CASE REPORT

Craniomandibular/Temporomandibular Disorder/Dysfunction Treatment: A Case Report

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ABSTRACT

The temporomandibular dysfunction (TMD) diagnosis is based on history, clinical examination, and imaging like cone beam computed tomography (CBCT) or magnetic resonance imaging (MRI). Now, it is accomplished using objective measurement technologies like T-scan (digital analysis of occlusion), joint vibratography (JVA), electromyography (EMG), joint tracker (JT), and ultralow frequency transcutaneous electrical nerve stimulation (TENS).

Clinical implications: A scientific method for TMD diagnosis and treatment is presented to help clinician to diagnose the situation before planning any treatment.

Keywords: Disclusion time, Disclusion time reduction, ICAGD—enameloplasty, T-Scan/BioEMG III/JVA/JT.

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INTRODUCTION

Dr Bernard Jankelson's study of the human dental occlusion¹ led to the recognition of the scientific methods to quantify the function of the masticatory system. It led to the development of gadgets like digital analysis of occlusion using T-scan, EMG, JVA, and JT to measure the function of the masticatory system—dental occlusion, temporomandibular joint (TMJ), and muscles—were subsequently invented.²

We the oral physicians have to believe in and recognize that craniomandibular or temporomandibular disorders have a physical or physiological basis with occlusion as a major etiologic factor. We utilize the biometric data from these biometric gadgets and employ occlusal and orthotic therapies as the 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), ultralow frequency TENS, MRI, and CBCT.

The T-scan (Fig. 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 disorder.^{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's records and scan files through the use of an intuitive database.

Surface EMG (Fig. 2) 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 while in function is seen in TMD patients.⁴ EMG measures masticatory muscles' activity in rest and function. This measured activity helps in finding the mandibular

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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.⁶ The combined data of surface EMG of masticatory muscles and the jaw tracking are a useful and objective method for quantifying the physical components of temporomandibular disorders treatment.^{7,8}

JVA (Fig. 3) records temporomandibular joint sounds, their amplitude, and frequencies produced by mandibular movements

Fig. 1: T-scan system

Fig. 2: Electromyography

Fig. 3: Joint vibratography

Fig. 4: Joint tracker

during mouth opening and closing with good accuracy than the other methods of diagnosing TMJ.⁹⁻¹² This technology is a precise objective measurement instrument which helps the clinician in diagnosis.

JT (Fig. 4) measures and records mandibular range of motion, direction, velocity, fluidity of jaw movements, and rest position of the mandible. Also CBCT and MRI imaging can be used to check the status of hard and soft tissues of the stomatognathic system.

These biometric devices have been reviewed by the US FDA in 1997 and 1998^{13,14} and the ADA Council on Scientific Affairs in 1986 and 1993.^{15,16} They have been recognized as safe and effective in the diagnosis and treatment of patients with temporomandibular disorders.

As per the ADA's Council on Scientific Affairs,^{17,18} surface EMG is used to assess the status of the muscles of mastication.¹⁹ It enables the clinician to assess the resting, functional, and postural hypertonicity muscles of mastication.^{20,21} 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 pretreatment status of patients with regard to mandibular and masticatory function and permit the evaluation of treatment outcomes.²¹⁻²⁷

Together with these measurement devices, TENS (Fig. 5) is a therapeutic device used for relaxation of masticatory and mandibular postural muscles. This is achieved by the 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 cranial nerve VII (CN VII).^{28,29} TENS is used during the treatment to achieve rest position of the mandible and neuromuscular occlusal position.³⁰⁻³²

CASE DESCRIPTION

A 23-year-old male patient visited the Orofacial Pain Clinic of RajaRajeswari Dental College and presented with a 2-year history of difficulty in biting, grinding of teeth, severe headaches, pain anterior to his ears, pain near occipital area, pain in the shoulder areas, frequent tiredness, and tenderness in his temples. Five previous dentists have treated him with occlusal splints that he discontinued, as appliance therapy did not noticeably reduce his symptoms. But he continues to use night guard, for protecting his teeth from the ill effects of grinding of teeth.

Fig. 5: Transcutaneous electrical nerve stimulation

The patient underwent a temporomandibular joint examination using joint vibration analysis (Fig. 3). The assessment determined that the patient had internal derangements of significance, Piper 5a on the left and 3b on the right (Fig. 6). Also, he presented with frictional forces in maximal intercuspal position (MIP) during multibite, prolonged left excursive disclusion time (DT) of 2.27 seconds, and prolonged right excursive DT of 2.25 seconds (Fig. 7A, 8A, and 9A). These are outside of the known physiologic ranges (physiologic occlusion time (OT) <0.2 seconds; DT < 0.5 seconds).^{9,15} Of note is that the time to muscle shut down¹⁴ of the working temporalis muscles in Figures 8A and 9A ranges between 2 and 3 seconds, which is far too long to be physiologic. This prolonged muscle firing is a major contributor to the occluso-muscular symptoms that the patient experiences.

