The Natural History of Great Toe Amputations

The purpose of this study is to report the prevalence of reamputation following resection of the great toe and first ray in adults with diabetes. We abstracted the medical records of 90 diabetic great-toe and first-ray amputees admitted between 1981 and 1991. The most common etiologies of initial amputations were ulcer with soft tissue infection (39%), ulcer with osteomyelitis (32%), and puncture wounds (12%). Sixty percent of all patients had a second amputation, 21% had a third, and 7% had a fourth. Fifteen percent of the patients who had a second amputation had it contralaterally. Seventeen percent subsequently underwent a below-knee amputation and 11% had a Transmetatarsal amputation on the same extremity, 3% had a below-knee amputation, and 2% a transmetatarsal amputation contralaterally. The mean time from the first to the second amputation was approximately 10 months.

The results of this study suggest that a large proportion of patients undergoing an amputation at the level of the great toe or first ray have subsequent amputations in the first year following the initial procedure. Additionally, it appears that the contralateral foot may be at significant risk for distal amputation following resection of the hallux or first ray. (The Journal of Foot & Ankle Surgery 36(3):204–208, 1997)

Key words: diabetes, amputation, great toe, hallux

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Between 5 and 15% of all people with diabetes will require a lower extremity amputation in their lifetime (1). One of the best predictors for future morbidity and limb loss may be a history of previous amputation (2). Kucan and Robson (3) found that 49% developed contralateral foot infections within 18 months following an amputation. As many as 50% of subjects receiving a lower extremity amputation have an amputation on the contralateral limb within 2 years (4, 5).

The goal of isolated partial-foot amputations such as the hallux amputation is to spare legs and keep patients productive, ambulatory, and functional members of society. Whereas nearly 75% of amputations performed at the level of the foot are performed on patients with diabetes, comprising approximately 60% of all diabetes-related lower extremity amputations (6), little has been reported about the long-term effectiveness of these procedures. Most previous reports have discussed initial success in short-term postoperative healing (7–9). To our knowledge, no previous articles in the literature have specifically reported on the long-term prevalence of reamputation procedures among diabetic patients receiving amputations of the medial column. The purpose of this study is to report the prevalence of reamputation following initial successful healing of amputations of the great toe or first ray in adults with diabetes.

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Materials and Methods

We abstracted the medical records of 90 diabetic patients admitted to University Hospital and the Audie L. Murphy Veteran's Hospital, San Antonio between 1981 and 1991. All patients had a history of a healed amputation at the level of the hallux or first ray, and all were diagnosed with diabetes mellitus based on World Health Organization criteria (94% type II, 6% type I) (10). Descriptive data for the study population is summarized in Table 1. Amputations were performed by either the Podiatric, Orthopedic, or Vascular Surgery Services. All subjects were followed for a minimum of three years following healing of their initial amputation.

The level and etiology of amputations, both initial and subsequent, were recorded along with the time interval between amputations. Level of initial first-ray amputation was defined by radiographs and categorized as: (*a*) amputations involving the hallux, (*b*) metatarsal phalangeal joint disarticulation, and (*c*) proximal first-ray am-

TABLE 1. Patient population

Sex	n=	Age (range)	White (%)	Black (%)	Hispanic (%)
Male	70	56.2 ± 9.8 (31–83)	14.3	4.3	81.4
Female	20	58.7 ± 5.7 (45–74)	20.0	5.0	75.0

putations. The levels of subsequent amputations were categorized as: (*a*) amputations involving the first ray, (*b*) lateral foot amputation, (*c*) proximal amputations, and (*d*) contralateral leg amputations. Amputations involving the first ray were defined as a subsequent amputation confined to the hallux or first metatarsal bone. Lateral amputations involved amputations to the 2nd, 3rd, 4th, or 5th toes or metatarsal. Proximal amputations were defined as amputations performed proximal to the ankle joint. Contralateral amputations involved any amputation of the contralateral foot or leg.

Results

Twenty-one percent (n = 19) of amputations were performed at the level of the hallux. First metatarsal phalangeal joint disarticulation accounted for 54% (n = 48) of medial column amputations. Twenty-six percent (n = 23) of amputations involved proximal metatarsal amputations. The levels of amputation are further delineated in Figure 1.

