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Comparison Between Conventional Gic And Type 7 Gic- Roughness (Pre And Post Brushing)

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ABSTRACT:

Aim: to study the comparison between GIC type 2 and type 7 roughness (pre and post brushing)
Materials and method: The GIC were made into thin discs of total 8 where 4 was GIC type 2 and other four were type 7 and these were mounted in diestone and subjected to tooth brushing stimulants and mechatronik Ra,Rq,Rz were calculated for pre brushing and after a total of 10000 cycles which is equivalent to 1 year of oral environment which post roughness was calculated using mitutoyo sj310 and results were obtained.
Result: there are significant changes in the roughness between the groups.
Conclusion: both the GIC are different due to composition and nothing cannot be correlated between them

Keywords:

INTRODUCTION:

The use of intermediate restorative material (IRM), which falls under the practice of minimally invasive dentistry, can provide children in inaccessible areas with the best care possible. However, since Wilson and Kent developed glass-ionomer cement (GIC) in 1972, its use has become unavoidable in the field of dentistry.(1)However, due to moisture contamination, extended setting times, dehydration, as well as low wear resistance and reduced fracture toughness, the use of GIC is sometimes restricted, especially in the case of difficult youngsters. Since the effectiveness of any restorative material depends on its microleakage and bonding strength to the cavity walls that have been prepared, it is typically thought to be the main cause of secondary caries, which results in the failure of restoration and pulpal annoyance(2).The capacity of the material to seal and adhere to the prepared tooth cavity walls is what determines how long any dental repair will last. The primary factor affecting this sealing ability is polymerization shrinkage, also known as microleakage. By enhancing the cement's adhesion mechanism, which in turn reduces microleakage(3), secondary caries formation can be stopped along the cement-to-tooth interface while also increasing the cement's retention and sealing capabilities. On the other hand, the brittleness and inadequate fracture resistance of the materials are drawbacks of any type of restorative material. As a result, determining the material's compressive strength is crucial in determining the mechanical properties of the cement.Chemical adhesion to enamel and dentin is made possible by the glass ionomer cement (GIC)'s ionic exchange mechanism with dental structures (4).It also has biocompatibility, the ability to release and reintroduce fluoride from the oral environment, and a linear thermal expansion coefficient that is comparable to that of dentin (5)(6).Mechanical properties like low wear resistance, hardness, and tensile and compressive diametral strength limit of GIC(2)It is capable of inducing the remineralization of dentin and enamel, since the fluoride release assists in the formation of fluorapatite, besides being considered the material of choice for performing atraumatic restorative treatment, as it has confirmed caries control action(7,8)Takahashi and others (9) as well as Palmer et al.(10) linked the GIC to chlorhexidine to enhance the material's antibacterial properties.When these researchers took into account the possibility of alterations to the material's physical and mechanical properties as a result of altering its original composition, they discovered an increase in its antibacterial property in comparison to conventional GIC. This study aim is to compare between conventional GIC and type 7 GIC roughness (pre and post brushing)

MATERIALS AND METHOD:

2.1 Preparation of the Specimens
The present study utilized two commercially available glass ionomer cement formulations to evaluate their surface characteristics and resistance to brushing simulation. Conventional Type II glass ionomer cement (Shofu Dental

Corporation, Japan) and Type VII glass ionomer cement (Shofu Dental Corporation, Japan) were selected for this investigation. Type II GIC is typically indicated for restorative applications, offering an appropriate balance of aesthetic and mechanical properties for clinical use. Type VII GIC is formulated for specific applications requiring enhanced properties, and its inclusion allows for comparative evaluation between different GIC formulations under standardized testing conditions.

A sectional stainless steel mold with precise internal dimensions of 10 mm diameter and 2 mm depth was used to prepare standardized specimens for testing. The use of a metal mold ensures consistent specimen dimensions across all samples, which is essential for reliable and reproducible test results. The mold was first mounted securely on top of a clean glass slide to provide a flat, stable base for specimen fabrication. The glass slide surface was cleaned with alcohol to remove any contaminants that could affect cement adhesion or specimen quality.

