

Quality Resource Guide

Intraoral Appliance Therapy in the Management of Temporomandibular Disorders

Author Acknowledgements

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Dr. Klasser has no relevant financial relationships to disclose.

Educational Objectives

Following this unit of instruction, the practitioner should be able to:

1. Understand the rationale for the utilization of various intraoral appliances.
2. Recognize the multifaceted nature of temporomandibular disorders (TMDs) leading to management considerations using multi-disciplinary case-specific approaches.
3. Appreciate the criteria for achieving an optimum treatment outcome with intraoral appliance therapy.
4. Minimize complications that may arise with the use of intraoral appliances.

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The following commentary highlights fundamental and commonly accepted practices on the subject matter. The information is intended as a general overview and is for educational purposes only. This information does not constitute legal advice, which can only be provided by an attorney.

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Introduction

Temporomandibular disorders (TMDs) comprise a broad subgroup of musculoskeletal conditions that affect the jaw joint or temporomandibular joint (TMJ) and/or the muscles associated with mastication (chewing). Commonly, clinicians often mistakenly refer to TMDs as a singular disorder despite the fact that patients often present with various and multiple sub-diagnoses which may or may not be painful (e.g., myalgia, myofascial pain, arthralgia, degenerative joint disease, disc displacements etc).¹⁻³ Determining a national prevalence (the proportion of people in a defined population who have a health condition during a specified time period) of TMDs is difficult to estimate due to challenges in conducting clinical examinations on a large scale, such that most prevalence data are based on self-reported symptoms associated with TMDs rather than examiner-verified classification. According to an estimate based upon a National Health Interview Study (NHIS) convened in 2017-2018, it was found that an estimated 11.2 to 12.4 million U.S. adults (4.8 percent of the population) had pain in the region of the TMJ that could be related to TMDs.⁴ Based on this data, TMDs have been identified as one of the most commonly occurring non-toothache related pain concerns in the jaw and facial region and may be comparable in prevalence to other chronic pain conditions such as fibromyalgia, chronic low back pain, and migraine disease.⁵ To determine the incidence (the rate at which new cases develop) of TMDs requires longitudinal (cohort) studies, where individuals are followed over time and their symptoms assessed periodically. The OPPERA (Orofacial Pain: Prospective Evaluation and Risk Assessment) community-based study reported an overall incidence rate of first-onset TMDs of 3.9%.⁶ Common signs and symptoms of TMDs include: pain in the jaw region; compromise in the range of motion with jaw movement (opening, closing, moving laterally/protruding or chewing); and joint sounds including popping, clicking, or crepitus (sandpaper-like noises associated with jaw movement). Pain may or may not be associated with these joint sounds. Studies indicate that 75% percent of individuals evaluated exhibited at least one sign, such as joint noise or palpation tenderness, and 33% of this non-

patient population exhibited at least one symptom that potentially could prompt that individual to seek evaluation and care. Signs and symptoms in the general population have been found to occur more frequently in females than in males, at a ratio of approximately 2:1. However, females are three to nine times more likely to be represented in patient populations between 15 and 45 years of age.⁷ Interestingly, only 3.6% to 7% of individuals with TMDs have been estimated to require treatment.⁸

This commonly occurring group of musculoskeletal conditions may be caused or perpetuated by several factors. The age-sex prevalence pattern of TMDs are consistent with a possible etiological role for female reproductive hormones.⁹ Additional factors that have been implicated include: structural abnormalities; sleep disorders which may be associated with clenching or grinding the teeth; bite-related abnormalities, especially when compounded by clenching or grinding the teeth^{10,11} postural compromise (jaw or head); anxiety/stress/other mood disturbance;⁷ habitual behaviors such as gum chewing, pencil biting or nail-biting; and poor nutrition.

The most common sign of TMDs are TMJ sounds such as clicking/popping.¹² General population-based studies have reported clicking to occur in about 50% of those studied. A magnetic resonance image study found 33% of non-patient controls to have a displacement of the TMJ articular disc. However, 86% of the patient population in this study demonstrated TMJ disc displacement.¹³ Therefore, it should be determined whether or not a natural course of TMD exists. Although the concept of natural progression has been suggested, there is currently no convincing evidence that TMJ clicking/popping routinely progresses to locking and degeneration or that arthritic changes must develop in joints that lock. It has been reported that most degenerating joints tend to become non-painful with time;¹⁴ although, as many as 16% of these individuals may experience pain long-term. It is noteworthy, since joint sounds are so common, often asymptomatic, not overtly progressive and associated with poor sensitivity to definitively identify most joint conditions² that it is important to avoid overtreatment of the TMJ in the absence of pain and impaired function.¹⁵

