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Temporomandibular disorders

A review of current understanding

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Objective. The purpose of this article is to conduct a narrative review of current evidence regarding the understanding, evaluation, management, and treatment of temporomandibular disorders to provide a broad perspective and updated introduction to an important and controversial subject with rapidly changing developments and limited well-designed research.
Data sources. Studies were identified through a search of MEDLINE for 3 topics (temporomandibular disorder, temporomandibular joint, and chronic pain) over a 10-year period (January 1988 to August 1998) and of bibliographies of identified studies and review articles.
Study selection. More than 5000 articles were produced. In-depth review of all of this literature was beyond the scope of the present article, which is intended to provide an overview. The amount and diversity of the literature and the limitations of covering such a broad topic being recognized, the papers selected were those that reviewed limited topics or studied focused areas. This report is not a systematic (qualitative) or meta-analysis (quantitative) review. An acknowledged limitation of this narrative review method lies in the potential for bias in selection. The referenced works do not include all papers reviewed; only pertinent literature and reviews with comprehensive references were selectively included.
Conclusions. Advances in basic and clinical science have resulted in important changes in the understanding and management of temporomandibular disorders. Many treatments are not supported by research, and the role of dentistry is changing to a more diagnostic and management-based model from the hands-on treatment procedures of the past. The present science-based understanding of a biopsychosocial disorder is important in properly and responsibly dealing with patients with temporomandibular disorders.
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Temporomandibular disorder (TMD) is a nonspecific diagnosis that represents a group of often painful and/or dysfunctional conditions involving the muscles of mastication and the temporomandibular joint (TMJ). Unfortunately, many aspects of TMD are controversial.[1-4] Scientific understanding of many aspects of TMD is rapidly progressing but has been only slowly incorporated into clinical practice.[5,6] At present, there is a gap between science-based TMD diagnostic and management methods and many clinical practices.[5]

DEFINITION AND CLASSIFICATION OF TMD

TMD is recognized as a nonspecific term representing a wide variety of painful and/or dysfunctional jaw conditions.[7] These conditions include symptoms and disorders of the muscles of mastication, the TMJ, the nervous system, and behavior. Most cases of TMD are recognized as instances of mild, self-limiting disorders that resolve without active treatment.[8] The most common TMD by far, comprising 90% to 95% of all TMD cases, is a condition with multiple musculoskeletal facial pain complaints and a variety of jaw dysfunctions and without an identified structural cause.[9] A correct diagnosis of TMD therefore requires a subset of specific diagnoses for appropriate understanding of the individual patient's condition.[9,10] The specific diagnosis must include consideration of all of the following: jaw muscles; bone and cartilage joint structures; soft tissue joint structures, including the articular disk and synovium; jaw and joint function; and analysis of the pain disorder, specifically including patient behaviors. Appropriate diagnoses of substance would thus resemble the following: (1) rheumatoid arthritis with synovitis, arthralgia, condylar degenerative disease, and open bite deformity or (2) chronic pain with a behavioral disorder, myofascial pain and dysfunction, and internal disk derangement with

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displacement and reduction. The term *TMJ* has been discontinued as an overall descriptor because it is inaccurate and misleading, implying structural conditions when none—or when many other, more important factors—are involved.[11]

CAUSATION OF TMD

The causes of TMD range from traumatic injury to immune-mediated systemic disease to neoplastic growths to incompletely understood neurobiologic mechanisms.[12,13] The medical cause of most instances of TMD is not established.[7,14] Less common but better recognized causes of TMD are (1) a wide range of direct injuries, such as fractures of the mandibular condyle, (2) systemic diseases, such as immune-mediated arthritis, (3) growth disturbances, and (4) tumors.

Some nonfunctional movements of the mandible (bruxing) and tooth-clenching habits are clinically associated with a variety of jaw muscle symptoms and are associated less clearly with internal joint disk derangements.[7] Chronic parafunctional clenching is suspected of association with chronic TMD and has been shown experimentally to cause acute TMD in human beings.[15] However, these behaviors are not established as causes of TMD and may be propagating factors only.

Malocclusion is not established as an important factor in TMD.[16-18] There is no compelling evidence that orthodontic treatment increases or decreases the chances of developing TMD, nor is there any evidence of increased risk for TMD related to any particular type of orthodontic mechanics or to orthodontic treatments with tooth extractions.[19,20]

Claims that TMD is caused by health care manipulations—eg, holding the mouth open wide, prolonging wide opening of the mouth, stretching or forcing the mouth open, and forcing the jaws shut—relate to routine dental examination, oral endotracheal intubation for general anesthesia, and the entire range of dental services, from restorative and orthodontic treatments to tooth extraction to orthognathic surgery. There is no scientific evidence that common or routine dental or medical procedures cause TMD.

