

# A review of the disorders of the temporomandibular joint

V. Hegde

Department of Prosthodontia, Manipal College of Dental Sciences, Manipal, Udupi, Karnataka, India

## For correspondence

Department of Prosthodontia, Manipal College of Dental Sciences, Manipal Udupi, Karnataka, India

Temporomandibular joint (TMJ) diseases and disorders refer to a complex and poorly understood set of conditions, manifested by pain in the area of the jaw and associated muscles, and limitations in the ability to make the normal movements of speech, facial expression, eating, chewing, and swallowing. It has been estimated that 25% of the general population suffer from TMJ related symptoms and only 2% of them seek treatment. General joint and muscle diseases, psychological and psychosocial factors, and local influences such as occlusal disturbances, parafunctional activities, that is, bruxism, and traumas, can affect the condition of the TMJ. This article describes the functional anatomy, classification, aetiopathology, and management of this condition in detail.

**Key words:** internal derangement; occlusal splints; temporomandibular joint (TMJ) disorders.

Temporomandibular joint (TMJ) disorder occurs when the muscles used in chewing, and the joints of the jaw fail to work in combination with each other. The TMJ disorder may have any number of causes, a few among them being habits such as clenching or grinding the teeth (bruxism), malocclusion (poor bite) that puts muscles under stress, accidents that damage the bones of the face or jaw and occasionally, a disease such as arthritis. A combination of dental and medical therapy is most effective in the treatment of TMJ.

The entity, temporomandibular joint (TMJ) disorders, is an umbrella term, which combines those with the true pathology of the TMJ and those with the involvement of the muscles of mastication (MPD). According to the American Academy of Orofacial Pain, temporomandibular disorders are defined as 'a collective term embracing a number of clinical problems that involve the masticatory muscles, the TMJ, and associated structures, or both.'<sup>[1]</sup> Symptomatic TMJ dysfunction affects 10–24% of the adult population, with a smaller, although significant, percentage experiencing severe impairment.<sup>[2]</sup> Women are affected four times more than the men,<sup>[3]</sup> and TMJ dysfunction is found infrequently in pediatric population.

Although no specific data exists about the social impact of TMJ disorders, it has been responsible for the loss of 550 million workdays every year in the United States. Accordingly, analgesics that are directed at these symptoms are among the top selling over the counter medicines in the society.

Despite the lack of specific data about the incidence of these disorders, much has been learned over the

last decade about the specific pathology and therapy.<sup>[4]</sup> With the advent of imaging studies, it is now possible to differentiate between true muscular disorders and those disorders with pathological changes of the TMJ.

## CLASSIFICATION

Currently the TMJ syndrome is divided into three categories:<sup>[5]</sup>

- Myofascial pain dysfunction (MPD) syndrome.
- Internal derangement (ID).
- Degenerative joint disease (DJD).

The MPD syndrome is considered the most common cause of TMJ pain and may be a psychophysiological<sup>[6]</sup> disease primarily involving the muscles of mastication. The ID is defined as an abnormal relationship of the articular disc to the mandibular condyle, fossa, and articular eminence. The DJD (osteoarthritis) is the organic degeneration of the articular surfaces within the TMJ.

## FUNCTIONAL ANATOMY

The temporomandibular joint is a synovial joint consisting of mobile condyloid process of the mandible articulating with the squamous portion of the temporal bone. The articular surface of the temporal bone is composed of the concave articular fossa and the convex articular eminence. The meniscus or the disc is a fibrocartilaginous, saddle-shaped structure that separates the condyle and the temporal bone. The meniscus varies in thickness: the thinner, central intermediate zone separates the thicker portions called



the anterior band and the posterior band. Posteriorly, the meniscus is contiguous with the posterior attachment tissues called the bilaminar zone. The bilaminar zone is a vascular, innervated tissue that plays an important role in allowing the condyle to move forward. The meniscus and its attachments divide the joint into superior and inferior spaces. The superior joint space is bounded on the top by the articular fossa and the articular eminence. The inferior joint space is bounded at the bottom by the condyle. Both joint spaces have small capacities, generally 1 cm<sup>3</sup> or less.

