

Use of the External Fixator Calcaneus Pin: Using the TRIMANO to Its Full Potential



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Abstract: Joint-spanning external fixation in acute ankle trauma is a means to provide temporary stability and restoration of length, alignment, and articular congruency. This allows for soft-tissue consolidation before definitive fixation to decrease the risk of wound complications. Traction is commonly used during definitive fixation to aid in fracture reduction and to maintain reduction during placement of internal hardware. Ankle arthroscopy for ankle fractures is also becoming increasingly popular to identify and treat intra-articular injury and uses traction for visual assistance and increased working space for instruments. We present a technique that uses a previously placed calcaneus external fixation pin and the TRIMANO (Arthrex, Naples, FL) external positioning arm to apply skeletal traction during arthroscopic and open definitive fixation procedures. This technique is extremely simple, can be used in both the supine and prone positions, and can be used during arthroscopic and open procedures.

Joint-spanning external fixation in acute ankle trauma allows for soft-tissue consolidation before definitive fixation to decrease the risk of soft-tissue complications. This is typically employed as a staged protocol, where the external fixator is placed to maintain length, alignment, and articular congruency until soft tissues about the ankle are amenable to undergoing open reduction internal fixation.¹ External fixation also can be used for additional stability and maintenance of reduction during definitive fixation. Indications for temporary joint-spanning ankle external fixation include pilon fractures, distal extra-articular tibia fractures, unstable ankle fractures, soft-tissue compromise, open fractures, and high-energy injuries with significant soft-tissue compromise.²

Ankle arthroscopy for fractures is becoming increasingly popular as direct visualization of the mortise joint allows for identification and treatment of intra-articular fractures and concomitant cartilage injuries.³⁻⁶ Ankle distraction is applied during arthroscopy to assist in visualization and increase the working space for arthroscopic instruments. The most commonly used methods are noninvasive distraction methods for the ankle. However, this typically results in a plantarflexed ankle, which may limit access to the talar dome or tibial plafond to assist in reduction. In 2 separate studies, Hirtler et al.^{7,8} demonstrated that the ability to plantarflex and dorsiflex the ankle during ankle arthroscopy can impact accessibility to the talar dome. For the open treatment of ankle fractures, applying traction helps with fracture reduction and maintaining reduction as fixation is applied. This surgical technique uses a previously placed calcaneus external fixation pin and the TRIMANO (Arthrex, Naples, FL) external positioning arm to apply skeletal traction during definitive fixation procedures. The setup for this technique is extremely simple, can be used in both the supine and prone positions, and can be used during arthroscopic and open procedures. It provides the operating surgeon with stable traction throughout the entirety of the case, allows for microadjustments in distraction force and position, and frees up assistants during the procedure (Table 1). In addition, because the ankle joint is free using this method of ankle distraction, dorsiflexion

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Table 1. Advantages, Risks, and Limitations

Advantages	Risks	Limitations
Extremely simple setup that can be used for both arthroscopic and open procedures in supine or prone position	Excessive traction placed by the surgeon can cause neurovascular damage, although very uncommon	This ankle distraction setup is limited to patients who were previously placed in ankle spanning external fixator for temporary stabilization before definitive fixation
Fixed traction force and position eliminates variability of manual reduction and allows for microadjustments in distraction force, length, alignment, and rotation	Excessive traction placed by the surgeon can cause neurovascular damage, though very uncommon	
Hands-free distraction allows assistant to help with other aspects of procedure		
Low-profile setup allows easy access for fluoroscopy		

and plantarflexion may be adjusted intraoperatively to increase visualization of the ankle joint.

Surgical Technique (With Video Illustration)

Skeletal traction using a transcalsaneal external fixator pin and the TRIMANO (Arthrex) external positioning arm is indicated in patients who previously underwent joint-spanning external fixation for length unstable ankle injuries and are returning to the operating room for definitive fracture fixation. This technique can be used during both the arthroscopic component of the procedure and for open reduction internal fixation to assist with maintenance of fracture reduction during placement of internal hardware.

