



AMERICAN SOCIETY OF
PLASTIC SURGEONS

Evidence-based Clinical Practice Guideline: Chronic Wounds of the Lower Extremity

INTRODUCTION

Rationale and Goals

Chronic wounds of the lower extremity, a well-known condition with high prevalence, high cost, and poor clinical outcome, are often managed by a non-integrated healthcare system, resulting in an inconsistent care pattern. In an effort to provide guidance on this topic, ASPS has developed an evidence-based guideline for assessing and treating chronic wounds of the lower extremity. These guidelines reflect the consensus of a task force of recognized experts in the field of wound care, convened by the Health Policy Committee of the American Society of Plastic Surgeons.

The group set forth to conduct a systematic review of existing scientific literature addressing the assessment and treatment of chronic wounds of the lower extremity and to develop recommendations that fairly reflect currently accepted medical standards.

Scope

Treatment for chronic lower extremity wounds takes place within a care continuum that includes: (a) diagnosis and risk assessment; (b) active treatment, including stabilization, early efforts to promote spontaneous healing, surgical cure, and management of comorbidities known to increase the risk of wound-related complications; (c) palliative treatment focused on improving the quality of life and relieving suffering, when wound closure is not attainable; and (d) continuing engagement as part of a longer-term chronic care plan aimed at slowing progression, preventing recurrence and/or new occurrence.

This guideline addresses the assessment of symptom distress and functional status, complete physical examination of both lower extremities along with careful examination of the wound, risk assessment for peripheral vascular disease and septic complications, pain control, an individualized plan of wound care, and recommendations for achieving long-term stability.

Target Audience

This guideline is designed for use by any health care practitioner who manages the ongoing care of patients with chronic wounds of the lower extremity. For high-risk wounds, a clinical wound expert often guides care. The guideline may be of value to ambulatory wound care centers that aggregate resources and personnel dedicated to the management of patients with high-risk wounds and chronic diseases. In this setting, wound care services are often coordinated among physician colleagues, home health care providers and inpatient staff.

BACKGROUND

Chronic wounds of the lower extremity (CWLEs) currently afflict over 6 million persons in the U.S. Among the elderly, the prevalence of chronic limb ulceration approaches 15 percent and is increasing. Under current projections, 25 percent of the elderly will suffer chronic limb ulceration by the year 2050.¹ Paralleling a sharp upward trend in adult-onset obesity, the incidence of chronic foot ulceration in patients with diabetes mellitus is increasing at an alarming 14 percent per year.² Currently, almost 10 percent of patients with diabetes mellitus develop CWLEs and 84 percent of those afflicted ultimately undergo amputation. Among the 82,000 patients who suffer limb loss each year, the 3-year survival rate following amputation is only 50 percent.³

The most common cause of chronic lower extremity ulceration is venous insufficiency and 600,000 new venous ulcers develop annually. Although the risk of amputation associated with venous ulceration is lower than diabetic ulceration, the prognosis for healing is only 40 percent and the rate of recurrence averages 75 percent. In a large sociodemographic study of patients with venous ulceration, 16 percent were out of work and 49 percent were disabled in terms of work tasks.⁴ Not to be overlooked, a nonhealing wound evokes powerful emotional issues with over 25 percent of patients reporting symptoms of depression or anxiety.⁵

DEFINITIONS

Chronic wound is defined as one that is unresponsive to initial therapy or persistent in the face of appropriate care. The most common types of chronic wounds of the lower extremity are described by their etiology: 1) vascular (e.g. arterial, venous, or mixed ulcers), 2) pressure ulcers, and 3) neuropathic (e.g. diabetic ulcers). Chronic wounds are not defined by size, complexity or failure to heal within a limited time frame.

Lower extremity is anatomically defined and includes the hip, thigh, leg, ankle, and foot.

METHODOLOGY

Literature Search and Admission of Evidence

This study was carried out using a prospective systematic method for identifying and evaluating current literature on the treatment of chronic wounds of the lower extremities. To identify relevant literature, a comprehensive search of the following databases was performed: OVID, Medline, CINAHL, Embase, the Cochrane Wounds Group database within the Cochrane Collaboration Library, the Agency for Healthcare Research and Quality (AHRQ) Clinical

Practice Guidelines, and the National Guideline Clearinghouse.[™] Additionally, the World Wide Web was searched using meta-search engines for national and international guidelines. The search term combination captured the concept “practice-guidelines AND wound” using a wide range of indexing terms, free text words and word variants. Search limits restricted results to English-language manuscripts.

Articles were selected if they met the following criteria: guideline, systematic review, consensus statement, care protocol or healthcare technology assessment produced by national or international professional organizations and societies or governmental agencies; subject: comprehensive management of wounds of the lower extremity. From this list, key articles were identified and corresponding bibliographies hand searched for citations and manuscripts relevant to clinical questions about patient assessment, treatment, follow-up and prevention of wound recurrence.

Excluded from the search were articles that specifically addressed assessment and treatment of patients with burn wounds of the lower extremity, patients whose wounds were surgically closed, and patients with uncomplicated wounds that heal by primary intention (matrix deposition, contraction, and epithelialization).

Critical Appraisal of the Literature

Relevant articles were categorized by study type: randomized controlled trial, systematic review, cohort study, and case-control study. Each article was critically appraised for study quality according to criteria referenced in key publications on evidence-based medicine.⁶⁻¹⁰ Depending on type (prognostic, diagnostic, or therapeutic) and quality of study, each article was assigned a corresponding level of evidence according to ASPS Evidence Rating Scales (Appendix A), which were modified from scales developed by other surgical specialties and authorities on evidence-based medicine.⁶⁻¹¹

Development of Clinical Practice Recommendations

Practice recommendations were developed through critical appraisal of the literature and consensus of the ASPS Health Policy Committee. Recommendations are based on the strength of supporting evidence and were graded according to the ASPS Grades of Recommendation Scale (Appendix A), which was modified from scales used by other surgical specialties and authorities in the practice of evidence-based medicine.⁶⁻¹¹ Practice recommendations are discussed throughout this document; however, graded recommendations are summarized in Appendix B.

PATIENT ASSESSMENT

Patient outcomes and appropriate treatment plans are based on accurate, timely and comprehensive patient assessment. Patients presenting with lower extremity wounds require comprehensive medical history and focused physical examination. Health care professionals trained in leg ulcer management best manage chronic wounds. Evaluation should focus on confirming the diagnosis, identifying etiology, discovering confounding factors, documenting

previous interventions, establishing level of impairment and/or disability and defining the wound in a standard and reproducible fashion.^{12, 13}

The medical history should include questions regarding comorbidities, medications, allergies, and family history; the physical exam should include measurement of pulse and blood pressure to assess cardiovascular status and focused examination of both legs, which aids in identifying etiology, confirms the diagnosis, provides an appraisal of condition severity, and identifies factors which may impede healing or impact the treatment plan.

Differentiating between the basic types of lower extremity wounds helps guide treatment. Therefore, a focused assessment of conditions commonly associated with chronic wounds is helpful.

Venous Insufficiency

The vast majority (over 80%) of wounds between the knee and ankle are venous insufficiency in etiology. The workup, therefore, should focus on establishing the likelihood of this diagnosis. Reports have described historical and physical findings that may be suggestive of venous insufficiency.¹⁴⁻³⁰

Historical findings suggestive of venous insufficiency include:

- Prior history of thrombophlebitis, venous thromboembolism, and/or deep vein thrombosis
- History of symptomatic varicosities during pregnancy
- Surgical history of lower extremity trauma, vascular injury or previous varicose vein surgery
- Hypercoagulable states (e.g. cancer, infection, Factor VIII excess)

Physical findings suggestive of venous insufficiency include:

- Edema
- Wound presentation as a shallow ulcer in the lower third of the leg
- Venous dermatitis
- Lipodermatosclerosis
- Varicose veins

Diagnostic testing which confirms venous disease aids in planning appropriate treatments. This may be particularly helpful in recalcitrant wounds or those with atypical presentation. Initial evaluation of the venous system is with hand held continuous wave Doppler ultrasonography. If deep venous thrombosis or venous valvular incompetence is suspected, venous duplex imaging is recommended. Additional testing, using venous duplex imaging, air plethysmography, and/or venography should be considered for patients with clinical stigmata of venous hypertension when evaluating both lower extremities for deep venous insufficiency, reflux volume, and thrombosis.^{24, 26, 31-36}

Arterial Occlusive Disease

Oxygen delivery is the primary determinant of wound repair. History of arterial peripheral vascular disease, ischemic complaints, and rest pain should be elicited. Up to one third of leg ulcer patients have some component of arterial insufficiency which impairs healing and impacts treatment options.³⁷⁻⁴⁰

Ischemic impairment of the extremity must be evaluated. Strong pedal pulses and/or normal ankle brachial index (ABI) are necessary for healing.

