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A Minimally Invasive Reduction and Synthesis Method for Calcaneal Fractures: The "Brixian Bridge" Technique

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Calcaneal fractures are difficult to treat because of their often-related sequelae. The authors present a simple, rapid, economic, and easy-to-perform technique that uses percutaneously positioned Kirschner wires plus a plaster cast for the reduction and stabilization of certain calcaneal fractures. A review of the relevant literature is also provided. (The Journal of Foot & Ankle Surgery 48(1):85–88, 2009)

Key Words: calcaneal fracture, calcaneus, heel, reduction, tuberosity

Treatment of calcaneal fractures represents a challenge for foot and ankle surgeons, since the calcaneus is a bone of crucial importance to ambulation. Traditional methods involving open reduction and internal fixation (ORIF) of the calcaneus, while providing a powerful way to restore the anatomical alignment of the calcaneus, are known to be associated with a wide range of potential soft tissue complications (1–4). In an effort to restore the normal alignment of the calcaneus, many surgeons will focus on restoration of Böhler's angle (5, 6). In fact, it has been shown that reductions in Böhler's angle below approximately 20 degrees are associated with worsening subtalar joint degeneration (7). To obtain satisfactory osteosynthesis in the treatment of calcaneal fractures, while trying to minimize complications related to soft tissue injury related to open reduction, a number of minimally invasive operative methods have been used, including use of the Ilizarov device (8), percutaneously applied distraction systems (9, 10), and percutaneous arthroscopy-assisted osteosynthesis (11). In this article, we illustrate a simple and minimally invasive technique that uses percutaneously introduced Kirschner wires (K-wires) to reduce and stabilize the fractured calcaneus. In a fashion similar to that described by Essex-Lopresti, the initial K-wire is manipulated like a joystick in order to reduce the fracture (12). Since the final orientation of the K-wires, when viewed in the lateral foot radiograph, resembles a bridge, and, to the best of our knowledge, this specific method of pins and plaster was conceived in Brescia, Italy, we refer to this method as the "Brixian Bridge" method of calcaneal fracture reduction and fixation.

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FIGURE 1 With the foot placed under the brilliance amplifier, the surgeon starts by introducing a K-wire posteriorly into the heel bone, which is maneuvered as a joystick (similar to the traditional Essex-Lopresti reduction maneuver) in order to lower the posterior tuberosity of the calcaneus. At the same time, the surgeon holds the forefoot with the contralateral hand.

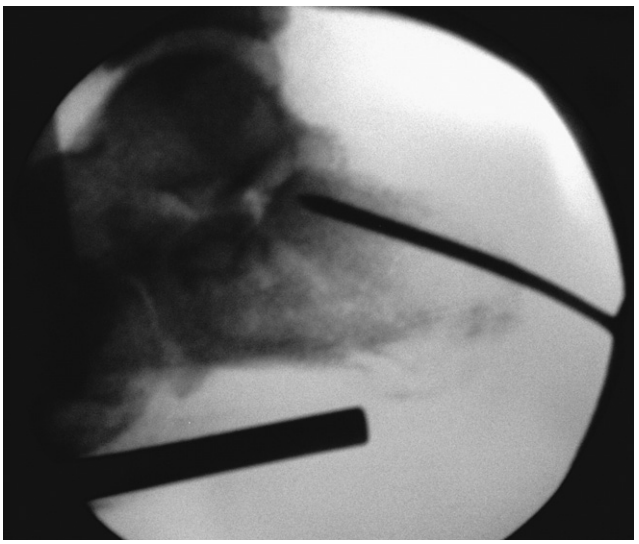

FIGURE 2 The control under the brilliance amplifier (fluoroscopic image intensification) following introduction of the first K-wire allows the surgeon to ensure correct reduction of the posterior tuberosity of the heel, with restoration of a correct Böhler's angle.

Surgical Technique

The surgical technique requires no more than 3 or 4 K-wires, or appropriately sized Steinmann pins, depending on the size of the involved osseous fragments. With the patient prone or in the ipsilateral decubitus position, and anesthetized, image intensification fluoroscopy is used to guide placement of the first percutaneously driven K-wire into the calcaneus, taking care to purchase the dense subchondral bone under the posterior facet without violating the subtalar joint cavity. After ensuring proper placement, this first K-wire is then maneuvered as a joystick in order to lower (move plantarward) the tuberosity of the calcaneus while simultaneously elevating the depressed posterior facet of the os calcis (Figures 1 and 2). When adequate correction of Böhler's angle has been obtained, a second K-wire is introduced percutaneously into the posterior and inferior aspect of the os calcis, and directed through the calcaneus and across the talocalcaneal joint until it adequately purchases the body of the talus, in order to stabilize the fracture fragments in the reduced alignment. A third K-wire is then placed in a fashion similar to that described for the second K-wire, essentially paralleling the second wire, after which the joystick wire is removed (Figure 3, A). Thereafter, a final K-wire is introduced percutaneously in a horizontal orientation parallel to the weight bearing substrate, and directed into the anterior portion of the calcaneus or, if desired, through the calcaneus and across the calcaneocuboid joint to settle securely in the cuboid, in an effort to further ensure stabilization of the fracture fragments (Figure 3, B). Finally, the foot is immobilized in a non–weight-bearing above-the-knee cast (Figure 4) for 35 days before reducing the plaster to a non–weight-bearing below-the-knee cast for and additional 35 days, following which radiographs are obtained and, thereafter, the K-wires as well the below-the-knee cast are removed and progressive weight bearing is allowed.

Discussion

This method of calcaneal fracture reduction and stabilization conveys some aspects worthy of note, not the least of which is elimination of the need for a more traditional ORIF. As such, the risk of soft tissue compromise, including injury to vessels, nerves, tendons, and skin, is reduced. Therefore, the method may be the preferred technique in certain patient populations, such as those affected by diabetes mellitus with neuropathy, peripheral vascular disease, immunocompromise, and tobacco use. Secondly, the method described in this report is relatively inexpensive, rapid, and easy-to-perform, in comparison to ORIF. Third, this method allows the surgeon to immediately assess the adequacy of restoration of Böhler's angle by means of fluoroscopic inspection, and alignment of the posterior facet of the calcaneus can be manipulated further by means of the joystick wire before stabilization, if further reduction is deemed necessary. It should be kept in mind that restoration of Böhler's angle, hence the alignment of the posterior facet, is the surgeon's primary goal in regard to reduction and stabilization of fractures of the calcaneus, and implementation of the Brixian Bridge, as described in this article, can be used to satisfy that aim in many cases. Naturally, the proposed technique should not be expected to be of much