The most common etiologies of initial amputations were ulcer with soft-tissue infection (39%), ulcer with osteomyelitis (32%), and puncture wounds (12%). Of the 54 patients that underwent a second amputation, the most common etiologies were soft-tissue ulceration (39%), and peripheral vascular disease (26%) (Figure 2) as documented by the admitting physician.

Figure 3 outlines the pathways after the initial amputation. To simplify these multiple pathways, Figures 4 through 6 illustrate the division of entry-level amputation as "partial hallux", "metatarsal phalangeal joint disarticulation" (including distal head resection), and "proximal first metatarsal", respectively. Seventy-four percent of patients receiving amputations performed at the level of the hallux had a second amputation (26% were more proximal first-ray amputations, 29% were proximal to Lisfranc's joint, and 19% were contralateral amputations). Forty percent (n = 9) of proximal first metatarsal amputations required a second amputation. Eleven percent of these (n = 1) were proximal first ray, 22% (n = 2) were lateral, and 65% (n = 6) were proximal to Lisfranc's joint. No contralateral amputations were identified following initial proximal first-ray resections.

Sixty percent of the total patient population went on to a second amputation, 21% to a third, and 7% to a fourth. The mean time from the entry-level amputation to the second was 9.6 ± 13.9 months. The duration from the second to third amputation was 13.4 ± 15.1 months. Duration from third to fourth amputation was 9.2 ± 4.0

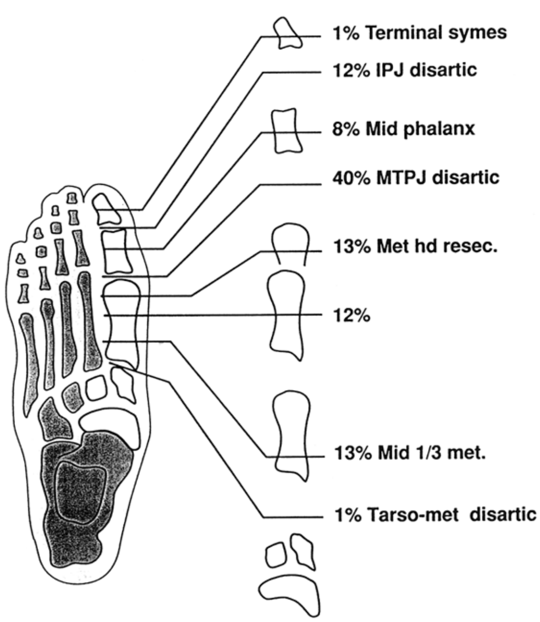

FIGURE 1 Overall distribution of level of initial first-ray amputation.

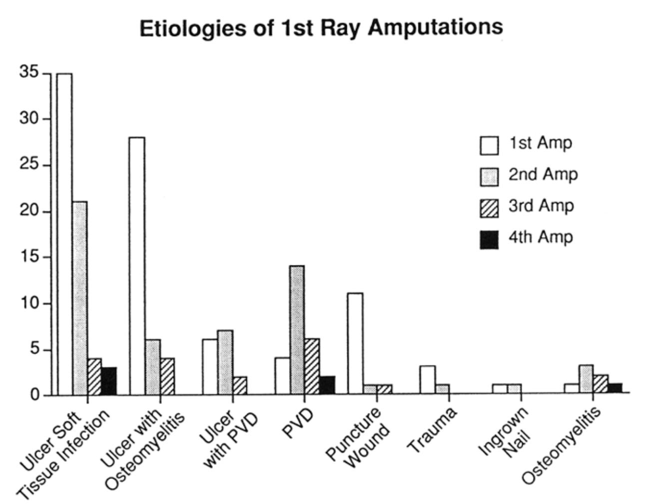

FIGURE 2 Etiology of each chronologic level of amputation (PVD, peripheral vascular disease).

