Surgical Management of Chronic Wounds

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ABSTRACT

In this article, we outline the important role the surgeon plays in the management of chronic wounds. Debridement and washout are required for grossly infected wounds and necrotizing soft tissue infections. Cutaneous cancers such as squamous cell carcinomas may contribute to chronic wounds and vice versa; if diagnosed, these should be treated with wide local excision. Arterial, venous, and even lymphatic flows can be restored in select cases to enhance delivery of nutrients and removal of metabolic waste and promote wound healing. In cases where vital structures, such as bones, joints, tendons, and nerves, are exposed, vascularized tissue transfers are often required. These tissue transfers can be local or remote, the latter of which necessitates anastomoses of arteries and veins. Pressure sores are managed by relieving pressure, treating acute trauma or infection, and using rotation fasciocutaneous flaps. Lastly, the surgeon must always consider the possibility of osteomyelitis and retained foreign body as etiology for chronic wounds.

KEYWORDS: chronic wound, surgical management, debridement, flap, pressure sore

INTRODUCTION

In the comprehensive care of chronic wounds, surgical evaluation and monitoring of wound progression are important components. Early involvement of the surgical team creates a collaborative multidisciplinary approach to the care of chronic wounds and greatly increases the probability that they will resolve. This article reviews surgical concerns and treatment options for chronic wounds.

There are certain conditions that warrant urgent or emergency surgical intervention. Gross wound infection or necrotizing soft tissue infections must be controlled with aggressive debridement and drainage of fluid collections. In these wounds, regardless of the root cause, the bacterial load and activation of virulence factors result in the invasion of the host tissue and systemic disease. Removal of necrotic tissue and its bacterial colonies helps to locally control the epicenter of the infection process. Bacterial concentrations found to be in excess of 10^5 colony forming units (CFUs), or the presences of beta hemolytic streptococci have been used as an objective measure for requiring intervention.[1] Systemic and topical antibiotics are administered to further quell the bacterial assault and move the wound from a state of bacterial invasion to a more quiescent colonization state. Serial debridement and washouts may be necessary until control of bacterial overgrowth is achieved.

The history and timeline of a chronic wound must be considered for concerns of malignancy. A skin malignancy can be the root cause of a chronic wound that cyclically recurs, or one that never fully heals. A chronic wound is also a risk factor for a malignant transformation and the formation of a Marjolin's ulcer, an aggressive squamous cell carcinoma at the site of a chronic wound. If there is suspicion for malignancy, a biopsy from the wound should be sent for pathologic evaluation. If there are no signs of uncontrolled infection or concern for malignancy, a detailed assessment of the wound and the patient proceeds.

The next assessment is often the patient's vascular status. Traditionally, arterial inflow and venous outflow were the primary concerns, but with more recent success in lymphedema surgeries, the lymphatic concerns should be investigated as well. The evaluation for arterial sufficiency in the extremities begins with the presence and quality of palpable pulses. The ankle-brachial index (ABI) and transcutaneous oxygen tension (TcPo2) can identify arterial insufficiency more objectively. ABI less than or equal to 0.7 indicates significant arterial insufficiency and a TcPo2 less than 30 mmHg is associated with impaired healing.[2] Arterial insufficiency should be evaluated by a vascular surgeon and treated with endovascular or bypass revascularization. Amputation of the extremity should be considered if revascularization is not possible.

After arterial inflow is addressed, venous flow is evaluated by Doppler ultrasound in the deep and superficial venous systems of the extremity for patency and competence. Though compression therapy is the cornerstone in the treatment of venous congestion, several surgical approaches have been successful in improving outcomes. Deep vein thrombosis should be addressed by anticoagulation therapy if appropriate. Furthermore, therapies such as superficial ablation, endovenous ablation, sclerotherapy, and subfascial endoscopic perforator surgery (SEPS) have been reported to be beneficial in combination with compression therapy.[3]

Lymphedema is a difficult medical condition that can create wound healing complications and lead to chronic

wounds. Patients were traditionally treated with compression protocols, both static and intermittent. More recently, positive clinical outcomes have been reported with combined treatment approaches using microvascular lymphovenous anastomosis and free lymph node transfer with compression therapy. Assessment of the lymphatic system involves imaging with lymphoscintigraphy to identify congestion in the lymphatic circulation of an extremity. Then lymphography is performed where a dye injection in the periphery is followed in real time imaging as it flows proximally. Regions showing lymphatic fluid backup are then addressed by meticulously identifying engorged lymphatic vessels and microsurgically anastomosing them to subcutaneous veins thereby shunting lymphatic fluid into the circulatory system. Greater success is seen when multiple lymphatic vessels are anastomosed to the venous system.[4] Another surgical approach to lymphedema is microvascular transfer of functional lymph nodes from a normal limb to the diseased.[5] When harvesting lymph nodes, care is taken to avoid harvesting nodes that are critical to the drainage of the normal extremity.

