

Diagnosis of *turf toe* on MR image: report of a clinical case

Diagnóstico de *turf toe* por imagen de RM: presentación de un caso clínico

Ricardo Uribe González[1]
Mauricio Estrada Castrillón[2]
Esteban Marín Ortega[3]
https://doi.org/10.53903/01212095.273

Key words (MeSH)

Foot injuries
Magnetic resonance imaging
Metatarsophalangeal joint

Palabras clave (DeCS)

Traumatismos de los pies
Articulación metatarsofalángica
Imágenes por resonancia magnética

Summary

To present a clinical case of *turf toe,* in the context of an amateur soccer player patient, making a practical review of the normal anatomy of the first metatarsophalangeal joint and pointing out some details about the sequences of magnetic resonance imaging used for the assessment, diagnosis and classification of said entity. Review of the literature and evaluation of images from the PACS *(Picture Archiving and Communication System)* and clinical history of an illustrative case of the pathology and anatomy of the metatarsophalangeal of the first toe.

Resumen

Se presenta el caso clínico de *turf toe,* en el contexto de un paciente jugador aficionado de fútbol. Se hace una revisión práctica de la anatomía normal de la primera articulación metatarsofalángica y se puntualizan algunos detalles acerca de las secuencias de resonancia magnética usadas para la valoración, diagnóstico y clasificación de dicha entidad. Se hizo una revisión de la literatura y evaluación de imágenes del PACS (Picture Archiving and Communication System) e historia clínica de un caso ilustrativo de la patología y anatomía de la metatarsofalángica del primer dedo.

Introduction

Turf toe is a term used to describe a group of injuries affecting the plantar capsul-ligament complex, tendons, cartilage and bony structure of the first metatarsophalangeal (MTP) joint. The mechanism of injury is multifactorial, but commonly involves hyperextension of the first MTP joint resulting from an axial load applied to the heel in a fixed position of forefoot hyper-dorsiflexion (1).

The concept of *turf toe* was introduced in the 1970s at West Virginia University, when Bowers and Martin used it to name a first MTP joint injury in soccer players wearing flexible-soled shoes on synthetic turf (2); however, today, it is used for all injuries, regardless of playing surface and type of sport, to the plantar aspect of the first MTP joint (3, 4). These injuries are infrequent, however, there is an apparent increase in their incidence nowadays, due to the greater knowledge of these conditions, the evolution of footwear towards lighter shoes and the use of artificial surfaces.

Good quality magnetic resonance imaging (MRI), coupled with detailed knowledge and evaluation of the anatomy of the first MTP joint, allows proper diagnosis of the turf toe, as well as determining the severity of the injuries and is essential for directing effective treatment (1).

Case

A 38-year-old male, with no important pathological history, who, while playing soccer on a synthetic turf field, suffered trauma to the first MTP joint of the left foot after forced hyperdorsiflexion of the forefoot. Physical examination revealed edema and ecchymosis adjacent to the lateral and plantar aspect of the joint associated with functional limitation for active and passive range of motion.

MRI without contrast medium of the first toe of the left foot showed: osteophyte formation in the head of the first metatarsal and in the medial sesamoid; subchondral cysts and bone edema with fluid in the MTP joint; high signal of the lateral sesamoid-phalangeal ligament with loss of continuity of its fibers; poor definition and high signal of the lateral metatarsophalangeal ligament (collateral), and fluid in the first intermetatarsal bursa (Figure 1).

[1]Medical specialist in Radiology. CES University. Section of Osteomuscular Radiology, Department of Radiology, Hospital Pablo Tobón Uribe. Medellin, Colombia.

[2]Specialist in Radiology. University of Antioquia. Osteomuscular Radiology Section, Department of Radiology, Hospital Pablo Tobón Uribe. Medellín, Colombia.

[3]General Physician. University of Antioquia. Radiology Resident. University of Antioquia. Department of Radiology, Pablo Tobón Uribe Hospital. Medellín, Colombia.

