Transmetatarsal Amputation for First Ray Ulceration or Osteomyelitis: A definitive procedure

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Statement of Purpose

Prior publications have indicated high rates of re-amputation after partial first ray resection in patients with diabetes mellitus and peripheral sensory neuropathy. In response, transmetatarsal amputation (TMA) has been proposed as an index procedure; however, details of its durability have been sparsely published. This case series details surgical outcomes of TMA for first ray ulceration or osteomyelitis.

Methodology & Hypothesis

A retrospective review of all TMAs performed at our institution over an 8 year period was undertaken to identify diabetic patients with peripheral neuropathy who underwent TMA for first ray ulceration or osteomyelitis of the 1st metatarsal rather than partial first ray amputation. Patients were excluded from review for vascular compromise. Ten patients (11 TMA procedures) meeting inclusion and exclusion criteria were identified. Formal chart review was performed collecting demographic, surgical, and follow-up data including time to heel ulceration, re-ulceration rate, 42.4% proximal amputation rate and 26.9% suggested reoperation and reamputation rates of 26.9% respectively. These results lead the authors to suggest caution in performing primary TMA.

Literature Review

Individuals with diabetes mellitus and peripheral neuropathy are at high risk for development of forefoot ulcerations. These ulcerations can be difficult to manage secondary to poor pedal hygiene, repetitive plantar stressors, difficulty obtaining appropriate offloading, and inadequate vascular supply. The first ray is especially prone to skin breakdown.

When soft tissue breakdown or underlying infection necessitates amputation, a partial first ray amputation is often performed in an effort to maintain the length of the residual foot thereby reducing the patient’s overall metabolic demand and subsequent mortality rate. However, prior literature has challenged the durability of partial 1st ray amputations. A 2012 systematic review of partial 1st ray amputations performed by Borokisy and Roukis identified a 19.8% re-amputation rate of which 52.6% were amputations at the transmetatarsal level and 29.7% at the below knee level. Subsequent retrospective review of cases at our institution revealed a 66% re-ulceration rate, 42.4% proximal amputation rate and 47.5% mortality rate within a mean of 34.6 months. In response, TMA was proposed as an index procedure. However, a TMA is not without its pitfalls. A review of the literature reveals a high rate of complications and re-amputations following TMA. In a retrospective review of 101 cases, Pollard and colleagues reported post-surgical complications in 87.1% of cases. This could be attributed to a myriad of causes including persistent host factors for delayed healing (i.e. protracted hyperglycemia, malnutrition, vascular insufficiency, etc.) and an untested structural or dynamic imbalances of the residual foot. Systematic review and meta-analysis by Thord et al. suggested reoperation and reamputation rates of 36.9% and 29.7% respectively. These results lead the authors to suggest caution in performing primary TMA.

It needs to be noted that these articles detailing re-operation and re-amputation rates after TMA fail to delineate between individuals with diabetes mellitus and peripheral neuropathy from those with concomitant vascular compromise. This case series is dedicated to investigating the durability and reliability of TMA for first ray ulceration or osteomyelitis utilizing the modified TMA technique. A unique and soft tissue balancing procedures were then performed to ensure a plantigrade and stable residual foot.

Procedure

Management of all patients was performed via a standardized protocol. Prior to intervention, operative extremities underwent surgical preparation with a chlorhexidine gluconate 4% scrub and an iodine impregnated alcohol paint. After intervention, operative extremities underwent surgical preparation with a chlorhexidine gluconate 4% scrub and an iodine impregnated alcohol paint. When soft tissue required time for demarcation. If a staged procedure was necessary amputation, a partial 1st ray amputation is often performed in an effort to maintain the length of the residual foot thereby reducing the patient’s overall metabolic demand and subsequent mortality rate. However, prior literature has challenged the durability of partial 1st ray amputations. A 2012 systematic review of partial 1st ray amputations performed by Borokisy and Roukis identified a 19.8% re-amputation rate of which 52.6% were amputations at the transmetatarsal level and 29.7% at the below knee level. Subsequent retrospective review of cases at our institution revealed a 66% re-ulceration rate, 42.4% proximal amputation rate and 47.5% mortality rate within a mean of 34.6 months. In response, TMA was proposed as an index procedure. However, a TMA is not without its pitfalls. A review of the literature reveals a high rate of complications and re-amputations following TMA. In a retrospective review of 101 cases, Pollard and colleagues reported post-surgical complications in 87.1% of cases. This could be attributed to a myriad of causes including persistent host factors for delayed healing (i.e. protracted hyperglycemia, malnutrition, vascular insufficiency, etc.) and an untested structural or dynamic imbalances of the residual foot. Systematic review and meta-analysis by Thord et al. suggested reoperation and reamputation rates of 36.9% and 29.7% respectively. These results lead the authors to suggest caution in performing primary TMA.

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Results

Ten patients (11 TMA procedures) were identified for inclusion in the study. Nine patients were male and 1 female. Mean age of diagnosis was 57.8 years (range 38 to 72 years). Lateralis was left for 6 and right for 5. Six TMAs were closed primarily and 5 were staged. Acute re-operation and re-reamputation rates were 36.4% and 29.7% respectively. Mean time to heal was 175.8 days. Re-ulceration was recorded in 5 patients and 6 TMAs at an average of 310.3 days after healing index procedure. Local wound cares were sufficient to heal 4 of the re-ulcerations, 1 remains ulcerated, and 1 has been lost to follow-up. No reoperations or reamputations were required.

Analysis & Discussion

The literature suggests that an isolated first ray amputation in the diabetic, neuropathic population lacks durability leading to high re-ulceration and re-amputation rates. The healing rate of a TMA as an index procedure varies depending on persistent host factors for delayed healing and structural or dynamic imbalances of the foot residual. This case series evaluates TMA durability within a specific subset of patients with diabetes mellitus, peripheral neuropathy, but without vascular compromise. TMAs were performed using a literature based limb salvage protocol, taking care to preserve residual musculature and vasculature. Structural or dynamic imbalances of the residual foot were systematically addressed in an attempt to provide a stable, plantigrade foot. In our review, Primary TMAs for first ray pathology presented in a 0% reoperation and re-amputation rate suggesting a modified TMA as a viable alternative to a first ray amputation to preserve limb function and prevent more proximal amputations. Weaknesses of this study include short follow-up size. While a single TMA protocol was in use for all surgeries, multiple surgeons performed the TMA’s introducing variability to the study. Despite these points, the results provide further promising information on this technique.

Figure 1: Pre-operative radiographs

Figure 2: Example of forefoot dissection and residual plantar soft tissue flap with retained intrinsic muscular and associated vasculature.

Figure 3: Intra-operative radiographs

References


