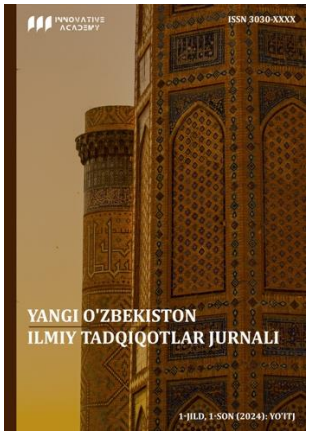

USE OF COMPUTER TECHNOLOGY AT THE STAGES OF DIAGNOSIS AND PLANNING ORTHOPEDIC TREATMENT BASED ON ENDOSSEAL IMPLANTS

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ABSTRACT

This study explores the integration of computer technology in the stages of diagnosis and planning orthopedic treatment, specifically focusing on endosseal implants. With the rapid advancements in computer-aided design (CAD), computer-aided manufacturing (CAM), and three-dimensional (3D) imaging technologies, orthopedic specialists are leveraging these tools to enhance the precision and efficacy of diagnosing and planning treatments involving endosseal implants. The utilization of computer technology facilitates a comprehensive understanding of patient anatomy, enables virtual simulations for surgical planning, and ensures personalized implant design. This paper reviews the current state of computer technology in orthopedics, highlighting its applications in diagnosis and treatment planning. Additionally, it discusses the potential benefits, challenges, and future prospects of incorporating computer technology into orthopedic practices, ultimately contributing to improved patient outcomes and the advancement of orthopedic surgical techniques.

In recent years, the method of orthopedic dental treatment using dental implantation has been an adequate way to compensate for dentition defects during oral prosthetics. However, in 60-70% of cases, patients have to be refused the method of dental intraosseous implantation due to the lack of sufficient volume and uneven bone texture. After tooth extraction, unfavorable conditions are created for implantation surgery and subsequent prosthetics, since the relief of the alveolar process changes not only in the vertical, but also in the horizontal directions, and, as a rule, serious obstacles arise for the use of intraosseous implants for this purpose.

All clinical, including instrumental, radiological studies, assessment of jaw models do not allow us to decide on implantation planning (with the full effect of aesthetics and functions of the

dental system)[1]. In cases where, based on the results of a clinical examination or orthopantomography, there is an assumption of the presence of a defect or a significant decrease in the volume of one of the cortical plates of the alveolar processes of the jaws in the area of the proposed surgical intervention, patients are sent for computed tomography (CT).

In order to deepen the diagnosis at the stage of examining patients and planning subsequent orthopedic treatment with the use of dental implants after multiple tooth extractions, computed tomography of the jaws using special navigation systems has been adopted as a mandatory additional examination. In particular, the latest advances in three-dimensional reconstruction[2][3] is an imitation of a three-dimensional image of the bone structure of the alveolar processes of the jaws. This technique is called virtual endoscopy and is implemented using Nawigator S.W. software, which allows the most adequate planning and modeling of the alveolar process. It should be noted that CT scanning before and after tooth extraction made it possible to study the structure of bone tissue and the relief of the contour of the alveolar process. Cross-sectional imaging of bone not only provides insight into its anatomy, but also allows separate measurements of cortical, cancellous, and total mineral content. It is possible to determine the linear absorption coefficient for a specific bone volume (true density measurement).

To process the data, we used the “Implant-Assistant” program, developed and presented by the Dental Implantation Center (Moscow). The advantage of a computerized tomogram in obtaining one-to-one images with unsurpassed detail quality of all potential implantation sites on the upper and lower jaws allows the data to be converted for subsequent use in drawing up a treatment plan individually for each patient. If with conventional radiography the density of the cortical bone can distort the true structure of the spongy substance, then computed tomography provides more reliable information. The use of computer densitometric analysis makes it possible to determine the quality of bone in various segments of the jaw in the form of digital data.

Methods and results:

Patient Data Acquisition: Collect relevant patient information, including medical history, imaging scans (X-rays, CT scans, MRIs), and dental records. Utilize computerized systems to organize and store patient data securely.

Imaging Processing and Analysis: Employ advanced imaging software for detailed analysis of orthopedic structures, focusing on endosseal implant sites. Utilize 3D reconstruction techniques to create virtual models for a comprehensive view of the affected area.

Virtual Surgical Planning (VSP): Implement VSP software to simulate and plan the orthopedic surgery, considering optimal implant placement. Integrate the virtual model with patient-specific anatomical details for precision in treatment planning.

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Computer-Aided Design (CAD): Utilize CAD tools to design customized endosseal implants tailored to the patient's anatomy. Ensure compatibility with existing bone structures and adjacent tissues for optimal functionality.

Biomechanical Analysis: Conduct biomechanical simulations using computer models to assess stress distribution and implant stability. Optimize implant design and placement to enhance long-term performance and minimize potential complications.

Collaborative Platforms: Facilitate interdisciplinary collaboration through computer-based platforms, enabling seamless communication among orthopedic surgeons, radiologists, and other specialists. Use telemedicine tools for remote consultations and expert opinions.

Enhanced Diagnostic Accuracy: Computer-assisted diagnosis improves the accuracy of identifying orthopedic issues and determining the suitability of endosseal implants. VSP and CAD technologies contribute to precise and individualized treatment plans, minimizing surgical complications and improving overall outcomes. Computer technology streamlines the surgical process by providing surgeons with a preoperative roadmap, reducing surgery time and improving overall efficiency.

Patient-Specific Implants: CAD enables the creation of patient-specific endosseal implants, ensuring a tailored fit and optimal integration with the patient's anatomy. Biomechanical analysis aids in identifying potential stress points and optimizing implant placement, reducing the risk of postoperative complications. Collaborative platforms and telemedicine tools foster efficient communication among healthcare professionals, promoting a multidisciplinary approach to patient care.

In conclusion, the integration of computer technology at various stages of diagnosis and treatment planning for orthopedic procedures involving endosseal implants offers a comprehensive and patient-specific approach, ultimately improving the precision and effectiveness of orthopedic interventions.
In conclusion, the utilization of computer technology in the stages of diagnosis and planning for orthopedic treatment, particularly involving endosseal implants, represents a paradigm shift in precision and efficiency within the field of orthopedics. The methods outlined, from advanced imaging analysis to virtual surgical planning and biomechanical simulations, collectively contribute to a more accurate, individualized, and streamlined approach to patient care.

The integration of computer-aided technologies ensures enhanced diagnostic accuracy, allowing orthopedic practitioners to pinpoint issues with greater certainty and determine the most suitable course of action. Virtual Surgical Planning (VSP) and Computer-Aided Design (CAD) not only optimize treatment planning but also pave the way for the creation of patient-specific implants, promoting a level of customization that was previously unparalleled. This not only improves the fit and functionality of endosseal implants but also contributes to reduced surgical risks and enhanced long-term outcomes.

Moreover, the collaborative platforms and telemedicine tools fostered by computer technology enable seamless communication among healthcare professionals, promoting a multidisciplinary and holistic approach to patient care. This interconnectedness facilitates remote consultations, expert opinions, and interdisciplinary collaboration, ensuring that patients benefit from the collective expertise of a diverse team of specialists.

In essence, the incorporation of computer technology at every stage of the orthopedic treatment process enhances precision, efficiency, and collaboration. As technology continues to advance, we can anticipate further refinements in these methodologies, leading to continued improvements in patient outcomes and the evolution of orthopedic care into an increasingly personalized and technologically integrated discipline. The use of computer technology in orthopedics is not merely a trend but a transformative force that continues to redefine the standards of patient care in the realm of orthopedic treatment.

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