Clinical Evaluation of Foot and Ankle Dysfunction

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Patients with foot and ankle dysfunction require a systematic approach in the evaluation process. An outline of the procedure is provided using the problem-oriented record system as a basis. Subjective data describe the patient's feelings toward the problem and goals concerning it. Objective data encompass several areas, including a detailed history; general posture; soft tissue structures; functional capacity; and the circulatory, musculoskeletal, and neuromuscular systems. The data are reviewed, and an accurate assessment of the nature and cause(s) of the dysfunction are made. Realistic goal statements are then written to prepare for successful treatment planning.

Key Words: *Ankle; Foot; Lower extremity, ankle and foot; Physical therapy; Tests and measurements, functional.*

Care of the patient with foot and ankle dysfunction requires a systematic approach to both evaluation and treatment. The purpose of this article is to describe a technique used to evaluate the foot and ankle structures. The therapist should review the subjective and objective data obtained by this technique to assess the dysfunction, determine the source of the dysfunction, and determine the nature and severity of the patient's pain. The therapist can then set realistic short- and long-term goals in relation to the assessment and in accordance with the patient's goals.

The problem-oriented record system's "SOAP" (subjective, objective, assessment, plan) note format is used as a method for organizing the evaluation process.[1] Table 1 is an outline of the evaluation process.

SUBJECTIVE

The subjective evaluation may offer some important clues on how to proceed. The first question asked should be: "What is the problem?" The patient's perception of the problem may initially help the therapist narrow the focus of the investigation. For instance, this question can be important with the athletic population, whose sense of their body and how it functions often is very keen.

The second question asked should be: "What are your goals?" The patient's goals should be incorporated into the goal statement and also into the treatment-planning process.

OBJECTIVE

History

The key to good history taking is asking specific questions. Biasing the patient with questions that are not neutral can give false information and prevent the therapist from zeroing in on the true problem. Table 2 contains examples of pertinent questions for the therapist to ask the patient.[2–4]

Based on the answers to these questions, in combination with the patient's subjective statements, the therapist should organize the physical examination. Traumatic lesions, such as an inversion (lateral collateral ligament) sprain, require evaluation of the ligaments and soft tissue, strength of muscle contractions, balance, proprioception, and functional ability. Someone with an insidious onset of foot pain needs a more general screening of each system, narrowing the focus as more information is gained. The history is also helpful in determining an appropriate treatment (eg, suggesting a change in activity level or wearing different shoes).

Inspection and Palpation

Posture. Observation of the patient begins in the waiting room. Watching the patient sit, stand, and walk to the treatment area gives the therapist a sense of the patient's functional ability. This observation also provides the first opportunity for gait analysis.

Assessing general posture requires observation in all three cardinal planes. Varus and valgus of the hip, knee, and tibia; shoulder and pelvic heights; and foot pronation and supination are noted in the frontal plane view of the patient. The sagittal plane view allows the therapist to observe spinal curves; pelvic rotation; and hip, knee, and ankle flexion or hyperextension. Rotational components of the trunk, femur, and tibia are noted in the transverse plane view of the patient.[3] If abnormalities are found in the pelvic, hip, or knee region, they should be investigated further for their possible implication in foot and ankle dysfunction.

General foot posture may also be observed at this point. Deformities such as pes planus (abnormally low-arched foot), pes cavus (abnormally high-arched foot), talipes equinus (abnormally plantar-flexed foot), talipes equinovarus (abnormally supinated foot), hallux valgus, and claw toe(s) (hammertoe) should be noted to guide the therapist in focusing on certain aspects of the evaluation.

Skin. The extensibility of the soft tissue of the foot and ankle is important for normal function. This extensibility is particularly important for patients who have had immobilization of the foot and ankle, where resulting scar tissue can inhibit motion. The movement of the tissue can be evaluated by stretching it in multiple directions with the fingertips. The tissue should move easily without restriction.

