Knee Arthrodesis

Chapter 52

James B. Single, MD

Secondary Arthrodesis

Patients may be severely

Most older patients will require amputation. Although the recognition

Secondary Arthrodesis: Is the

When the increasing success rates of

Secondary Arthrodesis

The prevalence of osteoarthritis and

The indications for knee arthrodesis

Primary Arthrodesis

Most older patients require a

Primary Arthrodesis

The indications that require knee arthrodesis

In general, patients adapt better to

indications

American Academy of Orthopaedic Surgeons

Ch. 52

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results, extensive scarring, and radiation fibrosis. Systemic factors include malnutrition, malignancy, extremes of age, hepatic or renal failure, diabetes mellitus, and alcohol abuse. Type C hosts are sufficiently fragile that they might not survive aggressive treatment. Type B and C hosts have a higher risk of infection recurrence, especially when combined with extensor mechanism problems such as patellar tendon rupture. Patients in whom a periprosthetic infection is unlikely to be cured include those with chronic malnutrition with decreased serum albumin and protein, multiple organism infections, chronic infections with persistent signs of inflammation, or life-threatening infections from methicillin-resistant *Staphylococcus aureus* or vancomycin-resistant *Enterococcus*. A recent study has shown chronic sepsis with resistant organisms is likely to recur in at least 50% of patients following two-stage debridement and reimplantation. Careful judgment is needed when treating each patient, and close consultation with an infectious disease specialist is required to balance the risk of long-term antibiotic treatment or suppressive antibiotic therapy against the surgical choices of fibrous resection arthroplasty, total knee reimplantation, arthrodesis, or, occasionally, amputation.

## Results

Several fixation techniques have been shown to result in a successful knee arthrodesis, including standard external fixation frames, Ilizarov technique with small-wire fixation, double-plate fixation, and intramedullary nailing. In severe cases, allografts or vascularized fibular grafts have been used to treat bone defects to promote fusion (Table 1).

### External Fixation

One report has shown 100% solid fusion using an anterior unilateral frame for arthrodesis. Another series demonstrated fusion in 20 of 21 knees when an Ilizarov-type fixation was used. This contrasts with the 40% to 80% success rate of earlier methods that used the Charnley compression technique. Inadequate stability probably explained these high failure rates.

Complications of arthrodesis reported in the literature include delayed union, recurrence of infection, wound healing problems, stress fracture, reflex sympathetic dystrophy, and partial peroneal nerve palsy. Complication rates have ranged from 38% to 50% in selected series. Peroneal nerve palsy has been noted by multiple authors, and no obvious explanation is offered other than that stretching of the peroneal nerve may result from positioning of the knee during the surgical procedure. Most of the reported peroneal nerve palsies resolved over time, and in no case was direct surgical trauma identified as the cause.

### Intramedullary Nail

The Wichita Fusion Nail (Stryker Orthopaedics, Rutherford, NJ) is a significant improvement over older methods. Compression at the fusion site is optimal with the turnbuckle bolt, and midterm experience has been excellent, with a 100% fusion rate in a recent series.

## Techniques

### Setup/Patient Positioning

For all methods of knee arthrodesis, the patient is positioned supine on the operating table or with a pelvic bumper if anterograde intramedullary nail insertion is planned. The entire lower extremity is prepared and draped in a standard fashion; if a proximal nail entry site is chosen, draping should include the hip joint. A sterile tourniquet is used during the exposure to minimize blood loss. The surgeon must plan in advance for the chosen fixation method, which may include an external fixation system, compression bone plates, or intramedullary nailing systems.

### Procedure

#### EXPOSURE

The standard exposure is an anterior midline incision or an incision that follows an older incision. Flaps are made that avoid undermining subcutaneous tissues. Typically, the extensor mechanism, including the patella and patellar tendon, is removed. During exposure, the surgeon must be wary of dissection that will damage neurovascular structures. As with total knee revision, a safe margin is the posterior cortex of the proximal tibia.

A sharp bone instrument such as a pointed Hohmann retractor is used to define this junction for posterior exposure (Figure 1). The posterior surface of the distal femoral condyles is relatively safe and may be stripped under direct visualization. The lateral fibula and lateral collateral ligament of the knee define the position of the peroneal nerve at the knee joint. Adequate soft-tissue mobilization allows the joint surfaces to be positioned for fixation.

### General Principles

To obtain successful fusion, standard concepts of primary bone healing apply. The ends of the distal femur and proximal tibia should be flat, with
### External Fixation

External fixation is a surgical technique used to stabilize and support injured bones during healing. It involves the use of external devices (fixtures) to apply a controlled amount of pressure to the bone, facilitating bone healing. This method is particularly useful when internal fixation (nailing or plating) is not feasible or when additional support is necessary to achieve proper bone alignment and healing.

#### Table 1: Results of Knee Arthrodesis

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<tr>
<th>Complications</th>
<th>Fusion Case (%)</th>
<th>Etiology</th>
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For most, some form of external fixation methods are preferred in primary TKAs.

#### Notes

- The surgical technique is designed to allow early weight-bearing to facilitate quicker rehabilitation.
- Proper planning is essential to avoid iatrogenic injuries and to ensure the bone heals correctly.
- The external fixator is removed once the bone has united, typically after 3-6 months.
cuts are made such that the normal femorotibial valgus of 7° is restored. One plate is placed anteromedially, and the other is placed anterolaterally. Careful contouring of the plates is usually needed. The patella may be osteotomized and applied to the anterior surface of the femur and tibia as a graft. In the presence of sepsis, a two-stage technique is required, with arthrodesis performed after 8 weeks of antibiotic treatment. Postoperative management includes a long-leg cast until the fusion is solid, which may take 5 to 6 months. Recently, authors have reported using this method with a locking compression plate in difficult cases.

