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Original Research

Assessment of compressive strength of GIC, amalgam and composite restorative materials

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ABSTRACT:
Background: The materials used in posterior restorations must be able to resist stress and compression forces. Posterior restorative materials have undergone continuous evolution, ranging from the early materials such as silver amalgam to the more recent developments in composites. The present study was conducted to compare compressive strength of GIC, composite and amalgam restorative materials. **Materials & Methods:** 60 specimenswere prepared in the cylindrical molds with standard dimensions. Group I comprised of GIC, group II composite and group III amalgam. Compressive strength was tested using the instron universal testing machine. For DTS testing, the dimension of specimens was 6.0 mm in diameter and 3.0 mm in height. **Results:** The mean compressive strength in group I was 57.6 MPa, in group II was 114.6 MPa and in group III was 128.7 MPa. The difference was significant (P< 0.05).Themean DTS in group I was 17.4 MPa, in group II was 42.6 MPa and in group III was 46.2 MPa. The difference was significant (P< 0.05). **Conclusion:** Amalgam exhibited highest compressive strength as compared to GIC and composite.
Key words: compressive strength,

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INTRODUCTION

Dental caries is the most common disease in the population, primarily caused by a high carbohydrate diet and a lack of awareness about good dental hygiene practices. Once that happens, the carious lesions must be restored.[1] Desirable qualities include adherence to the tooth structure, materials' load-bearing strength, retention of biocompatibility, and ease of application.[2,3]

The materials used in posterior restorations must be able to resist stress and compression forces. Posterior restorative materials have undergone continuous evolution, ranging from the early materials such as silver amalgam to the more recent developments in composites.[4] Before choosing a restorative material, the benefits and drawbacks of any material used to replace posterior teeth should be carefully considered.[5]To improve their mechanical qualities and increase their range of indications and clinical uses, a number of changes have been made. These days, glass ionomer modified with resin and resin composites are accessible, offering higher mechanical strength values than traditional cements. Due to the poor mechanical qualities of GIC, including its low compressive strength, brittleness, and toughness, research has been done on substitute filler materials.[6,7]The present study was conducted to compare compressive strength of GIC, composite and amalgam restorative materials.

MATERIALS & METHODS

The present invitro study comprised of 60 specimens. These specimens were prepared in the cylindrical molds with standard dimensions of the American Dental Association (ADA) specification.All the materials were mixed and prepared according to the instruction from the manufacturer.

Based on the material used, grouping was performed. Group I comprised of GIC, group II composite and

group IIIamalgam. Compressive strength was tested using the instron universal testing machine. For DTS testing, the dimension of specimens was 6.0 mm in diameter and 3.0 mm in height. The sample was placed with the flat ends perpendicular to the platens in the Instron universal testing machine. The DTS was calculated as: $T = 2P/\pi DL$, where P is the maximum applied load (N), D is the measured diameter of the sample (mm), and L is the measured length of the sample (mm). Results were tabulated and assessed statistically. P value less than 0.05 was considered significant.

RESULTS

Table I Comparison of compressive strength

Groups	Mean(MPa)	P value
Group I	57.6	0.01
Group II	114.6	
Group III	128.7	

Table I, graph I shows that mean compressive strength in group I was 57.6 MPa, in group II was 114.6 MPa and in group III was 128.7 MPa. The difference was significant (P< 0.05).

