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Assessment of Disclusion Time and Occlusal Force Distribution in the Iraqi Patients with TMJ Internal Derangement Using T-Scan

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ABSTRACT

Objective: Is to evaluate the effects of occlusal instability (disclusion time in the lateral and protrusive mandibular movement and the occlusal forces distribution) in Iraqi patients with intraarticular joint disorder (disc displacement) in the temporomandibular joints using the T-Scan NOVUS digital occlusal analysis system. Materials and Methods: case-control study design. Subjects of both genders (>19 years old) were selected for both patients and control according to the inclusion criteria; subjects should have full dentition with angle class I relation. Patients with TMJ disc displacement (internal derangement) were diagnosed according to DC/TMD. Digital occlusal evaluation of the occlusal parameters; disclusion time and occlusal force was performed using the T-Scan 10 (NOVUS) for both patients and control group. Results: One hundred and nine (109) subjects were participated in this study with age range (19-45 years old) and divided into two main groups: (84) patients TMD group with signs and symptoms of intraarticular joint disorders and (25) healthy control free from signs and symptoms of TMD. Significant prolonged disclusion time at (p=0.004) and asymmetry of occlusal forces at (p=0.03) were registered in the right lateral side of the mandibular movement in TMD patients in comparison to control. Conclusion: Prolonged disclusion time with the asymmetry of occlusal forces in Iraqi patients with TMJ internal derangement in the lateral excursive mandibular movement.

Keywords: T-Scan, Disclusion time, TMJ, TMD, Disc displacement, Internal derangement

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INTRODUCTION

The Internal Derangement (ID) in temporomandibular joints consider as one of the most common category of temporomandibular disorders (TMDs), comprising 41.1% of patients with TMD. The ID of TMJ is defined as a joint dysfunction associated with an abnormal disc position [1,2]. Schiffman and colleagues in (2014) published a specific diagnostic criterion for the diagnosis and management of patients with TMDs (DC/TMD) [3]. Occlusion is "the static relationship between the incising or occlusal surfaces of the maxillary or mandibular teeth. The occlusion should be balanced and as stress free as possible". For perfect functioning, the occlusion need to be in harmonization with other structures of the stomatognathic system, any improperly distributed occlusal forces that occur during occlusion can adversely affect other parts of the stomatognathic system: the dentition, periodontal tissue, muscles of mastication and Temporomandibular Joints (TMJs) [4]. A comprehensive dental examination should evaluate all factors that could cause pain or deterioration in these structures. Assessing the occlusion is an integral part of this procedure. Bilateral, even contacts on posterior teeth decrease the force on each tooth. An arc of closure interference on a single posterior tooth concentrates all the force of closure on a single tooth. This adverse force stimulates a neurophysiological protective response via the mechanoreceptors of the periodontal ligament to program muscles to avoid the traumatic tooth contact [5]. Digital occlusal analysis (T-Scan) permits obtaining extra information about time of occlusion and disclusion of the teeth, the force of occlusion, and the force distribution on the mandibular right and left side [6-8]. Digital evaluation of the occlusion in patients with TMDs may allow assessing the association between occlusal factors and various pathologies within the temporomandibular joint [9, 10]. The Disclusion Time (DT) represent the time extended in seconds when the molars and premolars in the working and non-working side are in contact during lateral and protrusive mandibular movement, starting from their maximum

intercuspal position, until the canines, and/or incisors reaching contacts in their anterior guided surfaces. The DT should be in < 0.4 seconds per lateral and protrusive excursive movement [11].

MATERIALS AND METHODS

According to the inclusion criteria and DC/TMD, subjects of both genders were selected to participate in the present study. They were with an age above 19 years old. The subjects were recruited from the attendants to the teaching clinic of Oral Medicine clinic at the teaching hospital of College of Dentistry/ University of Baghdad and College of Dentistry/ Mustansiriyah University, during the period from April 2019 to January 2020. The study protocol was approved by the ethical committee of the College of Dentistry/ University of Baghdad. Informed consent was obtained from all the enrolled subjects. The diagnosis of the patients was done according to the diagnostic criteria for temporomandibular joint disorders, clinical protocol, and assessment instruments (DC/TMD). Digital evaluation of occlusal parameters of all the included subjects was performed using the T-Scan NOVUS (T-Scan, Tekscan, Inc., S. Boston, MA, USA), as shown in figure 1.

