“Columbus MIOS™, the manual solution to the challenges of minimally invasive surgery”
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“Minimally invasive surgical techniques are currently being developed and evaluated for use in knee joint arthroplasty surgery. It is hoped that the reduction in soft tissue trauma that may be associated with these approaches will improve functional outcomes, especially in the early post-operative period, reduce peri-operative morbidity, and accelerate post-operative recovery. The surgical exposures used for the various minimally invasive techniques greatly reduce visualization of important anatomic landmarks as compared to conventional exposures. As a result, a number of techniques have been developed to deal with the reduction in visualization. These include the use of 1) "mobile windows"; 2) special retractors; unique, downsized instruments; 4) alterations in surgical exposure; and 5) the use of multiple assistants. The consequences of reduced visualization include the potential for implant mal-position, fractures, neurovascular injuries, compromised wound healing, and prolonged operative time. The precise implantation of arthroplasty components may also be difficult if the entire implantation surface is not visible.

This surgical technique is designed to outline the manual approach for less invasive total knee arthroplasty. However, it is important to recognize the value of computer-assisted surgical navigation when using a less invasive approach. Computer-assisted orthopaedic surgical navigation systems are now widely available and are increasingly used to overcome the inherent limitations of manual instrumentation. These limitations are magnified when minimally invasive exposures are used.
The rationale for merging minimally invasive surgical techniques with computer-assisted orthopaedic navigation is that the accuracy and reliability that is possible with the use of computer-assisted techniques can be retained when less invasive exposures are used. The results from a number of centers using a variety of image-free computer-assisted systems and conventional surgical exposures have indicated that the average limb alignment achieved with these systems is as good or better than that achieved with manual instruments, that the number of limbs significantly mal-aligned ("outliers") is reduced, and that the alignment of each of the arthroplasty components is more accurate. The increase in surgical time is often no more than 5-10 minutes. The use of computer-assisted techniques also helped to emphasize the usefulness of measuring the accuracy of each step of the surgical procedure.

The extraordinary interest by patients and surgeons in minimally invasive TKA approaches is a stimulus for the continued evolution and merging of computer-assisted and minimally invasive orthopaedic surgical technologies. The Columbus MIOS approach to less invasive knee arthroplasty from Aesculap Implant Systems effectively combines less invasive surgical techniques, instrumentation, implant design, and computer-assisted navigation to help surgeons optimize surgical and clinical outcomes for total knee arthroplasty. The Columbus MIOS Manual technique is part of a comprehensive approach to the performance of knee arthroplasty using less invasive surgical techniques.

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Indication

The Columbus MIOS manual surgical technique can be used in primary TKA procedures in which minimally invasive or traditional exposures are appropriate.

Contraindication

- Active infection, sepsis, and ostomyelitis

Relative Contraindications

- Patients who may be incapable of following directions
- Osteoporosis
- Metabolic disorders which may affect bone formation
- Osteomalacia
- Infections that may spread to the implant site
- Vascular insufficiency, muscular atrophy, and neuromuscular disease
- Incomplete of deficient soft tissue surrounding the knee
- Marked bone loss or bone resorption apparent on x-ray

Potential Advantages of a Minimally Invasive Technique

- Less blood loss
- Reduced swelling of the associated soft-tissues
- Rapid wound healing
- Improved Cosmesis
- Reduced post-operative pain
- Reduced hospital stay
- Faster restoration of function
Preoperative Planning

The Columbus Knee System provides X-ray templates which help the surgeon to define the following parameters:

- Frontal, sagittal limb alignment
- Levels of bone resection
- Optimal position of implant
- Size of implants

The following X-rays are recommended:

- Long standing weight bearing A/P bilateral or single limb view
- Lateral view
- Skyline view

Fig. 1
Columbus MIOS™ TKA Approach

Columbus MIOS instruments are designed to be used with any of the currently recommended TKA exposures including:
- Standard medial parapatellar
- Mini midvastus
- Mini subvastus
- Mini medial parapatellar

![Fig. 2 Mini midvastus](image1)

![Fig. 3 Mini subvastus](image2)

![Fig. 4 Mini medial parapatellar](image3)

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**Standard Medial Parapatellar Approach**

**MIOS TKA Approach**
Surgical Technique

This Columbus MIOS Manual surgical technique provides an overview of general recommendation for the use of the Columbus MIOS Manual instrumentation for implantation of the Columbus Total Knee. Prior to adopting the Columbus MIOS technique, it is recommended that the surgeon and operative team be familiar with the surgical technique and the use of the Columbus Knee System.

Patient Preparation
The patient is placed in the supine position and is prepped and draped in the usual fashion. A leg holder is recommended to help control the prepped limb at various points in the surgical procedure. Several changes in limb position are required to complete the bone cuts. The leg holder permits changes in the knee position from full extension to full flexion and provides the stability required to successfully carry out each step.

To help mobilize the quadriceps, inflate the tourniquet with the limb in full flexion. (Fig. 5)
Surgical Technique

Incision
An anterior longitudinal incision is made along the medial border of the patella. The incision extends from the medial border of the tibial tuberosity to the superior pole of the patella. Extending the incision may be necessary to perform a safe and correctly aligned primary total knee arthroplasty. (Fig. 6 & 7)
**Arthrotomy**

After the incision is made, the knee should be placed in 70-90° of flexion to allow full exposure of the VMO fibers and capsule. A mini medial parapatella, mini subvastus or mini midvastus approach may be used. (Fig. 8)

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**Exposure**

Perform a subperiosteal release of the medial capsule and anterior portion of the medial collateral ligament. Partially remove the fat pad and release the soft-tissue that is attached to the anterolateral tibia. Release the proximal capsule underneath the quadriceps which will facilitate lateral retraction of the patella and further expose the anterior femur and proximal tibia. (Fig. 9)
Measured Resection Technique – Femur First

Preliminary Patella Cut (optional)
Prior to preparation of the femur, the surgeon may choose to carry out the patella resection in order to improve distal femoral visualization. The use of specially designed patella clamps will help facilitate control of the patella. The patella protection plate NQ943R is placed on the resected surface to help avoid damage that may be caused during retraction or from other surgical instruments during the procedure. (Fig. 10)

The surgeon may also elect to resect the tibial spine at this point to further improve visualization of the femur.

Identify Whiteside’s Line (optional)
For the purpose of establishing rotation of the femoral component, Whiteside’s line is identified and marked with a sterile marker. (Fig. 11)
Resection of the Distal Femur

The entry point of the femoral medullary cavity is opened with the 9mm drill (NE443R). The 8mm intramedullary femoral rod (NQ475R) is introduced into the medullary cavity using the handle and the distal femoral alignment system (NQ470R). (Fig. 12)

The femoral cutting block (NQ471R) is then placed onto the device connecting to the two stainless steel posts. This system offers the possibility of varus/valgus adjustment in 1° intervals A. The adjustment range extends to 11° (Fig. 13)
The distal resection is set by adjusting the cutting block holder to the required resection thickness. The typical distal resection thickness is 9mm which is equal to the thickness of the distal femoral condyles of the Columbus Knee femoral component. The surgeon may choose to modify the distal resection thickness based on the need for increased/decreased range of extension and/or joint stability.