Clinical signs of arterial insufficiency include:

- Cold pale feet (in a warm environment)
- Shiny, taut skin
- Dependent rubor
- Punched out appearance of the ulcers^{41, 42}

If there is any question regarding arterial occlusive disease in the lower extremities, based on the above history and physical examination, further workup is needed. Measurement of ankle brachial index (ABI) should be considered prior to initiating surgical intervention or applying compression dressings. The ankle brachial pressure index is a reliable predictor of adverse outcomes in wound healing and risk of limb loss. An ABI between 0.6 and 0.8 is associated with peripheral arterial occlusive disease. Critical ischemia is signaled by an ABI < 0.5 and an ABI > 1.2 is suggestive of calcification and noncompressibility of the arterial walls. For patients with clinical stigmata of severe arterial occlusive disease or abnormal ABI, further evaluation is indicated. Vascular intervention or reconstruction is a therapeutic option. Contrast arteriography (or magnetic resonance angiography) along with vascular specialty referral is recommended.^{36, 43}

Diabetes

Wounds in patients with diabetes are poorly understood, but may derive from a combination of microangiopathy, neuropathy and an impaired immune response. Frequently diabetics have sensory derangements that impact their wound healing and the development of future wounds. Sensory exams are essential in identifying areas of deficit and can assist in determining the treatment plan. Semmes-Weinstein is an accepted evaluation tool to accomplish this.⁴⁴⁻⁴⁷

History and Characteristics of the Wound

Detailed history of the wound care plan to date is helpful for understanding what treatments have already been tried. A standardized approach to taking the patient's history of leg ulceration would include:

- Date and site(s) current ulceration began
- Date and site(s) of previous ulcers
- Prior duration to heal
- Length of prior disease-free interval(s)
- Prior treatments
- Past surgical history of venous operation
- Use of compression garments

The ulcer should be characterized by size (measurement of largest dimensions, tracing, photography), nature of the wound base tissue (granulation, fibrous, slough, necrotic), and amount of drainage (heavy, moderate, light, none).

The wound should be evaluated for evidence of infection including necrotic tissue, purulent drainage, odor, induration, and cellulites. Wound cultures should be taken and debridement performed if

indicated. A critical quantity of bacteria appears to predict wound infection in complex extremity wounds. Further, quantitative culture has been shown to have high predictive value, sensitivity, and specificity. Most authors recommend the following technique for acquiring high quality wound cultures: After skin disinfection, a strip of necrotic wound tissue weighing 0.1 to 0.5 gram is excised for quantitative culture. This specimen is placed in an aerobic/anaerobic culture medium. Simultaneously, routine cotton swab is taken from the site of excision-debridement, taking care to avoid the ulcer's surface.⁴⁸

For wounds that are atypical in presentation or appearance, less common causes of ulceration should be considered. This is also true for wounds that do not respond to the appropriate therapy. Other possible causes of ulcers include rheumatoid arthritis, sickle cell disease, pyogenic gangranosum and tumors, especially squamous cell carcinoma and basal cell carcinoma. It may occasionally be necessary to biopsy the ulcer in order to rule out these uncommon causes of lower extremity ulcers.

Additional Considerations

Comorbidities

Common comorbid factors include:

- Impaired tissue perfusion (cardiopulmonary disease, obesity)
- Endocrine and metabolic disturbances (diabetes mellitus, chronic renal disease)
- Immune suppression
- Tobacco abuse
- Drugs known to impair healing (corticosteroids, cancer chemotherapy)
- Connective tissue diseases known to impair healing (rheumatoid arthritis, systemic lupus erythematosus)⁴⁹⁻⁵¹

Allergies

A history of true dermatologic allergies (allergic contact dermatitis, and immediate or delayed hypersensitivity) should be documented. Screen for latex sensitivity and when identified, avoid dressings that contain latex.⁵²

Presence of Osteomyelitis

Osteomyelitis is a serious complication of wound chronicity, insidious in onset and often clinically occult. Accurate detection of osteomyelitis is an essential component of the approach to chronic wound treatment. A high index of suspicion is a prerequisite to a timely diagnosis and appropriate therapy. A delay in the diagnosis of wound-related osteomyelitis carries significant morbidity. Those consequences include non-healing, wound sepsis, and limb loss.

Risk factors include:

- Bone exposed (or easily probed)
- Tissue necrosis overlying bone
- Gangrene
- Persistent sinus tract
- Underlying open fracture
- Underlying internal fixation
- Wound recurrence

If the patient is at high risk for osteomyelitis, a radiographic evaluation should include plain radiographs, nuclear bone scan and/or magnetic resonance imaging (MRI). MRI is considered the imaging test of choice with sensitivity and specificity exceeding 90 percent. If findings are suggestive of osteomyelitis, histologic evaluation and culture of a bone biopsy specimen should be considered.^{53, 54}

Risk of Remote Site or Systemic Infection

At the initial evaluation, the practitioner should document the patient's susceptibility to septicemia, endocarditis and prosthesis infection. This risk is high during surgical debridement of grossly infected wounds where bacteremia may result. During the continuum of care, patients at risk for infective endocarditis presenting with persistent fever and wound infection should be considered for blood cultures and cardiac echocardiography. Referral to infectious disease and cardiology specialists is also recommended. In these patients, selective use of antibiotic prophylaxis prior to excisional debridement or skin grafting warrants consideration.

Endocarditis and contamination of prosthetic implants are well-documented complications of excisional surgery on inflamed or infected tissue. Because of its severity, infectious endocarditis and prosthesis infection should be prevented whenever possible. Rational antibiotic use in the treatment of chronic wounds of the lower extremity distinguishes among contamination, inflammation, and infection. Appropriate antibiotic selections with site-specific consideration and appropriate timing of antibiotic administration are key factors in providing effective prophylaxis. Properly stratifying for risk reduces overuse and the adverse events associated with antibiotics.

Anatomic risk factors include:

- Prosthetic heart valve
- Acquired cardiac valvular dysfunction
- Cardiac malformation
- Hypertrophic cardiomyopathy
- Orthopedic prosthesis
- CNS shunts
- Nearby arteriovenous fistula

Comorbid risk factors:

- History of bacterial endocarditis
- Immune compromised or suppressed host
- Colonization, multi-drug resistant organisms⁵⁵⁻⁵⁸

Assessment of Pain, Functional Status and Quality of Life

Pain is a major component of the leg ulcer disease process. The evaluation and the treatment plan must focus on assessment of the patient's symptom distress, pain, functional status, and perceptions of care. The patient's role is central to the decision process and is incorporated into the overall evaluation through the assessment of pain level and functional status. Severity of pain can be tracked using the Visual Analog Scale. For functional status and quality of life, validated questionnaires can be used.⁵⁹⁻⁶²

TREATMENT

Establishing a treatment plan that represents the highest standards offers the patient the best hopes of healing. Fundamentally, chronic wounds of the lower extremity are treated with a protocol emphasizing debridement, pressure relief, infection control and management of exudates. For high risk wounds and recalcitrant wounds, reconstructive plastic surgery and adjunctive therapies may also play a role in seeking to restore soft tissue integrity.

Two adjunctive treatments deserve comment, namely growth factors and negative pressure wound therapy.

Potentially, the most important growth factors are recombinant human platelet-derived growth factor-BB (PDGF) and granulocyte colony-stimulating factor (G-CSF). There is evidence that PDGF may promote healing of chronic diabetic neurotrophic foot ulcers, when combined with basic preferred practices in wound care.^{63, 64} Available evidence is insufficient, however, to recommend the use of G-CSF as standard practice in the care of complex wounds.

Negative pressure wound therapy is the controlled application of subatmospheric pressure to the surface of a wound, using a closed suction drainage system. Although the wound care literature is rife with uncontrolled studies reporting the effectiveness of negative pressure wound therapy, few prospective randomized trials exist. Despite a lack of strong evidence to support its use, negative pressure wound therapy has gained wide acceptance by multiple specialties for a myriad of wounds.⁶⁵⁻⁶⁷

Four core practices are supported by evidence of effectiveness:

Practice 1. Debridement of Pathologic Tissue

Effective debridement of necrotic tissue is essential for wound healing.^{44, 68-73} A thorough excision of all pathologic tissue to include necrotic, infected, and poorly vascularized soft tissue is recommended. Debridement is often performed serially, depending on the response of the wound bed to previous treatment. Debridement is contraindicated in the presence of dry gangrene or a stable, dry, ischemic wound until vascular status is evaluated. If vasculitis or pyoderma gangrenosum is suspected, sharp debridement is not recommended. Following surgical debridement, irrigation with saline is considered a complementary form of mechanical debridement, as well as a key component of chronic wound management.^{74, 75} Several studies provide evidence that pulsed saline lavage, at irrigant pressures of 4-15 psi, safely and effectively reduce bacterial surface contamination.^{76, 77}

Tissue which might be suspect for malignancy should be biopsied and submitted for definitive histopathologic analysis.^{78, 79}

Practice 2. Pressure Relief

Unrelieved pressure increases the risk of tissue necrosis and impaired healing.⁸⁰ In patients at high risk of pressure ulcer development, consideration should be given to methods to reduce pressure, including use of an established repositioning schedule, maintenance of the head of the bed at lowest level consistent with medical condition, and static or dynamic pressure-reducing devices.⁸¹

Peripheral edema is a clinical sign of fluid accumulation brought about by excessive interstitial hydrostatic pressure. Edema independently compromises skin perfusion and thus contributes to poor healing and increase risk of infection. Several clinical studies provide evidence that external compression bandages play a key role in reducing edema and improving wound closure rates in patients with venous insufficiency.¹

Practice 3. Infection Control

Patients with chronic wounds of the lower extremity are predisposed to soft tissue infections caused by specific pathogens. Exposed subcutaneous tissue provides a favorable substratum for a wide variety of microorganisms to contaminate the wound.

The majority of chronic wounds are colonized by a polymicrobial aerobic-anaerobic microflora.⁸² If the involved tissue is devitalized (e.g., ischemic, hypoxic, or necrotic) and the host immune response is compromised, conditions are optimal for microbial growth and invasion.

