Tibial Plafond Fractures: Changing Principles of Treatment

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Abstract

Tibial plafond fractures from axial loading are high-energy injuries with significant associated soft-tissue damage. New classification methods include detailed anatomic subgroupings and highlight the soft-tissue injury. The traditional treatment of this intra-articular fracture with open reduction and internal fixation resulted in high rates of wound breakdown and infection. Treatment of these complications is lengthy and costly and not infrequently results in a poor outcome. Newer techniques using external fixation minimize disturbance of the soft-tissue envelope and have decreased these complications. Because the long-term outcome with all techniques is variable and often depends on factors beyond the surgeon's control, it is particularly important to avoid complications of initial treatment. Longer follow-up will determine whether patients treated with these techniques have a different rate of arthrosis.

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Intra-articular fractures of the distal tibia secondary to axial loading present a great challenge to the orthopaedic surgeon. These high-energy injuries often result in significant soft-tissue damage, bone comminution, and articular surface disruption. Until recently, treatment has followed the AO principles of open reduction and internal fixation (ORIF) with plates and screws to permit early motion.[1] Recent publications, however, have called attention to the high rates of complications following such treatment.[2,3] For many of these fractures, the risk of complications from ORIF outweighs the potential benefit. For these reasons, the principles of tibial plafond fracture treatment are rapidly changing. Techniques utilizing external fixation are associated with satisfactory results and appear to significantly decrease the incidence of soft-tissue complications.

Terminology

The terms *pilon fracture, pylon fracture,* and *plafond fracture* have all been used to describe high-energy fractures of the articular surface of the distal tibia. Destot used the term *pilon* in 1911,[4] while likening the distal tibia to a pestle. However, the word *pilon* does not appear in either *Webster's Ninth New Collegiate Dictionary*[5] or *Dorland's Illustrated Medical Dictionary*.[6] *Pylon*, according to *Webster's*, comes from the Greek word *pylē*, meaning "gate," and is currently used to describe a massive gateway, a towerlike structure, a conical road marker, or a rigid structure on the outside of an aircraft for supporting something. *Dorland's Illustrated Medical Dictionary* defines *pylon* as a temporary artificial leg. These definitions of *pilon* and *pylon* do not relate generally to the distal tibia or specifically to fractures in this area.

According to *Webster's*,[5] *plafond* is a French word originating in Middle French from *plat* meaning "flat" and *fond* meaning "bottom." In English, *plafond* refers to an elaborate ceiling. Since the articular surface of the bottom of the tibia does indeed form a ceiling over the ankle joint, the term *plafond* bears some relationship to the local anatomy of this region (DeCoster TA, oral and written communications, September 1994). Therefore, fracture of the tibial plafond is our preferred terminology.

Classification, Mechanism, and Incidence

The prevalence of fractures of the tibial plafond has been reported variously as between 1% and 10% of

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lower-extremity fractures. This tenfold variation probably is a reflection of the confusion in determining exactly which fractures should be classified as tibial plafond fractures. Rotational fractures of the ankle joint have been classified into five types based on the injury mechanism.[7] These rotational injuries may be associated with fractures of the articular surface of the distal tibia and classified as tibial plafond fractures. For instance, the type V pronation dorsiflexion fracture invariably involves the tibial plafond.

Giachino and Hammond[8] described the combination of an oblique fracture of the medial malleolus with an anterolateral tibial plafond fracture and noted that the mechanism was external rotation, dorsiflexion, and abduction. These rotational injuries involve relatively low energy, cause minimal injury to the soft tissues, and usually have an excellent prognosis.

At the other end of the spectrum is the high-energy fracture of the distal tibia secondary to axial compressive forces caused by a fall from a height, a motor-vehicle accident, or any other vertical-loading injury. These high-energy axial compressive forces shatter all or part of the articular surface depending on the direction of impact of the talus against the tibial plafond. They also produce significant injury of the soft tissues (Fig. 1). These axial compressive injuries have typically been called pilon fractures in the English-language literature.

A wide range exists between the two extremes of the low-energy rotational injury and the high-energy axial compressive injury. The eventual outcome depends on where a fracture falls on this spectrum. Unfortunately, most classifications do not adequately substratify fractures, which has led to errors in treatment, uncertainty about prognosis, and difficulty in evaluating the literature.

