Physical Assessment

The purpose of this chapter is to discuss the essential components of a physical assessment of the foot and lower extremities. The goal of assessment is to determine underlying systemic and localized diseases or conditions that directly affect the health of the foot.

There are key components of assessment to be addressed in a foot and nail care practice to identify conditions requiring intervention, education, or referral. These components include the use of non-invasive, inexpensive, and quantitative tools to assess individuals for risk of lower extremity wounds that may lead to amputation. Research has shown that implementation of a foot care program using effective assessment tools and education with motivational strategies directly influences reduction of injuries among people at risk for limb loss (Driver, 2005; Frykberg,et al., 2006). The physical examination should be thorough and address functional disability, circulation, neuropathy, edema/lymphedema, musculoskeletal deformities, pain, dermatologic conditions, and toenail and cuticle conditions.

Functional Disability

One-quarter of all of the bones in the human body are in the feet. If these bones are out of alignment, the whole body is out of alignment, contributing to functional disabilities (Mahoney & Euhardy, 1994). Functional disabilities are physical or mental impairments that prevent mobility and reduce ones' ability to conduct activities of daily living. Balance, strength, and presence of foot pain are common factors that lead to mobility problems. Loss of balance and mobility are not inevitable; however, they are of concern because the incidence of balance problems is known to increase with age.

Functional disabilities are typical of people who have poor foot health, pain, and deformities that affect gait, mobility, and balance. One study addressing the lived experience of having a chronic wound Beitz & Goldberg (2005) identified living with pain and losing mobility as the most common themes expressed by an elderly population.

Balance in daily life is vital to normal every day life activities such as getting out of a chair and or bending over to put on your shoes. Ability to maintain balance is a complex process requiring the sensory systems for accurate information about the body's position; the brain's ability to process this information; and the muscles and joints for coordinating the movements to maintain balance. The sensory systems include the sense of touch and proprioception (position of feet, ankle, and joints), vision, and inner ear motion sensors. Gait abnormalities and balance disorders often result in falls and fractures. In assessing for functional ability the clinician should:

- Observe speed, steadiness, and confidence of movement. (Can the client get out of a chair and walk from one point to another?)
- Assess mobility. (Can the client move around the room with ease?)
- Observe the ability to raise feet and legs. (Can the client climb stairs?)
- Assess for ability to stand erect with correct posture (Does the client lean to one side? Does the client exhibit kyphosis, lordosis, or scoliosis?)
- Assess for visual acuity (Can the client tell if the environment is moving or still?)
- Assess cognitive ability (Can the client interact in a coherent manner?)

Circulation

Diminished blood flow is the single most important factor in lower extremity wounds leading to amputation. Early detection of compromised blood flow allows for prompt

medical treatment and less invasive surgical procedures to eradicate blockages (Kesselman, 2006; Frykberg, et al., 2006).

Circulation to the lower extremity can be classified as indicated in Table 2-1.

Table 2-1 Classification and Characteristics of Lower Extremity Perfusion

Classification	Characteristics
Adequate	Presence of palpable dorsalis pedis and posterior tibial pulses; normal skin texture, color, warmth, and hair distribution; and absence of nocturnal pain and pain on exertion (claudication)
Diminished	Symptoms of claudication (pain in the lower legs with exertion), pulses that are neither palpable nor obtainable by Doppler, and lower extremity abnormalities suggesting poor perfusion such as hairlessness, cool temperature, and pale color
Severely Diminished	All of the symptoms of diminished circulation plus parasthesia (tingling sensation) and/or nocturnal pain

Lower Extremity Arterial Disease (LEAD)

Diminished circulation to the lower extremity, also known as lower extremity arterial disease (LEAD), is frequently encountered in people with coronary artery disease, diabetes, and a long-term history of smoking. Physical signs of ischemic skin and nail changes associated with LEAD include:

- Sores on legs or feet that will not heal.
- Decreased temperature of the legs, both ipsilateral (same side of the body) and contralateral (other side of the body).
- Color changes in the skin of the legs and feet, such as elevation pallor and dependent rubor (are explained in detail in the next section).
- Taut shiny skin; thin, smooth, parchment-like.
- Onychodystrophy; abnormal shaped toenails.

- Changes in or absence of hair growth on the lower extremity- sparse or no hair especially on the great toe.
- Muscle atrophy below the level of blood flow occlusion.

A non-invasive lower extremity assessment for adequacy of blood flow should include:

- Checking the pulses- check the posterior tibialis and the dorsalis pedis- Document findings as absent, diminished, normal, or strong and bounding. If the pulses are difficult to palpate, check them with a hand held Doppler.
- Palpating legs for temperature- place the back of the hand against the lower leg, ankle, foot, and toes comparing the temperature of one foot with the other. Record findings as hot, warm, cool, or cold.
- Checking for capillary refill- apply firm pressure with your thumb to the tip of the great toe for two seconds. When pressure is released, the color should return to normal within two-three seconds. If greater than three seconds; suspect LEAD.

> **Clinical Note**
> Nails are often discolored or thickened in the older population with LEAD and or people with diabetes due to onychomycosis and cannot be used reliably to check capillary refill.