Discussion

The first MTP joint is a complex structure consisting of three joints: the metatarsophalangeal and two metatarsosesamoid (MTS); the capsuloligamentary complex (CLC) provides stability to these joints, as it is a confluence of soft tissue consisting of the sesamoid-phalangeal ligaments (SPL), the metatarsosesamoid ligaments (MTSL), the intersesamoid ligament (ISL), the joint capsule, the plantar capsule/plate and the collateral ligaments; Additionally, the tendons of the medial and lateral heads of the short flexor, abductor and adductor muscle of the first toe also support the CLC and fuse with the capsule, while inserting into the sesamoids and the first proximal phalanx (1-5) (Figures 2 to 5). All CLC and osteoarticular components of the first MTP joint should be carefully evaluated on MR imaging. Table 1 presents each of the aforementioned structures.

The most important mechanism of injury in *turf toe* is hyperextension of the MTP joint of the first toe with fixed plantar flexion of the foot during axial loading. In this hyperextension, force is applied especially to the SPLs (4), which makes them more vulnerable to trauma and uni- or bilateral injury; the medial SPL is most often affected.

Anderson described a classification system for *turf toe* based on severity (6). This system divides injuries into three grades using MRI to identify the injured structures of the CLC (3, 4). This classification is summarized in Table 2. The lesion in the case described was classified as grade III due to total rupture of the lateral SPL fibers.

Table 1. Anatomical and MRI considerations of the *turf toe*

Structure of the *turf toe*	Comments
Sesamoid-phalangeal ligaments	Thicker ligaments of the plantar capsule, they are more frequently injured. Partial or complete tear may occur with uni or bilateral involvement; in this case, it is associated with sesamoid migration. MRI: They are evaluated in sagittal images, characteristically have a uniform low signal in T2W and PDW sequences.
Metatarsals-samoid ligaments	They are thin ligaments, difficult to differentiate from the capsules and adjacent muscle. MRI: They are best identified in the sagittal plane.
Intersessamoid ligament	Located between the medial and lateral sesamoids. In case of injury, concomitant dislocation of the sesamoids and tear of the plantar capsule should be ruled out. MRI: They are best seen in coronal and axial planes.
Plantar capsule/plate	Difficult to visualize on MRI. MRI: Thickened or surrounded by fluid in case of injury.
Medial and lateral collateral ligaments	Provide medial and lateral stability to the MTP joint. In cases of tear, this is more common in the proximal insertion due to greater mobility of the phalanx with respect to the metatarsal. MRI: It is evaluated in axial slices.
Muscles and tendons	Short flexor, adductor and abductor muscle of the first toe. MRI: They are observed in axial PDW or T2W FS sequences as low signal linear structures. Muscle mass is evaluated in coronal T1W sequences to see atrophy.
Bone and osteochondral structures	Stress fractures of the sesamoids are common, mainly of the medial sesamoid. MRI: Evaluate the bone marrow on T1W/T2W to assess bone edema. Sesamoid diastasis and bone fractures should be evaluated by computed tomography (CT) or conventional radiography.

MRI: magnetic resonance imaging; PDW: proton density-weighted sequence; T1W: T1-weighted sequence; T2W: T2-weighted sequence; T2W FS: T2-weighted sequence with fat saturation; MTP: metatarsophalangeal.

Source: Own elaboration based on references (1-4).