Muscle-related signs and symptoms are also very common in the general population with masticatory muscle related conditions being the most common subgroup of TMDs. It has been reported that approximately 80% of patients diagnosed with TMDs have muscle related pain¹⁶ In a systematic review on the prevalence of masticatory muscle disorders in the general population involving six studies and including a total of 2,491 subjects, the prevalence rates ranged from 6-13.3%. A meta-analysis of the data showed an overall 9.7% prevalence.¹⁷ In another study, utilizing a similar protocol, but focusing on patients seeking TMD treatment diagnosed with muscle disorders; there was a reported prevalence of masticatory muscle disorders of 56.4% with muscle disorders alone being diagnosed in 19.9%.¹⁸ Current understanding of the complexity of masticatory muscle function and its dynamic relationship with the cervical musculature provides ample rationale for a thorough assessment of these areas during routine TMDs patient evaluation. Individual variations in muscle anatomy, biomechanics, and fiber type/composition potentially related to muscle fatigue must be considered. The demands on the musculature in normal function and excessive function while awake or asleep must be appreciated. Importantly, age-related decline of symptomology may not be as great with respect to muscular involvement as that identified with the TMJ.¹⁹

The key to successful management of TMDs is for the health care professional to determine an accurate and complete diagnosis. Critical causative and maintaining factors must be identified and addressed in the case-specific plan of care. The cornerstone of any management protocol is patient education. Since the most common reason for compromise of this musculoskeletal orthopedic system is overload or excessive mechanical stress, the patient must participate in their management by conscious avoidance of activities which may aggravate the condition. Typically, interventions will include physical, pharmacologic, and behavior management strategies. Altering the consistency of foods, limiting jaw movements, use of moist heat and/or ice, and avoidance of parafunctional behaviors such as clenching/grinding the teeth, thrusting/bracing of the jaw and/or placement of

foreign objects between the teeth (including gum chewing) can be extremely beneficial. Generally, mild pain relievers such as acetaminophen, non-steroidal anti-inflammatory medications, or aspirin provide appropriate relief. Muscle relaxant and sleep aid medications may also enhance treatment outcomes in select cases. Most importantly, TMDs are musculoskeletal disorders that are best managed by reversible and non-invasive forms of therapy. The majority of cases managed following a well-designed, case-specific approach will experience a very satisfactory outcome.²⁰

Intraoral Appliances: Overview

One of the more commonly utilized approaches for management of TMDs is intraoral appliance therapy.²¹ Intraoral appliances have been employed to manage a range of conditions such as sleep bruxism, myofascial pain, TMJ capsulitis, TMJ degenerative joint disease and tension-type headaches.²²⁻²⁴ Essentially, an intraoral appliance is a removable

device, usually made of hard acrylic, that is custom made to fit over the occlusal surfaces of the teeth in one arch, either the maxilla or mandible. There are generally three types of intraoral appliances that may be used: the flat plane (stabilization) appliance, the anterior repositioning appliance, and the anterior bite plane device.^{25,26}

The effects of intraoral appliance therapy include:

- Prevention/reduction in attrition to the dentition
- Alteration of the motor pattern of the masticatory musculature by altering periodontal ligament proprioception
- Alteration of muscle length
- Enhanced patient awareness of masticatory parafunctional behavior
- Alteration of the number, direction, location and quality of tooth contacts

Table 1 provides a perspective regarding the most commonly used intraoral appliances.

The major functions of stabilization (flat plane) appliance therapy are muscle relaxation, dispersal of biting forces, enhanced TM joint stability and protection of the teeth from abnormal forces such as those associated with bruxism. The intraoral appliance is fabricated to cover all of the teeth in the arch. **Figure 1** provides an example of a maxillary stabilization appliance.

Figure 1



Maxillary stabilization (flat plane) intraoral appliance.

