Effectiveness of conservative approaches for temporomandibular joint arthritis in children and adolescents with juvenile idiopathic arthritis: a scoping review

Martina Ferrillo [1], Romina Gallizzi [2], Nicola Marotta [3,4], Marco Mazzei [5], Chiara Conte [5], Antonio Ammendolia [4,5], Amerigo Giudice [1], Alessandro de Sire [4,5]

[1] Dentistry Unit, Department of Health Sciences, University of Catanzaro "Magna Graecia", Catanzaro, Italy; [2] Paediatric Unit, Department of Health Sciences, University of Catanzaro "Magna Graecia", Catanzaro, Italy; [3] Physical Medicine and Rehabilitation Unit, Department of Experimental and Clinical Medicine, University of Catanzaro "Magna Graecia", Catanzaro, Italy; [4] Research Center on Musculoskeletal Health, MusculoSkeletalHealth@UMG, University of Catanzaro "Magna Graecia", Catanzaro, Italy; [5] Physical Medicine and Rehabilitation Unit, Department of Medical and Surgical Sciences, University of Catanzaro "Magna Graecia", Catanzaro, Italy

ABSTRACT

Background: Juvenile idiopathic arthritis (JIA) is a heterogeneous group of chronic inflammatory diseases affecting connective tissue, with onset before the age of 16 years and characterized by the persistence of an arthritic pattern for at least six weeks. Among the potentially involved joints, the temporomandibular joint (TMJ) is clinically relevant, as it can be affected in 39%–78% of patients with JIA, both at disease onset and throughout its course.

Aim: This scoping review set out to analyze the available scientific evidence on the effectiveness of conservative approaches in improving the clinical signs and symptoms of TMJ arthritis in children and adolescents with JIA.

Methods: A scoping review design and methodology was selected, and the main databases (PubMed/Medline and Scopus) were searched. To be eligible for inclusion, articles had to be in English and involve patients with a diagnosis of JIA affecting the TMJ, who were treated with conservative approaches for TMJ arthritis (physiotherapy, intra-articular and/or extra-articular injections, arthrocentesis, and functional appliances), evaluated using clinical or radiological measures (maximal incisal opening, MRI findings, pain Visual Analog Scale score).

Results: Out of 215 papers suitable for title/abstract screening, 17 studies were included. The included studies evaluated the effectiveness of intra-articular corticosteroid (IACS) injections, arthrocentesis alone or in combination with IACS injections, intra-articular infliximab injections, functional appliances, occlusal splint, and physiotherapy.

Conclusion: Currently available evidence suggests that conservative approaches play a central role in the management of TMJ arthritis in pediatric patients with JIA. IACS infiltrations are effective in controlling pain and inflammation in the short term, and arthrocentesis, conservative orthodontic therapies, occlusal splints, and physiotherapy represent valid alternatives or complementary treatments.

KEYWORDS

TMJ arthritis, juvenile idiopathic arthritis, orofacial pain, rehabilitation, temporomandibular joint disorders.

Introduction

Juvenile idiopathic arthritis (JIA) is a heterogeneous group of chronic inflammatory diseases affecting connective tissue, with onset before the age of 16 years and characterized by the persistence of an arthritic pattern for at least six weeks [1]. It is the most common pediatric rheumatic disease, with widely varying incidence and prevalence rates [2].

Temporomandibular joint (TMJ) involvement in JIA is associated with pain, reduced mandibular mobility, and impaired masticatory function. The chronic-relapsing course of the disease, together with the need for prolonged treatments, has a significant impact on patients' health-related quality of life and daily activities. In this context, TMJ alterations may further contribute to orofacial functional limitations and are a major contributor to disease-related disability. Although dysphagia is not commonly reported as a direct manifestation of JIA, TMJ dysfunction may theoretically affect the oral phase of swallowing, particularly in patients with severe limitation of jaw opening or mastication. Therefore, TMJ involvement should be primarily interpreted as a contributor to functional disability and reduced quality of life, as also supported by qualitative evidence on patient experience, rather than as a well-defined cause

Article history
Received 16 Feb 2026 – Accepted 28 Mar 2026

Contact
Martina Ferrillo; martina.ferrillo@unicz.it

of dysphagia [3,4]. According to the classification proposed by the International League of Associations for Rheumatology (ILAR), JIA includes several clinical forms, including systemic arthritis, persistent and extensive oligoarthritis, rheumatoid factor-negative or -positive polyarthritis, enthesitis-associated arthritis, psoriatic arthritis, and undifferentiated forms [1]. The etiopathogenesis of JIA is not yet fully defined [3]. Among the joints potentially involved, the TMJ plays a clinically relevant role, being affected in high percentage (39–78%) of patients, both at disease onset and throughout its course [5-7]. Clinical manifestations of TMJ arthritis include orofacial pain, joint noises, stiffness, and limited oral opening [6,7].

Persistent inflammation can cause structural joint changes over time, such as joint effusion, bone marrow edema, bone erosions, changes in the mandibular condyle, sclerosis, and changes in the articular disc [5]. Cartilage and bone damage can compromise craniofacial development, causing facial asymmetries, micrognathia, retrognathia, malocclusions, and functional dysfunction. Diagnosis of TMJ involvement is based on regular clinical monitoring of joint function and facial growth [6]. However, in the early stages of the disease, clinical signs may be subtle, making it necessary to resort to instrumental diagnostic methods such as ultrasound, cone beam computed tomography, and magnetic resonance imaging (MRI) [5,6]. Management of orofacial manifestations associated with JIA requires a multidisciplinary approach involving pediatric rheumatologists, pediatric dentists, maxillofacial surgeons, and physiatrists [6,7].

Rehabilitation treatment, aimed at reducing pain and improving joint function, is based on the integration of systemic drug therapies and conservative supportive interventions such as counseling, physiotherapy, use of occlusal devices during growth, intra-articular (IA) procedures on the TMJ, arthroscopy, and, in selected cases, surgery [5-7]. Despite the high frequency of TMJ involvement in JIA and the clinical relevance of associated complications, the scientific literature on the topic is limited. Prior to 2014, only one systematic review was available comprehensively synthesizing the evidence on TMJ arthritis rehabilitation treatments [5].

Taking all these aspects into account, this scoping review set out to evaluate the available scientific evidence on the effectiveness of conservative approaches in improving the clinical signs and symptoms of TMJ arthritis in children and adolescents with JIA.

