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Contents

Introduction .................................................. 3
Surgical Approach ........................................... 4
Appendix I: Posterior Up Femoral Sizing Guide .......... 48
Appendix II: Non-Cemented M.B.T. Tray Application .......... 50
Appendix III: Ligamentous Balance in TKA .................. 52
Appendix IV: Balancing Flexion / Extension Gaps .......... 56
Appendix V: Alternative Cutting Block Option for Less Invasive Technique .......... 58
For certain groups of patients undergoing total knee replacement, high range of motion is necessary for daily activities, which may include prolonged kneeling, squatting or cross-legged sitting. Therefore a knee implant that addresses these parameters is required.

The basic concept of the P.F.C. SIGMA RP-F total knee prosthesis is to provide sufficient articular surface and proper patella tracking as well as rotational freedom to accommodate deep knee flexion up to 155 degrees.

**Indications**
P.F.C. SIGMA RP-F is indicated for patients with preoperative ROM of 0 degrees to 120 degrees and varus/valgus deformity of less than 20 degrees with osteoarthritis, rheumatoid arthritis, osteonecrosis, or certain types of post-traumatic arthritides.

**Contraindications**
P.F.C. SIGMA RP-F cannot be recommended for patients with significant instability, major bone loss, compromised quadriceps mechanism or limited ROM due to tight adipose tissue.

The motivation of the patient to be able to perform deep knee flexion after total knee replacement should be taken into consideration.
Surgical Approach

The extremity is appropriately prepared and draped. A tourniquet is applied and, following application of an Esmarch bandage, inflated.

A straight incision is initiated proximal to the superior margin of the patella and an equivalent distance distal to its inferior margin. Thereby, reducing the degree of skin retraction and lowering the risk of subsequent adipose tissue necrosis.

The incision is developed at the deep fascial level to the tendon of rectus femoris and the patellar tendon. Undermining of the bilateral skin flaps is avoided.

The tendon of rectus femoris is incised and the incision carried 2-3 mm medial to the medial margin of the patella, the patellar tendon and, subperiosteally, 5 cm distal to the superior margin of the tibial tubercle.
Exposure and preliminary balance must be based on the patient’s pre-operative deformity and soft-tissue stability. The following is for mild varus deformity.

**Note: See Appendix III for discussion of soft-tissue balance.**

The patella is everted laterally and the knee placed in full flexion. The cruciate ligaments and the menisci are excised. Where the knee is tight and in varus, preliminary soft-tissue release is performed. A curved osteotome is passed along the medial tibial border posterior to the midcoronal plane to release the meniscotibial ligament and promote anterior subluxation of the tibia.

With the knee in 90 degrees of flexion, the tibia is externally rotated with posteromedial dissection, bringing its medial condyle clear of the femur.

Medial meniscectomy is completed, and attention directed to the lateral side.
A 90 degree Hohmann retractor is positioned between the everted patella and the distolateral femur, exposing the lateral patellofemoral ligament, which is incised with electrocautery.

The retractor is repositioned at the interval of the iliotibial tract and the tibial attachment of the capsule. The capsule is dissected free from the infrapatellar fat pad and a lateral meniscectomy is performed. The lateral inferior genicular artery is coagulated. The insertion of the iliotibial tract is identified and the capsule dissected from the lateral tibial condyle. The retractor is repositioned against the lateral tibial condyle.
Place the knee in maximum flexion with the tibia distracted anteriorly and stabilised.

Assemble the upper cutting platform and secure it onto the proximal uprod of the tibial alignment device. Choose a 0 degree cutting block.

Position the malleolar clamp of the tibial alignment device immediately proximal to the malleoli. Raise the platform to the level of the tibial condyles.
Translate the lower assembly anteroposteriorly to align it parallel to the tibial axis.

The proximal tibial cut must be perpendicular to the tibial axis (0 degree posterior slope).

Mediolateral alignment is approximately parallel to the tibial axis, but as the lateral malleolus is more prominent, bisecting the transmalleolar axis will prejudice the cut into varus. The midline of the tibia is approximately 3-5 mm medial to the transaxial midline. Translate the lower assembly medially to the palpable anterior crest of the tibia, usually somewhere between the first and second vertical mark. There are scribe marks at 3 mm and 6 mm for reference. If the platform is medially displaced, make an adjustment at the lower assembly.
Tibial Alignment

The distal portion of the long arm of the tibial alignment device should align with the centre of the talus.

Lateral alignment is similarly confirmed.

