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T- Scan – The dental advisor

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Abstract

A technological revolution in dentistry has created new paradigms of innovations which are unimaginable. Adventurous Dentist and their patients are beginning to enjoy a new world of peerless technical excellence with immense potential. The dentist could essentially make a correct diagnosis for their patient. It is the foundation for success. Normal occlusal and articulation relations between jaws ensures that the distribution of the generated forces is balanced. Articulating paper- the most commonly used tool to identify contact points can only reflect the contact points but cannot quantify their intensity and measure magnitude of generated forces. T scan is an occlusal analysis. A System is designed to measure and record relative biting force over time. T Scan has been repeatedly modified to present day version of T Scan III. T Scan III processes the data and shows them in full-color 3d or 2d graphics and analyses the order of occlusal contacts while simultaneously measuring the force percentage changes of point occlusal contacts begin to centric intercuspation.

Keywords: Dentistry, Temporo Mandibular Disorders, T Scan III System

Introduction

Dentistry has been using less accurate methods for occlusal analysis for a long time. But with the invention of T-scan occlusal analysis has eliminated guesswork by the dentist. The T Scan III (S. Boston, MA, USA) is an occlusal analysis system that records occlusal contact force distribution from the first tooth contact till maximum intercuspation.¹ It is a thin, flexible, pressure-sensitive bite transducer embedded in a dental arch-shaped recording sensor. It can be displayed graphically for analysis in two or three dimensions. It has various applications in recording patient parameters like a center of force, explaining the symmetry of the occlusal force, initial contact, maximum bite force and maximum intercuspation.

The T-Scan III in dentistry is used for natural dentition with occlusal disturbances, implant placement, orthodontics, temporomandibular disorders, MPDS, endodontics and prosthodontics, patient treatment, occlusal diagnosis, and equilibration. In essence, a T-Scan system is a diagnostic tool that assesses dental occlusion and finds utility in any field that required a diagnosis of the occlusion and occlusal balancing.

It is well known dental implants may deteriorate under excursive overload and higher bite forces, eventually leading to bone loss and implant failure. Therefore, assessment of the occlusion is of utmost importance to relief these occlusal issues.

The T-Scan System is a computerized device that consists of:

1) Device with a flat U-shaped pressure measuring sensor, and 2) computer software.

The recent form of this technology is T-Scan III system accompanied by a software version 8.0, Tekscan Inc. (South Boston, MA, USA).

The use of this sensor is occlusal registration. It is used to obtain reliable measurements of occlusal biting forces quantitatively.

It records force associated with each occlusal contact. The hand-held device is the hardware for the system which contains the U-shaped sensor, fitting into the patient's mouth between occlusal surfaces of teeth. The T-Scan III is connected to the USB port of a computer (Figure 1).

A crucial aspect of the T-Scan system to be considered is that the timing of contact and the force analysis can be studied on the software.

The feature of synchronization of T-Scan data with electromyography has demonstrated the abnormal muscle dysfunction and the disclusion timing.

T-Scan can provide an ultimate diagnosis of the occlusal force balance and masticatory muscular function.

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Commonly used techniques are Articulating Paper Foils/Ribbon Silk strips, Foils Impression materials and Occlusal indicator wax.

The conventional static occlusal indicators such as articulating paper and waxes only reveal the contact size and location, whereas the T-Scan has an additional ability to quantify occlusal contact timings and forces.

Thinner occlusal registration materials provide more consistent records of the contact points. The T-Scan sensors are made very thin (0.1mm) to fulfill the technological demands. It may significantly alter the functional occlusion, and even affect the activity of the masticatory muscles. Every clinician must be aware that alteration of occlusion is shown to occur with all occlusal registration products.

T-Scan sensors may be damaged when forces are extended on a sharp tooth cusp like area.

This is due to increased intensity of low bite forces which become focused on sharp tooth cusp like the area and produce high pressure. It may also lead to the inaccurate recording of the occlusal contact and artifacts in the manufactured images. The T-Scan system can reproduce occlusal interferences only exceeding 0.6mm in dimension. Also, modes like force and time analysis may produce a copy of different occlusal contact data.



Fig 1: T-Scan III recording handle connects directly to a computer via a USB interface.

Discussion

The basics of T-Scan technology and its components have been explained in this article. Along with the brief of how the T-Scan HD sensor records the relative occlusal force, occlusal contact time sequences and the hardware and software features is given.

In dentistry the T-Scan system has various clinical applications. T-Scan can guide occlusal adjustments done following orthognathic surgery, implant procedures, or dental prostheses, and these adjustments be guided precisely by analysis. Occlusal contacts could be evaluated by T-Scan before making a bite adjustment. In orthodontics and orthognathic surgery, the absence or the presence of asymmetric contacts can indicate the need for further correction and finishing. The T-Scan system helps locate and identify traumatic occlusal contacts along with used to compare occlusal force symmetry before and after treatment. Also, the T-Scan system can be a useful tool for patient follow-up and the diagnosis or evaluation of relapse.