Materials and methods

Given the exploratory nature of the research question, a scoping review design and methodology was selected, with search of the main databases (PubMed/Medline and Scopus). To be eligible for inclusion, articles had to be in English and involve patients with a diagnosis of JIA affecting the TMJ, who were treated with conservative approaches for TMJ arthritis (physiotherapy, IA and/or extra-articular injections, arthrocentesis, and functional appliances) and assessed using appropriate clinical or radiological measures (maximal incisal opening, MRI findings, pain Visual Analog Scale [VAS] score).

The following exclusion criteria were applied: patients with a history of TMJ trauma; patients with congenital abnormality or neoplastic conditions in the TMJ region; surgical treatments; studies involving animals; studies written in languages other than English or with unavailable full texts.

The search strategy included the keywords: “juvenile idiopathic arthritis”, “temporomandibular joint disorder”, “rehabilitation”, “exercise”, “physiotherapy”, “physical agent modalities”, “acupuncture”, “needling”, “injection”, and “arthrocentesis”. Eligibility for inclusion of all studies identified by the search was assessed through title review, followed by abstract analysis and full-text evaluation. Publications that did not meet the inclusion criteria were excluded from the review, and all duplicates were removed. The documents that met the inclusion criteria were further categorized.

Results

We conducted a targeted literature review to identify high-quality studies examining the specific effects of various rehabilitation approaches for children and adolescents with JIA. The systematic database search initially identified a total of 215 records. After removing 54 duplicates, 161 studies were reviewed based on title and abstract.

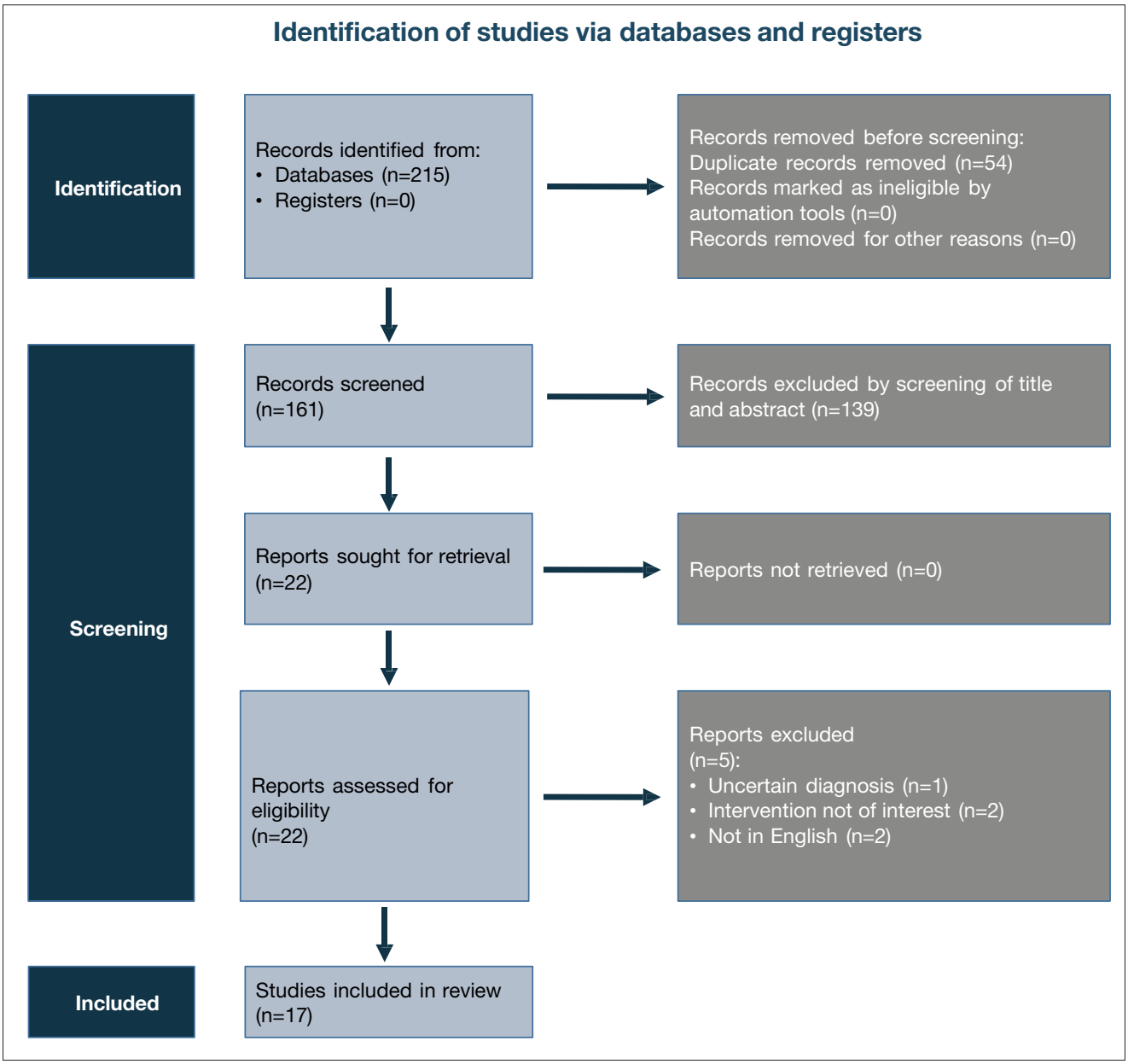
Of these, 139 were excluded because they did not meet the inclusion criteria. The remaining 22 full-text articles were assessed for eligibility. Of these, five were excluded: two because they were not in English, one due to uncertain diagnosis, and two because the interventions were outside the scope of this review. Ultimately, just 17 studies met all eligibility criteria and were included in the final review, as shown by the PRISMA flow diagram in Figure 1. The main characteristics of these studies are detailed in Table I.

Intra-articular corticosteroid injections

Frid *et al*. [8] evaluated the efficacy of treatment with intra-articular corticosteroid (IACS) injections in 15 adolescent patients with JIA and TMJ involvement, who were administered 22 injections at the TMJ level. Corticosteroids were injected according to a landmark-guided technique: methylprednisolone acetate in the first patient and triamcinolone hexacetonide in all subsequent patients. Each procedure was performed once per treatment session and further sessions were scheduled individually based on clinical judgment.

The patients underwent a clinical examination and MRI at study baseline (before receiving the IACS injections) and at follow-up visits after 1–3 months, 1 year, and 2 years. At the 2-year follow-up, pain and mandibular function scores had improved from baseline in terms of pain frequency (p=0.016), pain intensity (p=0.012), mandibular VAS score (p=0.034), and pain index score (p=0.012). The MRI results showed a statistically significant reduction in the inflammatory domain from baseline to 2-month follow-up and from baseline to 2-year follow-up (p=0.040 and p=0.017, respectively). The study results indicate improved inflammation as assessed by MRI, mostly stable condylar bone condition, and minimal clinical improvement in adolescents with JIA.