*Note: Where indicated, make varus/valgus corrections by sliding the distal portion of the tibial alignment to the appropriate location.*
Upper Platform

Align the upper cutting platform with the medial third of the tibial tubercle and the medial margin of the lateral intercondylar eminence with the extremities of the cutting surface against the cortex.

The exact level of resection will vary according to patient anatomy. As the mediolateral transverse plane of the tibial plateau is usually 3 degree from the perpendicular and the projected cut is perpendicular to the anatomic axis, more bone is typically removed from the lateral condyle.

Composite thickness of the P.F.C. SIGMA RP-F tibial insert is 10 mm, 12.5 mm, 15 mm, and 17.5 mm.
The stylus determines the exact level of resection.

The outrigger of the stylus is marked non-slotted and slotted at either end. When the tibial resection is performed from the surface of the block, choose the non-slotted end of the outrigger; conversely when the resection is performed through the slots, choose the slotted end of the outrigger. There is a 4 mm difference between the top surface and the slot.

Insert the cylinder foot into the slot of the cutting block and adjust to the appropriate level. It is marked in 2 mm increments, indicating the amount of bone and residual cartilage to be resected.

A level of 10 mm is suggested when resection is based on the less involved condyle. Adjust the block so that the stylus rests on the centre of the condyle. The cutting block is secured by the large anterior set screw.

Select level 0 when resection is based on the more involved condyle and does not result in excessive contralateral resection. Secure the cutting block by the large anterior set screw.

*Note: When this indicates greater than 10 mm of resection from the contralateral condyle, a more proximal level is indicated. Augment the deficiency with cement or bone graft as the situation dictates. In special cases, a M.B.T. revision tray with augmentation option may be indicated.*
Securing the Platform and Tibial Resection

Introduce Steinmann pins or 3.2 mm (1/8") drill bits through the central holes into the tibia, stopping well short of the posterior cortex. The tibial alignment device can either be removed by unlocking the cutting block or left in place for additional stability.

Resection is made either through the slot or on the top surface, depending upon the stylus reference used. A 1.19 mm saw blade is recommended when cutting through the slots.
The medullary canal is entered at the midline of the femoral trochlea 7-10 mm anterior to the origin of the PCL, to a depth of about 5-7 cm using a 8 mm (5/16") drill.

Care is taken that the drill avoids the cortices. It is helpful to palpate the distal femoral shaft as the drill is advanced. The drill hole may be biased anteromedially to facilitate unobstructed passage of the long intramedullary rod to the diaphyseal isthmus, if indicated by pre-operative radiographs.
The Intramedullary Rod

With the handle assembled onto the long intramedullary rod, the rod is introduced slowly into the canal to the level of the isthmus to confirm unobstructed passage. The rod is fluted to relieve intramedullary pressure and permit the release of bone marrow, avoiding embolisation. It is subsequently withdrawn.

Note: Avoid using excessive force to drive the rod into the I.M. canal. If a large amount of force is required to insert the rod, the femoral canal may be overly bowed, or the distal entry hole may be too tight to permit the rod to centre in the canal. Should this be encountered, using a shorter I.M. rod may be more appropriate. Enlarging the distal entry hole may help as well.

The Femoral Locating Device

The desired valgus angle with the appropriate Right/Left designation, as indicated on the pre-operative films, is set and locked into place on the front of the locating device. The angle can be set from 0 degrees to 9 degrees in 1 degree increments.

With the rod repositioned in the medullary canal, the handle is removed and the locating device is placed over the rod.
A radiopaque marker is positioned over the ipsilateral hip, parallel and immediately distal to the inguinal ligament. An A/P radiograph indicates which of four markers most closely approximates the rotational centre.

At surgery, the femoral-head locating strip is aligned with the markers. A target screw is introduced into the position overlying the rotational centre. Draping is such that the screw is readily palpated as the coxal reference point.

The alignment tower is assembled onto the femoral locating device. The alignment rod is passed through the hole and advanced to the hip. Where the rod fails to align with the coxal reference point, a different angle is selected.

Note: Where indicated, as in femoral deformity, 0° is selected and a short intramedullary rod is substituted.
Rotational Correction

Orientation is initially determined with reference to the posterior femoral condyles, subject to subsequent correction at the A/P resection. The graduated outrigger is centred at the femoral trochlea, placing it in slight external rotation and exposing a greater amount of medial condyle.

Alternatively, it may be externally rotated until perpendicular to the mechanical axis of the tibia in 90 degrees of flexion.

The femoral locating device is tapped into position at the more prominent condyle (usually the medial).

