A step forward into a world of innovation

Surgical Technique
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VIRA® The definitive solution for severe calcaneal fractures?

Chronic residual pain is the most common consequence following comminuted thalamic fracture of the calcaneus. A number of factors may account for this problem: compartmental syndrome, reflex sympathetic dystrophy, plantar pad syndrome, tarsal and fibular canal syndrome, and subtalar arthritis. The latter disorder has been defined as the main cause of poor long-term fracture treatment results.

The treatment of severe calcaneal fractures is a controversial topic. Many authors defend conservative fracture management because open reduction and osteosynthesis are technically difficult, biologically aggressive and do not always achieve a satisfactory clinical outcome.

The VIRA® SYSTEM offers a solution for the treatment of displaced calcaneal fractures, with rapid clinical and functional recovery, along with a low risk of complication.

What does VIRA® offer?

- **Minimally invasive surgery**: a closed reconstruction of the foot anatomy using cannulated screw combined with a guided percutaneous technique.
- **Rigidity and calcaneal support** via two tubero-talar P/A locking screws.
- **Reconstruction of the calcaneus and restoration** of the foot to its normal anatomy.
- **Avoidance of chronic residual pain** through the fusion of the subtalar joint.
- **Early mobility and weight bearing**, as early as two weeks after surgery.
- **Avoids long-term degenerative changes in the subtalar joint** such as atrophy and osteoporosis.
- **Specific and simple instrumentation**, guiding the surgeons through each stage of the operation.
In which cases can it be used?

- Displaced intra-articular calcaneal fractures.
- Consequences of intra-articular calcaneal fractures: subtalar arthrosis and defective consolidation.

Contraindications:

a) Absolute Contraindications: Heel Infection, patients with immature skeleton, extra articular fracture of the calcaneus, hypersensitivity to stainless steel.

b) Factors increasing the risk of surgical failure: non-cooperative patients, or patients suffering from neurological disorders, unable to follow medical instructions; metabolic disorders. Factors affecting wound healing (decubitus ulcers, diabetic patient, severe protein deficiency and/or malnutrition).

How does VIRAX® work?

The implant consists of a nail seated into the calcaneal greater tuberosity along with two cannulated tuber-talar locking screws. These screws are inserted through the nail and into the talus. The strong and stable construct generates ligamentotaxis allowing for the reduction and consolidation of the fractured calcaneus. The VIRAX® system stabilizes the subtalar joint via an acute subtalar arthrodesis, restoring and maintaining the normal biological function of the hind foot.
Surgical technique

Patient positioning

A prone position on a radiolucent table is recommended. The injured lower limb should be positioned higher than the contra lateral limb, to avoid interferences when taking X-rays. Figure 1 & 2.

Fracture reduction using the Omoto technique

Before the first incision, it is recommended to manipulate the heel to reduce the bony fragments, narrow the lateral canal and improve the axial alignment of the calcaneus. This can be achieved by using the Omoto technique: Using both hands the surgeon grasps the heel, applying compression, traction and oscillation movements Figure 3.

Note: This fracture reduction technique is generally indicated in the case of severely displaced fractures or when the inferior cortex of the calcaneus is fractured.

Surgical exposure

A 3 cm para-Achilles tendon incision is made laterally taking care to avoid damaging the sural nerve. Through this incision the upper surface of the calcaneus is exposed permitting access to the posterior aspect of the subtalar joint. Figure 4
Preparation of the subtalar joint

The debridement of both the subtalar facet of the talus and the fractured calcaneal facet is undertaken to eliminate all the cartilage. Figure 5. It is important that both prepared bony surfaces are kept in contact to facilitate the fusion. In some cases, a curette may have to be used to elevate the collapsed remains of the fractured calcaneus so that contact with the denuded surfaces of the talus is achieved.

Placement of the guide wire in the centre of the neck of the talus.

Note: The surgical technique using the talar K-wire to position the VIRAV® instruments is only recommended when the calcaneal fracture is impacted, or if the distraction of the calcaneal tuberosity is required to restore the length of the heel.