The distal cutting block is fixed to the femur using two headless pins through the holes marked “0”. One additional converging pin is introduced to stabilize the block and prevent it from lifting off the bone during the bone resection. (Fig. 14).

The distal femoral cutting guide assembly is removed leaving the femoral cutting block in place. (Fig. 15)

**Note:** The Columbus Knee distal femoral implant thickness is 9mm
Checking the Mechanical Axis and Distal Femoral Cut Orientation (optional)

Perpendicular alignment of the distal femoral cut to the mechanical axis of the limb can be confirmed by placing the alignment rod control plate (NQ488R) into the cutting slot in the femoral cutting block. The alignment rod assembly (NP471R & NP331R) is attached and used to check the orientation of the fixed cutting block to the mechanical axis of the limb. The rod should align over the center of the femoral head, knee and ankle simultaneously. (Fig. 16)

The thickness of the proposed resection can be checked by placing the cutting depth check blade (NM350R) through the distal femoral cutting block slot.

The recommended blade thickness is 1.27mm. To insure complete bone cuts, use of a 13mm wide blade is recommended. A narrow saw blade will permit greater angulation through the specially designed slots in the cutting block helping to reach the posterior medial and lateral corners of the bone. The resection is performed with careful attention to protect the soft tissues, ligaments and tibia from injury. Use of the special MIOS soft tissue retractors is recommended. (Fig. 17)
The femoral component size and the medial-lateral width of the distal femur are measured using the femoral ruler NQ959R (Fig. 18). To further insure that the correct femur size is selected, it is helpful to template the femur prior to the procedure.

**Anterior Referencing**
The femoral orientation guide (NQ476R) *without the footplate* is pre-assembled with the stylus from the NQ474R measuring guide and set so that the “SZ” indicator aligns to the femoral component size selected. The guide is placed on the resected distal femur and centered in the medial-lateral direction. Rotation is set by placing the guide parallel to Whiteside’s line. The anterior probe is set at the selected femoral component size and used to confirm the anterior flange position of the femoral component. Careful attention to avoid notching and medial-lateral overhang must be observed. (Fig. 19)

The holes for the orientation of the 4-in-1 cutting block are drilled using two 3.2mm x 63mm threaded pins (NP583R) through the holes that correspond to the selected femoral component size (S, M, L).

**Posterior Referencing**
In the posterior referencing technique, the size of the femur is estimated using pre-operative x-ray planning and confirmed intra-operatively using the femoral size gauge (NQ959R). The femoral measuring device “modular” (NQ954R) *with the footplate* is placed onto the distal femur with careful attention to insure that the posterior footplate is in full contact with the posterior condyles.

The guide should be centered in the medial-lateral direction on the distal femur. The holes for the orientation of the 4-in-1 cutting block are drilled using the 3.2mm long threaded pin (NP583R) through the holes in the distal femoral orientation guide that correspond to the selected femoral component size, (S, M, L). (Fig. 19) To further insure that the correct femoral component is selected, it is helpful to template the femoral component size prior to the procedure.
With the posterior foot plates positioned flush against the posterior condyles, the stylus is placed on the anterior cortex at the location of the preferred exit point of the anterior bone cut (or where the anterior lateral aspect of the anterior flange of the femoral component is ideally positioned). The femoral component size is read directly from the gauge at the “SZ” size location A. The femoral component size is also indicated on the gauge on the stylus B (Fig. 20 & 21).

Setting the Orientation of the Femoral Component (4-in-1 cutting block orientation)
The “Adjust Size” mechanism is locked using screw A so that the arrow N aligns with the femoral component size selected in line with the size indicator “SZ”. The stylus screw B is locked at the appropriate anterior lateral location (the point on the anterior cortex at which the anterior flange of the femoral component will end) and the holes for the 4-in-1 cutting block are drilled through the two “parallel” drill hole positions for the appropriate component size (S, M, L). In the example shown in Fig. 22, a size 5 femoral component is indicated. In this case, the size “M” holes are drilled through the two parallel holes (□). If 3 degrees of external rotation is preferred, the holes are drilled through the appropriate “offset” holes (□) for the right or left femur. In this example, the “offset” holes for a right femur are drilled. (Fig. 22)

Note: If a left femur is drilled, the opposite set of “offset” holes is selected.

If after setting the anterior probe, the SZ indicator falls between sizes, the size is adjusted by moving the SZ component of the femoral measuring device to the preferred size and locked using screw A. The appropriate size 4-in-1 cutting block (femoral component size) holes are then drilled using the same technique as noted in the previous step. (Fig. 23)

<table>
<thead>
<tr>
<th>Drill Holes</th>
<th>Cutting block size</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>1, 2</td>
</tr>
<tr>
<td>M</td>
<td>3, 4, 5</td>
</tr>
<tr>
<td>L</td>
<td>6, 7</td>
</tr>
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</table>
Completing the Femoral 4-in-1 Bone Cut

The 4-in-1 (NQ441R-NQ446R) cutting block size that corresponds to the femoral component size is fixed into the predrilled peg holes in the distal femur using the handle (NQ460R) insuring that the anterior cut mark (ANT) is visible and is on the anterior side of the block. The guide is impacted until it is flush with the distal femoral resection. Two converging headed pins (NP586R) are used to prevent the block from lifting off the bone when performing the bone cuts. (Fig. 24)

Due to the limited space available when using a less invasive technique, the recommended cutting sequence is somewhat different from the more traditional approach as follows:

1. Anterior Cut
2. Anterior Chamfer Cut
3. Posterior Cut
4. Posterior Chamfer Cut

The four femoral bone cuts are performed using a special narrow 1.27mm thick saw blade. (Fig. 25)

Prior to cutting, the tibia stylus or "wing" should be placed in the anterior slot in the cutting block to confirm that the anterior resection will not notch.

During each bone cut, special care must be taken to protect the surrounding soft tissues and ligaments. Use of the specially designed Columbus MIOS retractors is recommended. To avoid damaging the tibia plateau, the tibia protection plate (NQ377R) may also be used. Once the cuts are completed, the converging pins and cutting block are removed.
Preparing the Tibia

The Columbus MIOS Manual surgical technique provides two approaches to performing the proximal tibial resection.

- Extramedullary Alignment
- Intramedullary Alignment

Extramedullary Alignment Approach:

The Columbus MIOS extramedullary alignment (EM) instrument should be pre-assembled on the sterile table using the appropriate tibial cutting block, “Left” (NQ500R) or “Right” (NQ501R). In this example, the “Right” Tibial cutting block is illustrated. (Fig. 26)

Anatomic landmarks for the alignment of the EM device in the frontal plane are the tibial spine and the mid point of the talus. Rotation of the device should point to the junction of the medial and mid third of the tibial tubercle. The device is aligned parallel to the long axis of the tibia in the sagittal plane. The cutting slope is set at 0° to the EM alignment guide. (3° of slope is built into every Columbus poly insert.)

