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T- SCAN: AN ADJUNCT TOOL IN NEUROMUSCULAR DENTISTRY

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ABSTRACT

Dentistry is that branch of science which is largely affected by its materials and equipment. The teeth which are extracted or decayed due to caries require replacement and rehabilitation. The development of various dental materials and precision technologies helps the dentist to successfully treat various clinical conditions that were previously difficult to diagnose. The dental occlusion develops under the guidance of genetic and functional influences through the differing stages of dental arch development and adaptations to Temporomandibular joint (TMJ) and masticatory muscles. The techniques and devices which are used to provide more objective information to the dental technician for the diagnosis, planning, and treatment phases are an intraoral scanner, a T-Scan system, and some specific open reverse engineering software. By means of a virtual procedure, the T-Scan system detects the occlusal contacts, and the occlusal surfaces are obtained using an intraoral scanner.

KEYWORDS: Neuromuscular Dentistry, Immediate complete anterior guidance development (ICAGD), Occluding Time (OT), Discluding time (DT).

INTRODUCTION

The T-Scan III Computerized Occlusal Analysis System is a device which overcomes the limitations of using Articulating Paper. This device quantifies and displays relative occlusal force information so that the clinician is able to minimize the repeated errors of incorrect occlusal contact selection rather than relying solely on the combination of dental articulating paper and patient feel. It is very difficult for a dental practitioner to predictably identify which occlusal contact has more force than the others when using articulating paper alone. The *T-Scan* III can help ensure that high quality and complete occlusal end-results in such clinical cases.

During maxillomandibular intercuspation, the two main factors the T-ScanIII can measurably isolate are time and force. It can easily identify the very first contact point as well as the numerous other contact points that occur during maxillo-mandibular functional movements. The T-Scan III gives us the contact time-sequencing, and the percentage of relative occlusal force between numerous occlusal contacts, and then displays all of them for dynamic analysis. It can, not only assess the initial occlusal contact but also the order that all the occlusal contacts occur in, and even the amount of relative occlusal force loading each contact. It enables us to assess the force changes, all during the process of contact evolution. It also enables to better identify many interfering contacts that were not identified by the articulation paper markings. Then the alteration of the poorly contacting tooth sequence can be adjusted using computer-guided occlusal adjustments software where multiple equal-intensity contacts are occurring simultaneously throughout the arches bilaterally. Due to various improvements made over the past three decades T-Scan System, now can successfully treat many occlusal problems and provide patients with predictable high quality occlusal treatment end results.[1]

Examination of Occlusal Contacts with T-Scan III Occlusal Analysis

Procedure

T-scan device is a USB-connected handle, which includes removable holders for sensors. Both T-scan holders and sensors are manufactured is small and large sizes. T-scan sensor holders are autoclavable. T-scan sensors are 0.1 mm thick pieces, which transmit the information about the occluding teeth to the T-scan III software. The patient is asked to bite on a sensor to make the software adjust the sensitivity. The patient's personal level of pressure defines the force characteristics obtained by the software. It means that the level of force is not measured in any units. The force level is a relative value, defined in terms of percents. The best way to perform the procedure is to follow patient's movements by watching the contact sequence directly on the screen.[2]

When a T-ScanIII sensor is placed intraorally, the "U-shape" surface contacts across the entire arch, and with all occluding teeth. Therefore, the entire arch has its vertical height increased uniformly; equal to the thickness of the sensor (100 microns). The uniform bilateral increase limits the possibility of recording errors caused by sensor thickness. The only possibility of obtaining minor recording errors might be where there are differences between the available space of the posterior teeth (less space) versus the anterior teeth (more space). However, the recording of accidental error is generally minimized because the sensor is only 100 microns thick.[3] The T-Scan III calculates the relative force values rather than absolute values as the applied force would change between various intercuspations, as the muscular force can vary significantly in different intercuspations. Alternately, if the same amount of muscular force is used during repeated mandibular intercuspations, the uneven topography of the contacting occlusal surfaces can slightly alter not only where on the contact points hit, but the applied force as well. Therefore, by measuring relative force levels across elapsed time on the different cusps and fossa, we can readily locate the contacts that strike too early, and locate the contacts where there is too much or too little occlusal force.[4,5]

Types of Recordings: After adjusting patient's sensitivity, the procedure goes on by recording the patient's static and functional occlusal movements. There is a variety of recording patterns. The simplest recording is a centric occlusion recording. The procedure goes as follows: patient is asked to occlude his teeth in maximum intercuspation with maximum force. The sensor is turned on to record the closing pattern just before the teeth are going to occlude. Then the recording starts and after disoccluding the teeth the handle is turned off. This centric occlusion recording usually lasts for about 2 seconds. The main characteristics of centric occlusion recording are discussed below. Each recording usually has two main stages, (a) closing stage, and (b) opening stage. They are also called occlusion and disocclusion stages, respectively. The purpose of defining the stages within the recording is to measure the duration of each stage. This is the main point, when analyzing the occlusion in a functional way. The duration of the closing stage as well as the force distributed during this period influence closing muscle activity. This can be observed on the overall force.[6]

