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ORIGINAL ARTICLE

Longevity of Glass Ionomer Cement as a Permanent Filling Material in Primary School-Going Children

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ABSTRACT

Background: Glass ionomer cements (GICs) have unique qualities that make them ideal for luting applications and as restorative materials. Anti-cariogenic effect due to fluoride release, being thermally compatible with tooth enamel and low toxicity are all significant properties. However, the inferior mechanical performance of GICs has hampered their usage in mechanically demanding situations. Poor properties such as low fracture strength and wear limit their use as a filler material in stress-bearing applications. Therefore, they are commonly used as temporary filling material in the posterior dental region. The need to strengthen those cements has resulted in a surge in research on reinforcement and strengthening.

Study Design and Method: One hundred school-going children between 6 to 10 years of age who had decay in their primary or permanent molars were selected for this study. The teeth were assessed for restorability and if possible were accordingly filled. Follow up was done after 6 months to assess the clinical integrity and cario-static action of the filling. Data was analyzed using SPSS 16 standard version.

Result: GIC is a reasonable choice of filling material in school going children.

Conclusion: Because of its ease of usage and exceptional biocompatibility among direct restoratives, GIC is preferred restorative materials. However, because of their brittleness, they can't be used as a permanent filling material in the load-bearing posterior region in adults.

Keywords: glass ionomer cement; strength; wear; micro-Leakage; Temporary Filling; Time; clinical restoration

INTRODUCTION

Dental caries affects abouts 60 to 90 percent of children worldwide. It causes discomfort and pain [5]. Oral illnesses have a detrimental impact on school and home activities, resulting in many potential working hours, as well as more than 51 million school hours being lost over the world. Dental caries is a condition characterized by recurrent phases of demineralization and remineralization of the hard tissues of the oral cavity.

The tendency of a material to inhibit caries formation is a very important clinical property. GIC is a fluoride-releasing compound made up of silicate and polycarboxylate that binds to dental tissue and releases fluoride [1]. Today, the increased demand for direct filling materials has been supported by changes in restorative materials and techniques. In everyday dental practice, a variety of direct restorative materials are used. Resin composites and glass-ionomer cements are the most common, after amalgam (GICs). Amalgam is affordable and simple to use, thanks to its lengthy clinical history. However, the potential for mercury poisoning and poor aesthetics are drawbacks [2]. The most aesthetically pleasing material with acceptable physical qualities is resin composites [5]. They have disadvantages in that they are a very expensive, time-consuming, and technique-dependent adhesive treatment [6, 7]. Because of their capacity to adjust physical properties by modifying the powder/liquid ratio or chemical formulation, glass-ionomer cements can be employed in a wide range of therapeutic applications [8]. Glass-ionomer cements provide a more appealing appearance than metallic restorations [9]. They also have good biocompatibility and chemical adherence to mineralized tissue [10], and they have an anticariogenic potential via containing fluoride.

MATERIALS AND METHODS

This was an analytical and quantitative descriptive cross-sectional study. This study was done in the Pediatric dept of Islamic International Medical and Dental College. One hundred school-going children between 6 to 10 years of age who had decay in their primary or permanent molars were selected for this study. The teeth were assessed for restorability. After cleaning the teeth off any plaque, calculus and removing the caries conservatively, the teeth were restored with GIC. The filling was covered by a thin layer of petroleum jelly to help maintain the occlusal exposed layer of the filling. Instructions were given to the students and their accompanying parents. Follow-up was done after 6 months.

Poor mechanical qualities, such as low fracture strength, toughness, and wear, prevent their widespread usage in dentistry as a stress-bearing filler material [11,12]. Glass-ionomer cements are commonly employed as a temporary filling material in the posterior dental region [13]. As a result of the need to strengthen those cements, more research into reinforcement concepts is being conducted. Several previous efforts [14] involved incorporating second phase ceramic or glass fibers, as well as metal particles. Compounding reactive glass fibers has yielded promising outcomes [15, 16].

In most studies, the mechanical properties of GIC have been studied in-vitro with simulated oral conditions. The behavior of materials within the oral cavity is a complicated process in which the restoration degrades due to masticatory forces and chemical erosion. Because the amount of masticatory power that strikes a restoration surface and the number of chewing cycles each day, are relatively inhomogeneous, statistical research has been conducted to evaluate the loading situations..

