EGYPTIAN
DENTAL JOURNAL
www.eda-egypt.org

Vol. 69, 1749:1755, July, 2023

Print ISSN 0070-9484 • Online ISSN 2090-2360

Orthodontics, Pediatric and Preventive Dentistry

Submit Date : 29-03-2023 • Accept Date : 31-5-2023 • Available online: 20-06-2023 • DOI : 10.21608/EDJ.2023.201829.2498

T-SCAN III POST-ORTHODONTIC TREATMENT OCCLUSAL ANALYSIS IN NON- EXTRACTION CASES

Mona Helal Mahmoud Helal[*], Noha Ezzat Sabet[**] *and* Noha Hussein Abbas[***]

ABSTRACT

Aim: To assess the occlusal analysis after orthodontic treatment in non-extraction cases with T-scan III, and compare it with control group having normal occlusion and non-orthodontically treated.

Materials and Methods: The current study was conducted on forty-eight participants (15 males and 33 females) with age ranges (17- 28 years). They were equally divided into two groups; **Group (A)** experimental group who finished their orthodontic treatment. and **group (B)** control group non-orthodontically treated. The T-Scan® III Occlusal Analyzing System version 8 was used for occlusal assessment for every participant. The force distribution percentage bilaterally in centric occlusion and mandibular lateral movement were measured. Data were collected and tabulated for statistical analysis.

Results: There was significant difference in bilateral force distribution in centric occlusion between the two groups, whereas there was no significant difference among both study groups in the bilateral force distribution during lateral movements for the working and balancing sides, where both groups showed balancing side contacts. The experimental group had higher percentage of first premolar interferences, whereas the control group had significantly higher percentage of central incisor interferences. However, both groups showed higher prevalence of balancing interference for the second molars.

Conclusions: The force distribution bilaterally in centric occlusion and balancing side interferences in lateral excursions were significantly different between post-orthodontic non-extraction and normal non-orthodontic groups. Also, the control group showed balancing side interferences in lateral movements of the mandible as well.

KEY WORDS: T-scan, post-orthodontic treatment, non-extraction, occlusal analysis, force distribution, centric occlusion, lateral movement.

* Orthodontic Department, Faculty of Dentistry, Ain Shams University, Cairo, Egypt .
** Professor, Orthodontic Department, Faculty of Dentistry, Ain Shams University, Cairo, Egypt .
*** Associate Professor, Orthodontic Department, Faculty of Dentistry, Ain Shams University, Cairo, Egypt.

INTRODUCTION

The dental occlusion is a complex relation that has significant effect on human's health and quality of life. Providing the patient with a proper and stable occlusion is one of the main goals for all dental specialties.

The Orthodontic treatment has always aimed to satisfy the patient`s requirements which is mainly related to esthetics. Concerning occlusion, orthodontists are mainly interested in achieving proper static occlusion as described by Angle, Andrews and others. [1,2] But they have to be alert to the functional needs during and after orthodontic treatment as well.

Studies showed that proper functional occlusal adjustments after orthodontic treatment can improve the stability and retention of the treatment progress. [3–7]

The orthodontic treatment has the ability to change the patients' occlusion, so, we have to assure that this change is within normal range of functional occlusion and not interfering with the force distribution.

The balanced distribution of forces generated in the jaws during mastication can be confirmed by normal occlusion and articulation relations. Any premature contacts can induce occlusal traumas. Occlusal traumas can cause changes in the tooth supporting tissues (bone, PDL, mucosa), masticatory muscles and TMJ. [3]

The functional orthodontic goals aim to establish tooth contacts that can function without interferences, to reduce the tempromandibular joint disorders (TMD). Unfortunately, these functional goals can't be fully recognized by the naked eye. [8]

Numerous occlusal indicators are used in clinical practice to register occlusal articulation relations and perform occlusal adjustments. The conventional methods used are: articulating paper, shim stock foil and impression waxes. They are usually subjective and depend on the patient occlusal feedback. The articulating paper is the most common method used to determine excessive forces in occlusal contacts and identify contact points between the maxillary and mandibular teeth. [3,4]

