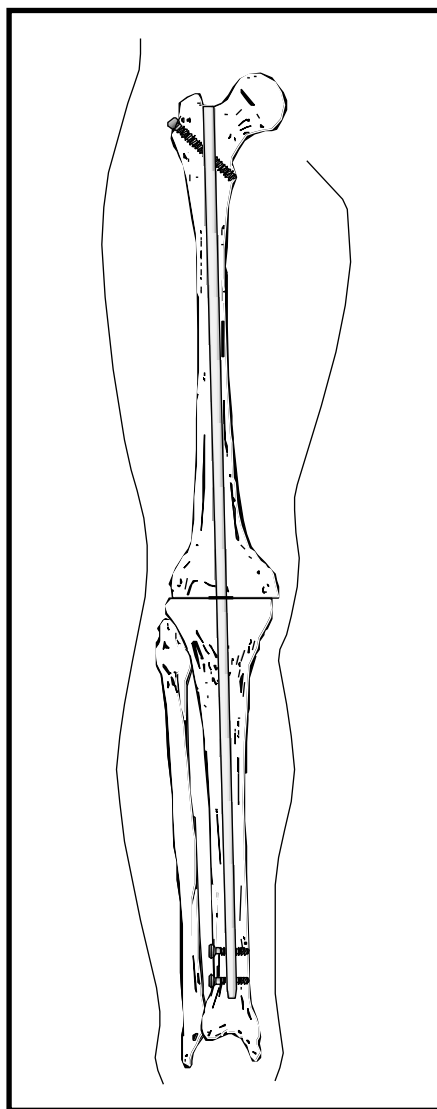


KNEE FUSION NAIL



S U R G I C A L T E C H N I Q U E

KNEE FUSION NAIL

Developed in conjunction with

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Nota Bene: The technique description herein is made available to the healthcare professional to illustrate the author's suggested treatment for the uncomplicated procedure. In the final analysis, the preferred treatment is that which addresses the needs of the specific patient.

WARNING: This device is not approved for screw attachment or fixation to the posterior elements (pedicles) of the cervical, thoracic, or lumbar spine.

PREOPERATIVE EVALUATION

Indications

Historically, knee arthrodesis has been used as one alternative form of treatment for knee arthritis. It should be considered in monarticular arthritis, most commonly secondary to trauma. A more common indication for knee arthrodesis, however, is following failed total knee arthroplasty. This may be secondary to infection, mechanical problems in the knee, or loss of the extensor mechanism. If the arthrodesis is being performed following an infection, this may be done as a one or two stage procedure.

Preoperative X-ray Evaluation

It is necessary to obtain long X-rays of the entire limb to assess the two most critical features regarding nail selection: nail length and nail diameter. Using an X-ray marker, long X-rays of the hip (that include the hip, knee, and ankle on A-P) are obtained. Laterals of the femur and tibia are also obtained as well as a lateral of the knee (Figure 1).

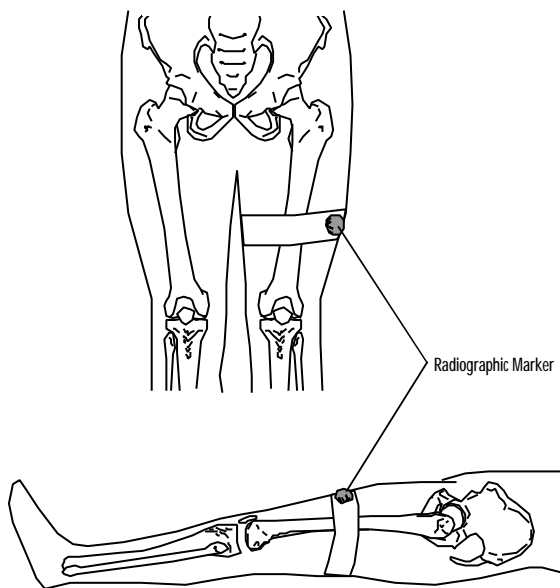


Figure 1

The nail should extend from the tip of the greater trochanter to within 2-6 cm from the plafond of the ankle. If the arthrodesis is being performed following a failed total knee arthroplasty, the thickness of the femoral and tibial components and any bone defects that will be resected needs to be subtracted (Figure 2).

