

Temperomandibular Joint & its disorders with Recent Advances in its Management – A Review¹Pooja Yadav, ²Hina Desai, ³Kalpesh Patel, ⁴Shreya Iyengar**Corresponding Author:** Dr. Pooja Yadav, 3rd year Postgraduate, Department of Orthodontics & Dentofacial Orthopaedics, Manubhai Patel Dental College, Hospital & Oral Research Institute, Vadodara.**Type of Publication:** Review Paper**Conflicts of Interest:** Nil**Abstract**

Temporomandibular joint dysfunction is a complex and multifactorial disorder of orofacial region. The usual complain of the patients with this syndrome are pain in the area of the jaw and associated muscles, eating problem, chewing and locking of the jaw. The association between orthodontic treatment and temperomandibular disorders has always been of great interest. Temperomandibular disorders have high prevalence in children and adolescents. Moreover, about 30 percent of the population receives orthodontic treatment during this period. Etiology for temperomandibular disorders is not yet well established. However it's successful management depends on identification and controlling of the etiological factors. The aim of this review is to evaluate the recent evidence, identify challenges, and propose solutions from a clinical point of view for patients with craniofacial pain and TMD.

Keywords: Orthodontic Treatment, Orthodontics, Temperomandibular Joint Disorders**Introduction**

Masticatory system is a functional unit of the body primarily responsible for mastication, swallowing, and speaking. TMJ is an important part of this system. It is a gingyloarthrodial joint. Muscles of mastication play an important role in movement of TMJ.¹

Tempermandibular Disorders (TMDs) is not a singular description but a collective term describing a group of

conditions affecting either the temporomandibular joint (TMJ), the masticatory musculature, or both²

TMD is a prevalent disorder most commonly observed in individuals between the ages of 20 and 40. It is more common in female than males. However irrespective of their correlation, TMDs do exist and there is no escape from their management as an orthodontist. Hence it is important to keep pace with every evolving change in TMD management.^{1, 3, 4} Diagnosis of functional disturbances of masticatory system is a complex procedure and should have a thorough understanding of its working and more importantly the normal working of TMJ⁵.

Two main questions about temporomandibular disorder (TMD) in relation to malocclusion /orthodontic treatment seem to be of interest in orthodontics. The first concerns correlation between TMD and different kinds of *functional or morphologic malocclusion*. The other seeks to determine whether the *severity and prevalence of TMD* are influenced or even caused by orthodontic treatment.⁶

The question whether a relationship exists between orthodontic treatment, abnormal condyle and disc position and temporomandibular joint disorders has been investigated since years and the mystery still continues.

However to study any correlations it is first important to learn about TMDs to be able to appropriately diagnose the same. Here, we have made an attempt to assimilate all the

currently available literature on TMD's to aid an understanding of a relatively complex to understand, problem.

Etiology

The etiology of TMJ disorders remains unclear, but it is mostly multifactorial. The factors that cause TMD are classified as:

ETIOLOGY
Occlusal disharmony
Genetic/Congenital
Habits and posture
Diet consistency/Hard Foods
Bruxism, Stress and Psychosocial factors
Malocclusion and Muscle parafunction

The following occlusal factors had a slight relation in patient with TMD symptoms: (7,8)

- a. Open bite
 - b. Overjet greater than 6-7 mm
 - c. Retruded contact position/intercuspal position with sliding greater than 4 mm
 - d. Unilateral lingual cross-bite
 - e. Five or more missing posterior teeth
- Faulty restorations and ill-fitting prosthesis

Classification

The International Research Diagnostic Criteria for Temporomandibular Dysfunction Consortium Network published an updated classification for TMD in 2013 and that is shown below. (9,10)

