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Scrutiny Of Temporomandibular Joint Disorders In Pediatric Patients: Diagnostic Approaches And Age-Related Treatment Strategies

Richa Wadhawan[1], Upma Dhakad[2], Jyoti Shukla[3], Raj Kamal Shrivastava[4], Priyam Pratim Saikia[5], A Shri Gayyatri Santhosh[6]

Professor, Oral Medicine, Diagnosis & Radiology, PDM Dental College & Research Institute, Bahadurgarh, Haryana
Post Graduate, Paediatric And Preventive Dentistry, Maharana Pratap College Of Dentistry & Research Centre, Gwalior, Madhya Pradesh
Post Graduate, Paediatric And Preventive Dentistry, R.K.D.F. Dental College And Research Center, Bhopal, Madhya Pradesh
Post Graduate, Paediatric And Preventive Dentistry, Maharana Pratap College Of Dentistry & Research Centre, Gwalior, Madhya Pradesh
Post Graduate, Paediatric And Preventive Dentistry, Maharana Pratap College Of Dentistry & Research Centre, Gwalior, Madhya Pradesh
Intern, Maharana Pratap College Of Dentistry & Research Centre, Gwalior, Madhya Pradesh

Abstract:
Temporomandibular joint disorders (TMDs) are becoming more common among children and adolescents, presenting distinct diagnostic and treatment challenges. Symptoms such as pain, limited mouth opening, and joint noises differ by age, requiring a nuanced diagnostic approach. Accurate diagnosis demands a detailed clinical examination, comprehensive patient history, and advanced imaging techniques such as Magnetic Resonance Imaging (MRI) and Cone Beam Computed Tomography (CBCT). Initial treatment typically involves conservative measures like occlusal splints and physical therapy, while more severe cases may necessitate orthodontic or, in rare instances, surgical interventions. Early detection and intervention are crucial to avoid long-term complications. This review underscores the complexities associated with TMDs in younger individuals, emphasizing the necessity for developmentally appropriate diagnostic and therapeutic strategies. Future research should concentrate on developing standardized diagnostic criteria and age-specific treatment protocols to improve care for young patients. By enhancing our understanding and approach, dental practitioners and pedodontists can substantially boost patient outcomes and quality of life. This review assists dental professionals in diagnosing and managing TMDs effectively, emphasizing the need for a thorough and integrated approach to optimize symptom management and prevent future complications.

Keywords: *Temporomandibular Disorders, Children, Adolescents, Diagnostic criteria, Myalgia*

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I. Introduction:

Temporomandibular joint disorders (TMDs) are an umbrella term that refers to a range of problems affecting the masticatory system. Pain in the masticatory muscles, preauricular area, or temporomandibular joints (TMJs) is the most common symptom of TMDs. In addition to pain, various other clinical symptoms can occur, such as limited opening, deviation of mandibular movement, TMJ dysfunction, and clicking sounds.[1]The prevalence of TMDs has been widely reported, ranging from 4.2% to 88%.[2]Women are predisposed to the condition, and the prevalence of signs and symptoms increases with age.[3] In children and adolescents, the prevalence of TMDs diagnosed according to the Research Diagnostic Criteria for TMDs (RDC/TMD) or the Diagnostic Criteria for TMD (DC/TMD) ranges from 7.3% to 30.4%.[4]The etiology of TMDs is as diverse and multifactorial as the various symptoms. There is no single etiology that explains all symptoms.[5]Various local and systemic factors, including occlusal conditions, trauma, emotional stress, deep pain, parafunctional activities, and systemic diseases, can interact to trigger TMD signs and symptoms, with similar etiologies observed in children and adolescents, such as macro-trauma, parafunctional habits, psychosocial factors, and systemic conditions.[6]It can be classified in various ways based on diagnostic criteria. According to the

DC/TMD, which provides reliable evidence-based criteria, TMDs can be classified as myalgia (**Figure 1**), arthralgia, disc displacement, or degenerative joint disease.