The acquisition of deep tissue following initial debridement and cleansing of superficial debris is the most useful method for determining the presence of invasive pathogens.⁵⁴ However, laboratory identification of a causative organism can be frustrating. Owing to this difficulty, many infectious pathogens ultimately elude diagnosis. Consequently, a clinical diagnosis of wound infection is based upon local manifestations including induration, erythema, warmth, suppuration, and pain or tenderness.

Empiric therapy with oral antibiotics is normal practice in the treatment of uncomplicated skin and soft tissue infections (uSSSI) in chronic wounds. Notably, optimum targeted antimicrobial therapy is only realized with results of culture and susceptibility testing. The choice of an empiric therapeutic agent is informed by what are the most likely bacterial pathogens along with knowledge of local resistance prevalence rates. The most frequently recommended oral antimicrobials for uSSSIs are oral cephalosporins, amoxicillin-clavulanic acid, macrolides (clindamycin and erythromycin), anti-staphylococcal penicillins, and fluoroquinolones. On the basis of available evidence, no single antibacterial or combination of drugs appears to be superior to others.⁸³ Mild to moderate infections by gram positive bacteria can usually be treated by surgical debridement and culture-based, narrow-spectrum antibacterials.⁸⁴ Severe infections and infections complicated by critical limb ischemia can be limb threatening and may require hospitalization. Severe wound infections in the lower extremity necessitate hospitalization, parenteral broad-spectrum antibiotics and surgical interventions.

Many factors contribute to the complexity of decision-making in treating infection in chronic wounds. For one, the clinical heterogeneity of wounds resists simple classification aimed at guidelines-based schema. Randomized trials comparing the efficacy of oral versus parenteral antibiotic therapy in treating infected chronic wounds are lacking.⁸⁵ No study has directly examined whether antibiotic strategies for the treatment of infection in chronic wounds play a beneficial role in reducing morbidity or is, moreover, associated with adverse effects such as selecting for antibiotic resistant bacteria. And finally, although several studies have identified the most common microorganisms cultured from chronic wounds, evidence regarding the effects of colonization on wound healing is scarce.

Despite these problems, the use of oral antibiotics in the treatment of wound infections is widespread and has progressively increased as antimicrobial activity, efficacy and relative safety have improved. Not to be forgotten, however, overuse of antibiotics for uncomplicated soft tissue infections risks tangible harm by promoting antimicrobial resistance.⁸⁶

There is insufficient evidence to support the routine use of topical antibiotics as a wound dressing. In view of emerging resistance and the risk of contact dermatitis following the use of topical antibiotics, it is prudent to vigilantly monitor the wound for clinical response if topical antibiotics are prescribed.⁸⁷⁻⁸⁹

Practice 4. Management of Exudate

Chronic wound exudate has been shown to contain solutes known to impede healing, namely increased levels of proteolytic enzymes and proinflammatory cytokine levels, with reduced levels of growth factors. Further, these factors predispose to chronic inflammation and bacterial invasion. Therefore, maintaining a moist environment, while simultaneously removing soluble factors detrimental to wound healing might logically provide optimal conditions for wound healing.

Classic dressings include gauze, foam, hydrocolloid, and hydrogels. Fluid-handling mechanisms include absorption, gelling, retention and vapor transmission. Bioactive dressings include topical antimicrobials, bioengineered composite skin equivalent, bilaminar dermal regeneration template, and recombinant human growth factor. Finally, negative pressure wound therapy (NPWT) is a mechanical treatment that uses negative pressure to remove wound exudate.

When compared to traditional moist saline gauze, however, no dressing or device has yet been proven superior.⁸⁹⁻⁹³ However, while the scientific evidence base to properly substantiate their effectiveness is lacking, a myriad of dressings are available to the wound care practitioner. Taken together, five general principles represent the underlying basis for the management of wound exudate.

The general principles that should guide the provision of high-quality dressing care are as follows:

- Dressing care is patient centered and individualized
- Dressing removal is atraumatic and minimally painful
- Dressings ensure a moist wound environment while absorbing excess exudate
- Dressing choice considers costs including individual price of the dressing along with labor costs associated with having a health care professional change the dressing

POSSIBLE SEQUELAE AND COMPLICATIONS

The critical loss incurred by cutaneous wounds is that of barrier function. Loss of epithelial integrity provides a portal of entry for microorganisms. In patients whose host defenses are impaired, there is increased susceptibility to local soft tissue infection, osteomyelitis, and secondary sepsis. In high risk patients, infectious threats loom large and include those resulting from hematogenous spread, namely bacterial endocarditis and prosthesis infection.

Osteomyelitis can result from direct inoculation of organisms from a focus of infection in a chronic wound of the lower extremity. Osteomyelitis complicating lower extremity ulceration is a complex and potentially limb-threatening problem. Poorly controlled bone infection can also cause wound healing failure.

Available published evidence supports the treatment of osteomyelitis, complicating lower extremity ulceration, by aggressive resection of infected bone, culture-directed antibiotic therapy, and coverage with well-perfused tissue, typically muscle.^{54, 94-97}

There is no evidence to support the routine use of systemic antimicrobials to prevent osteomyelitis, bacterial endocarditis, or prosthesis infection in dermatologic surgical cases involving chronic wounds. In high risk patients, endocarditis prophylaxis is indicated when dermatologic procedures are performed on visibly inflamed or infected wounds.^{56, 86} There are no published guidelines on antibiotic prophylaxis in patients with orthopedic prostheses undergoing cutaneous surgery.

FOLLOW UP

Patients treated for a chronic lower extremity wound frequently have persistent physical conditions that put them at risk for relapse and recurrence. As part of the continuum of care, regular follow up and treatment should be aimed at slowing the progression of underlying disease processes and preventing recurrence of the wound.⁹⁸ Both the patient and primary care provider should be educated about the long-term nature of this process and the importance of incorporating self-care practices into the patient's life.

Follow up of patients with chronic wounds of the lower extremities should include:

- Monthly follow up visits until wound has completely re-epithelialized
- Assessment and documentation of any clinical signs associated with developing systemic illness, such as septicemia, prosthetic valve or joint infection and endocarditis

- Assess level of pain and adjust pain medications accordingly; patients with diabetic neuropathy often experience chronic pain and may benefit from referral to a pain specialist
- Assess functional status and quality of life

Common comorbidities are diabetes, venous insufficiency and peripheral vascular disease. How frequently the patient is seen by his/her health care provider and wound care specialist is determined by etiology of the chronic lower extremity wound, the wound's progress toward healing, the patient's ability for self care, and the patient's social situation and support system.

Patients with Venous Insufficiency

Eighty percent of patients with chronic wounds of the lower extremity have venous insufficiency.²⁹ This is an incurable disease and frequently waxes and wanes in its clinical symptoms with gradual worsening. These patients need follow up as frequently as every week during wound healing.⁹⁹ Once the wound has healed, visits can be extended to every 3 to 6 months; however, this depends on the particular patient, the presence of comorbidities, and the patient's ability to continue self-care practices. The patient needs to be seen more urgently for worsening symptoms of leg swelling, pain or enlargement of the wound.

Follow up of patients with venous insufficiency should include:

- History of any changes in condition since last visit
- Physical exam of the lower extremities, including notation of any changes in skin color, temperature, tone, or accessory organs such as hair, and the presence of swelling⁹⁸
- New areas of skin breakdown or maceration should be addressed (please see treatment).
- Diagnostic studies such as venous duplex can be performed to further assess disease and presence of dysfunctional perforators
- In preparation for surgical intervention, venography (e.g., vein stripping and ligation or sub-fascial perforator ligation) can be performed, but should be ordered by the specialist planning surgery and not on a routine basis.^{1, 100, 101}

Patients with Peripheral Arterial Disease

Patients with venous disease frequently have a component of peripheral vascular disease. Peripheral vascular disease is progressive and the patient should be monitored for signs of worsening ischemia.³⁹

Follow up of patients with peripheral vascular disease should include:

- Thorough history of activity level, presence of pain and changes in skin temperature or color⁵⁰
- Physical exam, including an inspection of the skin, pulses and capillary refill of the toes⁵⁰
- ABI measurement may help determine progression of disease⁵⁰, 102 and may indicate need for further studies such as angiography
- If intervention is needed, referral to a vascular surgeon or interventional radiologist should be made

Patients with Diabetes

Foot ulcers occur in 12 to 25 percent of patients with diabetes.⁴⁴ Chronic wounds involving the foot are increasing as the incidence of adult onset diabetes increases in our country. These patients require close monitoring of their diabetes, which usually falls to their primary care provider. The coordination of care between the wound specialist and primary care physician is extremely important. Diabetic patients who develop foot ulcers have a complex array of pathogenesis for their ulcers. Vascular disease and neuropathy are common in diabetics and the presence of these diseases must be addressed during their follow up.¹⁰³

Diabetics are also at higher risk for secondary infections, especially osteomyelitis; therefore, the history and physical exam should assess for the presence of bone infections. Eighty-four percent of diabetics with lower extremity wounds end up in amputation due to lack of control over infection, coexistence of peripheral vascular disease, and multiple recurrences; therefore, these areas need to be addressed and treated during follow up. Diabetics also have an increased risk for neuropathy which puts their weight bearing surface of their foot at risk for friction or pressure injuries. These patients frequently have diminished visual acuity, which makes self monitoring extremely difficult. Therefore, patients with diabetic neuropathy should be seen at least every three months to check for skin trauma and early breakdown.¹⁰⁴

Follow up of patients with diabetes should include:

- Assessment of any comorbidities (vascular disease, neuropathy, osteomyelitis)
- Thorough review of the patient's blood sugars, their diet and their exercise program. Laboratory studies such as HbA1c, fasting glucose and lipid profile should be used as barometers for control of the underlying disease process
- Physical exam, including assessment of the skin, noting pressure points, ischemic changes and skin maceration
- ABI may not be accurate in diabetics due to stiffness of their vessels (ABI < 0.08 does indicate peripheral vascular disease,¹⁰² which should be addressed)
- Off loading prosthetics or shoes should be checked for signs of abnormal wear
- If exposed bone or persistent drainage is identified, the patient may need to be evaluated for bone infection, as clinical signs of osteomyelitis are not always evident even in the face of osteomyelitis⁴⁴

Patients with Osteomyelitis

Patients with a history of osteomyelitis should be seen every 3 to 6 months to assess for recurrence. Patients with chronic wounds are at risk for developing osteomyelitis and should be seen every month for reevaluation of the wound and underlying bone.

