REVIEW ARTICLE

The management of temporomandibular disorder using occlusal splint therapy and bio-behavioral therapy

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Abstract

Temporomandibular disorder (TMD) is a collective term that includes a number of clinical complaints involving the muscles of mastication, the temporomandibular joint, and associated orofacial structures. Diagnosing orofacial pain can be quite difficult as patients may have multiple pain complaints and often present with a confusing constellation of signs and symptoms. Management of TMD is based on certain basic principles that include the formulation of an accurate diagnosis, gradual escalation of therapy, restraining from irreversible forms of treatment and the psychophysiological aspects of the disease. A multidisciplinary model that includes patient awareness and self-care, cognitive behavioral intervention, occlusal splint therapy (OST) is endorsed for the management of most patients. The current article reviews the management of TMD by the OST and bio-behavioral therapies.

Introduction

The temporomandibular joint (TMJ) is one of the most complex joints in the body and is the area in which the mandible articulates with the cranium.[1] The American Academy of Orofacial Pain has defined temporomandibular disorders (TMD) as: "A collective term embracing a number of clinical problems that involve the masticatory musculature, TMJ, and associated structures, or both."[2] They are characterized by three types of clinical signs: Muscle and/or TMJ tenderness; TMJ sounds; and restriction, deviation, or deflection of the mouth. TMD are considered to be the most common orofacial pain conditions of non-dental origin. The frequent concurrent presence of other symptoms such as earache, headache, neuralgia, and tooth pain, which may be related to the TMD or be present as ancillary findings to be assessed in the differential diagnosis process and makes the assessment of TMD prevalence a complex issue.[3]

From its earlier days, when TMD was thought to be caused by a single etiology, to the present day multifactorial etiology, the role of psychosocial and other factors which play a key role in initiating TMD has now been identified.[4] Based on these different etiological concepts, totally divergent treatment protocols have now been established.

The treatment of TMD is typically driven by the physical diagnosis alone, without addressing the personal or psychological impact of TMD pain or the patterns of coping used for TMD patients. Although TMD is widely considered as a condition in which psychosocial factors influence the course of the disease, very little attention has been paid toward assessing the influence of psychological or psychosocial factors on the outcome of the treatment and the association of successful clinical outcome with improved psychosocial function.[5] This article reviews the management of TMD by occlusal splints and bio-behavioral therapies.

History

Historically, TMD management has largely been based on the belief systems and testimonials according to the theory of causation. In the past, successful TMD treatment was compromised as a result of idealized morphologic belief systems by a limited mechanical reparative approach rather than a comprehensive multidisciplinary approach.[6]

In the late 1800s, a major structural concern of dentists was the need to manage the occlusion during replacement of natural teeth with artificial ones. In the mid-1800s through the early

1900s, well-known prosthodontists including Balkwell, Bonwell, Bennett, Spee, and Wadsworth published occlusal concepts based on geometric and functional norms to establish "balanced occlusions" that would "equalize muscle activity and resultant interarch forces." This led to strong and lasting convictions that the health and the function of the TMJ and associated muscles were primarily dependent on the occlusion.[6]

In 1934, "TMJ" became universally recognized when Costen published his legendary treatise claiming that pain in and around the jaw and "related ear symptoms" improved with alteration of the bite. In the 1940s, Thompson was recognized as a leading proponent of limited mandibular repositioning and rest position intraoral appliances. In the 1960s, Ramjford popularized the use of occlusal splints. The multifactorial nature of TMD began to be acknowledged in the 1960s and 1970s. Stress and other psychological factors were being recognized more and more as contributing factors. In the late 1980s and early 1990s, a surge of knowledge occurred in the primary mechanisms of pain and major advances in the neurophysiology and neuropharmacology of pain.[6]

Diagnostic Criteria

Most clinical researchers view the Research Diagnostic Criteria for TMD (RDC/TMD) as an improvement from previous diagnostic classifications, as it offers a dual-axis system. The RDC/TMD embraces a biopsychosocial model which highlights the importance of a multimodal approach toward the treatment of pain conditions.[7] According to this perspective; physical, cognitive, affective, and behavioral factors interact and contribute to the experience of chronic pain. These factors are thought to be interdependent, with each factor impacting the others.[8]

