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## Original Research

## Distal Syme Hallux Amputation for Tip of Toe Wounds and Gangrene Complicated by Osteomyelitis of the Distal Phalanx: Surgical Technique and Outcome in Consecutive Cases

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## ABSTRACT

Distal hallux gangrene and neuropathic ulceration associated with digit deformity frequently result in osteomyelitis of the distal phalanx. Ideal treatment would involve limited resection to preserve function. We describe our surgical technique and retrospective results for distal Syme hallux amputation with plantar flap closure. An institutional review board-approved review was conducted on cases performed over 8 years. A total of 15 consecutive patients (16 digits) with hallux soft tissue loss who had undergone distal Syme hallux amputation were included. In each case, initial resection removed the distal hallux wound, nail bed, and distal phalanx. The proximal phalanx tip was remodeled, allowing margin biopsy and reduction of prominence. Of the 16 digits, 5 (31.3%) had hammertoe deformity and 1 (6.3%) was excessively long. Positive probe-to-bone status was identified in 8 of the 16 digits (50.0%). All 8 ulcers (100.0%) that probed to bone had histologic or culture results consistent with distal phalanx osteomyelitis. A proximal margin biopsy was taken in 12 of 16 digits (75.0%), and proximal phalanx osteomyelitis was observed in 4 of 12 proximal margin biopsies (33.3%). Two digits (12.5%) failed to heal. Three digits (18.8%) required a more proximal amputation, and the remaining 13 (81.3%) were found to be well-healed and functional at the final follow-up examination. The mean follow-up period was 27.6 (range 8 to 97) months. We have found distal Syme hallux amputation to be an effective treatment when used judiciously for distal hallux gangrene and osteomyelitis associated with neuropathic ulceration. This procedure permits bone biopsy for early diagnosis, confirmation of clean margins, removal of nonviable tissue and the abnormal toenail, and some deformity correction.

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Distal hallux ulceration is frequently associated with diabetes, peripheral neuropathy, peripheral vascular disease (PVD), and digital deformities, such as hammertoe contracture or excessive digit length. These factors in combination predispose to nonhealing wounds and secondary osteomyelitis of the distal phalanx, with the potential for limb loss if the infection spreads proximally. The ideal treatment would involve resection of nonviable soft tissue and bone, biopsy of the distal phalanx, proximal margin biopsy, correction of digital deformity, removal of the abnormal toenail, partial preservation of hallux function, and primary wound closure with native soft tissue. Distal Syme hallux amputation (DSHA) is a familiar procedure that can yield these

treatment objectives. However, partial hallux amputation at the level we describe has received little attention in the published data, with limited discussion of the patient selection criteria and indications for the procedure. Recent studies of DSHA have included the procedure as part of a larger discussion regarding the safety and efficacy of various hallux amputation levels. Evidence exists to suggest that partial hallux amputation is favored over total hallux amputation and might result in a lower reamputation rate (1–4).

We describe our indications, preoperative workup with imaging studies, surgical technique, and retrospective results for DSHA with plantar flap closure.

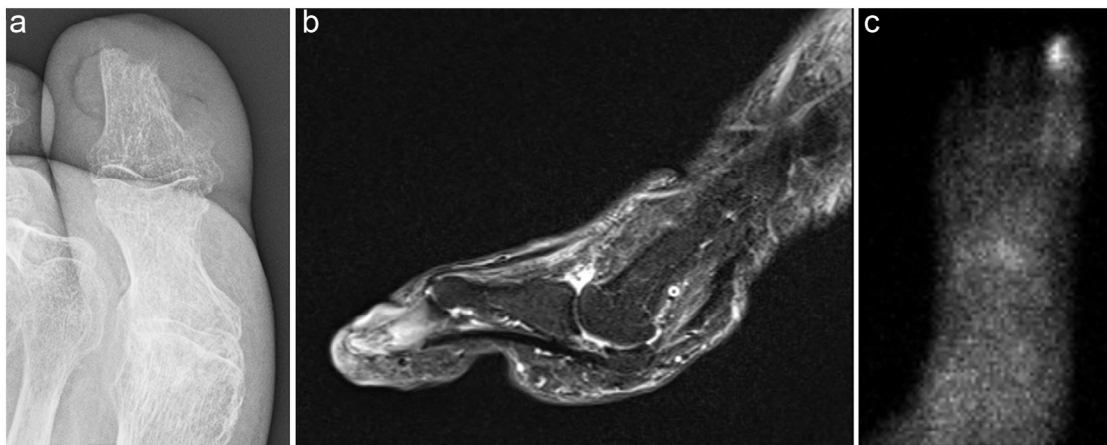
## Patients and Methods

An institutional review board-approved review of consecutive cases involving patients who had undergone DSHA for a nonhealing tip of toe ulceration, gangrene, or nail bed wound from December 2008 to June 2016 was performed. The reviewed cases were identified using a Current Procedural Terminology (CPT®) code from the

