

Temporomandibular Disorders

Evaluation and Management

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KEYWORDS

• Temporomandibular disorders • Orofacial pain • Myalgia • Arthralgia • TMJ surgery

KEY POINTS

- Temporomandibular disorder (TMD) is a multifactorial disease process with various causes, including parafunctional habits (eg, nocturnal bruxing, tooth clenching, lip or cheek biting), emotional distress, acute trauma to the jaw, trauma from hyperextension (eg, dental procedures, oral intubations for general anesthesia, yawning, hyperextension associated with cervical trauma), instability of maxillomandibular relationships, laxity of the joint, and comorbidity of other rheumatic or musculoskeletal disorders.
- Symptoms of TMD include decreased mandibular range of motion, muscle and joint pain, joint crepitus, and functional limitation or deviation of the jaw opening.
- Treatment of patients with TMD initially should be based on the use of conservative, reversible, and evidence-based therapeutic modalities.
- Only after failure of noninvasive options should more invasive and nonreversible treatments be initiated.
- Temporomandibular joint replacement is reserved for severely damaged joints with end-stage disease that has failed all other conservative treatment modalities.

Disclosures: None.

This article includes portions of material previously published in De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. *Dent Clin North Am* 2013;57(3):449–64; and Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79.

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Med Clin N Am ■ (2014) ■–■

<http://dx.doi.org/10.1016/j.mcna.2014.08.009>

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INTRODUCTION

Temporomandibular disorders (TMDs) are a broad group of clinical problems involving the masticatory musculature, the temporomandibular joint (TMJ), surrounding bony and soft tissue components, and combinations of these structures.¹ Symptoms of TMD may include decreased mandibular range of motion, pain in the muscles of mastication, TMJ pain, associated joint noise (clicking, popping, or crepitus) with function, generalized myofascial pain, and a functional limitation (locking) or deviation of jaw opening.¹ TMD is classified as a subtype of secondary headache disorders by the International Headache Society in the International Classification of Headache Disorders. The common perception that all symptoms of the head, face, and jaw without an identifiable cause constitute a TMJ problem is unfounded.

EPIDEMIOLOGY

The prevalence of TMD is thought to be greater than 5% of the population.² Lipton and colleagues³ showed that about 6% to 12% of the population experience clinical symptoms of TMD but only about 5% have significant signs and symptoms warranting treatment. Patients with TMD symptoms present over a broad age range; however, there is a peak occurrence between 20 and 40 years of age.⁴ TMD symptoms are more prevalent in women than in men. Contrary to the known increased health risk in postmenopausal women of conditions such as heart disease and stroke, women tend to develop TMD during their premenopausal years.^{1,2} The reasons behind the gender disequilibrium in TMD prevalence are not clear, but some clinicians have suggested a hormonal influence.⁵⁻⁷ Both animal and human studies have suggested that sex hormones may predispose to TMJ dysfunction and cartilaginous breakdown.⁵⁻⁷ Increased levels of estrogen have been found in patients with TMD.² However, no definitive link between these hormones and causation of TMD has been established.

CAUSES

TMD was first described in the 1930s when otolaryngologist JB Costen established the TMJ as a separate source of otalgia (**Box 1**). He assumed that TMJ problems were the result of structural malalignments between the mandible and the cranium and that only dentists could take care of TMJ problems because of the structural corrections that would be required.² This relationship between dental occlusion and TMD has been of interest for the past 55 years, often promoting acrimonious and

Box 1

Multifactorial causes of TMD

Parafunctional habits (eg, nocturnal bruxing, tooth clenching, lip or cheek biting)

Emotional distress

Acute trauma to the jaw

Trauma from hyperextension (eg, dental procedures, oral intubations for general anesthesia, yawning, hyperextension associated with cervical trauma)

Instability of maxillomandibular relationships

Laxity of the joint

Comorbidity of other rheumatic or musculoskeletal disorders

Poor general health and an unhealthy lifestyle

counterproductive discussions. However, during the past 15 years, a mounting body of evidence has challenged past thinking about the role of dental occlusion in various TMDs. Malocclusions (eg, anterior open bite) may be the result of anatomic changes in the TMJs caused by inflammation and degenerative changes associated with rheumatoid arthritis (RA) as opposed to causing TMD. Recent scientific literature has not supported a relationship between occlusal factors and TMD because occlusal issues fail to meet the Hill criteria of causation for TMD. In addition, the scientific literature has not shown effectiveness of occlusal adjustments such as grinding and/or orthodontic therapy in the treatment of TMD.^{2,8,9}

CLASSIFICATION OF TEMPOROMANDIBULAR DISORDERS

In general, TMDs can be divided into articular and nonarticular disorders, and these are synonymous with intracapsular and extracapsular conditions, respectively. Most nonarticular disorders present as myofascial pain focused to the muscles of mastication (Fig. 1). Other nonarticular disorders include chronic conditions such as fibromyalgia, muscle strain, and myopathies. Most myofascial pain and dysfunction (MPD) is theorized to arise from clenching, bruxism, or other parafunctional habits. This condition leads to masticatory musculature strain, spasm, pain, and functional limitation.² Emotional stress also predisposes to clenching and bruxism, which contributes to myofascial pain.¹⁰ Symptoms include chronic pain in the masticatory muscles, and radiating pain to the ears, neck, and head. The American Academy of Orofacial Pain (AAOP) highlights 3 main diagnostic categories of TMD (Table 1).¹¹

Articular disorders can be divided into inflammatory and noninflammatory arthropathies. Inflammatory articular disorders include rheumatologic processes such as RA, seronegative spondylopathies such as ankylosing spondylitis, psoriatic arthritis, gout, and infectious arthritis. Noninflammatory articular disk disorders include osteoarthritis, joint damage from prior trauma or surgery, or other cartilage or bone disorders (see Table 1). Articular disorders occur mechanistically as a result of an altered balance of anabolic and catabolic cytokines. This cytokine imbalance creates

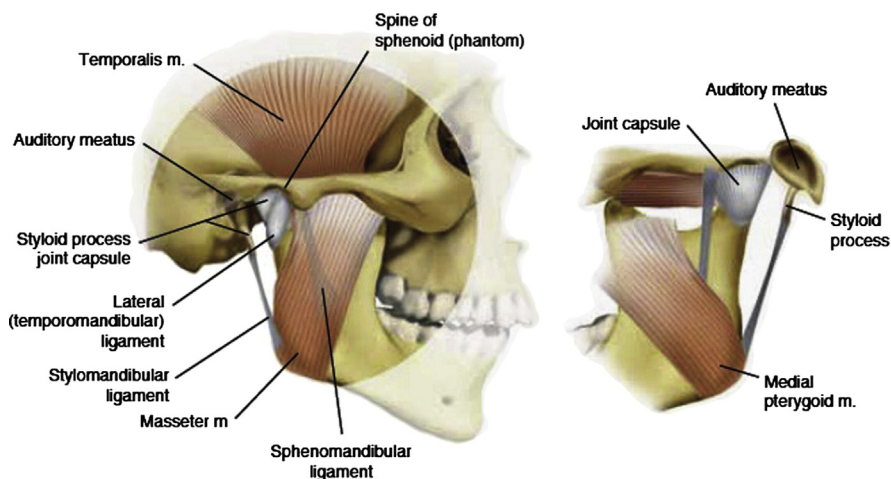


Fig. 1. Musculoskeletal structures of TMJ (lateral and medial views). (From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79.)

Diagnostic Category	Diagnoses
Cranial bones (including the mandible)	Congenital and developmental disorders: aplasia, hypoplasia, hyperplasia, dysplasia (eg, first and second branchial arch anomalies, hemifacial microsomia, Pierre Robin syndrome, Treacher Collins syndrome, condylar hyperplasia, prognathism, fibrous dysplasia) Acquired disorders (neoplasia, fracture)
TMJ disorders	Deviation in form Disc displacement (with reduction; without reduction) Dislocation Inflammatory conditions (synovitis, capsulitis) Arthritides (osteoarthritis, osteoarthritis, polyarthritides) Ankylosis (fibrous, bony) Neoplasia
Masticatory muscle disorders	Myofascial pain Myositis spasm Protective splinting Contracture

Adapted from de Leew R. Orofacial pain: guidelines for assessment, classification, and management. The American Academy of Orofacial Pain. 5th edition. Chicago: Quintessence Publishing; 2013.

an inflammatory milieu that leads to oxidative stress, free radicals, and ultimately joint damage.¹²

Internal derangement equates to changes in the disc-condyle relationship.¹¹ Disc displacements are categorized as disc displacement with reduction or disc displacement without reduction (**Fig. 2**). The fibrocartilage disc is typically displaced anteromedially but rarely is displaced laterally or posteriorly.^{13–15} The anatomy of disc displacement with reduction is an interference between the mandibular condyle and the articular disc during jaw opening or closing. This interference may generate clicking, popping, or crepitus in the joint, which can be associated with discomfort. However, clicking alone is not diagnostic of articular disc displacement. During disc displacement with reduction, the condyle meets the posterior aspect of the disc, which then reduces to its proper position between the condyle and glenoid fossa.^{11,15} Articular disc displacement is associated with TMD. One study found MRI evidence of disc displacement in 84% of symptomatic patients with TMD versus 33% of asymptomatic patients.¹⁶ However, MRI findings should not solely dictate treatment, because disc displacement may occur in asymptomatic patients. Disc displacement without reduction results in a closed lock, in which the condylar movement is physically blocked by the anteriorly displaced disc. Acute closed lock is associated with limited mandibular opening and severe pain.^{11,15} Common causes of articular and nonarticular TMD are summarized in **Box 2**.

