Prospective observational study of midtarsal joint sprain: Epidemiological and ultrasonographic analysis

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1. Introduction

Midtarsal joint sprain (MJS, also known as Chopart’s joint sprain) has been little studied. Foot and ankle injuries (FAI) are the most frequent traumas seen in consultation in France: about 6000 per day [1]. Lateral ankle sprain (LAS) is the most frequent diagnosis, whereas MJS is less well-known and less frequently considered.

The midtarsal joint comprises the talonavicular joint medially and the calcaneocuboid laterally. It lies along an oblique superior-to-inferior medial-to-lateral axis at 45° to the horizontal, and forms a hinge allowing naviculocuboid displacement in supination (inferomedical) and pronation (superolateral) [2,3]. It is stabilized by dorsal ligaments (from medial to lateral: talonavicular [TNL], bifurcated [BL] and dorsal and plantar calcaneocuboid [CCl] [4]). Plantar ligament lesions are rare and secondary either to high-energy trauma causing joint fracture-dislocation [5] or to forced inversion [6].

The present study concerned sprain involving the 3 dorsal ligaments of the midtarsal joint, with trauma comparable to that found in LAS: i.e. mainly forced inversion of the foot [7,8].

We suspect that, in FAI management in A&E departments, MJS is often overlooked and mistaken for LAS [9]. As treatment is specific, precise identification seems essential to avoid functional sequelae due to misdiagnosis.

The present prospective study analyzed the frequency and epidemiology of MJS and detailed clinical characteristics and diagnosis on a precise ultrasound protocol.

2. Patients and methods

2.1. Inclusion criteria

A single-center prospective study enrolled patients in the Accident and Emergency department of our institution, between June 1st, 2012 and September 30th, 2013. Patients presenting with FAI at admission underwent standardized clinical examination, with a report-form detailing signs predictive of MJS: audible crack at trauma, total persistent functional impotence (inability to place the foot on the ground), ecchymosis or hematoma adjacent to the midtarsal joint, and/or pain on palpation of the dorsal side of the joint or joint mobilization. The form also recorded the principal location...
of pain reported by the patient, according to 4 regions: adjacent to the medial collateral ligament of the ankle, lateral collateral ligament, talonavicular joint or calcaneocuboid joint. AP ankle view in 30° internal rotation, lateral ankle view and AP and three-quarter foot views were systematically taken in all cases of FAI.

In case of ≥1 sign (predictive of MJS without radiographic bone lesion, other than bone avulsion of the ligament insertion), ultrasound examination of all foot and ankle ligaments was performed by an experienced radiologist specialized in osteoarticular radiology, using a 10–12 mHz ultrasound probe; results were recorded for each ligament of the foot (dorsal talonavicular and Lisfranc ligaments) and ankle (lateral and medial planes and tibiofibular ligaments). Results were classified as normal or sprain, in 3 grades [10]: grade 1, benign, with simple ligament stretching; grade 2, moderate sprain with partial ligament tear or partial bone avulsion; and grade 3, severe sprain, with complete tear or complete bone avulsion.

The main inclusion criterion was an ultrasound lesion in at least 1 of the 3 dorsal midtarsal ligaments. MJS could be associated with other ligament lesions, constituting 3 groups: isolated MJS (MJSi), MJS with LAS (MJS + LAS), and isolated LAS (LASi). Other associations and normal ultrasound results were excluded from the study (Fig. 1).

2.2. Epidemiology

Clinical and ultrasound characteristics were first studied in the overall MJS population. Comparison of clinically painful regions and lesion location on ultrasound showed concordance between the two. Comparison was then made between clinical characteristics in the MJSi and LASi groups.

2.3. Statistics

Quantitative variables were compared between groups on Student t tests and qualitative variables on Chi² tests, using R Project® software. The significance threshold was set at $P<0.05$.  