Fig. 1 High-energy fractures are prone to severe soft-tissue injury, swelling, and fracture blisters, particularly along the anteromedial tibial surface.

The most commonly used classification is that of Rüedi and Allgöwer,[1] in which plafond injuries are divided into types I, II, and III on the basis of the size and displacement of articular fragments. Type I fractures are cleavage fractures of the joint surface without displacement. Type II fractures have significant displacement of the articular surface without comminution. Type III fractures are associated with metaphyseal and epiphyseal comminution. This classification is widely used in the literature, but unfortunately lacks enough detail to be used to accurately predict outcomes. A wide range of fractures with different prognoses fit between the definitions of types II and III.

The AO classification currently provides the most detail to define subtypes of tibial plafond fractures (Fig. 2).[9] The anatomic classification includes the full spectrum, from simple rotational fractures with a plafond component (type B1) to high-energy axial compressive fractures (types B3, C2, and C3). When the soft-tissue injury is well described, this classification contains sufficient detail to assist in determining treatment and prognosis.

The degree of soft-tissue injury must be considered in the classification, as well as in planning treatment and determining outcome. Open fractures are appropriately classified by the method of Gustilo and Anderson.[10] In our experience, the prevalence of associated open wounds has been approximately 20%. However, associated soft-tissue injuries are significantly underestimated if only the size of open wounds is considered. Patients with closed tibial plafond fractures often have severe soft-tissue injuries. Tscherne and Gotzen[11] have provided a useful classification of soft-tissue injuries associated with closed fractures (Table 1).

In tibial plafond fractures, most soft-tissue injuries are caused by the fracture itself. The energy stored in the distal tibia during an axial compressive injury dissipates into the soft tissues as the force exceeds the yield point and the distal tibia shatters. This release of energy in an area without covering muscles injures the skin and subcutaneous tissues. The fracture pattern (amount of comminution and displacement) is therefore important in appreciating the degree of associated soft-tissue injury.

Other soft-tissue factors the surgeon should consider in planning treatment include the presence or absence of fracture blisters or tense swelling around the ankle or in areas of planned incisions. The patient's local circulatory status and associated medical problems, such as diabetes, also can affect wound healing and are, therefore, relevant in planning appropriate treatment.

Treatment

The treatment options for fractures of the tibial plafond include nonsurgical care, internal fixation, external fixation with or without limited internal fixation, and primary arthrodesis. In

