

Systematic Review TMJ Disorders

Ultrasound versus magnetic resonance imaging of the temporomandibular joint in juvenile idiopathic arthritis: a systematic review

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Abstract. A systematic review of published articles on ultrasound (US) and magnetic resonance imaging (MRI) of the temporomandibular joint (TMJ) in juvenile idiopathic arthritis (JIA) was performed to answer the question “What is the sensitivity and specificity of US as compared to MRI in diagnosing acute and chronic joint changes in patients with JIA?” The most recent evidence was sought in published articles via a search of the PubMed, Ovid, and Embase databases. Article appraisal was performed by two reviewers. Nineteen articles reporting prospective or ambispective studies comparing US to MRI in TMJ imaging were found. Six of these articles were specific to JIA patients. The heterogeneity of these articles made comparison difficult. Of the acute and chronic changes assessed (disk displacement, joint effusion, bony deformity), only joint effusion was appropriately assessed by multiple authors, with US having a sensitivity of 0–72% and specificity of 70–83% as compared to MRI. There was a paucity of studies specific to JIA, with many studying adult, non-rheumatic patients. This systematic review found that dynamic imaging with high-resolution US improves sensitivity and specificity compared to static, low-resolution US. Additionally, there is evidence to suggest that US imaging following a baseline MRI can increase US sensitivity and specificity and may have a future role in disease surveillance.

Key words: juvenile idiopathic arthritis; JIA; temporomandibular joint; TMJ; ultrasound; MRI.

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Juvenile idiopathic arthritis (JIA), formerly known as juvenile rheumatoid arthritis (JRA), is an umbrella term including six subtypes of arthritis, all of which require

arthritis to be present for six or more weeks in an individual less than 16 years of age. While each subtype has its own characteristics, temporomandibular joint

(TMJ) arthritis has been described across subtypes and is in fact one of the most commonly involved joints in JIA, with a prevalence of 17–87%¹. The large range in

prevalence is due in part to the difficulty in detecting involvement of the TMJ. The unreliability of the clinical examination means that imaging plays an important role in detection.

Although it may be difficult to detect, the results of undiagnosed, untreated TMJ involvement can be catastrophic to a child with JIA. Untreated disease can result in a variety of deformities and even cause condylar resorption severe enough to require a total joint replacement. Given that the diagnosis of JIA occurs before the age of 16 years, if joint replacement was necessary it would ultimately require multiple replacements in the individual's life given the lifespan of current prostheses. While this is a rare complication, it does illustrate the importance of early discovery and treatment of TMJ involvement in JIA. Other more common sequelae include mandibular asymmetry, retrognathia, malocclusion, pain, joint noises, deviation or limitations with laterotrusive jaw movements, and changes in maximum mouth opening. Given that the TMJ is used over 2000 times per day during speech and mastication, it is easy to see why early detection and intervention is so critical².

In JIA patients with acute TMJ arthritis, it has been reported that 71% of cases may be asymptomatic and 63% may have normal findings on clinical examination³. Similarly, Melchiorre et al. found that in newly diagnosed JIA patients with ultrasound (US) evidence of joint effusion, more than 95% did not complain of joint pain⁴. Furthermore, many of these patients may be taking anti-rheumatic medications, thus the symptoms of temporomandibular dysfunction (TMD) may be masked.

The absence of clinical predictors is an especially important distinction between JIA patients and non-rheumatic TMD patients, since providers who frequently treat non-rheumatic TMD patients (dentists, oral and maxillofacial surgeons, and otolaryngologists) often do not recommend imaging until significant signs or symptoms are present. Magnetic resonance imaging (MRI) has become the gold standard imaging modality for the TMJ in all patient populations, and in the JIA patient population in particular, TMJ imaging is vital given that clinical signs and symptoms may lag significantly behind anatomical changes^{5,6}.