The subjects involved in the study were divided into: Group I (TMD Group): Consist of patients with TMJ internal derangement. The Patients were also subdivided into four groups: (Group 1: Patients with disc displacement with reduction. Group 2: Patients with disc displacement with reduction, with intermittent locking. Group 3: Patients with disc displacement without reduction, without limited opening. Group 4: Patients with disc displacement without reduction, with limited opening). Group II (Control Group): Consisted of subjects who were clinically healthy and free from signs and symptoms of TMD. The inclusion criteria were: Subjects of both groups (patients and controls) should have full dentition with angle class I relation. Subjects with good general health with no history or signs and symptoms of any systemic diseases. Patients with TMJ pain and clicking with/or without limitation of mouth opening. T-Scan provides a video with 2D or 3D materials.

The occlusal analysis provided by these videos can detect the occlusal force and the times of disclusion of the occluded teeth during side to side movements or forward mandibular movement. The sensor conducted the data on the occlusal time and force to the computer program in real-time. For data analysis, the asymmetry of maximum occlusal force Index was used to measure the difference of the occlusal force between both mandibular sides. It is calculated as follows: "Max. AOF (%) = occlusal force of left side – the occlusal force of right side/total occlusal force * 100%" [12]. Statistical data analysis of the study under the application of the statistical package (SPSS) ver. (22.0). Descriptive data analysis: Mean value, Standard Deviation. Inferential data analysis: Mann-Whitney U test and t-test.

RESULTS

One hundred and nine subjects were participated in this study with age range (19-45 years old) and divided into two main groups: 84 patients TMD group with signs and symptoms of intraarticular joint disorders healthy control free from signs and symptoms of TMD Regarding the TMD group, the patients group is subdivided into four subgroups, included: Group1: includes 26 (30.95%) patients with a disc displacement with reduction, Group 2: includes 22 (26.19%) patients with disc displacement with reduction, with intermittent locking, Group 3: includes 21 (25%) patients with disc displacement without reduction, without limited opening, Group 4: includes 15 (17.86%) patients with disc displacement without reduction, with a limited opening, showed 6(40%) were males and 9 (60%) were females. A summary statistic for (Disclusion time DT, Right Force and Left force) parameters concerning studied groups among different locations (left lateral movement, Right lateral movement and protrusion), shown in table 1. The data were presented as Mean±SD.

A Mann-Whitney U test's statistic for testing Disclusion time readings between TMD group and control in different locations, which indicating that there is no significant difference at P>0.05 are accounted in (left lateral and protrusion), except with the right lateral location, which was recorded highly significant level at P=0.004. As shown in Table 2.

Figure 1: T-Scan Components.

Table 1: The summary statistic for (Disclusion time, occlusion time, left force and right force) parameter concerning studied groups on Right lateral and Left lateral movements.

	Group1	Group2	Group3	Group4	Control
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Right Lateral					
DT	0.30±0.28	0.15±0.17	0.21±0.26	0.25±0.26	0.10±0.11
Right Force	78.40±24.56	84.85±20.78	74.70±28.88	71.83±25.87	87.56±21.43
Left Force	20.83±23.64	15.15±20.78	25.72±28.57	28.10±25.36	12.43±21.43
Left Lateral					
DT	0.20±0.23	0.22±0.25	0.22±0.26	0.26±0.32	0.16±0.20
Right Force	24.04±29.32	22.50±25.01	27.17±28.93	19.87±22.80	18.47±24.96
Left Force	74.62±29.01	75.90±24.67	72.87±28.95	80.11±22.86	81.53±24.95
protrusion					
DT	0.23±0.32	0.26±0.33	0.29±0.32	0.23±0.24	0.17±0.20
Right Force	55.55±28.23	54.62±22.80	58.56±30.04	58.69±26.85	55.69±22.18
Left Force	44.07±28.09	43.79±22.36	40.77±29.91	41.31±26.85	44.29±22.19

Data were presented as Mean±SD

Table 2: Mann-Whitney U test for testing differences between patients and control readings concerning (Disclusion time) test of the studied locations.

