CASE REPORT

Diagnostic tests for temporomandibular disorders

Prafulla Thumati

Department of Prosthodontics, Dayananda Sagar Dental College and Hospital, Bengaluru, Karnataka, India

Abstract

Etiology and treatment of temporomandibular disorders (TMDs) have two schools of thought; one depends on the Axis I (physical/functional) and the other is on Axis II (biopsychosocial) as per the research diagnostic criteria for TMDs. TMDs are a group of musculoskeletal disorders affecting the structure and/or function of the temporomandibular joints (TMJ), masticatory muscles, dentition, and supporting structures.

The initial TMD diagnosis is based on history, clinical examination and imaging, if indicated. Diagnosis is greatly enhanced with physiologic measurement devices providing objective measurements of the functional status of the masticatory system: TMJ's, muscles, and dental occlusion. Dental occlusion may have a significant role in TMD. Therefore, the majority of dentists treating TMD believe occlusion plays a major role.

Initially, reversible TMD treatment leading to healthy masticatory muscle function and a stable occlusion is most often successful. This is accomplished using objective measurement technologies such as T-scan (digital analysis of occlusion), electromyography (EMG), joint tracker, and ultra low frequency Transcutaneous Electrical Nerve Stimulation (TENS). Literature substantiates the scientific validity of the physical/functional basis of TMD, the efficacy of measurement devices and TENS. A scientific basis for TMD diagnosis and treatment is presented to help the clinician to diagnose the situation before planning any treatment.

Keywords

Disclusion time, disclusion time reduction, immediate complete anterior guidance, development enameloplasty, myofascial pain, T-scan/BioEMG III

Correspondence

Prafulla Thumati, #296, Orofacial Pain Center, Katriguppa Main Road, Banashankari 3rd Stage, Rajiv Gandhi University of Health Sciences, Bengaluru - 560 085, Karnataka, India. Phone: +91-9845203217. E-mail: thumatiprafulla@gmail.com

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Introduction

Dr. Bernard Jankelson’s study of the human dental occlusion were precursors to the neuromuscular occlusion published in 1955[1] lead to the recognition of the scientific methods to quantify the function of the masticatory system. Gadgets like digital analysis of occlusion using T-scan, electromyography (EMG), joint vibratography (JVA), and joint tracker (JT) to measure the function of the masticatory system-dental occlusion, temporomandibular joints (TMJ) and muscles were subsequently invented.[2] These biometric diagnostic tools help in the practice and management of painful conditions related to temporomandibular disorders (TMDs).

Oral physicians believe in and recognize that TMDs have a physical or physiological basis with malocclusion as a major etiologic agent. They utilize the biometric data from these biometric gadgets and employ occlusal therapies as primary modality to improve muscle and joint function.

Technologies used

In the past few decades, computerized biometric measurement devices have been developed to record and analyze with high degrees of precision; digital analysis of occlusion (T-scan), masticatory muscle function (EMG), mandibular movements (JT), TMJ joint sounds (JVA), and also ultralow frequency transcutaneous electrical nerve stimulation (TENS).

The T-scan [Figure 1] system is a valuable tool that aids in analyzing a patient’s bite. When a bite is unstable, it can cause pain, teeth, and dental restorations to crack and break, gum disease, tooth loss, headaches, and TMJ disorders.[3-5]

The T-scan software offers features that allow the user to: Scan the patient’s occlusal contact data. View the patient’s tooth contacts and associate them with specific teeth. Analyze the data, with force and time relationships of contacts displayed as color contour images. Manage patient records and scan files through the use of an intuitive database.
Surface EMG, [Figure 1] is a modality used to evaluate muscle function. Scientific literature published in the last 5 decades proves that elevated muscle activity while resting and weak or asymmetrical functional muscle activity is seen in TMD patients. EMG measures masticatory muscles activity in rest and function. This measured activity helps in finding the mandibular rest position as a point for the selection of the neuromuscular occlusion. Evidence-based literature has substantiated the reliability and reproducibility of surface EMG for evaluating the status of the masticatory muscles. The combined data of surface EMG of masticatory muscles and the jaw tracking is a useful and objective method for quantifying the physical components of TMDs treatment.

JT [Figure 1] measures and records mandibular range of motion, direction, velocity, fluidity of jaw movements, and rest position of the mandible. JVA [Figure 1] records TMJ sounds, their amplitude and frequencies produced by mandibular movements during mouth opening and closing with good accuracy than the other methods of diagnosing TMJ. This technology is precise objective measurement instrument which helps the clinician in diagnosis. These biometric devices have been reviewed by the US FDA in 1997 and 1998 and the American Dental Association (ADA) Council on Scientific Affairs in 1986 and 1993. They have been recognized as safe and effective in the diagnosis and treatment of patients with TMDs.

As per the ADA’s Council on Scientific Affairs surface EMG is used to assess the status of the muscles of mastication. It enables the clinician to assess the resting, functional and postural hypertonicity muscles of mastication. There is considerable agreement among both clinicians and researchers that masticatory muscle activity is increased in symptomatic patients compared to normal subjects, and EMG is one tool that can be used to study such differences.

These devices, T-scan for digital analysis of occlusion, computerized jaw tracking, EMG, and JVA provide objective documentation of the pre-treatment status of patients with regard to mandibular and masticatory function and permit evaluation of treatment outcomes.

