

REVISIONAL FOREFOOT SURGERY

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Revision surgery for iatrogenic forefoot deformities is challenging, yet rewarding when successful. Many factors are considered in order to achieve a positive outcome. These factors vary from patient to patient, as well as from surgeon to surgeon. The ultimate goal of any revision surgery is to relieve pain. A secondary goal is to attempt to recreate a more functional anatomic structure. Patient expectations should be addressed prior to surgery, and the patient should fully understand your goals for improvement of their malady. They should realize that their foot will never be a “normal” foot, but rather a more comfortable and more functional foot. Successful revision surgery can radically change a patient’s quality of life.

The patient factors to be considered include age / health, ability to be non-weight bearing, bone stock, activity level, compliance, other complicating factors (deep venous thrombosis / pulmonary embolus, peripheral vascular disease, etc.), and the condition of the foot. Severe disruption of normal osseous anatomy, nerve entrapment, osteomyelitis, nonunions, and contracture of skin and tendons must all be addressed when present. Attempts should be made to restore the iatrogenic deformity and spare the normal anatomy. In certain situations, the normal anatomy may need to be altered to achieve a more functional structure to the foot. In select patients, a simple ostectomy may serve its purpose, while in other patients a pan metatarsal head resection might be necessary to accomplish the goal of alleviating pain.

The surgeon must also be aware of his limitations and not further harm the patient. The dissection is more tedious than in “first-time” surgery. The blood supply is already compromised in most severe cases, so extra care should be taken to perform precise anatomic dissection. Prophylactic antibiotics should always be administered preoperatively. A tourniquet is helpful in revisional cases to provide hemostasis. A plan of action should be in place prior to surgery, but intraoperative decision making may override the preoperative plan.

The following cases demonstrate a few of the wide range of procedures for addressing iatrogenic forefoot deformities. They also provide examples of the possible complications that may be encountered.

CASE ONE

A 70-year-old woman with a history of multiple orthopedic forefoot procedures presented complaining of severe pain on the plantar aspect of both feet. She could not walk barefooted due to extreme pain. She also had a history of osteomyelitis in the right calcaneus at age 9. This was treated with multiple debridements of the calcaneus and antibiotics. She was left with a callus that developed beneath the heel. She also had a Keller bunionectomy, partial ostectomy of the fifth metatarsal head, arthrodesis of the second, third, and fourth digits, and proximal phalangectomy of the fifth digit. She later underwent base resection arthroplasties on the second, third and fourth toes. Five years after her last surgery she presented with painful calluses on the left forefoot (Figure 1) and on the right heel and tibial sesamoid (Figure 2). Conservative treatment consisted of accommodative shoe gear and gel padding. She would wrap the gel padding to her feet with an elastic bandage in order to walk barefooted. She had a history of heart disease treated with angioplasty, arthritis, and hypothyroidism controlled with medication. Radiographs revealed prominent



Figure 1. Clinical photo of left foot pre-op.

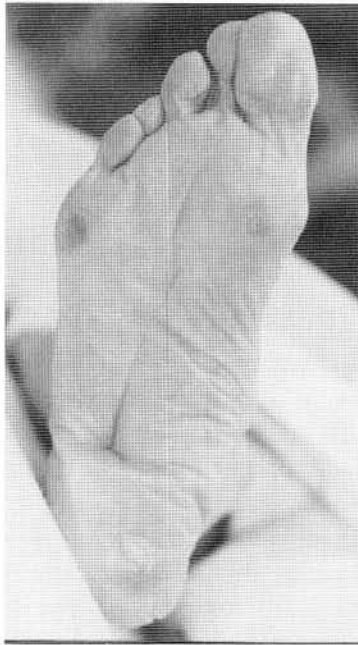


Figure 2. Clinical photo of right foot preoperative.



Figure 3. Dorsal-plantar view of left foot preoperative.



Figure 4. Lateral view of right foot preoperative.

metatarsal heads on the left foot (Figure 3) and exostosis on the plantar right heel (Figure 4). A pan metatarsal head resection was performed on the left foot (Figure 5) and a partial calcanectomy, tibial sesamoidectomy, and arthrodesis on the fourth toe on the right foot (Figure 6). The patient was non-weight bearing on the right foot for three weeks after surgery. K-wires were removed from the left foot at 4 weeks and from the right fourth toe at 6 weeks. The patient was able to walk barefooted for the first time in fifty years and resumed her golfing at 8 weeks. At eleven month follow-up radiographs showed near rectus alignment of all digits (Figure 7).