Follow up of patients with osteomyelitis should include:

- A thorough history and physical exam of the lower extremity, which will indicate need for further tests

- Laboratory studies such as erythrocyte sediment rate (ESR) and C reactive protein (CRP) can be used to monitor the course of chronic osteomyelitis during treatment; when elevated in patients with chronic lower extremity wounds and no known history of bone infection, these markers can indicate the development of a deeper (bone) infection
- X-rays can be ordered to monitor the healing of an underlying fracture or to assess the presence of infection; however, specific tests such as MRI or bone scans should be ordered based on deterioration of symptoms

PREVENTION OF RECURRENCE

Part of any prevention program must be patient education. This education should include the patient's individual skin care program, moisturizers, soaps and protective measures. The patient should be educated about the long term nature of this medical condition and the signs and symptoms of recurrence. The primary care provider may also need to be educated regarding preventative measures and when to refer the patient back to a wound care specialist. Management of comorbidities and stabilization of underlying disease processes by the primary care provider will enhance the prevention program for chronic lower extremity wounds.

There are many therapeutic modalities that have been shown to reduce the recurrence of lower extremity wounds.^{28,30}

Recommended measures are:

- Graduated compression stockings (GCS) for patients with venous hypertension or at risk for venous insufficiency disease
- Off- loading devices and pressure dispersing surfaces for patients at risk wounds in areas of pressure points
- Repositioning and support surfaces for patients at risk for wounds secondary to abnormal sensitivity or mobility
- Exercise programs are also recommended and help improve patient mobility, joint movement and the patient's ability to protect lower extremities from wound recurrence.

DISCLAIMER

Clinical practice guidelines are strategies for patient management and are developed to assist physicians in clinical decision making. This guideline, based on a thorough evaluation of the scientific literature and relevant clinical experience, describes a range of generally acceptable approaches to diagnosis, management, or prevention of specific diseases or conditions. This guideline attempts to define principles of practice that should generally meet the needs of most patients in most circumstances.

However, this guideline should not be construed as a rule, nor should it be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed at obtaining the appropriate results. It is anticipated that it will be necessary to approach some patients' needs in different ways. The ultimate judgment regarding the care of a particular patient must be made by the physician in light of all circumstances presented by the patient, the available diagnostic and treatment options, and other available resources.

This guideline is not intended to define or serve as the standard of medical care. Standards of medical care are determined on the basis of all facts or circumstances involved in an individual case and are subject to change as scientific knowledge and technology advance, and as practice patterns evolve. This guideline reflects the state of knowledge current at the time of publication. Given the inevitable changes in the state of scientific information and technology, periodic review, updating and revision will be done.

REFERENCES

1. Mustoe, T. A., O'Shaughnessy, K., and Kloeters, O. Chronic wound pathogenesis and current treatment strategies: a unifying hypothesis. *Plast. Reconstr. Surg.* 117: 35S, 2006.
2. Magee, M. *Health Politics: Power, Populism and Health*. New York: Spencer Books, 2005.
3. Harrington, C., Zagari, M., Corea, J. et al. A cost analysis of diabetic lower-extremity ulcers. *Diabetes Care* 23: 1333, 2000.
4. Abbade, L. P., Lastoria, S., de Almeida Rolla, H. et al. A sociodemographic, clinical study of patients with venous ulcer. *Int. J. Dermatol.* 44: 989, 2005.
5. Jones, J., Barr, W., Robinson, J. et al. Depression in patients with chronic venous ulceration. *Br. J. Nurs.* 15: S17-S23, 2006.
6. Greenhalgh, T. *How to read a paper: the basics of evidence-based medicine*, Third Ed. Oxford: Blackwell Publishing, 2006.
7. Lang, T. A., Secic, M. *How to report statistics in medicine*, Second Ed. Philadelphia: American College of Physicians, 2006.
8. Straus, S. E., Richardson, W. S., Glasziou, P., Haynes, R. B. *Evidence-based medicine: How to practice and teach EBM*, Third Ed. Philadelphia: Elsevier Churchill Livingstone, 2005.
9. Guyatt, G. and Rennie, D. The evidence-based medicine working group *Users' guides to the medical literature. Essentials of evidence-based clinical practice*. Chicago: American Medical Association, 2002.
10. Center for Evidence Based Medicine . Levels of evidence and grades of recommendations. Center for Evidence Based Medicine website. 2001. http://www.cebm.net/levels_of_evidence.asp#levels Accessed 4-30-2007.
11. The Journal of Bone and Joint Surgery . Instructions to authors: Levels of evidence for primary research question. JBJS Online. 2007. <http://www2.ejbs.org/misc/instrux.shtml#levels> Accessed 4-30-2007.
12. Kerstein, M. D., van Rijswijk, L., and Beitz, J. M. Improved coordination: the wound care specialist. *Ostomy Wound Manage.* 44: 42, 48, 50, 1998.
13. Keast, D. H. and Orsted, H. The basic principles of wound care. *Ostomy Wound Manage.* 44: 24, 1998.
14. Burton, C. S. Venous ulcers. *Am. J. Surg.* 167: 37S, 1994.
15. Lindholm, C., Bjellerup, M., Christensen, O. B. et al. A demographic survey of leg and foot ulcer patients in a defined population. *Acta Derm. Venereol.* 72: 227, 1992.
16. Baker, S. R., Stacey, M. C., Jopp-McKay, A. G. et al. Epidemiology of chronic venous ulcers. *Br. J. Surg.* 78: 864, 1991.
17. Berard, A., Abenheim, L., Platt, R. et al. Risk factors for the first-time development of venous ulcers of the lower limbs: the influence of heredity and physical activity. *Angiology* 53: 647, 2002.
18. Blomgren, L., Johansson, G., Siegbahn, A. et al. Coagulation and fibrinolysis in chronic venous insufficiency. *Vasa* 30: 184, 2001.
19. Labropoulos, N., Patel, P. J., Tiongson, J. E. et al. Patterns of venous reflux and obstruction in patients with skin damage due to chronic venous disease. *Vasc. Endovascular. Surg.* 41: 33, 2007.
20. Fink, A. M., Kottas-Heldenberg, A., Mayer, W. et al. Lupus anticoagulant and venous leg ulceration. *Br. J. Dermatol.* 146: 308, 2002.
21. Dajani, O. M., Haddad, F. F., Hajj, H. A. et al. Injury to the femoral vessels--the Lebanese War experience. *Eur. J. Vasc. Surg.* 2: 293, 1988.
22. Aharinejad, S., Nedwed, S., Michlits, W. et al. Valvular density alone cannot account for sites of chronic venous insufficiency and ulceration in the lower extremity. *Microcirculation.* 8: 347, 2001.
23. Aitken, R. J., Matley, P. J., and Immelman, E. J. Lower limb vein trauma: a long-term clinical and physiological assessment. *Br. J. Surg.* 76: 585, 1989.
24. Shami, S. K., Sarin, S., Cheatle, T. R. et al. Venous ulcers and the superficial venous system. *J. Vasc. Surg.* 17: 487, 1993.
25. Bollinger, A., Leu, A. J., Hoffmann, U. et al. Microvascular changes in venous disease: an update. *Angiology* 48: 27, 1997.
26. Alguire, P. C. and Mathes, B. M. Chronic venous insufficiency and venous ulceration. *J. Gen. Intern. Med.* 12: 374, 1997.
27. McGuckin, M., Waterman, R., Brooks, J. et al. Validation of venous leg ulcer guidelines in the United States and United Kingdom. *Am. J. Surg.* 183: 132, 2002.
28. Duby, T., Cherry, G., Hoffman, D. et al. A randomized trial in the treatment of venous leg ulcers comparing short stretch bandages, four layer bandage system, and a long stretch-paste bandage system. *Wounds* 5: 276, 1993.
29. Wipke-Tevis, D. D., Rantz, M. J., Mehr, D. R. et al. Prevalence, incidence, management, and predictors of venous ulcers in the long-term-care population using the MDS. *Adv. Skin Wound. Care* 13: 218, 2000.
30. Shebel, N. D. An early intervention plan for identification and control of chronic lower extremity edema. *J. Vasc. Nurs.* 20: 45, 2002.
31. Nicolaidis, A. N. Investigation of chronic venous insufficiency: A consensus statement (France, March 5-9, 1997). *Circulation* 102: E126-E163, 2000.
32. Beebe, H. G., Bergan, J. J., Bergqvist, D. et al. Classification and grading of chronic venous disease in the lower limbs. A consensus statement. *Int. Angiol.* 14: 197, 1995.
33. Porter, J. M. and Moneta, G. L. Reporting standards in venous disease: an update. International Consensus Committee on Chronic Venous Disease. *J. Vasc. Surg.* 21: 635, 1995.
34. Robson, M. C., Cooper, D. M., Aslam, R. et al. Guidelines for the treatment of venous ulcers. *Wound Repair Regen.* 14: 649, 2006.
35. Wong, J. K., Duncan, J. L., and Nichols, D. M. Whole-leg duplex mapping for varicose veins: observations on patterns of reflux in recurrent and primary legs, with clinical correlation. *Eur. J Vasc. Endovasc. Surg.* 25: 267, 2003.
36. Baxter, G. M. and Polak, J. F. Lower limb colour flow imaging: a comparison with ankle: brachial measurements and angiography. *Clin. Radiol.* 47: 91, 1993.
37. Dormandy, J. A. and Murray, G. D. The fate of the claudicant--a prospective study of 1969 claudicants. *Eur. J. Vasc. Surg.* 5: 131, 1991.
38. Jelnes, R., Gaardsting, O., Hougaard, J. K. et al. Fate in intermittent claudication: outcome and risk factors. *Br. Med. J. (Clin. Res. Ed)* 293: 1137, 1986.
39. Stoffers, H. E., Kester, A. D., Kaiser, V. et al. Diagnostic value of signs and symptoms associated with peripheral arterial occlusive disease seen in general practice: a multivariable approach. *Med. Decis. Making* 17: 61, 1997.
40. Criqui, M. H., Fronek, A., Klauber, M. R. et al. The sensitivity, specificity, and predictive value of traditional clinical evaluation of peripheral arterial disease: results from noninvasive testing in a defined population. *Circulation* 71: 516, 1985.