Circulatory disturbances are common in the foot and ankle. Extracellular fluid pools on the dorsum of the foot and around the malleoli after injury and after surgery, and edema can be felt through palpation. Swelling may also

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TABLE 1
Evaluation Outline

Subjective
What the patient feels is wrong
The patient's goals of treatment, including functional level
Objective
History (trauma and previous injury, description of pain, medical-surgical history, weight changes, activity level)
Inspection and Palpation
Posture (general and foot-ankle complex)
Skin (soft tissue, circulation, temperature, swelling)
Footwear and orthoses
Measurement
Range of motion
Joint play
Muscle strength and extensibility
Sensation and tone
Stability (anterior drawer and talar tilt)
Alignment
Plantar pressure
Balance
Gait
Assessment
Dysfunction and probable cause(s)
Goal statement
Plan

TABLE 2
Questions for Comprehensive History Taking

Where specifically are the symptoms?
Was trauma involved? If so, what was the exact mechanism of your injury?
How long ago did the symptoms begin?
When are the symptoms most severe? Least severe?
How are the symptoms affected by physical activity (walking, running, athletic activities)? By rest?
What do you do to alleviate the symptoms when they are severe?
Has there been any change in the symptoms from the onset?
What type of treatment have you had for these symptoms? How soon after the onset did you seek treatment?
Have you ever had any previous injuries to the low back or any part of the lower extremities?
Have any surgical procedures been performed on these areas?
Do you have a history of heart disease, diabetes, poor circulation, neurological disease (eg, peripheral neuropathies, stroke, Guillain-Barré syndrome, multiple sclerosis, transverse myelitis), or arthritis (rheumatoid arthritis or osteoarthritis)?
Are you on any medications? For what conditions?
Have you had any radiographs (x-ray films)?
Have you had any changes in weight or activity level over the last six months?
What type of regular exercise do you perform?
What types of shoes do you wear for work? Recreation? Around the house?
What activities have you been able to perform since the symptoms began?
Is there anything else you would like to add?

occur along the Achilles tendon and heel (secondary to tendinitis or bursitis) and in the first metatarsophalangeal joint (in relation to hallux valgus or hallux rigidus) (R. R. Ellingsen, unpublished data, 1981).

Temperature changes should be noted in this region as well. The therapist can feel for subtle differences by lightly moving the dorsal surface of the hand over the patient's lower leg and foot. Hand-held skin thermistors can also be used for more specific temperature readings.

Pulses should be checked to determine whether any potential vascular problems exist. The dorsalis pedis pulse can be felt between the extensor hallucis longus tendon and the extensor digitorum the foot. The posterior tibial artery pulse is found posterior to the medial malleolus and anterior to the Achilles tendon.[5]

The condition of the nail beds may also give some indication of circulatory dysfunction, as does hair growth. Bluish nails and shiny, hairless skin are signs of poor circulatory function.[6]

Callus formation on the sole of the foot is an indicator of dysfunction. Callus formation under the second and third metatarsal heads may be indicative of excessive pronation in a flexible foot. Sometimes this callus formation is accompanied by callus along the medial aspect of the great toe because of friction with the shoe.[4] Callus under the second metatarsal head may also be a sign of Morton's toe (metatarsalgia that tends to occur when the second toe is longer than the great toe) or hallux valgus (and possibly the presence of bunions). The callus is located under the fifth (and sometimes fourth) metatarsal head when the foot is abnormally rigid. With a medial push-off, a callus may develop along the great toe.[4] The onset of claw toes also brings about callus formation on the plantar fat pads of the toe.

Blisters and ulcer formation should be evaluated as potential sources of infection. The skin condition surrounding the area, the color of the lesion, and any odor may also be indicators of infection.[6]

Footwear and orthoses. Shoes play a major role in foot and ankle function (see article by McPoil in this issue). Proper style and fit are very individual, and cosmetic considerations compound the issue. It is important to note that shoes play a major role in the extent of symptomatic dysfunction. A well-fitting shoe that supports and controls movement may mean the difference between painful and nonpainful gait.[7] Also, the person with an insensitive foot requires special protection from a shoe (see article by Sims et al in this issue).[7]

The majority of physical therapists do not have an opportunity to fabricate foot orthoses. Many therapists may not even have input in the actual prescription, especially with foot orthoses. Nevertheless, the therapist should be able to evaluate the effectiveness of any given orthosis and to determine the need for one (see article by Lockard in this issue). The following are key issues that should be addressed when assessing an orthosis.[7]