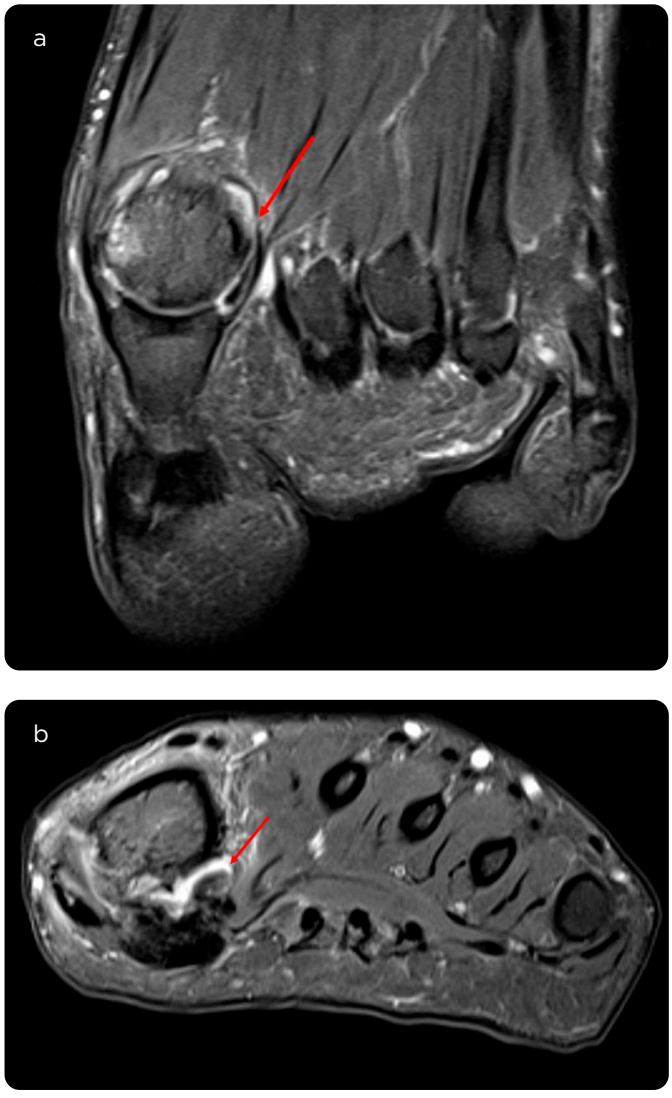


Figure 1. Proton density weighted sequence MRI with fat saturation (PDW FAT-SAT). a) Coronal section. b) Axial section. Rupture of the lateral phalangeal and lateral metatarsophalangeal (collateral) sesamoid ligament (arrow), due to turf toe with osteoarthritic changes and joint effusion. The patient received conservative management with good clinical evolution.

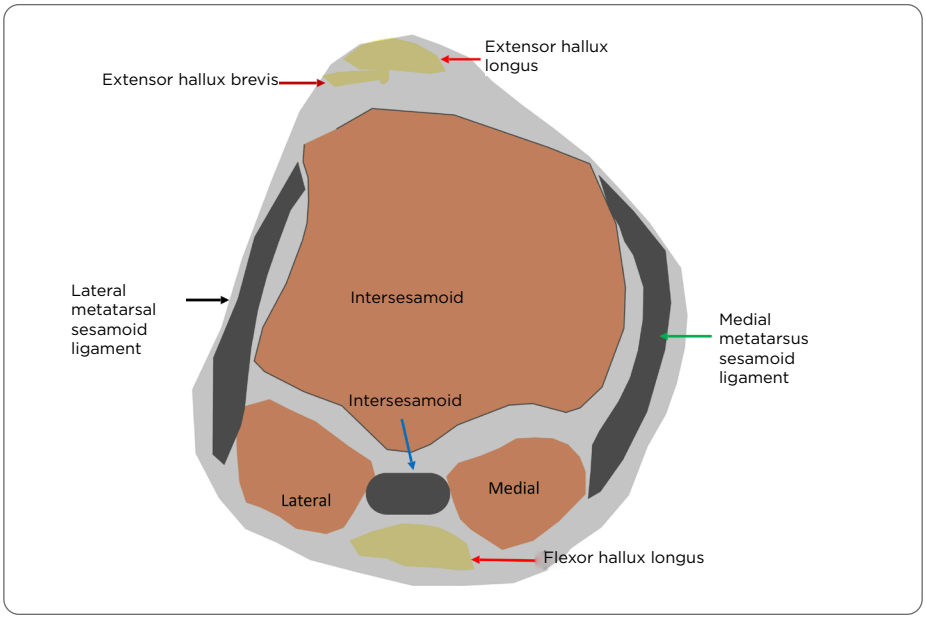


Figure 2. Coronal anatomical diagram showing the different ligaments between the first metatarsal, medial and lateral sesamoid. Source: Authors' elaboration.



