

Evaluation of Occlusion Using T Scan and its Implications in Periodontology: A Review

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ABSTRACT

Background: There is a wide variety of methods in current dental practice for evaluating occlusal analysis like articulating papers, waxes, impression paste etc. They do not detect simultaneous contact nor quantify time and force. Normal occlusion and articulation between dental arches ensure equal distribution of occlusal forces during mastication. The T Scan system is a revolutionized concept of occlusal analysis. Its system is Microsoft windows based with associated hardware and thin sensor. The patient is asked to bite on center and the occlusal contact is transferred to the computer and allows for full color 2 dimensional or 3-dimensional graphics. It shows the percentage of force per tooth. The software enables the clinician to visualize occlusion from beginning to end and in between. The final qualitative data is converted into quantitative and it is displayed digitally.

Keywords: T Scan, Bite force, Occlusal analysis.

INTRODUCTION

For a good clinical practice, knowledge about occlusion is critically important. There has been an increasing interest among clinicians on treatment planning focusing on the biomechanical elements associated with occlusion. All disciplines of dentistry require the clinicians to assess the articulation of the teeth/prosthesis with respect to simultaneous contacts, biting time and biting force. There has been a lot of guesswork among the dentists to analyze the occlusion. There are a variety of occlusal analyzers used to register the occlusal-articulation relations. These historic methods employed to evaluate occlusion are articulating papers, wax, pressure indicating pastes etc. These methods failed to correctly detect and assess simultaneous occlusal contact as well as measure both biting time and force.¹ The periodontium has a unique ability to have adaptive capacity against occlusive forces exerted on the teeth. Occlusal trauma is not an etiological factor for

periodontal disease but its presence may exaggerate the severity of periodontitis.² For premature contacts or interferences in the teeth, occlusal adjustments have been recommended. The effect of these occlusal forces on the periodontium is dictated by its magnitude, direction, duration and frequency. For the general description of occlusal status, there are usually two characteristics described: intra- arch relationship (within the same arch) and inter arch (between opposing teeth) relationship. The occlusal disharmonies are frequently detected in patients with chronic periodontitis and significantly correlated with increased severity. This causes risk of further periodontal breakdown.

Now at this time in the era of immobile dental implants and all ceramic restorative materials, more precise occlusal force control is required to ensure the longevity of prosthesis. One of the most innovative systems for quantitative occlusal analysis was developed by Maness in 1987 called

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the T- Scan system. It is considered as a computerized device which is capable to interpret occlusal contact information quantitatively. T- Scan was invented 25 years ago, and since then, the entire system has undergone hardware and software revisions such that today T-Scan III system is vastly improved over the earliest T- Scan I system.¹

Utilizing a well-planned strategy for patient education in combination with the T-Scan Computerized Occlusal Analysis System, there can be improvement in the number of patients who accept occlusal therapies that likely would benefit them.³

T SCAN SYSTEM

The T-Scan System is a computerized device that consists of: 1) hand-held device with flat U-shaped pressure-measuring sensor, and 2) computer software. The patient is asked to bite down on thin sensor. The occlusal contact data is transferred to the computer and presented in a dynamic movie format. The movie format allows for playback in vivid, full color, three- dimensional or two – dimensional graphics. The software of T Scan plays back the percentage of force per tooth, half dental arch and the quadrant. This software enables the clinician to visualize patient's bite from beginning to end and, in between. By this way, the clinician can better adjust the occlusion and restorative services. Also, the teeth can be balanced functionally, muscular activity is positively influenced and a good periodontal support is established.¹

