CHAPTER **14**

SINGLE STAGED CORRECTION OF THE DIABETIC CHARCOT EQUINOCAVOVARUS DEFORMITY: Internal versus External Fixation

Stanley Kalish, DPM, FACFAS
John Ruch, DPM, FACFAS
Dorian Jimenez, DPM

Diabetic Charcot malformations present a complex and challenging situation for the foot and ankle surgeon. As with all neuroarthropathic dislocation deformities, early recognition and complex management provide the greatest opportunity for successful outcomes. The standard of care continues to be prolonged non-weight bearing with immobilization in the early phases of diabetic neuroarthropathy.[1,2] Unfortunately, initial patient presentation may involve fixed deformities requiring more extensive treatment considerations. This discussion is concentrated on surgical stabilization of the rigid diabetic Charcot equinocavovarus deformity.

Conservative treatments provide temporary, palliative relief of deformity manifestations. Such treatment modalities may consist of padding, bracing, casting and local wound care in an attempt to slow progression and decrease complications related to the primary pathology. While "conservative" most often implies non-surgical therapies, "lump and bump" procedures do not address the underlying deformity and should not be grouped into the surgical category. The nature of the rigid equinocavovarus deformity lends itself only to intense surgical intervention if complete correction is the desired goal.

Throughout the literature, a variety of surgical approaches have been described to tackle the severe diabetic neuropathic destruction of joints. These include midfoot arthrodesis, major hindfoot arthrodeses, tibiotalar arthrodesis, stabilization with external fixation devices, talectomy and various amputations.[3-11] Limb salvage and prevention of amputation is a major goal of Charcot foot reconstruction. It has been reported that 55% of individuals treated with amputation undergo a second amputation in less than five years.[12]

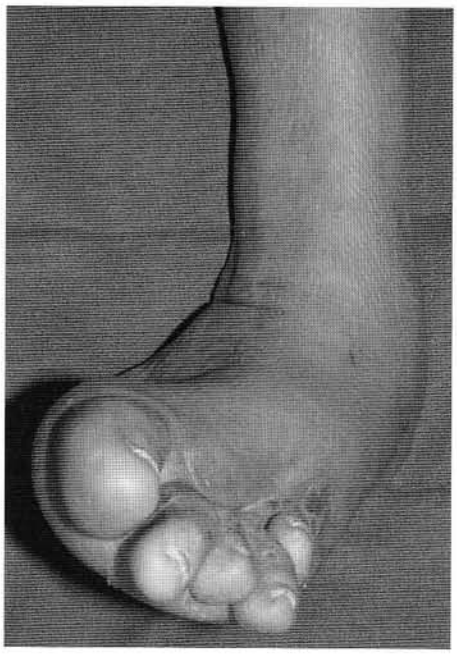
In the following two brief case studies, talectomy is utilized to achieve desired correction of the rigid equinocavovarus deformity. Once touted as a valuable surgical approach for clubfoot surgery in children too young for a triple arthrodesis, talectomy is accepted as a powerful tool for correction of the rigid adult equinovarus deformity. Coupled with tibiocalcaneal arthrodesis, maintenance of position is accomplished helping to create a stable, plantigrade surface for ambulation. Our paper outlines procedure and compares internal versus external fixation in talectomy coupled with tibiocalcaneal arthrodesis as a single stage in carrying out this complicated reduction.

CASE PRESENTATION 1

A 56-year-old male presented with a "gradually progressive" equinocavovarus deformity of both lower extremities. The left was affected to a greater degree than the right side (Figures 1-4). The past medical history of the patient was remarkable for long standing diabetes mellitus with profound peripheral neuropathy, chronic ulcerations, infections and osteomyelitis. He had undergone multiple relatively minor surgical procedures due to diabetic complications over a period of many years. Approximately one year prior to presentation, the patient was involved in a motor vehicle accident which worsened the already existing deformity of the left foot. Following the accident, the patient was referred for surgical consultation after conservative therapy had failed. A nonreducible varus dislocation of the ankle joint was present involving the left lower extremity along with rigid equinocavovarus deformity (Figure 5). The patient elected for surgical correction of the left lower extremity.