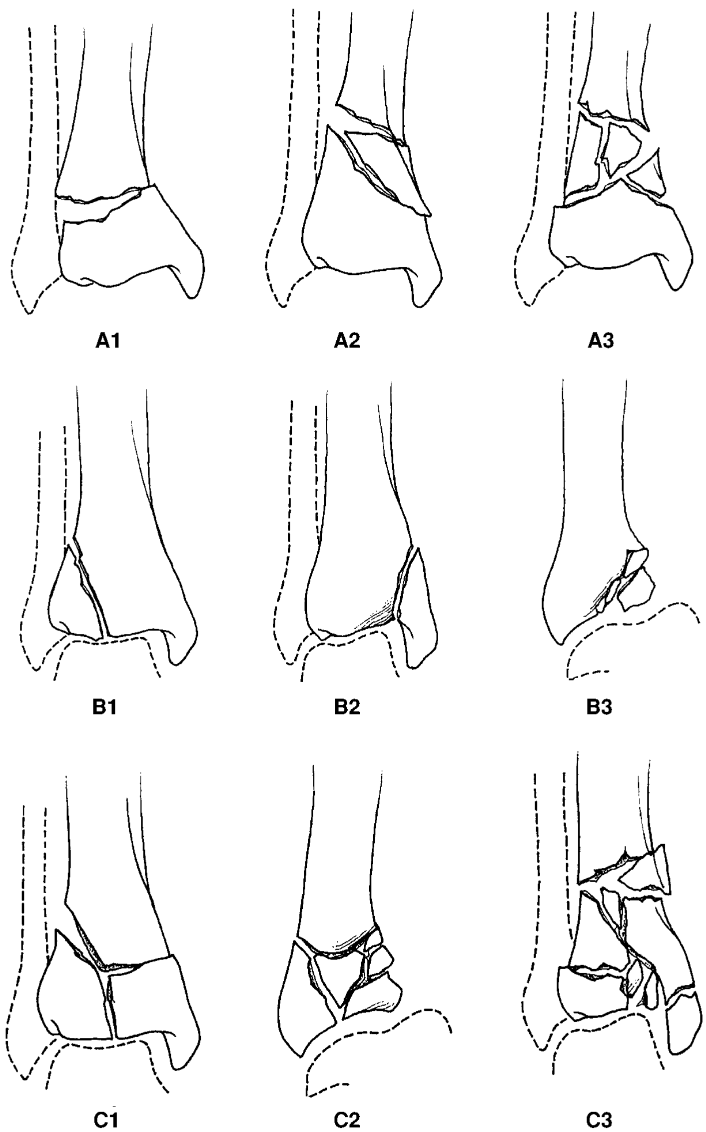

Fig. 2 The AO-Müller classification of long-bone fractures applied to the distal tibia[9]: type A, extra-articular distal tibial fractures (A1, simple nonarticular fracture line; A2, comminuted wedge fracture; A3, complex comminuted metaphyseal fracture); type B, partial articular fractures with a portion of the joint surface intact with the metaphysis and shaft (B1, simple articular fracture line; B2, marginal impaction; B3, comminuted partial articular fracture); type C, complete metaphyseal fractures with articular involvement (C1, noncomminuted; C2, comminuted in the metaphysis with a simple articular fracture; C3, metaphyseal and articular comminution).

discussing these alternatives, we will present general guidelines for which fracture types are most appropriately treated by each method. However, the literature does not contain enough data to determine exactly which treatment option has the best chance for an optimal result for each fracture subtype. Other factors must also be considered, such as the surgeon's preference and experience, patient characteristics, and, most important, the amount of soft-tissue injury present.

Nonsurgical Care

Reports of complications secondary to aggressive internal fixation have caused more conservative forms of treatment to be reconsidered. Casting is commonly used to treat stable ankle fractures but is reserved for plafond fractures where there is minimal articular displacement and where limb alignment can be controlled with a cast. This is most appropriate for AO type A1, B1, and C1 fractures with less than 2 mm of articular displacement. When in doubt, computed tomography (CT) or plain tomography can aid in determining articular congruity. Weight-bearing should be restricted for 4 to 6 weeks. The prognosis is usually good.

Traction is rarely used as definitive treatment because of the need for prolonged recumbency. Instead, traction is used as a temporary measure to keep the ankle joint reduced while soft-tissue swelling decreases. This is commonly necessary in AO type B3, C2, and C3 fractures when a splint will not hold the talus centered under the tibia. A calcaneal pin is placed, and the limb is elevated on a Böhler frame for 7 to 14 days before definitive treatment.

Limited pin or screw fixation to improve articular congruity has been reported in conjunction with combinations of casting or traction. These methods may have fewer complications than have been reported for internal fixation and may be applied in unusual circumstances; however, they are usually best combined with use of an external skeletal fixator, rather than with use of a cast or traction.

Internal Fixation

Until recently the standard care for tibial plafond fractures has been ORIF following AO principles, as described by Rüedi and Allgöwer.[1] The operative steps are as follows: (1) Internal fixation of the fibula

Table 1
Classification of Soft-Tissue Injuries Associated With Closed Fractures, According to Tscherne and Gotzen[11]

	Soft-Tissue Injury	Fracture Pattern	Associations
Grade 0	Negligible	Simple (torsion)	. . .
Grade I	Superficial abrasion or contusion	Mild to moderate (ankle fracture dislocation)	. . .
Grade II	Deep abrasion with localized skin and muscle contusion	Severe (segmental tibia)	Impending compartment syndrome
Grade III	Extensive contusion or crush with severe muscle damage	Severely comminuted	Compartment syndrome, rupture of a major blood vessel

restores length and overall alignment and reduces the anterolateral corner of the tibial plafond. (2) The articular surface of the distal tibia is reduced and provisionally fixed through a wide operative approach. (3) The metaphyseal defect is rigidly fixed with an anterior or medial buttress plate, and a bone graft is placed. (4) Early range-of-motion exercises are instituted with prolonged non-weight-bearing.

