



Standard of Care: Physical Therapy Management of the Patient with Peripheral Vascular Disease

Case Type / Diagnosis: Vascular Diseases

Practice Patterns Include:

- 4J Impaired Motor Function, Muscle Performance, Range of Motion, Gait, Locomotion, and Balance Associated with Amputation
- 6B Impaired Aerobic Capacity/Endurance Associated with Deconditioning
- 7A Primary Prevention/Risk Reduction for Integumentary Disorders
- 7B Impaired Integumentary Integrity Associated with Superficial Skin Involvement

ICD 9 Codes Include:

- 250.1 NIDDM
- 250.2 IDDM
- 440.20-24 Atherosclerosis of the extremities
- 440.0 Atherosclerosis NOS
- 443 Other peripheral vascular disease
- 443.9 Peripheral vascular disease, unspecified
- 453.9 Venous Thrombosis
- 459 Other disorders of the circulatory system
- 459.81 Venous Insufficiency NOS
- 707 Chronic ulcer of the skin
- 707.1 Ulcer of lower limbs, except decubitus
- 682 Other cellulitis and abscess

Introduction:

This standard of care will provide guidelines for the management of individuals with vascular disease and its many symptoms and sequelae. Vascular disease can be divided into two general categories: Arterial and Venous (Please refer to the chart in Appendix 1 for symptom comparison between these two systems). Both types of vascular disease can have an impact on all organ systems and affect function and quality of life.

Peripheral Artery Disease (Also known as Peripheral Arterial Occlusive Disease)

Peripheral arterial disease (PAD) most commonly occurs when atherosclerotic plaques produce localized stenosis of the arterial lumen. The atherosclerotic plaque is comprised of fibrous tissue, smooth muscle cells, cholesterol, microphages, and platelets. Atherosclerotic plaque lesions can vary in structure and progression, causing a great variability in symptom presentation.²

PAD affects 8-12 million Americans.³ Given that atherosclerosis is a systemic disease, individuals with PAD also have vascular involvement in other organ systems such as the heart.

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e.g. coronary artery disease, and the brain, e.g. cerebrovascular disease. They are at high risk for myocardial infarction and stroke. Predisposing risk factors for PAD include smoking, diabetes, hypertension, hypercholesteremia and male gender. The most common symptom of mild/moderate PAD is intermittent claudication, defined as “walking-induced pain, cramping, aching, tiredness, heaviness in one or both legs (most often calves) that does not go away with continued walking and is relieved with rest”.³ Individuals with PAD involving the calf or foot and diabetes have the poorest medical outcomes and require more surgical intervention.²

Early detection of PAD is a crucial step in avoiding the need for surgical intervention. Early PAD is often diagnosed using the ankle-brachial index (ABI). This is a non-invasive test that compares the systolic blood pressure (SBP) at the ankle to the brachial SBP (ankle SBP/brachial SBP = ABI). An ABI less than .96 is suggestive of PAD. Non-surgical management includes exercise, medication, and changes in lifestyle to minimize risk factors.^{4,5} Smoking cessation has the most positive impact, stopping PAD progression and even improving circulation. Remaining active is also important. Many studies show that regular exercise including active and resistive range of motion exercises, and walking “results in a measurable improvement in walking distance, quality of life, and community-based functional capacity.”^{6,15} One study has even shown that a “supervised treadmill exercise also increased brachial arterial flow-mediated dilation and improved quality of life”¹⁵ Exercise and ambulation may prevent or slow the progression of PAD. Unfortunately individuals with PAD and resulting claudication often have an insidious decrease in activity and walking in response to discomfort. They also may have the incorrect belief that walking can cause them injury. This decrease in activity causes faster progression of PAD.⁷ It is important to provide early education about how, in many cases, ambulation and exercise can slow the progression of the disease. The goal of surgery is to regain adequate blood flow thus relieving pain, improving function and quality of life and prolonging patient survival.¹⁶ Unfortunately, most patients with lower limb ischemia have a heavy disease burden related to their comorbidities. The 5-year survival rate is poor.¹⁶

Venous Disease

Venous insufficiency occurs when the venous system is unable to provide adequate antegrade blood flow back toward the heart, i.e. venous return, and fails to prevent retrograde flow into the extremities.