1. What is the purpose(s) of the orthosis (eg, stabilization, total contact, softness, shock absorption, balance) and

does it fulfill its purpose?
2. Are the patient's symptoms alleviated?
3. Does the orthosis fit the patient correctly (wide and long enough and heel cup deep enough), especially in a weight-bearing position?
4. If the orthosis is not new, is it worn down and not functioning properly?
5. Is the footwear used with the orthosis appropriate (eg, not excessively worn, low heeled, sufficient eyelets to hold the foot snugly, rigid or soft midfoot and heel counter depending on the patient's foot type, deep enough to accommodate the foot and orthosis without "pistoning")?
6. If there is posting (or wedging) on the orthosis, 1) Is the medial heel wedge too high, thus causing the patient to be unbalanced laterally? 2) Is the medial heel wedge not sufficient in controlling the excessive pronation of the subtalar joint? 3) Is the forefoot post uncomfortable (eg, too far proximal or distal, or not beveled enough)? 4) Is the heel lift the appropriate height, thus balancing the pelvic landmarks (posterior and anterior superior iliac spines and iliac crests)? and 5) Is the rocker bottom positioned just proximal to the metatarsal heads?
7. Does the patient know how to don and doff the foot or ankle-foot orthosis?
8. Does the patient know when and how long it should be worn?

Orthoses should be prescribed for specific dysfunction of the foot-ankle complex. It is vital that the true dysfunction be identified and treatment directed at correcting that dysfunction.

Measurement

Range of motion. Range-of-motion measurements of the lower extremity are evaluative techniques that are important in finding areas of dysfunction.

Tibial torsion is the relationship of the transverse axis of the knee to the frontal plane axis of the ankle.[3] The measurement is done with the patient sitting over the edge of a treatment table. The patella is in the frontal plane and the angulation of the malleoli is used as the landmark. The therapist palpates the apex of the medial malleolus and the anterior border of the lateral malleolus. Medial (internal) or lateral (external) torsion is seen by noting the direction of the imaginary line between the palpating fingers (Fig. 1). The norm is about 15 degrees of lateral tibial torsion.[8]

Tibial varum, not to be confused with tibia vara (see introduction to this issue), refers to the frontal plane angle of the tibia in relationship to the floor while the patient is standing. A bowleg deformity (genu varum) results from the distal tibia being angulated toward the midline in relationship to the proximal tibia.[4] The degree of tibial varum is measured using the midline of the distal one third of the tibia and the floor as references.

Because of the significance of tibial varum during the stance phase, it is important that the patient be standing in his or her normal base of gait. This posture can be accomplished by having the patient stand on one foot (the side being measured) while allowing the opposite side to balance with toe contact (Fig. 2). The stance foot is placed in the subtalar neutral position by equal palpation of the talar heads while the patient rotates the trunk.[4,8]

This measurement is used as an indicator of the amount of movement needed from the subtalar joint during mid-stance. The foot is placed in the subtalar neutral position in the same manner as with the tibial varum measurement.[4] A protractor is used to measure the angle between the vertical plane, that is, perpendicular with the support surface, and the angle of the calcaneal midline during stance. The straight edge is placed along the supporting surface, with the center aligned with the calcaneal midline, and the angle is read as the midline deviates from the center (Fig. 3).[3,4]

Ankle dorsiflexion is measured with the foot nonweight-bearing and maintained in the subtalar neutral position. This posture gives the examiner a true sense of talocrural joint motion by attempting to prevent compensation from the subtalar joint. The patient is positioned prone lying. The stationary arm of the goniometer is aligned with the head of the fibula and the lateral malleolus, and the moving arm is placed along the lateral aspect of the heel (Fig. 4). Full dorsiflexion is achieved by passively moving the foot while maintaining the

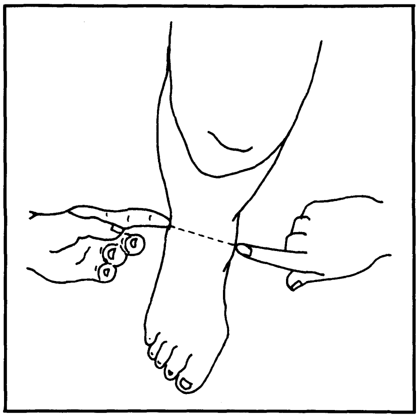

Fig. 1. Measuring tibial torsion of right lower extremity.