Figure 3. MRI sequence T1W. Coronal section. The medial (yellow arrow) and lateral (red arrow) collateral ligaments are observed, with low signal, without loss of continuity or fluid around them.

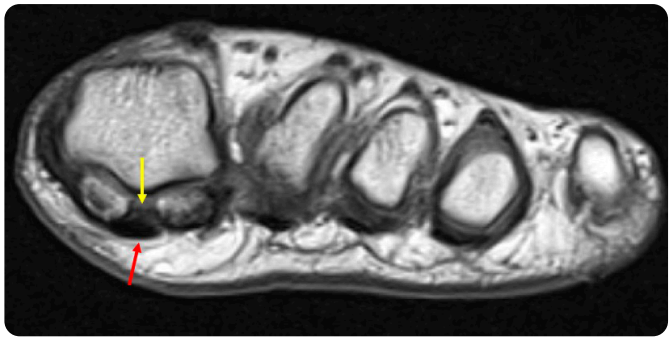


Figure 4. MRI sequence T1W. Axial section. The intersesamoid ligament is observed (yellow arrow) joining the two sesamoid bones. The flexor hallux longus tendon is found plantar to it (red arrow).

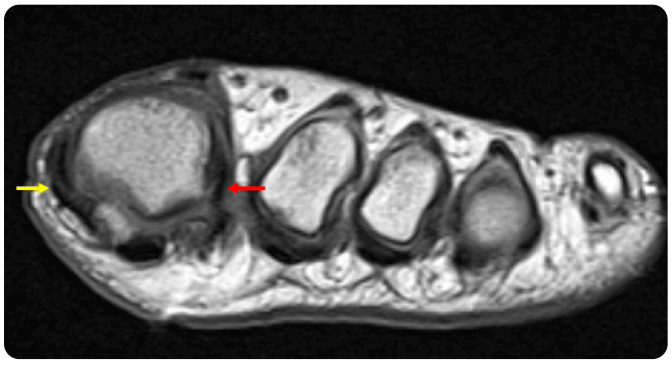


Figure 5. MRI sequence T1W. Axial section. The medial (yellow arrow) and lateral (red arrow) sesamoid-phalangeal ligaments are observed with low signal.

Table 2. Anderson classification in *turf toe*

Grade of injury	Characteristics
I	Stretching of the plantar complex. No ligament tear. Focal pain and mild edema without hematoma. Recovery 3-5 days.
II	Partial ligament tear. Diffuse pain, moderate edema, ecchymosis and moderate functional limitation. Recovery up to 2 weeks.
III	Complete disruption of the plantar complex. Complete tear of the ligament. There may be sesamoid fracture or bipartite sesamoid diastasis. Intense pain. Edema and hematoma of the soft tissues and severe functional limitation. Prolonged recovery, up to 6 months.

Source: Own elaboration based on references (4, 6).

MRI evaluation should be performed in patients with clinically suspected grade II or III lesions. The MRI protocol should include at least one T1-weighted (T1W) or proton density weighted (PDW) sequence without fat suppression in all three planes to observe the bony structures and general anatomy. It should be noted that PDW sequences provide greater detail of ligaments and tendons and better delineation of the chondral surfaces (1-4). In addition to these anatomical sequences (for optimal evaluation of the first MTP joint), it is recommended to add fat-suppressed T2-weighted (T2W) images in the three planes, these could be short tau inversion recovery (STIR) sequences, fat-suppressed T2W sequences or fat-suppressed PDW sequences, to observe in detail the acute pathology, according to institutional preference (1-4). In the present case, PDW, T1W, T2W and fat-suppressed PDW images were obtained.