Figure 5. Dorsal-plantar view left foot postoperative.



Figure 6. Lateral view of right foot postoperative.



Figure 7. Dorsal-plantar view of left foot 11 months postoperative.

CASE TWO

A 75 year old woman with rheumatoid arthritis presented with a painful plantar callus on the right foot. She had previously been treated by an orthopedic surgeon. She had an implant arthroplasty of the first metatarsal phalangeal joint and fusion of the lesser metatarsal phalangeal joints. Her medical history was significant for heart disease and hypertension. She took methotrexate, plaquenil, disalcid, lanoxin, lotensin, inderal, ecotrin and premarin. Allergies included penicillin and hydrocodone. The patient lived alone. She had severe deformities of both hands and a left knee replacement. Her circulation was mildly compromised. The toes were fused in a dorsiflexed position. She had a preulcerative callus beneath the second metatarsal phalangeal joint. Radiographs (Figures 8, 9) revealed hammertoe deformities on all lesser digits with metatarsal phalangeal joint fusions. A fragmented total silastic implant was noted at the first metatarsal phalangeal joint. This was clinically asymptomatic. A pan metatarsal head resection with revisional joint implant of the hallux was discussed

with the patient, however a simple second metatarsal head resection was recommended initially due to the patient's health and living circumstances. Intraoperatively, an ossified rheumatoid nodule was noted to be fused to the plantar surface of the metatarsal head (Figure 10). An arthroplasty was performed on the second toe due to a transverse plane deformity of the proximal interphalangeal joint. The toe was pinned across the metatarsal shaft (Figure 11). The patient developed a postoperative infection one week after surgery. The kirschner wire was removed and the patient was placed on levofloxacin 500 mg daily. At the third week postoperative appointment, bone was noted to be exposed medially. The patient underwent successful excision of infected bone with primary closure of the wound. The bone was positive for osteomyelitis with coagulase negative staphylococcus as the isolated organism. She recovered without any further complications. She reported complete relief of her plantar pain.



Figure 8. Dorsal-plantar view of right foot preoperative.



Figure 9. Lateral view of right foot preoperative.

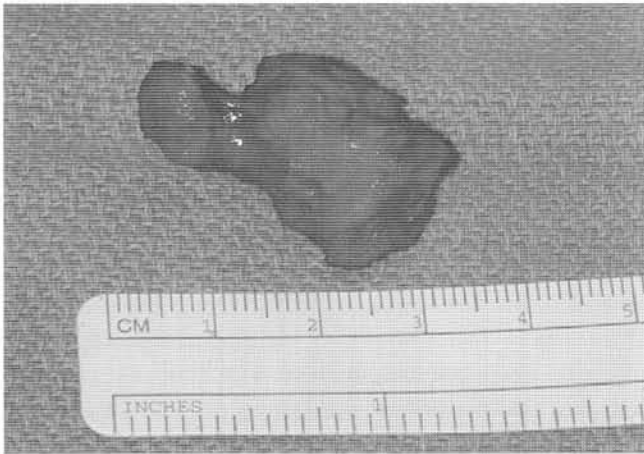


Figure 10. Excised second metatarsal head with pedunculated, ossified rheumatoid nodule fused to the plantar weight bearing surface.



Figure 11. Dorsal-plantar view postoperative.

CASE FOUR

A 54-year-old woman presented with a seven year history of painful plantar lesions and hammertoes on both feet. She had previous forefoot surgery on the right foot.

She continued to have painful calluses on the plantar lateral forefoot and plantar aspect of the interphalangeal joint of the hallux. She also had rigid hammertoes on the right foot and an extension deformity of the hallux interphalangeal joint. Medical history was significant for hepatitis and hypothyroidism. She was a half pack per day smoker.