The device may be aligned in three planes. (Fig. 26)

A Height (or the amount of bone resection)
B Slope
C Varus/Valgus

Height Adjustment

The amount of bone resection is defined based on the individual patient’s needs. The goal is to remove any defect on the tibial plateau surface as completely as possible in order to create a stable, intact bone surface for the tibial base plate implant. The tibial stylus is set for the amount of bone to be resected and introduced into the slot of the tibial cutting block. (Fig. 27) The height of the extramedullary alignment device is adjusted until the stylus comes into contact with the point corresponding to the joint line. (Fig. 26)

Note: Columbus Knee polyethylene implants have a 3° posterior slope built into the surface of each component. The polyethylene components range in size from 10mm to 20mm in 2mm increments. The polyethylene component size represents the final thickness of the assembled tibia implant when combined with the tibial base plate.
Slope Alignment
Alignment for slope in the sagittal plane is adjusted by unlocking screw 2 and moving the construct along the length of the malleolar connecting rod (NQ494R). The distance between the etched lines on the ankle clamp connecting rod correspond to 1° of slope where the tibial length is 40cm and can be used as a guide for the average patient. (Fig. 26)

Varus/Valgus alignment
Varus/Valgus alignment is controlled by adjusting the connecting rod screw 3 of the ankle clamp. In the unlocked position, the connecting rod can be moved medial or lateral thereby adjusting the varus/valgus orientation of the tibial cutting block. The distance between the etched lines on the anterior surface of the ankle clamp correspond to a 1° change in cases where the tibial length is 40cm and can be used as a guide for the average patient. (Fig. 26)
Intramedullary Alignment Approach:
The entry point of the tibial intramedullary canal is prepared using a standard punch and opened to accept the intramedullary alignment device using the 9mm drill (NE443R). The correct location for this opening generally lies behind the anterior cruciate ligament insertion point. The 8mm diameter IM alignment rod (NQ475R or NQ473R) and IM rod adapter (NE320R) assembly is carefully introduced into the intramedullary tibial canal. (Fig. 28)

Note: The symmetrical tibial cutting block (NE423R) must be used for the IM alignment approach.

The IM tibial cutting guide alignment device should be assembled on the sterile table. The IM cutting guide assembly is then attached to the IM rod. The device may be aligned in three planes. (Fig. 29)

- **T** Height (or the amount of bone resection)
- **S** Slope
- **V** Varus/Valgus

### Height Adjustment
The resection height is defined based on the needs of the patient. The tibial stylus is set to the amount of bone to be resected and introduced into the cutting slot of the tibial cutting block. The assembly is lowered on the IM rod until the stylus comes into contact with the joint line and locked into place by tightening the locking screw 1.

### Alignment in the Sagittal Plane (slope)
Alignment in the sagittal plane (parallel to the mechanical axis) is achieved by adjusting slope screw 5. The value corresponding to the degree of tibial slope be read on the scale 2.

### Varus/Valgus Alignment
Varus/valgus alignment is achieved by adjusting the varus/valgus screw v. The alignment chosen can be read on the scale 3.

Note: Columbus Knee polyethylene implants have a 3° posterior slope built into the surface of each component. The polyethylene components range in size from 10mm to 20mm in 2mm increments. The polyethylene component size represents the final thickness of the assembled tibia implant when combined with the tibial base plate.
Recession of the Tibial Plateau

The tibial cutting block is fixed to the bone with three threaded headless pins (NP583R). Two pins are placed through the holes marked “0” and one pin is placed through the appropriate medial converging hole. The extramedullary or intramedullary alignment device is now removed and the proximal tibial bone resection is performed using a 1.27mm thick saw blade. Careful attention not to damage the posterior cruciate and collateral ligaments should be observed during the resection procedure. Should the surgeon choose to resect additional bone from the proximal tibia, the cutting block may be moved on the existing parallel headless pins in increments of 2mm for a total of 4mm. (Fig. 30)

Note: Because each Columbus Knee polyethylene insert has 3° of slope built into the component surface, the recommended proximal tibial resection is generally performed at 0° of slope. The surgeon may choose to introduce more or less slope depending on the needs of the patient.

Sizing the Tibial Plateau Component

The trial tibial plateau (NQ381R – NQ389R) that best fits the resected tibial surface is selected. Five full sizes and four plus sizes, which are 3-4 mm wider in the AP dimension, are available.

The trial polyethylene insert is placed on the trial base plate.

Rotational Alignment of the Tibial components

Rotational alignment of the tibial base plate can now be established by aligning the tibial base plate trial under the femoral trial and “floating” the tibial component into position while performing a flexion/extension maneuver of the limb. This trial reduction maneuver is performed using a trial polyethylene insert thickness that provides accurate limb alignment and joint stability in flexion and extension. The Columbus Knee polyethylene inserts come in 6 sizes matching each tibial base plate and ranging in sizes from 10 – 20 mm in 2mm increments.
Rotation of the trial tibial base plate can also be established by aligning the trial using anatomic landmarks. These include:

- A point on the anterior tibia at the junction of the medial and mid-third of the patella tendon
- A line connecting the insertion of the posterior cruciate ligament and the middle of the patella tendon.

Once the rotational alignment of the tibia base plate trial is determined, a mark is made on the anterior edge of the resected tibia in line with the laser mark on the anterior edge of the tibial base plate trial. This mark will provide a rotational alignment reference that will be used later in the procedure to complete the bone preparation for the final tibial implant. (Fig. 31)

**Checking the Tibial Resection**

Using the alignment rod (NP471R), the surgeon can reaffirm the varus/valgus orientation of the bone cut using the midpoint of the ankle joint for correct alignment orientation. (Fig. 32 & 33)
Preparation of the Tibial Plateau
The appropriate size trial tibial base plate is fixed onto the resected surface of the tibia using the previous rotational alignment mark for alignment. Each Columbus Knee tibial base plate trial (and final implant component) features a rotational alignment mark on the anterior edge. The plateau is fixed to the resected surface using two short headed pins (NP585R). The appropriate tibia drill sleeve is introduced onto the trial base plate and the bone is drilled with the correct drill size to accept the base plate stem. A special handle is provided to stabilize the drill sleeve when drilling. (Fig. 34)

- Tibial plateau sizes T1 – T3/T3+ – use the 12mm diameter drill (NQ366R)
- Tibial plateau sizes T4/T4+ –T5 – use the 14mm diameter drill (NQ376R)

The winglet chisel/keel trial (NQ391R – NQ395R) and handle (NQ565R) assembly is impacted to the stop position through the winglet chisel/keel trial guide (NQ396R). (Fig. 35)

The winglet chisel/keel trial is disengaged from its handle and left in place in the base plate to perform a trial reduction.
Trial Reduction

The femoral trial component is attached to the resected femur and the correct size polyethylene trial is inserted into the joint space until the polyethylene trial locks into place on the base plate surface. The trial reduction maneuver can now be performed. (Fig. 36)

