CHAPTER

15

Foot and Nail Care

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OBJECTIVES

1. Correlate medical conditions with potential foot problems.
2. Describe the structure and function of the foot and nails.
3. Compare and contrast foot malformations addressing key features, prevention, and management.
4. Describe common foot lesions, including their etiology, manifestations, treatment, and prevention.
5. Distinguish between two toenail disorders and their treatments.
6. Develop an appropriate plan for routine care of the foot.

Foot problems occur in at least 75% of Americans (Menz et al, 2001). The five most common problems in the elderly population are *toenail disorders* (75%), *toe deformities* (60%), *corns and calluses* (58%), *bunions* (37%), and *dry skin, fungal infections*, or *maceration between the toes* (36%). Most of these foot problems can be prevented by proper foot care performed on a regular basis (Badlissi et al, 2005).

Age-related changes (e.g., impaired vision, inability to reach feet, thinning of epidermis and dermis), vascular related skin changes (e.g., trophic, edema), and deformed hardened toenails impact on foot hygiene. An age-related change of the foot and lower extremity is loss of hair, which leads to increased dry skin. Trophic changes in the skin are related to loss of vasculature (e.g., pigmentation changes; shiny, red skin; hair loss).

Chronic foot problems (i.e., those lasting more than 2 weeks) are associated with diabetes, peripheral vascular disease, neuropathy, atherosclerosis, arthritis, and obesity. In fact, the signs and symptoms of many of these systemic disorders manifest initially in the feet. Improper shoe wear, overuse, or systemic disease can trigger chronic foot pain. These issues magnify the importance of a good foot assessment (Popovic and Jenkins, 2004).

QUALITY OF LIFE

Foot diseases and their treatments have a tremendous impact on quality of life (Katsambas et al, 2005). In fact, patients with diabetes who have foot ulcers report a poorer quality of life than patients with diabetes who have amputations (Price and Harding, 2006). In a large-scale, quality-of-life survey of 45,593 patients with various foot diseases representing 17 countries (the Achilles Project), the researchers found that 40.3% of the respondents experienced discomfort in walking, 30.7% had pain, 27.3% had embarrassment, and 19.6% experienced limitations in their activities of daily living (Katsambas et al, 2005).

Overall, foot disease has a significantly greater effect on the quality of life of women than of men with regard to their experience of pain, discomfort in walking, and embarrassment (Katsambas et al, 2005; Leveille et al, 1998). One explanation is that the many types of shoes typically worn by women are tighter-fitting, which increases their risk of developing toenail onychomycosis, which is associated with pain and discomfort in walking.

STRUCTURE AND FUNCTION

The foot has two key functions: weight bearing and propulsion. To perform properly, the foot requires a high degree of stability and must be flexible to adapt to uneven surfaces. Flexibility is provided by the numerous bones and joints in the foot; these bones also form the arch to support weight (Quinn, 2009). Each foot contains 26 bones, 33 joints, and a network of more than 100 tendons, muscles, ligaments, blood vessels, nerves, and nails. Together, the feet comprise a quarter of the 206 bones in the body. An average day of walking exerts a force equal to several hundred tons to bear on the feet. As such, feet are more subject to injury than is any other part of the body (Cavanagh and Ulbrecht, 2005; Mitz, 1999).

Skeletal Components

The three functional units of the foot are the hindfoot (2 bones), midfoot (5 bones), and forefoot (19 bones). All units must work together to provide both flexibility and stability (Figure 15-1).

Within the forefoot are the phalanges (toes) and the five metatarsal bones. Each toe (phalanx) is made up of several bones. The great toe (also called the hallux) consists of two phalanx bones: proximal and distal; these phalanges are larger than all the other phalanges. Phalanges two through five have three phalanx bones each: proximal, distal, and intermediate (an additional middle bone). Each phalanx is connected to a metatarsal at the metatarsophalangeal (MTP) joint; together the MTP joints form the ball of the foot. The proximal portion of a metatarsal is called the *base*, the middle is the *shaft*, and the distal is the *head* (Figure 15-2). Each of the five metatarsals is unique in size. The first metatarsal is the shortest in length, the largest in diameter, bears the most weight and plays the most important role in propulsion (Quinn, 2009). At the head of the first metatarsal bone on the plantar surface of the foot are two sesamoid bones that serve to attach small muscles and aid in stabilizing the first MTP joint. (A sesamoid bone is a bone imbedded within a tendon and functions to protect the tendon where it passes over a bony prominence.) The second, third, and fourth metatarsal bones are the most stable metatarsal bones. At the fifth metatarsal base is an eminence on the lateral aspect called the *tuberosity of fifth metatarsal* or *styloid process*. This area is easily palpated on the lateral aspect of the foot.

In the midfoot, five of the seven tarsal bones are located (Figure 15-2). These irregularly shaped tarsals (the navicular, cuboid, and three cuneiform) form the arch and contain multiple joints. The three cuneiform bones articulate with the navicular bone in the proximal midfoot. The midfoot connects with the forefoot at the five tarsometatarsal (TMT) joints and connects to the hindfoot by muscles and ligaments.

The hindfoot links the midfoot to the ankle and consists of two of the seven tarsal bones, the talus and the calcaneus. The talus sits on top of the calcaneus and articulates with the tibia and fibula at the calcaneus and navicular bones, allowing the foot to move up and down. The calcaneus forms the heel and is the largest tarsal and the largest bone in the foot. It allows the foot to become rigid or loose to accommodate the process of walking. It is also the cause of numerous heel-related pains (Jolly et al, 2005).

Ligaments hold the bones together at the joints. The Achilles tendon stretches from calf muscle to heel and is the largest, strongest tendon in the foot. The planter fascia is the longest ligament and forms an arch on the sole of the foot from the heel to the toes. These long fibrous strands are vulnerable to injury (e.g., a strain or sprain in the foot or ankle) because the ligaments can overstretch, break, and curl back on themselves. Over time the strain heals with scar tissue; however, the scar is never as strong as the original fibers of the ligament.

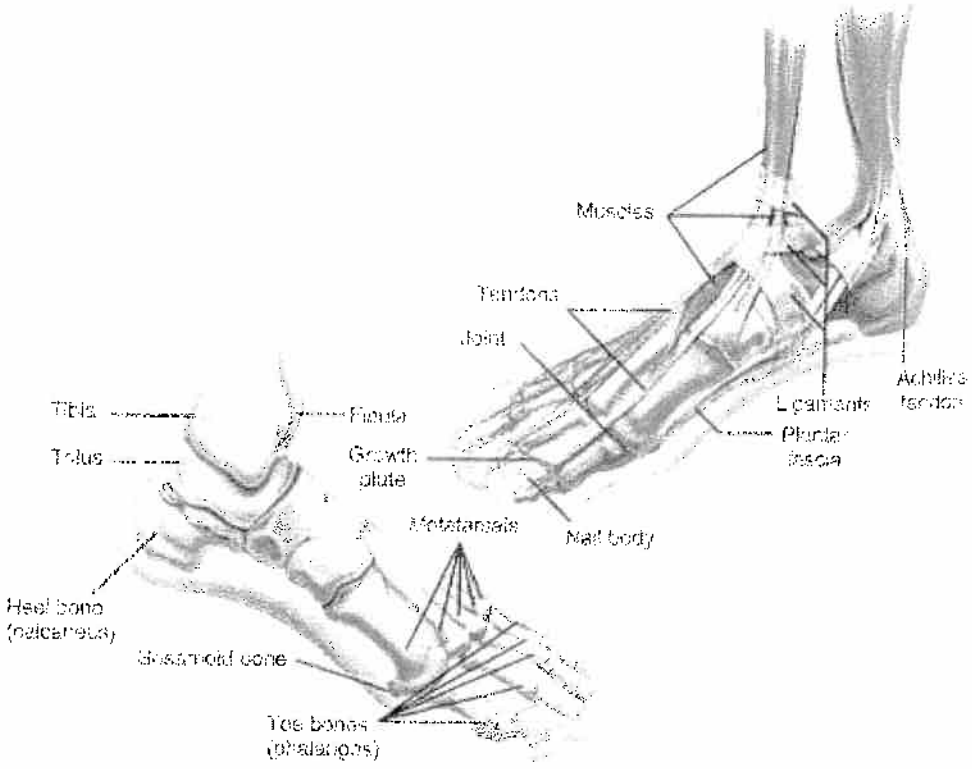


FIGURE 15-1 Anatomic structures of the foot. (Courtesy Ken Wirth Orthopaedics.)