When the mouth opens, two distinct motions occur at the joint. The first motion is rotation around a horizontal axis through the condylar heads. The second motion is translation. The condyle and meniscus move together anteriorly beneath the articular eminence. In the closed-mouth position, the thick posterior band of the meniscus lies immediately above the condyle. As the condyle translates forward, the thinner intermediate zone of the meniscus becomes the articulating surface between the condyle and the articular eminence. When the mouth is fully open, the condyle may lie beneath the anterior band of the meniscus.

The meniscus is believed to have several roles, such as, cushioning and distributing joint loads, promoting joint stability during chewing, facilitating lubrication and nourishment of the joint surfaces, preventing gross degenerative changes in the condyle and fossa, and promoting the normal growth of the mandible.

## ETIOPATHOLOGY

Understanding trigeminal nerve innervation greatly helps to know the pain pattern in TMJ disorders. The trigeminal nerve, as the name indicates is composed of three large branches. They are the ophthalmic (V1, sensory), maxillary (V2, sensory), and mandibular (V3, motor and sensory) branches. Ophthalmic branch has sensory supply to superior orbital fossa and skin of the forehead. Maxillary nerve supplies inferior orbital fossa, cheek, upper teeth, soft and hard palate, nasal cavity, and pharynx. The sensory part of the mandibular nerve is composed of branches that carry general sensory information from the mucous membranes of the mouth and the cheek, anterior two-thirds of the tongue, lower teeth, skin of the lower jaw, side of the head and scalp, and meninges of the anterior and middle cranial fossae. Knowledge of this sensory distribution helps to explain the referred pain from the TMJ to these areas. Motor fibers of mandibular nerve supply the muscles of mastication, tensor veli palatini and tensor tympani muscles and its irritation may be the cause for painful spasm of facial muscles, and ear pain.

The cartilaginous disc between the condylar process and the glenoid fossa provides a stable platform for the rotational and gliding movements of the joint. It

also acts as a shock absorber. An alteration in the normal position of the disc is known as an ID. Initially the posterior band of the meniscus is anteriorly displaced in front of the condyle. As the meniscus translates anteriorly, the posterior band remains in front of the condyle and the bilaminar zone becomes abnormally stretched and attenuated. Often the displaced posterior band will return to its normal position when the condyle reaches a certain point. This is termed as anterior displacement with reduction. In some patients, the meniscus remains anteriorly displaced when the mouth is fully opened. This is termed as anterior displacement without reduction. Patients with anterior displacement without reduction often cannot fully open their mouths. Sometimes there is a tear or perforation of the meniscus. Grinding noises in the joint are often present.

## In summary

- MPD is believed to be a stress-related disorder.<sup>[7],[8]</sup> There is an increase in mandibular muscle tension in tandem with teeth grinding and/or clenching resulting in spasm, pain, and dysfunction.
- The ID<sup>[9]</sup> is caused by the alteration in the normal position of disc.
- DJD is secondary to micro or macro trauma of the mandibular condyle and connective tissue, ankylosis, and meniscal malalignment.

## CLINICAL FEATURES

Myofascial pain disorders are the most common cause of pain in the head and neck, and those disorders involved in the TMJ are no exception. The complex symptomatology and frequent psychosocial factors often make these disorders difficult to treat.<sup>[10]</sup> The muscles of mastication are primarily involved, and the condition is characterized by a unilateral, dull, aching pain, which increases with muscular activity, and progressively worsens towards the end of the day.<sup>[11]</sup> The patient may experience limitation of mouth opening. Common complaints associated with referred pain include headache, earache, tinnitus, burning tongue, and sometimes decreased hearing.

It is believed that there is a large psychosocial component of this disease.<sup>[12],[13]</sup> Increased stress levels are believed to result in poor habits, including bruxism, clenching, and even excessive gum chewing. These lead to muscular overuse, fatigue and spasm, and subsequently pain.

Many symptoms may not appear related to TMJ itself. They are:<sup>[14]</sup>

- Headache: Eighty percent of patients with a TMJ disorder complain of headache, and 40% report facial pain. Pain is often made worse while opening and closing the jaw. Exposure to cold weather or

air-conditioned air may increase muscle contraction and facial pain.