If no vascular or lymphatic concerns exist, or have been adequately addressed, the next evaluation is of the wound itself. The wound bed is scrutinized to evaluate for vascular tissue, necrotic tissue, and exposed structures. Necrotic tissue or eschar on a non-infected wound does not necessitate immediate debridement or surgery. If there is tight adherence of viable and non-viable tissue, the autolytic process can be allowed to proceed to better define a plane of what needs to be removed. A healthy cellular immune system will effectively remove necrotic tissue; however, this process does require more time than surgical debridement. Tissue that is debrided in this manner is less likely to bleed. If significant bleeding is encountered, this is a sign that viable tissue has been excessively damaged in a healthy wound bed. For wounds with only scant amounts of debris, enzymatic debriders may help to keep the wound bed clean and promote healing. In anatomical regions with little soft tissue to spare, such as the anterior leg, dorsal foot, and ankle, these conservative approaches help preserve viable tissue and prevent exposure of critical structures. More aggressive debridement of wounds is warranted if adequate healthy soft tissue is found under necrotic tissue. Thorough debridement of non-viable tissue with immediate graft or flap can greatly speed the healing process. Using a hydrodebrider machine in these cases has been helpful to more precisely control the depth of debridement while assisting in the removal of all non-viable tissue and debris.[6]

If exposed bone, cartilage, and tendon are noted, surgical treatment is indicated sooner rather than later to protect these structures from infection and desiccation. Such structures have insufficient vascularity to encourage soft tissue overgrowth or accommodate a skin graft and will likely result in a chronic wound. To cover these wounds, soft tissue with intact vascular supply can be borrowed either locally with adjacent soft tissue rearrangement, or more distantly with pedicled and free flaps. This allows taking soft tissue from areas of relative excess to cover wounds that are deficient in necessary vascularized tissue.

Adjacent skin and subcutaneous tissue can sometimes be moved as a flap by extending incisions from the wound. Local flap techniques include rotation, advancement, and transposition of the nearby tissue relying on its elasticity and laxity. Incisions around the wound can help to shift tension from one direction to provide more laxity in another. One common example is a V shaped incision that is then closed as a Y shape recruiting laxity in the perpendicular plane to allow more advancement to the tissue between the limbs of the V shape. Combining several techniques can be beneficial such as in a keystone flap which consists of one large advancement flap that is augmented by 2 V-Y advancement flaps (**Figures 1–4**).[7]

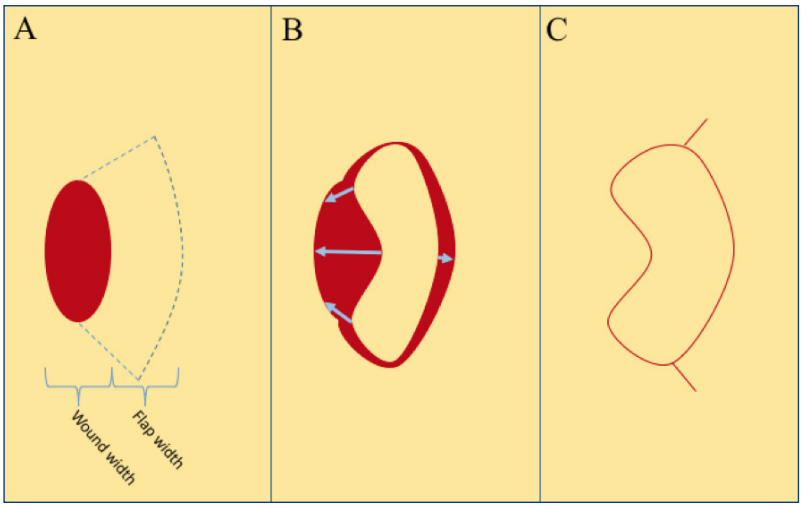
Pedicled flaps and free flaps involve mobilizing soft tissue based on an angiosome.[8] This is a portion of tissue that can be isolated on a single vascular pedicle. By doing this, the

Figure 1. Rotation flap and transposition flap with skin graft to donor site for ankle wound and exposed hardware.