The 2.5mm K-wire is the spatial reference point of the Viral® guide. Using radioscopic guidance, the K-wire must be inserted from the medial side of the foot into the centre of the talar neck. In the coronal plane the wire must be positioned parallel to the interarticular line of the ankle, and in the sagittal plane perpendicular to the axis of the foot. It is recommended to maintain the foot in a neutral position during this step of the surgical procedure. Surgery should not be continued until correct positioning of the guide wire has been achieved. Figures 6 and 7.
Initial positioning of the VIRA® guide

The VIRA® guide is initially placed with the anterior arms ahead of the talar K-wire, and with the posterior grasping arms over the heel. The guide must be adjusted in order to leave the posterior grasping arms completely open. Figures 8 and 9

The posterior arms of the VIRA® guide are radiolucent. At each extremity of these posterior arms an imbedded radio opaque marker is found which will help in locating the future positioning of the tip of the nail on X-Ray (lateral view). Figure 10

Under lateral radioscopic imaging, the radiolucent posterior arms are positioned over the greater tuberosity of the calcaneus, so that the nail entry point is located immediately above the posterior superior process, and the tip of the nail in the posterior inferior process. This positioning can be achieved by adjusting the bolt at the end of the guide handle. Figure 11

In this initial position, two K-wires are inserted in the lateral holes of the posterior arms. These wires allow the future location of the tubero-talar screws to be estimated via lateral X-ray. Figure 12

Depending on the nature of the fracture and the anticipated distraction/reduction that must be achieved, these K-wires will reach the talus in different positions. Where it is anticipated that little distraction is needed, the superior wire should be positioned in the posterior third of the subtalar facet. In the case of more comminuted or impacted fractures where it is anticipated that a greater degree of distraction will be necessary, the K-wires should lie in the anterior third of the subtalar facet. Figure 13

Note: In impacted or comminuted fractures, this is Not the anticipated final position of the cannulated screws.
Capture of the greater tuberosity

The surgeon’s assistant should maintain the VIRA® guide in position while the lateral bolt of the guide is tightened to close the posterior arms onto the greater tuberosity of the calcaneus. No incision is needed, since the capturing pins perforate the skin. The lateral screw is tightened until firm grasp of the calcaneus is achieved. Figure 14. The assistant must continue to maintain the position of the VIRA® guide until the complete insertion of the nail is achieved.

Drilling

In order to prepare the calcaneal tuberosity a 10 mm drill bit is inserted through the upper nail insertion hole of the VIRA® guide. The drill bit should be inserted until the stop impacts the VIRA® guide. Care should be taken to avoid damaging the Achilles tendon. Figure 15

In some cases, the severely comminuted nature of the fracture necessitates drilling through the bony fragments. This will not alter the clinical or functional outcomes of the operation.

Bone Grafting

The morselised bones produced by the drilling of the calcaneus should be carefully removed and retained, it will be used as graft material for the subtalar arthrodesis prior to the insertion of the nail. Thus eliminating the need to harvest autologous bone. Figure 16

Nail Insertion

The nail is placed onto the nail insertion adapter. The driver bolt is passed through the nail inserter and tightened to firmly lock the nail to the inserter. The nail is passed through the VIRA® guide and into the patient.

NOTE: A tuning fork impactor may be used to fully insert the nail. Do not directly impact the top of the insertion adapter with any type of mallet. This could damage the insertion adapter and cause problems in nail insertion. Utilize the tuning fork impactor for impacting.

Final positioning is achieved when the stop of the nail inserter contacts the top of the VIRA® guide. Figure 17. The nail should be fully seated; this can be achieved using the tuning fork impactor. The nail insertion adapter will remain in place until the end of surgery. It will be used by the surgeon’s assistant as a lever to adjust the alignment and angulation of the guide and nail in relation to the talus.
Definitive positioning of the guide

a) Using the guide and talar k-wire
If the technique using the talar K-wire has been carried out, the anterior arms of the VI$\text{RA}^\text{™}$ guide are anchored over the talar K-wire by a simple fingertip pressure. Figure 18. This generates an initial distraction and extension of the calcaneus that helps reduce the fracture. Should further distraction and extension be required to restore the normal foot anatomy, the bolt at the extremity of the guide handle can be adjusted increasing the relative distance between the posterior and anterior arms. Figure 19.

b) Using the free-hand technique
If a free-hand surgical technique (without the talar k-wire) has been carried out, the surgeon manipulates the guide handle while the assistant holds the nail insertion adapter. Distraction, varus/valgus angulation corrections and sagittal alignment corrections can be achieved. Figure 20 and 21.

