Percutaneous Fixation of the Medial Condyle in Bicondylar Tibial Plateau Fractures: Novel Use of the 3.5-mm Medial Distal Tibia Plate

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Abstract

Internal fixation for fractures involving the medial tibial plateau is a controversial topic. Surgical options include buttress plating with antiglide plate, T-shaped proximal tibia plates, external fixation, and isolated screw fixation. Operative management is often complicated by soft-tissue concerns. In this article, we describe a percutaneous surgical technique in which a 3.5-mm medial distal tibia plate, originally designed for distal tibial shaft or pilon fractures, is used in osteosynthesis of the medial tibial plateau. Use of this implant reduces soft-tissue dissection and thereby decreases risk for soft-tissue infection or slough while preventing medial column collapse and varus deformity of the knee. Orthopedic surgeons should consider this novel hardware application as an option for osteosynthesis in certain bicondylar tibial plateau fractures.

Although fractures of the tibial plateau have been reviewed extensively, there is no consensus on optimal treatment.[1-17] Schatzker and colleagues[4] described a classification system (based on extent of involvement of the tibial condyles) and made treatment recommendations. For fractures involving both tibial condyles (Schatzker types V and VI; Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association type C), internal fixation on the medial and lateral cortices of the tibia is usually recommended.[4,5,18] However, disruption of the proximal tibial blood supply by the extensive exposure required for bicondylar fixation can result in osteonecrosis and a "dead bone sandwich" between the 2 plates.[1,19,20] Furthermore, with the 2-incision technique, soft-tissue compromise can cause problems. Development of LISS (Less Invasive Stabilization System; Synthes, Paoli, PA) technology has led to smaller incisions and less bone stripping with use of a single lateral plate.[6,7,21,22] However, fixation of the medial condyle is still a challenge.

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We have used a 3.5-mm medial distal tibial plate (Synthes) for fixation of the medial tibial condyle in fractures involving both tibial condyles. When this plate is inverted from its usual orientation in the distal tibia, its contour matches that of the medial proximal tibial condyle and makes it ideal for buttressing the medial tibial plateau in nondisplaced or minimally displaced medial condyle fractures (Figure 1). Also, the low-profile design of the plate allows percutaneous insertion through a small incision with minimal soft-tissue disruption.

Materials and Methods

Before internal fixation of the medial plateau, the lateral tibial plateau fracture should be reduced and fixed with conventional methods based on surgeon preference and experience. Anatomical reduction and fixation of the lateral plateau aid in alignment of the medial column. Furthermore, care must be taken to

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Figure 1. Profiles of a 3.5-mm medial distal tibia 6-hole plate, inverted for use on the medial proximal tibia.

ensure that the medial plateau is not fixed in varus during placement of the screws from lateral to medial while securing the lateral plate.

After fixation of the lateral fragment, the joint line of the knee and the posterior border of the tibia should be identified by palpation before making an incision for placement of the 3.5-mm medial distal tibia plate. Fluoroscopic localization can also be used to allow for accurate placement of these minimal incisions. For most fractures, the 3.5-mm medial distal tibia plate should be placed posteromedially; placement can be confirmed with preoperative computed tomography of the fracture geometry. A 2-cm incision is made on the medial aspect of the tibia extending distally from the joint line to allow for insertion of the medial plate. In the rare event that more exposure is needed for additional reduction maneuvers, the incision may be extended. Blunt dissection is performed until the periosteum of the medial cortex is identified, protecting the saphenous neurovascular bundle. The periosteum is sharply incised to gain access to the medial cortex of the proximal tibia, and a periosteal elevator or a Cobb elevator is used to elevate the periosteum over the metaphysis toward the shaft of the tibia. If exposure of the medial condyle is adequate, the periosteum may be left intact, and the plate may be placed directly on the bone, on top of the periosteum, and the periosteum need not be incised. Next, another 2-cm incision is made over the metaphyseal–diaphyseal junction of the tibia, allowing for cephalad elevation as well. Usually it is necessary to elevate a portion of the pes anserinus to place the plate beneath the muscle. If the pes anserinus is elevated, it must be later repaired.

