

Review Article

Multidisciplinary Approach in Management of Temporomandibular Joint Diseases in Dental practice: A Review Article

Meenakshi Priyamvada¹, Aakash Gupta², Garvita Chaudhary³, Anju Yadav⁴, Pranesh Rattan Trehan⁵, Nishu⁶

¹⁻⁶Post Graduate Student, Department of Prosthodontics and Crown & Bridge, Inderprastha Dental College & Hospital, Sahibabad, Ghaziabad, Uttar Pradesh, India

ABSTRACT:

Temporomandibular disorders (TMDs) represent a multifactorial group of musculoskeletal conditions affecting the temporomandibular joint (TMJ), associated musculature, and supporting structures. The clinical presentation often includes pain, joint sounds, and functional limitations, significantly impacting patients' quality of life. Due to the complexity and heterogeneity of TMDs, treatment approaches vary widely, encompassing conservative, minimally invasive, and surgical interventions. There exists a wide range of TMD therapies, including physical therapy, cognitive-behavioural therapy (CBT), intra-articular injections, laser treatments, acupuncture, splints, botulinum toxin injections, and surgical modalities. The importance of individualized, evidence-based, and often multidisciplinary approaches is apparent, with conservative and minimally invasive treatments preferred as first-line options. Emerging biological therapies, such as platelet-rich plasma (PRP) and mesenchymal stem cells, hold promise but require further validation through robust clinical trials. This review contextualizes the treatments available in current literature and presents a critical analysis of their implications for contemporary clinical practice.

Keywords: Temporomandibular Disorders, Occlusal Splints, Myofascial Pain Disorder Syndrome

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Corresponding Author: Garvita Chaudhary, Post Graduate Student, Department of Prosthodontics and Crown & Bridge, Inderprastha Dental College & Hospital, Sahibabad, Ghaziabad, Uttar Pradesh, India

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INTRODUCTION

Temporomandibular disorders (TMDs) are a spectrum of musculoskeletal and neuromuscular conditions involving the temporomandibular joint (TMJ), the masticatory muscles, and related tissues. These disorders constitute the most common cause of orofacial pain of non-dental origin (Okeson, 2019). The aetiology of TMDs is widely accepted to be multifactorial, incorporating anatomical, psychological, and behavioural contributors. Frequently cited risk factors include bruxism, occlusal discrepancies, trauma, stress, systemic conditions (e.g., rheumatoid arthritis), and psychosocial distress (Table 1) (Slade et al., 2007). TMDs can be broadly categorized into three groups according to the Diagnostic Criteria: myogenous TMDs (related to muscular pain), arthrogenous TMDs (involving the joint), and combined forms (Fig1). Clinical manifestations commonly include pain in the

preauricular area or masticatory muscles, joint clicking or crepitus, restricted mandibular motion, and deviation upon opening (Schiffman et al., 2014). These symptoms may co-occur with co morbidities such as fibromyalgia, migraine, cervical spine disorders, and sleep-related disturbances, suggesting a systemic interplay complicating diagnosis and management (Velly et al., 2010; Balasubramaniam et al., 2010). Recent epidemiological studies indicate a prevalence of up to 31% in adults, with higher incidence among females, particularly in the reproductive age group. This sex disparity is attributed to hormonal factors, heightened somatic awareness, and differential pain modulation mechanisms (LeResche L, 1997). In light of the clinical heterogeneity and the evolving understanding of TMDs, therapeutic modalities have diversified. Historically managed with occlusal adjustments and

surgical correction, contemporary treatment paradigms now emphasize conservative strategies.

Diagnostic Considerations and the Dentist's Role

Dentists are often the first healthcare providers to evaluate TMD-related symptoms. A comprehensive dental assessment entails:

Axis I (Physical Diagnoses): Classification into myogenous pain, arthrogenous disorders and headache attributed to TMD.

- Occlusal Analysis: Evaluating intercuspal contacts, overjet/overbite relationships, and occlusal discrepancies (Manfredini et al., 2010).
- Palpation: Palpation of masticatory muscles for tenderness at standardized sites (temporal, masseter, lateral pterygoid)
- TMJ Auscultation: Listening for clicking, crepitus, and noting location and timing of joint sounds.
- ROM Measurements: Measurement of maximum unassisted and assisted mouth opening; lateral and protrusive movements (Schiffman et al., 2014). Unassisted maximum interincisal opening < 35 mm is considered restricted warranting further evaluation (Ohrbach et al., 2016)

Axis II (Psychosocial Assessment): Employs validated instruments to evaluate psychosocial risk factors (Dworkin et al., 2010; Ohrbach and Dworkin, 1998).

