



Case report

EVALUATION OF THE OCCLUSION WITH TWO DIFFERENT METHODS: A T-SCAN II OCCLUSAL ANALYSIS AND THE TEETHAN SYNCHROMYOGRAPHY RECORDING SYSTEM

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ABSTRACT

The article presents a case of a sixty-seven-year-old female patient who complains of an uncomfortable bite after full-mouth rehabilitation three months ago. Before inserting the crowns, the patient did not have any complaints. The complaints included: chewing only unilaterally (on the right side), and premature contact in the left canine area. Also the patient suffered masticatory muscles soreness in the afternoons and uncomfortable bite that started after the rehabilitation with zirconium crowns.

Evaluation of the occlusal contacts is necessary after any dental intervention which affects occlusion. In this case report, two methods for evaluation of the occlusion are compared – one with a T-scan analysis, using a sensor between the teeth, and the second by evaluating the electromyographic activity of the masticatory muscles (via surface electromyography (sEMG)). The occlusion was estimated by both methods during voluntary clenching, and the results from both methods were compared. Articulating paper was used for visualization of the contacts as an additional method.

Conclusion: The results of the two methods (T-scan analysis and through sEMG) were very similar. In this clinical case, the application of both the T-Scan II occlusal analysis and the Teethan sEMG system demonstrated their effectiveness in evaluating and improving occlusal balance and muscle activity following extensive dental rehabilitation. The complementary nature of these diagnostic methods was highlighted, with each providing distinct and valuable insights—T-Scan focusing on the occlusal force and timing, while Teethan emphasized neuromuscular balance. The occlusal adjustments informed by these technologies significantly alleviated the patient's discomfort, confirming their utility in clinical practice for diagnosing and addressing occlusal discrepancies. This case reinforces the importance of integrating advanced diagnostic tools to ensure optimal patient outcomes in prosthetic and restorative dentistry.

Keywords: occlusal equilibration, T-scan, Teethan, sEMG, occlusal contacts,

INTRODUCTION

There are many methods for the evaluation of the dental occlusion. Articulating paper, articulating silk, articulating film and metallic shim stock film are known as qualitative indicators. They are most commonly used due to their low cost and easy application. However, the sequence of occlusal contacts and time magnitude remain unknown, which is considered their biggest drawback.

T-scan occlusal analysis system from Tekscan Inc. (South Boston, MA, USA) is a quantitative indicator of the occlusal contacts. It evaluates the occlusion by a sensor on which the patient bites. The T-scan shows the time magnitude and the distribution of the occlusal contacts, and this makes it suitable for simultaneous bilateral evaluation of the occlusal contact. It is appropriate for diagnosing bruxism [1, 2, 3], in cases of complete arch restoration, occlusal splints, natural tooth occlusal equilibration and fixed or removable partial or complete dentures [4].

Surface Electromyography (sEMG) of the chewing muscles is used to evaluate the occlusion and its effect on the masticatory activity. It is a non-invasive objective method for the analysis of the myoelectric activity generated during clenching. In clinical practice, EMG may be used to assess the influence of occlusal contacts on stomatognathic function [5] and is widely applied in dentistry for the evaluation of the results of prosthetic rehabilitation, orthodontic treatment, temporomandibular dysfunction and orthognathic surgery [6, 7, 8, 9, 10, 11, 12, 13]. An innovative and technologically advanced electromyographic instrument that gives a complete picture of the patient's occlusal balance is Teethan® (Teethan S.p.A. Italy). Teethan performs a surface electromyographic analysis of the main masticatory muscles to quantify the influence of the occlusal contacts on the patient's neuromuscular balance.

A case of a patient with complaints after extensive dental rehabilitation is presented here. During the occlusal equilibration, two methods for evaluation were used and compared, together with articulating paper for visualization of the interdental contacts. The aim of the study is to compare the two digital methods and determine whether the information from them is similar.

