The Foot and Ankle: Physical Therapy Patient Management Using Current Evidence

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ABSTRACT

This monograph discusses evidence-based evaluation and treatment of common foot and ankle problems. The evaluation section focuses on reliable and valid measures of foot and ankle function. The foot and ankle problems reviewed include foot deformities, plantar fasciitis, sprains, fractures, tendinopathy, and various specific foot and ankle problems. The goal is to provide a narrative review of current best evidence of the epidemiology, diagnosis, prognosis, and treatment for common foot and ankle conditions. Five intriguing case studies are presented. Each case highlights an evidence-based approach to diagnosis and treatment. The cases specifically address non-insertional Achilles tendinopathy, chronic ankle instability, posterior tibial tendon dysfunction, Sever's disease, plantar fasciitis, and medial tibial stress syndrome. Each case highlights key issues that are critical to clinical decision-making based on current best evidence.

LEARNING OBJECTIVES

Upon completion of this monograph, the participant will be able to:

1. Define terminology common to foot and ankle pathologies that are consistent throughout this monograph of the Orthopaedic Section of the American Physical Therapy Association.
2. Determine and assess key anatomical structures and biomechanical concepts that motivate clinical models of foot and ankle care.
3. Evaluate and prioritize knowledge of normal and abnormal foot and ankle biomechanics related to clinical problems during walking, running, and other tasks.
4. Discuss and prioritize relationships between foot and ankle biomechanics and proximal (hip and knee) biomechanics.
5. Discuss and prioritize the linkages between body structure and function, activity, and participation using the International Classification of Functioning, Disability, and Health (ICF) model as it applies to the foot and ankle.
6. Assess and apply evaluative methods that assist with differential diagnosis of foot and ankle problems.
7. Classify and apply current evidence-based examination techniques and interventions of common foot and ankle problems.
8. Contrast the strengths and weaknesses of various outcome scales that target foot and ankle problems.
9. Describe common usage of specific radiographs and give examples of the emerging use of ultrasound imaging in the foot and ankle.

INTRODUCTION

The goals of this monograph are to provide evidence-based information that is patient centered and management based. The framework for the current version builds from the previous edition of this monograph, including retaining most of the same headings and general outline. The modifications are primarily in the addition of literature on various foot and ankle problems that has expanded considerably since the last edition. For this reason, some foot and ankle problems were not included. Notably among them were foot and ankle issues associated with diabetes mellitus. The literature on this topic is complex and covers a wide range of issues; therefore, it was decided to detail only the more common pathologies and topics in this version of the monograph. The authors recognize that some primary resources and references are omitted. As such, some sections are based more on secondary sources (ie, narrative or Cochrane reviews) than primary sources. Therefore, what follows is an attempt to present clinicians with an update of current studies on common foot and ankle problems. Purposefully the sections on common foot and ankle problems were written first, emphasizing the new evidence associated with etiology, diagnosis, treatment, and prognosis. This left less space and time for the theoretical basis of practice; however, given the shift in practice toward evidence-based outcomes, we felt this emphasis was justified. We do hope the theoretical sections are robust, despite their brevity, and will provide a strong foundation for problem solving when evidence is lacking to guide treatment.

FOOT AND ANKLE

Terminology Common to Foot and Ankle Pathologies

Terminology associated with the foot and ankle is occasionally vague, poorly defined, ubiquitously used when referring to disparate things, and is therefore, frequently inconsistent. This is especially true when describing foot postures and foot movement. Table 1 defines foot postures and Table 2 defines movements that are used throughout this monograph to provide some consistency for the reader of this monograph. In this monograph, the terms pronation and supination are used to refer to subtalar movement around an oblique axis. Pronation and supination are commonly used to describe motion around an oblique axis in the 3 cardinal planes of the body (ie, frontal, sagittal, and transverse). Readers should note however, that studies of joint kinematics rarely record supination and pronation around an oblique axis. More commonly a single component of pronation and supination is documented (eg, hindfoot inversion/eversion around an anterior/posterior axis) and this may erroneously be referred to as pronation and supination. A full discussion of this practice is outside of the scope of this

