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T Scan – A Revolutionary Digital Dental Technology

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Abstract: The process of evaluating dental contact relationships is time consuming and less accurate using conventional methods. The emergence of T-Scan as a way to tackle these setbacks has revolutionised dentistry. Numerous authors have studied the various possibilities of TScan and came up with more updated versions of it.

The aim of this review article is to gain a better picture of this technology that has made numerous dental diagnostic and treatment procedures easier.

Keywords- Temperomandibular joint, T-scan, Implant

Introduction

Because it is essential to guarantee that the occlusal forces are distributed equally during mastication, occlusal considerations are crucial to the success of any dentalprocedure.

Early occlusal contacts and other high occlusal forces have been shown to affect the periodontal tissues, mucosa, and bone, in addition to the temporomandibular joint (TMJ) and masticatory muscles, which together comprise the dental support system.

A patient's occlusion can be assessed objectively using the T-Scan Novus. T-Scan Novus is able to measure two of the most important parameters for evaluating occlusion: force and timing. This is in contrast to articulating paper, which just measures location.Theocclusal relationships and force distribution throughout an articulating cycle can be dynamically analysed with the use of T Scan. It has been shown to be advantageous in other domains, including as gnathology, implantology, and other prosthetic occlusal scheme analysis, as well as orthodontic and post-orthodontic therapies. With numerous modifications

throughout the years, T-Scan has become an increasingly sophisticated alternative for evaluating a patient's occlusion.

History

Using the T-SCAN intraoral sensor, Maness created the T-scan system for computer occlusal analysis in 1987. The process of measuring occlusal data involves inserting a thin film, coated with mylar, between the patient's teeth and sending it to a computer. From the first T-scan version 1 to the most recent T-scan 8, 9, and 10, T-Scan has undergoneevolution.

The first T-Scan was created in 1984. Later, T-scan II was developed for Windows in 1995. T-Scan III, which had software versions 5, 6, and 7, was created in 2004. T-Scan 8 with turbo recording was created in 2014. T-Scan 10 with an updated Novus handpiece and HD sensor was created in 2015. The most recent software update, T-Scan v10, was released in 2018 and includes digital impression overlays and implant warning features.

T-Scan Machinery and Working Principle

T-Scan system consists of 2 primary parts. The first is a sensor, which is a patient-bites-through thin polyester film with a thickness of 0.1 mm. Next comes a handle that offers the sensor's supporting system as well as sensor calibration for accurate   data   registration. There are two operating modes for the T-Scan: force mode and time mode. **Time mode:** The screen shows the time value of each point of touch along with an emphasis on the first three points of contact. (Figure 1)

Figure:1

Force mode: Shows information according on the force's location and strength. Data is presented and visualized using either 2D or 3D visuals using the TScan system. Contact points are shown along the tooth arch as outlines or images resembling cells in 2D depictions.

In 3D graphics, however, distinct columns in a range of colors and heights are employed. These colours indicate the occlusal load; **PINK** indicates the most stress and **BLUE** the lowest. The height of the columns reflects the severity of the occlusal force. (Figure 2 and 3)

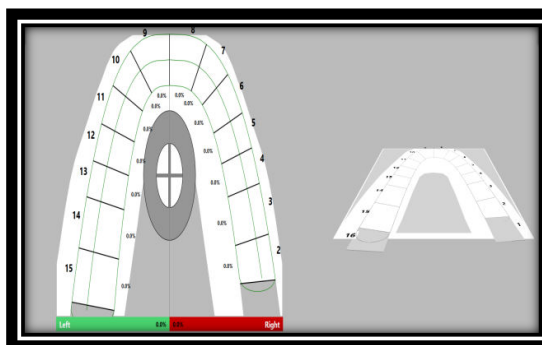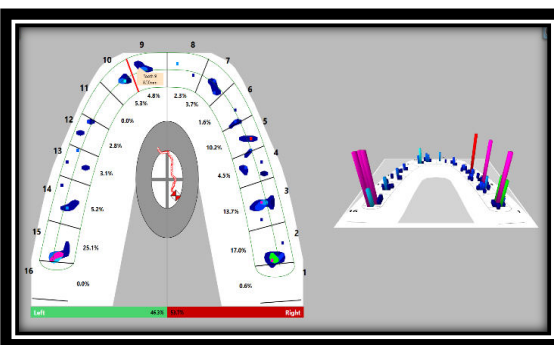Figure 2   Figure 3