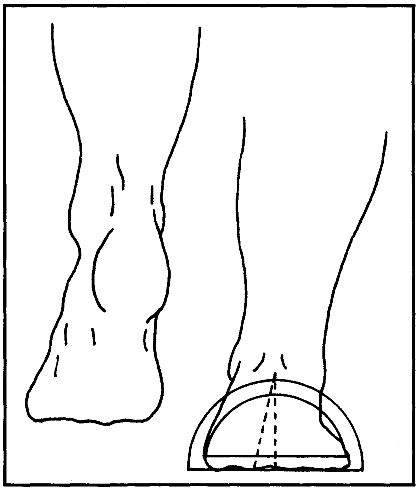

Fig. 3. Measuring neutral calcaneal stance on right side.

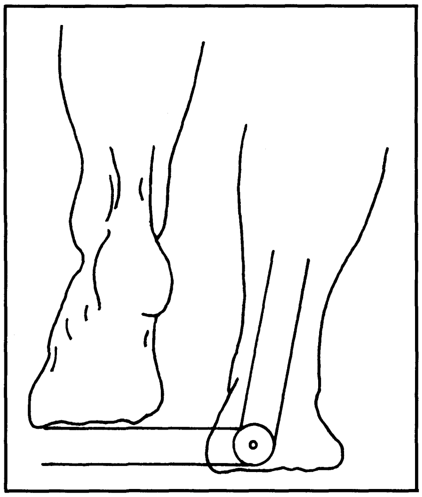

Fig. 2. Measuring tibial varum of right lower extremity.

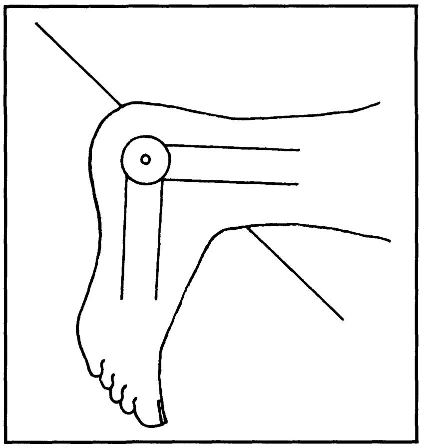

Fig. 4. Measuring right ankle dorsiflexion.

neutral position. The test is repeated with the knee flexed in an attempt to release the gastrocnemius muscle and assess joint motion.[3,4,8]

Ankle plantar flexion is performed in the same manner as dorsiflexion. Knee flexion, however, is not necessary because of the lack of a two-joint muscle that would influence the measurement.

The triplanar motion of the subtalar joint makes it difficult to measure. This measurement, therefore, is made by assessing the frontal plane components of pronation, supination, eversion, and inversion, respectively (see article by Oatis in this issue). Calcaneal eversion is measured with the goniometer's stationary arm placed along the midpoint of the distal one third of the tibia and the moving arm along the midpoint of the calcaneus (Fig. 5). Full eversion is achieved by passively moving the calcaneus laterally.[3,4,8] Calcaneal inversion is evaluated in the same position. It is measured by passively moving the calcaneus medially.[3,4,8]

Extension of the great toe is a necessity for smooth push-off.[7] It can be measured in both nonweight-bearing and weight-bearing positions by aligning the goniometer's moveable arm with the lateral border of the first phalanx and the stationary arm with the first metatarsal (Fig. 6).[3,4]

Joint play. The following motions, which occur when normal joint ROM is present, should be evaluated whenever ROM is reduced in the ankle and foot

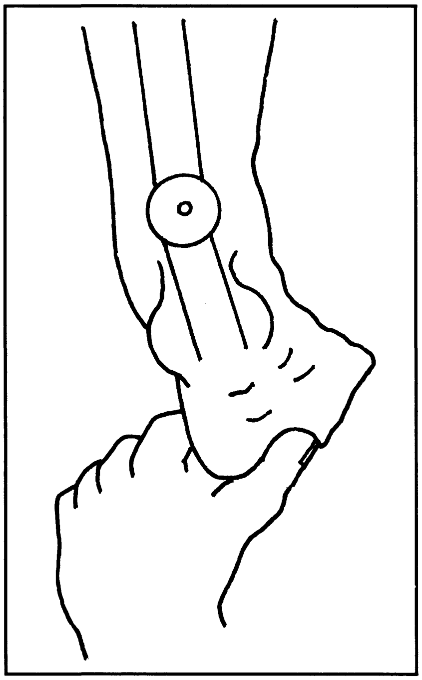

Fig. 5. Measuring right calcaneal eversion.