Test Statistic	Locations	Right	Left	Protrusion
	Test Statistics	Lateral	Lateral	
	P-value			
Mann-Whitney U - test	Chi-Square	-2.848	-1.178	-0.989
	Asymp. Sig.	0.004HS	0.239	0.323

(*) HS: Highly Sig. at P<0.01; NS: Non Sig. at P>0.05

Table 3: Multiple Comparison's significant among studied groups concerning of studied locations concerning Disclusion time test.

		Right Lateral		Left		Protrusion	
Studied Locations				Lateral			
		P-value		P-value		P-value	
Group 1	Group 2	0.091	NS	0.764	NS	0.429	NS
	Group 3	0.274	NS	0.716	NS	0.205	NS
	Group 4	0.659	NS	0.883	NS	0.253	NS
	Control	0.004	S	0.257	NS	0.962	NS
Group 2	Group 3	0.494	NS	0.643	NS	0.592	NS
	Group 4	0.334	NS	0.939	NS	0.819	NS
	Control	0.145	NS	0.266	NS	0.459	NS
Group 3	Group 4	0.727	NS	0.825	NS	0.704	NS
	Control	0.027	S	0.5	NS	0.172	NS
Group 4	Control	0.043	S	0.581	NS	0.292	NS

Significant at P< 0.05; Non Significant at P> 0.05

The Multiple comparisons of probable pairs wised comparisons among different groups in light of different locations shows no significant differences at P>0.05, except of groups 1 and control at the right lateral at P=0.004, as well as a significant difference at P=0.027 was presented between group 3 and control at right lateral location. Group 4 and control also showed a significant difference p=0.043 right lateral locations, as shown in Table 3.

The significant comparisons of asymmetry of force index (right and left forces) between the TMD group and control group. Results showed that there are no significant differences p=0.17 and p=0.43 at (left lateral and protrusion respectively) locations. Only at Right lateral location there is a significant difference at p < 0.05. As shown in Table 4.

All probable comparisons among the studied groups are presented in the table 5 and results showed that there are no significant differences between groups at p >0.05, except, significant differences (p=0.04 and p=0.03) are registered at right lateral location between control group and each of group 3 and group 4 respectively.

DISCUSSION

Measureable analysis methods of the occlusion have been established to reduce the limits of qualitative occlusal evaluation. The accuracy of the system of T-Scan for recording the results was confirmed by multiple studies [13]. The T-Scan system provided a results that can be easily reproducible and documented the occlusal contacts, occlusal forces and occlusal times in dynamic

Table 4: Significant Comparisons of (Asymmetry of Force Index) between the studied groups distributed for different locations.

Locations	Groups	t-test	P-value (*)
	Control		
Right Lateral	TMD	1.88	0.03S
	Control		
Left Lateral	TMD	0.97	0.17NS
	Control		
Protrusion	TMD	-0.18	0.43NS
	Control		

Significant at P< 0.05; Non Significant at P> 0.05; t-test for testing equality of means of two independent groups.

Table 5: All probable pair's comparisons of Asymmetry of force index among studied groups for the studied locations.

Studied groups		Right Lateral	Left Lateral	protrusion
Group 1	Group 2	0.32	0.47	0.42
	Group 3	0.29	0.39	0.36
	Group 4	0.2	0.29	0.37
	Control	0.09	0.21	0.5
Group 2	Group 3	0.2	0.36	0.29
	Group 4	0.11	0.31	0.3
	Control	0.21	0.23	0.41
Group 3	Group 4	0.4	0.21	0.49
	Control	0.04S	0.14	0.34
Group 4	Control	0.03S	0.43	0.35

(*) NS: Non Sig. at P>0.05; Testing based on Independent t-test.

and quantitative analysis and, even during a continuous movement of the mandible [14, 15]. T- Scan was adopted in the present study relate occlusion to other elements of articulatory system simply through DT and these results also demonstrated in previous studies [16, 17]. Disclusion time could relate the occlusion to the activity of muscles. Any abnormalities in disclusion time would effect and change in muscle activity, thus resulting in the incidence of TMD [18].

