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Smoking Effects in a Distal Tibia Fracture Treated With External Fixation

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Distal tibia fractures are one of the most demanding injuries in orthopaedic traumatology, due mainly to frequent coexistence of covering tissue problems and poor blood supply. Smoking exerts a detrimental effect on fracture healing, increasing the time to union. We report the case of a 60-year-old heavy-smoker (about 20 cigarettes a day) with a distal tibia fracture that necessitated synthesis with an external fixator to maximize the healing process, which nevertheless required more than one and half year to heal. We consider this case as a "take-home message" against tobacco use during the treatment of any orthopaedic issue.

Introduction

Distal tibia fractures are difficult to manage due to the usual presence of comminution, needing stable internal fixation by means of the less traumatic technique. Complications are critical, namely, possible wound problems, osteomyelitis, malunion, nonunion, pintract infections, and hardware failure (Sirkin, 2007). In the literature, smoking has been recognized as a detrimental factor to diaphyseal bone healing. Nicotine adversely affects revascularization, thus increasing the rates of nonunion (Hernigou & Schuind, 2013). As compared with nonsmoking patients, this results in a prolonged period of healing following intramedullary nailing or external fixation (Schmitz, Finnegan, Natarajan, & Champine, 1999). Here the authors report a peculiar clinical and radiographic description of a heavy-smoker with a left distal biosseous leg fracture that required more than one and half year to heal after external fixation.

Case Report

A 60-year-old male patient required our attention due to a motor vehicle accident. He suffered a left distal tibia fracture and a diaphyseal fracture of the fibula with little displacement of the broken bony ends. A thorough evaluation of the fracture features, as well as the patient's social and medical history, was completed. The fracture involved the metaphyseal complex (see Figure 1) and was classified as "43 A3" according to the AO ankle fracture classification. The patient was both splenectomized and heavy-smoker (the term "heavy" defines a smoker of 15, 20, or 25 cigarettes a day; Neumann, Rasmussen, Heitmann, & Tønnesen, 2013). Considering these patient-specific factors, external fixation was the chosen intervention to respect biological healing of the fracture. A radiolucent monolateral hinged transarticular "XCaliber Articulated Ankle Fixator" (Orthofix, Verona, Italy) was used (see Figure 2, top). This system allows early ankle function and good fracture union (Mitkovic, Bumbasirevic, Lesic, & Golubovic, 2002). Radiolucency feature allows useful unobstructed view of the fracture site. The fixator spans two pins in the foot bones, one in the talus, one in the calcaneus, and two or three in the medial aspect of the tibia next to the fracture. The fibula fracture was synthesized by means of a Steinmann pin (see Figure 2, bottom). Stabilization of this fracture is important in cases of distal lower leg fractures, attaining a great importance according to the state of compromise of the tibial soft tissues (Salvi & Metelli, 2005). After restoration of fibula length, distraction was applied through the fixator, thus improving reduction by means of ligamentotaxis. The bolt for the articulated fixator hinge was unlocked, permitting the patient to flex and extend the ankle in bed, avoiding early stiffness while maintaining the length of the bone. Of utmost importance, the patient was educated about smoking cessation, given the undesired impact on bone healing. This recommendation was ignored. Hence, 7 months later, the patient reported continued pain and intolerance of the external fixator. This was removed along with the Steinmann pin, and he was placed in a full weight-bearing plaster cast, as bone fracture had not healed as expected (see Figure 3, left). After 9 months, the cast was removed and a functional brace with a Tensoplast bandage was applied (Falez & Moreschini, 1988). Because radiographic reports were overall stable, he was allowed full weight-bearing to promote healing. In addition, a therapy involving alendronate sodium tablets was prescribed. During following

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FIGURE 1. Fracture of the left distal tibia with comminution, classified as "43 A3" according to AO score and involvement of the fibular shaft. Fracture ends of both the tibia and the fibula are in the axis and at risk of displacement.