- Graded Chronic Pain Scale,
- Depression Anxiety Stress Scales
- Pain Catastrophizing Scale

In clinical practice, Axis II findings guide the need for psychological interventions (e.g., CBT) alongside physical therapies.

Imaging Modalities

- Panoramic Radiography: Provides a broad survey but may miss early osseous changes (Emshoff et al., 2012).
- Cone Beam Computed Tomography (CBCT): High resolution assessment of condylar morphology, osseous degenerative changes, and ankylosis (Garcia et al., 2018).
- Magnetic Resonance Imaging (MRI): Gold standard for soft tissue evaluation—disc position, joint effusion, synovitis. (Gleberzon et al., 2012).
- Adjunctive imaging indicated when clinical findings suggest internal derangement or advanced degenerative changes (Nitzan et al., 2010).

Differential diagnoses include trigeminal neuralgia, otitis media, sinusitis, Eagle syndrome, and cervical spine disorders (Schiffman et al., 2014). A thorough history and examination—evaluating referral patterns of pain, otologic symptoms, and cervical range of motion—helps distinguish TMD from these mimickers (De Leeuw and Klasser, 2018).

Integration into Multidisciplinary Practice

Collaboration among various specialists allows for accurate diagnosis, individualized treatment planning, and long-term management. Regular meetings and shared electronic health records facilitate communication, treatment planning, and prevention of chronicity. (Truelove et al., 2010; Rothstein et al., 2018).

Optimal TMD management often requires collaboration among:

- Oral and Maxillofacial Surgeons (OMS): Evaluation of internal derangements, arthrocentesis/arthroscopy, and management surgical cases (Wilkes, 2015; McCain et al., 2013).
- Physical Therapists: Implementation of manual therapy, myofunctional exercises, postural correction, and other modalities to restore biomechanics (La Touche et al., 2010; Costa et al., 2013).
- Psychologists/Psychiatrists: Provision of CBT and other interventions to address anxiety, depression, and catastrophizing behaviours (Humphris et al., 2010; Dworkin et al., 2010).
- Pain Specialists: Management of pharmacological regimens for refractory cases (Greene and Jacks, 2013; Moore et al., 2017).
- ENT Specialists and Neurologists: Exclusion of ear and neurologic pathologies when differential diagnoses are considered (Schiffman et al., 2014).
- Orthodontists and Prosthodontists: Addressal of occlusal discrepancies and definitive prosthetic rehabilitation when necessary (Manfredini et al., 2010; Emodi-Perlman et al., 2017).
- Primary Care Physicians: Evaluation of systemic contributors and coordination of comorbidity management (De Leeuw and Klasser, 2018).

American Association of Oral and Maxillofacial Surgeons (AAOMS) and the International RDC/TMD Consortium advocate for stepwise, evidence-based treatment plans with regular re-evaluation (Fig 2).

Management of TMD

Review of Current Literature

A comprehensive search was performed in PubMed, Scopus, Embase, and the Cochrane Library for literature published between January 2005 and December 2024. Search terms included MeSH and free text keywords: “temporomandibular disorders,” “TMD therapy,” “conservative management,” “arthrocentesis,” “occlusal splint,” “platelet rich plasma,” “stem cells,” “cognitive behavioural therapy,” “laser therapy,” and “TMJ surgery.”

Inclusion Criteria

- Peer reviewed RCTs, systematic reviews, meta analyses, and observational studies.
- English language.

- Studies reporting clinical outcomes (e.g., VAS pain scores, MMO) with follow up ≥ 3 months.

Exclusion Criteria

- Case reports, animal studies, and abstracts without full texts.
- Studies focusing exclusively on pediatric populations.

Potentially relevant articles were retrieved and reviewed to extract data on:

- Patient demographics and TMD subtype (myogenous vs. arthrogenous vs. combined).
- Intervention details (e.g., dosage of intra articular injections, duration of CBT sessions, occlusal splint type, laser parameters).
- Outcomes: pain (VAS or Numerical Rating Scale), functional measures (MMO), psychosocial scales, imaging findings.
- Adverse events and follow up durations.

Evidence levels were graded per Oxford Centre for Evidence Based Medicine guidelines: Level I (systematic reviews/meta analyses of RCTs), Level II (individual RCTs), Level III (cohort studies), and Level IV (case series). Disagreements were resolved by consensus.

