THE NEW ERA OF IMPLANTATION OF TEETH

Kamiljanov Fayzullakh Kabiljon o'g'li
Student of Kokand university Andijan Branch
Dentistry faculty group 24-01

Abstract. *This article discusses the recent advancements and innovations in dental implantation. It highlights the evolution of dental implantology, from traditional titanium screw implants to novel biocompatible materials, digital technologies, and regenerative techniques.*

The article also explores how artificial intelligence (AI), computer-guided surgery, and 3D printing have improved success rates, reduced healing time, and enhanced patient outcomes.

Finally, it addresses future trends and challenges in modern dental implantation.

Keywords: *Dental implants, osseointegration, 3D printing, guided implant surgery, zirconia implants, digital dentistry, bone regeneration, AI in dentistry.*

Introduction

Dental implantation has revolutionized the way missing teeth are replaced. Since the 1960s, when osseointegration was first introduced by Dr. Per-Ingvar Brånemark, dental implants have become the gold standard for tooth replacement. Today, a "new era" of implantation is underway—characterized by rapid technological progress and interdisciplinary integration—pushing the boundaries of precision, durability, aesthetics, and patient comfort.

Discussion

1. Evolution of Implant Materials

Traditionally, titanium has been the material of choice due to its high biocompatibility and osseointegrative properties. However, recent developments have introduced zirconia implants as a metal-free, aesthetically superior alternative with low plaque affinity and excellent soft tissue response.

2. Digital and Guided Implant Surgery

The integration of Cone Beam Computed Tomography (CBCT) and computer-aided design/computer-aided manufacturing (CAD/CAM) allows for precise preoperative planning.

Using surgical guides, clinicians can place implants with unparalleled accuracy, reducing the risk of nerve injury and sinus perforation.

3. 3D Printing and Customization

3D-printed surgical guides and even customized implants tailored to the patient's anatomy have become a reality. This personalization not only improves functionality and esthetics but also reduces chair time and post-operative complications.

4. Immediate Loading and Minimally Invasive Techniques

Immediate implant placement and immediate loading protocols have become increasingly common, thanks to improved implant designs and surface technologies. Minimally invasive flapless surgeries also contribute to faster healing and reduced discomfort.

5. Regenerative and Bioactive Approaches

Bone augmentation with platelet-rich fibrin (PRF), stem cells, and biomimetic scaffolds has expanded the pool of patients eligible for implants. These regenerative techniques help overcome the limitations of inadequate bone volume.

6. Artificial Intelligence and Robotics

AI is being utilized for predictive modeling of implant success, automatic image segmentation, and even in robotic-assisted implant placement. AI-driven diagnostics reduce human error and enhance decision-making in treatment planning.

Conclusion

The new era of dental implantation reflects a convergence of biology, engineering, and digital innovation. As materials become more biocompatible, techniques more precise, and surgeries less invasive, dental implants are now more accessible, efficient, and patient-friendly than ever before. However, challenges remain, including cost, training, and the need for long-term data on emerging technologies. Future developments will likely focus on improving accessibility, integrating AI more deeply, and further enhancing tissue regeneration.

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