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Computerized Analysis of the Occlusal Balance in Patients with Circular Bridges.

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ABSTRACT

The success of the dental bridges and their longevity, among other factors, depends on achieving optimal inter occlusal balance. The aim of this investigation was to analyze the occlusal contacts in patients with circular dental bridges. Thirty patients with mandibular and maxillar circular bridges were subjected to occlusal analysis, using both articulating paper and T-Scan III computerized system. The analysis were performed during try-in procedure, after the cementation of the bridges and in 6 months recall visit. T-Scan III was used for measuring 4 parameters: distribution of occlusal contacts during maximal intercuspidation; maximal cumulative force; interceptive contacts and centar of force. The differences between the mean values of the occlusal contacts in the patients with circular bridges were not statistically significant in the test phase, after cementation and six months latter.

Keywords: occlusion, circular dental bridges, articulation, intercuspidation

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INTRODUCTION

The ideal occlusal morphology presents tripodization of the contacts and balanced bilateral contacts, but occlusion with its static or dynamic parameters, has individual characteristic for every patient [1]. Dental occlusal surfaces are changing during the life as result of normal and paranormal contacts influenced by abrasion, cavities, bruxism, traumas etc. It influence the teeth, periodontium, TMJ and neuro-muscular system in general [2]. Angle defined occlusion as normal relationship of inclined teeth planes when jaws are closed, while Andrew established six keys of normal occlusion [3]. Modern occlusal concept in artificial teeth in prosthodontics is balanced occlusion when instead of curvatures of Spee and Wilson, occlusal surfaces possess compensation curvatures [4].

The examination of the occlusal contacts and balance has always been great challenge for prosthodontists. The success or failure of dental crowns and bridges, among other factors, depends on achieving this balance. Despite modern technology, traditional methods are still part of the everyday clinical practice. Very often we rely our work on the personal "feelings" of the patients about occlusion of the dental bridges. Articulating paper is most commonly used to assess the bite forces, with red and blue marks left on the teeth surface. Big marks mean higher forces, little marks smaller, but according to Kerstain [5] it does not accurately measure in quantifiable way. New technology device using computerized measuring of occlusal contacts T SCAN system was presented as breakthrough in attempts for obtaining the correct contacts, and it is probably the only reliable method today [6,7].

The aim of the paper is to examine and evaluate occlusal contacts through in-vivo study at patients with full arch circular metal-ceramic dental bridges with T SCAN III, instead of conventional articulation paper usually used for balancing occlusal contacts.

MATERIALS AND METHODS

For the purpose of the examination we made full arch circular metal-ceramic dental bridges in 30 patients (both male and female, age 30-50) where antagonist teeth were repaired with conservative fillings or intact. Our patients received their bridges at the university dental clinic (The Faculty for Dental Medicine in Skopje, Macedonia). The analysis of the occlusal contacts was made with two different methods: articulating paper and T SCAN III (Tekscan Inc., South Boston, MA, USA). Patients occlusal bite forces were examined three times, during the tray in visit, after definite fixation and 6 month after cementation of the bridges. We registered and analyzed the occlusal contact in the frontal and lateral region of the jaw, in both ways, while T SCAN III also measured four parameters: distribution of the occlusal forces in maximal intercuspidation position, maximal cumulative force, interceptive contacts and center of the force.

EXPERIMENTAL

Each of the patients was examined first with conventional, descriptive method, with extra thin red/blue articulating paper (Bausch, Extra Thin 0.0016"). The paper was placed between the teeth on the top of the restoration, on both left and right side of the mouth. Then patients were instructed to close and open their jaws in central position, and to do lateral and protrusive movements of the mandibula. The articulating mark areas were then compared with the measurements made with T SCAN III system.

The T SCAN III digital system is composed of a computer with a software capable of converting information recorded by the sensor into visual and numerical information of tooth contacts. For the experiment we used small and large sensor handle supports with appropriate ultra-thin sensors (100 microns thick**)**. The recording was taken by placing the sensor in the patient's mouth, with the sensor support pointer between the two central incisors and keeping the scanning handle as parallel to the occlusal plane as possible. Then we instructed the patient to bite on the sensor with normal force, until the first tooth contact caused the system to record. Statistical analysis of the collected data was made, we used Student t-test and Tukey honest significant difference (HSD) test.

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RESULTS AND DISCUSSION

The success and failure of the prosthodontic treatment, especially in patients with full arch-circular bridges, where the occlusal surface is completely changed, is based on achieving optimal occlusal balance. This balance give efficient masticatory function and longevity of the restorations [8]. The fundamentals of gnatology were set up many years ago, and they include the concept of centric relation, anterior quittance, vertical dimension, intercuspal design and position of the lower jaw determined with different methods and instrumentarium. FPD must restore both gliding tooth contacts in the frontal area, and vertical dimension in the posterior, so they provide mutual protection from overloading contacts that can lead to failure of the abutment, cement bonding and restoration damage [9, 10].

