



# When Amputation Surgical Wounds Won't Heal

Infection, vascular compromise, or excessive edema must be monitored.

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**A**mputation wounds can many times be frustrating, time-consuming and complicated. This may lead to unsatisfied patients with an increase in out-of-pocket costs for wound care supplies, medications, and other devices. Any surgical procedures, including elective procedures and amputations, may result in a surgical wound. The likelihood of a wound infection after surgery is between 1-3%. Risk factors for post-operative wounds include diabetes, idiopathic neuropathy, smoking, PAD, chemotherapy, age, and obesity, as well as socioeconomic factors. This article will discuss how to manage amputation wounds, while considering alternatives and exploring other treatment modalities.

First, one must consider several factors as to why the wound is not healing. Is there presence of infection? Is there a vascular issue such as occlusion of an arterial bypass or stent? Is there improper off-loading leading to excess pressure on the wound? Is there edema leading to excess drainage? Is the wound being managed properly with the correct wound care dressing and products?

Surgical wounds fall into 4 different categories.<sup>1</sup>

- **Class I:** These are typically wounds that show no signs of inflammation or infection. These are clean wounds. There is no evidence to provide antibiotic coverage for this type of wound with the exception for immunosuppressed patients or patients with an artificial heart valve patients, as they have a 1-2% infection rate.

- **Class II:** These are surgical wounds without signs of infection; however, they are considered at increased risk due to the nature of the location. Typically, these are GI, genital and urinary tract locations. Prophylactic antibiotics are required. (Less than 10% infection rate)

- **Class III:** These are contaminated wounds that have a high rate of infection (15 to 20% infection rate).

spectrum antimicrobials targeting aggressive gram-negative aerobes and obligate anaerobes.<sup>3</sup>

Decisions must be made whether further deep debridement, excision of bone, or prolonged antibiotic therapy is required. Inflammatory markers can also assist in antibiotic therapy, but should not be the sole determining factor. Van Asten, et al.<sup>4</sup> assessed the effectiveness of inflammatory markers to

## The presence of an amputation wound without evidence of infection does not require antibiotic therapy.

Therapeutic antibiotics are aimed at treatment, not prophylaxis.

- **Class IV:** These wounds have a high risk of infection (>40% infection rate). They can be contaminated with fecal materials or urine. They may present with purulence with entry into an abscess cavity.

The presence of an amputation wound without evidence of infection does not require antibiotic therapy. However, when there are signs of infection at the amputation site, such as erythema, edema, pain, or delayed healing, it is advisable to obtain a wound culture. A deep-tissue culture or punch biopsy is preferred and is the gold standard for identifying wound bioburden over a swab culture.<sup>2</sup> Consider getting serial radiographs or an MRI for evaluation of osteomyelitis. Treatment of mild and moderate infection requires empiric therapy covering gram-positive cocci, whereas severe infection caused by drug-resistant organisms need broad

diagnose and monitor the treatment of osteomyelitis in the diabetic foot. They assessed erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), procalcitonin (PCT), interleukin-6 (IL-6), interleukin-8 (IL-8), tumor necrosis factor alpha (TNF $\alpha$ ), monocyte chemoattractant protein-1 (MCP-1), and macrophage inflammatory protein-1 alpha (MIP1 $\alpha$ ) in patients with and without osteomyelitis at 3 and 6 weeks of standard therapy.

Only PCT levels in the osteomyelitis group were significantly higher at baseline than in the group without osteomyelitis. There were no significant differences between the two groups in the other markers. The results suggest PCT might be useful to distinguish osteomyelitis in the infected foot, while the other markers are valuable when monitoring the effect of therapy.

Evaluating the arterial status of the lower extremity is necessary if an amputation or surgical wound is not

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healing, even after revascularization. Oxygen is pivotal for tissue viability and healing potential; however, using transcutaneous oxygen measurements can be unreliable. One study assessed the use of TcPO<sub>2</sub> measurements for major amputation selection and found these unreliable, which resulted in an increased rate of revisional amputation.<sup>5</sup> Nearly 30-40% of patients

recurrence, more major amputations and death. Therefore, evaluating and monitoring the vascular status frequently after an amputation may play a beneficial role in wound healing after amputations.

When a more extensive amputation is performed, such as a ray amputation, transmetatarsal, or Choparts, it is crucial for the patient to abstain from putting pressure on the amputation site. This can be difficult

facilities are more apt to use this device and find it easier to manage. Regardless of which device you use, remember to have a physical therapist assess the patient for proper height and weight adjustments. Additionally, there are several surgical shoes and walking boots that can assist with off-loading of the surgical amputations. One example is a Darco heel wedge surgical shoe, which off-loads the forefoot.