Although it is clear that imaging the TMJ before clinical signs and symptoms arise is more important in JIA patients than in non-rheumatic TMD patients, when these patients should be imaged and how images should be interpreted is not well defined. One particular concern is

delineating normal versus pathological, given the spectrum of findings that may be considered normal. Regarding joint effusion and synovial enhancement, Kottke et al. evaluated 27 healthy children without TMJ pathology and showed that 83% had small amounts of fluid (visible on T2-weighted, fat-saturated images) and 79% had intense joint enhancement⁷. The amount of fluid detected in these patients—a thin line around the upper or lower joint compartment—has been considered 'moderate effusion' by some investigators⁸, while others have considered this normal-to-mild disease⁹.

Additionally, a lack of synovial enhancement may not exclude joint inflammation. Von Kalle et al. compared TMJs in healthy children to those in JIA patients who were symptomatic (96% of patients had pain, clicking, or deviated/limited jaw opening) and concluded that enhancement within the normal range did not exclude joint inflammation in these patients⁶. Studies such as these comparing normal TMJs to TMJs in patients with JIA raise serious questions regarding what clinically relevant data we are actually obtaining or omitting on MRI.

While MRI is the gold standard, there is uncertainty regarding how signs and symptoms relate to imaging findings and how to interpret the imaging findings themselves in an individual patient. Moreover, although MRI uses no ionizing radiation, it is not an innocuous procedure. It is expensive, time-consuming, and often requires sedation⁹. As JIA patients are typically subjected to frequent imaging evaluations, an alternative imaging modality such as US that is less costly, less time-consuming, and does not require sedation would be beneficial. In the two decades since the publication of the article by Emshoff et al. in 1997 comparing US to MRI imaging of the TMJ¹⁰, interest has grown in using this modality to evaluate arthritic TMJs.

The sensitivity and specificity of US in detecting early TMJ changes in JIA is currently unknown. How the performance of US compares to MRI in the JIA patient population is also unknown. Given the frequent imaging interventions required in this patient population, a systematic review to determine the sensitivity, specificity, and accuracy of US as compared to MRI in detecting TMJ disease in the JIA patient appears warranted.

Materials and methods

A systematic review was performed to answer the following question: "What is

the sensitivity and specificity of US as compared to MRI in diagnosing acute and chronic joint changes in patients with JIA?"

To answer this question, an electronic search was performed via the PubMed, Ovid, and Embase databases through April 2017. A search strategy was used including the following key words: Temporomandibular AND (Juvenile Idiopathic Arthritis OR Juvenile Rheumatoid Arthritis) AND (MRI OR Ultrasound). Titles and abstracts were then screened by two reviewers. For articles appearing relevant or those with insufficient data in the abstract; the full article was obtained. The reference lists from articles were also reviewed for relevant citations.

Applicable full-text articles were then screened independently by two reviewers. Articles were excluded during the screening phase if deemed non-relevant. To be accepted for eligibility review, studies had to compare US and MRI (either directly or indirectly) in JIA patients. Studies had to include at least 10 patients. No restrictions on language, publication location, or publication date were imposed. In an attempt to avoid selection bias, studies had to be prospective or ambispective, and include consecutive patients or indicate why this was not possible.

For those articles accepted for final eligibility review, the data review included sensitivity and specificity of diagnosing acute changes (joint effusion, synovial thickening) and chronic changes (any bony irregularities), as well as disk displacement.

Results

The electronic database search last updated on 23 April 2017 yielded 135 hits from PubMed, 130 hits from Ovid, and 117 hits from Embase. Thirteen additional articles from the reference lists of those studies were found to be of particular interest and were added to the initial record list. After duplicates had been removed, 167 records were screened and 19 titles were identified as possibly relevant to the clinical question. One additional article did appear relevant and eligible; however, it could not be included in the final analysis as no finalized publication could be found and the authors could not be reached¹¹. The full-text review was then performed^{3,4,9,10,12–25}. After reviewing the full texts, 13 articles were excluded, primarily because the MRI and US comparison did not include a true JIA population (Table 1). Thus, six articles were accepted for final qualitative and/or

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