

POSTAXIAL POLYDACTYLY-TYPE A WITH POLYMETATARSIA: A Surgical Case Study

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In the May 1976 issue of the Journal of the American Podiatry Association, this article's senior author (JAR) with Green and Butlin introduced a comprehensive case of anatomical surgical correction of postaxial polydactyly.¹ This article presents a similar bilateral case that updates, details, and illustrates the anatomic, preoperative, intraoperative, and postoperative considerations of postaxial polydactyly with an accessory metatarsal.

HISTORY AND BACKGROUND

Polydactyly (Greek: poly = many, dactylos = digit) represents an excess of 5 digits in humans occurring primarily as an isolated deformity and sometimes in association with congenitally inherited syndromes.² As a solitary anomaly, polydactyly is thought to be expressed in an autosomal dominant pattern with incomplete penetrance in approximately 1 out of 1000 live births.^{3,4} Infrequently, syndactyly of the toes or polydactyly of the hand may coincide with supernumerary digits which may or may not include an accessory metatarsal.^{3,4} Duplications may also occur bilaterally in about 50% of patients, but often the duplications are not symmetric.^{2,5,6} Postaxial polydactyly denotes lateral digital duplication, whereas preaxial is applied to medial digital duplication. Postaxial polydactyly is the most common hyperdactyly variant and may be associated with certain autosomal recessive syndromes.⁵

CLASSIFICATION

Temtamy and McKusick used pedigree analysis to divide polydactyly of the hand into those associated with a syndrome and those that are nonsyndromic, then further applied preaxial, central, and postaxial groups into subtypes. Nonsyndromic postaxial polydactyly was subdivided into A and B types. Type A postaxial polydactyly is described as an extra digit that is "rather well formed and articulates with the fifth or an extra metacarpal (metatarsal).⁵ Conversely, Type B involves an extra digit that "is not well-formed and is frequently in

the form of a skin tag.⁵ This classification system is the most frequently utilized in describing pedal polydactyly.

Polymetatarsia associated with postaxial polydactyly was separated by Venn-Watson (Figure 1) into 4 anatomical types based on the degree of duplication: Wide metatarsal head, Y-shaped metatarsal, T-shaped metatarsal, and metatarsal Duplication. The most common pattern has been reported as the Y-shaped incomplete duplication type followed by Wide metatarsal head, T-shaped, and metatarsal duplication.⁶

CLINICAL PRESENTATION

A 12-year-old male originally presented to the senior author's office complaining of pain due to severe plantar-lateral prominence of the sixth metatarsal head bilaterally (Figure 2). He and his parents were concerned about his discomfort with shoes and the foot's cosmetic appearance. The patient had an otherwise unremarkable medical history. On lower extremity physical exam this well-nourished, well-developed child had a grossly obvious postaxial supernumerary 6th digit and metatarsal bilaterally that were well-formed (Type A). The sixth metatarsal

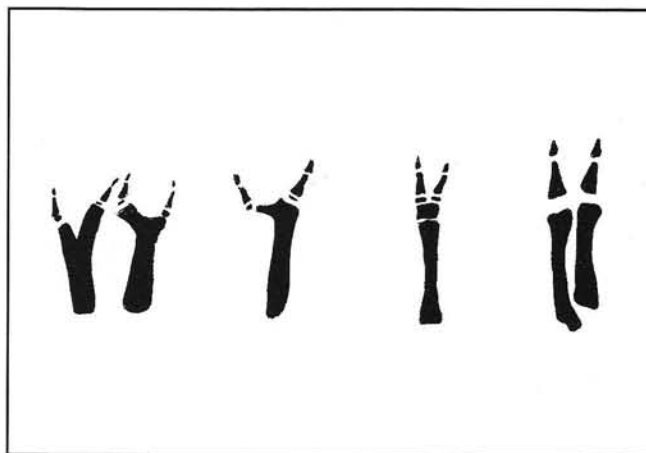


Figure 1. Venn-Watson's anatomic types of polymetatarsia associated with postaxial polydactyly. Shown above are, in order, Y metatarsal, T metatarsal, Wide metatarsal, and Complete duplication. (Figure adapted from Gastwirth et al: Congenital polydactyly with polymetatarsia in a ten-month-old child: A case report. JAPA 70:517-520, 1980).