T-Scan III Computerized Occlusal Analysis System as method for evaluating occlusal contacts and balance in FPD should overcome limitation of other descriptive tools (articulating paper, wax) and should minimize the mistakes from incorrect occlusal contacts. Many studies [11, 12] showed that for clinician sometimes is hard to obtain and identify optimal contacts, so in our study we made 30 ceramic dental bridges and adjusted the contacts with T SCAN system and evaluate them during three visits (tray-in, immediately after fixation and 6 months after cementation).

Results from the investigation were gathered by analysing the occlusal contacts showed in 2D and 3D occlusal view. Beside graphical presentation of the force, we were also able to quantify (measure) the force and its distribution on every tooth, and along dental arches too. Most of the analysed occlusal contacts were equally and evenly positioned left and right of the median line (Table 1).

Table 1. Mean values of the occlusal contacts left and right of the median line during MIC, MCF and DELTA

Patients	MIC				MCF				DELTA			
	Average left	Average right	±SD left	±SD right	Average left	Average right	±SD left	±SD right	Average left	Average right	±SD left	±SD right
tray-in	20.9	19,7	8.7	9,6	28.1	24,7	24.7	23,0	8.4	6,3	24.9	22,0
after fixation	18.7	17,9	8.3	8,3	26.3	23,1	21.8	21,1	6.0	4,5	19.2	16,0
6months after fix.	16.3	15,3	7.9	6,7	21.2	19,3	13.7	13,0	3.7	2,6	10.7	8,2

Statistical analysis of the data with Student t-test showed no significant statistical differences among occlusal contacts left and right of the line mediana during MIC (maximal intercuspidation), MCF (maximal cumulative force) and DELTA, in three visits: tray-in, after fixation and 6 months after (Table 2). The Delta feature is intended to identify the differences between the Max and MA movie frames, and is used to demonstrate areas representing slides and potential interceptive contacts otherwise difficult or impossible to register.

Table 2. Statistical difference among occlusal contact on the left and right side during MIC, MCS and DELTA

Tested group		Occlusal contacts on the left side		Occlusal contacts on the right side		t-test p
		Average	±SD	Average	±SD	
Tray-in first visit	MIC	20.9	8.7	19.7	9.7	0.6159
	MCF	28.1	24.7	24.7	23.0	0.5832
	DELTA	8.4	24.9	6.3	22.0	0.7305
After the fixation	MIC	18.7	8.3	17.9	8.3	0.7103
	MCF	26.3	21.8	23.1	21.1	0.5657
	DELTA	6.1	19.2	4.5	16.1	0.7278
6 months after fixation	MIC	16.3	7.9	15.3	6.7	0.5990
	MCF	21.2	13.7	19.3	13.0	0.5837
	DELTA	3.7	10.7	2.6	8.2	0.6566

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The study of McDevitt and Warreth had showed wide variety and asymmetry of occlusal contacts distribute in MIC, MCS and DELTA in patients with normal dentition. According their investigation of occlusion in the restorative dentistry, every restorative treatment should reduce any possible unwanted effects caused by occlusal interference [13, 14]. Proper design also maintain good occlusal relationship between opposing teeth resulting comfort and function for long-term success. Our results showed satisfactory occlusal balance after occlusal adjustment with T SCAN in the first visit, and this results were continuous in the period after cementation and control visit after 6 months, in every analysed interocclusl position.Occlusal forces were measured in the position of maximal intercuspation (MIC), and the average values of the occlusal forces showed no statistical differences during three visits. (Table 3).

Table 3. Tukey honest significant difference (HSD) test for differences of the average values of the number of occlusal contacts during MIC, MCF and DELTA in three visits

TESTED GROUP NO. 30		TUKEY HSD TESTP
MIC	Tray-in first visit	0.9242
	After the fixation	0.5741
	6 months after fixation	0.9114
MFC	Tray-in first visit	0.9912
	After the fixation	0.6984
	6 months after fixation	0.8577
DELTA	Tray-in first visit	0.9724
	After the fixation	0.8241
	6 months after fixation	0.9735

T-Scan III helped us analysed the order of the occlusal contacts while simultaneously measuring the force percentage changes of those same contacts, from the moment the teeth first made occlusal contact, all the way through to maximum intercuspation. It enabled us to assess the force changes, during the process of contact evolution (Table 4).

Table4. Student-test for Statistical signification of the differences between average values of percentage of the force on the left and right side

PATIENTS NO 30	% OF FORCE ON THE LEFT SIDE		% OF FORCE ON THE RIGHT SIDE		T-TEST P
	average	±SD	average	±SD	
	51.0	7.5	49.0	7.6	0.3092

Computer-guided occlusal adjustments was used to alter any poorly contacting tooth sequence into a contact sequence where multiple equal-intensity contacts occurred simultaneously throughout the arches bilaterally. T-Scan III also quantified the amount of relative occlusal force, which enabled us to predictably identify and locate traumatic occlusal contacts.