Figure 1 Flow diagram.



In line with this efficacy, Arabshahi *et al*. [9] further demonstrated that IACS injections into the TMJ are effective and safe in most children with JIA, especially when performed early, reducing pain and inflammation.

The retrospective longitudinal study by Lochbühler *et al*. [10] highlighted the difference in the effects obtained by intra- and extra-articular injections of corticosteroid therapy, respectively. In 53% of cases, at the first MRI follow-up, a greater improvement in the mean inflammatory degree was obtained after IACS injections (p=0.001). However, severe condylar destruction was observed in 26% of joints, including 24% with development of IA calcifications/ossifications.

Therefore, despite the reduction in inflammatory activity, repeated IACS injections (156 in total in this study) can cause even more pronounced destruction and reduction of mandibular condyle growth than arthritis alone, although the study does not specify a safe or critical number of injections associated with condylar damage.

The retrospective study by Resnick *et al*. [11] also demonstrates the efficacy of IACS as a symptomatic treatment, but longitudinal studies are still needed to evaluate its impact on disease progression and long-term joint destruction.

The following year (2017), the same author published a retrospective study [12] that explored complementary aspects, comparing the efficacy of and time needed to perform IACS injections in the TMJ of children with JIA, with or without intraoperative imaging guidance. This work found no significant differences in pain resolution (p=1.00) or increase in maximum incisal opening (MIO) (p=0.975), thus confirming the overall positive impact of IACS injections, regardless of imaging guidance technique, and complementing previous evidence on early intervention.

Table I Main characteristics of the studies included in the present review.

AUTHORS, PUBLICATION YEAR, JOURNAL	POPULATION (M/F)	AGE	ILAR DIAGNOSIS	SYSTEMIC THERAPY	INTER-VENTION	COMPA-RISON	OUTCOMES	TIME POINTS	MAIN FINDINGS IN TERMS OF PRIMARY OUTCOME
Ringold *et al.*, 2008, J Rheumatol	Total: n=25; 4 M/21 F	Total: 8.9 years	Oligoarticular (n=9), Oligoarticular extended (n=3), Polyarticular RF negative (n=7), Psoriatic (n=2), Enthesitis related (n=4).	Twenty-two children were receiving no therapy or NSAIDs, 3 were on MTX, and 1 was on TNF-α inhibitor.	IACS injections with 0.5–1 ml triamcinolone acetonide (40 mg/ml) or triamcinolone hexacetonide (20 mg/ml) using a 22-gauge, 1.5-inch spinal needle, under general anesthesia and without imaging guidance	N/A	MIO, patient-reported symptoms	Data were retrospectively collected over a 6-year period.	When comparing baseline MIO measurements with the last MIO measurements of the study period, the authors showed a mean increase in MIO of 3.8 mm following therapy (p =0.003; 95% CI [1.4; 6.2]) and patients who underwent multiple injections reported a mean increase in MIO after subsequent injections of 0.4 mm (p = 0.8; 95% CI [-3.5; 4.4]).
Habibi *et al.*, 2012, Rheumatology	Total: n=38; 4 M/34 F	Total: 12.25 ± 3.55 years	Oligoarticular extended (n=9), Oligoarticular persistent (n=11), Polyarticular RF negative (n=12), Polyarticular RF positive (n=1), Systemic (n=3), Psoriatic (n=1), Enthesitis related (n=1).	Twenty-six children were receiving MTX and nine were on anti-TNF-a therapy (etanercept (n=4), adalimumab (n=4), infliximab (n=1)), while one patient was on anakinra.	IACS injections (triamcinolone hexacetonide 10mg for children 10–20 kg body weight; 15 mg for 20–40 kg body weight and 20 mg for >40 kg body weight) using US guidance under general anesthesia	N/A	Patient-reported symptoms	Data were collected at T0 (baseline) and T1 (6-8 weeks post-injection).	The injection improved TMJ complaint in 58/63 (92.06%) joints. All (100%) patients had resolution of pain, and improvement in chewing dysfunction was reported in 5/7 (71.4%).
Stoll *et al.*, 2012, J Oral Maxillofac Surg	Total: n=63; 20 M/43 F	Total: 9.5 ± 4.2 years	Not reported	Two subjects were receiving corticosteroid treatment, 10 were on conventional disease-modifying antirheumatic drugs alone ± corticosteroid treatment, 5 were on biologic-disease modifying antirheumatics alone ± corticosteroid treatment, and 41 were on conventional and biologic disease-modifying antirheumatics ± corticosteroid treatment.	IACS injections with triamcinolone hexacetonide (20 mg/ml) diluted by an equal volume of 1% lidocaine HCl with 1:100,000 epinephrine, creating triamcinolone hexacetonide 10 mg/mL, under monitored anesthesia care without image guidance	N/A	MIO, MRI findings	Data were collected at T0 (baseline) and T1 (after injection).	Authors showed an improvement of TMJ complaint in 36 patients (66%), with a MIO that increased from 40.8 ± 0.93 mm to 43.5 ± 0.9 (p = 0.001). Moreover, 31 patients underwent repeat MRI after a mean interval of 5.3 ± 5.1 months after injection. MRI assessment revealed that 51% of TMJs showed improvement of arthritic changes and 18% complete resolution of arthritis.
Stoll *et al.*, 2013, Rheumatology	Total: n=24; 9 M / 15 F	Total: 12.0 ± 0.9 years	Oligoarticular (n=5), Polyarticular RF negative (n=9), Psoriatic (n=5), Enthesitis related (n=5).	Twenty-two patients were receiving TNF-α inhibitor ± conventional disease-modifying agents, 1 patient was on abatacept and leflunomide, and 1 was on MTX.	Intraarticular injections with 0.5±1.0 ml of 10 mg/ml infliximab, under monitored anesthesia care without image guidance This therapy was performed in patients who are refractory to systemic immunosuppressive therapy and IACS injections.	N/A	MIO, MRI findings	Data were collected at T0 (baseline) and T1 (after injection).	Authors showed a non-significant improvement in MIO (45.0 ± 1.2 mm to 44.6 ± 0.7; p = 0.888). MRI findings of acute synovitis were present in 42/48 (88%) subjects following intraarticular infliximab injections. Thus, intraarticular infliximab injections did not appear to significantly improve the arthritis.