General contraindications to this technique include factors that would inhibit one from undergoing ankle arthroscopy or open reduction internal fixation. This

includes, but is not limited to, poor vascular status, fracture blisters, contaminated open fractures, and active infections. This technique also may be used for patients who already had a joint-spanning ankle external fixator placed. Theoretically, it could be employed as a means of traction in patients without an ankle external fixator but may provide a less-invasive soft-tissue traction setup in this scenario.

The patient is positioned supine or prone depending on fracture pattern characteristics and plan of fixation. If positioning supine, the following ordered steps are then conducted. (1) A small bump is placed under the patient's ipsilateral hip to align the ankle perpendicular to the table. (2) A well-padded thigh tourniquet is applied with assembly positioned on the lateral side. (3) A standard safety strap is applied around the waist, and the contralateral lower extremity is secured to the bed

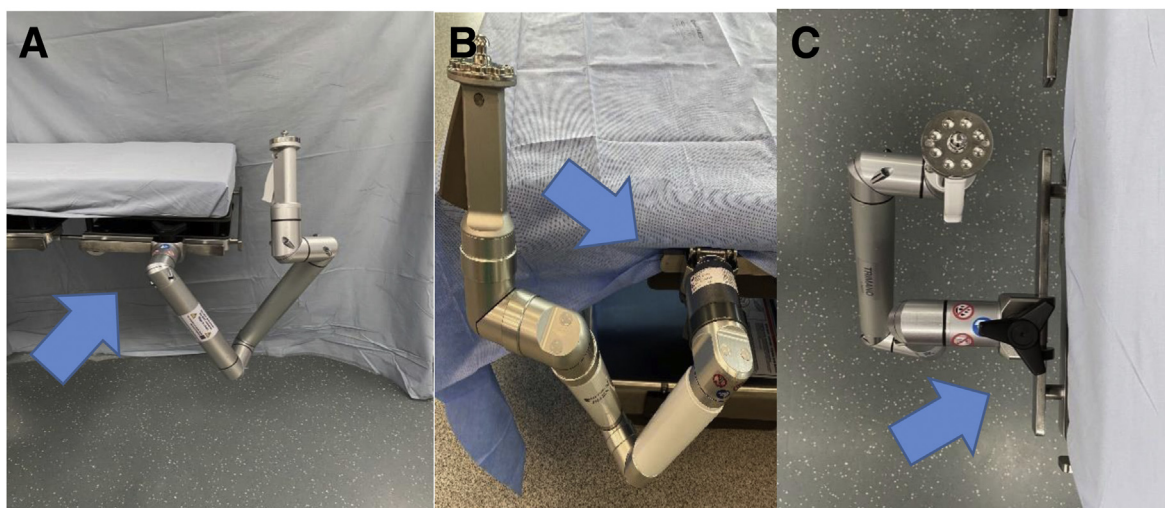


Fig 1. The TRIMANO (Arthrex, Naples, FL) external positioning arm is attached to the ipsilateral surgical side of the bed with the mounting bracket placed at most distal part of the main bedrail in a non-sterile manner. This should be done before draping but after the patient is positioned to ensure distraction can be achieved. (A) The proper TRIMANO (Arthrex) placement for right lower-extremity surgery if the patient is positioned supine or left lower-extremity surgery if the patient is positioned prone. (B-C) The TRIMANO (Arthrex) should be attached to the most distal aspect of the bedrail.

