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# Advances in Personalized Diagnosis and Treatment Strategies for Temporomandibular Disorders

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*Temporomandibular Joint Disorders, Personalized, Diagnosis, Treatment*

ABSTRACT

Temporomandibular joint disorders (TMDs) is a broad term encompassing pain and/or functional impairment of the masticatory muscles and the temporomandibular joint. Currently, the clinical treatment principles for TMDs mainly include etiological treatment and symptomatic treatment. In addition, the development of personalized diagnostic and treatment plans is crucial for the effective management of TMDs. This review systematically outlines the patient intake process for TMDs and discusses the importance and methods of developing personalized etiological and symptomatic treatment plans based on patient characteristics such as age and symptoms, aiming to provide clinical practitioners with guidance on patient management.

## 1. Introduction

Temporomandibular disorders (TMDs) are the fourth most common oral disease following dental caries, periodontal diseases, and malocclusions. This condition significantly affects patients' physical and mental health, as well as their quality of life, and has gradually received increasing attention (Ohrbach et al., 2013). Numerous reviews have been published regarding treatment methods for TMDs; however, there are fewer articles discussing the personalized treatment approaches for TMD patients. In clinical practice, although clinicians have a general understanding of the dual-axis diagnosis of TMDs, it is often challenging to select the appropriate treatment approach based on treatment principles for patients with varying demographics and symptoms. Therefore, this review combines diagnostic methods and treatment principles for TMDs from both China and abroad, with a focus on how to tailor personalized treatment strategies for patients of different ages and symptom profiles. The aim is to provide clinicians with scientifically sound and reasonable approaches for patient management.

## 2. Diagnostic Approach

The classification of TMDs is highly diverse, with the dual-axis diagnostic criteria occupying a dominant position in China. This diagnostic framework includes two axes: Axis I for the assessment of physical condi-

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tions and Axis II for evaluating pain-related disability and psychological status. Accurate diagnosis is crucial for successful treatment. Chinese scholars advocate for a comprehensive diagnostic approach that combines disease classification, imaging-based diagnosis, and etiological assessment. This integrative method enables a clear characterization of the affected region, the nature and severity of the disease, as well as its potential triggers.

Typically, clinicians perform a thorough medical history review and specialized examination of the temporomandibular joint (TMJ) to make a preliminary determination of the TMD subtype based on the Axis I classification of the Chinese dual-axis diagnostic criteria. Beyond physical assessment, psychological factors such as anxiety, depression, and somatization are considered key susceptibility factors for TMDs. Therefore, a comprehensive evaluation of mental health, psychological status, and physical comorbidities is deemed essential before determining the treatment plan, aligning with the Axis II diagnostic framework.

In clinical practice, commonly utilized tools for Axis II diagnosis include the Patient Health Questionnaire-9 (PHQ-9) for assessing depression, the Generalized Anxiety Disorder-7 (GAD-7) for anxiety evaluation, and the Patient Health Questionnaire-15 (PHQ-15) for somatic symptom assessment. These tools enable a systematic evaluation of TMD patients' psychological and somatic conditions, facilitating individualized treatment planning.

In addition to classifying the disease according to the dual-axis diagnostic criteria and evaluating the psychological status of the patient, it is also essential to conduct an etiological assessment. This involves inquiring about harmful chewing habits, the presence of nocturnal bruxism, and the patient's occlusal condition. These evaluations provide critical insights into the underlying causes of temporomandibular disorders (TMDs), enabling a more targeted and personalized treatment approach (Murphy et al., 2013).