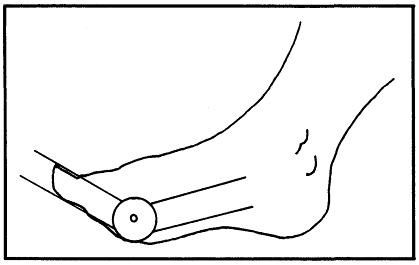

Fig. 6. Measuring right great toe extension.

(R. R. Ellingsen, unpublished data, 1981, and S. V. Paris, unpublished data, 1979): 1) fibular dorsal and ventral glides; 2) talar distraction and talocrural dorsal and ventral glides; 3) calcaneal medial and lateral glides and distraction; 4) dorsal and ventral glides of the cuboid, navicular, and cuneiforms; 5) intermetatarsal dorsal and ventral glides and tilting; and 6) phalanges distraction, dorsal and ventral glides, and tilting. The motions are graded from 0 to 6, with 0 being ankylosed, 3 being normal, and 6 being dislocated (S. V. Paris, unpublished data, 1979).

Muscle strength and extensibility. Muscle balance contributes to the proper functioning of the foot and ankle. Muscle strength is especially important in controlling the gravitational forces during gait. Screening of muscle strength, therefore, should be performed in more functional weight-bearing positions as well as in the standard nonweight-bearing methods. This screening is particularly relevant for the gastrocnemius, soleus, anterior tibialis, posterior tibialis, and peroneus longus and brevis muscles. The following are examples of screening techniques: 1) rising up on the toes rapidly in succession, 2) walking on the heels, 3) slowly lowering from a toe-rise position in succession, 4) toe rising slowly in an inverted position, and 5) resisting dorsiflexion and plantar flexion of the tibia on the foot.

Testing the muscle's reactions to various types of contractions is another method used to focus on problem areas. These tests may indicate more subtle strength deficits and include 1) holding an isometric contraction at various points in the ROM, 2) performing different patterns of facilitation such as rhythmic stabilization and noting the reaction compared with the sound side, and 3) bridging and noting the ability of the foot and ankle to stabilize with and without proximal resistance (R. R. Ellingsen, unpublished data, 1981).

Isokinetic techniques and standard manual muscle testing positions are also options that offer a more standardized form of evaluation. Care should be given to stabilizing the lower extremity to prevent substitution and overflow from more proximal musculature. Comparison to the sound side should always be made.

Sensation. Sensation testing is important when examining patients with neurological or circulatory disorders. Two-point discrimination, skin temperature, and response to light touch should be tested along the lower leg and foot in accordance with a dermatome chart. A commonly used tool to measure sensitivity to light touch is nylon monofilament. The monofilaments are graded such that feeling the pressure induced by the #5.07 monofilament indicates the presence of protective sensation. The #6.10 monofilament and higher grades are indicative of a loss of protective sensation (see article by Sims et al in this issue).[6]

Tone. *Tone* is the tension in the muscle that is present when the muscle is relaxed. Evaluation of changes in tone and posturing is vital in treatment planning for the neurologically impaired patient. Tone should be evaluated in the trunk and the entire lower extremity; proximal instability can adversely affect the function of the foot and ankle distally.[9] One method of evaluating tone is through the description of movement patterns. Ryerson has suggested three patterns of movement for the hemiplegic patient.[10] These patterns can be used to describe the functional changes of the patient that occur with differences in the level of tone and help guide appropriate treatment planning.

1. Pattern I demonstrates low postural tone and little muscle activity, with no weight-bearing on the calcaneus, decreased ankle dorsiflexion ROM, and subsequent excessive pronation of the midfoot and forefoot during weight-bearing.
2. Pattern II demonstrates the beginning of increased tone, excessive pronation with an everted calcaneus, midfoot collapse, and toe clawing during weight-bearing.
3. Pattern III demonstrates increased tone and an excessively supinated foot, in conjunction with lateral tibial rotation during weight-bearing.

