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RECENT DIAGNOSTIC AIDS FOR TEMPOROMANDIBULAR DISORDERS

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ABSTRACT The diagnosis of Temporomandibular disorders (TMD) includes the physical examination of the masticatory muscles and temporomandibular joint (TMJ) through muscle palpation, palpation and auscultation of TMJ sounds, and measurement of mandibular range of motion. Imaging is considered to be a useful adjunct in the diagnosis of TMD. The recent advancement in biometric gadgets has helped in more accurate and precise diagnosis. This article reviews the recent diagnostic aids used for temporomandibular disorders.

KEYWORDS : Temporomandibular joint, Temporomandibular disorders, Diagnostic aids.

INTRODUCTION

Disorders of the temporomandibular joint (TMD) are one of the most challenging areas of dentistry. [1] It can manifest in a variety of ways at any point in a person's life and present with symptoms like restricted mouth opening, pain in the TMJ region, pain in the masticatory muscles, headaches, particularly in the anterior temporal area, sounds coming from the temporomandibular joints, morning soreness, bruxism, clenching, head and neck pains, attrition and/or abfraction of teeth, internal temporomandibular disc derangement. The temporomandibular joint disorder is a functional disturbance.[2]

TMJ issues are the only issue in dentistry that requires a comprehensive approach to management. One of the main causes of temporomandibular disorders is possible occlusal trauma following restorations. Other significant conditions that contribute to this discomfort include dental extractions and orthodontic restorations. For temporomandibular dysfunction diagnosis and therapy, a variety of tools and techniques are employed. This is due to the complexity of the issue as well as the requirement for the use of non-invasive techniques.[3-5]

Diagnosis Of Temporomandibular Disorders

Temporomandibular disorders are diagnosed by reviewing the medical history and performing a physical examination. However, diagnostic TMD imaging techniques are used to evaluate the health of its constituent parts and their relationship to one another, to validate how far a disease has progressed, and to evaluate and record the results of a previously prescribed treatment.[6]

The recent advances in these diagnostic aids include:

1. T Scan
2. EMG
3. Joint Vibrator Analysis
4. Jaw Tracker

T Scan

Maximum voluntary biting force measurement has been demonstrated to be a crucial sign of the health of the temporomandibular joint, jaw muscles, and dentition.[7] Any premature occlusal contacts and occlusal-articulation obstructions generate occlusal traumas, which result in changes to the tissues supporting the teeth, the masticatory muscles, and the temporomandibular joint.[8]

The T-Scan sensor is made up of two layers of 25-m Mylar, on which rows of silver ink have been printed both vertically and horizontally. These rows together resemble a conductive grid. A layer of conductive ink is positioned in between the printed Mylar sheets. The silver traces constantly have a 60 A current flowing through them. When pressure is applied to the sensor, electrical resistance decreases, and an increase in current flow is interpreted as an increase in force by the programme. [9]

After processing the data, the programme displays it in full colour 2D or 3D visuals. The resulting occlusal contacts are represented as outlines or cellular pictures on the dental arch in the 2 D graphics. The dentition can be split into its anterior and posterior halves, creating four segments for analysis. Color coding of the occlusal load's magnitude shows the maximum force in red and the minimum force in blue. Additionally, from the point at which the teeth initially make occlusal contact until centric intercuspation, it analyses the order of the occlusal contacts while also monitoring the force percentage variations of those same contacts.[8]

Thus, the T Scan system can be used to evaluate changes in the state of a patient's occlusion and diagnosis of TMD.

Fig. 1 – T Scan sensor

Fig. 2 – Readings for the occlusal analysis with T Scan

Electromyography (EMG)

The analysis of electrical signals generated during muscular contractions is known as electromyography, which is the study of muscle function.[10] Surface electrodes are positioned on the skin above the muscle as part of the non-invasive method of measuring muscular activity.[11] Operators frequently utilise EMG to study the process of muscular fatigue, examine the pattern of muscle contraction in the function of body movement, and determine the timing of muscle contractions.[12] The theoretical basis behind using EMG to diagnose TMD is the belief that a painful muscle in spasm has a high electrical potential that can be detected by using EMG.[13] The most important advantage of sEMG is its non-invasiveness. It is a non-invasive, painless technique that might theoretically be used to detect TMDs. Nevertheless, due to the wide range of outcomes reported in the literature, its use in the diagnosis of this condition is still debatable.[14]

Eight EMG channels and four support channels make up the twelve simultaneous EMG signal channels used for recording. The band-pass filter has cutoff frequencies of 10Hz (high-pass) to 1500Hz and amplifies the analogue EMG signal (low-pass). The analogue signals are converted to digital at a sampling rate of 2 to 4 KHz using a 12 bit A/D converter. The electrodes utilized have a contact diameter of 10 x

2 mm, are parallel bars of pure silver (Ag), spaced 10 mm apart, and are bonded to acrylic resin that measures 23 x 21 x 5 mm. The skin of the volunteer is cleansed with 70% alcohol before the electrodes are applied. The silver bars are perpendicular to the electrodes, maximizing signal capture and reducing noise interference. The electrodes are positioned in proportion to the length of the muscle fibres.[15]

Masseter muscle: electrodes positioned on muscle belly that could be better located during dental clenching (2 cm above the external angle of the jaw).

