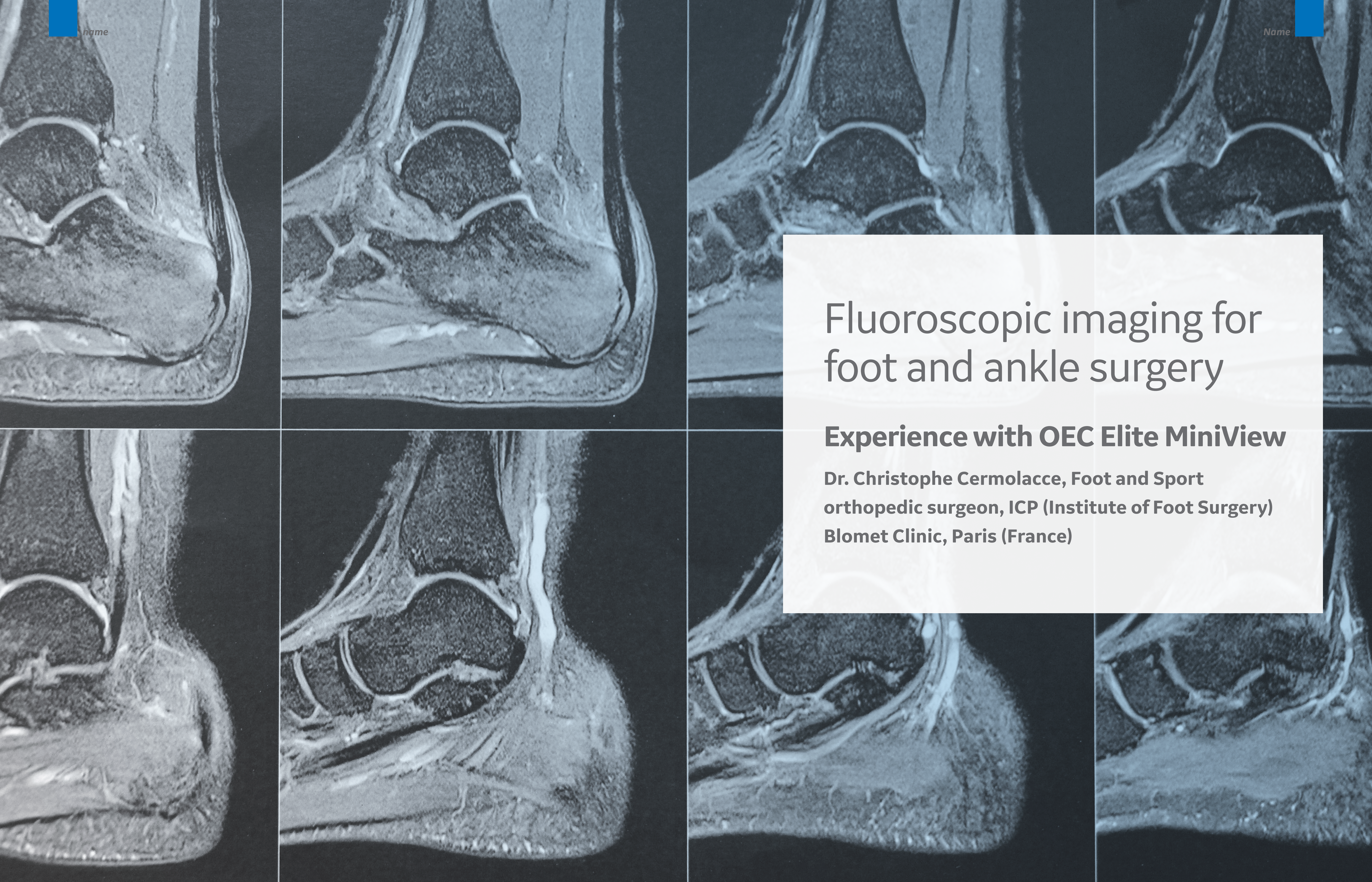

Fluoroscopic imaging for foot and ankle surgery

Experience with OEC Elite MiniView

Dr. Christophe Cermolacce, Foot and Sport orthopedic surgeon, ICP (Institute of Foot Surgery) Blomet Clinic, Paris (France)




What are the main criteria that made you choose the OEC Elite Miniview C-arm for foot surgery at the Blomet Clinic in Paris?