Venous disease can manifest in minor ways such as varicose veins which affect the superficial veins or more advanced as in chronic venous stasis which affect the deeper veins. The changes that are seen in deep vein disease are most commonly caused by deep vein thrombosis (DVT). Reflux disease due to venous valvular incompetence accounts for 80% of chronic venous insufficiency (CVI). The venous valve leaflets can become thickened, shortened or embedded in scarred vein wall during the process of phlebotic inflammation. The vein becomes rigid and thickened with fibrous material crossing the lumen.²

Venous disease can be congenital or of unknown etiology. Factors that increase the risk of venous disease are pregnancy and hormone therapy. Physical symptoms of venous disease include ankle edema, subcutaneous fibrosis, brownish skin discoloration, eczema, and dilation of subcutaneous veins. Arterial pulses are usually present. Disease which occurs below the knee appears more commonly in the more severe cases of venous insufficiency. Severe CVI often includes the development of chronic, difficult to heal ulcers.

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Typically the symptoms of CVI can be managed nonsurgically. Treatment focuses on leg elevation and compression to decrease edema, the management of infected ulcers with local wound care such as debridement using pulsatile lavage or topical enzymatics, and antibiotics. The ultimate goals are to heal and/or prevent ulcers and preserve a functional lifestyle. The size of the ulcer, length of time the ulcer has been present, and the amount of early healing that occurs in the first three weeks, are important predictors of successful nonoperative therapy.¹⁰ Studies such as that done by Padberg and Johnston suggest that exercise that improves calf muscle strength may improve the pump function of calf muscles, thus improving venous return.¹⁰ The average peak venous velocity increases at least 200% with active ankle dorsiflexion.⁸ Surgical intervention is mostly focused on management of venous stasis ulcers with irrigation/debridement and skin grafting.

As mentioned previously, vascular disease is systemic and can affect any part of the body, including the upper extremities. Individuals with renal disease requiring dialysis are at the highest risk for upper extremity involvement as their dialysis access is most commonly located in their arms. These grafts (most often a polytetrafluorethylene or PTFE graft) are at high risk for clotting and infection, partly due to the synthetic material used and also because of the dialysis patients' comorbidities such as diabetes and cardiac disease. These thrombi often require surgery (e.g., thrombectomy, dialysis access revision). Less frequently, upper extremities can require the same interventions as lower extremities, such as bypass grafts or wound management.

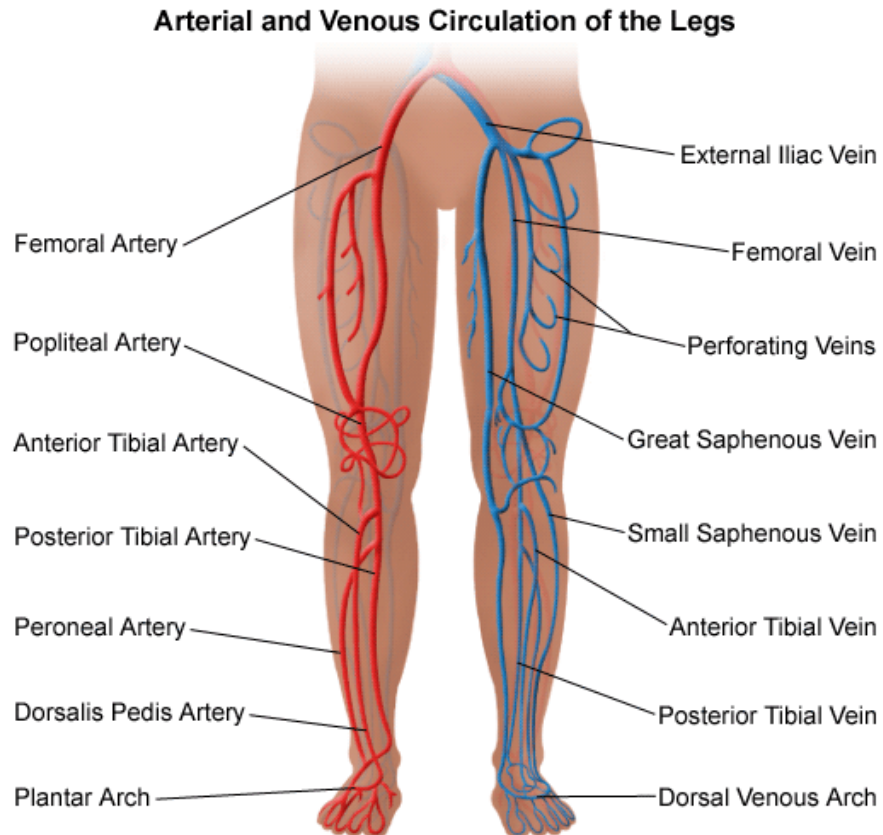
DVT can also be a manifestation of venous disease. Two million Americans develop DVT each year.⁸ DVT is the most common cause of secondary venous disease. Conversely venous stasis can cause DVTs. Venous stasis "promotes thrombus formation by reducing clearance of activated coagulation factors."⁹ Symptoms of DVTs can include skin that is warm to the touch, blue/brown/red skin discoloration, dependent edema, and pain with palpation. There are several types of DVT. Deep calf thrombi are generally small and asymptomatic but 30% can extend into proximal veins within 1-2 weeks.¹² There is a low risk of pulmonary embolus (PE) and the best treatment is early mobilization. Proximal DVT (popliteal or more proximal) tend to be more symptomatic and have a 50% risk of PE. In cases of proximal DVT, there is a higher incidence of PE with activity resumption within 48 hours so caution should be taken.¹²