CASE DESCRIPTION

The case presents a sixty-seven-year-old female patient who complains of an uncomfortable bite after full-mouth rehabilitation three months ago. She did not have any complaints before inserting the crowns. The patient complained of being able to chew unilaterally (on the right side) and of premature contact in the left canine area as well. She suffered masticatory muscles soreness in the afternoons and uncomfortable bite after full-mouth rehabilitation with zirconium crowns (Fig. 1).

Fig. 1. Dentition after the restorative work.



Technical devices.

Two different technical methods were used to evaluate the occlusion: a). A T Scan II Occlusal Analysis System (Fig. 2), and b). A Teethan Synchronomyography Recording System (Fig. 3).

Articulating paper was used for visualization of the contacts as an additional method.

Fig. 2. T-Scan II evolution 7.01 device



The T-Scan II Occlusal Analysis System (Tekscan, inc. Boston, MA) is a clinical device that measures occlusal contact timing sequences in real time, as well as the occlusal forces.

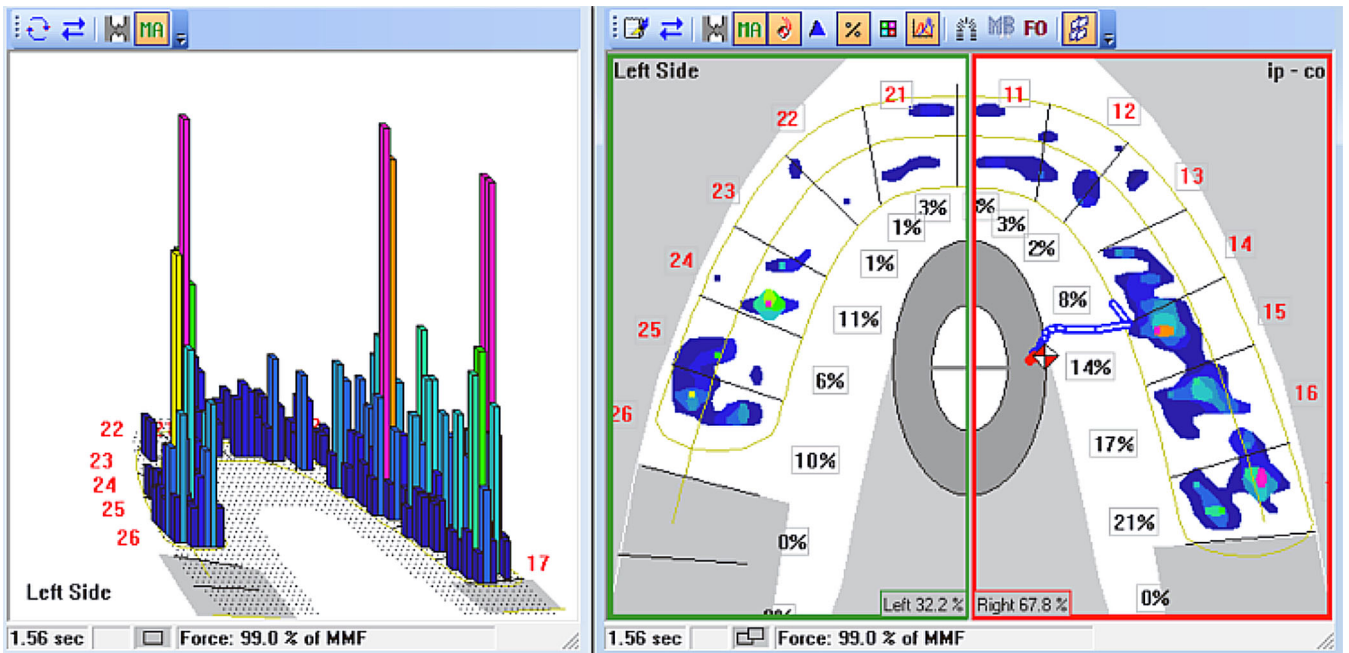
Fig. 3. Teethan Synchronomyography® Recording System



Teethan® (Teethan S.p.A., Milan, Italy) is a device for functional analysis of dental occlusion by surface EMG (Fig. 3). It provides information about neuromuscular alterations induced by the occlusal contact. It is designed for the evaluation of the patient's occlusal balance. Muscular balance of the anterior temporalis and the masseter muscles is representative of the occlusion and deviations from the norm. The advantage of this method is that during registration there is not a sensor between the teeth.