Dworkin *et al.* (1992) developed the RDC/TMD, and these criteria have become the gold standard in the diagnosis and assessment of TMD.[8] Since the time of their introduction, the RDC/TMD have been used to classify TMD patients according to their physical diagnosis (Axis I) and pain-related disability and psychological status (Axis II). One of the primary goals of this system of classification was to implement diagnostic standardization, to enable cross-population comparison between different investigations to increase knowledge on TMD epidemiology and to avoid confusion generated by the use of multiple terms to indicate the same disorders.[3]

Axis I allows the diagnosis of: (i) Muscle disorder (myofascial pain or myofascial pain with limited opening), (ii) a disc displacement diagnosis for each joint (disc displacement with reduction, disc displacement without reduction with limited opening, and disc displacement without reduction without limited opening), and (iii) up to two diagnoses of a joint condition (arthralgia, arthritis, or arthrosis).

Axis II consists of three components: A graded chronic pain scale, measures of depression, and a number of non-specific physical symptoms.[8] Axis II also consists of a self-administered questionnaire for the patient that the clinician can use, with the scoring system provided, to assess the level of the patient's: Chronic jaw pain; disability caused by their jaw complaint; depression and non-specific symptoms.[2]

Management of TMD

Occlusal therapy is the treatment aimed toward altering the mandibular position or occlusal contact pattern of the teeth and is divided into reversible and irreversible therapies. The reversible therapy alters the patient's occlusal condition only temporarily and is accomplished with occlusal splints, whereas the irreversible occlusal therapy permanently alters the occlusal condition and/or alters the mandibular position.[9]

Occlusal splint therapy (OST)

According to glossary of prosthodontic terms (8th edition), occlusal splint is any removable artificial occlusal surface that fits over the incisal and/or occlusal surfaces of teeth in one arch, creating precise occlusal contact with the teeth of opposite arch, and used for diagnosis or therapy affecting the relationship of the mandible to the maxillae. It may be used for the treatment of TMJ disorders, stabilization and to prevent the wear of the dentition.[10]

The important goals of OST are: The protection of TMJ discs from dysfunctional forces that may cause perforations or permanent displacements; improving the jaw-muscle function, and alleviating the associated pain by creating a stable, balanced occlusion.[10] Most occlusal splints alter the occlusion to prevent the interference with complete seating of the condyles in centric relation.[11]

Types of occlusal splints

Okeson classified splints as:

1. Muscle relaxation appliance/stabilization appliance used to reduce muscle activity
2. Anterior repositioning appliances (ARA)/orthopedic repositioning appliance.[12]

Other types:

a. Anterior/posterior bite plane
b. Pivoting appliance
c. Soft/resilient appliance (silicone).

Dawson classified splints as:

1. Permissive splints/muscle deprogramer
2. Directive splints/non-permissive splints
3. Pseudo permissive splints (e.g., soft splints and hydrostatic splint).[13]

The permissive splints allow the teeth to glide without any hindrance over the biting or contact surface by disengaging the occlusion, to remove deviating tooth inclines from contact. These include bite planes (anterior deprogramer, Lucia jig, and anterior jig) and stabilization splints (tanner, centric relation, flat plane, and superior repositioning).[14,15] The flat plane stabilization appliance (also known as the Michigan splint, muscle relaxation appliance, or gnathologic splint) is designed for the maxillary

arch. When a stabilization type of appliance is placed intraorally, there is minimal change to the maxillomandibular relationship other than that produced by the thickness of the material. This is the most common type of intraoral appliance and has the least potential for adverse effects to the oral structures.[10]

The non-permissive splints have indentations that restrict the movement of the mandible. They are designed in such a way that the mandible is positioned in a specific relationship to the maxilla. The function of a directive splint is to align the condyle-disk assemblies. Examples include an ARA and a mandibular orthotic repositioning appliance.[15]

The function of the ARA is to modify the maxillomandibular relationship so that the mandible can assume a more anterior position. This type of appliance was used to treat patients with internal derangements.[16]

Posterior bite plane appliances are custom made to be worn on the mandibular arch. This appliance alters the vertical dimension and the horizontal maxillomandibular relationship.[10]

Anterior bite plane is a palatal-coverage horseshoe shaped occlusal platform covering six or eight maxillary anterior teeth. The pivoting appliance is constructed with hard acrylic resin that covers either the maxillary or mandibular arch and incorporates a single posterior occlusal contact in each quadrant. This is designed with a purpose of reducing the intraarticular pressure by condylar distraction as the mandible fulcrums around the pivot, resulting in an unloading of the articular surfaces of the joint.[17]