Arch can customized as either maxillary or mandibular arch for the patient with measured Central incisor width of the patient with Medium sensitivity set for T-SCAN.Bite can be registered in Multi –bite, Centricocclusion, CentricRelation, Protrusivemovements. Homogeneity of bite on both right and left side can be calculated in percentage when patient bite on the sensor at Centric relation. Also Occlusion time and Disclusion time can be calculated. Disclusion time reduction (DTR) can be done thereafter as subtractive neuromuscular dentistry treatment(Subtraction NMD).Orthodontic and Prosthodontic rehabilitation and Correction can be done as an Additive NMD treatment. Premature contacts and force profile can also be visualized as colour gradients.

## Interpretation
T Scan Reading in Centric Occlusion
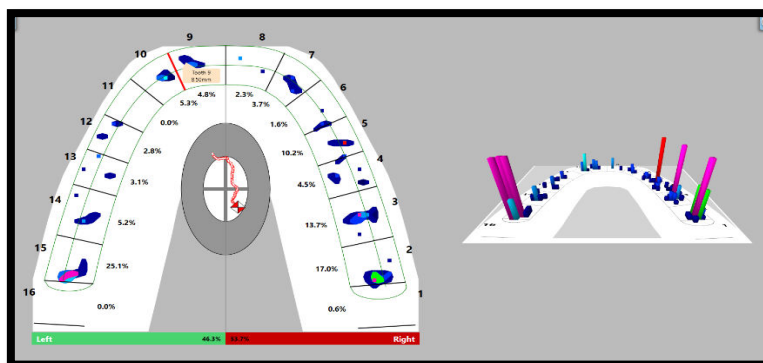
- Bite recorded in centric relation
- More bite recorded in right side (53.7%) than left side (46.3%)

- No premature contact registered
- High force profile recorded in 14,16,17,27
- Correlate with articulating paper marks to find anatomical location and to correct the interference
- Occlusion time – 0.50s
- Disclusion time – 0.12s
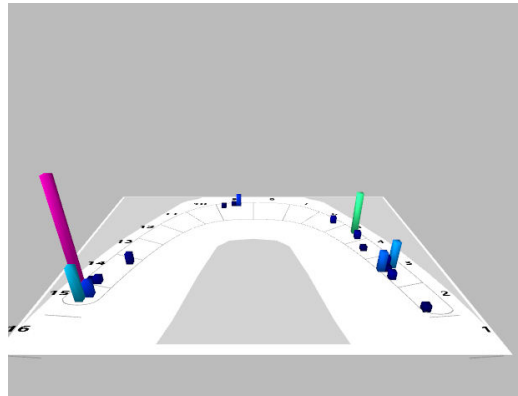
T-Scan Reading in Right Lateral Movement
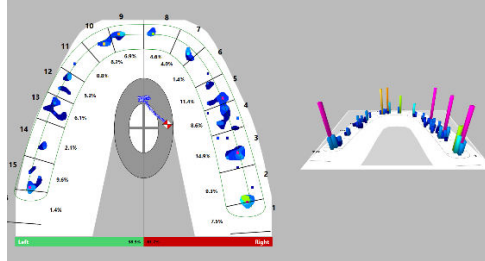
- High force profile recorded in 14,16,17,27

T-Scan Reading in Left Lateral Movement
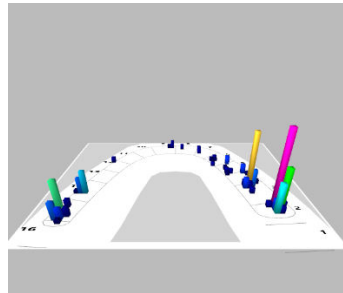
- High force profile noted on 17

T-Scan Reading in Protrusive Movement

Single point high force contact noted on 27

Applications

- **Evaluation of Normal Occlusion**

Evaluating normal occlusion with T-Scan includes assessing the occlusal contact force levels, the occlusal force percentage distribution, the Occlusion Time, and the Disclusion Time.[1]It aids in necessary occlusal corrections to achieve occlusal harmony.

