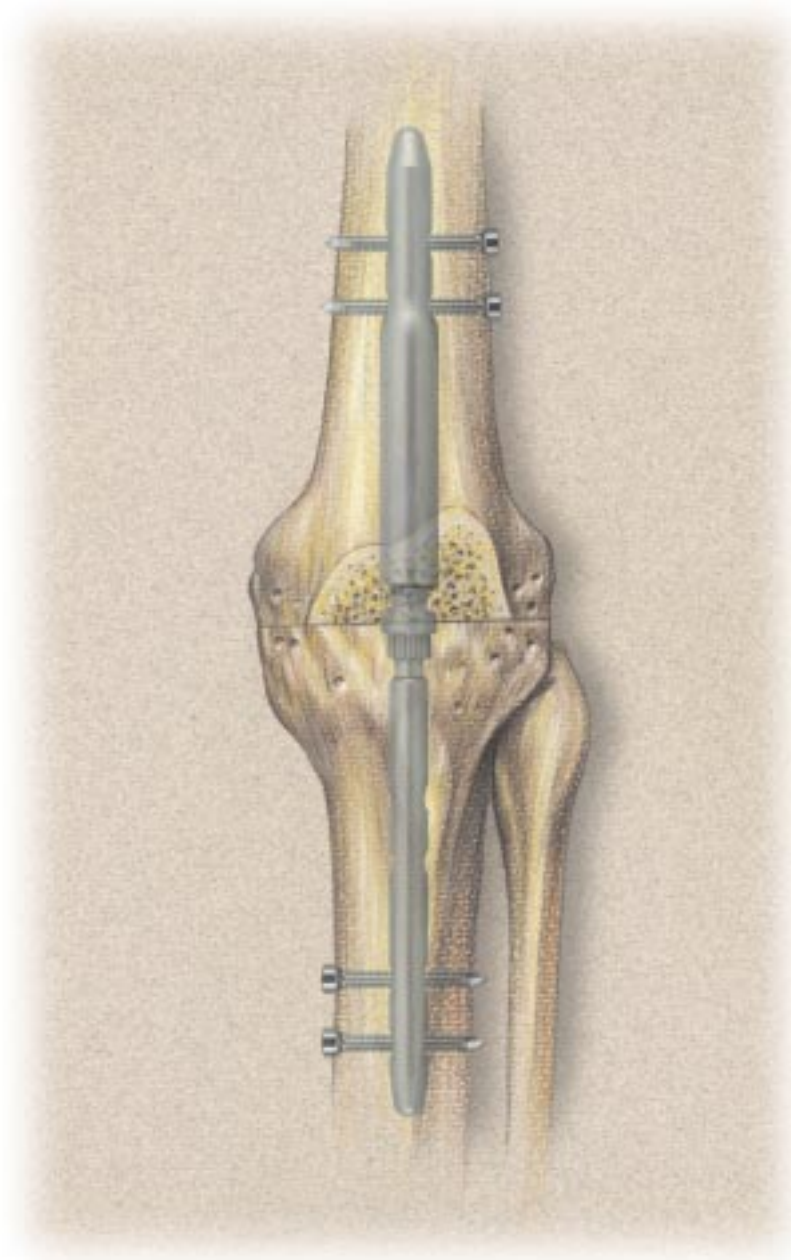




WICHITA[®]

F U S I O N N A I L

David A. McQueen, MD



WICHITA FUSION NAIL

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Wichita® Fusion Nail Surgical Technique

David A. McQueen, MD
Associate Clinical Professor of Orthopaedics
Department of Surgery
University of Kansas School of Medicine
Orthopaedic Research Institute
Via Christi Regional Medical Center
Wichita, Kansas

Introduction

The Wichita® Fusion Nail is a device designed to provide simultaneous compression and intra-medullary fixation for arthrodesis of the knee. The device is implanted through a single knee incision, using four main components:

- Compression Screw Component (a)
- Femoral Component, ø18mm (b)
- Tibial Component, ø12mm (c)
- Transverse Screws (4) (d)

The Femoral Component is bullet-shaped with a distal diameter of 18mm and a proximal diameter of 14mm. The femoral component inserts retrograde into the distal femur, and has two holes in its proximal end to accept transverse screws.

