Tibio-calcaneo-naviculo-cuboidale arthrodesis

6 patients followed for 1–8 years

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ABSTRACT – As a salvage procedure for patients with irreparable damage to the peritalar anatomy, we used a new method, the Ilizarov ring fixator, to stabilize a tibio-calcaneo-naviculo-cuboideal (TCNC) arthrodesis after resecting the talus in 6 patients with an average follow-up of 3 years. The tibia was lengthened by callus distraction, mean 6 (3.5–10) cm.

Patients with exacerbation of a chronic talar osteomyelitis, symptomatic posttraumatic changes, and those with extremely unstable club feet and talar deformity preventing an adequate reduction of the joint, were successfully treated with the TCNC-fusion. The method permits early weight bearing, while providing stability and compression of the fusion, thereby avoiding further loss of bone stock.

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Methods for arthrodesis of the ankle and/or the subtalar joint have given unsatisfactory results in patients with necrosis, sclerosis, infection, dysplasia of the talus, and complex deformities of the foot. The Ilizarov technique has been used for ankle fusions in patients with problems not permitting the use of conventional procedures (Ilizarov 1992, Johnson et al. 1992). We describe a new method, which simplifies treatment after removal of the talus.

Method

The new procedure consists of removal of the talus, creating a rabbet and shifting the foot posteriorly on the tibia. This leads to osseous contact between the tibia, calcaneus, navicular and cuboid (tibio-calcaneo-naviculo-cuboideal (TCNC) arthrodesis) (Figure 1). The Ilizarov fixator with inclusion of the foot is used for fixation of the tibiotarsal fusion and permits simultaneous callus distraction of the proximal tibia to correct leg length.

Surgery

We use an anterolateral longitudinal incision beginning 8–10 cm proximal to the joint line at the level of the fibula and ending at the lateral tarsometatarsal joint. The distal third of the tibia, ankle and talonavicular joint are exposed. The lateral malleolus is resected proximal to the joint line with the osteotomy angled towards the medial cortex, while sparing the syndesmosis. The soft tissues are dissected subperiosteally from the ventral and dorsal surfaces of the distal tibia, the navicular and cuboid bones. The talus is freed from the adhering capsular and ligamentous structures. Sharp bone forceps can be used to dislocate the talus. Next, the tissues are dissected subperiosteally from the medial tibia, including the medial malleolus. Hohmann's retractors are introduced to protect the adjacent structures. The distal tibial joint surface, including the medial malleolus, is resected until bleeding trabecular bone can be seen. Now the foot can be placed on the tibial surface to delineate the resection planes of the calcaneal, navicular and cuboid bones. The resections are carried out sparingly, but with complete removal of the joint cartilage. To obtain optimal alignment of the foot, the tibial surface should be cut so as to form a rabbet. For proper contact with the resection areas of the navicular and cuboid bones, the ventral tibia is resected and

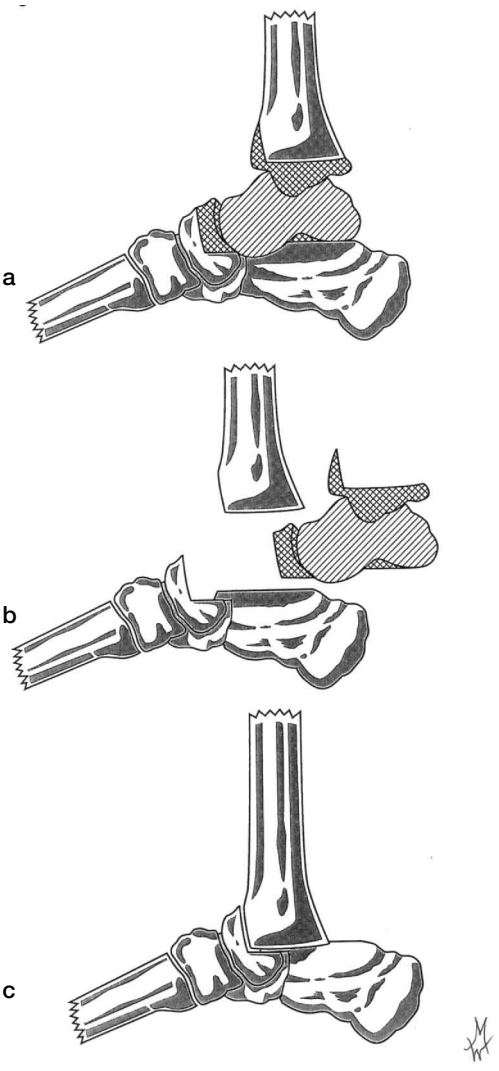


Figure 1. Resection planes for tibio-calcaneo-naviculo-cuboidal (TCNC) arthrodesis.