Generally, Disclusion Time (DT) in patients with TMJ internal derangement was consistently longer than control. This results were in agreement with many previous studies [19-21]. Chutchalermpan reported DT of the lateral excursion and protrusion longer than registered in the healthy control of the present study [22].

Previous studies conducted found significantly high right and left lateral DT, and protrusive DT in patients with TMD and in patients with intra-articular joint disorders in comparing to the control group. Haralur SB, reported a significant difference between TMD patients and control regarding DT in (lateral right and left and in protrusion). The study suggested that patients with TMD had prolonged DTs compared with healthy TMJ patients. When considering the findings of the present study there would be an agreement except in DT of the left lateral and protrusive DT which showed non-significant differences.

An old study conducted by Mizui whom used the T-Scan system to estimate the occlusal force distribution; they found that healthy subjects showed bilateral balanced force and this results are similar to present study findings in the control group [23]. Ciavarella also reported the asymmetry in the occlusal force in TMD (intracapsular joint) disorders. Therefore, the forces of occlusion between both mandibular sides are distributed unequally in TMD patients, which effects in activate the muscles masticatory on one or both sides and may distress the temporomandibular joint [24].

Long right and left (DT) were also reported in a study done by Sarah Qadeer whom study groups of TMD patients [25]. The pattern of occlusal forces in healthy subjects and TMD patients were conducted by many researchers. The results showed that the maximum force showed asymmetric occlusal contact distribution [26].

Kirveskari, and Wang YL, have documented that when the DT is short then this return in benefit to dentition and joint structures [27,28]. Prolonged DT leads to increase in EMG activity of the muscles of mastication and this increase the stress on the ligaments of the disc in the temporomandibular joint [29]. The disparity of results in occlusion parameters between the present study and the other studies may be attributed to the sample size, samples inhomogeneity.

CONCLUSION

Prolonged disclusion time with the asymmetry of occlusal forces in Iraqi patients with TMJ ID in the lateral excursive mandibular movement.

REFERENCES

1. Manfredini D, Guarda-Nardini L, Winocur E, et al. Research diagnostic criteria for temporomandibular disorders: A systematic review of axis I epidemiologic findings. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011; 112:453-62.