Orthognathic surgery, orthodontic treatment, prosthodontic rehabilitation, and mandibular fracture repairs have been associated with morphologic TMJ changes and worsening of preexisting TMD.[21-24] Changes of the mandibular condyle range from remodeling to resorption, are probably associated with biomechanical loading and altered jaw position and mechanics, and are related to the inherent adaptive capacity of the TMJ.[23] Additional factors may be compressive forces associated with surgery and with bone fixation methods; there are soft tissue factors as well. Clearly defined parameters of skeletal deformity, surgical procedures, surgical methods, and underlying patient factors do not presently allow reliable prediction or prevention of morphologic TMJ changes associated with orthognathic, orthodontic, or prosthodontic treatments.

Research has suggested that in most cases TMD may be a manifestation of chronic pain, with pain and chronic pain recognized as disorders.[25] Contemporary understanding of chronic pain characterizes chronic TMD as a psychophysiologic disorder of the central nervous system that modulates emotional, physiologic, and neuroendocrine responses to emotional and physical stressors.[26,27] Disorders of central pain regulatory systems have been demonstrated in patients with TMD.[27,28]

Important biopsychosocial factors are implicated as causally related to TMD, as they are to muscle tension headache, chronic low back pain, and the most anatomically widespread chronic pain condition, fibromyalgia (FM).[29-31] There is a recognized overlap of musculoskeletal TMD symptoms in FM cases[30-32]; however, the concept of TMD as a regional manifestation of FM is not proven. TMD is considered a disorder separate from FM, patients with FM being more functionally disabled and more distressed than patients with TMD; however, many patients with FM have TMD.[33]

We do not adequately understand the factors relating to which individuals will develop chronic TMD, nor do we presently know how to reliably identify risks for the development of chronic TMD. A variety of physical and psychologic factors are implicated in chronicity, such as oral habits, radiographic changes, secondary gain, coping skills, and higher levels of pain and disability on specific psychologic tests.[34]

There are no scientifically established anatomical risk factors for developing TMD. Anatomical variations in TMJ structure, jaw relationships, and dental relationships are wide, and dentitions are altered by orthodontic treatments; none of this predisposes a person to TMD.[16,17,35,36] The clinically observed common relationship between TMD and parafunctional jaw/tooth habits does not reliably predispose to TMD; parafunctional jaw habits do, however, seem to propagate TMD symptoms already established and may be associated with TMD as a component of the disorder(s) rather than as an external factor.[37] A wide range of associated factors, including depression, anxiety, and gum chewing, may propagate TMD symptoms on the basis of physical, emotional, and/or neurobiologic factors. Pain, muscle tension headache, and chronic pain in the head, neck, and jaws may predispose to TMD via neuroanatomical and neurobiologic mechanisms.[26-28,38,39]

DIAGNOSIS OF TMD

The gold standard of diagnosis in TMD consists of (1) patient history, (2) physical evaluation, and, in most

chronic cases, (3) behavioral or psychologic assessment.[7,10,11,40-43] This evaluation should include a detailed pain and jaw function history as well as objective measurements of such jaw functions as interincisal opening, opening pattern, and range of eccentric jaw motions. TMJ sounds should be described and related to symptoms. Techniques for muscle evaluation should also include control (sham or placebo) site evaluation.[44-45] Psychosocial and behavioral factors are important, as are physical alterations; the former relate specifically to our current understanding of pain.[10,40,46,47] Because dentists' recognition of psychologic factors is inaccurate,[47] use of a valid screening instrument or referral to an appropriate professional may help in formulating a complete diagnosis.[47] A "dual diagnostic" approach, detailing physical findings in muscle, joint, and disk as well as behavioral and psychosocial findings, is the present science-based standard of care in the diagnosis of TMD.[10,40,43]

The panoramic radiograph is the standard screening radiograph for bony jaw structure in TMD, and more advanced techniques may be indicated on the basis of the panoramic film or the clinical factors.[48] The use of tomography or computed tomography and magnetic resonance imaging are current standards for hard and soft tissue TMJ imaging, respectively.[48,49] Dental radiographs, cephalometric radiographs, and cervical spine films are usually not useful for the diagnosis of TMD.