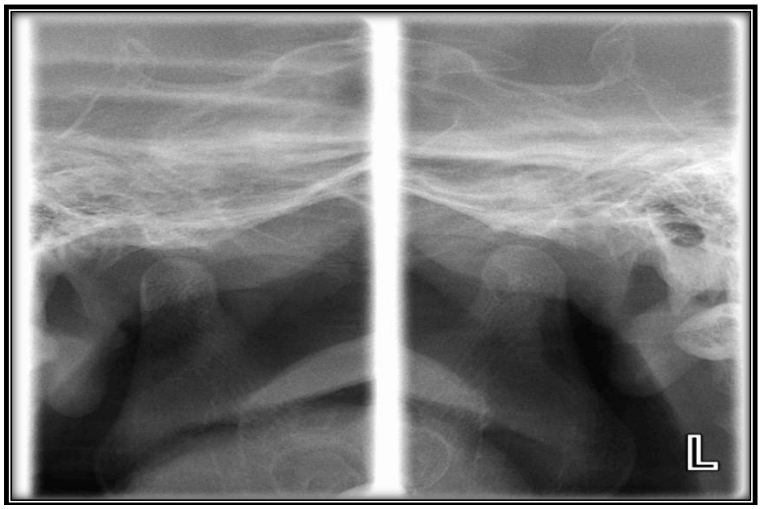

Figure 1: Panoramic temporomandibular joint (TMJ) radiograph of patient with myalgia reveals no significant pathological findings.

Classification - Taxonomic Classification for Temporomandibular Disorders (Table 1)

Table 1 – Classification of TMDs

Joint pain	(a) Arthralgia (b) Arthritis
Joint disorders	(a) Disc disorders i. Disc displacement with reduction ii. Disc displacement with reduction with intermittent locking iii. Disc displacement without reduction with limited opening iv. Disc displacement without reduction without limited opening (b) Other hypo mobility disorders i. Adhesions/adherence ii. Ankylosis A. Fibrous B. Osseous (c) Hypermobility disorders i. Dislocations A. Subluxation B. Luxation
Joint diseases	(a) Degenerative joint disease i. Osteoarthrosis ii. Osteoarthritis (b) Systemic arthritides (c) Condylysis/idiopathic condylar resorption (d) Osteochondritis dissecans (e) Osteonecrosis (f) Neoplasm (g) Synovial chondromatosis
Fractures	
Congenital/developmental disorders	(a) Aplasia (b) Hypoplasia (c) Hyperplasia
Masticatory muscle disorders	1. Muscle pain (a) Myalgia i. Local myalgia ii. Myofascial pain iii. Myofacial pain with referral (b) Tendonitis (c) Myositis (d) Spasm 2. Contracture 3. Hypertrophy 4. Neoplasm

	5. Movement disorders (a) Orofacial dyskinesia (b) Oromandibular dystonia 6. Masticatory muscle pain related to systemic/central pain disorders (a) Fibromyalgia/ widespread pain
Headache	Headache associated withTMDs
Associated structures	Coronid hyperplasia[7]

To diagnose TMDs, history-taking, examination, and imaging procedures are necessary. In clinical practice, history-taking of the present illness is important to identify the contributing etiological factors. This should include parafunctional, psychosocial factors, TMJ locking history, joint noise, and limitations severe enough to interfere with the ability to eat.[8] A clinical examination should involve palpation of muscles or TMJ and evaluation of signs of TMDs, such as opening movements, lateral or protrusive movement, and clicking or popping noise present with jaw movements.A diagnosis based on a clinical examination should be supported by appropriate imaging modalities. The successful management of TMDs depends on accurate diagnosis and control of these etiological factors, making an appropriate diagnostic and therapeutic approach through clinical and radiographic examinations essential.[9]The goal of treatment for TMDs in children and adolescents is to improve quality of life through pain relief and restoration of TMJ function.[10] However, symptoms are often mild, and a child's expression of them can be inaccurate, making diagnosis challenging.[11]It involves a range of joint and muscle dysfunctions affecting the craniofacial region.[12]Traditionally associated with adults, TMDs are increasingly common in children and young adolescents, with manifestations including pain in the masticatory muscles and TMJ, restricted or uneven mouth opening, and abnormal TMJ sounds.[13]Prevalence rates vary due to differing study methodologies and the need for age-specific diagnostic criteria.[14] The causes of TMDs in these age groups are multifactorial, including trauma, occlusal issues, physical and developmental problems, and psychological factors.[15] TMDs is a significant concern due to its potential to cause pain and disability, ranking as the second most common form of pain after back pain.[16] Proper diagnosis and treatment involve a thorough patient history, clinical examination, and sometimes imaging studies, with a focus on recovery.[17]Research from the 1970s indicates that TMDs signs and symptoms are commonly observed in preschool children.[18] Despite variable reporting, TMDs is increasingly recognized in younger populations, complicating the understanding of its true nature and the need for treatment.[19] The TMJ, which facilitates movement between bones covered with hyaline cartilage, plays a central role in TMDs. The TMJ comprises the mandibular condyle, mandibular fossa, and articular disk. Growth of these structures begins about 8 weeks after conception.[20]Major changes to the mandibular condyle's shape and structure are largely completed by age 10, with slower growth continuing into the second decade of life.[21]By ages 12 to 16, approximately 5% of mandibular condyles exhibit noticeable changes on X-rays**(Figure2**).[22]