Articular disorders are classified according to the Wilkes Staging Classification for Internal Derangement of the TMJ (stages I–V). The Wilkes classification is based on clinical, radiologic, and anatomic findings (**Box 3**).¹⁷ For research purposes, a more detailed diagnostic classification is used, known as the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). The RDC/TMD classification system is divided into 3 axes: axis 1 (muscle disorders), axis 2 (disc disorders), and axis 3 (arthralgias).^{18,19}

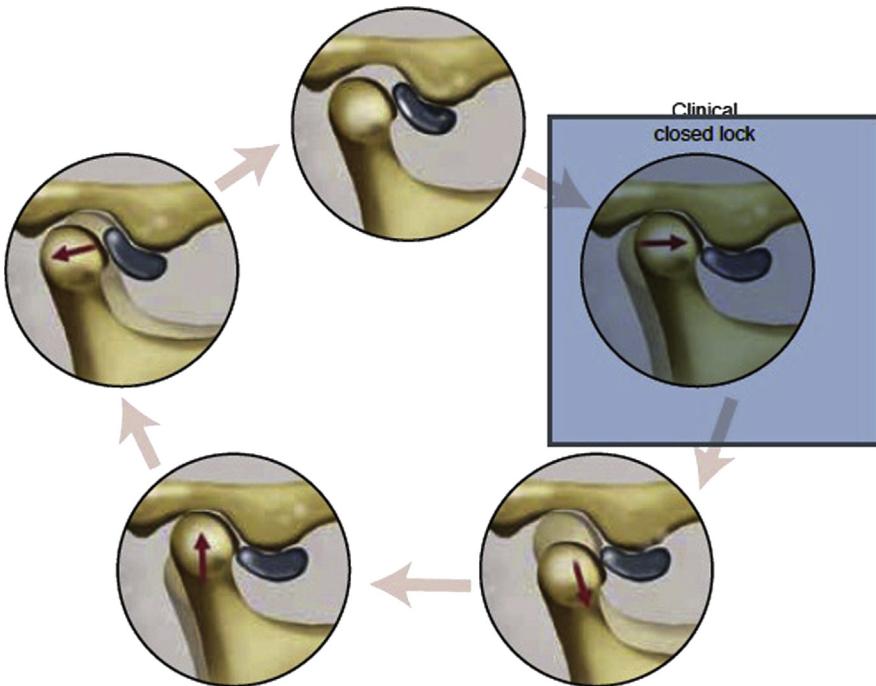


Fig. 2. Motion mechanics seen in TMJ with anteriorly displaced disc and resultant closed lock. (From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79.)

Box 2

Common causes of articular and nonarticular TMD

Articular disorders

Osteoarthritis
Trauma
Infectious arthritis
Prior surgery (iatrogenic)
Gout/pseudogout (crystal arthropathies)

Psoriatic arthritis
RA/juvenile RA
Ankylosing spondylitis

Nonarticular disorders

Myofascial pain
Acute muscle strain
Muscle spasm
Fibromyalgia
Chronic pain conditions
Myotonic dystrophy

Adapted from Ghali GE, Miloro M, Waite PD, et al, editors. *Peterson's principles of oral and maxillofacial surgery*. 3rd edition. Shelton (CT): People's Medical Publishing House—USA; 2012.

Box 3**Wilkes staging for internal derangement of the TMJ**

- I. Early stage
 - A. Clinical presentation: no pain or decreased range of motion, possible clicking
 - B. Radiographic presentation: disc anteriorly positioned, normal bony contours
 - C. Anatomic correlation: anterior displacement, normal anatomic form of bone and disc
- II. Early/intermediate stage:
 - A. Clinical presentation: episodes of pain, opening clicks, intermittent locking
 - B. Radiographic presentation: anterior disc displacement, thickened posterior disc, bony contours normal
 - C. Anatomic correlation: early disc deformity, anterior displacement normal bony contours
- III. Intermediate stage
 - A. Clinical presentation: many painful episodes, intermittent closed locking, multiple functional symptoms, decreased range of motion
 - B. Radiographic presentation: anterior disc displacement with disc deformity
 - C. Anatomic correlation: marked disc displacement and deformity, normal bony contours
- IV. Intermediate/late stage
 - A. Clinical presentation: increased pain relative to earlier stages
 - B. Radiographic presentation: bony changes such as flattened eminence, condylar deformity, osteosclerotic changes
 - C. Anatomic correlation: adhesions of disc, bony changes, evidence of osteoarthritis, osteophytes, no disc perforations
- V. Late stage
 - A. Clinical presentation: episodic or continuous pain, crepitus, limited range of motion at all times, constant functional difficulties
 - B. Radiographic presentation: disc perforations, gross deformities of bony structures and cartilage, progressive arthritic changes
 - C. Anatomic correlation: gross hard and soft tissue changes, perforations, adhesions, subcortical cysts

Adapted from Wilkes CH. Internal derangements of the temporomandibular joint: pathological variation. Arch Otolaryngol Head Neck Surg 1989;115:469–77.

DIAGNOSIS OF TEMPOROMANDIBULAR DISORDERS

Diagnosing TMD requires a focused history and physical examination. Pain and limited range of motion are accepted symptoms and signs of TMJ dysfunction warranting treatment. Radiographic studies can also be used as supplemental diagnostic tools. Dental radiographs can be used to rule out dental disorder as a cause of referred pain. Cone beam computed tomography scans and panoramic radiographs provide detailed imaging of the joint's bony structures, but not of the articular disc. MRI is the modality of choice for examining disc position and morphology (gold standard). MRI may also show degenerative bony changes. MRI findings alone should not dictate treatment strategies. Clinicians must combine the patient's clinical presentation, signs, and symptoms along with TMJ imaging when developing a diagnosis and plan of treatment. On MRI, joint effusions are imaging signs of inflammation.²⁰

Inflammation indicates a transition from adaptive to pathologic changes within the joint. The MRI diagnosis of anterior disc displacement uses the most superior aspect of the condyle (12 o'clock position) as a reference point.²⁰ Anterior disc displacement is defined radiographically when the posterior disc tissue is located anterior to the 12 o'clock condylar position. Disc displacement may occur in asymptomatic patients, such that all imaging findings must be placed in clinical context before beginning TMJ treatments.

The algorithm in **Fig. 3** summarizes the Research Diagnostic Criteria Decision Tree for Pain-related TMD/Headache and Joint Disorders.

CLINICAL EVALUATION

The most effective approach for diagnosis of TMDs involves careful review of the chief complaint; the history of present illness (**Table 2**); the dental, medical, and psychosocial behavioral histories (**Box 4**); and a comprehensive head and neck evaluation, including a cranial nerve assessment (**Table 3**).¹² In addition, imaging modalities may be important to rule out other conditions. No single physical finding can be relied on to establish a diagnosis, but a pattern of signs and symptoms may suggest the source of the problem and a diagnosis.²¹ However, masticatory muscle tenderness on palpation is the most consistent examination feature present in TMDs.^{3,22–26} The clinical features that distinguish patients with TMD from those with non-TMD or masticatory muscle pain most consistently in the literature are restricted passive mouth opening without pain, masticatory muscle tenderness on palpation, limited maximal mouth opening, and an uncorrected deviation on maximum mouth opening and tenderness on muscle or joint palpation.^{2,3,22–26}

Objective determination of the presence or absence of parafunctional jaw behavior is challenging.²⁷ Although the presence of these behaviors may not have proven diagnostic validity, their assessment remains important because it provides potential causative or perpetuating factors and/or effects on the masticatory system. An oral behavior checklist is a useful instrument for determining the presence or awareness of parafunctional behaviors.²⁸

Interincisor separation (plus or minus the incisor overlap in centric occlusion) provides the measure of mandibular movement. Maximum interincisal opening (MIO) should be measured using a ruler without pain, as wide as possible with pain, and after opening with clinician assistance. Mouth opening with assistance is accomplished by applying mild pressure against the upper and lower incisors with the thumb and index finger. Passive stretching often allows the clinician to assess and differentiate the limitation of opening caused by a muscle or joint problem by comparing assisted opening with active opening. This comparison provides the examiner with the quality of resistance at the end of the movement. Often, muscle restrictions are associated with a soft end-feel and result in an increase of more than 5 mm more than the active opening (wide opening with pain), whereas joint disorders such as acute nonreducing disc displacements have a hard end-feel and characteristically limit assisted opening to less than 5 mm (normal MIO is ~40 mm; range, 35–55 mm). A simple clinical assessment is to use fingerbreadths, assuming each fingerbreadth to be approximately 15 mm. Measurements of lateral movement are made with the teeth slightly separated, measuring the displacement of the lower midline from the maxillary midline and adding or subtracting the lower-midline displacement at the start of movement. Protrusive movement is measured by adding the horizontal distance between the upper and lower central incisors and adding the distance the lower incisors travel beyond the upper incisors; normal lateral and protrusive movements are ~7 mm.