Soft rubber splints and aqualizers are fabricated from a resilient material and are adapted to the maxillary teeth function.[10] They are quick to fabricate and can be provided as an "emergency treatment" for a patient, who presents with an acute TMD. The aqualizer has a unique water system that optimizes biomechanics, supports the jaw in a comfortable position, places bite and body in harmony, straightens the bite to maximize other structures, enables systemic function and balance, allows the body to naturally balance itself, and finds perfect occlusal balance at the onset of the treatment.[17,18]

Occlusal splints provide diagnostic information in different ways to determine the scope of the function, impingements to the potential neutral zone, parafunctional habits and anterior guidance requirements, and also obtain information from patients about vertical dimension.[19] The following concepts explain the different uses of occlusal splints:

1. Limiting the closure in maximal intercuspal position: The occlusal splint help the patient to place his mandible in a new posture, thus resulting in a new muscular and articular balance
2. Distribution of forces: The forces generated during bruxism can be as much as six times the maximal force generated by normal chewing. They act by distributing these forces across the masticatory system
3. Normalizing periodontal ligament proprioception: An occlusal splint balances the load and allows for muscle symmetry by dissipating the forces placed on individual teeth by utilizing a larger surface area covering all teeth in the arch
4. Relaxing the muscles: A splint will relax the elevator and positioning muscles, with immediate disclusion of all posterior teeth by the anterior guidance and condylar guidance in all movements
5. Allowing the condyles to seat in centric relation: A properly balanced splint allows the articulator disc to obtain its antero-superior position over the condylar head, resulting in an occlusion associated with relaxed positioning and elevator muscles
6. Increase in the vertical dimension of occlusion: Occlusal splints can be adjusted with a vertical height that exceeds the physiologic interocclusal distance
7. Cognitive awareness theory: A patient can learn what position or activities are harmful, by increased cognitive awareness regarding the positioning and use of the jaw, the change in oral tactile stimuli, and the decrease in oral volume.[17]

Occlusal splints allow the patient to seek the most comfortable muscle and joint position without the excessive influence of the occlusion. For the results to manifest, the patient is advised to use the splint at night for several months. However,

Figure 1: Occlusal splint

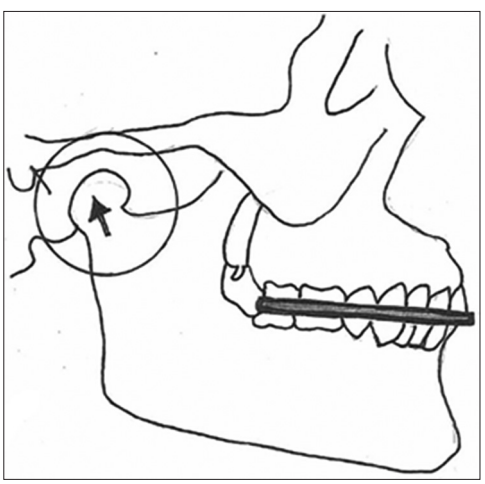

Figure 2: Maxillary hard acrylic splint increases joint space when used; it allows for disc reduction, relieves spasms, redistributes occlusal forces, and prevents attrition

