Partial Foot Amputations for Salvage of the Diabetic Lower Extremity

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KEYWORDS

• Diabetic lower extremity • Partial foot amputation • Lower limb amputation
• Diabetes mellitus

KEY POINTS

- A variety of partial foot amputation procedures exist for salvage of the diabetic lower extremity.
- Procedure selection is based on the extent of nonviable or infected tissue, healing potential from a vascular standpoint, biomechanical functionality, and patient goals.
- The surgical approach for partial foot amputations varies from elective procedures, often requiring staged surgery and a unique surgical technique.
- A subset of patients may be better served with proximal amputation depending on medical comorbidities, ambulatory status, and ultimate patient goals.

INTRODUCTION

Diabetes-related lower extremity ulcers are a common yet unfortunate complication of diabetes mellitus. Fifteen to 25% of diabetic patients are at risk of developing an ulcer during their lifetime, with 15% of these requiring subsequent amputation for infection management.[1–4] Of the approximately 80,000 amputations performed in the United States annually, half of these consist of a below-knee or more proximal amputation.[5] Patients with a below-knee amputation have a 1-year mortality rate between 20.8% and 35.5%,[6,7] with a reported contralateral limb loss rate of 53.3% within 5 years.[8] Furthermore, ambulatory status is decreased in patients with proximal amputations due to inefficient biomechanics leading to increased energy and oxygen demand.[9,10] Thus, partial foot amputation should be attempted when possible to help minimize morbidity and optimize functionality in this high-risk patient population. The principal goals of surgical treatment of diabetes-related foot infection, complicated ulceration, osteomyelitis, or gangrene consist of selecting the appropriate procedure to

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effectively eradicate nonsalvageable tissue, relieve pain, achieve primary healing, and preserve as much limb length as possible from a functionality standpoint.[11,12] Procedure selection in determining the most appropriate amputation level is typically based on ulcer location, extent of osteomyelitis or gangrene, and biomechanical implications. Local amputation options mainly consist of partial or complete toe, partial or complete ray, transmetatarsal, Lisfranc, Chopart, or Syme amputations. This article discusses each of these amputation procedures in a distal to proximal fashion, with ray amputations being stratified into first and fifth ray, or border ray, amputation and central ray amputation, as the surgical approach varies between these 2 groups. Discussion focuses on procedure selection as well as both standard and advanced surgical techniques in performing partial foot amputations for the prevention of major proximal lower limb amputations.

SURGICAL CONSIDERATIONS

Although surgical management of wounds with underlying soft tissue infection in the diabetic patient must often be addressed in an urgent fashion, careful preoperative planning is of paramount importance. When determining the surgical plan in this setting, consideration must be given to the location and extent of ulceration, infection, or gangrene, healing potential from a vascular standpoint, and the implications of a particular partial foot amputation on biomechanical function. The necessary laboratory, imaging, and, when appropriate, vascular studies should routinely be correlated with clinical findings. A single-stage amputation with immediate closure is possible when osteomyelitis is present without associated abscess or cellulitis, but acute soft tissue infection often requires a staged surgical approach. The surgeon should not feel compelled to solve complex diabetes-related foot infections with a single surgery. Staged surgery can oftentimes lead to better results with fewer complications than nonstaged surgery. The optimal definitive incision plan can be drawn out before making the stage 1 incision to ensure that the initial incision and drainage procedure will not compromise subsequent closure options. The first-stage procedure typically involves excision of the ulcer and surrounding necrotic tissue, incision and drainage of any abscess, resection of bone, and bone biopsy, as needed, to allow resolution of soft tissue infection. Multiple incision and drainage procedures may be necessary every couple of days in the setting of persistent cellulitis, abscess, or unresolving leukocytosis. Final-stage treatment occurs once the soft tissue infection has resolved and involves thorough irrigation and debridement, raising a flap if necessary, resection of previous incision borders, final proximal margin bone biopsy, and tension-free closure.

The incision and dissection technique in wound, flap, and amputation surgery differs from typical elective foot surgery because of the increased concern for maintaining tissue viability, decreased concern for sensory nerves, and salvage nature of diabetic foot surgery. The incision is made full-thickness with the scalpel plunging down to bone at a 90-degree angle to the skin surface in an attempt to avoid skiving or undermining skin edges, which could compromise viability of the local soft tissue and healing potential (**Fig. 1**). The scalpel is then advanced using a vertical sawing motion. The skin should be in a relaxed, tension-free position when performing the incision to avoid creating a serrated wound edge. This is particularly important at certain amputation sites, such as incising between the toes in a digital amputation. Longitudinal tension applied in line with the incision can also be helpful in creating a smooth incision. No undermining or layered dissection is typically performed, as this can act to devitalize tissues. Dissection should be full-thickness in nature whenever possible, with tissue