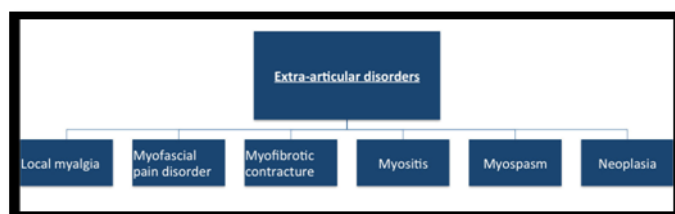
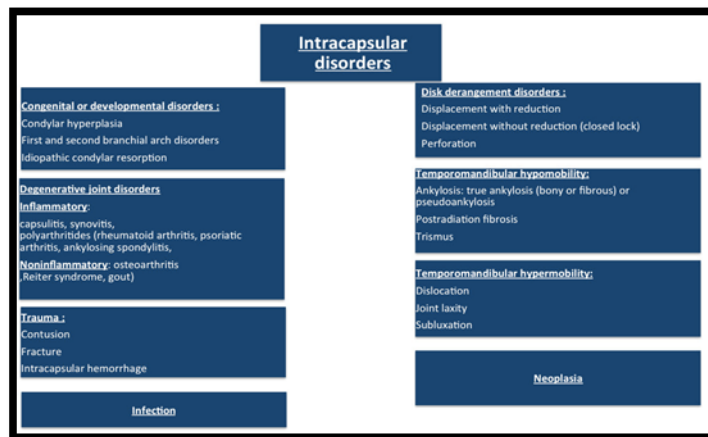


Fig 1: Flowchart showing classification of intracapsular & extra capsular disorders

Signs and Symptoms of Temporomandibular Disorders

The clinical signs and symptoms of joint :

- noises (e.g., clicking, crepitus),
- limitation in ROM,
- mandibular gait (deviation/deflection),
- tenderness of the mastication muscles (masseter, temporalis, lateral pterygoid, medial pterygoid, suprahyoid), posterior cervical muscles, and temporomandibular joint areas should be recorded.

Begin by inspecting the preauricular area for swelling or erythema. Palpate directly over the joint while the patient opens and closes the mandible, and the extent of mandibular condylar movement can be assessed. Have the patient close slowly, and we can will feel the condyle move posteriorly against our finger. Tenderness elicited by this maneuver is invariably associated with articular inflammation. Palpate the superficial temporal artery for nodularity and tenderness.

Palpate the masticatory and cervical muscles and search for areas of tenderness or sustained contraction. Palpate the masseter at its attachments to the zygomatic arch and angle of the mandible, the temporalis both in the temporal fossa and intraorally along the ascending ramus of the mandible, and the medial pterygoid bimanually, placing one finger externally at the medial aspect of the angle of the mandible and the other finger orally in the lingual vestibule in the retromolar region. The lateral pterygoid is accessible to the examining finger intraorally posterior to the maxillary tuberosity.

Examine the external auditory canal and tympanic membrane with the otoscope and do tuning fork tests to rule out ear pathology, particularly important in patients who complain of hearing changes in association with TMJ symptoms. An audiogram may be indicated if hearing loss is suspected.

