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# ADVANTAGES AND DISADVANTAGES OF MODERN GLASS CARBOMER CEMENTS

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## INTRODUCTION

Glass carbomer cements are modern dental materials, which are used more often in the dental practice, in the treatment of tooth decay or for fixing of different prosthetic constructions. **Objective:** The aim of this research is to analyze the advantages and disadvantages of glass carbomer cements, as a comparison between their physico-mechanical and biological properties with the same features of classical glass ionomer cements, and to determine the indications for their application in dental medicine. **Results:** The results of the investigation shows, that glass carbomer cements have numerous of advantages, than glass ionomer cements. Some of the disadvantages of glass ionomer cements are eliminated, which reduces solubility and increases flexure and compressive strength. Better microhardness and excellent chemical bond with the enamel and dentin are achieved. This provides improved retention and marginal adaptation of the fillings. The incorporated nanocrystals of hydroxyapatite and fluorapatite increase the natural process of mineralization and regeneration of the dentin and the biological properties of the cement. **Discussion:** The comparative research of the different types of glass ionomer cements definitely prove, that glass carbomer cements have better phisyco-mechanical and biological properties. **Conclusion:** The numerous advantages of glass carbomer cements and their simple manipulation protocol, lead to their common application in the dental practice.

**KEYWORDS:** Glass ionomer cements, glass carbomer cements.

## 1. INTRODUCTION

Glass ionomer cements are modern materials, used for decay treatment and fixation of prosthetic constructions.[1,2] They have remarkable biological activity and remineralization

ability, which is due to their fluor-releasing feature.[1,3,4] They are determined as a "Materials of the future", because of their stable chemical adhesion to the dental structures and disinfection property of the polyalkenoic acids.[1,2]

Glass ionomer cements are developed and patented by Wilson and Kent in 1969.[1] At first, they were presented in a classic trade form as a powder and a liquid, but later they were sold like a powder and distill water, two pastes for manual and automatic dosage and mixing and in capsules. This facilitates their preparation and homogenization.

Researches revealed, that the main disadvantages of the glass ionomer cements, which restrict their application as definitive obturation materials, are bad mechanical properties and abrasion.[5] The reason is caused by the alteration of the water balance in the first 24 hours after setting, when hydration and desiccation reduce their mechanical and biological properties.[1] That's why it is recommended to cover the obturation with a layer of glaze after finishing it.[6] Another option is to use fast setting cements, which do not contain potassium ions and allow fast building of strong aluminum-polyalkenoic chains. That makes the cement less sensitive of moisture.[1] Problem with the moisture leads to creation of resin-modified glass-ionomer (hybrid) cements, which include in their composition hydroxyethyl methacrilate (HEMA), which creates waterproof grid after polymerization.[1] These cements are avoided lately, due to the toxic action of the non-polymerized methacrylic, which hits the saliva and leads to permanent monomer releasing.[1] Some of them can cause endocrine disorders or allergies. Another trait is the possibility of the hybrid cement monomers to transform themselves to the dangerous Bisphenol A and its derivatives. This requires companies to mention explicitly its presence in their products' list. The disadvantages and the material's shrinking after setting, are the reasons why hybrid cements are replaced by fast-setting glass-ionomer materials[1]. Development of atraumatic restorative treatment (ART) confirmed that these cements are more efficient and preventive than other adhesive materials.[7] This is proven by the researches of Frencken[7], Makoni и Sithole[1,2] as well, who claim that glass-ionomer cements are foundation of the modern minimum invasive decay treatment conception. The trend of continuous improvement and the desire for creation of cement with optimum properties, is the reason for development of glass carbomer cements, which physico-mechanical and biological characteristics are still not well investigated.

## 2. OBJECTIVE

The aim of this research is to analyze the advantages and disadvantages of glass carbomer cements by comparing their physico-mechanical and biological characteristics with classical glass ionomer cements, and to define their indications for application in dental medicine.

## 3. LITERATURE SURVEY

The variety of dental cements and seeking of universal filling material leads to development of new and modern cements. A new glass ionomer filling material, which includes hydroxyapatite and fluorapatite nanocrystals, responsible for increasing the natural process of regeneration and mineralization, is created as a result of many experimental and clinical researches. This glass carbomer material eliminates some of the disadvantages of glass ionomer cements, such as reduces the solubility and increases flexural and compressive strength (Table 1). The cement does not contain resin ingredients, solvents or metal components and monomers, which is marked on the package as "Monomer free and BPA free". The material is activated through heat with special photopolymerizing diode lamp, GCP CarboLED CL with luminous intensity of 1400 mW/cm2, which increases setting reaction. The cement is manufactured only in capsule trade form for precise dosage of the components.[1]

According to the company's researches glass carbomer cement is biocompatible material, which provides excellent chemical bond with the enamel and dentin.[8] The nanotechnology with fluorapatite crystals, increases the speed of remineralization, which is initiated by high energy lamp.

**Table 1: Solubility and compressive strength of glass carbomer cement in a comparison with another type of cements.**

| Materials | Lactic acid solubility [mm] | Compressive strength [MPa] |
|---|---|---|
| GCP Glass Fill | -0,08 | 260 |
| Ketac Fill Plus | -0,10 | 171 |
| Ketac Molar | -0,03 | 242 |
| Chem Flex | -0,23 | 247 |
| Fuji IX | -0,11 | 256 |
| Ionofil Molar | -0,12 | 191 |

The protocol of application of modern glass carbomer cements includes the following steps[6]:

1. Cleaning of the cavity preparation with water or ethylenediaminetetraacetic acid (EDTA).
2. Rinsing and drying, without drying out of the cavity.

