



**OPTIMIZATION OF THE CLINICAL METHODOLOGY OF SELECTIVE
OCCLUSAL ADJUSTMENT IN PATIENTS WITH GENERALIZED
PERIODONTITIS USING THE T-SCAN DIGITAL OCCLUSAL SYSTEM**

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ABSTRACT

This article presents the scientific and theoretical foundations for optimizing the selective occlusal adjustment protocol in patients with generalized periodontitis using the T-Scan digital occlusal analysis system. The mechanisms for detecting hidden super contacts, objectively assessing masticatory load distribution, and reducing occlusion time to physiological values through digital monitoring are examined. The role of traumatic occlusion in the development of destructive processes in periodontal tissues is scientifically substantiated, along with the advantages of digital occlusal analysis over traditional diagnostic methods. Contemporary occlusal correction protocols, the principles of functional stability of the dentofacial system, and the significance of a comprehensive approach in the treatment of generalized periodontitis are analysed.

KEYWORDS

Generalized periodontitis, selective occlusal adjustment, traumatic occlusion, digital occlusal analysis, T-Scan, occlusal contacts, occlusal balance, functional load, tooth mobility, prosthodontics.

INTRODUCTION

Generalized periodontitis remains one of the most prevalent and clinically significant pathologies in dental practice, affecting, according to the World Health Organization, between 40 and 60% of the adult population worldwide. The disease is characterized by progressive destruction of periodontal tissues, including disruption of the periodontal ligament, resorption of the alveolar bone, and the formation of pathological pockets. One of the key pathogenetic factors aggravating the clinical course of periodontitis and reducing treatment effectiveness is the disruption of occlusal relationships - a condition in which uneven distribution of masticatory load across the dental arch leads to chronic traumatic overloading of individual teeth and their surrounding periodontal tissues (Grudyanov, Frolova, 2021).

Traditional methods of marking occlusal contacts - the use of articulating paper with a thickness of 40-100 µm - are subject to fundamental limitations: subjectivity in interpreting the ink markings, inability to quantitatively assess the force of contacts and the chronological sequence of their

occurrence, and dependence of results on the pressure applied by the patient and oral cavity moisture. These limitations have served as the impetus for developing digital occlusal analysis systems, among which the T-Scan system has achieved a leading position (Dawson, 2019).

The introduction of the T-Scan digital occlusal analysis system (Tekscan Inc., USA) has opened fundamentally new possibilities in the diagnosis and correction of occlusal disorders. The system records up to 1,500 contact points in real time at 100 frames per second, enabling visualisation of load dynamics throughout the entire masticatory cycle and objective measurement of occlusion and disclusion time. The use of T-Scan in the comprehensive treatment of periodontitis allows the selective occlusal adjustment protocol to be transferred from the realm of subjective clinical judgement into the domain of precise, reproducible, and documentable medicine (Kerstein, 2020).

Pathogenetic Aspects of Traumatic Occlusion in Generalized Periodontitis.

The relationship between occlusal disorders and the condition of periodontal tissues has been the subject of research for several decades. Contemporary concepts regard traumatic occlusion as a co-factor acting synergistically with the inflammatory component in the progression of periodontal destructive changes. In the presence of active inflammation in periodontal tissues, occlusal overloading accelerates alveolar bone resorption, increases the depth of periodontal pockets, and aggravates tooth mobility - itself a biomechanical factor contributing to further deterioration of prognosis (Dmitrieva, 2020).

The mechanism of periodontal tissue damage in traumatic occlusion operates through several pathways. First, excessive compressive loading on the periodontal ligament disrupts its vascular blood supply, induces local ischaemia, and leads to subsequent necrosis of Sharpey's fibres. Second, bone remodelling of the tooth socket, initiated by mechanical stresses, acquires a predominantly resorptive character in the context of the reduced reparative potential of inflamed periodontium. Third, pathological tooth mobility, developing as a consequence of traumatic overloading, creates constant mechanical irritation of the pocket epithelium, impeding the formation of new attachment and the stabilisation of the clinical condition (Jankelson, 2018).

The T-Scan Digital System: Operating Principles and Diagnostic Capabilities.

The T-Scan Novus system consists of a thin (0.1 mm) disposable polymer sensor equipped with a matrix of 1,370 pressure-sensitive cells, a handle with an analogue-to-digital converter, and specialised software for data recording, processing, and analysis. As the patient's teeth occlude, the sensor records force distribution in each cell, converting pressure into a digital colour code at a sampling frequency of 100 Hz. The resulting three-dimensional dynamic occlusal map enables analysis of the sequence of contact formation, their relative force, the degree of left-right asymmetry, and temporal parameters - occlusion time (OT) and disclusion time (DT).

The key diagnostic parameters measured by the T-Scan system are as follows. Occlusion Time (OT) - the interval from the moment of first tooth contact to the achievement of maximum intercuspation. Normal OT does not exceed 0.2 seconds; values exceeding 0.5 seconds indicate pronounced occlusal instability. Centre of Occlusal Force (COF) - the geometric centre of the total occlusal load; anterior displacement of the COF from its physiological position is an objective marker of supercontacts in the anterior tooth region. Left-right asymmetry - physiological load distribution is considered to be (50 ± 10)%; exceeding 60% on one side indicates pathological asymmetry. Disclusion Time (DT) - the

interval between the point of maximum intercuspatation and the complete separation of contacts during mandibular movements; DT values exceeding 0.5 seconds are associated with increased loading of the elevator muscles and risk of musculoskeletal dysfunction (Kerstein, 2020).