Figure 2. Clinical preoperative photograph demonstrating bilateral postaxial polydactyly.

segment created a significant plantar and lateral prominence which was the source of pain, especially with weightbearing and shoe pressure. Dermatological evaluation revealed hyperkeratotic tissue plantar-laterally at the sixth metatarsophalangeal joint prominence. Vascular and neurological evaluations were all within normal limits and noncontributory. Radiographs revealed well-formed sixth digit phalanges and a “Y” shaped partial postaxial metatarsal duplication with the sixth metatarsal shaft extending from the proximal one-third of the 5th metatarsal shaft on the left foot and from the middle one-third on the right foot (Figure 3).

Anatomic/Surgical Considerations

The choice of surgical procedure, as a general rule, “is the one that will give the most normal shape to the forefoot.”⁶ Given a similar appearance and function of the fifth and sixth digits, excision should involve the lateral most digit in repair of postaxial polydactyly. However, the internal or fifth digit may be the appropriate digit to resect if it is vestigial or diminutive compared to the sixth digit.⁷ This may necessitate osteotomy or redirection of the appropriate metatarsal segment. Redundant skin and soft tissue should also be removed for good forefoot contour. Incompletely duplicated metatarsals of the Y or T shape, such as the Y-shaped anatomy in this case, should be resected down to one shaft. Venn-Watson showed that the remaining fifth metatarsal remodels over time and maintains its new shape without regression after resection.⁶ Growth plate disturbances should be avoided, however if a wide metatarsal head is prominent, it should be trimmed flush to the metatarsal shaft at right angles to the physis so as to not impede growth.⁶



Figure 3. Preoperative radiographs of the right and left foot. Note that the left sixth metatarsal originates more proximal than the right off the fifth metatarsal.

The overall surgical goal in this case was to excise the supernumerary digit and metatarsal while providing the most natural contour of the foot and preserving normal foot function. Additional considerations parallel those enumerated in the senior author’s original 1976 JAPA article and are assimilated into the following anatomical and surgical considerations¹:

Plan a well-counteracted skin incision border of equal length and shape dorsal to plantar in order to facilitate a plastic closure without redundancy.

- Avoid scar formation over pressure areas with placement dorsal to the 5th metatarsal head and shaft.
- Lateral coverage of 5th metatarsal protected with thicker dermal tissue originating from the plantar aspect of the 6th metatarsal head.
- Preservation of neurovascularity and musculotendinous insertions to lateral 5th ray through anatomic dissection and atraumatic technique.⁸
- Preservation of enough soft tissue laterally after resection to avoid bony prominence with resection of any excessive or redundant soft tissue.
- Transect lateral ray at its junction with the 5th to avoid cortical splitting.
- Avoid disruption of growth plates.
- Maintain and repair periosteal tissues over remaining 5th ray.
- Preservation of the peroneus brevis insertional attachment.
- Anatomic closure with plastic-type reapproximation of tissues.

SURGICAL PROCEDURE

The patient had the left and right foot operated upon approximately 2 months apart from each other. For each case, the patient was laid supine and after local and general anesthesia, the patient's foot and leg were prepped and draped in the usual sterile fashion. After exsanguination of the foot, a pneumatic mid-calf tourniquet was inflated to 225 mmHg. The procedure began as outlined below with variations of technique between the left and right foot noted.

Metatarsectomy with excision of supernumerary digit.

1. Teardrop shaped dorsolateral forefoot incision encompassing the sixth digit between the shaft of the fifth and sixth metatarsals, on the medial border of the 6th metatarsal. Care was taken to match the length and shape of the dorsal and plantar incisions (Figures 4A, 5A).
2. Full-thickness skin flap elevated from proximal to distal at the level of the subcutaneous and deep fascial junctions and carried out to the level of the sixth metatarsophalangeal joint (Figures 4B, 4C, and 5B).
3. Racket-shaped incision from the dorsal aspect of the sixth metatarsal incising through the metatarsophalangeal joint capsular ligaments allowing for disarticulation of the digit (Figures 4D, 5C).
4. Dorsal skin flap and digit excised as a unit (Figures 4E, 5D).
5. Subcutaneous tissues freed from deep fascia surrounding the sixth ray to the 5th-6th metatarsal junction.
6. "Y" shaped junction noted at the proximal third (left foot) and middle third (right foot) of the 5th-6th metatarsal shafts.
7. On the left foot, the peroneus brevis insertion was noted at the dorsolateral aspect of the 6th metatarsal base and was reflected with the periosteal flap for reattachment to the 5th after resection of the 6th metatarsal base (Figures 4F-I). The right foot's 6th metatarsal shaft began more distal than that on the left foot, therefore the periosteal tissues need only be reflected off the shorter 6th ray and proximally onto 5th ray segment (Figures 5E-F).
8. Oscillating saw used to remove the sixth ray and a portion of the lateral cortex of the 5th metatarsal to

