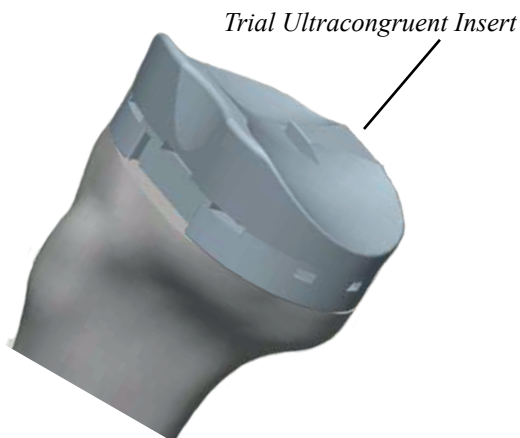


Figure 22



Figure 23

Place a thin **Trial Tibial Insert** on the tibial tray (Figure 22) and then place the previously assembled femoral trial and stem on the distal femur (Figure 23). Check the range of motion, tightness of the collateral ligaments, and increase the thickness of the polyethylene as needed to result in the best function and collateral ligament adjustment.

The principle is to restore the joint line anatomically. This is approximately located one half the distance between the inferior portion of the patella and the patella tendon's insertion into the tibial tubercle. The knee should extend fully but not hyperextend. There should be 1 to 3 mm of laxity in the bent 20° to 30° and in deep flexion there still should be 1 to 3 mm of laxity in both the medial and the lateral collateral ligaments. Appropriate ligamentous adjustment needs to be achieved using anatomic principles. The variables include changing the thickness of the tibial insert, changing the level of the femoral cut, changing the size of the tibial component and changing the level of the tibial component. Other methods include soft tissue balancing techniques which should be part of the orthopedist's surgical skills.

Anterior-posterior stability can be improved by using the posterior cruciate substituting polyethylene inserts that are part of the Consensus Knee System.

Patella Preparation

Once the sizing of the femur and tibia is appropriate then attention should be turned to the patella. If the patella component has not been removed, and it is deemed necessary, then take great care to remove the patella component without sacrificing bone. Disruption of the cement polyethylene surface prior to removing the cement from the bone will often result in less bone loss.

Measure the thickness of the VitalitE patella. The polyethylene pegs on the Consensus patella need about 8 mm of bone, therefore the minimum thickness to result in an effective fixation of this



Trials, Ultracongruent Inserts (Left, Sz. 1-2)



Trials, Ultracongruent Inserts (Left, Sz. 3-4)



Trials, Ultracongruent Inserts (Left, Sz. 5-6)



Trials, Ultracongruent Inserts (Right, Sz. 1-2)



Trials, Ultracongruent Inserts (Right, Sz. 3-4)



Trials, Ultracongruent Inserts (Right, Sz. 5-6)

VitalitE patella is about 10 mm. Normal patellas measure about 23 to 26 mm in thickness. This would be the goal for the composite thickness of the VitalitE and patella bone. Using the oscillating saw, flatten the patella bone using haptic (finger to thumb) determination. Care should be used to avoid beveling or slanting of the cut.

Carefully debride the scar or osteophytes from the patella margin. Use the patella sizer to determine the appropriate size of the patella. Note that the Consensus patella is anatomic and asymmetric. The thicker portion should be centered over the true medial aspect of the patella. Use the drilling guide to drill the appropriate holes taking care not to puncture the anterior cortex of the patella. Place the tibial trial to make sure that the component sits well against the remaining normal bone.

Reduce the patella in the trial trochlear groove and then check the tracking of the patella through range of motion. The patella should be stable in the trochlear groove. The Revision Knee femoral component has a laterally reduced femoral condyle that is anatomically designed and greatly reduces the need for lateral releases. It is important to make appropriate releases where needed to assure accurate tracking of the patella in the trochlear groove.

