Diagnostic and Interventional Imaging (2012) **93**, 884—886

LETTER / *Musculoskeletal imaging*

The role of computed tomography in the exploration of Madura foot (pedal mycetoma)

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KEYWORDS
Mycetoma;
Foot;
Imaging;
Computed tomography

Madura foot or pedal mycetoma is a fungal or actinomycotic infection located on the foot and is quite rare outside of the tropical areas where it is endemic. This case report from the Central Radiology Department of the Ibn Rochd Hospital Center in Casablanca describes the different ways that Madura foot appears on imaging.

Case report

This case concerned a 39-year-old man, a mason by trade, who sought care for inflamed swelling of the right foot with multiple sinus tracts, and the discharge of pus with both black and white granules. Swelling had been developing for 18 months, after direct trauma to his bare foot on a construction site. The microbiological study found actinomycotic bacterial mycetoma.

Standard AP and profile radiography showed infiltration of the soft tissue of the foot, associated with osteolysis of the cuneiform bones, the navicular and first two metatarsal bones, as well as an irregular periosteal reaction (Fig. 1). Computed tomography (CT) showed diffuse infiltration of the plantar and dorsal surfaces of the foot, with dense thickened tissue, enhanced heterogeneously on injection of contrast product, with several hyperdense nodules. It was associated with diffuse osteolysis of the cuneiform bones, the first four metatarsals and two sesamoid bones, with discrete lamellar and spiculated periosteal reaction. It also showed geodes of the navicular and cuboid bones and intertarsal joint narrowing. It confirmed the integrity of the other bones of the foot and ankle and ruled out the presence of bone sequestration or accumulation (Fig. 2).

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2211-5684/$ — see front matter
http://dx.doi.org/10.1016/j.diii.2012.05.003

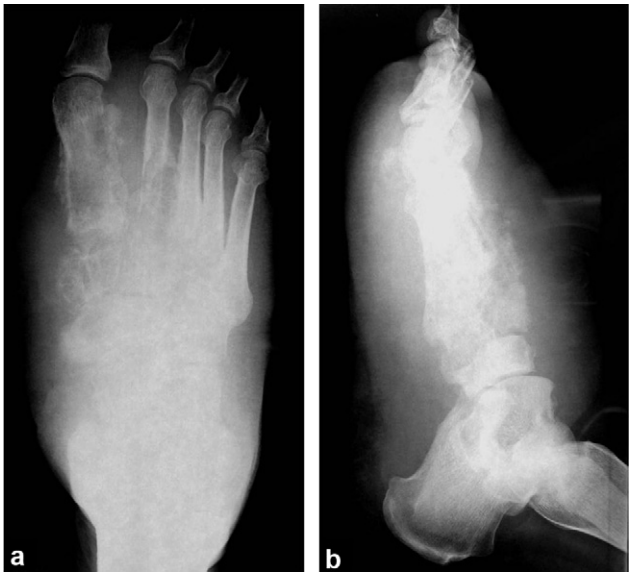

Figure 1. Radiography of the right foot, frontal (a) and lateral (b). Infiltration of the soft tissue, osteolysis of the cuneiform, navicular and first two metatarsal bones and an irregular periosteal reaction.

In view of the extent of bone damage, the foot required amputation. The histologic examination confirmed the diagnosis of actinomycotic mycetoma.

Discussion

Madura foot is defined as mycetoma of the foot, that is a chronic granulomatous pseudotumor due to fungi (eumycetoma) or actinomycotic bacteria (actinomycetoma), soil saprophytes that produce mycelial filaments. Mycetoma is endemic in dry tropical and subtropical regions [1—7].

A history of some minor trauma of a bare foot, often forgotten or neglected by the patient, may be found [1—4]. The infection develops over several years, beginning with painless swelling, unless a superinfection or bone damage develops; otherwise multiple skin sinus tracts or fistulae develop and often lead to consultation, as here. These tracts discharge black, white, red or yellow granules, depending on the microorganism involved. Bone damage is not correlated to the degree of clinical damage; it is generally late and determines both prognosis and management [1—7]. Our case is remarkable for the early onset — barely 18 months — of advanced bone damage.