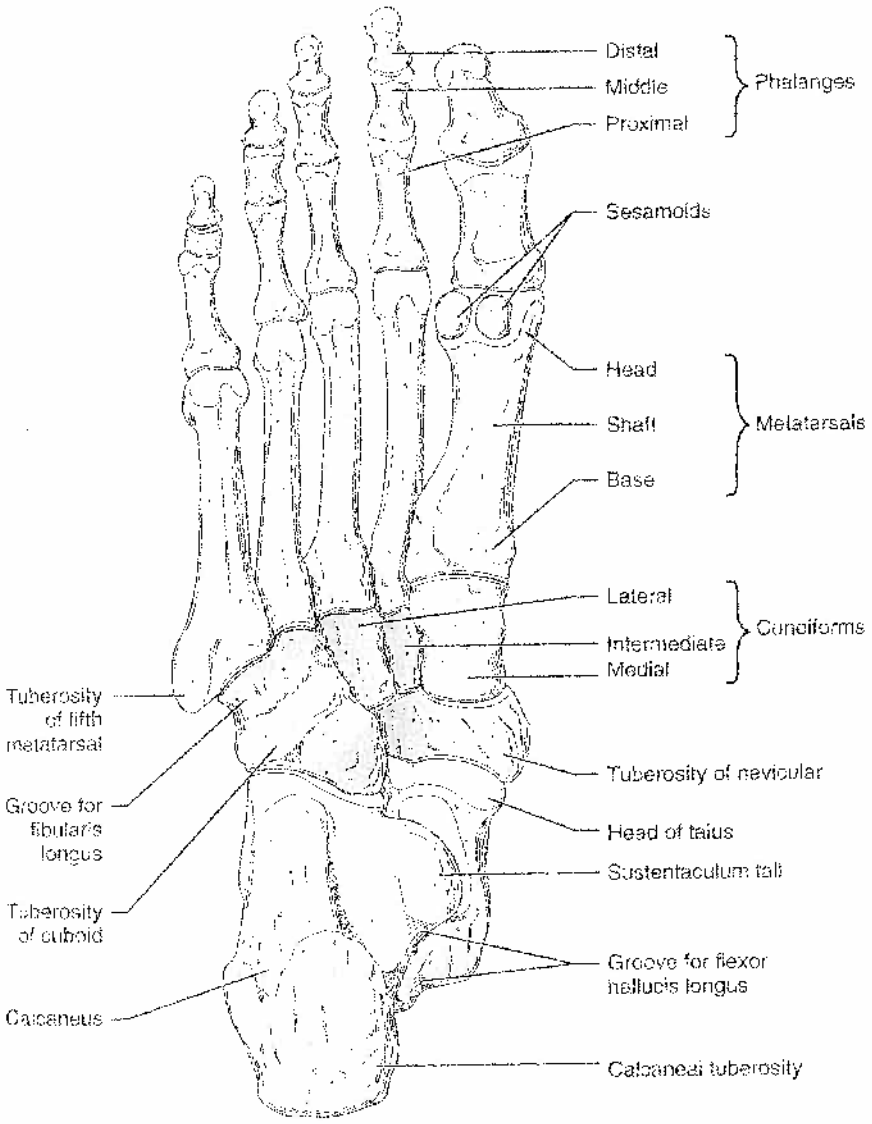


FIGURE 15-2 Dorsal view of anatomic structures of foot. (From Jenkins DB: *Hollinshead's functional anatomy of the limbs and back*, ed 9, St. Louis, 2009 Saunders/Elsevier, p 333.)

Muscular Components

The foot is constructed of 20 muscles. These muscles hold the bones in place, providing the foot with its shape and contracting and relaxing to allow for movement. Key muscles are the anterior tibial (moves foot upward), posterior tibial (supports arch), peroneal tibial (controls lateral ankle movements), extensors (help ankle raise toes to begin walking), and flexors (stabilizes to the ground).

Neurovascular

The feet are innervated by the sciatic nerve, which branches off the spinal cord at the sacral level. As it descends, the sciatic nerve divides into the tibial and common peroneal nerves and further subdivides into numerous branches.

Branching off the popliteal artery in the lower leg are the anterior tibial artery and the posterior tibial artery. The anterior tibial artery becomes the dorsalis pedis (dorsum of the foot). The posterior tibial artery passes posterior to the medial malleolus, divides into the peroneal and plantar arteries, and then feeds into the lateral plantar and medial plantar arteries. The two most dominant arteries in the foot are the dorsalis pedis and the posterior tibial artery. Two sets of veins drain the leg and foot: deep veins and superficial veins.

As shown in Figure 10-2, the dorsalis pedis pulse is palpated or auscultated over the navicular and middle cuneiform bones. The posterior tibial pulse is palpated over the medial malleolus of the tibia.

Cutaneous and Subcutaneous Components

The skin on the plantar surface of the foot is thick and hairless and contains numerous sweat glands. Eccrine sweat glands are densely populated on the soles of the feet, palms, and axillae. Their primary function is

thermoregulation through evaporation of sweat. The sebaceous and apocrine sweat glands empty into the upper portions of the hair follicles. Sebaceous glands produce lipid-rich sebum that prevents the skin and hair from drying out. Because the foot has little hair growth and therefore very few *sebaceous* glands, the foot is extremely vulnerable to dryness and xerosis.

Three anatomic areas on the plantar surface of the foot have increased fat in the form of fat pads: the calcaneus, the metatarsals, and the lateral longitudinal arch. Contained by the subcutaneous tissue, the fat pad absorbs impact and tolerates weight-bearing as a means of protecting the underlying bones. With age, these fat pads thin and provide less shock absorbency. More pressure is then exerted over the calcaneus and metatarsal. Thinning of the fat pad is accelerated by obesity, diabetes, and constant high impact. The thinning process begins as early as 30 years of age. An orthotic or insole cushioning can be used to provide additional shock absorption (Ozdemir et al, 2004).

Nail Structure

Nails are made of epidermal cells converted to hard plates of keratin. The highly vascular nail bed lies beneath the plate, giving the nail its pink color. The stratum corneum layer of the skin covering the nail root is the eponychium (cuticle), which forms a seal between the nail and the digit to prevent foreign matter from entering. The paronychia is the soft tissue surrounding the nail border. The normal nail is composed of six parts: nail root, nail bed, nail plate, eponychium (cuticle), perionychium, and hyponychium as illustrated in Figure 15-3 and described in Box 15-1.

Nails grow all the time, but their rate of growth slows with age and poor circulation. Fingernails grow faster than toenails. They grow at a rate of 3 mm per month and take 6 months to grow from root to free edge. Toenails grow approximately 1 mm per month and require 12 to 18 months to be completely replaced. Actual growth rate is dependent upon age, gender, season, exercise level, diet, and hereditary factors (Sinni-McKeehen, 2007).

PHYSICAL ASSESSMENT

Components of an initial evaluation of the patient with an actual or potential foot disorder are listed in Checklist 15-1. Because so many patients with foot disorders have concomitant lower extremity disease, perfusion and sensation must be assessed (see Chapters 10, 11, 12, and 14), and a baseline health history is essential. The following discussion presents the unique assessment parameters for the foot and nail.

Specific information should be elicited about routine care of the foot, any history of foot and nail problems, and how these problems were treated either personally or by a health care provider. Effects of prior treatments, including prescription and over-the-counter medications, should be assessed (Piraccini, 2004; Sprecher, 2005). Quality-of-life-information should be solicited (Garrow et al, 2004; Vileikyte et al, 2003).

Musculoskeletal Function

Musculoskeletal function of the foot involves assessment of range of motion, deformities, and strength. Passive range of motion of the first MTP joint and the subtalar joint should be assessed. Maximal range of motion is

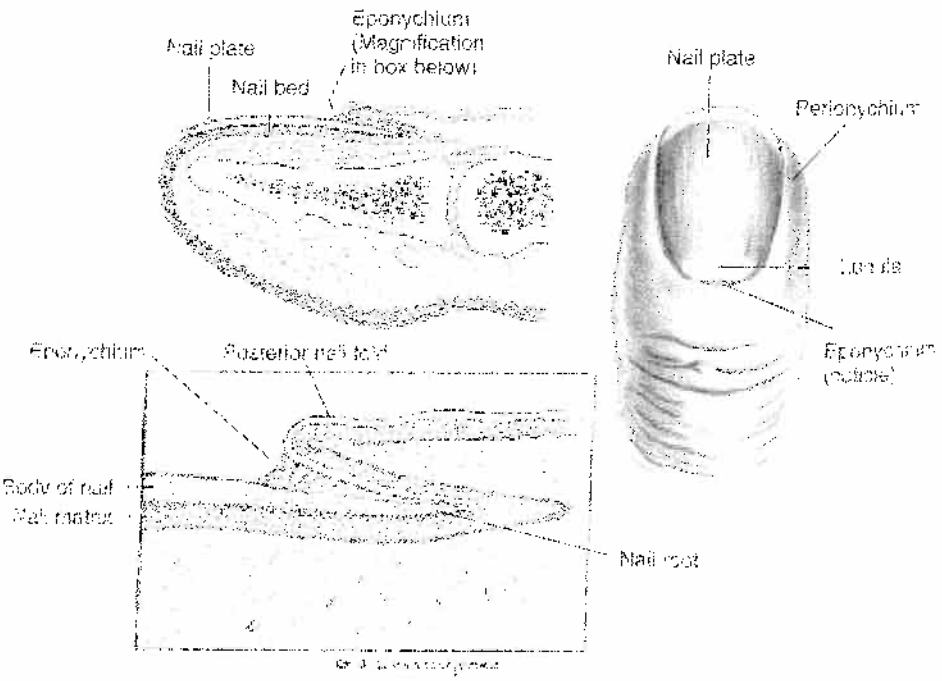


FIGURE 15-3 Anatomic structures of the nail. (From Thompson JM et al: *Mosby's Clinical Nursing*, ed 5, St Louis, 2002, Mosby.)

BOX 15-1 Nail Anatomy

Nail Root (Matrix): Root of fingernail is also known as the *matrix*. The matrix begins 7 to 8 mm under proximal nail fold to lunula (white crescent at distal nail). Fingernail root produces most of volume of nail plate and nail bed.

Nail Bed: Part of nail matrix, under the nail plate. Extends from lunula (white crescent at distal nail) to hyponychium. Nail bed contains blood vessels, nerves, and melanocytes or melanin-producing cells. As nail is produced by root, it streams down along the nail bed, which adds material to the undersurface of the nail, making it thicker.

Nail Plate: The actual fingernail, made of translucent keratin. Pink appearance of nail comes from blood vessels underneath nail. Underneath surface of nail plate has grooves along length of nail that help anchor it to the nail bed.

Eponychium (Cuticle): Fold at proximal end of nail plate. Nail plate has very firm adhesion to the cuticle. Both epidermal structures are directly continuous with one another, overlapping the lunula. Fusing of these structures provides a waterproof barrier.

Perionychium: Skin that overlies nail plate on its sides. Also known as the *paronychial edge*. Site of hangnails, ingrown nails, and infection of skin called *paronychia*.

Hyponychium: Area between free edge of nail plate and epidermis of toe. Continuous fusing of these areas to epidermal structures provides waterproof barrier.

Periungual: Tissue around nail plate.

Subungual: Tissue under nail plate.

Ungual: Pertaining to the nail.

From Mix G: *The salon professional's guide to foot care*, Albany, NY, 1998, Milady Salon Ovations.