Alignment can be checked in flexion and extension by inserting the alignment rod assembly (NP471R & NE331R) through the hole in the tibial plateau holder (NQ378R). The position of the trial components is checked in relation to the mechanical axis from the midpoint of the femoral head to the midpoint of the ankle joint. (Fig. 37)

Once the correct tibial and femoral component alignment is achieved, the peg holes for the femoral component are prepared by drilling the two distal condylar holes through the trial femoral component with the 6mm drill w/stop (NQ449R).
Posterior Stabilized Technique (PS Implant)
The PS box cut is prepared using the appropriate size PS Femoral Box Preparation Guide (NQ571R – NQ577R). The guide is placed onto the resected femur into the peg holes previously drilled. It is stabilized with two headed threaded pins (NP585R). (Fig. 38)

The 14mm diameter drill sleeve (NQ589R) is attached to the femoral box preparation guide using the medial and lateral holes in the guide. Both corners are drilled using the 14mm drill w/stop (NQ590R). (Fig. 39)

The 22mm diameter drill sleeve (NQ591R) is then introduced onto the guide and the center box position is drilled using the 22mm diameter drill (NQ592R). (Fig. 40)

The drill guide is removed and the medial and lateral walls of the box are finished using the chamfered chisel (NQ593R). The chisel is used with the chamfers facing toward the center of the box. (Fig. 41)
Correct positioning of the box is confirmed when the trial box sits flush with the distal femoral resection and complete bone contact of the posterior pegs is achieved. (Fig. 42 & 43)

**PS Trial Reduction**

The appropriate size femoral trial is assembled with the correct size box trial and placed onto the femur. Next, the appropriate size tibial trial base plate, with the PS polyethylene insert and post assembly, are placed onto the tibia. A trial reduction maneuver may be performed. (Fig. 44)
Measured Resection Technique – Femur First

**Preparation of the Patella**

The patella clamp is attached to the patella and the clamp is tightened until it is securely locked on the anterior and posterior surfaces of the bone. (Fig. 45)

The thickness of the patella may be measured using the patella clamp (NE346R). The clamp is set to the chosen resection height and the resection is performed with the oscillating saw through the cutting slot in the halo portion of the device. (Fig. 46)

The measured thickness should not be exceeded after implantation of the patella implant.

The cutting guide halo is removed and the drill guide (NQ478R) is fixed onto the clamp. The patella peg holes are drilled with the 6mm drill w/stop (NQ449R). (Fig. 47)

The size of the patella is determined using one of the four trial patella implants. For patella size options see the overview on page 37.

**Note:** The Columbus Knee patella component includes three symmetric fixation pegs and, therefore, can be placed in any rotational position.
Final Implant positioning
The Columbus Knee femoral and tibial implants are available in cemented and non-cemented designs. The surgeon can select the appropriate implant design based on the bone quality and his personal preference.

The following implantation sequence is recommended:
- Tibial Plateau
- Femur
- Polyethylene
- Patella

The tibial plateau is connected to the impactor holder assembly (NQ565R & NQ399R) and impacted precisely into the previously prepared proximal tibia. (Fig. 48)

A trial gliding surface may be placed onto the final tibial base plate to help protect the femoral implant from any damage during final implantation.

The femoral implant is oriented onto the distal femur using the femoral implant holder assembly (NQ560R & NQ565R). After the correct flexion and M/L alignment is confirmed, the femur is impacted into its final position ensuring that the component is fully seated and stable. (Fig. 49)

The patella is implanted using the patella clamp (NE346R). A special plastic cement adapter (NE347) is provided to maintain pressure on the implant while waiting for the cement to dry. (Fig. 50)

The Columbus Knee polyethylene trial implants may be used to conduct a final assessment of the implant position, joint stability, and gap balance prior to insertion of the actual polyethylene insert.
Measured Resection Technique – Femur First

Closure
The wound is closed using standard closure techniques. (Fig. 51)
Preliminary Patella Cut (optional)
To help release the extensor mechanism, the exposure is completed by a preliminary patella cut. It is important to avoid everting the patella during this step. The Patellar Protection Plate NQ943R is placed on the resected surface to help avoid damage that may be caused during retraction or from other surgical instruments during the procedure. (Fig. 52)
Preparing the Tibia
The Columbus MIOS manual surgical technique provides two approaches to performing the proximal tibial resection.
• Extramedullary Alignment
• Intramedullary Alignment

Extramedullary Alignment Approach:
The extramedullary alignment (EM) instrument should be pre-assembled on the sterile table by the scrub nurse using the appropriate tibial cutting block, “Left” (NQ500R) or “Right” (NQ501R). In this example, the “Right” Tibial cutting block is illustrated. (Fig. 53)

Anatomic landmarks for the alignment of the EM device in the frontal plane are the tibial spine and the mid point of the talus. Rotation of the device should point to the junction of the medial and mid third of the tibial tubercle. The device is aligned parallel to the long axis of the tibia in the sagittal plane. The cutting slope is set at 0° to the EM alignment guide. (3° of slope is built into every Columbus poly insert.)

The device is aligned in three planes. (Fig. 54)
A Height (or the amount of bone resection)
B Slope
C Varus/Valgus

Height Adjustment
The amount of bone resection is defined based on the individual patient’s needs. The goal is to remove any defect on the tibial plateau surface as completely as possible in order to create a stable, intact bone surface for the tibial base plate implant. The tibial stylus is set for the amount of bone to be resected below the stylus T and introduced into the slot of the tibial cutting block. (Fig. 54) The height of the extramedullary alignment device is adjusted T until the stylus comes into contact with the point corresponding to the joint line. (Fig. 53 & 54)

Note: Columbus Knee polyethylene implants have a 3° posterior slope built into the surface of each component. The polyethylene components range in size from 10mm to 20mm in 2mm increments. The polyethylene component size represents the final thickness of the assembled tibia implant when combined with the tibial base plate.
Gap Balancing Technique – Tibia First

**Slope Alignment**
Alignment for slope in the sagittal plane is adjusted by unlocking screw 2 and moving the construct along the length of the malleolar connecting rod (NQ494R). The distance between the etched lines on the ankle clamp connecting rod correspond to 1° slope where the tibial length is 40cm and can be used as a guide for the average patient. (Fig. 55)

**Varus/Valgus alignment**
Varus/Valgus alignment is controlled by adjusting the connecting rod screw 3 of the ankle clamp. In the unlocked position, the connecting rod can be moved medial or lateral thereby adjusting the varus/valgus orientation of the tibial cutting block. The distance between the etched lines on the anterior surface of the ankle clamp correspond to a 1° change in cases where the tibial length is 40cm and can be used as a guide for the average patient. (Fig. 55)
Intramedullary Alignment Approach:
The entry point of the tibial intramedullary canal is prepared using a standard punch and opened to accept the intramedullary alignment device using the 9mm drill (NE443R). The correct location for this opening generally lies behind the anterior cruciate ligament insertion point. The 8mm diameter IM alignment rod (NQ475R or NQ473R) and IM rod adapter (NE320R) assembly is carefully introduced into the intramedullary tibial canal. (Fig. 56)

Note: The symmetrical tibial cutting block (NE423R) must be used for the IM alignment approach.