AUTHORS, PUBLICATION YEAR, JOURNAL	POPULATION (M/F)	AGE	ILAR DIAGNOSIS	SYSTEMIC THERAPY	INTER-VENTION	COMPA-RISON	OUTCOMES	TIME POINTS	MAIN FINDINGS IN TERMS OF PRIMARY OUTCOME
Olsen-Bergem *et al.*, 2014, Int J Oral Maxillofac Surg	Total: n=21; 6 M / 15 F	Total: 11.4 years	Oligoarticular (n=10), Polyarticular (n=10), Systemic (n=1).	Fourteen subjects were receiving MTX, 12 were on ibuprofen, 7 were on NSAIDs and MTX, 4 were on corticosteroid therapy, 1 was on TNF-α inhibitor.	Group 1: arthrocentesis using a closed single-needle system with a solution of vitamin B12 and saline (1:4 ml), using US guidance under general anesthesia	Group 2: arthrocentesis in combination with IACS injection (triamcinolone hexacetonide), under US guidance and general anesthesia	MIO, Pain on incisal opening, VAS pain and function scores	Data were collected at T0 (baseline), at T1 (3 months after injection), and T2 (8 months after injection).	The authors showed a significant decrease in pain from T0 to T1 and T2 for overall pain and improvements in overall function. Interestingly, no statistically significant difference was reported between arthrocentesis alone or in combination with glucocorticoid injection.
Stoustrup *et al.*, 2014, Scand J Rheumatol	Total: n=28; 2 M / 26 F	Total: 15.5 years	Oligoarticular extended (n=6), Oligoarticular persistent (n=6), Polyarticular RF negative (n=4), Polyarticular RF positive (n=4), Systemic (n=1), Psoriatic (n=2), Enthesitis related (n=1), Undifferentiated (n=4).	Thirteen subjects were receiving MTX, 12 were on NSAIDs, no subjects were on corticosteroid therapy, 10 were on biologic therapy, 2 had received IACS injections during the previous year.	Mandibular stabilization splint therapy. Patients were instructed to use the splint during sleeping hours.	N/A	MIO, pain frequency, pain intensity, pain index.	Data were collected at T0 (baseline), at T1 (8 weeks).	Significant reductions in orofacial pain frequency and intensity were reported, with VAS pain score improving from 55.2 mm to 40.5 mm ($p = 0.0001$) and pain index from 178.6 to 106.9 ($p = 0.0017$). Moreover, MIO significantly increased, from 41.4 mm to 45.3 mm ($p = 0.0005$).
Lochbühler *et al.*, 2015, J Rheumatol	Total: n=33; 10 M / 23 F	Total: 5.3 ± 1.9 years	Oligoarticular extended (n=11), Oligoarticular (n=12), Polyarticular (n=2), Psoriatic (n=2).	Not reported	Group 1: IACS injections with triamcinolone hexacetonide (6 to 20 mg/ml), without image guidance	Group 2: extraarticular CS injections with triamcinolone hexacetonide (6 to 20 mg/ml), without image guidance	TMJ deformity and inflammation on MRI, growth rates of the mandibular ramus on cephalograms	Data were collected at T0 (baseline) and at T1 (after injection).	IACS injections improved TMJ inflammatory grade compared to extra-articular injections ($p = 0.005$) and led to more improvement of the mean inflammatory grade ($p = 0.001$). Rate of osseous deformities of the TMJ decreased from 51% at T0 to 62% after therapy. Thus, repetitive did not prevent progressive osseous deformation. Mean growth rate of the mandibular ramus was positive only for extra-articular corticosteroid injections ($p = 0.036$), however, it remained significantly lower than the reported normal age-matched growth rate ($p < 0.0001$).

AUTHORS, PUBLICATION YEAR, JOURNAL	POPULATION (M/F)	AGE	ILAR DIAGNOSIS	SYSTEMIC THERAPY	INTER-VENTION	COMPA-RISON	OUTCOMES	TIME POINTS	MAIN FINDINGS IN TERMS OF PRIMARY OUTCOME
Stoll *et al.*, 2015, J Rheumatol	Total: n=33; 8 M / 25 F	Not reported	Oligoarticular (n=7), Polyarticular RF negative (n=11), Polyarticular RF positive (n=1), Psoriatic (n=6), Enthesitis related (n=8).	Two subjects were receiving MTX, 5 were on TNF-α inhibitor, 25 were on TNF-α inhibitor + disease-modifying antirheumatic drug or MTX or leflunomide, and 1 on leflunomide + abatacept. All subjects had received IACS injections in the previous year.	Intraarticular injections with 0.5 ± 1.0 ml of 10 mg/ml infliximab, under monitored anesthesia care without image guidance. This therapy was performed in patients refractory to systemic immunosuppressive therapy and IACS injections.	N/A	MIO, MRI findings	Data were collected at T0 (baseline) and T1 (after injection).	MIO did not significantly change from T0 to T1. A worsening of both acute and chronic findings was detected after therapy, with the median acute score increasing by 0.25 and the median chronic score by 0.75 points. Interestingly, each 1-mm decrease in MIO was associated with a 1.1-point worsening of MRI chronicity score ($p = 0.052$).
Stoustrup *et al.*, 2015, Pediatric Rheumatology	Total: n=13; 0 M / 13 F	Total: 17.2 (15–18.4) years	Oligoarticular extended (n=3), Oligoarticular persistent (n=1), Polyarticular (n=8), Systemic (n=1).	Five subjects were receiving NSAIDs, 1 was on hydroxychloroquine, 5 were on MXT, 9 were on biologic TNF-α inhibitor, and 6 were on combination of 2 or 3 drugs.	IACS injections (triamcinolone hexacetonide 20 mg/ml), without image guidance	N/A	MIO, pain frequency, pain intensity, pain index	Data were collected at T0 (baseline), at T1 (34 days post-treatment, range 7–58 days), T2 (mean 333 days post-treatment, range 190–600 days).	Pain significantly improved from T0 to T1, but a worsening was observed between T2 and T3. Overall, pain frequency decreased from 4.5 to 2.7 (ANOVA $p = 0.0001$), pain VAS score decreased from 65.2 mm to 49.3 mm (ANOVA $p = 0.0006$), and pain index from 295.5 to 154.7 (ANOVA $p = 0.0002$). Mouth opening improved from 35.5 mm to 39.3 mm.
Isola *et al.*, 2017, Minerva Stomatol	Total: n=54; 32 M / 22 F	Total: 13.2 ± 3.7 years	Oligoarticular (n=25), Polyarticular (n=15), Systemic (n=9), Psoriatic (n=3), Enthesitis related (n=2).	Not reported	Functional appliance, individually customized, made of acrylic resin and resilient stainless steel, with posterior and anterior metallic bite planes The participants were instructed to use the appliance 12–14 hours/day.	N/A	MIO, pain during jaw movement, TMJ sounds, click and crepitation, condylar and mandibular ramus modifications on cephalograms	Data were collected at T0 (baseline) and T1 (24 months after therapy).	A statistically significant improvement from T0 to T1 was reported for: pain during jaw movement ($p < 0.001$), maximal incisal opeening (from 34.45±2.3 mm to 45.32±3.2 mm, $p < 0.001$), TMJ sounds ($p < 0.001$), TMJ click ($p < 0.05$), and TMJ crepitation ($p < 0.001$). Moreover, condylar width significantly increased after treatment.