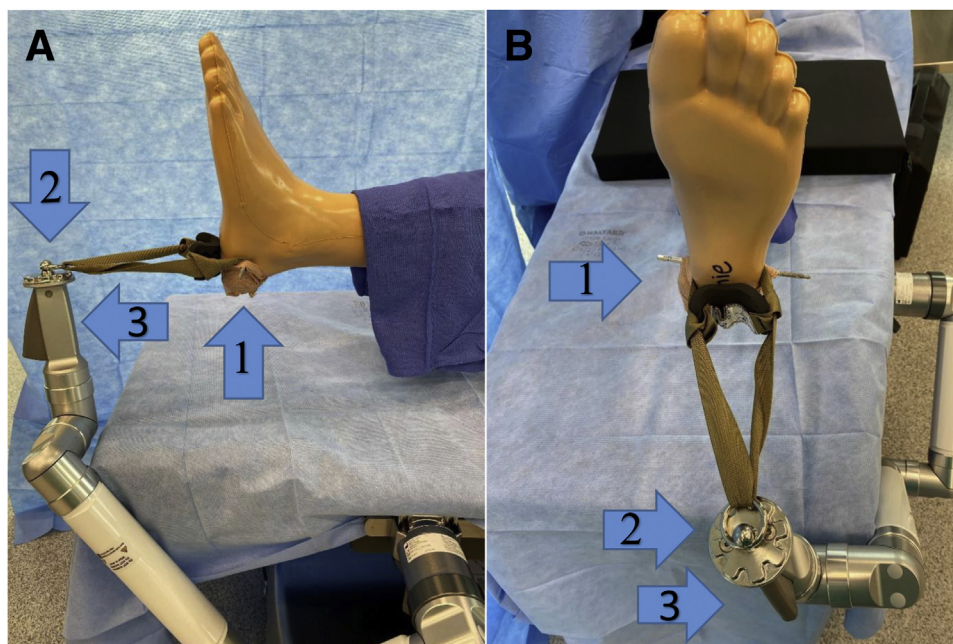


Fig 2. Sterile draping of the operative extremity and the TRIMANO (Arthrex, Naples, FL) external positioning arm with a sterile disposable clear camera sheath (3M Steri-Drape, 13 cm × 244 cm; 3M, St Paul, MN) is performed. A sterile ankle distractor strap is then placed around the calcaneus traction pin with one loop around the medial aspect of the calcaneus pin and the other loop around the lateral aspect. This strap is then secured to the calcaneus pin with sterile Coban (arrow 1). The free end of the ankle distractor strap is looped around the sterile external positioning arm (arrow 2). The TRIMANO (Arthrex) is then manipulated by squeezing the handle (arrow 3) and gently pulling toward the operating physician at the end of the bed to obtain the desired amount of ankle distraction.

with tape and padding to decrease movement of the body and contralateral leg during the procedure. (4) The TRIMANO (Arthrex) external positioning arm is attached to the ipsilateral surgical side of the bed (Fig 1A). The mounting bracket of the external positioning arm is placed at the most distal point of the main bedrail (Fig 1B). (5) The external fixator bars and proximal pins are then removed, with the calcaneus pin left in place.

If positioning prone, the following ordered steps are conducted. (1) Adequately sized gel pads are pre-positioned for the chest, elbows, and patellae ensuring the feet are off the bed and in a neutral position. (2) A well-padded thigh tourniquet is applied in the same manner as described above. (3) Safety straps around the waist and contra-lateral lower extremity are applied to secure the patient to the operative table (4) The TRIMANO (Arthrex) external positioning arm is attached to the ipsilateral surgical side of bed with the mounting bracket placed at most distal part of the main bedrail. (5) The surgical extremity is then flexed at the knee to allow removal of external fixator bars and proximal pins, with the calcaneus pin left in place. (6) The patient undergoes sterile preparation and draping in the standard fashion. (7) Once the patient and table are fully draped, the external positioning arm is prepared with a sterile disposable clear camera sheath (3M Steri-Drape,

13 cm × 244 cm; 3M, St. Paul, MN) standard to most operating room supplies. The external fixation device is now ready to be positioned properly relative to physician preference for the procedure being performed. (8) The ankle is positioned on a soft bump under the distal tibia using sterile towels. The patient should already be marked with all major landmarks and port sites clearly visible for the arthroscopic or open procedure being performed. (9) The leg is exsanguinated, and a pneumatic thigh tourniquet is used based on surgeon preference. (10) An ankle distractor strap is placed around the calcaneus traction pin with one loop around the medial aspect of the calcaneus pin and the other loop around the lateral aspect. (11) Sterile Coban is wrapped around the pin and ankle distractor strap to secure the pin to the strap (Fig 2, arrow 1). (12) The free end of the ankle distractor strap is looped around the sterile TRIMANO external positioning arm (Fig 2, arrow 2). (13) The TRIMANO external positioning arm is then manipulated by gently pulling toward the operating physician at the end of the bed to obtain the desired amount of ankle distraction for the planned open or arthroscopic surgical procedure (Fig 2, arrow 3). If a certain angle needs to be obtained for visualization, the external fixation arm allows for side-to-side or superior-posterior movements depending on the angle needed. The same steps are followed to attach the