*Note: It is essential that firm contact be established at the subchondral level of the condyle, clear of any residual peripheral osteophytes.*
Note: For P.F.C. SIGMA RP-F femoral components, the following distal femoral resection is recommended: Sizes 1 to 5: 9 mm distal resection, Size 6: 10 mm distal resection.

The cutting block is assembled onto the marked outrigger by depressing the button located on the right proximal end. The resection of the more prominent condyle, inclusive of residual cartilage, will correspond to the distal dimension of the femoral prosthesis. Where the femoral locating device rests on eburnated bone, resection is 2 mm less than the distal dimension of the femoral prosthesis to allow for absent cartilage and to avoid elevation of the joint line.

The scale for the numbers on the outrigger is even on the left and odd on the right. The number corresponding to the appropriate resection level is aligned with the inscribed line in the centre of the window of the distal femoral cutting block.

The base block is slotted; however, if used without the slot and the resection is initiated from the top of the block, 4 mm is added to the resection level. For example, if 9 mm is the desired resection level, add 4 mm to this and set the block at 13 mm and cut from the surface of the block. Note the top of the block is engraved “4 mm offset”.

The outrigger and cutting block is lowered onto the anterior cortex by depressing the button on the left-hand side of the locating device. Either 3.2 mm (1/8”) drill bits or Steinmann pins are introduced through the holes designated zero and enclosed in □’s. They are advanced into the anterior cortex.
The Distal Femoral Cut

The locating device and intramedullary rod are disengaged from the cutting block by depressing the right button on the cutting block. The holes on the block are designated -2, 0 and +2, indicating in mm the amount of bone resection each will yield supplemental to that indicated on the marked outrigger.

The oscillating saw blade is positioned through the slot, or, where applicable, the blade is positioned flush to the top cutting surface of the block. A 1.19 mm saw blade is recommended. The condyles are resected and the surface checked for accuracy.
Evaluating the Extension Gap

The knee is placed in full extension and lamina spreaders applied medially and laterally. Peripheral osteophytes have to be removed at this stage, since they may influence ligament balancing. The extension gap must be rectangular in configuration. Where it is trapezoidal, the bilateral soft tissue must be balanced (see Appendix III). Bone cuts are not altered.

In extension, the spacer block is assembled from the base element and the insert shim of the appropriate thickness. The spacer indicates the appropriate thickness of the tibial insert, subject to re-evaluation at trial reduction.
Careful preoperative planning, including the application of templates to lateral radiographs, is critical to the sizing of the femoral component. Priority is given to re-establishment of the A/P dimension, as this will restore normal kinematics and quadriceps function.

Under-sizing will cause looseness in flexion and possible notching of the anterior femoral cortex. Over-sizing will create tightness in flexion and increased tension in the quadriceps mechanism.

Sizing the Femoral Component
Femoral Sizing: Anterior Down

Note: Care should be taken if there are deficient medial or lateral posterior condyles as this may affect femoral rotation.

Seat the chosen sizing guide flush and centred on the prepared distal femoral surface. Allow the stylus to move freely within the guide, and move it proximal to the articular surface.

Pass the stylus over the anterior cortex immediately proximal to the articular surface. At the appropriate level where the stylus is not impeded, turn the stylus locking knob clockwise until it is tight, to fix its position.

Use the sizing guide to position the femoral cutting block so the anterior flange of the prosthesis is flush with the anterior cortex of the femur. When the sizing device indicates a whole size, 8 mm will be resected from the posterior condyles, corresponding to the posterior condyle thickness of the prosthesis. The serrated edges of the drill guide show the M/L dimension of the femoral component.

Decide whether to upsize or downsize based on where the femur falls between sizes.
If choosing to downsize when the upper scale reads 3.5, set the sizing guide to size 3 and use a size 3 A/P cutting block. Because the guide uses the anterior cortex as the reference, the anterior cut level remains constant and more bone will be resected from the posterior condyles.

The extra posterior resection increases the size of the flexion gap. If, at trial reduction, there is marked laxity in flexion, remove more distal femur and use a thicker tibial insert.

When electing to upsize the femur, set the sizing guide to size 4 and use a size 4 A/P cutting block. The anterior cut remains constant and less bone is removed from the posterior condyles.

The under-resection of the posterior condyles will decrease the size of the flexion gap.

*Note: Alternatively the posterior up method of femoral sizing may be used as shown in Appendix I.*
Control internal/external rotation of the A/P cuts by resting the skids of the sizing guide on the posterior condyles. The natural joint line lies medially oblique by approximately three degrees. The tibial resection at 90 degree to the tibial mechanical axis effectively rotates to prosthetic joint line three degrees laterally (external rotation).