**INTRAMEDULLARY NAIL FIXATION**

Several different rod configurations have been developed, with particular advantages noted for each. This technique is particularly valuable if a long interposing allograft is required, as rigid fixation of the graft is essential for union. The procedure is done using fluoroscopic guidance, and it is important to have the imaging machine placed such that the nail insertion can be visualized all the way down the leg, to be sure that the distal aspect of the rod remains within the bone. After exposure, the knee implant is removed or the previously débrided infected knee is assessed, and the fusion site is prepared. At this point, an incision is made over the greater trochanter and the gluteus medius muscle is split to expose the piriformis fossa. An entry site is created in the piriformis fossa, and a guidewire is passed into the proximal femur down to the knee joint. The bone surfaces may then be cut, using the axis of the guide pin to create maximally abutting surfaces. Anterograde reaming of the femur is done over the guidewire. Generally, this can be done to 12 or 13 mm, which is the nominal size of the tibial reaming and provides a suitable nail size for strength. The guide pin is passed down the tibia under fluoroscopic control to make certain that the center of the ankle joint is reached. Depending on the nail used, one may overream 0.5 mm on the tibial side and 1 mm on the femoral side. The dimensions of the nail are determined on the basis of the tibial size. The length of the nail is based on guidance measurement from the tip of the greater trochanter to a point 2 cm above the ankle joint. The bowed insertion nail is then carefully inserted over the guide pin down to the knee joint and passed across to the tibia while the assistant holds the bone ends in apposition. The anterior bow of the femoral shaft determines the position of the nail and tends to direct the nail out the most anterior cortex of the distal femur. Insertion into the tibia must be assessed carefully to prevent perforation and to ensure distal positioning about 2 cm above the ankle joint. The proximal end of the nail should be within 1 cm of the tip of the greater trochanter. At this point, adjustment may be considered. A 10-hole medullary AO neutralization plate, crossed cancellous screws, or proximal and distal locking screws in the nail may be considered. Additional bone graft or bone graft substitutes may be added to the fusion site. Postoperatively, non-weight-bearing for 6 to 10 weeks, depending on the progression of healing. The shortened immobilization could be an advantage over dynamic plating or external fixators.

**DVD**

**Video 52.1 Arthrodesis of the Knee Utilizing Intramedullary Nailing. Steven Inman, MD; Todd Havener, MD; and ...**

**AUTHOR'S PREFERRED TECHNIQUE: INTRAMEDULLARY NAIL (MCQUEEN TECHNIQUE)**

Although other devices may be used, my preference is to use the Wright Fusion Nail (Figure 2), a unique intramedullary nail that can be assembled and compressed in situ. This nail has relatively short femoral and tibial
Knee Arthrodesis

Figure 2: Photographs of the Wichita Fusion Nail. A. Engagement of the tibial and femoral components of the Wichita Fusion Nail require screws or each end. Reaming is done using fixed-dimension reamers matching female side in the femoral part of the fusion nail. A turnbuckle nut that secures and provides compression of the fusion site is seen.

Figure 3: Femoral preparation for knee arthrodesis using the Wichita Fusion Nail. A. An intramedullaryreamer is used. B. An autologous graft is used. C. A cortical rod is used for additional compression. D. A cortical rod is used for additional compression. The screws extend through the nail and engage both cortices of the bone.
sion site is possible and blood loss is minimal, which can be a problem if intramedullary reaming is needed. Another important advantage is that the Wichita Fusion Nail is relatively short compared with other intramedullary nails and therefore can be removed without taking down the fusion. McQueen and associates advise cutting the tibial component at the smaller dimension through a window for removal and state that the femoral component is short enough that removal can be done in a straightforward manner without disturbing the fusion site (Figure 5).

Wound Closure
Wound closure requires that soft tissues be reapproximated without excessive tension. This may be problematic, as typical leg shortening after failed TKA creates significant redundant tissue. Debulking of soft tissues and removal of the patella may be helpful. Wound healing problems are rare, however, because the wound is held rigidly in one position. Because wound debridement may lead to oozing from the soft tissues, a wound drain may be preferable for the first 24 hours after the procedure.

Postoperative Regimen
With any of the compression fusion techniques, the extremity must be kept strictly non-weight bearing for the initial 6 to 12 weeks, or longer if intercalated allografts. Most authors recommend casts or splints with plate fixation. With intramedullary fixation, no external immobilization or splint is needed. For most patients, only sedentary activities with transfer techniques are allowed. Partial weight

Figure 4 Tibial preparation for knee arthrodesis using the Wichita Fusion Nail. An outrigger applied to the tibial rod places the device at the appropriate position for interlocking. Note the beveled surface of the proximal bolt; this engages a female hole in the femoral nail.

Figure 5 Final placement of the intramedullary fusion nail. A, The turnbuckle nut is engaged through a small window that is created when the fusion site is prepared. Postoperative AP (B) and lateral (C) radiographs show excellent placement of the fusion nail and correct placement of screws in the interlocking holes.


**Video Reference**

Incavo SJ, Havener T: Video. *Arthrodesis of the Knee Utilizing Intramedullary Nailing*. Video clip from *Arthrodesis of the Knee Utilizing Intramedullary Nailing*. Houston, TX, 2003.

### Coding

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