41. Marston, W. A., Davies, S. W., Armstrong, B. et al. Natural history of limbs with arterial insufficiency and chronic ulceration treated without revascularization. *J. Vasc. Surg.* 44: 108, 2006.
42. Hopf, H. W., Ueno, C., Aslam, R. et al. Guidelines for the treatment of arterial insufficiency ulcers. *Wound Repair Regen.* 14: 693, 2006.
43. Hiatt, W. R., Hoag, S., and Hamman, R. F. Effect of diagnostic criteria on the prevalence of peripheral arterial disease. The San Luis Valley Diabetes Study. *Circulation* 91: 1472, 1995.
44. Brem, H., Sheehan, P., Rosenberg, H. J. et al. Evidence-based protocol for diabetic foot ulcers. *Plast. Reconstr. Surg.* 117: 193S, 2006.
45. Armstrong, D. G., Lavery, L. A., Vela, S. A. et al. Choosing a practical screening instrument to identify patients at risk for diabetic foot ulceration. *Arch. Intern. Med.* 158: 289, 1998.
46. Pham, H., Armstrong, D. G., Harvey, C. et al. Screening techniques to identify people at high risk for diabetic foot ulceration: a prospective multicenter trial. *Diabetes Care* 23: 606, 2000.
47. Abbott, C. A., Vileikyte, L., Williamson, S. et al. Multicenter study of the incidence of and predictive risk factors for diabetic neuropathic foot ulceration. *Diabetes Care* 21: 1071, 1998.
48. Breidenbach, W. C., III. Emergency free tissue transfer for reconstruction of acute upper extremity wounds. *Clin. Plast. Surg.* 16: 505, 1989.
49. Burns, P., Gough, S., and Bradbury, A. W. Management of peripheral arterial disease in primary care. *BMJ* 326: 584, 2003.
50. Khan, N. A., Rahim, S. A., Anand, S. S. et al. Does the clinical examination predict lower extremity peripheral arterial disease? *JAMA* 295: 536, 2006.
51. Weitz, J. I., Byrne, J., Clagett, G. P. et al. Diagnosis and treatment of chronic arterial insufficiency of the lower extremities: a critical review. *Circulation* 94: 3026, 1996.
52. Saap, L., Fahim, S., Arsenault, E. et al. Contact sensitivity in patients with leg ulcerations: a North American study. *Arch. Dermatol.* 140: 1241, 2004.
53. Gold, R. H., Hawkins, R. A., and Katz, R. D. Bacterial osteomyelitis: findings on plain radiography, CT, MR, and scintigraphy. *AJR Am. J. Roentgenol.* 157: 365, 1991.
54. Lipsky, B. A., Berendt, A. R., Deery, H. G. et al. Diagnosis and treatment of diabetic foot infections. *Clin. Infect. Dis.* 39: 885, 2004.
55. Hill, E. E., Herijgers, P., Herregods, M. C. et al. Evolving trends in infective endocarditis. *Clin. Microbiol. Infect.* 12: 5, 2006.
56. Dajani, A. S., Taubert, K. A., Wilson, W. et al. Prevention of bacterial endocarditis: recommendations by the American Heart Association. *Clin. Infect. Dis.* 25: 1448, 1997.
57. Messingham, M. J. and Arpey, C. J. Update on the use of antibiotics in cutaneous surgery. *Dermatol. Surg.* 31: 1068, 2005.
58. El-Ahdab, F., Benjamin, D. K., Jr., Wang, A. et al. Risk of endocarditis among patients with prosthetic valves and Staphylococcus aureus bacteremia. *Am. J. Med.* 118: 225, 2005.
59. Phillips, T., Stanton, B., Provan, A. et al. A study of the impact of leg ulcers on quality of life: financial, social, and psychological implications. *J. Am. Acad. Dermatol.* 31: 49, 1994.
60. Garratt, A. M., Ruta, D. A., Abdalla, M. I. et al. The SF36 health survey questionnaire: an outcome measure suitable for routine use within the NHS? *BMJ* 306: 1440, 1993.
61. Launois, R., Reboul-Marty, J., and Henry, B. Construction and validation of a quality of life questionnaire in chronic lower limb venous insufficiency (CIVIQ). *Qual. Life Res.* 5: 539, 1996.
62. Price, P. and Harding, K. Cardiff Wound Impact Schedule: the development of a condition-specific questionnaire to assess health-related quality of life in patients with chronic wounds of the lower limb. *Int. Wound. J.* 1: 10, 2004.
63. Steed, D. L. Clinical evaluation of recombinant human platelet-derived growth factor for the treatment of lower extremity ulcers. *Plast. Reconstr. Surg.* 117: 143S, 2006.
64. Embil, J. M., Papp, K., Sibbald, G. et al. Recombinant human platelet-derived growth factor-BB (becaplermin) for healing chronic lower extremity diabetic ulcers: an open-label clinical evaluation of efficacy. *Wound Repair Regen.* 8: 162, 2000.
65. Morris, G. S., Brueilly, K. E., and Hanzelka, H. Negative pressure wound therapy achieved by vacuum-assisted closure: Evaluating the assumptions. *Ostomy Wound Manage* 53: 52, 2007.
66. Evans, D. and Land, L. Topical negative pressure for treating chronic wounds: a systematic review. *Br. J. Plast. Surg.* 54: 238, 2001.
67. Argenta, L. C., Morykwas, M. J., Marks, M. W. et al. Vacuum-assisted closure: state of clinic art. *Plast. Reconstr. Surg.* 117: 127S, 2006.
68. Attinger, C. E., Janis, J. E., Steinberg, J. et al. Clinical approach to wounds: debridement and wound bed preparation including the use of dressings and wound-healing adjuvants. *Plast. Reconstr. Surg.* 117: 72S, 2006.
69. Steed, D. L. Debridement. *Am. J. Surg.* 187: 71S, 2004.
70. Steed, D. L., Donohoe, D., Webster, M. W. et al. Effect of extensive debridement and treatment on the healing of diabetic foot ulcers. Diabetic Ulcer Study Group. *J. Am. Coll. Surg.* 183: 61, 1996.
71. Attinger, C. E. and Bulan, E. J. Debridement. The key initial first step in wound healing. *Foot Ankle Clin.* 6: 627, 2001.
72. Thow, J. and Smith, J. Update of systematic review on debridement. *Diabetic Foot* 1: 12, 2003.
73. Smith, J. Debridement of diabetic foot ulcers. *Cochrane Database Syst. Rev.* CD003556, 2002.
74. Cunliffe, P. J. and Fawcett, T. N. Wound cleansing: the evidence for the techniques and solutions used. *Prof. Nurse* 18: 95, 2002.
75. Fernandez, R., Griffiths, R., and Ussia, C. Water for wound cleansing. *Cochrane Database Syst. Rev.* CD003861, 2002.
76. Granick, M. S., Tenenhaus, M., Knox, K. R. et al. Comparison of wound irrigation and tangential hydrodissection in bacterial clearance of contaminated wounds: results of a randomized, controlled clinical study. *Ostomy Wound Manage.* 53: 64, 72, 2007.
77. Bergstrom, N. Treatment of Pressure Ulcers. Clinical Guideline Number 15. <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hstat2.chapter5124> 1994. National Library of Medicine. Accessed 4-30-2007.
78. Kirsner, R. S., Spencer, J., Falanga, V. et al. Squamous cell carcinoma arising in osteomyelitis and chronic wounds. Treatment with Mohs micrographic surgery vs amputation. *Dermatol. Surg.* 22: 1015, 1996.
79. Trent, J. T. and Kirsner, R. S. Wounds and malignancy. *Adv. Skin Wound. Care* 16: 31, 2003.
80. Thomas, D. R. Issues and dilemmas in the prevention and treatment of pressure ulcers: a review. *J. Gerontol. A Biol. Sci. Med. Sci.* 56: M328-M340, 2001.
81. Whitney, J., Phillips, L., Aslam, R. et al. Guidelines for the treatment of pressure ulcers. *Wound Repair Regen.* 14: 663, 2006.
82. Fung, H. B., Chang, J. Y., and Kuczynski, S. A practical guide to the treatment of complicated skin and soft tissue infections. *Drugs* 63: 1459, 2003.
83. Lipsky, B. A. Evidence-based antibiotic therapy of diabetic foot infections. *FEMS Immunol. Med. Microbiol.* 26: 267, 1999.