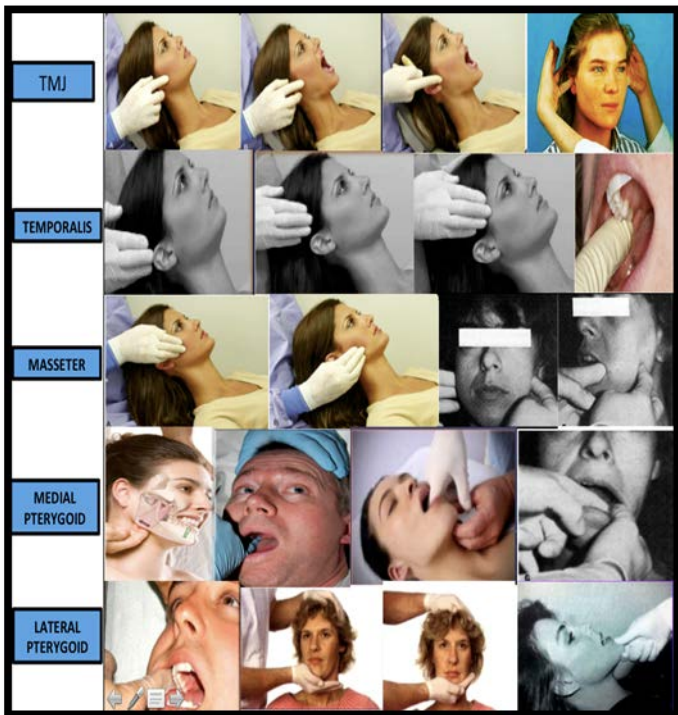


Fig 2: Examination of TMJ and Muscles

The joint is auscultated during mandibular motion. The normal joint functions relatively quietly. Listen for crepitus or grinding and clicking or popping sounds.

The degree of mandibular opening is measured using the distance between the incisal edges of upper and lower anterior teeth. Opening of less than 35 mm is considered abnormal in an adult. Observe the opening pattern for deviation. The mandible often deviates toward the affected side during opening because of muscle spasm or mechanical locking by a displaced meniscus.



Fig 3 (a)Deviation (b)Deflection

Selaimen et al. (2007)

Examined occlusal factors in the aetiology of TMD - results confirmed that some occlusal factors (overbite, overjet, number of anterior and posterior teeth and protrusive movements) including the absence of canine guidance, may be considered risk factors for TMD.

Occlusal Interferences: Occlusal contact relationships that interfere in a meaningful way with function or parafunction (Ash and Ramfjord, 1998).

1. Occlusal contacts on the non-working side
2. Unilateral contacts in the CR
3. Slides from CR to CO which are greater than 1mm
4. Asymmetric slide between CR and CO

Dao and LeResche, (2000) TMD pain resulting from occlusal interferences may also be influenced by changes in oestrogen levels. Oestrogen administration can increase the incidence of chronic pain conditions and, as such, may precipitate or exaggerate any pain if occlusal interferences exist.

The most common signs and symptoms in patients with TMDs are:^{11,12}

- pain in the temporomandibular joint
- pain in muscles

- facial pain
- headache (tension type)
- ear pain
- pain in the region of the neck (shoulders and back)
- noise in the joint
- uncomfortable or variable occlusion
- limited mouth opening (or with disturbances)
- deviation of the jaw (opening/closing)
- locked joint (opening/closing)
- buzzing in ears, impaired hearing (and/or hyperacusis)
- dizziness
- sense of swelling in the face (and/or the mouth)
- disturbances of vision.

In patients with TMDs, muscular disorders are present in about 70% of cases, while the articular disorders, that is, articular disc disorders, as well as disorders due to arthritis, arthralgia and arthrosis were present in about 30% of cases ¹³

- *Limited mandibular movements* are most commonly the result of joint trauma, more often as a result of pain than of physical limitation. *Noise* in the joint as an isolated sign is not a reliable indicator of TMDs. It is estimated that about 40% of people have noise without dysfunction of the joint.
- *Symptoms of the ear* such as pain, hearing disturbances or noise (buzzing) in ears, are more rarely reported by patients with TMDs. Causal correlation between TMDs and ear symptoms is unknown ^{11,14,15}.
- *Change in occlusion*, that is, of contact (bite) between the upper and lower dental arch, or occlusion with strain is a very reliable indicator of TMDs. This condition is often the result of disc dislocation caused by trauma or due to inflammation of retrodiscal tissues.

Normal TMJ - position of disc, posterior band - 12'o clock, and intermediate zone - 1'o clock.