- Performing an ankle brachial pressure index (see Appendix A).
- Checking for distended veins on the dorsum of the foot.
- Checking for blanching of the skin of the lower extremity or pallor on elevation. Ask the client to lie down and raise one foot above the level of the heart for 10 to 20 seconds. If the foot blanches (turns white), arterial insufficiency may be present.

- Checking for dependent rubor. Ask the client to sit down and raise the foot for 10 to 20 seconds then lower it, if the lower leg becomes dark red (rubor) arterial insufficiency may be present.

When results of the non-invasive assessment suggest LEAD consider the need for further vascular studies.

Table 2-2 Disguised Compromised Diabetic vs Non-Diabetic Clinical Presentation

Clinical Note
People with diabetes may have a clinical presentation of LEAD very different from those without diabetes as indicated in the table below:

Sign/Symptom of LEAD	Non-Diabetic	Diabetic
Rest pain and/or claudication	present	absent
Pedal and popliteal pulses	absent	present
Foot color and temperature	pale and cool	pink and warm
Venous filling	may be delayed	brisk
Ankle/brachial indices	diminished	normal or elevated

Adapted from Sykes & Godsey, Podiatry Today, 1998

Lower Extremity Wounds Due to LEAD

Wounds on the feet and legs of people with LEAD are classic with respect to location, size, amount of drainage, characteristics of surrounding skin, and type of pain. Wounds on clients with LEAD are generally small, round, and punctuate. These wounds occur between or on the tips of their toes or the medial or lateral malleolus. The wounds are partial to full thickness with a wound bed that is black and necrotic or pale

pink. Drainage is minimal, but the pain may be severe enough to interfere with activities of daily living. A typical wound resulting from LEAD is depicted in Figure 2-1.

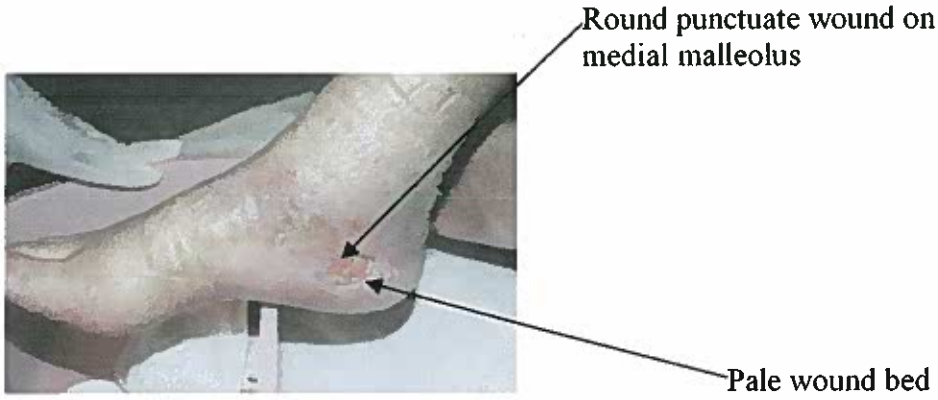


figure 2-1 Wound Characteristic of LEAD

Neuropathy

Neuropathy is a neurologic deterioration that can give rise to multiple foot problems, consequent disability, or other adverse outcomes. Figure 2-2 indicates type of neuropathy involving the sensory, autonomic, and/or musculoskeletal system.

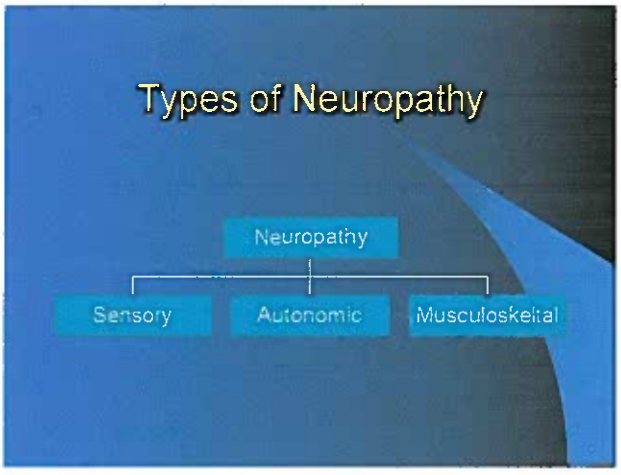


figure 2-2. Types of Neuropathy

Sensory Neuropathy

Sensory neuropathy (also known as distal symmetric sensorimotor polyneuropathy, diabetic neuropathy, or peripheral sensory neuropathy) in people with diabetes is related to poor glucose control. It affects all peripheral extremities, but is more pronounced in the feet. Sensory neuropathy is characterized by the absence of peripheral reflexes (patellar and Achilles) and a patient report of altered sensations in the feet, such as numbness, burning and tingling, and sharp pains in the arms and legs. An unsteady gait develops leading to falls and injuries because the patient has diminished sensorimotor awareness.

Sensory neuropathy is associated with diabetes, Hansen's disease, spinal cord injury, multiple sclerosis, and alcoholism. The underlying pathology of diabetic sensory neuropathy may actually be the consequence of abnormal microvascular function, with reduced neural blood flow, causing neural hypoxia (Frykberg, et al., 2006). Clinical studies have shown that high glucose levels increase the likelihood of developing diabetes-associated complications, such as sensory neuropathy (Marston, 2006).