2. Israel HA. Internal derangement of the temporomandibular joint: New perspectives on an old problem. Oral Maxillofac Surg Clin 2016; 28:313-33.
3. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic criteria for temporomandibular disorders (DC/TMD) for clinical and research applications: recommendations of the international RDC/TMD consortium network and orofacial pain special interest group. J Oral Facial Pain Headache 2014; 28:6.
4. Prosthodontics T. The glossary of prosthodontic terms. J Prosthet Dent2005; 94:10-92.
5. Okano N, Baba K, Igarashi Y. Influence of altered occlusal guidance on masticatory muscle activity during clenching. J Oral Rehabil 2007; 34:679-84.
6. Koos B, Godt A, Schille C, et al. Precision of an instrumentation-based method of analyzing occlusion and its resulting distribution of forces in the dental arch. J Orofac Orthop 2010; 71.
7. Baldini A, Nota A, Cozza P. The association between occlusion time and temporomandibular disorders. J Electromyogr Kinesiol 2015; 25:151-4.
8. Sierpinska T, Kuc J, Golebiewska M. Assessment of masticatory muscle activity and occlusion time in patients with advanced tooth wear. Arch Oral Biol 2015; 60:1346-55.
9. Kerstein R, Radke J. Computer-guided Occlusal Treatment Improves the Smoothness Timing and Velocity of Gum Chewing Galley Proof 3-12-2018. Adv Dent Tech 2019.
10. Sutter B, Kerstein R, Radke J, et al. A review of: "Comparison between conventional and computerized methods in the assessment of an occlusal scheme". Adv Dent Tech 2020.
11. Kerstein RB, Wright NR. Electromyographic and computer analyses of patients suffering from chronic myofascial pain-dysfunction syndrome: before and after treatment with immediate complete anterior guidance development. J Prosthet Dent 1991; 66:677-86.
12. Dzingutė A, Pileičikienė G, Baltrušaitytė A, et al. Evaluation of the relationship between the occlusion parameters and symptoms of the temporomandibular joint disorder. Acta Med Litu 2017; 24:167.
13. Hirano S, Okuma K, Hayakawa I. *In vitro* study on accuracy and repeatability of the T-Scan II system. J Stom Soc 2002; 69:194-201.
14. Kerstein RB, Chapman R, Klein M. A comparison of ICAGD (immediate complete anterior guidance development) to mock ICAGD for symptom reductions in chronic myofascial pain dysfunction patients. Cranio 1997; 15:21-37.
15. Wang C, Yin X. Occlusal risk factors associated with temporomandibular disorders in young adults with normal occlusions. Oral Surg Oral Med Oral Pathol Oral Radiol 2012; 114:419-23.
16. Kerstein RB, Thumati P, Padmaja S. Force finishing and centering to balance a removable complete denture prosthesis using the T-Scan III computerized occlusal analysis system. J Indian Prosthodont Soc 2013; 13:184-8.
17. Da Silva Martins MJ, Caramelo FJ, da Fonseca JA, et al. In vitro study on the sensibility and reproducibility of the new T-Scan®III HD system. Rev Port Estomatol 2014; 55:14-22.
18. Thumati P, Manwani R, Mahantshetty M. The effect of reduced disclusion time in the treatment of myofascial pain dysfunction syndrome using immediate complete anterior guidance development protocol monitored by digital analysis of occlusion. Cranio 2014; 32:289-99.
19. Haralur SB. Digital evaluation of functional occlusion parameters and their association with temporomandibular disorders. Clin Diagnostic Res 2013; 7:1772.
20. Baldini A, Nota A, Cozza P. The association between occlusion time and temporomandibular disorders J Electromyogr Kinesiol 2015; 25:151-4.
21. Jivnani HM, Tripathi S, Shanker R, et al. A study to determine the prevalence of temporomandibular disorders in a young adult population and its association with psychological and functional occlusal parameters. J Prosthodont 2019; 28:e445-9.
22. Chutchalermpan T, Pumklin J, Piyapattamin T. Evaluation of disclusion time in various angle's malocclusions by T-scan III system. Eur J Dent 2019; 13:510-3.
23. Mizui M, Nabeshima F, Tosa J, et al. Quantitative analysis of occlusal balance in intercuspal position using the T-Scan system. International Journal of Prosthodontics. 1994; 7.
24. Ciavarella D, Mastrovincenzo M, Sabatucci A, et al. Clinical and computerized evaluation in study of temporo-mandibular joint intracapsular disease. Minerva Stomatol 2010; 59:89-101.
25. Qadeer S, Abbas AA, Sarinnaphakorn L, et al. Comparison of excursive occlusal force parameters in post-orthodontic and non-orthodontic subjects using T-Scan® III. CRANIO 2018; 36:11-8.
26. Sutradhar W, Thumati P, Poovani S. Digital evaluation of occlusion treatment in pat with TMD: A case report. Adv Dent Tech 2019.
27. Kirveskari P. Assessment of occlusal stability by measuring contact time and centric slide. J Oral Rehabil 1999; 26:763-6.
28. Wang YL, Cheng J, Chen YM, et al. Patterns and forces of occlusal contacts during lateral excursions recorded by the T-Scan II system in young Chinese adults with normal occlusions. J Oral Rehabil 2011; 38:571-8.
29. Kerstein RB, Radke J. The effect of disclusion time reduction on maximal clench muscle activity levels. Cranio 2006; 24:156-65.