Table 1

Type of Oral Appliance	Characteristics	Pros	Cons	Material
Full arch stabilization appliance	Full arch: all teeth covered for either the maxilla or mandible.	Stable: evenly spreads the occlusal loading over multiple posterior teeth.	Takes clinician time to adjust over several appointments.	Hard acrylic
Anterior Segmental appliance: maxillary or mandibular	Coverage of only a few anterior teeth.	Easy to fabricate. Provides immediate disclusion of posterior teeth and often pain relief.	Risk of extrusion/eruption of posterior teeth and/or intrusion of anterior teeth. Risk of pain in the TMJs.	Hard acrylic
Posterior segmental appliance	Coverage of some teeth: all posterior teeth.	None	Significant risk of intrusion of posterior teeth and/or extrusion of anterior teeth.	Hard acrylic
Anterior full arch repositioning appliance	Similar to the stabilization appliance: force that advances the mandible in an anterior direction.	May provide pain relief in the TMJ when TMD is due to trauma.	Long term utilization result in significant risk of TMJ dysfunction, orthodontic tooth movement and long-term skeletal misalignment.	Hard acrylic
Soft full arch appliance	Full arch: all teeth covered for either the maxilla or mandible.	Inexpensive and a rapid delivery of appliance to the patient.	Risk of increasing masticatory muscle activity due to patient chewing on the appliance. The appliance can provide no occlusal stability since the appliance is compressible and the soft acrylic cannot be adequately adjusted.	Soft acrylic

Criteria for optimum treatment effects include:

1. Stable and retentive.
2. Bilateral equal intensity anterior and posterior occlusal contacts so that an environment of a stable physiological mandibular posture (typically in centric relation or adapted centric relation) is created.
3. Canine guidance in lateral and protrusive excursions of the mandible.
4. No distalizing contacts that could compress highly vascularized and innervated retrodiscal tissues hence the occlusal surface of the appliance should be as flat as possible.

Importantly, as pain, muscle activity and inflammation subsides, the resulting changes in maxillo-mandibular relationships must be compensated for by regular adjustment of the appliance. Most patients are advised to wear the appliance during sleep and/or when their activity prohibits conscious awareness of awake parafunctional behaviors such as clenching. With improvement, the patient may be gradually weaned off the appliance. However, some patients engage in sleep bruxism, a recognized oral motor behavior often associated with disturbed sleep. Long-term wear of an appliance while sleeping may be necessary in selected cases. If there is no improvement within the first 2-4 weeks after judicious use of the appliance, then the patient should be re-evaluated for other factors that may require a partial or complete reassessment of the management regime.

Systematic review of randomized clinical trials for intra-oral appliances suggests that:^{27,28}

1. Stabilization splints can reduce TMD pain compared to non-occluding splints in those subjects with more severe pain.
2. Stabilization splints in the short term were equally effective in reducing TMD pain compared to physical medicine, behavioral medicine, and acupuncture.

Anterior repositioning appliances (**Figure 2**) are used less often because repositioning of the mandible over some time can result in irreversible changes to the occlusion such as bilateral posterior

open bites. The purpose of these appliances is to alter the structural condyle-disc-fossa relationship to decrease adverse joint loading. Although compression of the retrodiscal tissues may be reduced by positioning the mandible anteriorly, the clinician must remember that the TMJ remains loaded when utilizing these devices. Recent studies looking at fluid film pressures within the TM joint in various circumstances raise a question as to the routine utility of this approach.^{29,30}

Systematic review of randomized clinical trials for intra-oral appliances suggests that:^{27,28}

1. Anterior repositioning and soft splints have some evidence to suggest efficacy in reducing TMD pain compared to placebo controls.
2. Anterior repositioning splints are at least equal to or more effective in treating TMJ clicking and locking than stabilization splints.

An anterior bite plane or anterior discluding device (**Figure 3**) is usually a segmental appliance that occludes only with anterior teeth. No particular closure position is dictated; a full range of motion

is permitted on a flat surface. Functionally, the patient will gravitate to occluding on the appliance in a centric relation position as long as there is no interfering contact. The rationale for the use of this device is the fact that separating the posterior teeth results in a decrease in the recruitment of the closure (elevator) muscles.

Indications for use of anterior bite plane include:

1. When manipulation cannot be accomplished due to muscle splinting (guarding or protective co-contraction).
2. Management of painful masticatory musculature on an emergency basis.
3. When limited opening prevents other forms of intervention.

The appliance must be used short-term or on an episodic basis to minimize the potential for re-eruption or supra-eruption of the posterior teeth and/or intrusion of the anterior teeth.

A systematic review of randomized clinical trials for intraoral appliances suggests that anterior bite planes demonstrate modest evidence of efficacy for headaches and inconclusive evidence of effectiveness compared to stabilization intraoral appliances for TMJ pain.^{27,28}

Effects of Intraoral Appliance Therapy

The mechanism of intraoral appliance therapy has long been debated. Some of the commonly mentioned mechanisms of action are: increasing the vertical dimension associated with the thickness of material utilized; protection of the dentition and/or supporting structures from excessive loads; redirection of the forces; alteration of sensory input from the mechanoreceptors in the periodontal ligaments; cognitive awareness of what the individual is doing with the teeth (behavioral changes); change in mandibular position/condylar position; providing elements of occlusal contact that may be lacking due to missing or malposed teeth; and a placebo effect.^{25,31}

Figure 2



Anterior repositioning intra-oral appliance.