Among the diagnostic findings of turf toe on MRI, the following should be noted:

- Plantar complex sprains are seen as mild edema of the soft tissues surrounding the plantar facet at the sesamoids, ligaments and capsule.
- The SPLs remain intact with uniformly low signal intensity, as well as normal signal in the sesamoid bone marrow (4).
- In partial tearing of the SPLs, ligament thinning and edema of the surrounding soft tissues are observed in acute cases (3, 4, 7, 8).
- Complete disruption of the plantar complex involves a complete tear of one or both SPLs. Acute tears are best visualized on the sagittal T2W sequence and are differentiated by discontinuity of the normal low signal ligament with intermediate fluid signal and possible disruption of the joint capsule.
- The lack of contiguous fibers extending from the base of the proximal phalanx to the sesamoid confirms a full-thickness tear of the SPL (3, 4, 7, 8).
- Acute sesamoid injuries correspond to increased T2 signal at the fracture site, with an associated low T1 signal and distraction of the sesamoid fragments (4).
- Muscle lesions generally correspond to strains of the short flexor, adductor and abductor muscle of the first finger, these are diagnosed by the increase of the signal similar to edema in T2W sequences with fat suppression in the muscle belly, which are often continued in the muscle-tendon junction (4, 7).
- Osteochondral and cartilaginous lesions are visualized on coronal T2W or PDW images as focal absence of normal cartilage signal replaced by fluid signal; in total cartilage loss, underlying bone marrow edema or cystic changes may be seen (3, 4, 7, 8).
- Lesions of the ISL are uncommon and may be the result of severe trauma, such as hallux luxation, visualized in coronal T2W images, with fluid signal and discontinuity of the ISL adjacent to the sesamoids (4).
- MTSL tears occur at the proximal insertion of the neck of the first metatarsal, although they are less common than SPL tears. These lesions are best visualized on coronal T2W or PDW images (3, 4).

Regarding treatment, in most cases, management is conservative; however, some MRI findings are indicative of surgical management, as is the case of capsular avulsion with joint instability, which may be related to complete SPL or MTSL tears with involvement of the capsule or collateral ligaments in hallux varus or traumatic valgus. Diastasis of a bipartite sesamoid or fracture, sesamoid retraction and osteochondral bodies in the first MTP joint are other indications for surgical repair (3). In the clinical case presented, conservative management was performed, with adequate evolution of the patient and reintegration to sports activity 6 months after the trauma.

Conclusion

Injuries to the first metatarsophalangeal joint are uncommon, but their incidence has increased due to the change in the terrains where sports are played and the type of footwear worn. The term *turf toe* includes all injuries of said articulation. Imaging plays an important role in diagnosis and classification, especially MRI, to allow proper management.

References

1. Crain JM, Phancao JP, Stidham K. MR imaging of turf toe. Magn Reson Imaging Clin N Am. 2008;16(1):93-103.
2. Clough T, Majeed H. Turf toe injury - current concepts and an updated review of literature. En: Foot and ankle clinics. Elsevier; 2018. p. 693-701.
3. Hallinan JT, Statum SM, Huang BK, Bezerra HG, García DAL, Bydder GM, et al. High-resolution MRI of the first metatarsophalangeal joint: Gross anatomy and injury characterization. RadioGraphics. 2020;40(4):1107-24.
4. Perry M, Pierce M. Imaging of Turf Toe. Clin Sports Med. 2021;40(4):755-64.
5. Watson TS, Anderson RB, Davis WH. Periarticular injuries to the hallux metatarsophalangeal joint in athletes. Foot Ankle Clin. 2000;5:687-713.
6. Anderson RB. Turf toe injuries of the hallux metatarsophalangeal joint. Tech Foot Ankle Surg. 2002;1(2):102-11.
7. Schein AJ, Skalski MR, Patel DB, et al. Turf toe and sesamoiditis: what the radiologist needs to know. Clin Imaging. 2015;39:380-9.
8. York PJ, Wydra FB, Hunt KJ. Injuries to the great toe. Curr Rev Musculoskelet Med. 2017;10:104-12.

Correspondence

Esteban Marín Ortega
Carrera 84 # 75C-77 Medellín, Colombia
esteban.marino@udea.edu.co

Received for evaluation: January 25, 2023
Accepted for publication: April 16, 2023