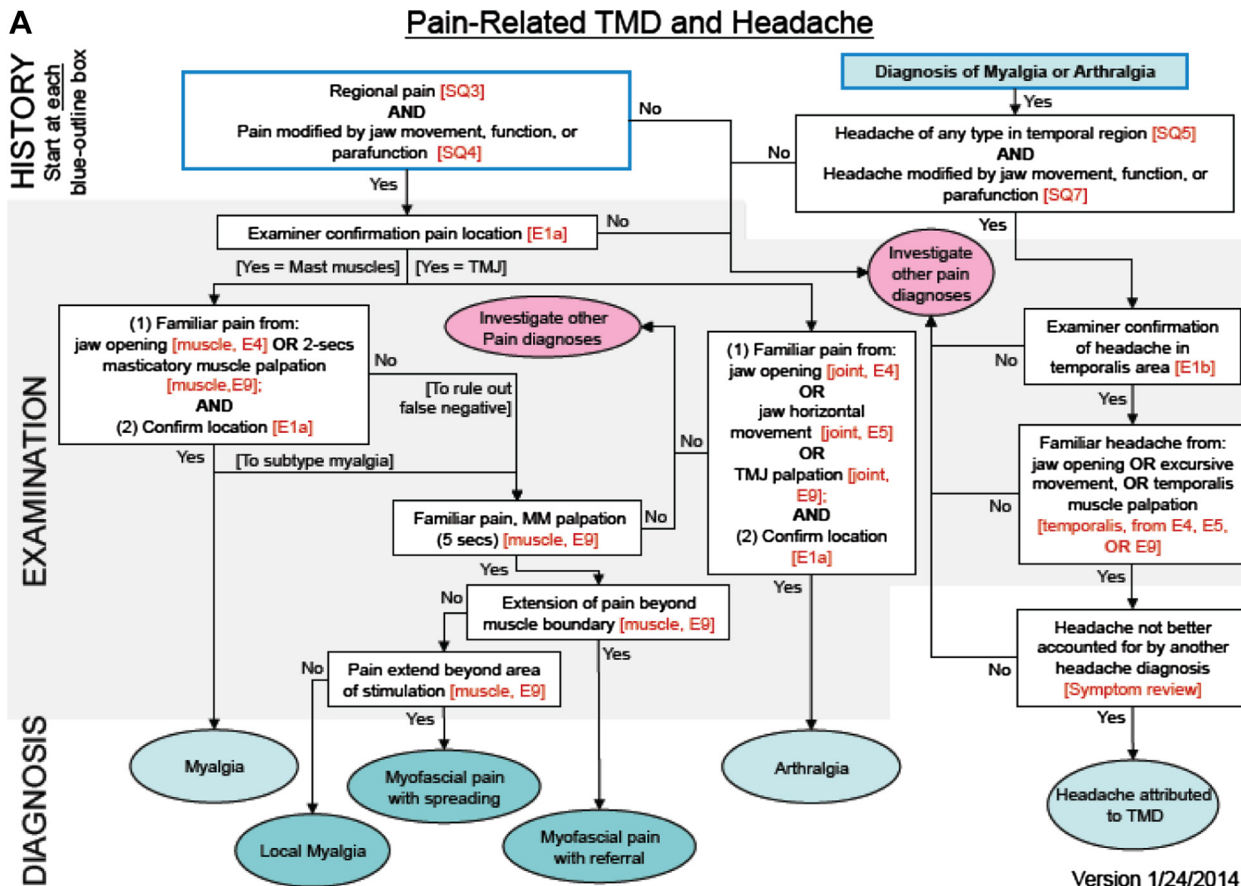


Fig. 3. Research diagnostic criteria decision tree for pain-related TMD/headache (A) and joint disorders(B). (From International RDC-TMD Consortium. Available at: www.rdc-tmdinternational.org. Accessed April 1, 2014.)

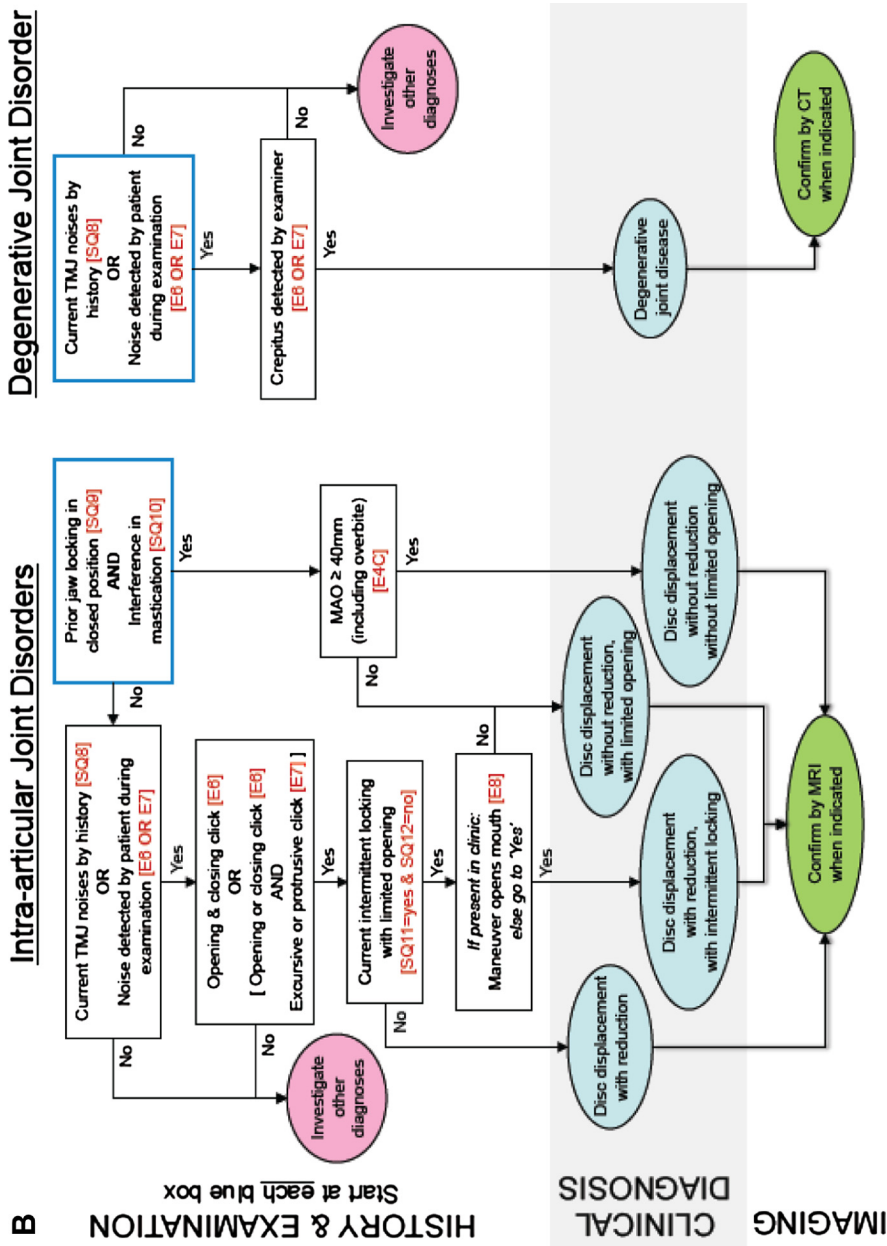


Fig. 3. (continued)

Table 2	
History of the present illness: pain characteristics	
Quality	Common patient descriptors (eg, dull, sharp, tight, aching, tired)
Location	Unilateral vs bilateral Pain confined to a single muscle or referred to a distant area
Intensity	On a scale of 1–10 Mild, moderate, or severe
Onset, duration, pattern	How long has the pain been present? What, if anything, caused the pain? (eg, trauma) What has been the course of pain since its onset? (eg, episodic, constant, fluctuating)
Modifiers	What exacerbates or diminishes the pain? Does anything you do or use help or worsen pain?
Chronicity	How long has the pain been present?
Comorbid symptoms and sign	Are there any other conditions or symptoms associated with pain? (eg, depression, acute anxiety, nausea/vomiting, tearing, visual changes, dizziness, numbness/tingling, weakness, generalized pain)

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. *Dent Clin North Am* 2013;57(3):449–64.