Current imaging modalities for TMDs include panoramic X-rays, CBCT, and magnetic resonance imaging (MRI) (Singer & Mupparapu, 2023).With advancements in imaging techniques for the temporomandibular joint (TMJ), MRI has gradually become the preferred diagnostic method, offering significant clinical value. Beyond X-ray imaging, arthroscopy has also gained increasing attention in the diagnosis and management of refractory TMJ conditions, proving to be indispensable (Verhelst et al., 2021). Professor Ma Xuchen proposed that in clinical practice, the dual-axis diagnostic approach should be adopted as the standard. Before formulating treatment plans, it is essential to conduct a comprehensive evaluation of patients' physical conditions and psychological status using the dual-axis diagnostic framework. This approach facilitates the development of personalized treatment strategies tailored to the individual characteristics of each patient. Nevertheless, TMDs are inherently complex. Some researchers advocate for the use of a "triple diagnostic approach," which integrates: Dual-axis diagnosis (assessment of physical and psychological conditions), Imaging diagnosis (evaluation of anatomical structures), and Etiological diagnosis (identification of underlying causes).

This comprehensive diagnostic framework helps elucidate the disease type, etiology, and anatomical abnormalities. Regarding treatment, it is recommended to address both symptoms and underlying causes, developing an effective management plan. Treatment strategies can be broadly classified into two categories: Definitive or etiological treatments, which target the root cause, and Supportive or symptomatic treatments, which focus on symptom relief. This integrated treatment strategy can be tentatively termed the "dual-axis therapy model" (Cadden, 2009).

## 3. Treatment Principles

Over the past few decades, the principles guiding the treatment of temporomandibular disorders (TMDs) in China have undergone significant evolution. Initially dominated by conservative approaches, the field later saw an expansion of surgical indications before ultimately r eturning to a conservative-first paradigm. Extensive clinical trials and controlled studies have demonstrated that many TMD patients can achieve symptom relief through appropriate self-management, patient education on joint health, and psychological support (Penlington et al., 2022), This phenomenon underscores the self-limiting nature of TMDs (Buescher, 2007). China currently advocates for a "graded intensification" treatment strategy for temporomandibular disorders (TMDs). This approach begins with reversible conservative treatments, followed by irreversible conservative treatments, and ultimately progresses to arthroscopic surgery or other invasive procedures if the aforementioned methods prove ineffective and the symptoms significantly impair the patient's quality of life. This treatment principle must be strictly adhered to.

Under this primary principle, several detailed treatment guidelines should also be followed: Strictly adhere to treatment indications: Avoid over-diagnosis and overtreatment.Emphasize personalized treatment: Focus on restoring joint function while tailoring interventions to individual patient needs.Ensure accurate diagnosis and classification. Conduct comprehensive patient evaluations. Address psychological health promptly.Emphasize health education and rehabilitation.Among these, personalized treatment is often overlooked by clinicians and is a key focus of this review. It highlights the importance of individualized care, which not only aligns with modern medical principles but also ensures optimized outcomes for patients with TMD.

## 4. Symptom-Based Treatmeny

### *4.1. Diagnosis and Treatment of Patients With Pain as the Primary Symptom in TMDs*

Pain is often the primary reason for patients with TMDs to seek medical attention. In developed countries, TMDs are among the most common causes of chronic orofacial pain, significantly affecting patients' daily lives (Wieckiewicz et al., 2015). Patients commonly report various pain-related symptoms during consultations, including pain while chewing hard foods, pain during wide mouth opening, pain associated with mandibular movements, spontaneous joint pain around the temporomandibular region, muscle soreness or fatigue, and even referred pain in the temporal region, neck and shoulders, or around the external auditory canal.

Although the manifestations of pain are highly diverse and its underlying causes remain a topic of debate, TMD-related pain is generally classified into two major categories: myofascial pain involving the masticatory muscles and arthralgia originating from the joint itself (Christidis et al., 2019).