Radiographs revealed hammertoes on the left foot and metatarsal head resections on the second, third, fourth, and fifth on the right foot (Figures 16, 17). The third and fourth metatarsals protruded beyond the weight bearing parabola. The right hallux interphalangeal joint was fused in an extended position, and the lesser digits were fused in flexed positions at the proximal interphalangeal joints. She underwent successful “peg-in-

hole” arthrodesis of the second, third, and fourth digits and arthroplasty of the fifth digit on the left foot. Five months later she presented for correction of the right foot deformities. A resection of the third and fourth metatarsals to create the normal weight bearing parabola was performed. The hallux interphalangeal joint was realigned and fused in a more anatomic position with an absorbable screw. The lesser digits were refused in more anatomic positions (Figures 18, 19). The possibility of needing a first metatarsal head resection or first metatarsal phalangeal joint fusion or implant arthroplasty was explained to the patient prior to surgery; however it was avoided due to the existing deformity of the hallux interphalangeal joint. Kirschner wires were removed at six weeks and complete resolution of painful calluses was achieved at week eight. Three and a half months postoperative, she developed pain beneath the first metatarsal phalangeal joint that was relieved with accommodative foot orthoses.



Figure 16. Dorsal-plantar view preoperative.



Figure 17. Lateral view preoperative.



Figure 18. Dorsal plantar view postoperative.



Figure 19. Lateral view postoperative.

CASE FIVE

A 57-year-old woman with a history of bilateral Mitchell bunionectomies presented complaining of pain beneath the right second metatarsal head and hallux varus deformity. Prescription orthoses, non-steroidal anti-inflammatories, and accommodative shoe gear failed to relieve symptoms. Medical history was significant for hormone replacement therapy and codeine allergy. Clinically, the patient had a painful callus beneath the second metatarsal head (Figure 20). The first metatarsal was elevated (Figure 21). The hallux, second, and third digits exhibited varus drift (Figure 22). Radiographs showed a shortened and elevated first metatarsal with a hallux varus deformity. The second and third digits also had medially deviated transverse plane deformities (Figures 23, 24). The proposed procedure was an elongating and plantarflexing osteotomy that would correct the negative intermetatarsal angle. A soft tissue release for the hallux valgus and second and third digits along with a shortening second metatarsal osteotomy would also be performed. The need to be non-weight bearing in a cast for 8 weeks postoperative was discussed with the patient. She stated that she was claustrophobic

and could not stay in a cast. She underwent the above procedures. The first metatarsal osteotomy was made at the level of overlap from the previous Mitchell. This allowed the distal fragment to be plantarflexed, elongated, and medially displaced (Figures 25,26). A posterior splint was applied. Three weeks postoperative, the patient presented with a dramatic change in the appearance of the foot with the 2nd metatarsal head protruding further than before surgery. She admitted to manually “popping” the toe. Radiographs revealed a proximally displaced fracture of the first metatarsal osteotomy (Figures 27, 28). Open reduction with internal and external fixation was performed (Figures 29, 30). The lateral cortex of the first metatarsal was violated from the fracture, so circlage wire technique was employed. The patient remained non-weight bearing for 4 weeks and was then allowed partial weight on the heel. The external fixator was removed after 8 weeks, and the patient was allowed full weight in a cast boot for 4 additional weeks. Prescription orthoses were made at 3 months and the patient was allowed to wear gym shoes. At 6 months postoperative, she related no pain and the toes were in acceptable alignment (Figures 31-34). She was walking 5 miles a day without a problem.

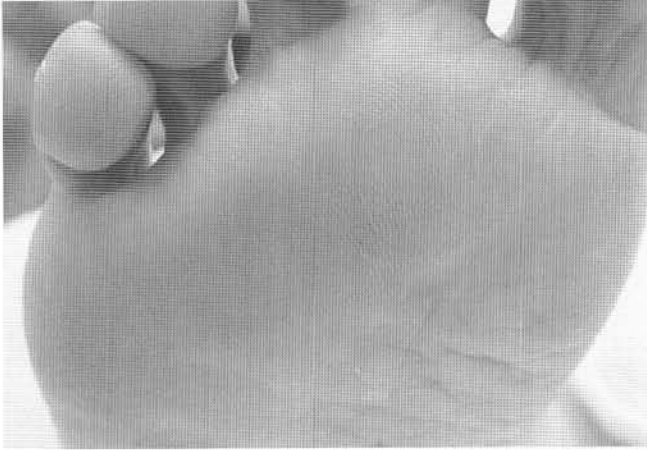


Figure 20. Clinical photo preoperative showing sub-two lesion.



Figure 21. Clinical photo preoperative showing first metatarsal elevation.

