oriented fibers of the aponeurosis are separated to expose muscle fibers of the flexor digitorum brevis muscle. These muscle fibers are then separated and retracted to expose the flexor digitorum longus tendon.

The identity of the tendon is verified by applying a pulling tension on the tendon through the proximal wound in the hindfoot and assessing transmission of the tension distally to the tendon identified in the midfoot and at the same time observing maximal flexion either in lesser toes or the great toe. The tendon is then cut sharply in the midfoot and the cut end pulled proximally through the wound in the hindfoot region.


**10:20-10:30 am - Minimally Invasive Calcaneus Fracture Fixation: European Experience**

Stefan Rammelt, MD, PhD
Dresden, Germany

Percutaneous reduction and screw fixation of calcaneal fractures aims at reducing the risk of wound complications and postoperative scarring as compared with open reduction via extended approaches. It is a suitable treatment for extra-articular and selected intra-articular calcaneus fractures provided anatomical reduction of the posterior calcaneal facet can be achieved.

The method of closed reduction with percutaneous pin leverage ("Essex-Lopresti reduction" in the English-speaking literature) was introduced by the German surgeon Westhues in 1934. This method has found reappraisal for less severe fracture patterns, like Sanders type IIC fractures, with the posterior facet being displaced as a whole. When applying this method to Sanders type IIA and IIB fractures, anatomic reduction of the posterior facet should be controlled with intra-operative subtalar arthroscopy or 3D fluoroscopy because subtalar joint congruity is highly predictive of the functional outcome.

Percutaneous reduction and screw fixation may also be a treatment alternative even in more severe fracture patterns (Sanders types III and IV) in patients with contraindications to open reduction and plate fixation (i.e. critical soft tissues, immunodeficiency, high perioperative risk).

Ideally, surgery should be performed within 3 to 5 days after the injury before the formation of excessive clots and fibrous adhesions makes percutaneous reduction difficult. Patients should be compliant with the postoperative protocol of partial weight-bearing and early active range of motion exercises for the ankle and subtalar joints in order to benefit from this type of treatment. Hardware removal is required for prominent screw heads only.
Fig. 1 (A) Reduction of the tuberosity fragment is achieved out with percutaneous leverage through a Schanz screw with handle (1). The amount of correction of the tuberosity-joint-angle (Böhler’s angle) and varus or valgus deformity is controlled fluoroscopically. The lateral posterior facet fragment is manipulated percutaneously with a smooth or sharp elevator (2), a pestle (3), or Kirschner wires. The lateral posterior facet fragment is disimpacted and tilted gently and then aligned to the medial fragment of the posterior facet at the joint level under arthroscopic control (4). (B) The fragments are fixed with three to six cannulated cortical screws introduced percutaneously via stab incisions (adapted from5).

Fig. 2 Arthroscopic control of percutaneous reduction and the corresponding coronal CT-scans before (A) and after (B) reduction.

If anatomical reduction by means of percutaneous manipulation is impossible because of deep impaction of the posterior facet fragment or soft tissue interposition, open reduction via a lateral approach becomes
necessary. To avoid severe soft tissue problems, the surgeon should not be overly zealous to achieve percutaneous reduction and increase swelling with repeated frustrating reduction attempts before converting to open reduction.

Starting in 1998, our group performed percutaneous reduction and screw fixation in 61 patients with Sanders Type II calcaneal fractures. In 33 displaced fractures through the posterior facet (Types IIA and IIB), anatomic reduction of the subtalar joint was confirmed arthroscopically. No wound complications or infections were seen. A prominent screw was removed in two patients, another patient underwent arthroscopic arthrolysis after one year. When comparing these patients to a historic cohort of 18 patients treated with open reduction and internal fixation via an extended lateral approach for Type II calcaneal fractures, the AOFAS scores after two years were comparable (92.1 vs. 88.2) and the calcaneal shape had been restored in both groups. The patients from the percutaneous treatment group had significantly less time off from work and better range of motion at the subtalar joint at follow-up.

Other European authors have reported favorable results with percutaneous reduction and fixation regardless of the type of fracture. Methods include external fixation with a three-point distractor, Steinmann pins, and Kirschner wires. Because of the different outcome measurements, no general conclusions can be drawn. Historically, Kirschner wire fixation resulted in articular step-offs in plain radiographs in 37% and some loss of reduction in 71% of cases. Although these numbers could be reduced substantially in the more recent series, percutaneous reduction of severely displaced, complex fractures carries the considerable risk of residual joint incongruity with an inferior functional outcome.

References