In addition to these original principles, several techniques have been noted to improve results and minimize complications.[11,12] Soft-tissue swelling should be allowed to subside before operative intervention, which may take 10 to 14 days. Direct approaches should be utilized, as they minimize the need for soft-tissue stripping and the development of extensive flaps. This requires careful preoperative planning to locate incisions over major fracture lines. Fluoroscopic visualization and the use of reduction forceps are important aids to moving bone fragments with less dissection. Incisions should be planned so that hardware will be covered by soft tissues and will not be directly under an incision. Indirect reduction utilizing intraoperative distraction with a femoral distractor or external fixator system decreases dissection and stripping of fracture fragments and permits reduction through less extensive approaches. Smaller implants are preferred, such as 3.5- and 4.0-mm screws and, if necessary, small, low-profile plates. Fractures without significant metaphyseal comminution can be fixed successfully with multiple screws alone (without plates), followed by external plaster immobilization (Fig. 3).

Internal fixation is appropriate for AO type B1 fractures, which are low-energy rotational injuries often seen with an associated fibular fracture. The plafond component is usually small and can be fixed with one or two 3.5- or 4.0-mm screws after fibular plating. Type B2 and C1 fractures are also often amenable to ORIF.

Type B3, C2, and C3 fractures without excessive soft-tissue injury may be successfully treated with internal fixation, but it is these fractures for which the complication rates are excessively high. In the hands of most surgeons, even a moderate degree of soft-tissue injury increases the risk prohibitively. Therefore, internal fixation should be considered very judiciously for B3, C2, and C3 fractures, and then only when the soft-tissue injury is controlled and an accurate reduction can be predicted without excessive soft-tissue stripping. In most instances, safer methods should be considered because of the potential for disastrous complications.

External Fixation With or Without Limited Internal Fixation

External fixation is becoming increasingly popular for the treatment of severe tibial plafond fractures.[13-17] The advantage of external fixation is that the metaphyseal portion of the fracture can be stabilized without a subcutaneous implant. Clinical reports on the use of a variety of external fixators show a substantial decrease in complications, particularly wound breakdown and infection. External fixation screws and wires are well tolerated around the hindfoot and ankle. The results and techniques of three methods have been published. These methods are (1) use of a hybrid frame and tensioned wires on the tibial side of the joint; (2) use of a nonmobile external fixator to cross the ankle joint; and (3) use of an articulated external fixator to span the ankle joint.

Further experience is required to determine the advantages and disadvantages and the long-term outcome for each technique. However, there is enough data to convincingly demonstrate that the complications of treatment of high-energy plafond fractures can be decreased by using one of these methods or something similar.

Use of a Hybrid Frame and Tensioned Wires

The application of a hybrid frame is accomplished by applying tensioned wires and a ring to the bottom of the tibia. The ring is connected by rods to half-pins proximally. This has the advantage of not spanning the ankle joint and, therefore, permitting ankle motion and avoiding

A B

Fig. 3 **A,** Anteroposterior (AP) radiograph of an AO type C1 fracture without significant metaphyseal comminution. The soft-tissue injury was not severe. **B,** Mortise-view radiograph obtained at 1-year follow-up after fixation with multiple screws.

screw or pin insertion into the hindfoot.[15]

The first step is reduction of the articular surface through an open approach aided by a femoral distractor. The articular section of the fracture is fixed with small screws. The transfixing wires are then introduced distally around the screws and tensioned onto a ring. The ring is then fixed proximally to a hybrid half-pin frame in the proximal tibia.

This technique may be applied to AO type A fractures (nonarticular distal tibial fractures) and C1 or C2 fractures, in which the distal articular section is most easily reconstructed. Since an open reduction is required to build back the distal articular block before wire and ring fixation, treating highly comminuted articular fractures by this method is more difficult. It is not applicable to type B (partial articular) fractures with talar displacement since the position of the talus is not controlled. The technique is technically demanding, and familiarity with tensioned-wire methods is required.