Table 1: A summary of occlusal appliance studies

Study	Type and no of subjects	Duration	Subjects	Outcome measures	Results
Okeson *et al.* 1983[21]	Between groups, randomized, comparative SOA (*n*=12), SRT (*n*=12)	4-6-week follow-up	TMD	Muscle palpation score (0-3), ROM, others	SOA>SRT
Ekberg *et al.*, 1998[22]	Randomized, placebo controlled, double-blind SOA (*n*=30); NOA (*n*=30)	10 weeks	TMJ pain	VAS, muscle palpation score (0-3), others	SOA>NOA (daily pain, *P*=0.02) (subjective symptoms, *P*=0.006)
Ferrario *et al.* 2002[23]	*n*=14	Recorded during maximum voluntary clench lasting 3 s	TMD	Quantitative EMG analysis	The splint reduced the electrical activity of the analyzed muscles (*P*<0.005) and made it more equilibrated both between the left and right side and between the temporal and masseter muscles (activity index, *P*<0.01)
Gavish *et al.* 2002[24]	*n*=37 With splint=21, without splint=16	8 weeks	Masticatory myofascial pain	Chewing test, VAS	The splint group had a statistically significant reduction in pain intensity, in mean muscle sensitivity to palpation and the pain experience than the non-splint group. A stabilization splint has a therapeutic value beyond its placebo effects
Tanaka *et al.*, 2004[25]	*n*=40	12 months, with semi-monthly follow-up	TMD	Pain scale	Complete remission=70%, partial remission=22.5%
Al Quran and Kamal, 2006[26]	A=38, (stabilizing splint) B=38 (no treatment)	10 weeks	TMD	Worst reported pain	A, B=Positive (within the group) A>B (between the groups)
Naikmasur *et al.*, 2008[27]	*n*=40 Group A=Muscle relaxants and analgesics *n*=20 Group B=Soft occlusal splints	After the 1st week of initiation of therapy and every month for 3 months of follow-up	Myofascial pain dysfunction syndrome	GPI, VAS, maximum comfortable mouth opening	Progressive decrease in GPI scores, number of tender muscles, TMJ clicking, and tenderness with various jaw movements and significant improvement in mouth opening in Group A during the follow-up period as compared to Group B
Ficnar *et al.*, 2013[28]	Randomized controlled study (*n*=63); Group 1 - Conservative therapy=21, Group 2 – Conservative+ occlusally adjusted=21, Group 3 – Conservative+ non-occlusally adjusted=21	2 weeks, with a follow-up after 2.5 months	TMD	Measurement of pain reduction in the palpation-sensitive masticatory muscles, questionnaire	Group 3=Mouth opening significantly enlarged after 2 weeks Group 2 and 3=Mouth opening significantly enlarged after 2.5 months Group 2 and 1=Significant reduction in the pressure-sensitive areas after 2.5 months
Gomes *et al.*, 2014[29]	Blinded randomized clinical trial, (*n*=28, 14 for massage therapy+ 14 for splint therapy)	4 weeks	TMD	Questionnaire, ROM	Significant increases in ROM were found for all measures in both the massage and occlusal splint groups (*P*<0.05)

SOA: Stabilization occlusal appliance, SRT: Simplified relaxation therapy, TMD: Temporomandibular disorder, TMJ: Temporomandibular joint, NOA: Non-occluding appliance, GPI: Global pain impact scale, VAS: Visual analog scale, ROM: Range of motion, EMG: Electromyography

splints may be required for a year or more to stabilize treatment, provide relief pain and discomfort of TMJ [Figures 1 and 2].[20] A summary of various studies on occlusal appliances has been shown in Table 1.

Bio-behavioral Therapy

The term "bio-behavioral" describes the treatment modalities derived from the application of behavioral science theories and methods used to change pain perception, aiming to ameliorate or eliminate affective dimensions and psychological dysfunctions that often accompany pain experience.[30] Bio-behavioral assessment includes assessment of patient's cognitive (i.e., thinking) and affective (i.e., emotional) status, as well as assessment of his or her current level of behavior and psychosocial function. The four most widely used approaches to bio-behavioral assessment of chronic pain patients are: Observational, self-report, self-monitoring, and multiaxial [Figure 3].[31]

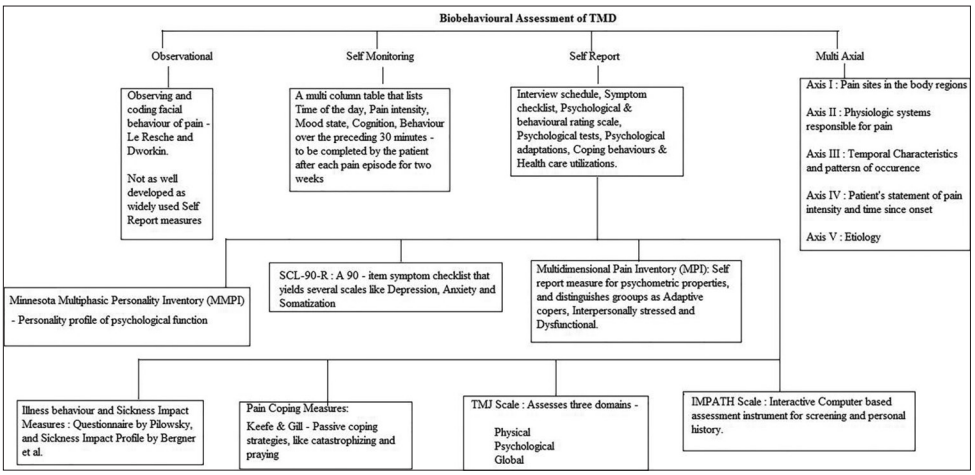

Figure 3: Bio-behavioral assessment of temporomandibular disorder

Bio-behavioral therapy is considered as a safe, reversible, and non-invasive treatment approach that includes a wide range of interventions such as electromyographic (EMG) biofeedback, cognitive behavioral therapy (CBT), hypnosis, re-education, and other relaxation techniques.[30]

