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Comparative Evaluation of Glass Ionomer Cements for Fixing Artificial Coatings

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Abstract: Glass ionomer cements (CC) occupy a special place among fixing materials in modern orthopedic dentistry, representing one of the most demanded groups of cements for permanent fixation of non-removable orthopedic structures. Having appeared in clinical practice about 50 years ago, these materials have undergone significant evolution, and today the dental market offers a wide range of glass ionomer cements with various physical and mechanical characteristics and clinical properties.
Keywords: adhesive strength, ceramic-metal alloy, compression strength, glass ionomer cements.

Introduction

The popularity of glass ionomer cements is due to their complex of positive qualities: chemical adhesion to hard tooth tissues and various orthopedic materials, biocompatibility, prolonged release of fluorides, providing a caries-static effect, as well as relative ease of use. At the same time, the variety of glass ionomer cements available on the market creates certain difficulties for practitioners in choosing the optimal material for specific clinical situations.

Modern glass ionomer cements are classified according to several criteria: by chemical composition (traditional, polymer-modified, metal-modified), by purpose (for sealing, for fixing, lining), by curing method (chemical curing, double curing). At the same time, physico-mechanical properties such as compressive strength, film thickness, solubility, adhesion to various surfaces, as well as clinical characteristics (working time, curing time, handling properties) can vary significantly not only between different CIC groups, but also among materials of the same group from different manufacturers.

Materials and methods

12 samples were produced for each grade of glass ionomer cements to assess compression and adhesive strength, respectively. The samples were further divided into three subgroups of four samples for each test.

Preparation of samples for testing compression strength. The samples measured 2 mm thick and 5 mm wide and long.The mixture of cement powder and liquid was prepared according to the manufacturer's recommendations and mixed mechanically for 20-30 seconds.The finished samples were kept at a controlled temperature and humidity (37-40 °C) before testing. The tests were carried out 2, 4, and 12 hours after sample preparation. The samples were placed vertically between two plates of the Instron apparatus, and a load was applied to them at a speed of 0.5 mm/min. The maximum load at which the sample was destroyed was recorded. Preparation of samples for testing adhesive strength: Ceramic-metal alloy samples had a diameter of 5 mm and a thickness of 2 mm, they were mounted on PMMA rods. Glass ionomer cements were prepared and applied in accordance with the manufacturer's recommendations. The surface of the alloy was pre-treated with three different methods: diamond boron, silicone carbide and sandblasting. The tests were carried out on the universal Instron device. The samples were mounted horizontally, and the load was applied vertically at a speed of 20 mm/min. The peak load value at which the separation of the samples took place was recorded.

Results and Discussions

The study showed that the compression strength was maximal for Glassing cement at all time intervals (392, 400 and 402 units after 2, 4 and 12 hours, respectively), which makes it the most preferable for clinical use. GC Fuji II took the second place in strength, and I-FIX showed the lowest values. The analysis of adhesive strength showed that sandblasting of the ceramic-metal alloy surface provided the highest adhesion rates compared to diamond boron and silicone carbide treatment. Discussion: The results obtained confirm that the use of sandblasting significantly improves the adhesion properties between glass ionomer cements and ceramic-metal alloys. This can reduce the risk of micro-penetration and increase the durability of dental restorations. The increase in adhesive strength during sandblasting is explained by micromechanical bonding. Studies conducted using scanning electron microscopy showed that the surface of the alloy treated with diamond boron or silicone carbide had fewer micro-irregularities compared to sandblasting, which can lead to a decrease in retention capacity. In clinical practice, the most important aspects of the use of glass ionomer cements are their ability to ensure reliable fixation of orthopedic structures, seal the boundary between restoration and tooth tissues, preventing the development of secondary caries, as well as the long-term stability of cement properties in the oral cavity. The choice of cement should take into account the type of fixed structure (metal, ceramic, metal-free restorations), the clinical situation (presence of moisture, possibility of isolation of the surgical field), as well as the individual characteristics of the patient (risk of caries, presence of hyperesthesia). Despite a significant number of studies devoted to certain aspects of the use of glass ionomer cements, a comprehensive comparative assessment of modern materials, taking into account all significant parameters, is an urgent scientific and practical task. Such an assessment will make it possible to systematize the available data on the properties of various CIC and develop scientifically sound recommendations for their differentiated use in clinical practice. It was to comprehensively study, evaluate and compare the adhesive and compression strength of various grades of glass ionomer cements when interacting with a ceramic-metal alloy. The study included the analysis of the following materials: GC Fuji II glass ionomer cements (GC Corporation, Tokyo), Glassing (Republic of Uzbekistan, Jizzakh region), I-FIX (I-Dental, Lithuania), as well as ceramic-metal alloy (Ni–Cr: Wiron 99; Bego, Bremen, Germany). The universal test apparatus Instron was used for testing.

Conclusion

Thus, the results of this study emphasize the importance of choosing the right glass ionomer cements to ensure reliable adhesion to ceramic-metal alloys. The use of sandblasting significantly improves the adhesive properties, which helps to increase the durability of dental restorations. Future research should focus on the long-term effectiveness of these materials in clinical settings and other surface treatment methods that can further improve their adhesive properties.

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