#### *4.1.1. Myofascial Pain in TMDs*

The most common method for diagnosing myalgia in TMDs is palpation of the masticatory muscles, typically focusing on the temporalis and masseter muscles. Palpation is performed by applying pressure perpendicular to the muscle fibers while moving the fingertips anteriorly and posteriorly(Schiffman et al., 2014). The overarching treatment principles for myofascial TMDs are pain relief and muscle relaxation. Stepwise management of myalgia typically begins with conservative approaches. During the acute pain phase, patients are advised to limit mandibular functional movements, consume soft foods, and avoid activities that could strain the joint. Subsequent conservative treatments may include physical therapy, pharmacotherapy, and cognitive behavioral therapy(Wieckiewicz et al., 2015). These interventions primarily aim to strengthen specific muscle groups while reducing the activity of others(Kijak et al., 2013), This facilitates isometric contraction of the bilateral masticatory muscles during functional activities, ultimately alleviating the symptoms of myalgia.

#### *4.1.2. Physical Therapies*

Currently, widely adopted physical therapies for TMDs can be broadly categorized into physical modality therapy, manual therapy, and movement therapy, collectively referred to as the "3M techniques." Among these, manual therapy and movement therapy are extensively utilized due to their pain-free, cost-effective, and repeatable nature (Shimada et al., 2019). Manual therapy involves interventions targeting the cervical muscle groups, suboccipital muscles, facial muscles, and joints to promote overall improvement in the temporomandibular joint (TMJ) region and alleviate myalgia symptoms(Asquini et al., 2021). The effectiveness of manual therapy, either as a standalone treatment or in combination with other modalities, in reducing TMD pain and surrounding muscle spasms, has been well-established. Therefore, it is frequently combined with other therapeutic approaches in clinical practice.Movement therapy aims to balance bilateral muscle strength and improve natural mouth opening by employing techniques such as stretching, relaxation, and isometric contraction exercises. This approach addresses imbalances in muscle tone or contraction intensity between the two sides (Wieckiewicz et al., 2015). Key techniques include muscle strengthening exercises (resistance training), coordination exercises, and myofascial release(Kalamir et al., 2012).

#### *4.1.3. Invasive Muscle Therapies*

Invasive muscle therapies have been shown to effectively alleviate myogenous pain associated with TMDs. The beneficial effects of masticatory muscle needling and low-concentration botulinum toxin injections are well-supported by the literature(Romero-Morales et al., 2021), Botulinum toxin, a biological neuromuscular blocker used as a muscle relaxant,

can relieve pain in the head and neck region. Additionally, it has been proven effective in reducing neuromuscular tension and nighttime bruxism (Ho & Tan, 2007; Schwartz & Freund, 2002). Consequently, invasive muscle therapies can serve as supportive or alternative treatments for myofascial pain.

### *4.2. Pain due to Osteoarthritic and Inflammatory Joint Diseases*

Temporomandibular joint osteoarthritis (TMJOA) represents the most severe form of TMDs, characterized by structural degeneration and non-inflammatory deterioration of joint tissues, including wear and degradation. Clinically, TMJOA is primarily manifested by joint pain, joint sounds, and functional impairment (Zarb & Carlsson, 1999). Inflammatory joint conditions, such as synovitis and/or capsulitis, can present in acute or chronic phases. These conditions are typically characterized by localized joint pain, which intensifies with posterior and superior movement of the condyle or upon palpation in the preauricular region. In many cases, inflammatory joint diseases co-occur with TMJOA, leading to a range of debilitating symptoms that severely impact patients' quality of life. Therefore, this article focuses on TMJOA for an in-depth discussion.

The most commonly utilized diagnostic modality for TMJOA is CBCT. The radiographic features of TMJOA include erosive resorption, sclerosis, attrition, osteophyte formation, and cystic changes of the condyle(Wang et al., 2015).The primary goals of TMJOA treatment are to alleviate pain, slow disease progression, and restore temporomandibular joint function(de Souza et al., 2012).Pain management can be effectively achieved with non-steroidal anti-inflammatory drugs (NSAIDs) or therapeutic interventions such as arthrocentesis(Machon et al., 2011).