The anterior and posterior cuts must be externally rotated in order to be parallel to the tibial cut and to provide a rectangular flexion gap. Follow the legend on the sizing guide, which places the medial pin in the upper hole and the lateral pin in the lower hole. Offsetting the holes produces a three degree external rotation of the cutting block.

Care should be taken if there are deficient medial or lateral posterior condyles as they may affect femoral rotation. The femoral rotation, suggested by the femoral sizing guide should always be verified against natural landmarks like the transepicondylar line or the AP axis, since rotational alignment may differ from patient to patient.
Alternative Method (Ranawat Block)

Select the appropriate intramedullary rod and assemble it to the appropriately sized femoral A/P cutting block with the appropriate RIGHT/LEFT designation to the anterior. Retract the pins.
Positioning the Cutting Block (Ranawat Block)

Insert the chosen I.M. rod into the canal so the A/P block is allowed to slide up or down to facilitate sizing. The cutting block is seated flush to the cut distal surface.

Fully seat the foot of the stylus assembly in its receptacle on the anterior surface of the block so that it reads 0.

Adjust the cutting block posteriorly until the stylus (which has the arm marked non-slotted positioned toward the bone) is in contact with the anterior femoral cortex.

Rotational Adjustment (Ranawat Block)

Determine rotation with the knee in 90° of flexion and position the block so that its posterior surface is parallel to the resected tibial plateau, creating the desired rectangular flexion gap. Tap the retractable pins into the distal femur when the collateral ligaments are equally tensioned.
Position a properly sized spacer block containing the base block and the adequate insert thickness shim between the resected proximal tibial surface and the posterior surface of the block.

*Note: Flexion adaptor shim is not required in this composition. The objective is a rectangular flexion gap with the collateral ligaments equally tensioned.*

*Note: Further ligamentous release is not recommended at this stage.*

The following guidelines are available to determine the rotation of the A/P cutting block:

1. Place the A/P cutting block parallel to the transepicondylar axis.
2. Place the anterior margin of the block perpendicular to the anteroposterior axis.
3. Position the block parallel to the resected proximal tibia (with the knee at 90 degrees flexion and collateral ligaments equally tensioned).
Anterior Femoral Cut

The anterior cut is made with the blade of the oscillating saw held flush against the cutting block surface. A 1.19 mm saw blade is recommended. Pop-up slots may be used. The cut is checked for accuracy.

Femoral Chamfer Cuts

Chamfer cuts are made through the slotted 4 in 1 block and the block is then removed.
RP-F Femoral Cutting Guide

Place the RP-F femoral cutting guide onto the prepared femur and position it such that the lateral flange of the cutting guide meets the lateral margin of the femur. Check the cutting line for the posterior cut. Steinmann pins are introduced (following the order indicated), to pin the block in place.

Perform the posterior cut with the oscillating saw through the slots provided.

Note: The saw capture can be removed to complete the cut.
Femoral notch trials may be used to check the notch cuts. The notch trial has to sit flush on the distal surface and flush to the anterior cut of the RP-F femoral cutting block. 

Note: It is recommended to re-cut the notch cuts if the notch trial does not sit properly. Do not impact the notch trial!

A small blade (13 mm x 75 mm x 1.19 mm) is recommended to cut the sides of the notch.

Cut the top of the box with an osteotome.

Femoral Notch Trial
Clearing Posterior Condyles

Posterior condyles have to be cleared from overhanging bone or osteophytes. A U-shaped or S-shaped retractor can be used to distract the joint and facilitate access to the posterior condyles.
Evaluating the Flexion/Extension Gap Balance

Use the base block and the insert thickness shim to evaluate the joint gap in extension. In flexion, use the base block, the insert thickness shim as well as the flexion adaptor shim. Use spacer blocks to determine the gap in extension as well as in 90° of flexion.

Ligamentous balance should be achieved following principles outlined in Appendix III and IV.

Where further distal femoral resection is required to establish equivalent flexion and extension gaps, return the Steinmann pins to their original position in the anterior femoral cortex and the distal femoral cortex. Reposition the distal femoral cutting block using the holes designated +2 and +4 as indicated.

The long alignment rod should align with the centre of the talus and lie parallel to the lateral tibial axis.

Femoral and proximal tibial cuts are now completed. Ligament balance has been achieved.
Patella Resurfacing

It is important that the sagittal dimension and accurate tracking are maintained, and that adequate bone stock is preserved. Problems will arise from inadequate or oblique resection resulting in greater thickness to the complex, asymmetric positioning of the implant, subsequent patellar tilt and increased implant wear.