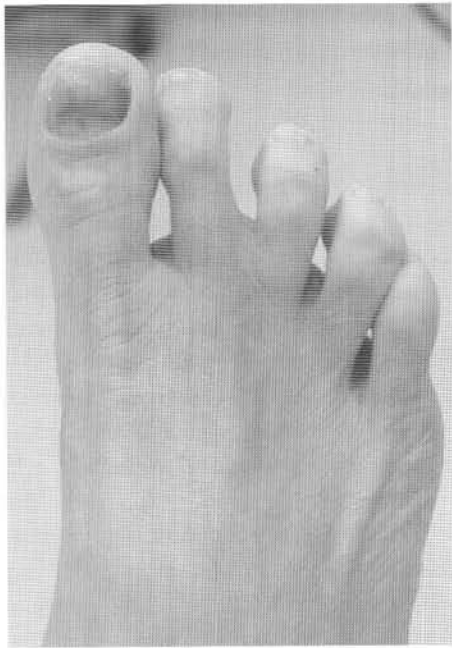


Figure 22. Clinical photo preoperative showing varus drift of hallux, second, & third digits.



Figure 23. Dorsal-plantar view preoperative.



Figure 24. Lateral view preoperative.



Figure 25. Dorsal-plantar view postoperative osteotomies & soft tissue balancing.



Figure 26. Lateral view postoperative.



Figure 27. Dorsal-plantar view showing fractured first metatarsal osteotomy.



Figure 28. Lateral view after fracture.



Figure 29. Dorsal-plantar view postoperative open reduction internal & external fixation.

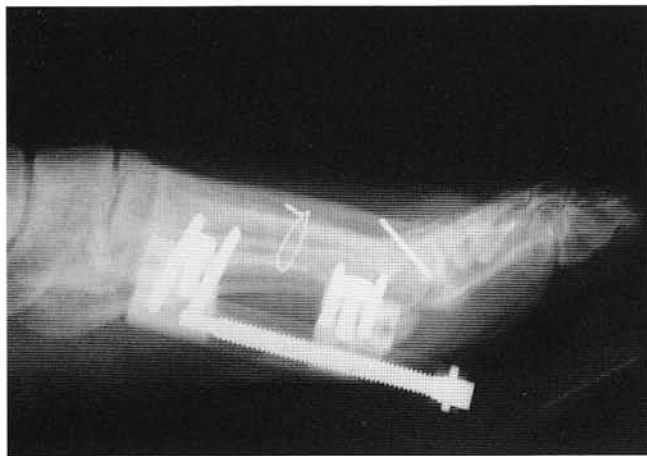


Figure 30. Lateral view postoperative.



Figure 31. Dorsal-plantar view postoperative six months.



Figure 32. Lateral view postoperative six months.

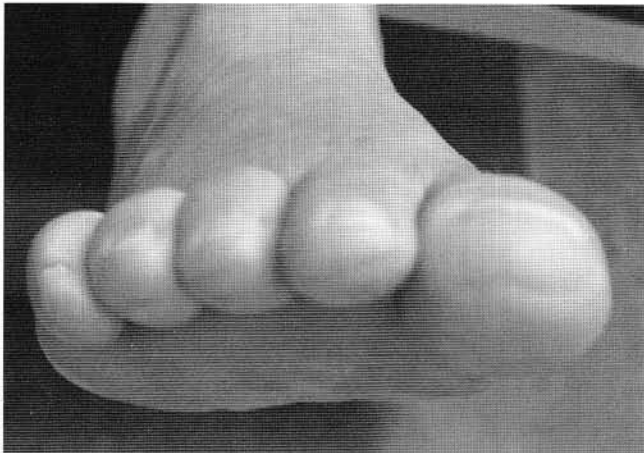


Figure 34. Clinical photo showing restoration of weight bearing attitude of first metatarsal.

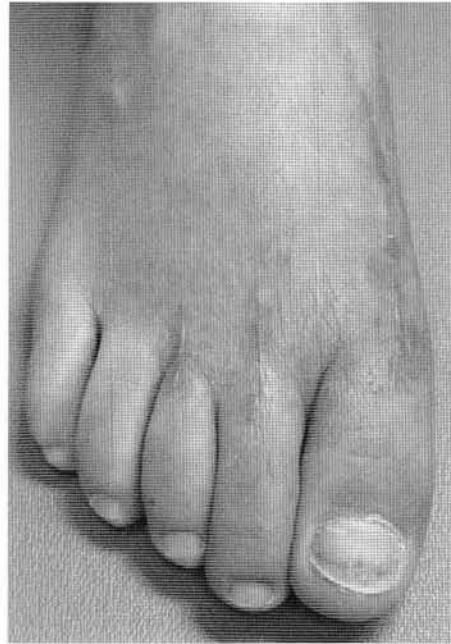


Figure 33. Clinical photo showing alignment of digits.