#### *4.2.1. Pharmacotherapy Treatment*

Oral pharmacotherapy is a common non-invasive treatment modality for TMJOA. Frequently used medications include NSAIDs, opioids, corticosteroids, and benzodiazepines (Freesmeyer et al., 2005; Ouanounou et al., 2017; Wieckiewicz et al., 2015). NSAIDs and analgesics are effective in alleviating pain in the head, mandibular muscles, face, neck, or shoulders, including referred pain. However, their side effects, such as gastric erosion, ulcers, and gastrointestinal bleeding, are significant, particularly in elderly patients, who are more susceptible to these adverse effects compared to younger individuals (Ouanounou & Haas, 2015). Studies have demonstrated that oral pharmacotherapy alone cannot cure TMJOA, and its efficacy is inferior to physical therapy and minimally invasive injection treatments. Nevertheless, oral medications have a positive impact on relieving pain and functional impairment in the temporomandibular joint region, making them a valuable adjunctive therapy (Wieckiewicz et al., 2015).

#### *4.2.2. Arthrocentesis Treatment*

Arthrocentesis has become increasingly popular in clinical practice due to its advantages, including a short treatment duration, minimal invasiveness, simplicity, and high efficacy (Pasqual et al., 2020). The principle involves flushing the TMJ cavity with physiological saline under pressure, followed by the injection of hyaluronic acid (HA) to alleviate joint symptoms. Hyaluronic acid is a critical component of normal synovial fluid and the articular cartilage matrix of the TMJ. It serves to lubricate and cushion the joint, reducing friction and stress during mechanical movement, and plays a vital role in maintaining TMJ homeostasis. Therefore, intra-articular injection of exogenous HA after arthrocentesis effectively replenishes intra-articular HA levels, thereby alleviating symptoms (Guarda-Nardini et al., 2014). The basic procedure typically involves performing a joint puncture followed by local surface anesthesia with lidocaine to minimize discomfort during subsequent steps. Pulsatile pressurized irrigation with physiological saline is then carried out, followed by the injection of 1 mL of HA. Arthrocentesis not only removes intra-articular debris and abnormal synovial fluid, especially inflammatory mediators, but also releases adhesions, reduces abnormal intra-articular pressure, and frees the articular disc. These effects collectively alleviate pain, increase joint mobility, and, when combined with manual repositioning, significantly improve mouth-opening limitations.

For patients with structural abnormalities in the TMJ, injecting HA into the superior joint cavity, combined with occlusal splint therapy, is often employed to reposition displaced discs. Some researchers have found that combining intra-articular HA injection with oral glucosamine has a synergistic effect in treating TMJOA. While there have been proposals to inject cytokines or anti-cytokines into the joint cavity to stimulate cartilage repair following arthrocentesis

(Urech et al., 2010), these approaches have not yet been applied to the treatment of TMJOA.

### 4.3. Diagnosis and Treatment of Patients With Joint Structural Disorder in TMDs

Structural disorders of the TMJ refer to abnormal alterations in the normal structural relationships of the joint, primarily encompassing anterior disc displacement with reduction (ADDWR) and anterior disc displacement without reduction (ADDWoR). ADDWR is commonly characterized by joint clicking, which often goes unnoticed by patients in its early stages and is typically discovered incidentally during other dental examinations or treatments. For such cases, if no other symptoms are present, specific treatment is not required. However, patients should be informed about joint protection measures to prevent progression to ADDWoR.

ADDWoR is a condition characterized by structural disruption in the relationships between the articular disc, mandibular condyle, and articular fossa, wherein the disc remains anterior to the articular eminence during mandibular opening and closing movements and cannot self-reduce(Minervini et al., 2023). Clinical symptoms of ADDWoR are often pronounced and may significantly impair masticatory function. These symptoms typically include pain in the joint area during opening or wide opening, chewing pain, restricted mouth opening, and mandibular deviation.