The Tibial Component has a diameter of 12mm and inserts antegrade into the proximal tibia. The tibial component has two sets of holes for transverse screw placement. The proximal set of holes is recommended except in cases of inadequate bone quality in the proximal tibia. In these cases, the distal set of holes may be used.

The Compression Screw Component is used to lock the femoral and tibial components together. As the screw is tightened, the cut surfaces of the femur and tibia are drawn together and compression is generated across the joint line.

6.0mm Self-Tapping Transverse Screws are available in 25-60mm lengths with 5mm increments. Using the dedicated Wichita® Instrumentation, transverse screws may be positioned without the use of image control.

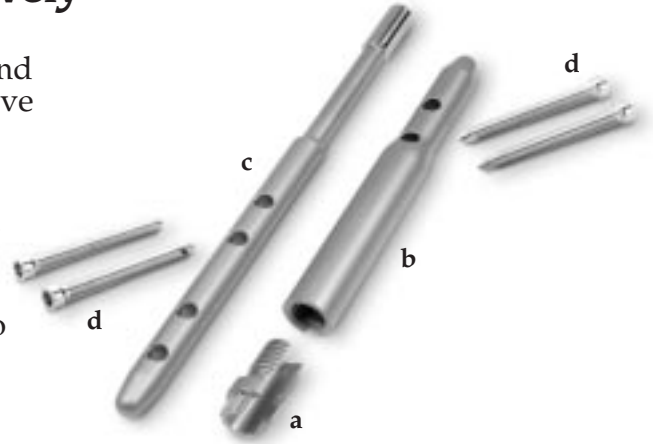
This publication sets forth detailed recommended procedures for using Howmedica Osteonics devices and instruments. It offers guidance that you should heed, but, as with any such technical guide, each surgeon must consider the particular needs of each patient and make appropriate adjustments when and as required.



The patented design with a dual advantage

Generates compression intraoperatively

- Innovative compression screw (a) locks femoral and tibial components (b & c), generating intraoperative compression across the joint line.
- 6.0mm transverse screws (d) in addition to the interlocking geometry of the components provide rotational stability.
- Dedicated Wichita® instrumentation is designed to provide a safe and efficient surgical technique.



WICHITA®

F U S I O N N A I L

Provides for dynamic compression postoperatively

- Unlike conventional systems, the Wichita® Nail provides for dynamic compression to encourage early weight-bearing.
- Designed to improve both the likelihood and speed of union.*
- Exceptional fatigue strength — laboratory tested to 10 million normal gait cycles with no failure.**

Patient profile: Revision TKA with failure of polyethylene and metal baseplate secondary to exogenous obesity.



Pre-op

Immediate post-op

12 months post-op

* SICOT Poster Presentation, 1996. D. Hahn and D. McQueen, MD

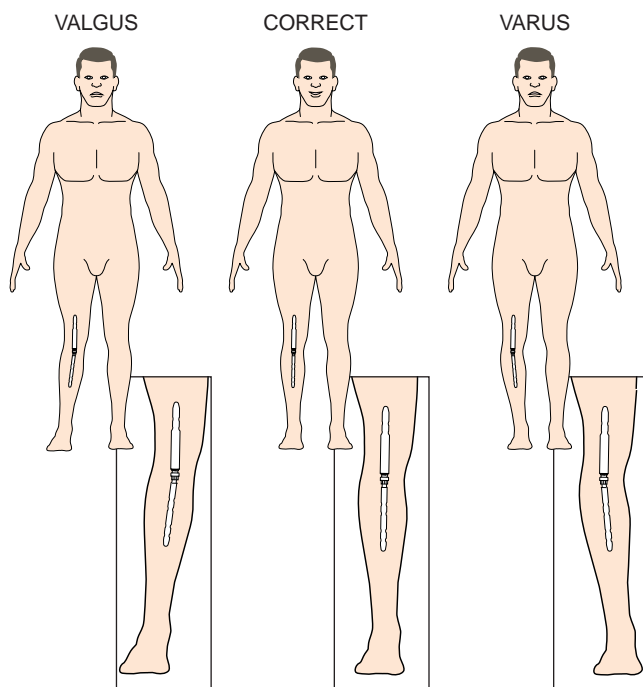
** Orthopaedic Research Institute, D. Hahn, 1994

Preoperative Planning

Preoperative templating is essential for successful implantation of the Wichita® Nail. Prior to surgery, A/P and lateral radiographs should be obtained, and templating performed to ensure proper fit of the implants within the femoral and tibial canals. It is also important at this stage to be sure that the sites of the transverse screw holes will be in bone of good quality.