CHECKLIST 15-1

Components of Initial Evaluation of Patient with Foot Disorder

History

- ✓ Presenting complaint including detailed description of pain
- ✓ General: vision, strength, dexterity, mobility
- ✓ Blood glucose readings for past month
- ✓ Personal or family history: skin, hair, or nail disease (especially rashes), lichen planus, psoriasis, diabetes, heart or vascular disease, obesity
- ✓ Specific history of foot problems: foot malformations, lesions, skin alterations, nail disorders, changes in sensation, foot/ankle strength
- ✓ Current and prior treatments and medications (including over-the-counter) used to treat nail and foot problems
- ✓ Health habits: smoking, exercise, hygiene, nutrition, weight management

Physical Assessment

- ✓ Overall skin condition
- ✓ Lesions on foot
- ✓ Foot malformations
- ✓ Condition of nails
- ✓ Perfusion and sensation; pulses, blanching, capillary refill, microvascular function (laser Doppler flowmetry), ankle-brachial index or toe-brachial index, temperature, hair growth
- ✓ Musculoskeletal function: gait, mobility, balance, hand strength and dexterity, visual cognition

Risk Assessment

- ✓ Ulceration risk
- ✓ Amputation risk

Equipment

- ✓ Footwear (including socks)
- ✓ Mobility aids (canes, walkers)

determined from maximal inversion to maximal eversion of the subtalar joint of the foot (Figure 15-4). If available, a goniometer can be used to quantify the arc or range of motion (Badlissi et al, 2005) (Figure 15-5). Range of motion can also be tested by supporting the heel with the hand and grasping the foot with the other hand, then moving the foot in dorsiflexion, plantar flexion, eversion, and inversion. The dorsiflexion position tests for shortening of the Achilles tendon. Inversion will be limited by a spasm of the peroneal. Eversion will be limited with a rigid flat foot. Restrictions in range of motion of the ankle might limit the ability to correct a loss of balance (Dorhus, 2007).

The strength of the anterior leg muscles can be tested by having the patient stand on the heels. Muscle strength can also be assessed by comparing both feet as the patient walks a few steps on the toes and then the heels. If the patient has difficulty with balance, cannot walk, or both, strength can be assessed with the patient sitting. With the clinician's hand under the patient's foot, the patient is asked to flex and extend the foot against resistance by "pressing down on the gas pedal." Next, with the clinician's hand positioned on the top of the patient's foot and the clinician's thumbs underneath, the patient is instructed to pull the "toes toward the nose" while the clinician applies gentle pressure downward. Any differences in strength currently or in the past 6 months should also be recorded (Frey, 2005).

To assess toe flexibility, the patient can be instructed to pick up a marble or a small dishtowel with the toes (Table 15-1). To test ankle flexibility, the patient is instructed to stand on a stair step, hang his or her heel off a step, and let the heel drop below the level of the stair. If this motion causes pain, the exercise should be stopped. The heel should be able to drop below the level of the stair without causing strain in the calf. Some strain can be improved with flexibility exercises (Frey, 2005).

To examine the medial longitudinal arch, have the patient stand with feet parallel, separated by 4 inches. Note if the arch flattens with weight-bearing and if it resumes to normal shape without weight bearing.

Muscle strength, reflexes (deep tendon reflexes) usually show no changes in the elderly patient, although nearly half have a diminished Achilles tendon reflex. This is likely due to slow nerve conduction and

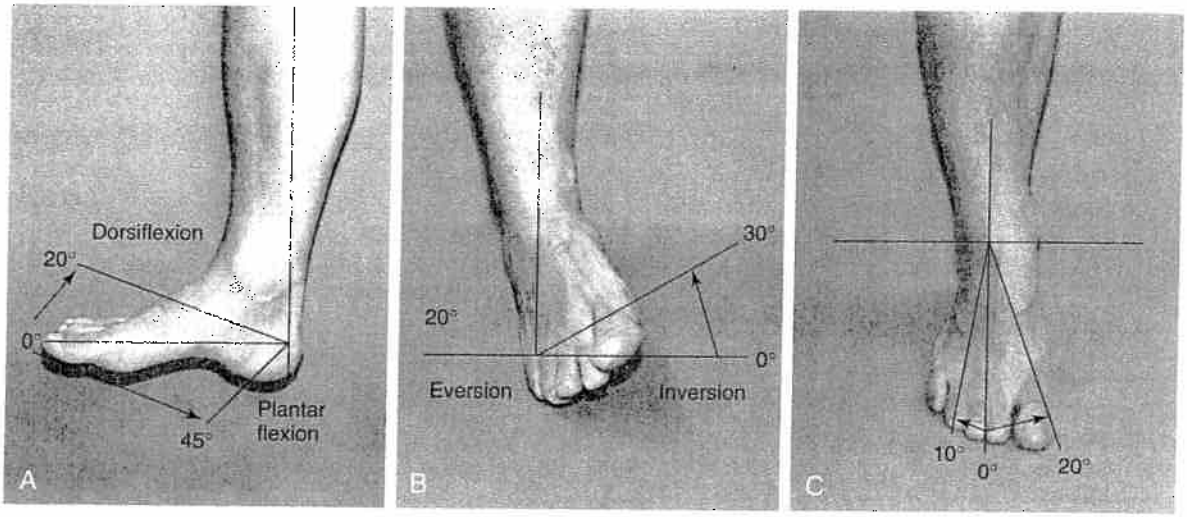


FIGURE 15-4 Range of motion of the foot and ankle. (From Seidel HM et al: *Mosby's guide to physical examination*, ed 6, St. Louis, 2006, Mosby.)

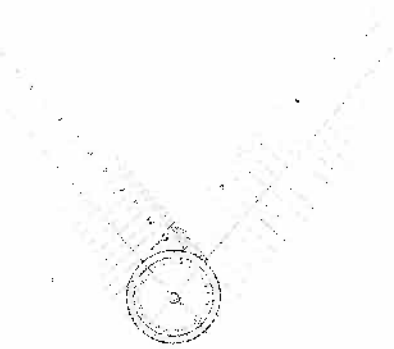


FIGURE 15-5 Goniometer.

decreased tendon elasticity. Hyperactive deep tendon reflexes suggest upper motor neuron disease; hypoactive reflexes suggest lower motor neuron dysfunction. Tone is assessed through passive motion. Increased tone is suggestive of upper motor neuron dysfunction; decreased tone is suggestive of lower motor neuron dysfunction.

Functional Ability

The patient's functional ability is a significant factor influencing his or her ability for self-care and safety. Assessments of functional ability should address cognition, vision, strength–hand dexterity, coordination, balance, proprioception, and gait. Because key interventions in the prevention and management of foot and nail disorders are patient education and self-care, the patient will need adequate cognition to conduct self-care or communicate pain. Vision and strength–hand dexterity are essential so that patients will be able to inspect their feet and remove footwear (Duthie, 2007). Many of these functional abilities can be assessed through observation and demonstration return.

Coordination can be determined with a rapid alternating movement that includes heel to shin testing. Another test in which the patient taps the feet rhythmically against the floor will assess the accuracy and reproducibility of endpoints as well as the ability to maintain motor movements over time. The coordination testing is documented qualitatively because no quantification guidelines are available (Duthie, 2007).

Proprioception is the awareness of the body's position in context with the surrounding environment. Disturbed proprioception (loss of position sense) in the feet is disabling; the patient may be clumsy, bump into things, or have an abnormal gait. In practice, the patient often comes down hard on the heels and then slaps the sole of the foot (high stepping and stamping) in an attempt to increase sensory feedback and restore proprioception. Proprioception disturbances are always worse in the dark when vision cannot be used to compensate for loss of position sense.

The Romberg test (Box 15-3) is positive in the patient with proprioception disturbances (Jarvis, 2004). In addition, the patient's gait may be slightly wide while the stride length is normal or a little reduced (Wallace, 2008). Gait should be assessed without an assistive device if possible so as not to mask deviations. Proprioception and vibration sense are carried by the same nerve pathways. Therefore, testing vibration may reveal proprioception disturbances. To test vibration sense, a 128-Hz tuning fork is applied over a bony prominence such as the medial malleolus and the

TABLE 15-1 Foot Flexibility Exercises

	Exercise	Instructions	Recommendations
	Toe raise, toe point, toe curls	Hold each position for 5 seconds and repeat 10 times.	Individuals with hammer toes or toe cramps
	Golf ball roll	Roll a golf ball under the ball of your foot for 2 minutes—great massage for bottom of foot.	Individuals with plantar fasciitis (heel pain), arch strain, or foot cramps
	Towel curls	Place small towel on floor and curl it toward you, using only your toes. You can increase resistance by putting a weight on end of towel. Relax and repeat exercise five times.	Individuals with hammer toes, toe cramps, and pain in the ball of the foot
	Marble pickup	Place 20 marbles on floor. Pick up one marble at a time with your toes and put it in a small bowl. Do this exercise until you have picked up all 20 marbles.	Individuals with pain in the ball of the foot, hammer toes, and toe cramps
	Sand walking	Any chance you get, take off your shoes and walk in the sand at the beach. This not only massages your feet but also strengthens your toes.	Good for general foot conditioning Watch out for glass!

Modified from American Orthopaedic Foot and Ankle Society: *Keep your foot flexible*, available at http://www.aofas.org/Scripts/4Disapi.dll/4DCGI/cms/review.html?Action=CMS_Document&DocID=71, accessed September 2, 2010.

BOX 15-2 Romberg (Equilibrium) Test

- Have patient stand with arms at side and feet together.
- Have patient maintain position for 20 seconds with only minimal swaying.
- Have patient perform initially with eyes open and then with eyes closed.
- Stand close to patient to prevent falls.

patient is asked to report when the vibration stops (Jarvis, 2004).

Condition of Legs, Feet, Toes, and Nails

Lower extremity assessment should include all of the components discussed in Chapter 10. In addition to examining skin integrity, color changes, sensation, pain, and vascular conditions, the foot must be inspected for skin that is too dry or too moist, evidence of fungal or bacterial infection, lesions, foot malformations, and nail conditions (Boulton and Armstrong, 2008). All surfaces (dorsal, plantar, medial, lateral, posterior surfaces) of the feet, areas between the toes (interdigitally), and each nail should be examined. Note the character of skin changes from the proximal leg to the distal foot. Compare the skin on the lower extremity and feet to the skin on the arms and hands.

