# Evaluation of the mechanical, biological and adhesive properties of a high viscosity glass ionomer modified with titanium dioxide

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## Introduction

Currently in pediatric dentistry, the requirements for an ideal restorative material include good adhesion to dental tissue, antimicrobial effect to inhibit dental caries-forming bacteria, and the ability to resist the forces of chewing. Glass ionomer cement (GIC) has several of the properties mentioned above, making it a versatile material.[1,2.]

The constant use of GIC in pediatric dentistry is associated with its chemical bond to the tooth structure and its anticariogenic activity as a result of the release of fluoride. However, GICs are brittle in high stress regions due to their low cohesive strength, especially in cavities with multiple compromised surfaces. Despite its advantages, it has some limitations such as susceptibility to dehydration, high solubility, slow setting speed, and low wear resistance. [2,3.]

Many researchers have tried to improve the properties of GIC by adding filler particles to its mixture; different materials have been incorporated in order to improve it. Some studies have focused on the addition of bioactive particles to ionomers. Among various materials, titanium dioxide ($TiO_2$) has been incorporated into GICs due to its high biocompatibility and mechanical properties, and also its potential antimicrobial activity. [4-6.]

The objective of this study was **to evaluate the mechanical, biological and adhesive properties of three samples; conventional glass ionomer (GIC), 3% titanium dioxide modified glass ionomer (GICM3%) and 5% titanium dioxide modified glass ionomer (GICM5%)**

## Materials and methods

GC Fuji IX (GIC) was mixed according to the manufacturer's instructions; Titanium dioxide was incorporated in a proportion of 3 and 5%.

Mechanical tests were performed using a Shimadzu AG1-100 mini universal testing machine, with a 5 kN load cell, at a spindle speed of 1 mm/min.

For the compression test, a cylinder was placed between two flat plates, one fixed and the other mobile attached to the machine head, and recorded.

For the three-point bending test, the machine was stopped when the specimen fractured. The specimens had a rectangular shape with dimensions of 20 mm long, 5 mm wide and 2 mm thick.

## Results

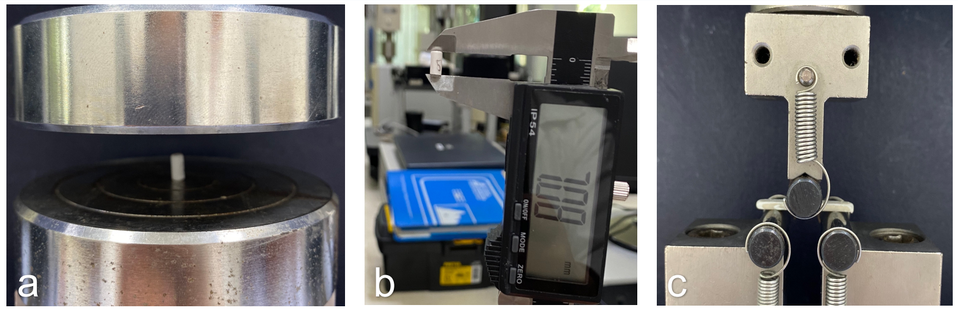


Figure a. Compression test. GIC cylinder with 5% $TiO_2$ between the two plates;
Figure b. Measurement of the height of the GIC sample using a vernier caliper;
Figure c. Three-point bending test. Rectangle shaped GICM5% specimen.

**Table 1. Mechanical adhesion properties of GIC and GICM with $TiO_2$ (MPa).**

| Sample | GIC | GICM3% | GICM5% |
|---|---|---|---|
| 1 | 1.418 | 1.957 | 2.016 |
| 2 | 1.665 | 0.921 | 2.904 |
| 3 | 1.350 | 0.199 | 4.314 |
| 4 | 1.464 | 0.580 | 1.133 |
| 5 | 1.365 | 1.998 | 1.156 |
| $\bar{x}$ | 1.452 ± 0.127 | 1 ± 0.754 | 2.305 ± 1.339 |

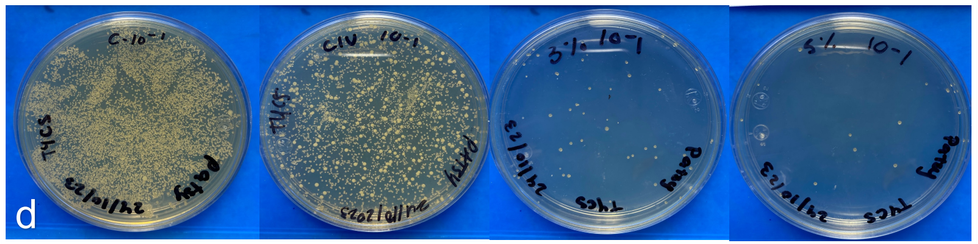


Figure d. Antimicrobial effect results. The amount of colony-forming units (CFU) decreases as the $TiO_2$ concentration increases in the samples.

## Materials and methods

For the adhesion test, 5 premolars were used per group (n=3). Which were introduced into acrylic molds. The test was carried out with a 1 kN load cell, the machine stopped with the detachment of the material from the tooth.

To measure the antimicrobial effect, colony forming units (CFU) *streptococcus mutans* were counted. There were 4 groups: control, conventional glass ionomer, glass ionomer modified with 3 and 5% $TiO_2$. The method consisted in making macro-dilutions which later be sown in Petri dishes with TYCS Agar medium.

## Conclusions

- The samples that showed the best results during the adhesion tests were those that belonged to the GICM5% group.
- In the current study, the data showed that $TiO_2$ added to the GIC potentially affected the growth of Streptococcus Mutans.
- Microbiological tests concluded that CIVM5% in contact with bacteria reduced CFU. The reduction was greater than 80%.
- The high viscosity glass ionomer combinated with $TiO_2$ obtained better results when the 5% portion was added.

## References

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