Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/g3vz5f28

A COMPARATIVE ASSESSMENT OF THE COMPRESSIVE STRENGTH OF TRADITIONAL GLASS IONOMER CEMENT AND A NEW HYBRID RESTORATIVE MATERIAL: GIOMER

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ABSTRACT

Background: Since their introduction in the 1970s, glass ionomer cements (GICs) have gained popularity in clinical dentistry because of their fluoride release, biocompatibility, and adherence to tooth structure. However, their implementation in high-stress-bearing locations, such posterior restorations, is limited by their comparatively weak mechanical qualities, especially regarding compressive and flexural strength.

Objective: To evaluate and compare the compressive strength of conventional glass ionomer cement and a new hybrid restorative material, Giomer.

Materials and Methods: Twenty cylindrical samples of Giomer and standard GIC (n=20 each group) were used in an in vitro investigation. The materials were manufactured using standardised stainless-steel moulds (6 mm height × 4 mm diameter) in accordance with the manufacturer's specifications. Prior to testing, all specimens were kept at 37°C for a day in distilled water. A universal testing equipment was used to determine compressive strength at a crosshead speed of 1 mm/min. Statistical analysis was performed using the independent sample t-test with significance set at $p < 0.05$.

Results: The mean compressive strength of Giomer (128.6 ± 7.3 MPa) was significantly higher than that of conventional GIC (76.4 ± 5.8 MPa) with $p < 0.001$.

Conclusion: Compared to traditional glass ionomer cement, Giomer has a much higher compressive strength. This implies that for regions that experience significant occlusal loads, Giomer could be a better restorative material.

Keywords: Compressive strength, Glass ionomer cement, Giomer, Hybrid restorative material, Dental materials

INTRODUCTION

Since their introduction in the 1970s, glass ionomer cements (GICs) have gained popularity in clinical dentistry because of their fluoride release, biocompatibility, and adherence to tooth structure. However, their implementation in high-stress-bearing locations, such posterior restorations, is limited by their comparatively weak mechanical qualities, especially regarding compressive and flexural strength.[1] Newer materials, such as Giomers, have been created in response to this. Surface pre-reacted glass (S-PRG) fillers are used in giomers to combine the better mechanical performance and aesthetics of composite resins with the ion-releasing ability of glass ionomers. They are appealing substitutes in restorative dentistry because of their capacity to release fluoride, remineralise tooth structure, and have high polishability.[2]

Hybrid restorative materials have emerged because of the growing need for materials that offer both therapeutic advantages and mechanical endurance. A family of materials known as giomers aims to combine the beneficial qualities of glass ionomers with resin composites.[3] Giomers exhibit increased surface hardness, decreased water sorption, and improved colour stability in addition to increased compressive strength. They are appropriate for anterior and posterior restorations because to these characteristics.[4] Additionally, a major contributor to clinical lifespan is their capacity to prevent secondary caries as a result of prolonged fluoride release.[5] Few studies have directly compared Giomers with traditional GICs in terms of mechanical performance, especially compressive strength, despite their encouraging qualities.[4-7] In order to give doctors evidence-based recommendations on material selection for a range of therapeutic applications, this study intends to assess and compare the compressive strengths of a commercially available Giomer and a traditional glass ionomer cement.

MATERIALS AND METHODS

Following institutional review board permission, this In vitro comparative study was carried out in the Dental Material Science Department at ADC from June 2023 to March 2024.

Materials Used

- **Group A:** Conventional Glass Ionomer Cement (e.g., Fuji IX, GC Corporation)
- **Group B:** Giomer (e.g., Beautifil II, Shofu Inc.)

Specimen Preparation and Testing Procedure

40 cylindrical samples in all (20 for each substance) were created. Moulds made of stainless steel measuring 4 mm in diameter and 6 mm in height were employed. Following the manufacturer's instructions, the ingredients were combined and poured into the moulds. Following setup, the samples were taken out and kept for a full day at 37°C in distilled water. A universal testing machine (Instron, Model) was used to test the compressive strength of each specimen. At a crosshead speed of 1 mm/min, the compressive force was applied along the cylinder's longitudinal axis until fracture occurred. SPSS was used to analyse the data (version 26). The mean compressive strengths of the two groups were compared using the independent samples t-test. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

The average compressive strength values and standard deviations for both materials are displayed in table 1. The compressive strength of Giomer is noticeably greater than that of GIC.