Limitations of the articulating paper are numerous. In addition to being subjective in interpretation by the clinician and depending on the patient's feedback, it is also inaccurate and irreproducible record that varies according to the paper thickness, shape and deepness of ink colour which is transferred to the tooth structure in a wet media of saliva. Also, it depends on enamel surface structure, occlusal morphology, presence of restorations with different finishing than natural teeth and biting force power of the patient. [9]

Due to the drawbacks of the conventional articulating paper, a new digitalized 3D system for analysis of occlusal force was greatly demanded. That can be helpful for both the clinician and the patient.

Maness in 1987 developed the first generation of the T-Scan system. Since then, many changes in the design and improvement of the registration capacity were undergone. The latest version of the T-Scan occlusal analysing system is HD with a very sensitive sensor and much thinner than previous ones. [3,10]

Many studies assessed the T-scan and its applications in different dental fields, also compared its quality and accuracy with other occlusal indictors. Only few studies investigated the use of T-scan in orthodontics and use it to compare occlusion of the post-orthodontic patients with individuals having normal occlusion.

Thus, the idea of this study was to use the T-Scan III occlusal analysing system to evaluate the occlusion of the post-orthodontic treatment in non-extraction patients, and compare it with non-orthodontically treated cases.

AIM OF THE STUDY

The current study aimed to assess the occlusal analysis after orthodontic treatment in non-extraction cases with T-scan III system, and compare it with control group having normal occlusion and non-orthodontically treated.

MATERIALS AND METHODS

This study was self-funded by the principal investigator, and no financial conflicts of interest were declared. The Current study was a partial fulfillment of the requirements for Master Degree in Orthodontics Faculty of Dentistry - Ain Shams University. The study design was approved by the ethics committee at Ain Shams University's Faculty of Dentistry.

The study was conducted on forty-eight participants (15 males and 33 females) with age ranges (17- 28 years) selected from the outpatient clinic of the department of Orthodontic of Ain Shams University's Faculty of Dentistry . They were equally divided into two groups; **Group (A)** experimental group who finished their orthodontic treatment. and **group (B)** control group non-orthodontically treated.

(A) Experimental group:

Twenty four orthodontic patients (6 males and 18 females) were included in this group. Patients who finished their treatment were evaluated to fulfill the following inclusion and exclusion criteria.

Inclusion criteria:

1. Full permanent dentition (third molars not included).
2. Non–extraction cases (generalized spacing, mild crowding treated with stripping, expansion, distalization …etc.) treated with conventional fixed orthodontic appliances (using either anterior / posterior bite plane or not using any occlusal raiser).
3. Patients who completed the finishing stage of their orthodontic treatment properly according to the static occlusion goals set by the American Board of Orthodontics (ABO). [11]

Exclusion criteria:

1. History of TMJ problems.
2. Cleft lip and/or palate.
3. Orofacial anomalies.(Peg-shaped lateral incisor, Bolton discrepancy, malformed teeth…. etc.)
4. Skeletal discrepancies.
5. Patients who need orthognathic surgeries.
6. Vulnerable groups.

(B) Control group:

Twenty four participants (9 males and15 females) were included in this group. They were selected to fulfill the following inclusion and exclusion criteria.

Inclusion criteria:

1. Full permanent dentition (third molars not included).
2. Class I molar relation.
3. Class I canine relation.
4. Normal overbite.
5. Normal overjet.

Exclusion criteria:

1. Previous orthodontic treatment.
2. History of TMJ problems.
3. Large restorations, fixed prosthesis, badly destructed tooth.
4. Cleft lip and /or palate.
5. Orofacial anomalies.
6. Skeletal discrepancies
7. Patients who need orthognathic surgeries.
8. Vulnerable groups.

