CHAPTER 43

TRANSMETATARSAL AMPUTATION AS AN EFFECTIVE ALTERNATIVE TO ABOVE-KNEE OR BELOW-KNEE AMPUTATION

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Locomotion is the primary function of the lower extremity, and foot preservation is a major goal of the podiatric surgeon. According to published statistics, over 20,000 amputations are performed annually on diabetic patients. Of these, 65% are leg amputations, 31% toe amputations, and 4% foot amputations. Of these amputations, there is a 30% mortality rate during the first three years, and a 60% mortality rate after five years.

Since the amount of energy expended during gait increases as the level of amputation progresses proximally, foot preservation becomes one of the major goals of the podiatric surgeon. As podiatrists, we are all aware of the excessive load placed on the remaining contralateral limb following leg amputation.

Transmetatarsal amputations, similar to lesser and first ray amputations, are indicated when the infection or necrotic tissue extends into the web space of the foot and involves the metatarsophalangeal joint. An understanding of the basic principles and techniques of amputation surgery is essential in obtaining an optimal surgical result.

The principles and techniques of amputation surgery, as applied to transmetatarsal amputations, will be presented. Emphasis will be placed on the intraoperative procedures and surgical technique. One of the major objectives of forefoot amputation is to maintain a functional stump which is capable of adequate wound healing, thus preventing the need for additional amputation at a more proximal level. Generally, most investigators agree that the more distal the site of amputation, the less energy that is required in walking, and the more functional the postoperative results.

The indications for transmetatarsal amputation include gangrene of one or more toes which does not involve the dorsal or plantar aspect of the foot. Transmetatarsal amputation is also effective in non-healing open, infected lesions of the forefoot in a neurotrophic foot, or when the infectious process has extended to the web space or plantar aspect of the distal foot.

GENERAL PRINCIPLES AND TECHNIQUES

Most surgeons agree on certain basic techniques in amputation surgery which are necessary to obtain a successful result. These may be categorized by the following anatomical groups: skin, muscle function, nerve endings, blood vessels, the bony prominences, and infected tissue.

Skin

Great care must be taken by the surgeon to minimize trauma to the skin by avoiding unnecessary instrumentation or excessive handling of the tissues. In transmetatarsal amputation surgery, anatomical dissection with separation of tissue layers is avoided in order to preserve the deep circulation and viability of the tissues. During surgery, consideration must be given to each tissue layer encountered, and the role that it will play in providing function following amputation. It is imperative that all diseased tissue is excised and that no dead space remains prior to final closure (Fig. 1). It is important to determine whether the wound should be packed open or allowed to close by secondary healing, delayed primary closure, or closed primarily.

The surgeon must avoid overlapping or inverting the skin margins during skin closure, as this could lead to an increased incidence of wound dehiscence, secondary infection, or progression to a more proximal amputation (Fig. 2). The optimal skin closure involves approximating skin margins end-to-end or slightly everted, using a non-reactive material, usually a monofilament suture, with no tension on the wound edges (Figs. 3, 4). Too few or too many sutures can also lead to complications of improper skin closure such as wound dehiscence.

The plantar skin incision is placed more distal than the dorsal skin incision in order to provide a skin flap with adequate length for tension-free

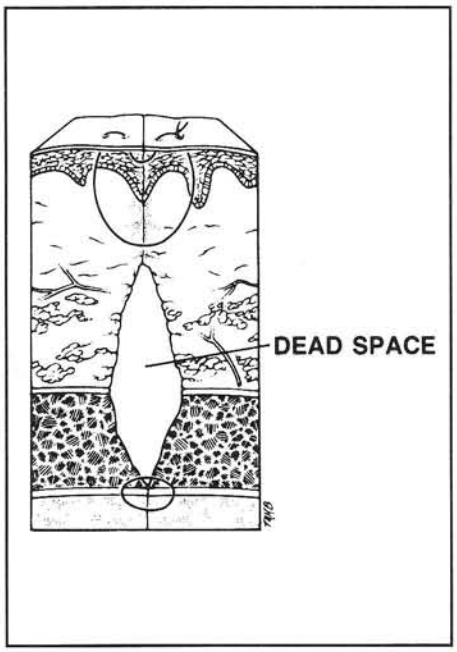

Figure 1. Eliminate dead space prior to final skin closure.