Figure 2. Transposition flap with skin graft to donor site for chronic leg wound.

Figure 3. Rotation flap with V-Y Advancement

Figure 4. Keystone flap diagram. A: original wound margins and flap outline. B: flap creation and transposition. C: final flap position and suture lines.



tissue can be moved a greater distance by freeing the artery and vein to allow mobility, or the vascular pedicle can be divided and anastomosed to an artery and vein closer to the wound. Knowledge of the local vasculature and perforator anatomy helps in successful transfer of tissue. If possible, donor sites are closed primarily; however, skin grafts are often necessary.

Pressure ulcers can result from either long-term conditions or acute events. In chronic conditions where mobility and sensation are affected, the importance of establishing a pressure relief protocol is the most vital component in treatment.[9] After addressing the root of the cause, these wounds will often heal with time and there is no urgency to operate in most instances. Monitoring the wound closely helps to evaluate the success and adherence to the pressure management giving valuable feedback to attentive daily caretakers (**Figure 5**). Surgical debridement and closure is warranted in patients if bone or other vital structures are exposed, or if the dressings and wound care regimen is not tolerated. Acute incapacitation due to trauma or illness can also lead to pressure ulcers. Often, after the injury is addressed, the underlying issue with mobility and

Figure 5. Progression of ankle wound with concern of impending hardware exposure. Treated with conservative debridement, wound care, and monitoring. A: initial wound presentation. B: wound healing progression. C: wound healed.

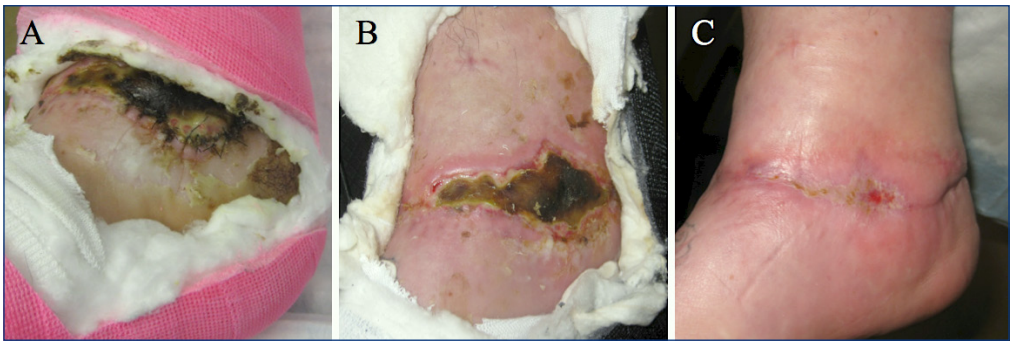


Figure 6. Gluteal rotation flap with buried de-epithelialized portion to fill in soft tissue defect.

sensation is also resolved. Pressure ulcers tend to form in regions of the body with more soft tissue available for re-arrangement such as the sacrum and buttock. If these sores do not heal, large rotation fasciocutaneous flaps are used to provide wound coverage. Figure 6 demonstrates the technique of a large gluteal rotation flap with a de-epithelialized portion used to fill a soft tissue void following excision of a chronic sacral wound. (**Figure 6**).

At times, chronic wounds involve a small tunneling wound with slow fluid discharge. If no progression of the wound is seen after a reasonable amount of time with regular wound therapy, the clinician must consider the possibility of an underlying osteomyelitis or retained foreign material. Exploration of the wound and associated sinus tract can sometimes reveal the reason for the chronic wound. To trace the extent of the sinus tract, methylene blue can be carefully injected into the sinus with a small syringe and angiocatheter. At times, previous gauze packing, pieces of negative pressure wound therapy (NPWT) sponge material, and portions of drainage catheters can get trapped in a closing or tunneling wound and lead to an indolent bacterial colonization. If the sinus tract leads to bone, a biopsy should be sent to evaluate for osteomyelitis, which can be a cause of chronic wounds.

Medical and surgical assessments of chronic wounds are interdependent and must be coordinated and collaborative. Nutrition, diabetes monitoring, pressure relief, social support, fluid management, cardiac status, and a myriad of other concerns need to be addressed for the optimal and successful care of patients. Surgical considerations for a chronic wound involve a more detailed examination of the surrounding tissue to find clues as to what may be preventing normal wound healing.

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Disclosures

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