The most common treatment of DVT is anticoagulant medication¹⁷ (e. g. Heparin, Lovenox, Coumadin, Fragmin, Bivalirudin, Argatroban). The treatment most commonly used at Brigham and Women's Hospital is Heparin until partial prothrombin time is therapeutic, 60-80 seconds, then transition to Coumadin with a goal INR of 2-3.¹⁸ Fragmin is an anticoagulant medication that is used when a patient has an allergy to Heparin. There are no lab value parameters when Fragmin is used because dosage is determined by weight. According to Dr. Samuel Z. Goldhaber, Director of the BWH Anticoagulation Service, Fragmin reaches therapeutic levels in "about an hour". Another source indicates that it is safe to mobilize a patient 3-5 hours after the first injection of Fragmin.²² Use of anticoagulation medications is highly effective in preventing DVT extension, embolization and recurrence.⁸ In cases where heparin is used there is a 5% risk of major bleeding and a 1% risk of inducing thrombocytopenia.⁸ It is important to note that anticoagulation does not eliminate an existing DVT. It can take the body months to absorb the clot.

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There are several factors that can reduce the risk of DVT. Activity, especially walking and exercise, causes skeletal muscle pumping which decreases venous stasis. Effective hydration and anticoagulation are also important. Compression that assists with venous return such as use of graduated compression stockings or pneumatic compression devices can also be effective.⁸

Figure 1



Vascular anatomy of the lower extremities. From www.ohsu.edu

Common Surgical Procedures for the management of Peripheral Vascular Disease

1. Carotid Endarterectomy (CEA)
2. Abdominal Aortic Aneurysm Repair—open (AAA) or endovascular (EVAR)
3. Thoracic Aortic Aneurysm Repair, open (TAA) or endovascular (TEVAR)
4. Aorto-bifemoral bypass graft
5. Axillo-femoral bypass graft
6. Femoral-popliteal bypass graft [above knee (AK) or below knee (BK)]
7. Femoral-anterior tibial bypass graft
8. Popliteal-dorsalis pedis bypass graft

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9. Tibial-dorsalis pedis bypass graft
10. Amputations [above knee (AKA), below knee (BKA), transmetatarsal (TMA), toe amputations]. (See Amputation Standard of Care for additional information about the management of patients following an amputation)
11. Debridement and skin grafting of decubitus ulcers due to PAD or venous stasis/insufficiency (See Wound Care Standard of Care for additional information about patients with integument issues)

Indications for Treatment: Some of the problems that patients with impaired peripheral vascular systems present with are impaired skin integrity, pain, decreased endurance and impaired mobility. Patients with impaired skin integrity can develop ulcers which often do not heal on their own. Decreased activity and mobility as well as pain can result in weakness, joint contractures, impaired aerobic capacity, and edema. The converse is also true, that is that weakness, contractures and edema can cause decreased function and increased pain. All these problems can lead to patients having difficulty performing activities of daily living (ADL) and complying with medical interventions. Patients may also lack knowledge about weight-bearing restrictions, wound healing and skin protection, safety awareness, and the importance of activity progression. Physical therapy can be involved with addressing all these problems in a variety of ways.