It is important that sufficient soft tissue is freed at the prepatellar bursa to position the calipers at the anterior cortex.

The greatest sagittal dimension is at the median ridge. The normal range is 20-30 mm. This dimension is established and an amount corresponding to the size of the selected implant subtracted. The remainder equals the target dimension following resection. Where the patella is small, a minimal residual bone thickness of 12 mm should be maintained.

Example: (for a 38 mm size dome or oval/dome patella) from a patella 25 mm thick, 9 mm of articular surface is resected, yielding 16 mm of residual bone to accommodate the 9 mm thick implant.

The template is selected that most adequately covers the articular surface without overhang. The handle is positioned on the medial side of the everted patella. Where bone is deficient on the lateral side, the next smaller size is selected, but positioned slightly to the medial side to enhance patellar tracking.

The amount of appropriate bone resection, as indicated on the template, is noted.

<table>
<thead>
<tr>
<th>Patella size</th>
<th>Resection</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 mm</td>
<td>7.8 mm</td>
</tr>
<tr>
<td>35 mm</td>
<td>8.5 mm</td>
</tr>
<tr>
<td>38 mm</td>
<td>9.1 mm</td>
</tr>
<tr>
<td>41 mm</td>
<td>11.4 mm</td>
</tr>
</tbody>
</table>
Synovial tissue is cleared to the level of the insertion of the quadriceps mechanism and the patellar ligament. The prongs of the knurled fork are adjusted to the predetermined thickness of residual patella as indicated on the graduated column.

The leg is placed in extension, the cutting guide positioned with the prongs of the fork deep to the pre-patellar bursa and against the anterior patellar cortex with the serrated jaws at the superior and inferior margins of the articular surface. The switch is placed to the LOCK position and the jaws closed to firmly engage the patella.
Patella Resection and Drilling

Resection is performed with an oscillating saw, maintaining the blade flush to the cutting surface. The guide is subsequently removed and the residual dimension checked with calipers, laterally, medially, proximally and distally. All dimensions should be equivalent. Asymmetry is addressed with saw or a bone rasp.

Alternatively, the saw blade is inserted into the well of the cutting surface of either of the jaws. The insert is lifted and the blade thereby confined within the slot created, ensuring that the cut will remain flush to the cutting surface. A 1.19 mm saw blade is recommended.

The previously selected template is positioned onto the cut surface with the handle positioned on the medial side of the everted patella, such that two drill holes lie at the medial side, one at the lateral. The template is firmly engaged to the resected surface and holes fashioned with the appropriate drill bit.
Plateau Preparation & Initial Trial Reduction

Build-a-Trial Tibial Preparation
With the knee in full flexion and the tibia subluxed anteriorly, assemble the alignment handle onto the M.B.T. tray trial.

Connect the tibial tray alignment handle to the M.B.T. tray trial by retracting the lever, inserting the two pins into the anterior portion of the tray trial and releasing the lever. Place the tray trial onto the resected tibial surface.

There are two options available to assess the knee during trial reduction. One or both may be used.

1. Trial reduction with trial bearing in non-rotation mode. This option is useful when the tibial tray component size is smaller than the femoral size (bearing size MUST match the femoral size).

Position the appropriate sized femoral trial onto the femur.

Position the lock-off evaluation bullet into the cut-out of the M.B.T. tibial tray trial.
Place the appropriately sized P.F.C. SIGMA RP-F femoral trial onto the femur.

Select the P.F.C. SIGMA RP-F tibial insert trial that matches the chosen femoral size and insert onto the M.B.T. tray trial.

With the trial prosthesis in place, extend the knee carefully, noting the anteroposterior stability, medial/lateral stability and overall alignment in the A/P and M/L plane.

If there is any indication of instability, substitute a tibial insert trial with the next greater thickness and repeat the reduction. Select the insert which gives the greatest stability in flexion and extension whilst still allowing full extension.
Trial Reduction (non-rotation mode)

Rotational alignment of the tibial tray is adjusted with the knee in full extension, using the alignment handle to rotate the tray and trial insert into congruency with the femoral trial. The rotation of the tibial tray is usually centred on the junction between the medial and central one-third of the tibial tubercle.

The appropriate position is marked with electrocautery on the anterior tibial cortex.

Overall alignment can be confirmed using the two part alignment rod, attaching it to the tibial alignment handle.

Fully flex the knee, and remove the trial components. Replace the M.B.T. tray trial back on the proximal tibia, and align the handle with electrocautery marks. Assessment can then be made of the overall tibial coverage.
2. Trial reduction with trial bearing free to rotate.  
This trial reduction can be done instead or in addition to the one described above.