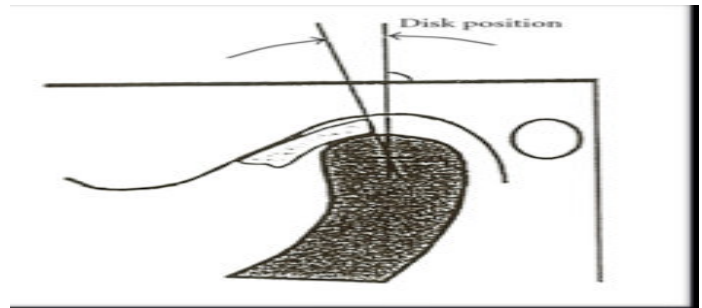


Fig 4: Normal relation of disc to condyle

Disk displacement with reduction: With the mouth closed, the disc is malpositioned anterior to the condyle (or less commonly medial or lateral to the condyle) and returns to its proper place when the mouth is opened, often producing joint noise (i.e., snap, pop or click). Then on closed relaxation, the disc slips anteriorly creating a second joint noise. A variation of this condition occurs when the disc temporarily does not reduce and the patient experiences intermittent episodes of the jaw locked in a closed mouth position. (Schiffman 2014)

Presentation :Clicking or popping with opening/closing produces a unilateral reciprocal joint noise; not usually associated with locking; can be associated with an opening "C" deviation (or an "S" deviation if bilateral); when reciprocal clicking is present, the opening click may occur when the mouth is in a wider position than when the closing click occurs (Wright 2010); possible palpatory pain in the cervical/masticatory muscles and capsule; compression of the joint will usually be positive for recreation of pain.

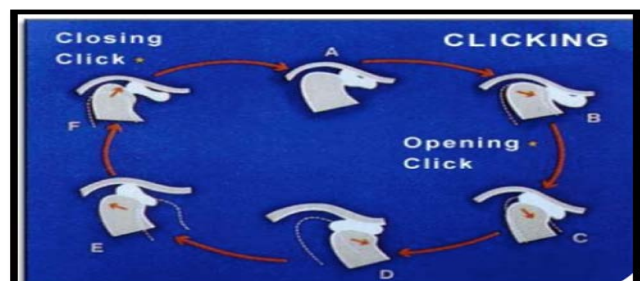


Fig 5: Disc displacement with reduction

Disk displacement without reduction: With the mouth closed, the disc is malpositioned anterior to the condyle (or less commonly medial or lateral to the condyle) and does NOT return to its proper place when the mouth attempts to open. This malposition results in persistent limited opening (i.e., closed lock position) present during the time of the examination or locked historically, but with normal opening at the time of the examination. A click with full opening or other TM noise does not preclude this diagnosis. (Schiffman 2014)

Presentation : Presents with an inability to fully open the mouth due to the anteriorly displaced disc and inability of the condyle to translate anteriorly in the superior joint space; an opening deflection (usually to the side of dysfunction); painful joint motion; possible history of reducing displacement or locking (lasting from seconds to days); usually no current popping or clicking, possible palpatory pain in the cervical/masticatory muscles and capsule, compression of the joint will be positive for recreation of pain.

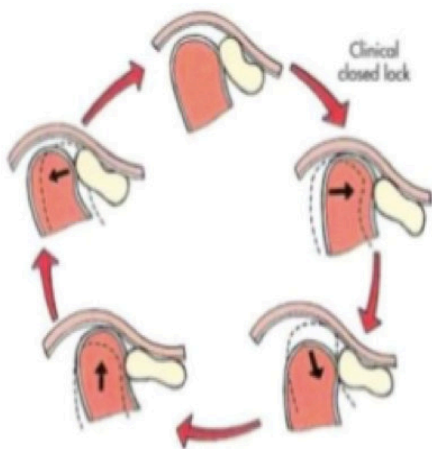


Fig 6: Disc displacement without reduction

The genesis of disk disorders and TMJ arthralgia has been at least partially attributed to abnormal biomechanical forces on the condyle, which alter the shape, form, and function of articular tissues.^{16,17}

TMJ subluxation or dislocation with or without a disk displacement is characterized by : Hypermobility of the joint due to laxity of the ligaments. Provoked in the dental office when the mouth is held open for an extended period, particularly in patients with systemic hypermobility. The condyle is anteriorly dislocated with respect to the disk and articular eminence, unable to return to the closed position because normal posterior translation is blocked. In most cases, the condyle can be moved laterally or medially by the patient or clinician to disengage the locking and allow normal closure. If the lock cannot be immediately disengaged, jaw manipulation inferiorly and anteriorly may be required before the jaw can glide posteriorly.