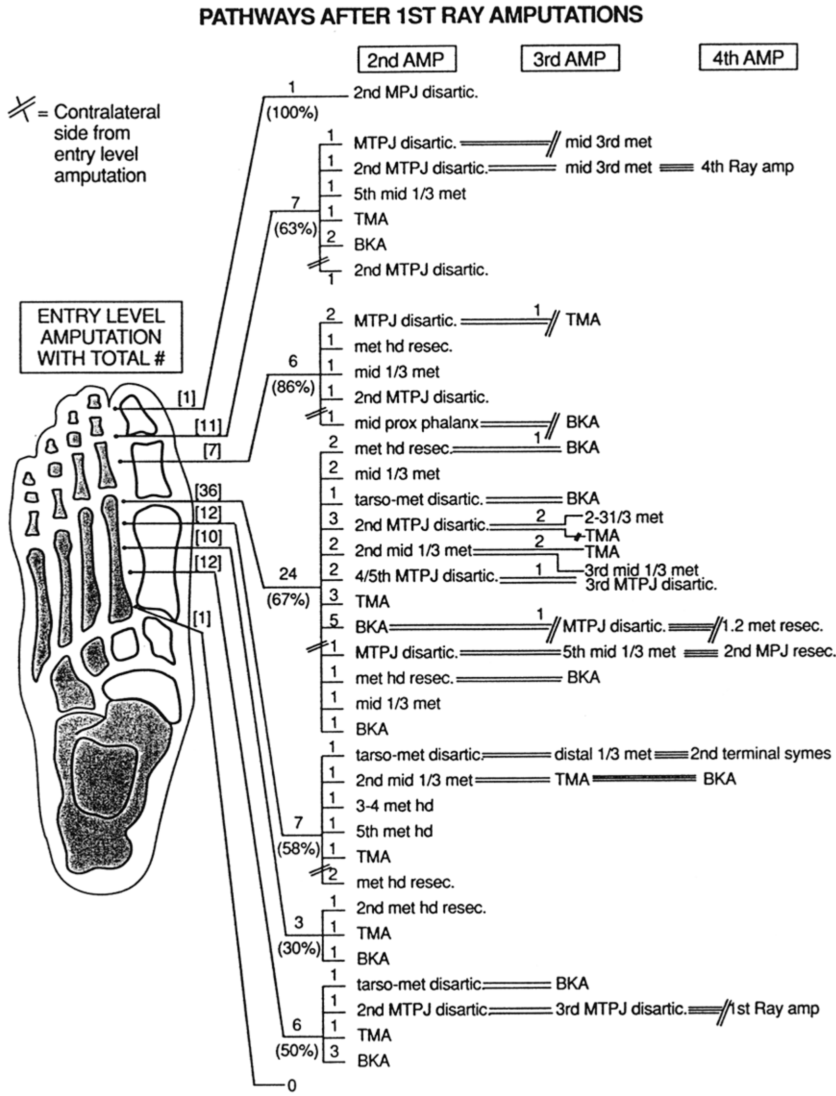

FIGURE 3 Outcomes after amputation. Entry level amputation and its prevalence at each anatomical level, followed by the type, number, and percentage of second, third, and fourth amputations for each level is Illustrated. Contralateral information is also given. (Abbreviations used: TMA, transmetatarsal amputation; BKA, below-knee amputation; Met Hd, metatarsal head; MTPJ, metatarsal phalangeal joint; Met, metatarsal; Resec., resection; Disartic., disarticulation; Amp, amputation).

months. Fifteen percent of patients receiving a second amputation received that amputation on the contralateral limb. The mean time to contralateral amputation was 17.8 ± 7.6 months following great-toe or first-ray amputation.

Incidence of below-knee amputations (BKA) and transmetatarsal amputations (TMA) are outlined in Figure 3. While many of these patients had additional foot amputations, only 18 of the 90 (20%) required an amputation involving the leg of the ipsilateral or contralateral extremity. Overall, 17% of the patients had a subsequent BKA and 11% had a TMA on the same extremity, whereas 3% had a BKA and 2% a TMA on the contralateral side.

Discussion

The results of this study suggest that a large proportion of patients receiving an amputation at the level of the great toe or first ray receive higher level amputations in the first year following the initial amputation. Additionally, it appears that the contralateral lower extremity may also be at significant risk for distal amputation following resection of the hallux or first ray.

