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Understanding Temporomandibular Joint Disorders: A Multidimensional Review of Etiopathogenesis and Treatment Modalities

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Abstract

Temporomandibular disorders (TMDs) is a comprehensive term that encompasses various clinical disorders that involve the masticatory musculature or temporomandibular (TM) joints and associated musculoskeletal structures. TMDs are one of the more common causes of facial pain other than the odontogenic origin. TMDs are of multifactorial etiology and are characterized by multiplicity of clinical signs and symptoms therefore, TMDs diagnosis and management are extremely complex for the clinician. Diagnostic criteria are used from a clinician perspective to achieve an accurate diagnosis based on a multiaxial diagnostic model. The emphasis is on a medical multi-disciplinary model similar to models used for other musculoskeletal disorders and involves the patient in physical and behavioral management of his or her predicament. The majority of TMD patients obtain excellent symptom relief from non-invasive reversible management. A depth understanding of the disorder and its associated tissues and etiopathology is essential for the development of an effective treatment plan.

Keywords: Temporomandibular Disorders (TMD); Temporomandibular Joint (TMJ); Orofacial Pain; Internal Derangement; Myofascial Pain; Etiopathogenesis; TMJ Imaging; Conservative Management; Pharmacologic Management; Arthrocentesis

1. Introduction

TMJ (temporomandibular joint) disorders develop when the muscles involved in chewing and the TMJ do not function together in synchrony [1]. The causes of TMJ disorders can vary widely, but common ones include habits like teeth grinding or clenching (bruxism), malocclusion (improper bite) which can stress the muscles, direct trauma to the face or jaw and less frequently systemic diseases such as inflammatory arthritis. Prevalence statistics may exaggerate the clinical importance of this problem [2]. The management of TMJ disorders should involve a combination of dental and medical therapy. The role of dental professionals in care for patients with head-and-neck symptoms is vital [3]. Temporomandibular disorders (TMDs) are among the most common chronic orofacial pain conditions unrelated to dental pathology [4]. As a group of disorders affecting the TMJ dysfunction/ disorders is an umbrella term that encompasses those with a disorder of the TMJ itself and those with a disorder of the muscles involved in chewing (myofascial pain dysfunction). Even in those individuals with clinical manifestations, it is estimated that only about 5% to 6% need treatment for TMD. These conditions often occurring in the head and neck region, comprise approximately 40 % of all patients presenting in major pain clinics [5]. In epidemiologic studies, it has been reported that approximately 33% of the population experiences at least one symptom of a TMD and 75% of the population experiences at least one sign of TMJ dysfunction. Signs and symptoms of temporomandibular disorders (TMD) tend to

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become more prevalent and more severe from the second through the fourth decades of life. TMD are recognized as the most prevalent nontoothed-related chronic orofacial pain problem seen by dentists and other health care providers [6]. Studies indicate that women are affected four times more than men, while TMDs are often not observed in the pediatric population [7].

2. Etiology

Temporomandibular joint disorders (TMDs) arise from a complex interaction of structural, functional, and psychosocial influences rather than a single cause [8]. Important contributing factors include occlusal anomalies, dental concerns, Trauma, Functional overload, Systemic and Degenerative Diseases, Psychological and Behavioral factors, Developmental or Anatomical Differences [9]. The increased mechanical load on the joint is due to factors such as malocclusion, excessive wear on teeth, or presence of parafunction like bruxism or jaw clenching [9]. Injuries to the jaw may be direct trauma to the joint, or indirect (such as whiplash), can damage tissues of the joint and result in dysfunction [9]. Repetitive or prolonged movements of the mandible, such as chewing gum, biting nails, or performing wind instruments can overload the joint and cause strain on the musculature of the joint [3]. Stress, anxiety, and other psychosocial factors can increase parafunction activity and muscle tension, resulting in further risk of TMD. Congenital anomalies, or acquired changes of the condyle, disc, or glenoid fossa, can also predispose to dysfunction of the joint [1]. Other considerations which are included to the TMD etiology includes biological factors such as sex hormones, endogenous opioid's function, and considerations of anatomical generations and parafunction. The role of dental occlusion remains debated within our literature [10]. Importantly, adolescents in Class II and III malocclusion present with a higher prevalence of myofascial pain (1.73 times, and 2.53 times) than adolescents in Class I [11]. At present the pathophysiological understanding of temporomandibular disorders (TMD) has evolved from a purely mechanical, theoretical understanding to a chronic pain biopsychosocial model [12].