Figure 2: Cone-beam computed tomography revealed a large defect region and erosion of the left condyle along with trauma to maxillary deciduous teeth

The terminology for temporomandibular disorders has evolved significantly over time.[23] In 1934, Dr. James Costen introduced the term "Costen syndrome" to describe symptoms related to the ear and TMJ.[24]By 1959, Shore referred to "TMJ dysfunction syndrome," and in the 1960s, Ramfjord and Ash used "functional

TMJ disturbances."[25]The 1970s saw the introduction of "craniomandibular disorders" to address a broader range of issues, while the 1980s brought "TM disorder," a term proposed by Bell to cover all concerns related to the masticatory system.[26] Currently, the American Dental Association uses the term "Temporomandibular Disorders TMDs"to describe these conditions.[27] The management of TMDs began with Dr. Costen's observations in 1934, connecting dental conditions with ear symptoms.[28] Initial treatments in the late 1930s and early 1940s primarily involved bite-raising appliances.[29] However, by the late 1940s and early 1950s; the effectiveness of these appliances came under scrutiny, leading the dental community to investigate occlusal interferences as possible contributing factors.[30]The late 1950s marked the publication of the first textbook on the masticatory system, highlighting issues related to masticatory muscle pain.[31]In the 1960s and 1970s, research into TMDs began to encompass the influence of occlusion and emotional stress.[32]By the 1980s, a more detailed understanding of TMDs complexities emerged.[33]The 1990s and 2000s saw the adoption of evidence-based practices and the creation of educational programs for TMDs management.[34] By 2010, the Commission on Dental Accreditation had established standardized postgraduate training programs to enhance professional competency in managing TMDs, which are recognized as a significant source of orofacial non-odontogenic pain.[35]Studies on the prevalence of TMDs in children and adolescents show notable variability, likely due to differences in populations, diagnostic criteria, and examination methods.[36] To address these inconsistencies, the Diagnostic Criteria (DC) TMD protocol has been developed.[37] Research indicates that approximately 11.9% of adolescents experience TMDs, with prevalence increasing with age.[38]For example, 4.2% of adolescents aged 12 to 19 report TMD pain, while 34% of those with primary dentition exhibit signs or symptoms.[39]A survey involving 4,724 children aged 5 to 17 found that 25% showed symptoms of TMD.[40] Clicking was observed in 2.7% of children with primary dentition, 10.1% in those with late mixed dentition, and 16.6% in those with permanent dentition.[41] Systematic reviews indicate that 16% of cases show clinical signs, and 14% exhibit TMJ sounds.[42]Girls are more likely than boys to experience TMD symptoms and require care, with symptoms often associated with puberty.[43] Between ages 16 and 19, school absences and analgesic use for pain are higher in girls (32.5%) compared to boys (9.7%).[44] Additionally, headaches in teenagers are frequently linked to TMDs, often occurring before the onset of jaw pain.[45]The article emphasizes that TMDs, traditionally associated with adults, are increasingly recognized in pediatric populations. It notes that TMDs can manifest in children and adolescents, and understanding their prevalence is crucial for timely diagnosis and treatment.[46]

