INNOVATIVE PUBLICATION
Journal of Effective Learning and Sustainable Innovation
Vol.4 №2 (2026). February
innovativepublication.uz

EVALUATION OF THE EFFECTIVENESS OF DIGITAL TECHNOLOGIES IN DENTAL IMPLANT PROSTHETICS

Rixsiyeva Dildora Ulug'bek qizi
Associate Professor, Department of Hospital Orthopedic Dentistry TSMU,
email address: dildoraa1995@gmail.com
Temirova Nazokat G'olib qizi
Master's degree from Tashkent State Medical University;
email address: temirova.1412.n@icloud.com
Xaitboyeva Mohirabonu Otkir qizi
Master's degree from Tashkent State Medical University;
Электронная почта: tojirova@mail.ru
Musabekova Azizabonu Azamat qizi
Master's degree from Tashkent State Medical University;
email address: zzmusabekova66@gmail.com

ABSTRACT: The article discusses the current possibilities and effectiveness of using digital technologies in prosthetic dentistry for dental implant prosthetics. It analyzes the main stages of the digital workflow, including intraoral scanning, virtual planning, and the use of CAD/CAM systems in the manufacture of prosthetic structures. Particular attention is paid to the influence of digital methods on the accuracy of prosthesis fit, functional stability of implants, aesthetic indicators, and clinical predictability of treatment. The advantages of digital technologies over traditional methods are discussed, as well as factors limiting their effectiveness in clinical practice.
Keywords: digital dentistry, dental implants, orthopedic prosthetics, digital planning, intraoral scanning, clinical effectiveness.

INTRODUCTION

Modern dentistry is evolving amid rapid digital transformation, encompassing all stages of patient diagnosis and treatment. Particularly significant changes are observed in orthopedic dentistry and dental implantation, where the accuracy of planning and manufacturing orthopedic structures directly affects clinical outcomes. The introduction of digital technologies allows us to rethink traditional approaches to prosthetics, increase the predictability of treatment, and improve its functional and aesthetic indicators.

Prosthetics on dental implants is one of the most complex and responsible areas of

orthopedic dentistry. The success of implant treatment depends not only on the quality of the surgical stage, but also on the accuracy of orthopedic prosthetics, the correctness of clinical information transfer, and compliance with biomechanical principles. Traditional methods based on the use of impression materials and manual modeling of structures are often accompanied by technological errors that can negatively affect the service life of implants and patient comfort.

METHODOLOGY AND LITERATURE REVIEW

The methodological basis of this study is formed on the basis of systematic, comparative-analytical, and clinically-oriented approaches, which allows for a comprehensive assessment of the effectiveness of digital technologies in dental implant prosthetics. The study used methods of theoretical analysis, interpretation of clinical data, comparison of traditional and digital orthopedic treatment protocols, as well as critical analysis of scientific publications and monographs in the field of orthopedic dentistry and implantology [1].

The fundamental principles of digital dentistry are described in detail in Schleyer P.'s monograph “Digital Dentistry in Clinical Practice,” where digital technologies are considered not only as a tool for automation, but also as a factor in the transformation of the clinical thinking of dentists. The author emphasizes that the digital workflow changes the logic of clinical decision-making, increasing the accuracy of diagnosis and the predictability of orthopedic treatment [2]. These provisions formed the basis of the methodological approach of this study.

The accuracy of digital impressions and their clinical reliability are discussed in the works of Ender A. and Mehl A., “Accuracy of complete-arch dental impressions: A new method of measuring trueness and precision,” where experimental data prove that intraoral scanning provides high reproducibility of results in implant prosthetics [3]. The authors note that digital impressions minimize the distortions characteristic of traditional impression materials, which is especially important in multiple implantations. These conclusions were used in forming the criteria for evaluating the accuracy of digital technologies in this work.

Miyazaki T. and Hotta Y. made a significant contribution to the study of CAD/CAM technologies in their monograph “CAD/CAM systems in dentistry,” which details the stages of digital modeling and automated manufacturing of orthopedic structures. The authors point out that the use of CAD/CAM systems allows for high precision in the fit of abutments and prostheses, reducing the risk of microgaps in the implant-abutment area [4]. These provisions are methodologically significant for assessing the clinical effectiveness of digital prosthetics.

The work of Güth J.F., Keul C., and Stimmelmayr M., "Accuracy of digital models obtained by direct and indirect data capturing," analyzes the impact of digital modeling on the quality of orthopedic structures.

The authors conclude that digital workflows ensure the stability of prosthesis parameters and reduce the number of clinical adjustments. These results confirm the feasibility of using digital technologies in orthopedic practice and are taken into account in this study.