84. Rao, N. and Lipsky, B. A. Optimising antimicrobial therapy in diabetic foot infections. *Drugs* 67: 195, 2007.
85. Gentry, L. O., Ramirez-Ronda, C. H., Rodriguez-Noriega, E. et al. Oral ciprofloxacin vs parenteral cefotaxime in the treatment of difficult skin and skin structure infections. A multicenter trial. *Arch. Intern. Med.* 149: 2579, 1989.
86. Hurst, E. A., Grekin, R. C., Yu, S. S. et al. Infectious complications and antibiotic use in dermatologic surgery. *Semin. Cutan. Med. Surg.* 26: 47, 2007.
87. White, R. J., Cutting, K., and Kingsley, A. Topical antimicrobials in the control of wound bioburden. *Ostomy Wound Manage.* 26: 26, 2006.
88. Nelson, E. A., O'Meara, S., Golder, S. et al. Systematic review of antimicrobial treatments for diabetic foot ulcers. *Diabet. Med.* 23: 348, 2006.
89. Nelson, E. A. and Bradley, M. D. Dressings and topical agents for arterial leg ulcers. *Cochrane Database Syst. Rev.* CD001836, 2007.
90. Bradley, M., Cullum, N., Nelson, E. A. et al. Systematic reviews of wound care management: (2). Dressings and topical agents used in the healing of chronic wounds. *Health Technol. Assess.* 3: 1, 1999.
91. Vermeulen, H., Ubbink, D. T., Goossens, A. et al. Systematic review of dressings and topical agents for surgical wounds healing by secondary intention. *Br. J. Surg.* 92: 665, 2005.
92. Palfreyman, S. J., Nelson, E. A., Lochiel, R. et al. Dressings for healing venous leg ulcers. *Cochrane Database Syst. Rev.* 3: CD001103, 2006.
93. Bouza, C., Munoz, A., and Amate, J. M. Efficacy of modern dressings in the treatment of leg ulcers: a systematic review. *Wound Repair Regen.* 13: 218, 2005.
94. Ger, R. Muscle transposition for treatment and prevention of chronic post-traumatic osteomyelitis of the tibia. *J. Bone Joint Surg. Am.* 59: 784, 1977.
95. Breugem, C. C. and Strackee, S. D. Is there evidence-based guidance for timing of soft tissue coverage of grade III B tibia fractures? *Int. J. Low Extrem. Wounds.* 5: 261, 2006.
96. Salgado, C. J., Mardini, S., Jamali, A. A. et al. Muscle versus nonmuscle flaps in the reconstruction of chronic osteomyelitis defects. *Plast. Reconstr. Surg.* 118: 1401, 2006.
97. Kuokkanen, H. O., Tukiainen, E. J., and sko-Seljavaara, S. Radical excision and reconstruction of chronic tibial osteomyelitis with microvascular muscle flaps. *Orthopedics* 25: 137, 2002.
98. Dowsett, C. Assessment and management of patients with leg ulcers. *Nurs. Stand.* 19: 65, 68, 70, 2005.
99. Hill, D. P., Poore, S., Wilson, J. et al. Initial healing rates of venous ulcers: are they useful as predictors of healing? *Am. J. Surg.* 188: 22, 2004.
100. Baumgartner, I., Schainfeld, R., and Graziani, L. Management of peripheral vascular disease. *Annu. Rev. Med.* 56: 249, 2005.
101. Glociczki, P., Bergan, J. J., Rhodes, J. M. et al. Mid-term results of endoscopic perforator vein interruption for chronic venous insufficiency: lessons learned from the North American subfascial endoscopic perforator surgery registry. The North American Study Group. *J. Vasc. Surg.* 29: 489, 1999.
102. Stein, R., Hriljac, I., Halperin, J. L. et al. Limitation of the resting ankle-brachial index in symptomatic patients with peripheral arterial disease. *Vasc. Med.* 11: 29, 2006.
103. Dolan, N. C., Liu, K., Criqui, M. H. et al. Peripheral artery disease, diabetes, and reduced lower extremity functioning. *Diabetes Care* 25: 113, 2002.
104. Mayfield, J. A., Reiber, G. E., Sanders, L. J. et al. Preventive foot care in people with diabetes. *Diabetes Care* 26 Suppl 1: S78-S79, 2003.
105. Wang, J. C., Criqui, M. H., Denenberg, J. O. et al. Exertional leg pain in patients with and without peripheral arterial disease. *Circulation* 112: 3501, 2005.
106. Henke, P. K., Blackburn, S. A., Wainess, R. W. et al. Osteomyelitis of the foot and toe in adults is a surgical disease: conservative management worsens lower extremity salvage. *Ann. Surg.* 241: 885, 2005.
107. de Vries M., Ouwendijk, R., Flobbe, K. et al. Peripheral arterial disease: clinical and cost comparisons between duplex US and contrast-enhanced MR angiography--a multicenter randomized trial. *Radiology* 240: 401, 2006.
108. Ouwendijk, R., de, V. M., Pattynama, P. M. et al. Imaging peripheral arterial disease: a randomized controlled trial comparing contrast-enhanced MR angiography and multi-detector row CT angiography. *Radiology* 236: 1094, 2005.
109. Yasuhara, H., Naka, S., Yanagie, H. et al. Influence of diabetes on persistent nonhealing ischemic foot ulcer in end-stage renal disease. *World J Surg.* 26: 1360, 2002.
110. O'Meara, S., Cullum, N., Majid, M. et al. Systematic reviews of wound care management: (3) antimicrobial agents for chronic wounds; (4) diabetic foot ulceration. *Health Technol. Assess.* 4: 1, 2000.
111. Cutting, K. F. Identification of infection in granulating wounds by registered nurses. *J Clin Nurs.* 7: 539, 1998.
112. Gardner, S. E., Frantz, R. A., Troia, C. et al. A tool to assess clinical signs and symptoms of localized infection in chronic wounds: development and reliability. *Ostomy Wound Manage.* 47: 40, 2001.
113. Labropoulos, N., Manalo, D., Patel, N. P. et al. Uncommon leg ulcers in the lower extremity. *J Vasc. Surg.* 45: 568, 2007.
114. Lim, K. S., Tang, M. B., Goon, A. T. et al. Contact sensitization in patients with chronic venous leg ulcers in Singapore. *Contact Dermatitis* 56: 94, 2007.
115. Tavadia, S., Bianchi, J., Dawe, R. S. et al. Allergic contact dermatitis in venous leg ulcer patients. *Contact Dermatitis* 48: 261, 2003.
116. Machet, L., Couhe, C., Perrinaud, A. et al. A high prevalence of sensitization still persists in leg ulcer patients: a retrospective series of 106 patients tested between 2001 and 2002 and a meta-analysis of 1975-2003 data. *Br. J Dermatol.* 150: 929, 2004.
117. Shih, H. N., Shih, L. Y., and Wong, Y. C. Diagnosis and treatment of subacute osteomyelitis. *J Trauma* 58: 83, 2005.
118. Senneville, E., Melliez, H., Beltrand, E. et al. Culture of percutaneous bone biopsy specimens for diagnosis of diabetic foot osteomyelitis: concordance with ulcer swab cultures. *Clin Infect. Dis.* 42: 57, 2006.
119. Cullum, N., Nelson, E. A., Flemming, K. et al. Systematic reviews of wound care management: (5) beds; (6) compression; (7) laser therapy, therapeutic ultrasound, electrotherapy and electromagnetic therapy. *Health Technol. Assess.* 5: 1, 2001.
120. Cullum, N., McInnes, E., Bell-Syer, S. E. et al. Support surfaces for pressure ulcer prevention. *Cochrane Database Syst. Rev.* CD001735, 2004.
121. Vermeulen, H., van Hattem, J. M., Storm-Versloot, M. N. et al. Topical silver for treating infected wounds. *Cochrane Database Syst. Rev.* CD005486, 2007.
122. Bergin, S. M. and Wraight, P. Silver based wound dressings and topical agents for treating diabetic foot ulcers. *Cochrane Database Syst. Rev.* CD005082, 2006.
123. Jones, J. and Nelson, E. Skin grafting for venous leg ulcers. *Cochrane Database Syst. Rev.* CD001737, 2007.
124. Bach, A. D., Leffler, M., Kneser, U. et al. The versatility of the distally based peroneus brevis muscle flap in reconstructive surgery of the foot and lower leg. *Ann. Plast. Surg.* 58: 397, 2007.
125. Eren, S., Ghofrani, A., and Reifenrath, M. The distally pedicled peroneus brevis muscle flap: a new flap for the lower leg. *Plast. Reconstr. Surg.* 107: 1443, 2001.