II. Discussion:

TMDs present a complex challenge in diagnosis and management due to their multifactorial nature and the variability of contributing factors.The development of TMDs is influenced by a range of factors categorized as predisposing, precipitating, and perpetuating, each contributing to the overall risk and severity of the disorder.[47] Despite extensive literature, evidence linking specific etiological factors to TMDs development remains weak, making prediction and prevention difficult.[48]Contributing factors to TMDs include occlusal conditions, trauma, emotional stress, deep pain input & parafunctional activities.[49]The role of occlusal factor such as bite misalignments or dental abnormalities in TMDs onset is debated.[50]Although occlusal discrepancies are frequently discussed, there is no strong evidence directly linking them to TMDs development. This suggests that while occlusal factors may contribute to TMDs, they are not the sole or primary cause.[51]Traumatic injuries to the jaw or face can significantly contribute to TMDs. Trauma can be classified into macro trauma involves significant force, such as a direct blow or car accident, which can cause immediate and severe damage to the TMJ. Chin traumas, a common occurrence in childhood because of falling, is a reported factor in the development of TMDs in pediatric patients.[52]A direct blow to the mandible from a traumatic incident e.g., motor vehicle accident, sports collision, physical abuse can damage masticatory structures and lead to signs and symptoms of inflammation and TMDs. TMJ injuries following jaw dislocation (**Figure 3**)and mandibular hyperextension during medical and dental procedures e.g., oral intubation, bite block placement, third molar extraction have been reported. Subcondylar fractures are the most common mandibular fractures in children.[53]Treatment of jaw fractures with closed reduction and prolonged immobilization can lead to TMJ ankylosis (**Figure 4**) and subsequent jaw dysfunction.[54] In growing patients, mandibular fractures might result in facial asymmetry. Due to the proximity of the TMJs to the base of the skull, traumatic brain injury or concussion may occur alongside jaw injuries. Additionally, indirect trauma, such as whiplash injuries, can affect pain processing and contribute to TMDs.[55]

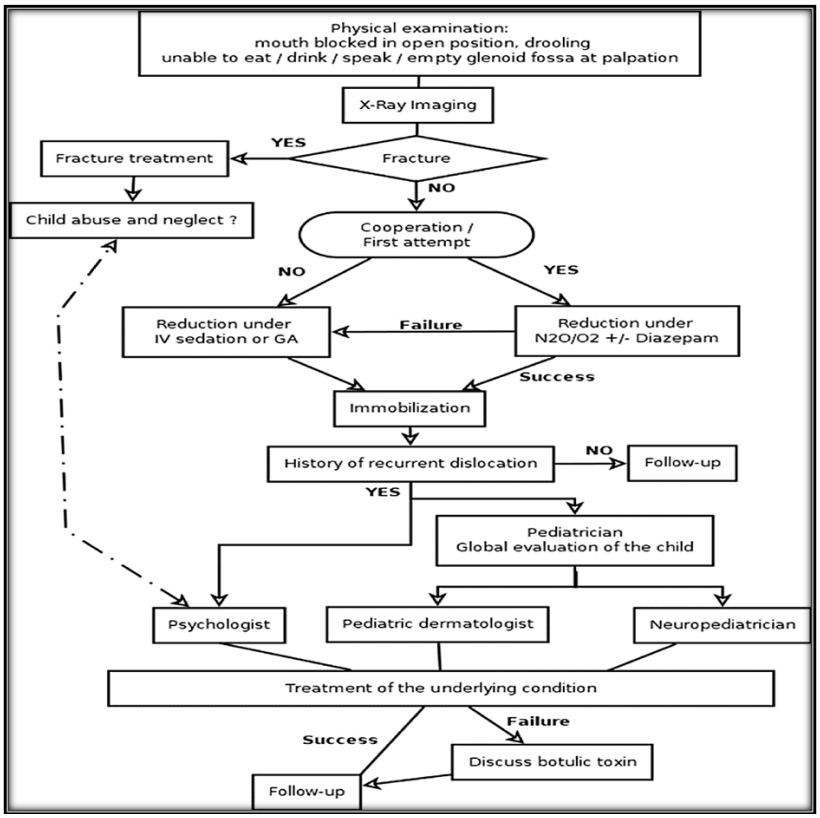

Figure 3-Treating TMJ dislocations in childen. (GA- general anesthesia; IV- intravenous; MEOPA- 50% nitrous oxide mixed with oxygen. (Adapted from - Sicard et al. Bilateral Dislocation of the TMJ in Children. J Oral Maxillofac Surg 2018)