Description of movement patterns and tone changes are most valuable in patients with foot and ankle dysfunction, especially during gait. Nonweight-bearing static measures may be inconsistent with functional ability because of changes in muscle tone following changes in posture. Description of the muscle activity is important in relationship to its ability to initiate and follow through with movement in the available ROM. Manual realignment of foot structures may also be required to determine whether structural malalignment or lack of muscle control is the problem.[10]

Stability. The anterior drawer test is used to check the integrity of the anterior talofibular ligament. This ligament limits anterior displacement of the talus on the tibia. It is also the most commonly injured ligament of the ankle.[11]

The test is performed with the knee flexed and the ankle plantar flexed. While stabilizing the lower leg, the heel is pushed in an anterior direction. The talus glides too far anteriorly when the test is positive. A comparison with the opposite side should always be made (Fig. 7).[11]

Excessive medial and lateral gliding of the talus in the mortise is a sign of laxity in the lateral collateral and deltoid ligaments, respectively. The talar tilt test is performed with one hand stabilizing the tibia and calcaneus and the other supinating the foot (and therefore the talus) to check the lateral ligaments. The foot is pronated to test the integrity of the medial ligaments. Again, a comparison must be made with the opposite ankle.[11]

Alignment. Forefoot and rear-foot measurements are taken with the subtalar joint placed in a neutral position (see article by Oatis in this issue). The subtalar joint is in the neutral position when the talonavicular joint is maximally congruent, as determined by equal palpation of the lateral and medial margins of the talar head. The lateral margin is felt anterior to the lateral malleolus toward the midline, and the medial margin is slightly inferior and anterior to the medial malleolus. The talus is prominent medially during pronation of the subtalar joint (because it is adducting and plantar flexing), whereas the opposite is true during supination.[3,4,8,12–15]

The patient is placed prone on the treatment table with the foot being examined hanging over the edge and the opposite limb flexed, abducted, and laterally rotated at the hip and flexed at the knee. Palpation of the talus is performed with the thumb on the medial margin and the index finger on the lateral margin, while the opposite hand grasps the forefoot to maintain the neutral position (Fig. 8).[3,4,8,12–15]

The forefoot and rear foot are evaluated using the metatarsal heads and the midline of the calcaneus as landmarks. In the neutral subtalar joint position, the five metatarsals should be perpendicular to the midline of the calcaneus. An inverted position is considered varus; an everted position is valgus (Fig. 9). The rear foot (midline of the calcaneus) should be a continuation of the distal one third of the tibia. The rear foot is in varus when the midline of the calcaneus is angled medially; the calcaneus angled laterally is considered valgus (Fig. 10). A relative position is noted[3,4,8,14,15] or a goniometric measurement can be taken using the same alignment as used for calcaneal inversion and eversion.[12,13]

The Feiss line test is a simple test that can be performed to assess a flexible versus a true flatfoot (pes planus) (Fig. 11). The navicular should be aligned with the medial malleolus and the first metatarsal head. If it is depressed in nonweight-bearing as well as weight-bearing, the patient has a true pes planus. If the navicular is depressed only in weight-bearing, however, a flexible flatfoot exists, and the potential causes should be investigated.[16]

Plantar pressure. Presence of calluses and other plantar conditions may indicate abnormal pressure distribution under the feet. A method to assess weight-bearing forces uses pressure-sensitive devices and materials. The podoscope, Harris footprint mat,* and slipper-socks† are some examples.[6]

The podoscope is a device that uses lights and mirrors to show the pressure distribution of the plantar surface (Fig. 12).[3] This method of assessing weight-bearing forces can be performed with either unilateral or bilateral stance. Darkened areas on the image of the plantar surface are associated with increased pressure. With insensitivity of the foot, high-pressure areas can be potential sites of skin breakdown. Proper orthotic management can alleviate some of this pressure and prevent ulceration (see article by Lockard in this issue).[6]

The Harris footprint mat and the microcapsular slipper-socks are qualitative measures of weight-bearing forces. Again, the darkened areas signify sites of increased pressure. Pressure-sensitive paper is another alternative. It is important to compare each side and to keep in mind that the normal, even distribution of force on the sole of the foot is posterolateral hindfoot to anteromedial forefoot.[4,6]