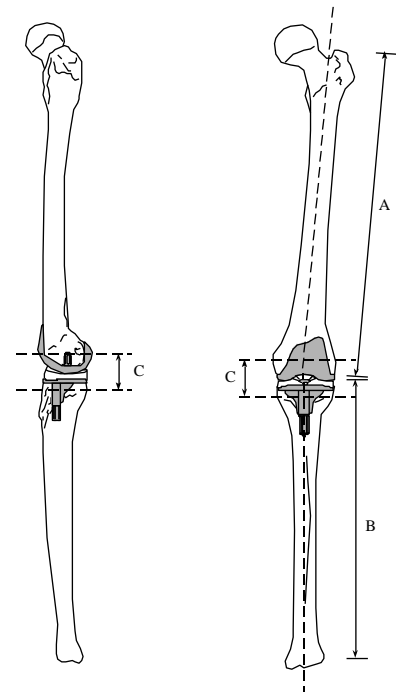


Figure 2

Magnification needs to be determined by the radiographic marker and the appropriate adjustment in measurement should be made. The Knee Fusion Nail comes in 65, 70, and 75 cm lengths. Additional lengths can be special ordered.

Canal diameter should also be determined preoperatively. Again, using the X-ray marker, the diameter of the femur and tibia at the isthmus should be obtained. The tibia usually has the smaller canal diameter. Cortical thickness may allow for a certain amount of reaming to increase the canal size for the nail. The Knee Fusion Nail comes in 11 and 12 mm diameters.



Smith & Nephew Knee Fusion Nails are available in the following sizes:

- Diameters 11 mm and 12 mm in lengths of 65 cm, 70 cm, and 75 cm.
- Proximal 7 cm of the nail is expanded to 13 mm.
- Proximal screw fixation with 6.4 mm fully-threaded, self-tapping bone screws.
- Insertion and proximal fixation are achieved with the Russell/Taylor® (R/T) Femoral/DELTA® Femoral Proximal Drill Guide. Distal screw fixation for the 12 mm nail with 6.4 mm screws; for the 11 mm nail with 5.0 mm screws.

Customized single diameter and stepped knee arthrodesis interlocking nails can be ordered to match the patient's femoral and tibial anatomy.

PREOPERATIVE PLANNING

The following surgical technique is for knee arthrodesis following a failed total knee arthroplasty. Modifications would be necessary for arthrodesis for other reasons.

The patient is positioned supine on an operating table. A fluoroscopic board is necessary to allow fluoroscopy from the hip to the ankle. A sand bag or a stack of linen should be placed under the ipsilateral pelvis to raise the greater trochanter into better position for visualization (Figure 3).

The involved extremity is prepped and draped to allow access to the greater trochanter all the way down to the foot. The foot needs to be visible to help with rotational alignment.

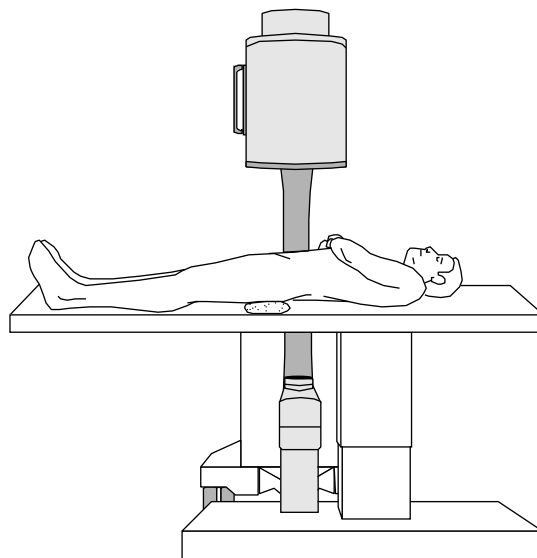


Figure 3

SURGICAL TECHNIQUE

The entry portal for the nail is exposed first. An incision is made at the tip of the greater trochanter and carried proximally about 5 cm. The limb is adducted and internally rotated and fluoroscopy is brought in from the opposite side of the table. The greater trochanter and piriformis fossa are identified on fluoroscopy. Either a curved awl or tip-threaded guide pin is used to create an entry portal, a 9 mm cannulated reamer is placed over the guide pin down to the level of the lesser trochanter (Figure 4). The skin protector is used to protect the soft tissues. The lateral of the proximal femur is visualized by tilting the image at the same time the leg is externally rotated. After confirming that the entry portal is in the center of the medullary canal of the femur in both the A-P and lateral