Position the appropriately sized P.F.C. SIGMA RP-F femoral trial onto the femur, and place the appropriately sized M.B.T. trial tray onto the resected tibial surface.

Assess the position of the tray to achieve maximal tibial coverage (align the handle with the electrocautery marks if procedure described in 1 has been followed). The rotation of the tibial tray is usually centred on the junction between the medial and central one-third of the tibial tubercle.

Note: Excessive mal-rotation of the tibial tray relative to the femoral component can result in excessive bearing overhang and impingement with soft tissues.

Position the pinned evaluation bullet into the cut-out of the M.B.T. tibial tray trial, and tap down lightly to secure the tray to the proximal tibia.

Select the P.F.C. SIGMA RP-F tibial insert trial that matches the chosen femoral size onto the M.B.T. tray trial.
Carefully remove the alignment handle and with the trial prosthesis in place, extend the knee carefully, noting the anteroposterior stability, medial/lateral stability and overall alignment in the A/P and M/L planes. Assessment of the bearing rotation and patellofemoral tracking can also be achieved. Overall alignment can be confirmed using the two part alignment rod, attaching it to the tibial alignment handle.

If there is any indication of instability, substitute a tibial insert trial with the next greater thickness and repeat reduction. Select the insert which gives the greatest stability in flexion and extension whilst still allowing full extension. Confirm tray rotation and position, and mark with electrocautery if this has not already been done.
Tibial Finishing

Fully flex the knee, and remove the trial bearing and femoral components. Secure the tray trial with two fixation pins inserted through the recessed holes. Remove the pinned evaluation bullet.

Seat the M.B.T. drill bushing into the tibial tray trial by lightly tapping the top of the drill bushing.

In cases where the proximal tibial bone is sclerotic, use a Steinmann pin to drill two small holes posteriorly to facilitate the placement of the spikes on the drill bushing onto the tray trial.

If a non-cemented M.B.T. tray is to be used, please follow Appendix II.
Cemented M.B.T. tray preparation
Assemble the drill stop onto the M.B.T. drill and position at the selected tray size. Advance the M.B.T. drill through the M.B.T. drill bushing and into the cancellous bone, until it hits the drill stop.

The M.B.T. drill creates a cavity that is line-to-line with the punch bushing and final implant. Cement will interdigitate as the tray is implanted.
Insert the M.B.T. keel punch bushing into the M.B.T. tibial tray trial, utilising the M.B.T. punch bushing impactor/extractor. When complete, the superior surface of the punch bushing should be flush with the superior surface of the tibial tray trial.

Remove the punch bushing impactor/extractor.

Assemble the universal handle to the appropriately sized M.B.T. keel punch and insert it into the M.B.T. punch bushing, being careful to avoid malrotation. Impact this composite into the cancellous bone until the shoulder of the punch is in even contact with the M.B.T. punch bushing. Disconnect the universal handle, leaving the M.B.T. punch in place.

*Note: If the bone on the medial or lateral plateau is sclerotic, it is helpful to initially prepare the keel slot with an oscillating saw or high speed burr.*
Additional Trial Reduction

This trial reduction can be performed once the central stem has been prepared.

Select the P.F.C. SIGMA RP-F tibial insert trial that matches the chosen P.F.C. SIGMA RP-F femoral trial size and insert it onto the M.B.T. tray trial.

With the trial prostheses in place, fully extend the knee carefully, noting the anteroposterior stability and overall alignment in the A/P and M/L planes. If there is any indication of instability, substitute a tibial insert trial with the next greater thickness and repeat reduction. Select the insert that gives the greatest stability in flexion and extension while still allowing full extension.
Implanting the Components

Cemented M.B.T. Tray
Thoroughly cleanse the entire site with pulsatile lavage. Prepare bone cement and apply it by syringe or with digital pressure in its low viscous state to assure maximal penetration into the trabecular bone.

Assemble the universal handle onto the M.B.T. tray impactor and carefully insert the tibial tray, avoiding malrotation. When fully inserted, deliver several mallet blows to the top of the universal handle. A swab may be inserted between the impactor and the component in order to protect the bearing surface.

The previous electrocautery marks will aid alignment of the tray.
As the cement polymerises, position a P.F.C. SIGMA RP-F trial femoral component on the prepared femur and the M.B.T. trial post into the central stem of the M.B.T. tray component and insert a P.F.C. SIGMA RP-F tibial insert trial. Take care to avoid scratching the proximal surface of the tibial tray. Place the knee in full extension and maintain even pressure across the bone/tibial implant interface.