CASE SIX

A 38-year-old woman presented with a 20 year history of painful calluses on both feet. She underwent bunion and hammertoe correction on all digits on both feet at age 18. She related a settled lawsuit over the surgeries. She claimed that only the bunions were to be corrected and not the hammertoes. The left second toe continued to stick up after the surgery. Two more attempts at arthroplasty were performed by different doctors. Medical history was significant for deep venous thrombosis in the right leg after a hysterectomy, a 20 pack year smoking history, and hormone replacement therapy. She had a painful callus beneath the left second metatarsal phalangeal joint and over the fifth metatarsal bases. Recurrent bunions and hammertoe deformities were noted digits two through five on both feet. The left

second toe had a flail toe deformity with extensive dorsal scarring. Radiographs revealed metatarsus adductus deformity, recurrent hallux valgus deformity with metatarsus primus varus, and hammertoe deformities with a severely shortened proximal phalanx on the left second toe (Figures 35,36). The patient underwent a base wedge osteotomy of the first metatarsal and revisional arthrodesis of the lesser digits with an autogenous calcaneal graft at the second toe. She was placed in a non-weight bearing short leg cast for 6 weeks. She was placed on lovenox and warfarin for deep venous thrombosis prophylaxis for 6 weeks. She was treated with an ultrasound bone stimulator for 6 months after surgery. At eight weeks the kirschner wire pulled out of the second toe in her sleep. Radiographs showed no evidence of deviation of the toe (Figure 37). The toe was splinted until three months after surgery. The plantar 2nd metatarsal head callus improved for over a year; then, it returned to the preoperative condition. Radiographs taken at 22 months postoperative revealed non union of the proximal graft host interface (Figure 38). Prescription orthoses failed to alleviate her symptoms. She underwent excision of the proximal phalangeal base and the callus resolved completely three weeks postoperative.



Figure 35. Dorsal-plantar view preoperative.



Figure 36. Lateral view preoperative.



Figure 37. Dorsal-plantar view eight weeks post-operative. Kirschner wire came out of toe. Note the washed out appearance of the graft.



Figure 38. Dorsal-plantar view 22 months post-operative. Distal graft-host interface healed, proximal did not.

CASE SEVEN

A 56-year-old woman presented for a third opinion for a flail second toe on the left foot. Previous surgery by a podiatrist consisted of an excision of a neuroma in the second intermetatarsal space followed by a minimal incision bunionectomy and arthroplasty on the second toe. The toe continued to buckle and a second arthroplasty was performed. The toe remained painful and floppy. The third and fourth toes were beginning to hammer as well. Medical history was significant for mitral valve prolapse. Clinically, the second toe was floppy and severely shortened (Figure 39). Extensive scarring was noted on the dorsal skin. A positive Moulder's sign was

elicited in the third intermetatarsal space on the left foot. Radiographs revealed shortened and elevated first metatarsal and severely shortened proximal phalanx of the second toe (Figure 40). The patient underwent excision of a Morton's neuroma in the third intermetatarsal space and arthrodesis with autogenous calcaneal graft on the second toe (Figures 41 – 54). She remained non-weight bearing for six weeks. Serial radiographs were taken every four weeks (Figures 55 & 56), and the kirschner wire was removed at three months (Figure 57). The digits were all on the same level in the sagittal plane. Her pain was completely relieved at 5 months after surgery. She had returned to her equestrian activities without limitations.

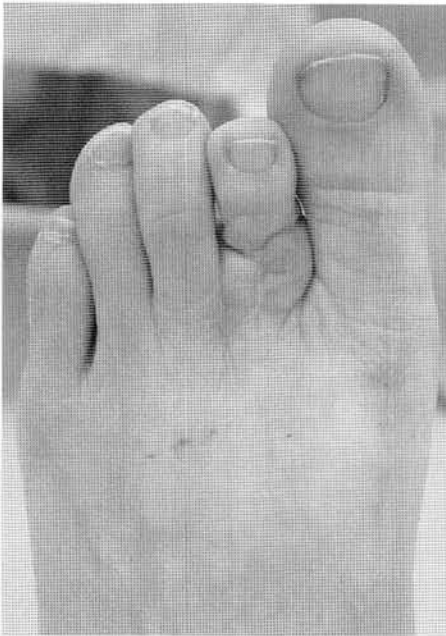


Figure 39. Clinical photo showing shortened flail toe deformity of the second digit.