The IM tibial cutting guide alignment device should be pre-assembled on the sterile table. The IM cutting guide assembly is then attached to the IM rod. The device may be aligned in three planes. (Fig. 57)

- **Height (or the amount of bone resection)**
- **Slope**
- **Varus/Valgus**

Height Adjustment
The resection height is defined based on the needs of the patient. The tibial stylus T is set for the amount of bone to be resected below the stylus and introduced into the cutting slot of the tibial cutting block. The assembly is lowered on the IM rod until the stylus comes into contact with the joint line and locked into place by tightening screw 1.

Alignment in the Sagittal Plane (slope)
Alignment in the sagittal plane (parallel to the mechanical axis) is achieved by adjusting slope screw S. The value corresponding to the degree of tibial slope is read on the scale 2.

Varus/Valgus Alignment
Varus/valgus alignment is achieved by adjusting the varus/valgus screw V. The alignment chosen can be read on the scale 3.

Note: Columbus Knee polyethylene implants have a 3° posterior slope built into the surface of each component. The polyethylene components range in size from 10mm to 20mm in 2mm increments. The polyethylene component size represents the final thickness of the assembled tibia implant when combined with the tibial base plate.
Gap Balancing Technique – Tibia First

**Tibial Resection**
The tibial cutting block is fixed to the bone with three threaded headless pins (NP583R). Two pins are placed through the holes marked “0” and one pin is placed through the appropriate medial converging hole. The extramedullary or intramedullary alignment device is now removed and the proximal tibial bone resection is performed using a 1.27mm thick saw blade. Careful attention not to damage the ligaments should be observed during the resection procedure. Should the surgeon choose to resect additional bone from the proximal tibia, the cutting block may be moved on the existing parallel headless pins in increments of 2mm for a total of 4mm. (Fig. 58)

**Note:** Should the surgeon choose to reduce the amount of resection prior to performing the bone cut, the tibia cutting block pin fixation holes allow for an additional 2mm of superior positioning.

**Note:** Because each Columbus Knee polyethylene insert has 3° of slope built into the component surface, the recommended proximal tibial resection is generally performed at 0° of slope. The surgeon may choose to introduce more or less slope depending on the needs of the patient.
Gap Balancing

Gap balancing is a 2 step process. In step 1, the flexion and extension gaps are measured and recorded. During step 1, it may be necessary to perform a ligamentous release to bring the gaps close to each other. In step 2, the average extension gap will be adjusted to equal the average flexion gap.

Step 1: Measure the Flexion and Extension Gaps

The goal in this step is to measure the average extension and flexion gaps. If there is significant discrepancy (greater than 3mm) between medial and lateral measurements in extension; or medial and lateral in flexion, a release may be performed. Then remeasure the collaterals in both extension and flexion. If you plan to resect the PCL, it should be resected prior to these measurements.

The extension gap is measured with the distractor, and the medial and lateral gaps are AVERAGED to obtain a measurement of the average extension gap. For instance, if the medial extension gap is 8mm, and the lateral extension gap is 12 mm, than the average extension gap “EG”, is 10mm. This measurement is taken with the knee in 0° of extension. If there is a large discrepancy (greater than 3mm), a standard collateral and soft tissue release must be performed, and new measurements obtained. (Fig. 59)

A similar measurement is taken to establish the average flexion gap “FG” at 90° of flexion. As an example, if the medial flexion gap is 13 mm and the lateral flexion gap is 15 mm, the average flexion gap is 14mm. If there is a large discrepancy between medial and lateral gaps, this may require a release. Small differences (less than 3 mm) can be corrected with rotation of the femoral component. (Fig. 60)
Gap Balancing Technique – Tibia First

Step 2: Adjust the Average Extension Gap to Equal the Average Flexion Gap

The goal in step 2 is to adjust the femoral component size, AP position, and/or distal resection height to obtain equality between the EG and FG.

Note: The height of the tibial resection, (or the tibia plateau and combined polyethylene thickness) affects the EG & FG equally, and does not change this calculation.

Femoral Sizing

The femoral measuring device and stylus (NQ472R) with posterior foot plate (NQ958R) are used to measure the AP dimension of the femur, and predict the size of the femoral component. (Fig. 61)

Femur Size Planning Calculation:

<table>
<thead>
<tr>
<th>Size</th>
<th>AP (mm)</th>
<th>AP Increase (mm)</th>
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</tr>
<tr>
<td>F7</td>
<td>75.5</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Notes:
1. The thickness of the distal condyles of each femoral Columbus Knee size is 9mm and the thickness of the posterior condyles is 8 mm.
2. The labeled polyethylene insert size includes the final dimension of the assembled tibial base plate and polyethylene insert. For example, a T5 tibial base plate with a 14 mm poly insert is 14mm. Sizes range from 10 to 20 mm in 2 mm increments.
3. Femoral component rotation affects only the flexion gap, and has no bearing on the extension gap. It can be used to “fine tune” the medial and lateral collateral balance in flexion.
4. External rotation of the femoral component will decrease the lateral flexion gap, and increase the medial flexion gap.
Gap Balancing Examples:
The following gap balancing scenarios are provided as examples of the 2-step gap balancing technique. These simplistic examples are provided to illustrate the concept of Gap Balancing and are not intended to provide complete details or methods. There are many accepted techniques to manage ligament balancing not presented here. The surgeon must have a complete understanding of all the principles and techniques for soft tissue balancing to fully utilize this approach. At the end of this step the amount of distal resection will be established. The standard resection is 9mm.

Example 1:
The average EG measures 11 and the average FG measures 16. The femur measures a size 4, using the femoral measuring device (NQ959R) or pre-op template. There are two solutions to balance this scenario.

Solution #1: Increase the femoral component size from size 4 to size 5; this will decrease the FG 4.5 mm. A 10 mm poly insert will reduce the EG to 1mm and the FG to 1.5mm. The distal femoral resection is 9mm.

Solution #2: Increase the amount of distal femur resected from the standard 9mm to 13mm, (increased 4 mm). The distal femoral resection is 13mm. This will increase the EG only. The EG is now 15mm and the FG is still 16mm. Increase the poly insert from 10 to 14 mm. This leaves 1 mm of “free space” in extension and 2 mm in flexion.

Example 2:
The average EG is 16mm and the average FG is 12mm. The femur measures a size 4 (using the femoral measuring device or pre-op template); use the following options to balance this scenario.

Solution #1: Decrease the femoral component size from a size 4 to a size 3. This will increase the FG 4mm and now the average EG & FG is 16mm. Increase the poly insert from 10 to 14 mm. This leaves 2 mm of ‘free space’ in extension and flexion. The distal femoral resection is 9mm.