Table 1. Terminology Used to Refer to Postures of Foot Bones

Posture	Definition
Plantar flexion/dorsiflexion	Sagittal plane rotation of one foot bone with respect to another
Hindfoot/rearfoot varus	An inward angled hindfoot position in the frontal plane
Hindfoot/rearfoot valgus	An outward angled hindfoot position in the frontal plane
Forefoot varus	An inward angled forefoot in the frontal plane
Forefoot valgus	An outward angled forefoot in the frontal plane
Forefoot adductus	An inward angled forefoot in the transverse plane
Forefoot abductus	An outward angled forefoot in the transverse plane
High arch	Higher than normal medial longitudinal arch
Low arch	Lower than normal medial longitudinal arch
Pes cavus	A foot posture that is characterized by a high arch and hindfoot varus
Pes planus	A foot posture that is characterized by a low arch and hindfoot valgus

Table 2. Terminology Used to Refer to Movements of Foot Bones

Joint	Movements-plane
Ankle	Plantar flexion/dorsiflexion–sagittal
Subtalar (talocalcaneal)	Supination Frontal – Inversion Transverse - Adduction Sagittal - Plantar flexion Pronation Frontal – Eversion Transverse - Abduction Sagittal - Dorsiflexion
Transverse Tarsal (or Chopart's) Joint (Talonavicular and Calcaneocuboid)	Inversion/eversion–frontal Adduction/abduction–transverse Plantar flexion/dorsiflexion–sagittal
Lisfranc Joint (Tarsal – Metatarsal joints)	Inversion/eversion–frontal Adduction/abduction–transverse Plantar flexion/dorsiflexion–sagittal
Forefoot	Inversion/eversion–frontal Adduction/abduction–transverse Plantar flexion/dorsiflexion–sagittal

monograph but the authors have made an attempt to reserve the terms supination and pronation to be used only when referring to movement about an oblique axis or when referring to clinical theory. However, where clinical treatment focuses on assessment in a single plane, this is emphasized.

Functional Anatomy of the Foot and Ankle

The foot and ankle anatomy underscores the interdependent role of bone, ligament, and muscle to maintain function of the foot. The foot is commonly involved in orthopaedic injuries because of the high loads and repetition of loading the foot undergoes in the course of a normal day. Interestingly the foot is able to accommodate to completely opposite roles, that of a rigid lever and that of a flexible, shock absorbing structure. When the foot acts as a rigid lever, the midfoot must be stable to transfer forces to the ground. When the foot is hitting the ground on an uneven surface, the demands now are for shock absorption and conforming to the uneven surface (eg, flexibility). Key anatomical features support these contradictory functions and identify important structures that are at risk of injury. The main joints of the foot are listed in Table 2 and what follows is a discussion of each joint and its supporting ligaments (Table 3).

Foot Bones and Segmentation

The foot is comprised of 28 bones and is commonly segmented into 3 sections (Figure 1). The 28 bones of the foot include 7 tarsal bones, 5 metatarsals, 14 phalanges, and 2 sesamoid bones. The bones comprising the foot are grouped or segmented into the hindfoot (also sometimes referred to as the rearfoot), midfoot, and forefoot (Table 4). The two posterior tarsal bones, the talus and calcaneus, are commonly referred to as the hindfoot (or rearfoot). The tarsal bones anterior to the hindfoot are referred to as the midfoot. The metatarsals and phalanges are referred to as the forefoot.