The variety of therapies and based on intervention type are:

1. Non-Invasive Approaches

Non-invasive or conservative therapies are typically the first-line interventions in TMD management. The shift from an exclusively dental or structural view of TMDs to a **biopsychosocial model** is increasingly validated by existing literature. This model recognizes the interconnection between biological dysfunction (e.g., joint or muscle disorders), psychological distress (e.g., anxiety, depression), and social behaviours (e.g., bruxism, sleep disturbances). Conservative modalities focus on reducing pain, improving joint function, and addressing behavioural and psychosocial factors without breaching anatomical barriers or involving surgical intervention. (Table 2)

1.1 Cognitive-Behavioural Therapy (CBT) and Counselling

CBT is a structured, time-limited psychotherapeutic approach aimed at modifying maladaptive thought patterns and behaviours that contribute to chronic pain. (Gatchel et al., 2007; Dworkin et al., 2010). CBT helps TMD patients manage pain perception, reduce catastrophizing, and improve coping strategies, particularly in those with coexisting anxiety or depression (Penlington et al., 2024). Counselling, often provided alongside other therapies, educates patients about their condition, encourages behavioural changes such as reducing parafunctional habits (e.g., clenching), and fosters adherence to treatment. It focuses on relaxation training, stress management, sleep hygiene, and cognitive

restructuring. (Humphris et al., 2010; Turner et al., 2006). These interventions are particularly effective in patients where psychosocial stressors play a major role in TMD pathogenesis.

1.2 Physical Therapy, Manual Therapy, and Myofunctional Exercises

Physical therapy encompasses a variety of active and passive modalities designed to restore the biomechanics of the TMJ and masticatory muscles. Manual therapy includes soft-tissue mobilization, joint mobilization, and stretching (Costa et al., 2013). Chiropractic interventions focusing on spinal adjustments, soft tissue therapy, and specific techniques like the Activator Methods protocol, has demonstrated potential in alleviating symptoms. Oral myofunctional therapy specifically targets orofacial muscles through retraining programs that correct dysfunctional swallowing, breathing, and postural habits. [15]Therapeutic isometric and range-of-motion exercises, controlled mandibular opening, lateral excursions against resistance, and proprioceptive neuromuscular facilitation, aim to enhance muscular coordination, endurance, flexibility and eliminate the negative impact of uneven load distribution on the TMJ. (La Touche et al., 2010; Costa et al., 2013). These interventions contribute to increasing maximum mouth opening (MMO), reducing pain sensitivity, and improving neuromuscular control, especially in patients with myogenous TMDs or postural dysfunctions.

1.3 Laser Therapy

Low-Level Laser Therapy (LLLT) uses non-thermal red or infrared light to promote cellular metabolism, reduce inflammation, and stimulate nerve regeneration. It has shown consistent short-term benefits in myogenous and arthrogenous TMDs by promoting microcirculation and mitochondrial biostimulation, targeting tender points and joint surfaces to provide analgesia and functional recovery. Lasers emitting in the 910–1100 nm range appear particularly effective [Ren et al., 2022].

1.4 Ultrasonic Therapy

Ultrasound therapy employs high-frequency sound waves applied externally over the TMJ region to enhance tissue healing, promoting collagen organization, vasodilation (Dinsdale et al., 2014). and pain modulation. However, in TMDs, its effectiveness has been inferior to other modalities like acupuncture or laser therapy, with its clinical adoption remaining limited and adjunctive. (De Morais et al., 2020; Antunes et al., 2015).

1.5 Pharmacotherapy

Common medications used include nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, and tricyclic antidepressants. Pharmacotherapy is typically used alongside non-pharmacologic

interventions for optimal outcomes (de Leeuw & Klasser, 2018).

1.6 Transcutaneous Electric Nerve Stimulation

Electric Nerve Stimulation applies electrical impulses via skin electrodes (high-frequency (80–100 Hz, 50–100 μ s pulse width) to disrupt pain transmission at spinal and supraspinal levels via gate control and endogenous opioid release (Antunes et al., 2015; Kyburz et al., 2018). It also enhances local circulation and relaxes tense muscles. It has been proven beneficial, particularly in mixed TMD types. It decreases masseter activity, improves comfort, and may be effective as an adjunct or alternative to pharmacological options (Serrano et al, 2022).

1.7 Oral Splints

Orthopaedic appliances, also known as intraoral devices, occlusal splints, orthotics, night guards, or bruxism appliances, are custom-fabricated devices worn over the dental arches. These appliances function by subtly modifying the structural relationships within the joint to relieve or relocate stress concentrations. Typically, these appliances are prescribed for nocturnal use, although in instances of severe pain, continuous wear may be warranted temporarily, their functions include:

- Reducing muscle hyperactivity
- Minimizing joint loading
- Alleviating bruxism-induced trauma
- Repositioning the condyle-disc complex

While splints may not resolve structural disc displacements or advanced joint degeneration, they appear beneficial in myofascial pain and parafunctional habits. Two principal categories are predominantly utilized in the management of temporomandibular disorders (TMD): stabilization appliances and anterior positioning appliances. The former are intended to enhance joint stability, redistribute occlusal and articular forces, facilitate temporary relaxation of the masticatory elevator muscles, and protect the dentition from the detrimental effects of bruxism (Al-Moraissi et al., 2020).