When assessing a surgical amputation

wound, you must determine if there is presence of infection. If the wound is clean, without evidence of infection or inflammation, there are various wound dressings that can be utilized. These types of surgical wounds can originate from a minor amputation or elective surgery. An example of an elective surgery is a first MTPJ arthrodesis where the patient has mild dehiscence and gapping of the surgical incision but clinically there are no signs of infection, no drainage, and there is presence of granulation tissue within the wound. Often



Figure 1-A: Neuropathic wound, nonhealing 4th toe amputation, plantar 5th MTPJ ulcer with osteomyelitis, 3rd toe ulcer.  
 Figure 1-B: Transmetatarsal amputation 4 weeks after surgery showing dehiscence, 5th metatarsal stump exposure and a necrotic wound.  
 Figure 1-C: Transmetatarsal amputation 4 months after surgery healed, with no infection or vascular compromise. Healed with periodic debridement and wound care.

who underwent stent implantation for femoropopliteal disease will experience in-stent restenosis (ISR) within two years of implantation.<sup>6</sup> Ghenzi, et al.<sup>7</sup> looked at the frequency of recurrence of PAD among angioplasty and stenting patients. Gender, age, size of lesion, smoking status, history of hypertension, and dyslipidemia were not significantly associated with the recurrence of stenosis. However, there was a significant relationship between the vessels involved and the type of revascularization method and the recurrence of PAD. Meloni, et al.<sup>8</sup> evaluated the rate of recurrence of CLI (Critical Limb Ischemia) in patients requiring a repeated angioplasty and found the average time was 3.5 months. The repeated angioplasty group had a lower rate of healing, higher rate of ulcer

for many patients. There are many modalities that can provide aid, such as a knee scooter. However, many patients do not have the balance or muscle strength to transfer the knee scooter from their car, or have knee or hip arthritis that prevents them from utilizing this device. It is best practice to have the patient utilize the device prior to surgery to ensure proper and safe utilization of the off-loading devices. There are times when patients have significant arthritis in the wrists or shoulders and do not have the ability to steer the knee scooter.

If this is the situation, then consider using a rolling walker with knee sling to be beneficial, especially with older patients. Patients who are in transitional care units and skilled nursing

these wounds need debridement with a curette every two to three weeks with application of a silver-based collagen dressing such as Aquacel Ag<sup>®</sup>, Prisma, or Promogran.

Other options include Endoform, an ovine extracellular matrix (ECM) for acute and chronic wounds. These products can be used on surgical wounds after certain surgeries such as toe arthroplasties, fusions, toe amputations, and ostectomies. It is very important to also control the patient's edema during this time period. Dehiscence may occur before the sutures are removed, but can also occur afterwards. Many times, utilizing compression devices such as Tubigrip, Sure Stretch, or Ready wraps can help limit the swelling and reduce the tension along the incision. Ace

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wraps have been discouraged as these can contribute to skin irritation and skin tears. Additionally, Ace wraps can easily be applied too tightly, which can contribute to ischemia.

Our second category involves infected wounds. With surgical wounds that present with faint signs of infection, applying Iodosorb® (Cadexomer Iodine) ointment can be very beneficial. This ointment is indicated for use on chronic and infected wounds where the bioburden is high, hindering the wound from healing. This medication is very effective, disrupting biofilm, reducing bioburden, and enzymatically debriding slough and bacteria. This leads to the promotion of a healthier wound base. Patients should apply this daily to their wound. Another option for these types

es regularly are using this to irrigate and cleanse the wound before using the other wound care supplies. In the inpatient setting, Vashe-soaked gauze will be the primary wound dressing on infected wounds. This will be changed by nursing staff twice daily.

from the bone. During the first few weeks after surgery, using a foam or absorbent antimicrobial dressing, such as Hydrofera Blue along the surgical incision, may help reduce maceration and skin breakdown. This product is a non-cytotoxic antibacterial foam often

## Another factor to consider for non-healing amputations is whether the patient had a previous gastroc recession or Achilles tendon lengthening.

Transmetatarsal amputations are a very common procedure, especially when diabetics have had previous toe and ray amputations. Many of these diabetic and PAD patients are on anticoagulants and other blood thinners. Despite pre-operative discontinuation of

combined with other wound dressings to soak up drainage.

Another factor to consider for non-healing amputations is whether the patient had a previous gastroc recession or Achilles tendon lengthening. In many cases, patients had no heel cord lengthening procedure performed during the original amputation or their Achilles tendon re-contracted. Limited ankle dorsiflexion leads to increased pressure at the amputation stump, resulting in recurrent wounds due to the pressures on the forefoot.<sup>9</sup> While total contact casting and other devices can help take pressure off the wound, the recurrence rate is high.<sup>10</sup> Achilles tendon lengthenings can be difficult in diabetics.