Care should be taken not to hyperextend the knee as this could apply unequal pressure to the anterior portion of the tray thereby causing posterior lift-off. When the cement has set, place the knee in flexion and remove the trial femoral component as well as the tibial insert trial and M.B.T. trial post. Carefully remove all extruded cement with special attention to the posterior compartment and entire periphery.

Note: For non-cemented M.B.T. tray application, see Appendix II.
The Femoral Component
The entry hole at the medullary canal is plugged with cancellous bone. All surfaces are thoroughly cleansed with pulsatile lavage. Cement is applied to the bone at the anterior, anterior chamfer and distal surfaces and to the inner surface of the component at the posterior condylar recesses. Care is taken to avoid the articular surface of the implant. The implant is assembled onto the femoral inserter. Care is taken that it is correctly oriented. The leading edges are advanced equally, parallel to the distal surface and protecting the carefully configured surfaces.

The inserter is subsequently released and seating completed with the femoral impactor and a mallet. All extruded cement is cleared with a scalpel and curette. The final tibial insert may now be implanted.
The Patellar Component
The patellar implant may be cemented at the surgeon’s convenience with either of the other components. The cut surface is thoroughly cleansed with pulsatile lavage. Cement is applied to the surface and the component inserted.

The patellar clamp is designed to fully seat and stabilise the implant as the cement polymerises. It is positioned with the silicon O-ring centred over the articular surface of the implant and the metal backing plate against the anterior cortex, avoiding skin entrapment.

When snug, the handles are closed and held by the ratchet until polymerisation is complete. Excessive compression is avoided as it can fracture osteopenic bone. All extruded cement is removed with a curette. To release the clamp, place the locking knob in the unlocked position and squeeze the handles together to release the pawl.
The posterior up sizing guide determines the femur in the same way as the anterior down guide. The sizing guide will position the femoral A/P chamfer cutting block so 8 mm will be resected from the posterior condyles, corresponding to the posterior condyle thickness of the prosthesis.

Three options are available when the femur falls between sizes.

**Option 1**
If choosing to downsize when the size indicator scale reads 3.5 set the sizing guide to size 3 and use a size 3 cutting block.

This will give an 8 mm posterior resection but will cause a larger anterior resection. Increased anterior resection may notch the anterior cortex of the femur. Femoral shaft notching should be avoided, since there is an associated risk for fracture.

Use the millimetre scale on the side of the drill guide to ‘ease’ the anterior cut by moving the drill guide anteriorly. This increases the posterior cut and thereby the flexion gap size. Keep a balance between the anterior cut and the flexion space.
Option 2
When electing to upsize the femur set the sizing guide to size 4 and use a size 4 cutting block. This again will resect 8 mm from the posterior condyles but less anteriorly.

The under-resection of the anterior surface can have a significant effect on the patella. It may cause tightness of the joint and high forces to be transmitted to the patella since the anterior articular surface would be positioned too anterior. Using the millimetre scale allows the anterior resection to be increased. This will cause under-resection posteriorly and a potentially tight flexion gap.

Option 3
Divide the extra bone resection involved in downsizing between the anterior and posterior cuts by setting the sizing guide to 4 and using the size 3 cutting block. This increases the posterior resection by 1.4 mm and the anterior by 1.2 mm.

The two sizing guides assure a consistent posterior cut or a consistent anterior cut and the ability to accommodate femurs which fall between whole sizes.
APPENDIX II
Non-Cemented M.B.T. Tray Application

Advance the M.B.T. stem punch into the drill bushing and impact into the cancellous bone until the appropriate tray size marking is reached.

Insert the M.B.T. keel punch bushing into the M.B.T. tibial tray trial, utilising the M.B.T. punch bushing impactor/extractor. When complete, the superior surface of the punch bushing should be flush with the superior surface of the tibial tray trial.

Remove the punch bushing impactor/extractor.
If the keeled version of the non-cemented M.B.T. tray is used, assemble the universal handle to the appropriately sized M.B.T. keel punch and insert it into the M.B.T. punch bushing, being careful to avoid malrotation. Impact this composite into the cancellous bone until the shoulder of the punch is in even contact with the M.B.T. punch bushing. Disconnect the universal handle, leaving the M.B.T. punch in place.