the cuboid, internal to the apophysis, in an attempt to preserve an anatomical metatarsal base (Figures 4J, 5G).

9. Lateral 5th metatarsal recontoured/smoothed (Figures 4K, 5H).
10. Periosteal flap with peroneus brevis tendon reapproximated into lateral aspect of 5th metatarsal base periosteal tissue with #2-0 nonabsorbable suture on the left foot (Figure 4L). Periosteal tissues reapproximated on right foot.
11. Debulking of distal intrinsic musculature for anatomic cosmesis (Figure 4M).
12. Deep fascia originally overlying the intrinsic musculature of the sixth ray was tied into the periosteal tissues dorsally for deep space closure (Figure 4N).
13. Skin flap remodeled to allow the junction of the dorsal and plantar skin to be equal along lateral border of foot for cosmesis (Figures 4O-P).
14. Subcutaneous tissues closed with #3-0 absorbable suture in a running fashion (Figure 4Q).
15. Skin closure with #5-0 absorbable suture in running subcuticular fashion (Figure 4R, 5I).

POSTOPERATIVE COURSE

For each foot, the immediate postoperative course consisted of a short leg non-weightbearing cast for 3-4 weeks with crutches. Weightbearing progressed to a CAM-walker, then regular shoes by 6 weeks. The patient had an uncomplicated postoperative course without loss of function or sensation and is satisfied with the results.

CONCLUSION

A surgical case of an adolescent male who suffered bilateral bone deformity and pain from his severe plantar-lateral prominent sixth metatarsal and digit is presented. This was especially painful with ambulation and shoe gear. Although this case report briefly reviews the history and classification of postaxial polydactyly with polymetatarsia, it primarily seeks to outline the surgical considerations and technique of treating this deformity. Utilizing the principles of anatomic dissection the redundant digit and metatarsal on each foot was isolated and resected resulting in clinical and radiographic feet of normal structure and function (Figures 6, 7).



Figure 4A. Left foot incision.



Figure 4B.



Figure 4C. Full thickness skin flap to 6th MTPJ.

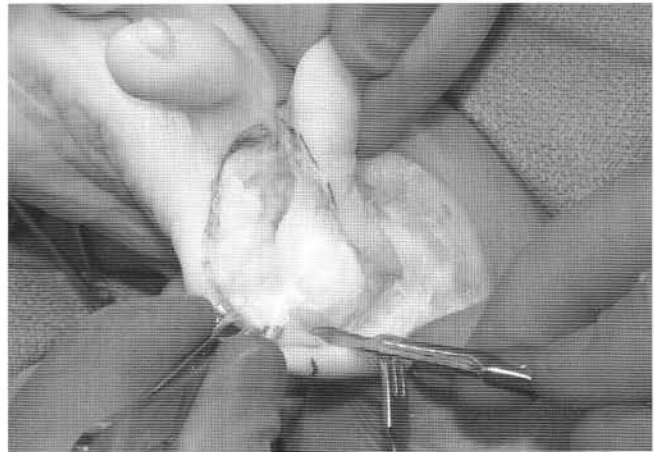


Figure 4D. Incising through 6th MTPJ capsular ligaments.

