Open Access Maced J Med Sci electronic publication ahead of print,
published on August 08, 2017 as https://doi.org/10.3889/oamjms.2017.094

ID Design 2012/DOOEL Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences.
https://doi.org/10.3889/oamjms.2017.094
eISSN: 1857-9655
Stomatology

Differences between Subjective Balanced Occlusion and Measurements Reported With T-Scan III

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Citation: Lila-Krasniqi Z, Shala K, Krasniqi TP, Bicaj T, Ahmedi E, Dula L, Dragusha AT, Guguvcevski L. Differences between Subjective Balanced Occlusion and Measurements Reported With T-Scan III. Open Access Maced J Med Sci. https://doi.org/10.3889/oamjms.2017.094

Keywords: Balanced occlusion; Dental occlusion; Temporomandibular disorder; T-Scan III; Traumatic occlusal interferences.

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Received: 25-Mar-2017; Revised: 13-May-2017; Accepted: 14-May-2017; Online first: 08-Aug-2017

Funding: This research did not receive any financial support.

Competing Interests: The authors have declared that no competing interests exist.

Abbreviations: TMD: Temporomandibular disorders; SG: Study Group; CG: Control Group; MHI: Maximum Habitual Intercuspation; TMJ: Temporomandibular Joint.

Abstract

BACKGROUND: The aetiology of Temporomandibular disorder is multifactorial, and numerous studies have addressed that occlusion may be of great importance in the pathogenesis of Temporomandibular disorder.

AIM: The aim of this study is to determine if any direct relationship exists between balanced occlusion and Temporomandibular disorder and to evaluate the differences between subjective balanced occlusion and measurements reported with T-scan III electronic system.

MATERIAL AND METHODS: A total of 54 subjects were divided into three groups, selection based on anamnesis-responded to a Fonseca questionnaire and clinical measurements analysed with electronic system T-scan III. In the I study group were participants with fixed dentures with prosthetic ceramic restorations. In the II study group were symptomatic participants with TMD. In the third control group were healthy participants with full arch dentition that completed a subjective questionnaire that documented the absence of jaw pain, joint noise, locking and subjects without a history of TMD. The occlusal balance was reported subjectively through Fonseca questionnaire and compared with occlusion analysed with electronic system T-scan III.

RESULTS: For attributive data were used percentage of the structure. Differences in $P < 0.05$ were considered significant. After distributing attributive data of occlusal balance subjectively reported and compared with measurements analysed with electronic system T-scan III were found significant difference $P < 0.001$ in all three groups.

CONCLUSION: In our study, it was concluded that there were statistically significant differences of balanced occlusion in all three groups. Also it was concluded that subjective data are not exact with measurements reported with electronic device T-scan III.

Introduction

Temporomandibular disorder (TMD) occurs with a dysfunction associated with pain in the muscles of mastication [1]. Accordingly, the symptoms of patients with TMD are musculoskeletal in essence and mostly derive from long-lasting muscle hyperactivity [2]. Several electronic instruments and radiological techniques have been proposed over the years in the attempt to integrate clinical evaluation of TMD patients [3]. Some studies have evaluated and reported the important role of occlusal alteration and strong correlation between occlusal interferences and TMD [3-6].

Nevertheless, currently, the role of occlusion in TMD is increasingly recognized as a controversial issue between clinicians and researchers, [7] there are multiple recognized occlusal disorders (traumatic occlusal interferences, phantom bites, attrition, unstable intercuspal position, and severe morphologic malocclusions [8].

TMD symptoms were evaluated by a structured questionnaire, and clinical signs/symptoms were evaluated during clinical examination [9].

Careful analysis of occlusal contacts should be performed in every fixed restoration in order to avoid the creation of iatrogenic interferences that can produce the signs and symptoms of TMD [10, 11] and not to conduct a disharmonic relation between the arches [12-17].

The traditional procedure based on subjective interpretation of the articulating paper marks is an

ineffective clinical method for determining the relative occlusal forces of tooth contacts, and thus a poor guideline for performing occlusal balance [18].

Studies repeatedly show that it can be very difficult for a clinician to predictably identify which occlusal contact has more force than the others nearby when using articulating paper alone [19-21].

The aim of this study is to determine if any direct relationship exists between balanced occlusion and TMD and to evaluate the differences between subjective balanced occlusion and measurements reported with electronic system T-scan III (Tekscan Inc., South Boston, MA, USA).

Material and Methods

This research has been realized in: Faculty of Medicine, School of Dentistry, Pristina, Kosovo and in Faculty of Dentistry, Skopje, Republic of Macedonia.

The study population consisted of total 54 participants.