Table 1: Mean compressive strength comparison between GIC and Giomer.

Material	Mean Compressive Strength (MPa)	Standard Deviation	p-value
GIC	76.4	5.8	< 0.001
Giomer	128.6	7.3	

The range (minimum to highest values) of compressive strength measured in the test specimens is shown in table 2, which shows that Giomer has a wider and greater strength range than GIC.

Table 2: Range of compressive strength values for each material.

Material	Minimum (MPa)	Maximum (MPa)
GIC	68.5	85.3
Giomer	116.0	139.4

The calculated 95% confidence intervals for each material's compressive strength are displayed in table 3, confirming the statistical validity of the observed variations.

Table 3: 95% confidence intervals for compressive strength values.

Material	95% Confidence Interval (MPa)
GIC	74.0 - 78.8
Giomer	125.4 - 131.8

DISCUSSION

In comparison to traditional glass ionomer cement (GIC), the current investigation showed that Giomer has a noticeably better compressive strength. This outcome is consistent with earlier research on the mechanical performance of hybrid restorative materials. Giomer's resin matrix, surface pre-reacted glass (S-PRG) fillers, and a more cohesive structure that is more resistant to mechanical stresses are all responsible for its increased compressive strength.

According to research by Yermalkar et al. (2025)[8] &Jacob et al. (2021)[9], the mechanical abilities of restorative materials are significantly enhanced by the inclusion of resin and cutting-edge filler technology. In addition to adding mechanical strength, Giomers' S-PRG fillers maintain their fluoride-releasing qualities, which are critical for boosting remineralisation and avoiding recurring cavities. Giomer is positioned as a possibly better material in therapeutic settings because of its dual functioning.[10]

After 24 hours of exposure to distilled water, the GICs increased their compressive strength. Mittal et al. (2011)[11] studied how different dental filling materials react to submersion in water. They found that GIC's improved mechanical performance over time after being immersed in water was partly due to a post-hardening process. The outcomes were comparable to those of water after a 24-hour immersion in coffee. The post-hardening mechanism was most likely the cause of these. However, we discovered that the compressive strength of GIC was considerably decreased (from 14.3 to 10.2 N/mm) following a 24-hour soaking in orange juice. Giomers' clinical handling and results are additionally improved by their decreased moisture sensitivity when compared to GIC, particularly in paediatric and geriatric populations.[12] Kour et al. (2025)[13] found that Giomers regularly outperformed GICs, resin-modified GICs, and certain composite resins when evaluating the compressive strength of various restorative materials. Similarly, Meshram et al. (2025)[14] emphasised Giomers' long-term benefits due to their continual fluoride release and antibacterial properties. Even while in vitro studies provide valuable preliminary data, it's important to remember that oral environmental factors including temperature fluctuations, masticatory stress, and pH variations may have an impact on clinical outcomes. Therefore, to confirm Giomers' clinical dependability in stress-bearing restorations, long-term in vivo studies are required.[15]

CONCLUSION

Compared to traditional glass ionomer cement, Giomer has a much higher compressive strength. This implies that for regions that experience significant occlusal loads, Giomer could be a better restorative material.