Comparative studies demonstrate that the T-Scan system enables the detection of supercontacts that are not identified by articulating paper in a significant proportion of cases. This is explained by the fundamental difference in measurement physics: articulating paper records only the fact of contact occurrence, whereas T-Scan measures the force of pressure dynamically. A contact that appeared insignificant based on the paper marking may prove to be the source of the greatest load in numerical terms, thereby altering the clinical priorities for correction (Dawson, 2019).

Selective Occlusal Adjustment: Theoretical Foundations and Optimisation Principles.

Selective occlusal adjustment is one of the primary methods of occlusal therapy, directed at eliminating premature contacts and interferences through the controlled removal of minimal volumes of hard tooth tissue. The theoretical rationale for the method is based on the concept of 'optimal functional occlusion', which presupposes the most even possible distribution of masticatory load across all functioning teeth in the position of centric relation, coinciding with the position of maximum intercuspatation (Dawson, 2019).

The Jankelson method (JPROS) involves the elimination of supercontacts according to the BULL/LULL scheme - Buccal Upper teeth into Lower fossae (BULL); Lingual Upper and Labial Lower surfaces (LULL) - following registration of the neuromuscular closing trajectory of the mandible. Integration of the T-Scan system into this protocol enables real-time verification of the results of each procedural step (Jankelson, 2018).

A critically important aspect of the optimised protocol is the distinction between the concepts of 'supercontact' and 'premature contact': the former characterises a contact with excessive force irrespective of its temporal characteristics, whereas the latter is defined exclusively chronologically. Digital analysis enables the simultaneous identification of both types of pathological contacts - something that is impossible when using articulating paper alone. This distinction is of substantial clinical significance: the elimination of premature contacts without accounting for the force component may lead to the overloading of adjacent teeth as a consequence of load redistribution, thereby worsening the periodontal condition in a proportion of patients.

Correlation Between Occlusal Disorders and Clinical Periodontal Parameters.

Analysis of the current scientific literature attests to the existence of a significant correlational relationship between the occlusal balance parameters recorded by the T-Scan system and the clinical indices of periodontal tissue condition. It has been established that an increase in occlusion time exceeding 0.5 seconds is associated with an elevation of tooth mobility by 1-2 grades on the Miller scale, while pathological asymmetry of occlusal load exceeding 30% correlates with deeper periodontal pockets on the side of overloading (Grudyaynov, Frolova, 2021).

Pathological tooth mobility, developing as a result of chronic occlusal overloading, serves both as a clinical indicator of its presence and as an independent pathogenetic mechanism driving further progression of periodontal changes. Vibrations of the tooth under pathological mobility create microtrauma of the epithelial attachment, promote apical migration of the epithelium, and impede adequate regeneration of periodontal tissues during remission periods. Consequently, normalisation

of occlusal relationships constitutes not an auxiliary but a mandatory component of comprehensive periodontal therapy (Dmitrieva, 2020).

Advantages of Integrating T-Scan into the Comprehensive Treatment Protocol for Generalized Periodontitis.

The application of the T-Scan system within the selective occlusal adjustment protocol for generalized periodontitis offers several fundamental advantages over traditional approaches. Objectivisation and documentation - digital recording of occlusal parameters before and after correction creates an objective evidence base for justifying the treatment performed, enables precise tracking of the dynamics of occlusal balance throughout the course of therapy, and permits comparison with the dynamics of clinical periodontal indices. This is particularly important from the perspective of evidence-based medicine and in cases requiring justification of the scope and cost of interventions (Kerstein, 2020).

Enhanced clinical precision - digital monitoring enables the sequential verification of each grinding step by immediately evaluating its result via changes in the force map and temporal parameters. This eliminates the risk of excessive tooth reduction, which in the traditional method may lead to over-reduction of the lower facial height or the loss of functionally significant occlusal contacts. The principle of 'minimal invasive approach' is most fully realised under digital control (Dawson, 2019).

Conclusion

The theoretical analysis conducted allows the following key conclusions to be formulated. First, traumatic occlusion constitutes a pathogenetically significant co-factor in the progression of generalized periodontitis, and its elimination represents a mandatory component of comprehensive treatment of this disease. Traditional methods of diagnosing occlusal contacts based on articulating paper are subject to fundamental limitations that preclude the quantitative assessment of load force and dynamics - a deficiency precisely compensated by the T-Scan digital analysis system.

Second, the integration of the T-Scan system into the selective occlusal adjustment protocol transfers the procedure from the realm of subjective clinical judgement into the domain of objective, reproducible, and documentable clinical practice. The ability to monitor the temporal parameters of occlusion - occlusion time and disclusion time - opens a new diagnostic horizon unattainable with traditional methods. Recording the dynamics of these parameters in conjunction with clinical periodontal indices creates an objective foundation for evaluating the effectiveness of ongoing treatment.

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