Graph I Comparison of compressive strength

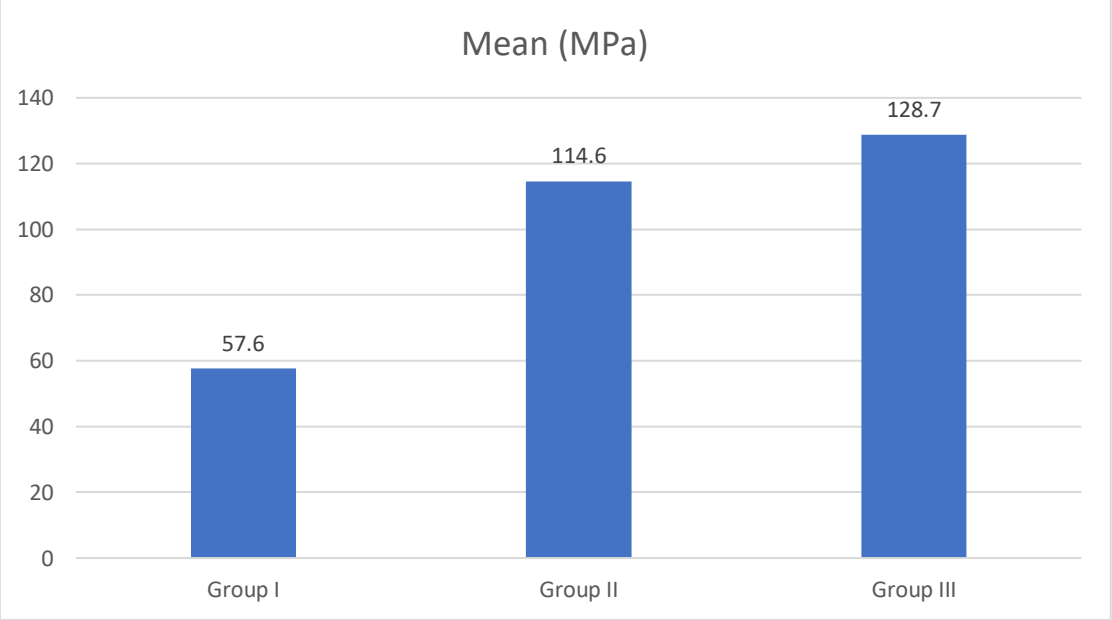
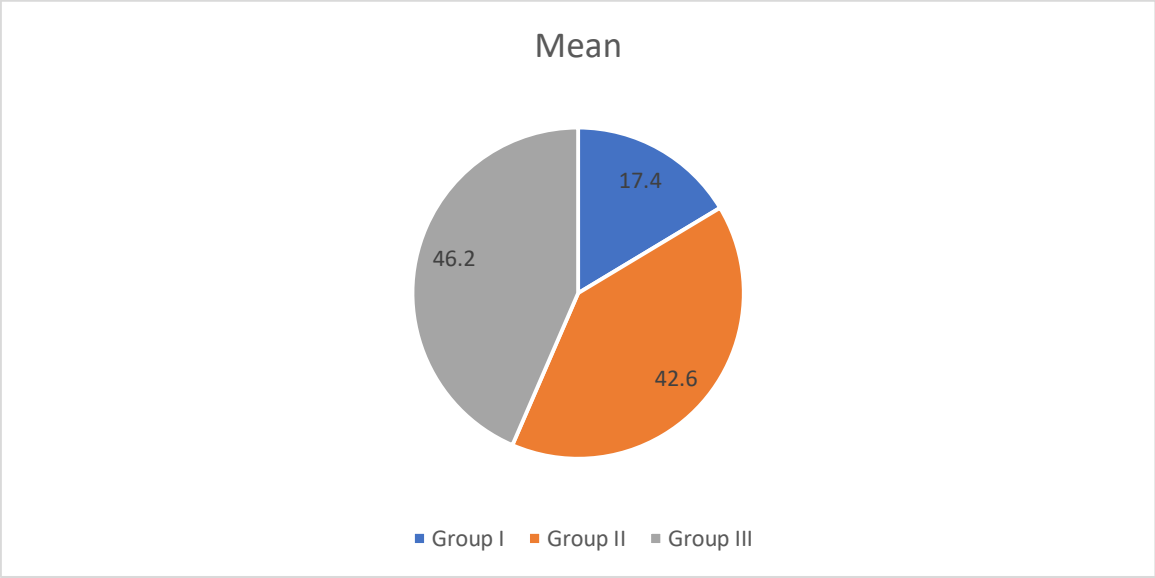


Table II Comparison of DTS

Groups	Mean	P value
Group I	17.4	0.05
Group II	42.6	
Group III	46.2	

Table II, graph I shows that mean DTS in group I was 17.4 MPa, in group II was 42.6 MPa and in group III was 46.2 MPa. The difference was significant (P< 0.05).

