directed **reading**
CLASSICS®

essential**education**

Imaging in Podiatry

asrt®
American Society of Radiologic Technologists

Imaging in Podiatry

ELIZABETH J CHURCH, JD

This article examines the vulnerability of the foot to injury and disease and the role imaging plays in ferreting out the causes of pain and dysfunction. The discussion includes a broad overview of foot disorders and describes the expanding role played by imaging in the diagnosis and management of foot disorders.

This ASRT Directed Reading Classic was originally published in Radiologic Technology, *September/October 2008, Vol. 80/No.1.*

Visit www.asrt.org/store to purchase other ASRT Directed Reading Classics.

After completing this article, readers should be able to:

- *Understand the anatomy of and various functions performed by the foot.*
- *Describe in general terms the injuries and diseases to which the foot is susceptible, including complications common among patients with diabetes.*
- *Discuss which imaging modalities are most useful in the diagnosis of specific foot problems.*
- *Be aware of why the complexity of the foot's anatomy poses particular imaging challenges.*
- *Explain how imaging assists in assessing the success of different treatments for foot disorders.*

In the United States, approximately 40% of adults suffer from foot problems.[1] Chronic foot pain is not only common but also can affect everyday activities such as walking, standing and driving. Even when patients provide detailed histories and clinicians conduct careful physical examinations, an accurate diagnosis can remain elusive, given the plethora of possible causes.

Imaging is capable of illuminating biomechanics and tissue swelling, and it can help confirm clinical suspicions, distinguish lesions and contribute other facts relevant to the diagnostic puzzle.[2] Sometimes, imaging proves useful in early identification of a degenerative disease process such as rheumatoid arthritis, and it assists in evaluating the effectiveness of different available treatments.

Although the entire spectrum of foot disorders is beyond the scope of this article, a solid range of diseases and anomalies will be examined. Because the complicated, overlapping anatomy of the foot can pose difficulties in terms of patient positioning, choice of imaging modality and interpretation of imaging studies, this article also includes a discussion of practical considerations in the context of each foot disorder.[3]

Foot Fundamentals

Function

The foot is one of the harder-working, if underappreciated, portions of human anatomy. Feet support us; they permit us to walk, run, jump, skip, dance, climb and kick. The importance of the foot is reflected in our language, in which it can be a unit of measurement or a descriptor, such as swift of foot, feet first, foot soldier, underfoot, footman, foot traffic, footbridge and footstool.[4] A person can be knocked off his feet, put her foot in her mouth or, if lucky, get a foot in the door. To evolutionary biologists, the foot is what puts *homo sapiens* in an upright position, gives us eyes that face forward and helps us remain at the top of the food chain.[5]

The human foot evolved to withstand and adapt to a range of stresses resulting from locomotion; it acts both as a shock absorber and rigid lever.[6] Progressive evolutionary changes in the skeletal and soft tissue composition of the foot resulted in a reduction in grasping function, formerly assigned to the big toe (the "prehensile role"), and certain bones enlarged over time to form a sturdy yet flexible structure.[5,6] Development of the heel led to the unique arch of the human foot, forming a structure that provides humans with the

posterior support and stability upon which to balance an upright body.[6]

Basic Anatomy

Feet come in a variety of shapes. Thanks to genetic contributions, some feet are long and narrow and thus more likely to be structurally unstable.[6] Others are short and broad, while still others are triangular with a broad forefoot and narrow heel (reportedly the most vulnerable of the 3 foot types).[6] Because the foot falls at the end of a kinetic chain ("the foot bone's connected to the ankle bone . . . "), it is particularly responsive to variations in normal anatomy and all pathological disorders that fall above it.[7] Often, this means that what appears to be a foot disorder might instead represent a reaction or adaptation to a pathology present in the body above the foot.

