

Sock-Filler: A Case Study of a Homemade Transmetatarsal Amputation Toe-Filler

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INTRODUCTION

Diabetic foot ulceration is the most common cause of patients undergoing an amputation (1). The International Diabetes Federation predicts the global prevalence of diabetes will reach 435 million by 2030. By 2050 there will be a predicted 3.6 million individuals with the loss of a limb or partial limbs. The hospital costs associated with amputation is more than \$8.3 billion (2). While novel technology has simplified and improved the efficiency of prosthetic fitting, these new modalities come at a cost ranging from \$5,000 to \$50,000 (3). In many communities and medical institutions, the patient population cannot afford this luxury.

Foot and ankle surgeons perform a large number of amputations each year, ranging from digital amputations, partial ray resections, transmetatarsal amputations, Lisfranc and Chopart disarticulations, and proximal Symes amputations. Each amputation requires unique post-operative care including management of phantom pain, gait instability, as well as proper fitting prosthetic or orthotic devices. New technology has made it possible for the most advanced prosthetic devices to replace portions of the foot or limb which has been lost. A successful prosthetic will fit and conform the filler to the patient perfectly to reestablish limb length, allowing for biomechanically stable ambulation, and the ability to perform activities of daily living painlessly without re-ulceration. Inadequate prosthetic devices can lead to increased pain, new onset ulcerations, as well as increased stress and degeneration to the remaining extremity due to altered anatomy. Statistics show that 30-40 percent of amputees suffer post-operative ulceration to the amputation site due to soft tissue breakdown, poor healing, or ill-fitting foot filler devices(2).

Transmetatarsal amputation (TMA) requires shoe modification with a forefoot space filler, and custom insert in order to reduce plantar pressure to the distal stump. A multidisciplinary team approach incorporating the expertise of not only a foot and ankle specialist, but also a primary care physician, physical therapist, and most importantly a skilled prosthetist is key to best treat these amputees. A knowledgeable prosthetist will perform a thorough physical examination with biomechanical assessment in order to determine the best material, rigidity, size, fit and offloading of a device for the patient's comfort and function. Oftentimes a carbon fiber foot plate extension can be incorporated with a steel shank along the longitudinal arch of the foot to mimic toe-off ambulation. The composition material of the custom toe-filler is key. It can be comprised of a simple foam pad or even a piece of lamb's wool to replace the forefoot and cushion the stump. Additionally, custom molded inserts modified with accommodative orthotics can also be used to address specific amputations, i.e. hallux, individual digital, complete digital and transmetatarsal amputations.

The most common complaints regarding these toe-filler prosthetics includes skin irritation, increased pressure to the distal stump with new ulcer formation, discomfort, and poor fitting in regular shoe gear. Many patients admit finding greater comfort using simple household items as toe fillers in their shoes as compared to the expensive custom built devices often prescribed following amputation. The following case report demonstrates a patient with a healed TMA stump free of added pressure or ulceration by simply using a rolled sock as a shoe filler after experiencing unexpected discomfort with a traditional EVA toe filler.

Figure 1: Patient's home-made sock filler



CASE

A 37-year-old male with a past medical history of smoking, insulin-dependent diabetes, and hypertension presented to our clinic with a new onset ulceration to his transmetatarsal amputation stump. The patient underwent amputation at an outside facility approximately 6 months prior after failing local wound care and offloading of a chronic forefoot ulceration with underlying osteomyelitis. Upon assessment, it was clear that the new ulcer developed secondary to shoe gear irritation from his custom made toe filler. After receiving a thorough biomechanical examination, a revisional TMA and percutaneous tendo-Achilles lengthening was performed. The revision healed uneventfully, and the patient was referred to a skilled prosthetist for offloading and custom shoe gear to avoid reulceration. Although working closely with the prosthetist, the patient had difficulty finding a comfortable toe filler which would fit into his desired shoe gear. He began using a rolled sock in his shoe instead of utilizing a traditional custom toe filler device. The patient expressed greater satisfaction using the sock filler as compared to the toe fillers he had previously tried. With the sock filler, he continued to ambulate in regular shoes without instability or recurrent ulceration. The sock provided an affordable, and comfortable material which fit snugly into any pair of shoes, reliably maintained adequate cushioning, and dispersed pressure evenly across the amputation stump. The patient was so pleased with the homemade sock filler's performance that he refused the custom EVA foam toe-filler, and continued to utilize his socks. At 2 years status post revisional transmetatarsal amputation (Figure 1 & 2), the patient has not suffered any new onset diabetic ulcerations and continues to ambulate in the shoes he loves with the ease and comfort of his sock filler.

DISSCUSSION

Transmetatarsal amputations (TMA) have become the most common and successful partial foot amputation. When performed correctly and in combination with adjunctive procedures when necessary, the TMA is a valuable surgery in the limb salvage effort, and preferred over and below or above knee amputation when functionally and physiologically reasonable with authors reporting success rates of over 90 percent.(5) The advantages of performing TMAs on patients include the preservation of lower extremity function, lower energy expenditure as compared to more proximal amputations, and the ability to use normal non-custom footwear. Foot and ankle surgeons who perform these amputations must ensure the procedure is performed in the appropriate patient population with proper techniques which provide adequate closure, tendon rebalancing, pressure dispersion across the stump, and maintenance of a closed soft tissue envelope. The amputation stump must be monitored closely in the post-operative period for skin mottling, epidermolysis, erythema, callus formation and any other signs of increased pressure points. Keeping in mind to avoid extreme dorsiflexion in patients with an insensate heel pad as up to 47 percent of patients may develop acute transfer ulcers to the heel (6).

Figure 2: Patient is free of ulceration at the 2-year follow up from a revision TMA



Individuals with a partial foot amputation may use a variety of prosthetic and orthotic devices, or choose not to use one at all. Toe filler inserts are made of high-quality EVA foam and can be crafted with 3D scanning technology and combined with more material to fill the void left by an amputation. The patient in this case report used a simple homemade sock filler (Figure 1) with much success due to affordability, comfortability and its adaptability in different shoes. Formal prosthetic devices can be unaffordable for many patients, and when not properly constructed can result in persistent discomfort and potentially ulceration. A properly constructed and placed toe or forefoot filler on an accommodative orthotic is very beneficial for the diabetic or neuropathic patient. Toe-fillers are important because not only do they limit excessive motion of the foot in the shoe, they prevent the shoe from collapsing and causing irritation on the distal or dorsal aspect of the foot. These fillers can even ease the pain and help prevent complications in the future. These devices come at a great cost and may still cause discomfort, irritation and ulceration. If these issues present with traditional toe fillers, providers can consider employing the simplicity of a sock filler or other simple cotton cloth toe filler as an affordable and reliable option.



Figure 3: Lateral Radiographs. (Above) Ulceration with more distal TMA. (Below) No Ulceration with more proximal TMA.

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