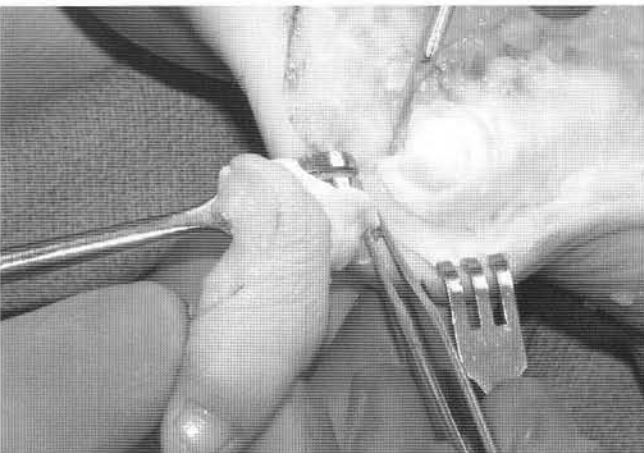


Figure 4E. Excising skin flap and digit as unit.

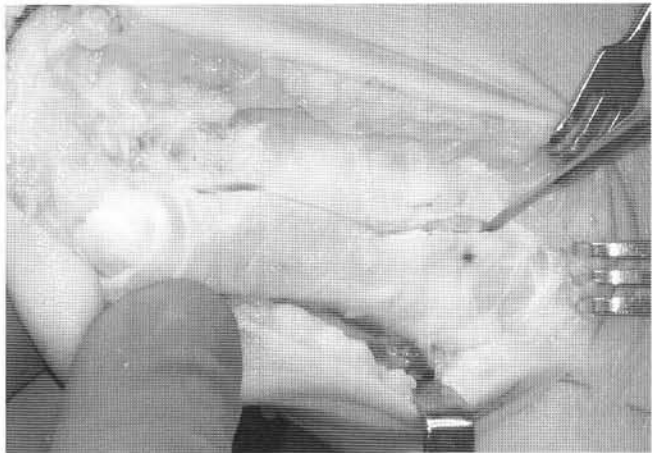


Figure 4F.

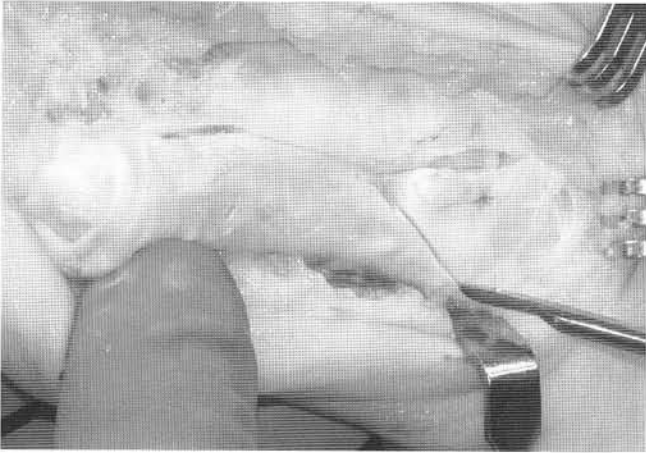


Figure 4G.

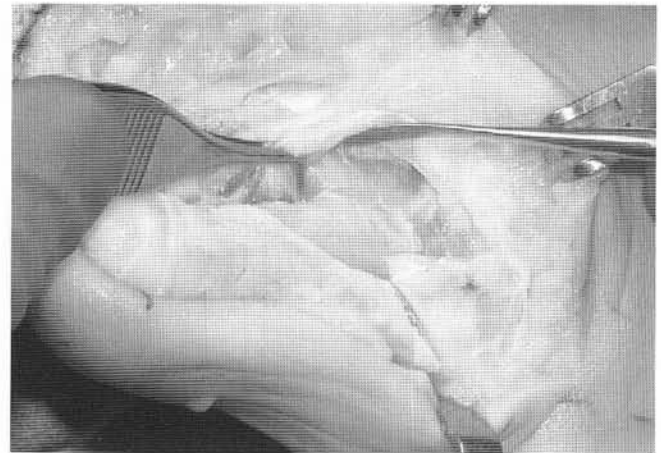


Figure 4H. Periosteal reflection.



Figure 4I. Peroneus brevis insertion reflected with periosteal flap.