126. Embil, J. M., Rose, G., Trepman, E. et al. Oral antimicrobial therapy for diabetic foot osteomyelitis. *Foot Ankle Int.* 27: 771, 2006.
127. Freeman, G. J., Mackie, K. M., Sare, J. et al. A novel approach to the management of the diabetic foot: metatarsal excision in the treatment of osteomyelitis. *Eur. J. Vasc. Endovasc. Surg.* 33: 217, 2007.
128. Cullum, N., Nelson, E. A., Fletcher, A. W. et al. Compression for venous leg ulcers. *Cochrane Database Syst. Rev.* CD000265, 2000.
129. Nelson, E. A., Bell-Syer, S. E., and Cullum, N. A. Compression for preventing recurrence of venous ulcers. *Cochrane Database Syst. Rev.* CD002303, 2000.
130. Cullum, N., Nelson, E. A., Fletcher, A. W. et al. Compression bandages and stockings for venous leg ulcers. *Cochrane Database Syst. Rev.* CD000265, 2000.
131. Ibegbuna, V., Delis, K. T., Nicolaidis, A. N. et al. Effect of elastic compression stockings on venous hemodynamics during walking. *J. Vasc. Surg.* 37: 420, 2003.
132. Zajkowski, P. J., Proctor, M. C., Wakefield, T. W. et al. Compression stockings and venous function. *Arch. Surg.* 137: 1064, 2002.

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APPENDIX A. SCALES FOR RATING LEVELS OF EVIDENCE AND GRADING PRACTICE RECOMMENDATIONS

Evidence Rating Scale for Diagnostic Studies

Level of Evidence	Qualifying Studies
I	High-quality, multi-centered or single-centered, cohort study validating a diagnostic test (with “gold” standard as reference) in a series of consecutive patients; or a systematic review of these studies
II	Exploratory cohort study developing diagnostic criteria (with “gold” standard as reference) in a series of consecutive patient; or a systematic review of these studies
III	Diagnostic study in nonconsecutive patients (without consistently applied “gold” standard as reference); or a systematic review of these studies
IV	Case-control study; or any of the above diagnostic studies in the absence of a universally accepted “gold” standard
V	Expert opinion; case report or clinical example; or evidence based on physiology, bench research or “first principles”

Evidence Rating Scale for Prognostic Studies

Level of Evidence	Qualifying Studies
I	High-quality, multi-centered or single-centered, prospective cohort study with adequate power; or a systematic review of these studies
II	Lesser-quality prospective cohort study; retrospective study; untreated controls from a randomized controlled trial; or a systematic review of these studies
III	Case-control study; or systematic review of these studies
IV	Case series
V	Expert opinion; case report or clinical example; or evidence based on physiology, bench research or “first principles”

Evidence Rating Scale for Therapeutic Studies

Level of Evidence	Qualifying Studies
I	High-quality, multi-centered or single-centered, randomized controlled trial with adequate power; or systematic review of these studies
II	Lesser-quality, randomized controlled trial; prospective cohort study; or systematic review of these studies
III	Retrospective comparative study; case-control study; or systematic review of these studies
IV	Case series
V	Expert opinion; case report or clinical example; or evidence based on physiology, bench research or “first principles”

Scale for Grading Recommendations

Grade	Descriptor	Qualifying Evidence	Implications for Practice
A	Strong Recommendation	Level I evidence or consistent findings from multiple studies of levels II, III, or IV	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
B	Recommendation	Levels II, III, or IV evidence and findings are generally consistent	Generally, clinicians should follow a recommendation but should remain alert to new information and sensitive to patient preferences.
C	Option	Levels II, III, or IV evidence, but findings are inconsistent	Clinicians should be flexible in their decision-making regarding appropriate practice, although they may set bounds on alternatives; patient preference should have a substantial influencing role.
D	Option	Level V; little or no systematic empirical evidence	Clinicians should consider all options in their decision-making and be alert to new published evidence that clarifies the balance of benefit versus harm; patient preference should have a substantial influencing role.

APPENDIX B. SUMMARY OF RECOMMENDATIONS

RECOMMENDATIONS FOR PATIENT ASSESSMENT	SUPPORTING EVIDENCE	GRADE
<p>General Medical History:</p> <ul style="list-style-type: none"> Assess comorbidities, medications, allergies, and family history Physical exam: <ul style="list-style-type: none"> Assess cardiovascular status (pulse, blood pressure) Perform focused examination of the legs 	Expert Opinion	D
<p>Venous insufficiency Historical findings suggestive of venous insufficiency include:</p> <ul style="list-style-type: none"> Prior history of thrombophlebitis, venous thromboembolism, and/or deep vein thrombosis History of symptomatic varicosities during pregnancy Surgical history of lower extremity trauma, vascular injury or previous varicose vein surgery Hypercoagulable states (e.g. cancer, infection, Factor VIII excess) <p>Physical findings suggestive of venous insufficiency include:</p> <ul style="list-style-type: none"> Edema Wound presentation as shallow ulcer in the lower third of leg Venous dermatitis Lipodermatosclerosis Varicose veins <p>Diagnostic Tests:</p> <ul style="list-style-type: none"> Doppler ultrasonography Duplex scanner plethysmography and venography <p>Determine severity of venous insufficiency</p>	<p>16-21</p> <p>18, 19, 35</p> <p>24, 26, 35, 36</p> <p>Expert Opinion</p>	<p>B</p> <p>B</p> <p>B</p> <p>D</p>
<p>Arterial occlusive disease Assess for a history of arterial occlusive disease:</p> <ul style="list-style-type: none"> Arterial peripheral vascular disease Ischemic complaints Rest pain 	29, 37, 38, 40, 41, 43, 50, 105, 106	B
<p>Assess for factors suggestive of arterial compromise:</p> <ul style="list-style-type: none"> Cold, pale feet (in warm environment) Shiny, taut skin Dependent rubor Punched out appearance of ulcer <p>Diagnostic Tests:</p> <ul style="list-style-type: none"> Ankle brachial index (ABI) If < 0.8, referral to specialist may be necessary to assess for arterial occlusive disease <p>Determine severity of arterial occlusive disease:</p> <ul style="list-style-type: none"> ABI 0.6-0.8, suggestive of peripheral arterial occlusive disease ABI < 0.5, suggestive of critical ischemia ABI >1.2, suggestive of calcification and noncompressibility of arterial wall Consider vascular intervention or reconstruction Contrast arteriography (or magnetic resonance angiography) Refer to vascular specialist, if needed 	<p>50</p> <p>36-39, 41, 43, 50, 107, 108</p> <p>41, 110</p>	<p>B</p> <p>B</p> <p>B</p>

<p>Diabetes</p> <ul style="list-style-type: none"> • Assess for comorbidities (microangiopathy, neuropathy, impaired immune response) • Assess for sensory derangement (e.g., Semmes-Weinstein) 	41, 43, 46, 47, 109	B
<p>History and Characteristics of the Wound</p> <p>Document history of the wound:</p> <ul style="list-style-type: none"> • Date and site(s) current ulceration began • Date and site(s) of previous ulcers • Prior duration to heal • Length of prior disease-free interval(s) • Prior treatments • Past surgical history of venous operation • Use of compression garments <p>Document characteristics of the wound:</p> <ul style="list-style-type: none"> • Size • Nature of wound base tissue • Amount of drainage 	<p>Expert Opinion</p> <p>41, 110</p>	<p>D</p> <p>B</p>
<p>Evaluate wound for evidence of infection:</p> <ul style="list-style-type: none"> • Necrotic tissue • Purulent drainage • Odor • Induration • Cellulitis <p>For atypical and/or recalcitrant wounds, rule out other, less common causes of ulceration (biopsy may be necessary):</p> <ul style="list-style-type: none"> • Rheumatoid arthritis • Sickle cell disease • Pyogenic gangranosum • Tumors (squamous cell and basal cell carcinomas) 	<p>111, 112</p> <p>113</p>	<p>B</p> <p>B</p>
<p>Additional Considerations</p> <p>Assess for confounding factors:</p> <ul style="list-style-type: none"> • Impaired tissue perfusion (heart disease, obesity) • Tissue hypoxia • Metabolic disturbances (diabetes, nephropathy) • Impaired healing • Immunosuppression • Tobacco use • Infection (systemic and local) • Nutrition and overall state of health <p>Assess and document allergies</p>	<p>29, 38, 50, 110</p> <p>52, 114-116</p>	<p>B</p> <p>B</p>

RECOMMENDATIONS FOR TREATMENT	SUPPORTING EVIDENCE	GRADE
<p>Debridement:</p> <ul style="list-style-type: none"> • Excise all necrotic, infected, and poorly vascularized soft tissue • May be necessary to perform serially • Contraindicated in cases of gangrene or stable, dry, ischemic wound (evaluation of vascular status needed) • Sharp debridement not recommended if vasculitis or pyoderma gangrenosum is suspected • Following debridement, consider irrigation with saline • If tissue is suspect for malignancy, perform biopsy and submit for histopathologic analysis 	72, 73, 76	B
<p>Pressure Relief:</p> <ul style="list-style-type: none"> • Implement established repositioning schedule • Head of the bed should be maintained at lowest possible level consistent with medical condition • Use pressure-reducing devices 	28, 119, 120	B
<p>Infection Control:</p> <ul style="list-style-type: none"> • Determine presence of invasive pathogens (culture and susceptibility testing of deep tissue sample; clinical presentation of induration, erythema, warmth, suppuration, and pain or tenderness) • If infection is confirmed or highly suspect, prescribe appropriate antimicrobial intervention (oral cephalosporins, amoxicillin-clavulanic acid, macrolides, anti-staphylococcal penicil lins, and fluoroquinolones can be used; however, no evidence supports superiority of one over the others) • When determining the need for antibiotic treatment, consider risk of antibiotic resistance • For mild to moderate infections, consider surgical debridement and narrow-spectrum antibacterials • Wound infections that are severe and/or complicated by critical limb ischemia often necessitate hospitalization, parenteral broad-spectrum antibiotics, and surgical intervention 	85, 87, 88, 91, 110, 121	B
<p>Management of Exudate:</p> <ul style="list-style-type: none"> • Maintain moist environment • Remove soluble factors detrimental to wound healing • Use appropriate dressings (available evidence shows no superiority in dressing materials) • Consider classic dressings (gauze, foam, hydrocolloid, hydrogels,) • Consider bioactive dressings (topical antimicrobials, bioengineered composite skin equivalent, bilaminar dermal regeneration template, recombinant human growth factor)s 	64, 91, 110, 121-123	B