The study population was divided into three groups:

• In the first study group (SG I) were participants with fixed dentures with prosthetic ceramic restorations

• In the SG II were symptomatic participants with TMD. Participants also underwent clinical and dental examination for signs and symptoms commonly associated with TMD or internal derangements. In this group were excluded patients with orthodontic problems or pretreated with the orthodontic device.

• In the third SG III-CG were healthy participants with full arch dentition that completed a subjective questionnaire that documented the absence of jaw pain, joint noise, locking and subjects without a history of TMD.

In order to obtain clinical study, the selection was based on anamnesis-responded to a Fonseca questionnaire on the self-perception of the balanced occlusion of the patients and clinical measurements analysed and compared with electronic system T-scan III.

The study has been initiated after the subjects had signed informed consent forms, and the research program had been approved by the Ethical Committee. All the subjects are examined clinically by the same trained dentist and answered the questionnaire for TMD-the anamnesis index proposed by the Fonsseca [22-25].

Using a simplified questionnaire, they were able to recognize unnoticed symptoms that could lead to wear or a greater disorder of the stomatognathic system [23]. The Fonseca's questionnaire follows the characteristics of a multidimensional evaluation. It is composed of 10 questions, which include checking for the presence of pain in temporomandibular joint, head, back, and while chewing, parafunctional habits, movement limitations, joint clicking, the perception of malocclusion and sensation of emotional stress [24-28].

With this questionnaire, an even non-patient population that was unaware can be identified that they had TMD (Fig. 1).

		NO	SOMETIMES	YES
1	Do you have difficulty opening your mouth wide?			
2	Is it hard for you to move your mandible from side to side?			
3	Do you feel fatigue or muscle pain when you chew?			
4	Do you have frequent headaches?			
5	Do you have neck pain or a stiff neck?			
6	Do you have ear aches or pain in that area (TMJ)?			
7	Have you ever noticed any noise in your TMJ while chewing or opening your mouth?			
8	Do you have any habits such as clenching or grinding your teeth?			
9	Do you feel that your teeth do not come together well?			
10	Do you consider yourself a tense (nervous) person?			

Figure 1: Picture of Questioner for Assessment of Prevalence and Severity of Temporomandibular Disorders (Fonsseca)

In this study, focus was in one of the questions about subjective feelings of the participants about balanced occlusion. On the other hand is used The T-Scan III - Computerized Occlusal Analysis System to measure the occlusion from maximum habitual intercuspation (MHI). Sensitive sensors that are used senses and analyses occlusal contact forces using pressure and those are shaped to fit the dental arch [29, 30].

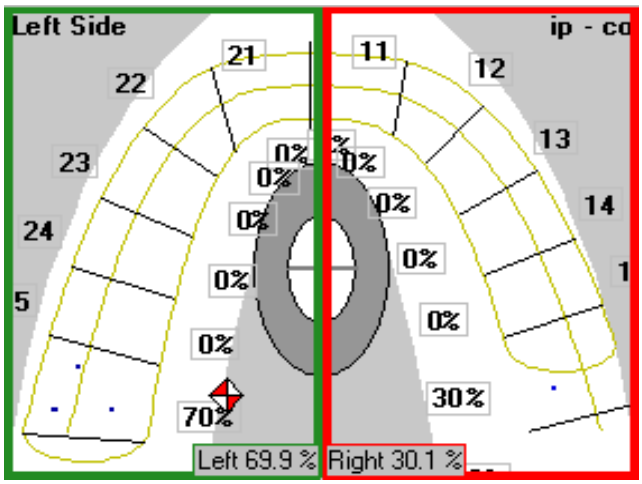

Figure 2: First contact points at TMD patients

The following aspects were recorded for the

evaluation of balanced occlusion: number of teeth present, the number of occlusal interferences [31] all starting from MHI. T-Scan system readily identifies the very first contact point (Fig. 2, 3) that precedes numerous other contact points that transitorily occur during maxilla-mandibular functional movements.

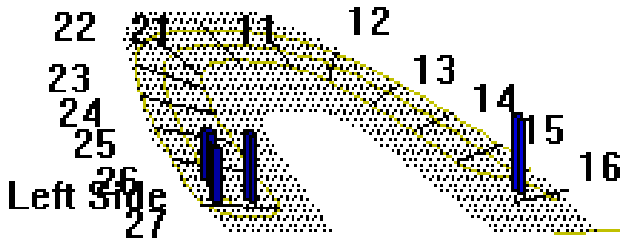

Figure 3: 3D First contact points at TMD patients

This enables the clinician to identify better many interfering contacts that are not readily identified by articulation paper markings (Fig. 4) [32].