AUTHORS, PUBLICATION YEAR, JOURNAL	POPULATION (M/F)	AGE	ILAR DIAGNOSIS	SYSTEMIC THERAPY	INTER-VENTION	COMPA-RISON	OUTCOMES	TIME POINTS	MAIN FINDINGS IN TERMS OF PRIMARY OUTCOME
Antonarakis *et al.*, 2018, J Oral Maxillo-fac Surg	Total: n=41; 5 M / 36 F	Total: 13.6 ± 4.0 years	Oligoarticular (n=16), Polyarticular (n=14), Systemic (n=1), Psoriatic (n=1), Enthesitis related (n=6). Undifferentiated (n=3).	Not reported	Group 1: 21 patients underwent lavage and IACS injection in at least 1 TMJ.	Group 2: arthrocente-sis using a double-ne-edle system with isotonic 0.9% NaCl solution. Group 3: no treatment.	Maximal mouth opening, Helkimo dysfunction index scores, pain inten-sity, TMJ inflam-mation on MRI	Data were collected at T0 (baseline) and T1 (6 months after therapy).	The mean clinical Helkimo dysfun-ction index scores decreased for Groups 1 and 2 but not for Group 3. A statistically significant difference was found for anamnestic Helkimo dysfunction index score, with a more positive effect found in the lavage with IACS group ($p = 0.047$). MRI examination revealed a signi-ficant improvement at the 6-month follow-up in Group 1 compared with other groups.
Frid *et al.*, 2020, Pediatric Rheumatology	Total: n=15; 3 M / 12 F	Total: 15 (11–16) years	Oligoarticular extended (n=3), Oligoarticular persistent (n=6), Polyarticular RF negative (n=5), Enthesitis related (n=1).	Three subjects were receiving MXT, 6 were on combination therapy with biologics.	IACS injections (triamcinolone hexacetonide 20 mg/ml), without image guidance under local anesthesia	N/A	MIO, pain fre-quency, pain inten-sity, pain index, TMJ inflam-mation on MRI.	Data were collected at T0 (baseline), T1 (2 months after treatment), and T2 (2 years after treatment).	A significant improvement in pain frequency ($p = 0.016$), pain inten-sity ($p = 0.012$), VAS jaw function ($p = 0.034$), pain index score ($p = 0.012$), and MIO ($p = 0.045$) were reported at T2. Moreover, statistically significant reductions of MRI mean additive in-flammatory score were detected at T1 ($p = 0.040$) and T2 ($p = 0.017$).
Vassis *et al.*, 2023, Pediatric Rheumatology	Total: n=12; 0 M / 12 F	Total: 15 (12–23) years	Oligoarticular persistent (n=2), Polyarticular RF positive (n=5), Psoriatic (n=3), Undifferentiated (n=2).	Five subjects were receiving NSAIDs, 6 were on biologics, 5 were on disease-modifying antirheumatic drugs, and one received IACS injections.	Physiotherapy treatment at cervical spine, orofacial muscles and TMJ (weekly physiotherapy sessions for eight weeks), home exercises, and education	N/A	Maximal mouth opening, pain fre-quency, pain inten-sity, pain index, orofacial dysfunction assessed at clinical examinations	Data were collected at T0 (baseline), T1 (during treat-ment), and T2 (3 months after treatment).	Pain frequency, pain intensity, and pain index significantly decreased at T1 ($p < 0.0002$). Temporalis and masseter tenderness decreased at T1 ($p = 0.297$ and $p = 0.009$). MIO significantly improved ($p < 0.054$). Pain intensity decreased from 53.8 mm at T0 to 32.5 mm at T2 ($p = 0.0002$).