CASE PRESENTATION 2

A 66-year-old female presented with a chief complaint of a large chronic non-healing ulceration about the plantar lateral aspect of the left foot along with a worsening club-foot-type deformity (Figures 6-9). As in Case 1, the



Figures 1. Case 1. Preoperative clinical photos and radiograph demonstrate fixed cavoadductovarus deformity of the left foot with varus dislocation of the ankle. Note evidence of previous surgical intervention and absence of open lesions clinically. Radiograph shows severe degree of ankle varus as well as fragmentation about the ankle joint.

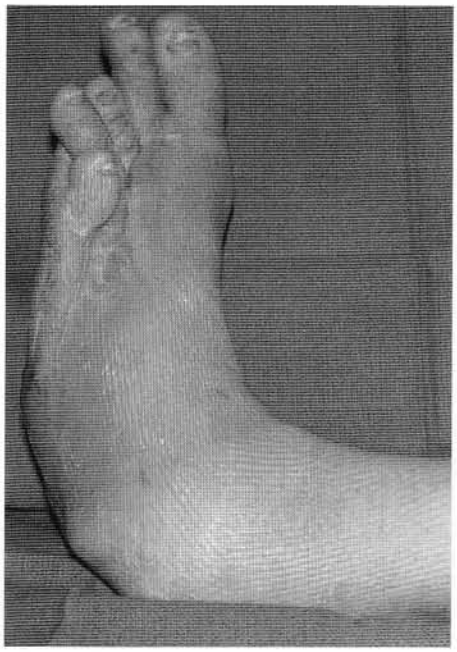


Figure 2. Case 1.

Figure 3. Case 1.

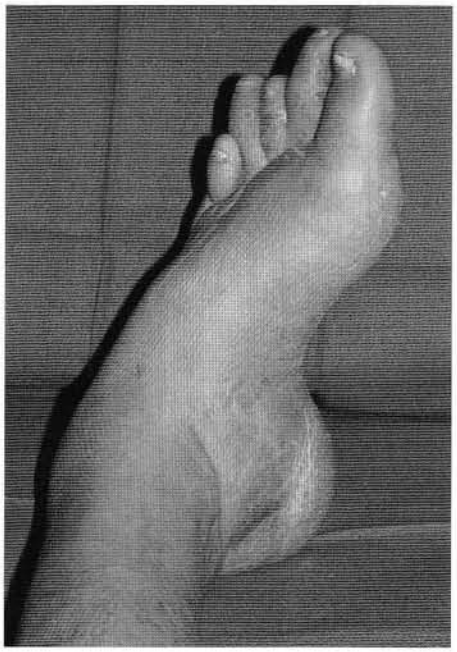


Figure 4. Case 1.

Figure 5. Case 1. Note severe degree of ankle vargus as well as fragmentation about the ankle joint.

Figure 7. Case 2.

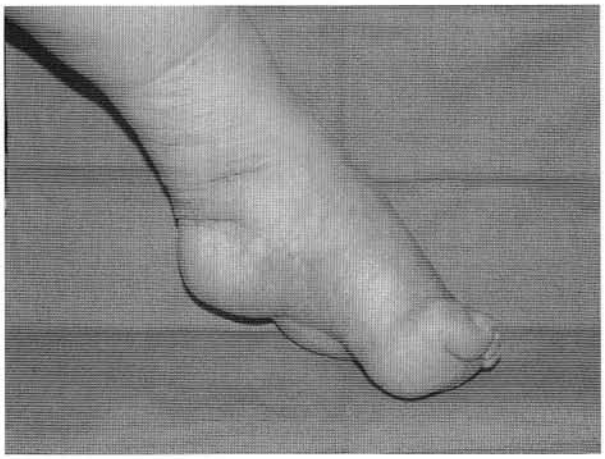
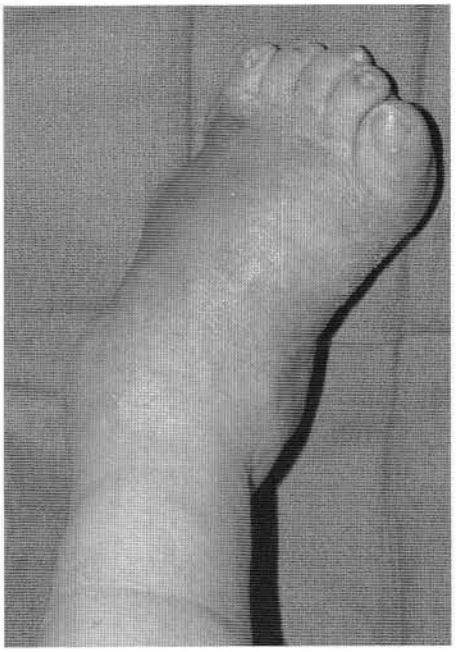


Figure 9. Case 2.