EMG biofeedback

EMG biofeedback is a muscular relaxation technique, in which a signal constantly provides patients feedback about their masticatory muscles' activity level. This technique can be used by healthcare providers to give patients the opportunity to evaluate a specific physiological parameter (e.g., blood pressure, skin temperature, muscular tension). Biofeedback is more effective for patients with daytime parafunctional habits than for patients with night time parafunctional habits.[30]

A variety of biofeedback techniques has been put into practice including: Muscle tension discrimination to increase the perception of contractions, training progressively lower levels of muscle tension to obtain maximal relaxation, deactivation training to promote rapid recovery from contraction, and home practice to ensure carrying out of the day to day activities.[32]

Relaxation Techniques

Relaxation techniques such as progressive muscular relaxation, yoga, and meditation, evoke the neurophysiologic response known as relaxation response. This reaction consists of a tone reduction in the sympathetic nervous system that results in muscle relaxation and a depression of neuroendocrine response to unfavorable external conditions, thus reducing the anxiety level in a patient. It has been hypothesized that TMD patients seem to over-respond to environmental stimuli with an increased sympathetic activation, which results in an altered breathing rate and an augmentation of cardiovascular activity. Thus, relaxation techniques may represent a suitable tool to control such hyper reactions.

Hypnosis

At a 1995 National Institutes of Health Conference, experts suggested that hypnosis was an effective treatment and a possible tool to manage bruxism and TMDs. Winocur *et al*. carried out a randomized, controlled clinical trial to evaluate the efficacy of hypnosis with respect to occlusal appliance therapy in a study population of 40 women with a history of at least 6 months of facial pain. The researchers assigned participants to 1 of 3 possible treatment groups: Hypno relaxation, occlusal appliances, and minimal treatment (i.e., counseling). At the end of the observation period, all patients reported a marked reduction of pain pressure threshold, but changes were significant only for the hypno relaxation group members.[33]

CBT

CBT is utilized for the management of chronic pain and is based on the biopsychosocial model. CBT should be custom made, monitored for effectiveness, and implemented for as long as required.[33]

CBT involves a number of therapeutic methods believed to modify the emotional approach of patients to their clinical conditions and reduce negative thinking and perceived impact of TMD symptoms, thus enhancing their personal strategies for coping with pain. Teaching systems created on the basis of this type of approach are numerous and have different characteristics, but they all share common targets such as teaching patients to recognize elements that affect pain perception, encouraging patients to reimage their pain experience, learning new methods of pain response, teaching pain control, and encouraging constant improvement in exercise and activity levels.[30]

Counseling

Counseling is effective in lowering symptom severity and the anxiety of the patients and must be oriented toward the specific complaints and address the cognition of the patient and the relatives. It must go beyond general statements.

Counseling consists of:

- Explaining the pain pathology and dysfunction in the particular patient
- Explaining the co-factors involved (psychosocial and behavioral aspects, general diseases)
- Indicating and explaining the important fluctuation in the symptoms
- Explaining the "burn-out" characteristic of the arthrogenous symptoms
- Making the patient aware of his responsibilities in the therapeutic process (compliance, motivation, coping)
- Evaluating and discussing the management goals and prognosis with the patient.[33]

Conclusion

As TMDs are diverse and often multifactorial from an etiologic standpoint, management requires a paradigm shift to a biopsychosocial medical model. The mindset change requires a shift from a singular approach, in which cause and effect are thought to be known, to a multidisciplinary one. Treatment should have a favorable risk-belief system, be cost-effective, and be evidence-based, comparable with other joint and muscle conditions in the body. Only a sound knowledge and precise tissue-specific diagnosis can lay the foundation for proper management. A good understanding of the anatomy and physiology of the entire stomatognathic system along with the understanding of the pathophysiology of the disorder is paramount in making the right decision regarding the treatment protocol to be followed.

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