3. Signs and Symptoms

Temporomandibular joint disorders encompass a spectrum of conditions affecting the temporomandibular joint (TMJ), masticatory muscles, and related structures and it cause pain, Joint sounds, altered mandibular movements, Muscle and joint tenderness, Associated complaints, Functional and Psychosocial impact [1]. Pain in the TMJ area or masticatory musculature is the most frequently noticed complaint. The pain may radiate to the ear, temple, or cervical area most commonly and is increased with functional activities including chewing, talking, or yawning [1, 3]. It may be continuous, or intermittent. Auditory findings such as clicking, popping, or crepitus during mandibular movement is both a distinguishing finding of TMD and often results from internal derangement (ID), defined to include disc displacement with or without reduction, or an altered relationship between the disc and the condyle [1]. Individuals often exhibit a restricted opening, primarily to <40 mm, deviation or deflection during opening, and periods of intermittent and/or persistent locking. Lateral excursions, as well as protrusive excursions, may also be restricted [1, 3].

Tenderness of the masticatory musculature, including the masseter, temporalis, and pterygoids, as well as tenderness of the TMJ capsule is routine [13]. Para-functional activities such as bruxism or clenching often exacerbate complaints [14]. In addition to common symptoms such as headaches (especially in the temporal region), ear pain, tinnitus, dizziness, neck pain, etc., referred to as TMJ pain, are often reported even without evidence of primary ear pain [15]. These symptoms likely share common neural pathways from the TMJ to the auditory system, and symptoms include difficulty in chewing, yawning, and prolonged speaking which impacts quality of life [16]. Stress, sleep disturbances and parafunctional habits like teeth grinding are also frequently reported in association with TMD [17].

4. Diagnosis

The most common symptoms associated with temporomandibular joint (TMJ) disorders include headaches, neck pain or stiffness, joint clicking or grinding, pain in the jaw, reduced movement or pain on opening, and in some cases, inability to open the mouth comfortably [18].

4.1. Clinical Examination of the Temporomandibular Joint (TMJ) and Masticatory Muscles:

4.1.1. Visual Inspection

The evaluation starts at the preauricular region, which is the area to the right front of the ear. This is the point at which the doctor will assess for swelling, discoloration, or asymmetry [13]. After that, the doctor will tell the patient slowly open and close his/her mouth while observing the movement of the jaw. The goal of the test is to evaluate the

smoothness of the jaw movement and to evaluate for any limitations or issues [19]. These types of observations will provide you with the most specific information about potential problems related to the temporomandibular joint [20].

4.2. TMJ Palpation

When palpation of TMJ is performed, the fingers are generally placed lightly over the joint area, which lies directly anterior to the ear [20]. In some cases, a fingertip is placed in the external auditory canal with light pressure anteriorly [1]. During this time the patient is opening and closing his or her mouth slowly so the clinician can observe the movements of the condyle. These movements indicate tenderness, abnormal depression, or joint effusion [21]. The clinician also feels and listens for sounds in the jaw joint, such as popping, clicking, or crepitus, which are typically signs of internal derangements, such as disc displacement [22].

4.3. Palpation of muscles

A thorough assessment of the masticatory muscles involves palpation of the masseter, temporalis, medial and lateral pterygoid muscles, as well as the sternocleidomastoid and trapezius muscles [3]. The masseter and temporalis muscles will be palpated extraorally and intraorally along their bony attachments to assess for Myospasm or trigger points [23].

5. Radiographic Diagnosis

Radiographic imaging is performed when abnormalities are suspected and is designed to identify the temporomandibular joint's (TMJ) structure or function [1].

5.1. Panoramic Radiography (Orthopantomogram – OPG)

With the image, clinicians will clearly evaluate cone morphology and symmetry of condyles. Normal variations can be evaluated like flattening, erosions or changes in bony morphology as it relates to evaluating TMJ disorders or degenerative joint disease [1, 3]. To begin measuring the asymmetries, one measure the heights of the mandibular ramus and condyle bilaterally on OPG. The mean difference in condylar heights in healthy people is approximately 1 mm with differences in height greater than the mean particularly over 3 to 5 mm may reflect adaptive condylar remodeling, disc displacement, among other pathologies is useful for visualizing fractures, ankylosis, malformations of the joint, hyperplasia or hypoplasia of the condyle [24].

5.2. Transcranial projection

Transcranial projection produces an oblique lateral view of the temporomandibular joint (TMJ) area that allows the clinician to evaluate the condyle's position in the mandibular fossa and observe degenerative bone changes. This projection is particularly useful as it visualizes the TMJ in two functional positions: open and closed mouth. This provides more options for visualizing condylar movement through mandibular motion [25].