Contraindications / Precautions for Treatment:

Contraindications:

- Orders for strict bedrest preclude Physical Therapy intervention. Reasons for bedrest order include excessive bleeding, critical ischemia of an extremity, post-op day 1 of a distal LE revascularization, post-op from a skin graft
- Patients with femoral line intravenous access are put on bedrest at Brigham and Women's Hospital and repetitive hip range of motion is not done. The thought is that repetitive hip ROM can introduce bacteria into the access site or increase the risk of arterial bleeding. In an article by Perme C. Lettvin C. Throckmorton T. et. al., however, thirty patients with femoral arterial catheters performed ambulation supervised by physical therapists without any adverse affects.²⁰
- Patients with unstable heart rate, unstable blood pressure and fevers of more than 102 degrees are not appropriate for physical therapy

Precautions:

- The following are commonly approved precautions for vascular surgery service, however individual physician preference or individual cases may differ
 - Open great toe amputations: patients are heel weightbearing to minimize pressure on amputation site that might slow healing
 - Closed great toe amputations: Patients are on bedrest for 24hrs postoperatively, then are non-weightbearing to prevent increased pressure on incision that might cause dehiscence
 - Peripheral artery revascularization: Patients are weightbearing as tolerated. In above knee bypass procedures positioning the operative leg in hip/knee flexion more than 90 degrees for more than ½ hour should be avoided to prevent tension on the vein graft. For bypasses of the distal vasculature (involving the dorsalis pedis artery), patients

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are on 24 hours of bedrest post-operatively as the vasculature is smaller and more fragile.

- Aortic Aneurysm repairs: Patients should avoid lifting/pulling/pushing more than 10lbs, avoid sit-ups and excessive twisting of trunk all of which can increase intra-abdominal pressure and put tension on the repair. Patients should also use logroll bed mobility to minimize tension on the repair.
- Skin breakdown, chronic ulcers: Activity precautions vary depending on location and treatment. There may be weightbearing restrictions if the area of breakdown is on the plantar surface of the foot. Confer with physician, physician's assistant (PA) or nurse practitioner (NP) for specifics on individual patients
- Venous Stasis: Patients should keep their legs should be elevated above the level of the heart in bed and chair to facilitate venous return and edema control. Ambulation should be encouraged as the pumping action of the muscles can assist the with venous return
- Patients on dialysis may experience significant fatigue and hypotension after dialysis which decreases their tolerance for Physical Therapy intervention. Attempts to schedule treatments before dialysis or on non-dialysis days should be made

Evaluation:

Medical History: Pertinent past and ongoing medical issues that may impact response to treatment include, but are not restricted to, diabetes and its sequelae such as neuropathy, nephropathy, retinopathy, prior vascular surgeries, and use of tobacco or ETOH

History of Present Illness:

- Surgical procedures and other interventions such as stenting
- Relevant medications (pain control, anticoagulants, thrombolytics)
- Medical complications
- Mental status changes

Hospital Course:

- Pertinent lab values [international normalized ratio (INR), prothrombin time (PT), partial thromboplastin time (PTT), Hematocrit, Platelets, White Blood Cells]
- Lab values related to comorbidities (Creatinine, Blood Urea Nitrogen, blood glucose levels)
- ABI value in those with PAD
- Ultrasounds (upper extremity or lower extremity non-invasives) to rule out DVTs
- Angiogram results

Social History:

- Specifics about home environment, architectural barriers
- Family support, normal role in family
- Baseline level of function
- Ability of patient to comply with precautions in the past
- Adaptive equipment used and tried currently and in the past
- Psychosocial issues, substance abuse issues

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Examination

Cardiopulmonary

Assess patient's cardio-pulmonary status during activity by monitoring vital signs; auscultating lungs for present of rales, rhonchii, wheezes; and observing patient for signs of dyspnea. Doing this is especially important in patients with significant cardiac or pulmonary comorbidities, which are common in patients with vascular disease. Surgery can exacerbate existing cardiac and pulmonary problems. It can also cause acute decrease in cardiopulmonary status due to depressed respiration rate during surgery and fluid overload from IV administration. In addition to objective values, a patient's response to activity should be measured using the Borg Scale; this indicates how hard a patient feels they are working during activity.

