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Temporomandibular disorders: A review

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Abstract
Temporomandibular disorders (TMDs) are a collective term that embraces a number of clinical conditions that involve the masticatory musculature and/or temporomandibular (TM) joints and associated structures.
Temporomandibular disorders (TMD) are examined from a biopsychosocial or illness perspective. It is considered that TMD share features with many common chronic pain conditions. Functional disturbances of the masticatory system can be as complicated as the system itself. Although numerous treatments have been advocated, the complex nature of TMD requires a multidisciplinary team.

Keywords: TMD, TMJ, joint, pain, disorder, management

Introduction

The Temporomandibular Joint (TMJ), one of the most complex; delicate and highly used joints in a human body; articulates to mandible with the cranium by means of muscles, ligaments and tendons. The uniqueness in the structural and functional components of the TMJ in association with the muscles of mastication and ligaments makes it more vulnerable to get afflicted by derangements or disorders [1].

Temporomandibular disorders (TMDs) are a collective term that embraces a number of clinical conditions that involve the masticatory musculature and/or temporomandibular (TM) joints and associated structures. They are considered a sub classification of musculoskeletal disorders [2]. TMDs are seen most commonly in people between the ages of 20 and 40 years, and occur more often in women than in men [3].

Temporomandibular disorders (TMD) are examined from a biopsychosocial or illness perspective. It is considered that TMD share features with many common chronic pain conditions. Functional disturbances of the masticatory system can be as complicated as the system itself. Although numerous treatments have been advocated, the complex nature of TMD requires a multidisciplinary team. The management goals for the Prosthodontist as a member of a TMD team are patient comfort, occlusal stability & the complex restoration of the teeth [2].

Historical Insight into Temporomandibular Disorders

Knowledge about TMD has grown throughout the ages. In general, treatment philosophies have moved from a mechanistic dental approach to a biopsychosocial medical model with the integration of neuroscience literature [4].

Table 1: The evolutionary history is presented below

500 B.C.	Historians explain that the management of temporomandibular disorders (TMD) began with the ancient Egyptians manually treating jaw dislocations [5].
Early 1800's	Beneficial occlusal appliance therapy and TMJ disc-recapturing surgery were reported [4, 5].
Late 1800's	Annandale received credit for the first surgical repositioning of an articular disc.
Early 1900's	Pringle being recognized as one of the first surgeons to perform a meniscectomy [5].
1926	With the formation of the Gnathological Society by McCollum, the role of occlusion rapidly gained in popularity [6].
1934	The dental profession generally was first drawn into the area of TM disorders (TMDs) by Costen's 1934 article. Costen was an otolaryngologist who, based on 11 cases, first suggested that changes in dental condition were responsible for various ear symptoms. Because of his work, the term Costen syndrome developed [1, 5, 6, 7, 8, 9]. Even though most, if not all, of Costen's hypotheses were refuted by Sicher and others, many dentists continued to embrace the concept that occlusal disharmonies were the primary cause of TMD [6].
1950's	The association between occlusion and TMD was beginning to be questioned by Schwartz and co-workers who emphasized the importance of the masticatory musculature and specifically emotional tension as a primary etiologic factor [8].
1951	Weinmann and Sicher gave the first classification scheme for TMJ problems [7].
1959	Shore introduced the term TMJ dysfunction syndrome [7, 8].
1969	Laskin and co-workers published their psychophysiological concept that. Stressed the roles of muscle spasm and fatigue produced by chronic oral habits and de-emphasized the mechanical role of occlusion in TMD [10]. Supporting the importance of the neuromuscular system, Jankelson developed clinical instrumentation, transcutaneous electric neural stimulation (TENS), in the form of a Myomonitor unit; to establish optimum neuromuscular jaw relationships as a basis for occlusal and TMD treatment [10, 11].