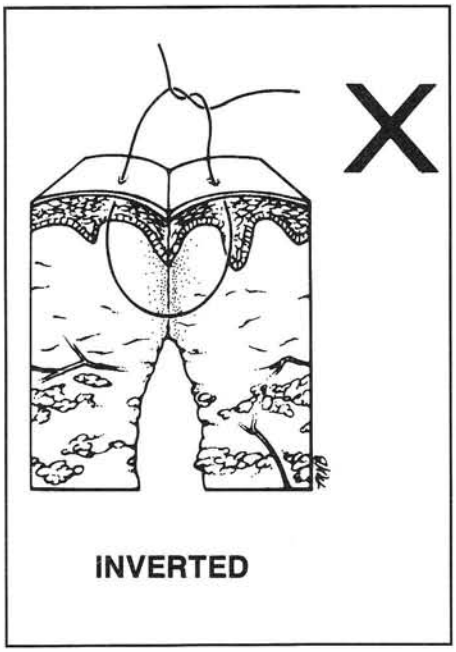

Figure 2. Avoid overlapping or inverting of the skin margins during skin closure.

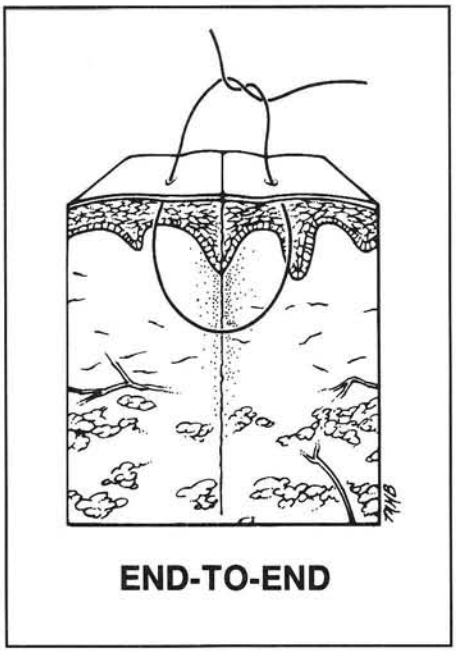

Figure 3. End-to-end skin margins

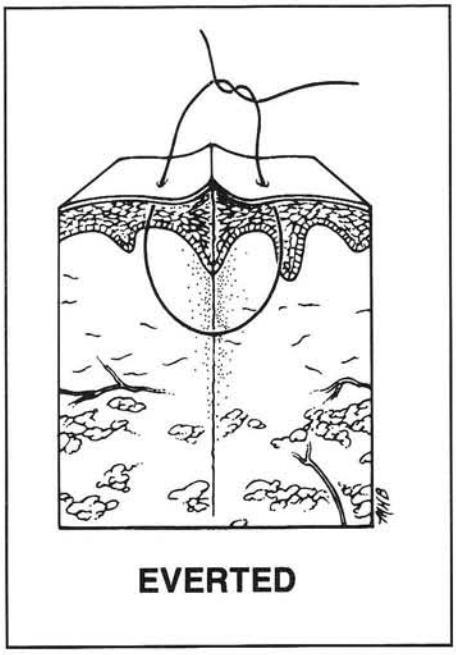

Figure 4. Everted skin margins

closure. In the presence of peripheral vascular disease, the surgery must be meticulous with delicate handling of all tissue. Strict aseptic technique should be utilized to avoid wound infection. In the presence of serious infection and ischemia, packing the wound open usually provides a lower rate of wound complications or sepsis.

Staging the time and level of the transmetatarsal amputation is imperative. In the presence of infection, appropriate antibiotics given preoperatively and postoperatively help assure appropriate healing of the wound. Strict non-weight bearing is mandatory in the immediate postoperative period. However, the use of a Cam walker three or four weeks following surgery does provide return to partial weight bearing (Fig. 5). Figure 6 demonstrates the dorsal skin incision in a critical diabetic foot where previous amputation of the great toe was performed one year prior to transmetatarsal amputation. Figure 7 demonstrates the dorsal medial surgical approach to transmetatarsal amputation. Figure 8 demonstrates the extensive necrotic tissue involving the forefoot of a diabetic patient, with appropriate surgical planning for the plantar skin incision in transmetatarsal amputation surgery. Note that the plantar skin incision is placed as distally as possible to assure an adequate skin flap to the dorsum of the foot, as well as assuring removal of all the diseased tissue.