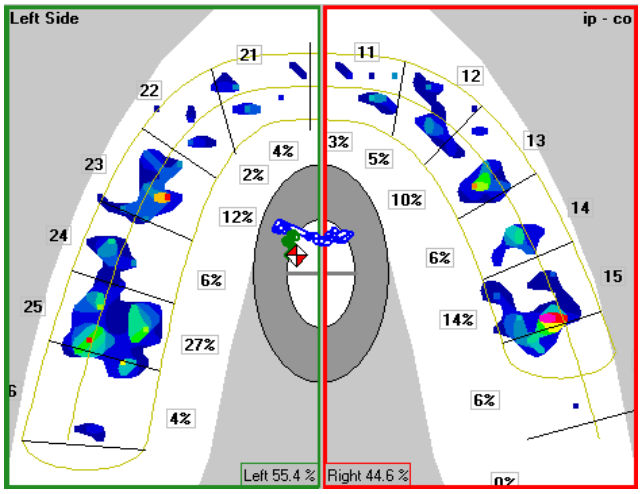

Figure 4: T-scan III helps identify many interfering contacts

A patient simply bites down on a thin sensor of the handle that is connected to the computer and the software displays the timing of contacts and levels of force in a dynamic movie [33].

Occlusal force, presented by percentage (automatically by the T-scan electronic system) was analysed in MHI.

The T-scan III (Tekscan Inc., South Boston, MA, USA), is a bite analysis system that measures the efficiency of how teeth come together and separate and overcomes the known limitations of articulating paper (Fig. 4), it quantifies and displays relative occlusal force information that often occurs from relying solely on the combination of dental articulating paper and patient feel [29-31, 34-38].

Data analysis

For data were used Statistical Package Statistica 7.1 for Windows (StatSoft. Inc., Tulsa, OK 74104, USA). Data were presented with Fisher exact test, Kruskal-Wallis ANOVA by Ranks (H), t-test, independent by groups (t) and Mann-Whitney U Test (Z), also the percentage of the structure were used for attributive data.

Differences in $P<0.05$ were considered significant. All data are presented in Table 1.

Results

The study population consisted of total 54 participants. The study population was divided into three groups.

The first study group (SG I) analysed according to gender and age consisted of 17 participants, 8 (47.06%) men, and 9 (52.94%) females with age range from 22 to 65, mean age 56.35. Second study group (SG II) consisted of 14 participants, 5 (35.71%) men, and 9 (64.29%) females with age range from 23 to 58, mean age 33.93, and CR consisted of 23 participants, 6 (26.09%) men and 17 (73.91%) females with age range from 20 to 35 years mean age 25.43.

After descriptive analysis of the three SGs for the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-Scan III, the value of $P<0.001$ (P = 5.2E-0.6) for distribution data was found significant (Table 1).

Table 1: Subjective feeling of occlusal balance compared with T – scan III measurements at three groups

	Subjective feeling		T-scan III measurements		
Group I (n =17)	Count	%	Count	%	P = 1.00
Unbalanced	9	52,94	17	100,00	
Balanced	8	47,06	0	0	
Group II (n = 14)	Count	%	Count	%	P = 0.02
Unbalanced	9	64,29	7	50,00	
Balanced	5	35,71	7	50,00	
Group III (n = 23)	Count	%	Count	%	P = 1.00
Unbalanced	1	4,35	8	34,78	
Balanced	22	95,65	15	65,22	

There were significant differences between Fixed bridges and group with TMD (P=6.8 E-05). There were significant differences between Fixed bridges and Control group (P=8.2 E-05). There were significant differences between groups with TMD and Control group (P=0.02).

Results of 8 (14.81%) patients from the SGI with fixed dentures had subjective feelings for balanced occlusion and the same patients analysed with T-Scan III had unbalanced occlusion. 9 (16.67 %) patients had subjective feelings for unbalanced occlusion and the same patients analysed with T-Scan III had unbalanced occlusion. Results of this distribution data for $P > 0.05$ (P = 1.00) was not significant (Tabel 1).

Five (5) (9.26%) patients from the SG II with

TMD had subjective feelings for balanced occlusion, and the same patients analysed with T- scan III had balanced occlusion too. Nine (9) (16.67 %) patients had subjective feelings for unbalanced occlusion from which 2 (3.70%) had balanced occlusion analysed with T-Scan III, and 7 (12,96%) had unbalanced occlusion. Results of this distribution data for P<0.05 (P = 0.02) was significant (Tabel 1).

At the SG III control group, 22 (40.74 %) healthy participants had subjective feelings for balanced occlusion from which 14 (25.93%) healthy participants analysed with T- scan III had balanced occlusion too, but 8 (14.81%) healthy participants analysed with T- scan III had unbalanced occlusion. One (1) (1.85%) healthy participant had a subjective feeling for unbalanced occlusion, and the same one had balanced occlusion analysed with T –Scan III. Nine (9) (16.67 %) patients had subjective feelings for unbalanced occlusion from which 2 (3.70%) had balanced occlusion analysed with T-Scan III. Results of this distribution data for *P* > 0.05 (*P* = 1.00) was not significant (Tabel 1).

