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"CHEMICAL COMPOSITION AND POLYMERIZATION PROCESS OF COMPOSITE FILLINGS (RESTORATIVE MATERIALS) "

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Kuryazov Akbar Kuramboyevich
Urgench State Medical Institute (Head of the Department of Dentistry, Professor)
Kuryazov Shokhrukh Akbar ugli
Urgench State Medical Institute (Assistant of the Department of Dentistry)
Abdullayeva Hafiza Davronovna
Urgench State Medical Institute (Assistant of the Department of Medical and Biological Chemistry)

Abstract

In modern dentistry, composite fillings are one of the most widely used materials due to their aesthetic, mechanical, and biological advantages. The correct choice of their chemical composition, polymerization mechanism, and clinical properties determines the quality of dental treatment. Therefore, a detailed examination of the chemical structure of composite materials and the photopolymerization process is of great scientific and practical importance.

Keywords

composite fillings, BIS-GMA, UDMA, TEGDMA, filler materials, silane coupling agents, photopolymerization, camphorquinone, radical, polymerization, polymerization shrinkage

OBJECTIVE

To analyze the main chemical components of composite fillings, their interactions, and the mechanism of the polymerization process.

TASKS

Study the chemical structure of the organic matrix (resin)

Determine the composition of filler materials

Explain the mechanism of photopolymerization from a chemical perspective

Evaluate the influence of chemical factors on the mechanical properties of the material

MAIN PART

1. Structure of composite fillings

Composites consist of 3 main parts:

Organic matrix (polymer resin)

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Most commonly used resins:

BIS-GMA (bisphenol A-glycidyl methacrylate)

UDMA (urethane dimethacrylate)

TEGDMA (triethylene glycol dimethacrylate) - viscosity-reducing modifier

Inorganic fillers

Silica (SiO2)

Zirconium oxide (ZrO)

Borosilicate glass

Barium aluminosilicate (increases X-ray contrast)

Silane coupling agents

Creates a chemical bond between the filler and the resin.

2. Chemistry of the polymerization process

The hardening of composite fillings occurs through the mechanism of radical polymerization.

Stages:

1) Initiation

A photopolymer lamp emits blue light (470 nm).

The most widely used photoinitiator is camphorquinone.

The resulting free radical opens the C=C bonds in the resin molecules.

2) Propagation

Monomers link together to form a macromolecule:

3) Termination

The radicals combine with each other to end the chain:

As a result, a solid polymer structure is formed.

3. Fillers and their role

The greater the amount of fillers:

Higher mechanical strength

Lower thermal expansion

Increased hardness

Enhanced wear resistance

In nano-hybrid composites, the particle size is 20-50 nm, and the aesthetic effect is very high.

4. Polymerization shrinkage

In resins, during polymerization, a volume decrease of 1.7-3.5% occurs.

Chemical cause: densification of monomer molecules.

This leads to clinical problems:

microvoids

marginal sealing failure

secondary caries

5. Resistance to alkaline environments

Composites are chemically stable, but:

strong acids

alcohols

enzymes in the oral cavity

can cause slow degradation of resins.

CONCLUSION

Composite fillings have a complex chemical structure, and their quality is determined by the combination of polymer resins, inorganic fillers, and photoinitiators. With proper control of the polymerization process, the clinical stability of the material increases. Modern nano-hybrid composites have high mechanical strength and aesthetic properties and are considered the primary restorative material in dentistry.

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