Muscle Function

Preservation of muscle function is extremely important when a transmetatarsal or midfoot amputation is performed. When the insertion of the tibialis anterior and peroneus brevis tendons are violated during midfoot amputation, there is a higher incidence of muscle imbalance, which commonly presents as an equinus or equinovarus deformity. In severe foot infections, there may be extensive necrosis of muscle, necessitating a more proximal amputation such as a below-knee or above-knee amputation. Preservation of these tendons cannot be over- emphasized, as a loss of function will result in an equinus deformity. Two major factors usually accounting for failure of transmetatarsal amputations are abnormal pressure at the stump site, and the development of an equinus deformity. The risk of pressure ulceration is minimized by appropriate resection of the metatarsals with power instrumentation, preserving a parabola which insures that no bony prominences are present plantarly, medially, or laterally (Fig. 9).

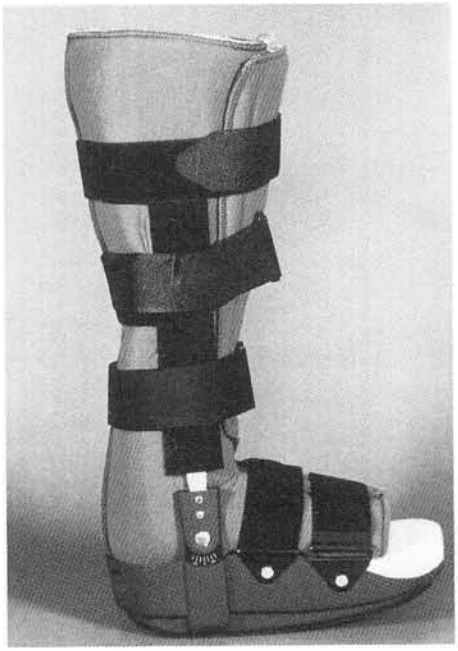

Figure 5. Use of a Cam walker to provide return to partial-weight bearing.

Figure 6. The dorsal surgical approach to transmetatarsal amputation.

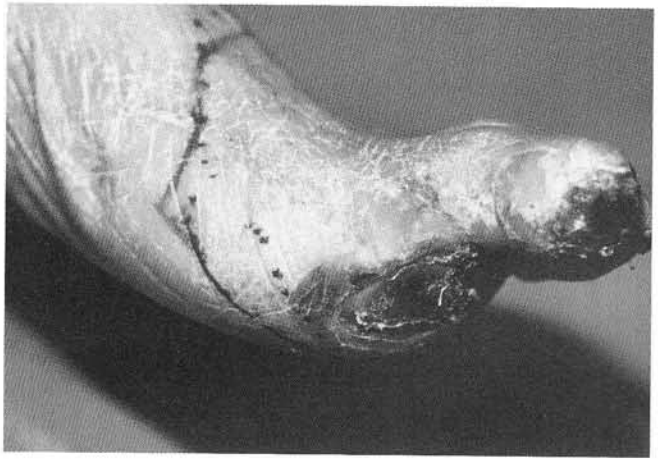

Figure 7. The dorsal-medial surgical approach to transmetatarsal amputation.

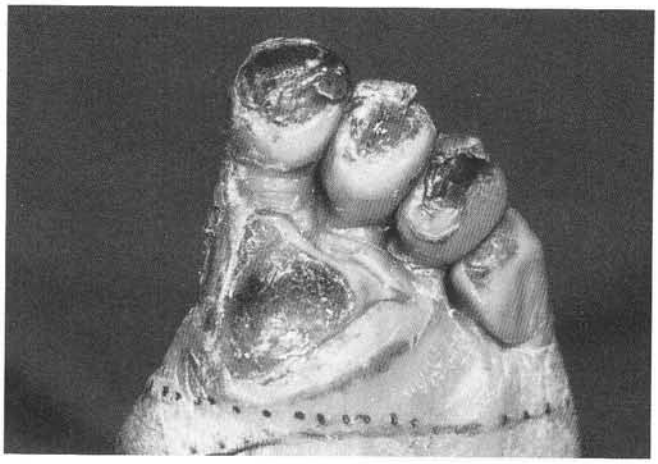

Figure 8. The plantar surgical approach to transmetatarsal amputation.

