DIGITAL OCCLUSION

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ABSTRACT

Introduction: Continuous technological innovation gives the opportunity to dental practitioners to explore occlusal-articulation relationships digitally through the T-Scan system. The technology can be used in the cases where diagnosis and treatment of occlusion is required and is the only quantitative method of analysis.

Aim: To demonstrate the capabilities of the newest T-Scan Novus for digital occlusal analysis.

Materials and methods: 17 patients were examined, including 9 men and 6 women aged 20-45 years. Each of them had an inaccurate dentition, the first Engle's class. The investigations were made with a T-Scan Novus diagnostic apparatus consisting of a hardware and software part. The results obtained were analyzed using the latest version of the software (version 9.1).

Results: Registered occlusal contacts were illustrated as 2D and 3D graphic images on upper and lower arch models. The new and advanced features of the software provide detailed digital information about the registered occlusal-articulation, which improves and facilitates their analysis.

Conclusion: The system allows dental practitioners to accurately diagnose and facilitate treatment as they provide dynamic data on the forces of occlusal contacts in real time and T-Scan helps to receive balance occlusion.

Key words: occlusion, forces, T-Scan Novus.

Background: The modern concept of occlusion includes the relationship between teeth, masticatory muscles and temporomandibular joints in a function and dysfunction (1). A stable occlusion is created, when multiple contacts of equal intensity occur between teeth. The correct occlusal contacts provide axial loading of the teeth, create a stable centric occlusion and eliminate the stress in periodontium. According Korioth, for achieving the perfect occlusion, all the distal teeth need to exhibit simultaneity and the contacts need to be equally distributed (2).

Any premature occlusal contacts and occlusal-articulating blockages cause acute or chronic occlusal traumas which induces changes in the tooth-supporting tissues (4-8) (the gingiva, periodontal tissues, and bone), in the masticatory muscles and the temporomandibular joint (9, 10).

For the study of occlusion-articulation relations in daily dental practice occlusal indicators are used. Harmonic and balance occlusal contacts are the ultimate goal in any dental treatment (11).

Qualitative and quantitative methods are used for occlusal records and evaluation of the occlusal contacts (12, 13).The reliability and sensitivity of the occlusal indicators depends on the thickness, strength and elasticity of the recording materials, as well as the conditions of the oral environment and the interpretation of the dentist (14).

The qualitative occlusal indicators are articulating paper, articulating foil, articulating silk, occlusal indicator wax and impression materials (15). They determine only the location and the number of the occlusal contacts and cannot assess the sequence of occurrence of the contacts (16). The paper can readily highlight occlusal contacts, but cannot accurately quantify their intensity and measure the magnitude of the generated occlusal forces. Very often the size of the marking area from the articulating paper is considered representative of strength of the occlusal load, which is incorrect (17).

To avoid the subjectivity in the interpretation of the articulation paper markings dental research introduced the T-Scan occlusal analysis system (18).

By the means of the quantitative method for testing of an occlusion may be determined in the strength and sequence of occurrence of the occlusal contacts (19).

The continuous technological innovations give the opportunity to dental practitioners to explore occlusal-articulation relations digitally through the T-Scan system. In Boston 30 years ago Maness developed a system for computer occlusal analysis, called T-Scan (20). This system yields measurements in real time of occlusal forces recorded using an intraoral sensor (21). The first version of the device underwent a number of modifications and improvements in the software and the hardware to reach the latest version T-Scan Novus (22).

Various aspects of the occlusion-articulation relation have been investigated with the system T-Scan II (23, 24).

Cranham's publications demonstrate the opportunities of the T-Scan III system, according to which this is a much more accurate way of studying and analyzing occlusal articulation relationships (25).

Aim: To demonstrate the capabilities of the newest T-Scan Novus for digital occlusal analysis.

Material and methods: Seventeen patients (9 male and 6 female) were recruited in this study in Department of Prosthetics, Faculty of Dental Medicine, Medical University, Plovdiv. The age of the participants was in the range of 20 to 45 years. During the clinical examination, seven subjects were selected to meet the following criteria - intact dentition and Angle's class I jaw relations. Each of the patients studied were made 5 records.

The studies were conducted with a diagnostic apparatus T-Scan Novus, consisting of hardware and software part (Fig. 1). The main parts of the system are shown in Figure 2.

Fig. 1.T-Scan Novus systemFig.

2. 1 - The Novus Handpiece

2 - Sensor Supports

3 –Sensor

The Novus Handpiece is with a new ergonomic design compared to older versions of the system. Working with it is facilitated by buttons and indicators located on the upper surface.