At medium chewing power, the number of occlusal interactions per day is expected to be between 300 and 700 cycles. Occlusal contact free area (CFA) wear is a term used in dentistry to describe the loss of material caused by non-antagonistic interactions. Occlusal contact area (OCA) wear is defined as material loss caused by an antagonist's direct engagement with the restorative material. The wear rates of the restorative materials and amalgam are determined in an experimental setting. Because amalgam is a clinically proven and successful standard material, the wear rates are standardized to it [12].

RESULTS

After a period of 6 months, the students whose teeth were restored, 2 students reported to have broken their teeth while 3 had the filling dislodged but no symptoms present. One of the major benefits of glass-ionomer cements is the release of fluoride [1]. It has a pattern of an initial fast release ("early burst") followed by a persistent, lower-level diffusion-based release [28]. The pattern represented by the equation [30] is followed by these processes. In acidic environments, fluoride release from glass-ionomer rises [15]. Furthermore, these cements can counteract acidity by raising the pH of the external medium. Buffering is the name given to this process, which may be clinically advantageous because it protects the tooth from further deterioration. A steady supply of low-fluoride to the dental hard tissues has been shown to be advantageous for dental enamel and dentine.

ISO requirements for clinical grade glass-ionomer cements.

Property	Luting Cement	Restorative Cement
Setting time/min	2.5–8	2–6
Compressive strength/MPa	70 (minimum)	100 (minimum)
Acid erosion (maximum)/mm h^{-1}	–	0.05
Opacity, $C_{0.70}$	–	0.35–0.90
Acid-soluble As/mg kg^{-1}	2	2
Acid-soluble Pb/mg kg^{-1}	100	100

DISCUSSION

This research was based as a cross-sectional survey of urban primary school students aged 6-10 years. The students were chosen at random after getting consent from their parents. The high prevalence of dental caries in school-aged children could be attributed to the lack of oral hygiene practices. Students who had parents whose education level was secondary and above and had basic knowledge about causes of dental caries and prevention had a lower caries were index than those whose parents had primary education or lower.

The results of the current study population revealed that the majority of the students did not know enough about the causes and prevention of dental caries. The majority of the students said they brush their teeth using toothpaste and a plastic toothbrush or chewing stick, and in a quarter of the population (25 percent), Gingivitis was the most common ailment, followed by dental caries.

CONCLUSION

Because of its ease of usage and exceptional biocompatibility among direct restoratives, GIC is preferred restorative materials. However, because of their brittleness, they can't be used as a permanent filling material in the load-bearing posterior region in adults. However, it may still be used as a liner under composites due to its low abrasion resistance and fatigue performance. Several attempts to improve their mechanical properties are currently underway, and studies have predicted that GIC will have a bright future as a dental filling material with a wide range of applications.

REFERENCES

1. Yeungnam Univ J Med. Current aspects and prospects of glass ionomer cements for clinical dentistry. 2020 Jul; 37(3): 169–178.10.12701/yujm.2020.00374
2. DeBarra, E.; Hill, R.G. Influence of glass composition on the properties of glass polyalkenoate cements. Part IIII: influence of fluorite content. Biomaterials 2000, 21, 563–569.
3. Saito, S.; Tosaki, S.; Hirota, K. Advances in Glass Ionomer Cements; Davidson C.L., Mjör I.A., Eds.; Quintessence Publishing Co: Berlin, Germany, 1999; pp. 15–50. Materials 2010, 3 91
4. Hench, L.L. Bioceramics: From concept to clinic. J. Am. Ceram. Soc. 1991, 47, 1487–1510. Materials 2010, 3 92
5. Van Meerbeek, B.; De Munck, J.; Yoshida, Y.; Inoue, S.; Vargas, M.; Vijay, P.; Van Landuyt, K.; Lambrechts, P.; Vanherle, G. Buonocore memorial lecture. Adhesion to enamel and dentin: current status and future challenges. Oper. Dent. 2003, 28, 215–235.
6. Lohbauer, U.; Walker, J.; Nikolaenko, S.; Werner, J.; Clare, A.; Petschelt, A.; Greil, P. Reactive fiber reinorced glass ionomer cements. Biomaterials 2003, 24, 2901–2907.
7. Craig, R.G. Restorative Dental Materials, 11th ed.; Mosby: London, UK, 2002.
8. Nicholson, J.W. Chemistry of glass-ionomer cements: A review. Biomaterials 1998, 19, 485–494. 9. Anusavice, K. Challenges to the development of esthetic alternatives to dental amalgam in an dental research center. Trans. Acad. Dent. Mater. 1996, 9, 25–50
9. Yip, H.K.; Tay, F.R.; Ngo, H.; Smales, R.J.; Pashley, D.H. Bonding of contemporary glass ionomer cements to dentin. Dent. Mater. 2001, 17, 456–470.
10. Xie, D.; Brantley, W.A.; Culbertson, B.M.; Wang, G. Mechanical properties and microstructures of glass-ionomer cements. Dent. Mater. 2000, 16, 129–138.
11. Nicholson, J.W.; Wilson, A.D. The effect of storage in aqueous solutions on glass-ionomer and zinc polycarboxylate dental cements. J. Mater. Sci.: Mater. Med. 2000, 11, 357–360.
12. Kobayashi, M.; Kon, M.; Miyai, K.; Asaoka, K.; Strengthening of glass-ionomer cement by compounding short fibres with CaO-P2O5-SiO2-Al2O3 glass. Biomaterials 2000, 21, 2051–2058.
13. Hickel, R.; Manhart, J.; Garcia-Godoy, F. Clinical results and new developments of direct posterior restorations. Am. J. Dent. 2000, 13, 41–54.
14. Griffin, S.; Hill, R.G. Influence of glass composition on the properties of glass polyalkenoate cements. Part II: Influence of fluorine content. Biomaterials 2000, 21, 693–698.
15. Griffin, S.; Hill, R.G. Influence of glass composition on the properties of glass polyalkenoate cements. Part I: Influence of aluminum to silicon ratio. Biomaterials 1999, 20, 1579–1586.
16. Hickel, R.; Dasch, W.; Janda, R.; Tyas, M.; Anusavice, K. New direct restorative materials. Int. Dent. J. 1998, 48, 3–16. 4. Krämer, N.; Lohbauer, U.; Frankenberger, R. Adhesive