Balance. Balance reactions should be evaluated in all patient populations. Freeman and Wyke demonstrated a loss of joint mechanoreceptors with ankle injury, which may account for the patient's lack of balance.[17]

Tests are performed on both a stable and a mobile support. With the patient sitting as well as standing, the therapist gently pushes the patient in all directions, carefully observing the reaction of the foot and ankle (and the trunk, pelvis, and lower extremity). The balance board (mobile) test should also be applied in all directions, if possible. The testing should be performed slowly, rapidly, and in succession to mimic many different functional situations. Single-limb stance with eyes shut is another potential test for balance. The patient should be able to hold the position for at least five seconds (R. R. Ellingsen, unpublished data, 1981).[10]

Gait. One of the major goals of evaluating the patient with foot dysfunction is to detect the ramifications of the problem on gait (see article by Rodgers in this issue). There are many ways to realize this goal, some more sophisticated than others. The elaborate computer-

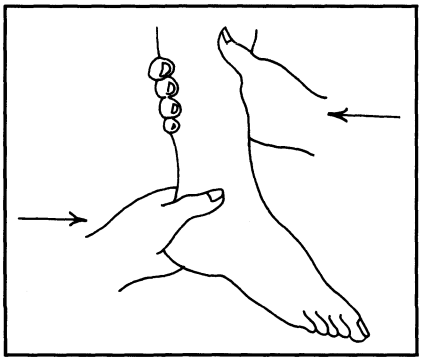

Fig. 7. Anterior drawer technique.

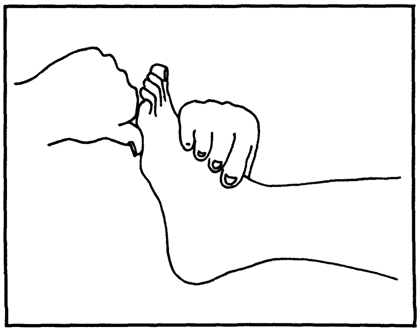

Fig. 8. Palpating neutral position on left foot.

* Smiths Industries Medical Systems, Downs Surgical Div, 301 Gough Rd, Markham, Ontario, Canada L3R 4Y8.

† Slipper-Sock Project, GWLHDC, Carville, LA 70721.

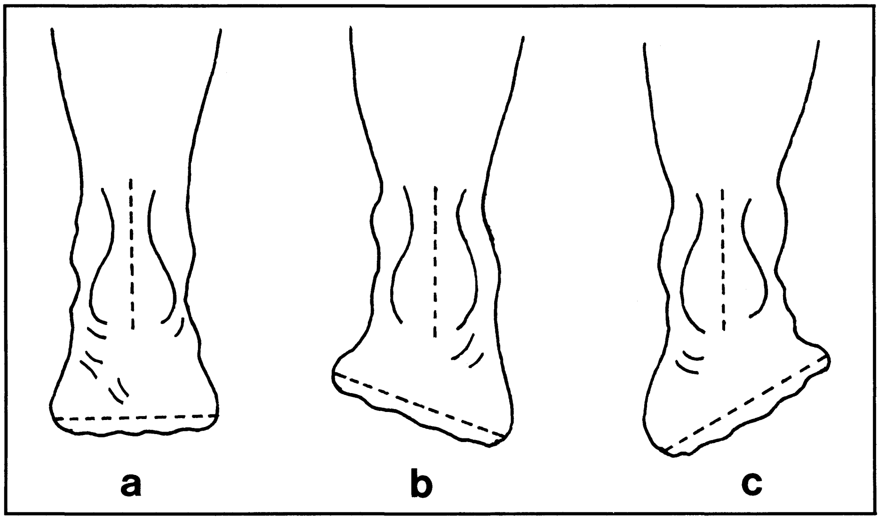

Fig. 9. Neutral (a), valgus (b), and varus (c) positions of left forefoot.