The latest type of the T Scan technology is marketed as the T-Scan III system with a software version 8.0, Tekscan Inc. (South Boston, MA, USA). The T-Scan III is connected to the USB port of a laptop or a Windows-based Personal Computer (PC). The T-Scan III™ system sensor consists of two polyester films as substrate, conductive ink as an interlayer and a vertical and horizontal woven wire grid with approximately 1500 sensor points. Mostly, the polyester films have property of high tear and strain resistance, so, the thin polyester films in the T-Scan III™ system can sustain occlusal forces and change form during the occlusal movement.² The sensor is 60µm thick approximately and it does not hinder the subjects when conducting different type's loops. Then, the relevant software can be utilized to

conduct quantitative analysis of the changes in occlusal contact points and force overtime and then compute a distribution of the occlusal forces after collecting the data. There has been improved accuracy and repeatability noted in T-Scan III™. This system can analyze the percentage of force distribution of one tooth, anterior, posterior occlusal forces and left and right occlusal forces. Also, the system can record the track of occlusal center from the initial contact position to the final position. Computerized occlusal analysis using T-Scan III™ guides the selection of tooth contacts for occlusal adjustment, also provides objective digital data for determining the quality of the orthodontic end-result, and observing the occlusal force distribution in natural dentition.

Applications

The T Scan device can reveal much of the invisible world of occlusion and its associated diagnostic capability since; many of the most influential tooth contacts in occlusion are so minute, as they cannot be identified through simple clinical observation. Its applications are:

Abfraction Formation and Root Recession Defects, Adhesive and Esthetic Prostheses, Cosmetic Restorations, Full Mouth Reconstruction, Implant prosthodontics, Natural Tooth, occlusal Function, Orthodontics, prosthodontics, Splint/Orthodontic Therapy, Temporomandibular Disorders etc.

Its benefits are: Improved diagnosis, increased quality of care, decreased treatment time, increased comfort of dental prosthetics, reduced risk of implant failure, traumatized teeth, unstable dentures, ineffective splints, and porcelain fractures. Legal documentation of outcome and enhanced patient education along with building up the practice are other important features.⁵

T SCAN IN PERIODONTOLOGY:

Occlusal trauma can be threatening to periodontal tissues status and impedes their longevity. Occlusal discrepancies affecting balanced occlusion causes periodontal breakdown because of deeper probing depths and thereby, affecting the prognosis.² Treatment of these occlusal discrepancies with selective occlusal grinding and occlusal appliances can be helpful in maintaining health of periodontal

tissues. Moreover, the evolution of T Scan from first generation to eighth generation has revolutionized the occlusal analysis concept. Occlusal disharmony is also a risk factor for the occurrence of bruxism, bruxomania, associated and arthropathy of the masticatory system and musculoskeletal complaints. The T Scan program processes the data and shows them in colored three- dimensional or two dimensional graphics. The generated occlusal contacts are visualized as contours or cellular images on the dental arch in the two dimensional graphics. There is also an optional feature which allows the left and right sides to be shown in different color codes. To analyze the four segments in the dentition, it can also be divided in anterior and posterior halves. In the three dimensional graphics, the registered contacts are visualized as columns of different color and height quantifying the intensity of the forces generated on occlusion.

T Scan helps to show the abnormal forces leading to trauma or pain in every tooth in the dental arch. This helps in balancing the forces on both sides of the dentition.⁵ In implantology, the requirement of specific concept of occlusion is needed. The age of patient, the condition of the alveolus, the position/direction of implants, the condition of remaining teeth, and other factors help in determining a plan for managing balanced occlusion.⁴ There are basically five main issues regarding unbalanced occlusion which are as follows : joint pain, muscle pain, broken teeth, worn teeth, and mobile teeth. It is therefore, critical for the clinician to carefully approach the diagnosis and treatments planning for maintaining a correct occlusion. Implant failure has been associated with excessive occlusal forces acting on implant prosthesis since there is absence of periodontal ligament which helps the natural tooth absorbs occlusal forces by providing a cushion effect.⁶ There are a number of features a T Scan which enable accurate measurement of occlusal forces. To indicate a balanced bite, there is "Centre of Force". The software of T Scan uses an icon which shows accurate location of balancing occlusion. T Scan also shows before and after measurements of the occlusal force. The technology also provides "Excursive Force Movements," which remove traumatic interferences. These results are helpful to load implants to preserve balanced occlusal forces.⁴



Figure 1: T Scan III™ System



Figure 2 : tscan with grid based sensor and USB cable.