Fig 7: Jaw manipulation inferiorly and anteriorly

Osteoarthritis

Involves degenerative changes of the articular surfaces of the joint that cause crepitus, jaw dysfunction, and radiographic changes. In osteoarthritis, pain, inflammation, and tenderness of the joint accompany the degenerative changes. The pain is typically aggravated by wide opening, chewing, clenching and bruxism. There often is clicking, popping or “locking” because of disc interference, which results in reflex masticatory muscle spasm. Incisal opening, protrusion, and contralateral movements are decreased and may interfere with mastication. The joint, muscles of mastication, sternocleidomastoid muscle and trapezius muscle are often tender to palpation. A history of changing occlusion and the acquired facial skeletal deformity of mandibular deficiency, open-bite and/or asymmetry may also be signs of Internal derangement/Osteoarthritis¹⁸.

Include disorders such as:

- Systemic osteoarthritis
- Rheumatoid arthritis
- Psoriasis
- Lupus erythematosus
- Scleroderma
- Sjogren's syndrome and hyperuricemia.

Ankylosis or total lack of joint movement can be due to osseous or fibrous attachment of the condyle to fossa. Extracapsular conditions such as coronoid process interference or muscle contracture can also cause significant jaw limitation. Traumatic injuries usually result in either a contusion with joint hemorrhage, a sprain with tearing of the joint capsule and ligaments, or a fracture of the condylar neck or head or of the external auditory canal. TMJ injuries are usually accompanied by pain and limited range of motion.³²

Disorders of the masticatory muscles are a series of different conditions which affect masticatory muscles and their main characteristics are pain and limited mandibular movements

Pain in disorders of masticatory muscles is most often of moderate intensity, diffuse, uncomfortable, and exhausting. It can be described as '*persistent deep blunt pain*', 'tension' or 'pressure'.

Pain upon palpation of masticatory muscles is a reliable indicator of dysfunction and is rated by different measuring methods (visual-analogue scales, VAS). Apart from pain in muscles, the patient can complain of weakness, tension, cramping as well as of limited mouth opening (less than 40 mm, measured between incisal edges of upper and lower central incisors).³¹

There are several distinct types of masticatory muscle pain subtypes in the masticatory system.

Myofascial pain

The most common systemic muscle pain disorder, characterized by regional pain associated with tender areas (trigger points) in taut bands of skeletal muscles, tendons, or ligaments

- Although pain typically occurs over the trigger point, pain can be referred to distant areas (e.g., the temporalis referring to the frontal area and the masseter referring into the ear).
- Reproducible pain upon palpation of the trigger point is diagnostic.
- Myofascial pain is the most common cause of masticatory pain, accounting for over 60% of all TMD cases.

In differential diagnosis of TMJ disorders and pains, problems such as neoplasms, migraine, neuralgia and mental disorders should be considered. Practitioners must be alert for unusual pain locations, pain qualities, pain-aggravating and pain-relieving events, and other factors (e.g., unexplained fever) suggestive of disorders that may mimic TMD symptoms (e.g., infection, giant cell arteritis, meningitis, etc.).^(4,19)

Diagnosis

Imaging plays an important role in the diagnosis of TMD when history and physical examination findings are equivocal.⁽³⁴⁾ The usual radiographs are plain radiograph, panoramic view, tomograms (frontal and lateral). Magnetic resonance imaging (MRI) or arthrography can be done for evaluation of the disc and associated soft tissue structures. ⁽³⁵⁻³⁹⁾ Ultrasonography, Isotope bone scan and Diagnostic Injections can be a diagnostic adjunct to distinguish the source of jaw pain.