Cross-Ankle External Fixation

A second external fixation strategy is to cross the joint with a fixator as the first step in the procedure.[13,17] Intraoperative distraction with the fixator provides provisional reduction of articular fragments. If necessary, further joint realignment and/or bone grafting can then be accomplished with the use of fluoroscopically guided minimally invasive or percutaneous techniques utilizing reduction forceps and cannulated screws.

The advantages of this strategy are its ease of application and its use of less invasive approaches to the distal tibia. The disadvantages include the need to use fixator screws in the hindfoot and ankle-joint immobility. Bone et al[13] have reported that, in conjunction with spanning external fixation, open reduction and plate fixation can be used safely in some cases.

Use of an Articulated External Fixator

The third approach, which we prefer, utilizes an articulated external fixator.[14,16] This device offers the simplicity of cross-ankle monolateral fixation combined with the possibility of early joint movements through an articulated hinge. It is particularly suitable for the most severely comminuted fractures (AO types B3 and C3), which have the highest risk of complications when treated with plating techniques. However, we have utilized it for all types of axially compressive tibial plafond fractures.

A potential disadvantage of the application technique is that the hinge axis is not consistently located in line with the axis of the ankle. However, both intraoperatively and in cadaveric specimens, there is little fracture site movement with ankle movements and a moderate range of ankle motion is possible with the articulated hinge in place. Our clinical experience indicates that articulated motion of the ankle does not prevent fracture healing.[14]

The fixator application technique is the same for all fracture patterns. The distal screws are placed first, under fluoroscopic guidance; one is placed in the talus, and one is placed in the calcaneus, straddling the medial neurovascular bundle and lying parallel to the dome of the talus, as seen radiographically in the coronal plane. Two screws are then placed proximally in the tibia, and the fixator is applied with the hinge approximated over the ankle joint. Distraction is applied to reduce the fracture through ligamentotaxis. The reduction is then checked fluoroscopically. Sometimes no further intervention is necessary, and the external fixator alone is accepted as definitive treatment. This typically occurs in type A2, A3, and C1 fractures and occasionally in type C2 fractures (Fig. 4).

In type B2, B3, and C3 fractures, further reduction of the articular surface is often needed. The extent of this reduction is determined on the basis of the preoperative planning, often done with the assistance of an axial CT scan, and the intraoperative appearance after distraction. Our overriding concern in the most severe fractures is the avoidance of wound complications, which occur more commonly after aggressive surgical approaches. The reduction obtained with traction often can be improved with percutaneous reduction by means of forceps manipulation, followed by placement of cannulated screws. If a more formal open reduction is required, limited incisions should be centered over major fracture lines, allowing visualization of the articular surface through a "fracture window." Fixation of reduced fragments is obtained with 3.5- or 4.0-mm cannulated screws. At the completion of the procedure, the distraction is decreased until the mortise takes on a normal symmetrical appearance on fluoroscopic views.