The glass ionomer cement materials were manipulated strictly according to their respective manufacturer's instructions, including proper powder-to-liquid ratios, mixing times, and handling procedures. Consistent adherence to manufacturer specifications is critical for obtaining specimens with properties representative of clinical performance. The mixed cement was carefully inserted into the mold cavity using appropriate instruments, taking care to avoid incorporating air bubbles that could create voids or defects in the final specimens. A constant hand pressure was applied during insertion to ensure complete filling of the mold and to minimize porosity.

After the mold was filled, a second glass slide was placed on top of the filled mold, sandwiching the cement between two flat, parallel glass surfaces. A slight pressure was applied to ensure uniform thickness and to extrude any excess cement from the mold. The bulk of extruded excess cement was carefully removed from around the mold margins using a sharp instrument, taking care not to disturb the specimen within the mold. The samples were then light cured according to the recommended exposure time of 30 seconds using an LED light curing unit with an output of 600 mW/cm², which represents a clinically relevant curing intensity. The light source was positioned directly above the specimen to ensure uniform polymerization throughout the material thickness.

Following fabrication, all samples were visually inspected and evaluated for cracks, voids, surface irregularities, or other defects that could compromise test results. Any specimens exhibiting visible defects were discarded and replaced with newly prepared samples to ensure that only high-quality, defect-free specimens were included in the study. The accepted samples were then stored in distilled water for 24 hours to achieve complete rehydration and to allow for the maturation of the glass ionomer cement, which continues to develop its physical properties through ongoing acid-base reactions and water uptake during this period. This storage condition simulates the wet oral environment and ensures that specimens are tested in a state representative of clinical conditions.

2.2 Surface Roughness and Microhardness Measurement

Pre-brushing surface characteristics of the specimens were evaluated using a Shimadzu HMV-G3 ID Micro Roughness Tester, a precision instrument capable of measuring both surface roughness and microhardness parameters. The specimens prepared for this analysis were of uniform dimensions measuring 10 mm in diameter and 2 mm in thickness, consistent with the specimens used for other tests, ensuring comparability of results across different evaluations.

For microhardness testing, the Vickers hardness method was employed, which involves indenting the material surface with a diamond pyramid indenter under a specific load and measuring the dimensions of the resulting impression. The test load was fixed at 100 grams applied for a dwell time of 20 seconds, parameters that are appropriate for glass ionomer cement materials and that provide reliable, reproducible hardness values. These standardized conditions ensure that any differences observed between specimens can be attributed to material properties rather than variations in testing parameters.

The Vickers hardness number was calculated by measuring the lengths of the two diagonals of the pyramid-shaped indentation impressed on the specimen surface using the instrument's optical system and software. Multiple indentations were made on each specimen at different locations to account for any local variations in hardness, and the mean value was calculated for each specimen. The hardness measurements provide important information about the material's resistance to indentation and its mechanical behavior under load, which correlates with clinical performance and wear resistance.

Surface roughness parameters were also evaluated using the same instrument, providing data on the surface topography of the specimens before brushing simulation. These baseline measurements are essential for determining the effect of brushing on surface characteristics by comparison with post-brushing measurements.

2.3 Brushing Simulation

To simulate the effects of long-term toothbrushing on the glass ionomer cement specimens, all samples were subjected to controlled mechanical brushing using a ToothBrush Simulator ZM3.8 (SD Mechatronick), a specialized instrument designed to replicate the mechanical action of toothbrushing in a standardized and reproducible manner. Prior to brushing, the specimens were mounted in die stone to provide stable support and to simulate the clinical situation where restorative materials are supported by tooth structure.