The study was performed at the outpatient clinic of the Orthodontic Department Faculty of Dentistry, Ain-shams University.

The T-Scan® III (Tekscan Inc, South Boston, MA, USA) Occlusal Analysing System version 8 was used for occlusal assessment for every participant.

The T-Scan III Occlusal Analysing System consists of recording handle where the high definition (HD) recording sensor with its holder is attached and changed for each participant. T-Scan III sensors and their holders are available in large and small sizes that were selected for each participant according to his / her arch size. The handle is connected to a computer by a USB cable where the T-Scan III software is installed on it. (Figure1)

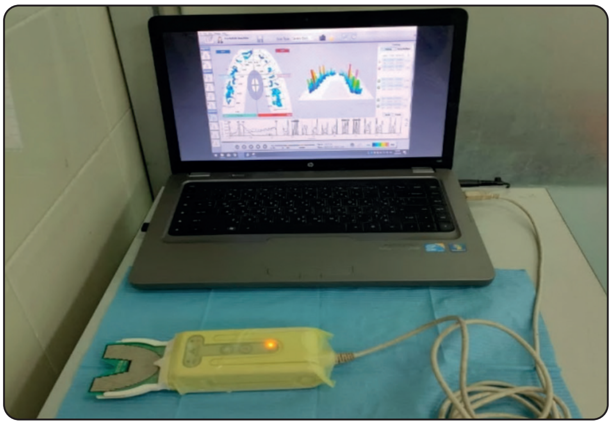

Fig. (1) T-Scan III system.

Study procedures:

- Patients who finished their Orthodontic treatment and volunteers having normal occlusal parameters were evaluated according to the eligibility criteria.
- Participants who met the eligibility criteria (according to the corresponding group) were invited to participate in this study.
- Before any procedure, the study was explained in full details to those who agreed to share.
- Before their enrollment in the study, the participants signed an informed consent which clearly describe the aim and the methodology of the study.
- TheT-Scan® records were taken (after debonding within 2 weeks) with subjects sitting upright in the dental chair, with the back of the chair upright and the head resting upright on the headrest.
- Participants have been trained to make the movements of the mandible before recording was started. They were given instructions to occlude in the maximum intercuspation, and then shift the mandible to the right permitting upper and lower canines to touch each other, and the same to the left side.
- The sensor was selected according to the proper size of the arch.
- The sensor was inserted into the participant's mouth in such a way as to make its support aligned centrally with the midline of the upper incisors.
- The participants were then asked to bite on the sensor in a maximum intercuspal position.
- When occlusal contacts appeared on the screen, the button on the handle was pressed and the arch model was automatically created.
- After this training, the participants were asked to perform the various bites in a natural unforced way.

The collected data were tabulated in Microsoft excel sheet 2010 for statistical analysis.

RESULTS

I- Bilateral force distribution in centric occlusion:

Results of **Independent t-test** for bilateral force distribution in centric occlusion are shown in (Table I). Results showed that for heavy force side, the experimental group had a higher significant value than the control group (p=0.022), while test results showed that for the light force side, the control group had higher significant value (p=0.001). As for the difference between heavy and light sides, test results showed the experimental group to have higher significant value than the control group (p<0.001). For the experimental group, **paired t-test** results showed that heavy side had higher significant value than light side (p<0.001). However, for the control group the difference was not statistically significant (p=0.054).

TABLE (I): Mean, Standard deviation (SD) values and results of Independent t-test of bilateral distribution of force for different groups

Side	Bilateral distribution of force in centric occlusion (mean±SD)		p-value
	Experimental	Control	
Heavy	57.62±4.70	52.67±4.09	0.022*
Light	42.38±4.68	49.33±3.09	0.001*
p-value	<0.001*	0.054ns	
Difference	15.24±4.38	5.34±2.19	<0.001*

; significant (p ≤ 0.05) ns; non-significant (p>0.05)

