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The Use of Fibular Allograft in Complex Periarticular Fractures Around the Knee

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Although the use of fibular strut allografts in proximal humerus fractures has gained popularity, their use in other types of fractures is less well described. Fibular allografts have recently been used in the repair of complex periarticular fractures of the proximal tibia and distal femur. Fibular allografts can be inserted in a variety of manners to achieve goals specific to each individual fracture pattern. In the proximal tibia, insertion through a fracture line or cortical window facilitates joint surface elevation, prevents subsidence and enhances overall construct stability. In distal femoral fractures, including complex periarticular fractures, insertion through the fracture or cortical window permits indirect reduction of the medial cortex and provides necessary medial column support. An additional option in distal femur fractures includes fibula insertion as an intramedullary nail, allowing enhanced fixation in short distal fracture segments. In all cases, the use of a fibular allograft augments poor bone stock and provides improved screw purchase and construct stability when combined with conventional plating methods. Here we present a series of cases at our institution illustrating an array of novel techniques utilizing endosteal fibular allografts in the fixation of complex periarticular fractures about the knee.

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Introduction

Structural nonvascularized frozen fibular allografts have resulted in substantial improvements in clinical and radiographic outcomes in periarticular fractures of the proximal humerus,⁽¹⁻⁸⁾ and new evidence documenting the success of fibular strut allografts in femoral neck and proximal tibia fractures is emerging.⁽⁹⁻¹³⁾ The biologic graft serves several purposes during surgical fixation of metaphyseal bone. During fracture reduction, the graft can be inserted as a reduction tool to facilitate indirect reduction of the far cortex or elevation of a joint surface. Once in situ, the fibula also acts as a bone substitute to fill osseous voids. The fibula also serves as structural support in the form of additional cortices

for screw fixation, a distinct advantage over alternative bone substitutes.

The use of fibular allografts in proximal tibia fractures with articular depression has been described previously by two groups.^(12,13) Advantages of this technique include the broad fibular surface that aids in elevation of articular depression, and improved structural support in metaphyseal voids to limit postoperative subsidence. The rate of subsidence after fixation augmented by the fibular strut allograft is substantially lower than rates seen with cancellous autograft or calcium phosphate cement.^(12,14) In proximal tibia fractures, the allograft can be inserted parallel to the joint surface to raft the articular surface (in purely depressed fractures), or inserted in retrograde fashion as an obliquely oriented kickstand through a pre-existing vertical fracture line or cortical window in order to support the subchondral bone of the tibial plateau. Using these techniques, articular subsidence rates have been reported to be less than 2 mm at minimum 1 year follow-up, with knee flexion of 118-130 degrees on average.^(12,13)

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Figure 1 (Proximal Tibia Technique 1). Preoperative imaging of a 57-year-old female with insulin-dependent diabetes. Anteroposterior (AP) (A) and lateral (B) knee X-rays demonstrate a complex fracture of the tibial metadiaphyseal junction with significant comminution, a separate tibial tubercle fragment, and concomitant fracture of the proximal fibula. Preoperative axial and coronal MRI images (C) reveal the intra-articular extension of the fracture into the tibial eminence, with minimal intra-articular fragment displacement. (Color version of figure is available online.)

The combined rate of infection following the use of endosteal fibular allograft in the two studies evaluating these fractures was low at 2.3%.^(12,13)

Distal femoral fractures often occur in elderly osteoporotic individuals with poor bone stock. The difficulties of fixation and achieving union in these patients has been reported by several investigators, with nonunion rates ranging from 10%-25% and implant failure rates ranging from 5%-16% in recent reports of locked lateral plating.⁽¹⁵⁻²¹⁾ When laterally-based plate fixation methods are used, endosteal allografts can aid in the reduction of the medial cortex, provide medial column support to enhance the biomechanical stability of the construct, and provide additional cortices for improved screw purchase. The allograft can be inserted through the fracture site or through the intercondylar notch using a standard entry point for a retrograde nail.

The use of dual surgical approaches has gained popularity in the treatment of complex periarticular fractures about the knee to allow for dual column fixation of the proximal tibia or distal femur. However, the biomechanical advantages afforded by combined medial and lateral plate fixation may, in some instances, be offset by the additional surgical insult to the surrounding soft tissues, periosteum, and vasculature in complex or high-energy fractures in which the soft tissues are already compromised. Furthermore, open wounds or fracture blisters may preclude a surgeon's ability to use a dual approach technique. In these cases, employing

alternative options to enhance the strength of the fixation construct without creating additional incisions can protect from further soft tissue damage and improve outcomes. The following cases from our institution illustrate multiple techniques utilizing endosteal augmentation as an alternative option to dual column plate fixation in the treatment of complex proximal tibia and distal femur fractures.

Proximal Tibia Operative Technique

Overview

The goals of osteosynthesis in intra-articular proximal tibia fractures include restoration of limb alignment, anatomic articular reduction, and prevention of postoperative subsidence or change in alignment. The use of an endosteal fibular allograft can both help with fracture reduction and increase construct stability, thereby enhancing the resistance of the construct to subsidence.

External Fixation

Injuries with significant soft tissue damage or the potential for significant swelling or blistering are initially temporized in a knee spanning external fixator on the day of or following

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