Conversely, anterior positioning appliances—also referred to as mandibular orthopaedic repositioning appliances (MORAs)—are primarily indicated in cases of acute temporomandibular joint (TMJ) discomfort, painful joint noises, closed-lock conditions, and associated muscle symptoms secondary to articular inflammation. A notable concern associated with prolonged use—particularly in devices that provide only partial arch coverage—is the potential for significant and irreversible alterations in the interocclusal or interarch relationships. The recommended mandibular advancement should be limited to 1–2 mm to mitigate the risk of long-term occlusal changes. Clinical outcomes vary based on the TMD subtype and patient compliance. Stabilization splints are generally more

effective than soft or non-occluding ones. Digitized fabrication has introduced higher accuracy and improved patient comfort,

2. Minimally Invasive Approaches

Minimally invasive interventions maintain tissue integrity while targeting intra-articular or pericapsular structures. (Table 3) These approaches are suited for moderate to severe TMD cases or when conservative therapies fail. (Wilkes, 2015; Emshoff et al., 2014).

2.1 Arthrocentesis

Arthrocentesis is a lavage procedure carried out under local anaesthesia. The superior joint space is flushed with saline or Ringer's solution to remove inflammatory mediators: cytokines (IL-1 β , TNF- α) and debris (Erbar et al., 2008; Nitzan et al., 2010). This technique also disrupts joint adhesions, reduces intracapsular pressure, and restores disc mobility, leading to improved mouth opening and decreased pain, particularly in internal derangements and closed lock conditions (Guarda Nardini et al., 2021). Arthrocentesis is often enhanced by post-procedural injections of hyaluronic acid (HA) or platelet-rich plasma (PRP) to facilitate joint lubrication and cartilage repair. (Ferrillo et al., 2019). Facial nerve weakness, local infection, and transient bleeding have been reported as side effects (Emshoff et al., 2014; Pihut et al., 2012).

2.2 Intra-Articular Injections (HA, PRP, PRF, CCS, Stem Cells)

Hyaluronic Acid (HA) is a naturally occurring synovial fluid component that restores joint viscosity and lubrication. Intra-articular HA injections improve TMJ biomechanics by modulating chondrocyte metabolism and reduce crepitus, inflammation in degenerative joint diseases like TMJ osteoarthritis. (Im et al., 2015; Garcia et al., 2018). Minimal transient joint discomfort is the primary adverse effect.

Platelet-Rich Plasma (PRP) and Platelet-Rich Fibrin (PRF) is autologous blood products rich in growth factors such as PDGF, VEGF and TGF- β . Injected into the TMJ, these biologics stimulate tissue regeneration, by promoting angiogenesis, chondrogenesis, and down regulating inflammatory cascades leading to sustained pain relief and improved function (Anitua et al., 2019; Kahler et al., 2017). Activation with calcium chloride immediately before injection enhances growth factor release (Mariani et al., 2014).

Corticosteroids (CCS) act as potent anti-inflammatory agents by NF- κ B suppression (Emshoff et al., 2003). While effective in reducing acute joint inflammation and effusion, repeated or high-dose administration may be chondrotoxic, potentially accelerating cartilage degradation. It is recommended only for acute synovitis unresponsive to other measures. (Christidis et al., 2024; Khan et al., 2017).

Mesenchymal Stem Cells (MSCs) derived from bone marrow or adipose tissue have shown early promise in regenerating condylar cartilage, reversing osteoarthritic changes, and enhancing biological repair mechanisms in refractory TMJ disorders. (Shen et al., 2020; Cheng et al., 2018) MSCs differentiate into chondrocytes, secrete anti-inflammatory cytokines (IL-10, TSG-6), and promote cartilage regeneration (Cheng et al., 2018; Li et al., 2021).

2.3 Oxygen–Ozone Therapy

Ozone therapy involves application of intra-arterial or pericapsular injection of gaseous mixture. In TMD, it may reduce oxidative stress in synovial tissues and enhance local microcirculation, upregulates antioxidant enzymes, and inhibits pro-inflammatory cytokines thereby decreasing pain and improving joint mobility. (Bocci, 2011; Bocci et al., 2015). Transient local oedema and synovial irritation are reported adverse effects (Bocci et al., 2015).

