Midfoot and Forefoot Ultrasound

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The superficial location of most midfoot and forefoot structures facilitates their assessment by ultrasound (US). US enables dynamic evaluation and image-guided interventions for both diagnostic and therapeutic purposes. However, ultrasound assessment remains limited for internal joint structures, subcortical bone, and the deeper plantar soft tissues of the midfoot.

1. Soft tissue masses

Soft tissue masses in the midfoot and forefoot are usually benign. Common lesions include ganglion cysts, plantar fibromas, angioleiomyomas, nerve sheath tumors, lipomas, vascular malformations, and tenosynovial giant cell tumors (TSGCT). In most cases, US allows accurate characterization without biopsy or additional imaging. MRI is useful when lesions are large or when their deep extent is not fully defined on US.

2. Morton's neuroma

Morton's neuroma is a common cause of metatarsalgia and represents perineural fibrosis of the interdigital nerve rather than a true neoplasm. It most often involves the third intermetatarsal space, followed by the second. On US, it appears as an oval or ginkgo leaf–shaped mass with variable echotexture. An enlarged interdigital nerve may be seen. Dynamic maneuvers, such as Mulder's maneuver, aid in detection. Most symptomatic lesions exceed 5 mm in transverse diameter, although size does not always correlate with symptoms, and multiple lesions may be present. The differential diagnosis includes intermetatarsal bursitis, tendon sheath ganglion, MTP joint synovitis, and nerve sheath tumors.

3. Bursitis

Intermetatarsal bursae are synovial-lined structures located dorsal to the intermetatarsal ligament. A transverse diameter greater than 3 mm is considered abnormal.

Adventitial bursitis occurs at pressure points, most commonly near the first and fifth metatarsal heads. When located plantar to the metatarsal heads, it is termed submetatarsal bursitis.

Diffuse submetatarsal alteration (DSMA), or fat pad atrophy, is a common cause of metatarsalgia and appears as thinning with poorly defined edema of the plantar fat pads on US.

4. Plantar plate injury of the lesser toes

The plantar plate is a fibrocartilaginous structure that stabilizes the MTP and interphalangeal joints and prevents hyperextension. Injuries most commonly involve the lateral distal insertion at the second MTP joint. These injuries cause pain and may lead to deformities such as dorsal dislocation, flexor tendon subluxation, and crossover toe deformity. On US, the normal plate appears as a homogeneous, mildly echogenic structure, whereas injury is seen as focal defects or thinning, often accentuated during toe dorsiflexion. Pericapsular fibrosis may mimic Morton's neuroma; distinguishing features are summarized in the Table.

Feature	**Pericapsular fibrosis (pseudoneuroma)**	**Morton's neuroma**
location	2nd > 3rd MTP joint	3rd > 2nd intermetatarsal space (IMS)
shape	crescent-shaped	round or ovoid; ginkgo leaf-shaped
base of lesion	eccentric (along the lateral/plantar lateral capsule)	central within the IMS (along the course of the interdigital N)
plantar plate integrity	degeneration or tear of the plantar plate	usually normal
MTP joint stability (Hamilton-Thompson test)	may be positive (unstable)	negative (stable)

5. Joint disorders

US is a valuable modality for evaluating crystal arthropathies, including gout and CPPD. It is particularly useful for early diagnosis and monitoring of gout, which most commonly affects the first MTP joint. Patients may present with acute pain mimicking septic arthritis or with chronic tophaceous disease. Diagnosis is typically established with radiography and US.

In rheumatoid arthritis, US and MRI can detect subclinical synovitis and tenosynovitis, while MRI additionally demonstrates bone marrow edema. Imaging is usually focused on the most symptomatic joint to optimize efficiency.

6. Osseous injury

Stress fractures most commonly involve the second, and less frequently the third, metatarsal midshaft. Early radiographs may be normal, whereas US can demonstrate periosteal thickening (periostitis) along the cortex.

Sesamoid disorders are common. Bipartite sesamoids show smooth, corticated margins and a larger combined size, whereas fractures typically demonstrate irregular, non-corticated, oblique margins.

7. Foreign body granuloma

Foreign body granulomas typically occur in the plantar subcutaneous tissues. Radiographs can detect radiopaque materials, whereas US is preferred for radiolucent foreign bodies such as wood or plastic.US enables precise localization and assessment of associated soft tissue injury. Foreign bodies appear echogenic, often with a surrounding hypoechoic halo of granulation tissue, with or without Doppler hyperemia.

Summary

US is well suited for evaluating the midfoot and forefoot due to its ability to assess superficial structures, provide dynamic evaluation, and allow real-time correlation with symptoms. It is often sufficient as a primary imaging modality and can be supplemented by radiography, CT, or MRI when needed.