Anterior portion of the temporalis muscle: on the muscle belly located by the application of muscle function test.

Suprahyoid muscle: below mentus process, on the midline, located by palpation of the muscle during deglutition.

Trapezius muscle: on the muscle belly midway between C7 and acromiun. - Posterior neck muscles: electrodes must be placed parallel to C4 (2 cm from the midline).

Between the skin and the electrode capsule, electrodes are secured using double-sided adhesive tape, leaving the bars open for signal capture. During the rest period and the maximal isometric contraction, 5 seconds of EMG signal recording are taken into account, and 10 seconds are used for the chewing test. For further analysis and processing, EMG signal recordings are saved on a computer. [15]

Fig. 3 – Surface EMG electrodes positioned on muscle fibres

Fig. 4 – EMG recordings showing the muscle activity

Joint Vibrator Analysis

Joint Vibration Analysis (JVA) is a computerised procedure that records bilateral TMJ vibrations and uses software to process the vibrations to get a reliable indication of whether the TMJs are healthy or injured. The range of motion (ROM) is measured prior to recording, and any deflection at the maximum opening of 3 mm or more is noted. Normal control subjects have frequently had deflections of less than 3 mm measured in them, [16] or 2 mm in children. [17] Then, the patient is told to open wide and close to a light tooth contact six or more times while two accelerometers are positioned directly over the TMJs. To manage the motion's speed, the patient uses an on-screen metronome. This simple movement necessitates the full translation of both condyles, exposing any range-of-motion restrictions, deviations, deflections, and/or joint sounds. The light tooth contact acts as a marker and confirms that the recording contains the whole ROM. To create a usable JVA record, it is crucial that the patient adheres to these directions, opening to maximum, closing all the way to light tooth contact, and following the metronome's pacing. Joint Vibration Analysis (JVA) can assist a trustworthy preliminary clinic diagnosis, is quick to implement, affordable, and can indicate whether additional testing with CBCT or MRI is necessary. Through the use of artificial intelligence and complex mathematics, JVA has developed over the last three decades into a 98% specific indicator of good TMJ function.[18]

Fig, 5 – Joint Vibrator Analysis

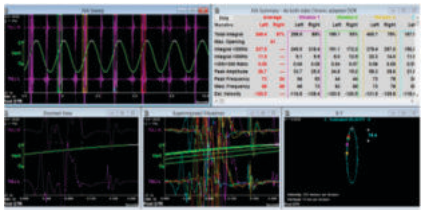

Fig. 6 – Readings of the JVA

Jaw Tracker

Loss of masticatory function is one of the consequence of temporomandibular disorders. Thus, to diagnose TMDs, evaluation of masticatory function is important. The development of techniques for assessing masticatory movements as a means of identifying system flaws has been pursued by researchers for more than three decades.[19,20]

The masticatory function is assessed using a variety of techniques, including the use of a single sieve, multiple sieves, color-changing chewing gum, the capacity to combine different coloured paraffin wax cubes, etc.[21] However, some of these approaches' drawbacks include their time commitment and the difficulty of standardising such investigations. Thus, with the help of Jaw Tracker, definitive objective data can be obtained, which provides incredibly accurate measurements in mandibular kinesiology (jaw movement).

The Jaw Tracker enables the physician to view the location of the jaw during specific functions in real-time. In order to diagnose a condition and formulate a treatment plan, the test collects objective data during chewing, speaking, range of motion, and swallowing and evaluates the pattern and speed of jaw movement.

The Jaw Tracker is a non invasive, non painful test that records incisor-point movements in three dimensions. The mandibular incisors' labial surfaces are attached to a tiny magnet, which is tracked to gather information on the teeth's vertical, anterior, and lateral movements. Jaw tracking can aid in the design of the best chewing patterns as well as the detection of abnormal functions that can help in more accurate diagnosis.[22]

Fig. 7 – Jaw Tracker

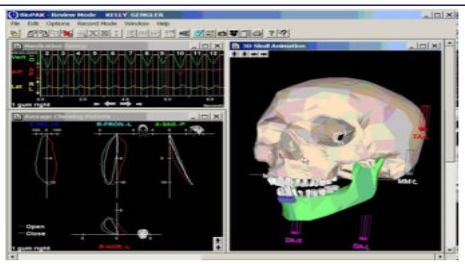

Fig. 8 – Readings of the Jaw Tracker

CONCLUSION

Using a collection of various tools known as Electromyography (EMG), T Scan, Joint Vibrator Study, and Jaw Tracker, biometric dentistry involves the computerised analysis of the teeth, jaw joint, and associated muscles. According to recent studies, objective measurements can improve both diagnosis and treatment. By monitoring the joint, muscle, and occlusal functions of the patients, this is performed biometrically. These biometric techniques can give a physician a comprehensive understanding of the stomatognathic system of the patient, assisting in the appropriate diagnosis and facilitating the treatment and management of temporomandibular disorders.