Sensor supports ensures correct position of the sensor during the study of the occlusion.

The recording sensor is a U-shape and thickness of 100 μ. The latest generation is high resolution. They come in two sizes - large and small (Fig. 3).

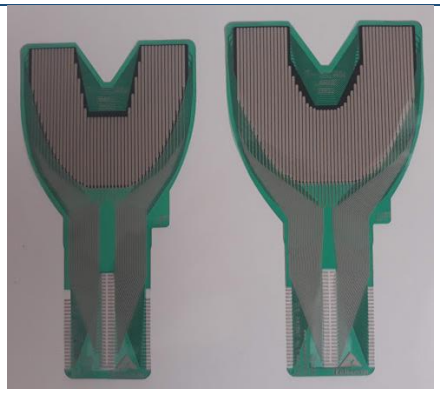

Fig. 3. T- Scan Novus sensor

Technique of recording - the patient is seated on the dental chair with the lower and upper parts of his body positioned at an angle of 90º.The selected size sensor is placed in the corresponding largest stand, connected to the scanner handle.The recording sensor is inserted intraorally between the dental arches so that the central mark is positioned between the central incisors of the patient (fig. 4).

Fig. 4. Proper positioning of the T-Scan registering sensor

Recording starts with pressing the button on the handlebar; the patient is instructed to occlude firmly to complete intercuspation.

The results of study were analysed using the latest version of the software – versions 9.1.

Results and discussion: We demonstrate the opportunities of the system T-Scan Novus in the study of the occlusion. Through which the registered occlusion-articulation relations are recorded in a film of the occlusion. This film can be stored in an individual file for each patient.

The software converts the data from the registered occlusal contacts and illustrates them on the screen as 2D and 3D images in different colours in a graphical model of the two dental arches (figure 5) that are individual for each patient.

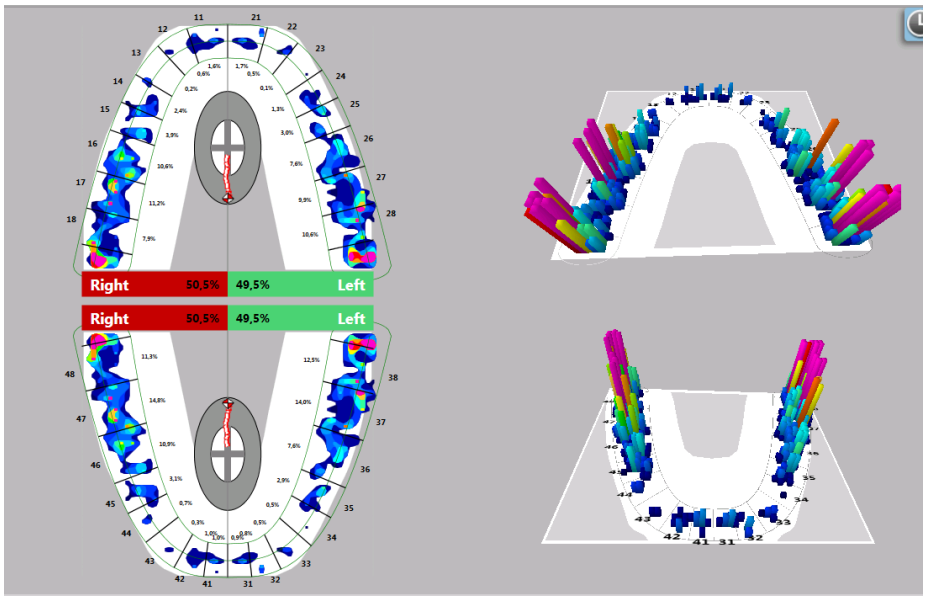

Fig. 5.2D and 3D view

The strength of occlusal load is colour coded, the maximal being shown in red, medium force in green and yellow and the minimal force in blue.

The model of the dental arch is divided into two quadrants, painted in different colors. The software calculates the applied occlusal forces in % for the left and right side of the dentition. Force placed on each tooth as a percentage, which is shown on the inside of the Arch Outline. Tooth numbers are shown on the outside of the Arch Outline. Each record can also show the centre of force and its trajectory, which indicate the balance of forces during occlusion (Figure 6).