The management of irreducible anterior disc displacement of the TMJ remains controversial. Some researchers consider ADDWoR a self-limiting condition, suggesting that its clinical symptoms, such as pain and restricted movement, may naturally resolve without treatment or without the need for aggressive disc repositioning (Sato et al., 1997). However, other scholars advocate for active conservative or surgical interventions to anatomically reposition the disc (He et al., 2015). A clinical study on the natural progression of ADDWoR patients revealed that most patients did not achieve complete symptom resolution. Over time, progressive anterior displacement and shortening of the disc, folding and deformation of the disc, condylar resorption, and secondary facial asymmetry or mandibular retrusion were observed in patients across different age groups. These findings underscore the importance of early detection, diagnosis, and treatment of ADDWoR.

Conventional treatment methods include conservative approaches such as medication, physical therapy, occlusal splints, and manual reduction. This article focuses on the use of occlusal splints, manual reduction, and HA irrigation for the treatment of ADDWoR.

#### 4.3.1. Acute Phase ADDWoR

The diagnostic criteria for acute ADDWoR as proposed by the American Academy of Orofacial Pain (AAOP) are as follows (Cadden, 2009):

1) Sudden onset of restricted mouth opening within 3 – 4 months, with a maximum interincisal opening ≤ 35 mm.
2) Mandibular deviation towards the affected side during mouth opening.
3) Marked limitation of contralateral lateral mandibular movements.
4) Confirmation through imaging studies.

For patients in the acute phase, treatment should aim to alleviate symptoms such as restricted mouth opening and pain, while striving to restore the normal position of the articular disc. The anterior repositioning splint (ARS) is designed to position the mandible in a forward protrusive posture that facilitates wide mouth opening. This approach allows the mandibular condyle to align with the anteriorly displaced disc, promoting an optimal condyle-disc relationship. Regular adjustments to the splint are made with the goal of gradually returning the anteriorly displaced disc to its normal position alongside the condyle (Guo et al., 2021). Chen Huimin et al. observed that when the condyle moves forward and downward, the disc simultaneously slides backward, restoring the normal condyle-disc relationship and preventing anterior displacement during mandibular closure. Although different mechanisms of action have been described, the effectiveness of ARS in disc repositioning for ADDWoR has been widely acknowledged (Dhar et al., 2023; Liu et al., 2017). Manual reduction can provide immediate relief from joint locking, thereby increasing the range of motion in the temporomandibular joint (La Touche et al., 2022). Studies have reported that combining manual reduction with occlusal splinttherapy can restore a normal disc-condyle relationship in approximately 60%-65% of ADDWoR patients (Wänman & Marklund, 2020). Therefore, treatment strategies often include the use of ARS in combination with joint lavage or manual reduction.However, a common criticism of ARS is the potential for re-displacement of the successfully repositioned disc (Guo et al., 2021). This underscores the importance of post-treatment

maintenance and regular follow-up to prevent recurrence.

#### *4.3.2. Chronic ADDWoR*

In patients with chronic ADDWoR, prolonged joint dysfunction often results in perforation of the articular disc. However, over time, adaptive changes may occur. The articular disc body undergoes significant deformation due to prolonged anterior and downward compression by the condyle, while the anterior bilaminar zone develops disc-like characteristics without actual perforation. At this stage, patients may experience significant improvement in mouth opening, potentially even returning to normal. For chronic ADDWoR patients without restricted mouth opening and with relatively stable joint structures, special treatment is not necessary. Interventions that could disrupt the stable condition formed through adaptive changes should be avoided. Patients should instead be educated on joint protection to minimize the risk of developing pain or related symptoms. If patients exhibit clinical symptoms such as joint pain or restricted mouth opening, treatment combining occlusal splint therapy with intra-articular injection of HA may be employed. HA helps lubricate the joint, reduce adhesions, and facilitate manual reduction to restore disc-condyle relationships. In advanced stages of ADDWoR, joint fibrosis, adhesions, and disc degeneration are common, significantly reducing the likelihood of successful disc repositioning. However, symptoms such as restricted mouth opening and pain may still be alleviated to some extent, even if full anatomical correction is unachievable.