Peripheral sensory neuropathy is one of the greatest risk factors for foot ulceration and amputation. Sensory neuropathy often leads to injury, due to the loss of protective sensation and decreased ability to feel pain from injuries affecting the foot (Kesselman, 2006). Since the individual has lost the ability to feel a puncture wound on the foot or discern when their bath water is too hot, injury often goes unnoticed until extensive damage has occurred (Frykberg, et al., 2006).

People with LOPS also lack appropriate tactile discrimination and are unable to determine the extent of an injury (Kesselman, 2006). A device known as the Semmes-

Weinstein 5.07 monofilament instrument (Figure 2-3) has been developed to assess for sensation (Frykberg, et al., 2006).

Figure 2-3 Tools for Testing Neuropathy

The Semmes-Weinstein Monofilament test (Appendix C) is recommended by the International Diabetes Federation and the World Health Organization (WHO) as a tool for quantitative assessment of LOPS. It is a device that can be used by health professionals at every level of care and is convenient, simple to use, inexpensive, and reliable. The monofilament is calculated to buckle when a force of 10 grams is exerted. This simple five minute screening examination provides clinicians with the data needed to make appropriate decisions concerning client care; education, treatment, and prevention strategies.

The use of a tuning fork is another cost effective and reliable method of testing for LOPS. Strike the tuning fork on an object or your hand; then touch the handle of the fork to the great toe and record how many seconds the individual senses the vibration. The normal time is 10-15 seconds. If the result is less than 10-15 seconds, suspect sensory neuropathy. Another option in instruments for semi-quantitative assessment of vibratory perception is to use a biothesiometer, an electronic hand held unit with a rubber tactor

(Frykberg, et al., 2006). The biothesiometer is used primarily for data collection in research studies rather than in day-to-day clinical practice.

Previously used methods of testing for sensory neuropathy included 1) a pin prick test with a sterile needle for pain; 2) light touch with cotton wool; 3) evaluation of deep tendon reflexes of patella and Achilles with a plexor (rubber-headed percussion hammer) (Boulton, 2005; Frykberg, et al., 2006). A random application of the tip of a safety pin, feather or cotton-tip applicator is not valid or reliable in assessment for LOPS, but may give you enough data to suspect sensory neuropathy. A determination of LOPS allows for opportunities to educate the individual, modify your teaching plan to include precautions to take into consideration with activities of daily living, and refer for further evaluation. Figure 2-4 is a typical injury (loss of the 5th toe) secondary to sensory neuropathy due to poorly fitted shoes,. People with diabetes and sensory neuropathy simply cannot sense a shoe too narrow or short creating an injury that often leads to amputation.

Figure 2-4 Loss of 5th toe due to poorly fitted shoes and sensory neuropathy.

Autonomic Neuropathy

The clinical presentation of autonomic neuropathy involves the functionally independent nervous system. In autonomic neuropathy the involuntary nervous system produces hyperhydrosis (excessive perspiration) above the waist and anhidrosis (lack of perspiration) below the waist. The distal anhidrosis of the smooth atrophic skin results in a loss of nails and leads to cracking, fissuring, and ulceration of the skin of the lower extremities (Kesselman, 2006). Autonomic neuropathy decreases the sympathetic tone that alters blood flow regulation, which can create a structural deformity of the foot known as a Charcot Joint. A separate section of this book will discuss skin related issues related to autonomic neuropathy.

Musculoskeletal Neuropathy

Motor or musculoskeletal neuropathy causes muscles to lose normal partnerships, resulting in muscle imbalance and anatomic and functional disorders (Kesselman, 2006). The weakness and atrophy associated with motor neuropathy leads to deformity, abnormal stress, high plantar pressures, and callus formation (Frykberg, et al., 2006). An extensive discussion of the effects of musculoskeletal deformities directly related to motor neuropathy is included later in this chapter.

Edema/Lymphedema

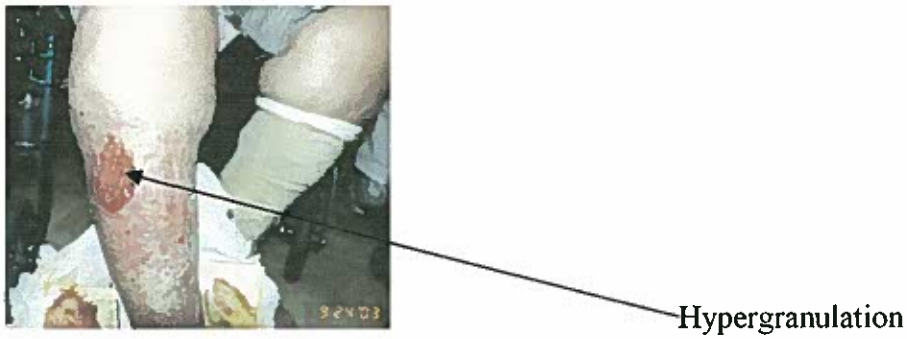
A discussion of lower extremity swelling is necessary since it is a precursor to major lower extremity injury, infection, and skin/nail complications. Edema/lymphedema may be a sign of underlying diseases such as congestive heart failure, liver disease, and thyroid disorders. Other conditions that may precipitate edema include malnutrition, medications, and other allergic reactions, and pelvic tumors.