Ulceration and Amputation Risk

The data collected during the examination will assist in identifying risk for ulceration and amputation. Risk assessment tools with management strategies are given in Tables 14-2 and 14-3. Risk factors include history of plantar ulcer, presence of foot deformity, presence of protective sensations, and presence of diseases that lead to decreased sensation. Risk categories range from 0 (no risk) to 3 (greatest risk). The level of risk determines the patient's management strategy. Yerzer (2004) recommends foot examinations at each visit (at least four times per year) regardless of risk score.

PREVENTION AND ROUTINE MANAGEMENT

Maintaining healthy nails and feet requires daily attention to the skin of the feet and ankle, nails and footwear. Routine over the counter remedies can be used to correct common problems and hopefully prevent deterioration into a serious condition.

Routine Foot Hygiene

Routine foot care includes daily inspection and moisturizing. Cleansing and bathing should be based on the individual needs of the patient and should consist of mild skin cleansers and lukewarm water to minimize drying effects.

After bathing, the feet must be dried completely, especially between the toes. Patients should wear socks to provide extra padding to bony prominences and to wick away moisture from the skin. Socks may need to be changed more than once per day if feet sweat excessively.

Maceration between the toes (interdigital) and under the toes (subdigital) is a very common foot problem. Such overhydration of the skin, characterized by a white, "waterlogged" appearance, weakens collagen, promotes overgrowth of bacterial and fungal species of skin flora, and decreases the skin's ability to resist trauma (Kelechi, 2005; Stroud and Kelechi, 2006). Pseudomonads as well as gram-negative organisms are common etiologic agents (Schwartz, 2009). Overhydration of the skin can occur with excessive perspiration (hyperhidrosis) related to endocrine, neurologic, or sweat gland disorders.

Maceration is prevented by keeping the skin dry and protected. Absorbent foot powder (e.g., Zeasorb) can be used twice per day. After bathing, the patient should pay special attention to drying the interdigit spaces; using a hair dryer on a cool setting may be helpful. Skin sealants may be used to protect the skin from moisture. If maceration persists after 1 week of care, consider the presence of interdigital tinea (Table 15-2) or superimposed bacterial infection. Treatment includes drying the interdigital web spaces, topical econazole, and daily to three times a day local application of Castellani paint (a drying agent containing 1.5% phenol in a water and alcohol base) (Schwartz, 2009).

Foot odor is caused by excessive perspiration from the more than 250,000 sweat glands in the foot. Bacteria living in shoes and socks metabolize the sweat to form isovaleric acid, which is responsible for foot odor. In addition to washing the feet and changing shoes and socks even more frequently than daily, the patient can dust the feet with a nonmedicated spray, foot powder, or antiperspirants. Soaking feet in vinegar and water can help lessen odor (American Podiatric Medical Association, 2010). Severe cases of foot odor may be caused by hyperhidrosis (excessive perspiration formation related to endocrine, neurologic, or sweat gland disorders). The prescription-strength antiperspirant Drysol can be used if over-the-counter antiperspirants or sprays fail (Hill, 2010). In severe cases the nerve controlling the sweat glands in the feet may be surgically severed, but compensatory sweating in other areas of the body may occur after surgery.

Anhidrosis (inability to produce sweat) is associated with autonomic dysfunction caused by endocrine or neurologic disorders, environmental conditions, and aging. Xerosis is a consequence of the skin's loss of natural moisturizing factors and loss of moisture from the stratum corneum and intercellular matrix (Hill, 2008). Clinically, xerosis appears as excessively dry, rough, uneven, and cracked skin. Raised or uplifted skin edges (scaling), desquamation (flaking), chapping, and pruritus may be present. This condition occurs particularly on the heels and bottoms of the feet. A person who has a decrease or loss of function of the sweat glands on the plantar surface of the foot will experience xerosis or anhidrosis of the feet (Kelechi, 2005). *Xerosis* can lead to fissures (linear cracks in the skin), which may serve as a portal of entry for bacteria. Consequently, fissures are associated with increased risk of cellulitis and foot ulceration (Hill, 2008). *Fissures* are treated with humectants and exfoliant moisturizers or sealants, such as Dermabond. Prevention includes ongoing use of moisturizers and exfoliants and wearing of shoes that do not flop at the heel. Hyperkeratotic tissue is common around fissures and often necessitates debridement and exfoliation. Table 15-3 provides a formulary of products for the prevention and treatment of dry skin.

Cuticles and Nails

About half of the foot care professional's activity is nail care and specifically nail debridement. Nail debridement and trimming can be accomplished with manual nippers (Box 15-3) or with a mechanical rotary tool (Box 15-4). The use of proper and professional-quality instruments is key to providing proper foot and nail care. Five basic instruments are recommended for providing foot and nail care: toenail nippers, curette, rasp, ingrown nail shaver, and cuticle nippers.

Nippers. Podiatry toenail cutters or pedicure nail nippers are best suited for trimming thicker toenails and lateral curves of the nail. This instrument should be used like scissors. The nail should be removed incrementally to avoid injuring the hyponychium and thus breaking the seal on the nail plate, which would open a portal of entry for fungal or bacterial infections (Godfrey, 2006). There is much debate regarding the best methods for debriding or trimming toenails: straight across versus rounding, or following the shape or contouring of the top of the toe. If the patient has a problem with nail corners curving and causing pain and thickening of the skin at the distal aspect of the nail groove, it is recommended that the corners be slightly rounded. Patients who have puffy or thick skin folds might require nails that are cut straight across so that the corners grow up out of the grooves to prevent ingrown toenails (Karoh, 2008). Box 15-3 gives a procedure for basic cuticle and nail trimming using a nipper.

Curette. The dull-edged curette is a small spoon-shaped instrument that allows for removal of debris under the nail margins. A scooping motion is used along the nail plate to remove debris from the nail groove. This process may need to be repeated until all the debris is removed.

Nail Rasp or Nail File. The medical field calls the nail file a nail rasp. It is used to smooth the distal edges of the nail in the nail groove. The file is placed gently in the nail groove against the free (distal) edges of the nail plate. The rasp is then pulled along the edges of the rough nail plate. Each nail should be smoothed with the nail rasp.

TABLE 15-2 Assessment, Prevention, and Management of Common Foot Lesions and Infections

Name	Description	Common Locations	Prevention	Treatment
Soft corn (heloma molle)	End of phalange is too wide, causing friction between toes Aggravated by tight shoes	Between fourth and fifth toes	Properly fitting shoes	Wider shoes Surgically reshape phalange
Hard corn (heloma durum)	Toes curl inside of shoes, creating pressure between toes against the sole Aggravated by narrow-toed shoes	Sides and tops of toes		Use wider shoes or sandals Reduce corn with file, pumice, rotary tool Assess for underlying ulceration Offload and pad as needed Surgically straighten toes
Callus (keratoma or tyloma) (see Plate 41a)	Thickened areas of skin without distinct borders caused by repeated pressure Aggravated by narrow-toed shoes and high heels	Planter surface, heel, under metatarsal head	Properly fitting shoes	Reduce with file, pumice, rotary tool Assess for underlying ulceration Moisturize and exfoliate (best applied to damp skin after bathing) Offload and pad as needed Use shoes with soft soles, lower heels, arch support, extra width
Planter wart (verruca plantaris)	Caused by a contagious viral infection (human papillomavirus) Overproliferation of skin and mucosa growing downward (iceberg effect) Single lesion or clustered Yellow, brown, gray, or black Vesicular inclusion from dried capillary ends leads to black/red appearance	Pressure points on sole, heel, ball of foot	Change socks and shoes daily Do not share shoes Keep feet clean and dry Avoid direct contact with warts on other people Use water-resistant footwear in showers, locker rooms, pools	Reduce with file or pumice Salicylic acid or cryotherapy Surgical curettage or laser removal Human papillomavirus dies within 1–2 years and wart disappears
Tinea pedis (interdigital)	Dermatophyte infection White macerated, denuded, vesicles, scales, or fissures	Between fourth and fifth toes		Topical antifungal twice daily for minimum of 1 week Urea cream for scaling, itching
Tinea pedis (planter)	Dermatophyte infection Itchy, hyperkeratotic scaling, cracking, peeling, dry patches Chronic, diffuse, noninflammatory	Sole, heel, side of foot (moccasin)		Topical antifungal twice daily for minimum of 1 week Urea cream for scaling, itching
Tinea pedis (vesiculobullous)	Dermatophyte infection Acute highly inflammatory eruptions	Arch, side of foot		Topical or systemic antifungals and corticosteroids (depending on severity)

beginning with healthy nails to prevent transmission of infection.

Ingrown Nail Shaver and Cuticle Nippers. These tools are used when a little more nail needs to be removed from the lateral nail margins. The nail shaver is shaped like a small paddle and has a slot in the middle of the paddle; the end of the slot is filed to a sharp cutting edge. The paddle portion of the nail shaver is placed in the nail groove so that the end of the nail edge is in the slot to trim the spicule of nail present (Mix, 1999).