3. The capsule is shaking energetic or has to be hit in hard surface for breaking the barrier between the powder and the liquid in the container. After this, the capsule is put in a mixer for 10-15 sec. in 4300 revolutions per minute for good homogenization of the components. Then the capsule is put in a special gun device and the material is squeezed directly on the bottom of the cavity to the surface for eliminating air bubbles in the obturation.
4. The cement is modeled with a special instrument and the working time is 1:15 min ($23^{o}$C). Prolonged shaping of the filling leads to violation of the bond with the enamel and dentin. The higher temperature shortens the setting reaction and the lower makes it longer. A metal matrix band is recommended to be used for better heat conduction. It has to be removed 3:30min after the final setting.
5. The designed filling is heated with light source and optimum results could be reached at power of 1400mw/$sm^2$ for 60-90sec.
6. The obturation has to be polished with yellow-marked fining burs.
7. The filling surface has to be covered with a protective polish GCP GLOSS, which protects from moisture and prevent dehydration from lamp heating. The patient is advised to avoid chewing for 1 hour after the procedure.

## 4. DISCUSSION

According to most researches the main advantages of glass carbomer cements are in their better physics and mechanical properties. The investigations of Gorseta et al.[9] prove 3 times higher flexure strength, than fast setting glass ionomer cements (Fuji IX GP Fast), activated with different light-cured sources - Bluephase G2 (IvoclarVivadent), Elipar™ FreeLight 2 and Elipar™ TriLight (3M ESPE). The results revealed 122.29 MPa flexure strength of glass carbomer cements and 57.85 MPa of Fuji IX Fast. In another research Gorseta et al.[10] announce about 5 times higher values of flexure strength (127.1±25.8 Mpa) in a comparison with fast setting glass ionomer cements, without light application. In the cases, when diode lamp is applied, the values of glass carbomer cements are 18% higher.

The studies of Lopes et al.[11] show, that glass carbomer cements have significantly higher hardness than Riva Light Cure hybrid cement. The authors study the microhardness of the materials Glass Fill, GCP Dental and Riva Light Cure and use four light cure sources (Carbo LED lamp, GCP-Dental, Demi LED curing light, Kerr, Poli Wireless, Kavo, Radii Plus, SDI). They proved, that glass carbomer cement has highest microhardness, despite of the

applied light source. The researches of Gorseta et al.[12] about microhardness of glass carbomer materials, heated with two different polymerization lamps, showed higher Vicker values when Elipar Freelight (3 M Espe, Germany) is used, in a comparison with Bluephase 16i (Ivoclar Vivadent, Liechtenstein). The authors think, that the amount of heat has significant influence of the setting reaction of class carbomer cements.

The evaluation of glass carbomer cements' biological properties includes studies of their marginal adaptation and microleakage. In a comparative research between these cements and glass ionomer materials, before and after gloss application, Cehreli et al.[13] establish highest microleakage in uncoated glass carbomer cements, followed by glass ionomer cements. The authors arange the materials in the following descendent row, according to their microleakage rate: uncoated with gloss glass carbomer cement, uncoated glass ionomer cement, coated glass ionomer, coated glass carbomer, compomer cement. This data is confirmed by Gorseta et al.[14], whose studies show lower values of microleakage in heat-cured glass carbomer in a comparison with fast setting glass ionomer cement.

Christina[15] claims, that GCP Glass Fill, GCP Dental, has lowest values of microleakage, that others glass ionomer materials. Subramaniam et al.[16] established, that GCP Glass Fill is less soluble and has low microleakage, than glass ionomer materials. That is why they recommend its application as a fissure sealant.

The retention of glass carbomer cements is very positive property. Their application as fissure sealants revealed 100% retention after 6 months and lack of secondary decays.[17] The results show, that their retention is similar to the retention of Helioseal F (Ivoclar Vivadent) filling materials, after polymerization with Bluephase 16i (Ivoclar Vivadent) polymerization lamp. The received data revealed comparable properties between glass carbomer and glass ionomer materials. One-year evaluation of similar study presents 75% material's retention with a presence of secondary decays in both groups and similar retention of the glass carbomer cement, compared with resin modified glass ionomer sealing material.[18] Two-year study of carbomer's decay protection, reveals high survival rate of the sealant coat and prevention from secondary caries.[19] This data are supplemented by the in vitro researches of Glavina et al.[20] who study glass carbomer's adhesion to the enamel. The investigation show values of the shear bond strength (13,7 MPa), which is twice higher than glass ionomer cements (6,7 MPa). However, the results of Chen et al.[21] two-year investigations establish, that the retention of glass carbomer cements is not reliable enough for successful fissure sealing.

Glass carbomer cements are biocompatible cements and contain fluorapatite, which has remineralizing action and protects the pulp from thermal damages. Different researches are conducted to evaluate thermal influence to the dental pulp during setting.[5,22] According to some of them, temperature increasing is below the critical values.[23] The investigation of van Duinen et al.[24] shows, that heat application is harmless for the pulp and recommend its usage in the clinical practice. This state is rejected by the investigations of Botsali et al.[22], who reveal a possibility of pulp damage, when the depth of dentin is less than 1mm. higher temperature rising is detected when Carbo LED diode lamp is used. Measured values are on the border of pulp damage, which according to the authors, requires additional laboratory and clinical studies of heat influence to the tooth vitality and the damage of causing an inflammatory reactions.

## 5. CONCLUSION

Glass carbomer cements are modern filling materials, which have improved physico-mechanical and biological properties and are used more often in the dental practice.

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