Box 4

Questions regarding oral behavior and parafunction.

Do you:

Clench or grind your teeth when asleep?

Sleep in a position that puts pressure on your jaw? (eg, side, stomach)

Clench or press teeth together while awake?

Touch or hold teeth together while eating?

Hold, tighten, or tense muscles without clenching or touching teeth together?

Hold out or jut jaw forward or to side?

Press tongue between teeth?

Bite, chew, or play with tongue, cheeks, or lips?

Hold jaw in rigid or tense position to brace or protect jaw?

Bite or hold objects between teeth (eg, pens, pipe, hair, fingernails)?

Use chewing gum?

Play musical instruments that involve mouth or jaw?

Lean with hand on jaw or chin?

Chew food on one side only?

Eat between meals (food requiring lots of chewing)?

Do sustained talking?

Sing?

Yawn excessively?

Hold telephone between head and shoulder?

Adapted from Ohrbach R, Markiewicz M, McCall WD Jr. Oral behaviors checklist: performance validity of targeted behaviors. *J Dent Res* 2004;83(Spec Issue A):T27–45.

Examination	Observations
Inspection	Facial asymmetry, swelling, and masseter and temporal muscle hypertrophy Opening pattern (corrected and uncorrected deviations, uncoordinated movements, limitations)
Assessment of range of mandibular movement	Maximum opening with comfort, with pain, and with clinician assistance Maximum lateral and protrusive movements
Palpation examination	Masticatory muscles TMJs Neck muscles and accessory muscles of the jaw Parotid and submandibular areas Lymph nodes
Provocation tests	Static pain test (mandibular resistance against pressure) Pain in the joints or muscles with tooth clenching Reproduction of symptoms with chewing (wax, sugarless gum)
Intraoral examination	Signs of parafunction (cheek or lip biting, accentuated linea alba, scalloped tongue borders, occlusal wear, tooth mobility, generalized sensitivity to percussion, thermal testing, multiple fractures of enamel and restorations)

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. *Dent Clin North Am* 2013;57(3):449–64; and *Data from Refs.* ^{2,3,22–26}

The primary finding related to masticatory muscle palpation is pain; however, the methods for palpation are not standardized in clinical practice.²⁹ The amount of pressure to apply and the exact sites that are most likely associated with TMD are unknown. Some clinicians have recommended attempting to establish a baseline (to serve as a general guide or reference) by squeezing a muscle between the index finger and thumb or by applying pressure in the center of the forehead or thumbnail to gauge what pressure becomes uncomfortable.¹⁸ The RDC/TMD guidelines recommend 0.45 kg (1 lb) of pressure for the joint and 0.9 kg (2 lb) of pressure for the muscles. Palpation should be accompanied by asking the patient about the presence of pain at the palpation site, whether palpation produces pain spread or referral to a distant site, and whether palpation reproduces the pain the patient has been experiencing.^{18,30} Reproducing the site and the character of the pain during the examination procedure helps identify the source of the pain. The distant origin of referred pain can also be identified by palpation.³⁰

Palpation of the muscles for pain should be done with the muscles in a resting state.³⁰ There are no standardized methods of assessing the severity of palpable pain, and the patient should be asked to rate the severity by using a scale (eg, a numeric scale from 1 to 10; a visual analog scale; or a ranking such as none, mild, moderate, or severe). The RDC/TMD recommends using the categories of pressure only, mild pain, moderate pain, and severe pain.¹⁸ These ratings may also be useful in assessing treatment progress in addition to asking patients what percent improvement they feel. The lateral pterygoid is in a position that does not allow access for adequate palpation examination even though there are examination protocols and descriptions for palpating this muscle.

Patients with TMDs often have musculoskeletal problems in other regions (eg, neck, back).³¹ The upper cervical somatosensory nerves send branches that

synapse in the spinal trigeminal nucleus, which is one proposed mechanism to explain referral of pain from the neck to the orofacial region and masticatory muscles.^{32–34} The sternocleidomastoid and trapezius muscles are often part of cervical muscle disorders and may refer pain to the face and head. Other cervical muscle groups to include in the palpation examination include the paravertebral (scalene) and suboccipital muscles.

Injections of anesthetics into the TMJ or selected masticatory muscles may help confirm a diagnosis. Elimination of, or a significant decrease in, pain and improved jaw motion should be considered a positive test result. Diagnostic injections may also be helpful in differentiating pain arising from joints or muscle.^{2,30} In situations in which a joint procedure is being considered, local anesthetic injection of the joint may confirm the joint as the source of pain. Injecting trigger points or tender areas of muscle should eliminate pain from the site and should also eliminate referred pain associated with the injected trigger point. Interpretation of injections must be in the context of all the diagnostic information because a positive result does not ensure a specific diagnosis. The use of botulin toxin has recently been advocated for trigger point injections and for the management of tension-type headache.^{8,30} In several case control studies and randomized trials, descriptive analysis showed that improvements in both objective (range of mandibular movements) and subjective (pain at rest; pain during chewing) clinical outcome variables were higher in Botox-treated groups than in the placebo-treated subjects. Patients treated with Botox had a higher subjective improvement in their perception of treatment efficacy than the placebo subjects. However, Botox does not seem statistically significantly better than saline, local anesthetic, or dry needle.^{2,30,35}

MASTICATORY MUSCLE DISORDERS

Mechanisms behind masticatory muscle pain include overuse of a normally perfused muscle or ischemia of a normally working muscle, sympathetic reflexes that produce changes in vascular supply and muscle tone, and changes in psychological and emotional states.³⁶ Neurons mediating pain from skeletal muscle are subject to strong modulatory influences. Bradykinin, serotonin, substance P, prostaglandins, and neuropeptides sensitize nociceptors and can easily sensitize nociceptive endings. Painful conditions of muscle often result in increased sensitivity of peripheral nociceptors and hyperexcitability in the central nervous system with hyperalgesia.³⁷

Muscle disorders can be divided into local and regional disorders, such as myalgia and myofascial pain, associated with TMD; and systemic disorders, such as pain associated with fibromyalgia.² The paucity of data on the causes and pathophysiology of muscle pain limits the ability to clearly delineate all groups of muscle disorders. Clinicians often must rely on clinical judgment to establish a diagnosis. Well-designed controlled trials and additional research are necessary for the development of validated diagnostic criteria and treatment protocols.^{8,18,38}

Chronic myalgia of the muscle of mastication (MOM) is one aspect of TMD.^{2,8} In the past, clinicians and researchers subclassified TMDs into intracapsular disorders and masticatory muscle disorders such as local myalgia, myofascial pain, centrally mediated myalgia, myospasm, myositis, myofibrotic contracture, and masticatory muscle neoplastic disease.¹⁸ Conflicting classification schemes and terminology have led to significant confusion among clinicians and perhaps inaccurate diagnosis and treatment of patients. Many studies continue to group muscle pain and painful TMJ disorders together under the term TMD, although these entities are pathophysiologically and clinically distinct.^{8,11,39,40} Although the most common feature of

most masticatory muscle disorders is pain, mandibular dysfunction, such as difficulty chewing and mandibular dysfunction, may also occur. Clinicians need to differentiate masticatory muscle disorders from primary TMJ disorders, such as those that involve pain associated with osteoarthritis, disc displacement, or jaw dysfunction (**Table 4**).