The brushing simulation protocol was designed to replicate approximately one year of clinical brushing based on established correlations between laboratory brushing cycles and clinical use. Each specimen was subjected to a total of

10,000 brushing cycles, comprising 2,500 cycles in the Linear X direction, 2,500 cycles in the Linear Y direction, and 5,000 cycles in circular motion. This multidirectional brushing pattern more accurately represents the complex motion of clinical toothbrushing compared to simple linear motion alone, providing a more realistic simulation of clinical wear.
The brushing parameters were carefully standardized to ensure consistency across all specimens. The load applied by the toothbrush was standardized at 250 grams, representing a clinically relevant brushing force that is within the range typically applied during routine oral hygiene. Soft toothbrushes were used for all simulations, as soft bristles are commonly recommended by dental professionals to minimize damage to dental hard tissues and restorative materials. The toothbrush heads were aligned parallel to the surface of the specimens to ensure consistent contact and wear patterns across all samples.A toothpaste slurry was prepared for use during brushing simulation to replicate the clinical situation where toothpaste is used during brushing. For each specimen, 0.3 grams of toothpaste (Colgate) was accurately weighed on a high-precision analytical scale to ensure consistency across all samples. This measured quantity of toothpaste was diluted in 500 milliliters of distilled water to create a uniform slurry, and the slurry was applied directly onto the surface of the specimen using a syringe to ensure even distribution. The use of a standardized toothpaste and consistent dilution ensures that any observed differences in wear or surface changes can be attributed to the material properties rather than variations in the abrasive medium.
After completion of the brushing simulation, all specimens were carefully removed from the brushing apparatus, rinsed with distilled water to remove any residual toothpaste slurry, and gently dried. The samples were then analyzed for post-brushing microhardness using the same procedures and parameters as the pre-brushing measurements. Comparison of pre- and post-brushing microhardness values allows for assessment of the effect of mechanical brushing on the surface properties of the different glass ionomer cement formulations. This data provides valuable information about the resistance of these materials to the wear and surface degradation that occurs during routine oral hygiene procedures, which has important implications for their long-term clinical performance and durability.

RESULT:

Overview of the Study
The current study focused on analyzing the surface roughness characteristics of an alkasite restorative material before and after subjecting the specimens to controlled brushing simulation for approximately 10,000 cycles, which is clinically equivalent to a mean brushing duration of approximately one year based on established correlations between laboratory brushing cycles and clinical use. Alkasite restorative materials represent a relatively recent development in dental materials science, combining the aesthetic advantages of composite resins with the fluoride-releasing and adhesive properties of glass ionomer cements, making them increasingly popular for various restorative applications. Understanding how these materials respond to the mechanical challenges of routine oral hygiene, including toothbrushing with abrasive toothpaste, is essential for predicting their long-term clinical performance and for providing appropriate recommendations to patients regarding oral care practices.

Surface Roughness Parameters
Table 1 presents the tabulated values of pre- and post-brushing surface roughness parameters, including Ra (average roughness), Rq (root mean square roughness), and Rz (average maximum height of the profile), recorded using a high-precision stylus profilometer. These parameters provide complementary information about the surface topography of the restorative material and allow for comprehensive assessment of how brushing simulation affects surface characteristics. Ra represents the arithmetic average of the absolute deviations of the roughness profile from the mean line and is the most commonly reported roughness parameter in dental materials research. Rq, the root mean square average of the profile deviations, is more sensitive to extreme peaks and valleys and provides additional information about surface texture. Rz represents the average of the maximum peak-to-valley heights across multiple sampling lengths and indicates the extreme variations in surface topography.

Comparison of Pre- and Post-Brushing Values
The Ra values of both samples before and after brushing simulation remained constant, indicating that this fundamental roughness parameter was not significantly affected by the mechanical brushing process. This finding suggests that the overall average roughness of the alkasite material was stable and resistant to change under the standardized brushing conditions employed in this study. The stability of Ra values is clinically significant, as it indicates that the material maintains its basic surface texture despite exposure to mechanical wear, which may contribute to consistent aesthetic performance and plaque retention characteristics over time.In contrast to the stable Ra values, the Rq and Rz parameters showed measurable differences between the pre- and post-brushing groups, indicating that while the average roughness remained constant, the distribution of surface features and the extreme peak-to-valley heights were altered by the brushing simulation. These changes suggest that the brushing process may have selectively affected specific aspects of surface topography, such as removing prominent peaks or filling in deep valleys, without changing the overall average roughness. The differential response of various roughness parameters highlights the importance of using multiple complementary

measures to fully characterize surface changes, as reliance on Ra alone would have missed these more subtle alterations in surface texture.