Figure 40. Dorsal-plantar view preoperative.

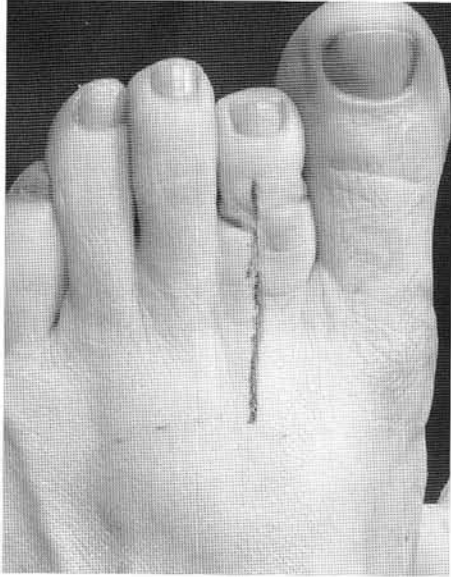


Figure 41. Incision line.

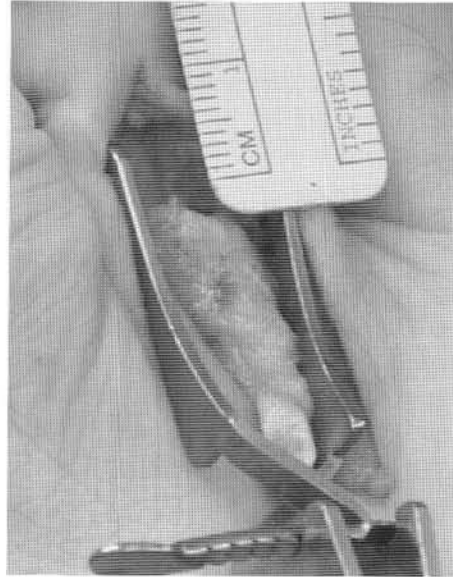


Figure 42. After exposure and debridement of bone ends, a ruler is used to measure the defect.

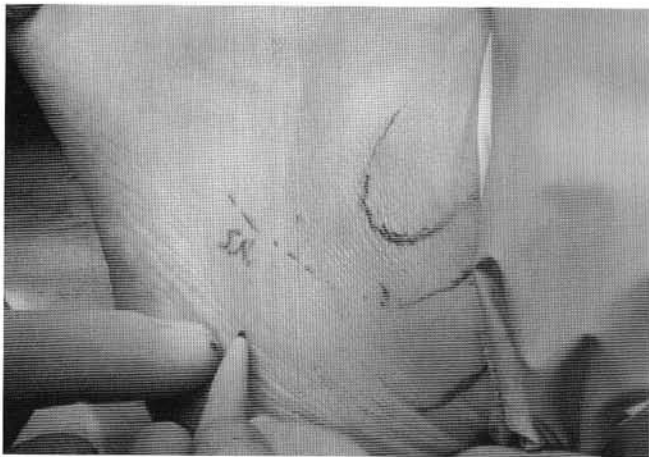


Figure 43. Lateral approach to the calcaneus for autogenous graft procurement. Incision courses obliquely between the sural nerve and the anterior border of the tendoachilles.



Figure 44. Exposure of lateral wall of the calcaneus.

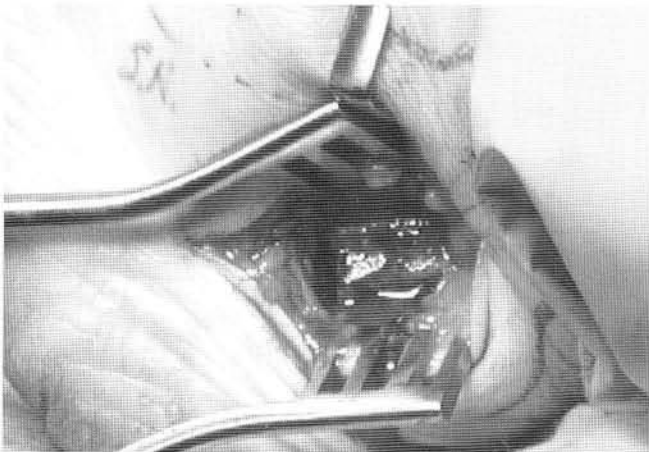


Figure 45. Drill holes created with a smooth 0.045 inch kirschner wire to outline the graft. The periosteum was left intact to reinforce the graft and to enhance revascularization when sutured to the extensor tendon.