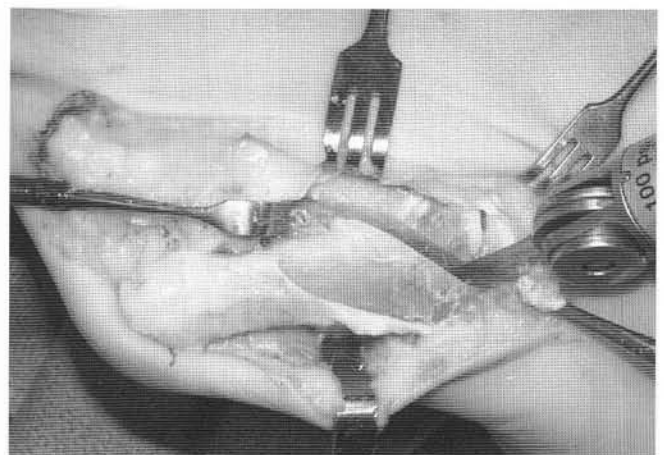


Figure 4J.

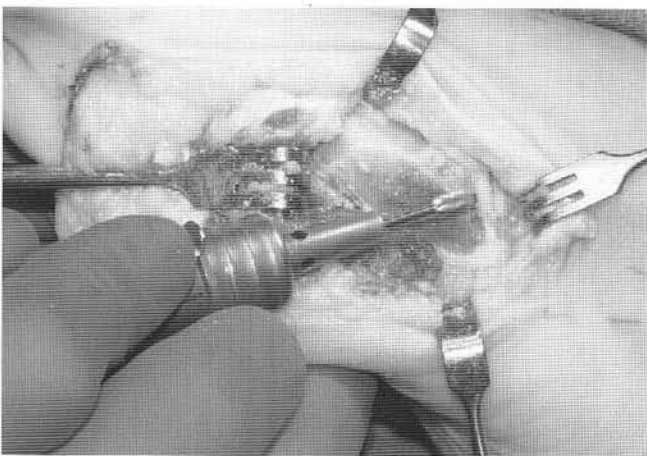


Figure 4K.

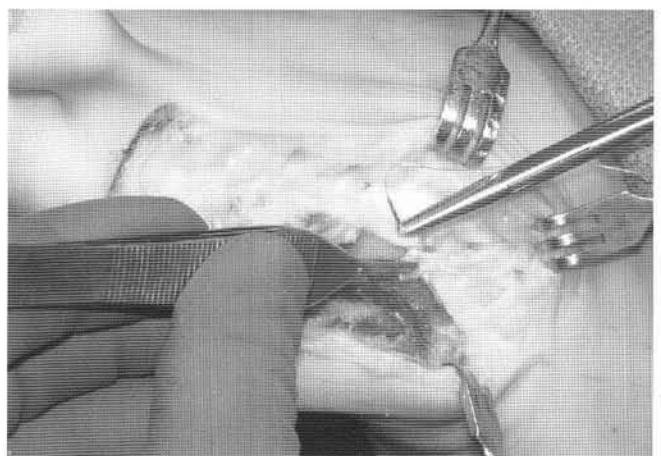


Figure 4L. Periosteal flap with peroneus brevis insertion reapproximated in periosteal closure.

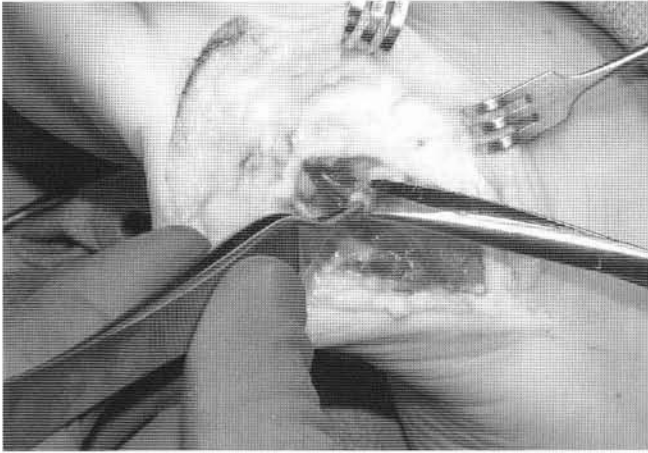


Figure 4M. Debulking of intrinsic musculature.