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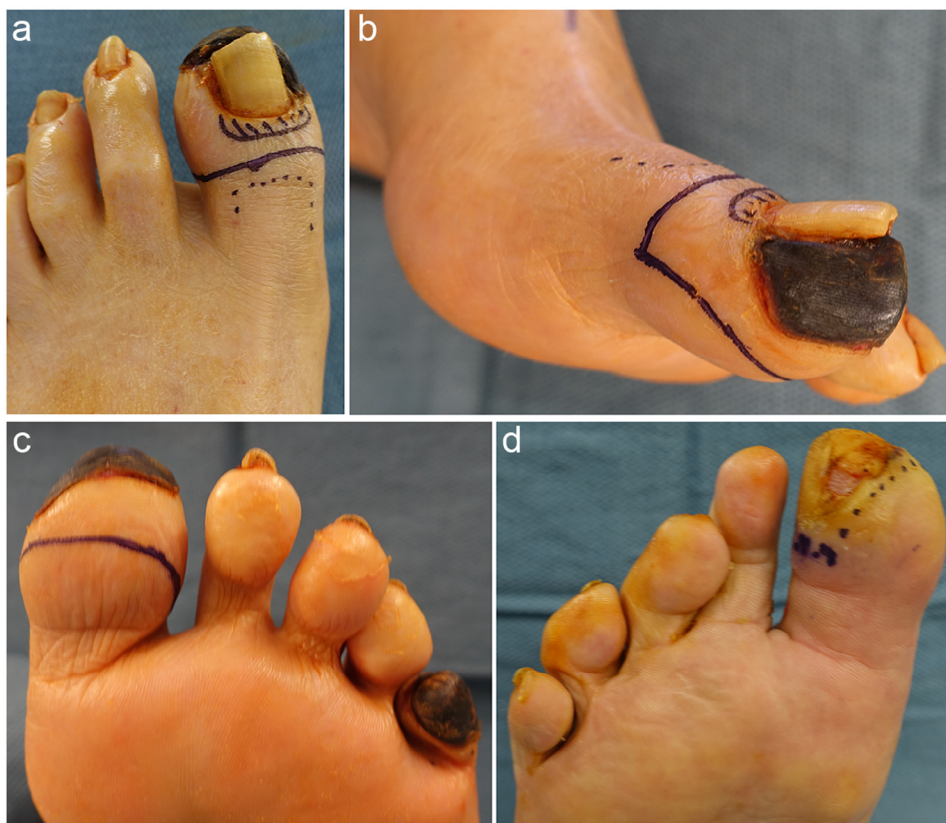
E-mail address: [Mark.S.Goss@HealthPartners.com](mailto:Mark.S.Goss@HealthPartners.com) (M.S. Goss).



**Fig. 1.** If considering distal Syme hallux amputation, osteomyelitis should ideally be isolated to the distal phalanx. Clinical evaluation, including probing of the tip of toe wounds and nail bed wounds combined with standard radiographs, is usually a sufficient evaluation. (A) Loss of bone cortex at the distal tuft will typically correlate with the wound location. Advanced imaging studies can be used for further evaluation if osteomyelitis is suspected and can help determine the extent of infection. Osseous involvement appears to be isolated to the distal phalanx on this (B) magnetic resonance image and (C) bone scan.

American Medical Association. Cases involving the use of CPT® code 28825, specifically meaning “amputation, toe; interphalangeal joint,” were reviewed and those involving the hallux were included (5). Data were collected by electronic medical record review by both of us (T.J.B., M.S.G.). This included review of the wound location, wound type, probe-to-bone status, bone biopsy results with culture and histologic findings,

presence of preoperative digit deformity, age at the time of surgery, documented comorbidities, subsequent need for more proximal lower extremity amputation, follow-up time in months, and the presence of a functional hallux at the final follow-up examination. All procedures were performed by the senior investigator (T.J.B.). The preoperative workup is shown in Fig. 1.



**Fig. 2.** Incision design using a plantar-based flap which allows full-thickness tissue to cover the weightbearing surface at the tip of the toe. The contribution from the dorsal tissue is small owing to the nail bed and nail matrix location. (A,B) Note the transverse nature of the dorsal incision at the level of the interphalangeal joint. Care should be taken to avoid making the plantar flap too long, which creates a mismatch at closure. (C) The standard plantar flap is shown but (D) can be rotated medially or laterally in the setting of gangrene or neuropathic wounds that are more extensive along the medial or lateral aspect of the tip of the toe.

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