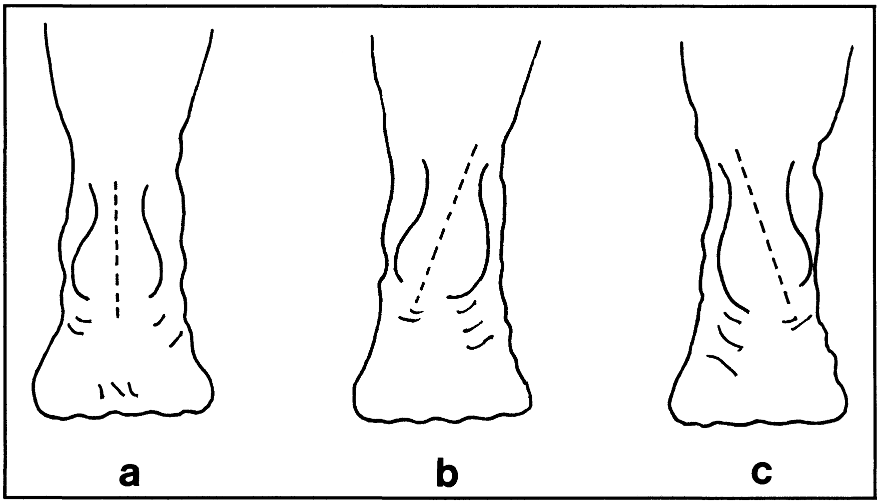

Fig. 10. Neutral (a), valgus (b), and varus (c) positions of left rear foot.

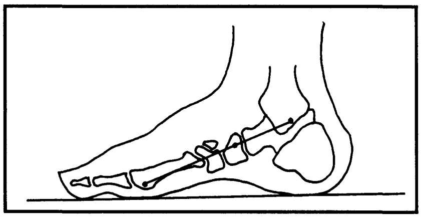

Fig. 11. Feiss line.

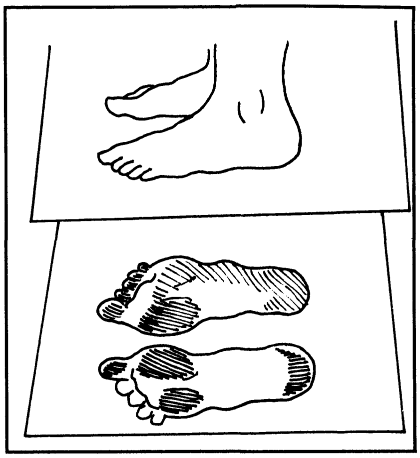

Fig. 12. Pressure distribution of plantar surface using podoscope.

ized motion analyzers provide objective data on force production, ROM, and other temporal and spatial variables. These devices are found in highly specialized gait laboratories and are not readily available to the general public. Videotaped gait analysis, especially with slow-motion capabilities, is very helpful and easily applied to the clinical setting. Video recorders allow the therapist to observe gait at different speeds and to slow down or stop the recording to view the joints of the ankle and foot more closely. An effective method of viewing calcaneal motion is marking the midline of the rear foot of the patient and then closely monitoring the movement throughout the entire gait cycle.[18]

The basic technique of gait analysis is observation from the frontal and sagittal view of the patient walking. By observing one joint at a time through the entire gait cycle, valid inspection can be made.

ASSESSMENT

Dysfunction and Probable Causes

The effectiveness of treatment depends on an accurate assessment of the dysfunction. After reviewing the subjective and objective data, the therapist should determine the nature of the dysfunction. The case studies by Selby, Mueller and Diamond, and Riddle and Freeman in this issue address the treatment-planning process in relation to evaluative findings.

Goal Statement

The last step before treatment planning is the setting of goals. Short- and long-term goals establish a logic and direction to the treatment. They should be attainable, measurable, and have realistic time frames.[1] They should also take into account the goals of the patient.

PLAN

Each treatment plan should be based on a goal. Reassessment of the goals should also be a significant part of the treatment-planning process.

SUMMARY

Evaluation of the patient with foot and ankle dysfunction requires a systematic approach. Subjective information gives the therapist an idea of how the patient feels about the injury. Objective information includes a thorough history and data on general posture, soft tissue, circulation, musculoskeletal factors, neuromuscular factors, and function.

Using the data collected in the evaluation, the therapist then makes an accurate assessment of the problem. Goals are established to incorporate the dysfunction with the treatment planning, which ensures that the treatment is focused on managing the dysfunction rather than the symptoms.

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