TITU MAIORESCU UNIVERISTY

DOCTORAL SCHOOL OF DENTAL MEDICINE

Experimental studies on a series of innovative dental materials

Doctoral Thesis

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București

2025

Abstract

The doctoral thesis “Experimental Studies on a Series of Innovative Dental Materials” analyzes the use and performance of advanced materials in fixed prosthodontics, focusing on mechanical properties, degradation resistance, and biomechanical behavior. The evolution of CAD/CAM technologies and 3D printing has revolutionized the fabrication of prosthetic restorations, ensuring precision, enhanced aesthetics, and improved biocompatibility.

The thesis is structured into two main sections: the theoretical part, which details dental materials and manufacturing methods, and the experimental part, which investigates their performance under simulated clinical conditions. Fixed prosthetic restorations are analyzed from the perspective of structure, chemical composition, and mechanical behavior, with a focus on zirconium dioxide, lithium disilicate, and 3D-printed polymeric materials.

Regarding manufacturing methods, traditional techniques are compared with modern approaches, and the Finite Element Method (FEM) is employed to analyze stress distribution and biomechanical performance in restorations.

The experimental part is structured around three key research directions:

1. Degradation assessment through immersion in artificial saliva, evaluating chemical stability and morphological changes over time.
2. Biomechanical behavior analysis using the Finite Element Method, assessing stress distribution in a multi-unit prosthetic restoration.
3. Experimental study of compressive strength, comparing the mechanical performance of innovative materials.

The research findings indicate that zirconium dioxide exhibits superior biomechanical resistance, making it ideal for restorations subjected to intense occlusal forces. Lithium disilicate, although less resistant, stands out for its excellent aesthetic properties, making it preferable for anterior restorations. 3D-printed composite materials, while promising due to their high degree of customization, have limited mechanical strength, making them more suitable for temporary applications or areas with reduced biomechanical stress.

Based on the conclusions obtained, the study highlights the need to optimize 3D-printed polymeric materials and integrates new findings into improved clinical application strategies. This research contributes to a deeper understanding of modern restorative materials and provides essential data for enhancing the durability and aesthetics of fixed prosthetic restorations.