5.3. Transpharyngeal projection

Transpharyngeal projection is an X-ray technique that provides a clear view of the head and neck of the mandible. This projection is very useful for diagnosing more serious conditions, such as ankylosis and condylar fractures. This projection provides an accurate representation of the appearance of the inside of the joint, which is difficult to visualize with standard X-rays since the X-ray beam passes through the pharynx to create the image of the condyle [26].

5.4. Transorbital projection:

The transorbital projection provides a frontal view of the mandibular condyle projection, also referred to as the Zimmer projection. It allows the evaluator to detect side by side displacement of the condylar head and neck, erosion, and fractures. This method can be very useful to differential diagnose various problems with the TMJ. This method allows for visualization of condylar changes in the TMJ that may not be easily identifiable on traditional lateral x-ray, but allows transmission of the X-ray beam through the eye socket [27].

5.5. Cone-beam computed tomography (CBCT)

Currently, cone beam computed tomography (CBCT) provides one of the best imaging modalities for investigating TMJ. It generates excellent three-dimensional images of bony structures with a low level of radiation exposure. Therefore, it is particularly useful in assessing the anatomy of the condyle and for recognizing changes such as osteophytes, erosions, subchondral cysts, and any other bony changes that provide useful information in diagnosing patients with osteoarthritis. In comparison to conventional 2D X-rays, CBCT eliminates overlap and distortion to provide a

significantly clearer image of the condyle, glenoid fossa, and the articular eminence. The scans can be obtained on the left or right side of the TMJ in order to detect even mild bony changes [28].

5.6. Magnetic resonance imaging (MRI)

Magnetic resonance imaging (MRI) is considered the best way to diagnose temporomandibular joint (TMJ) problems because it gives exceptionally good images of soft tissues. In comparison with other imaging studies, MRI can easily show articular discs, retro discal tissues, joint effusion, and inflammatory changes. Scans are usually done with the mouth open and closed to facilitate imaging of dislocation and joint function. MRI is exceptionally useful in identifying disc dislocation and internal derangements, which are common causes of TMJ dysfunction [29].

5.7. The T-Scan system

The T-Scan system is a digital device that can assess occlusion. It elevates the standard evaluation from older measurements, like articulating paper, to record the timing sequence and intensity of occlusal interactions during different movements of the mandible. The dynamic 3D display of the measurements greatly improves clinicians understanding of occlusal function in the patient. This examination would be beneficial to patients with temporomandibular joint (TMJ) symptoms due to occlusal discrepancies, premature contacts, or unequal forces. A small pressure sensitive sensor is placed between the upper and lower teeth for the duration of the evaluation while the patient is asked to clench, close, and move their jaw side to side [30].

6. Management of Temporomandibular Disorder: Pharmacological Management

Pharmacological approaches are meant to be adjunctive methods for temporomandibular disorder (TMD) treatment. They primarily focus on pain relief, inflammation control, and reducing muscle hyperactivity [3].

6.1. Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

Patients with pain due to temporomandibular joint (TMJ) disc displacement were randomized to receive 6 weeks of naproxen 500 mg twice daily, celecoxib 100 mg twice daily, or placebo twice daily [31]. Although the authors of a separate study found that topical diclofenac containing dimethyl sulfoxide applied four times a day was equally efficacious as diclofenac sodium 50 mg taken orally twice daily in patients with pain and tenderness due to osteoarthrosis of the joint [32].

6.2. Opioids

Opioid analgesics are safe and effective to treat moderate to severe acute pain in dentistry; they can also be cautiously used to treat chronic temporomandibular disorder (TMD) pain, prescribed as a last chance when other modalities failed [33]. Commonly prescribed oral opioids include codeine and oxycodone, while hydromorphone is reserved for severe cases [34]. Available formulations include patches with transdermal fentanyl or parenteral opioids, which may include intra-articular morphine post-procedure arthrocentesis for select cases [35].

6.3. Corticosteroids

Corticosteroids are powerful anti-inflammatory medications that may be given orally, or injected into the joint space. Reports from uncontrolled studies of inflammatory arthritis in TMJs suggest that intra-articular corticosteroids including 0.7 mL of methylprednisolone acetate 40 mg/mL (Depo-Medrol) combined with local anesthetic which are sometimes used in children and 1 mL of triamcinolone acetonide (Kenalog-40) or 1 mL of triamcinolone hexacetonide (Aristospan-20) in adults, may have significant effects on pain reduction and functional improvement. In addition, oral corticosteroid therapy should be limited to duration of 2 weeks, because of risk to increase susceptibility to infection, raise blood glucose levels, cause osteopenia/osteoporosis, and suppress the hypothalamic-pituitary-adrenal axis [32].