the tibia is advanced over the calcaneus until contact is obtained (Figure 1). Care must be taken to ensure proper alignment of the foot in all planes, when compared to the healthy contralateral foot. A temporary fixation is done with K-wires inserted from the plantar aspect into the tibia in 10–15° of external rotation. The tourniquet can be released and hemostasis carried out.

The prepared Ilizarov frame is placed in position. The proximal tibia is stabilized proximally in an appropriately-sized 5/8-ring (open dorsally for better knee motion) connected to a full ring at a distance of 4 cm distally. In patients with good bone stock, the use of two proximal 5/8 rings may be enough to permit full flexion of the knee joint. Between the two segments of the callus distraction, 3–4 distractors (depending on the size and weight of the patient) are interposed. The rings are fixed to the bone with percutaneously-drilled transosseous wires under tension or half-pins. The foot is stabilized with the help of dual half rings and connection plates in the shape of a horse shoe. Two crossed-beaded wires are introduced into the calcaneus and the metatarsals are fixed with 2 countered beaded wires. Afterwards, the foot construct is attached to the tibial ring system with the help of threaded rods and placed under compression (Figure 2). The procedure ends with a proximal metaphyseal corticotomy of the tibia and osteotomy of the fibula. Early functional weight-bearing is permitted postoperatively. An orthotic custom-made sandal is attached to the ring system to permit easy ambulation. After 10 days, callus distraction of 1 mm/day is started with four partial turns a day. Depending on the amount of resection required, the leg length discrepancy amounts to 3.5–6 cm. When planning the leg length correction, the 1.5 cm required for shoe modification must enter into the equation. Once the callus has consolidated, the frame is dynamized before its removal.

Results

We have operated on 6 patients with this method; 2 because of septic arthritis of the ankle and 4 for changes secondary to malformation, deformity or trauma (Table; Figure 3). They have been followed for mean 46 (16–96) months. All fusions healed, while in one instance, the callus distraction of the proximal tibia was slow to mature (Figure 4).

The fixator was removed after mean 12 (7–16) months. Pin infections (all patients) and wire breakage (2 patients) were common complications due to the extended periods the fixator had to remain in place. Thanks to meticulous pin care and the use of antibiotics, surgical revision was required in only one instance.

The patients were satisfied with the outcome; 4 had no pain and all could bear full weight on the affected foot. None of the patients needs custom-made orthopedic footwear (Figures 5 and 6).

