63 Tarsometatarsal arthritis

63.1 Introduction

Tarsometatarsal (TMT) arthritis is a debilitating condition characterized by midfoot instability, severe functional impairment, and pain. The most common cause of midfoot arthritis is post-traumatic arthritis, followed by primary osteoarthritis and other inflammatory processes. Patients with secondary degeneration become symptomatic earlier than those with primary osteoarthritis, usually in the fourth decade as compared to the sixth decade.\textsuperscript{12,19} The most common area of secondary midfoot arthritis is from Lisfranc injuries, resulting in degeneration of the 1st, 2nd, and 4rd TMT joints. In the case of primary osteoarthritis, the 2nd and 3rd joints are most commonly involved.

Injury to the TMT complex occurs in 1 in 55,000 person per year in the United States, which accounts for 0.2\% of all fractures.\textsuperscript{11} Unfortunately, 20\% of these injuries are misdiagnosed or undiagnosed at time of injury.\textsuperscript{5} The mechanisms for TMT joint complex injury are caused by either direct or indirect trauma. These injuries generally are caused by motor vehicle collisions (40-45\%), followed by lower-energy mechanisms (30\%). High-energy trauma is usually directed to the dorsum of the foot with resultant significant soft tissue and bony crushing injuries. Indirect trauma may occur when there is unusual axial loading of the plantarflexed foot.\textsuperscript{24}

Midfoot arthritis may also result from long-standing pes planus. Loss of the longitudinal arch, hindfoot valgus, and forefoot abduction are common features of midfoot arthritis caused by acquired flatfoot.\textsuperscript{14}

63.2 Anatomy
Reviewing the bony and ligamentous structures of the TMT complex is integral in highlighting midfoot biomechanics and subsequent pathology. The tarsometatarsal complex divides the midfoot from the forefoot. The midfoot itself is anatomically divided into three longitudinal columns:\(^{15}\)

- **Medial**, composed of the 1st metatarsal and medial cuneiform
- **Middle**, composed of 2nd and 3rd metatarsals and the intermediate and lateral cuneiform, with the navicular bridging the medial and middle columns
- **Lateral**, composed of the 4th and 5th metatarsals and cuboid

The Lisfranc joint complex structurally supports the transverse arch of the foot. Its strength and stability is inherent in the bony and ligamentous anatomy. The middle cuneiform is recessed by approximately 8 mm to 4 mm proximal to the medial and lateral cuneiforms, respectively. This recess allows for the 2nd metatarsal to articulate with five osseous structures (which includes the three cuneiforms).\(^{15}\) Coronally, the bases of the 2nd, 3rd, and 4th metatarsals are trapezoidal and make up a “Roman arch” configuration which further enhances stability.\(^5\)

The Lisfranc joint is further stabilized by many robust ligaments, as organized by dePalma et al.\(^2\) The anatomic organization is divided into plantar, dorsal, oblique, transverse, and interosseous. The transverse ligaments run plantarly and dorsally between the bases of the 2nd through 5th metatarsals. Instead of a transverse ligament between the 1st and 2nd metatarsal, there are plantar, interosseous, and dorsal oblique ligaments that runs from the medial cuneiform and the base of the 2nd metatarsal. The oblique interosseous ligament, also known as the Lisfranc ligament, is the strongest and most robust of all the midfoot ligaments. The Lisfranc ligament itself runs from the second metatarsal base to the medial cuneiform.

### 63.3 Biomechanics

The sagittal motion of each tarsometatarsal joint increases the more lateral in position (Table 1).\(^{13}\)

<table>
<thead>
<tr>
<th>TMT joint</th>
<th>Motion (°)</th>
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<tbody>
<tr>
<td>1(^{st})</td>
<td>1.6</td>
</tr>
<tr>
<td>2(^{nd})</td>
<td>.6</td>
</tr>
<tr>
<td>3(^{rd})</td>
<td>3.5</td>
</tr>
<tr>
<td>4(^{th})</td>
<td>9.6</td>
</tr>
<tr>
<td>5(^{th})</td>
<td>10.2</td>
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Solan and colleagues evaluated the biomechanical characteristics of the midfoot ligaments, and they discovered that the dorsal ligaments are weaker than the plantar ligaments and that the Lisfranc ligament is the strongest.\(^{22}\) In a Lisfranc injury, therefore, the dorsal ligaments are most likely to tear first, followed by the plantar ligaments and, finally, the Lisfranc ligament.
During gait, the TMT joint complex and the Chopart joint (calcaneocuboid and talonavicular joint) allow for load transmission from the hind to the forefoot. The Chopart joint is flexible during heel strike (increases efficiency of gastroc-soleous complex) and rigid during toe-off, which then transfers the forward movement through to the TMT joints.\(^{13}\)

### 63.4 Clinical Presentation

Patients with midfoot arthritis present with pain localized to the involved TMT joints. This pain may be aggravated by activities that require the midfoot to be rigid, such as heel rise (walking up stairs) and walking on level surfaces.\(^{14}\) Flatfoot deformity may also be present; 78% of patients complain of difficulty with shoe wear or unusual foot posture.\(^{10}\)

Because the majority of patients with midfoot arthritis have had prior trauma, it is important to ask patients about any relevant trauma to the foot.