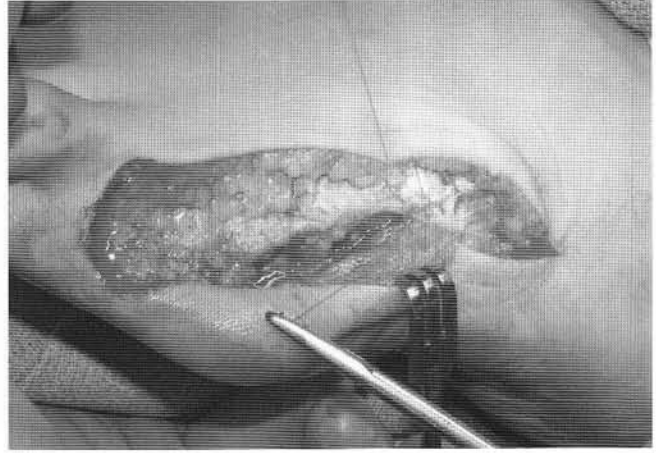


Figure 4N.

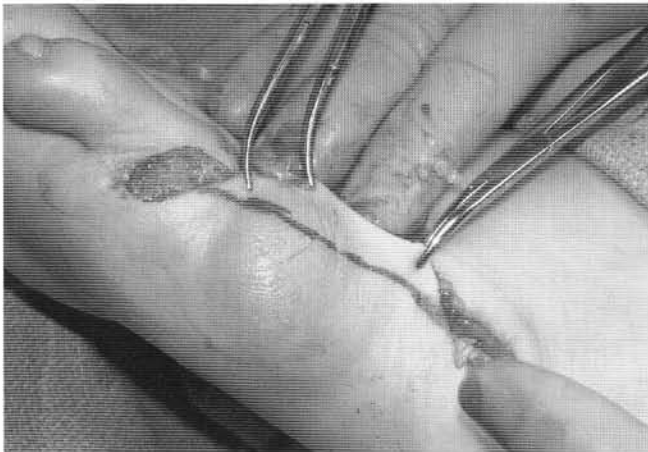


Figure 4O. Skin flap remodeling.



Figure 4P.



Figure 4Q. Skin closure.



Figure 4R.

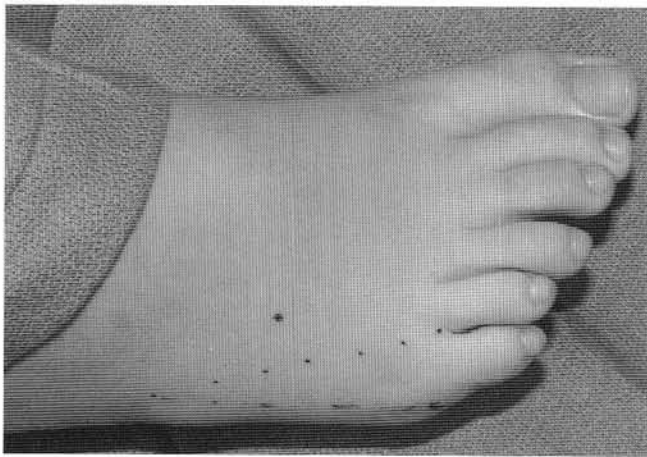


Figure 5A. Right foot incision placement.

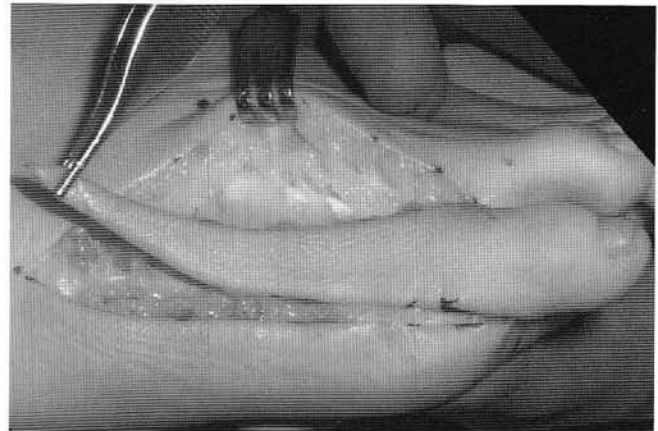


Figure 5B. Full thickness skin flap to 6th MTPJ.