Understanding that following a first-ray amputation the ipsilateral and contralateral foot are at great risk for subsequent adverse events, steps may be taken to mitigate future risk. Following great-toe amputation, patients frequently develop rigid contractures of the lesser

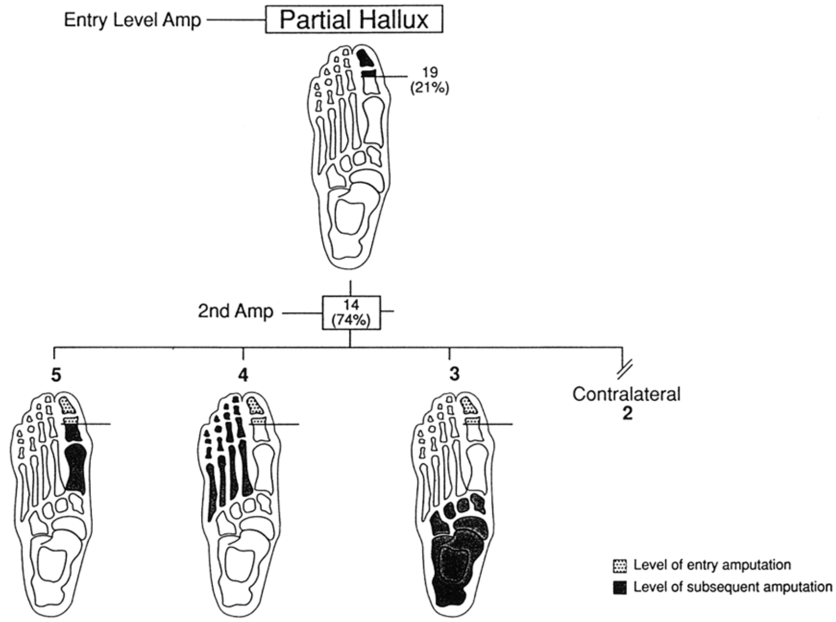

FIGURE 4 Pathway of "partial hallux" level of entry amputation. Figure shows the number (percentage) that entered at this level, then the number (percentage) that had a second amputation, and the distribution of that second amputation, *i.e.*, more proximal first ray (5), more lateral amputation (4), more proximal amputation (3), or contralateral amputation (2).

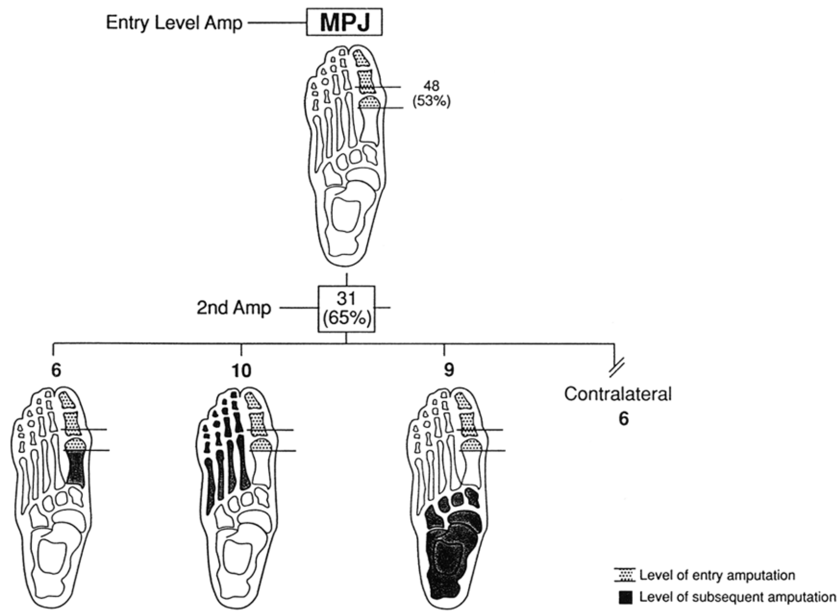

FIGURE 5 Pathway of "metatarsal phalangeal" level of entry amputation. Figure shows the number (percentage) that entered at this level, followed by the number (percentage) that had a second amputation with distribution of that second amputation, *i.e.*, more proximal first ray (6), more lateral amputation (10), more proximal amputation (9), and contralateral amputation (6).