Graph II Assessment of DTS



DISCUSSION

Restorations should be strong enough to withstand fractures and allow for the prolonged masticatory forces that occur in the oral cavity. Dental materials are known for their adaptability, appropriate mechanical qualities, and simplicity of handling.[7,8] The primary mechanical characteristic of materials is their CS, as restoratives typically replace a significant portion of the tooth structure and need to be strong enough to withstand intraoral masticatory stresses.[9] Even though some of them weren't created especially for this use, glass ionomer restoratives (GIs) have been used in restorative procedures because of the advantages of new GI materials, which adhere directly to the dental hard tissues and don't require additional steps for consistent application.[10] Recent research, however, has demonstrated that modern GIs, with their high strength toward tension and pressures and resistance to moisture contamination, are physically suited to repair cores and restore the majority of missing teeth.[11]The present study was conducted to compare compressive strength of GIC, composite and amalgam restorative materials.

We found that the mean compressive strength in group I was 57.6 MPa, in group II was 114.6 MPa and in group III was 128.7 MPa. Kaur Get al[12]evaluated and compared the compressive strength of Ceramic-Reinforced Glass Ionomer cement, Zirconia-Reinforced Glass Ionomer cement, High Strength Glass Ionomer Posterior restorative material, Alkasite restorative material, and Amalgam when used as posterior restorative materials. Fifty cylindrical specimens measuring 6mm in height and 4mm in diameter were fabricated using test materials. Class II cavity was prepared on fifty intact permanent human molar teeth and randomly divided into five groups based on the material to be filled with ten specimens each: Group 1- Ceramic-Reinforced Glass Ionomer cement, group 2- Zirconia-Reinforced Glass Ionomer cement group 3- High Strength Glass Ionomer Posterior restorative material group 4- Alkasite restorative material and group 5- amalgam. All the specimens were thermocycled and stored in artificial saliva for 24 hours. The specimens were subjected to compressive strength testing using Universal Testing Machine. The present study reveals a significantly high compressive strength of cylindrical specimens of Group 4, followed by Group 5, Group 3, Group 1, and least by Group 2. The highest maximum compressive load was supported by teeth restored with the material of Group 4, Group 1, Group 5, Group 2, and least by Group 3.

We found that the mean DTS in group I was 17.4 MPa, in group II was 42.6 MPa and in group III was 46.2 MPa.Iftikhar et al[13]compared the mechanical properties (compressive strength (CS) and diametral tensile strength (DTS)) of four different restorative materials: conventional glass ionomer (Fuji IX), ClearFil AP-X, Filtex Z350-XT, and Cention N. Specimens (n = 80) were prepared from Fuji IX, ClearFil AP-X, Filtex Z350-XT, and Cention N for testing compressive strength and DTS. There were significant differences among restorative materials tested. ClearFil AP-X exhibits the highest mechanical properties (CS and DTS) and least values were obtained by the Fuji IX.Seirawan et al[14]compared the compressive strength of zinc-reinforced glass ionomer (ZRGI) restorations with high-viscosity glass ionomer (HVGI) cement and posterior composite restorations. Twenty-four cylindrical blocks (6 ± 0.1mm height, 4 ± 0.1mm diameter) were prepared from the three studied materials using a prefabricated Teflon mold and were divided into three equal groups. The compressive strength test was performed by Instron mechanical test system model 1195. Posterior composite restoration showed the highest compressive strength (239MPa), whereas there was no difference

between ZRGI and HVGI (154MPa and 151MPa, respectively).