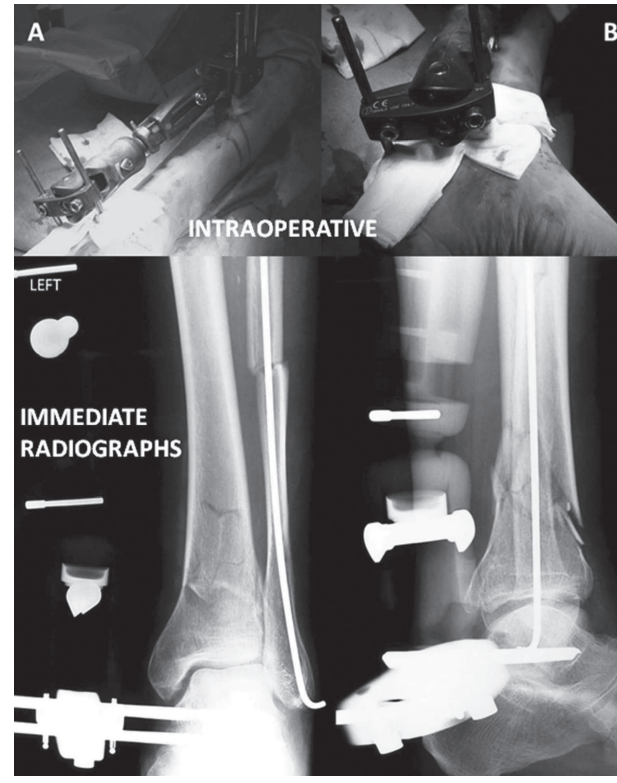

FIGURE 2. (*Top*) The Orthofix XCaliber unilateral radiolucent fixator in place with cross ankle joint fixation. Center of rotation is the sinus tarsi. Three self-compressing bone pins are located in the diaphysis of the tibia and two for the ankle are located one in the talus and the other in the heel bone for articulated clamp (A). It is visible in a closer manner the articulated mechanism at the ankle that permits early joint motion (B). (*Bottom*) Immediate postoperative radiographs. External fixator is radiolucent, hence allowing excellent visualization of the fracture site, where fracture ends are maintained stable in axis. The Steinmann pin is located in the fibula.

months, the patient reported decrease in, but not resolution of, his symptoms. Radiographs showed little improvement and he reached a plateau after 20 months (see Figure 3, right) with removal of the Tensoplast bandage. In the following 6 months, he reported further clinical improvement and full weight-bearing with continued mild pain.

Discussion

The illustrated case highlights the risk of delayed healing and nonunion of fractures within the population of smokers. Six months after surgery, with continued tobacco use, the patient developed nonunion as evidenced by the presence of pain and lacking radiographic progression of bone healing with new bone formation. We hypothesized that endosteal bone healing had been

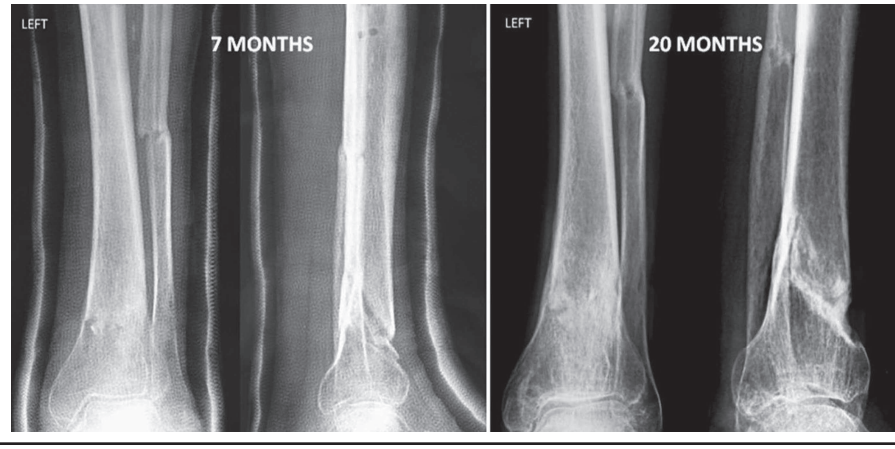

FIGURE 3. (*Left*) After 7 months, the fixator with the Steinmann pin was removed and a plaster cast was applied. Atrophic pseudoarthrosis is evident. (*Right*) After 20 months, the bony bridge is visible on the fibular fracture ends. Scarce signs of periosteal callus are visible on the tibia.

started successfully and periosteal response should be under development, even if strongly delayed. External fixation seems to be an ideal solution to solve critical concerns previously illustrated (Bone, Stegemann, McNamara, & Seibel, 1993). Nevertheless, smokers have a longer mean time to fracture union and a higher incidence of nonunion with significant poor results than nonsmokers (Al-Hadithy, Sewell, Bhavikatti, & Gikas, 2012). Even when treating pseudoarthrosis with external fixation, a study with the use of Ilizarov fixator shows that abstinence from smoking should be given maximum importance (Gualdrini, Zati, & Degli Esposti, 1996). This particular case report could be criticized for the choice of fixation, but considering the detrimental smoking behavior of the patient, we feel it was the most appropriate intervention. To conclude, patients undergoing bone fixation procedures should be strongly encouraged to abstain from smoking or other tobacco products.

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