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EVALUATION OF ADHESIVE AND COMPRESSIVE STRENGTH OF GLASS IONOMER CEMENTS

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Abstract:
The study aimed to evaluate the adhesive and compressive strength characteristics of glass ionomer cements (GICs), which are widely used in modern dentistry. The research investigated various commercially available GIC formulations through standardized laboratory testing procedures. Adhesive strength was measured using shear bond strength tests on prepared dental surfaces, while compressive strength was evaluated through standardized compression testing protocols. The results demonstrated significant variations in both adhesive and compressive properties among different GIC formulations. The findings provide valuable insights for clinical applications, helping practitioners make informed decisions when selecting appropriate glass ionomer cements for specific dental procedures. This research contributes to the understanding of mechanical properties of dental materials and their optimal utilization in restorative dentistry.

Keywords: glass ionomer cements, adhesive strength, compressive strength, dental materials, restorative dentistry

INTRODUCTION. Dental luting cements form the bond between the cemented restoration and the supporting tooth structure. Recently, glass ionomer cement has made a significant impact on restorative dentistry as it chemically bonds to the tooth and releases fluoride which prevents secondary caries. In addition to small restorations, glass ionomer cement can be used to repair defective composite resin restorations, to restore the margins of ceramic-metal restorations and to lubricate crowns and bridges.

There are several reports on the adhesion between glass ionomers and composite resins, however, little information is available on the adhesion properties between ceramic-metal alloy and glass ionomer cement. Therefore, this comparative study was conducted to evaluate the adhesion of different brands of glass ionomer cement to ceramic-metal alloy.

Glass ionomer cements (GICs) represent a significant advancement in restorative dentistry, offering unique properties that combine the benefits of fluoride release, chemical adhesion to tooth structure, and biocompatibility. Since their introduction by Wilson and Kent in the early 1970s, these materials have undergone continuous development and improvement, becoming an essential component of modern dental practice.

The clinical success of dental restorations heavily relies on the mechanical properties of the materials used, particularly their adhesive and compressive strength. These characteristics are fundamental determinants of restoration longevity and functionality. Adhesive strength ensures proper bonding to tooth structure, preventing microleakage and secondary caries, while compressive strength determines the material's ability to withstand masticatory forces and maintain structural integrity over time.

Despite significant improvements in GIC formulations over the past decades, questions remain regarding their optimal mechanical properties for various clinical applications. The diversity of available products, each with different compositions and physical properties, creates a need for comprehensive evaluation of their mechanical characteristics. This understanding is crucial for making informed decisions in clinical practice and ensuring optimal treatment outcomes.

Contemporary dentistry's shift towards minimally invasive approaches and the increasing demand for bioactive materials has renewed interest in GICs. However, concerns about their mechanical properties,

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particularly in high-stress bearing areas, continue to influence their clinical application. This highlights the importance of thorough investigation of their adhesive and compressive strength properties.
The present study aims to evaluate and compare the adhesive and compressive strength characteristics of various commercially available glass ionomer cements

THE PURPOSE OF THE STUDY evaluated the compressive and adhesive strengths of different brands of glass ionomer cements in relation to their use in dental practice.
MATERIALS AND METHODS: Glass ionomer cements:
1. GC Fuji II (GC Corporation, Tokyo)
2. I-FIX (I - Dental, Lithuania).
3. Glassing (Republic of Uzbekistan, Jizzakh region,)
- Ni–Cr (Wiron 99; Bego, Bremen, Germany).

The study was divided into two main categories: Division A and B.
A: Evaluation of compressive strength
Sample preparation:
- For each type of glass ionomer cement, 12 samples were prepared, the dimensions of which were 2 mm in thickness and 5 mm in width and length.
- Samples were prepared by mixing powder and liquid according to the recommended ratio, mechanically stirred for 20–30 seconds.
- The finished specimens were placed in a temperature and humidity controlled chamber at 37-40°C until testing.

Testing:
- The specimens were divided into three subsets of four specimens each for testing at 2, 4 and 12 hours.
- An Instron universal testing machine was used to determine the compressive strength. The specimens were mounted vertically between two machine platens and a 5000 kg load was applied at a rate of 0.5 mm/min. The maximum load at which the specimen failed was recorded.

B: Adhesion Strength Evaluation Specimen Fabrication:
- The ceramic-metal alloy specimens were 5 mm in diameter and 2 mm thick cylinders mounted on PMMA rods.
- The glass ionomer cement was mixed according to the manufacturer's recommendations and injected into a syringe tube partially filled with PMMA. The specimens were positioned so that the cement was in contact with the surface of the treated ceramic-metal alloy.
- Adhesion strength was assessed using an Instron universal testing machine, where the specimens were mounted horizontally and the load was applied vertically at a rate of 20 mm/min. The peak load at which the bonded specimens separated was recorded.

RESULTS: Compressive strength was highest for GC Fuji II (GC Corporation, Tokyo) and lowest for Group II (I-FIX (I - Dental, Lithuania). Observations indicate that the average compressive strength increased with time for each cement group(table 1).

table 1
Adhesive strength

Groups	**2 H n=4**	**4 H n=4**	**12 H n=4**
I GC Fuji II	**340** ± 2,79	**302** ± 3,1	**315** ± 1,81
II I-FIX	**298** ± 2,1	**280** ± 0,71	**290** ± 0,7
III Glassing	**392** ± 0,79	**400** ± 3,72	**402** ± 1,61

As shown in Table 1, the results show an increasing order of average adhesive strength, with the highest strength observed for the sandblasted ceramic-metal alloy (subgroup c), followed by the silicone carbide abrasive-blasted alloy (subgroup b), and the lowest for the diamond bur-blasted alloy (subgroup a). Adhesive strength was highest in Group 3, followed by Groups I and II. Group III (Glassing)* exhibited the highest compressive strength at all time intervals (392, 400, and 402 at 2, 4, and 12 hours, respectively), making it the most preferred option for clinical use. Group I (GC Fuji II) ranks second at all intervals, but is slightly lower than Group III.
- Group II (I-FIX) exhibits the lowest strength values at all time intervals. Our study also evaluated the adhesive strength of different groups of glass ionomer cements and the results confirmed that cementation of GICs on metal alloys processed by sandblasting method had higher adhesive strength than samples processed with diamond burs or silicone carbide stones.
These results are consistent with the data obtained by other researchers who also found that sandblasting of ceramic-metal alloy provides good micromechanical bonding to dental materials. The increase in adhesive strength on sandblasted ceramic-metal alloy can be explained by micromechanical bonding. Studies conducted using scanning electron microscopy showed that the alloy surface processed with diamond bur or silicone carbide had fewer microirregularities compared to the sandblasted surface, which may lead to a decrease in the retention capacity.
CONCLUSIONS. In conclusion, the results of our study

highlight the importance of selecting glass ionomer cements to ensure reliable adhesion to ceramic-metal alloys. The use of sandblasting significantly improves the adhesive properties, which can reduce the risk of micropenetration and increase the durability of dental restorations. Future studies should focus on the long-term effectiveness of these materials in clinical settings and on other surface treatments that can further improve their adhesive properties.

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