Late 1970's	Using arthrography, Farrar and McCarty challenged the neuromuscular concepts and refocused on internal derangements as the primary cause of TMD signs and symptoms.
1982	Understanding the critical need for definitive guidelines, the American Dental Association (ADA) held an important conference on the examination, diagnoses, and management of TMD. The conference stressed the importance of an improved classification system that would permit proper comparison of epidemiologic, diagnostic, and treatment data [10]. Bell suggested the term TM disorders, which has gained popularity [1, 4, 10, 7, 8].
1983	ADA adopted the term Temporomandibular Disorders (TMD).
1986	As interest in TMD grew, the first issue of the Journal of Orofacial Pain (formerly the Journal of Craniomandibular Disorders: Facial and Oral Pain) was published [10].
1990	The American Academy of Orofacial Pain (AAOP) established the first well defined diagnostic classification for TMD, which was revised in 1993 [9, 10].
1992	The original research diagnostic criteria for Temporomandibular disorders (RDC/TMD) was published [9, 12].
1994	In order to establish credentials in head and neck region, the American Board of Orofacial Pain was established by an independent medical testing agency [10].
1996	The AAOP published an updated diagnostic classification [9].
2010	The latest revised version of RDC/TMD was published [12].
2015	(Dr. Bader's Classification) of edentulous patients according to TMJ changes based on clinical and radiological findings had been proposed. The classification will be a helpful tool for assessment as well as for planning treatment for edentulous patients [13].

TMJ Anatomy

The human masticatory system is a typical example of a kinematically and mechanically indeterminate system. Two segments, the mandible and the skull, are able to move with respect to each other. These movements are guided by two mutually linked temporomandibular joints [14].

In order to appreciate the function of this joint, it is necessary to describe its anatomy [15].

TMJ Anatomy

- The area where the mandible articulates with the temporal bone of the cranium is called the temporomandibular joint (TMJ), certainly one of the most complex joints in the body [1, 4].
- The TMJ is a compound, ginglymoarthrodial joint. The TMJ is formed by the mandibular condyle and the mandibular fossa of the temporal bone, into which it fits. The articular disc separates these two bones from direct articulation. Disc made of fibrocartilage instead of hyaline cartilage, the feature that differentiate and make the TMJ a unique joint, that acts as a cushion to absorb stress and allows the condyle to move easily when the mouth opens and closes [3, 6].

Temporomandibular Ligaments Complex

The TMJ is supported by three major-Collateral, Capsular and Temporomandibular and two minor Sphenomandibular and Stylomandibular ligaments [1, 9].

Biomechanics of Temporomandibular Joint

It is generally accepted that the joint acts like a third-class lever and is therefore loaded under compression, it is also recognized that such stresses can lead to degenerative changes within the articular structures and the question of how much loading should be considered 'normal' remains unanswered.

- Biotensegrity is a structural design principle that describes a relationship between every part of the organism and the mechanical system that integrates them into a complete functional unit. It looks at the whole picture first and then examines each part in context, where the human body is the complete functional unit, and evolution and developmental processes have ensured that each 'part' is integrated into that whole.
- "The biotensegrity model considers the temporomandibular joint from this perspective, where the mandible is suspended within a tensioned network that extends over a much wider anatomical field than is generally recognized and significant motion control is contained within the structure itself."

It is an evolutionarily-conserved arrangement that enables the system to rapidly respond to changing functional demands and provides a more complete model of mandibular physiology that can be used to guide further research [16, 17].

Classification

In 2010, the latest revised version of RDC/TMD was published [1, 12].

The RDC (Research Diagnostic Criteria) was developed by an international project team using the concept of a dual-axis classification system.

- The first axis includes the physical diagnoses of myofascial pain, disk displacement, and the arthritides, and
- The second axis includes assessment of pain-related disabilities and psychological status.
- The classification used for diagnosing TMDs is summarized below: [1, 2, 7, 18].

i) Masticatory muscle disorders

A. Protective co-contraction (11.8.4)*
B. Local muscle soreness (11.8.4)
C. Myofascial pain (11.8.1)
D. Myospasm (11.8.3)
E. Centrally mediated myalgia (11.8.2)

ii) Temporomandibular joint (TMJ) disorders

A. Derangement of the condyle-disc complex
   1. Disc displacements (11.7.2.1)
   2. Disc dislocation with reduction (11.7.2.1)
   3. Disc dislocation without reduction (11.7.2.2)
B. Structural incompatibility of the articular surfaces
   1. Deviation in form (11.7.1)
      a. Disc
      b. Condyle
      c. Fossa

2. Adhesions (11.7.7.1)
   a. Disc to condyle
   b. Disc to fossa
3. Subluxation (hypermobility) (11.7.3)
4. Spontaneous dislocation (11.7.3)

