The Journal of Foot & Ankle Surgery 53 (2014) 511–514

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Tibiocalcaneal Arthrodesis Using a Simple External Fixator

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ARTICLE INFO

Keywords:
ankle
calcaneus
external fixation
hindfoot
talus
tibia

ABSTRACT

Tibiocalcaneal arthrodesis has been a salvage option for conditions with extensive loss of the talar body. In conditions that preclude the use of internal fixation, external compression arthrodesis has been the preferred technique to achieve fusion about the hindfoot. Since Sir John Charnley elucidated the technique of compression arthrodesis using compression clamps, various modifications and techniques of external compression arthrodesis have been described. Various clinical and biomechanical studies have established the superiority of triangular transfixation in external compression arthrodesis. We have described a simple technique of compression arthrodesis after the principle of triangular transfixation using easily available hardware from Ilizarov instrumentation. This technique is relatively inexpensive in terms of the cost of the materials, uses a modular construct, and allows multiplanar correction of the hindfoot. It can be used intraoperatively to distract the hindfoot joints, especially in the presence of fibrosis and poor skin conditions. We believe this device can be a reasonable alternative to the conventional external fixation techniques for tibiocalcaneal arthrodesis.

Tibiocalcaneal arthrodesis has been a salvage option often used for conditions with extensive loss of the talar body such as advanced neuropathic arthropathy of the hindfoot, failed ankle arthroplasty, and open ankle injury with talar loss (1,2). To achieve fusion around the hindfoot, various internal and external fixation techniques have been described. External compression arthrodesis has been the preferred technique when poor bone quality, compromised soft tissue, and infection preclude the use of internal fixation (3,4). Sir John Charnley first described compression arthrodesis in 1951 using an external compression device transfixed on either sides of the ankle (5). The inability to resist rotatory forces and the high nonunion rates using Charnley's external compression device led to modification of external fixation techniques (6,7). Compression arthrodesis using triangular external fixators improved triplanar stability, decreased movement at the arthrodesis site, and increased the union rates (8,9).

We have devised a technique of compression arthrodesis in accordance with the principle of triangular transfixation (8,10) using easily available standard components from Ilizarov instrumentation (Fig. 1). Our technique is relatively inexpensive, uses a modular construct, and allows multiplanar correction of the hindfoot. It can be used intraoperatively to distract the hindfoot, especially in the presence of fibrosis and poor skin conditions.

Surgical Technique

The device primarily consists of 4 compression–distraction (CD) limbs. The CD limbs are preassembled and sterilized. The components required to assemble 1 CD limb include one 150-mm-long fully threaded connecting rod, two 2-hole Rancho™ cubes (Smith & Nephew, Andover, MA), one 10-mm hexagonal nut, and 2 square nuts. The CD limb should be assembled as follows (Fig. 2):

1. A 2-hole Rancho™ cube is threaded and locked against a nut at 1 end of the threaded rod. This will form the distal end of the CD limb.
2. The proximal end of the CD limb is assembled by threading a square nut into position a few centimeters down the other end of the threaded rod. A Rancho™ cube is then slid after the nut through 1 of its nonthreaded holes. A second square nut is threaded down the rod after it. Next, the Rancho™ cube can be freely slid along the rod between these square nuts. This

Financial Disclosure: None reported.
Conflict of Interest: None reported.
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http://dx.doi.org/10.1053/j.jfas.2014.02.010

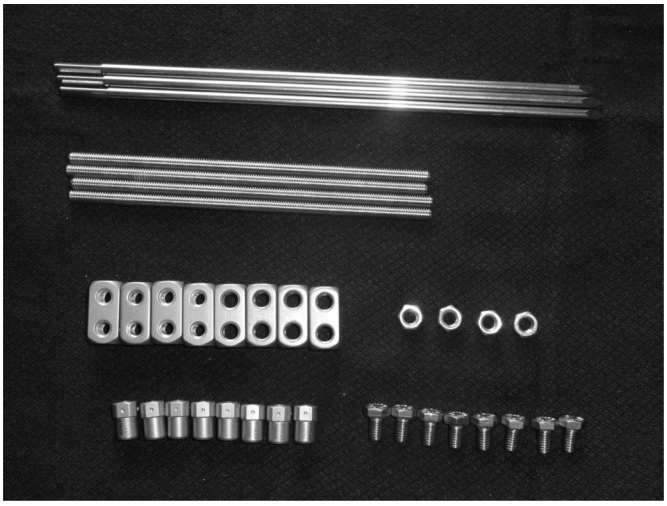

Fig. 1. The components required to assemble the fixator included three 4.5-mm Steinmann pins, four 150-mm fully threaded rods, eight 2-holed Rancho™ cubes, four 10-mm hexagonal nuts, eight 10-mm square nuts, and eight 10-mm short bolts.

configuration of the square nuts and the Rancho™ cube will form the CD motor (adjusting) unit of the limb. Tightening these square nuts against the cube will lock the cube in the final desired position.

Four such preassembled CD limbs, three 4.5-mm Steinmann pins, and 8 short bolts form the final construct (Fig. 3).

Procedure

The patient was placed supine on a radiolucent table, and the diseased hindfoot joints were visualized and debrided using an anterolateral or a lateral approach. With image intensifier guidance, 1 Steinmann pin was passed through the calcaneus anteriorly and another pin posteriorly, such that they were parallel to each other and to the plane of arthrodesis. A third Steinmann pin was passed through the distal tibia, approximately 10 cm proximal to its distal end and parallel to the plane of arthrodesis. The CD limbs should be attached to these Steinmann pins as follows.

