MR Imaging of the Midfoot Including Chopart and Lisfranc Joint Complexes

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KEYWORDS

• MR imaging • Midfoot • Chopart joint complex • Lisfranc joint complex

KEY POINTS

- The navicular, cuboid, and 3 cuneiform bones form the midfoot, the anatomic region located between the Chopart and Lisfranc joints.
- Midfoot pathology, involving the osseous and soft tissue structures at the midfoot and at the junction of the midfoot with the hindfoot (Chopart joint complex) and forefoot (Lisfranc joint complex), is a common, albeit elusive cause for pain.
- Navicular, cuboid and cuneiform fractures represent radiographically occult causes of foot pain that often require evaluation with MR imaging.
- MR imaging is the modality of choice for detection of several tendon and ligamentous pathology about the midfoot.

INTRODUCTION

The midfoot, composed of the navicular, cuboid, the 3 cuneiform bones and their interconnecting articulations and ligaments, is located between the Chopart (talonavicular and calcaneocuboid articulations) and the Lisfranc (tarsometatarsal) joints.[1] Forces generated during normal gait are transmitted from the hindfoot to the forefoot through the midfoot.[2] The midfoot remains mobile during the first phase of heel strike and first 15% of the gait cycle and converts to a rigid lever during the toe-rise or push-off phase. Injuries to the midfoot are less common than those of the hindfoot and forefoot and can be easily missed because of lack of obvious radiographic findings in up to 33% of such injuries.[3,4]

Following a brief description of the normal anatomy and biomechanics of the midfoot, this article focuses on imaging features, with emphasis on MR imaging of common osseous, tendon, and ligament abnormalities that affect the midfoot. Discussion of Chopart joint complex and Lisfranc joint complex, both of which play important roles in linking the midfoot to the hindfoot and the forefoot respectively, also is included. Charcot arthropathy, even though it commonly occurs in the midfoot, is beyond the scope of this article, and will not be discussed.

NORMAL ANATOMY OF THE MIDFOOT

The midfoot is located between the Chopart and Lisfranc joints and includes the navicular, cuboid,

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and the 3 cuneiform bones (Fig. 1). The Chopart joint, also known as the Chopart joint complex, or midtarsal or transverse tarsal joint, consists of the calcaneocuboid and talocalcaneonavicular joints (Fig. 2). These 2 joints lie in a plane perpendicular to the longitudinal arch of the foot, and act as a single unit with respect to the hindfoot.[3] The Lisfranc joint complex, also called the tarsometatarsal joint, represents the junction of the midfoot and the forefoot. It consists of several articulations between the 3 cuneiforms, the metatarsals, and the cuboid bone (Fig. 3).[1]

Many tendons traverse or insert at the midfoot, and, thus, are susceptible to injury in this region. The most important tendons include the posterior tibial, the anterior tibial, the peroneus longus, and the flexor hallucis longus tendons. The dorsalis pedis artery traverses the midfoot, on its way distally, between the first and second metatarsal bases, to the plantar surface of the foot to form the plantar arch. The artery may be injured or thrombosed in a midfoot/forefoot fracture-dislocation, resulting in hematoma or compartment syndrome. The deep peroneal nerve follows the dorsalis pedis artery, providing innervation to the extensor digitorum brevis muscle and to the first dorsal web space. Thus, the nerve is also susceptible to entrapment at the dorsal aspect of the midfoot. The medial and plantar nerves contribute to innervation of the plantar region and forefoot.[1]

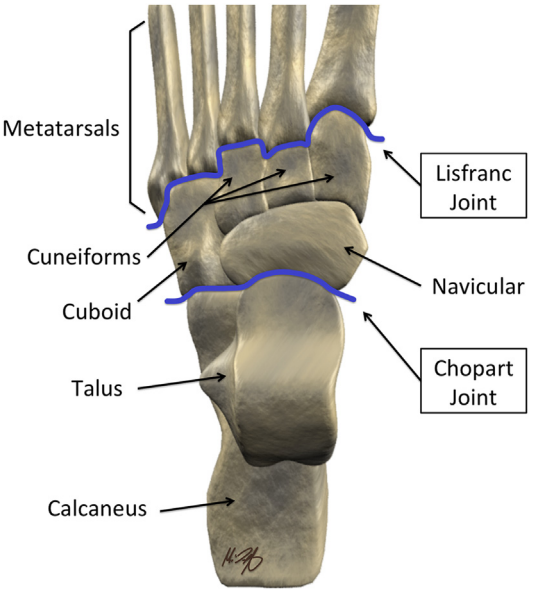

Fig. 1. Normal anatomy of the midfoot. The midfoot contains osseous, ligamentous, and tendinous structures located between the Chopart and the Lisfranc joints.

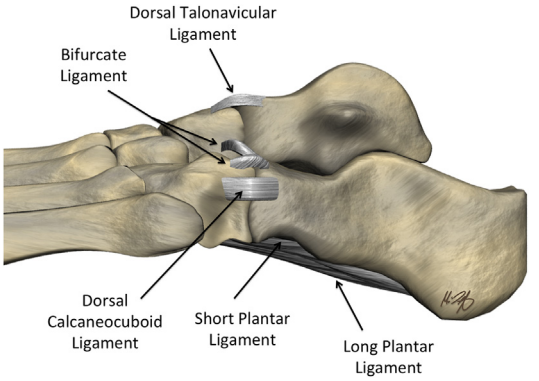

Fig. 2. Normal anatomy of Chopart joint. The dorsal talonavicular, bifurcate, and dorsal calcaneocuboid ligaments are important passive stabilizers of Chopart joint. The short and long plantar ligament help to stabilize the midfoot to the hindfoot.

Biomechanical Properties

Normal biomechanics of the foot are best understood with the use of the column theories. The Chopart joint consists of flexible medial (talus and navicular bones) and lateral (calcaneus and cuboid bones) columns. The more distal medial column, including the cuneiforms and the first, second, and third metatarsals, is limited in motion, providing stability to the transverse and longitudinal arches. The more distal lateral column, consisting of the cuboid fourth and fifth metatarsal joints, is highly mobile accommodating walking on varied surfaces.[3]

The midfoot locks the hindfoot to the forefoot, during the normal gait cycle. Talonavicular motion

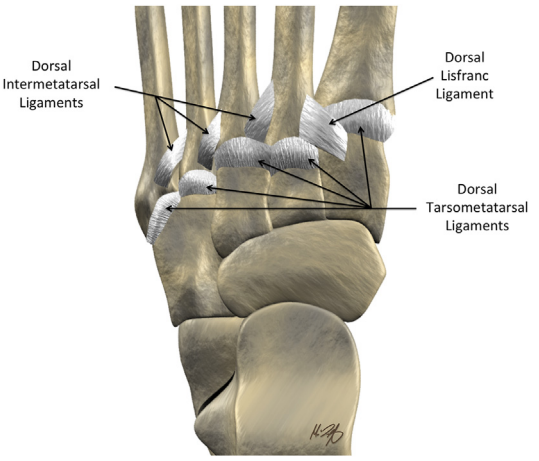

Fig. 3. Normal anatomy of Lisfranc joint. Intricate ligamentous insertions help to stabilize the Lisfranc joint, including the Lisfranc ligament complex, and intermetatarsal and tarsometatarsal ligaments. Only the dorsal ligaments are noted in this drawing.