RECOMMENDATIONS FOR MANAGEMENT OF COMPLICATIONS	SUPPORTING EVIDENCE	GRADE
<p>Osteomyelitis:</p> <ul style="list-style-type: none"> • Consider aggressive resection of infected bone • Implement culture-directed antibiotic therapy • Use well-perfused tissue (typically muscle) for coverage 	106, 124-127	B
<p>Antibiotic prophylaxis :</p> <ul style="list-style-type: none"> • Routine use of systemic antimicrobials not recommended for prevention of osteomyelitis, bacterial endocarditis, or prosthesis infection • Endocarditis prophylaxis is indicated for high risk patients undergoing dermatologic procedures on visibly inflamed or infected wounds 	106	B

RECOMMENDATIONS FOR FOLLOW-UP	SUPPORTING EVIDENCE	GRADE
<p>Patients with chronic wounds:</p> <ul style="list-style-type: none"> • Perform follow-up every month during wound healing • Assess for systemic infection • Assess pain, discuss pain reduction methods, and adjust pain medication accordingly 	Expert Opinion	D
<p>Patients with venous insufficiency:</p> <ul style="list-style-type: none"> • During wound healing, weekly follow-up may be necessary • After wound healing, follow-up can be performed every 3-6 months, depending on patient, comorbidities, and patient's ability for self care • Patients with worsening symptoms may require more aggressive follow-up regimen • Perform physical exam of lower extremities (note changes in condition, skin color, temperature, tone, and hair, and presence of swelling; note new areas of skin breakdown or maceration) • Order additional diagnostic studies (venous duplex, venography) as indicated 	16-18	B
<p>Patients with Peripheral Arterial Disease</p> <ul style="list-style-type: none"> • Assess activity level, pain, changes in skin temperature and color; inspect skin, pulses and capillary refill of the toes • Obtain ABI, which may indicate angiography • If necessary, refer to vascular surgeon or interventional radiologist 	39, 102	B
<p>Patients with diabetes:</p> <ul style="list-style-type: none"> • Physical exam should include assessment of comorbidities (presence of bone infections, peripheral vascular disease, neuropathy, and multiple recurrences) • Evaluate patient's blood sugars, diet, and exercise • Assess skin for pressure points, ischemic changes, and skin maceration • Check prosthetics or shoes for abnormal wear • Assess for peripheral vascular disease (ABI <0.08) • Assess for osteomyelitis • Order laboratory studies (HbA1c, fasting glucose, lipid profile) • If patients have increase risk for or have diabetic neuropathy, assess for friction or pressure injuries • Patients with diabetic neuropathy should be seen every 3 months for assessment of skin trauma and early breakdown • Assess for chronic pain and consider referral to pain specialist 	37, 38, 46, 103	B
<p>Patients with history of osteomyelitis:</p> <ul style="list-style-type: none"> • Perform follow-up every month during wound healing • Perform follow-up every 3-6 months to evaluate for recurrence of osteomyelitis • Evaluate lower extremities to determine need for further tests • Consider laboratory studies (ESR, CRP) • Consider x-rays, MRI or bone scans, depending on symptoms 	Expert Opinion	D

RECOMMENDATIONS FOR PREVENTION OF RECURRENCE	SUPPORTING EVIDENCE	GRADE
Patient education: <ul style="list-style-type: none"> • Long-term nature of condition • Signs/symptoms of recurrence • Skin care (soaps, moisturizers, protective measures) 	Expert Opinion	D
Therapeutic modalities: <ul style="list-style-type: none"> • For patients with venous hypertension or risk for venous insufficiency, consider Graduated Compression Stockings • For patients with wounds in pressure point areas, consider off-loading devices, pressure dispersing surfaces • For patients with wounds secondary to abnormal sensitivity or mobility, consider repositioning and support surfaces 	28, 119, 120, 128-132	B
Exercise programs improve: <ul style="list-style-type: none"> • Patient mobility • Joint movement 	Expert Opinion	D

Procedure	CPT Code(s)
Incision and drainage of abscess	10060-10061
Incision and removal of foreign body	10120-10121
Incision and drainage of hematoma, seroma or fluid collection	10140
Incision and drainage, complex, postoperative wound infection	10180
Debridement	11040-11044
Biopsy of skin, subcutaneous tissue and/or mucous membrane (including simple closure), unless otherwise listed	11100-11101
Simple repair of superficial wounds of scalp, neck, axillae, external genitalia, trunk and/or extremities (including hands and feet)	12001-12007
Treatment of superficial wound dehiscence	12020-12021
Layer closure of wounds	12031-12047
Repair, complex	13100-13133
Secondary closure of surgical wound or dehiscence, extensive or complicated	13160
Adjacent tissue transfer or rearrangement	14000-14041
Adjacent tissue transfer or rearrangement, more than 30.0 sq cm, unusual or complicated, any area	14300
Filletted finger or toe flap, including preparation of recipient site	14350
Surgical preparation or creation of recipient site by excision of open wounds, burn eschar, or scar (including subcutaneous tissues) or incisional release of scar contracture	15002-15005
Harvest of skin for tissue cultured skin autograft; 100 sq cm or less	15040
Pinch graft, single or multiple, to cover small ulcer, tip of digit, or other minimal open area (except on face), up to defect size 2 cm diameter	15050
Split-thickness autograft, trunk, arms, legs	15100-15101
Epidermal autograft	15110-15116
Split thickness autograft, face, scalp, eyelids, mouth, neck, ears, orbits, genitalia, hands, feet and/or multiple digits	15120-15121
Acellular dermal replacement	14170-15176
Full thickness graft, free, including direct closure of donor site	15200-15241
Allograft skin for temporary wound closure	15300-15321
Acellular dermal allograft	15330-15336
Tissue cultured allogeneic skin substitute	15340-15341
Tissue cultured allogeneic dermal substitute	15360-15366
Xenograft, skin (dermal), for temporary wound closure	15400-15421
Formation of direct or tubed pedicle, with or without transfer	15572-15574
Delay of flap or sectioning of flap (division and inset)	15600-15620
Transfer, intermediate, of any pedicle flap (eg, abdomen to wrist, Walking tube), any location	15650
Muscle, myocutaneous, or fasciocutaneous flap; trunk	15734
Muscle, myocutaneous, or fasciocutaneous flap; lower extremity	15738
Flap, island pedical	15740
Flap; neurovascular pedicle	15750
Free flap with microvascular anastomosis	15756-15758
Graft; composite (eg, full thickness of external ear or nasal ala), including primary closure, donor area	15760
Graft; derma-fat-fascia	15770
Intravenous injection of agent (eg, fluorescein) to test vascular flow in flap or graft	15860
Excision, ischial pressure ulcer	15940-15946

Excision, trochanteric pressure ulcer	15950-15958
Incision of soft tissue abscess (eg, secondary to osteomyelitis)	20000-20005
Biopsy, bone, open	20240-20245
Removal of foreign body in muscle or tendon sheath	20520-20525
Decompressive fasciotomy, leg	27600-27602
Incision and drainage, leg or ankle	27603-27604
Incision (eg, osteomyelitis or bone abscess), leg or ankle	27607
Biopsy, soft tissue of leg or ankle area	27613-27614
Radical resection of tumor (eg, malignant neoplasm), soft tissue of leg or ankle area	27615
Excision, tumor, leg or ankle area	27618-27619
Decompression fasciotomy, leg	27892-27894
Incision and drainage, foot	28001-28003
Fasciotomy, foot and/or toe	28008
Suture of nerve	64831-64836
Suture of major peripheral nerve, arm or leg, except sciatic	64856-64857
Diagnosis	ICD-9 Code(s)
Other specified peripheral vascular diseases	443.8
Peripheral vascular disease, unspecified	443.9
Varicose veins of lower extremities, with ulcer	454.0
Varicose veins of lower extremities, with ulcer and inflammation	454.2
Postphlebitic syndrome	459.10-459.19
Decubitus ulcer, hip	707.04
Decubitus ulcer, ankle	707.06
Decubitus ulcer, heel	707.07
Ulcer of lower limb	707.10-707.19
Acute osteomyelitis	730.06-730.07
Chronic osteomyelitis	730.15-730.17
Unspecified osteomyelitis	730.25-730.27
Periostitis without mention of osteomyelitis	730.36-730.37
Other infections involving bone in diseases classified elsewhere	730.86-730.87
Unspecified infection of bone	730.96-730.97
Open wound of hip and thigh	890.0-890.2
Open wound of knee, leg (except thigh), and ankle	891.0-891.2
Open wound of foot except toe(s) alone	892.0-892.2
Open wound of toe(s)	893.0-893.2
Multiple and unspecified open wound of lower limb	894.0-894.2
Prosthetic joint implant failure	996.43
Other mechanical complication of prosthetic joint implant	996.47
Vascular complications of other vessels	997.79