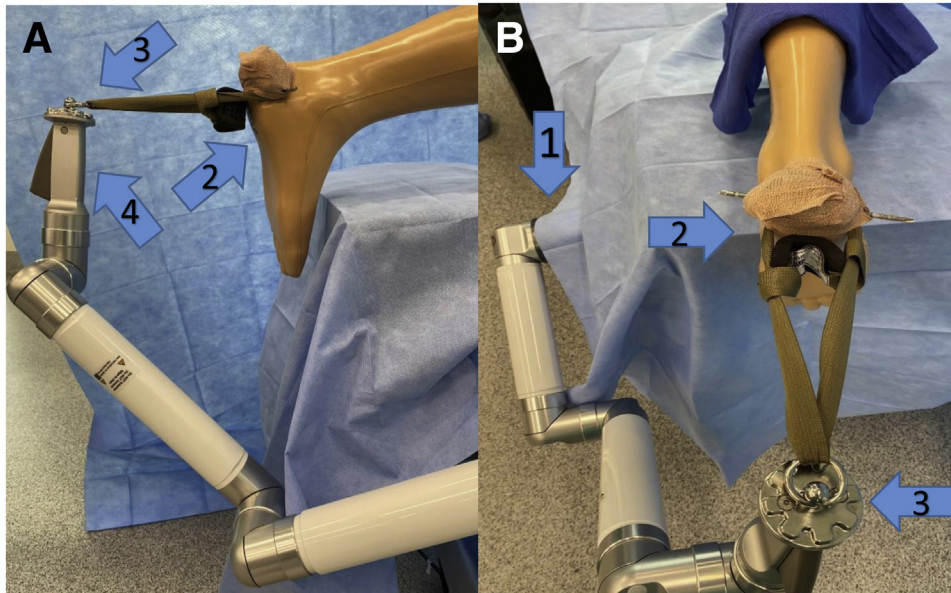


Fig 3. For operations that require prone positioning, the same steps are followed to achieve ankle distraction through the calcaneus traction pin using the TRIMANO (Arthrex, Naples, FL) external positioning arm. The TRIMANO (Arthrex) is attached to the most distal aspect of the main bedrail on the ipsilateral surgical side in a nonsterile manner (arrow 1). After prepping and draping of both the operative extremity and the TRIMANO (Arthrex), the sterile ankle distractor strap is looped around the calcaneus traction pin and secured with sterile Coban (arrow 2). The free end of the sterile ankle distractor strap is looped around the sterile external positioning arm (arrow 3). The desired ankle traction is achieved by squeezing the handle of the external positioning arm and gently pulling toward the operating surgeon at the end of the bed (arrow 4).

operative extremity to the TRIMANO (Arthrex) if the patient is positioned prone (Fig 3). Table 2 highlights pearls and pitfalls of the set up, and Video 1 details our technique.

Discussion

In patients with a previously placed joint-spanning external fixator, using the calcaneus pin and the TRIMANO (Arthrex) external positioning arm is an extremely simple way to apply traction and use the concepts of ligamentotaxis to aid in reduction and definitive fixation. In addition, with traction applied during the time of definitive fracture fixation,

arthroscopic-assisted reduction can be used, which has demonstrated benefits recently in the foot and ankle literature.^{4,6} The setup itself is extremely simple, as the calcaneus pin is already in place and the TRIMANO (Arthrex) attaches in a nonsterile manner to the operative table. This setup does not use any reprocessed sterile equipment, which may reduce overall surgical costs and decrease the burden of the sterilization process.⁹

Furthermore, the setup is low-profile, and mini c-arm imaging can be easily positioned around the TRIMANO (Arthrex) external positioning arm for intraoperative fluoroscopy (Fig 4A). This traction set up can be applied in a multitude of ways, as the patient can be positioned

