



Обговорення

Успішність фіксації мікроімплантів становить 80 %. Відсоток успіху не залежить від статі, віку та локалізації, але підвищується зі збільшенням щільності кісткової тканини. Рівень успіху ортодонтичних мікроімплантів істотно не корелює зі щільністю кортикальної кістки. Не виявлено кореляції між значеннями діаметра та крутного моменту шести різних самосвердлювальних мікроімплантів. Швидкість затягування гвинта значного впливу на пікове значення крутного моменту не має, але було показано, що 6-мм ортодонтичні мікроімпланти

характеризуються значно вищими значеннями крутного моменту, ніж 8- та 10-міліметрові. Рівень успіху ортодонтичних мікроімплантів підвищувався зі збільшенням їх довжини та висоти розміщення, а також зі зменшенням кута.

Висновки

Використання мікроімплантів у сучасній ортодонтії для лікування усіх можливих патологій прикусу дозволяє досягнути якісного переміщення зубів, надійної фіксації ортодонтичних апаратів тим самим прискорює та оптимізує ортодонтичне лікування будь-якої складності.

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Ashrafov Davud Sergey

Azerbaijan Medical University, Azerbaijan, Baku

Fabrication of a Removable Reinforced Retainer Using CAD/CAM Technologies

▷ **Abstract.** CAD/CAM technologies and 3D printing have revolutionized modern dentistry. This digital approach to creating restorations (crowns, veneers, bridges, abutments, aligners) has replaced traditional impressions, making the process faster, more accurate, and more individualized. The integration of digital technologies into dental practice, such as CAD/CAM systems and 3D printing, significantly increases the precision, speed, and quality of various superstructures that differ in purpose, manufacturing material, and method of fixation. These innovations reduce the degree of dental technicians' involvement, improve the functional characteristics of prosthetic products, and ensure a personalized approach for each patient.

Keywords: *digital technologies; photopolymer 3D printing; CAD/CAM technologies; removable retainer; prosthetic constructions.*

Introduction

These innovations not only optimize workflow processes but also ensure a personalized approach for every patient. One of the most promising directions is the use of CAD/CAM technologies, which, in combination with photopolymer 3D-printing, open new possibilities for the design and fabrication of prosthetic constructions [1, 3].

Special attention should be given to the fabrication of retainers, as their functionality and comfort directly depend on the accuracy of the design. Despite the rapid advancement of technologies, the scientific literature still lacks comprehensive coverage of the digital clinical and laboratory stages involved in creating such constructions, leaving open questions regarding their standardization and optimization. These gaps highlight the relevance of the present study, aimed at systematizing the processes, evaluating the effectiveness of new fabrication methods, and developing recommendations for their application in dental practice [2, 4].

Aim of the study: To improve the efficiency of manufacturing removable reinforced retainers through the use of precision digital CAD/CAM technologies and photopolymer 3D printing, which ensure individualized design and optimization of functional characteristics.

Materials and Methods

Before fabricating the retainer, one-step two-layer working impressions of both jaws were obtained using an A-silicone impression material, along with a silicone occlusal registration. Using the facebow of the analog articulator system Artex, the spatial position of the maxilla relative to the patient's skull was recorded. The obtained analog data were scanned with a laboratory 3D scanner to produce working models using 3D printing and to transfer them into the digital environment of the virtual Artex CR articulator.

Digital design of the removable reinforced retainer was carried out in the EXOCAD CAD system for PC, taking into account all undercut areas to ensure reliable fixation and stabilization of the appliance in the oral cavity. After printing was completed, a multistrand stainless-steel reinforcing wire

was fixed along the clinical equator of the crown portions on the vestibular surfaces of 12 teeth by thermo-vacuum forming the model with the mounted removable reinforced retainer using a standard 1 mm polyvinyl chloride sheet.

Manufacturing was completed with the final individual modeling of the occlusal surfaces of the posterior segment teeth in the interframe space of the analog Artex CR articulator, followed by polishing.

Results of the Study

The final design of the removable reinforced retainer consists of two parts: an internal and an external one.

The individually designed internal part of the appliance, created in the virtual articulator, is fabricated using photopolymer 3D printing. This component has a thickness of 0.2-0.3 mm, completely covers the crown portions of all anterior teeth from the vestibular, occlusal, and oral surfaces, and the posterior segment from the vestibular and oral surfaces only, and is reinforced with multistrand stainless-steel wire. The external part of the appliance is fabricated by thermo-vacuum forming in a vacuum former using 1 mm polyvinyl chloride sheets. Afterward, occlusal surfaces of the posterior segment teeth are adjusted in the interframe space of the analog articulatory system.

The proposed methodology made it possible to create a removable reinforced retainer with a high degree of adaptation accuracy and reliable fixation. The 3D-printing technology ensured the minimal wall thickness of the construction (≤ 1.5 mm), which contributed to improved patient comfort and rapid adaptation. Reinforcement significantly increased the strength and stability of the appliance.

Conclusion

Digital technologies have demonstrated their strong potential in dentistry, opening new opportunities for the standardization and optimization of processes. The developed methodology showed high clinical effectiveness in creating individualized structures with minimal thickness, facilitating patient adaptation. The use of CAD/CAM technologies and 3D printing significantly improved the accuracy, reliability, and comfort of the proposed removable reinforced retainer design.

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