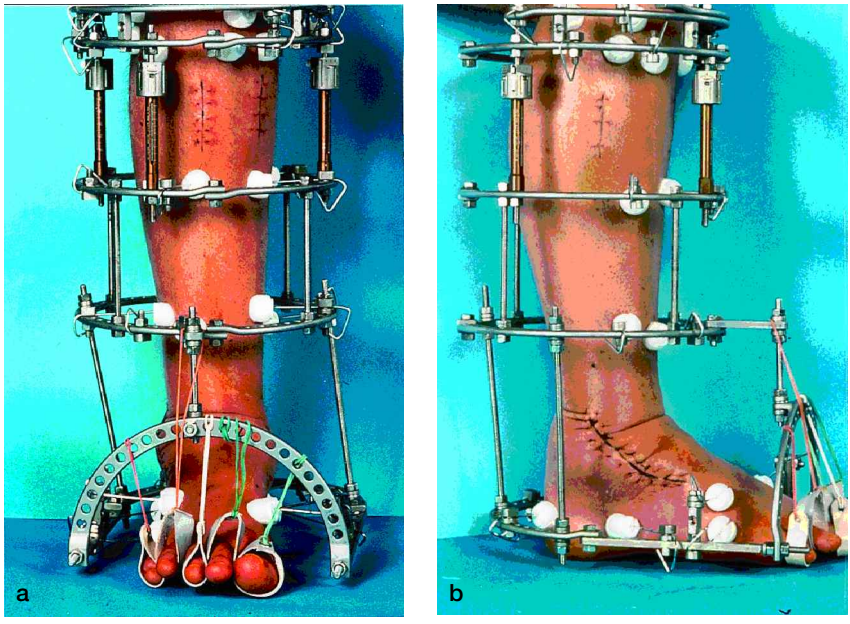


Figure 2. The Ilizarov frame shown from the anterior (a) and lateral (b) aspects. The proximal tibial segment is stabilized with two 5/8-rings; the distal segment is held by 2 full rings. Both segmental constructs are connected with 4 distractors. The foot is stabilized in a horse shoe construction (case 3).

Patient data

A	B	C	D	E	F	G	H	I	J	K	L
Chronic talar osteitis											
1	52	m	R	after failed fusion for talar osteo-necrosis	1	septicopyemia diabetes type I gout	4.5	9.5	96	pin infection (revised)	infection subsided, WB asymptomatic
2	62	m	R	after failed fusion	1	diabetes type I	6.5	16	50	wire breakage (no revision)	infection subsided, WB asymptomatic
Posttraumatic arthrosis											
3	34	m	R	pantalar arthrosis after open fracture	11	talar osteo-necrosis	5	9.5	29	wire breakage (no revision)	satisfactory full WB
Neuromuscular club foot											
4	44	f	R	neurological club foot	congenital	peroneal paralysis	3.5	7	16	delayed maturation of callus	satisfactory full WB
5	40	m	R	poliomyelitis club foot	acquired at age 4	leg hypotrophy and paralysis	6	15	19	wire breakage (no revision)	full WB asymptomatic
Congenital foot deformity											
6	22	m	L	talar dysplasia, flail foot	congenital	fibular hemimelia	10	14	67	pin infection (no revision)	WB asymptomatic

A Case
B Age
C Sex
D Side
E Diagnosis
F Intervall to injury or index operation, years
G Concomitant disease
H Distraction, cm
I Fixator period, months
J Follow-up, months
K Complications
L Outcome (WB weight bearing)