Dental study models may be an aid in diagnosing TMD[50]; however, occlusal analysis is unlikely to be helpful. Electronic devices such as surface electromyography, jaw tracking (mandibular kinesiography), ultrasound, and thermography have little or no scientific validity in TMD clinical diagnosis,[51-55] as these techniques are unable to distinguish reliably between normal and abnormal or between treated and untreated patients.[56]

NATURAL HISTORY OF TMD

Growing understanding of the natural history of TMD and some of the physical changes associated with TMD and TMJ disorders has played an important role in the treatment and management of TMD and in assessment of prognosis. Many of the signs and symptoms of TMD are present and detected in significant portions of the normal nonpatient population; for example, approximately 33% of humans have a TMJ click without pain or significant dysfunction.[57-60] This suggests that a TMJ click may be a normal variant rather than a disorder.[58] Altered condylar morphology in the TMJ and disk displacement appear to be strongly related but may occur independently,[61] and degenerative joint disease (DJD) related to systemic causes is usually distinguished from DJD related to mechanical disk derangements. Current research indicates that biochemical mechanisms and biomechanical adaptive mechanisms play a major role in the natural course of DJD, a self-limiting and nonprogressive course usually being expected in the absence of systemic disease and/or iatrogenesis. Morphologic change does not indicate a poor prognosis and may be considered physiologic adaption.

Most instances of TMD involve masticatory muscle pains that vary in location and intensity with time; the majority of these resolve without intervention.[61] Most of these cases of TMD are found in people ranging in age from puberty to middle age. Masticatory muscle pain TMD does not appear to progress in severity with age,[61] and facial pain is less prevalent in older persons than younger persons, thus distinguishing TMD from many other chronic diseases associated with increasing age. The present state of knowledge indicates that in general, patients with TMD would be expected to improve in time without intervention. The natural course of internal TMJ derangements has been shown to generally develop favorably without treatment.[62,63] Most patients with anterior disk displacement without reduction are expected to experience resolution of clinical signs and symptoms progressively with time.[64-66]

Associations between TMD and other disorders such as headache and neck pain are well established, and the fact that the severity of these other problems can be modified after TMD treatment suggests that TMD may represent a more general health problem.[67] Additionally, most TMJ articular disorders follow a natural course independent of the treatment.[62,63] This correlates with the present standard of care for most cases of TMD and DJD: (1) reversible therapy that facilitates natural musculoskeletal healing and symptom improvement and (2) avoidance of irreversible treatments.

TMD occurs predominantly in women, who display higher levels of all physical and psychologic symptoms than do men with TMD.[68] These observations coincide with gender studies of pain patients that show women to be more likely than men to experience recurrent pains, severe pain, frequent pain, and longer-lasting pain.[69] Women may be more likely than men to be disabled by pain, and women may respond better to management.[69] Biologic, psychologic, and social factors may all relate to the significant gender differences seen in patients with TMD and in pain patients in general. Women may also be more vulnerable than men to unwarranted psychogenic attributions by health care practitioners,[69] indicating the need for objectivity and sensitivity in assessing TMD patients.

MANAGEMENT AND TREATMENT OF TMD

All therapies require accurate diagnoses, and every treatment plan must be based on the individual patient's needs, with appropriate expectations of results for the

specific therapy. The current standard of care for common chronic nonstructural TMD is management with multidisciplinary cognitive behavioral therapy and muscle relaxation measures.[70-73] Dentistry plays a cooperative, coordinating, and supportive role in managing these patients. Educating and advising the patient is paramount because of the recognition that most instances of TMD are not oral or tooth-related disorders. Treatment of a TMJ sound is not indicated unless pain and/or dysfunction requires treatment[7]; treatments are primarily aimed at pain and/or dysfunction.

The most common dental treatment in TMD is a splint or interocclusal orthosis, an intraoral device that is designed to fit over either the maxillary or the mandibular teeth and provide an artificial occlusal surface.[7] The current standard of care recognizes that a dental splint should not permanently alter tooth or jaw position.[74,75] The dental literature has documented harmful splint effects.[75] Patients generally perceive a splint to be at least partially effective in symptomatic improvement; however, a scientific basis for the efficacy of dental splints is lacking.[76,77] It is reasonable to consider an oral splint to be an adjunct for pain management—a "healing aid" rather than a definitive treatment.[77] Appropriate uses for splints in TMD may involve protecting teeth from habit-related wear, temporarily altering proprioception, and even aiding in behavioral management on a clinical basis; however, the standard of care requires a device that at the least is not harmful and causes no physical changes.

Because malocclusion is not established as an important factor in TMD, treatments such as occlusal adjustments, orthodontics, dental restorations, and TMJ or jaw surgery that alter the bite or teeth are inappropriate in the initial management of TMD.[78,79] The clinically based literature has provided a framework for the possible relevance of occlusal factors and treatments in TMD that are neither proven nor well accepted in the science-based literature.[80] Acute malocclusions with TMD are indications for proper diagnosis and management of the muscle or TMJ alteration and recognition of the expected natural course for the TMD. Acute symptoms related to new restorations usually reflect a parafunctional impulse that responds to adjustment of the restoration. The present science-based standard of care for the management of TMD would not include initial irreversible treatment of nonacute malocclusion by any means.[78]