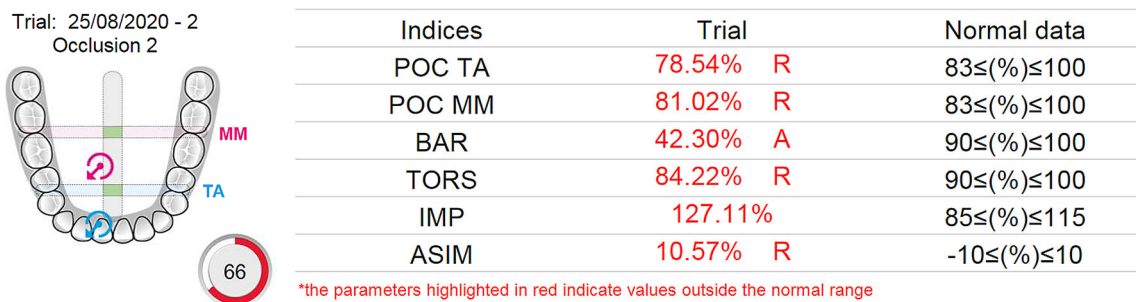
Results before occlusal adjustments

Fig. 4. Initial T-scan report.



Initially, the findings corresponded to the complaints of the patient (Fig. 4). The diagram shows the prevalence of the contacts on the right side. There is a strong occlusal contact in the right premolar area.

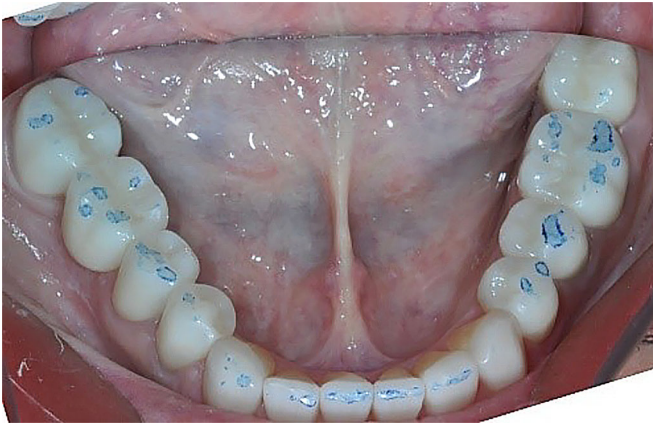
Fig. 5. Initial Teethan report.



All the presented indices are outside normal values. The right temporalis and masseter prevalence correspond well with right asymmetry, which points to stronger interdental contacts on the right side (Fig. 5). The barycentre (BAR) depicts the antero-posterior concentration of occlusal contacts. In a case like this, when the barycentre is more anteriorly positioned, the temporal muscles exert greater contractile forces. The result is an overload of the temporomandibular joints bilaterally, that over time, can lead to pathological conditions. A mandibular shift to the right side also can be discovered (TORS).

Fig. 6. Occlusal contacts, visualized by the articulating paper (initial situation).





The darker markings on the left side is well visible on the occlusal surfaces of the second premolars (Fig. 6). As a whole, occlusal contacts on the left side appear tighter, which was not confirmed by the two digital methods used. Occlusal adjustments were required to decrease and dissipate the abnormal occlusal forces. The adjustments were performed on the teeth on both right and left side but mostly on the side corresponding

(according to the T scan) to the much stronger contacts (75,3% for the right half to 24,7% for the left half). The occlusal corrections were performed very cautiously using fine-grit diamond burs, an accelerating handpiece (at a low-speed mode), abundant water cooling. A meticulous surface polishing at the corrected areas was performed under a microscope using a straight angle handpiece and a dedicated set for zirconia (EVE Diacera HP set).