My partners and I at ICP Paris tested several mini C-arms in accordance with our buying process. The two main criteria that brought us to select the OEC Elite Miniview C-arm are image quality and arm mobility.

The image that we obtain with our OEC Elite MiniView is clear, in particular at the level of the ankle, which is my concern as the surgery of the ankle accounts for a large proportion of the procedures I perform. With some other mini C-arms, we do not see the ankle because the beam is not powerful enough to pass through it. With the OEC Elite Miniview, the beam penetration is sufficient to provide a clear image with the details of the small bones of the ankle.

The flexibility of the articulated arm allows me to position the system in the axis of the patient's legs, at the end of the patient table, instead of placing it on the side of the patient bed, as is the case with other mini C-arms. This setup, in the prolongation of the patient's legs, is more comfortable for the surgeon. With my assistant we can sit on each side of the foot and change position. Once the OEC Elite Miniview is in place, I do not move its base anymore. To acquire the images, I simply move the articulated arm and I can automatically lock and unlock it with one button. The articulated arm can be pushed away from the operating zone and parked quite easily.

Image quality and maneuverability are the two most important criteria for my foot surgery activities. I now use fluoroscopic imaging guidance and control for at least 40% of the several hundreds of procedures I perform per year.

Can you describe the main procedure in foot and ankle surgery for which you need to use fluoroscopy?

In this department, we use fluoroscopy in all ankle arthrodesis procedures (subtalar, talocalcaneal, tibiotalar) to verify the length of the screws and the bone mating after fusion. One colleague is specialized in percutaneous-access surgical techniques in the hindfoot and midfoot. Because the incisions are the smallest possible, he needs continuous fluoroscopy control to guide his tools while doing osteotomies and milling.

In my specialty of sport medicine, I also use fluoroscopy extensively for the treatment of the ankle, as for example when I treat the osteochondral lesions of the talus (Talus Dome Lesions TDL). Recent treatments consist of injecting medullar stem cells at the basis of the necrosis of the talar bone to stimulate the regeneration of the cartilage. The injection is done after the curettage is performed via intra-articular access. As the injection point is difficult to reach, I guide the insertion of the needle using fluoroscopy to go underneath the TDL.

> *"Image quality and maneuverability are the two most important criteria for my foot surgery and the OEC Elite Miniview allows me to see the small details of ankle bones."*

There are several other procedures where I use fluoroscopy such as the treatment of strong tendinitis of the calcaneus (see the clinical illustration below). In this procedure, the approach is minimally invasive to be able to inject stem cells and boosters. I need to use fluoroscopy because it is very difficult to see the calcaneus, and I need to make sure its axis is correct after the osteotomy.

In forefoot and midfoot surgery, hallux valgus deformity surgery, and with the Lapidus procedure, we systematically use fluoroscopy. The goal of the surgery is to stabilize the first metatarsal (M1) at its basis with the cuneiform bone C1, to maintain it at the right location while there is hyper-laxity of the tendons. We do not need a large number of images, but after completing the wedge resection and closing, we need to verify the axis of the metatarsal bones (M1 and M2). Today we know that the metatarsal head has to be in the same axis as M2 so it can regain its role of support for the other metatarsals. If this geometry is not maintained, there will be a relapse of the deformation. We therefore check the positioning of the M1 head and the axis of the head using fluoroscopy. We then verify the length of the screw put in place.

In some ankle-trauma surgical procedures, often caused by motorcycle accidents, or in post-trauma treatment when there is a luxation of the ankle, we need to precisely verify the anatomy of the foot using fluoroscopy.