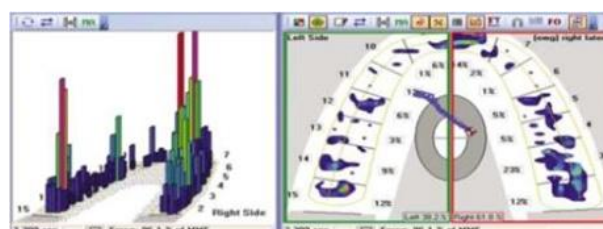


Figure 3: Software depicting three dimensional graphics, representing percentage graphics per tooth and two dimensional graphics.

DISCUSSION

T scan is a reliable source for analyzing the occlusion for further treatment planning of evidence based clinical decisions, in clinical dental treatments and research.⁷ It has an additional ability of quantifying occlusal contact timings and forces over conventional static occlusal indicators. From the periodontal point of view, the occlusal discrepancies deepen the probing depths and worsen the prognosis. Selective grinding and treatment of occlusal discrepancies have been the treatment modalities to maintain periodontal health. A number of researches have indicated that T Scan system can be used as a measurement tool in clinical experiments in measuring occlusal forces at different ranges because occlusal forces affect the teeth to a variety of forces by going through primary intra socket forces and secondary intra alveolar movements. Sadamori et al⁸ in their study analyzed and reanalyzed the occlusal force distribution using T Scan III™ system. The analysis presented a nearly equal distribution of forces and if these occlusal forces are unbalanced it could lead to temporomandibular disorders and masticatory muscle pain. Thus, the analysis of the distribution of occlusal loading forces using T-Scan III™ system provides an aid in treating and as well as managing the periodontal deterioration and preventing further periodontal breakdown.⁹ Qadeer et al¹⁰ in their study described that Computerized occlusal analysis using T-Scan III™ guides the selection of tooth contacts for occlusal adjustments. They also stated that T Scan provides objective digital data for determining the quality of the orthodontic end-result, and observing the occlusal force distribution in natural dentition. Liu et al¹¹ in their pilot study explained the various parameters of T Scan system like introduction time, occlusal center, track of occlusal center and percentage of occlusal force distribution, which can provide a reference for analyzing instant occlusal condition. This results in formation of a time track distribution of points of maximum occlusion and occlusal force through contact of the teeth with sensor. This was beneficial for quantitative research in occlusal equilibrium. The concept of occlusal equilibrium has been revolutionized through the evolution of T Scan from 1st generation to 8th generation. The product is now marketed in its third version as T-Scan III with software version 8.0. Moreover, the newer software

provides a better representation of the intraoral dental arch in the analysis program of the software when compared to previous versions.¹¹

Safety issues

T-Scan systems are classified as Class I devices by the FDA. They have been stated that these are not "life-supporting, life-sustaining or of substantial importance in preventing impairment of health and they do not present a potential unreasonable risk of illness or injury.

Limitations

The sensors of T Scan are supposed to be made relatively thin so as to provide more consistent record of contact points. However, these sensors are relatively thicker as compared to articulating papers. This can result in alteration of functional occlusion and can affect activity of masticatory muscles. So it is important for the clinicians to be aware of these limitations while recording the occlusal movements.³

CONCLUSION

The patient will have the best chance of treatment outcome when all the elements of teeth, muscles, joints, neurology, pain and occlusal forces are well balanced.¹ The T Scan system has been shown to correct occlusal discrepancies and thus contributing equal occlusal force distribution bilaterally in dental arch.² Further long term studies are required to check for the occlusion analysis and its correction in preventing further disease.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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