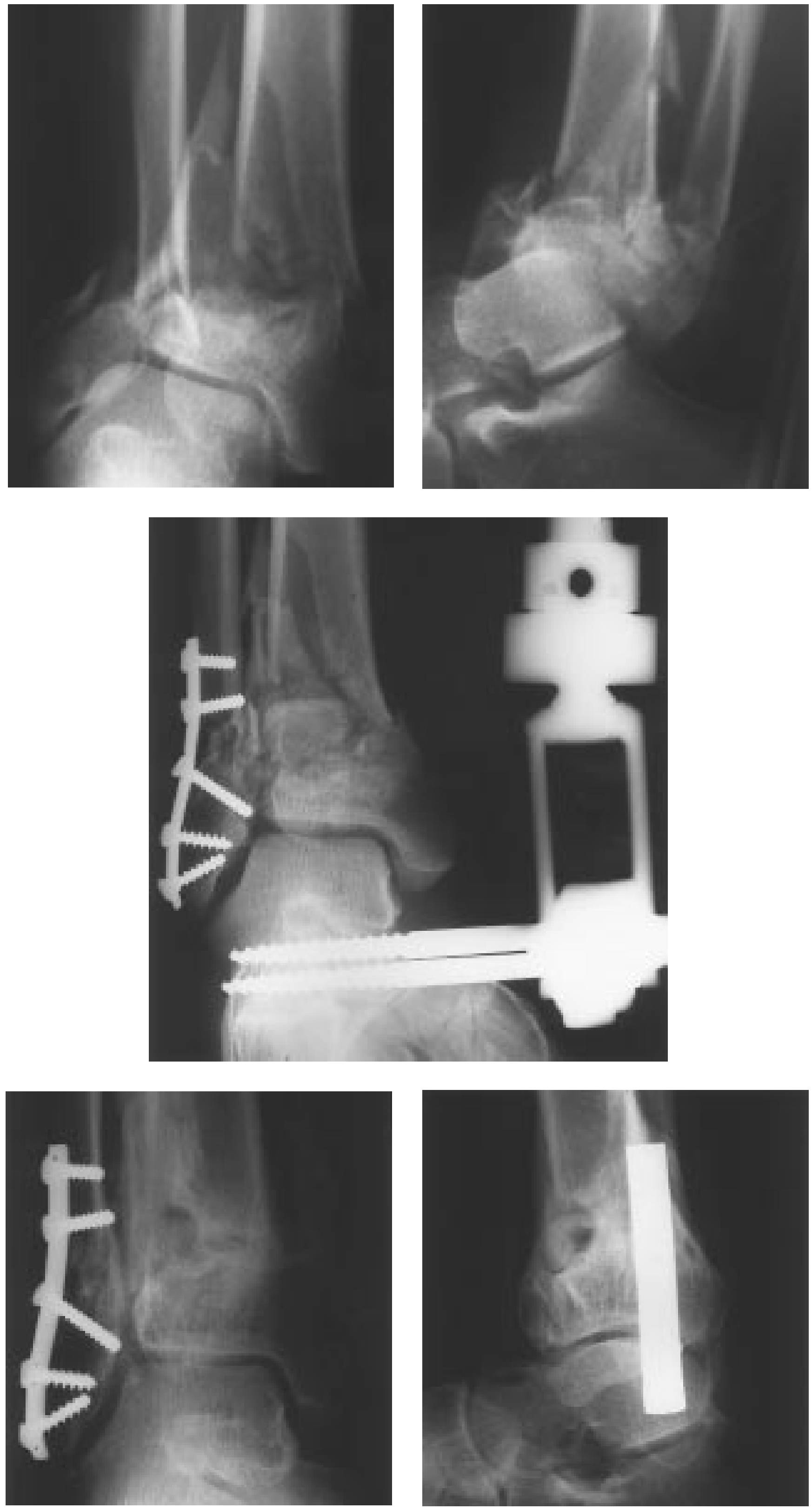

Fig. 4 **Top,** AP **(left)** and lateral **(right)** radiographs of the ankle of a 27-year-old man who sustained a closed AO type C2 tibial plafond fracture in a motor-vehicle accident. There is significant metaphyseal comminution. **Center,** AP radiograph obtained after application of the articulated external fixator and fibular plating. The joint reduction was satisfactory without further internal fixation. The fibula was plated because it remained posteriorly displaced after fixator application. **Bottom,** AP **(left)** and lateral **(right)** radiographs obtained 12 months after treatment show a healed fracture with preservation of the joint space.

The fixator hinge is locked in the neutral position.

Bone grafting usually is necessary when there is a large metaphyseal defect. This is done through a small incision, and soft-tissue stripping is kept to a minimum. We have considered bone grafting to be necessary in fewer than 25% of our cases. The need for bone grafting is less with this technique because soft tissues are left intact on metaphyseal fragments, and large cavities are created less frequently than they are with larger open surgical approaches.

An associated fibular fracture may not require fixation, since the fixator maintains the overall length and alignment. Sometimes, however, exact restoration of the fibula may assist in reduction of an anterolateral fragment of the tibial plafond, or the distal fibula may become trapped posteriorly, necessitating open reduction to restore its position. In these cases, a lateral approach is made to the fibula, and it is plated with a 1/3 tubular plate.