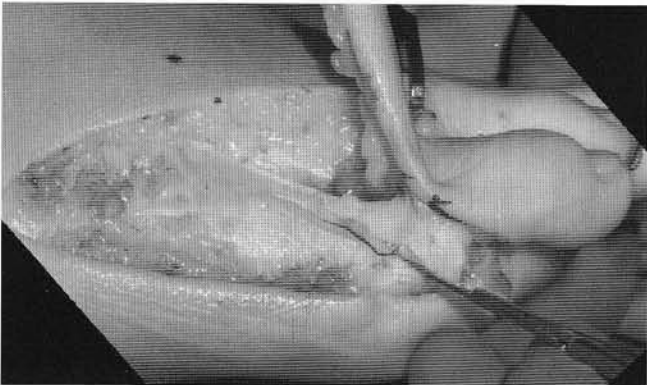


Figure 5C. Incising through 6th MTPJ capsular ligaments.

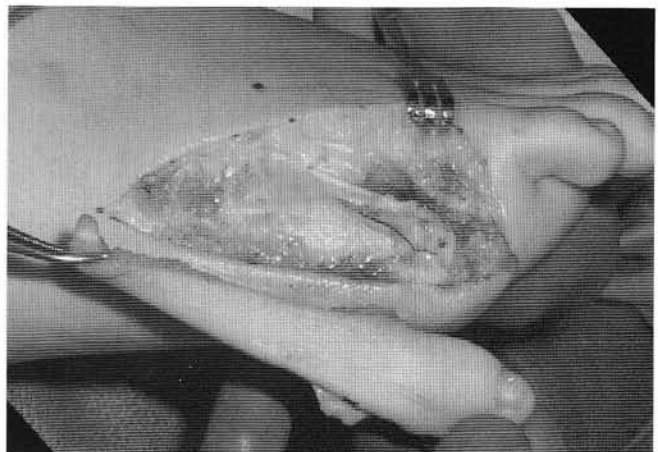


Figure 5D. Excising skin flap and digit as unit.

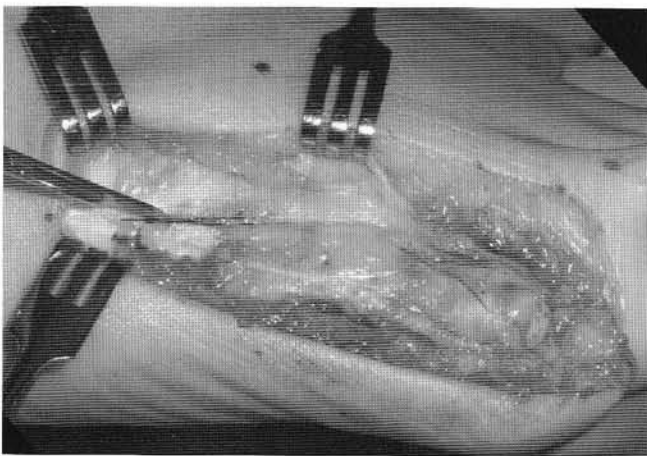


Figure 5E.

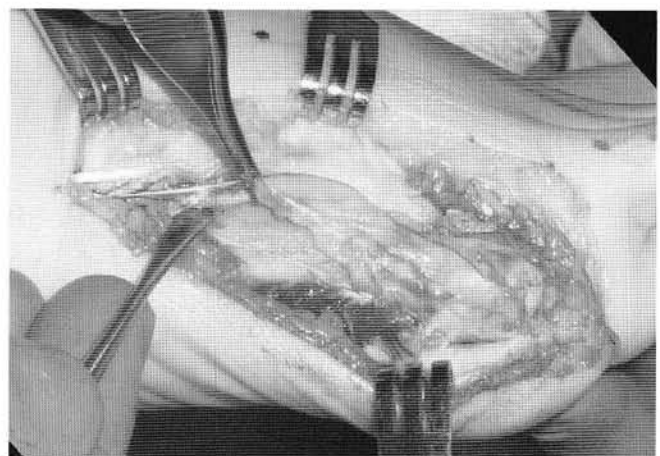


Figure 5F. Periosteal tissue reflection.