Among domestic and regional (CIS) researchers, Alimov A.A., Saidov Sh.R. Their work "Digital Technologies in Orthopedic Dentistry" examines the practical aspects of implementing CAD/CAM systems in clinical settings and analyzes errors that arise when specialists lack sufficient digital training. The authors emphasize the need for a phased introduction of digital technologies, taking into account the material and technical capabilities of the clinic [5].

The works of Ibragimov N.K. "Modern approaches to prosthetics on dental implants" are devoted to the analysis of clinical results of orthopedic treatment using digital and traditional methods. The author notes that digital technologies demonstrate high efficiency provided that planning protocols and interdisciplinary interaction between the doctor and dental technician are strictly followed. These conclusions are used in the methodological part of this article.

In the studies by Rakhimov B.M. and Yuldashev D.A. "Digital modeling in implant prosthetics" emphasize the role of virtual design in achieving optimal aesthetic and functional results [6]. The authors point out that digital modeling allows for the individual anatomical features of the patient to be taken into account, which increases the clinical reliability of orthopedic structures.

An analysis of scientific sources shows that digital technologies in dental implant prosthetics have significant potential to improve the accuracy, functionality, and predictability of orthopedic treatment. At the same time, their effective application requires a scientifically sound methodological approach, systematic training of specialists, and rational integration of digital solutions into clinical practice. The presented analysis forms a solid theoretical and methodological basis for further discussion of the results and conclusions of this work.

RESULTS AND DISCUSSION

Analysis of the effectiveness of digital technologies in dental implant prosthetics shows a significant improvement in the quality of the orthopedic stage of treatment compared to traditional methods. The results obtained show that digital workflows have a

comprehensive impact on the accuracy, clinical predictability, functional stability, and aesthetic parameters of orthopedic structures [7].

One of the most significant results of the introduction of digital technologies is the increased accuracy of orthopedic prosthetics. The use of intraoral scanning allows for the creation of high-precision digital models of dental arches and implants, which significantly reduces the likelihood of distortions characteristic of traditional impressions. In clinical practice, this manifests itself in a more precise fit of orthopedic structures to implants, a reduction in the number of adjustments, and a lower risk of microgaps in the implant-abutment area.

Clinical observations confirm that digital impressions provide more stable data reproducibility, especially in multi-implant prosthetics [8]. In traditional methods, accuracy largely depends on the physical and chemical properties of impression materials and the experience of the dentist, whereas digital technologies minimize the influence of the human factor. This is particularly important in complex clinical cases requiring high precision orthopedic designs.

Digital modeling of orthopedic designs using CAD programs has proven highly effective in the treatment planning stage. The ability to virtually analyze the position of implants, the shape of the future prosthesis, occlusal contacts, and aesthetic parameters allows the doctor to predict the clinical outcome in advance. As a result, the likelihood of functional disorders, such as implant overload or occlusal relationship disorders, is reduced [9].

When discussing the results, it should be noted that digital planning promotes closer interaction between the orthodontist and the dental technician. Working in a unified digital space ensures accurate transmission of clinical information, which is especially important when manufacturing individual abutments and complex orthopedic structures. This allows for a high degree of compliance of the manufactured prosthesis with clinical requirements [10].

The use of CAD/CAM technologies in the manufacture of orthopedic structures has also shown significant advantages. Automated milling ensures high precision in the processing of materials, which has a positive effect on the fit and durability of prostheses. Improved connection accuracy reduces the risk of micro-mobility of structures, which in turn reduces the likelihood of inflammatory complications in peri-implant tissues.

From a functional point of view, digital technologies allow optimizing the biomechanics of orthopedic structures [11]. Accurate modeling of the prosthesis shape and occlusal contacts contributes to the even distribution of chewing load, which is an

important factor for the long-term stability of implants. In clinical settings, this manifests itself in a reduction in the frequency of complications associated with implant overload and the destruction of orthopedic structures.

The assessment of the aesthetic results of digital prosthetics deserves special attention. Digital modeling allows for the individual anatomical features of the patient, the shape of the soft tissues, and the aesthetic parameters of the smile to be taken into account. As a result, a high degree of aesthetic harmony of orthopedic structures is achieved, which has a positive effect on patient satisfaction with the treatment results.

An analysis of treatment time indicators shows that the use of digital technologies helps to reduce the overall duration of the orthopedic stage. Fewer clinical visits, fewer laboratory processing stages, and less need for repeat adjustments optimize the treatment process. For patients, this translates into increased comfort and reduced psychological stress associated with long-term treatment.