C. Inflammatory disorders of the TMJ
1. Synovitis/capsulitis (11.7.4.1)
2. Retrodiscitis (11.7.4.1)
3. Arthritides (11.7.6)
   a. Osteoarthritis (11.7.5)
   b. Osteoarthrosis (11.7.5)
   c. Polyarthritides (11.7.4.2)
4. Inflammatory disorders of associated structures
   a. Temporal tendonitis
   b. Stylomandibular ligament inflammation

iii) Chronic mandibular hypermobility

A. Ankylosis (11.7.6)
1. Fibrous (11.7.6.1)
2. Bony (11.7.6.2)

B. Muscle contracture (11.8.5)
1. Myostatic
2. Myofibrosis

C. Coronoid impedance

IV. Growth disorders

A. Congenital and developmental bone disorders
1. Agenesis (11.7.1.1)
2. Hypoplasia (11.7.1.2)
3. Hyperplasia (11.7.1.3)
4. Neoplasia (11.7.1.4)

B. Congenital and developmental muscle disorders
1. Hypotrophy
2. Hypertrophy (11.8.6)
3. Neoplasia (11.8.7)

Etiology

The etiology of TMD is complex and multifactorial. There are numerous factors that can contribute to this disorder, which are grouped into three categories: [1, 2, 9, 19, 20, 21].

1. **Predisposing factor:** Factors occurring naturally during the lifetime of an individual; increase the risk of developing TMD.
   a. Anatomic factors: structural deformities, morphologic malocclusions
   b. Pathophysiologic conditions: pathology of the joints, changes in the masticatory muscles.
   c. Genetic factors
   d. Psychological and behavioral factors
2. **Initiating factors/Precipitating factors:** Cause the onset of the disease.
   It includes microtrauma and macrotrauma.
3. **Perpetuating factors:** Interfere with the healing process or enhance the progression of TMD. It includes behavioural factors, social factors, emotional factors, cognitive factors.

Signs and Symptoms of Temporomandibular Disorders

Signs and symptoms of temporomandibular disorders (TMDs) may include pain, impaired jaw function, malocclusion, deviation or deflection, limited range of motion, joint noise, and locking. Headache, tinnitus, visual changes, and other neurologic complaints may also accompany TMDs. Because of many etiologic factors, the diagnosis and treatment of patients with TMDs is complex.

History and Examination

The patient history is the foundation and a prerequisite for the diagnosis and treatment of functional disturbances. Together with the examination findings, it is used primarily in attempting to identify all regions of the masticatory system that have undergone structural damage [1, 4].

Features to be included in the history: [1, 2, 18, 22, 23, 24].

1. The chief complaint
   a. Location of pain
   b. Onset of pain
   c. Characteristics of pain
   d. Aggravating and alleviating factor
   e. Past consultations and/or treatments
   f. Relationship to other pain complaints
2. Past medical history
3. Review of systems
4. Psychological assessment

Examination

Physical Examination [1, 2, 18, 23, 24]

The physical examination includes a neurologic screening; general inspection of ears, nose, and oropharynx; TMJ; palpation of masticatory and cervical muscles; cervical spine evaluation (posture and range of motion); and a detailed intraoral evaluation.

Radiographic Examination [1, 4, 24].

Rationale for Imaging: Diagnostic imaging, when indicated, is an important part of the examination process for TMD and orofacial pain patients. Imaging may be used to confirm suspected disease, rule-out disease, and gather additional information when the clinical diagnosis is equivocal or unclear.

Imaging Modalities

1. **Two-dimensional**
   - Conventional tomography.
   - Transcranial, transmaxillary, transpharyngeal projections.
   - Submentovertex projection.
   - Posteroanterior and lateral cephalometric projections.
   - Panoramic radiography: open and closed views.
2. **Three-dimensional**
   - Multislice computed tomography (MSCT)
   - Cone beam computed tomography (CBCT)
   - Magnetic resonance imaging (MRI)

Indications for diagnostic imaging of the TMJ are trauma, **c**hanges in occlusion, limitation of opening/closed lock, presence of reciprocal click, crepitus, systemic diseases, swelling/infection and failure of conservative treatment.