Natural Valgus Alignment

Although it is very important to restore the natural valgus alignment of the knee in total knee arthroplasty or osteotomies about the knee to provide normal joint mechanics, with knee arthrodesis the critical issue is efficient placement of the foot at the center of gravity during normal gait. To be able to accomplish this, the knee has to either be arthrodesed in 0° of varus and 0° of valgus or even positioned in slight varus. The act of placing the foot efficiently at the center of gravity during gait reduces the amount of energy required for ambulation.



Incision and Preparation

The knee is approached through a direct mid-line incision using a medial parapatellar approach. The quadriceps muscle is split at the junction of the vastus medialis and the quadriceps tendon.

Distal Femoral Cut

A starter hole is created approximately 5mm anterior to the insertion of the posterior cruciate ligament, using a 5/16" drill bit. A 1/2" drill bit is then used to open the distal femur. After slowly passing an intramedullary alignment guide, the distal femoral cut is made with 0° of varus and valgus, and 0 to 5° of flexion. The level of the cut should be sufficient to expose good trabecular bone.

Technical Hint: Flexion is achieved by reaming perpendicular to the transverse bone cuts. If, for example, 6° of flexion is desired, both the femur and tibia can be cut into 3° of posterior slope. Once the transverse cuts have been made, reaming should start slightly posterior to the center of the shaft and progress slightly anteriorly.

By positioning either the femoral or tibial rod more posteriorly at the articulation, this will allow for 5 to 10° and occasionally more flexion depending on the metaphyseal size.

Since flexion is built into the joint by reaming posterior to anterior, the degree of flexion that can be achieved depends on the size of the femoral canal, and thus will vary from patient to patient.

In a large patient, there is more room to safely advance the reamer in an anterior direction. Therefore, a greater degree of flexion can be obtained. In a small patient, the degree of possible flexion will be very limited.

Proximal Tibial Cut

A starter hole is created using a 5/16" drill. After positioning an intramedullary alignment guide, the proximal tibial cut is made with 0° of varus and valgus, and 0 to 5° of flexion. The level of the cut should be sufficient to expose good trabecular bone without undue shortening.



Femoral Reaming

The femoral reamer is used to prepare the femoral canal (**Figure 1**). Advance the reamer slowly until the circumferential depth marking of the reamer reaches the level of the distal femoral bone cut, and remove.



- 1 ▲** The femoral reamer is used to prepare the femoral canal.

Femoral Component Implantation

Attach the femoral component to the *Femoral Target Frame* by aligning the femoral component keyway with the target frame key (**Figure 2**). Turn the target frame knob clockwise until the implant is firmly seated and the knob is tight. (**NOTE: Proper attachment of the component to the target frame is required to assure successful implantation of the device.**)



- 2 ▲** The femoral component is attached to the femoral target frame, aligning the femoral component keyway with the target frame key.

In order to ensure proper alignment of the hole locator prior to implantation of the femoral component, mount the appropriate *Hole Locator* (left leg or right leg) on the femoral target frame on the **lateral side** (see **Figure 4, page 4**). Use the *Hole Locator Knob* to secure the locator to the target frame. Proper alignment can be checked visually by ensuring the holes of the locator are in line with the transverse screw holes in the femoral component.

Once proper alignment is obtained, place the knee in sufficient flexion to allow for insertion of the femoral component. Insert the component into the femoral canal aligning the target frame handle with the center of the femoral shaft (**Figure 3**). The transverse screw holes should be in the coronal plane. Once positioned, gently tap the target frame on the knob until the spikes are fully seated on the cut surface of the distal femur. (**NOTE: Retighten the target frame knob if necessary.**) Drill pins can now be inserted through the distal target frame plate for added security of the target frame to the femur. Two transverse screws are now positioned through the femoral component following the technique outlined in the following section. Once screws are placed, remove the femoral target frame and hole locator from the femoral component.



- 3 ▲** The femoral component is inserted with the target frame handle aligned with the center of the femoral shaft.