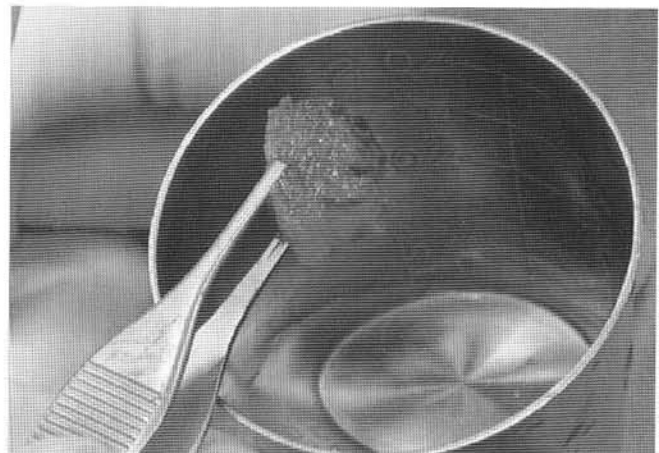


Figure 46. Harvested corticocancellous graft.

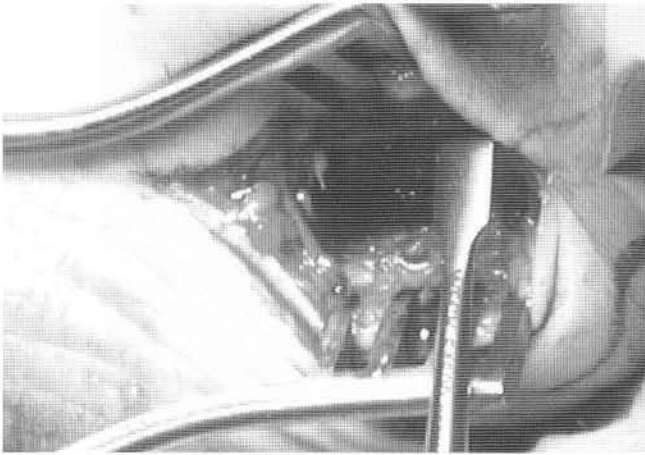


Figure 47. Defect left in the calcaneus.



Figure 48. Defect packed with demineralized bone matrix to achieve hemostasis and promote consolidation.

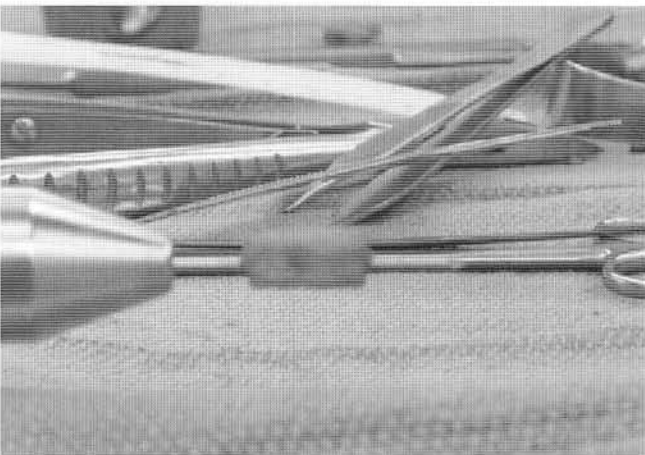


Figure 49. Graft remodeled and pre-drilled with 0.062 Kirschner wire.

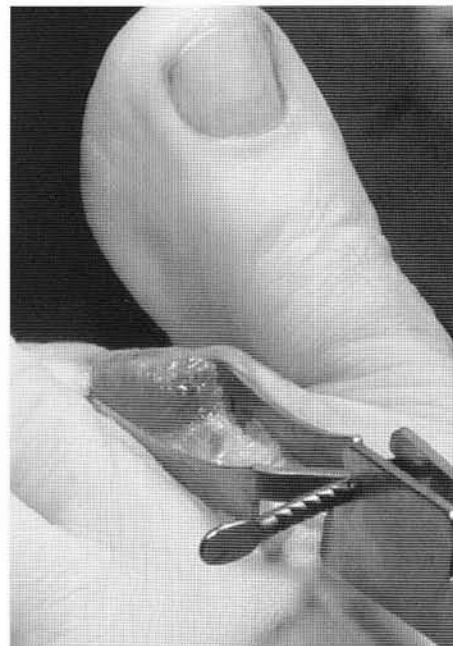


Figure 50. Wire is driven from the middle phalanx out the tip of the toe. The graft is then skewered onto the wire.