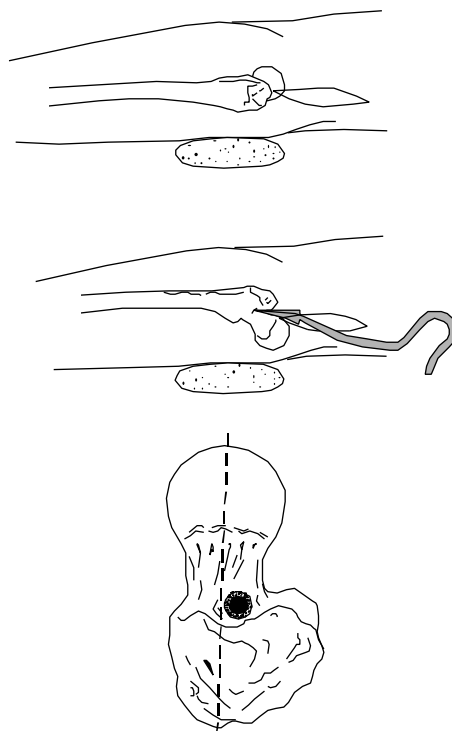


Figure 4

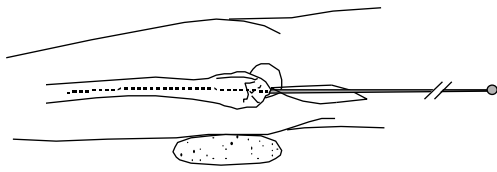


Figure 5

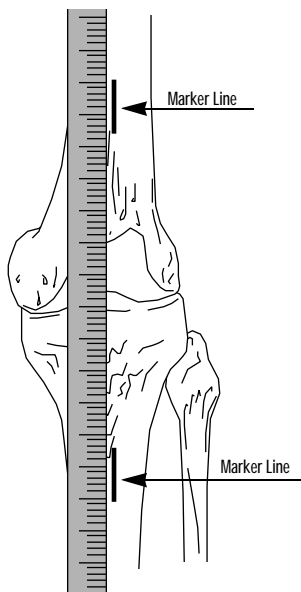


Figure 6

planes, a ball-tip guide wire is passed down the medullary canal to just above the knee. The smooth end, not the ball-tip end, is introduced to facilitate reaming from the knee. This is left in place while the knee is being exposed (Figure 5) .

A sterile tourniquet is applied to the leg. Make an incision over the knee at approximately the same location as prior surgery. A medial parapatellar incision is made and the knee joint is entered. Cultures are obtained as needed.

Prior to removal of the total knee components, a long ruler is placed anteriorly over the distal femur and proximal tibia. Using an osteotome or an electrocautery, a line is drawn superficially in the anterior tibial shaft and in the anterior femoral shaft along the line of this ruler (Figure 6) . This line will be used later to determine rotational alignment when inserting the nail. This line should be preserved and not removed with bone cuts or resection of the tibial or femoral implants.

Using osteotomes and the appropriate total knee instrumentation, all of the total knee components are extracted. Usually, there is debris and erosion of the bone that has to be curetted and cleaned. As much bone as possible should be preserved. If the patella is in good condition, it can also be preserved to be used as a bone graft. Otherwise, a patellectomy may be performed.

The distal femur and proximal tibia may need to be recut. This can be done with standard intramedullary knee resection guides for total knee prostheses or with the Smith & Nephew intramedullary cutting guides. A minimal amount of bone should be resected (Figures 7 and 8).

After removal of all of the total knee components, the cement, and after cutting the proximal tibia and distal femur, the intramedullary canals should be reamed from the knee. This should be done over the guide wire that has already been inserted. The femur and tibia should be over-reamed by 1 to 2 mm, depending on the diameter of the isthmus in both the tibia and femur. Reaming should be done with the tourniquet removed. The intertrochanteric region must be reamed to 13 mm in diameter. The guide rod must be removed, turned around, and reinserted to ream the 13 mm proximal end from above.

Nail length can be confirmed at the time of surgery using fluoroscopy. A marker can be placed over the greater trochanter and over the distal tibia where the tip of the nail should be driven. The distance can then be measured correctly with the tibia and femur opposed.