- **Evaluation of occlusion after implant placement**

Heavy occlusal loading is possible after implant placement which is difficult to track using traditional methods. TScan makes the process simple.

- **Analysing occlusion and posture**

T-Scan helps adjust the occlusion in different head postures in cases of full mouth Rehabilitation. It was with the help of T-Scan that it was initially possible to detect the

Variations in occlusion time and disclusion time with head posture.

- **Diagnosing traumatic occlusal forces**

Detrimental forces leading to trauma can be identified by T-Scan.

- **Bruxism**

TScan helps evaluate the occlusal load profiles in patients with bruxism who tend to have a longer disclusion time and shorter occlusion time than normal people.[2]

- **Occlusion in patients with fixed or removable denture prosthesis**

A proper occlusal scheme is the key factor that determines the success of a denture. T-Scan

Helps identify unfavourable occlusal forces that can dislodge the prosthesis and correct them.[3]

- **Frictional hypersensitivity of teeth**

Abnormal frictional contact between occluding surfaces can lead to dentinal hypersensitivity.TScan can help to equilibrate the undue forces.[4]

- **Gnathology**

TScan can help to improvise Gnathological postural position of splints worn in sports resulting in enhanced performance.[5]

- **Electromyography and joint vibration analysis**

EMG helps to evaluate the muscle activity inclusive of occluso-muscular disorder and JVA evaluates derangements of joint. T-Scan synchronizes with EMG and JVA.

Tscan in Temporomandibular Joint Disorders

Temporomandibular disorders (TMDs) develop as a result of instability in the bite, leading to excessive pressure on the chewing system. The T-scan system aids in precisely pinpointing premature contact points that may not be visible to the naked eye and also quantitatively measures the force applied[6].

The T-scan I technology was introduced to the realm of temporomandibular disorders (TMDs) back in 1984.

Occlusion Time (OT), represented as (A–B), denotes the duration in seconds, starting from the initial tooth contact until achieving maximum intercuspation with all teeth in contact. An OT of ≤0.2 s is considered optimal.[7]

Disclusion Time (DT), represented as (C–D), signifies the duration in seconds from the onset of lateral or protrusive movement from maximum intercuspation until only canines and/or incisors are in contact. An ideal DT is ≤0.5.[8]Prolonged DT

may trigger increased muscle activity during lateral or protrusive movements, contributing to muscular TMD symptoms.[9]

A study conducted by a Japanese team 1994 on TMD patients noted a difference between test and control groups. The TScan results of control group showed a more symmetric distribution of contacts and clustering of centre of force around the first molar as opposed to the TMD group which showed an asymmetrical distribution of force and contact duration and scattered centres of force.[10]

Wangetal observed that the Center of Force (COF) was found to be situated farther from the desired COF target position in individuals with temporomandibular disorder (TMD) issues, as opposed to those without TMD concerns. This deviation was linked to increased occlusal asymmetry indices (AOF) within the TMD-affected group.[11]

Ferratoetal determined that in TMD patients, the COF was often located more anteriorly compared to normal individuals.[12]

Thus, a TScan shines light into the anomalies in force centering, asymmetries and abnormalities in intensity of force which might be an indicator of muscular spasms or functional asymmetries. According to some authors, condylar position indicator (CPI) when combined with TScan can be used to study the dynamics of occlusal forces occurring between CO and CR.[13]

An electromyography (EMG) that records the efficiency of masticatory muscles at rest and all other functional and non-functional movements can be combined with T-Scan to record simultaneously the muscle action in response to an existing occlusal discrepancy, an unbalanced contact force, abnormal timing or abnormal location of contact forces.[14]

Conclusion

Occlusion is one of core subjects in dental practice. T-Scan overcomes the shortcomings of traditional methods of occlusal analysis with adequate reliability and sensitivity.

T-Scan is a versatile device with multiple uses in various fields of dentistry, like Prosthodontics, Implantology, Oral surgery, Periodontics, Pedodontics and Endodontics.

T-Scan has been a reliable indicator of occlusal interferences for the precise identification and occlusal equilibration and helps in the management of TMDs.

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