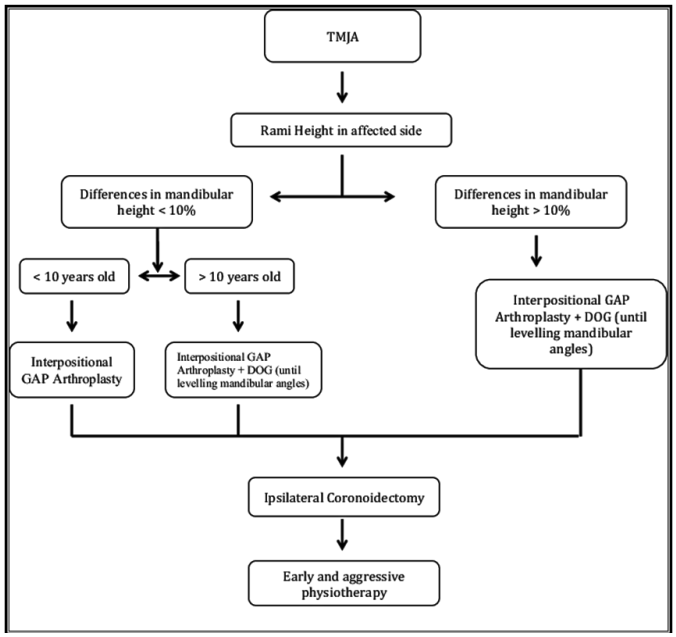

Figure 4- Treatment algorithm in temporomandibular joint ankylosis (Adapted from –FariñaRodrigo et al (2017). Temporomandibular Joint Ankylosis: Algorithm of Treatment)

Micro trauma involves repeated minor forces, like those from bruxism or chronic jaw clenching, causing cumulative damage over time.Tooth grinding, clenching, and other repetitive parafunctional mandibular behaviors are believed to contribute to TMDs development. Prolonged use of wind instruments or fingernail biting can also stress the masticatory system. Excessive loading of the TMJ over time can lead to cartilage degradation, changes in synovial fluid, and structural alterations within the joint, such as degenerative joint

disease, as well as in the masticatory muscles, including masseter hypertrophy.Bruxism characterized by tooth clenching and grinding, can occur with varying intensity and frequency during both sleep and wakefulness. Sleep bruxism(figure 5), a sleep-related masticatory muscle activity with potential physiological or protective relevance, is most common in childhood and typically decreases with age.[54]

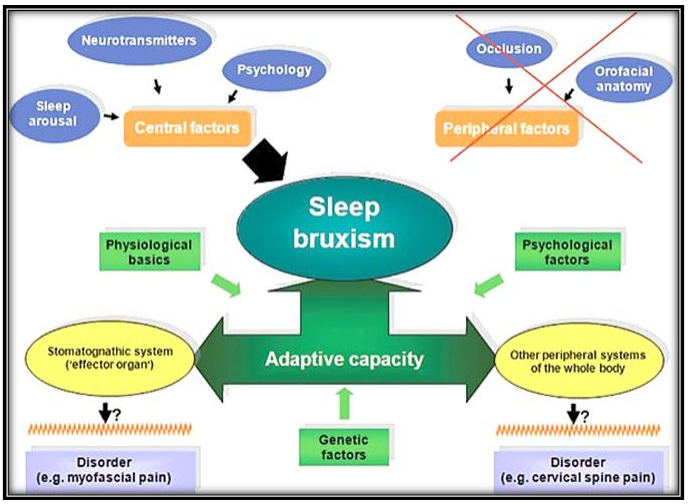

Figure 5: Onset of sleep bruxism and its implications for the stomatognathic system and body's peripheral systems. (Adapted from Alicia Ommerborn*et al 2012.* Effects of sleep bruxism on functional and occlusal parameters: a prospective controlled investigation. *Int J Oral Sci*)