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
Place the TRIMANO on the distal foot rail of the bed before draping but after the patient is positioned to ensure distraction can be achieved	Positioning the patient with the foot proximal to the end of the bed may not allow for proper ankle distraction or easy fluoroscopic access during the procedure
Cover the ends of the pin with a marker cap and Coban to prevent accidental injury	Failure to secure the TRIMANO to the calcaneus pin with a strap overwrapped with Coban may result in micromotion or loss of distraction during the procedure
The TRIMANO allows the surgeon to use a large bone foam under the operative leg to make fluoroscopy with mini c-arm easy	
Do not open the additional TRIMANO pieces and accessories to save money and reduce waste	
Before pulling distraction, inform the anesthesia staff they may appreciate patient motion	

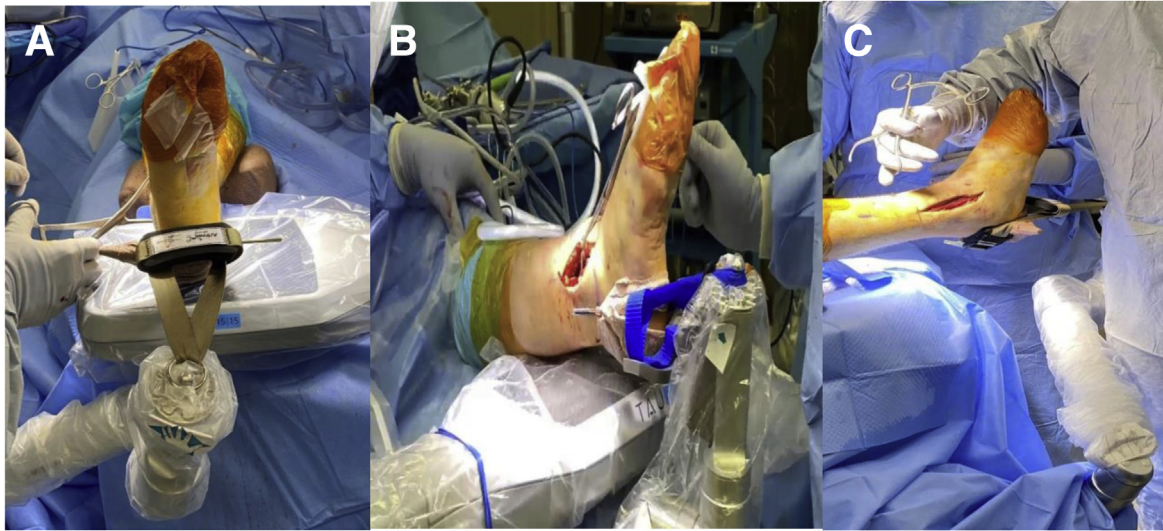


Fig 4. Intraoperative photos of the TRIMANO (Arthrex, Naples, FL) external positioning arm applying ankle distraction through a previously placed calcaneus traction pin. (A) The low-profile nature of this set up is shown, as the sterile mini c-arm can be easily brought into the surgical field for intraoperative fluoroscopy. (B) A patient with a pilon fracture in whom both arthroscopic and open procedures were performed with intraoperative fluoroscopy used throughout the case. (C) The hands-free aspect of this ankle distraction set up is shown, so assistants can actively participate in the case as opposed to pulling manual traction throughout the majority of the procedure.

supine or prone and traction can be used for both the arthroscopic and open portions of the surgical procedure (Fig 4B). Intraoperatively, this technique allows the operating surgeon to work hands-free and the assistants can be used to help with the procedure as opposed to manually pulling traction (Fig 4C).

In conclusion, the TRIMANO (Arthrex) external positioning arm provides stable traction throughout definitive fixation of high-energy ankle injuries. Furthermore, this novel technique allows for micro-adjustments to be made throughout the procedure, facilitating fracture reduction and use of arthroscopic assisted reduction when indicated. Using the calcaneus traction pin and TRIMANO (Arthrex) external positioning arm ankle distraction setup is an extremely simple, versatile, and effective way to apply traction during operative stabilization of injuries involving the tibiotalar joint.

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