The clinical features of masticatory muscle disorders are as follows:

Features of local myalgia

- Sore MOM with pain in cheeks and temples on chewing, wide opening, and often on waking (eg, nocturnal bruxism)
- Bilateral
- Described as stiff, sore, aching, spasm, tightness, or cramping
- Sensation of muscle stiffness, weakness, fatigue
- Possible reduced mandibular range of motion
- Differential diagnosis: myositis, myofascial pain, neoplasm, fibromyalgia

Features of myofascial pain

- Regional dull aching muscle pain
- Trigger points present and pain referral on palpation with/without autonomic symptoms
- Referred pain often felt as headache
- Trigger points can be inactivated with local anesthetic injection
- Sensation of muscle stiffness and/or malocclusion not verified clinically
- Otologic symptoms including tinnitus, vertigo, and pain
- Headache or toothache
- Decreased range of motion
- Hyperalgesia in region of referred pain
- Differential diagnosis: arthralgia, myositis, local myalgia, neoplasia, fibromyalgia

Features of centrally mediated myalgia

- Trigger points and pain referral on palpation
- Sensation of muscle stiffness, weakness, and/or fatigue
- Sensation of malocclusion not verified clinically
- Otologic symptoms including tinnitus, vertigo, and pain
- Decreased range of motion
- Hyperalgesia
- Does not respond to treatment directed at painful muscle tissue
- Differential diagnosis: arthralgia, myositis, myofascial pain, local myalgia, neoplasm, fibromyalgia

Features of myospasm

- Sudden and involuntary muscle contraction
- Acute malocclusion (dependent on muscles involved)
- Decreased range of motion and pain on function and at rest
- Rare disorder in orofacial pain population
- Differential diagnosis: myositis, local myalgia, neoplasm

Features of myositis

- History of trauma to muscle or source of infection
- Often continuous pain affecting the entire muscle
- Pain aggravated by function
- Severe limited range of motion

Disorder	Cause	Diagnostic Criteria
Centrally mediated chronic muscle pain	Chronic generalized muscle pain associated with a comorbid disease	History of prolonged and continuous muscle pain Regional dull, aching pain at rest Pain aggravated by function of affected muscles Pain aggravated by palpation
Myalgia (local)	Acute muscle pain Protective muscle splinting Postexercise soreness Muscle fatigue Pain from ischemia	Regional dull, aching pain during function No or minimal pain at rest Local muscle tenderness on palpation Absence of trigger points and pain referral
Myofascial pain	Chronic regional muscle pain	Regional dull, aching pain at rest Pain aggravated by function of affected muscles Provocation of trigger points alters pain complaint and reveals referral pattern >50% reduction of pain with vapocoolant spray or local anesthetic injection to trigger point followed by stretch
Myofibrotic contracture	Painless shortening of muscles	Limited range of motion Firmness on passive stretch (hard stop) Little or no pain unless involved muscle is forced to lengthen
Myositis	Inflammation secondary to direct trauma or infection	Continuous pain localized in muscle area following injury or infection Diffuse tenderness over entire muscle Pain aggravated by function of affected muscles Moderate to severe decreased range of motion caused by pain and swelling
Neoplasia	Benign or malignant	May or may not be painful Anatomic and structural changes Imaging and biopsy needed
Myospasm	Acute involuntary and continuous muscle contraction	Acute onset pain at rest and function Markedly decreased range of motion caused by continuous involuntary muscle contraction Pain aggravated by function of affected muscles Increased electromyogram activity (higher than at rest) Sensation of muscle tightness, cramping, or stiffness

Adapted from de Leew R. Orofacial pain: guidelines for assessment, classification, and management. The American Academy of Orofacial Pain. 5th edition. Chicago: Quintessence Publishing; 2013.

Features of myofibrotic contracture

- Not usually painful
- Often follows long period of limited range of motion or disuse (eg, intermaxillary fixation)
- History of infection or trauma is common
- Differential diagnosis: TMJ ankylosis, coronoid hypertrophy

Features of masticatory muscle neoplasia

- Pain may or may not be present
- Anatomic and structural changes: tumors may be in muscles or masticatory spaces
- Swelling, trismus, paresthesias, and pain referred to teeth
- Positive findings on imaging or biopsy

Some clinicians have stressed classifying myogenic disorders based on an anatomic system, allowing a simpler diagnostic process because the patient evaluation involves careful palpation of the masticatory muscles and joints.^{40–42} The clinician needs to determine the causes and pathophysiology that occur with the various masticatory muscle disorders, such as disorders caused by trauma and so forth. A thorough history and clinical examination, an understanding of pain neuroanatomy and neurophysiology, and an in-depth knowledge of muscle pain research are important.^{42–44} Various causes of myogenous pain are reviewed in [Table 5](#).

Cause	Criteria
Focal myalgia from direct trauma	History of trauma preceding pain onset Subjective pain in muscles with function Pain reproduced on palpation
Primary myalgia caused by parafunction	No history of trauma Subjective pain in muscle with function Pain reproduced on palpation No trigger points
Secondary myalgia caused by active local disorder or recent medications	History of recent joint, oral soft tissue, or pulpal disease or medication (eg, SSRI) that coincides with muscle pain Subjective pain in muscle with function Pain reproduced on palpation
Myofascial pain	No history of recent trauma Subjective pain in muscles with function Pain reproduced on palpation Trigger points and pain referral
Diffuse chronic muscle pain and fibromyalgia	Subjective pain in multiple sites aggravated by function Widespread pain involving more than 3 body quadrants >3-mo duration Pain on palpation in 11 of 18 body sites

Abbreviation: SSRI, serotonin-selective reuptake inhibitors.

Adapted from Clark GT, Minakuchi H. Oral appliances. In: Laskin DM, Greene CS, Hylander WL, editors. TMDs, an evidence-based approach to diagnosis and treatment. Chicago: Quintessence; 2006. p. 377–90.

A new term, persistent orofacial muscle pain (POMP), was recently introduced to more accurately reflect the interplay between peripheral nociceptive sources in muscles, faulty central nervous system components, and decreased coping ability.⁸ POMP likely shares mechanisms with tension-type headache, regional myofascial pain, and fibromyalgia and has genetically influenced traits that determine pain modulation and pharmacogenomics interacting with psychological traits to affect disease onset, clinical progression, and pain experience.^{8,9} To date, these factors cannot be identified in individual patients in order to tailor focused, mechanism-based treatment. POMP is consistent with the condition often referred to as centrally mediated myalgia and, as such, treatment needs to be redirected from local and regional therapies to systemic and central ones.

TREATMENT OF MASTICATORY MUSCLE DISORDERS

It is important for the clinician treating patients with TMDs to distinguish clinically significant disorders that require therapy from incidental findings in patients with facial pain from other causes.² TMJ abnormalities are often discovered on routine examination and may not require treatment, such as with asymptomatic clicking of the TMJ. The need for treatment is largely based on the level of pain and dysfunction as well as the progression of symptoms. With respect to disorders of MOM, the principles of treatment are based on a generally favorable prognosis and an appreciation of the present lack of clinically controlled trials indicating the superiority, predictability, and safety of treatments.^{2,8,18,45} The literature suggests that many treatments have some beneficial effect, although this effect may be nonspecific and not directly related to the particular treatment.^{2,8,18}

According to the American Association of Dental Research, it is strongly recommended that, unless there are specific and justifiable indications to the contrary, treatment of patients with TMD, including those with disorders of MOM, initially should be based on the use of conservative, reversible, and evidence-based therapeutic modalities.⁴⁵ Studies of the natural history of many TMDs suggest that they tend to improve or resolve over time.^{39,41,43} Although no specific therapies have been proved to be uniformly effective, many of the conservative modalities have proved to be at least as effective in providing symptomatic relief as most forms of invasive treatment. Because those modalities do not produce irreversible changes, they present less risk of producing harm. Professional treatment should be augmented with a home care program, in which patients are taught about their disorders and how to manage their symptoms.^{45,46}

Treatments that are accessible, not prohibitive because of expense, safe, and reversible should be given priority, such as education, self-care, physical therapy, intraoral appliance therapy, short-term pharmacotherapy, behavioral therapy, and relaxation techniques (Table 6). There is evidence to suggest that multimodal therapy and combining treatments produces a better outcome.^{47,48} Occlusal therapy continues to be recommended by some clinicians as an initial treatment or as a requirement to prevent recurrent symptoms. However, research does not support occlusal abnormalities as a significant causal factor in TMD including masticatory muscle disorders.^{2,49–52}

Avoidance therapy and cognitive awareness play a vital role in patient care but have little scientific evidence to support their use.^{2,26,27,43} In general, common sense dictates that, if something hurts, it should be avoided. Four behaviors should be avoided in patients with masticatory muscle pain:

1. Avoidance of clenching by reproducing a rest position in which the patient's lips are closed but the teeth are slightly separated

Treatment Component	Description
Education	Explanation of the diagnosis and treatment Reassurance about the generally good prognosis for recovery and natural course Explanation of patient's and doctor's roles in therapy Information to enable patient to perform self-care
Self-care	Eliminate oral habits (eg, tooth clenching, chewing gum) Provide information on jaw care associated with daily activities
Physical therapy	Education regarding biomechanics of jaw, neck, and head posture Passive modalities (heat and cold therapy, ultrasonography, laser, and TENS) Range-of-motion exercises (active and passive) Posture therapy Passive stretching, general exercise, and conditioning program
Intraoral appliance therapy	Cover all the teeth on the arch on which the appliance is seated Adjust to achieve simultaneous contact against opposing teeth Adjust to a stable comfortable mandibular posture Avoid changing mandibular position Avoid long-term continuous use
Pharmacotherapy	NSAIDs, acetaminophen, muscle relaxants, antianxiety agents, tricyclic antidepressants
Behavioral/relaxation techniques	Relaxation therapy Hypnosis Biofeedback Cognitive-behavior therapy

Abbreviations: NSAIDs, nonsteroidal antiinflammatory drugs; TENS, transcutaneous electrical nerve stimulation.