Paul et al[15]compared the mechanical properties (compressive strength (CS) and diametral tensile strength (DTS)) of GIC, Cention-N and nanohybrid composite restorative materials. Thirty specimens with 10 in each group were prepared from Glass Ionomer Cement (GIC), Cention-N and nanohybrid composite restorative materials for testing compressive strength and DTS. Results obtained were statistically evaluated. They observed highest mean compressive strength for Cention-N 248.52±4.28MPa, followed by 203.11±1.35 MPa in Nano hybrid composite and least for GIC i,e 157.32±1.58 MPa, which is statistically significant (P< 0.001). Highest mean diametral tensile strength was observed with Cention-N (108.63.76±1.73 MPa) followed by Nanohybrid composite (92.54±1.21MPa) and least with GIC (54.28±1.12MPa) which is statistically significant.

CONCLUSION

Authors found thatamalgam exhibited highest compressive strength as compared to GIC and composite.

REFERENCES

1. Prosser HJ, Powis DR, et al. Characterization of glass-ionomer cements. 7. The physical properties of current materials. J Dent 1984 Sep;12(3):231–240.
2. Gu YW, Yap AU, et al. Effects of incorporation of HA/ZrO(2) into glass ionomer cement (GIC). Biomaterials 2005 Mar;26(7):713–720.
3. Fron Chabouis H, Smail Faugeron V, et al. Clinical efficacy of composite vs ceramic inlays and onlays: a systematic review. Dent Mater 2013;29(12):1209–1218.
4. Khurshid Z, Zafar M, et al. Advances in Nanotechnology for Restorative Dentistry. J Materials 2015;8(12):717–731.
5. Abraham D, Thomas AM, et al. A comparative evaluation of microleakage of glass ionomer cement and chitosanmodified glass ionomer cement. An in vitro study. Int J Clin Pediatr Dent 2014 Jan;7(1):6–10.
6. Ayad NM, Elnogoly SA, et al. An in vitro study of the physic-mechanical properties of a new esthetic restorative vs dental amalgam. Rev Clin PesqOdonttol 2008;4(3):137–144.
7. Chalissery VP, Marwah N, et al. Study of the Mechanical Properties of the Novel Zirconia – reinforced Glass Ionomer Cement. J Contemp Dent Pract 2016 May;17(5):394–398.
8. Costa CA, Ribeiro AP, Giro EM, Randall RC, Hebling J. Pulp response after application of two resin modified glass ionomer cements (RMGICs) in deep cavities of prepared human teeth. Dent Mater 2011;27:158-70.
9. Cehreli SB, Tirali RE, Yalcinkaya Z, Cehreli ZC. Microleakage of newly developed glass carbomer cement in primary teeth. Eur J Dent 2013;7:15-21.
10. Topbasi B, Öveçoglu ML, Türkmen C. Flexural strength and fracture surface characterization of glass-ionomer cements stored in water. Oral Health Dent Manag 2003;2:18-26.
11. Kumar G, Shivrayan A. Comparative study of mechanical properties of direct core build-up materials. Contemp Clin Dent 2015 Jan– Mar;6(1):16–20.
12. Kaur G, Shetty C, Shetty A, HEGDE M. A comparative evaluation of compressive strength of posterior restorative materials: An in vitro study. Authorea Preprints. 2021 Feb 23.
13. Seirawan MY, Doumani M, Seirawan MK, Habib A, Dayoub M. Compressive strength of three different restorative materials (in vitro study). Int J Oral Care Res 2019;7:4-7.
14. Iftikhar N, Devashish, et al. A Comparative Evaluation of Mechanical Properties of Four Different Restorative Materials: An In Vitro Study. Int J Clin Pediatr Dent 2019;12(1):47–49.
15. Paul U, Selvan AS, Revankar VD, Ravikumar K, Ganapathy A, Mohammed Noon A, Manoharan S. An in vitro Evaluation of Mechanical Properties of GIC, Cention N and Composite Restorative Materials. Int J Cur Res Rev. 2021;13(05):S92-5.