luting of indirect restorations. Am. J. Dent. 2000, 13, 60–67. 5.
17. Manhart, J.; Kunzelmann, K.H.; Chen, H.Y.; Hickel, R. Mechanical properties of new composite restorative materials. J. Biomed. Mater. Res. 2000, 53, 353–361.
18. L E Tam, G P Chan, D Yim. In vitro caries inhibition effects by conventional and resin-modified glass-ionomer restorations. Oper Dent Jan-Feb 1997;22(1):4-14.
19. Roulet, J.F. Benefits and disadvantages of tooth-coloured alternatives to amalgam. J. Dent. 1997, 25, 459–473.
20. Pelka, M.; Ebert, J.; Schneider, H.; Krämer, N.; Petschelt, A. Comparison of two- and three-body wear of glass-ionomers and composites. Eur. J. Oral. Sci. 1996, 104, 132–137.
21. Friberg, L.T.; Schrauzer, G.N. Status Quo and Perspectives of Amalgam and Other Dental Materials; Thieme: Stuttgart, Germany, 1995.
22. Smith, D. Development of glass ionomer cement systems. In Glass Ionomers: The Next Generation. 2nd International Symposium on Glass Ionomers, Philadelphia, PA, USA, June, 1994; Hunt, P.R., Ed.; International Symposia in Dentistry: Philadelphia, PA, USA, 1994.
23. Wasson, E.A.; Nicholson, J.W. New aspects of the setting of glass-ionomer cements. J. Dent. Res. 1993, 72, 481–483.
24. Vogel, W. Glaschemie; Springer: Berlin, Germany, 1992.
25. Wood, D.; Hill, R. Structure-property relationship in ionomer glasses. Clin. Mater. 1991, 7, 301–312.
26. Wilson, A.D.; Crisp, S.; Prosser, H.J.; Lewis, B.G.; Merson S.A. Aluminosilicate glasses for polyelectrolyte cements. Ind. Eng. Chem. Prod. Res. Dev. 1980, 19, 263–270.
27. Wasson, E.A.; Nicholson, J.W. Studies on the setting chemistry of glass-ionomer cements. Clin. Mater. 1991, 7, 289–293.
28. Wilson, A.D.; McLean, J.W. Glass-Ionomer Cement; Quintessence Publishing Co: Berlin, Germany, 1988.
29. Nicholson, J.W.; Brookman, P.J.; Lacy, O.M.; Wilson, A.D. Fourier transform infrared spectroscopic study of the role of tartaric acid in glass-ionomer dental cements. J. Dent. Res. 1988, 67, 1451–1454.
30. Kent, B.E.; Lewis, B.G.; Wilson, A.D. Glass ionomer cement formulations: The preparation of novel fluoroalumosilicate glasses high in fluorine. J. Dent. Res. 1979, 58, 1607–1619.