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. *Dent Clin North Am* 2013;57(3):449–64; and *Data from Refs.*^{2,43,51,52}

2. Avoidance of poor head and neck posture
3. Avoidance of testing the jaw or jaw joint clicking
4. Avoidance of other habits such as nail biting, lip biting, and gum chewing (**Box 5**).

Many patients report benefit from heat or ice packs applied to painful MOM. The local application of heat can increase circulation and relax muscles, whereas ice may serve as an anesthetic for painful muscles. In addition, stretch therapy must be part of a self-care program. Stretches should be done multiple times daily to maximize effectiveness. The most effective stretching exercise is passive stretching, which is summarized in **Box 6**.

Physiotherapy helps to relieve musculoskeletal pain and restore normal function by altering sensory input; reducing inflammation; decreasing, coordinating, and strengthening muscle activity; and promoting the rehabilitation of tissues.¹¹ A licensed professional therapist is recommended for treatment. Despite the absence of well-controlled clinical trials, physiotherapy is a well-recognized, effective, and conservative therapy for many disorders of the MOM.

Physical therapy techniques:

- Posture training
- Exercises
- Mobilization

Box 5**Patients instructions for self-care**

Be aware of habits or patterns of jaw use.

- Avoid tooth contact except during chewing and swallowing.
- Notice any contact the teeth make.
- Notice any clenching, grinding, gritting, or tapping of teeth or any tensing or rigid holding of the jaw muscles.
- Check for tooth clenching while driving, studying, doing computer work, reading, or engaging in athletic activities, and also when at work or in social situations and when experiencing overwork, fatigue, or stress.
- Position the jaw to avoid tooth contacts.
- Place the tip of the tongue behind the top teeth and keep the teeth slightly apart; maintain this position when the jaw is not being used for functions such as speaking and chewing.

Modify your diet.

- Choose softer foods and only those foods that can be chewed without pain.
- Cut foods into smaller pieces; avoid foods that require wide mouth opening and biting off with the front teeth or foods that are chewy and sticky and that require excessive mouth movements.
- Do not chew gum.

Do not test the jaw.

Do not open wide or move the jaw around excessively to assess pain or motion.

Avoid habitually maneuvering the jaw into positions to assess its comfort or range.

Avoid habitually clicking the jaw if a click is present.

Avoid certain postures.

- Do not lean on or cup the chin when performing desk work or at the dining table.
- Do not sleep on the stomach or in postures that place stress on the jaw.

Avoid elective dental treatment while symptoms of pain and limited opening are present.

During yawning, support the jaw by providing mild pressure underneath the chin with the thumb and index finger or with the back of the hand.

Apply moist hot compresses to the sides of the face and to the temple areas for 10–20 minutes twice daily.

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. Dent Clin North Am 2013;57(3):449–64.

Physical agents and modalities

- Electrotherapy and transcutaneous electrical nerve stimulations (TENS)
- Ultrasonography
- Iontophoresis
- Vapocoolant spray
- Trigger point injections with local anesthetic or botulin toxin
- Acupuncture
- Laser treatment

SPLINT THERAPY

Splints, orthotics, orthopedic appliances, bite guards, nightguards, or bruxing guards are used in TMD treatment and often for disorders of masticatory muscles (Box 7).²

Box 6**Patient exercise instructions**

Certain exercises can help to relieve the pain that that comes from tired, cramped muscles. They can also help if you have difficulty opening your mouth. The exercises described here work by helping to relax tense muscles and are referred to as passive stretching. The more often you do these exercises, the more you will relax the muscles that are painfully tense.

Do these exercises 2 times daily:

1. Ice down both sides of face for 5 to 10 minutes before beginning (ice cubes in sandwich bags or packs of frozen vegetables work well for this).
2. Place thumb of one hand on the edge of the upper front teeth and the index and middle fingers of the other hand on the edge of the lower front teeth, with the thumb under the chin.
3. The starting position for the stretches is with the thumb of one hand and index finger of the other hand just touching.
4. Gently pull open the lower jaw, using the hand only, until you feel a passive stretch, not pain. Hold for 10 seconds, then allow the lower jaw to close until the thumb and index finger are once again contacting; it is crucial when doing these exercises not to use the jaw muscles to open and close, but rather manual manipulation only (ie, the fingers do all the work).
5. Repeat the above stretching action 10 times, performing 2 to 3 sets per day, 1 in the morning and 1 or 2 in the evening.
6. When finished with the exercises, moist heat can be applied to both sides of the face for 5 to 10 minutes (heating a wet washcloth in the microwave for about 1 minute works well for this).



Demonstration of a passive stretch using the fingers.

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. Dent Clin North Am 2013;57(3):449–64.

Box 7**Splint therapy**

- The appliance most commonly used is described as a stabilization appliance or muscle relaxation splint.
- These splints are designed to cover a full arch and are adjusted to avoid altering jaw position or placing orthodontic forces on the teeth.
 - Should be adjusted to provide bilateral even contact with the opposing teeth on closure and in a comfortable mandibular posture
 - Should be reexamined periodically and readjusted as necessary to accommodate changes in mandibular posture or muscle function that may affect the opposing tooth contacts on the appliance
- At the beginning of appliance therapy, a combination of appliance use during sleep and for periods during the waking hours is appropriate.
 - Factors such as tooth clenching when driving or exercising or pain symptoms that tend to increase as the day progresses may be better managed by increasing splint use during these times
- To avoid the possibility of occlusal change, appliances should not be worn continuously (ie, 24 hours per day) for prolonged periods.
- Full-coverage appliance therapy during sleep is a common practice to reduce the effects of bruxism and is not usually associated with occlusal change.

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. Dent Clin North Am 2013;57(3):449–64.

Their use is considered to be a reversible part of initial therapy. Several studies on splint therapy have shown a treatment effect, although researchers disagree as to the reason for the effect.^{11,41} In a review of the literature on splint therapy, Clark and colleagues²⁶ found that patients reported a 70% to 90% improvement with splint therapy.⁴³ A recent review of the research on splint therapy suggests that using a splint as part of therapy for masticatory myalgia, arthralgia, or both may be supported by the literature in case control studies.⁵¹ In contrast, there is insufficient evidence in reviewing randomized controlled trials published to support the use of stabilization splint therapy rather than other active interventions in treatment of myofascial pain (MFP). It seems better than no treatment, but only as effective as other active interventions for MFP.^{51–53} A systematic review and meta-analysis by Ebrahim and colleagues⁴⁸ of 11 eligible studies of 1567 patients showed promising results for pain reduction, very low evidence for effect on quality of life, and high research bias.

PHARMACOLOGIC THERAPY

Both clinical and controlled experimental studies suggest that medications may promote patient comfort and rehabilitation when used as part of comprehensive treatment. Although there is a tendency for clinicians to rely on favorite agents, no single medication has proved to be effective for the entire spectrum of TMDs.^{2,8,26,43,47} With respect to pain associated with disorders of the MOM, analgesics, nonsteroidal anti-inflammatory agents, corticosteroids, benzodiazepines, muscle relaxants, and low-dose antidepressants have shown efficacy.^{31,43,47} Many of the medications used for fibromyalgia can be used for patients with masticatory muscle disorders (**Table 7**).³¹ These medications are versatile and effective at treating the multiple symptoms associated with chronic muscle pain.

Medication Class	Effect
TCA's	Moderately helpful for pain Strong side effects (xerostomia, fatigue)
SSRIs	Less strong side effects than TCAs More effective for anxiety/depression than pain
Muscle relaxants	Moderately helpful for local muscle pain Strong side effects (xerostomia, sedation)
Serotonin-norepinephrine reuptake inhibitors	Moderately helpful for fibromyalgia-related pain
Low-potency opioids	Moderately helpful for fibromyalgia-related pain
NSAIDs	Helpful for acute inflammatory pain but not chronic muscle pain or fibromyalgia-related pain

Abbreviation: TCAs, tricyclic antidepressants.

From De Rossi SS, Stern I, Sollecito TP. Disorders of the masticatory muscles. *Dent Clin North Am* 2013;57(3):449–64.

TREATMENT OF INTRACAPSULAR DISORDERS

The treatment of TMJ osteoarthritis and internal derangement can be divided into 3 broad categories: noninvasive, minimally invasive, and invasive management. The management plan can vary depending on the specific diagnosis and severity of TMJ disorder, but the underlying principles of treatment apply universally.²

1. Multidisciplinary approach involving multiple specialties, including general dentistry, oral medicine, orofacial pain, orthodontics, oral surgery, physical therapy, and psychiatry, may be necessary to address the problem fully from all aspects.
2. Progression of treatment only after failure of more conservative modalities. The least invasive and most reversible treatments should be tried first. Only after a failure to alter the disease process and clinical symptoms should more invasive and often nonreversible treatments be initiated.