Together with these measurement devices, TENS [Figure 1] is a therapeutic device used for relaxation of masticatory and mandibular postural muscles. This is achieved by use of low frequency, low current stimulation of the mandibular division of the trigeminal nerve (cranial nerve V [CN V]) and a branch of the facial nerve (CN VII). TENS is used during treatment to achieve rest position of the mandible and neuromuscular occlusal position.

Case Report

A male patient aged 38 years presented with a 5 years history of difficulty in biting, grinding of teeth, severe headaches, pain anterior to her ears, and frequent tiredness and tenderness in his temples. Three previous dentists have treated him with occlusal splints that he discontinued, as appliance therapy did not noticeably reduce his symptoms. However, continues to use night guard for the fear of breaking teeth.

The patient underwent a TMJ health examination using joint vibration analysis [Figures 1-3]. The assessment determined the patient had no internal derangements of significance but did present with frictional forces in MIP during Multibite, prolonged left excursive disclusion time (DT) of 2.28 s, and prolonged right excursive DT of 2.45 s [Figures 4-6]. These are outside of the known physiologic ranges (physiologic OT ≤0.2 s; DT <0.4 s). Of note is that the time to muscle shut down of the working temporalis muscles in Figures 5 and 6 ranges between 2 and 3 s, which is far too long to be physiologic. This prolonged muscle firing is a major contributor to the Occluso-muscular symptoms the patient experiences.
The patient was explained that his DTs were too long, causing excursive muscle hyperactivity detected in the EMG data [Figures 5 and 6 to the right of line C], which caused his muscular symptoms. He was further explained that his muscular pains could be minimized or eliminated if he elected to have his DTs reduced.

After obtaining patient consent, the immediate complete anterior guidance development enameloplasty (ICAGD) enameloplasty was performed on his right and left excursive movements as previously described,[30] to remove the prolonged occlusal surface friction and reduce the DTs to within physiologic durations. Post ICAGD, the JVA frequency spectra [Figure 3] analysis showed normalization of amplitude and frequency of left and right joint. Furthermore, the corrected OT was 0.15 s [Figure 4], the left excursive DT was 0.13 s [Figure 5], and the right excursive DT was 0.45 s [Figure 6] immediately after the first correction on day 1. When comparing the pretreatment excursive EMG hyperactivity [Figures 5 and 6] with the post ICAGD excursive EMG data in Figures 5 and 6, the excursive hyperactivity in both treated excursions was markedly lessened following ICAGD [Figures 5 and 6 to the right of line C]. In addition, the time to muscle shut down[10] of both working temporalis was drastically shortened from the ICAGD corrections. This is the reason that ICAGD is effective in treating Occluso-muscle Disorder symptoms; ICAGD shortens the contraction times of the involved muscles, thereby allowing for ischemic and painful muscle fiber re-oxygenation and fiber healing.[10]

**Discussion**

The presented case illustrates that muscular TMD symptoms respond well to occlusal adjustment therapy that is guided by precise closure and excursive timing measurements. This patient’s response mirrors which has been reported in many published ICAGD studies and Clinical reports,[6-10,29,31] since the inception of the T-scan I technology in the mid 1980’s,[14,15] such that treating the myofascial pain dysfunction with ICAGD is not new. Lengthy DT has been shown in EMG studies to elevate excursive muscle activity levels, and that proper reduction of the DT to <0.4 s, can reduce the muscle hyperactivity and related myofascial pain symptoms.[8,9,29]

The beauty of this computer-guided treatment approach is that it lessens hyperactive muscles from within the central nervous system, by controlling the molar periodontal ligament (PDL) mechanoreceptors, which synapse directly with efferent motor fibers that contract the four masticatory muscles.[16] Prolonged excursive frictional contacts increase the total time PDL mechanoreceptors are compressed in excursive movements, where the PDL compression time is equal to the DT duration of that same excursion.[32] The more time the excursive interferences contact, the longer time the PDL are compressed, resulting in prolonged durations of masticatory muscle contractions.[6,8,29] By reducing the length

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Figure 2: Normal joint vibratography: Temporomandibular joints vibratography

Figure 3: Pre- and post-treatment fast Fourier transform spectra
of time, the posterior occlusal surfaces contact excursively, the volume and duration that PDL mechanoreceptors are reduced, thereby interrupting the PDL compression-to-muscle hypercontraction. Post ICAGD, the PDL no longer hyper functions the involved muscles into a painful ischemic state, allowing for re-oxxygenation and muscle fiber recovery, leading to symptom resolution without the patient wearing an appliance, undergoing TENS, taking pain, muscle relaxant, or anti-inflammatory medications, or requiring trigger point and/or Botox injections. Properly performed ICAGD is a
marked improvement in the treatment of myofascial pain dysfunction symptoms when compared to unmeasured occlusal equilibration involving centric relation manipulation,\(^1\,^6\,^7\) and to the many commonly employed symptomatic, non-occlusal therapies.

**Conclusion**

Successful treatment of TMDs using biometric devices such as T-scan, EMG, JT, JVA, and TENS helps in treatment which is diagnostically driven. This helps in the elimination of the cause of the disease and not just symptom relief. If the etiology is not successfully recognized and treated, the acute physical form of temporomandibular dysfunction may become a chronic pain condition. Symptom-oriented treatment can adversely affect the patient’s and lead to poor quality of life.

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**References**


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