Physical therapies for TMD are commonly used in dental practice. There is little evidence that any specific therapy can cause long-lasting reductions in signs or symptoms of TMD.[81,82] The present state of knowledge indicates that during the time they are treated, patients with TMD are helped with most forms of physical therapy and that patients receiving multiple forms of physical therapy may do better than patients with single therapies.[81,82] The use of biobehavioral muscle relaxation techniques assisted by electromyographic biofeedback has been demonstrated to be useful in treating chronic musculoskeletal pain; it may be useful in TMD.[54,70]

There are no generally recognized surgical protocols for TMD[83,84]; therefore, any surgery on the TMJ should be the least invasive procedure associated with an expectation of benefit on the basis of the patient's condition. Indications for TMJ surgery are relative, and reasonable guidelines[84-87] such as the following should be considered as prerequisites to TMJ surgery:

1. The TMJ is the source of pain and/or dysfunction that results in a significant impairment to the patient.
2. Appropriate nonsurgical management was unsuccessful.
3. The pain is securely localized to the TMJ; this includes pain on TMJ loading and TMJ movement.
4. Interferences with proper TMJ function are mechanical.
5. The patient requests surgical treatment.
6. There are no medical or psychologic contraindications to surgery.

TMJ surgery should be reserved for clearly diagnosed conditions known to be amenable to surgical improvement. TMJ surgery is not indicated for TMD pain, especially given our current understanding of the multifactorial nature of pain and the well-documented experience with surgically induced iatrogenic pain complications.[88] Morphologic change alone is not an indication for surgery.

Arthroscopic surgery and TMJ irrigation procedures may be helpful in some cases with internal joint disk mobility and dysfunction disorders,[89-91] but the benefit of these procedures with respect to pain is not established. The injection of corticosteroids into the TMJ may be useful in rheumatoid arthritis cases, and injecting hyaluronic acid may be beneficial both in rheumatoid arthritis and in painful and dysfunctional displaced disks that reduce.[90,92]

There is no scientific basis for orthognathic (jaw repositioning) surgery for internal joint disorders or for jaw muscle or TMJ pain.[21] Orthognathic surgery should be considered on its own merits. TMJ arthrotomy procedures are infrequently indicated in TMD, usually being reserved for significant structural joint abnormalities. The small but important population of multiply operated patients with TMD serves to reinforce a cautious approach to TMJ surgery and the use of grafted or alloplastic materials in the TMJ. (The status of alloplastic TMJ treatments is beyond the scope of this review.)

Growing evidence and awareness of the biopsychosocial nature of most instances of TMD support the important standards of noninvasive and reversible treatments and modalities of management.[93] Multidisciplinary chronic pain management emphasizing a biobehavioral approach is the most commonly indicated standard of care for the management of TMD.[70-72,94]

PROGNOSIS

In general, patients with TMD improve in time without intervention. Predictors of outcome for treatments of TMD are behavioral, psychologic, and psychosocial factors rather than physical or structural factors.[95,96] Long-term outcomes in pain may be independent of clinical signs, and improvement in pain may correlate with improvement in psychologic status.[97] Assessing a prognosis for TMD cases therefore requires a behavioral or psychologic assessment and multifactorial diagnosis according to the current standard of care for diagnosis. Predictors of poor outcome relate to depression, somatization, anxiety, and low self-esteem.[94,95]

PREVENTION OF TMD

There are no scientifically based methods, treatments, or measures known to prevent TMD.[78]

SUMMARY

Recent evidence has suggested that in most cases TMD may be a manifestation of chronic pain. The medical cause of TMD in the majority of instances is not established. Chronic parafunctional clenching is associated with chronic TMD; however, this may be merely a propagating factor. There is no scientific evidence that common or routine intraoral dental or medical office procedures cause TMD.

Malocclusion is not an important factor in TMD, and there is no compelling evidence that orthodontic treatment causes or worsens TMD. TMJ changes are usually self-limiting and nonprogressive in the absence of systemic disease. In general, patients with TMD are expected to improve in time without intervention. The natural course of internal TMJ derangements has generally been shown to develop favorably without treatment.

The current standard of care for common chronic nonstructural TMD recognizes the biopsychosocial nature of most instances of TMD, multidisciplinary chronic pain management emphasizing cognitive behavioral therapy and muscle relaxation measures. Oral splints may be considered as an adjunct for pain management rather than a definitive treatment. The present science-based standard of care for the management of TMD would not include initial irreversible treatment of the occlusion by any means. There are no generally recognized surgical protocols for TMD, and TMJ or orthognathic (jaw repositioning) surgery is not indicated for chronic TMD pain.

The TMD literature is voluminous, controversial, and limited regarding current standards of scientific research. Many recent advances have not been published in the scientific dental literature, which impedes a science-based clinical perspective. Additional well-designed research is necessary, and results must be communicated to clinical practitioners.

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