Note: If the bone on the medial or lateral plateau is sclerotic, it is helpful to initially prepare the keel slot with an oscillating saw or high speed burr.
Following is the suggested sequence of ligamentous releases to correct varus or valgus deformity and quadriceps-mechanism imbalance. There is no general agreement on the order; however, there is consensus on the principles:

- Perform preliminary soft tissue release at the start of surgery based upon preoperative evaluation.
- Establish balance by eliminating soft tissue contractures, not by modifying the bone cuts.
- Ensure flexion/extension gaps are equal.
- Establish final correction at trial reduction.

After removing peripheral osteophytes, excise the medial meniscus (1) and the meniscotibial ligament (2). In rheumatoid arthritis and minimal deformity, this is often sufficient.
If further release is indicated, release the posterior expansion of the deep medial collateral ligament from its tibial attachment (3) using a curved osteotome.

If further release is still indicated, denude the medial tibia subperiosteally (4).

Release the superficial portion of the medial collateral ligament from its tibial attachment (5) if further release is still indicated. Generally, this is indicated only in severe deformity associated with significant flexion contracture.
Following removal of peripheral osteophytes, initial release comprises lateral meniscectomy (1) and release of the iliotibial band from its tibial insertion (2). A lateral quadriceps retinacular release is indicated when there is poor patellar tracking at trial reduction.

Perform lateral retinacular release on the internal surface in the longitudinal plane. Take care that the lateral superior genicular artery is protected. Isolate it at the intermuscular septum as it penetrates the retinaculum superficially. Then, retract it proximally as the retinacular incision is carried to the level of the joint line and distally as the incision is extended superiorly to the intermuscular septum (3).

If indicated, further release is effected by extending the distal terminus of the incision transversely to the lateral margin of the patellar tendon (4) and posteriorly to the lateral collateral ligament (5).
If further release is once again indicated, release the lateral collateral ligament and popliteus tendon from the femoral epicondyle, allowing them to slide posteriorly (6).

If balance requires still further release, extend the dissection posteriorly, freeing the intermuscular septum (7) and the lateral head of the gastrocnemius (8). Take care that the posterolateral neurovascular structures are preserved and that the insertion of the biceps femoris, which overlies the common peroneal nerve, remains intact.
APPENDIX IV
Balancing Flexion / Extension Gaps

If the joint line is maintained, flexion and extension gaps are usually balanced at trial reduction, but where there is preoperative deformity and contracture, imbalance may be present.

Residual Flexion Contracture
Where there is restriction in extension but not in flexion, remove additional bone from the distal femur. This affects the extension gap but not the flexion gap. Where contracture persists, following appropriate retinacular release and removal of posterior osteophytes and scar tissue, depending on severity, remove an additional 2-4 mm of distal femur.

Return the Steinmann pins to their original position in the anterior femur and return the distal femoral cutting block to the pins using the holes designated +2 as the degree of contracture indicates. Revise the distal cut accordingly.
Chamfers are subsequently revised to maintain the correct configuration; anterior and posterior cuts are not. This affects ligamentous tension in extension but not in flexion.

Residual Tightness in Flexion and Extension
A thinner tibial insert or additional tibial resection is indicated, as either will affect both flexion and extension gaps. If resection is selected, it is recommended that 2 mm of proximal tibia be removed. Return the Steinmann pins to their drill holes in the anterior tibial cortex, and reposition the cutting block on the pins using the holes designated +2. Accordingly revise the cut.
For surgeons, practising “less invasive techniques” in total knee replacement, the use of the RP-F-MiTKR cutting blocks might be an option.

*Note: Visibility of anatomic landmarks may be compromised in a minimally invasive technique. We recommend the use of the computer navigated Ci™ System to support the positioning of the RP-F cuts (the navigation system does not navigate this step, however other cuts in an MI approach can be navigated).*

The RP-F-MiTKR cutting block is positioned on the resected anterior and distal surface of the femur. Check the medial-lateral positioning of the block. Pins are introduced to secure the block in place. A sawblade may be used to check the posterior cutting line.

*Note: The medial-lateral width of the RP-F-MiTKR cutting guide represents the medial-lateral width of the P.F.C. SIGMA RP-F femoral component. The anterior lateral flange of the RP-F-MiTKR cutting guide does not represent the lateral anterior flange of the P.F.C. SIGMA RP-F femoral component.*
To perform the posterior cut with an oscillating saw, a 25 mm x 75 mm x 1.5 mm blade is recommended. Take care not to damage collateral or posterior structures of the knee.

Chamfer cuts are performed subsequently.

The use of a small blade (13 mm x 75 mm x 1.5 mm) is recommended to cut the sides of the notch. Use an osteotome to cut the top of the box. When removing the bone from the notch care should be taken to avoid damaging the posterior structures of the knee.