### 63.5 Pathogenesis

After an injury, the midfoot may become unstable due to a loss of the bony and ligamentous architecture. This, in turn, alters midfoot loading, which may cause the longitudinal arch to collapse, increasing plantar ligament loading in the foot and decreasing the rigid level arm needed during midstance phase of the gait cycle.\(^{4}\)

### 63.6 Physical Examination

On examination, assess the positioning of the hind-, mid-, and forefoot and take note of any rotational or coronal abnormalities. Palpate each TMT joint in a standardized manner. The medial-most TMT joint is first localized by palpating for the medial-most dorsal prominence near the joint. Once this is identified, the joint is palpated and stressed. Any prominent bossing at this joint may cause skin irritation during shoe wear. The 2nd TMT joint is approximately 1-2 cm proximal to the 1st TMT joint. Again this joint should be stressed. The 3rd TMT joint is in line with the 1st and should be palpated along with the 4th and 5th TMT joints. As stated before, the range of motion at each of these TMT is subtle and not clinically relevant.

A useful provocative maneuver is to dorsally and plantarly translate the 1st ray while stabilizing the 2nd through 5th TMT joints. This may reveal subtle arthritic pain. Of note, one should also determine if there is an Achilles contracture as some surgeons will release a tight gastrocnemius tendon at the time of TMT fusion.

Patients who suffer midfoot arthritis also have a “stiffening strategy” during walking.\(^{18}\) The patient will try to reduce the range of motion of the 1st metatarsal. However, with increased activity, the midfoot decompensates due to its lack of stability, allowing for an increase in calcaneal eversion and 1st metatarsal dorsiflexion.

### 63.7 Imaging
Weight-bearing anteroposterior (AP), lateral, and oblique radiographs are the most useful imaging modality for evaluating for midfoot arthritis (Figures 1-2). Both post-traumatic arthritis and primary degenerative arthritis of the TMT joint complex can have a more pronated foot position. This pronation is made apparent by the lower medial cuneiform along with a negative talo-1st metatarsal angle. The AP radiographs may reveal an old Lisfranc injury, as demonstrated by incongruous 1st and 2nd TMT joints. Lateral radiographs may reveal a flattening of the longitudinal arch as well as a sagging medial column at either of proximal or distal articulations.

Figure 1.

Figure 2.

While not necessary, a CT scan may be useful to determine the bony anatomy of the arthritic midfoot.

63.8 Conservative Treatment

The goal for conservative treatment of midfoot arthritis is to balance the need for midfoot stability and midfoot function. The first line of management is non-steroidal anti-inflammatory drugs (NSAIDs). While, they may be helpful in managing pain, their chronic use comes at a cost of adverse effects on the gastrointestinal and cardiovascular systems.
Concurrently, either shoe modification or orthoses should be prescribed to alter the loading of the TMT joints. Shoes wear may be modified by wearing rocker-bottom or stiff-soled shoes. Rocker-bottom soles help to facilitate the transfer of load from the hindfoot to the forefoot, bypassing the TMT joints. Stiff-soled shoes attempt to mimic the “stiffening strategy” that a patient with midfoot arthritis develops with normal gait. The strategy is to limit 1st metatarsal range of motion. Stiff carbon fiber, full-length inserts can be used in place of a stiff-soled shoe and are easily transferable between shoes; however, they can be uncomfortable in the shoe. Further motion-limiting orthoses may be used such as the ankle foot clamshell orthosis coupled with a rocker-bottom sole. However, this increased stability comes at the cost of function.

Injectable therapy includes corticosteroid and hyaluronic acid. There are few studies that rigorously look at the efficacy of these treatments. However, Drakonaki et al studied 59 patients with ultrasound-guided steroid injections into the midfoot. Most patients experienced partial pain relief for up to 3 months.

### 63.9 Operative Treatment

Patients who fail conservative management and who wish to pursue more aggressive treatment strategies may be candidates for operative management. Pre-operatively, each symptomatic joint should be identified. This can be further investigated with intra-articular anesthetic injection of the specific joint if necessary. The mainstay of treatment of midfoot arthritis is arthrodesis and is conceptually separated into treatment for medial and middle column arthritis and treatment for lateral column arthritis.

#### 63.9.1 Medial and Middle Column Arthrodesis

This arthrodesis requires fixation of the 1st, 2nd, and sometimes the 3rd TMT joints along with their intercuneiform joints (Figure 3). The naviculocuneiform joints may need to be included in this fusion if found to be unstable on examination or radiographically. Successful fusion requires appropriate preparation of the bony surfaces with removal of cartilage, restoration of foot rotation, and rigid stabilization.

Outcomes are favorable. Patients who underwent this type of arthrodesis had improved AOFAS scores, from 44 to 78, 3 years after surgery. Significant improvements have been seen in gait (59.7%), alignment (47.1%), and pain (60.5%). The best predictor of long-term outcomes in midfoot arthrodesis is the quality of anatomic reduction of the TMT joint complex. Approximately 83% to 97% of all patients fuse, with older patients having the highest risk for nonunion. Long-term complications include metatarsalgia, reflex sympathetic dystrophy, and neuritis.
63.9.2 Lateral Column Arthrodesis and Its Controversy*

Management strategies for lateral column arthritis are varied and controversial. Because the lateral column is more mobile compared with the other columns, some surgeons argue that motion must be preserved. Komenda et al argue that fusion may result in increased rates of metatarsal stress fractures, chronic lateral foot pain, and increased rate of nonunion. However, Raikin and Schon argue that lateral column arthrodesis may benefit patients with lateral column collapse, rocker bottom deformity, and severe pain.¹⁶

There are two attractive motion-sparing procedures to treat lateral column arthritis:
Lateral TMT joint resection with peroneus tertius soft-tissue interposition
Ceramic interpositional arthroplasty

Both procedures result in significantly decreased pain,¹²¹ although each may have its own unique complications.

63.10 Controversy

Please see above in regards to operative treatment of lateral column arthritis.

63.11 References