Figures 6. Case 2. Preoperative clinical photos and radiographs reveal significant ankle equinovarus deformity as well as cavoadductovarus deformity of the foot. A large ulceration is present about the fifth metatarsal base. Fragmentation of the ankle joint is demonstrated radiographically.

Figure 8. Case 2.

patientís past medical history was significant for long standing diabetes mellitus. She had previously undergone unsuccessful surgical resection of the ulceration on two occasions. At the time of presentation, she was unable to ambulate without assistance and utilized an electric wheelchair for daily activities. She had failed multiple conservative treatment modalities and was performing local wound care for the persistent ulceration. Orthopedic examination revealed approximately 35 degrees of fixed left ankle equinus with non-reducible cavovarus foot deformation (Figures 10, 11). The talar head was prominent over the lateral rear foot. A deep ulceration was present encompassing a large area of the lateral aspect of the left midfoot.

Figure 10.

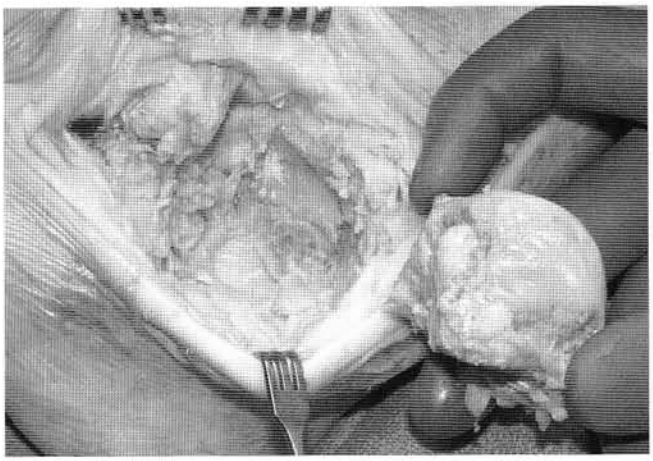
Figure 11.

OPERATIVE TECHNIQUE

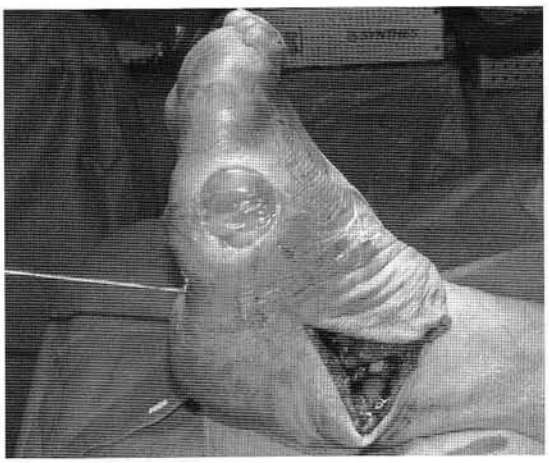
Both surgical cases utilized a single lateral incisional approach extending approximately 10 centimeters overlying the distal fibula and lateral midfoot. A fibular osteotomy was carried out removing the distal 6-8 cm of fibula in order to access the talus. With the extreme deformity present, it was elected to remove the body of the talus (Figure 12). Subsequently, full correction of the preexisting rear foot equinocavovarus was attained as the calcaneus was temporarily held in a rectus alignment with the tibia (Figure 13). The articular surfaces of the inferior tibia and superior calcaneus were removed with osteotome and mallet. Full apposition of the tibiocalcaneal fusion site required removal of the medial malleolus due to impingement against the sustentaculum tali. Intraoperative fluoroscopy revealed a significant defect present between the anterior aspect of the tibia and navicular in Case 2. The proximal articular surface was removed from the navicular and the anterior tibial surface was equally decorticated. An autogenous graft fashioned from the talus was then inserted into the defect and fixated with 4.0 mm screws in order to prevent posterior translation of the foot on the leg. Contoured resection of joint surfaces was accomplished in order to maintain as much length as possible. Closed suction drains were inserted in each case to help prevent post-operative hematoma formation.