The appropriate length and diameter nail should then be inserted in the entry portal of the femur. The guide wire is not needed for this step. The nail should be inserted in about 45° of internal rotation. This position provides both some flexion as well as some valgus to the limb. The nail should be carefully driven down the femoral shaft without excessive force (Figure 9). Look for the signs of impending incarceration or fracture. As the tip of the nail

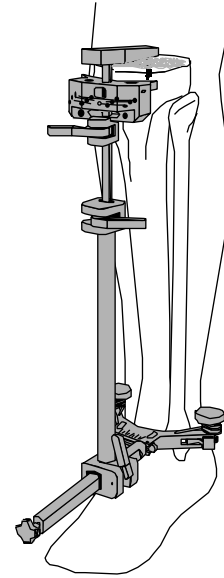


Figure 7

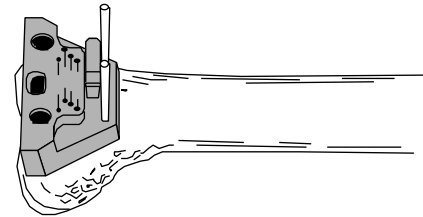


Figure 8

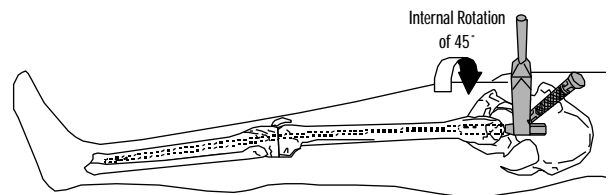


Figure 9

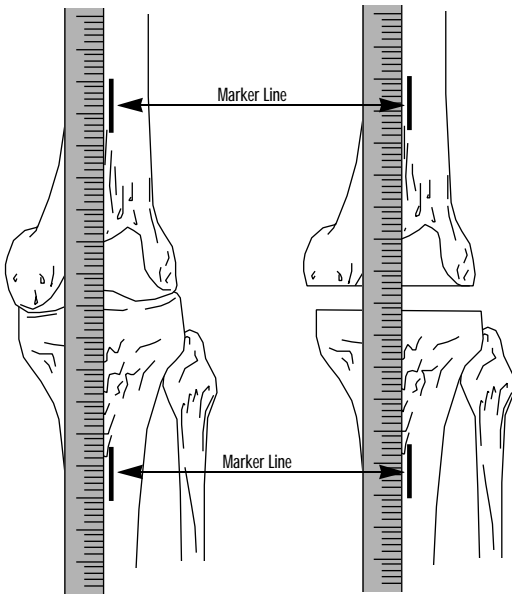


Figure 10

exits the femur, the tibia is reduced on the femur with the rotational alignment achieved by recreating the “marker line” that was placed in the anterior femoral and anterior tibial cortices (Figure 10). The nail is then carefully driven across the knee into the proximal tibia. Sink the nail to the point to where the tip of the nail proximally is flush with the greater trochanter. The knee is reduced and the bone ends are opposed and the nail is sufficiently positioned in the tibia where the tip of the nail is distal to the isthmus of the canal and proximal to the ankle joint.

Any defects or gaps noted in the region of the knee should be compressed or filled. Small segments of bone may be removed from the distal femur to improve contact medially or laterally. Bone grafts should be used to fill any gaps in place if the knee is not actively infected at the time of arthrodesis. The patella may also be used as bone graft.

The proximal femur is locked using the 4.8 mm drill, green and blue drill sleeves, and proximal drill guide for the nail. Distal screw fixation for the 12 mm diameter nail uses the 6.4 mm screw; the 11 mm diameter nail uses the 5.0 mm screws. Refer to the Smith & Nephew Russell/Taylor Femoral Nail Surgical Technique for the insertion of the distal interlocking screws.

The hip and knee are closed in traditional fashion.



POSTOPERATIVE CARE

The patient is instructed in hip abduction and flexion exercises as well as ankle exercises.

The patient is instructed to touch-down weight bearing for the first four to six weeks and then progress to weight bearing as tolerated. If significant gaps are noted at the knee at 6-12 weeks, the proximal or distal locking screws are removed to dynamize the nail.

Additional bone grafting may also be required if significant defects are noted. Nail removal is usually the decision of the surgeon and patient.

