CHAPTER **16**

FOREFOOT AMPUTATIONS: Alternative to AK/BK

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INTRODUCTION

Many surgeons have documented the success of more distal amputations emphasizing the techniques of limb preservation. The primary function of the lower extremity is locomotion, and the podiatrist's goal is to preserve this function. Because the amount of energy expended in walking increases as the level of the amputation progresses proximally, the primary objective of amputation surgery, when necessary, is the maintenance of a functional stump at a level capable of healing. Partial forefoot amputations may allow for preservation of a functional foot with a major advantage being the ability to bear weight.

According to published statistics, over 40,000 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. Furthermore it is estimated that 85% of these amputations could be prevented through proper patient education and proper early treatment in preventing foot ulcerations. When a neurotrophic diabetic patient presents with chronic foot ulceration, a more proximal amputation is not always necessary. Digital or partial forefoot amputations may allow for preservation of a functional foot with the major advantage being the ability to bear weight.

Therefore, 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 contra lateral limb following leg amputation. Digital amputations unlike lesser ray amputations are indicated when the infection or necrotic tissue does not extend to the web space of the foot or the metatarsophalangeal joint. An understanding of the basic principles and techniques of amputation surgery is essential in obtaining an optimal surgical result.

DIGITAL AMPUTATIONS

The indications for digital amputation include gangrene of one or more toes that has stabilized and does not involve the dorsal or plantar aspect of the foot. Digital amputations are also effective in non-healing open infected lesions of the digits in a neurotrophic foot and when the infectious process has not extended to the web space or plantar aspect of the distal foot.

It is essential to determine the adequate level of amputation to maintain a functional stump that is capable of adequate wound healing. The author prefers the use of a distal Symes type of incision, beginning just above the midline of the toe medially and laterally, running distally to the base of the proximal phalanx. The incision is then extended distally both medially and laterally, joining plantarly and distally in a transverse fashion, joining both ends of the previous dorsal incisions. This assures adequate closure over the metatarsal head. It is essential that the incisions be carried deep and directed to bone with no attempt for anatomical dissection with separation of layers. All nerves and tendons should be incised sharply proximally and allowed to retract proximally. A common complication of digital amputation is subsequent amputation of the remaining digits due to progression of the disease process, or a surgical result, which may not provide the optimal result during gait.

HALLUX AMPUTATION

The typical surgical approach for hallux amputation is through two semi-elliptical incisions encompassing the diseased tissue extending from the first metatarsal distally to the proximal phalanx with dorsal and plantar extension encompassing the hallux and joining on the plantar aspect. Alternative surgical approach for the procedure utilizes an extended plantar viable skin flap to allow closure following hallux amputation. Hallux amputation may consist of a disarticulation amputation in which

the level of amputation is at the interphalangeal joint or an osteotomy amputation in which the amputation level is in the proximal shaft of the proximal phalanx.

FIRST RAY AMPUTATION

Resection of the first ray is considered when infection extends proximally to the metatarsal phalangeal joint. The surgical approach for this procedure is through a linear incision extending from the metatarsal cuneiform articulation distally to the metatarsal phalangeal joint, with medial and lateral extension encompassing the great toe and joining on the plantar aspect of the great toe. Adequate bleeding at the time of the skin incision is a strong indication that the patient has adequate circulation for appropriate healing of the wound following amputation. The skin incisions are carried directly from skin to bone without undermining any of the tissue. The extensor tendon is identified and incised proximally and allowed to retract. The first metatarsal is identified and disarticulated at the first metatarsal cuneiform joint. The sesamoid apparatus is identified and excised. Specimens submitted to pathology include the diseased hallux, extensor tendon, first metatarsal, flexor tendon, and sesamoid apparatus. Hemostasis is provided by electrocautery prior to packing of the wound or primary closure with the use of a closed suction drain.

LESSER RAY AMPUTATION

Lesser ray amputations, like first ray amputations, are indicated when the infection extends into the web space and involves the metatarsal phalangeal joint. Resection of the first metatarsal and lesser metatarsals may lead to functional imbalance requiring additional surgery, due to increased pressure under the remaining metatarsals.