## 5. Diagnosis and Treatment for Special Populations

### *5.1. Diagnosis and Treatment of TMDs in Pediatric and Adolescent Patients*

In addition to the widely recognized need for treating TMDs in adults, leading Chinese and international scholars have recently acknowledged that a significant number of adolescents are also affected by TMDs. Adolescents typically present with milder joint symptoms and often report dentofacial deformities as their chief complaint. However, at this stage, the joint structures may already be compromised. Failure to understand the close relationship between TMDs and dentofacial deformities often results in missed opportunities for timely intervention, potentially leading to idiopathic condylar resorption (ICR).

ICR is a progressive bone resorption disease affecting the mandibular condyle. Evidence indicates that ICR predominantly occurs in adolescent females and has more severe consequences for adolescents than for adults (Hatcher, 2013; Sansare et al., 2015), Typical clinical manifestations include a reduction in mandibular ramus height, progressive anterior open bite, and facial asymmetry. These changes significantly impair physiological functions such as swallowing, speech, and breathing, and often lead to varying degrees of psychological distress (Mori et al., 2010). These findings underscore the significant joint damage, high prevalence, and insidious nature of TMDs, emphasizing their considerable potential harm. Presently, there is no unified consensus regarding the etiology and pathogenesis of ICR. However, it is generally believed that ICR results from multiple factors, primarily a decreased remodeling capacity of the temporomandibular joint and increased joint pressure. ADD is the most common condition among TMD patients and a major contributor to increased joint pressure Extensive literature reviews suggest a potential correlation between ADD and ICR, with ADD likely serving as a critical etiological factor for ICR.

Numerous studies have confirmed that condylar resorption is more likely to occur in patients with ADDWoR (Hatala et al., 1996; Lei et al., 2017). As the mandibular condyle serves as the growth center for the mandible, its damage can lead to underdevelopment of the affected side, resulting in facial asymmetry, malocclusion, functional impairments, and even psychological issues. Therefore, for adolescents and even children diagnosed with ICR, symptomatic treatment alone is far from sufficient. Identifying the underlying causes and implementing early intervention are essential. Particular attention should be paid to preserving the integrity of critical anatomical structures surrounding the joint, especially the condyle.

#### *5.1.1. Condylar Resorption Without Significant Absorption*

For patients without obvious condylar destruction, where the disease duration is relatively short, the joint area may exhibit inflammation and increased pressure, but no condylar resorption. Confirmation of the absence of condylar resorption through CBCT is essential. In such cases, the treatment strategy should prioritize addressing the patient's chief complaints

while identifying and managing the underlying causes to prevent disease progression.

Conservative management typically involves a multidisciplinary approach, including joint lavage, pharmacotherapy, occlusal splint therapy, orthodontic treatment, psychological counseling, and cognitive behavioral therapy. This section focuses specifically on the roles of occlusal splint therapy and orthodontic treatment for these patients.

#### *5.1.2. Stabilization Splints Treatment*

Numerous studies have demonstrated that stabilization splints are highly effective in alleviating muscle tension, reducing joint loads, and improving joint function (Devi et al., 2017; Pandis, 2011). A stabilization splint is a full-arch appliance that maintains even occlusal contact without altering the anterior-posterior or lateral position of the mandible. Its primary mechanism is to eliminate premature contacts and occlusal interferences, thereby disrupting deleterious occlusal habits and establishing a favorable occlusal state.

This process mitigates the adverse stimuli from abnormal occlusion on periodontal proprioceptors, reducing abnormal muscle activity. Stabilization splints relax the elevator muscles, activate the depressor muscles, relieve muscular spasms, and restore balance to the bilateral masticatory muscles, enhancing the mouth-opening reflex.

Critically, the use of a stabilization splint allows the mandibular condyle to shift anteriorly and inferiorly, increasing the posterior superior joint space. This decreases intra-articular pressure, alleviating stress on the retrodiscal tissues of the joint, reducing pain, and restoring the coordination and positional stability of the joint structures. Furthermore, stabilization splints play a vital role in preventing condylar resorption by maintaining a harmonious joint environment.