2.4 Acupuncture

Acupuncture is a traditional Chinese practice involving insertion of fine needles at specific anatomical points. It modulates endogenous opioid peptides (β -endorphin), down regulates nociceptive peptides (substance P), and activates descending inhibitory pathways (Zhang et al., 2015; Lee et al., 2017). It has demonstrated efficacy in reducing nociceptive signalling, enhancing endorphin release, and relaxing hypertonic muscles in TMD patients with myofascial pain (DiFrancesco et al., 2024).

Battlefield Acupuncture (BFA) is a specialized auricular acupuncture technique designed to deliver quick and efficient pain relief. This method entails the insertion of semi-permanent needles into designated points on the external ear to alleviate pain and associated symptoms.

Laser acupuncture substitutes needles with low-intensity laser beams (830 nm, 100 mW, 15 J/cm² per point) targeted at acupoints. This technique provides non-invasive neuromodulation, making it suitable for needle-averse individuals or those with medical contraindications to penetration-based therapies. (Dreis et al., 2019; Gameiro et al., 2020).

2.5 Botulinum Toxin (BTX)

Botulinum toxin type A (BTX-A) is a neurotoxin inhibiting the release of acetylcholine at the neuromuscular junction, causing temporary muscle paralysis and reducing nociceptive input (Kahler et al., 2017; Greene and Jacks, 2013). In TMDs, BTX-A is injected into masticatory muscles to reduce hyperactivity, muscle fatigue, and pain (Machado et al., 2020). Its use is primarily reserved for refractory myofascial pain, bruxism, or cases where conservative modalities have failed. (Ahmed et al., 2016). Although, it carries risks of muscle atrophy, facial asymmetry, altered occlusion if dosed improperly, dysphagia if lateral pterygoid injections

are misplaced, and immunogenic resistance over repeated injections (Grätz et al., 2018; Khan et al., 2017).

3. Surgical Approaches

Surgical interventions are generally placed at the end of the therapeutic hierarchy. Employed when conservative and minimally invasive measures fail, or when anatomical derangement is too severe. Surgical approaches are tailored to the specific structural pathology identified via clinical examination and imaging (e.g., ankylosis, neoplasia, disc perforation), and have shown effectiveness in restoring MMO and alleviating chronic dysfunction. (Table 4)

Inherent risks of nerve injury, infection, and prolonged rehabilitation exist concomitant with these procedures. (Fig 3)

3.1 Arthroscopy (Minimally Invasive TMJ Surgery)

Arthroscopy involves the insertion of a thin fibre-optic camera and instruments into the TMJ via small incisions. It allows for diagnostic visualization, lysis of adhesions, joint lavage, and injection of therapeutic agents. Compared to arthrocentesis, arthroscopy offers better access and precision, particularly in cases with fibrous adhesions, synovitis, or disc displacement.

Indications include internal derangements unresponsive to arthrocentesis, synovitis, disc perforation, and joint effusion (McCain et al., 2013; Svensson et al., 2016).

It is associated with low morbidity, shorter recovery time, and favourable outcomes in intermediate to advanced intra-articular pathology (Mittal et al., 2019). Complications include facial nerve injury, tympanic membrane perforation, and postoperative fibrosis (McCain et al., 2013; Ferreira et al., 2019).

3.2 Open Joint Surgery

Open surgical approaches are reserved for advanced conditions such as:

- Severe internal derangement disc perforation / joint destruction
- Ankylosis of TMJ (fibrous or bony).
- Degenerative joint disease
- Tumors or structural deformities

Procedures include:

Discopexy: Repositioning and suturing of the articular disc to the condyle. Indicated in early disc displacement with reduction in younger patients. Long-term recurrence rates exist at 12%–26% at 5 years (Wilkes, 2015; Yan et al., 2017).

Arthroplasty: Removal of perforated disc, reshaping condylar head, and synovectomy. Clinical outcomes demonstrate MMO gain of 8–12 mm, VAS reduction of 60% at 12 months (Friedlander et al., 2013; Ferrillo et al., 2019).

Gap Arthroplasty/Interpositional Arthroplasty: Used for TMJ ankylosis. Interpositional materials include autogenous fascia lata, temporalis muscle flaps, and

costochondral grafts. Reankylosis rates is 5%–15% if no interpositional graft is used but can be reduced to < 5% with interposition (Replogle et al., 2015).