Figure 3



Anterior bite plane intraoral appliance.

Empirically and experimentally there is evidence to suggest that intraoral appliances produce a decrease in sleep-related muscle activity in many patients. Clark *et al.*,³² explained this as a reflexive response to the presence of a “foreign object” between the teeth, leading to an avoidance behavior. Hiyama *et al.*,³³ had similar findings in their six study participants, but nevertheless they suggested that masticatory muscle activity during sleep is significantly reduced by wearing an intraoral appliance. Similar effects have also been observed and measured in sleep laboratory studies.³⁴ Nitzan measured the fluid film pressure in the upper compartment of the TMJ during clenching while wearing and not wearing a mandibular appliance in a population of subjects diagnosed with severe closed lock, degenerative joint disease, or transient locking. She reported that utilization of the appliance resulted in a marked (82.5%) reduction in superior joint space pressure.²⁹ In a similar study, investigating the influence of oral stabilization appliances on intra-articular pressure of the TMJ, Casares *et al.*,³⁰ found a 31.2% decrease in fluid film pressure in the superior joint space. These studies demonstrate that in many cases, an intraoral appliance can mitigate and/or influence intra-articular pressure in the TMJ. Therefore, a stabilization appliance has great potential to support an increased adaptability in the masticatory system.

Maxillary or Mandibular?

The decision to fabricate a maxillary or mandibular appliance should be made after careful assessment of several clinical conditions. Incisal edge positions and defects are important factors. If the mandibular incisor edges are irregular, a mandibular oral appliance can cover them and make the delivery and adjustment of a new intraoral appliance much easier. Occlusal plane challenges can often be minimized by placing the intraoral appliance on the most uneven arch. The patient may display several missing teeth or teeth out of alignment. One arch or the other may have more mobile teeth or challenges with esthetics. Again, the intraoral appliance should be placed on the arch that displays the greatest irregularity. An analysis of these factors guides the

maxillary/mandibular decision. For patients who have worn an oral appliance previously, it is wise to duplicate their desire for a similar appliance. From an efficacy perspective, there is lack of compelling evidence thus preventing the endorsement regarding the superiority of a maxillary or mandibular intraoral appliance.³⁵ The only potential exception is that a maxillary thick intraoral appliance may not be indicated in patients with a sleep-related breathing disorder such as obstructive sleep apnea, because this may exacerbate the existing breathing disorder.^{36,37}

Complications

Complications associated with intraoral appliance therapy arise from poor design, faulty construction or improper use of the appliance. Poor design, especially the utilization of a segmental appliance without full arch coverage, may result in unwanted tooth movement.³⁸ Excessive use of the appliance may lead to psychological dependence. Utilization of an intraoral appliance only during sleep is a partial safeguard against both unwanted tooth movement and psychological dependence but by doing so, will not circumvent poor design. The clinician and patient should be aware of a general timeframe in which the appliance should be expected to be efficacious. Intraoral appliances will only be successful as part of an overall management plan that addresses all appropriate etiologic factors. Clear management objectives and goals in addition to communication are essential for the patient to understand their role as the most important person on the team in their management plan.

Potential Pitfalls of Over the Counter (OTC)/ Online Intraoral Devices

The availability of intraoral devices from over the counter (OTC) or online sources is widespread and poses numerous concerns.³⁹ These appliances represent a plethora of varying designs, materials and can create a host of potential irreversible negative effects.

The use of these devices without an accurate and complete diagnosis by a dental professional is

ill-advised. Documented negative effects include undesired tooth movement, supraeruption of unopposed or uncovered teeth, negative forces on the mandible, increased pressures on compressible anatomic structures, muscle pain and TMJ pain.³⁹ The most prevalent reason patients gave in one study for discontinuing the use of a boil and bite OTC appliance was the discomfort of wearing it. Both hyposalivation and hypersalivation were mentioned as adverse effects associated with the use of this type of appliance.⁴⁰ Data indicates that most OTC and online intraoral devices typically do not provide the user with risk/benefit awareness, an evidence-based rationale for use, nor instructions for use.³⁹ It is strongly recommended that if these devices are being used, they are carefully monitored by a dental professional to avoid undue and undesirable effects. Dental professionals are advised to routinely inquire if their patients are utilizing such devices.