In Case 1, internal fixation was employed utilizing large internal cancellous bone screws to accomplish primary tibiocalcaneal arthrodesis (Figures 14, 15). An EBI OsteoGen® single lead bone stimulator was implanted within the arthrodesis site. Post-operatively, a below knee cast was applied and the patient was instructed to be non-weight bearing.

In Case 2, minimal internal fixation was utilized. An Ilizarov external fixator was applied to the foot and ankle to accomplish tibiocalcaneal compression arthrodesis and maintain correction in an adequate plantigrade and axial position (Figures 16, 17). A rotational skin flap was utilized for complete closure of the lateral midfoot ulceration.



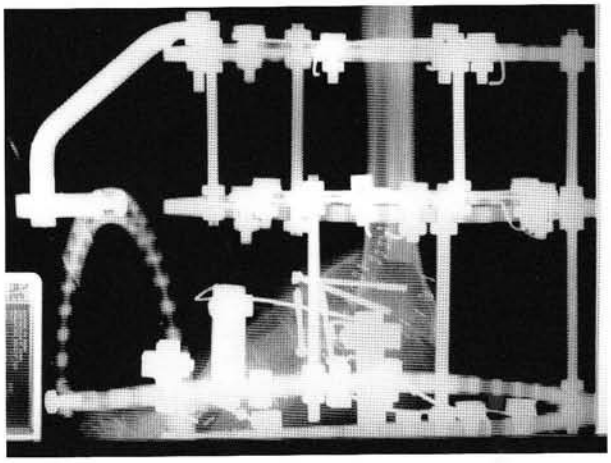
Figures 12. Intraoperative photos demonstrate excision of the talar body performed in each case.



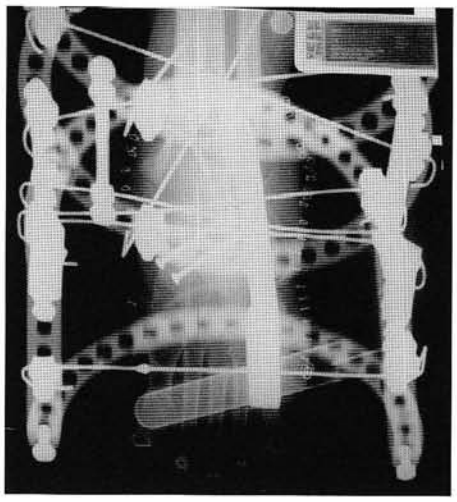
Figures 13. Reduction of rear foot deformity with temporary Steinman pin fixation post talectomy.

Figures 14. Case 1. Postoperative radiographs with realignment of rear foot via tibiocalcaneal fusion. Large osseous screws placed across arthrodesis site maintain position. Internal bone stimulator is later placed.

Figures 15.



Figures 16. Case 2. Postoperative radiographs reveal a plantigrade foot with external ring fixator. Complete realignment of deformity is attained.



Figures 17.

DISCUSSION

The overall surgical procedure is similar in each case. A lateral incision beginning over the distal fibula curving towards the calcaneocuboid joint provides the needed exposure for removal of the talus. In this rigid deformity, the talus functions as a large spacer essentially preventing reduction in all three planes. With the talus absent from the ankle joint, the entirety of the deformity is able to be radically reduced. Functional lengthening of all soft tissue about the ankle joint occurs converting the once rigid equinocavovarus rear foot to a flexible reducible construct. It is for this reason that talectomy is considered one of the most powerful procedures in the arsenal of complex foot and ankle reconstruction.

In our diabetic cases, tibiocalcaneal arthrodesis was chosen in order to stabilize the correction attained. The main indication for this fusion is severe instability resulting in the presence of recurrent ulcerations.[4] The goals of the combined single stage talectomy with tibiocalcaneal fusion are threefold: 1) reduce the rigid deformity, 2) create a stable, plantigrade construct allowing for ambulation and 3) prevent or slow progression. As previously explained, the talectomy portion of the procedure is similar in each case. Though the same general principles of arthrodesis are applied, it is with this portion that our procedures differ.