Approximately one in four children experiences probable or possible sleep bruxism, with no significant gender differences.[55]Research on the link between parafunctional behaviors and TMDs in both pediatric and adult populations is mixed.[56] However, childhood parafunctional habits have been identified as a predictor of similar behaviors later in life. [57]A systematic review identified a positive link between awake bruxism and painful TMDs in children and adolescents, although no similar association was found for sleep bruxism.[58] Sleep bruxism frequently occurs in conjunction with sleep breathing disorders, such as snoring and obstructive sleep apnea, but there is limited evidence regarding the underlying pathophysiological connection and the timing of this condition.[59]The connection between skeletal and occlusal factors and the development of TMDs is relatively weak. Some occlusal findings, such as an anterior open bite or nonworking occlusal interferences, may be consequences of TMDs rather than its causes.[60]Evidence does not support that orthodontic treatment, whether involving premolar extractions or not, prevents or improves TMDs.[61] Changes in the freeway space, the vertical dimension between occluding teeth, may be affected by occlusal changes or restorations. While most children and adolescents adapt to changes in vertical dimension, TMDs may develop in some due to the masticatory system's inability to adjust, combined with emotional stress, physical symptom reporting, and fear of pain from jaw movement.[62] Social factors like lack of family support, access to care, and stigma can also impact TMDs.[63]Emotional stress and other psychosocial factors make children over six more prone to sleep bruxism. Conditions such as depression, anxiety, post-traumatic stress disorder, psychological distress, and sleep dysfunction can affect TMD prognosis and symptoms.[64]Greater pain intensity in the orofacial region correlates with a more significant impact on quality of life, including difficulties with prolonged jaw opening, eating, and sleeping. Persistent TMDs pain is associated with other co morbid pain complaints and pain-related disability. Evidence supporting psychological therapies alone for reducing TMD pain is limited.[65]Rheumatic diseases like systemic lupus erythematosus, juvenile idiopathic arthritis (JIA), and psoriatic arthritis can involve the TMJs. Imaging studies show that most children with JIA exhibit TMJ degeneration, even in the absence of pain.[66] Connective tissue disorders with generalized joint laxity or hypermobility, such as Ehlers-Danlos syndrome and Marfan syndrome, are associated with chronic pain and TMD symptoms. Unique TMD categories include congenital or acquired hypoplasia, pathological hyperplasia, bifidity, and condylar tumors.[67]Although no specific biomarkers for TMD exist, studies indicate that patients with painful TMD have elevated levels of inflammatory cytokines, such as interleukins and tumor necrosis factor, as well as neurotransmitters like glutamate, serotonin, and cortisol. Genetic factors influence biological systems related to pain processing, and research into genetic polymorphisms associated with pain sensitivity is ongoing. Variations and mutations in specific genes, including catechol-O-methyltransferase, glucocorticoid receptors, and serotonin receptor genes, are linked to an increased risk of orofacial pain and TMDs.The role of hormones, such as estrogen, in TMDs development is debated.[68]Although females have a higher prevalence of symptomatic TMDs, no clear link between TMDs development and estrogen levels related to menstrual or