Total Joint Replacement (TJR): Indicated for end stage osteoarthritis or neoplastic resections. Custom

prostheses demonstrate 10 year survivorship $\geq 90\%$; stock prostheses slightly lower (85%) (Mercuri et al., 2017; Wolford et al., 2018)

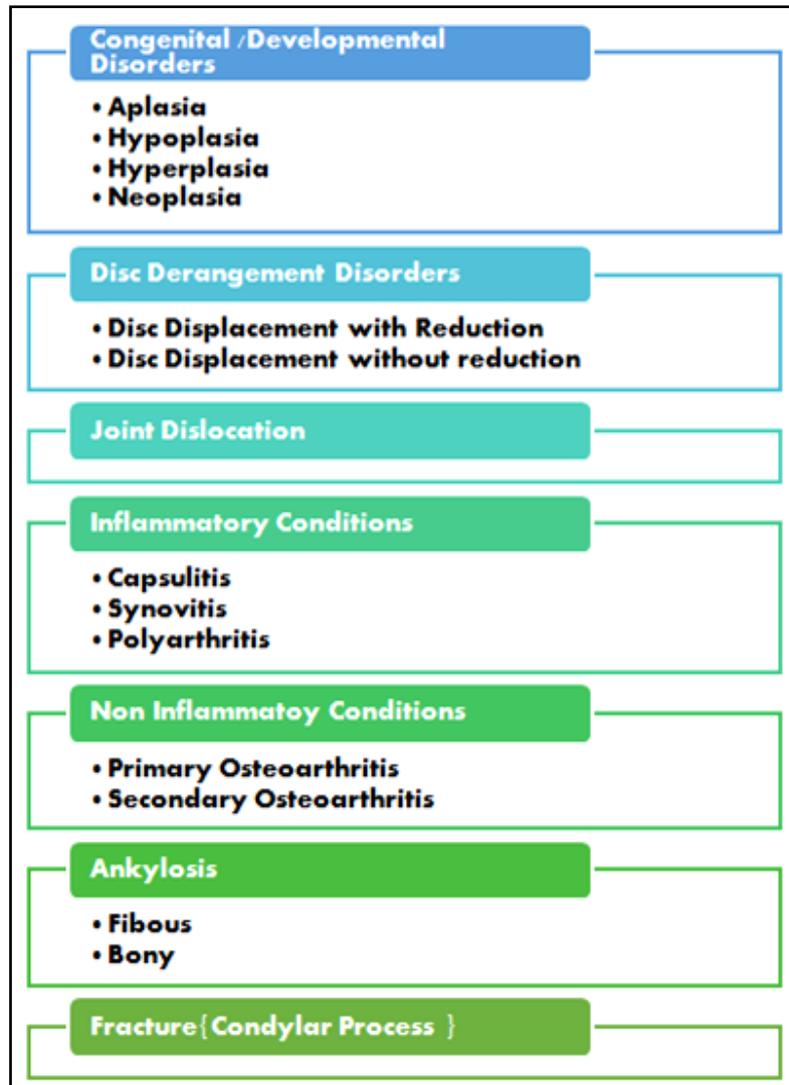


Fig 1: Diagnostic Classification of TMDs

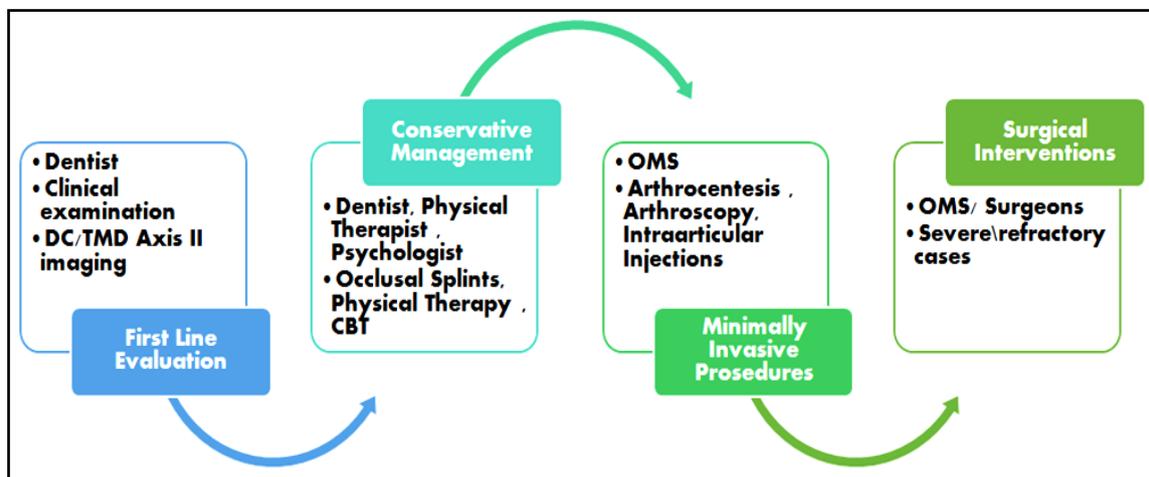


Fig 2: Coordinated Care Pathway

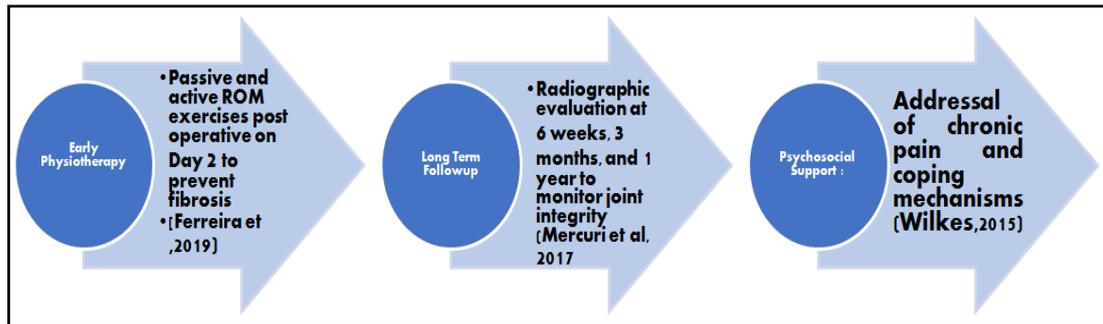


Fig 3: Postoperative Management of Surgical Interventions

Table 1: Etiologic factors for Temporomandibular Disorders

| Category | Definition | Examples | Clinical Notes |
|----------------------|--|--|--|
| Predisposing Factors | Conditions that increase the risk of developing TMD but are not direct causes. | - Structural: Extreme anterior open bite, >6–7 mm overjet, posterior tooth loss - Metabolic: Systemic diseases - Psychological: Stress | Difficult to establish direct causality due to confounding variables. Some occlusal traits may be consequences rather than causes of TMD |
| Initiating Factors | Events or conditions that trigger the onset of TMD symptoms. | - Direct trauma: Head/neck injury, flexion-extension trauma, yawning - Dental procedures with prolonged mouth opening-Parafunctional habits | Cause-and-effect relationship between parafunction and TMD is still inconclusive. |
| Perpetuating Factors | Factors that maintain or aggravate the disorder after its onset. | - Parafunction (e.g., bruxism) - Hormonal influences - Psychosocial stressors | Often coexist with predisposing and initiating factors; complicate treatment and contribute to chronicity. |