Descriptive analysis of the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-Scan III in the relation between the group with Fixed bridges and group with TMD. Value of P < 0.001 (P = 6.8E-05) for distribution data was found significant (Tabel 1).

Descriptive analysis of the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-Scan III between groups with Fixed bridges and Control group for the value of *P*<0.001 (P=8.2E-05) of distribution data was found significant (Tabel 1).

Also, descriptive analysis of the subjective feelings of participants for balanced occlusion compared with data received from balanced occlusion measured with T-Scan III between groups with TMD and Control group for the value of P < 0.05 (P = 0.02) of distribution data was found significant (Tabel 1).

Discussion

From the information gathered, it was evident that occlusal interferences can lead to the development of or to an increase in the severity of TMD.

Considering that many etiologic factors, such as parafunctional and postural habits, but also psychological and occlusal factors, are usually attributed to the onset of TMD and also to the perpetuation of the muscular-related disturbances [2], it is necessary to understand the anatomy and morphology of the Temporomandibular Joint (TMJ) in order not to misinterpret a normal situation as an abnormality [39].

Clinicians are interested that new restorations are fabricated in harmonious contact relative to the opposing teeth. Sometimes, however, the patient has tooth pain, and one of the possible reasons for tooth pain is excessive occlusal loading. In this context, it is necessary to evaluate the tooth for the presence of a super contact [7].

In order to obtain and compare results from different clinical studies, there was a need for using reliable and valid instruments to measure TMD severity within the sample, which also consisted of nonpatient volunteers who could present TMD symptoms [28, 35].

The T-Scan III system is a quantitative and reliable method for occlusal evaluation and represents a potential substitute for occlusal indexes [40].

In this study was found that subjective data are not exact with measurements reported with electronic device T-scan III, also after distributing attributive data of occlusal balance subjectively reported and compared with measurements analysed with electronic system T-scan III were found significant difference *P* < 0.001 in all three groups. TMD subjects had a significantly higher frequency of premature contacts and greater bilateral asymmetry in the occlusal force.

One surprising result in one of the studies was that occlusal asymmetry it was associated with contra lateral muscular asymmetry and the balancing of muscular activity is a more challenging goal than Centering the Occlusal Force which, on the other hand, is an immediate result [2]. These side-related discrepancies have been reported previously in several of Kerstein´s studies [41, 42].

The T-Scan III helps us to measurably adjust and create a balanced force distribution between the left and right arch halves. When comparing T-Scan III data with the paper markings, we can see the accidental force determination errors caused by observing paper mark shapes that appear to indicate teeth which are receiving more force, but in reality, when forces are measured with the T-Scan III, we find that another region is receiving more force.

The possibility that occlusal interference results in TMD have been investigated in one study in humans using a double-blind, randomized design. It was found that subjects without a history of TMD show fairly good adaptation to interferences. In contrast, subjects with a history of TMD develop a significant increase in clinical signs and self-report stronger symptoms (occlusal discomfort and chewing difficulties) in response to interferences [1].

Numerous etiological and therapeutic theories are based on this presumed association and have

been applied to justify the use of several therapeutic approaches, such as occlusal appliance and anterior repositioning appliance therapies, occlusal adjustment, restorative procedures and orthodontic and orthognathic treatments [43].

Conversely, many TMD experts hold opposing views [1], and various types of dental interventions, including routine orthodontic treatment, have been reported as causes of TMD [15]. In fact, these interferences can be formed by uneven tooth wear, but also by restorative procedures performed incorrectly, which can lead to a disharmony between the articulation of the teeth and the centric relation position of the TMJ [44]. The TMD group presented higher means regarding: age, time of chewing, the number of chewing strokes and TMD severity. Chewing time and type were positively correlated with TMD severity and negatively correlated with a number of occlusal interferences [45].

According to previous studies conducted on subjects with adequate occlusion and no dysfunction, the process occurs with symmetrical activity between the left and right masseter and anterior temporal muscles [32, 46].

However, in subjects with occlusal balancing side interferences and with unilateral crossbite, an altered and symmetrical pattern of muscle contraction has been observed by electromyography and by palpation during mastication [33, 46].

Also in one study, was tested that the condylar path and the lateral anterior guidance angles did not differ between the symptomatic and nonsymptomatic side among individuals with chronic unilateral TMD [47].

In our study, it was concluded that there were statistically significant differences of balanced occlusion in all three groups with predomination of the disharmonic relation between the arches with an overload of the occlusal force on the one side at the groups with TMD and fixed dentures. Also, it was concluded that subjective data are not exact with measurements reported with electronic device T-scan III.

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