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Imaging in paediatric rheumatology: Is it time for imaging?

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A B S T R A C T

Juvenile idiopathic arthritis (JIA) is a heterogeneous group of arthritides characterized by chronic synovial inflammation that can lead to structural damage. The main objective of JIA therapies is to induce disease control to avoid disability in childhood. The advances in therapeutic effectiveness have created a need to search for imaging tools that describe more precisely disease activity in children with JIA. Musculoskeletal ultrasound and magnetic resonance imaging have demonstrated to be more sensitive than clinical examination in early detection of synovitis. These modalities can detect both inflammatory and destructive changes. The unique characteristics of the growing skeleton and a scarce validation of imaging in children result in important challenges in evaluating paediatric population. This review describes indications and limitations of these imaging techniques and suggests some advices for a rational use in the management of JIA in clinical practice.

Introduction

Juvenile idiopathic arthritis (JIA) is the most common chronic rheumatic disease in children [1]. JIA includes a group of clinically heterogeneous arthritis that develop before the age of 16 years, persist for

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at least 6 weeks and have no identifiable cause. It is characterized by a chronic inflammatory process of the synovium and periarticular tissue that can lead to structural damage and growth abnormalities. The International League of Association for Rheumatology proposed the current classification for JIA that aims to enable the identification of homogeneous groups of children suitable for etiopathogenetic studies [2]. JIA could affect the appendicular skeleton and the axial skeleton. The presence of joint involvement in JIA may be expressed by some imaging findings such as synovial proliferation, effusion, cartilage thinning and bone erosions.

Historically, conventional radiography (CR) was a mainstay for the evaluation of children with suspected JIA, because it allows to easily rule out traumas and some tumours [3]; moreover, it shows the irreversible structural damage that occurs late in the disease course. The availability of therapeutic agents to prevent joint destruction, especially when treatment is initiated promptly, highlights the importance of early detection of inflammation and initial signs of damage [4,5]. As a result, the management of JIA has evolved to include greater use of imaging techniques such as high-frequency ultrasound (US) and magnetic resonance imaging (MRI). In the last few years, a considerable amount of evidence has shown that these imaging modalities are sensitive in detecting inflammatory lesions and monitoring disease progression, thus playing an important role in the assessment of juvenile arthritis [6–10]. However, there are hardly any studies that focussed on demonstrating the real validity of these techniques in children [11]. Furthermore, the peculiarities of the growing skeleton, which include age-related variations in the thickness of the articular cartilage and incomplete ossification, make the evaluation of children's joints a real challenge.

In the present article, we will discuss utility of the most modern imaging modalities (US and MRI) integrated in practice for the management of children with known or suspected JIA and further applications of these modalities.

Plain radiography, US or MRI in JIA; which, when and for what purpose?

The imaging approach to JIA has radically changed over the last decades, and new imaging modalities such as musculoskeletal US and MRI are increasingly overtaking plain radiography for the assessment of children with JIA. As reported in Table 1, there are strengths and weaknesses for each imaging technique that should be considered by clinicians when choosing the best imaging modality for the assessment of JIA. Furthermore, choosing wisely, the question 'why is imaging required' cannot be ignored. Answering this question (for what purpose?) will also allow us to delineate a timeline scheduled workflow for imaging JIA (when?).

Plain radiography imaging

Until 15 years ago, imaging for JIA was largely confined to plain radiography, which is however insensitive for the detection of active arthritis and rarely shows erosive changes to the joint until late in the disease course [12]. Despite these limitations, plain radiography should not be considered obsolete because it has still much to offer to clinicians. Doubtless, it is a useful imaging modality in diagnosis, especially to rule out trauma, osteochondroses, bone tumours and congenital dysplasias that may mimic JIA. Localised hyperaemia around joints can initially cause epiphyseal enlargement (Fig. 1) and advancement of bone maturation, while in the later stages, accelerated bone maturation promotes premature fusion of the physis [13,14]. These growth disturbances, which are distinctive of JIA, are well visualised by plain radiography. Of note, this technique remains the current reference for the assessment of structural damage to the joints, which traditionally manifests itself as joint space narrowing, bone erosions or other abnormalities such as bone deformities [15]. Over the last decades, new radiographic scoring systems have been devised, and adult radiographic scores have been adapted for use in JIA [16–20]. Their use in non-controlled clinical studies has clearly demonstrated that a standardized assessment of radiographic progression in children with JIA is feasible [21–23], suggesting that quantitative measurement of radiographic damage should be included in the evaluation of treatment efficacy [24]. Finally, late in the disease course, plain radiography has a pivotal role in the assessment of joint deformities such as joint subluxation, dislocation and flexion/extension defects, which are associated with severe impaired physical function [3,25].