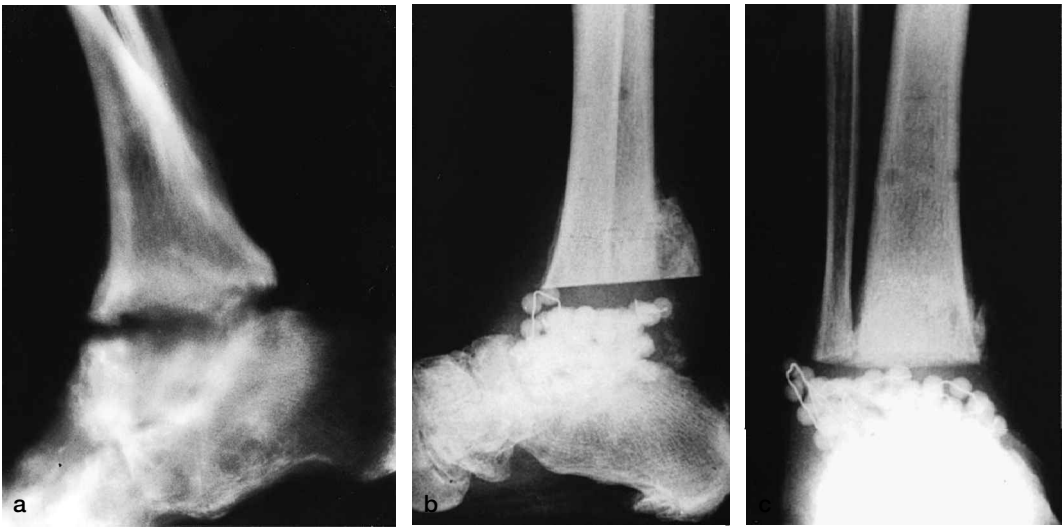


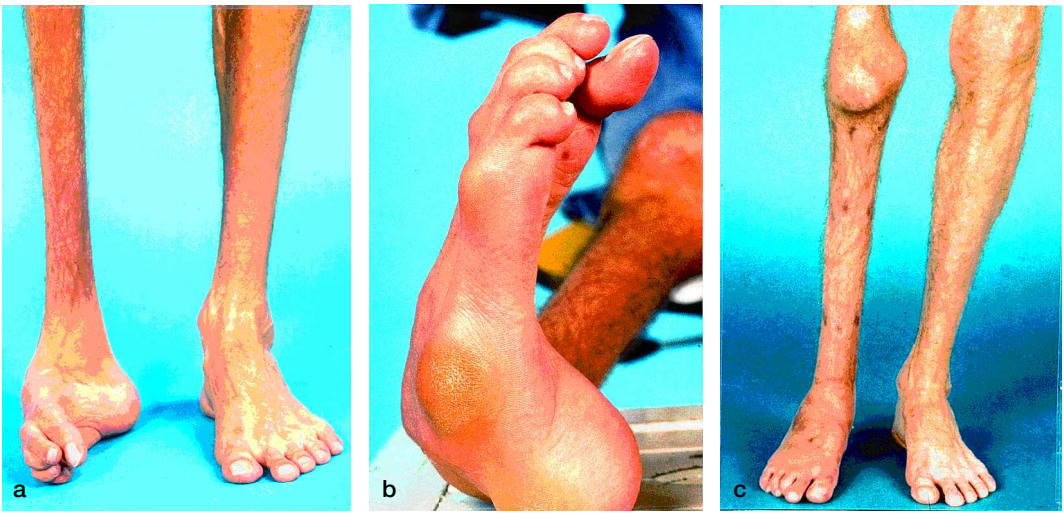
Figure 3. Case 2. (a) chronic talar osteitis after failed upper ankle fusion using the Charnley technique (tomography, lateral view). (b) lateral view and (c) anterior view after resection of the talus, debridement and temporary packing with PMMA beads, as well as resection of the distal tibia. With subsidence of the infection, the TCNC arthrodesis was completed.

Figure 4. Case 3. 1 year after removal of the fixator showing complete consolidation of the fusion and intact Lisfranc joint (lateral view).

Discussion

Previously described techniques for arthrodesis of the ankle are dependent on good bone quality of the talus (Greifensteiner et al. 1948, Charnley 1951, Müller 1978a, Hefti 1981, Mittelmeier and Nizard 1981, Wagner and Pock 1982). If there is deformity, necrosis, sclerosis, osteitis, sequestration, etc., the outcome with standard fusion procedures becomes unfavorable (Moore et al. 1995, Janis et al. 1996). With chronic osteomyelitis of the talus, the likelihood of healing is minimal (Müller 1978a). To resolve this type of septic arthritis, removal of the focus or rather removal of the infected talus may become necessary. An astragalectomy has also been described as a treatment for severe neurogenic club feet. The procedure permits plantigrade positioning of the foot, but an unstable ankle requiring orthotic management results. Occasionally, such situations can only be treated by amputating of the leg (Müller 1978b, Hawkins et al. 1994). An Ilizarov ankle fusion has also been described as a salvage procedure (Johnson et al. 1992).

With the surgical procedure we describe, all the above-mentioned problem cases are manageable with few complications. Although the ring fixator remains in place for a long time and the prevalence



Figures 4. Case 5. (a) A 40-year-old man with extreme neurogenic clubfoot secondary to poliomyelitis during childhood. (b) Weight bearing surface was on the lateral aspect of the foot. (c) Outcome after TCNC-arthrodesis and tibial lengthening of 6 cm.