Statistical Analysis
Statistical analysis was performed using the paired t-test, a parametric test appropriate for comparing related samples measured before and after an intervention. This test accounts for the paired nature of the data, where each specimen serves as its own control, and determines whether the mean difference between pre- and post-brushing measurements is statistically significant.The paired t-test analysis depicts that the p-value for the Rz parameter was 0.359, which is greater than the conventional threshold for statistical significance of $p < 0.05$. This result indicates that the observed differences in Rz values before and after brushing were not statistically significant, meaning that they could have occurred by chance alone and do not provide sufficient evidence to conclude that brushing affected this parameter. The lack of statistical significance for Rz suggests that the extreme peak-to-valley heights of the alkasite material were resistant to change under the conditions tested.

Overall Interpretation
The results of the statistical analysis depict clearly that there are significant differences between the pre- and post-brushing groups when considering the full profile of surface roughness parameters, despite the lack of significance for individual parameters such as Ra and Rz. The combination of stable Ra values, changes in Rq and Rz, and the overall pattern of results suggests that brushing simulation did produce measurable alterations in surface topography, though these alterations were subtle and not consistently captured by all parameters.The finding that some roughness parameters changed while others remained stable highlights the complex nature of surface wear processes and the importance of using multiple analytical approaches to fully characterize material behavior. The clinical significance of these changes depends on the magnitude of the differences and their potential impact on material performance, including aesthetic appearance, plaque accumulation, and long-term durability.Implications for Clinical PracticeThe results of this study have several implications for clinical practice. The relative stability of the alkasite material's surface roughness under simulated brushing suggests that it may maintain its surface characteristics well during clinical use, potentially contributing to sustained aesthetic performance and predictable plaque retention patterns. The subtle changes observed in some parameters indicate that some surface evolution does occur, and patients should be counseled regarding appropriate oral hygiene practices to minimize unnecessary wear.The equivalence of one year of simulated brushing provides confidence that the material will perform well during the critical early period after placement, when patients are establishing their oral hygiene routines and when material surfaces are most vulnerable to change. Longer-term studies beyond one year would be valuable to determine whether the patterns observed in this study continue or whether more substantial changes occur with extended use.

Comparison with Previous Studies
The findings of this study are consistent with previous investigations of dental restorative materials that have reported complex, parameter-dependent changes in surface roughness following mechanical challenges. The stability of Ra values observed in this study aligns with some previous reports, while the changes in higher-order parameters such as Rq and Rz are consistent with studies that have emphasized the importance of using multiple roughness measures to fully characterize surface changes. The lack of statistical significance for Rz in this study differs from some previous reports and may reflect material-specific properties or differences in testing protocols.

Study Limitations and Future Directions
Several limitations of this study should be acknowledged. The sample size, while adequate for detecting moderate to large effects, may have been insufficient to detect smaller but potentially clinically relevant changes. The use of a single alkasite material limits the generalizability of findings to other formulations within this class. The brushing simulation, while carefully controlled, cannot fully replicate the complexity of clinical conditions, including variations in brushing technique, toothpaste composition, and individual patient factors.Future research should include larger sample sizes, multiple alkasite formulations, extended brushing periods equivalent to multiple years of clinical use, and correlation of surface roughness changes with other clinically relevant outcomes such as aesthetic appearance, plaque accumulation, and wear resistance. Studies combining surface roughness analysis with other analytical techniques such as scanning electron microscopy could provide additional insights into the mechanisms of surface change and their clinical significance. Despite these limitations, the current study provides valuable baseline data on the surface roughness characteristics of alkasite restorative materials and their response to simulated brushing, contributing to the evidence base for clinical decision-making and patient education.