Goals of treatment:

1. Decreasing joint pain
2. Increasing joint function and opening
3. Preventing further joint damage
4. Improving overall quality of life and reducing disease-related morbidities

NONINVASIVE TREATMENT OPTIONS

Occlusal or Stabilization Splints

Various types of splints have been used by physicians since the eighteenth century for the treatment of TMJ disorders.⁵⁴ Today the use of splints has become one of the most common in-office initial treatments for TMD-associated pain. Since their inception, splints have been thought to work by unloading the condyle and protecting the TMJ and articular disc from degeneration and excessive articular strain.⁵⁴ Although there are varying designs, they all function similarly to disengage the condylar head from the fossa and articular disc.

A recent meta-analysis of randomized controlled trials evaluating intraoral orthopedic appliances for TMDs showed that hard stabilization appliances have good evidence of modest efficacy in the treatment of TMJ disorder pain compared with nonoccluding

appliances and no treatment.⁵² Other types of appliances, including soft stabilization appliances, anterior positioning appliances, and anterior bite appliances, have some evidence of efficacy in reducing TMD pain.^{52,55} However, a Cochrane Database review of stabilization splint therapy for TMJ pain revealed that there is insufficient evidence either for or against the use of stabilization splint therapy.⁵² Further randomized controlled studies with larger sample sizes and longer duration of follow-up are needed to study the effectiveness of splint therapy for TMD pain (**Table 8**).

Pharmacotherapy

Pharmacologic therapy in conjunction with other treatment modalities often plays an important role in the management of articular disc and TMJ disorders. Pharmacotherapy has 2 main goals⁵⁶:

1. Treatment of the underlying disease process
2. Alleviation of disease-associated symptoms such as pain and swelling

There are various classes of medications that function to target each of the two treatment goals. Often, it is necessary to use a combination of medications to treat both the pain and the inflammatory disease process depending on the severity of disease. However, care must be taken to avoid the prolonged use of certain medications, particularly analgesics, to prevent drug tolerance and dependency. The health provider's ultimate goal should be symptomatic relief for a period of time in the hopes that this will break the disease cycle and lead to permanent improvement.

Despite the frequent use of pharmacologic agents, numerous review articles have shown insufficient evidence to support or not support the effectiveness of pharmacologic interventions for pain in patients with TMJ disorders.^{57,58} There is an obvious need for further randomized control trials to study the effectiveness of pharmacologic interventions to treat pain associated with TMD. The medication classes are often similar for intracapsular and myogenic disorders (**Table 9**).

Physical Therapy

Physical therapy is commonly used in the outpatient setting to relieve musculoskeletal pain, reduce inflammation, and restore oral motor function. Physical therapy plays an adjunctive role in virtually all TMJ disorder treatment regimens. Various physical therapy modalities are available to the outpatient health provider. Although the evidence is weak, there are numerous systematic review articles that support the efficacy of exercise therapy, thermal therapy, and acupuncture to reduce symptoms such as pain, swelling, and TMJ hypomobility (**Table 10**).⁵⁹⁻⁶¹

Table 8

Major types of occlusal splints used in TMD therapy

Splint Type	Design
Stabilization splint	Hard acrylic with full coverage of maxillary and mandibular dentition in centric occlusion
Repositioning splint	Hard acrylic with full coverage of maxillary or mandibular dentition with inclines to guide mandible to a more anterior position
Soft splint	Similar to hard stabilization splints but made from a less expensive pliable material

From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465-79.

Class	Examples	Function
NSAIDs	Ibuprofen, naproxen, diclofenac, aspirin, etodolac, and others	Reduce inflammation and pain
Opioids	Codeine, oxycodone, morphine, hydromorphone, meperidine	Reduce pain
Corticosteroids	Prednisone, dexamethasone, hydrocortisone	Reduce inflammation and pain
Muscle relaxants	Cyclobenzaprine, carisoprodol, baclofen, and others	Reduce muscle spasm
Antidepressants	Amitriptyline, trazodone, fluoxetine, sertraline	Reduce muscle tension
Anxiolytics	Alprazolam, lorazepam, oxazepam, diazepam, buspirone	Reduce tension and muscle spasm

From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79; and *Data from* List T, Axelsson S, Leijon G. Pharmacologic interventions in the treatment of temporomandibular disorders, atypical facial pain, and burning mouth syndrome. A qualitative systematic review. *J Orofac Pain* 2003;17(4):301–10.

MINIMALLY INVASIVE TREATMENT OPTIONS

Intra-articular Injections

Different therapeutic solutions can be injected directly into the TMJ space and allow the targeted treatment of inflammation and joint degeneration (see [Table 9](#)). The TMJ has 2 unconnected cavities, superior and inferior, partitioned by the articular disc. The superior space injection is the commonly used technique. However, a recent review article showed that an inferior space injection, or simultaneous injections of the upper and lower spaces, seemed to be more effective, with increasing mouth opening and decreasing TMJ-associated pain ([Table 11](#)).⁶²

Arthrocentesis/Arthroscopy

Arthrocentesis and arthroscopy are safe and quick minimally invasive procedures that are used in patients who are resistant to more conservative treatment modalities.

Modality	Description
Exercise therapy	Techniques include manual therapy, postural exercises, muscle stretching, and strengthening exercises. Passive and active stretching of muscles or range-of-motion exercise are performed to increase oral opening and decrease pain
Thermal therapy	Involves the superficial application of a dry or moist heat/cold pad directly to the affected area typically in 20-min intervals. Used in conjunction with exercise therapy in the treatment of inflammation and TMJ hypomobility
Acupuncture	Thought to stimulate the production of endorphins, serotonin, and acetylcholine within the central nervous system, or may relieve pain by acting as a noxious stimulus. Treatments involve placement of needles in the face and hands, and are typically given weekly for a total of 6 wk ⁶¹

	Hyaluronic Acid	Corticosteroids
Benefits	Sodium hyaluronate is a natural component of TMJ synovial fluid, and lubricates and maintains the normal internal environment of the joints ⁶³	Reduction of inflammatory factors and reducing the activity of the immune system
Adverse effects	Mild pain and swelling at injection site, mostly transient	Infection and destruction of articular cartilage. Long-term repeat injections should be avoided ⁶⁴
Efficacy	Improved long-term clinical signs of TMD and overall improvement of symptoms compared with placebo. No difference in radiological progression of disease ⁶³	Same short-term and long-term improvements in symptoms, clinical signs, and overall condition compared with hyaluronic acid ⁶³

Often they are combined with immediate postoperative intra-articular injections and the use of occlusal splints, pharmacotherapy, and physical therapy during the recovery period (Tables 12 and 13).^{65–67}

INVASIVE TREATMENT OPTIONS

It is strongly recommended that, unless there are specific and justifiable indications to the contrary, treatment of patients with TMD initially should be based on the use of conservative, reversible, and evidence-based therapeutic modalities. Studies of the natural history of many TMDs suggest that they tend to improve or resolve over

	Arthrocentesis^{65–67}
Description	Saline lavage of the superior joint space, hydraulic pressure and manipulation to release adhesions, and elimination of intra-articular inflammatory mediators (see Fig. 3). Less invasive than arthroscopy and can be done in outpatient setting with local anesthesia and intravenous sedation
Indication	Limited opening with anteriorly displaced articular disc without reduction Chronic pain with good range of movement and displaced articular disc with reduction Painful degenerative osteoarthritis
Contraindications	TMJ with bony or fibrous ankylosis Extracapsular source of pain Patients who have not undergone noninvasive treatment modalities
Efficacy	Recent studies report 83.5% treatment success rate in patients with internal derangement and osteoarthritis, defined as an improvement in maximum jaw opening and a reduction in pain level and mandibular dysfunction

From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79.

Arthroscopy⁶⁸	
Description	Involves insertion of an arthroscope and inspection of the TMJ under fluid distention under general anesthesia. Allows irrigation of joint space, lysis of these adhesions, and mobilization of the joint under direct visualization (Fig. 4)
Indication	Limited opening and pain secondary to internal derangement TMJ hypomobility secondary to fibrosis or adhesions Degenerative osteoarthritis
Contraindications	TMJ with severe bony or fibrous ankylosis Extracapsular source of pain Patients who have not undergone noninvasive treatment modalities Practitioner with lack of open joint surgery experience
Efficacy	A large multicenter study reports >90% success rate as defined as improved mobility, pain, and function. ⁴⁰ Arthroscopy led to greater improvement in opening after 12 mo than arthrocentesis; however, there was no difference in pain. ³⁹

From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79.

time. Although no specific therapies have been proved to be uniformly effective, many of the conservative modalities have proved to be at least as effective in providing symptomatic relief as most forms of invasive treatment.⁴⁵ However, surgical interventions are occasionally necessary to restore function and reduce pain.