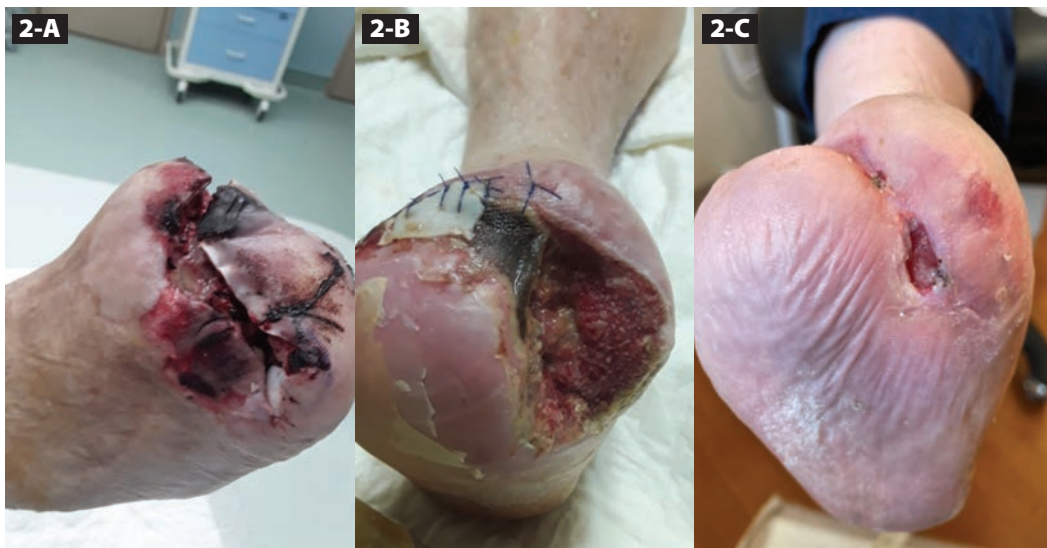


Figure 2-A: Open transmetatarsal amputation after infected, gangrene of 1st ray and 3rd toe

Figure 2-B: Status post debridement of transmetatarsal amputation with application of wound vac and Primatrix; 4 weeks after original surgery

Figure 2-C: Transmetatarsal amputation 5 months after original surgery with various biological wound dressings.

of wounds is collagenase santyl. Santyl ointment enzymatically debrides slough and necrotic tissue and helps promote better byproducts for wound healing. Santyl can be effective with long necrotic amputation incisions.

Another effective modality is the use of Vashe® Wound Solution. This product contains hypochlorous acid, which helps to remove microbial contamination. Vashe is very effective in cleaning up wounds and removing dirt and debris. Home health nurs-

these medications, many patients will bleed considerably after surgery and are at risk for hematoma or abscess. Consider utilizing a Jackson-Pratt drain in the amputation site for 4 to 7 days. Keeping these drains in longer helps prevent hematomas and sloughing. Dermabond can also augment healing and prevent dehiscence along with keeping sutures in 6 weeks. Additionally, using hemostatic agents, such as Flowseal, injected during the surgery, can help reduce oozing and bleeding

are thick, fibrotic, and have significant tendinopathy.<sup>11</sup> The tendon changes include decreased collagen fibril diameter, changed morphology, increased packing and disorganization, with overall thickening and calcification. Caution should be taken with these lengthenings as they can lead to over-correction, rupture, or imbalance.<sup>12</sup> Gastroc recessions can be an easier and safer option in these diabetics with fibrotic Achilles tendons.