Check the proper positioning of the guide with X-ray. The lateral K-wires indicating the future position of the screws should be located in the body of the talus, going through the posterior subtalar zone. Figure 22. If this is not the case, further extension and distraction should be applied until the desired position is achieved.
Insertion of the tubero-talar screws

The superior cannulated screw must be fully positioned before starting the procedure with the inferior screw. Both screws are inserted thru the same 3cm incision. Figure 23 Thread the trocar into the soft tissue guide and insert them through the upper screw target hole of the VIRA® guide. Mark the position of the trocar on the skin and make a 3cm vertical incision. Push the trocar and tissue guide through. Tap lightly to rest against the bone.

Remove the trocar. Thread the 2.5mm wire bushing into the soft tissue guide. Under radioscopy, pass the 2.5mm k-wire through the wire bushing reaching the talar done. Figure 24. The tip of the wire should be positioned 5mm from the talus subarticular surface. Check the sagittal position of the wire via an A/P X-Ray. Replace the wire bushing with the 4.5mm drill bushing. Place the 4.5mm drill bit over the 2.5mm wire and advance through the bone. Figure 25. Remove the drill and drill bushing from the upper target hole.

In order to achieve the correct seating of the cannulated screws into the posterior aspect of the calcaneus and VIRA® nail, it is necessary to countersink the bone. Pass the 8mm countersink drill bit over the K-wire until the stop of the countersink drill contacts the VIRA® guide, thus preventing over drilling. Figure 26

Remove the drill bit and drill bit sleeve. Pass the depth gauge over the 2.5mm wire. The correct screw length can be read from the target hole. Figure 27

The 6.5mm screw is then inserted using the T-handle screwdriver until the posterior thread is locked into the nail. At least 1 thread must be engaged in the nail. The difference between the two thread pitches of the screw will assist in the compression of the subtalar joint.

The above procedure is then repeated with the inferior cannulated screws. Figure 28
SPECIAL SITUATIONS

Bone Defect

The bone graft formerly harvested during the drilling is introduced in the subtalar joint. The graft should be impacted to ensure good graft filling between the talus and the fractured calcaneus. In the case of a severely impacted calcaneus, the harvested bone graft may not be sufficient to fill the resultant defect. In such cases, it may be necessary to harvest autologous bone from the iliac crest. Figure 29

Tongue Fractures

In case of Tongue fracture, Figure 30, a secondary fracture line appears beneath the facet and exits posteriorly through the tuberosity. It creates an important bone defect which can compromise the arthrodesis. It is recommended to manipulate the bony fragment via a percutaneous approach with a curette and position it as close as possible to its normal anatomical location.
Wound Suturing

The para-Achilles tendon incision is sutured in two layers. A single layer suturing of the heel incision is recommended.

Postoperative Care

The foot should be kept raised, with the necessary level of antithrombotic medication and exercises being prescribed. Hospital stay should be adapted to the degree of inflammation of the foot.

In most cases, weight bearing can be allowed following suture removal. In some cases this can be as early as two weeks after surgery. Initial weight bearing should be partial, with a progressive return to normal activity.

Nail removal

Nail removal is not compulsory. Should nail removal be desirable, the following steps should be undertaken:

- First, an incision over the screws is done until reaching the bone. Secondly, the bone that has grown over the heads of the tubero-talar screws should be removed. A wire is inserted through the cannulated screws and the 8mm cannulated drill bit, Figure 31, is threaded over in order to remove the bony debris. Finally a curette may be used to complete the removal of the bony ongrowth.

- The T-handle screwdriver is inserted onto the screws and the screws are removed.

- To remove the nail, a second para-achilles incision is used over the previous scar. The bone covering the upper end of the nail is eliminated. The driver bolt is passed through the nail inserter and tightened to lock the nail to the inserter. The tuning fork impactor is used to ease the removal of the nail.
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