Biophysiologic Measurement Technologies

There are four bio-physiologic measurement technologies that can be applied in both the diagnosis, and the treatment monitoring procedures that involve dysfunctional masticatory conditions:

- Surface Electromyography (sEMG).
- Magnet-based Electroglottography (3-Dimensional Mandibular Tracking).

- Temporomandibular Joint Vibration Analysis (JVA), and
- T-Scan Computerized Occlusal Analysis.

Technology for diagnosis and treatment monitoring is routinely used in everyday medicine, yet unfortunately, the digital approach to diagnosis and treatment planning seems to have faced significantly more resistance within the dental community.

Management of Temporomandibular Disorders [18]

There is no 'gold standard' approach to treating temporomandibular disorders (TMD) and treatment strategies vary from lifestyle changes, physiotherapy and simple pain relief, through to the provision of specially made splints, the use of specific medications, adjustments to the occlusion, complementary therapies and occasionally even surgery [25].

Management Protocol

In managing/treating the TMD patient, the primary goals are to

1. Achieve normal jaw function.
2. Reduce or eliminate pain.
3. Encourage a return to normal activities of daily living.
4. Reduce long-term health care use [18, 19].

Other important goals are to

5. Improve the patients' understanding of the complaint.
6. Improve the patients' management of the complaint.
7. Eliminate unhelpful thinking about the complaint.
8. Increase the patients' confidence in his or her ability to function and cope.
9. Reduce or eliminate powerful medications [19].

Many therapies have been advocated for treating TMD, and many health professionals have found that they are able to help patients improve TMD symptoms. The practitioner managing the patient's therapy should decide which therapies are most cost-effective and evidence-based, and which have the greatest potential to provide the patient with long-term symptom relief. The most cost-effective therapies are the TMD self-management therapies, specifically when use is continuous and adhered to [26].

All the treatment methods being used for TMDs can be categorized generally into one of two types: definitive treatment or supportive therapy.

Definitive Treatment [1, 2, 4]

Definitive therapy is aimed directly at eliminating or altering the etiologic factors responsible for the disorder. An improper diagnosis will lead to improper treatment selection.

The definitive treatments for each etiologic consideration are given below

Definitive therapy considerations for

1. **Occlusal factors:** Reversible and irreversible occlusal therapy.
2. **Emotional stress:** Relaxation therapy.
3. **Trauma:** soft occlusal appliance or mouth guard.
4. **Deep pain input:** Once its etiology is resolved, the TMD will also resolve.
5. **Parafunctional activity:** education, relaxation, biofeedback techniques, and occlusal alterations

Supportive Therapy [1, 2, 4]

Pain is often the chief complaint that brings the patient to the dental office. Much of the supportive therapy used to treat TM disorders therefore is directed towards reducing or eliminating pain. Supportive therapy for pain consists of two types.

1. Pharmacologic Therapy such as use of analgesics, tranquilizing agents, local anaesthetics, anti-inflammatory agents and muscle relaxants.
2. Physical Therapy which includes Thermotherapy, Coolant therapy, Massage therapy, Electrical stimulation therapy, Relaxation therapy.

It is important that patient is referred to correct specialist. It is not necessary that the patient should be referred to oral surgery. Even when the referral has been made, the prosthodontist has an important role and should remain in contact with the patient throughout treatment to ensure progress and satisfaction of the treatment.

Referrals are done for Orthodontic treatment, Operative treatment, Neurology, ENT, Psychiatric treatment, Oral Surgery.

Surgical treatment

Overall percentage of the patients requiring surgery is approximately 2-3% of all TMD cases. The patients are referred for surgery treatment after the initial conservative treatment has failed. Surgery is performed only on the bases of clinical diagnosis and supportive radiographic imaging.

Conclusion

The temporomandibular joint disorders which has been challenging the diagnostic ability of the best of clinician since Costen in 1934, continues to do so today, even with the current advances in bio medical research and technology. Perhaps the most important reason to this is that the temporomandibular disorders are multifactorial in origin. There is no single contributory factor leading to a particular temporomandibular disorder. It is the inter play of wide variety of etiologic agent which combines together to bring about any temporomandibular disorders.

Treatment of any condition involves an accurate diagnosi which in turn entails finding the exact etiology. Before any treatment plan is begun, ample evidence must exist that treatment will benefit the patient.

A systematic interdisciplinary approach is required in patients with severe temporomandibular disorders and orofacial pain syndromes.

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