Edema is an abnormal accumulation of fluid in the interstitial spaces of tissues. This can be a local or systemic condition, common in the lower extremities among persons who have diabetes, chronic venous insufficiency (CVI), or a history of deep vein thrombosis (Gallagher, 2006; Parnell, 2006,). Lymphedema is the accumulation of lymphatic fluid in the interstitial spaces (Holcomb, 2006), resulting in an abnormal collection of excess tissue proteins leading to chronic inflammation and fibrosis.

Lower extremity edema/lymphedema is frequently associated with a diagnosis of chronic venous insufficiency. The underlying pathology is complex and controversial. The suspected course of the disease process includes direct injury to the vein, that combined with obesity or extensive exercise, may cause perforators (valves between the superficial and deep vein system) to fail. This allows for leaky valves and pooling of blood, and fluid resulting in lower extremity edema.

Dull achiness in the later part of the day and evening is common among those who have pooling of fluid in the lower extremities. People with chronic venous insufficiency tend to have a stained appearance of the skin due to hemosiderin deposits (leakage of red blood cells into the tissues) in the lower extremities, causing discoloration or hyperpigmentation (Figures 2-5 and 2-6).

In addition, edema/lymphedema is a common a precursor to lower extremity cellulites, or chronic venous insufficiency ulcers. Chronic venous insufficiency ulcers are typically large, may be circumferential (extend completely around the leg), and very exudative. These wounds are typically shallow, with pink or red granular tissue.



Wound with hypergranulation, and leg with stasis dermatitis

Figure 2-5 Chronic venous insufficiency with wound, edema, stasis dermatitis

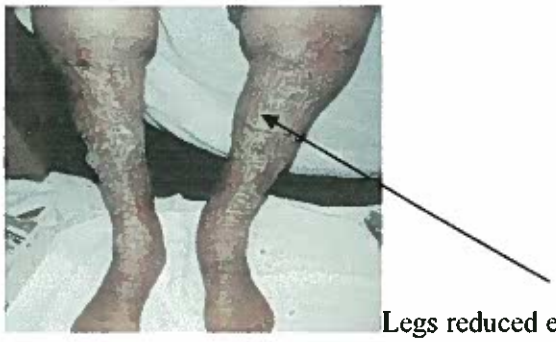


Figure 2-6 Clinical presentation of chronic venous insufficiency with ulceration, edema, stasis dermatitis, and lipodermatosclerosis.

Assessment of the lower extremity, to determine the underlying etiology of edema/lymphedema, involves a simple but comprehensive investigation including:

- Observation of the edema pattern- document areas where the edema starts, when it occurs (e.g., after feet and legs are dependent), and what areas are involved (e.g., legs, feet, and toes).
- Identification of wounds- document wound location, shape, size, and skin texture and color changes. Figures 2-5 and 2-6 present a large, hypergranular wound, extending around the limb with the dry scaly skin (stasis dermatitis) and leathery texture and appearance (lipodermatosclerosis) typical CVI lesions.

- Measurement of the circumference of the calves and ankle with a tape measure to determine any changes over time. The calf is measured at its largest diameter. The ankle is measured at the level of the medial and lateral malleoli. To facilitate measurement of the same location each time, mark the skin with a nontoxic, semi-permanent medical marker.

The International Society of Lymphology (Holcomb, 2006) has developed a staging system that could clarify controversy in identify and documenting the clinical presentation of edema and lymphedema. It could also help us speak a common language among clinicians in reference to lower extremity pooling of fluids.

Staging system defined by Holcomb (2006) is depicted in Table 2-3

Table 2-3 Staging system of lower extremity edema/lymphedema

Stage	Characteristic Feautres
Stage 0	Subclinical condition in which swelling is not evident despite impaired lymph transport. It may exist for months or years before edema occurs. Edema is not usually detectable clinically until the interstitial volume is about 30% above normal (Holcomb, 2006).
Stage I	Pitting may occur and is reversible. It may take up to a few hours of rest and elevation to reverse
Stage II	Pitting occurs, and the edema is not appreciably reduced with elevation of the affected limb. In late Stage II, the issue hardens and becomes fibrotic, and pitting no longer occurs.
Stage III	Pitting is absent. Skin changes, such as acanthosis (increase in thickness and hyperpigmentation), fat deposits, and warty overgrowths may develop. Fluid may ooze from the skin due to high pressure in the lymphatic and venous vessels. Oozing of the skin commonly occurs in the legs and results from long-standing inadequately and or untreated lymphedema. (This is the stage also referred to as elephantiasis).

Source: Holcomb, 20006

Musculoskeletal Deformities

Glycosylation of collagen, directly related to high blood sugars in people with longstanding diabetes, may lead to stiffening of musculoskeletal structures and ligaments

resulting in deformities (Frykberg, et al., 2006). Motor neuropathy results in muscle atrophy and wasting that can lead to foot deformities, such as a foot drop, hammertoe, and prominent plantar metatarsal heads (Frykberg, et al., 2006). Decreased ankle motion (equinus) causes higher-than normal plantar pressures on the forefoot. Motor neuropathy occurs early in the course of the disease of diabetes and leads to fat pad displacement of the plantar surface of the foot. Common deformities include Charcot arthropathy, hallux varus, and hallux valgus.