Various authors have explained that the T-Scan system allows for assessment of the occlusal discrepancies.

In 1994, Mizui *et al.* showed that the T-Scan system could be used to distinguish between the subjects with normal

occlusion and those with affected occlusion [3].

In another study, Ciavarella demonstrated the diagnostic utility of the T-Scan system for temporomandibular joint intracapsular disease, where the occlusal forces differed from healthy subjects [5].

Dees *et al.* described the earlier version of T-Scan (T-Scan I) in functional diagnostics. It will aid in patient planning and follow-up of the patient. One crucial property of a diagnostic tool is reliability, which is the ability of the instrument to yield the same result when measured at different times under similar conditions.

Kalachev *et al.* found T-Scan to be a valuable and reliable system for the localization and distribution of occlusal contacts in dynamic occlusion.

To date, dentistry continues to advocate the use of Articulating Paper (primarily) as the means to evaluate occlusal contacts before making occlusal adjustments. Despite that, many dental practitioners recognize the importance of the occlusion when fabricating a dental prosthesis; dentists continue to rely on patient “feel” statements regarding the nature of the perceived occlusal contact comfort level, as an indicator of treatment correctness. The T-Scan III Computerized Occlusal Analysis System overcomes the known limitations of Articulating Paper.

During maxillomandibular intercuspation, time and force are the main occlusal factors which the T-Scan III could measure. It readily identifies the very first contact point that precedes numerous other contact points that transitorily occur during maxilla-mandibular functional movements. The T-Scan III determines the contact time-sequencing, and the percentage of relative occlusal force between various occlusal contacts, and then displays them all for dynamic analysis.

The T-Scan III System is a dental device used to analyze relative occlusal force that is recorded intraorally by a pressure-mapping sensor. The recorded force data is stored on a hard drive and can be played back incrementally for data analysis in a time-based dynamic video. T-Scan III analyzes the order of the occlusal contacts while simultaneously measuring the force percentage changes of those same contacts, from the moment the teeth first begin making occlusal contact, all the way through to maximum intercuspation. Therefore, it can assess the initial occlusal contact, the order in which they occur and the amount of relative occlusal force which each bear. It enables us to evaluate the force changes, all during the process of contact evolution. Computer-guided occlusal adjustments can then be employed to alter a poorly contacting tooth sequence into multiple equal-intensity contacts occurring throughout the arches bilaterally.

T-Scan III quantifies the amount of relative occlusal force to predictably identify and locate traumatic occlusal contacts.

Patients may be able to feel occlusal discrepancies of that dimension when the restoration of teeth has been done. Accurate methods of locating the altered occlusal contact points in maximum intercuspation clinically are essential during rehabilitation of maxillofacial trauma patients. These adjustments for the corrections are made by selectively grinding the marks to obtain occlusal stability, multiple contacts throughout the arches that exhibit simultaneity and reduce stress on the occlusal contacts and the periodontium.

It quantifies and displays relative occlusal force information, so the clinician can minimize repeated errors of incorrect occlusal contact selection that often occur from relying solely on the combination of dental articulating paper and patient feel. T-Scan III ensures that high quality and complete

occlusal results are predictably obtained from clinical occlusal treatment.

Temporomandibular disorders (TMD)

Temporomandibular Disorder symptoms (TMD) have been induced within hyperactive masticatory muscles due to prolonged Disclusion Time, occlusal interferences, and occlusal surface friction. Disclusion Time can be reduced using the T-Scan.

Moreover, TMJ may be harmed especially in atypical protrusive interferences which may lead to sore neck and facial muscles hypertrophy, along with endangering nerves as has been seen in various temporomandibular disorders [7]. In contrast, a lower occlusal height may result in diseases such as disuse osseous atrophy and unstable centric occlusion [8,9]. Occlusal interferences often causes muscle dysfunction and consequently TMDs and MPDs.

Conclusions

T-Scan technology helps in assessing treatment outcomes. It provides detailed information about a patient's occlusion.

T-Scan system has demonstrated sufficient sensitivity and specificity as a diagnostic tool and also presented higher reliability in intra-oral conditions in the presence of saliva.

It is a tool for the assessment in orthognathic surgery patients for detection of relapse at an earlier stage.

Temporomandibular disorders caused due to occlusal disturbances are treated with the use of T-scan.

Articulating paper mark size is known to be non-descriptive of occlusal loads. Computerized T-scan completely removes the operator's subjectivity from the clinical decision-making process when observing paper markings of various sizes and configurations.

Since 25 years, T-Scan I has undergone hardware, sensor, and software revisions, such that today's "T-Scan III" system (version 7.0) is vastly improved over the earliest "T-Scan I" system.

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