AUTHORS, PUBLICATION YEAR, JOURNAL	POPULATION (M/F)	AGE	ILAR DIAGNOSIS	SYSTEMIC THERAPY	INTER-VENTION	COMPA-RISON	OUTCOMES	TIME POINTS	MAIN FINDINGS IN TERMS OF PRIMARY OUTCOME
Resnick *et al.*, 2017, Journal of Oral and Maxillofacial Surgery	Total: n=45; 13 M / 32 F	Total: 13.5 ± 1.6 years	Psoriatic (n=19), Oligoarticular (n=13), Polyarticular (n= 9), Systemic (n=3).	Not reported	22 subjects received IACS injection into the TMJ under imaging guidance.	23 subjects received IACS injection into the TMJ using anatomical landmarks only, without imaging guidance.	MIO, patient-reported pain, synovial enhancement ratio	Data were collected at T0 (baseline) and T1 (after treatment).	This work found no significant differences in pain resolution (p=1.00) or increase of MIO (p=0.975), thus confirming the overall positive impact of IACS injection regardless of the use of imaging guidance technique and supporting previous evidence on early intervention.
Resnick *et al.*, 2016, Journal of Oral and Maxillofacial Surgery	Total: n=29; 5 M / 24 F	Total: 12.1 ± 1.9 years	Psoriatic (n=14), Oligoarticular (n=8), Polyarticular (n= 5), Systemic (n=2).	Nine subjects were also being treated with MTX, with NSAIDs, 6 with adalimumab, 4 with leflunomide, 3 with etanercept, and 1 with prednisone.	ICS injections (10 mg triamcinolone hexacetonide), without image guidance under local anesthesia	N/A	MIO, patient-reported pain, synovial enhancement ratio (ER).	Data were collected at T0 (baseline) and at T1 (after treatment).	ER decreased in all injected joints (p<0.001). Resolution of pain (p<0.001) with increased MIO (p<0.001) was observed in 89% of subjects after corticosteroid injections. These findings demonstrate that CT-guided corticosteroid injections are an effective and safe therapy for reducing TMJ inflammation, relieving pain, and improving mandibular function in children with JIA.
Arabshahi *et al.*, 2005, Arthritis & Rheumatism	Total: n=23; 3 M / 20 F	Total: 4–16 years	Psoriatic (n=1), Oligoarticular (n=5), Polyarticular (n= 17).	Five subjects were receiving NSAIDs + MXT + TNF-α inhibitor, 10 were receiving NSAIDs + MXT; 4 were on NSAIDs only, and 4 were not receiving any therapy.	CT-guided TMJ injections of corticosteroid: triamcinolone acetonide (n= 16) or triamcinolone hexacetonide (n=7).	N/A	MIO, patient-reported pain, MRI evidence of TMJ inflammation	Data were collected at T0 (baseline) and T1 (after injection). Fourteen patients had follow-up MRI studies of the TMJ 6–12 months after injection.	Ten patients reported complete pain resolution (p<0.05) and MIO was increased by at least 0.5 cm (p=0.0017), with evident improvements in patients younger than 6 years after corticosteroid injections. Resolution of TMJ effusions was observed in 11 of 14 patients undergoing MRI follow-up.
Parra et al., 2010, Pedriatr Radiol.	Total: n=83; 12 M / 71 F	Total: 12.0 years	Psoriatic (n=7), Oligoarticular (n=34), Polyarticular (n= 29), Systemic (n=2), Enthesitis related (n=6), Undifferentiated (n=5).	Not reported	US-guided TMJ injections of triamcinolone hexacetonide (92%) and triamcinolone acetonide (8%), under sedation or general anesthesia	N/A	Safety and accuracy of US-guided TMJ injections	Data collected during the procedure and after treatment	In 91% of CT-confirmed cases, the needle tip was intra-articular, demonstrating the high accuracy of the ultrasound-guided technique. Furthermore, only one major complication of skin atrophy was reported, and two patients presented with transient facial swelling. The results confirm the accuracy and reasonable safety of ultrasound-guided TMJ injections in children with JIA.

Values are presented as mean ± standard deviation and maximum-minimum (range). Abbreviations: **M**=male; **F**=female; **CT**=computed tomography; **ER**=enhancement ratio; **F**=female; **IACS**=intra-articular corticosteroid; **ILAR**=International League for Associations for Rheumatology criteria; **MRI**=magnetic resonance imaging; **MIO**=maximum incisal opening; **MXT**=methotrexate; **N/A**=not applicable; **NSAIDs**=non-steroidal anti-inflammatory drugs; **RF**=rheumatoid factor; **TNF-α**=tumor necrosis factor alpha; **TMJ**=temporomandibular joint; **US**=ultrasound; **VAS**=Visual Analog Scale.

These findings on the technique-independence of IACS treatment benefits align seamlessly with the retrospective study by Stoll *et al*. [13], which further evaluated the safety and efficacy of IACS injections into the TMJ of children with JIA, performed by an oral and maxillofacial surgeon without imaging guidance and under monitored anesthesia. From an efficacy point of view, a significant increase in MIO was observed. In a subgroup of patients with follow-up MRI, 51% of TMJs showed improvement in arthritis, with complete resolution in 18%, although some joints showed worsening. The study concluded that TMJ IACS injections can be performed safely and effectively even without radiological guidance, thereby avoiding radiation exposure and prolonged anesthesia.

In 2008, Ringold *et al*. [14] conducted a retrospective study to describe clinical and radiographic findings in 25 patients with JIA undergoing one or more IACS injections into the TMJ. In each TMJ, 0.5–1 ml of triamcinolone acetonide (40 mg/ml) or triamcinolone hexacetonide (20 mg/ml) was injected. At the last MIO measurement, these patients showed a mean increase from baseline of 6.9 mm (p=0.002; 95% CI: 3–10.7)**.** Increases in MIO were observed both after the initial injection and throughout the study period (January 1, 2000 to January 1, 2006), although responses to subsequent injections were minimal.

In this regard, it is worth considering the 2015 study by Stoustrup *et al*. [15] evaluating the short- and long-term effects of IACS on orofacial signs and symptoms related to TMJ arthritis. Thirteen patients underwent TMJ IACS injections (11 bilateral and two unilateral). In short-term follow-ups, a significant reduction in pain level was found in most patients, indicating a short-term beneficial effect of IACS. Conversely, between short-term and long-term follow-up, increased pain levels were observed in seven of the 13 patients, suggesting a loss of efficacy of IACS at long-term follow-up in some patients. Thus, the above study demonstrates a short-term improvement in orofacial symptoms related to TMJ arthritis.

Antonarakis *et al*. [16] conducted a prospective study to evaluate whether TMJ lavage combined with IACS injections is more effective than either lavage alone or no intervention in the treatment of TMJ in JIA. All groups showed a mean improvement in MIO and pain, but with wide interindividual variability. Over 50% of TMJs showed no significant changes on MRI. This study suggests that TMJ lavage, with or without IACS, does not guarantee systematic resolution of symptoms or inflammation, and that washing combined with IACS appears to offer a greater benefit, but the response is unpredictable and patient dependent.

The studies by Parra *et al*. [17] and Habibi *et al*. [18] both show improvement in clinical symptoms and target signs of inflammation after treatment (respectively, a total of 180 and 63 TMJ injections), demonstrating that the procedure is safe and effective in the short term and represents a valid therapeutic option when TMJ arthritis is active.

Intra-articular infliximab injections

The retrospective study by Stoll *et al*. [19], published in 2013, aimed to test the safety and efficacy of IA therapy with infliximab (IA-IFX) for TMJ arthritis in children with JIA, and demonstrated that IA-IFX was well tolerated and may have stopped the progression of arthritis in some cases.

Two years later, in 2015, the same author [20] expanded this investigation with another retrospective study, focusing on the use of IA-IFX in the management of TMJ arthritis associated with JIA refractory to systemic treatment and IACS injections. In this work, 33 children treated with 1–7 cycles of injections (up to 1 ml of IFX per side, equal to 5–10 mg bilaterally) were analyzed, evaluating MIO with the Therabite scale at baseline and at follow-up. However, the results showed no significant improvements in either acute or chronic findings of TMJ arthritis, with changes in MIO found to be at or below the clinical relevance threshold (4.9 mm) in 22/32 subjects. The study thus showed a minimal overall effect and suggested caution in the routine use of this therapy for refractory cases.