Key Terms
Bunion/bunionette-
Charcot's joint (tabetic arthropathy)- a neuropathic joint commonly associated with tabes dorsalis or diabetic neuropathy
Claw toes- two joint bend in toes
Corns (clavus)- a small conical callosity caused by pressure over a bony prominence, usually on a toe.
Hallux- the big toe
Hallux flexus- hammer toe of the big toe
Hallux rigidus- a condition in which there is stiffness in the metatarsophalangeal joint of the big toe
Hallux valgas- deviation of the tip or main axis of the big toe toward the outer side of the foot
Hallux varus- deviation of the main axis of the big toe to the inner side of the foot

The musculoskeletal examination includes:

- Testing for strength and resistance. Muscle strength is assessed by using passive range of motion exercises, and by testing strength against gravity and resistance applied by the examiner. The examiner instructs the client to try to move the extremity against the examiner's hand. Both extremities are evaluated; one side is compared to the other.

Grading Scale for Muscle Strength

Score	Findings
0	No movement.
1	Weak contraction palpated or observed.
2	Muscle moves when supported against gravity.
3	Active muscle movement against gravity
4	Active full range of motion against gravity but with some weakness when resistance is tested
5	Full active range of motion against gravity and Resistance

(Linton, Matteson, & Maebius, 1995)

- Assessing for pain due to deformities such as plantar fasciitis, rheumatoid arthritis, metatarsalgia, and interdigital neuroma (also defined in glossary).

Key Terms
Bunion/bunionette- a localized swelling at either the medial or dorsal aspect of the first joint of the big toe, caused by an inflamed bursa
Metatarsalgia- a cramp like burning pain that focuses in the region of the metatarsal bones of the foot
Neuroma- a neoplasm derived from nerve tissue typical interdigital spaces of the foot
Plantar fasciitis- inflammation in the fascia of the sole of the foot
Rheumatoid arthritis- a chronic and progressive systemic disease, especially common in women, characterized by stiffness and inflammation of the joints and sometimes leading to deformity and disability

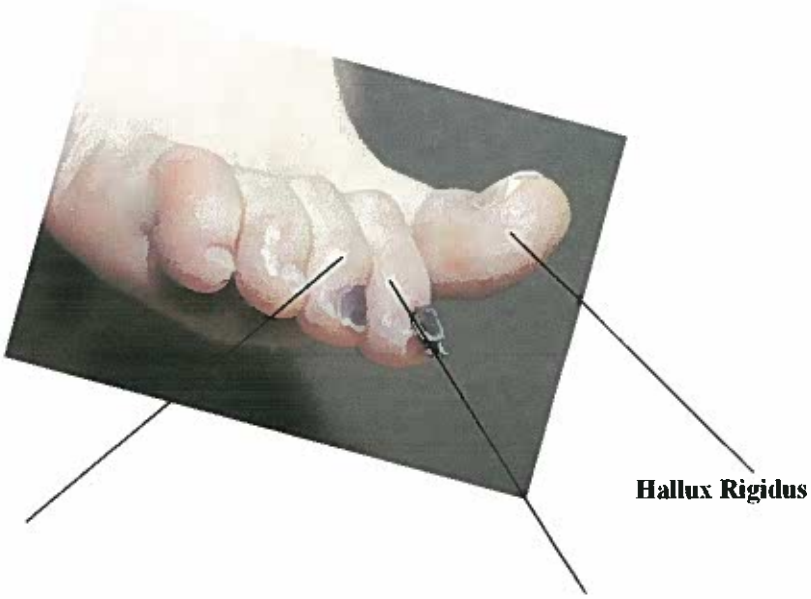
- Checking for active and passive range of motion. Have the individual move his foot and ankle in a circular motion and toes up and down.
- Checking for midfoot flatness and altered pressure points on the plantar aspect of the foot. Use a pressure mapping device (e.g. Harris Mat-

Appendix D) to identify "hot spots". These are areas where bony prominences are protruding through the plantar, medial, or lateral aspect of the foot.

- Identifying deformities and conditions which may precipitate ulcers and other conditions leading to disability.

For further definitions of terms and deformities, please see the glossary at the end of this chapter

Any deformity, no matter how minimal, may create a high-risk situation for a person with diabetes, sensory neuropathy, and/or lower extremity arterial disease. Hammertoes, claw toes, bunion/bunionette, hallux vulgas, corns, calluses, and toe and nail deformities may all lead to ulcerations (see Figure 2-7). People who have toe deformities, in which the great or second toe crosses over or under an adjacent toe, are at high risk for ulcerations (see Figures 2-7, 2-8, and 2-9). Hammertoes and claw toes have permanent sideways bends in the metatarsals. A bunion/bunionette (see Figure 2-9) is an enlargement of the first or fifth metatarsal, often misshapen, and painful when wearing footwear.



Hallux Rigidus

Claw toe (two joints affected) with injury to nail

Hammer toe (one joint affected) with injury to nail and toe

Figure 2-7 Claw toes with discolored 2nd and 3rd nail, due to pressure from foot wear.
Hallux Rigidus

Ischemic wound on hammertoe

Figure 2-8
Injury on dorsal surface 2nd toe due to hammertoe deformity and foot wear.
Note lack of hair on great toe, pale color, and nail deformity.