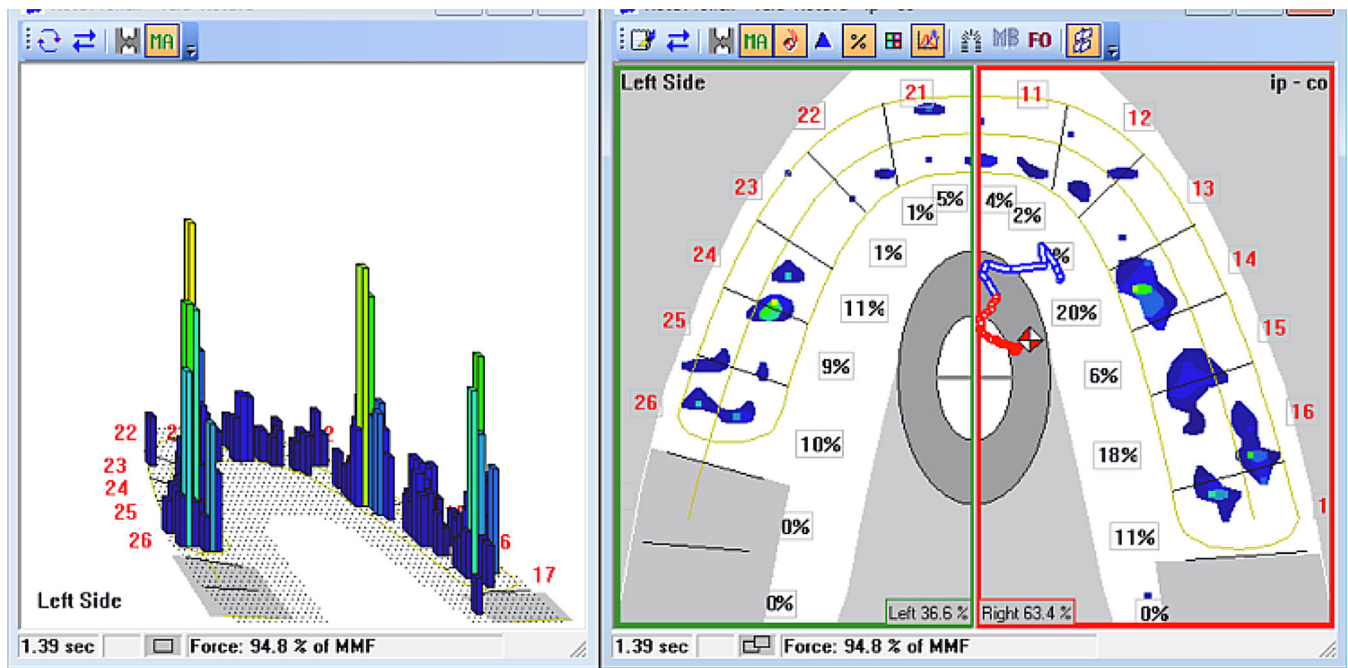
The occlusal changes appeared immediately after the corrections and were recorded by both devices. As the material is very sensitive to grinding and is prone to breakage, after the corrections were very subtle, and a 10-day pause is necessary for the muscles to adapt.

Results after the occlusal adjustments

After the corrections, the patient reported an improvement in the occlusion, and the premature contact on the left was not so prominent.

The diagram shows the improved balance of the occlusal contacts (Fig. 7).