Articulations and Ligamentous Support

The hindfoot includes the talus and calcaneus and their articulations. The foot connects to the leg through the ankle or talocrural joint. The talocrural joint is formed by the ankle mortise comprised of the distal tibia and fibula, and trochlea of the talus. The motions allowed at the talocrural joint are usually listed as primarily plantar flexion and dorsiflexion; however, our ability to appreciate movement of the talus makes understanding the contribution to motion from the talocrural and subtalar joints

Table 3. Joints of the Foot and Ankle

Bones	Joint	Classification	Key Supporting Ligaments
Ankle mortise (tibia and fibula) and trochlea of talus	Ankle (talocrural)	Hinge, uniaxial	Lateral–anterior talofibular, calcaneofibular Posterior talofibular Medial–deltoid
Talus (inferior facets) and calcaneus (superior facets)	Subtalar (talocalcaneal)	Hinge, uniaxial	Lateral–calcaneofibular Medial–deltoid (parts) Midline–interosseous talocalcaneal
Calcaneus (anterior) and cuboid (posterior)	Calcaneocuboid	Planar, nonaxial	Long plantar and short plantar
Talus (talar head) and navicular (posterior)	Talonavicular	Ball and socket, triaxial	Plantar calcaneonavicular (spring)
Medial cuneiform and second metatarsal	Tarsometatarsal	Planar, nonaxial	Dorsal, plantar, and Lisfranc (interosseous)
Proximal phalangeal and first metatarsal (head)	First metatarsophalangeal	Bicondylar, biaxial	Sesamoid collateral and intersesamoid ligaments bind the sesamoid bones to the joint

Figure 1. Schematic of the Foot Bones and Segmentation of the Foot

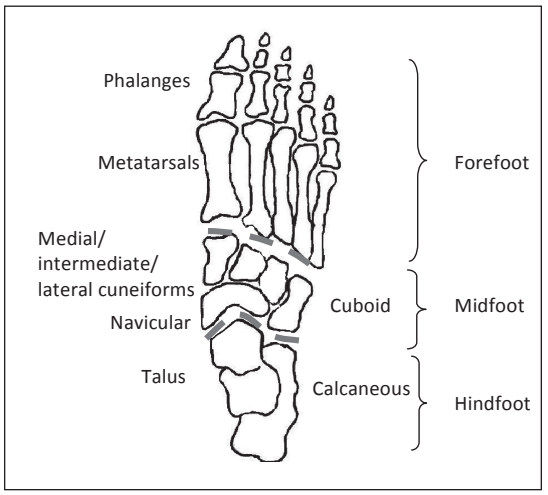

Table 4. Terminology Used to Refer to Groupings (Segments) of Foot Bones

Segment	Bones
Hindfoot	Calcaneus, talus
Midfoot	Cuneiforms, navicular, and cuboid
Forefoot	Metatarsals, phalanges

difficult.[1] The trochlea of the talus is wider anterior than posterior resulting in a tighter fit between the talus and ankle mortise when in dorsiflexion and allows some joint play medial/lateral in plantar flexion. The primary ligaments supporting the ankle joint laterally are the anterior talofibular ligament (ATFL) and calcaneofibular ligament (Figure 2). The ATFL prevents anterior displacement of the talus relative to the ankle mortise. The calcaneofibular ligament (CFL) is taught with inversion and adduction of the calcaneus relative to the fibula. The posterolateral ankle is supported by the posterior talofibular ligament, which is taught in external rotation of the talus relative to the ankle mortise. Extensions of the crural fascia that cover the fibularis longus and brevis tendons are frequently involved in lateral ankle sprains. They include the superior and inferior fibular retinaculum that prevents dislocation of the tendons when these lateral compartment muscles contract.

The subtalar joint is the second major articulation of the hindfoot and plays a major role in foot function. The subtalar joint is formed by the superior bony facets of the calcaneus (may include 2-3 facets) and inferior facets on the talus. The 2 to 3 facets form planar joints that function together resulting in uni-axial or hinge, screw motion, of the subtalar joint (see section Biomechanics of the Foot and Ankle-Subtalar Joint). The ligaments that limit motion at the subtalar joint include the calcaneofibular, cervical ligaments, parts of the deltoid ligament, interosseous talocalcaneal, lateral talocalcaneal ligament, and lateral talocalcaneal ligament. The interosseous talocalcaneal ligament lies in the sinus tarsi running inferior and superior between the talus and calcaneus. Severing the interosseous ligament results in (1) increased range of subtalar joint motion especially toward supination, (2) instability of the subtalar joint, and (3) disconnect between the calcaneus and talus resulting in marked motion between