Arthrocentesis versus arthrocentesis combined with intra-articular corticosteroid injections

The study by Olsen Bergem *et al*. [21] set out to evaluate the effects IA treatment of the TMJ in patients with JIA. In particular, 21 patients (range 6–18 years) diagnosed with JIA and TMJ arthritis were recruited. Each joint was randomly assigned to treatment with arthrocentesis alone (treatment A) or to arthrocentesis and glucocorticoid injection (triamcinolone hexacetonide 20mg/ml, 0.5ml) (treatment B). The 21 recruited patients all underwent arthrocentesis, performed with a push and pull method, using a solution of vitamin B12 and saline (1:4 ml), under ultrasound guidance. A total of 38 joints were randomly assigned to treatment: 17 with arthrocentesis alone and 21 with arthrocentesis combined with triamcinolone. With both treatments, pain on palpation was found to improve significantly from baseline (VAS 52.7) to the 3-month follow-up (VAS 14.4) and to the 8-month follow-up (VAS 4.6), with no difference between the two treatments. Similarly, lateral excursion improved significantly (4.6–7.7–8.8 mm), again with no difference between the two treatments. The results therefore show a decrease in pain and an improvement in function for the entire patient group, confirming the effectiveness of arthrocentesis treatment, even in the absence of steroid administration.

Occlusal splint and functional appliances

The prospective observational study by Stoustrup *et al*. [22], published in 2014, evaluated changes in orofacial pain and TMJ function after stabilization splint treatment, demonstrating significant reductions in VAS pain (p=0.0001) and pain index (p=0.0017), and an improvement in MIO (p=0.0005), thus supporting the use of this conservative and reversible therapy – safe, inexpensive, and familiar to dentists – as an effective alternative to previously examined pharmacological approaches to manage the symptoms of TMJ arthritis.

Also adopting a non-pharmacological perspective, Isola *et al*. [23] analyzed the effects of personalized functional appliances (acrylic, resilient resin, and stainless steel, worn 12–14 hours a day) in 54 patients with JIA (mean age 13.2 years) over 24 months, observing statistically significant improvements in pain during jaw movements (p<0.001), maximum mouth opening (p<0.001), and TMJ joint sounds (p<0.001).

Both these studies show the effectiveness of conservative

orthodontic therapies, providing additional therapeutic options for children with JIA with TMJ involvement.

Physiotherapy

The prospective single cohort study published in 2023 by Vassis *et al*. [24] included 12 patients who performed weekly physiotherapy sessions for 8 weeks. Physiotherapy treatment included: TMJ mobilization techniques, physiotherapy including stretching exercises for the masticatory muscles, and laser therapy. Additionally, patients received instruction in resting mouth/tongue position and parafunctional activities, as well as mobilization and muscle relaxation exercises to be performed at home. The authors reported significant decreases in pain frequency, pain intensity, and the pain index ($p<0.0002$) and a significant improvement in MIO ($p<0.054$). Mouth opening ability with and without pain, laterotrusion, and protrusion improved between baseline and short-term follow-up (T0 to T9, $p<0.054$), and continued to improve after physiotherapy ended. Furthermore, a non-significant trend toward reduced crepitation was observed during treatment. The results of the above study suggest a beneficial effect of physiotherapy and home exercise on JIA-related orofacial symptoms and dysfunction.

Discussion

This scoping review analyzed the available evidence on conservative approaches for the treatment of TMJ arthritis in children and adolescents affected by JIA. TMJ involvement is a frequent and clinically relevant manifestation of the disease, with potential repercussions on orofacial function, craniofacial growth, and patient quality of life [12-14]. An analysis of the included studies shows that IACS is the most investigated therapeutic approach. Most studies show significant improvements in pain and MIO, especially in the short term [8,9,11,13,14]. Furthermore, some studies report a reduction in inflammatory activity assessed by MRI, suggesting a positive effect of IACS injections on the control of joint inflammation [8,10,13].

However, these benefits are not always maintained in the long term, as highlighted by Stoustrup *et al*. [15], who describe a loss of efficacy at long term follow-up in some patients. A critical aspect concerns the potential side effects of repeated corticosteroid injections. Lochbühler *et al*. [10] documented structural alterations of the mandibular condyle, including bone destruction and intra-articular calcification, suggesting that repeated use of IACS may have a negative impact on mandibular growth, sometimes greater than that attributable to the arthritis itself. These observations indicate the need for prudent use of this therapy, especially in pediatric patients, and for careful clinical and radiological monitoring.

Several studies have also shown that the effectiveness of IA infiltrations does not appear to depend on the technique used or radiological guidance. Resnick *et al*. [12] and Stoll *et al*. [13] reported overlapping results in terms of pain reduction and improvement of MIO regardless of the use of intraoperative imaging, suggesting that such procedures can be performed safely even without exposure to ionizing radiation. Regarding alternative IA therapies, the use of infliximab has been investigated in patients with refractory disease.

Although a preliminary study suggested a possible stabilization of joint disease progression [19], subsequent findings did not demonstrate clinically relevant improvements in TMJ arthritis-related function or signs [20], limiting support for the routine use of this therapeutic option. Arthrocentesis represents an additional conservative option. The study by Olsen Bergem *et al*. [21] highlighted a significant improvement in joint pain and function both with isolated arthrocentesis and in association with corticosteroids, with no significant differences between the two approaches. This suggests that mechanical removal of IA inflammatory mediators may be sufficient to achieve clinical benefit in some patients. Non-pharmacological approaches, such as the use of occlusal splints, functional devices, and physiotherapy, are particularly important. The studies by Stoustrup *et al*. [22] and Isola *et al*. [23] demonstrated a significant reduction in pain and an improvement in mandibular function through conservative orthodontic therapies, confirming their role as safe, reversible, and well-tolerated options. Similarly, the prospective study by Vassis *et al*. [24] showed a significant improvement in pain symptoms and MIO following a structured program of physiotherapy and home exercises, suggesting a positive effect even in the medium term.

Despite the overall favorable results, the quality of the available evidence remains limited. Most of the included studies have retrospective designs, small sample sizes, and heterogeneous control and follow-up groups, making direct comparisons between different therapeutic strategies difficult and limiting the generalizability of the results.