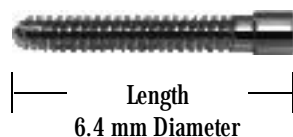
FEMORAL KNEE FUSION INTERLOCKING NAILS



Cat. No.	Outside Diameter	Length
7192-1565	11 mm	65 cm
7192-1570	11 mm	70 cm
7192-1575	11 mm	75 cm
7192-1596	12 mm	65 cm
7192-1601	12 mm	70 cm
7192-1606	12 mm	75 cm

FEMORAL DISTAL LOCKING SCREWS

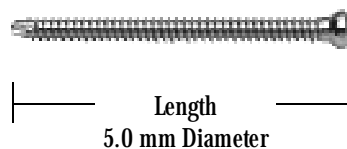
6.4 mm Diameter
(Used distally on 12 mm nails,
proximally on all nail sizes)



Cat. No.	Length
12-2262	30 mm
12-2263	35 mm
12-2264	40 mm
12-2265	45 mm
12-2266	50 mm
12-2267	55 mm
12-2268	60 mm
12-2269	65 mm
12-2270	70 mm
12-2271	75 mm
12-2272	80 mm
12-2273	85 mm
12-2274	90 mm

FEMORAL DISTAL LOCKING SCREWS

5.0 mm Diameter
(Used distally on 11 mm nails)



Cat. No.	Length
12-2280	25 mm
12-2281	30 mm
12-2282	35 mm
12-2283	40 mm
12-2284	45 mm
12-2285	50 mm
12-2286	55 mm
12-2287	60 mm
12-2288	65 mm
12-2276	70 mm
12-2277	75 mm
12-2278	80 mm
12-2279	85 mm
12-2289	90 mm

IMPLANTS

Curved Awl
 Cat. No. 21-6600



9.0 mm Cannulated Reamer
 Cat. No. 11-2003



Tip-Threaded Guide Pin
 3.2 mm x 305 mm
 Cat. No. 11-2057



Skin Protector
 Cat. No. 41-5330



T-Handle Jacob's Chuck
 Cat. No. 11-0257



11/16" Open-End Wrench
 (2 required)
 Cat. No. 11-0564



Guide Rod for Nail
 4 mm x 900 mm
 Cat. No. 11-2020



**Russell-Taylor Femoral/DELTA
 Femoral Proximal Drill Guide**
 Cat. No. 11-2099





**Bolt-On Femoral Proximal
Drill Guide (Replacement)**
Cat. No. 11-2093



Slotted Hammer
400 mm x 7 mm Slot
Cat. No. 11-5175



Supine Driver
Cat. No. 11-2024



8.0 mm Drill Sleeve (Green)
Cat. No. 11-2012



4.8 mm Drill Sleeve (Blue)
Cat. No. 11-2042



3.2 mm Drill Sleeve (Red)
Cat. No. 11-2045



Femoral Drill
4.8 mm x 311 mm
Cat. No. 11-2048



Tibial Drill
4.0 mm x 311 mm
Cat. No. 11-2049

Screw Length Gauge

Cat. No. 11-5058



Hexdriver for Femoral Interlocking Screws

Cat.No. 11-5052



Hexdriver Shaft

5.0 mm Screws

Cat. No. 11-5059



Hexdriver Shaft

6.4 mm Fully-Threaded

Cat. No. 11-2095



Quick Release T-Handle

Cat. No. 11-6011



Knee Fusion Adaptor

(Not shown)

Cat. No. 7192-2489

Sound Set

(Not shown)

Cat. No.	Description	Qty.
7111-8203	7.0 mm Sound	1
7111-8204	8.0 mm Sound	1
7111-8205	9.0 mm Sound	1
7111-8206	10.0 mm Sound	1
7111-8207	11.0 mm Sound	1
7111-8208	12.0 mm Sound	1
7111-8209	13.0 mm Sound	1
7111-8210	14.0 mm Sound	1
7111-8211	15.0 mm Sound	1
7111-8212	T-Handle Shaft for Sounds	1
7111-8213	13.5 mm Fixed Proximal Reamer	1
7111-8214	Sleeve for 13.5 Fixed Proximal Reamer	1
7111-8215	15.5 mm Fixed Proximal Reamer	1
7111-8216	Sleeve for 15.5 mm Fixed Proximal Reamer	1
7111-8258	Sound Sterilization Case	1



11/16" Universal Socket Wrench

Cat. No. 11-5177

Flexible Shaft:

Small 9.0 mm-12.5 mm

(Used with 3.2 mm Guide Rod)