How are foot and ankle surgery techniques evolving and what are their fluoroscopy needs?

Foot surgery centers are not as well developed as hand surgery centers, maybe because there are no acute pathologies of the foot, and there are *no emergency networks of foot surgery units. While all orthopedic surgeons are trained to perform foot surgery, it is important to emphasize that the anatomy of the foot and the ankle is particularly complex. Surgery techniques to address congenital deformities, neurological dysfunctions, or sport pathologies must be performant to ensure the most performant patient outcome. Many minimally-invasive techniques are being developed, which require guidance using fluoroscopic imaging.*

About 20 years ago, we started performing minimally-invasive techniques, which were brought to Spain by Dr. Mariano de Prado from American podiatrists (forefoot surgeons). He demonstrated that this type of surgical access ensures the preservation of muscles and tendons, and he started to train other European surgeons in the use of the technique. My partners and I trained with him and to sustain this best practice of evaluating and validating minimally-invasive foot and ankle surgery, we created an international association made up of orthopedic surgeons called GRECMIP. Today foot surgery requires multidisciplinary techniques (percutaneous, minimally invasive and open access surgery). One mission of GRECMIP is to provide training in the most appropriate techniques to treat a given pathology.

With this goal of developing the ankle and foot surgery specialty, we decided to create this center of excellence in Paris (ICP Blomet Clinic). We recruited surgeons from different regions (Paris, Lyon, Bordeaux, London) based on specific surgical skills. The goal of the team is to contribute to the development of new surgical techniques, and new implants for the surgical treatment of the foot and ankle. Currently we are working on the development of new procedures based on stem cell therapy.

Today foot and ankle surgery is codified and validated. We see an increase in the demand for procedures because we can now offer better treatment.

I was able to develop foot and ankle surgical management for professional athlete, thanks to minimally invasive surgical techniques. This is a very interesting domain in continuous development. The pathologies of professional athletes are very specific, and the surgical techniques need to be tailored to this. Once validated, these surgical techniques can be beneficial to other traditional patients.

Dr. Christophe Cermolacce is an orthopedic surgeon. In 1992, he completed his fellowship with Pr. Groulier (University of Marseille) in orthopedic surgery. An associate of Pr. Franceschi, he specialized in the surgery of the foot, a discipline that was not recognized at that time. He trained in the United States with foot surgery specialist Dr. Weil, and in France with Dr. Barouk who brought a new forefoot bone procedure from the US, the so-called Scarf technique (for hallux valgus deformity). Dr. Cermolacce started his foot surgery activities with these procedures in Marseille and joined the Clinique Juge focusing on orthopedic surgery of the lower limbs.

From his collaboration with Pr. Franceschi, he developed his interest in sport surgery, estimating that minimally-invasive surgery techniques should be considered to manage sport injuries. Dr. Cermolacce is consulted by professional athletes from Marseille's soccer team (Olympic de Marseille), as well as local basketball and rugby clubs, for ankle sport pathologies. His goal is to develop a similar activity in the Paris area. This year, he will join the team managing Stade of France athletes.

Surgical excision of accessory navicular bone in a dancer's foot

Challenge

A 25-year-old female presented with chronic pain due to synchondrosis development between the accessory and the navicular bone. Diagnosis was confirmed by MRI (see Figure 1).
Examination showed the prominence of the navicular bone from the head of the talus.
Conservative therapy (physical and medication) gave inconclusive results. The patient approached the clinic for minimally-invasive surgical treatment using a surgical technique recommended for athletes and which has become increasingly prevalent over the last few years.
The procedure consists of the excision of the accessory navicular bone leading to the reduction of its prominence. The surgical procedure is followed by physical therapy to reinforce musculature.