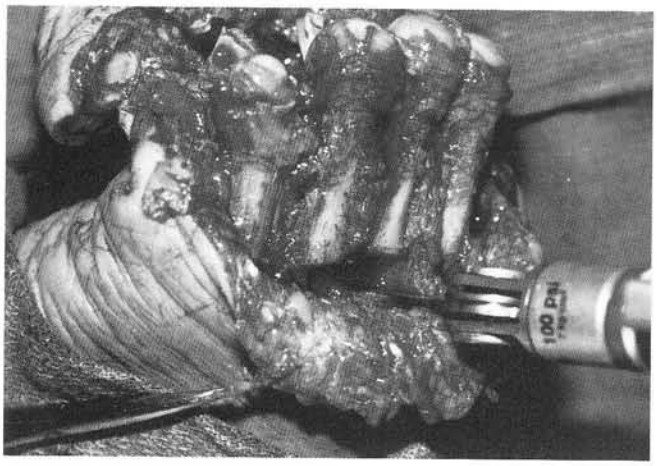

Figure 9. Resection of the metatarsals with power instrumentation to preserve a parabola assuring no bony prominences are present.

Figure 10. Proximal incision of tendons and nerves which are allowed to retract.

Nerve Endings

Painful and disabling stump neuromas are common following transmetatarsal amputation. All sensory nerves encountered dorsally and plantarly should be sharply incised at a proximal level, protecting them from any potential external force such as the patient's prosthesis or shoe. The incised nerve endings should be allowed to retract proximally to avoid reinnervation of the skin or distal anatomical structures. In addition to nerve endings being sharply incised, all flexor and extensor tendons are identified and incised at a proximal level, allowing the tendon to retract proximally. Care is taken to maintain the insertions of the peroneus brevis tendon laterally, and the tibialis anterior tendon medially, to prevent equinus deformity post-operatively (Fig. 10).

Blood Vessels

Hemostasis is essential during amputation surgery to avoid complications of hematoma formation, which may increase the risk of wound dehiscence and secondary infection. Blood vessels should be cauterized or ligated; however, efforts should be made to limit the amount of absorbable suture which is placed in the wound. Frequent lavage with cool, sterile water during surgery, and placement of the patient and extremity in a slight Trendelenburg position, assists in hemostasis. A tourniquet is rarely used. However, if a tourniquet is used, it is deflated before final wound closure or packing the wound open, to assure adequate hemostasis. The use of a closed suction drain is essential to reduce postoperative hematoma formation (Fig. 11).

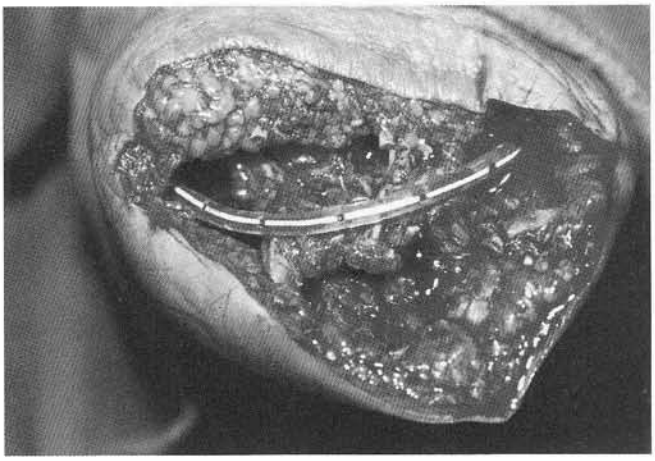

Figure 11. Use of a closed-suction drain to reduce the chance of post-operative hematoma.

Figure 12. Intra-operative soft tissue gram stain, cultures for aerobes, anaerobes, mycology, and acid fast stain.

Figure 13. Final skin closure with interrupted, non-absorbable sutures without skin tension.

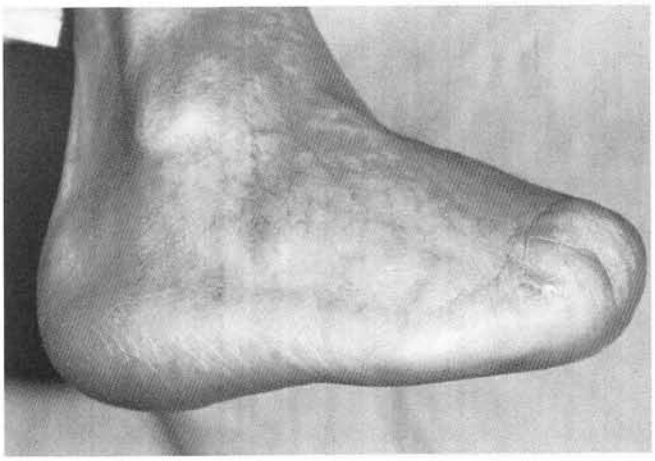

Figure 14. Final clinical result following successful transmetatarsal amputation.