pregnancy status has been established.[69] A systematic review found that TMJ symptom reporting might relate to depression and somatization during puberty, particularly in females. Individuals with neurological disorders, such as spastic cerebral palsy, are more likely to exhibit parafunctional oral habits and bruxism.[70] Psychological factors, including stress and anxiety, significantly influence TMDs.[71] Stress exacerbates muscle tension, leading to increased jaw clenching and grinding. Activation of the hypothalamic-pituitary-adrenal (HPA) axis and autonomic nervous system due to stress can worsen TMDs symptoms. Stress-related disorders like depression and anxiety have a notable impact on TMDs symptoms, especially during periods of social isolation, such as during the COVID-19 pandemic.[72]Chronic or deep-seated pain conditions in the masticatory system, such as pulp necrosis, can contribute to TMDs. These pain conditions may lead to involuntary mouth opening or other compensatory behaviors that can be mistaken for primary TMD symptoms. Deep pain input can trigger muscle contractions and exacerbate TMD symptoms.[73] Parafunctional habits, like bruxism and habitual jaw clenching, are strongly linked to TMDs, placing additional stress on the TMJ and surrounding muscles and contributing to symptom development or worsening.[74]Diagnosing TMDs in children and adolescents is challenging due to their difficulty in articulating symptoms and the variability of these symptoms, complicating the use of standard diagnostic criteria such as the DC/TMD, which are primarily validated for adults.[75] Essential diagnostic methods include understanding the patient's experience. Collecting a detailed history of symptoms and functional limitations is crucial.Evaluating jaw movement and pain clinical assessments should include measuring limitations in jaw opening and detecting pain.Magnetic Resonance Imaging (MRI)imaging is essential for visualizing disc displacement and joint structures, while Cone beam computed tomography(CBCT) provides detailed bone images but is less effective for soft tissues.[76]Palpation and functional tests help detect tenderness, abnormal sounds, and range of motion issues.Disc displacement with or without reduction (DDWoR) affects approximately 8.3% of individuals and can lead to joint pain and limited jaw opening.[77]Degenerative joint disorders (DJD) are more common in patients with DDWoR and may cause irreversible changes.[78]Treatment approaches for TMDs in pediatric patients include Orthotic Splint Therapy. An occlusal splint appliance (OSA) is commonly used to alleviate pain, enhance mouth opening, and stabilize the TMJ by redistributing forces and reducing pathological stress.TMJ Involvement in Juvenile Idiopathic Arthritis (JIA): This condition can lead to complications such as malocclusion, asymmetry, and micrognathia.[79] Management strategies include systemic medications, occlusal appliances, and intra-articular treatments (**Figure 6**).Continued research is essential to develop and validate diagnostic criteria tailored specifically for pediatric populations and to improve treatment methods.Studies should focus on understanding long-term outcomes and evaluating the effectiveness of various treatments for TMDs in children and adolescents. Patient and family education Providing education and resources to patients and their families are vital for effective TMDs management involves helping them understand the disorder, its management, and coping strategies to improve treatment adherence and quality of life. Regular evaluations & consistent assessments are necessary to monitor disease progression, adjust treatments, and prevent long-term complications. Routine check-ups should include TMD evaluations to detect and address issues early.Comprehensive and interdisciplinary approachmanaging pediatric TMDs effectively requires a collaborative approach involving dentists, orthodontists, and otherhealthcare professionals. Joint efforts among specialists help develop a holistic treatment plan tailored to the patient's specific needs.By combining clinical expertise, patient education, and ongoing research, the diagnosis, management, and outcomes for pediatric TMDs patients can be significantly improved, ultimately enhancing their overall quality of life.[80]

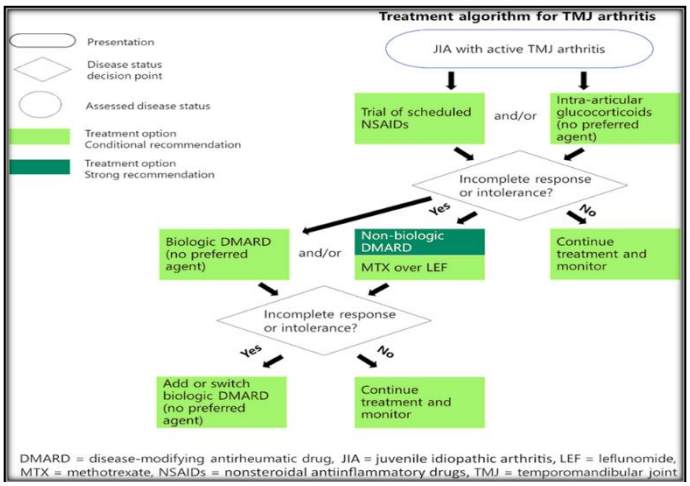

Figure 6: Management of JIA with TMJ involvement(Adapted from – Onel Karen B et al. American College of Rheumatology Guideline for the Treatment of Juvenile Idiopathic Arthritis; 2022)

III. Conclusion:

TMDs present a multifaceted challenge in pediatric patients due to the range of symptoms, variability in prevalence, and the impact on quality of life. The evolving understanding of TMDs in younger populations highlights the need for precise diagnosis and customized treatment strategies. The use of advanced diagnostic methods improves the ability to differentiate TMD from other conditions and to create a clear and actionable treatment plan. Treatment approaches for TMDs in children must be developmentally appropriate and address their unique developmental and psychological needs. Because symptoms in children and adolescents are often mild and difficult to articulate, thorough clinical examinations are recommended for early diagnosis of TMDs. Additionally, patients with risk factors like parafunctional habits and systemic diseases should be carefully assessed for TMDs during regular follow-ups. With growing interest in pediatric TMDs, further research on the prevalence of TMDs and validation studies of diagnostic criteria like the DC/TMD in children are needed.

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Conflicts of interest There are no conflicts of interest

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