Procedure

Surgery for this pathology is the last solution after conservative treatments, to reduce the pain, and recover mobility. It is very important for the athlete going through surgery to recover as fast as possible in order to go back to her training activity. While structural bone recovery can be obtained within six weeks, the physiological recovery requires an additional three months. Stopping training over such a long period (five to six months) can be very disruptive for high-level athletes. This is why they turn to sport surgery techniques, which are less invasive.
Minimally-Invasive Surgery techniques, combined with stem-cell treatment, allows a return to training two months after the surgical intervention.
Stem-cell treatment allows a decrease in the healing time of the osteo-cartilaginous wound. This consists of the injection of Platelet-Rich Plasma (PRP) in the lesion created by the bone resection.
PRP is obtained by collecting a blood sample that is processed by centrifuging to obtain a serum in which periostin protein, an osteogenic agent, is concentrated.
PRP is harvested in the operating room before starting patient anesthesia. It is implanted over the bony wound after surgery, before suturing the skin incision.
A final verification of the bone excision is performed using fluoroscopy (see Fig. 2).
The small footprint of the OEC Elite MiniView C-arm allows it to stay in the OR and not interrupt the procedure workflow. The articulation of the arm allows an easy and fast positioning of the C-arm over the patient's foot at the end of the patient table.

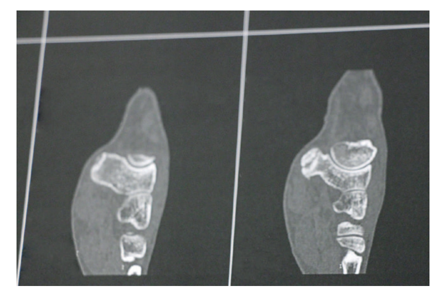

Fig. 1 MRI of the foot showing the disunion of the accessory navicular bone from the navicular.

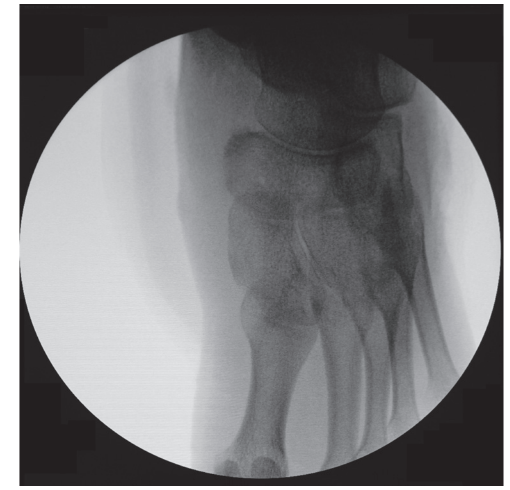

Fig. 2 Final verification showing complete removal of the accessory navicular bone.

Conclusion

The procedure was performed in ambulatory care. The total procedure duration was about 30 minutes. The patient was able to return home the same day of the operation. At the follow-up consultation, the pain had considerably subsided. Patient resumed her professional dancing training two months after surgery.

The statements by GE's customers described here are based on their own opinions and on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist, i.e. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results.

Calcaneus osteotomy to correct congenital elongation and Haglund's deformity

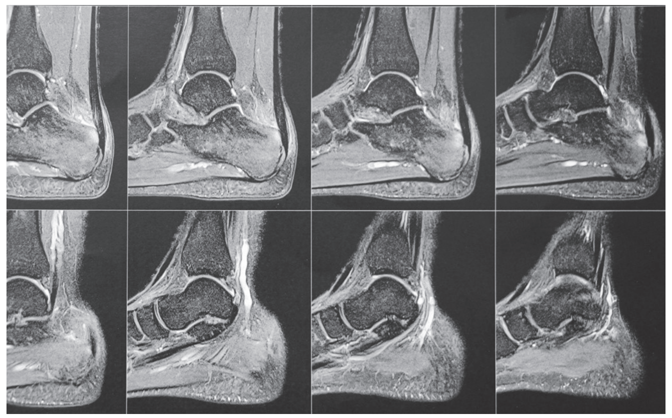

Fig. 3 Sagittal MRI view of the heel.