Mechanical Rotary Tool. The mechanical rotary tool (Dremel drill, cordless or plug-in) is a standard tool used

TABLE 15-3 Formulary of Moisturizing Products: Descriptions, Examples, and Indications

Moisturizer	Indications and Actions	Ingredient Examples*	Product Examples*
Emollients	Prevent dry skin Fill in cracks between clusters of desquamating corneocytes Not occlusive unless applied heavily	Lipids Oils Dimethicone	Keri Original (Bristol Myers Squibb) Cavilon Emollient Cream (3M) Cetaphil Lotion (Galderma Laboratories)
Occlusives	Treat dry skin Reduce transepidermal water loss by creating hydrophobic barrier over skin Has most pronounced effect when applied to slightly damp skin	Petrolatum Lanolin Mineral oil Dimethicone	Cetaphil Cream (Galderma Laboratories) Remedy Skin Repair Cream (Medline) Sween 24 Cream (Coloplast)
Humectants and exfoliants	Treat dry skin, xerosis, fissures, ichthyoses Contains urea, lactic acid, or both, which are naturally present in healthy skin and markedly reduced in dry skin Enhance water absorption by drawing and absorbing water from environment and retaining moisture within skin cells Keratolytic effects soften scales to be easily released from skin surface Urea has antipruritic effects	Urea Lactic acid	Eucerin 10% Urea Lotion (Beiersdorf) Lac-Hydrin Lotion (Bristol Myers Squibb) Atrac-Tain Lotion (Coloplast)

*Concentrations and total formulation determine actions and effectiveness. List is not all inclusive.
Data from Pham HT et al: A prospective, randomized, controlled double-blind study of a moisturizer for xerosis of the feet in patients with diabetes, *Ostomy Wound Manage* 48(5):30, 2002; *Ostomy/Wound Management (OWM) 2009 Buyers' Guide*, 55(7) Malvern, PA, 2009, HMP Communications. Loden M: Role of topical emollients and moisturizers in the treatment of dry skin barrier disorders, *Am J Clin Dermatol* 4:771, 2003.

for nail debridement. Use of a rotary tool disperses nail dust into the air, which can be inhaled by the patient as well as the clinician and can settle on surfaces throughout the room. Aerosol nail dust, particularly from onychomycotic toenails, can lead to conjunctivitis, rhinitis, asthma, coughing, hypersensitivity, and impaired lung function (Ward, 2005). These hazards have resulted in a great deal of controversy within the nursing community about the appropriateness of using drill types of mechanical nail avulsion and debridement tools (Rees, 2008). Box 15-4 lists equipment options and sterilization tips that enhance safety and effectiveness. For example, a drill with an attached vacuum is available that will automatically contain large particles. However, personal protection equipment is still required to prevent exposure to small particles.

Footwear

The main purpose of the shoe is to protect and cushion the foot. Incorrectly fitting footwear is common in older people and is strongly associated with forefoot pathology (hallux valgus, lesser toe deformities, corns, calluses), foot pain, skin breakdown, abnormal foot pressures, ischemia, and inflammation from repetitive stress (Menz and Morris, 2005; Ward, 2005). Although foot size increases with age, surprisingly, many people continue to wear the same size shoe throughout their lifespan. As a result, the foot will take on the shape of the shoe regardless of the fit. A proper shoe fit requires appropriate length and width measurements as well as an assessment of the person's style of arch. Box 15-5 provides several considerations for selecting and maintaining appropriate footwear.

Any patient with foot or ankle problems should have their shoes evaluated. Assessment parameters include wear pattern, a tracing of the weight-bearing foot, footprints, and use of heels, arch supports, and heel cushions. Normal wear patterns occur on the outsole and slightly medial at the great toe and lateral calcaneus. Different wear patterns may be indicative of underlying foot problems or problems with alignment and gait as illustrated in Figure 15-6. For example, wear on the ball of the foot may indicate that the heel tendon is tight, in which case heel-raising exercises can be recommended to release this tendon. Toe-shaped ridges on the upper toe box may indicate that the shoes are too small or that hammer toes are developing. A bulge and wear on the side of the great toe may indicate that the shoe is too narrow or that a bunion is present. Finally, unusual wear on the upper toe box generally indicates that the front of the shoe is too low (Ward, 2005).

A tracing of the weight-bearing foot is useful in assessing the fit of the shoe in terms of length and width. The foot tracing is compared to the current shoe to objectively reveal the flaw in the fitting, whether the foot is wider or longer than the shoe (see Figure 14-4). For example, toe box width plays an enormous role in the development of bunions, toe deformities, and corns. This type of foot tracing will also reveal the source of

BOX 15-3 Basic Cuticle and Nail Trimming Using Toenail Nippers

1. Begin cuticle and nail care after bathing when nails are softer.
2. Examine nails.
   A. Observe for presence of hyponychium that has hypertrophied, hypergranulation tissue, ingrowing corners of nail borders, hyperkeratosis, or other abnormal findings. Patients with very thick or ingrown nails require referral to foot care professional.
   B. Define the free nail border by assessing the tissue underneath the nail, using beveled edge of orangewood stick.
   C. Unhealthy nails should be trimmed last to prevent the transmission of infection.
3. Remove any loose debris from under the nail.
4. Gently trim excessively thick or loose cuticles.
   A. Avoid excess manipulation of the cuticle, which may lead to infection.
5. Decide between slightly rounded cut and straight across cut:
   A. *Straight across* (not too short) for puffy or thick skin folds prone to ingrown toenails
   B. *Slightly rounded* for problems with nail corners curving and causing pain and thickening of skin at distal aspect of nail groove
6. Remove free edge of nail.
   A. Do not trim nail off in one clip; make small cuts.
   B. Begin at one edge of nail, nip smoothly working across entire nail border no lower than 1/16 to 1/8 inch from end of toe (lateral plate should extend beyond nail fold).
   C. Do not cut deeply into lateral corners of nail bed.
   D. Avoid cutting skin; openings in skin are avenues of entry for bacteria and other infectious agents.
7. Use fine point of nipper to trim out sharp edge of lateral aspect of nail that curves deeply in nail margin.
8. Smooth nail with emery board.

BOX 15-4 Nail Debridement Using Mechanical Rotary Tool

1. Before using a Dremel drill, patients should be informed that they will feel a vibration while the nail is being debrided.
2. Don appropriate personal protective equipment.
3. Remove most of fungal nail with quality nippers before using drill to minimize dust.
4. Support toe between index finger and thumb of nondominant hand to prevent toe from moving during debridement. The other toes should be held away from the bur during the procedure.
5. Set grinder speed to 10,000–15,000 rpm.
6. Debride nail by slowly and gently applying pressure as grinder is moved from proximal to distal portion of plate.
7. Keep nail plate visible at all times. Frequently stop grinding to wipe away dust with a cloth (do not blow).
8. Stop grinding when nail is thin or when dust becomes very fine and is not visibly produced during debridement.
9. *Do not grind through nail plate!* Soft underlying layers of plate can be abraded, possibly resulting in subungual wound to nail bed.
10. Avoid surrounding tissue, which can become abraded.

Equipment Options

- Drill with attached vacuum
- Room air circulators with high-efficiency particulate air (HEPA) filters
- Tungsten carbide burs and bits are preferable because they run cold, do not abrade skin, and produce big particles rather than dust
- Ruby carvers and diamond bits are preferable to steel

Equipment Sterilization

- Proper cleansing of equipment between patients is single most important task in reducing or eliminating spread of infection.
- Sterilize in autoclave or use antifungal cold soaking solution (glutaraldehyde, phenol, sodium hypochlorite, sodium bromide, iodophors).
- Alcohol does not kill fungus and should not be used for cleansing nail equipment.

Personal Protective Equipment and Back Safety

- Gloves, mask, goggles, gown, hair covering
- Height-adjustable chair or examination table for patient
- Height-adjustable chair for clinician
- Change positions frequently; stretch back muscles

any foot pain. This tracing can be used to reinforce teaching to the patient about proper shoe fitting. Because the proper fitting of shoes is not an exact science, the patient should be encouraged to take the tracing to the shoe store when purchasing new shoes.

To evaluate the arch, a footprint can be made by placing the foot into a bucket of water and making a footprint on a piece of brown paper (Figure 15-7). A footprint that is very wide in the middle is indicative of flat feet. With flat feet, the foot rolls excessively to the inside (i.e., overpronation), which leads to arch strain and pain on the inside of the knee. Adaptations to overcome flat feet and overpronation include molded leather arch supports (available over the counter) and athletic shoe styles. These types of shoes are designed with "control" features that aid in preventing the rolling in motion of the ankle. If arch supports or sports shoes are ineffective, a foot specialist can fabricate a custom-molded orthotic shoe insert.

If the footprint shows little or no connectedness between the heel and the forefoot, the person has a high arch (underpronation). In this case, the foot rolls too much laterally, with a lot of weight landing on the outside edge of the foot. With this type of situation, the ankle becomes more susceptible to sprains and stress fractures. Again, athletic shoes are most appropriate because (1) "stability" athletic shoes are built with extra cushioning and (2) high-top athletic shoes cover the foot and ankle snugly to reduce the risk of ankle sprains and minimize damage to the ankle from twists (American Orthopaedic Foot & Ankle Society, 2010).

High heels increase torque on the knee and increase pressure on the forefoot. In addition, women naturally pronate more than men and naturally rely heavily on heel cushioning and arch support to reduce pronation. Unfortunately, high heels and arch supports restrict the

BOX 15-5 Selecting and Maintaining Appropriate Footwear

Shoe Size
- Do not select shoes by size marked inside shoe; sizes vary among shoe brands and styles.

Measurement
- Measure *both* feet regularly; size of feet change with age.

Fitting
- Fit to larger foot.
- Fit at end of the day when feet are at their largest.
- Stand during fitting process.
- Hold new shoe over foot tracing to be certain entire tracing is covered by shoe.
- There should be ⅜ inch to ½ inch between longest toe and end of each shoe.
- Stand next to shoes to determine if shoes are shaped like feet or if there are areas of constriction.
- Shoe should conform as much as possible to shape of foot.
- Heel should fit comfortably in shoe with minimum amount of slippage.
- Ball of foot should fit comfortably into widest part (ball pocket) of shoe.
- Do not purchase shoes that feel too tight, expecting them to "stretch" to fit.
- Examine inside of shoe by hand to check for seams, tacks, rough places.
- Walk in shoe to make sure it fits and feels right.

Shoe Type
- A healthy shoe is one that is shaped like the foot. Shoe has deep, roomy, and rounded or square toe box (area of shoe over toes).
- Shoe should be made of very soft material similar to glove leather.
- Flat shoes (with heel height of 1 inch or less) are the healthiest shoes for feet. If high-heeled shoes are needed, keep to heel height of 2 inches or less, limit wearing of shoes to 3 hours at a time, and take shoes off coming to and from work, dinner, or church.
- Soles should be shock-absorbing and skid-resistant (rubber rather than smooth leather).
- Avoid shoes that have seams over areas of pain (e.g., bunion).
- Avoid shoes with heavy rubber soles that curl over top of toe area (e.g., some running shoes) because they can catch on carpets and cause accidental falls.
- Lace-up rather than slip-on shoes provide more secure fit and can accommodate insoles and orthotic devices.
- Select and wear shoe appropriate to activity (e.g., steel-toed boots for farm work, running shoes for running).