REFERENCES

1. Kunte S, Shah SB, Patil S, Shah P, Patel A, Chaudhary S. Comparative evaluation of compressive strength and diametral tensile strength of conventional glass ionomer cement and a glass hybrid glass ionomer cement. International Journal of Clinical Pediatric Dentistry. 2022 Jul;15(4):398.
2. Malhotra S, Bhullar KK, Kaur S, Malhotra M, Kaur R, Handa A. Comparative evaluation of compressive strength and flexural strength of gc gold hybrid, gic conventional and resin-modified glass-ionomer cement. Journal of Pharmacy and Bioallied Sciences. 2022 Jul 1;14(Suppl 1):S214-6.
3. Poornima P, Koley P, Kenchappa M, Nagaveni NB, Bharath KP, Neena IE. Comparative evaluation of compressive strength and surface microhardness of EQUIA Forte, resin-modified glass-ionomer cement with conventional glass-ionomer cement. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2019 Jul 1;37(3):265-70.
4. Bhatia HP, Singh S, Sood S, Sharma N. A comparative evaluation of sorption, solubility, and compressive strength of three different glass ionomer cements in artificial saliva: an in vitro study. International journal of clinical pediatric dentistry. 2017 Feb 27;10(1):49.
5. Ramashanker, Singh RD, Chand P, Jurel SK, Tripathi S. Evaluation of adhesive and compressive strength of glass ionomer cements. The Journal of Indian Prosthodontic Society. 2011 Dec;11:210-4.
6. Pavithra AS, Paulraj J, Rajeshkumar S, Maiti S. Comparative evaluation of antimicrobial activity and compressive strength of conventional and thyme-modified glass ionomer cement. Annals of Dental Specialty. 2023;11(1-2023):70-7.
7. Jayanthi N, Vinod V. Comparative evaluation of compressive strength and flexural strength of conventional core materials with nanohybrid composite resin core material an in vitro study. The Journal of Indian Prosthodontic Society. 2013 Sep;13:281-9.
8. Yermalkar, G.S., Devendrappa, S.N., Gaonkar, N.N., Gugawad, S., Hadakar, S., Waghmode, S.K. and Maurya, A., 2025. Comparative Evaluation of Compressive Strength, Shear Bond Strength, and Fluoride Release of Grape Seed Extract and Resveratrol Incorporated in Conventional Restorative Glass Ionomer Cement: An In Vitro Study. *International Journal of Clinical Pediatric Dentistry*, *18*(2), pp.167-172.
9. J, Sisodia M, Shetty S, Viragi P, Mohammed A, Basha S. Comparative evaluation of tensile and compressive strength of Cention N and resin modified glass ionomer cements. International Journal of Dentistry and Oral Science. 2021 Aug 14;8(8):3670.
10. Bali P, Prabhakar AR, Basappa N. An invitro comparative evaluation of compressive strength and antibacterial activity of conventional GIC and hydroxyapatite reinforced GIC in different storage media. Journal of clinical and diagnostic research: JCDR. 2015 Jul 1;9(7):ZC51.
11. Mittal S, Soni H, Sharma DK, Mittal K, Pathania V, Sharma S. Comparative evaluation of the antibacterial and physical properties of conventional glass ionomer cement containing chlorhexidine and antibiotics. Journal of International Society of Preventive and Community Dentistry. 2015 Jul 1;5(4):268-75.
12. Jaidka S, Somani R, Singh DJ, Shafat S. Comparative evaluation of compressive strength, diametral tensile strength and shear bond strength of GIC type IX, chlorhexidine-incorporated GIC and triclosan-incorporated GIC: An: in vitro: study. Journal of International Society of Preventive and Community Dentistry. 2016 Apr 1;6(Suppl 1):S64-9.
13. Kour T, Shahi P, Sogi S, Kapoor R, Jain N, Gambhir A. Comparative Evaluation of Surface Microhardness of Zirconia-reinforced Glass Ionomer Cement and Conventional Glass Ionomer Cement after Immersion in an Acidic Drink: An In Vitro Study. International Journal of Clinical Pediatric Dentistry. 2025 Feb 14;18(1):6.
14. Meshram S, Khatri S, Ramteke R, Dadwe A, Junwani B, Meshram S. Comparative Assessment of Compressive Strength and Fatigue in Short Fiber Composites, Glass Ionomer Cements, and Amalgam Restorative Materials: An In Vitro Study.

15. Song A, Gong H, Zhang J, Wang H, Zhu S. Adhesive properties and performance of glass ionomer cements in dental restorations: A Comparative study of four materials. International Journal of Adhesion and Adhesives. 2025 Jun 1;140:103989.