The patient was explained that his DTs were too long, causing excursive muscle hyperactivity detected in the EMG data (Figs 8A and 9A 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 DT reduced (DTR).

After obtaining patient consent, the immediate complete anterior guidance development (ICAGD) enameloplasty was performed on his right and left excursive movements as previously described,⁶ to remove the prolonged occlusal surface friction and reduce the DTs within physiologic durations. Post ICAGD, the JVA frequency spectra analysis showed normalization of amplitude and frequency of the left and the right joint. Also, the corrected OT was <0.2 seconds (Figs 8B and 9B), the left excursive DT was 0.38 seconds (Fig. 8B), and the right excursive DT was 0.38 seconds (Fig. 9B) immediately after the first correction on day 1. When comparing the pretreatment excursive EMG hyperactivity (Figs 8A and 9A) with the post ICAGD excursive EMG data (Figs 8B and 9B), the excursive hyperactivity in both treated excursions was markedly lessened following ICAGD (Figs 8B and 9B to the right of line C). Additionally, the time to muscle shut down¹⁴ 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 reoxygenation and fiber healing.¹⁴

DISCUSSION

The case illustrates that muscular craniomandibular/TMD symptoms respond well to occlusal adjustment therapy that is guided by precise closure and excursive timing measurements. This patient's response mirrors that which has been reported in many published ICAGD studies and clinical reports,⁸⁻¹⁴ since the inception of the T-scan I technology in the mid-1980s,^{18,19} 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 seconds can reduce the muscle hyperactivity and related myofascial pain symptoms.^{9,12,13}

Figs 6A and B: Temporomandibular JVA

Figs 7A and B: Pretreatment multibite: High EMG amplitude in the three clenches due to hyperactive muscles. *Note:* Normalized amplitude of all clench EMG data and “better force curves in T-scan data”

Figs 8A and B: (A) Pretreatment: left lateral—time to muscle shut down (from C to the arrow; very long = 2.27 seconds); (B) Posttreatment: left lateral—time to muscle shut down after C shorter from ICAGD 0.38 seconds

Figs 9A and B: (A) Pretreatment: right lateral—time to muscle shut down after C very long = 2.25 seconds; (B) Posttreatment: right lateral—time to muscle shut down shorter after C = 0.38 seconds

The beauty of this computer-guided treatment approach is that it lessens hyperactive muscles within the central nervous system (CNS), by controlling the molar periodontal ligament (PDL) mechanoreceptors, which synapse directly with efferent motor fibers that contract the four masticatory muscles.²⁰ Prolonged excursive frictional contacts increase the total time of PDL mechanoreceptors that are compressed in excursive movements, where the PDL compression time is equal to the DT duration of that same excursion.⁷ The more time the excursive interferences contact, the longer time the PDLs are compressed, resulting in prolonged durations of masticatory muscle contractions.^{9,12,13} By reducing the length of time, the posterior occlusal surfaces contact excursively, and the volume and duration of PDL mechanoreceptors are reduced, thereby interrupting the PDL compression-to-muscle hypercontraction. Post ICAGD, the PDL no longer hyperfunctions the involved muscles into a painful ischemic state, allowing for reoxygenation 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,^{1,21} and to the many commonly employed symptomatic, non-occlusal therapies.

CONCLUSION

Successful treatment of temporomandibular disorders using biometric devices like T-scan, EMG, JT, JVA, and TENS helps in

the 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 and lead to poor quality of life.

REFERENCES

1. Jankelson B. Physiology of human dental occlusion. *J Am Dent Assoc* 1955;50:664–680. DOI: 10.14219/jada.archive.1955.0130.
2. Jankelson B, Swain C. Kinesioelectric instrumentation: a new technology. *J Am Dent Assoc* 1975;90(4):834–840. DOI: 10.14219/jada.archive.1975.0164.
3. Kerstein RB, Farrell S. Treatment of myofascial pain dysfunction with occlusal equilibration. *J Prosthet Dent* 1990;63:695–700. DOI: 10.1016/0022-3913(90)90328-a.
4. Kerstein RB. A comparison of traditional occlusal equilibration and immediate complete anterior guidance development. *J Cranio Pract* 1993;11:126–140.
5. Kerstein R. Disclusion time reduction therapy with immediate complete anterior guidance development: the technique. *Quintessence International* 1992;23:735–747. DOI: 10.4103/0972-4052.194948.
6. Thumati P, Manwani R, et al. The effect of reduced disclusion time in the treatment of myofascial pain dysfunction syndrome using immediate complete anterior guidance development protocol monitored by digital analysis of occlusion. *Cranio* 2014;32:289–299. DOI: 10.1179/2151090314Y.0000000004.
7. Maness WL, Benjamin M, et al. Computerized occlusal analysis: a new technology. Chicago. Quintessence International 1986;15:287.
8. Erlandson PM, Poppen R. Electromyographic biofeedback and rest position training of masticatory muscles in myofascial pain-