Imaging guides the positive diagnosis when clinical and other investigations are not determinative. It is especially important for staging the disease.

Radiography shows infiltration of soft tissue, associated more or less with bone resorption. In 2003, Abd El Bagi [5] devised a 7-stage classification based on the extent of bone damage on the radiographs, ranging from stage 0 (no bone damage) to stage VI (multidirectional bone damage). Nonetheless, this damage is often underestimated by radiography, as in our patient, for whom it failed to identify the damage to the cuboid bone and the 3rd and 4th metatarsals. Ultrasound is especially interesting in countries where the disease is endemic. It shows multiple cavities, with thickened walls and without posterior reinforcement, with multiple hyper-reflective echoes corresponding to the mycetoma grains. The examination is more precise in the case of lesions without sinus tracts, because fibrosis of these tracts can make interpretation difficult [1].

Multislice CT is highly useful for assessing osteoarticular damage. It shows a mass isodense to muscle, heterogeneous, which can contain denser rounded nodules that infiltrate the skin and the subcutaneous fat tissues. The affected muscles are thickened or partially destroyed. Enhancement is heterogeneous and moderate. CT is more sensitive than MRI for detecting osteoperiosteal damage and for early visualization of small cortical lesions, which can be sought more easily by visualizing the hyperdense granules in direct contact with the bone [1,2,6].

The CT signs of bone damage essentially match those described in conventional radiology [1,2]. In our case, CT made it possible to detect the damage to the cuboid bone and the 3rd and 4th metatarsals and to confirm the integrity of the other bones.

MRI is the most helpful examination for a positive diagnosis and for staging mycetoma, which appears, in comparison to muscle, as a discrete hyperintense signal with T2 weighting and as a hypo- or iso-intense signal with T1 weighting. Contrast uptake after gadolinium injection is moderate and heterogeneous; the signal from the mycelial granules remains clearly hypointense. The characteristic appearance is that of an infiltrating mass made up of small cavities, hyperintense on T2 weighting, and circumscribed by hypointense fine partitions containing central dots, hypointense on all sequences and creating a nearly pathognomonic sign, called the ''dot-in-circle'', especially useful when clinical, microbiological and histological findings are not determinative. This dot-in-circle sign is correlated with the histology: the primary hypointense point corresponds to the mycelial granule, the surrounding hyperintense signal to the inflammatory granuloma, and the hypointense partitions to the fibrous matrix [1,2,7].

At the initial stage, MRI is relatively insensitive, compared with CT, for demonstrating limited cortical erosion. Spongiosis is visualized on T1-weighted sequences where the hyperintense marrow fat signal is replaced by the hypointense mycetoma and especially on the fat-suppressed T2 weighted sequences, where the hyperintense signal is clear. It is difficult to differentiate between the healthy muscle structures and the mycetomatous process, and the replacement of the T1-weighted hyperintense signal of the soft tissue fat by a hypointense signal is one of the best signs of this invasion [1,2,6].

The diagnosis, evident when multiple sinuses in swollen tissue discharge mycelial granules, can be difficult at earlier stages, especially the initial pre-sinus tract phase. MRI seeking the dot-in-circle sign allows a differential diagnosis, ruling out an invasive soft-tissue or bone tumor, chronic osteomyelitis (no bone sequestration), tuberculous osteomyelitis, and neuroarthropathy (no background of neurological disorders) [1,2,4,7].