Knee Alignment



Femoral/Tibial Impactor

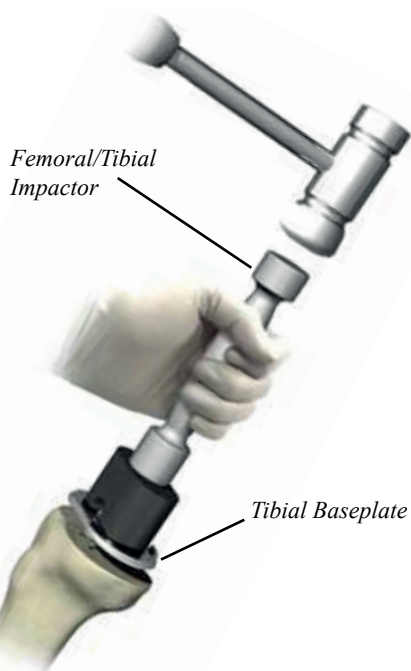


Figure 24

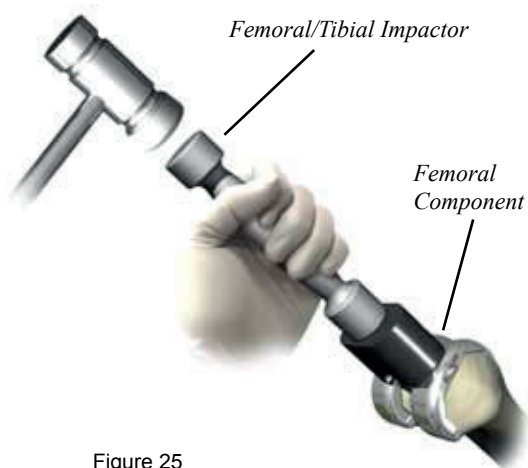


Figure 25

Numerous methods exist to determine appropriate overall alignment and at this point, with all of the trial components in place, overall mechanical alignment should be assessed.

One standard approach is to use a long straight rod centered over the ankle joint as well as centered over the hip joint. Numerous methods described in the literature exist for ensuring appropriate placement of the mechanical axis guide and this is left to the surgeon's experience and expertise. It is desirable to balance the forces through the components. On the average it is desirable to have the resultant forces being squarely through the center of the knee and perpendicular to the tibial polyethylene.

At this point any additional ligamentous or bony adjustments can be addressed.

Cementing the Components

Modern cement technique should be utilized. This includes, but is not limited to, pulsatile lavage of the bone, drying of the bone, placement of the cement in a bloodless field, compression of the cement onto the trabecular bone, impaction of the components with enough cement that it is extruded around the margins during placement, and using a sharp scalpel to remove the excess cement without pulling it from underneath the components (Figure 24, 25). The actual technique is left up to the experienced surgeon. The usual sequence of cementing is tibia and patella with the first batch of cement. After its set, the femur is cemented with the second batch.

After the cement has hardened on the component, check for any extrusion or fragment of cement throughout the interfaces including flexing the knee to a marked degree looking for retained cement around the posterior aspect of the components.

The appropriate size and thickness of the tibial polyethylene is then positioned into place by

engaging the dovetail locking feature of the insert/ baseplate anteriorly and pushing posteriorly until the insert snaps into place. Then recheck alignment, balance, and patella tracking. (Figure 26)

Closure

The experienced surgeon will be familiar with closure of the wound and this includes, but is not limited to, reconstruction of anatomy, hemostasis, accurate re-approximation of the subcutaneous tissue to relieve tension from the skin closure and then accurate closure of the skin followed by light compression of the wound.

Postoperative Care

Of note is that the quality of bone and fixation to the bone will guide the experienced orthopedic surgeon in postoperative care. The common approach is to start early ambulation and range of motion. The weight bearing status is determined by the surgeon using experienced judgment regarding bone quality and fixation.



Figure 26

References

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*Short pegs are only intended to fill the distal femoral augment holes and baseplate augment holes when augments are not desired. Screws are not intended to fill the femoral or tibial augment holes when augments are not desired. Pegs are not intended to fill the posterior femoral augment holes with or without augments. Short screws and medium pegs are only intended for use with 5mm augments. Long screws and long pegs are only intended for use with 10mm augments.



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