- Ear pain: Fifty percent of patients with a TMJ disorder notice ear pain but do not have signs of infection. The ear pain is usually described as being in front of or below the ear. Often, patients are treated multiple times for a presumed ear infection, which can often be distinguished from TMJ by an associated hearing loss or ear drainage (which would be expected if there really was an ear infection). Because ear pain occurs so commonly, ear specialists are frequently called on to make the diagnosis of a TMJ disorder.
- Sounds: Grinding, crunching, clicking, or popping sounds<sup>[15]</sup>, medically termed crepitus, are common in patients with a TMJ disorder.<sup>[16]</sup> These sounds may or may not be accompanied by increased pain.
- Dizziness: Forty percent of patients with a TMJ disorder report a vague dizziness<sup>[17]</sup> or imbalance (vertigo). The cause of this type of dizziness is not well understood.
- Fullness of the ear: Thirty-three percent of patients with a TMJ disorder describe muffled, clogged, or full ears.<sup>[18]</sup> They may notice ear fullness and pain during airplane takeoffs and landings. These symptoms are usually caused by the Eustachian tube dysfunction, the structure that is responsible for the regulation of pressure in the middle ear. It is thought that patients with TMJ disorders have hyperactivity (spasms) of the muscles responsible for regulating the opening and closing of the Eustachian tube.
- Ringing in the ear (Tinnitus): For unknown reasons, 33% of patients with a TMJ disorder experience noise or ringing (tinnitus).<sup>[19]</sup> Of those patients, half will have resolution of their tinnitus after successful treatment of their TMJ.

Clinical signs of myofascial dysfunction include limitation of jaw opening (normal range is at least 40 mm as measured from lower to upper anterior teeth), palpable spasm of facial muscles (masseter and internal pterygoid muscles), clicking or popping in the TMJ, tenderness on palpation of the TMJ via the external auditory meatus, crepitus over joint (in advanced disease), and lateral deviation of the mandible.

The ID is often associated with inflammation of joint space and is characterized by the progressive anterior disc displacement. On physical examination, a popping or clicking is felt and a clicking sound is heard on opening or closing of the jaw, with associated pain. The popping is due to the noise the condyle makes as it moves under the anteriorly displaced disc. The greatest difficulty facing the clinician is distinguishing these disorders from those involving the muscles because the presentations are often similar. Sometimes, the chief complaint is not a pop, but an occlusal instability

associated with locking.

Donlon and Jacobson<sup>[20]</sup> has classified derangements based on the findings of the history and physical examination. The patient often gives a history of having passed through each stage of derangement.

- Type IA: Derangement is found with a popping over the joint without associated pain. It is seen in more than 50% of healthy subjects.
- Type IB: Popping of the joint is associated with pain. The pain is due to the stretching and subsequent inflammation of the retrodisc pad.
- Type II: This is similar to a type IB derangement, but a history of lockjaw can be elicited. There are two types of lockjaw. The closed lock is due to the inability of the condyle to slide under the anteriorly displaced disc. The open lock is due to the inability of the condyle to slide back over the disc into its normal position.
- Type III: This is a persistent lock, usually closed. Hence, there is usually no associated click or pop on physical examination.

Traumatic injuries to the condyle are common (e.g. whiplash injuries).<sup>[21],[22]</sup> The diagnosis of a condylar fracture is usually made easily by physical examination and radiographic studies. A unilateral condylar or subcondylar fracture results in the deviation of the jaw towards the site of fracture with opening.

Ankylosis of the TMJ is an obliteration of the joint space with abnormal bony morphology. It is important to distinguish true ankylosis from false ankylosis, which is an extracapsular condition resulting from zygomatic arch fracture or scarring from surgery.

Arthritic changes are the most frequent pathologic conditions affecting the TMJ, but most are asymptomatic. All types occur, but degenerative and rheumatoid arthritis are the most common.<sup>[23]</sup>

Degenerative arthritis can be either primary or secondary. Primary disease is seen in old people and is a disease of wear and tear. Patients are usually asymptomatic, and when symptomatic, the complaints are usually mild. Secondary degenerative arthritis occurs secondary to trauma or chronic bruxism. It occurs in younger people and the symptoms are much more severe.

Rheumatoid arthritis is usually seen in other joints before the TMJ involvement.<sup>[24]</sup> With progression, bilateral TMJ tenderness and swelling are seen. In the early stages, there are a few radiographic changes, but as the disease advances the joint space becomes progressively narrower. In end stage rheumatoid arthritis of the TMJ, this joint space obliteration results in an anterior open bite. In juvenile rheumatoid arthritis with TMJ involvement, end stage disease can result in destruction of the condylar growth plate.