Table 2: Non-Invasive Therapeutic Modalities for TMD Management

| Specific Modality | Protocol Summary | Mechanism of Action | Evidence Base | Adverse Effects/Notes |
|------------------------------------|---|---|---------------------------------------|-------------------------------------|
| Cognitive Behavioral Therapy (CBT) | 8–12 weekly sessions; relaxation, stress, cognitive restructuring | Modifies central pain processing, reduces catastrophizing | VAS ↓ 2.8 vs 1.1 at 6 months (p<0.01) | Well tolerated |
| Physical Therapy & Manual Therapy | 8–10 sessions over 6 weeks; TMJ mobilization, home exercises | Restores biomechanics, releases trigger points | MMO ↑ 5.2 mm; VAS ↓ 2.7 | Effective in functional improvement |
| Therapeutic Ultrasound | 1 MHz, 1.5 W/cm ² for 5 min, 3x/week for 4 weeks | Promotes vasodilation and collagen remodeling | No significant VAS reduction vs sham | Adjunctive use |
| TENS | 20 min/session, 3x/week for 4 weeks | Gate control, endogenous opioid release | VAS ↓ 3.1 vs 1.7 with splint (p=0.03) | Mild skin irritation |
| Oral Splints | Night-time use, periodic adjustments | Redistributes occlusal forces, reduces parafunction | 56–78% ≥ 50% pain relief | Long-term risk: occlusal changes |

Table 3: Minimally Invasive Therapeutic Modalities for TMD Management

| Specific Modality | Protocol Summary | Mechanism of Action | Evidence Base | Notes |
|-------------------|----------------------------|--------------------------------------|-----------------------------|---------------------------|
| Arthrocentesis | 100–200 mL lavage; ±HA/PRP | Removes cytokines, reduces adhesions | Pain ↓ >50%, MMO ↑ 10–15 mm | Facial nerve weakness <2% |