Once this limited soft-tissue dissection is complete, a 3.5-mm medial distal tibia plate is inverted and inserted through the proximal incision and advanced (Figures 2A, 2B). An appropriate-length plate is selected, and fluoroscopy is used to verify that its position is optimal. Screws are placed percutaneously. Our experience is that 1 screw placed at the apex of

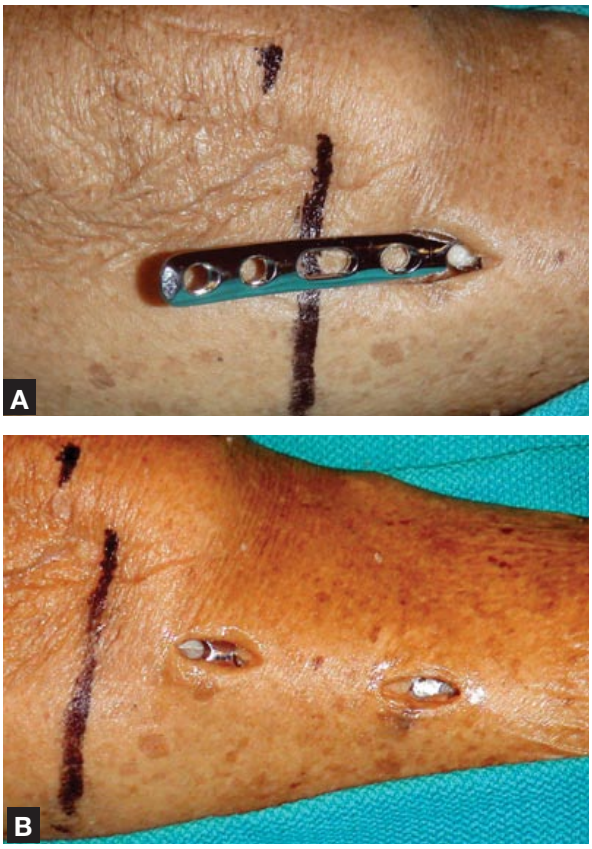

Figure 2. **(A)** Insertion site and plate placement onto proximal tibia. **(B)** Two small incisions with underlying implant in medial leg.

the fracture in the distal tibial fragment and additional screws placed distally in the plate allow for appropriate buttressing of the medial tibial plateau in bicondylar fracture models. Additional screws, placed proximally, may be required for the few cases in which the plate does not abut the medial cortex. The wounds are then copiously irrigated and primarily closed. Postoperative x-rays are used to verify reduction, implant placement, and deformity correction (Figures 3A, 3B).

Discussion

Various fixation techniques have been described for complex tibial plateau fractures.[1-17] Dual buttress plating has been used for bicondylar fractures, but infections and soft-tissue complications occur often with this technique because of extensive dissection through injured soft tissues.[20,23] Deep infection has been reported to occur in 8% to 87% of patients treated with dual plating.[6,11,15,20] Malalignment, most often varus, also is a problem after dual plating, occurring in 14% to 33% of high-energy tibial plateau fractures.[6] In addition, use of large-fragment medial and lateral buttress plates can result in a "dead bone sandwich" because of extensive periosteal damage and devitalization of bone fragments.[1,19,20]

Because of the frequent complications associated with traditional dual plating with 4.5-mm plates, alternative methods were developed, including a