Bunion

Cross-toed Deformity

Figure 2-9 Bunion (hallux vulgas) on left diagram of Xray with cross toed deformity on right

Increased pressure, shear, and friction (rubbing of skin) from a shoe due to a deformity, can easily cause blisters, nail injury, infections, further deformity, and ulceration. Ulcerations on the foot are related to forces including increased pressure or abnormal shear and friction on the plantar surface of the foot (see Figure 2-10).

Figure 2-10 Wound on plantar aspect of foot at 4th metatarsal due to loss of fat pad and increased shear and friction from foot wear

Charcot Joint

The musculoskeletal exam should also include evaluation for a Charcot foot deformity (also known as osteoarthropathy or neuroarthropathy). A Charcot joint, with resultant fractures and dislocations, is a deformed area usually at the ankle, but possibly the great toe, knee, or other jointed area.

The Charcot foot is the most severe deformity of the foot and is directly related to poor glucose control. Peripheral sensory neuropathy starts the process in people with LOPS cannot sense an injury resulting in repeated trauma that goes unnoticed. It is common for these repeated injuries, such as a fracture of the foot, to cause an inflammatory response with increased perfusion and destruction of a joint in the foot, creating a deformity.

Autonomic neuropathy is a common condition among people with diabetes. The foot becomes red, hot, and swollen from inflammation followed by bone destruction and deformity. The Charcot deformity limits joint motion and creates altered pressure points, leading to a neuropathic foot ulcer and possible amputation (Figures 2-11 and 2-12). It is

important to rule out an infectious process by assessing for fever, elevated white blood cell count (WBC), and hyperglycemia. The diagnosis of Charcot may be complex due to an underlying infectious disease, foreign body response, or both.

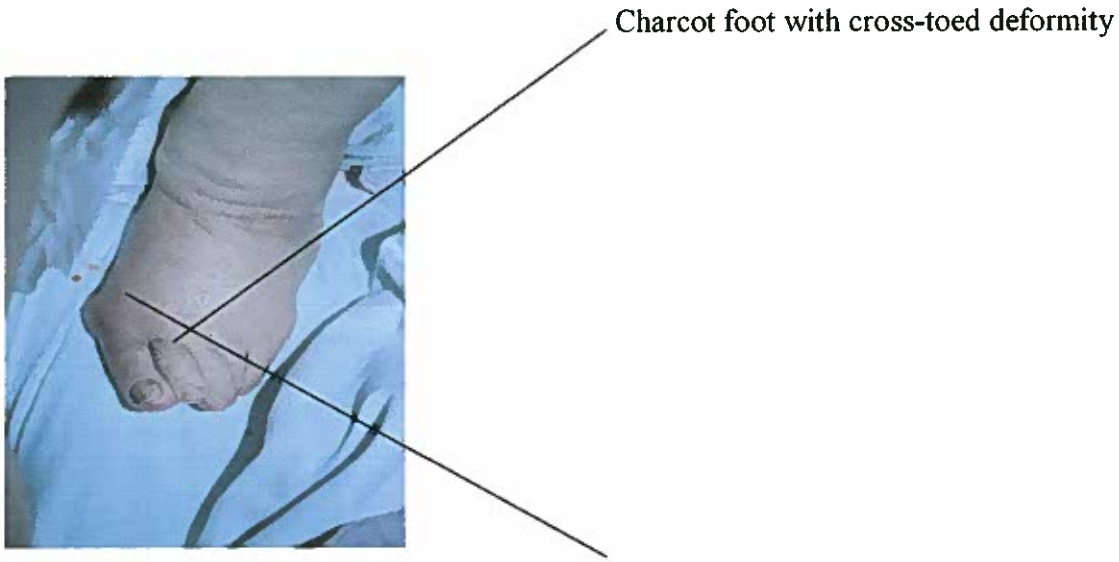


Figure 2-11 Bunion (hallux valgus), cross-toed deformity and Charcot

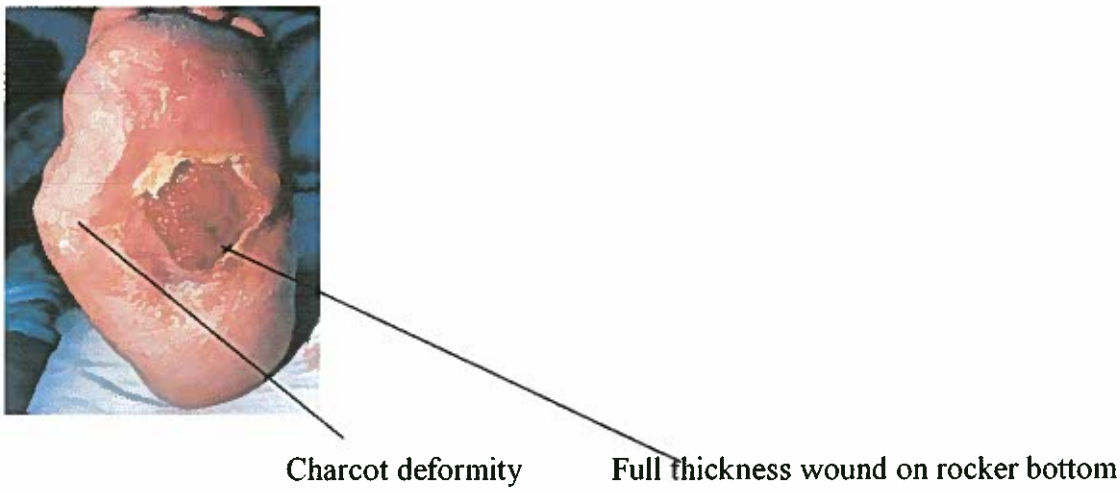


Figure 2-12
Severe deformity with rocker bottom and full thickness wound and Charcot deformity