Additional Tips
- Wear new shoes initially for short intervals (e.g., 20 minutes twice per day) and check feet and toes upon removal.
- Indentations, skin discoloration, warmth may be signs of mechanical trauma (pressure points, friction, repetitive stress).
- Do not wear same pair of shoes every day.
- Prior to putting on shoes, shake them and feel inside them to remove any foreign objects
- Note lumpy insoles or torn linings. Replace worn-out shoes as soon as possible.
- White or light-colored socks are preferred so that any drainage (suggestive of ulceration) is readily apparent.
- Avoid walking barefoot, even at home, because feet are more susceptible to injury and infection.
- Apply sun block to feet when wearing sandals or at the beach.
- Discard socks with holes, socks that have been darned.
- Tops of socks should not restrict circulation.

Data from Orthopaedic Foot and Ankle Society, the National Shoe Retailers Association, and the Pedorthic Footwear Association (*Am Orthop Foot Ankle Soc* 2003).

natural movement of the ankle. Furthermore, by reducing pronation, the natural function in ankle motion also increases torque on the knee (Godfrey, 2006).

Offloading and Padding

Offloading and padding are used to protect bony structures of the foot, such as prominent metatarsal heads, or toe deformities from mechanical trauma caused by seams in the socks or shoes. Offloading techniques such as those summarized in Table 15-4 and illustrated in Figures 14-5, 14-6, 14-7, and 14-8 include total contact casts, removable splints and casts, and customized shoes, pads, and inserts.

Over-the-counter and custom-molded padding and inserts can be used to redistribute pressure, reduce hyperkeratotic lesions, and eliminate repetitive stress and friction (Freeman, 2002; Wound, Ostomy and Continence Nurses [WOCN] Society, 2004). Pads can be used

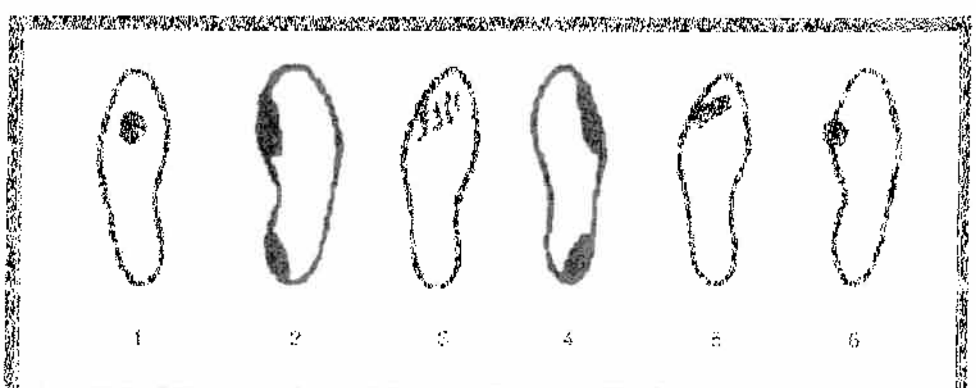


FIGURE 15-6 How to "read" your shoes. **1,** Wear on the ball of the foot. **2,** Wear on the inner sole. **3,** Toe-shaped ridges on the upper toe box. **4,** Outer sole wear. **5,** Bulge and wear on the side of the big toe. **6,** Wear on the upper and above the toes. (Modified from American Orthopaedic Foot & Ankle Society: *How to "read" your shoes*, available at http://www.aofas.org/Scripts/4Disapi.dll/4DCGI/cms/review.html?Action=CMS_Document&DocID=73, accessed September 2, 2010.)

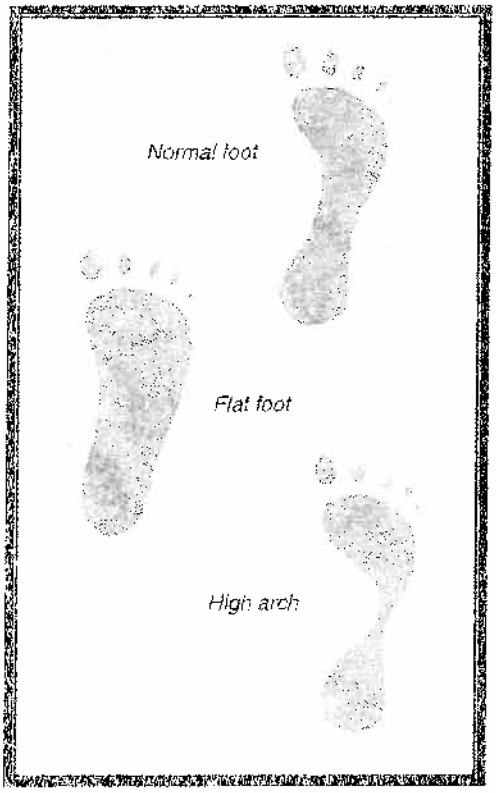


FIGURE 15-7 How to "read" your footprint. (From American Orthopaedic Foot & Ankle Society: *How to "read" your footprints*, available at http://www.aofas.org/Scripts/4Disapi.dll/4DCGI/cms/review.html?Action=CMS_Document&DocID=158, accessed September 2, 2010.)

to protect diminished fat pads on the plantar surface of the foot. However, pads with aggressive adhesives should be avoided on fragile elderly skin. Nonadherent silicone pads should be used and can be held in place with socks over prominent metatarsal heads. Tubular pads can be fit on the tips of toes to protect at-risk areas or used between toes where intradigital calluses may form. Lamb's wool can be woven between all toes or placed between at-risk toes. The wool provides inherent moisturizing from the lanolin while also absorbing perspiration and excess moisture (Kelechi and Lukacs, 1996; Ozdemir et al, 2004).

MANAGEMENT OF SPECIFIC CONDITIONS

Many conditions and circumstances can greatly affect the integrity and function of the foot, such as obesity, anemia, renal insufficiency, impaired circulation, gout, warfarin therapy, Raynaud disease, immunosuppression, and recurrent cellulitis. The 33 joints in each foot must accommodate an extraordinary weight load, making the feet particularly susceptible to arthritic inflammation and swelling of the cartilage and lining of the joints. Individuals older than 50 years are at greatest risk for arthritis. Osteoarthritis is the most common form of arthritis and is associated with aging, injury, or overuse. The foot is one of the first places for osteoporosis to appear; a stress fracture of the foot is often its first sign. A variety of normal age-associated changes occur in the foot: the foot becomes wider, longer, and flatter; the fat pad on the bottom of the calcaneus thins; and the foot and ankle lose some degree of range of motion and become stiff, which

TABLE 15-4 Techniques for Offloading the Foot

Method	Characteristics
Bed rest	Total non–weight-bearing Patient adherence is difficult Presents quality-of-life issues Promotes hyperglycemia Promotes patient debilitation Increases risk of posterior heel pressures
Total contact cast	Forces adherence Allows for limited ambulation Requires specialized skill to make Not advisable for infected or highly exudative wounds
Walking splints/ removable casts	Allows for daily wound surveillance and care Requires strict patient adherence
Wedge-soled shoe	Commercially available Can be customized May cause balance problems
Healing shoe with large toe box and customized inserts	Provides offloading to specific wound locations Requires specialized equipment Requires specialized skill to make
Adhesive felt pad	Simple to make Inexpensive Easy to use with dressings Requires at least weekly dressing changes
Felted foam pads	Simple to make Inexpensive Easy to use with dressings Requires replacement every 3–4 days
Crest pads (adjunct for hammer or claw toes)	Simple to make Commercially available Inexpensive May be used for wound prevention Requires frequent replacement
Interdigital pads	Commercially available May be used for wound prevention Ineffective if shoes are too narrow
Lamb's wool	Commercially available Inexpensive May cause toe constriction
Padded socks	Commercially available May be cause of foot pressure and/or toe constriction if shoe fit does not allow for increased padding

From WOCN Society: Guideline for management of wounds in patients with lower-extremity neuropathic disease. WOCN Clinical Practice Guideline Series #3, Glenview, IL, 2004.

contributes to some loss of balance with ambulation (Ozdemir et al, 2004; Williacy, 2008). Impaired circulation due to lower extremity arterial disease or lower extremity venous disease as well as decreased foot sensation due to lower extremity neuropathic disease, syphilis, leprosy, myelomeningocele, syringomyelia, hereditary neuropathies, or traumatic nerve injury contribute to problems with the foot (Adler et al, 1999; Younes et al, 2004). Superficial as well as deep lesions and skin alterations can potentially lead to significant infection.

Skin Conditions

A variety of skin conditions (e.g., vesicles, bullae, or ulcers) can develop on the feet due to repetitive friction and prolonged pressure from ill-fitting shoes. Infection can develop in the foot triggered by a moist environment and require treatment with appropriate medications (antifungal, antibacterial, or antiviral). Hyperkeratotic lesions (corns and calluses) are among the most common foot problems among older people (Figure 15-8). Ulcers can develop under these hyperkeratotic lesions with long-term low-level insult and become particularly problematic in the person with loss of protective sensation (Spink et al, 2009).

Warts (*Verruca papillomai*) are common dermatologic infections. Plantar warts, specifically, are caused by the human papillomavirus, affect persons of all ages, are contagious, and will spread to other people especially where the epidermal barrier is disrupted (Watkins, 2006). Plantar warts can also spread to other histologically similar sites (Lichon and Khachemoune, 2007).

Fungal infections may develop and include candida (rarely seen on the feet) and dermatophytes. More commonly called tinea, dermatophyte lesions are discussed in detail in Chapter 5. Dermatophyte symptoms may be less pronounced in elderly individuals and in individuals with altered sensation (Hill, 2008). The moccasin type of tinea pedis is often mistaken for dry skin on the plantar surface of the foot but does not respond to emollient application (Crawford, 2004). Tinea pedis may co-exist with a secondary bacterial infection (Erbagci, 2004).

Table 15-2 summarizes the assessment, prevention, and management of common foot lesions. The variety of interventions include properly fitting shoes, offloading, positioning, and topical agents such as emollients, antifungals, and, in some cases, corticosteroids. Offloading and padding as described previously is needed to interrupt the presence of the stressors causing vesicles, ulcers, and corns. In general, a vesicle or bulla should be left intact. Topical care of open lesions should be selected based on the needs of the wound as described in Chapter 18.