![Foot and Ankle Trauma Flowchart](image-url)
3. Results

3.1. Inclusion

The study was performed on a continuous basis, for a 16-month period, during which 2412 patients came to A&E with FAI. A total of 188 (8%) showed ≥1 sign predictive of MJS without radiographic fracture, and underwent ultrasonography. Ultrasound diagnosed MJS in 82 of the 188 patients (44%), with MJSi in 60 of the 82 cases (73%), the other 22 MJSs being associated with other ligament lesions: 20 MJS + LAS, and 2 MJS with lesion of 1 of the 2 collateral ankle ligaments. 61 of the 188 patients (32%) showed LASi. Thirty scans were normal; 11 Lisfranc sprains and 4 medial collateral ankle ligament sprains were also diagnosed (Fig. 2).

3.2. MJS population characteristics

In the MJS population, mean age was 32.7 ± 12.1 years (range, 17–69 years), with 40 male (49%) and 42 female patients (51%). The left foot was involved in 43 cases (52%) and the right foot in 39 (48%). Twenty-nine cases (35%) implicated sports accidents; there was no single predominant sport, but pivot sports were mainly involved; soccer, rugby, basketball, tennis. There were 14 work accidents (17%), mainly due to tripping (not specifically occupation-related). The most frequent trauma mechanism was foot inversion (76% of cases); others comprised plantar hyperflexion (21%), dorsal hyperflexion (2%), and foot eversion (1%).

The rates of the various clinical signs predictive of MJS varied: 58% for audible crack at trauma, 73% for persistent total functional impotence, 30% for ecchymosis or hematoma adjacent to the midtarsal joint, and 83% for pain on palpation of the dorsal side or mobilization of the joint.

Ultrasound analysis of the ligaments of the dorsal side of the midtarsal joint found predominance of complete tear or avulsion: 70% grade 3, 21% grade 2 and 9% grade 1 ligament lesions (Fig. 3).

The calcaneocuboid ligament was involved in 36% of cases, the talonaviculal ligament in 34% and the bifurcated ligament in 30%.

Only 45% of cases showed concordance between the precise clinical locus of pain (at the talonaviculal or calcaneocuboid or both) and ultrasound findings.

3.3. Ultrasound classification of MJS

Individual analysis of each ligament enabled ultrasound classification of MJS. Several lesion associations were possible, and MJS was divided into 3 types: medial, with TNL ± BL involvement (29%); lateral, with CCL ± BL involvement (32%); and complete, involving all 3 ligaments (33%). Five patients did not fit this classification, showing isolated BL tear (6%). Rates for medial, lateral and complete sprain were comparable. Factors for MJS type, such as lesion mechanism or association with LAS (MJS + LAS), were investigated, but no significant associations emerged. In foot inversion, lateral MJS was more frequent, but not significantly (P = 0.71); in plantar hyperflexion, complete MJS was more frequent, but not significantly (P = 0.71); in MJS + LAS, lateral MJS was more frequent, but again not significantly (P = 0.72).

3.4. Comparison between MJSi and LASi

To understand the particularities of MJS as compared to LAS, we compared the MJSi and LASi groups (Table 1).

There was a significant difference in lesion mechanism (P = 0.002). In the MJSi group, foot inversion predominated (75%), but plantar hyperflexion was not a negligible cause (22%). In the LASi group, in contrast, foot inversion constituted an overwhelming majority of cases (95%). Sports accidents were significantly more frequent in MJSi (68% vs 21%; P = 0.04). On clinical examination,

![Fig. 2. Inclusion results.](image_url)
total persistent functional impotence was significantly more frequent in MJSi (70% vs 41%; P = 0.001).

On the other hand, the two groups were comparable for gender (P = 0.53), age (P = 0.57), lesion side (P = 0.65), accident context (P = 0.28), audible crack (P = 0.63) and hematoma (P = 0.62).

Logically, pain location was predominantly at the midtarsal joint in the MJSi group (82%; P < 0.001) and at the LCL in the LASi group (98%; P < 0.001). However, 51% of MJSi patients had pain adjacent to the LCL, without LCL lesion on ultrasound; conversely, 20% of LASi patients had pain adjacent to the midtarsal joint, without corresponding ligament lesion.