## INVESTIGATIONS

Blood investigations include calcium, phosphate, or alkaline phosphatase, for possible bone disease. Raised erythrocyte sedimentation rate (ESR) and positive Rheumatoid Factor point to rheumatoid arthritis. Serum uric acid levels have to be estimated if gout is suspected. Serum creatine and creatine phosphokinase levels serve as indicators of muscle disease.

The main modality of investigations in TMJ disorders include radiological/computerized tomography (CT) scan studies,<sup>[25]</sup> before arthritic changes and congenital bone abnormality are visualized fairly well on plain films.

The MRI is the examination of choice whenever ID is suspected because it is the only modality that directly visualizes the meniscus and other soft tissue joint components. However, bony components are visualized better on a CT than on an MRI.

Arthrography/arthroscopy provides the criterion standard in the investigation of TMJ meniscus abnormality but is invasive and presently used very selectively because of associated complications.<sup>[26]</sup>

Although arthrography is said to be the criterion standard, MRI<sup>[27]</sup> appears to be fast becoming the examination of choice. Advantages of MRI over arthrography include the facts that MRI is noninvasive, requires no ionizing radiation for image acquisition, readily obtains multiplanar images in an infinite array of anatomic sections, allows direct visualization of soft tissue components (including disc and joint structures), allows easy bilateral assessment, allows assessment of joint effusion and inflammation, and easily can image structures outside the joint, such as the joint capsule and muscles of mastication.

## MANAGEMENT

Despite the large percentages of the population having signs and symptoms of TMD, it has been estimated that only 2% or less of the general population seeks treatment for a TMD symptom.<sup>[28]</sup>

The treatment of myofascial pain is divided into four phases. Phase I treatment is initiated upon diagnosis, and consists of educating the patient on muscle fatigue and spasm as the cause of pain and dysfunction. It helps to explain referred pain. The avoidance of clenching and grinding is emphasized, and a soft diet is instituted. Nonsteroidal anti-inflammatory agents (NSAIDs)<sup>[29]</sup> are prescribed, with or without a muscle relaxant. The most commonly used agents are diazepam (2–5 mg twice a day) and ibuprofen (400 mg thrice a day).<sup>[30]</sup> Naproxen (500 mg twice daily) and celecoxib (100 mg twice daily) are equally effective.<sup>[31]</sup> Moist heat and massage of the masticatory muscles helps to relieve the pain. One half of patients will obtain significant

relief in 2–4 weeks.

Phase II therapy is initiated if Phase I treatment fails. Medications are continued, but a custom made acrylic appliance (splint) is added.<sup>[32]</sup> This helps prevent muscle overuse, including bruxism. The appliance is usually worn at night, but can also be worn during the day, if necessary. Care should be taken to instruct the patient not to wear the appliance at all times, as the posterior teeth may become displaced. An additional 25% of patients will receive relief with this therapy. If the patient remains asymptomatic, the appliance is discontinued. If symptoms return, the appliance may be resumed at night, and its use continued as long as necessary.

Some of the common occlusal splints used in clinical practice are

- Centric relation splint.
- Anterior repositioning splint.
- Soft or resilient splint.
- Anterior bite plane.
- Posterior bite plane.

**Centric relation splint:** Also known as a superior repositioning splint, this provides an occlusal relationship in the masticator system that is considered optimal, that is, the condyles are in the most stable position and at the same time, the teeth are contacting evenly and simultaneously. This splint is indicated for night-time wear, over a period of approximately 4 weeks.

**Anterior repositioning splint:** Also known as a pull-forward splint or mandibular orthopedic repositioning appliance (MORA), it is used to advance the mandible through a construction bite, obtaining the proper relationship of the disc to the condylar head in the glenoid fossa.<sup>[33]</sup> This splint is to be worn at all times except during meals. It is used temporarily for a period of 4–6 weeks.

**Anterior bite plane:** It is a hard acrylic appliance worn over the maxillary teeth, providing contact with the mandibular anterior teeth. It is primarily intended to disengage the posterior teeth and thus, eliminate their influence in the function of the masticatory system. They should be used for only a short period.

**Posterior bite plane:** This has been advocated in cases of severe loss of vertical dimension or for anterior repositioning of the mandible. Its use can also be indicated for certain disc interference disorders.