6.4. Muscle Relaxants

Muscle relaxants that work in the central nervous system are frequently utilized in clinical practice for the management of patients with TMD. These agents function by decreasing the tone in the skeletal muscle, which may mitigate the excessive muscular activity that is frequently present in individuals with chronic orofacial pain experiences. Muscle relaxants are usually prescribed for the night because they cause abnormal drowsiness. Common muscle relaxants include carisoprodol, cyclobenzaprine, metaxalone and methocarbamol [32].

7. Non-Pharmacological Management

Non-pharmacological management represents the most significant approach to the treatment of TMD, particularly in prosthodontic practice, where reversible and conservative methods of management should be implemented [1].

7.1. Surgical management

The main goals of surgery are to restore joint function, lower pain and improve the movement of the jaw. Surgical management are Arthrocentesis, open joint surgery, Eminectomy, Condylotomy [36].

7.2. Arthrocentesis

Arthrocentesis is a minimally invasive surgical procedure that is often performed for temporomandibular joint (TMJ) disorders in case where conservative care has failed [37]. This procedure is performed under local anesthesia and two small needles are placed in the upper joint compartment. These needles are used to irrigate the joint space using sterile fluid such as saline or Ringer's lactate. The lavage facilitates joint mobility by washing out inflammatory mediators and breaking up intra articular adhesions. For resistant fibrous adhesions, hydraulic distension can also be employed to help restore mobility [37]. Adjunctive agents such as hyaluronic acid, platelet-rich plasma (PRP) or corticosteroids can also be injected following lavage. These adjunctive agents additionally help to heal, anti-inflammatory response and promote lubrication of the joint [38].

7.3. Open Joint Surgery

Open joint surgery is almost always the last chance for severe temporomandibular joint (TMJ) disorders when conservative interventions or minimally invasive interventions such as arthrocentesis or arthroscopy have failed [36]. Access to the joint in open joint surgery gives the surgeon the opportunity to assess the joint anatomy and repair structural abnormalities more accurately than with an arthroscopic procedure. The severity of the patient's condition will determine whether the surgery entails disc repositioning, discectomy, adhesions removal, condylar reshaping, or possibly joint replacement. Although open joint surgery poses greater risk of complications and longer recovery periods than minimally invasive procedures, it remains an option for many cases in patients with severe internal derangement, ankylosis, neoplasms, or severe degenerative changes [36].

7.4. Types of Open Joint Surgery

7.4.1. Disc repositioning or repair

Disc repositioning or repair is effective in restoring the normal position of the articular disc in relation to the mandibular condyle in patients with disc displacement who do not respond to conservative management. This is generally a secondary option utilized once non-surgical, and minimally invasive interventions are exhausted without sufficient symptom relief. Disc repositioning aims to alleviate pain, improve joint function, and avert further structural degeneration by restoring disc-condyle relationship [39].

7.4.2. Discectomy

Discectomy is the term used for the surgical removal of a severely damaged or dysfunctional articular disc in relation to the temporomandibular joint (TMJ). To prevent bone to bone contact, which could obstruct the movement and increase degeneration, an inter-positional graft is usually placed to maintain joint functionality. The temporalis muscle or fascia flap, dermis, or synthetic implants are common graft options and ultimately it is at the surgeon’s discretion which one is used for the present condition of the patient. Discectomy can relieve pain, maintain jaw mobility and promote long-term stability of the joint by replacing the damaged disc with a biocompatible substitute [36].

7.4.3. Eminectomy

This procedure may include the removal of the articular eminence; a procedure often used for people with recurrent TMJ dislocation. Removing this bony projection decreases the chance that the mandibular condyle is pushed too far forward thus stabilizing the joint [40].

7.4.4. Condylotomy

A condylotomy is an extra-articular osteotomy of the mandibular condyle that reduces pressure within the joint without entering the joint space directly. Condylotomy is particularly indicated for the treatment of internal derangements and chronic pain in patients who have not responded to less invasive measures. The risk of intra-articular trauma or scarring

and complications is usually lower with this procedure because the joint capsule is not opened. Condylotomy has been reported to significantly improved to relieve pain and jaw range of motion [41].

8. Conclusion

Temporomandibular disorders encompass a wide range of conditions affecting the temporomandibular joint, the associated masticatory musculature and related craniofacial structures, often associated with considerable pain and impact on function. Recognition of signs and symptoms and competent use of clinical examination and imaging contribute to an accurate diagnosis. TMD management is effective if it commences with conservative and reversible strategies that include behavioral modification, physiotherapy, splint therapy, and pharmacotherapy when indicated. Only a small percentage of patients go on for invasive care, and surgery is only indicated for structural pathology that does not respond to conventional care. Overall, prognosis for TMD is good and, when management is tailored to individual needs, a considerable number of patients achieve symptom reduction.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed

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