Cat. No. 11-8150



Flexible Shaft:

Large 13.0 mm-21.0 mm

(Used with 3.2 mm Guide Rod)

Cat. No. 11-8151



Reamer Set

(Not shown)

Cat. No.	Description	Qty.
11-5128	Pseudoarthrosis Chisel	1
11-8165	5.0 mm T-Handle Reamer	1
11-8166	6.0 mm T-Handle Reamer	1
41-5330	Skin Protector	1
7111-8200	Flexible Shaft for Reamer	1
7111-8201	2.0 Ball Tip Guide Rod	1
7111-8202	3.0 Ball Tip Guide Rod	1
7111-8220	6.0 mm Fixed Pilot Nose Reamer	1
7111-8221	6.5 mm Fixed Pilot Nose Reamer	1
7111-8222	7.0 mm Fixed Pilot Nose Reamer	1
7111-8223	7.5 mm Fixed Pilot Nose Reamer	1
7111-8224	8.0 mm Fixed Pilot Nose Reamer	1
7111-8225	8.5 mm Fixed Pilot Nose Reamer	1
7111-8226	9.0 mm Fixed Pilot Nose Reamer	1
7111-8227	9.5 mm Fixed Pilot Nose Reamer	1
7111-8228	10 mm Fixed Pilot Nose Reamer	1
7111-8229	10.5 mm Fixed Pilot Nose Reamer	1
7111-8230	11.0 mm Fixed Pilot Nose Reamer	1
7111-8231	9.0 mm End Cutting Interchangeable Head	1
7111-8232	9.0 mm Pilot Nose Interchangeable Head	1
7111-8233	9.5 mm Pilot Nose Interchangeable Head	1
7111-8234	10.0 mm Pilot Nose Interchangeable Head	1
7111-8235	10.5 mm Pilot Nose Interchangeable Head	1
7111-8236	11.0 mm Pilot Nose Interchangeable Head	1
7111-8237	11.5 mm Pilot Nose Interchangeable Head	1
7111-8238	12.0 mm Pilot Nose Interchangeable Head	1
7111-8239	12.5 mm Pilot Nose Interchangeable Head	1
7111-8240	13.0 mm Pilot Nose Interchangeable Head	1
7111-8241	13.5 mm Pilot Nose Interchangeable Head	1
7111-8242	14.0 mm Pilot Nose Interchangeable Head	1
7111-8243	14.5 mm Pilot Nose Interchangeable Head	1
7111-8244	15.0mm Pilot Nose Interchangeable Head	1
7111-8245	15.5 mm Pilot Nose Interchangeable Head	1
7111-8246	16.0 mm Pilot Nose Interchangeable Head	1
7111-8247	16.5 mm Pilot Nose Interchangeable Head	1
7111-8248	17.0 mm Pilot Nose Interchangeable Head	1
7111-8249	17.5 mm Pilot Nose Interchangeable Head	1
7111-8250	18.0 mm Pilot Nose Interchangeable Head	1
7111-8251	18.5 mm Pilot Nose Interchangeable Head	1
7111-8252	19.0 mm Pilot Nose Interchangeable Head	1
7111-8253	19.5 mm Pilot Nose Interchangeable Head	1
7111-8254	20.0 mm Pilot Nose Interchangeable Head	1
7111-8255	20.5 mm Pilot Nose Interchangeable Head	1
7111-8256	21.0 mm Pilot Nose Interchangeable Head	1
7111-8257	Reamer System Sterilization Case	1



**Pilot Nose
Interchangeable Head**

SUGGESTIONS CONCERNING ORTHOPAEDIC METALLIC INTERNAL FIXATION DEVICES

Prepared by the Orthopaedic Surgical Manufacturers Association ATTENTION OPERATING SURGEON

The use of metallic surgical implants has given the surgeon a means of bone fixation and helps generally in the management of fracture and reconstructive surgery; however, these implants are intended only to assist healing and are **not** intended to replace normal body structures. Metallic bone fixation devices are internal splints which align the fracture while normal healing occurs. The size and shape of bones and soft tissue place limitations on the size and strength of implants. If there is delayed union or nonunion of bone in the presence of weight bearing or load bearing, the implant could eventually break due to metal fatigue. Therefore, it is important that immobilization of the fracture site be maintained until firm bony union (confirmed by clinical and radiographic examination) is established. All metallic surgical implants are subject to repeated stresses in use which can result in metal fatigue. Factors such as the patient's weight, activity level, and adherence to weight bearing or load bearing instructions have effect on the load and number of cycles to which the implant is subjected.