Concordance between clinical pain location and ultrasound lesion assessment was significantly better in the LASi group (98% vs. 40%; P < 0.001).

4. Discussion

To our knowledge, no epidemiological studies have focused on isolated midtarsal joint ligament trauma. In contrast, there are numerous studies of ankle sprain [1], Lisfranc sprain and midtarsal fracture-dislocation [5]. The present MJS rate (3.4% of FAIs) seems low; however, given the very large number of FAIs in France (more than 6000 per day [1]), the number of cases of MJS exceeds 74,000 per year, which is a considerable prevalence.

One strong point of the present study was the large number of patients receiving ultrasound assessment for suspected MJS: 188 scans. This is one of the largest emergency foot and ankle ultrasound series in a prospective study [11]. The largest emergency ankle ultrasound series was that of Ekinci et al. (131 cases), but their objective was to screen for fracture and not ligament lesion [12].

Boutry et al. previously demonstrated the interest of emergency ultrasonography in FAI [10]. It establishes precise lesion location [13] and assesses sprain severity, which is not possible on simple clinical examination. A radiologist specialized in osteoarticular ultrasonography is an essential member of the team. In our institution, such radiologists are available in emergency only between 8:00 am and 6:00 pm from Monday to Friday. Patients with criteria for ultrasound presenting outside these time slots were called back and ultrasonography was implemented some days post-trauma; some were lost to follow-up, which was one limitation of the study. We preferred ultrasound to MRI, as it provides more precise lesion analysis in the acute phase, when MRI tends to overestimate severity [14], allows dynamic examination, is more easily available in our structure, and costs less.

Ultrasound analysis of the midtarsal dorsal ligaments showed comparable lesion distribution between the three: 36% in the CCL, 30% in the BL and 34% in the TNL. Seventy percent of midtarsal ligament lesions were grade 3. It was noteworthy that most bone-insertion avulsions were not visible on radiography, testifying to its inadequacy in screening for MJS.

The poor concordance between clinical and ultrasound results in MJS confirms the difficulty of this diagnosis. This may be related to the difficulty of clinical examination due to acute-phase edema or examiner's lack of experience. The poor concordance supports the hypothesis that MJS is under-diagnosed. There are in fact no guidelines for diagnostic management of suspected MJS; nor are there any clinical criteria to be applied in FAI examination to indicate ultrasound exploration of foot and ankle ligament structures.

In the present series, MJS most frequently involved a sports accident or plantar hyperflexion. Clinical signs of MJS comprised total persistent functional impotence of the foot and pain on palpation and/or mobilization of the joint. These 4 clinical criteria are suggestive of MJS, and the presence of 1 or more is an indication for emergency ultrasound exploration of the foot and ankle ligaments, similarly to the Ottawa criteria for radiography [15].

Finally, the topographic precision of ultrasonography enabled a classification of MJS to be drawn up, with 3 types: lateral, medial and complete. No clinical criteria emerged for MJS type, but the classification may prove useful in adapting treatment and especially in rehabilitation.

5. Conclusion

The present study showed that midtarsal sprain is frequent and has clinical and ultrasonographic specificities distinguishing it from ankle sprain.

In the light of these results, we recommend emergency ultrasound exploration of foot and ankle ligament structures screening...
for midtarsal joint sprain in all patients presenting 1 or more of the following 4 clinical criteria: trauma sustained during sports activity, lesion mechanism consisting in plantar hyperflexion, total persistent impotence of the foot, and/or pain on palpation and/or mobilization of the midtarsal joint.

Lack of diagnostic awareness may lead to painful sequelae in the absence of appropriate treatment; thus positive diagnosis of MJS has immediate therapeutic consequences that will be the focus of an up-coming study.

Disclosure of interest

The authors declare that they have no competing interest.

References