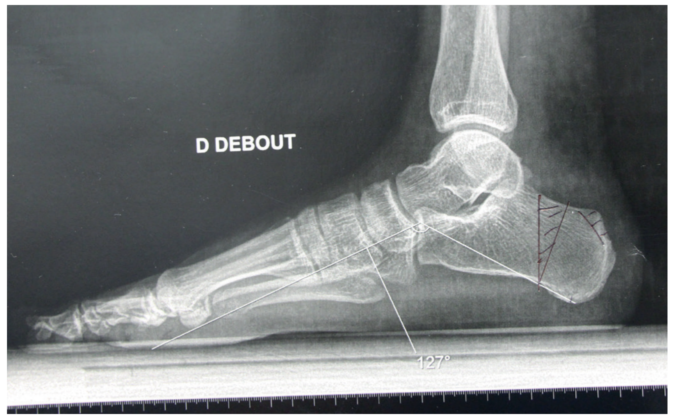

Fig. 4 Lateral X-ray image for surgery planning.

Challenge

A 37-year-old male was admitted for surgical treatment of a congenital elongation of the calcaneus bone of the right foot, causing chronic Achilles tendon tendinopathy. Diagnosis was confirmed by MRI (see Figure 3) showing a thicker Achilles tendon, calcaneal bursitis, and Achilles tendinosis.
The treatment selected was calcaneal osteotomy and calcaneus fixation with internal screws, through a minimally invasive approach.
Fluoroscopic imaging was used to check the line of bone resection and the offset of the alignment of the calcaneus after osteotomy to ensure that the vertical axis of the calcaneus was preserved. As the approach was minimally open, this verification cannot be performed visually.

Procedure

The procedure consisted of the removal of a triangle of bone, the closing of the bone wedge, and the anchoring of the calcaneus with two screws to stabilize the osteosynthesis. The approach was minimally open to permit the injection of PRP in the lesion created by the bone resection.
The patient was put in prone position with the C-arm positioned at the end of the patient table in the axis of the legs. The procedure was performed under general anesthesia.

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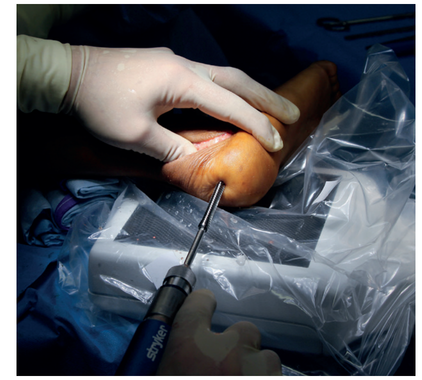
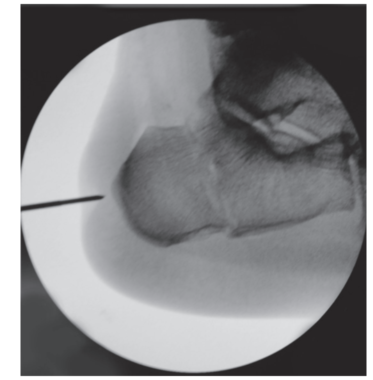
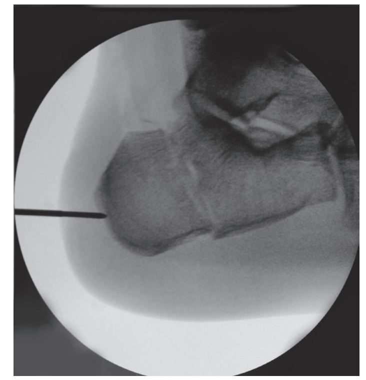
Definition of osteotomy line – calcaneus profile view.