As with all interventions, reevaluation of the effectiveness of the intervention is needed. If the problem deteriorates or fails to respond to treatment within a reasonable period of time (i.e., 7 days), reassessment and modification of the treatment should be conducted. For example, topical antibiotics and corticosteroids may need to be delivered systemically rather than topically. However, use of these medications should be recommended only by a practitioner who is well informed of their potential complications and side affects, which can include conditions such as skin reactions, liver enzyme abnormalities, diarrhea, and visual and taste disturbances.

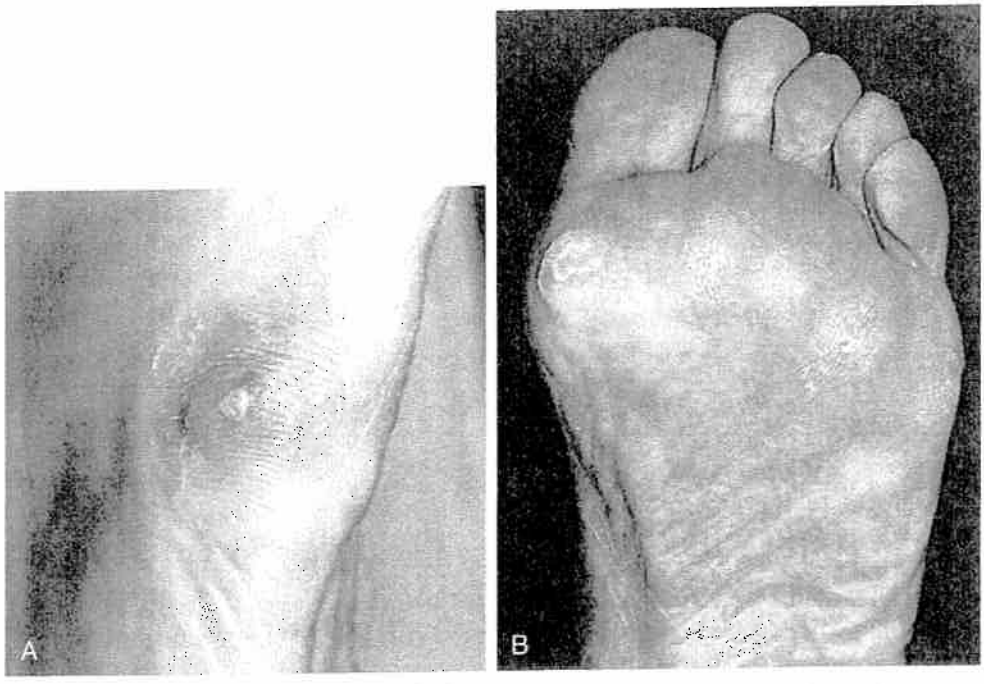


FIGURE 15-8 Selected lesions and skin alterations. A, Corn. B, Callus. (From Seidel HM et al, *Mosby's guide to physical examination* ed 7, St. Louis, MO, 2007.)

Foot Conditions (Malformations)

Foot malformations can affect all three sections of the foot: forefoot, midfoot, and hindfoot. Charcot arthropathy (see Figure 14-1, *B*) is a fairly rare but serious condition caused by the disruption or disintegration of some of the foot and ankle joints. Redness, swelling, and deformity may develop and may be misinterpreted as cellulitis. Charcot arthropathy is frequently associated with diabetes (discussed in greater detail in Chapter 14).

Forefoot. The forefoot area has the highest prevalence of foot malformations. The most common problems that arise in the forefoot are hallux valgus (bunions), bunionettes, hallux rigidus, claw toes, hammer toes and mallet toes, metatarsalgia, and interdigit neuromas (Morton neuroma). Forefoot problems are painful and are generally accompanied by ingrown toenail, calluses, and corns (Hsi et al, 2005). Forefoot problems occur nine times more often in women than in men and are most commonly associated with wearing shoes with high heels and a narrow toe box. Once forefoot problems develop, finding footwear can be difficult. Brief descriptions of forefoot malformations are provided in Table 15-5 and illustrated in Figure 14-1 (Ferrari et al, 2004; Larson et al, 2005; Thomson et al, 2004). Forefoot pain, specifically metatarsalgia, results from an abnormal metatarsal length with alteration of the weight-bearing forces. Symptoms of metatarsalgia include callus formation and localized pain in the plantar aspect of the forefoot over the metatarsal heads. Treatment of forefoot pain involves the application of a metatarsal pad and paring down of calluses (Hsi et al, 2005).

Midfoot. The primary midfoot problem is pain. Midfoot pain is commonly caused by arthritis in the midfoot joints, including the tarsometatarsal joint, subtalar joint, and talonavicular joint. The exact area of pain is easily pinpointed with palpation. The palpation of a bony prominence that is an osteophyte or dorsal bossing corresponds with the joint with the arthritis. Although less common, soft tissue pain can be present on the plantar aspect of the midfoot, which occurs with plantar fasciitis; this is discussed in more detail in the "Hindfoot" section below (Frey, 2005).

Hindfoot. Heel pain, a typical hindfoot problem, is caused by stress on the calcaneus and results from poorly made footwear and walking or jumping on hard

TABLE 15-5 Types of Forefoot Malformations

Name	Description	Common Location(s)
Hallux valgus (bunion) (see Figure 14-1C)	Lateral deviation of great toe (hallux) Produces abnormal hypertrophic bursa over medial eminence of first metatarsal Diagnostic testing includes examination and radiograph to determine degree of deviation Symptoms include pain, redness, and swelling at or near the joint; as toe devastation progresses, bunion becomes more painful	First MTP joint
Bunionette (tailor's bunion)	Less common than bunion; see description above	Fifth MTP joint
Hallux rigidus	Degenerative arthritis of MTP joint Presents with pain in great toe with activity, especially in toe-off phase of gait Stiffness of great toe and loss of extension at MTP joint Toe in normal alignment Radiographs show narrowing of MTP joint of great toe	First MTP joint
Interdigit neuroma (Morton neuroma)	Not a true neuroma Perineural fibrosis of common digital nerve as it passes through metatarsal head; fibrosis results from repeated irritation of nerve that may be caused by bones or other tissue rubbing against and irritating the nerves Plantar pain in forefoot is most common presenting symptom Pain usually is alleviated by rubbing ball of the foot after removing shoes	Metatarsal head
Claw toe	Usually associated with neurologic disorder or inflammatory arthritis	Lesser toes
Hammer toe (see Figure 14-1A)	Fixation of proximal dorsiflexion, middle joint is fixed in plantar flexion, distal joint is moveable Usually bilateral Often accompanied by hallux valgus	Lesser toes
Mallet toe	Distal interphalangeal joint is plantarflexed on intermediate phalanx with rest of joint in normal position	Lesser toes
Charcot arthropathy (see Figure 14-1B)	Fairly rare but serious; associated with diabetes Caused by disruption or disintegration of some of the foot and ankle joints Redness, swelling, and deformity may develop and may be misinterpreted as cellulitis (Discussed in greater detail in Chapter 14)	Foot

MTP, Metatarsophalangeal.

surfaces. Common causes include plantar fasciitis, heel spur, tarsal tunnel syndrome, and Achilles tendonitis (Labib et al, 2002). Additional causative factors include arthritis, gout, ankylosing spondylitis, Reiter syndrome, radiculopathy, inferior calcaneal bursitis, calcaneal fracture, foreign bodies, circulatory problems, and obesity. Calcaneus pain can be palpated directly over the plantar medial calcaneal tuberosity. A heel spur, an osteophyte bony growth on the underside, foremost part of the calcaneus bone, is commonly associated with plantar fasciitis, as illustrated in Figure 15-9 (Frey, 2005).

Plantar fasciitis is the most common condition causing heel pain. This pain occurs with weight-bearing or faulty biomechanics that place too much stress on the calcaneus bone, ligaments, or nerves in the area (Jolly et al, 2005; La Porta and La Fata, 2005). Plantar fasciitis is essentially an inflammation of the long band of connective tissue running from the calcaneus to the ball of the foot that forms the arch of the foot (Lemont et al, 2003). Symptoms include pain on the plantar surface of the heel and pain that is worse upon arising or after sitting a long time and increases over a few months. Plantar fasciitis is most likely to develop in people with either overly flat feet or high arched feet.

Posterior heel pain causes symptoms behind the foot rather than underneath, is likely related to irritation from shoes, and presents with a prominence over the superior process of the calcaneus. A common cause of posterior heel pain is Achilles tendonitis, considered a jumping injury. The Achilles tendon connects the calf muscle to the heel bone and facilitates walking by helping raise the heel off the ground. Symptoms of Achilles tendon pathology includes pain along the tendon (aching, stiff, soreness) and pain that begins upon arising and after periods of rest, improves slightly with movement, then worsens with increased activity. Athletes are at high risk for developing Achilles tendon pathology. Tarsal tunnel syndrome causes heel pain similar to carpal tunnel syndrome in the hand and is a repetitive motion injury (Badissi et al, 2005).

The cause of heel pain must be determined before a plan of treatment is initiated. General treatments include rest or avoiding the precipitating activity (e.g., jogging), icing the heel, exercises and stretches, and nonsteroidal antiinflammatory medications. An orthotic device, such as a silicone heel pad insert with shock absorbing soles, is often key to successful treatment of calcaneus pain. Exercises such as "alphabet exercise," where the patient moves the ankle in multiple planes of motion by drawing both lowercase and uppercase letters of the alphabet with the foot, is particularly beneficial for heel spurs. Cortisone injections as well as over-the-counter heel cups or custom-made orthotics also may be warranted.

Nail Conditions (Onychopathy)

Onycho means "nail." Onychopathy is any disease or deformity of the nail. Abnormal nails are clues to multisystem diseases. The growth rate, discoloration, thickness, and structural changes can be equated to specific disease processes. Nails should be inspected for general appearance; nail plate for length, color, thickness, presence of subungual debris, odor, hyponychium or eponychium for separation from the nail plate; and paronychial edge for infection, ingrown nails, hangnails, and pain. The toenails should be assessed for changes in color, continuity of the nail plate, missing nails or nail malformations, and infection. Selected nail disorders, descriptions, symptoms, and causes are listed in Table 15-6. This section describes management strategies.