Fig. 7. T-scan results after corrections. The occlusal contacts appear to be much more evenly balanced between the left and right half (40,2/59,8% - compared to the 75,3/24,7 % in the initial recording in fig.4)



Immediately after adjustment, there was an improvement in the temporalis and masseter muscle balance (Fig. 8). There is still some shift to the right side in maximal intercuspation. The barycenter is forward, which means more tight contacts in the anterior parts of the arches. The patient was dismissed for 10 days so that the muscles could adapt to the new occlusion.

The comparison of the patient data delivered by both devices demonstrated similar results regarding occlusal diagnostics. After the corrections were done, both occlusion and function were significantly improved, and the patient's

complaints diminished.

In case when only articulating paper is used, the clinician cannot evaluate the force and timing, which are fundamental characteristics of the occlusion [2]. Although T-scan gives such information, muscle balance remains unknown. The Teethan electromyographic device does not give a detailed picture concerning occlusal contacts but provides a wider perspective of the muscle balance as a result of the occlusion.

Both diagnostic methods give similar information, and the results are complementary.

Fig. 8. The results after occlusal equilibration according to TEETHAN

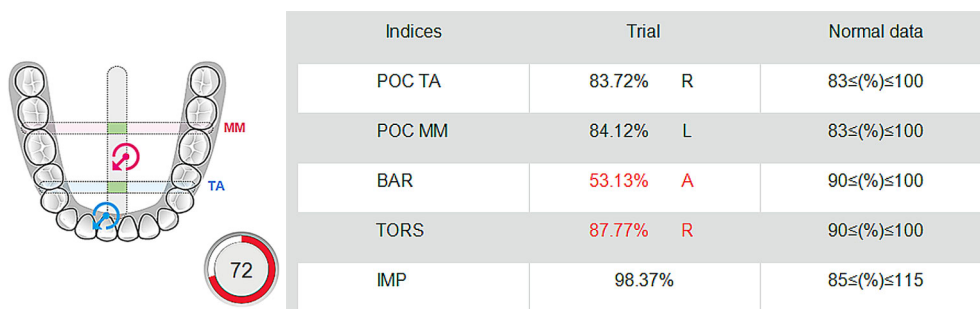
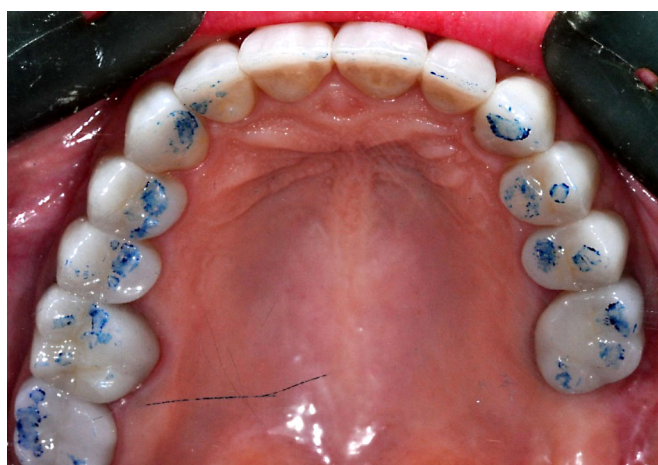
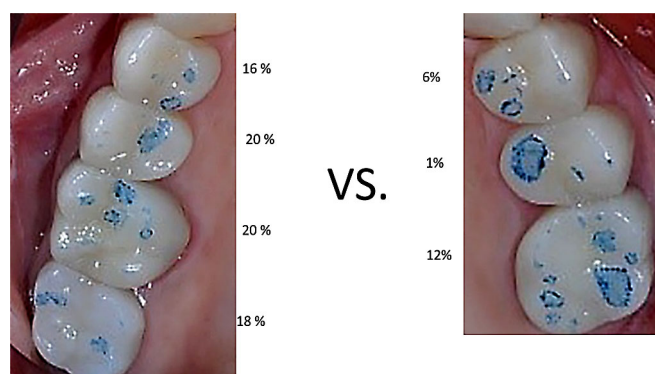


Fig. 9. Contacts registered using Baush progress 200im occlusal paper following the corrections



cited above the figure indicate that our approach to how to read the occlusal paper markings should be reconsidered.