Transverse Screw Implantation

1. A stab skin incision is made in line with the two holes in the hole locator.
2. Insert the *Obturator* into the *Tissue Protector* and position through the hole locator.
3. With the tip of the obturator positioned against the bone, twist the T-handle to score the cortex.
4. Remove the obturator. Leaving the tissue protector in place, insert the *Guide Sleeve for the 4.5mm Drill*.
5. Drill a transverse hole through both the near and far cortices using the *4.5mm Drill*.
6. Remove the drill and guide sleeve from the tissue protector and measure the appropriate screw length using the *Screw Depth Gauge*. (NOTE: *The Screw Depth Gauge measures the functional length of the screw. For example, if the reading on the gauge shows 60mm, a 60mm screw should be selected, which ensures both cortices are engaged by threads. There will be a protrusion of the non-threaded, tapered end of the screw. Transverse screws are available in 5mm increments. When determining screw length, if the exact length measured is not available, always "round up" to the next size.*)
7. Select the appropriate length *Transverse Screw* component and affix the screw to the *T-handled Screwdriver*.
8. Pass the screw and driver through the tissue protector and turn the T-handle in the clockwise direction until the screw is tight. (NOTE: *Grooves are provided along the length of the screwdriver so that forward progress can be visualized.*)
9. Once the screw is tight, remove the screwdriver and tissue protector.
10. Repeat steps 2 through 9 for implantation of the second transverse screw (Figure 4).

NOTE: *During insertion of the transverse screws, the knee should be supported by a surgical roll. This ensures the knee is arthrodesed in flexion.*



4 ▲ With the hole locator mounted on the lateral side, two transverse screws are positioned.

Tibial Reaming

The tibial reamer is used to prepare the tibial canal (Figure 5). With the tibia translocated anteriorly, the reamer is placed in the center and neutral axis of the tibial shaft. Advance the tibial reamer slowly until the circumferential depth marking reaches the level of the proximal tibial bone cut, and remove.



5 ▲ The tibial reamer is used to prepare the tibial canal.



Anterior Tibial and Femoral Bone Slots

An anterior **TIBIAL Bone Slot** is **REQUIRED** to allow for final assembly of the device. The tibial slot allows for proper placement of the tibial component within the intramedullary canal, and permits attachment of the compression screw.

The anterior **FEMORAL Bone Slot** is **OPTIONAL**. However, creating the femoral slot can be an important adjunct to proper rotational alignment and may facilitate more rapid arthrodesis by allowing for placement of a bridging bone graft anteriorly across the cut surfaces of the two bones. (NOTE: *The basis for this approach is similar to the Blair technique for tibio-talar arthrodesis*¹.)

The **Slot Marking Jig** and **Slot Marking Block** are used to determine the location of tibial and femoral bone slots. (NOTE: *It is especially important to be certain of the proper rotational alignment of the femur and tibia prior to marking bone slots.*)

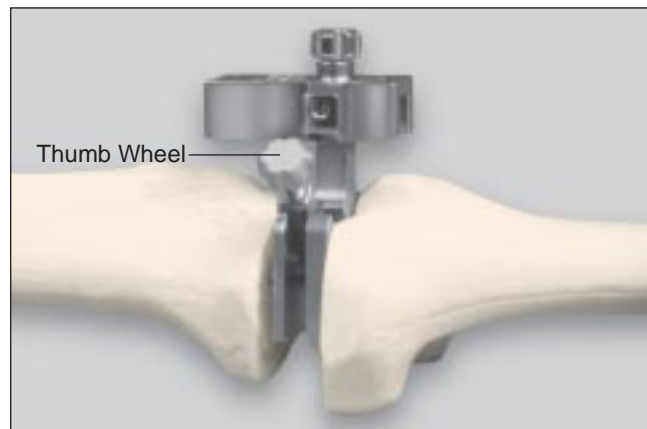
Prior to inserting the slot marking jig into the tibial canal, the jig slide should be closed and the thumb wheel tightened. With the knee placed in an adequate degree of flexion to insert the Slot Marking Jig, position the jig in the tibial canal with the post oriented with the center of the tibial shaft (Figure 6). Using a mallet, lightly tap the jig until it is firmly seated on the proximal tibia.



6 ▲ The slot marking jig is positioned in the tibial canal with the post oriented with the center of the tibial shaft.

With the leg placed back in extension and the femur positioned against the slot marking jig, position the Slot Marking Block on the post of the jig with the arrows pointing toward the femur. The longer portion of the block should be positioned toward the tibia, and the shorter portion positioned toward the femur. Slide the marking block onto the post until it stops; secure it to the jig by tightening the knob on the top of the block.