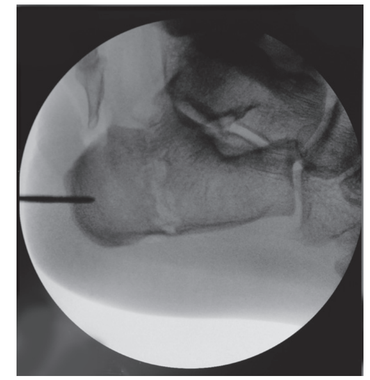




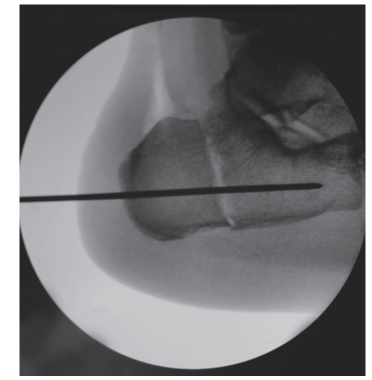
Drilling of the calcaneus under fluroscopic imaging guidance.



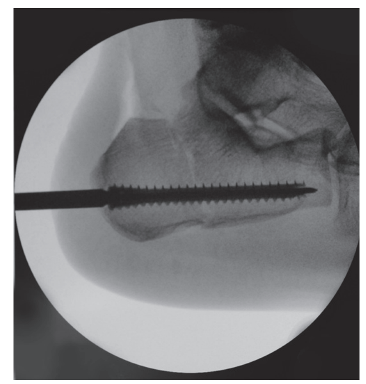
Drill final positioning and orientation for the first screw.



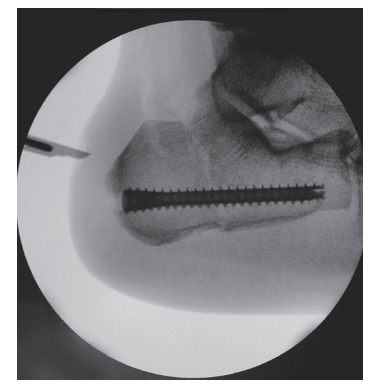
Drill progression in the distal area of the calcaneus.



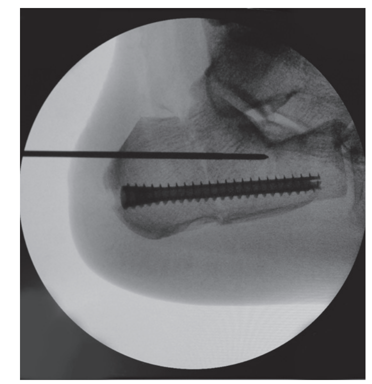
Drill progression in the proximal area of the calcaneus.



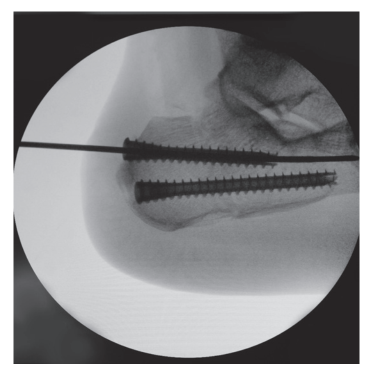
First screw placement.



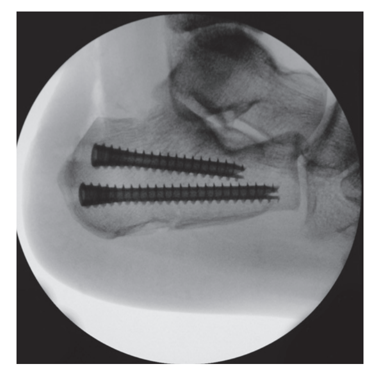
First screw placement.



Entry point definition for second screw.



Second screw placement.



Final verification image of calcaneus anchoring.

Conclusion

OEC Elite MiniView was set in continuous fluoroscopy and low-dose mode.
The total procedure duration was about 40 minutes.
The total fluoroscopy time was 13.8 seconds and total Dose Area Product was 0.0111 Gy.cm².
The patient was able to return home two days after the operation. The functional rehabilitation for walking was completed after one month. Upon careful osteotomy consultation, re-athletisation was completed within three months after surgery.