Solution #2: Release the PCL and remeasure the average extension gap and average flexion gap. This will increase the flexion gap (typically 4mm). The distal femoral resection is 9mm.
Gap Balancing Technique – Tibia First

**Solution #3:** Resect 7mm of distal femur and install a 12mm (2mm less than standard) insert. This will leave 2mm “free space” in extension and 0mm “free space” in flexion. The **distal femoral resection** is 7mm.

**Example 3:**
The average EG is 14mm and the average FG is 14mm. The femur measures a size 4, (using the femoral measuring device or pre-op template).

**Solution:** Install a 12 mm polyethylene insert. This leaves 2 mm of ‘free space’ in extension and flexion. The **distal femoral resection** is 9mm.

**Example 4:** The average EG is 7mm and the average FG is 7mm. The femur measures a size 4, (using the femoral measuring device or pre-op template).

**Solution:** Resect an additional 4 mm of proximal tibia and select a 10 mm poly insert. This leaves 1 mm of “free space” in extension and flexion. The **distal femoral resection** is 9mm.

**Notes:**
1. When choosing the size of the femoral component, the femoral measuring device can be held against the distal femur in line with the transepicondylar line to predict the medial/lateral size of the implant.
2. Translating the femoral component posteriorly will decrease (tighten) the flexion gap. When translating the femoral component posteriorly to adjust the flexion gap, the femoral component must not be moved to far posteriorly, or anterior notching may occur.
3. The examples provided predict a final “free space” (remaining gap after implantation). Some surgeons may prefer 0, 1, or 2 mm in extension, and slightly larger in flexion. It is left to the surgeon’s judgment as to the correct amount of “free space” necessary to create an ideal “balance” based on the patient’s individual needs.
Resection of the Distal Femur

The entry point of the femoral medullary cavity is opened with the 9mm drill (NE443R). The 8mm intramedullary femoral rod (NQ475R) is introduced into the medullary cavity using the handle and the distal femoral alignment system (NQ470R). (Fig. 62)

The femoral cutting block (NQ471R) is then placed onto the device connecting to the two stainless steel posts. This system offers the possibility of varus/valgus adjustment in 1° intervals A. The adjustment range extends to 11° (Fig. 63)
Gap Balancing Technique – Tibia First

The distal resection is set by adjusting the cutting block holder to the required resection thickness. The typical distal resection thickness is 9mm which is equal to the thickness of the distal femoral condyles of the Columbus Knee femoral component. The surgeon may choose to modify the distal resection thickness based on the value obtained from the gap balancing steps. The varus/valgus orientation is adjusted off the anatomical axis of the femur.

The distal cutting block is fixed to the femur using two headless pins through the holes marked "0". One additional converging pin is introduced to stabilize the block and prevent it from lifting off the bone during the bone resection. (Fig. 64).

The distal femoral cutting guide assembly is removed leaving the femoral cutting block in place. (Fig. 65)

Note: The Columbus Knee distal femoral implant thickness is 9mm.
Checking the Mechanical Axis and Distal Femoral Cut Orientation (optional)

Perpendicular alignment of the distal femoral cut to the mechanical axis of the limb can be confirmed by placing the alignment rod control plate (NQ488R) into the cutting slot in the femoral cutting block. The alignment rod assembly (NP471R & NP331R) is attached and used to check the orientation of the fixed cutting block to the mechanical axis of the limb. The rod should pass over the center of the femoral head, knee and ankle simultaneously. (Fig.66)

The thickness of the proposed resection can be checked by placing the cutting depth check blade (NM350R) through the distal femoral cutting block slot.

The recommended blade thickness is 1.27mm. To insure complete bone cuts, use of a narrow saw blade is recommended. A narrow saw blade will permit greater angulation through the specially designed slots in the cutting block helping to reach the posterior medial and lateral corners of the bone. The resection is performed with careful attention to protect the soft tissues, ligaments and tibia from injury. Use of the special MIOS soft tissue retractors is recommended. (Fig. 67)
The femoral component size (predicted from the gap balancing steps) and the medial-lateral width of the distal femur are checked using the femoral ruler (Fig. 68) (NQ959R).

**Anterior Referencing**
The femoral alignment guide (NQ476R) without the footplate is placed on the resected distal femur and set so the “SZ” points to the femoral size (predicted from the gap balancing steps) A. (Fig. 69) Rotation is set by placing the alignment guide parallel to Whiteside’s line. The femoral size is selected by adjusting the anterior probe on the anterior cortex at the location of the preferred exit point of the anterior bone cut (or where the anterior lateral aspect of the anterior flange of the femoral component is ideally positioned). Careful attention to avoid notching and medial-lateral overhang must be observed when selecting femoral size. The guide should be centered in the medial-lateral direction on the distal femur. The holes for the orientation of the 4-in-1 cutting block are drilled using two 3.2mm x 63mm threaded pins (NP583R) through the holes that correspond to the selected femoral component size (S, M, L) To further insure that the correct femoral component is selected, it is helpful to template the femoral component size prior to the procedure.

**Posterior Referencing**
In the posterior referencing technique, the size of the femur is estimated using pre-operative x-ray planning and confirmed intra-operatively using the femoral size gauge (NQ959R). The femoral measuring device (NQ954R) with the footplate is placed onto the distal femur with careful attention to insure that the posterior footplate is in full contact with the posterior condyles.

With the posterior footplates positioned against the posterior condyles, the stylus is placed on the anterior cortex at the location of the preferred exit point of the anterior bone cut (or where the anterior lateral aspect of the anterior flange of the femoral component is ideally positioned). The femoral component size is read directly from the gauge at the “SZ” size location A. The stylus needs to be set to the corresponding size of the femoral component. The guide should be centered in the medial-lateral direction on the distal femur. B (Fig. 70 & 71)
Setting the Orientation of the Femoral Component (4-in-1 cutting block orientation)

The "Adjust Size" mechanism is locked using screw A so that the arrow "N" aligns with the femoral component size selected in line with the size indicator "SZ". The stylus screw B is locked at the appropriate anterior lateral location (the point on the anterior cortex at which the anterior flange of the femoral component will end) and the holes for the 4-in-1 cutting block are drilled through the two "parallel" drill hole positions for the appropriate component size (S, M, L). In the example shown in Fig. 72, a size 5 femoral component is indicated. In this case, the size "M" holes are drilled through the two parallel holes ( ). If 3 degrees of external rotation is preferred, the holes are drilled through the appropriate "offset" holes ( ) for the right or left femur. In this example, the "offset" holes for a right femur are drilled. (Fig. 72)

Note: If a left femur is drilled, the opposite set of "offset" holes are selected.