Diagnostic injections include:-²⁰

1. Nerve block (auriculotemporal nerve) : The anesthetic blockage of the auriculotemporal nerve may be used in acute cases of pain in the temporomandibular joint, being

efficient for the mandibular movements such as jaw protrusion and for decreasing pain in the immediate post-operative period.

2. Trigger points injection: Trigger point injections cause pain reduction and relaxation in muscle groups. This is particularly true for muscle groups that refer pain from one specific area to other areas of the head, neck, and even the upper shoulder areas. In order to relieve pain, small quantities of an anesthetic and anti-inflammatory medication will be injected directly into the painful, sore, tense, inflamed, stiff muscle groups.

3. TMJ injections : A temporomandibular joint (TMJ) injection is the injection of a corticosteroid into the affected jaw joint. The injections help to reduce inflammation and pain in the temporomandibular joint associated with chewing, talking, or yawning. This procedure can also help those suffering from chronic jaw pain.

Differential Diagnosis

Extracapsular and Intracapsular disorders have some clinical findings in common, there are seven areas of information acquired during the history and examination that will assist in separating them. These keys to diagnosis are the following:^{21,22}

Sr. No.	Intracapsular	Extra capsular
1. History	Symptoms are likely to begin in association with trauma and to be relatively constant or to worsen from that time forward	<ul style="list-style-type: none"> Symptoms appear to fluctuate and cycle from severe to mild with no apparent initiating event. More closely related to changes in levels of emotional stress.
2. Mandibular restriction	<ul style="list-style-type: none"> Restriction in mouth opening because of intracapsular problems (e.g., a dislocated disc without reduction) usually occurs at 25 to 30 mm. At that point the mouth cannot be opened wider, 	<ul style="list-style-type: none"> Restricted mouth opening as a result of a muscle disorder can occur anywhere during the opening movement. For example, a restricted opening of 8 to 10 mm is most certainly of muscle

	<p>even with mild passive force. This hard “end feel” is commonly associated with a dislocated disc blocking translation of the condyle.</p> <p>In patients with an intracapsular restriction (i.e., disc dislocation without reduction), a contralateral eccentric movement will be limited but an ipsilateral movement will be normal.</p>	<p>origin.</p> <ul style="list-style-type: none"> When the mouth opening is restricted by muscles, mild passive force will usually lengthen the muscles slightly and result in a small increase in opening. This represents a soft end feel and is typical of muscle restriction <p>normal range of eccentric movement exists.</p>
3. Mandibular interference	<p>If the deviation occurs during opening and the jaw then returns to midline before 30 to 35 mm of total opening, it is likely to be associated with a disc derangement disorder</p> <p>If the problem is intracapsular, the mandible will often deflect to the side of the involved joint during protrusion and be restricted during a contralateral movement (normal movement to the ipsilateral side).</p>	<p>Muscle disorders that cause deviation of mandibular opening pathways are commonly large, inconsistent, sweeping movements not associated with joint sounds. These deviations result from muscle engrams</p> <p>If the problem is extracapsular (i.e., stemming from muscle), there will be no deflection during the protrusive movement and no restrictions in lateral movements.</p>
4. Acute malocclusion	<p>sudden change in the occlusion characterized as heavy posterior contact on the ipsilateral side. If this condition continues, retrodiscitis may result and cause tissue inflammation with swelling of the retrodiscal tissues characterized by loss of posterior tooth contacts on the ipsilateral side.</p>	<p>will vary according to the muscles involved. If the inferior lateral pterygoid is in spasm and shortens, the condyle will be brought slightly forward in the fossa on the involved side. This will result in a disocclusion of the ipsilateral posterior teeth and heavy contact on the contralateral canines (Figure 10-14). If the spasms are in the elevator muscles, the patient is likely to report a feeling that the teeth “suddenly don’t fit right”</p>
5. Loading the joint	<p>A bilateral manipulation technique will load the</p>	<p>positioning the condyles to their musculoskeletally</p>