Integument

- Observe surgical incisions for presence of drains, integrity of sutures/staples, amount and quality of drainage, type of dressing being used. Note presence of open areas (e.g. open toe amputations or incisions that have been left open due to edema)
- Check skin integrity, including color, trophic changes (thickness, hairlessness, flaking).
- Note presence of open wounds. Note size (length, width, and depth), type of tissue present and amount of each. Refer to Wound Care Standard of Care which includes a detailed wound assessment screening chart
- Examine extremities for edema. Edema after surgery can be acute or chronic. Circumferential measurements can be used to monitor changes in edema

Musculoskeletal

- Range of motion is measured using goniometric measurements. Incisions that cross the joint line increase risk of contracture due to pain and edema that make patients hesitant to move the operative area
- Strength is measured using manual muscle test (MMT) if patient is able to participate. If not, functional and spontaneous active motion can be observed and documented. In many cases a patient will not tolerate resistance to a newly operative limb, so measurement may be restricted to a MMT of 3/5 or less

Neuromuscular

- Pain is measured using Visual Analog Scale (VAS) (0-10). Consider pre-medication for pain. Communicate to nursing regarding pain during activity, need for additional pain medication. Instruct patient in deep breathing and relaxation techniques for pain control
- Always assess patient's ability to perceive light touch. If it is impaired, assess ability to perceive sharp-dull and deep pressure sensations as sensation impairments can impact skin integrity and balance. Also assess patient's proprioception which is also commonly impaired in patients with PAD. These patients often have peripheral neuropathy which can cause the sensation impairments
- Balance can be impaired in patients with vascular insufficiency. Balance can be affected by sensation deficits. More details can be found in the Balance Standard of Care.

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Balance can be assessed by a variety of balance test such as the Berg Balance Assessment, Dynamic Gait Index, Function in Sitting

Functional Capacity

- Functional mobility including use of ambulatory devices, lifts

Mental Status and Cognition

- Level of consciousness
- Orientation
- Safety judgment
- Ability to follow direction and comply with restrictions (especially regarding level of activity and weightbearing status)

Psychological Considerations

- Learning style
- Patient's goals for recovery
- Impact of psychiatric disorders on participation and recovery

Assessment:

Problem List (This is not an exhaustive list and problems can vary among individual patients)

- Impaired range of motion of involved extremities
- Edema
- Presence of/risk for skin breakdown
- Impaired mobility
- Impaired endurance
- Impaired respiratory status
- Impaired balance
- Impaired strength
- Knowledge deficit regarding precautions, activity progression, healing process
- Pain
- Sensation deficits

Prognosis:

Symptomatic vascular disease can impact an individual's functional level in a variety of ways. Claudication pain, skin breakdown and weightbearing restrictions can all limit activity and affect quality of life.¹⁹ Many studies have detailed the benefits of various types of exercise. McDermott et. al. showed that group participation in a supervised treadmill program and lower extremity resistance training improved 6 minute walk performance, brachial artery flow-mediated dilation, stair climbing ability and quality of life.¹⁴ Other studies document that exercise increases quality of life and activity level even without improvement in brachial artery flow.^{6,19} These findings show that a progressive walking program and exercises can be beneficial in any person with vascular disease admitted to the hospital and improve their functional and vascular prognosis.

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compressive items. Active exercise and elevation are also components of edema control

- Integument
 - Specialized footwear prescription to off-load portions of the foot depending on the surgical site. Particular physician preference also needs to be considered. At BWH flat soled post-op shoes, heel weightbearing shoes and forefoot weightbearing shoes are available. Custom-made footwear may be needed in isolated cases. “Offloading is important for reducing foot pressure points and for prevention, as well as for healing”.²¹
 - Wound care such as pulsatile lavage can be initiated for open wounds that have been slow to heal and contain necrotic tissue(refer to Wound care SOC)
- Range of Motion, Stretching and Strengthening

Active, active assisted, passive ROM and stretching as tolerated can be performed to preserve and increase flexibility and strength. Ideally the incision site should be visible during stretching so as not to overly stress the incision. Resistive exercises as tolerated can increase strength but also improve circulation and decrease claudication^{6 15}
- Endurance

A progressive activity program that includes progressive ambulation, exercises performed in increasing repetition and frequency can increased a patient’s activity tolerance. A stationary bike, treadmill, elliptical can also be used.
- Pulmonary Conditioning