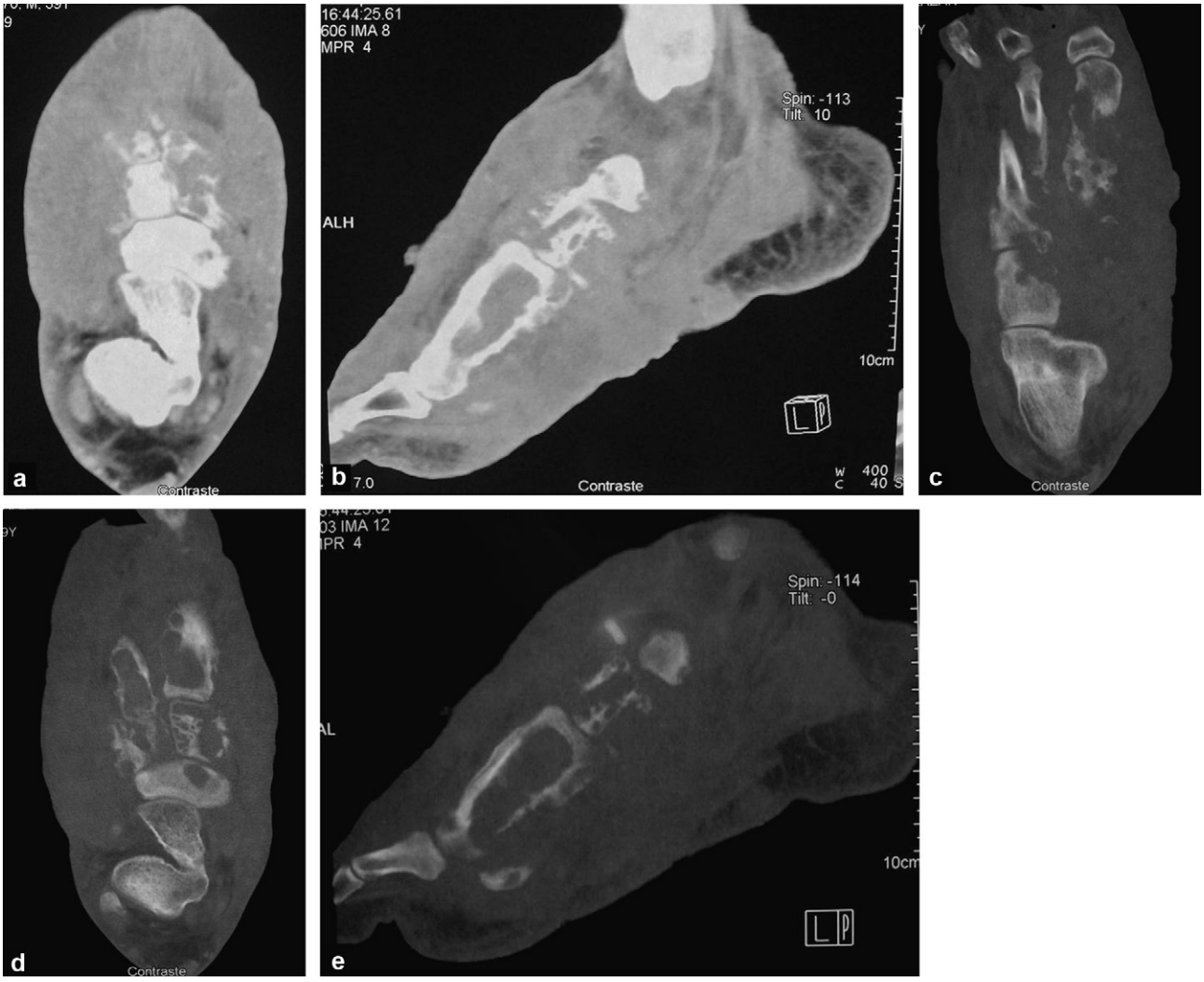

Figure 2. Volume computed tomography (CT) of the foot after injection of contrast product. a and b: soft tissue window: frontal (a) and sagittal (b) slices: diffuse infiltration of the dorso-plantar soft tissue, enhanced heterogeneously with hyperdense micronodules; c, d and e: bone window: frontal and sagittal slices: diffuse osteolysis of the cuneiform, metatarsal and sesamoid bones with geodes of the navicular and cuboid bones and an irregular periosteal reaction.

Treatment combines in various ways long-term antibiotic or antifungal agents and surgery, which can include amputation in advanced stages of bone extension [1—4].

Conclusion

Madura foot or pedal mycetoma is a mycelial soft-tissue infection with the potentially severe complication of osteoarticular extension that can result in amputation of the affected bone segment. Imaging, in particular CT and MRI, allow a specific assessment of the osteoarticular damage and can thus guide therapeutic management.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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