	<p>joints and pain is produced, one should be suspicious of an intracapsular source of pain.</p>	<p>stable position and loading the structures with manipulative force does not produce pain in a healthy joint.</p>
<p>6. <i>Functional Manipulation</i></p>	<p>When a patient bites unilaterally on a hard substance, the joint on the biting side has a sudden reduction in interarticular pressure while the opposite joint has a sudden increase in pressure. If a patient has right-side TMJ pain (e.g., osteoarthritis), the right TMJ will be painful when the patient clenches the teeth. If a tongue blade is placed between the right-side molars and the patient is again asked to bite on the tongue blade, the right-side TMJ pain will be reduced or eliminated. This is due to reduced loading of the painful structures. If, however, the tongue blade is moved to the left molar area and the patient is asked to bite, the increased loading of the right TMJ will result in increased pain in the right preauricular area.</p>	<p>If the patient has primary muscle pain (e.g., right-side masseter pain), when he or she is asked to clench the teeth, the right masseter will produce pain. If a tongue blade is placed on the right molar and the patient is asked to bite on it, pain will also be increased. This is due to the increase activity of the painful masseter muscle. If, however, the tongue blade is moved to the left side and the patient is asked to bite on it, there will be a reduction in pain on the right. This occurs because the predominant muscle activity now comes from the left masseter muscle</p>
<p>7. <i>Diagnostic anesthetic blockade</i></p>	<p>Anesthetic blocking of the auriculotemporal nerve can quickly rule in or out an intracapsular disorder. If the TMJ is a source of pain, this nerve block will quickly eliminate the pain.</p>	<p>If an auriculotemporal nerve block does not resolve the pain, aggressive therapies should not be considered until the true source of the pain is identified.</p>

Further we can also differentially diagnose the extracapsular disorders by functional manipulation of muscle & point out the particular muscle responsible for muscular pain.

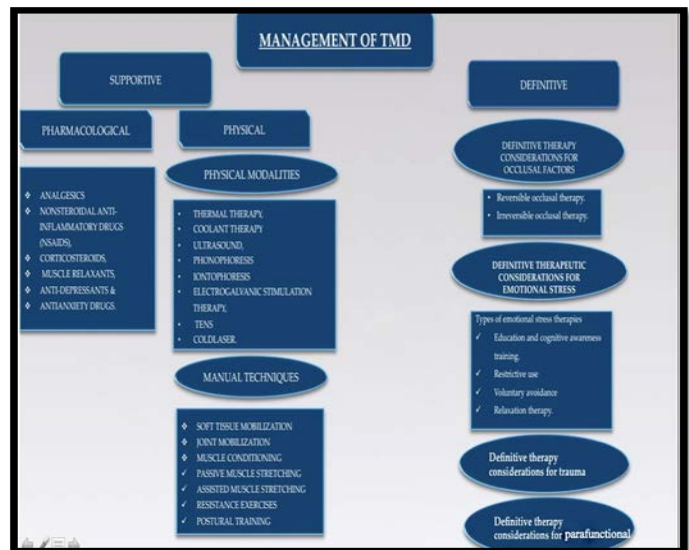


Fig 8: Algorithm for Management of TMD Management of TMD of Muscular Origin:

Local muscle soreness

Definitive Therapy

- Restrict the use of mandible to within painless limits
- Soft diet, smaller bites and slower chewing encouraged.
- Patient should be made aware of subconscious oral habits
- Occlusal appliance therapy for night use only.