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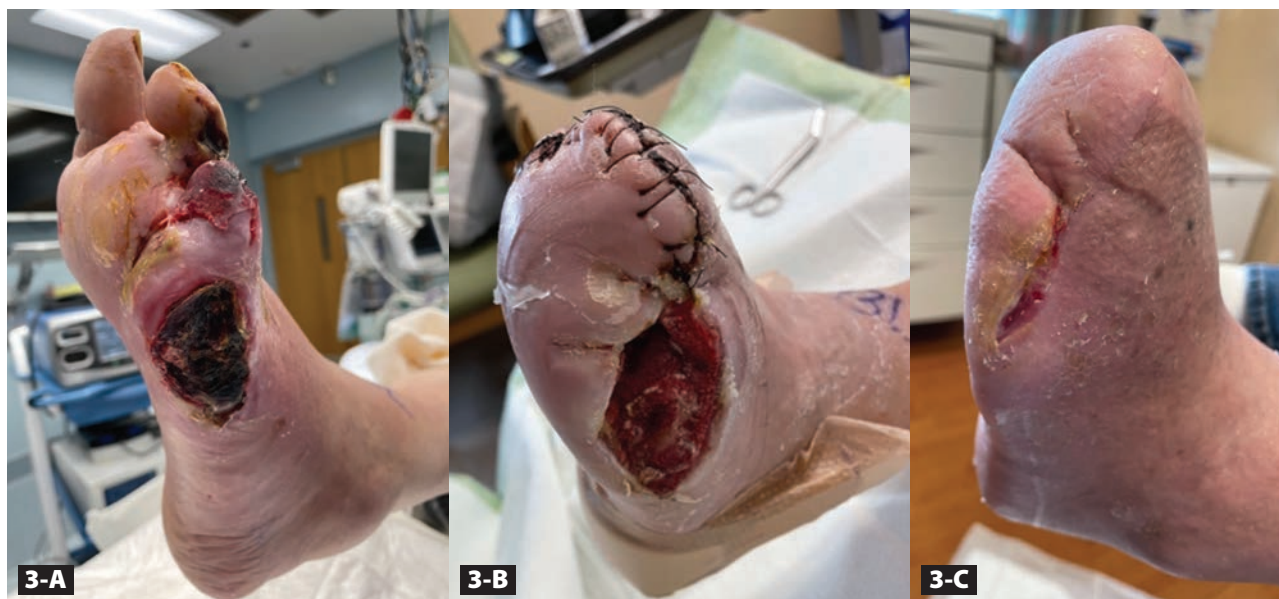


Figure 3-A: Gangrenous, infected 5th ray, 4th toe with previous 2nd and 3rd toe amputations.  
 Figure 3-B: Open transmetatarsal amputation with closure of central and medial aspects and wound vac to lateral wound. Approximately 5 days after surgery.  
 Figure 3-C: Mostly healed transmetatarsal amputation 3 months after surgery with various biological wound dressings.

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In summary, it is important to monitor all factors in amputation healing and to monitor the wound for any infection, vascular compromise, or excessive edema. Additionally, periodic aggressive debridements and irrigation in the operating room may be necessary to get complicated wounds to heal.

### Case #1 (Figures 1A-C)

76 y/o male, diabetic, neuropathic with PAD underwent right transmetatarsal amputation after non-healing toe amputation wounds. The patient had a previous left Chopart amputation with bypass. Patient did not require any vascular intervention on right leg. Patient had infected ulcers on right hallux, 5th MTPJ and a non-healing 4th toe amputation. Patient previously healed a partial right 2nd and 3rd toe amputation. He continued to smoke cigarettes despite counseling and recommendations to cease smoking. It was difficult to off-load the patient due to the instability with the Chopart amputation on contralateral foot. He utilized a motorized scooter most of the time. Local wound care was not healing his surgical wounds, and he was developing new ulcers and developed osteomyelitis. It was decided to perform a transmetatarsal amputation and patient

healed up with better vascularity further proximally.

### Case #2 (Figures 2A-C)

68 y/o male, diabetic, neuropathic with PAD had an infected ulcer with osteomyelitis of the first ray and gangrene of the second toe. Due to being septic and having a severe infection, an open transmetatarsal amputation was

performed. After 8 months, the patient has finally healed this difficult and complicated wound.

### Case #3 (Figures 3A-C)

A 76 y/o male, diabetic, neuropathic with PAD. The patient underwent a left superficial femoral atherectomy and a popliteal artery angioplasty. Unfortunately, he was not able to

## Periodic aggressive debridements and irrigation in the operating room may be necessary to get complicated wounds to heal.

performed for source control. Then the patient underwent successful angioplasty of the peroneal artery and the posterior tibial artery. There was rapid restoration of blood flow from the posterior tibial artery to the plantar artery. The patient was then taken back a few days later for a revisional transmetatarsal amputation with a wound vac. During the following 2 months, the patient was taken back to the operating room twice for debridement, irrigation, and application of Primatrix and wound vac. After the vac was removed, the wound was debrided every 2-4 weeks with usage of Endoform, Hy-

drofera Blue, and Promogran. After 8 months, the patient has finally healed this difficult and complicated wound.

heal a 2nd toe amputation with further ischemia and osteomyelitis to the distal lateral forefoot. A transmetatarsal amputation with an Achilles tendon lengthening was performed. A wound vac was applied in the days after the procedure. An Apligraf was applied one month after the amputation. Then Endoform and Hydrofera Blue were applied every other day. Patient was also on intravenous antibiotics for 6 weeks. Then after a few weeks, we decided to switch to Promogran, which was applied regularly to the wound. **PM**

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