Loosen the thumb wheel on the jig and spread open the slide as far as the surrounding tissue tension will allow, maximizing the space between femur and tibia (Figure 7). When the slide is spread as far as possible, re-tighten the thumb wheel to lock the jig in position. Two (2) 1/8" diameter drills may now be inserted through the holes of the slot marking block, fixing the marking block to the tibia.



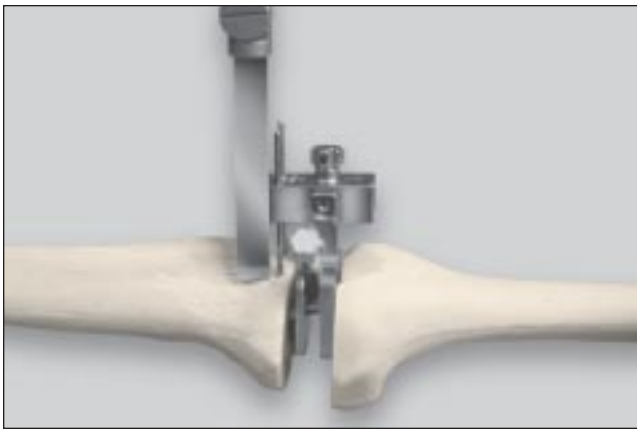
7 ▲ The slot marking block is secured on the post of the slot marking jig. The thumb wheel on the jig is loosened and the slide spread open as far as the surrounding soft tissue will allow (maximizing the space between femur and tibia).

¹Dennis, David M., and Tullos, Hugh S.: Blair Tibio-talar Arthrodesis for injuries of the talus. J. Bone and Joint Surg., 62-A: 103-107, 1980.



Anterior Tibial and Femoral Bone Slots (continued)

Using an osteotome, mark the outline of the tibial bone slot by following the outline of the block (Figure 8). If a femoral bone slot is planned, mark this slot in the same fashion. After the slots have been marked, loosen the knob on the marking jig and remove the jig from the tibial canal, leaving the marking block itself in place. Again, using an osteotome, complete the tibial slot (and femoral slot, if applicable) through the anterior cortex.

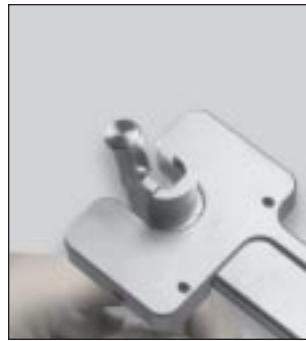


8 ▲ Following the outline of the block, the bone slots are marked using an osteotome.

After the bone slots are completed, remove the marking block and drill pins from the tibia. A curette may be used to remove any interfering additional cancellous bone. The bone blocks removed should be saved for bone grafting at surgical closure.

Tibial Implantation

Turn the thumb wheel on the *Tibial Target Frame* in the counter clockwise direction until the clamping arm is in the fully extended position. This allows the small diameter of the proximal portion of the tibial component to be inserted into the slot of the target frame. Once this has been done, position the proximal end of the *Tibial Component* into the target frame slot, aligning the flat surface of the implant with the flat surface of the target frame slot (Figure 9). It is important that the flat of the implant is fully seated in the recess, as indicated by the engraved stop line.



9 ▲ The tibial component is loaded onto the tibial target frame.

While applying downward pressure to the proximal end of the implant, tighten the thumb wheel until secure. Using the closed end of the *Compression Screw Wrench*, tighten the thumb wheel of the target frame a maximum of one half turn to further secure the implant in place. Once the thumb wheel is tightened, retract the target frame slide.



With the knee in flexion, position the tibial component into the tibial canal, with the target frame handle oriented anteriorly (**Figure 10**). The tibial target frame should be advanced distally to the maximum depth of the tibial bone slot.



10▲ The tibial component is positioned in the tibial canal with the target frame slide retracted and the handle oriented anteriorly.

Place the knee in extension and advance the tibial component cephalad to engage the inner flat surface of the femoral component (**Figure 11**). Slight rotation of the tibial target frame may be necessary to ensure proper femoral and tibial interlock.

Extend the target frame slide into the joint space to maintain the proper space between the femur and tibia. (**Important: While holding the foot, compress the knee joint and, once again, check proper alignment of the extremity.**) Two 1/8" diameter drills may now be placed through the target frame slide to secure the target frame to the cut surface of the proximal tibia.