Supportive Therapy

- Analgesics for 7-10 days to break the cyclic effect of deep pain
- Manual physical therapy– Passive muscle stretching.
- Gentle massaging.
- Relaxation therapy to reduce stress.

Myospasm

Definitive Therapy

- Reduction in pain can be achieved by: passive stretching of involved muscle, use of ice, vapocoolant spray or using 2% lidocaine without vasoconstrictor.
- Eliminate etiologic factors causing deep pain input.
- If repeatedly occurs, Botulinum toxin A can be considered for night use only.

Supportive Therapy

- Physical therapy – massaging and passive stretching.
- Pharmacologic therapy if needed.

Myofascial pain (trigger point myalgia):

Definitive Therapy

- Eliminate local muscle soreness
- Reduce local and systemic factors contributing to myofascial pain
- Sleep disturbances – sedatives, tricyclic antidepressants – Amitriptyline 10 mg before bedtime.
- Treatment and elimination of trigger points – painless stretching of muscle containing trigger points

Supportive Therapy

- Muscle relaxants
- Analgesics
- Regular exercise

Spray and stretch

Vapocoolant (fluoromethane spray) is sprayed in direction of referred symptoms and then muscle stretched.

The vapocoolant spray provides a burst of cutaneous nerve stimulation temporarily that reduces pain in the area.

Pressure and massage

- Increase pressure to trigger point to 10 lbs for 30 – 60 secs.
- If painful, discontinue

Management of Disc Displacements

The main etiology for disc displacement is parafunctional activity & orthopedic instability. Some studies indicate that Class II Div 2 malocclusion is associated with jaw instability & thus can cause disc derangement disorder.

Objective of treatment: Re-establishment of normal disc–condyle relationship.

Disc Displacements with Reduction

Farrar (early 1970's) introduced anterior repositioning appliance, which provides an occlusal relationship that requires the mandible to be positioned forwardly, that will reestablish the normal disc condyle relationship. This

anterior repositioning will recapture the disc onto the condyle. The studies show that the anterior repositioning device is helpful in reducing the pain symptoms associated with disease by 75%. However, joint sounds appear to be more resistant to therapy. The condyle articulation with well vascularised & innervated retrodiscal tissue is prevented by anterior positioning devices which forwardly advances the mandible. During this period the retrodiscal tissues undergo fibrotic & reparative changes which enable them to bear load later without any pain.

Two different belief systems existed.

1. Mandible is needed to be in permanently maintained in this forward position which sometime requires occlusal adjustments.
2. Once the discal ligaments are repaired, the mandible should be returned to musculoskeletally stable position and the disc would remain in proper position. Neither was supported by long term data.

Disc Displacements without Reduction

Initial therapy include - Recapture disc by manual manipulation

- Reduction without assistance

Move mandible to contra lateral side and then open mouth maximally.

- Reduction with assistance

Reduced by operator by applying downward force on the molar by thumb & at same time upward force is applied on the outer inferior border of mandible.

Once reduced – Anterior repositioning appliance given. If disc does not reduce – superior retrodiscal lamina lost its elastic property. Conservative approach first attempted - Muscle relaxation appliance - encourages adaptation of retrodiscal tissues.

If this fails – surgical procedures considered:

- Arthrocentesis
- Arthroscopy

- Disc – repositioning surgery
- Condylotomy
- Arthroplasty
- Total joint displacement.

Conclusion

TMD should be treated with multidisciplinary approach as other musculoskeletal complaint. It is important to note that treating TMD only from the dental perspective may fail. If TMD is left untreated, symptoms can worsen and extend far beyond the jaw and mouth area. Conservative therapy is best as a first-line approach for treating the patient. Treatment goals in patients with TMD are pain relief and return of function. These goals will be achieved only if diagnosed properly and the treatment plan is taken with consideration of mental and physical problems with predisposing factors.

Acknowledgment: The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank” Instead, write “F. A. Author thanks” Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page.

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