#### *5.1.3. Orthodontic Treatment*

Malocclusion is recognized as one of the critical etiological factors in TMDs. Some studies suggest that abnormal occlusion may also serve as a contributing factor to bruxism, potentially exacerbating masticatory muscle tenderness, pain, and TMJ noises, all of which are characteristic symptoms of TMDs (Ramfjord, 1961). Furthermore, evidence from epidemiological (Marangoni et al., 2014),imaging (Manfredini et al., 2012), histopathological (Ibi, 2019), and animal model studies (Ren et al., 2019 has demonstrated a significant association between malocclusion and ADD. For instance, Nebbe et al. (Prevalence of TMJ Disc Displacement in a Pre-Orthodontic Adolescent Sample - PubMed, n.d.) conducted a pretreatment survey of orthodontic patients and found that 71%-73% of females and 50% of males presented with varying degrees of ADD.

Given the strong correlation between malocclusion and ADD, early orthodontic intervention is crucial for patients with abnormal occlusion to prevent further complications, such as severe malocclusion induced by idiopathic condylar resorption (ICR). However, it is imperative to address concurrent or underlying TMJ disorders before initiating orthodontic treatment. Failure to do so may compromise treatment stability or lead to recurrence, underscoring the need for a comprehensive, interdisciplinary approach.

### *5.2. Condylar Resorption With Significant Absorption*

For patients with established idiopathic condylar resorption (ICR), the primary therapeutic goals are to control the inflammatory response, reduce intra-articular pressure, and maximize the preservation of condylar morphology and function. Additionally, preventing further functional loss and progressive resorption of the condyle is essential, along with efforts to promote condylar bone regeneration wherever possible (Ow & Cheung, 2010). A single therapeutic approach is often insufficient to achieve satisfactory outcomes. Therefore, a multidisciplinary treatment strategy should be adopted, involving intra-articular injections, stabilization splint therapy, orthodontic treatment, disc repositioning surgery, and mandibular distraction osteogenesis as key treatment modalities.

Intra-articular injections play a crucial role in alleviating inflammation within the joint cavity, reducing joint resorption, and potentially promoting tissue regeneration through the use of biofunctional agents. Among these, platelet-rich plasma (PRP) injections into the joint cavity are particularly notable. Studies have shown (El-Sharkawy et al., 2007) that platelets contain abundant growth factors and cytokines, which contribute significantly to soft tissue healing and bone tissue remineralization.

When combined with stabilization splint therapy, intra-articular injections can not only relieve intra-articular pressure and eliminate interferences but also reduce muscle tension and effectively assist in determining whether ICR is in its progressive or stable phase. Once the condylar resorption enters a stable

phase, orthodontic treatment alone or combined or thodontic orthognathic therapy can be employed to restore the patient's facial profile to the greatest extent possible, while providing a stable and comfortable joint environment to prevent reactivation of the progressive phase.

As mentioned earlier, IRC patients often present with ADDWoR. Therefore, a cohort study (Bodine et al., 2016) was conducted on female adolescents aged 9-15 years with IRC, who underwent disk repositioning surgery and were followed up for more than one year. The results showed that after disk repositioning surgery, the growth pattern of the condyle tended to normalize. Thus, for IRC patients with ADDWoR, disk repositioning surgery can be attempted, and regular monitoring of condylar development should be performed. After the surgery, a splint or functional appliance can be used to guide the mandible forward, promoting condylar bone remodeling. For cases with progressive condylar resorption, extensive condylar destruction, or no regenerative capacity, condylar reconstruction or distraction osteogenesis should be considered.