FIFTH RAY AMPUTATION

The surgical approach for fifth ray amputations is through two semi-elliptical incisions encompassing the diseased tissue extending from the metatarsal cuboid articulation distally to the metatarsal phalangeal joint, with medial and lateral extension encompassing the fifth toe and joining on the plantar aspect of the fifth toe.

Both of the incisions are carried from skin to bone without undermining the tissues. The extensor tendon is identified and incised proximally and allowed to retract. The fifth metatarsal is identified and disarticulated at the fifth metatarsal cuboid joint. All necrotic and diseased tissue is removed at the time of amputation to prevent further complications from infection, or necrotizing fasciitis. Intraoperative cultures are taken. Hemostasis is provided by electrocautery. All specimens are submitted to pathology including the entire fifth ray and diseased tissue. The importance of appropriate bone biopsy to identify a clean margin and bone cultures cannot be overemphasized.

TRANSMETATARSAL AMPUTATION

Transmetatarsal amputations, similar to lesser and first ray amputations, are indicated when the infection or necrotic tissue extends into the web space and involves the metatarsal phalangeal joint. The surgical approach is through a dorsal medial skin incision extending dorsally to the lateral aspect of the foot joining a distal plantar surgical incision to assure adequate wound closure. The incisions are carried from skin to bone without undermining the tissues. Power instrumentation is utilized to resect the metatarsals in order to preserve a parabola, assuring no bony prominences plantarly, medially, and laterally. Extensor and flexor tendons are identified, incised, and allowed to retract proximally. All diseased tissues are removed, and intraoperative soft tissue cultures are obtained. A closed suction drain is utilized to reduce postoperative hematoma. Final skin closure consists of interrupted nonabsorbable sutures without skin tension, followed by a compressive dressing, bed rest, elevation, and nonweightbearing ambulation when able.

GENERAL PRINCIPLES AND TECHNIQUES OF FOREFOOT AMPUTATIONS

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

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 digital 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 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. It is important to determine whether the wound should be packed open or closed by secondary healing, delayed primary closure at a later date or closed primarily at the time of surgery.

The surgeon must avoid overlapping or inverting the skin margins during skin closure, which lead to an increased incidence of wound dehiscence, secondary infection, and possible progression to a more proximal amputation. The optimal skin closure involves skin margins end to end or slightly everted utilizing a non-reactive material, usually a monofilament suture, with no tension on the wound edges (Figure 1).

Too few or too many sutures also lead to complications of improper skin closure causing wound dehiscence in many cases. 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, which may lead to a disastrous result. 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 digital amputation is imperative. In the presence of infection, appropriate antibiotics given preoperatively and postoperatively help assure appropriate healing of the wound edges. Strict non-weight bearing is not mandatory and the patient may usually ambulate in a surgical shoe.

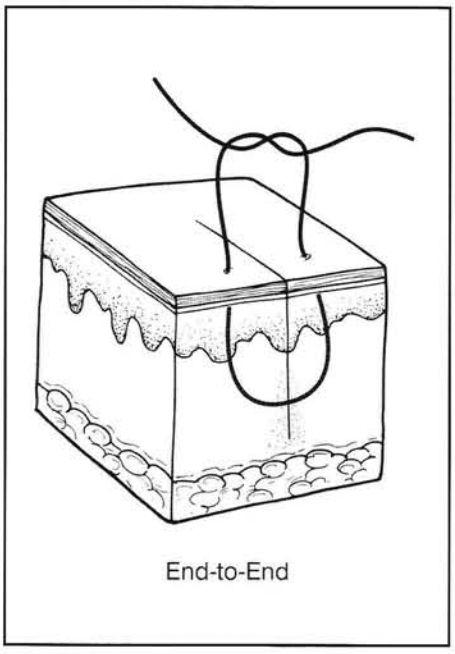

Figure 1. Skin margins end-to-end or slightly everted.