If after setting the anterior probe, the SZ indicator falls between sizes, the size is adjusted by moving the "adjust size" block of the femoral measuring device to the preferred size and locked using screw A. This allows the surgeon when between sizes, to move either up or down to the appropriate size. The appropriate size 4-in-1 cutting block (femoral component size) holes are then drilled using the same technique as noted in the previous step. (Fig. 73)

<table>
<thead>
<tr>
<th>Drill Holes</th>
<th>Cutting block size</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>1, 2</td>
</tr>
<tr>
<td>M</td>
<td>3, 4, 5</td>
</tr>
<tr>
<td>L</td>
<td>6, 7</td>
</tr>
</tbody>
</table>
Completing the Femoral 4-in-1 Bone Cut
The 4-in-1 (NQ441R-NQ446R) cutting block size that corresponds to the femoral component size is fixed into the predrilled peg holes in the distal femur using the handle (NQ460R) insuring that the anterior cut mark (ANT) is visible and is on the anterior side of the block. The guide is impacted until it is flush with the distal femoral resection. Two converging headed pins (NP586R) are used to prevent the block from lifting off the bone when performing the bone cuts. (Fig. 74)

The recommended cutting sequence is as follows:
1. Anterior cut
2. Posterior cut
3. Posterior chamfer cut
4. Anterior chamfer cut

The four femoral bone cuts are performed using a special narrow 1.27mm thick saw blade. (Fig. 75)

Prior to cutting, the tibia stylus or “wing” should be placed in the anterior slot in the cutting block to confirm that the anterior resection will not notch.

During each bone cut, special care must be taken to protect the surrounding soft tissues and ligaments. Use of the specially designed Columbus MIOS retractors is recommended. To avoid damaging the tibia plateau, the tibia protection plate (NQ377R) may also be used. Once the cuts are completed, the converging pins and cutting block are removed.
Sizing the Tibial Base Plate Component
The trial tibial base plate (NQ381R – NQ389R) that best matched the resected tibial surface is selected. Five full sizes and four plus sizes, which are 3-4 mm wider in the AP dimension, are available.

The trial polyethylene insert is placed on the trial base plate.

Rotational Alignment of the Tibial Components
After placement of the trial femoral base plate on the femur, rotational alignment of the tibial base plate can now be established by “floating” the tibial component into position while performing a flexion/extension maneuver of the limb. This trial reduction maneuver is performed using a trial polyethylene insert thickness that provides accurate limb alignment and joint stability in flexion and extension. The Columbus Knee polyethylene inserts come in 6 sizes matching each tibial base plate and ranging in sizes from 10 – 20 mm in 2mm increments.

Rotation of the trial tibial base plate can also be established by aligning the trial using anatomic landmarks. These include:

- A point on the anterior tibia at the junction of the medial and mid-third of the tibial tubercle

- A line connecting the insertion of the posterior cruciate ligament and the middle of the patella tendon.

Once the rotational alignment of the tibia base plate trial is determined, a mark is made on the anterior edge of the resected tibia in line with the laser mark on the anterior edge of the tibial base plate trial. This mark will provide a rotational alignment reference that will be used later in the procedure to complete the bone preparation for the final tibial implant. (Fig. 76)
Checking the Tibial Resection
Using the alignment rod (NP471R), the surgeon can reaffirm the varus/valgus orientation of the bone cut using the midpoint of the ankle joint for correct alignment orientation. (Fig. 77 & 78)

Fig. 77

Fig. 78
Preparation of the Tibial Plateau

The appropriate size trial tibial base plate is fixed onto the resected surface of the tibia using the previous rotational alignment mark for alignment. Each Columbus tibial base plate trial (and final implant component) features a rotational alignment mark on the anterior edge. The base plate is fixed to the resected surface using two short headed pins (NP585R). The appropriate tibia drill sleeve is introduced onto the trial base plate and the bone is drilled with the correct drill size to accept the stem. A special handle is provided to stabilize the drill sleeve when drilling. (Fig. 79)

- Tibial plateau sizes T1 – T3/T3+ – use the 12mm diameter drill (NQ366R)
- Tibial plateau sizes T4/T4+ -T5 – use the 14mm diameter drill (NQ376R)

The winglet chisel/keel trial (NQ391R – NQ395R) and handle A (NQ365R) assembly is impacted to the stop position through the winglet chisel guide (NQ396R). (Fig. 80)

Optional:
The winglet chisel/keel trial is disengaged from its handle and left in place in the trial plateau to perform a trial reduction.
Gap Balancing Technique – Tibia First

**Trial Reduction**

The femoral trial component is attached to the resected femur and the correct size polyethylene trial is inserted into the joint space until the polyethylene trial locks into place on the base plate surface. The trial reduction maneuver can now be performed. (Fig. 81)

Alignment can be checked in flexion and extension by inserting the alignment rod assembly (NP471R & NE331R) thru the hole in the tibial plateau holder (NQ378R). The position of the trial components is checked in relation to the mechanical axis from the midpoint of the femoral head to the midpoint of the ankle joint. (Fig. 82)

Once the correct tibial and femoral component alignment is achieved, the peg holes for the femoral component are prepared by drilling the two distal condylar holes through the trial femoral component with the 6mm drill w/stop (NQ449R).
Optional: 
Posterior Stabilized Technique (PS Implant)

The PS box cut is prepared using the appropriate size PS femoral box preparation guide (NQ571R – NQ577R). The guide is placed onto the resected femur into the peg holes previously drilled. It is stabilized with two headed threaded pins (NP585R). (Fig. 83)

The 14mm diameter drill sleeve (NQ589R) is attached to the femoral box preparation guide using the medial and lateral holes in the guide. Both corners are drilled using the 14mm drill w/stop (NQ590R). (Fig. 84)

The 22mm diameter drill sleeve (NQ591R) is then introduced onto the guide and the center box position is drilled using the 22mm diameter drill (NQ592R). (Fig. 85)

The drill guide is removed and the medial and lateral walls of the box are finished using the chamfered chisel (NQ593R). The chisel is used with the chamfers facing toward the center of the box. (Fig. 86)
Correct preparation of the box is confirmed when the trial box sits flush with the distal femoral resection and complete bone contact of the posterior pegs is achieved. (Fig. 87 & 88)

**PS Trial Reduction**
The appropriate size femoral trial is assembled with the correct size box trial and placed onto the femur. Next, the appropriate size trial tibial base plate, with the PS polyethylene insert and post assembly, are placed onto the tibia. A trial reduction maneuver may be performed. (Fig. 89)
**Preparation of the Patella**

If the patella was not resected after initial exposure, the patella clamp is attached to the patella and the clamp is tightened until it is securely locked on the anterior and posterior surfaces of the bone. (Fig. 90)

The thickness of the patella may be measured using the Patella Clamp (NE346R). The clamp is set to the chosen resection thickness and the resection is performed with the oscillating saw through the cutting slot in the halo portion of the device. (Fig. 91)

The measured thickness should not be exceeded after implantation of the patella implant.

The cutting guide halo is removed and the drill guide (NQ478R) is fixed onto the clamp. If the patella was resected after the patella peg holes are drilled with the 6mm drill w/stop (NQ449R). (Fig. 92)

The size of the patella is determined using one of the four trial patella implants. For patella size options see the overview on page 37.

**Note:** The Columbus Knee patella component includes three symmetric fixation pegs and, therefore, can be placed in any rotational position.
Final Implant positioning
The Columbus femoral and tibial implants are available in cemented and non-cemented designs. The surgeon can select the appropriate implant design based on the bone quality and his personal preference.