digital interphalangeal and metatarsophalangeal joints (11, 12). These contractures cause prominences dorsally at the interphalangeal joints and plantarly beneath the metatarsal heads with anterior migration of the plantar fat pad and a subsequent increase in focal foot pressures (13). If not accommodated through appropriate shoe gear and, if necessary, prophylactic surgery (14), these may lead to ulceration, infection, and amputation. Additionally, changes in gait pattern may place additional stress on the contralateral limb, predisposing it to increased repetitive pressure and a similar potential pathway to limb loss. During the majority of the study period, resources for a multispecialty diabetic limb salvage team such as a dedicated vascular laboratory, a certified pedorthic labora-

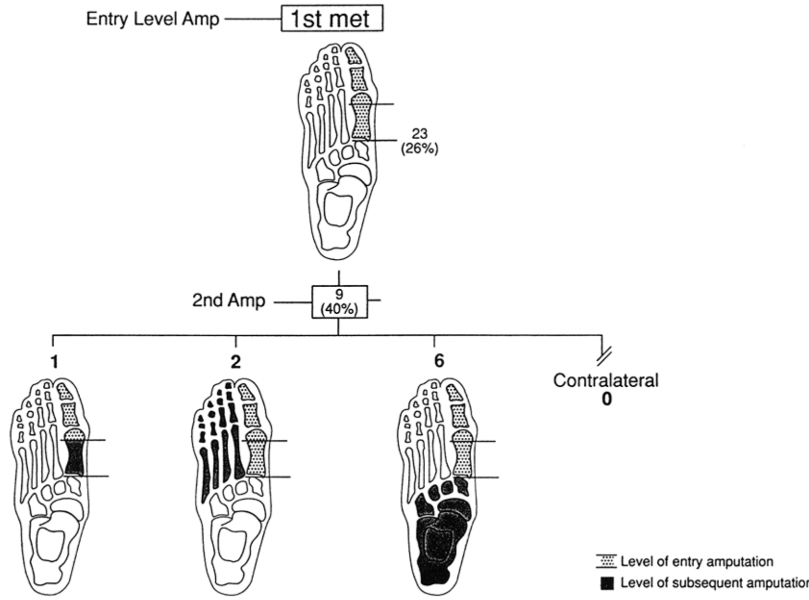

FIGURE 6 Pathway of "first metatarsal" level of entry amputation. Figure shows the number (percentage) that entered at this level, followed by the number (percentage) that had a second amputation and the distribution of that second amputation, *i.e.*, more proximal first ray (1), more lateral amputation (2), more proximal amputation (6), and contralateral amputation (0).

tory, and a full-time vascular surgeon were not in place. We believe that this may have contributed to inadequate access to numerous essential factors in follow-up care, such as appropriate foot-risk classification (2), shoe-gear accommodation, and timely insole replacement in a large percentage of the patients reviewed.

There are several limitations involved in the collection of these data that must be considered. Information that we assumed would be identified in every medical record, such as the presence or absence of pedal pulses, was not mentioned consistently in many of the hospital or outpatient records. We were therefore unable to specifically evaluate or identify patients with peripheral vascular disease using pedal pulses as a criteria. More objective information about peripheral arterial occlusive disease (*e.g.*, segmental pressure analysis, pulse volume recording, or transcutaneous oxygen tension measurements) was rarely available in the medical records. During the majority of the 10-year period studied, a vascular laboratory had not yet been established in the hospitals in which the records were reviewed. However, because the study-inclusion criteria required a *healed* hallux or first-ray amputation, patients with severe peripheral vascular insufficiency were most likely eliminated.

It is the intention of this manuscript to serve as a descriptive survey reporting on the outcomes of first-ray amputations. Clearly, this subject calls for further prospective investigation. Subsequent studies in this area should document outcomes at various levels in the foot, as well as quantifying peripheral arterial occlusive disease and degree of neuropathy.

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