- dysfunction patients. *J Prosthet Dent* 1998;62:335–338. DOI: 10.1016/0022-3913(89)90345-4.
9. Santana-Mora U, Cudeiro J, et al. Changes in EMG activity during clenching in chronic pain patients with unilateral temporomandibular disorders. *J Electromyogr Kinesiol* 2009;19(6):e543–e549. DOI: 10.1016/j.jelekin.2008.10.002.
10. Castroflorio T, Bracco P, et al. Surface electromyography in the assessment of jaw elevator muscles. *J Oral Rehabil* 2008;35(8): 638–645. DOI: 10.1111/j.1365-2842.2008.01864.x.
11. Deng M, Long X, et al. Electrosonographic characteristics of sounds from temporomandibular joint disc replacement. *Int J Oral Maxillofac Surg* 2006;35(5):456–460. DOI: 10.1016/j.ijom.2005.09.007.
12. US Food and Drug Administration. Re-review of Devices for Diagnosis and Management of TMJ/TMD, October 20, 1997.
13. US Food and Drug Administration. Meeting of the Dental Products Advisory Panel regarding the Classification of Devices for the Treatment and/or Diagnosis of Temporomandibular Joint Dysfunction and/or Orofacial Pain; August 5, 1998.
14. ADA Council on Dental Materials, Instruments and Equipment: Seal of Recognition; January 3, 1986.
15. ADA Council on Dental Materials, Instruments and Equipment: Seal of Acceptance; June 16, 1993.
16. Report on Acceptance of TMD Devices. ADA Council on Scientific Affairs. *JADA* 1996;127:1615–1616.
17. Council on Dental Materials, Instruments and Equipment. Acceptance Program Guidelines for Instruments as Aids in the Diagnosis of Temporomandibular Disorders. Chicago American Dental Association; 1991.
18. Dahlstrom L. Electromyographic studies of craniomandibular disorders: a review of the literature. *J Oral Rehab* 1989;16:1–20.
19. Travell JG, Simons DG. *Myofascial Pain and Dysfunction*. Baltimore: Williams and Wilkins; 1983; pp. 169–170.
20. Talley RL, Murphy GJ, et al. Standards for the history, examination, diagnosis, and treatment of temporomandibular disorders: a position paper. *J Craniomandib Pract* 1990;8:60–64.
21. McCall WD Jr. *A Textbook of Occlusion*. Carol Stream, Ill: Quintessence; 1988.
22. Moller E. Clinical electromyography in dentistry. *Int Dent J* 1969;19:250–266.
23. Kawazoe Y, Kotani H, et al. Effect of occlusal splints on the electromyographic activities of masseter muscles during maximum clenching in patients with myofascial pain dysfunction syndrome. *J Prosthet Dent* 1980;43:578–580. DOI: 10.1016/0022-3913(80)90334-0.
24. Myslinski NR, Buxbaum JD, et al. The use of electromyography to quantify muscle pain. *Meth and Find Exptl Clin Pharmacol* 1985;7(10):551–556.
25. Sheikholeslam A, Holmgren K, et al. A clinical and electromyographic study of the long-term effects of an occlusal splint on the temporal and masseter muscles in patients with functional disorders and nocturnal bruxism. *J Oral Rehabil* 1986;13:137–145.
26. Bracco P, Deregibus A, et al. TMJ clicking: a comparison of clinical examination, sonography, and axiography. *J Craniomandib Pract* 1997;15(2):121–126.
27. Hugger A, Hugger S, et al. Surface electromyography of the masticatory muscles for application in dental practice. Current evidence and future developments. *Int J Comput Dent* 2008;11(2): 81–106.
28. Jankelson RR. Effect of vertical and horizontal variants on the resting activity of the masticatory muscles. *Anthology of Craniomandibular Orthopedics*. Seattle WA: Coy R Ed. International College of Cranio-Mandibular Orthopedics; 1997. pp. 69–76.
29. Miralles R, Dodds C, et al. Vertical dimension Part I: Comparison of clinical freeway space. *J Craniomandib Pract* 2001;19(4):230–236.
30. Gomes MB, Guimarães JP, et al. Palpation and pressure pain threshold: reliability and validity in patients with temporomandibular disorders. *J Craniomandib Pract* 2008;26(3):202–210. DOI: 10.1179/crn.2008.027.
31. Cooper BC, Kleinberg I. Examination of a large patient population for presence of symptoms and signs of temporomandibular disorders. *J Fam Pract* 2007;25(2):114–126. DOI: 10.1179/crn.2007.018.
32. Beitollahi JM, Mansourian A, et al. Evaluating the most common etiologic factors in patients with temporomandibular disorders: a case control study. *J Appl Sci* 2008;8(24):4702–4705. DOI: 10.3923/jas.2008.4702.4705.