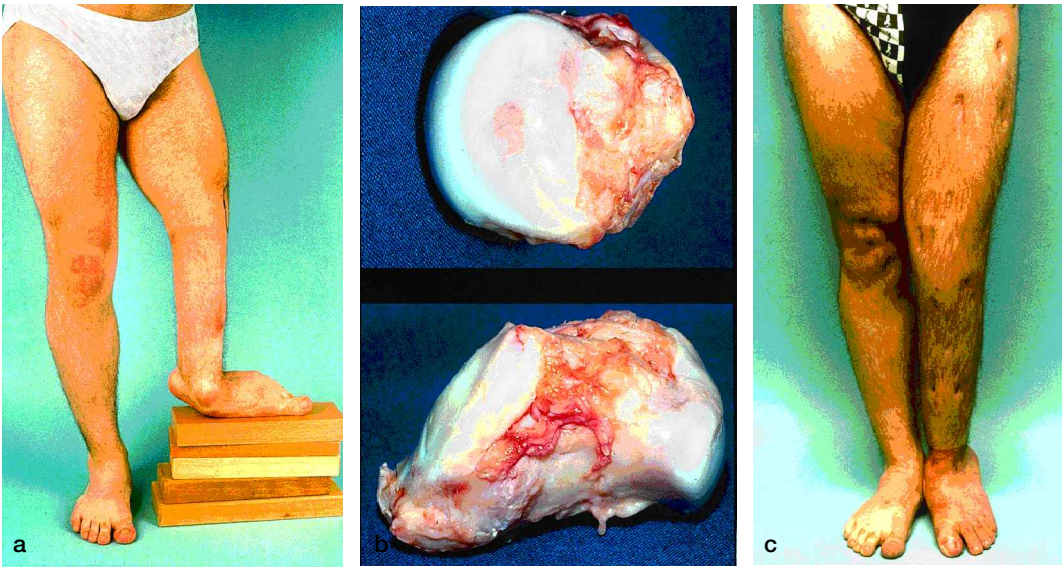


Figure 5. Case 6. (a) A 22-year-old man with fibular hemimelia, leg length discrepancy of 10 cm and ankle instability. (b) Secondary dysplasia of talus with flattening of the bone (lower picture) and cartilage defect (upper picture). (c) 1 year after removal of fixator; asymptomatic with full weightbearing.

of infection at the pin sites is high (all reported cases), meticulous pin care and the rational use of oral antibiotics reduces the need for surgical revision (1 ring level in 1 case). A late pin breakage was seen in two instances, in neither case was a replacement required. In 4 of the cases (patients 2, 3, 5, and 6) with lengthening of 5 cm or more, the callus distraction led to a temporary flexion contracture of the knee. Such problems can be managed with the help of intensive physical therapy and a Dynasplint (Polytech Silimed Europe, Dieburg, Germany), a brace mounted on the ring fixator with a spring mechanism that passively places the knee in extension, while permitting active flexion.

All patients are presently walking long distances painfree in modified shoes with an arch support.

Only one reported pain at the Lisfranc-joint line. It is not surprising that, after a fusion of the ankle, subtalar and Chopart joint, the adjacent Lisfranc joint is more loaded due to compensatory motion. The progression of the degenerative disease of the Lisfranc-joint should be periodically assessed because this joint compensates for the loss of motion in the ankle joint after TCNC-arthrodesis. Generally, the patients report a vast improvement in their ability to walk, even with the ring system in place, compared to their preoperative state.

To the best of our knowledge, no similar method has been described in the literature. Johnson et al. (1992) reported four patients with failed infected ankle fusion, where an arthrodesis was stabilized with an Ilizarov construct. They carried out two tibiocalcaneal fusions, but did not resect the Chopart joint as required with our method. Simultaneous leg lengthening by distraction osteogenesis was also not done (Johnson et al. 1992). Kitaoka and Patzer (1998) reported good results in 2 cases after tibiocalcaneal arthrodesis stabilized with a Hoffmann device because of complete osteonecrosis of the talar body secondary to fracture. Hawkins et al. (1994) reported 21 patients with complex ankle pathology and fusion of the ankle joint with the help of the Ilizarov external fixator. They did a tibiotalar fusion, while simultaneously lengthening the tibia. Solidly fused ankles were obtained in 16/20 patients on follow-up.

Our new fusion method offers distinct advantages compared to conventional procedures, especially when the bone stock of the talus is poor or when foot deformities require complete removal of the talus for an adequate correction. Our follow-up is short and more observation will undoubtedly be necessary. This tibio-calcaneo-naviculo-cuboideal (TCNC) fusion can be used for the complete spectrum of ailments of the talus and/or ankle.

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