Pulmonary status, similar to endurance, can be addressed by instruction of a progressive activity and exercise program for home use. Individuals can walk, use a treadmill, stationary bicycle or other type of aerobic equipment and start at a low duration. They can then increase the amount of time they exercise, with a goal of RPE of “moderate” or rating of 3-5/10 on the Modified Borg Scale. These conditioning activities have added benefits of increasing muscle strength and blood flow. Exercises can be done that focus on strengthening respiratory muscles such as the diaphragm and trunk musculature. For people with a lower activity tolerance as well as all patients, education about pacing, modification of activities, energy conservation, and effective deep breathing can be useful in improving quality of life and level activity

Frequency & Duration

The intensity of physical therapy intervention in the acute care setting depends on several things. Although treatment frequency varies, patients are typically seen 3-5 times weekly. Patients with less complicated surgeries such as an endovascular AAA repair often require only a few treatments, while a patient with a complex revascularization or chronic skin breakdown requires more frequent, ongoing physical therapy.

Medical issues that arise can impact length of stay and the patient’s ability to progress toward goals. Length of stay can vary widely in this group of individuals depending on complexity of the surgery or the severity of the disease. Patients can be at BWH from several days for a patient with an uncomplicated revascularization procedure to several weeks or longer for a patient with more complex vascular medicine issues. A patient’s

level of impairment will dictate what goals need to be addressed and what the best discharge destination should be.

Patient / family / caregiver education

Discussion with patient and family/caregivers regarding physical therapy involvement with patient and expected progression should include:

- Detailed explanation of weightbearing restrictions and discussion of importance of compliance for optimal healing
- Discussion of importance of moving affected extremity (within precaution parameters) to prevent joint contractures, particularly at the ankle and knee
- Instruction of patient and family/caregivers in appropriate exercises and activities
- Patients and family should be instructed in a skincare regimen including daily check of problem areas to ensure no new skin breakdown. This is especially important in individuals with impaired sensation. Shoes should also be checked for proper fit and modified by an orthotist or podiatrist. Patients should be encouraged to contact their physicians quickly if any skin or wound changes occur

Recommendations and referrals to other providers

- Social Work/Care Coordination
- Occupational Therapy
- Psychiatry
- Orthopedic Technician
- Prosthetist/Orthotist

Re-evaluation

Standard Time Frame: 10 days or sooner as appropriate

Other Possible Triggers: A significant change in signs and symptoms, new surgical procedure, significant progress with PT intervention requiring re-assessment of needs

Discharge Planning

Commonly expected outcomes at discharge:

- Return to at least baseline function
- Maximal range of motion
- Patient is independent with exercise program and walking program
- Patient is independent with skin inspection

Transfer of Care

- Home with services if the patient has good support system and safe living situation but continues to have impairments and functional limitations that could be improved with further physical therapy intervention. Intervention at home can also work to educate family on how to optimally care for and/or assist the patient
- Home with family assistance if the patient is able to mobilize and function safely without assistance or family is proficient in caring for and assisting the patient

- Extended care facility patient requires extensive skilled medical care for safety and requires ongoing physical therapy to make functional progress

Patient's discharge instructions

- Progressive activity program including use of activity log
- Weightbearing restrictions
- Management of assistive devices and other equipment such as or intravenous pump poles
- ROM and strengthening exercise program
- Proper management of positioning devices and splints including wearing schedule, don/doff procedure

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APPENDIX 1

Comparison of Arterial and Venous Disease Symptoms¹³

	Arterial	Venous
Pain	Intermittent claudication, may progress to pain at rest	Chronic, dull aching pain which progresses throughout the day
Color	Pale to dependent rubor, dull to bright reddish color	Normal to cyanotic
Skin temperature	Takes on environmental temperature, cool	Normal
Pulses	Diminished to absent	Normal but difficult to palpate due to edema
Edema	Not present with isolated PAD	Present, can be pitting. Can have weeping of serous fluid
Tissue changes	Skin is shiny with hair loss. Trophic changes in nails, muscle wasting	Stasis dermatitis with flaky dry and scaly skin. Can have brownish discoloration. Fibrosis with narrowing of the lower legs ("bottle legs")
Wounds	Occur distally especially at toes and web spaces. May develop gangrene and tissue loss	Shallow ulcers on the foot and ankle, usually medially

From Sussman C. Bates-Jensen B. Wound Care; A Collaborative Practice Manual for Physical Therapists and Nurses. Aspen Publishers, Inc. 2001, page 179.