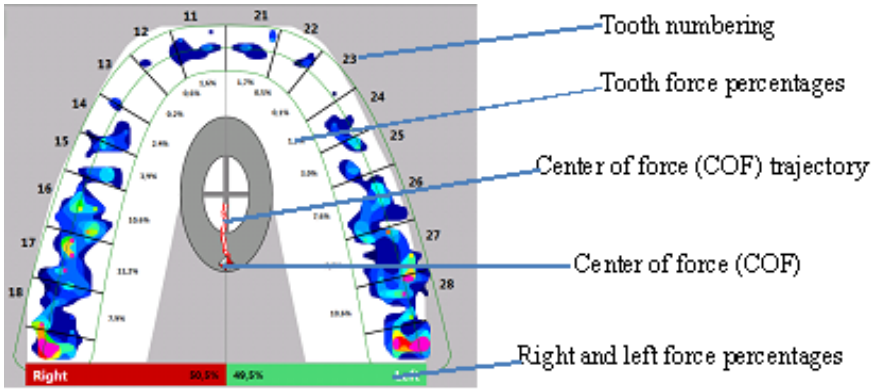

Fig.6. 2D Force View

The Arch Quadrants view divides the Arch model into four quadrants as following: left - anterior and posterior and right - anterior and posterior. Each quadrant is displayed in a different color (Fig. 7)

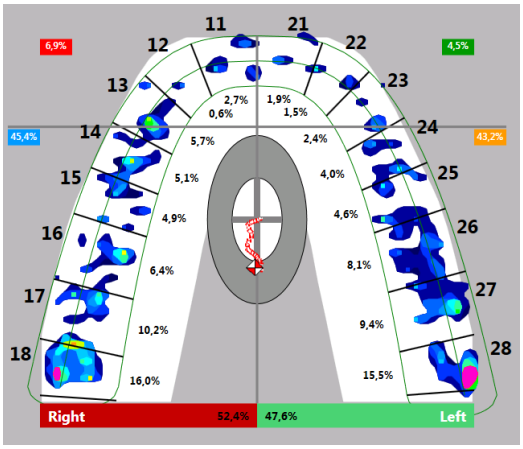

Fig. 7. Arch model into four quadrants

The Graph displays the force versus time for the patient's overall bite, from the initial contact up to the end of the record (fig. 8). Each graph line is color coded to provide an easy visual reference to areas of the Arch Model or individual teeth.

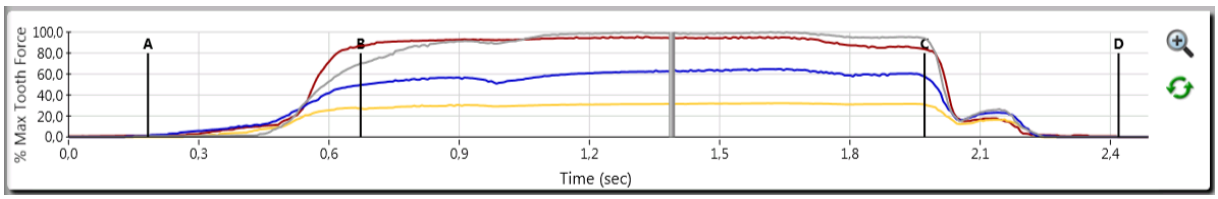

Fig. 8. Graph force/time

The timing Table displays the patient's total occlusal bite timing, and the force applied. Theselinesareused to marktwoseparatesets of positions (frames) of thescan. The A-B Increment/Differential lines denote the start and end of the Occlusion Time and the C-D Increment/Differential lines denote the start and end of the Disclusion Time (Fig. 9).

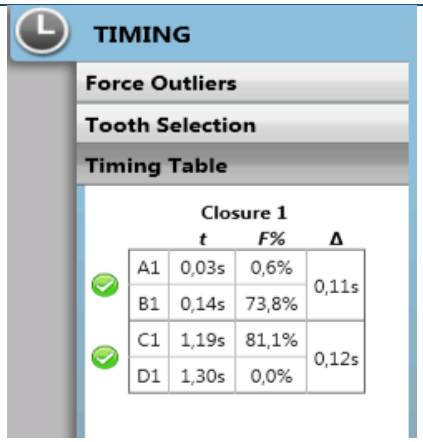

Fig. 9. Occlusion Time and Disclusion Time

The results of the T-Scan Novus study show that valuable information of both occlusal contacts time and localization as well as the occlusal forces.

Conclusion: The new and advanced features of the software provide detailed digital information about the registered occlusion-articulation ratios, which improves and facilitates their analysis.

The system allows the dental practitioners to accurately diagnose and facilitate treatment, as it provides dynamic data on the strength of occlusal contacts in real time and helps achieve a balanced occlusion

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