The following implantation sequence is recommended:
- Tibial Plateau
- Femur
- Polyethylene
- Patella

The tibial plateau is connected to the Impactor/Holder assembly (NQ565R & NQ399R) and impacted precisely into the previously prepared proximal tibia. (Fig. 93)

A trial gliding surface may be placed onto the final tibial base plate to help protect the femoral implant from any damage during final implantation.

The femoral implant is oriented onto the distal femur using the femoral implant holder assembly (NQ560R & NQ565R). After the correct flexion and M/L alignment is confirmed, the femur is impacted into its final position insuring that the component is fully seated and stable. (Fig. 94)

The patella is implanted using the patella clamp (NE346R). A special plastic cement adapter (NE347) is provided to maintain pressure on the implant while waiting for the cement to dry. (Fig. 95)

The Columbus Knee polyethylene trial implants may be used to conduct a final assessment of the implant position, joint stability, and gap balance prior to selection of the actual polyethylene insert.
Closure
The wound is closed using standard closure techniques. (Fig. 96)
Columbus® Implant Sizes

The table gives an overview of the most important dimensions of the Columbus® femoral implants.

Measurements in [mm]

<table>
<thead>
<tr>
<th>Size</th>
<th>ML</th>
<th>AP</th>
<th>Box</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Z</th>
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<tbody>
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<td>34</td>
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Overview – Table of Columbus® femoral implants for combined use with intramedullary nails if required.

<table>
<thead>
<tr>
<th></th>
<th>AP nails CR</th>
<th>AP nails PS</th>
<th>ML nails</th>
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</thead>
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<td>F7</td>
<td>35</td>
<td>42.5</td>
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</table>
Overview of the most important dimensions for Columbus® tibial implants

Measurements in [mm]

<table>
<thead>
<tr>
<th></th>
<th>T1/T1+</th>
<th>T2/T2+</th>
<th>T3/T3+</th>
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<td>12.3</td>
<td>14.3</td>
<td>14.3</td>
</tr>
</tbody>
</table>

The overall length of the tibia plateau with the respective extension stem is given by the dimension D in the upper table and the stem length Small (52 mm) or Long (92 mm).

Overview of extension stem lengths
Measurements in [mm]

<table>
<thead>
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<th></th>
<th>T1/T1+</th>
<th>T2/T2+</th>
<th>T3/T3+</th>
<th>T4/T4+</th>
<th>T5</th>
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<tbody>
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<td>28</td>
<td>33</td>
<td>38</td>
<td>43</td>
<td>48</td>
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<tr>
<td>D+S stem (Small)</td>
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<td>85</td>
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<td>95</td>
<td>100</td>
</tr>
<tr>
<td>D+L stem (Large)</td>
<td>120</td>
<td>125</td>
<td>130</td>
<td>135</td>
<td>140</td>
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</tbody>
</table>

Overview of patella sizes

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<th></th>
<th>D_{patella} x H</th>
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</thead>
<tbody>
<tr>
<td>P1</td>
<td>ø 27 mm x 7 mm</td>
</tr>
<tr>
<td>P2</td>
<td>ø 30 mm x 8 mm</td>
</tr>
<tr>
<td>P3</td>
<td>ø 33 mm x 9 mm</td>
</tr>
<tr>
<td>P4</td>
<td>ø 36 mm x 10 mm</td>
</tr>
</tbody>
</table>
### Columbus® Ordering Information

#### Femoral Component CR Cruciate Retraining Cemented
- NN001K Columbus® CR Femur F1L
- NN002K Columbus® CR Femur F2L
- NN003K Columbus® CR Femur F3L
- NN004K Columbus® CR Femur F4L
- NN005K Columbus® CR Femur F5L
- NN006K Columbus® CR Femur F6L
- NN007K Columbus® CR Femur F7L
- NN011K Columbus® CR Femur F1R
- NN012K Columbus® CR Femur F2R
- NN013K Columbus® CR Femur F3R
- NN014K Columbus® CR Femur F4R
- NN015K Columbus® CR Femur F5R
- NN016K Columbus® CR Femur F6R
- NN017K Columbus® CR Femur F7R

#### Femoral Component CR Cruciate Retraining Cementless
- NN021K Columbus® CR Femur F1L Plasmapore
- NN022K Columbus® CR Femur F2L Plasmapore
- NN023K Columbus® CR Femur F3L Plasmapore
- NN024K Columbus® CR Femur F4L Plasmapore
- NN025K Columbus® CR Femur F5L Plasmapore
- NN026K Columbus® CR Femur F6L Plasmapore
- NN027K Columbus® CR Femur F7L Plasmapore
- NN031K Columbus® CR Femur F1R Plasmapore
- NN032K Columbus® CR Femur F2R Plasmapore
- NN033K Columbus® CR Femur F3R Plasmapore
- NN034K Columbus® CR Femur F4R Plasmapore
- NN035K Columbus® CR Femur F5R Plasmapore
- NN036K Columbus® CR Femur F6R Plasmapore
- NN037K Columbus® CR Femur F7R Plasmapore

#### Femoral Component PS Posterior Stabilized Cemented
- NN161K Columbus® PS Femur F1L
- NN162K Columbus® PS Femur F2L
- NN163K Columbus® PS Femur F3L
- NN164K Columbus® PS Femur F4L
- NN165K Columbus® PS Femur F5L
- NN166K Columbus® PS Femur F6L
- NN167K Columbus® PS Femur F7L
- NN171K Columbus® PS Femur F1R
- NN172K Columbus® PS Femur F2R
- NN173K Columbus® PS Femur F3R
- NN174K Columbus® PS Femur F4R
- NN175K Columbus® PS Femur F5R
- NN176K Columbus® PS Femur F6R
- NN177K Columbus® PS Femur F7R
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### PE Gliding Surface CR Cruciate Retraining Deep Dish

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### PE Gliding Surface PS Posterior Stabilized

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**Columbus® Obturator Screws**

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<th>Code</th>
<th>Description</th>
<th>Plateau Range</th>
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<tr>
<td>NN261K</td>
<td>Obturator screw D 12</td>
<td>1–3+</td>
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<tr>
<td>NN264K</td>
<td>Obturator screw D 14</td>
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**Columbus® Extension Stems**

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<td>NN266K</td>
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**Columbus® Patella**

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<th>Dimensions</th>
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<tr>
<td>NN481</td>
<td>P1 Patella size 1</td>
<td>Ø 27 mm x 7 mm</td>
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<tr>
<td>NN482</td>
<td>P2 Patella size 2</td>
<td>Ø 30 mm x 8 mm</td>
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<tr>
<td>NN483</td>
<td>P3 Patella size 3</td>
<td>Ø 33 mm x 9 mm</td>
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<tr>
<td>NN484</td>
<td>P4 Patella size 4</td>
<td>Ø 36 mm x 10 mm</td>
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</tbody>
</table>
X-ray templates (incl. DD+PS)

DOC451  Scale 1,15:1
DOC452  Axis planing

Sawblades

Note: The sawblade used is 1.27 mm thick.