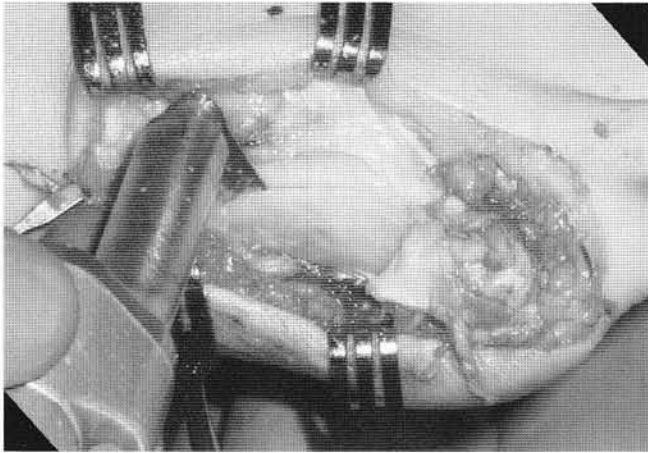


Figure 5G.

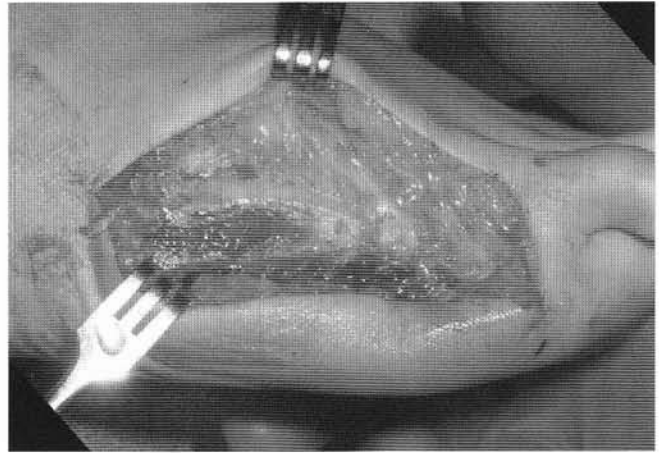


Figure 5H.

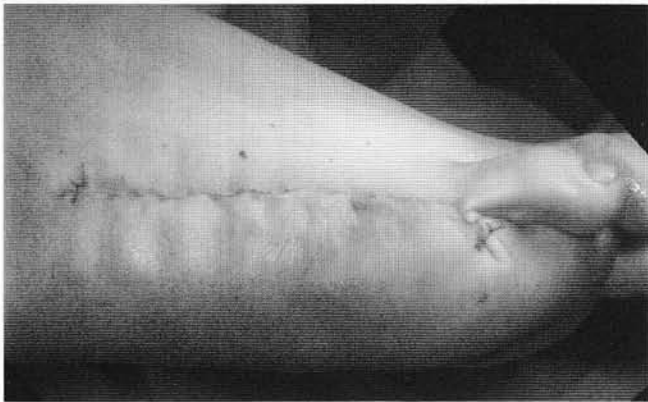


Figure 5I. Skin closure, right foot.



Figure 6A. Left foot postoperative clinical photograph.

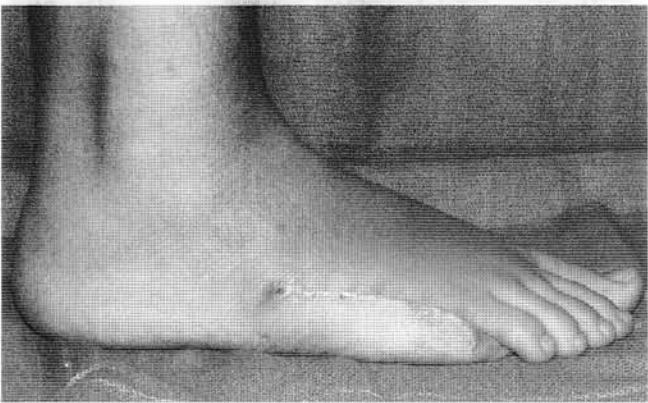


Figure 6B. Right foot postoperative clinical photograph.



Figure 6C. Postoperative clinical photograph (Left foot 3 months post-op, Right foot 1 month postoperative).



Figure 7. Postoperative radiographs (Left foot 3 months post-op, Right foot 1 month postoperative).

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