At the same time, discussion of the results reveals a number of factors that limit the effectiveness of digital technologies. One of the key conditions for the successful application of digital protocols is the level of professional training of the doctor and dental technician [12]. Insufficient digital competence can lead to errors at the virtual modeling stage, which negates the advantages of digital methods. This highlights the need for systematic training and professional development of specialists.

In addition, the introduction of digital technologies requires significant material and technical resources. The high cost of equipment and software may limit the availability of digital solutions, especially in small dental clinics. However, in the long term, investments in digital technologies may be justified by increased treatment efficiency and reduced clinical complications [13].

It should be emphasized that digital technologies are not a universal solution and do not replace the need for clinical experience and professional judgment on the part of the dentist. Digital tools should be viewed as a means of improving the accuracy and predictability of treatment, rather than a substitute for clinical thinking. Only through the rational integration of digital and traditional approaches is it possible to achieve optimal clinical results.

CONCLUSION

The analysis confirms that the use of digital technologies in prosthetics on dental implants is an important stage in the evolution of prosthetic dentistry and meets the modern requirements of clinical practice. Digital methods, including intraoral scanning, virtual planning, and CAD/CAM fabrication of prosthetic structures, have a comprehensive impact on the quality and predictability of prosthetic treatment.

The findings indicate that digital technologies can significantly improve the accuracy of the prosthetic stage of treatment by minimizing technological errors and reducing the influence of the human factor. The high accuracy of digital impressions and automated manufacturing of orthopedic structures contributes to improving the fit of prostheses to implants, which is a key condition for their functional stability and durability. This, in turn, reduces the risk of biomechanical overload and inflammatory complications in peri-implant tissues.

Thus, digital technologies in dental implant prosthetics should be viewed not as an alternative to clinical experience, but as an effective tool for expanding it. The rational integration of digital and traditional approaches allows for achieving an optimal balance between technological capabilities and clinical thinking, ensuring high-quality orthopedic treatment and stable long-term results.

REFERENCES

1. Schleyer T.K.L. Digitale Zahnmedizin in der klinischen Praxis // Zeitschrift der American Dental Association. – 2015. – Band 146, Nr. 2. – S. 101–107.
2. Miyazaki T., Hotta Y. CAD/CAM-Systeme in der Zahnmedizin: aktueller Stand und Zukunftsperspektiven // Journal of Prosthodontic Research. – 2009. – Band 53, Nr. 3. – S. 105–112.
3. Ender A., Mehl A. Genauigkeit von Zahnabdrücken des gesamten Zahnbogens: Eine neue Methode zur Messung von Genauigkeit und Präzision // Journal of Prosthetic Dentistry. – 2013. – Band 109, Nr. 2. – S. 121–128.
4. Güth J.F., Keul C., Stimmelmayr M. Genauigkeit digitaler Modelle, die durch direkte und indirekte Datenerfassung gewonnen wurden // International Journal of Prosthodontics. – 2013. – Band 26, Nr. 2. – S. 152–159.
5. Joda R., Bragger U. Digitale vs. konventionelle Arbeitsabläufe in der Implantatprothetik // Clinical Oral Implants Research. – 2015. – Band 26, Nr. 12. – S. 1431–1436.
6. Mangano C., Luongo G., Migliario M. Kombination von intraoralem Scannen und CAD/CAM für implantatgetragene Restaurationen // International Journal of Dentistry. – 2018. – Band 2018. – S. 1–9.
7. Noort R. Die Zukunft der Dentalgeräte ist digital // Dental Materials. – 2012. – Band 28, Nr. 1. – S. 3–12.
8. Алимов А.А. Цифровые технологии в ортопедической стоматологии. – Ташкент: Fan va texnologiya, 2020. – 168 с.

9. Saidov Sh.R., Karimov M.T. Einsatz von CAD/CAM-Systemen in der implantologischen Prothetik // Usbekische Zeitschrift für Zahnmedizin. – 2021. – Nr. 2. – S. 45–50.
10. Ibragimov N.K. Moderne Ansätze zur Prothetik auf Zahnimplantaten. – Taschkent: Medizin, 2019. – 204 S.
11. Rakhimov B.M., Yuldasheva D.A. Digitale Modellierung in der implantologischen Prothetik // Zahnmedizin. – 2020. – Nr. 4. – S. 32–37.
12. Papaspyridakos P., Chen C.J. Digitaler Arbeitsablauf in der Implantatprothetik // Journal of Prosthetic Dentistry. – 2016. – Band 116, Nr. 5. – S. 741–751.
13. Abdukarimov F.X. Implantologik ortopediyada raqamli texnologiyalarni joriy etish masalalari // Tibbiyot va innovatsiya. – 2022. – Nr. 1. – S. 58–63.