Preservation of Muscle Function

Preservation of muscle function is extremely important when a digital and forefoot amputation is performed. As the insertion of the flexor digitorium longus and extensor digitiorium longus tendons are violated during digital amputation, there is a higher incidence of muscle imbalance, which commonly presents as an associated deformity of the adjacent digits. Amputations involving the entire second digit commonly are associated with subsequent hallux valgus deformity in which the hallux deviates laterally filling the void created by the amputation of the second digit. In severe foot infections, there may be extensive necrosis of major muscle function necessitating a more proximal amputation such as a below-the-knee or above-the-knee amputation. Two major factors usually accounting for failure of digital and forefoot amputations are abnormal pressure at the stump site and the development of adjacent deformity.

Nerve Endings

Painful and disabling stump neuromas are common following digital and forefoot 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 diseased tendons are identified and incised at a proximal level allowing the tendon to retract proximally.

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 (Figure 2); however, efforts should be made to limit the amount of absorbable suture utilized in the wound. Frequent lavage with cool sterile water during the operation and the placement of the extremity in slight Trendelenburg assists in hemostasis. A tourniquet is rarely used. However, if it 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.

Bony Prominences

Adequate surgical planning is necessary to assure that no remaining bony prominences are evident in potential weight bearing areas. Appropriate power instrumentation and remodeling of any irregular surfaces prior to closure are essential. This is imperative when an osteotomy amputation technique is utilized rather than a disarticulation amputation.

Removal of Diseased Tissue

It is essential that all necrotic or diseased tissue be 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. It should be noted that when the patients are on pre-operative antibiotics, the cultures might 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. (Figure 3) 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 lead to more proximal amputation at a later date.

Postoperative Management

Most postoperative regimens do not require non-weight bearing with the exception of transmetarsal amputation. It is important for the podiatric surgeon not to neglect the contralateral limb, which is at increased risk, which requires frequent monitoring, and protective measures. The use of surgical shoes is an excellent regimen to progress to normal footgear. Dry sterile bandaging is applied using concentric bandaging using more compression distally than proximally. It is imperative to avoid using excessive pressure during bandaging the toe, foot and ankle. No Kling on skin without proper padding of the potential pressure sites and bony prominences (Figure 4).

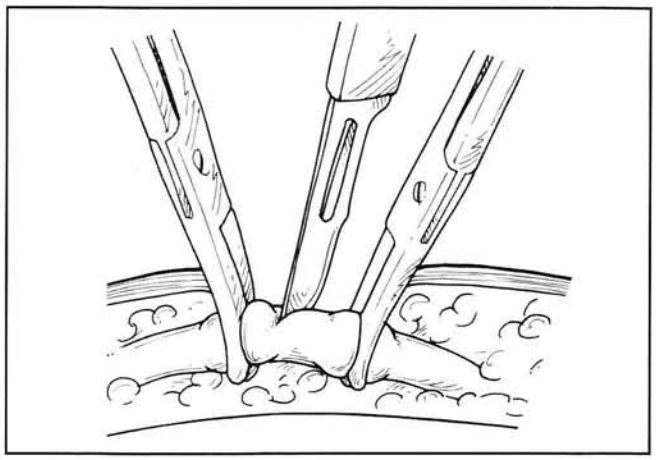

Figure 2. Ligation of blood vessels to prevent hematoma.

Figure 3. Pathology specimen.

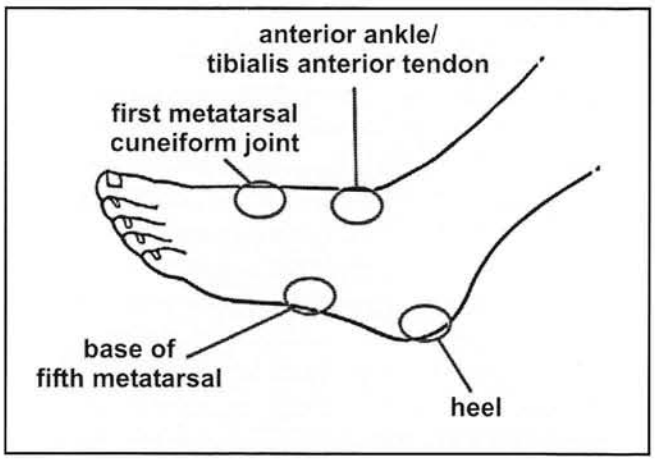

Figure 4. Avoid bony prominences during bandaging.

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