Usually, the fixator hinge is unlocked and the patient is allowed to do range-of-motion exercises 2 to 5 days after surgery, depending on the status of the soft tissues. A splint keeps the foot in the neutral position when the patient is not doing exercises. If a patient has a strong tendency to position the ankle in equinus with the hinge unlocked, we prefer to relock the hinge in the neutral position until weight-bearing is begun.

Patients are kept non-weight-bearing for 4 to 6 weeks or longer if there is a large metaphyseal defect. When weight-bearing is begun, the axial slider mechanism of the fixator body should be released. The fixator is removed when there is radiographic and clinical evidence that the fracture has healed, which has taken an average of 13 weeks in our cases.

Primary Arthrodesis

Primary arthrodesis is a consideration for only the most comminuted fractures (AO type B3 or C3) and only when articular repositioning is impossible. Even in these fractures we recommend that the surgeon avoid routine primary arthrodesis in favor of delayed arthrodesis. Several investigators have noted that the final subjective results do not correlate with the severity of the initial fracture or even with the quality of the reduction. The percentage of patients who actually require delayed arthrodesis is low. Delaying arthrodesis ensures that it will be performed only in the patients whose symptoms warrant the procedure. The procedure is also easier at the later date because the bone stock is better and the acute soft-tissue injury has resolved.

There are unusual circumstances in which primary arthrodesis should be considered. The most common situation is a severe open fracture with gross contamination and loss of cartilage from the distal tibia or talus. This usually occurs when penetrating trauma destroys one of the articular surfaces. Bone loss at the distal end of the tibia may accompany this type of injury and make arthrodesis more difficult.

To perform an acute arthrodesis, the cartilage should be removed from the articular surfaces of the tibia and talus. External fixation is most frequently used for stabilization with fixation into the tibia above the injured area and into the talus. Bone grafting is necessary, and soft-tissue defects require free-tissue transfer for coverage.

Sanders et al[18] have described a technique of anterior plating that was successful in obtaining arthrodesis and fracture union in contaminated severe open plafond fractures. Despite their success, they recommended caution because of the high cost of treatment and the residual functional and psychosocial disabilities they observed in their patients. Their experience should remind the surgeon that when a plafond fracture is severe enough that primary arthrodesis is being considered, amputation is also a treatment alternative.

Complications

Wound Complications and Infection

Major wound complications have been reported in an alarming number of closed fractures treated by ORIF (Fig. 5).[2,3] Teeny and Wiss[2] reported poor results in 50% of their patients, a 37% infection rate, and a 26% fusion rate for Rüedi and Allgöwer type 3 fractures treated with ORIF. One would expect that the more severely comminuted vertical-compression injuries would be at greatest risk. It is of concern that 50% of the major complications in a series reported by McFerran et al[3] occurred in the less severe Rüedi and Allgöwer type I and II fractures. This indicates that the soft-tissue injury can be more severe than the fracture classification implies, which may lead to an underestimation of the risk of wound complications. These complications can be devas-

Fig. 5 Wound complications can be devastating, as in this case in which the tibial buttress plate was exposed after ORIF of a tibial plafond fracture.

tating, occasionally resulting in amputation after lengthy and costly treatments. In the series of McFerran et al,[3] 21 patients in whom complications developed required 77 additional surgical procedures.

The best treatment for potential wound complications is prevention. Wound complications can be minimized by avoiding large incisions, extensive stripping of soft tissues, and large plates. Skin incisions should be more than 7 cm apart. Surgery should be avoided during the period when there is severe soft-tissue swelling, which often necessitates an extended waiting period. Surgical incisions through or near fracture blisters should be avoided by choosing alternative treatment plans or by delaying surgical incisions in the blister area for more than 2 weeks to allow complete reepithelialization.[19]

After surgical intervention, it is important to recognize a wound at risk and to take an early aggressive approach to wound dehiscence. Significant areas of wound compromise with impending skin sloughing require debridement and soft-tissue transfers. Stable internal fixation devices may be left in place. Local rotational flaps are not suitable in the distal tibia; instead, free-tissue transfer is required. The possibilities include gracilis, latissimus, lateral thigh, and radial forearm flaps.