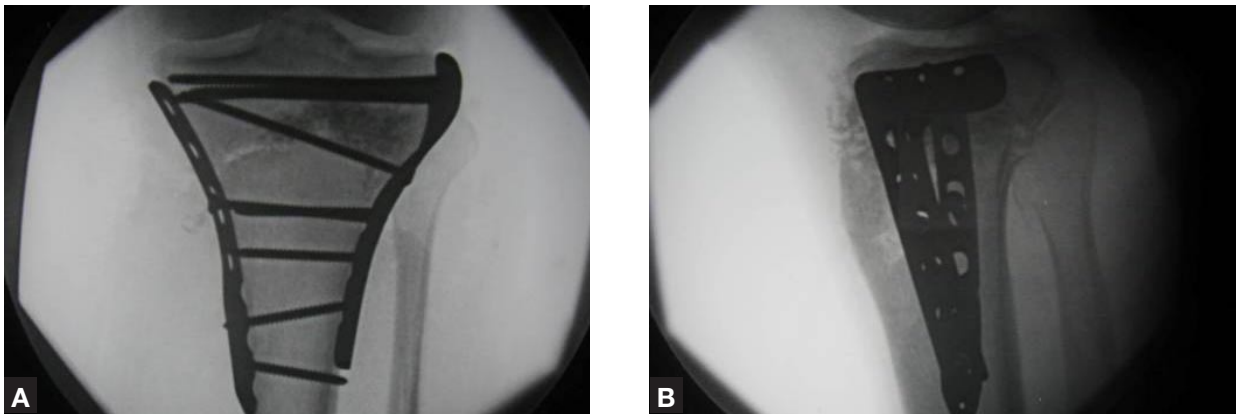

Figure 3. Postoperative anteroposterior (A) and lateral (B) x-rays verify acceptable reduction and implant placement.

2-incision approach for application of an antiglide or buttress plate medially in addition to the lateral plate.[24] Horwitz and colleagues[23] described using a 3.5-mm antiglide plate anteromedially instead of a conventional 4.5-mm medial buttress plate. Their biomechanical study was the first to demonstrate that single lateral buttress plating had a significantly larger loss of reduction of the medial plateau with axial loading compared with double plating, confirming the need for a medial buttress in repair of bicondylar tibial plateau fractures. Furthermore, their study demonstrated that use of a 3.5-mm anteromedial antiglide plate construct was as stable as the traditional dual buttress plating with 4.5-mm plates and provided an alternative to traditional dual plating.[23] Other studies have confirmed that smaller plates, which can be applied with less soft-tissue trauma, can provide adequate fixation of the medial component of bicondylar fractures.[19,23]

Whether medial buttress plating is needed in bicondylar fractures fixed with a lateral LISS plate remains controversial. Cole and colleagues[21] recommended medial buttress plating when comminution along the medial column extends very proximally. Gosling and colleagues[11] reported loss of reduction in 9 (14%) of 63 tibial plateau fractures fixed with LISS plates; 4 of the 9 had varus malalignment secondary to subsidence of the medial fragment. However, Stannard and colleagues[6] reported no varus or valgus malalignment in 24 Shatzker types V and VI tibial fractures treated with lateral LISS plating alone. Egol and colleagues[25] demonstrated that, at 500 N, the LISS plate construct had almost twice the displacement of the medial fragment compared with the dual plate construct; however, they concluded that the LISS plate alone provided sufficient stability for fixation of bicondylar tibial plateau fractures.

"...when used in carefully selected patients, [a medial distal tibial plate] can prevent varus collapse without the complications associated with an extensive approach."

Spanning external fixation and hybrid external fixation have been described for fixation of tibial plateau fractures.[8,9] Although these techniques avoid large incisions and soft-tissue stripping, they are associated with complications, such as pin-tract infection, tethering of musculotendinous structures, hardware failure, and persistent joint stiffness.[6,8]

LISS plates allow fixation of bicondylar fractures of the tibial plateau with a single lateral plate, which has the biomechanical advantages of fixed-angle stability and locked screws, both of which may prevent varus collapse of the medial condyle.[11,21] Biomechanical studies have demonstrated that the overall construct stiffness of a lateral fixed-angle plate is similar to that obtained with dual plating.[11,19]

We believe that the addition of a medial buttress plate, using an inverted medial distal tibial plate, adds little surgical time, minor additional expense (retail price for the distal tibial plate is $347), and minimal additional morbidity but ensures that subsidence of the medial fragment does not occur, avoiding the risk for varus malalignment. Although this technique may not be appropriate for grossly displaced or severely comminuted fractures of the medial condyle in bicondylar tibial plateau fractures, when used in carefully selected patients, it can prevent varus collapse without the complications associated with an extensive approach.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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