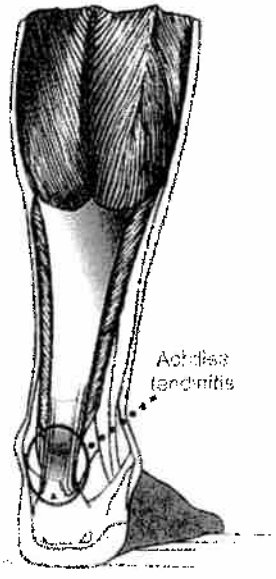


FIGURE 15-9 Locations of Achilles tendonitis and heel spur. (From American Physical Therapy Association, 1996.)

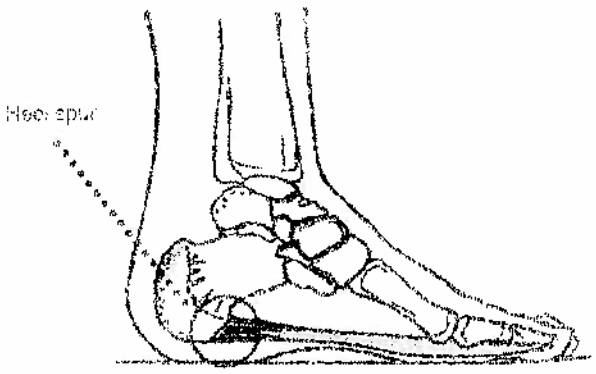
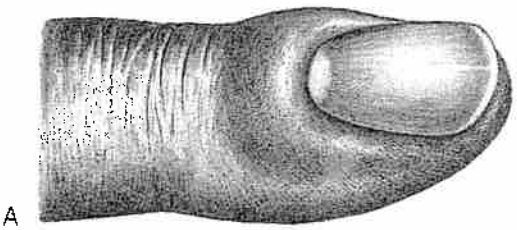


TABLE 15-6 Selected Nail Disorders

Name	Description	Symptoms	Cause
Paronychia (see Figure 15-10A)	Painful infection of tissue around base of nail (perionychium)	Swelling and tenderness posterior or lateral to nail folds May progress to superficial abscess	Bacteria enter break in skin caused by damage, trauma (e.g., nail biting, chemical irritants)
Onychocryptosis (ingrown nail) (see Figure 15-10B)	Penetration of segment of nail plate into nail sulcus and subcutaneous tissue	Acute inflammation, edema, exudate, pain Can evolve into infection, (paronychia, cellulitis), ulceration, necrosis Most commonly affects large toes	Improper nail trimming Shoe pressure Injury or fungal infection Poor foot structure Onychogryposis Higher risk: male, increasing age, immunosuppression, diabetes, PVD, peripheral vascular disease
Onychomycosis (fungal infection)	Tinea unguium or dermatophyte infection Occurs in three distinct forms: distal subungual, proximal subungual, white superficial	Painless, dystrophic changes (thick, brittle discoloration) of one or many toenails Psoriasis, lichen planus, dermatitis, dyshidrosis may mimic onychomycosis	Infectious agent present on susceptible host Chronic exposure to moisture Hyperhidrosis Tinea pedis Poor hygiene
Onychogryposis (ram's horn nail)	Large, deformed, hypertrophic nail	Thick hard nails that curl like horn of ram	Nail was permitted to grow without trimming or debridement
Onychophosis	Localized or diffuse hyperkeratosis on lateral or proximal nail folds, in space between nail folds and nail plate	First and fifth toes are commonly affected	Poor-fitting shoes
Onychatrophia	Atrophy of nails	Softer, thinner, smaller nails Nail detachment	Skin diseases, underlying diseases

Onychocryptosis (Ingrown Nail). Management of onychocryptosis includes education on proper nail trimming and proper fitting of shoes. The lateral plate should be allowed to grow well beyond the nail fold before trimming horizontally. The mild to moderate ingrown nail with minimal pain and erythema and no discharge can be treated with the application of a cotton wedge or dental floss underneath the lateral nail plate. This separates the nail plate from the lateral nail fold, which relieves the pressure. The moderate to severe ingrown toenail with substantial erythema and pustular discharge (Figure 15-10B) will require a digital block and removal of the involved nail wedge with a hemostat. Cleansing the area with 1:1 peroxide and water two to three times per day followed by the application of a topical antibiotic is recommended (Rounding and Bloomfield, 2005).

Onychomycosis (Fungal Infection of Nail). Fungal infections account for only 50% of the dystrophic nails. Nail conditions such as psoriasis, lichen planus, dermatitis, dyshidrosis, and other infections may mimic onychomycosis (Baran and Kaoukhov, 2005). Therefore culturing the nail has become a standard of practice before treatment with an antifungal. The antifungal chosen is usually driven by insurance reimbursement of the medication. The highest cure rates are associated with oral terbinafine and itraconazole. Topical nail



A

Paronychia

B

FIGURE 15-10 Selected nail disorders. **A.** Paronychia **B.** Onychocryptosis (ingrown nail). (A, from Seidel HM et al. *Mosby's guide to physical examination*, ed 6. St. Louis, 2006, Mosby. B. From White GM: *Color atlas of regional dermatology*. St. Louis, 1994, Mosby.)

lacquer containing ciclopirox is used for mild to moderate onychomycosis that does not involve the lunula (see Figure 15-3). The lacquer is applied once daily to the affected nail, 5 mm of surrounding skin, the nail bed (hyponychium), and the undersurface of the nail plate. Once per week, the nail is wiped off with alcohol. Studies have showed increased efficacy with the combination treatment (Sidou and Soto, 2004).

Paronychia. Paronychia is inflammation of the cells that grow the nail (matrix) (see Figure 15-10A) resulting in edema and erythema from many of the disorders described in Table 15-6. For chronic paronychia, treatment consists of warm soaks and topical antifungal agents. Treatment of acute paronychia includes warm compresses for 20 minutes three times per day and topical antibiotics (triple antibiotic) applied after the warm soaks. For more severe infections, oral antibiotics with gram-positive coverage may be necessary (Lee et al, 2009).

Referral

Numerous specialists (e.g., primary care provider, podiatry, orthopedics, dermatology, endocrinology, vascular surgery, general surgery, physical therapy, occupational therapy, pedorthist/orthotist, home health, pain management, diabetes education, smoking cessation, case/care manager, social worker, wound specialist) may be required to provide comprehensive foot and nail care. Results of the foot screening must be communicated to the appropriate health care provider, along with the patient's foot ulceration risk and a record of the educational materials given to the patient and family (Boulton and Armstrong, 2008; Patout et al, 2001).

Patient and Caregiver Education

Involving patients in their own care decreases foot complications therefore it is important to provide education on foot and nail care to the patient and caregiver (Howell and Thirlaway, 2004). Box 15-6 lists the components of patient and family education related to foot care (Phillip, 2005). Patients should be taught that they can protect the health of their feet by maintaining a normal weight to lessen changes due to osteoporosis (Nemo, 2007; Woodrow, et al 2005). Additional foot care instructions can be found in Box 14-5. The patient should be taught to call the health care professional when problems as listed in Box 15-6 arise (American Orthopaedic Foot & Ankle Society, 2008; Grimaldi et al, 2005; van Os et al, 2005).

BOX 15-6 Components of Patient and Family Education

- Foot care (hygiene, skin care, inspection, nail care)
- Anatomy and pathophysiology affecting the foot
- Age-specific foot changes
- Ulcer and amputation risk
- Lifestyle choices that affect health (exercise, smoking, nutrition, weight management)
- Plans for preventing foot disorders
- Proper footwear (see Box 15-5)
- Plan for follow-up
- Problems that should be reported:
  - Foot or ankle pain that is intense
  - Foot or ankle pain that persists for more than 72 hours
  - Lower extremity pain that increases with exercise or ambulation, rest, or elevation
  - Swelling of one leg or foot that persists for more than 24 hours
  - Sudden progression of a foot deformity
  - Unilateral flattening of foot arch
  - Infection
  - Loss of sensation
  - Blister or ulcer on foot that developed without the patient feeling it
  - Blister or ulcer on foot that is not healing

Home Remedies

Many over-the-counter and home remedies are used for treatment of foot and nail problems. Four products are most commonly used: Vicks VapoRub, vinegar, vegetable oil, and Vaseline. Vaseline and vegetable oil (Crisco) are inexpensive options and can be used to moisturize the skin. Vegetable oil has a risk of bacterial growth while in the container and the risk of allergic dermatitis. Vaseline (petroleum) comes in different grades, which vary depending on composition, purity (depending on stock), production, and packaging. Petrolatum-based products have been identified as clinically effective and cost-effective. Allergic dermatitis can occur from petroleum products (Kelechi, 2005).

Vinegar and Vicks VapoRub are used to treat fungal and bacterial infections. In various dilutions, vinegar is effective in reducing or eliminating growth of bacteria. Evidence for the use of vinegar in treating fungal infection is limited. The literature has reported vinegar (one part vinegar and 2 parts water for 15 minutes per day) used as treatment of toenail fungus, athlete's foot, and foot odor and as an excipient. Long-term use of vinegar (regardless of concentration) is contraindicated, however, due to the drying effect and potential for skin irritation. Anecdotally, Vicks VapoRub applied topically to the nail daily has been used for treatment of toenail fungus (Kelechi, 2005).

Unsupervised home remedies for foot ailments should be avoided. Self-treatment has the potential for turning a minor problem into a major one. Persons with diabetes, poor circulation, or heart problems should not treat their own feet because they are more prone to infection. It is vital that older individuals see a foot care specialist at least once per year for a checkup (Nemo, 2007; Woodrow et al 2005).

SUMMARY

Foot and nail disorders are predominantly a reflection of the patient's overall health status. By conducting a regular and routine foot and nail assessment in conjunction with a routine skin assessment, preventive interventions can be identified that will prevent the discomfort and secondary complications that arise from foot and nail disorders. Routine foot care should be integrated into everyday practice, thus keeping the skin healthy and intact and minimizing the risk of trauma or malformation (Howell and Thirlaway, 2004).

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