The surgeon must be thoroughly knowledgeable not only in the medical and surgical aspects of the implant but also must be aware of the mechanical and metallurgical aspects of surgical implants. Postoperative care is extremely important. The patient should be warned that noncompliance with postoperative instructions could lead to breakage of the implant and/or possibly migration requiring revision surgery to remove the device.

The following are specific warnings, precautions, and adverse effects which should be understood by the surgeon and explained to the patient. These warnings **do not** include all adverse effects which could occur with surgery in general, but are important considerations particular to metallic internal fixation devices. General surgical risks should be explained to the patient prior to surgery.

WARNINGS

1. **Correct selection of the implant is extremely important.** The potential for success on fracture fixation is increased by the selection of the proper size, shape and design of the implant. While proper selection can help minimize risks, the size and shape of human bones present limitations on the size and strength of implants. Metallic internal fixation devices cannot withstand activity levels and/or loads equal to those placed on normal

healthy bone. **These devices are not designed to withstand the unsupported stress of full weight bearing or load bearing.**

2. **These devices can break when subjected to the increased loading associated with delayed union or nonunion.** Internal fixation appliances are load sharing devices which hold a fracture in alignment until healing occurs. If healing is delayed, or does not occur, the implant could eventually break due to metal fatigue. Loads produced by weight bearing and activity levels will dictate the longevity of the implant. Notches or scratches put in the implant during the course of surgery may also contribute to early breakage.
3. **Corrosion.** Implanting metals and alloys in the human body subjects them to a constant changing environment of salts, acids, and alkalis which can cause corrosion. Putting dissimilar metals in contact with each other can accelerate the corrosion process which in turn may enhance fatigue fractures of implants. Thus, every effort should be made to use compatible metals and alloys when marrying them to a common goal (i.e., screws in a bone plate).

PRECAUTIONS

1. **Surgical implants must never be reused.** An explanted metal implant should never be reimplanted. Even though the device appears undamaged, it may have small defects and internal stress patterns which may lead to early breakage.
2. **Correct handling of the implant is extremely important.** Contouring of metallic implants should be avoided where possible. If contouring is necessary, or allowed by design, the surgeon should avoid sharp bends, reverse bends, or bending the device at a screw hole. The operating surgeon should avoid any notching or scratching of the device when contouring it. These factors may produce internal stresses which may become the focal point for eventual breakage of the implant.
3. **Removal after fracture healing.** Metallic implants can loosen, fracture, corrode, migrate, cause pain, or stress shield bone even after a fracture has healed, particularly in young, active patients. If an implant remains implanted after complete healing, it can actually increase the risk

of refracture in an active individual. The surgeon should weigh the risks versus benefits when deciding whether to remove the implant. Implant removal should be followed by adequate postoperative management to avoid refracture. If the patient is older and has low activity level, the surgeon may choose not to remove the implant thus eliminating the risks involved with a second surgery.

4. **Adequately instruct the patient.** Postoperative care and the patient's ability and willingness to follow instructions are two of the most important aspects of successful fracture healing. This is particularly important should the device be used to treat an unstable fracture, such as intertrochanteric or subtrochanteric. The patient must be made aware of the limitations of the implant and that physical activity and full weight bearing or load bearing have been implicated in premature loosening, bending or fracture of internal fixation devices. The patient should understand that a metallic implant is not as strong as a normal, healthy bone and will fracture under normal weight bearing or load bearing in the absence of complete bone healing. An active, debilitated, or demented patient who cannot properly use weight supporting devices may be particularly at risk during postoperative rehabilitation.

POSSIBLE ADVERSE EFFECTS

1. Nonunion or delayed which can lead to breakage of the implant.
2. Metal sensitivity, or allergic reaction to a foreign body.
3. Limb shortening due to compression of the fracture or bone resorption.
4. Decrease in bone density due to stress shielding.
5. Pain, discomfort, or abnormal sensations due to the presence of the device.
6. Nerve damage due to surgical trauma.
7. Necrosis of bone.

STERILITY

Unless supplied sterile, metallic internal fixation devices must be sterilized prior to surgical use.

Smith+Nephew

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