The foot is composed of 26 bones, with the hindfoot containing 2 bones (calcaneus, talus), the midfoot 5 bones (navicular, cuboid, 3 cuneiforms) and the forefoot 19 (5 metatarsals, 14 phalanges) (see Figure 1).[8] The foot also contains sesamoid bones, which are small nodular bones embedded in a tendon or joint capsule.[9] Given the number of bones found in the foot, it is not surprising that there are a total of 57 articulation points.[10] The ankle, composed of 7 bones, is designed to provide balance and stability, and it withstands 3 to 5 times the body's weight during normal walking.[11,12] The foot contains 2 other joints: the hindfoot connects to the midfoot at the Charcot joint, and the forefoot connects to the midfoot at the Lisfranc joint.[8]

The skeleton of the foot is surrounded by numerous ligaments that ensure a strong structure.[5] The plantar fascia, which is susceptible to injury and overuse problems, is a strong band of connective tissue that stretches between the inner portion of the calcaneus and the heads of the 5 metatarsal bones. The Achilles, or calcaneal, tendon attaches calf muscles to the calcaneus and is another site of frequent injury.[9] Muscles, nerves and a system of vascularization complete the composition of the foot.

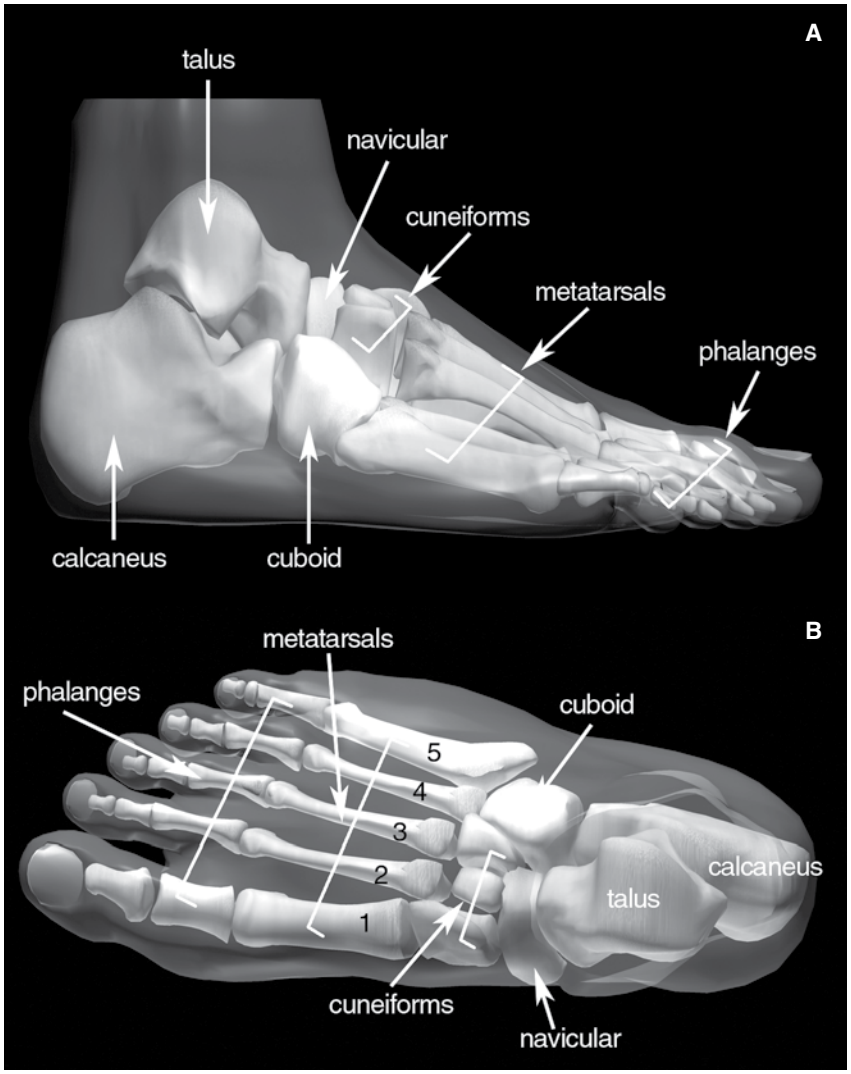

Figure 1. *A. The bones of the foot, lateral view. B. The bones of the foot from above.*

Pediatric Foot Disorders

At birth, the human foot appears flat, and a child's foot is relatively shorter and wider than that of an adult.[7] The flat appearance is due to a fatty pad on the sole of the foot that is absorbed gradually during the first year of a child's life. The shape of a child's foot also differs from that of an adult in that the heel and hindfoot are less developed than the forefoot. As previously stated, the heel is largely responsible for our ability to stand, balance and walk; when that portion of a child's foot becomes more developed, he or she can begin to walk, balance and stand. The ultimate shape of an individual's