REFERENCES

1. Scrivani SJ, Keith DA, Kaban LB. Temporomandibular disorders. New England Journal of Medicine. 2008 Dec 18;359(25):2693-705.
2. Issa TS, Huijbregts PA. Physical therapy diagnosis and management of a patient with chronic daily headache: a case report. Journal of Manual & Manipulative Therapy. 2006 Oct 1;14(4):88E123E.
3. Baba K, Tsukiyama Y, Yamazaki M, Clark GT. A review of temporomandibular disorder diagnostic techniques. The Journal of prosthetic dentistry. 2001 Aug 1;86(2):184-94.
4. Bas B, Yılmaz N, Gökce E, Akan H. Diagnostic value of ultrasonography in temporomandibular disorders. Journal of oral and maxillofacial surgery. 2011 May 1;69(5):1304-10.
5. Dolwick FM, Abramowicz S, Bagheri SC. Diagnosis and management of temporomandibular joint pain and masticatory dysfunction. InCurrent therapy in oral and maxillofacial surgery 2012 Jan 1 (pp. 859-868). WB Saunders.
6. Lewis EL, Dolwick MF, Abramowicz S, Reeder SL. Contemporary imaging of the temporomandibular joint. Dent Clin North Am. 2008;52:875-90.
7. Throckmorton GS, Rasmussen J, Caloss R. Calibration of T-Scan sensors for recording bite force in denture patients. Journal of oral rehabilitation. 2009 Sep;36(9):636-43.
8. Bozhkova TP. The T-SCAN system in evaluating occlusal contacts. Folia medica 2016 Apr 1;58(2):122.
9. Chapman RJ, Maness WL, Osorio J. Occlusal contact variation with changes in head position. International Journal of Prosthodontics. 1991 Jul 1;4(4).
10. Soderberg GL, Knutson LM. A guide for use and interpretation of kinesiologic electromyographic data. Phys Ther 2000;80(5): 485-498.
11. Al- Saleh MA, Flores-Mir C, Thie NM. Electromyography in diagnosing temporomandibular disorders. The Journal of the American Dental Association. 2012 Apr 1;143(4):351-62.
12. De Luca CJ. The use of surface of electromyography in biomechanics. J Appl Biomechan 1997;13(2):135-163.
13. Okeson JP. Management of temporomandibular disorders and occlusion. St. Louis: Mosby Elsevier; 2008:277.
14. Szyszka-Sommerfeld L, Machoy M, Lipski M, Wozniak K. The diagnostic value of electromyography in identifying patients with pain-related temporomandibular disorders. Frontiers in Neurology. 2019 Mar 5: 10:180.
15. Pedroni CR, Borini CB, Berzin F. Electromyographic examination in temporomandibular disorders – evaluation protocol. Brazilian Journal of Oral Sciences. 2004;3(10):526-9.
16. Zhang XN, Nishiyama H, Murakami S, Fuchihata H. A study of condylar movement by bilateral simultaneous videofluorography. Dentomaxillofac Radiol. 1998 Sep; 27(5): 279-86.
17. Köhler AA, Helkimo AN, Magnusson T, Hugoson A. Prevalence of symptoms and signs indicative of temporomandibular disorders in children and adolescents. A cross-sectional epidemiological investigation covering two decades. Eur Arch Paediatr Dent. 2009 Nov;10 Suppl 1:16-25.
18. Radke J, Velasco GR. Joint Vibration Analysis (JVA) bridges the gap between clinical procedures and sophisticated TMJ imaging. Advanced Dental Technologies and Techniques. 2020 Sep 21.
19. Ferrario VF, Sforza C, Gianni AB, Daddona A, Deli R, Giuliani M. Analysis of chewing movement using elliptic Fourier descriptors. Int J Adult Orthodon Orthognath Surg. 1990;5(1):53-7.
20. Mongini F, Tempia-Valenta G, Conserva E. Habitual mastication in dysfunction: a computer- based analysis. J Prosthet Dent. 1989 Apr;61(4):484-94.
21. Van der Bilt A, Fontijn-Tekamp FA. Comparison of single and multiple sieve methods for the determination of masticatory performance. Archives of Oral Biology. 2004 Mar 1;49(3):193-8.
22. Thumati P, Radke JC, Thumati RP, Thumati PP. An introduction to the clinically relevant analysis of mastication. Journal of Interdisciplinary Dentistry. 2017 May 1;7(2):80-6.