COF (Centre of force) presented by red-white diamond shape mark, is situated in MIC in 'normal" occlusion in smaller white ellipse in 68% of the patients, while surrounding grey ellipse present 95 % (Figure1).

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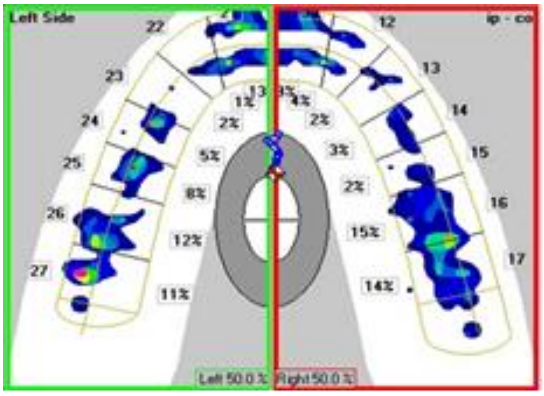

Figure 1. COF centre of force (red-white mark)

Our results showed that 53, 3 % of the tested patients with circular bridges had their COF located in the white field, 36, 7% in the grey ellipse, while only 10 % had COF dislocated outside of the grey field.

Force Centering as an occlusal adjustment can be applied to full arch dental prosthesis including full arch implant reconstruction, porcelain fused to metal full arch prostheses, crowns, bridges, fixed and removable combination construction [15, 16,17].

CONCLUSIONS

Analyzing the results of the study, it can be concluded that:

1. Patients with full arch circular bridges included in the investigation had no significant statistical difference in the number and position of the occlusal contacts left and right of the median line and in MIC, MCF and DELTA during three patients visits.
2. Computerized method reduces the subjective interpretation of occlusal analysis data and provides accurate registration of static and dynamic occlusal information.
3. Therefore we can recommend the use of T-Scan III system in clinical practices for the diagnosis and occlusal optimization, due to its capability of measuring occlusal force and contact timing.

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REFERENCES

[1] Sodeyama A. Shinogaya T. Matsumoto M. Reproducibility of maximal bite force distribution over dentition. Kokubyo Gakkai Zasshi.1998;65(3):339-43.
[2] Lazić V. Živković S. Popović G. Kompjuterska analiza okluzije T-ScanII sistemom. Serbian Dental J. 2004; 51: 24-9.
[3] Kerstein RB. Combining technologies: a computerized occlusal analysis system synchronized with a computerized electromyography system. Cranio 2004;22(2):96-109.
[4] Kerstein RB. Current applications of computerized occlusal analysis in dental medicine. Gent Dent. 2001;49(5):521-30.
[5] Kerstein R. Understanding and using the " Center of Force ", Dentistry Today, 1998; (4):116-119.
[6] McDevitt WE, Warreth AA. Occlusal contacts in maximum intercuspation in normal dentitions. J Oral Rehabil. 1997 24(10):725-34.
[7] Beyron H. Occlusion: point of significance in planning restorative procedures. J Prosthet Dent. 1973;30(4):641-52

[8] Alstergren P. Determinants of a healthy aging dentition: freedom in the retrusive range of occlusal contacts and multidimensional freedom for functional tooth contact. Int J Prosthodont 2003; 16 Suppl: 79-80.
[9] Carey J, Craig M, Kerstein RB, et al. Determining a relationship between applied occlusal load and articulation paper mark area. The Open Dentistry Journal. 2007; 1:1-7.
[10] Preston JD. A reassessment of the mandibular transverse horizontal axis theory. 1979. J Prosthet Dent 2004; 91:505-12.
[11] Kerstein RB. Articulating paper mark misconceptions and computerized occlusal analysis technology, Dent Implantol Update. 2008 Jun; 19(6):41-6.
[12] Gümüs H.Ö., Kılınç H.I., Tuna S.H., Ozcan N. Computerized analysis of occlusal
a. contacts in bruxism patients treated with occlusal splint therapy. J Adv Prosthodont2013; 5 (3): 256-261.
[13] Warreth, Abdulhadi. Fundamentals of occlusion and restorative dentistry. Part II: occlusal contacts, interferences and occlusal considerations in implant patients.Journal of the Irish Dental Association 2015; 61 (5): 252-259.
[14] Droter JR, T- Scan as a patient education Tool, 2015. Handbook of Research on Computerized Occlusal Analysis Technology Applications in Dental Medicine', pp.672-73.
[15] Reeta J1, Ravudai J, Shweta B, Swati A.T- Scan a digital pathway to occlusal perfection: a review.Annals of Prosthodontics and Restorative Dentistry, October-December, 2015;1(1):32-35.
[16] Mariana Dimova. Occlusion and articulation in bruxismand bruxomania investigated with thesystem t-scan III. J of IMAB. 2014; 20, (5): 665-660.
[17] TEKSCAN.T-Scan Clinical Application Sheet.Tekscan, Inc. 307 West First St., S. Boston, MA 02127.Website: www.tekscan.com. July 2002.