II. Bilateral force distribution in lateral movement:

For working and balancing sides, results of **Mann-Whitney U** test showed that there was no significant difference between both groups regarding bilateral force distribution (p = 0.172). (Table II)

TABLE (II): Mean, Standard deviation (SD) values and results of Mann-Whitney U test of bilateral force distribution

Side	Bilateral force distribution in lateral movement (mean±SD)		p-value
	Experimental	Control	
Working	84.28±15.19	88.49±12.78	0.172ns
Balancing	15.72±15.19	11.51±12.78	0.172ns

; significant (p≤0.05) ns; non-significant (p>0.05)

III- Balancing side interferences in lateral movement

Results of **Fisher's exact** test showed that there was a significant difference between both groups regarding balancing side interferences (p=0.025), with the experimental group having higher percentage of first premolar interferences and the control group having higher significant percentage of central incisor interferences (p<0.05). (Table III)

TABLE (III): Frequency and percentage values for balancing side interferences in different groups

Tooth		Experimental	Control	p-value
Central incisor	n	8^{B}	18^{A}	0.025*
	%	8.8%	21.2%	
Lateral Incisor	n	1^{A}	3^{A}	
	%	1.1%	3.5%	
Canine	n	1^{A}	4^{A}	
	%	1.1%	4.7%	
First Premolar	n	17^{A}	6^{B}	
	%	18.7%	7.1%	
Second Premolar	n	12^{A}	9^{A}	
	%	13.2%	10.6%	
First molar	n	18^{A}	9^{A}	
	%	19.8%	10.6%	
Second Molar	n	22^{A}	21^{A}	
	%	24.2%	24.7%	
Third molar	n	12^{A}	15^{A}	
	%	13.2%	17.6%	

Different superscript letters indicate a statistically significant difference within the same horizontal row *; significant (p ≤ 0.05) ns; non-significant (p>0.05)

DISCUSSION

In this study there was significant difference between both groups in bilateral distribution of force in centric occlusion. The control group showed no statistically significant difference bilaterally, which indicate symmetrical balanced occlusion. Whereas for the experimental group, results showed that heavy side had significantly higher value than light side. For the difference between heavy and light sides, results showed that the experimental group had significantly higher value than the control group.

These findings were found to be in agreement with **Qadeer et al.**, [12] **Trpevska et al**., [13] and **Zhigang Hu et al.** [14] As the control non-orthodontic group had nearly an equal balanced occlusion bilaterally. Also, these results were in agreement with **Cohn et al.** [15] who concluded that even when the set-up goal was reached, the occlusal forces might be distributed unevenly, remaining asymmetric and potentially signaling a functional imbalance. Also, he justified the occlusal balancing adjustment during retention stage.

But the results of our study differed from that of **Qadeer et al.** [12] concerning the experimental orthodontic group; as they found the orthodontic group to have symmetrical bilateral force distribution. This difference in finding might be owing to the different experimental criteria of the sample. Where the participants in their study presented with no more than four missing teeth excluding third molars and had their orthodontic appliances debonded at least one year (but no more than three years) before their enrollment in the study.

In the current study, the asymmetry in bilateral distribution of force in the experimental group might indicate presence of premature contacts on the heavy side or inadequate settling immediately after debonding of the orthodontic appliances.

There was no significant difference among both study groups in the bilateral force distribution during lateral movements for the working and balancing sides, where both groups showed balancing side contacts.

These results meet those of **Qadeer et al** [16] who found that both groups showed frictional contacts on the non-working/balancing side, but also the force distribution on balancing side in the post-orthodontic group was increased significantly than in non-orthodontic group. This difference may be due to different criteria for the participants as previously mentioned.

Results also showed that there was a significant difference between both groups regarding balancing side interferences. While the experimental group had higher percentage of first premolar interferences, the control group had significantly higher percentage of central incisor interferences. However, both groups showed higher prevalence of balancing interference for the second molars.