Conclusion

The goals for treating an orthopedic system such as the TMJ and the masticatory system need to address all factors contributing to orthopedic overload. Intraoral appliances can help to relieve some of the excessive forces generated through parafunctional behaviors. The intraoral stabilization appliance (splint) remains the gold standard for therapy of patients with temporomandibular pain especially for those individuals who have pain localized to the masticatory system.

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POST-TEST

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(1.0 CE Credit Contact Hour) Please circle the correct answer. 70% equals passing grade.

1. Factors contributing to the development of TMD

include:

- a. Structural abnormalities
- b. Advancing age
- c. Sleep disorders
- d. Habitual behaviors
- e. a, c & d only

2. Principles for the management of TMD include:

- a. Control parafunctional behaviors
- b. Occlusal adjustment in the symptomatic patient
- c. Develop a case-specific plan of care
- d. a & c only
- e. a, b & c

3. Risk factors associated with intraoral appliances

include:

- a. Movement of teeth
- b. Aberrant positioning of the mandible
- c. Temporomandibular joint pain
- d. Hypersalivation
- e. All of the above

4. The _____ intraoral appliance has demonstrated the greatest potential for benefit.

- a. anterior bite plane
- b. soft mouth guard
- c. stabilization
- d. anterior repositioning
- e. segmental

5. One of the most critical errors in the design of an intraoral appliance is:

- a. Seated condylar position
- b. Distalizing contacts
- c. Utilization of a mandibular appliance
- d. Equal intensity posterior contacts
- e. None of the above

6. Indication(s) for use of an anterior bite plane are:

- a. Acute masticatory muscle pain
- b. Temporomandibular joint inflammation
- c. Disclusion of posterior teeth to gain muscle relaxation
- d. All of the above.
- e. a & c only

7. Intraoral appliance patient utilization is best described as:

- a. A 24-hour, seven day a week regimen
- b. Utilized on an as-needed for pain only basis
- c. Part of a multidisciplinary management plan
- d. Episodic use with no definitive plan
- e. b & c only

8. The decision tree to determine whether to utilize a maxillary or mandibular appliance includes:

- a. Mobile teeth
- b. Malposed teeth
- c. Missing teeth
- d. Irregular incisal edges
- e. All of the above

9. One of the benefits of intraoral appliance therapy is that it is a reversible approach to care.

- a. True
- b. False

10. A major consideration in the use of an intraoral appliance is:

- a. As an orthodontic device.
- b. To provide stability to a dynamic orthopedic system.
- c. To determine an acceptable vertical dimension of occlusion.
- d. To best distribute loads within the system.
- e. b & d

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Date of Birth: _____ Email: _____

State(s) of Licensure: _____ License Number(s): _____

Preferred Dentist Program ID Number: _____ Check Box If Not A PDP Member

AGD Mastership: Yes No

AGD Fellowship: Yes No Date: _____

Please Check One: General Practitioner Specialist Dental Hygienist Other

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OFFICE
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ONLY

Evaluation - Intraoral Appliance Therapy in the Management of Temporomandibular Disorders 1st Edition

Providing dentists with the opportunity for continuing dental education is an essential part of MetLife's commitment to helping dentists improve the oral health of their patients through education. You can help in this effort by providing feedback regarding the continuing education offering you have just completed.

Please respond to the statements below by checking the appropriate box, using the scale on the right.

	1 = POOR					5 = Excellent					
	1	2	3	4	5						
1. How well did this course meet its stated educational objectives?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
2. How would you rate the quality of the content?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
3. Please rate the effectiveness of the author.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
4. Please rate the written materials and visual aids used.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
5. The use of evidence-based dentistry on the topic when applicable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	N/A				
6. How relevant was the course material to your practice?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
7. The extent to which the course enhanced your current knowledge or skill?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
8. The level to which your personal objectives were satisfied.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
9. Please rate the administrative arrangements for this course.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
10. How likely are you to recommend MetLife's CE program to a friend or colleague? <i>(please circle one number below:)</i>											
	10	9	8	7	6	5	4	3	2	1	0
	extremely likely					neutral					not likely at all

What is the primary reason for your 0-10 recommendation rating above?

11. Please identify future topics that you would like to see:

Thank you for your time and feedback.



To complete the program traditionally, please mail your post test and registration/evaluation form to:
MetLife Dental Quality Initiatives Program | 501 US Highway 22 | Bridgewater, NJ 08807