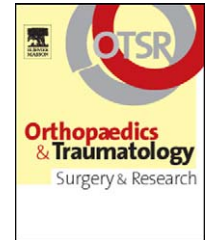




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ORIGINAL ARTICLE

Child calcaneonavicular coalitions: MRI diagnostic value in a 19-case series

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KEYWORDS

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Summary

Introduction: In case of hindfoot pain, diagnosis of calcaneonavicular tarsal coalition may be missed on X-ray due to the absence of any visible synostosis. All other possible etiologies (too-long anterior process (TLAP) of the calcaneum, synchondrosis, syndesmosis) must be investigated. The literature tends to recommend imaging associating standard X-ray and CT, and possibly bone scintigraphy. MRI is, however, also worth assessing, due to the many non-osseous forms calcaneonavicular pain may take.

Material and methods: Thirty-two cases of surgically treated calcaneonavicular tarsal coalition were studied. Nineteen cases, in 14 children, over a 10-year period, showed no visible synostosis on initial standard X-ray. In seven cases, bone scintigraphy was performed, CT in seven and MRI in 12. On the basis of the literature, our attitude was in favor of X-ray associated to CT in our early experience. Repeated diagnostic difficulties, however, led us to replace CT by MRI in case of foot pain combined to symptomatology suggestive of coalition.

Results: The series comprised four cartilaginous forms, four fibrous forms and eight TLAPs. In 10 of the 19 feet, radiology was strictly normal, the others showing indirect osseous signs. Only three of the seven scintigraphies showed hyperfixation. CT-scan enabled diagnosis in seven cases (two synchondroses and five rudimentary forms), and missed diagnosis in four (two cartilaginous and two fibrous forms). Second intention MRI showed two synchondroses and two syndesmoses. In the light of these 11 cases, a subsequent series of eight feet was assessed by MRI in first intention, obtaining systematic diagnosis. In all the feet of the series, the symptomatic coalition was treated by surgery, allowing peroperative findings to be compared with the imaging data.

Discussion: Given a rigid and painful foot syndrome suggestive of tarsal coalition, two diagnostic situations arise: (a) the clinical aspect is suggestive and standard X-ray enables diagnosis;

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(b) the clinical aspect is suggestive, but radiography proves non-contributive, in which case we recommend MRI with sagittal, frontal and axial slices in gadolinium-enhanced T1-weighted and fat-sat T2-weighted sequences, revealing direct (cartilaginous or fibrous coalition) or indirect signs (peripheral inflammation, osteomedullary edema, chondral lesion) unobtainable on CT scans. MRI is particularly effective in as much as most of the children concerned will not have reached bone maturity.

Conclusion: We consider MRI to be the most effective means of precise diagnosis (causes and consequences) of tarsal coalition, especially for calcaneonavicular locations. It entails minimal invasion and irradiation, at a lower cost than CT associated to scintigraphy.

Level of evidence: IV. Diagnostic study.

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Introduction

Calcaneonavicular tarsal coalition is an abnormal union bridge between the calcaneus and the navicular or tarsal scaphoid bone, and may be osseous (synostosis), cartilaginous (synchondrosis) or fibrous (synfibrosis or syndesmosis).

This is an ancient concept, first described in 1769 by Buffon [1], and later by Cruveilhier [2]; only in 1947 was a large-scale epidemiological study performed, by Harris and Beath [3]. Along with the talocalcaneal form, it is the most frequent tarsal coalition. Blockley [4], Harris [5] and Roger and Méary [6] reported a rudimentary form, which first Hardy and Pouliquen [7] and then Rouvreau et al. [8] described as a too-long anterior process (TLAP) of the calcaneus inducing symptomatology identical to that of calcaneonavicular synostosis.

Despite suggestive clinical signs, standard X-ray may miss diagnosis, due to the lack of synostosis. All other forms should be identified for treatment. The contribution of MRI should be investigated, given the many non-osseous forms, which make such coalition so variable.

We present a series of 19 cases followed up in our department over a 10-year period. The aim was to develop a simple and effective diagnostic strategy in case of suggestive symptomatology.

Material and methods

Of the 24 children (32 feet) managed in our department for calcaneonavicular tarsal coalition between 1997 and 2007, only those without radiologically visible synostosis (fibrous, cartilaginous or TLAP) were included in the present study.

This provided a series of 14 children (19 feet): six male, eight female; nine right, 10 left, including five bilateral coalitions.

Two subgroups were defined: 11 cases analyzed retrospectively, followed by eight with complementary prospective analysis.

Clinical study

For each foot, symptomatology, age at onset, age at surgery and complementary exploration enabling diagnosis were analyzed.

The symptoms studied comprised: pain facing the tarsal sinus, forefoot stiffness, and reduced amplitude in inversion, eversion and plantar flexion; patients presented with one or more signs.

History of repeated false ankle sprain with associated chronic pain was investigated.

Radiological study

All children underwent standard foot X-ray with three incidences: AP and lateral weight-bearing, and 45° lateral oblique according to Harris [5] (incidence with the highest sensitivity for detecting calcaneonavicular coalition).

The radiologic criteria were, firstly, direct signs: reduced or irregular physiological calcaneonavicular space, considered pathological if < 5 mm [7].

Then indirect, non-pathognomic signs related to impaired mobility [6,7]:

- increased talar neck concavity or talar neck "cup";
- talar head hypoplasia;
- talar head osteophytes.

These also served to rule out differential diagnoses such as trauma or tumor.

In 14 of the 19 feet, standard X-ray proved insufficient: bone scintigraphy was associated in seven cases (one isolated, four after other imaging, two after CT), CT in 11 and MRI in 12.

The CT criteria related to an aspect of non-union, with irregular condensed calcaneonavicular edges, indicative of cartilaginous, fibrous or rudimentary tarsal coalition. Sagittal, axial and coronal slices, with 3D reconstruction, were performed for each foot. X-ray associated to CT was preferred during our early experience, in line with the literature.

With case experience and in the light of diagnostic problems encountered, we revised our attitude in case of painful foot with symptomatology suggestive of coalition, replacing CT by MRI. The young age of our patients was part of the reason for this changeover, as the amount of cartilage hampered interpretation of CT data in a number of cases.

MRI systematically comprised T1-weighted and fat-sat T2-weighted frontal, sagittal and axial slices, which were explored for cartilage bridges, in the form of loss of joint space and continuity of signal, and fibrous bridges, in the

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