Arthroplasty

TMJ arthroplasty involves the reshaping of the articular surface to remove osteophytes, erosions, and irregularities found in osteoarthritis refractory to other treatment modalities.⁶⁴ These patients frequently also present with articular disc degeneration or displacement, which can be repositioned, repaired, or removed. All such procedures should be performed by an experienced oral and maxillofacial surgeon under general anesthesia, and done using an open surgical approach through a periauricular skin incision (**Fig. 5**). Complications are rare but can include wound infection, facial nerve injury, permanent occlusal changes, relapsing joint pain, and life-threatening vascular injuries. As with all TMJ-related surgeries, early postoperative physical therapy and range-of-motion exercises are vital to achieving long-term functional improvements.

- Disc repositioning: reposition of the disc back to its normal anatomic position in patients with internal derangement. This procedure is most effective in discs that are normal appearing (white, firm, shiny) with minimal displacement.
- Disc repair: small disc perforations can be repaired with a tension-free primary closure.
- Discectomy alone: removal of the articular disc is indicated in patients with severe disc perforation, complete loss of disc elasticity, and who are persistently symptomatic even after disc repositioning.⁴¹ Although studies have shown there is generally an improvement in pain and maximal mouth opening following the surgical removal of the disc, patients also showed signs of fibrous adhesions, narrowing of joint space, and osteophyte formation on MRI.^{69–71}
- Discectomy with graft replacement: the placement of a graft is thought to protect the joint from further degeneration and prevent the formation of fibrous

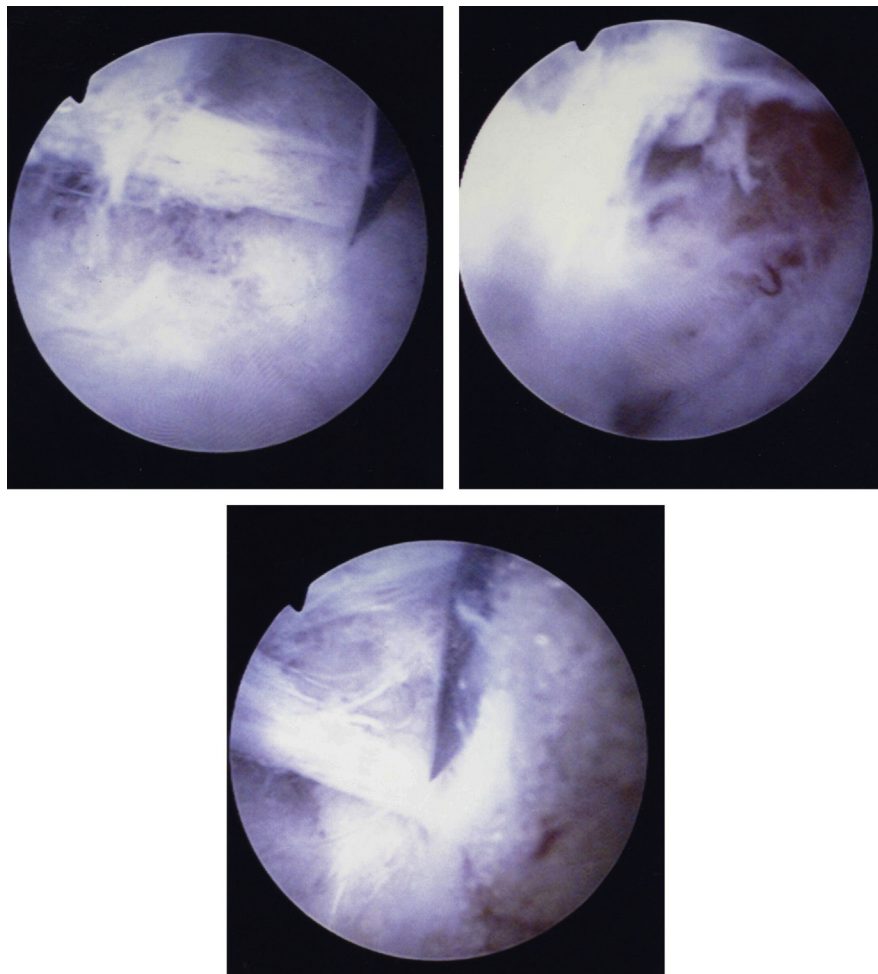


Fig. 4. Arthroscopic views of TMJ space showing evidence of multiple disk adhesions. (From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465-79.)



Fig. 5. Open surgical approach made through outlined periauricular and endaural skin incision. (From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465-79.)

Box 8**Criteria for successful TMJ disc surgery**

1. Mild, brief pain of no concern to the patient
2. Vertical range of motion greater than 35 mm and lateral range of motion greater than 6 mm
3. Ability to tolerate a regular diet
4. Stabilization of any degenerative radiological changes
5. Absence of symptoms for at least 2 years
6. Absence of significant surgical complications

From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. Dent Clin North Am 2013;57(3):465–79; and Data from Holmlund AB. Surgery for TMJ internal derangement. Evaluation of treatment and criteria for success. Int J Oral Maxillofac Surg 1993;22:75–7.

adhesions. The use of autogenous sources, such as temporalis flaps, auricular cartilage, and dermal grafts, results in superior clinical outcomes compared with alloplastic grafts.⁷² Studies have shown that autogenous graft does not prevent remodeling of the joint but may help to reduce the onset of crepitus resulting from discectomy alone.⁷² However, it was shown that discectomy with dermis graft replacement does result in a statistically significant improvement in pain, chewing, and general health (**Box 8**).

Total Joint Replacement

TMJ replacement is intended primarily to restore form and function and any pain relief gained is only a secondary benefit.⁷² The need for TMJ replacement typically indicates severely damaged joints with end-stage disease that has failed all other

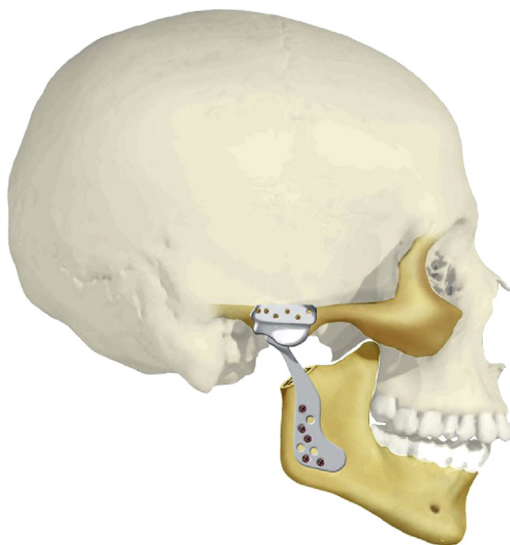


Fig. 6. Total joint replacement consisting of a fossa and condylar component held in place by screw fixation. (*From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. Dent Clin North Am 2013;57(3):465–79.*)

Box 9**Indications and relative contraindications for TMJ alloplastic replacement***Indications*⁷²

1. Ankylosis or reankylosis with severe anatomic abnormalities
2. Failure of autogenous grafts in patients who underwent multiple operations
3. Destruction of autogenous graft tissue by pathosis
4. Severe inflammatory joint disease that results in anatomic mutilation of the total joint components and functional disability
5. Failure of Proplast-Teflon implant
6. Failure of Vitek-Kent total or partial joints

Relative contraindications

1. Pediatric patients with immature facial skeleton
2. Patient with unrealistic expectations or lack of understanding of procedure
3. Uncontrolled systemic disease
4. Allergy to implant material
5. Active infection at implantation site

From Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. *Dent Clin North Am* 2013;57(3):465–79.

more conservative treatment modalities. Autogenous costochondral bone grafts have frequently been used in TMJ reconstruction because of their gross anatomic similarity to the mandibular condyle, ease of adaptation to the recipient site, and their growth potential in juveniles.⁷³ However, because of potential harvest site morbidity and failure during the transplantation process or from functional loading, the use of alloplastic materials has become increasingly popular in the adult population. At present, various custom and stock titanium joint designs are available that consists of both a fossa and a condylar component held in place by screw fixation (**Fig. 6**). Studies have shown that both custom and stock alloplastic TMJ replacements resulted in statistically significant improvement in pain level, jaw function, and incisal opening (**Box 9**).^{74,75}

SUMMARY

TMDs remain a common cause of visits to primary care physicians, internists, pediatricians, and emergency departments. Although the exact cause and fundamental pathogenesis of these disorders remains poorly understood, significant advances in the clinical diagnosis, radiographic imaging, and classification of these disorders have improved long-term management. It is clear that there are several types of disorders of the masticatory muscles and the TMJ as well as associated structures and each may have a complex cause, clinical course, and response to therapy. Host susceptibility plays a role at several stages of these disorders, including pain modulation and response to therapy. Future research in the area of genetics, pain, and arthritides offers greater possibility in defining this heterogeneous group of disorders and providing more focused and effective treatment strategies.

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