The interference of the first premolar on balancing side may be due to the type of occlusal contact after orthodontic treatment which was group function. It may be preferable to establish canine guided occlusal contact in planning orthodontic treatment. The second molar interferences may be attributed to not including them in the treatment plan for all the participants.

CONCLUSIONS

The following conclusions could be derived from the results of this study:

1. The force distribution bilaterally in centric occlusion and balancing side interferences in lateral excursions were significantly different variables between post-orthodontic non-extraction and normal non-orthodontic groups.
2. T-Scan III is a benefecial digital tool for occlusal analysis and to detect occlusal interferences and imbalances that is difficult to be recognized by the naked eye and can't be fully detected by another method of occlusal detectors.
3. The participants of the control group showed balancing side interferences in lateral movements of the mandible.

REFERENCES

1. Angle E. Classification of malocclusion. Dent Cosm. 1899;41:248–264.
2. Andrews LFS, San D. AJO-DO 1972 Sep (296-309): The six keys to normal occlusion - Andrews. Am J Orthod Dentofac Orthop.
3. Bozhkova TP. The T-SCAN System in Evaluating Occlusal Contacts. Folia Med (Plovdiv). 2016;58(2):122-130.
4. Jain R, Jabbal R, Bindra S, Aggarwal S. T- Scan a digital pathway to occlusal perfection : a review. Ann Prosthodont Restor Dent. 2015;1(1):32-35.
5. Koval S. Assessment of Occlusal Contacts Leading to Orthodontic Relapse. A Case Study. J Dent Oral Disord Ther. 2017;5(2):1-4.
6. Șoaita C, Popșor S. Pre and Post Orthodontic Simulated Occlusions. 2012;4(4):83-88.
7. R J, Koval S. The procedure of Anteroposterior Tooth Contact Adjustment (APTCA) in Orthodontic patients. J Dent Probl Solut. 2017;4(Figure 1):044-047.
8. Koval S. T-Scan III Occlusal Analysis in Orthodontic Patients. orthodontics. 2017:1-18. www.avidscience.com
9. Cohen-Lévy J, Cohen N. Computerized occlusal analysis in Dentofacial orthopedics: indications and clinical use the T-scan III system. J Dentofac Anomalies Orthod. 2012;15(2):203.
10. Trpevska V, Kovacevska G, Benedeti A, Jordanov B. T-scan III system diagnostic tool for digital occlusal analysis in orthodontics - a modern approach. Pril (Makedonska Akad na Nauk i Umet Oddelenie za Med Nauk. 2014;35(2): 155-160.
11. Goyal M, Student PG, Hasan S. Dental Sciences A Systematic Method of Evaluating Treatment Outcome Using Abo Grading System : A Review. Indian J Res. 2015;4(4):4-7.
12. Qadeer S, Yang L, Sarinnaphakorn L, Kerstein RB. Comparison of closure occlusal force parameters in post-orthodontic and non-orthodontic subjects using T-Scan® III DMD occlusal analysis. Cranio - J Craniomandib Pract. 2016;34(6):395-401.
13. Trpevska V, Lidija K;, Kovacevska G, Alberto B. Occlusion Timeline Analyses with T-Scan III System in Subjects with Neutroocclusion. Int J Sci Res. 2017;6(3):66-69.
14. Hu Z gang, Cheng H, Zheng M, Zheng Z qiang, Ma S zhi. [Quantitative study on occlusal balance of normal occlusion in intercuspal position]. Zhonghua Kou Qiang Yi Xue Za Zhi. 2006;41(10):618-620.
15. Cohen-Levy J, Cohen N. Computerized analysis of occlusal contacts after lingual orthodontic treatment in adults. Int Orthod. 2011;9(4):410-431.
16. Qadeer S, Abbas AA, Sarinnaphakorn L, Kerstein RB. Comparison of excursive occlusal force parameters in post-orthodontic and non-orthodontic subjects using T-Scan® III. Cranio - J Craniomandib Pract. 2018;36(1):11-18.