**Soft or resilient splint:** These are fabricated from a resilient material (such as poly vinyl chloride). They are worn on either arch to achieve even and simultaneous contacts with the opposing teeth and act as a cushion to prevent traumatic gnashing of the teeth against each other.

Recently, the NTI tension suppression system (NTI-TSS)<sup>[34]</sup> is under clinical trial. By preventing the nocturnal parafunctional occluding of the canine and

molar teeth (which is required to generate significant muscle contraction intensity and jaw joint strain), the NTI-TSS device prevents and reduces the muscular-triggering component.

Phase III includes the physiotherapy of the muscle groups, including ultrasonic therapy, and electrogalvanic stimulation.<sup>[35]</sup> Another 15% of patients will find relief within 4 weeks. Recently, it has been reported that pulsed radio frequency energy therapy (PRFE) in patients with TMJ arthralgia is safe and effective and also increases mandibular motion.<sup>[36]</sup>

Phase IV involves psychological counseling to identify stress factor and referral to a TMJ center. The TMJ centers employ a multidisciplinary approach, including psychological counseling and trigger-point injections, for treatment. Biofeedback helps patients to recognize times of increased muscle activity and spasm, and provides methods to help control them.

In preliminary studies, botulinum toxin has been used successfully to treat various pain syndromes, including TMDs. Because of the complex nature of the TMDs and proximity of affected muscles to facial nerves, correct injection technique and appropriate dosing guidelines are very important for successful results.<sup>[37]</sup>

Early treatment of the ID is imperative, as progression of disease leads to a less favorable prognosis. Therapy for types I and II derangements is similar to that for myofascial disorders. The NSAIDs and muscle relaxers (valium) are prescribed, as is the instruction of a soft diet and jaw rest.<sup>[38]</sup> Failure of these methods requires the addition of a splint to attempt the repositioning of the condyle. The purpose is to reposition the condyle into a more favorable position related to the disc. Clicking is usually not eliminated, but it may be reduced to a soft pop with reduced pain. If repositioning with a splint fails, arthroscopic or open surgical repair is recommended. The purpose of these procedures is to surgically remove adhesions and to reposition the disc into a favorable position. A type III derangement requires aggressive therapy. The joint is unlocked, usually under anesthesia. Physical therapy and an anterior bite plate is used. If no improvement results after 3 weeks of therapy, TMJ surgery is undertaken to reposition or repair the disc.

Severe ankylosis is treated with a prosthetic condyle. First, the new joint should be established at the highest possible point on the ramus to maintain maximal mandibular height. Second, an interpositional material is placed to avoid fusion. Third, aggressive, long term physical therapy is important. In children, a costochondral graft is preferred over a prosthetic joint to attempt to replace the condylar growth center.

Treatment of degenerative arthritis is similar to that of myofascial disorders and early IDs. The NSAIDs and muscle relaxers with a soft diet are the primary treatment. Bite appliances are added as necessary. When

conservative medical management fails to improve the symptoms after a 3- to 6-month trial, surgery is considered. Surgical intervention includes removal of any surgical capsular abnormality, including osteophytes, until the joint space is smooth. A condylar shave (removal of the entire cortical plate) should be avoided if possible, as resorption of the condyle is a known complication.<sup>[39]</sup>

Treatment of rheumatoid arthritis of the TMJ is similar to other joints. Nonsteroidal anti-inflammatory medications are used during the acute phase along with jaw exercises once the pain subsides. In severe, chronic cases, drugs such as penicillamine and gold are used. Some cases benefit from intra-articular steroid injections.<sup>[40]</sup> Surgery is limited to severe, refractory ankylosis, as discussed earlier.

## PROGNOSIS

Most cases can be successfully treated, although initially it may be difficult to diagnose the problem and find an effective solution. Some cases of pain go away on their own, without treatment. The TMJ-related pain tends to be cyclical and may return again in the future. If the cause is night-time clenching, treatment can be particularly tricky because it is a sleeping behavior and that is hard to control. Patients with ear symptomatology tend to have a prolonged course of illness.

Known complications of long standing TMJ dysfunction include alterations in dentition, chronic facial pain and malocclusion.<sup>[41]</sup> The establishment of a multidisciplinary pain team can assist the practitioners in reducing such complications.

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