Management is different once deep infection has been established. An extensive debridement must be done, and any involved hardware must be removed. The reduction is usually maintained with an external fixator, and intravenous antibiotic therapy is begun. If there is a defect, antibiotic beads can be used to fill dead space and deliver high local concentrations of antibiotics. Once the surgical bed is clean, soft-tissue coverage is obtained by free-tissue transfer. Bone grafting is done 4 to 6 weeks after soft-tissue coverage.

Successful ankle arthrodesis in the presence of ongoing infection has been reported in two series, with a high cost in terms of time, money, and emotional toll on the patients. Most patients changed or lost their jobs and had significant stress on their personal relationships. The authors concluded that amputation should be considered as a treatment option in cases of severe and resistant infection.[20,21]

Nonunion and Delayed Union

The incidences of nonunion and delayed union have been variously reported in the literature as ranging from 5% to 8%. Although the fracture is through cancellous bone, poor soft-tissue coverage and stripping by wide operative approaches contribute to delayed healing. Most advocates of internal fixation recommend routine bone grafting to support fixation and to encourage healing and prevent nonunion.

Treating a supramalleolar nonunion due to an old plafond fracture is challenging and depends on the condition of the soft tissues and the presence of infection and ankle arthrosis. If the nonunion is well aligned, an onlay bone graft will stimulate union. A posterolateral approach avoids the anteromedial soft tissues, which are often scarred from the previous injury and surgery. Most commonly, supplemental stabilization will be chosen for this type of periarticular nonunion. Internal fixation with plates and screws is much safer in noninfected nonunions than in acute plafond fractures. Hypertrophic nonunions will often heal with plate stabilization and compression alone, and bone grafting is not necessary.

External fixation provides stability for infected nonunions. Fixator frames can also be used for gradual realignment when deformity is present. Ideally, fixation should be obtained in the distal tibial fragment, rather than by spanning the ankle joint. If the distal fragment is small or osteopenic, fixation with a tensioned wire and a ring is preferable. In some infected nonunions, excision of the entire distal tibial segment, tibiotalar arthrodesis, and then distraction osteogenesis to regain length through a proximal corticotomy may be the only option besides amputation.

Another challenge is a supramalleolar nonunion combined with ankle arthrosis. Extensive stabilization and bone grafting are required to secure union and ankle arthrodesis at the same time. Patients should be counseled about the difficulty of management. When these two problems are further complicated by infection, amputation should be considered if the patient is unwilling to undergo resection and distraction osteogenesis to reconstruct the defect.

Arthrosis

The prevalence of arthrosis following tibial plafond fractures has not been well documented because there are few long-term studies and the criteria for diagnosis vary widely. Arthrosis rates of up to 50% have been reported. Two points should be emphasized. First, significant arthrosis typically makes its appearance within the first 1 to 2 years after injury.[1] Second, the radiographic evidence of the presence or degree of arthrosis does not correlate well with the subjective clinical results.[22]

The cause of the arthrosis has been debated and is probably related to several factors. The quality of reduction is thought to be important, but the relationship is inconsistent and is difficult to predict for an individual patient. This is most likely because articular cartilage damage at the time of injury contributes to the development of arthrosis irrespective of the quality of articular reduction. Another contributing factor is osteonecrosis of subchondral bone fragments. When rapid loss of articular cartilage occurs in the first 6 months after injury, infection should be considered.

The conservative treatment of posttraumatic ankle arthritis includes custom-molded, ankle-foot orthoses with rocker-bottom soles and occasionally anterior clam shells or leather ankle lacers for further support. The surgical treatment of severe posttraumatic arthritis of the ankle is arthrodesis. Many techniques are available, and damaged soft tissues and previous incisions must be taken into account when planning surgery.

Summary

The treatment of high-energy fractures of the tibial plafond has changed considerably due to recognition of the high frequency and severe consequences of complications secondary to ORIF. To prevent these complications, the surgeon must be aware of soft-tissue injuries with both open and closed fractures. High-energy fracture patterns with associated soft-tissue injury require more conservative approaches to fracture stabilization. Several authors have reported decreased complications using various external fixation techniques.

The long-term outcome with all treatment techniques is variable and often depends on factors beyond the surgeon's control, such as initial articular cartilage damage. The uncertain nature of the prognosis further emphasizes the importance of avoiding complications of initial treatment.

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