Bony Prominences

Adequate surgical planning is necessary to assure that no remaining bony prominences are present in potential weight-bearing areas. Appropriate power instrumentation and remodeling of any irregular surfaces prior to closure are essential.

Removal of Diseased Tissue

It is essential that all necrotic or diseased tissue is removed at the time of amputation, to prevent further complications from infection, or in more severe cases, necrotizing fasciitis. Appropriate intraoperative cultures including gram stain, culture and sensitivity for aerobes and anaerobes, acid fast, and fungal cultures are imperative. In the presence of osteomyelitis, appropriate bone specimens should be sent for definitive diagnosis by pathology, as well as bone cultures to isolate the infective organism(s). It should be noted that when the patient is on preoperative antibiotics, the cultures may show no growth, even in the presence of chronic disease. When removing diseased bone, adequate margins must be obtained proximal to the diseased area to assure adequate resection. The importance of appropriate bone biopsy and bone culture cannot be over-emphasized (Fig. 12).

Final skin closure, utilizing interrupted non-absorbable sutures without skin tension, followed by compressive dressings, bed rest, elevation, and non-weight bearing ambulation, help to prevent wound complications including dehiscence and secondary infection which may necessitate a more proximal amputation at a later date (Fig. 13). The final clinical result following a successful trans-metatarsal amputation is illustrated in Figure 14.

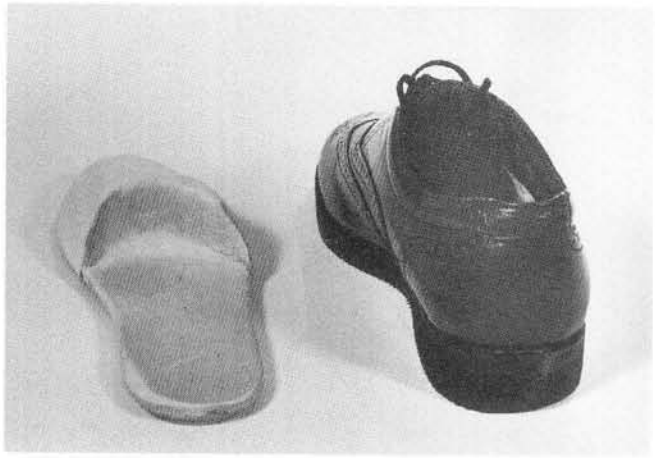

Figure 15 . Plastizote forefoot filler and inlay combination with rocker sole and rigid shank shoe.

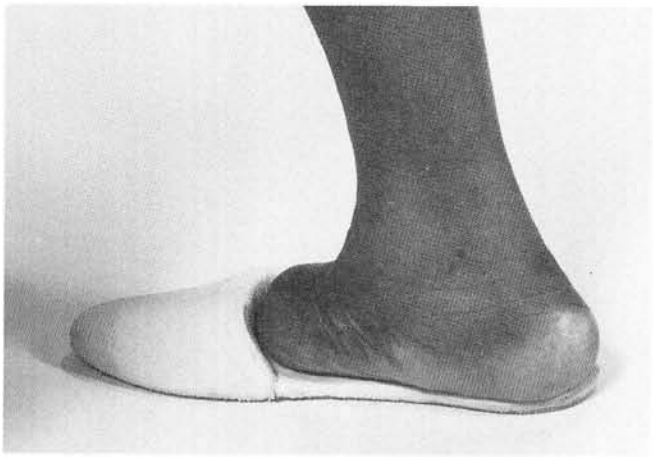

Figure 16. Forefoot plastizote filler (lateral view).

POSTOPERATIVE MANAGEMENT

Most postoperative regimens following transmetatarsal amputation initially require strict non-weight bearing of the involved extremity. It is important for the podiatric surgeon to not neglect the contralateral limb which is at increased risk. This requires frequent monitoring and protective measures. The use of a Cam walker is an excellent regimen to progress from a non-weight bearing to a partial-weight bearing status. The Cam walker can be used effectively until it is appropriate to advance to the use of a shoe. An extra-depth shoe with a prescribed plastizote forefoot filler and inlay, combined with a rocker sole and a rigid shank is recommended for ambulation following successful healing.(Figs. 15, 16) The rigid shank and rocker sole assist the patient, by allowing the foot to clear the ground, since the patient following transmetatarsal amputation loses the ability to push off adequately during gait.

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