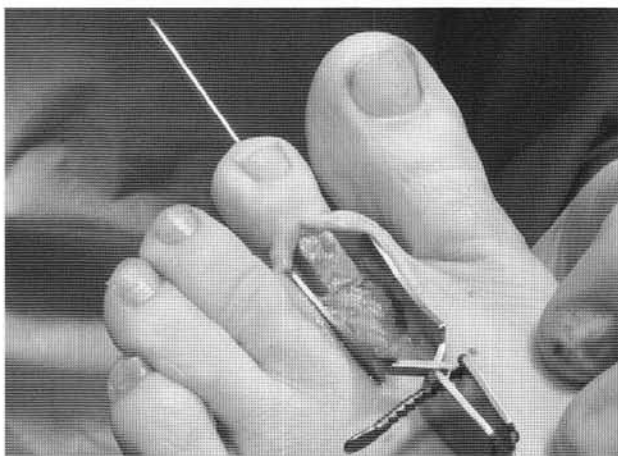


Figure 51. The wire is then driven through the proximal phalanx, across the metatarsal phalangeal joint, and into the metatarsal with the toe held in a reduced position.

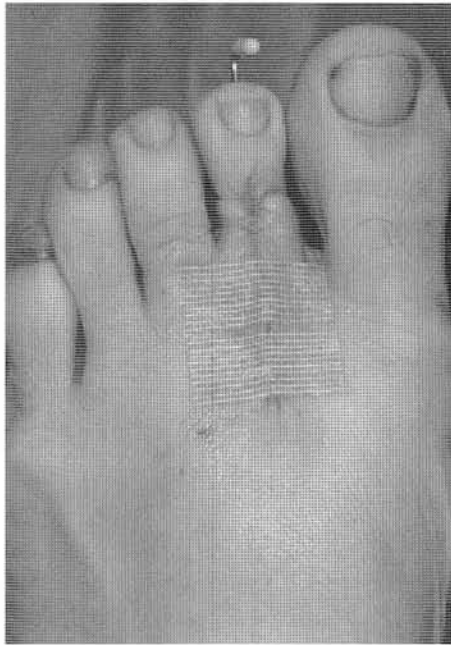


Figure 52. Final appearance of the toe after closure. Note the normal position of the second toe relative to the remaining lesser digits.



Figure 53. Dorsal plantar view postoperative.

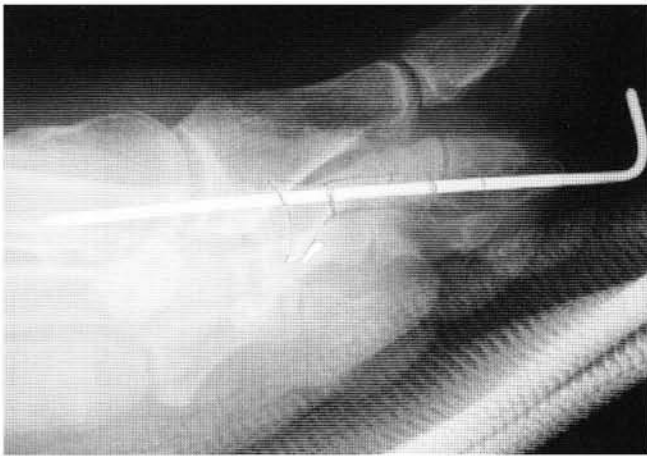


Figure 54. Lateral view postoperative with bone segments outlined.



Figure 55. Dorsal-plantar view at one month postoperative.



Figure 56. Dorsal-plantar view at two months post-operative.



Figure 57. Dorsal-plantar view at three months post-operative. Wire was removed at this visit.

SUMMARY

As demonstrated by the previous cases, revisional forefoot surgery requires not only a thorough consideration of the patient's foot deformity but also a thorough consideration of the patient's physical condition and compliance. By using careful preoperative planning, sound intraoperative decision making, and appropriate postoperative management, successful results can be achieved. It is very important to make sure your expectations and the patient's expectations are similar in order to avoid dissatisfaction with the surgery. Realistic expectations of reduced pain and improved function should be stressed to the patient prior to the procedures.