Radiographs may be useful for detecting arthritic conditions, gout, early or mild Charcot, foreign body objects, and fractures. The Charcot deformity is easily visually much better assessed because it is a severely deformed joint.

Pain of the Lower Extremity

Pain has been defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or disease" (Garnett, 2005). Pain is considered subjective, and no confirmatory physical or laboratory examination can substantiate its presence or severity. With lower extremity diseases, deformities, and physical conditions, the way pain is defined and expressed cab facilitate diagnosis of the underlying etiology.

Pain assessment for lower extremity disease should include:

- Intensity – on a scale of 1 to 10 or using faces technique
- Time of day or night experienced
- Frequency
- Location
- Duration
- What exacerbates it?
- What relieves it?

LEAD Pain

Lower extremity arterial disease (LEAD) pain is typically sharp and shooting. It is usually present at night and or during exercise (claudication). Wounds from LEAD are painful to the touch, with treatment procedures, and are sensitive to skin and wound care product ingredients.

Neuropathic Pain

Neuropathic pain is often described in as burning, tingling, shooting, or electrical in nature. Neuropathic pain results from damage or pathologic changes to the nerves in the peripheral or central nervous system (Garnett, 2005). Up to 24% of patients with diabetic peripheral neuropathy have paresthesias, numbness, or pain. The incidence of diabetic neuropathic pain increases with age, duration of disease, and poor glycemic control

Pressure Pain

Pain due to pressure, shear, and friction is localized and relieved with off-weighting or pressure redistribution. The pain can be intense or dull and depends on the position of the wound or tissue injured area when lying, sitting or standing.

Chronic Venous Insufficiency Pain

Chronic venous insufficiency (CVI) pain has been reported as moderate-to-severe (Chase et al, 2000). People with CVI pain report an enormous impact on quality of life due to interference with activities of daily living. Clients described the discomfort as "aches all of the time". The interference with personal ability to be mobile, due to discomfort, was critically important for those experiencing the pain (Beitz & Goldberg, 2005).

Dermatologic Conditions

The condition of the skin of the lower extremity and foot is an important indicator of underlying conditions, such as poor circulation, sensory neuropathy, and or use of poor foot wear. The feet, web spaces, and legs can reveal findings suggestive of underlying conditions such as sensory, autonomic, and motor neuropathy, as well as lower extremity arterial disease. An assessment of lower extremity skin integrity involves:

- Assessing the skin for fissures, especially on the heels.
- Assessing for corns between the toes and callus build up on the great or fifth toe or plantar surface of the foot. Soft corns can occur between the toes causing pain and infection. Corns and calluses are caused by pressure on the skin of the foot, usually due to foot wear.
- Checking the plantar surface of the foot for warts. Plantar warts (verruca plantaris) are result of a papilloma virus. These warts do not erupt outward due to the pressure of weight bearing during standing or walking, so they grow inward.
- Checking the web spaces for maceration, lesions, redness, and tenderness.
- Assessing for tinea pedis (athlete's foot), a fungal infection on the feet or nails and xerosis (dry scaly skin) (Figures 2-11 and 2-12). Tinea pedis may present as dry scaly skin between the toes that if left untreated becomes red, moist, macerated, and painful.
- Assessing skin texture and hair distribution patterns. It is important to rule out other types of common conditions of the feet, such as hyperkeratosis of the heels, ringworm, lipodermatosclerosis, stasis dermatitis of the lower legs, contact dermatitis, psoriasis, or other skin diseases.

Tinea Pedis

Figure 2-11 Hyperkeratosis of heel and feet due to tinea pedis

Figure 2-12 Tinea pedis between toes may become macerated, weepy, and painful

Key Terms
Callus- build up of kerotinocytes usually at the plantar, medial, or lateral aspect of foot due to pressure, shear, and friction
Hyperkeratosis- hypertrophy of the horny layer (epidermis) of the skin
Lipodermatosclerosis- progressive hardening of the skin and subcutaneous tissue (fibrosis)
Onychodystrophy- dystrophic changes in the fingernail or toenails, such as malformation or discoloration
Onychogryposis- enlargement of the fingernails or toenails accompanied by increased thickening and curvature-rams horn
Onychomycosis- fungal infection of the fingernails or toenails that results in thickening, roughness, and splitting of the nails, usually due to Trichophyton rubrum also called tinea ungunium
Psoriasis- a noncontagious inflammatory skin disease characterized by recurring reddish patches covered by silvery scales
Ringworm- any of a number of contagious fungal skin diseases characterized by ring-shaped scaly itching patches on the skin
Stasis dermatitis- inflammation and scaling of the legs due to impaired venous circulation