DISCUSSION

The evaluation of occlusal parameters plays a critical role in diagnosing and addressing complications following extensive dental rehabilitations. In the presented case, two advanced diagnostic tools—T-Scan II occlusal analysis and the Teethan surface electromyography (sEMG) system—were utilized to analyze and improve the patient’s occlusion. Both methods provided complementary insights that enabled the identification and correction of occlusal imbalances, significantly alleviating the patient’s symptoms.

The T-Scan II system offered quantitative data on occlusal contact timing and force distribution, which is indispensable for diagnosing and addressing issues such as bruxism and occlusal imbalance, particularly in cases of full-mouth rehabilitation [1, 2].

Our study confirmed the latter statement.

Fig. 10. A zoomed image from the initial clinical situation and a comparison between the articulating paper markings (Baush progress 200 im) and the relative percentage of the overall occlusal loading according to the T-scan. The literature claims that darker and wider markings correspond to stronger occlusal contacts. In the example above this is clearly not the case. Extremely stunning is the marking on teeth 15 and 25, where the corresponding occlusal force of 15 is 20 times stronger than the one on the 25, which is definitely not what a clinical interpretation of these markings will be. This example as well as the literature references

By identifying premature contacts, the T-Scan system enabled precise adjustments to the zirconium crowns, minimizing the risk of unnecessary reduction and potential damage to the restorative material. This approach aligns with findings that emphasize the utility of T-Scan in achieving optimal occlusal equilibration in cases involving complex prosthetic rehabilitations [4].

On the other hand, the Teethan system complemented the T-Scan by evaluating the functional impact of occlusal contacts on neuromuscular activity. Surface electromyography (sEMG) is increasingly recognized as a reliable method for assessing the balance of masticatory muscles, particularly in the context of temporomandibular disorders and post-prosthetic adjustments [5, 6]. In this case, the Teethan sEMG analysis highlighted muscle imbalances and asymmetries that were subsequently addressed through targeted occlusal adjustments. These findings are consistent with previous studies demonstrating the efficacy of sEMG in improving stomatognathic function following corrective interventions [7].

A key advantage of combining these diagnostic tools is the ability to gain a holistic understanding of the occlusal system. While articulating paper remains a common qualitative method, it lacks the capacity to provide quantitative insights into force distribution and muscle activity, which are critical for achieving long-term functional stability [3]. In contrast, the integration of T-Scan and sEMG technologies allows for a comprehensive assessment of both the mechanical and neuromuscular aspects of occlusion. This combined approach ensures that not only are the visible occlusal discrepancies corrected, but their functional consequences are also addressed, reducing the risk of recurrence and enhancing patient satisfaction.

The results of this case highlight the importance of advanced diagnostic tools in the management of complex occlusal conditions. The observed improvements in occlusal contact balance and muscle activity post-adjustment demonstrate the effectiveness of these technologies in restoring functional harmony. However, it is essential to note that both devices require expertise for interpretation and application, underscoring the need for adequate training and clinical experience to maximize their potential benefits.

Future research should focus on larger-scale studies to further validate the complementary use of T-Scan and sEMG in diverse clinical scenarios. Additionally, the development of standardized protocols for integrating these technologies into routine clinical practice could enhance their accessibility and utility for practitioners worldwide.

CONCLUSION:

The recordings made with these two systems allowed us to analyze the occlusion and to make the necessary changes required for its improvement. Therefore, the occlusal condition of extensive dental restorations or the occlusion of the natural teeth before and after corrective occlusal adjustments can be readily evaluated, documented, and quantified for both the quality of occlusal parameters and muscle activity, and for the responses to the changes of the occlusal condition.

In the present clinical case, both occlusal devices detected similar occlusal problems and appropriate corrections were made that improved the patient's condition.

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