| | | | | |
|---------------------------------------|---|---|--------------------------------|-----------------------------------|
| HA Injection | 2 mL (20 mg/mL), weekly x3 | Restores synovial lubrication, modulates chondrocytes | VAS ↓ 3.5, MMO ↑ 6 mm | Mild joint discomfort |
| PRP/PRF Injection | 2 mL weekly x3, prepared via double-spin | Promotes healing, angiogenesis | VAS ↓ 4.2, MMO ↑ 6 mm | Protocols vary |
| Corticosteroids | 1 mg dexamethasone or 10 mg triamcinolone | Anti-inflammatory (NF-κB inhibition) | Short-term VAS ↓ 3.0 | Cartilage thinning risk |
| MSCs | 2 × 10 ⁶ cells, 2x injections spaced 2 weeks | Differentiation into chondrocytes, regeneration | VAS ↓ 4.5, MRI improvement | Pending large RCTs |
| O ₂ O ₃ Therapy | Intra-articular O ₃ (10 μg/mL) weekly x3 | Reduces oxidative stress, cytokine inhibition | VAS ↓ 40%, similar to HA | Local edema, synovial irritation |
| Acupuncture & Laser Acupuncture | 8 sessions manual, or 3x/week laser for 4 weeks | Modulates nociceptive peptides, activates inhibition pathways | Manual: 35% more VAS ↓ vs sham | Well accepted, minor side effects |
| BTX-A | Masseter: 25 U; Temporalis: 15 U; repeat every 3–4 months | Inhibits acetylcholine release, reduces muscle tone | VAS ↓ 2.8 at 3 months | Risk of asymmetry, resistance |

Table 4: Surgical Treatment Modalities for TMD Management

| Specific Modality | Protocol Summary | Mechanism of Action | Evidence Base | Notes |
|--------------------|--|--|-------------------------------------|-----------------------------|
| Arthroscopy | Irrigation, adhesion lysis, HA injection | Direct visualization, adhesion removal | 85% success vs 65% (arthrocentesis) | Facial nerve injury <0.5% |
| Open Joint Surgery | Disc repair/removal, reshaping, interposition graft and others | Structural correction of joint damage | MMO ↑ 8–12 mm, pain ↓ 60% | Indicated in advanced cases |

DISCUSSION

A stepwise, individualized approach—beginning with conservative care and progressing to minimally invasive or surgical intervention—appears optimal. Conservative therapies (CBT, physical therapy, occlusal appliances) achieve moderate quality evidence (Level II–III) for short term pain relief (Humphris et al., 2010; Costa et al., 2013; Manfredini et al., 2010). Non-invasive modalities carry low risk and can often obviate the need for invasive procedures. Among minimally invasive options, arthrocentesis with or without adjunctive injections demonstrates consistent outcomes: > 50% pain reduction and 10–15 mm MMO gains at 6–12 months (Erbasar et al., 2008). Injectable biologics (HA, PRP) further enhance outcomes: PRP yields superior analgesia (mean VAS drop = 4.2) and MMO improvement compared to HA (Emshoff et al., 2003; Ferrillo et al., 2019; Tavassoli et al., 2020). However, variability in PRP preparation (single vs. Double spin, activation) complicates direct comparison (Mariani et al., 2014). Arthroscopy offers superior outcomes to arthrocentesis for refractory internal derangement,

with success rates > 80% for pain and function (McCain et al., 2013; Odell et al., 2017; Svensson et al., 2016). Nonetheless, its higher cost and requirement for specialized training limit universal adoption. Open surgery remains the final option for severe structural pathology (Wilkes, 2015; Mercuri et al., 2017). Techniques such as discopexy, arthroplasty, and TJR restore function and reduce pain when performed by experienced surgeons. Long-term data support custom TJR survival at ≥ 90% over 10 years (Wolford et al., 2018).

SUMMARY

It is essential for dental practitioners to accurately diagnose and effectively manage acute orofacial pain using practical, cost-efficient, and evidence-based strategies. Prompt intervention is crucial in order to prevent the transition of acute pain into a chronic pain condition. Without proper intervention, maladaptive neurochemical alterations can occur within the central nervous system's pain pathways leading to complex clinical scenarios prompting unnecessary treatments, prolonged pharmacologic dependence, and continual

reliance on healthcare services. Furthermore, the dental community should adopt a biopsychosocial framework for the management of chronic orofacial pain and temporomandibular disorders. Effective care for chronic orofacial pain requires a well-coordinated, multidisciplinary or interdisciplinary team composed of healthcare professionals. Emerging trends suggest promising developments. Tools like 3D imaging and joint movement trackers improve diagnostic precision. Genetic and biomarker profiling may guide individualized therapeutic strategies. Magnetic NPs could help regenerate or modulate damaged or dysfunctional trigeminal nerve pathways involved in TMD, through precise drug delivery, stimulation, or regenerative therapies. Tele-consultation expands access to psychological support and specialist input, particularly in underserved areas. As research progresses, more targeted, patient-centric interventions will likely redefine TMD management paradigms.

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