Other important features of T-scan occlusal analysis procedure are describing the nature and balance of force distribution between right and left sides, analysing occlusal contact distribution along the dental arches, and measuring force levels on every pair of occluding teeth. Occlusal balance should be equal between right and left sides at every period of time during centric occlusion and multi-bite recordings. Overall side force level is composed of individual force levels on occluding pairs of teeth. Force levels are visible on 3-Dimensional Force Views colored columns, and also on 2-Dimensional dental arch template as colored single and fused spots. The overall side force level should not exceed 50 percents, which are distributed among all of the teeth on the corresponding side. One of the most applicable types of recordings is multi-bite recording, which records the sequence of more than two biting cycles. The average recording usually contains three biting cycles, which are enough to measure patient's closing stage, define whether muscle weakness exists in the patient, and to analyse side-to-side occlusal balance.[7] Multi-bite recording is aimed at analysing the repeatability of the occluding pattern. If the first closing cycle has a prolonged closing stage, and the other cycles distribute faster closing movements, it can be assumed that some interference disturb the closing pattern. Functional disturbances could be either of an occlusal origin or muscle origin. More severe dysfunctions include also temporomandibular joint components. Functional movements are of the major importance. These include left and right lateral and protrusion movements. The recording is made when asking a patient to occlude the teeth in intercuspation position and then slightly move away from this position to canine edge-to-edge contact. This movement is recorded and the time is measured from the start of disocclusion until canines contact. The software divides dental arches into quadrants according to the function of the teeth enclosed.[8,9] Once the alignment between the 3- dimensional occlusal surface and the T-Scan registration is carried out, the resulting contacts are projected onto the patient's occlusal surfaces; in this way, occlusal forces are obtained over time. The results obtained with this procedure demonstrate the feasibility of integrating different tools and software and the full integration of this procedure into a dental digital workflow.

DISCUSSION

This article discusses about the basics of T-Scan technology and its various components which use the T-Scan high definition sensors to record the relative occlusal forces and occlusal contact time sequences. The primary advantage of this technique is the accuracy of alignment and it provides the real-time individualized occlusal contacts and relative forces. In addition, this technique could be integrated with mandibular movement registration to obtain the real time information which could be useful in correcting occlusal derangements in natural dentition. This data can also be very helpful in programming the articulators for fabrication of prosthesis.[10]

The other advantages of this computer-guided treatment approach includes it lessens hyperactive muscles from within the central nervous system, by controlling the molar periodontal ligament (PDL) mechanoreceptors, which synapse directly with efferent motor fibres that contract the four masticatory muscles. Prolonged excursive frictional contacts increase the total time of PDL mechanoreceptors compressed in excursive

movements, where the PDL compression time is equal to the DT duration of the same excursion. The more time the excursive interferences contact, the longer time the PDLs are compressed, resulting in prolonged durations of masticatory muscle contractions. By reducing the length of time that posterior occlusal surfaces contact excursively, the duration of PDL mechanoreceptors compression is reduced, thereby interrupting the PDL compression-to-muscle hyper contraction. Post-ICAGD, the PDL no longer hyperfunctions the involved muscles into a painful ischemic state, allowing for re-oxygenation and muscle fiber recovery, leading to symptom resolution.

Since its first development, this procedure has been improved to minimize deviations. The technique presented in this article describes the different steps needed to carry out a customized dynamic mandibular registration. This procedure includes an alignment between digital casts (maxillary or mandibular) and the registration of the contacts using a T-Scan. The new T-Scan software (v9.1) can load the 3D digital casts. However, the alignment must still be performed manually, without any objective reference.

CONCLUSION

Overall, this technique constitutes a step forward, because once the patient has left the dental clinic, the data remain in the computer, facilitating the work of both the dentist and the dental technician. However, the contradictory statements in terms of precision and repeatability of the T-Scan device have demonstrated that additional studies are needed to validate the accuracy and reproducibility of these promising digital systems. The studies mentioned analysed the presence or absence of occlusal contacts; the next step should be to measure the locations and deviations of equivalent contacts. The proposed methodology provides more objective and meaningful information to the dental professional for the diagnosis, planning, and treatment phases, and more especially for the design phase. In this last phase, knowing where and when the forces occur during occlusion is essential. This integration can also be applied ina variety of other dental fields.

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 aetiology 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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