The similarities include carefully contoured resection of the corresponding tibial and calcaneal articular surfaces in an attempt to maintain as much length as possible. Earlier reports have identified significant limb length discrepancies inherent with removal of the talus. An average of 3.5 cm loss in length of the affected extremity is reported in a series by Mirzayan et al in which planal resection was utilized.[13] However, loss may be minimized with joint resection. Another similarity involves insertion of the decorticated talar head and neck between the navicular and anterior aspect of the tibia. First described by Smith in 1963,[14] this serves to prevent posterior translation of the foot on the leg thus maintaining a more normal foot length aiding in ambulation and balance.

The final aspect of our discussion focuses on the different fixation techniques employed. One uses internal fixation with below-knee cast application and the other uses external fixation via Ilizarov ring fixators. As with any method of fixation and stabilization, each carries advantages and disadvantages.

The primary advantage of internal fixation hinges on the concept of interfragmentary compression across the arthrodesis site. The disadvantage of Ilizarov ring fixator is that the amount of compression achieved with this construct is less. We do not know of any literature reviews that compare quantitative values for interfragmentary screws versus external rings. However, it is our hypothesis that the former is greater. Internal fixation via insertion of screws also boasts the advantage of direct visualization of the arthrodesis site. Generally the ring fixator is applied after joint resection and skin closure. Therefore, the compression achieved via the Ilizarov method is visualized under fluoroscopy post surgical wound closure.

The Ilizarov external fixator provides the patient with the opportunity of guarded weight bearing throughout the immediate and long term post operative period. In contrast, cast application requires long periods of non-weight bearing. The stability achieved with ring fixators in fact encourages weight bearing as this is said to enhance the strength of the arthrodesis site through a process known as dynamization. With continued weight bearing, the patient is able to achieve active muscle function. As a result, atrophy of the lower extremity muscles is limited. Conversely, cast disease is a significant disadvantage with use of the below-knee non-weight bearing cast. The lack of active muscle function leads to calf atrophy, weakness and osteoporosis of the involved limb. In our cases, each patientís ability to bear weight had been limited prior to undergoing surgery. Subsequently, the affected lower extremities were already relatively weakened. The patient in which external fixation was utilized did not attempt early weight bearing. However, in theory, further atrophy and weakening may be avoided with guarded ambulation.

Besides morbidity involved with non-weight bearing devices and negotiating difficult situations such as tight spaces in the home, the risk of deep venous thrombosis demands careful attention. As with cast

disease, the lack of active mobility associated with casting creates an environment which may lead to the formation of DVT. Our patients were administered adequate perioperative DVT prophylaxis while hospitalized. The non-weight bearing patient requires further prophylaxis as compared to the ambulatory (external ring fixator) patient. This includes weekly monitoring of anti-coagulation in the patient treated with coumadin. When using low molecular weight heparins, pain associated with injections may be a concern.

In our cases, each patient initially presented with lateral border ulcerations of the affected foot. Though the ulcer was healed prior to surgery in Case 1, the large wound was addressed as part of the primary surgical procedure in Case 2. An advantage of external fixation is direct monitoring of the wounds. This proved to be extremely important since our patient underwent a rotational skin flap which required careful attention. The external fixation method is an advantage over cast application in cases where the wound needs to be monitored. However, a significant disadvantage present with external ring fixators is entry and exit wound sites created by multiple pins. Pin tract infections occur with relative frequency requiring local wound care and antibiotic coverage generally not necessary with internal fixation and cast application.

Other points of consideration include keeping the casts dry in cases of internal fixation. With external fixation, the extremity can be bathed. Cosmesis can be a patient concern with large ring fixators while claustrophobia may occur with casting. Hardware breakage or loosening of both internal and external fixation can be a complication. Finally, physician preference and comfort level factor highly in procedure choice. Internal fixation demands a thorough appreciation of AO principles. External fixation likewise has a set of principles and concepts that must be fully understood and applied for maximum benefit. There are a number of possible complications inherent to both techniques. These can only be avoided and addressed with a full understanding of the chosen method.

SUMMARY

The rigid Charcot equinocavovarus deformity demands correction by experienced foot and ankle surgeons who regularly perform rear foot and ankle surgery. A single stage procedure offers an acceptable option for tackling the challenge. In the final analysis, the decision of internal versus external fixation is ultimately surgeon dependent. We have presented some of the pros and cons of each method as they apply to complicated rear foot pathology. We anticipate that this will stimulate the interest for further research in this and other fields of foot and ankle reconstructive surgery.

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