OPTIMIZING IMPLANT TREATMENT PLANNING IN CLINICAL PRACTICE THROUGH THE COMPREHENSIVE APPLICATION OF 3D RADIOGRAPHY AND LDF METHODS

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Relevance: The success of dental implant treatment is fundamentally dependent on accurate diagnostics and meticulous planning. While 3D radiography has become the standard for assessing bone structure, it provides limited information about the biological vitality and healing potential of the implant site. Laser Doppler Flowmetry (LDF) offers a functional assessment of tissue microcirculation, which is a key determinant of healing and osseointegration. The combined, comprehensive use of these structural and functional diagnostic tools has the potential to significantly optimize treatment planning. This approach allows clinicians to move beyond simple anatomical assessment to a more holistic, biological-based strategy, helping to identify at-risk patients and customize treatment protocols to reduce complications and accelerate healing.
Keywords: 3D radiography, laser doppler flowmetry (LDF), implant planning, diagnostics, osseointegration, bone healing, microcirculation.
Objective: To substantiate the optimization of implantological treatment planning by demonstrating how the comprehensive and dynamic application of 3D radiography and Laser Doppler Flowmetry (LDF) provides a more accurate and objective diagnosis, aids in identifying patients with relative indications, and helps in planning additional therapeutic and prophylactic measures.
Materials and Methods: The research framework involved the examination of 90 patients scheduled for dental implant treatment. The planning and follow-up protocol was based on a comprehensive diagnostic approach utilizing two key methods: 3D Radiography: Employed to study the dynamics of bone tissue healing in the peri-implant area, providing precise structural data on bone quantity and quality. Laser Doppler Flowmetry (LDF): Utilized to study the dynamic changes in blood supply and microcirculation in the soft tissues adjacent to the implant site, offering a functional assessment of tissue vitality. These diagnostic methods were planned for use in a dynamic fashion, with control examinations at multiple intervals (1, 3, 6, 9, and 12 months) to monitor the healing process.
Results: Based on the study's design, it is expected that the integrated analysis of data from 3D radiography and LDF will lead to a more reliable and objective diagnosis compared to using either method in isolation. This comprehensive approach is anticipated to be highly effective in identifying patients with relative indications for implantation (e.g., compromised bone quality or suboptimal vascularity) who may not be flagged by structural imaging alone. By correlating anatomical data from 3D scans with physiological data from LDF, the clinical team can make a more accurate prognosis regarding the healing process, which is crucial for planning interventions aimed at accelerating recovery and reducing negative reactions to the implantation.
Discussion: The synergy between 3D radiography and LDF is the key to optimizing treatment planning. 3D radiography provides the essential "anatomic map" of the surgical site, while LDF offers critical "physiologic intelligence" on the tissue's capacity to heal. For instance, a patient may present with adequate bone volume on a 3D scan, but LDF might reveal compromised microcirculation, indicating a higher risk for poor osseointegration. This knowledge allows the clinician to plan for additional measures, such as using specific surgical techniques or biological modifiers, to enhance healing. Conversely, excellent LDF readings could provide the confidence to proceed with more

advanced protocols like early functional loading, even in anatomically borderline cases. This dual-assessment strategy transforms implant planning from a static, structure-based decision to a dynamic, biology-based one, directly contributing to more predictable and successful outcomes.

Conclusions: The comprehensive application of 3D radiography and Laser Doppler Flowmetry provides a more accurate, objective, and biologically-informed basis for planning dental implant treatment. This integrated diagnostic approach is crucial for identifying patients with relative indications and for planning targeted therapeutic and prophylactic measures to minimize risks and accelerate healing. Optimizing the diagnostic phase with both structural and functional assessment tools is a key factor in improving the overall effectiveness and predictability of implantological treatment.

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