On the medial side, the distal end of 1 CD limb is placed on the anterior calcaneal Steinmann pin through the distal nonthreaded hole of the Rancho™ cube. The proximal end of this CD limb is passed onto the tibial Steinmann pin through the threaded hole of its Rancho™ cube such that the threaded rod of the CD limb lies posterior to the tibial Steinmann pin (Figs. 3 and 4, label A). A second CD limb is positioned on the posterior calcaneal Steinmann pin through its distal end in a similar manner. The proximal end of the second CD limb is placed on to the tibial Steinmann pin through the threaded hole of its Rancho™ cube, such that the threaded rod of this CD limb lies anterior

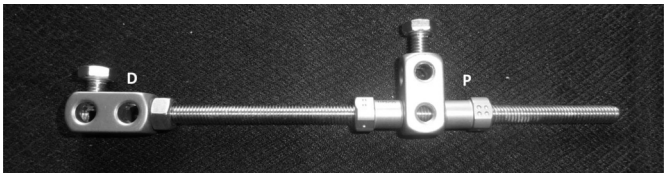

Fig. 2. Assembling the compression device (CD) limb. The distal end of the CD limb (marked as "D") is assembled by locking a 2-holed Rancho™ cube against a nut at 1 end of the threaded rod. The proximal end of the CD limb (marked as "P") consists of 2 square nuts and 1 Rancho™ cube. This forms the CD motor unit.

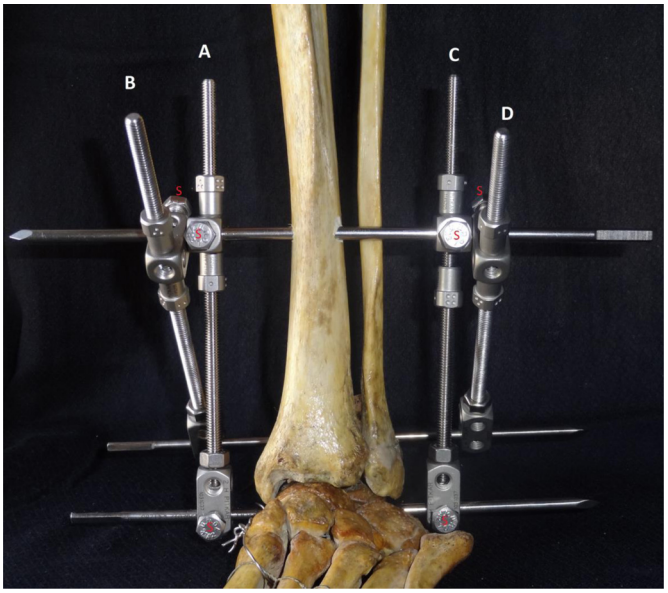

Fig. 3. The construct consists of 4 CD limbs (marked A to D) affixed on three 4.5-mm Steinmann pins using 10-mm short bolts (marked "S").

to the tibial pin (Figs. 3 and 4, label B), creating a crossed configuration of the threaded rods. Similarly, a crossed triangular construct is built on the lateral side of the ankle and hindfoot using another pair of CD limbs (Figs. 3 and 4, labels C and D). The CD limbs should be secured to the Steinmann pins using 10-mm short bolts threaded through the adjacent threaded hole of the Rancho™ cubes (Fig. 3).

Once the external fixation construct has been positioned as described, the joint can be compressed or distracted by turning the CD motor unit on the proximal end of the CD limbs. Intraoperative distraction using the device can be helpful for making congruous bone

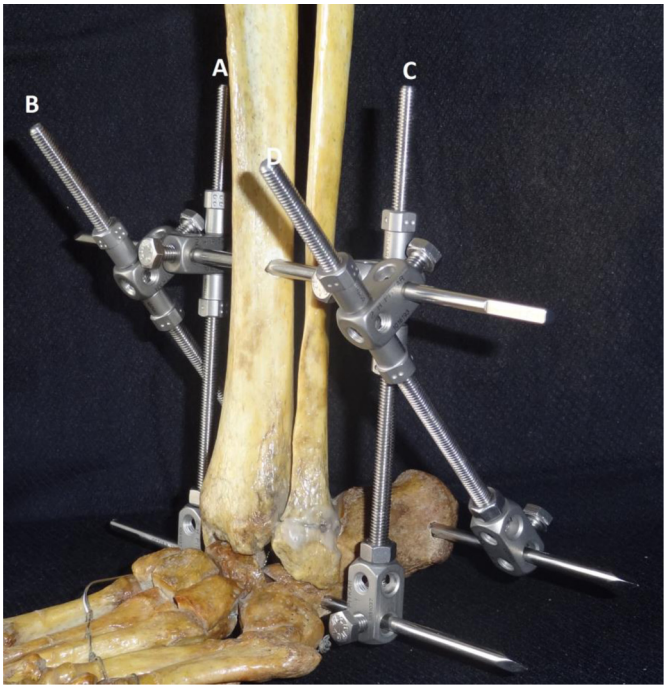

Fig. 4. The final assembly provides triangular transfixation, with crossed rods situated medially and laterally about the arthrodesis.