Toenails and Cuticles

Toenails should remain relatively the same throughout old age, except for the normal age-specific changes, discussed in another section of this book. Old and new injuries may affect the shape, size, and rate of growth of the nail. A number of considerations guide assessment of the nails and cuticles including:

- Assessing the nails for brittleness, thickness, and color.
- Palpating for pain in or around the toenail.
- Evaluating for deformities. Toe nails may become onychodystrophic, onychogryphosis (thickened) and incurvated (see Figure 2-13).
- Assessing for underlying fungal infections (onychomycosis) that presents itself as a thickened, rough, discolored, and splitting nail that flakes off easily.
- Assessing for decreased circulation as described earlier.
- Assessing the cuticle for integrity, pain, redness, drainage, and any color change different from normal skin tone.

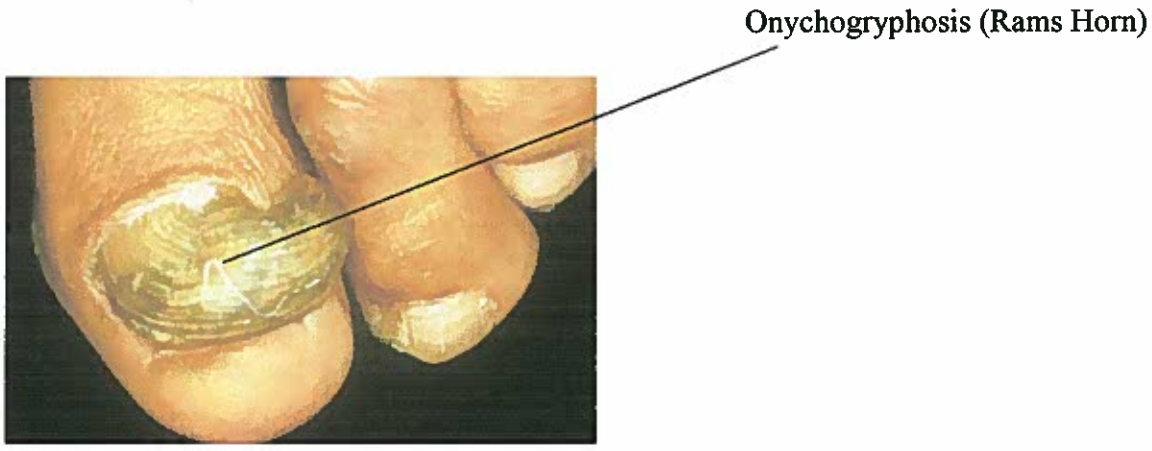


Figure 2-13 Onychogryphosis (Rams Horn Nail deformity) of great toe creating source of injury to 2nd toe

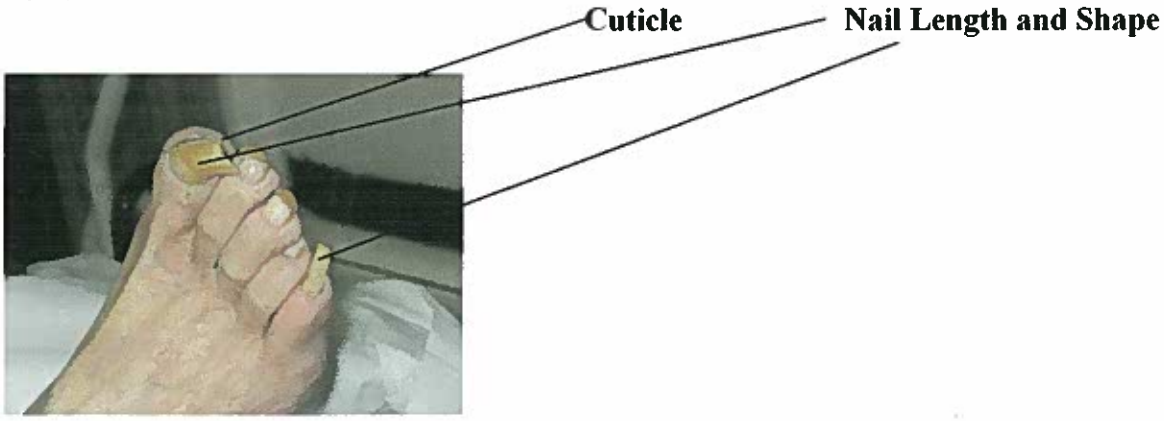


Figure 2-14 Note nail shape and length, cuticle, and pressure points.

Conclusion

A thorough physical assessment of the lower extremity promotes proactive foot and nail care. It also provides the clinician with opportunities to educate, refer, and make recommendations for intervention as indicated.

Foot wounds are now the most common diabetes-related complication and cause of hospitalization and are frequently a precursor to amputation (Lavery, 2006). Individuals with diabetes have a 30-fold higher lifetime risk of undergoing an amputation compared to those without diabetes. Sustaining a foot wound is the most important antecedent to an infection leading to a lower limb amputation.

A discussion of the risk, risk factors, and opportunities to educate, refer, and make recommendations for intervention will be continued in the next chapter. An understanding of evidence-based risk of injury for high-risk client populations allows for early intervention and prevention of injuries leading to amputation.

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