Mount the appropriate *Hole Locator* (right leg or left leg) on the tibial target frame on the medial side. (**NOTE: The hole locator is mounted on the proximal hole of the tibial target frame if the proximal set of screw holes are to be used, it is mounted on the distal hole of the target frame if the distal set of screw holes are to be used.**) Using the *Hole Locator Knob*, secure the locator to the target frame and tighten.



11▲ With the knee in extension, the tibial component is advanced cephalad to engage the inner flat surface of the femoral component. The target frame slide is extended into the joint space.

Two transverse screws are next implanted through the holes in the tibial component in the same manner as for the femoral side (**Figure 12**). (**NOTE: The proximal set of holes should always be used unless bone quality is inadequate. In these cases, the distal set of holes should be used.**)



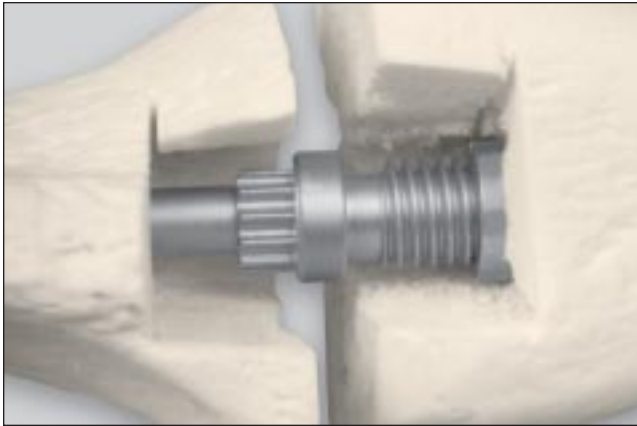
12▲ The hole locator is mounted on the medial side and two transverse screws are implanted.

Once the transverse screws have been secured, remove the hole locator and tibial target frame.



Implant Assembly

Position the *Compression Screw Component* on the small diameter of the Tibial Component with its screw threads placed into the Femoral Component (**Figure 13**). Align and engage the open end of the *Compression Screw Wrench* with the screw, and rotate clockwise to tighten (**Figure 14**).

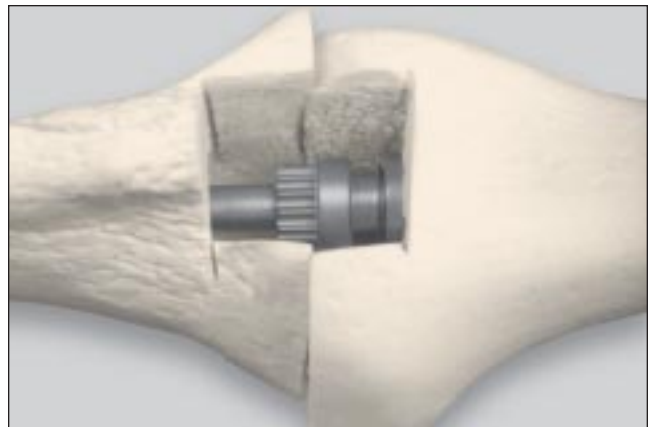


13▲ The compression screw component is positioned on the small diameter of the component with its screw threads placed into the femoral component.



14▲ The open end of the compression screw wrench is aligned and engaged with the screw, and rotated clockwise to tighten.

It is helpful to apply constant downward pressure to the compression screw until the threads adequately engage the femoral component; otherwise the compression screw may drop away from the tibial component into the posterior tibiofemoral gap. Continue tightening until a stable interface is created between the femur and tibia (**Figure 15**). (**CAUTION: Avoid over-tightening as an intra-operative fracture may occur with excessive force.**)



15▲ Tightening continues until a stable interface is created between the femur and tibia. Bone blocks removed at the beginning of the procedure may be replaced.

Bone graft may now be added around the component, and the bone block(s) removed at the beginning of the procedure, may be replaced. (**NOTE: If a femoral slot has been made, the tibial bone block may be re-positioned on the femoral side and the femoral bone block positioned on the tibial side, to bridge across the cut surfaces as in the Blair technique referred to earlier.**)

Surgical Closure

Prior to closure, A/P and lateral radiographs are recommended to check on final screw placement as well as the overall fit of the implants within the intramedullary canal. The joint is irrigated and closed in the routine fashion.





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