Conclusions

Currently available evidence suggests that conservative approaches play a central role in the management of TMJ arthritis in pediatric patients with JIA. Intra-articular corticosteroid infiltrations are effective in controlling pain and inflammation in the short term, but their use should be carefully balanced against potential adverse effects on mandibular growth. Arthrocentesis, conservative orthodontic therapies, occlusal splints, and physiotherapy represent valid alternatives or complementary treatments, with favorable safety profiles and significant clinical benefits. Given the methodological heterogeneity of the included studies, there is a need for further prospective, randomized, controlled studies with larger samples and long-term follow-up to define standardized, evidence-based treatment protocols. A multidisciplinary and personalized approach remains essential to optimize TMJ management in patients with JIA and prevent long-term functional and skeletal complications.

References

1. Petty RE, Southwood TR, Manners Pet al.; International League of Associations for Rheumatology. International League of Associations for Rheumatology classification of juvenile idiopathic arthritis: second revision, Edmonton, 2001. J Rheumatol. 2004;31(2):390-2.

2. Thierry S, Fautrel B, Lemelle I, Guillemin F. Prevalence and incidence of juvenile idiopathic arthritis: a systematic review. Joint Bone Spine. 2014;81(2):112-7.
3. Ravelli A, Martini A. Juvenile idiopathic arthritis. Lancet. 2007;369 (9563):767-78.
4. Tong A, Jones J, Craig JC, Singh-Grewal D. Children's experiences of living with juvenile idiopathic arthritis: a thematic synthesis of qualitative studies. Arthritis Care Res (Hoboken). 2012;64(9):1392-404.
5. Te Veldhuis EC, Te Veldhuis AH, Koudstaal MJ. Treatment management of children with juvenile idiopathic arthritis with temporomandibular joint involvement: a systematic review. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014 May;117(5):581-589.e2. doi: 10.1016/j.oooo.2014.01.226.
6. Stoustrup P, Twilt M, Spiegel L, et al.; euroTMjoint Research Network. Clinical orofacial examination in juvenile idiopathic arthritis: international consensus-based recommendations for monitoring patients in clinical practice and research studies. J Rheumatol. 2017;44(3):326-33.
7. Arabshahi B, Cron RQ. Temporomandibular joint arthritis in juvenile idiopathic arthritis: the forgotten joint. Curr Opin Rheumatol. 2006;18(5):490-5.
8. Frid P, Augdal TA, Larheim TA, et al. Efficacy and safety of intraarticular corticosteroid injections in adolescents with juvenile idiopathic arthritis in the temporomandibular joint: a Norwegian 2-year prospective multicenter pilot study. Pediatr Rheumatol Online J. 2020;18(1):75.
9. Arabshahi B, Dewitt EM, Cahill AM, et al. Utility of corticosteroid injection for temporomandibular arthritis in children with juvenile idiopathic arthritis. Arthritis Rheum. 2005;52(11):3563-9.
10. Lochbühler N, Saurenmann RK, Müller L, Kellenberger CJ. Magnetic resonance imaging assessment of temporomandibular joint involvement and mandibular growth following corticosteroid injection in juvenile idiopathic arthritis. J Rheumatol. 2015;42(8):1514-22.
11. Resnick CM, Vakilian PM, Kaban LB, Peacock ZS. Quantifying the effect of temporomandibular joint intra-articular steroid injection on synovial enhancement in juvenile idiopathic arthritis. J Oral Maxillofac Surg. 2016;74(12):2363-9.
12. Resnick CM, Vakilian PM, Kaban LB, Peacock ZS. Is intra-articular steroid injection to the temporomandibular joint for juvenile idiopathic arthritis more effective and efficient when performed with image guidance? J Oral Maxillofac Surg. 2017;75(4):694-700.
13. Stoll ML, Good J, Sharpe T, et al. Intra-articular corticosteroid injections to the temporomandibular joints are safe and appear to be effective therapy in children with juvenile idiopathic arthritis. J Oral Maxillofac Surg. 2012;70(8):1802-7.
14. Ringold S, Torgerson TR, Egbert MA, Wallace CA. Intraarticular corticosteroid injections of the temporomandibular joint in juvenile idiopathic arthritis. J Rheumatol. 2008;35(6):1157-64.
15. Stoustrup P, Kristensen KD, Küseler A, Pedersen TK, Herlin T. Temporomandibular joint steroid injections in patients with juvenile idiopathic arthritis: an observational pilot study on the long-term effect on signs and symptoms. Pediatr Rheumatol Online J. 2015;13:62.
16. Antonarakis GS, Courvoisier DS, Hanquinet S, et al. Benefit of temporomandibular joint lavage with intra-articular steroids versus lavage alone in the management of temporomandibular joint involvement in juvenile idiopathic arthritis. J Oral Maxillofac Surg. 2018;76(6):1200-6.
17. Parra DA, Chan M, Krishnamurthy G, et al. Use and accuracy of US guidance for image-guided injections of the temporomandibular joints in children with arthritis. Pediatr Radiol. 2010;40(9):1498-504.
18. Habibi S, Ellis J, Strike H, Ramanan AV. Safety and efficacy of US-guided CS injection into temporomandibular joints in children with active JIA. Rheumatology (Oxford). 2012;51(5):874-7.
19. Stoll ML, Morlandt AB, Teerawattanapong S, Young D, Waite PD, Cron RQ. Safety and efficacy of intra-articular infliximab therapy for treatment-resistant temporomandibular joint arthritis in children: a retrospective study. Rheumatology (Oxford). 2013;52(3):554-9.
20. Stoll ML, Vaid YN, Guleria S, Beukelman T, Waite PD, Cron RQ. Magnetic resonance imaging findings following intraarticular infliximab therapy for refractory temporomandibular joint arthritis among children with juvenile idiopathic arthritis. J Rheumatol. 2015;42(11):2155-9.
21. Olsen-Bergem H, Bjørnland T. A cohort study of patients with juvenile idiopathic arthritis and arthritis of the temporomandibular joint: outcome of arthrocentesis with and without the use of steroids. Int J Oral Maxillofac Surg. 2014;43(8):990-5.
22. Stoustrup P, Kristensen KD, Küseler A, Verna C, Herlin T, Pedersen TK. Management of temporomandibular joint arthritis- related orofacial symptoms in juvenile idiopathic arthritis by the use of a stabilization splint. Scand J Rheumatol. 2014;43(2):137-45.
23. Isola G, Ramaglia L, Cordasco G, Lucchese A, Fiorillo L, Matarese G. The effect of a functional appliance in the management of temporomandibular joint disorders in patients with juvenile idiopathic arthritis. Minerva Stomatol. 2017;66(1):1-8.
24. Vassis S, Resnick CM, Nørgaard M, et al. Impact of physiotherapy on orofacial manifestations of juvenile idiopathic arthritis. Pediatr Rheumatol Online J. 2023;21(1):116.