Diagnosis and Treatment of TMDs in Elderly Patients

TMDs are most commonly observed in young adults, with the highest incidence seen in individuals aged 20-30 years. However, some studies(Yadav et al., 2018)have shown that, in terms of age of onset, TMDs also have a second peak in prevalence in the 45-65 age group. The main reasons for this are as follows:

1) Elderly individuals may experience changes in occlusion due to tooth loss or excessive wear, which gradually alters the position of the condyle, leading to pathological changes.
2) With aging, the TMJ undergoes degenerative changes (Manfredini et al., 2010). While the exact causes of TMJ degenerative changes remain unclear, some scholars suggest that it may be related to the following factors: As individuals age, the remodeling and regenerative ability of the TMJ fibrocartilage decreases (Bouvier, 1988). Therefore, as age increases and the use of the TMJ continues, the extent of damage may exceed the joint's repair and remodeling capacity, leading to degeneration. Furthermore, some scholars have proposed that the main factor contributing to TMJ degenerative changes in older women is menopause. One study found histological evidence of TMJ degeneration in rats after ovariectomy. As women progress to menopause, the decrease in estrogen levels may affect the TMJ. Therefore, we should pay close attention to the TMJ health of elderly individuals, particularly middle-aged and older women. The symptoms of TMDs in elderly patients are usually different from those in younger individuals, with the latter often presenting with clicking sounds as the main symptom, whereas older patients tend to seek treatment primarily for joint pain. However, the good news is that most elderly TMJ pain patients describe their pain as mild, and only a small number report it as severe. Thus, for elderly patients with TMDs, conservative treatment methods, such as medication or joint lavage, can typically alleviate symptoms quickly once the underlying causes are addressed.

## 6. Discussions and Conclusion

TMDs have complex etiologies, mainly including occlusion, anatomy, load, psychological factors, and so on. While the dual-axis diagnosis of TMDs is relatively well-defined, clinical patients often present with overlapping symptoms. In addition, TMDs in adolescents are associated with significant joint damage, high prevalence, and insidious onset. It can even cause idiopathic condylar resorption, leading to facial asymmetry, open bite, and other symptoms. Thus, the efficient diagnosis and treatment of TMDs remain a key and challenging focus of research for many scholars. This review advocates a combined diagnostic approach based on detailed medical history inquiry and comprehensive physical examination, known as the "triad diagnosis," which includes: dual-axis diagnosis, etiology diagnosis, and X-ray diagnosis. Once the disease type, etiology, and joint anatomical structure are clarified, a "dual-axis treatment" strategy should be adopted, which involves symptomatic treatment and etiological treatment. This approach leads to a personalized treatment plan tailored to the patient's unique symptoms and underlying causes, thereby more effectively alleviating symptoms, restoring function, and improving the success rate and long-term efficacy of treatment.

As numerous scholars in China continue to explore the field of joint disorders, various conservative and surgical treatments have emerged. While this review introduces most of the treatment methods and their indications, it focuses mainly on single symptom treatment. For patients with overlapping symptoms and complex etiologies, a single treatment approach

is often insufficient to achieve the desired therapeutic outcomes. Therefore, on the basis of the existing "triad diagnosis" and "dual-axis treatment," treatment plans should be personalized and designed to combine multiple therapeutic methods. This approach not only improves the cure rate but also facilitates the transition from traditional sequential therapies to more specialized sequential therapies. Additionally, the effectiveness of different therapies helps to explore the pathogenesis and mechanisms of TMDs, opening up multidimensional approaches to the treatment of this condition.

In the future, the diagnosis, treatment, and research of TMDs should focus on improving public awareness, analyzing the disease's development, and exploring the mechanisms of different non-surgical and surgical therapies. Clinical practitioners should comprehensively analyze the patient's symptoms, psychological status, financial conditions, follow-up frequency, etc., and be adept at combining different treatment methods based on the patient's specific situation. This will help maximize therapeutic efficacy, achieve early results, and maintain long-term effectiveness. At the same time, the clinical translation of other technologies, such as temporomandibular joint tissue engineering, should be promoted to provide new treatment options for TMD patients.

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