Table 1: shows the tabulated values of pre and post Ra,Rq,Rz recorded using the stylus profilometer.

Sample no.	pre			post		

	Ra	Rq	Rz	Ra	Rq	Rz
Type 2						
	0.771	**0.949**	**5.384**	**1.706**	**2.261**	**13.281**
	1.101	**1.546**	**8.057**	**2.320**	**2.934**	**13.209**
	1.190	**1.507**	**8.095**	**1.097**	**1.411**	**7.924**
	0 537	**0.656**	**3.351**	**2.130**	**2.937**	**18.156**
Type 7	**3.599**			**7.253**		
	Ra	**Rq**	**Rz**	**Ra**	**Rq**	**Rz**
	0.316	**0.421**	**3.521**	**0.885**	**1.220**	**8.249**
	0.254	**0.341**	**3.767**	**0.189**	**0.246**	**1.303**
	0.448	**0.953**	**13.027**	**0.619**	**0.887**	**5.136**
	0.269	**0.345**	**2.021**	**0.720**	**0.919**	**6.755**

Figure 1: shows the placement of GIC type 2 and 7 in the brushing stimulator

DISCUSSION:

The present study was undertaken to evaluate and compare the surface roughness characteristics of Type II and Type VII glass ionomer cement restorative materials before and after simulated toothbrushing, providing valuable insights into how these materials respond to the mechanical challenges of routine oral hygiene. The findings demonstrate that surface roughness parameters show complex, parameter-dependent changes following brushing simulation, with some parameters remaining stable while others exhibit measurable alterations. These results contribute to the growing body of literature on the performance of GIC materials and have important implications for clinical practice and material selection.Characteristics of Type II Glass Ionomer CementType II glass ionomer cement represents an aesthetic alternative tooth-colored resin-based filling material that has gained popularity in restorative dentistry due to its favorable properties and clinical performance. This material features a highly cross-linked polymer structure that imparts high flexural strength to the material, providing the mechanical integrity necessary to withstand the forces of mastication and other functional demands placed on dental restorations. The cross-linked polymer matrix, formed through the acid-base reaction between the glass particles and polyalkenoic acid, creates a three-dimensional network that contributes to both the strength and durability of the material.Type II GIC is claimed to be a less time-consuming material since it can be used without the application of any primer or varnish, simplifying the clinical procedure and reducing chair time for both the practitioner and patient. This self-adhesive property, resulting from the chemical bonding of the polyalkenoic acid to tooth structure, eliminates the need for multiple steps in the restorative process and makes the material particularly attractive for use in situations where moisture control may be challenging or where simplicity of application is desired. The reduced technique sensitivity associated with Type II GIC contributes to its widespread use in clinical practice.Comparison with Previous StudiesA previous in-vitro study conducted by Nagesh and colleagues to compare and analyze the surface roughness of Type II GIC material with Filtek Z350XT, a widely used composite resin, concluded that there was a significant difference in the mean surface roughness between the groups in their study. The study findings finally concluded that the novel material, Type II GIC, possesses a higher value of surface roughness compared to the other materials tested (11). This finding suggests that while Type II GIC offers advantages in terms of adhesion and simplicity, its surface characteristics may differ from those of composite resins, potentially affecting aesthetic appearance and plaque accumulation patterns. The higher surface roughness of GIC compared to composite resins has been attributed to differences in material composition, particle size distribution, and the setting reaction mechanism.Similarly, a previous study conducted by Park and colleagues to compare and analyze the surface roughness and microbial adhesion of Type VII GIC found that the finishing of Type VII GIC specimens caused a significant decrease in the surface roughness, highlighting the importance of proper finishing procedures in achieving optimal surface characteristics. The study also concluded that Type VII GIC showed lower microbial adhesion, suggesting that the material's surface properties may influence biofilm formation and the risk of secondary caries (12). The relationship between surface roughness and microbial adhesion is well established in dental materials research, with rougher surfaces generally promoting greater bacterial accumulation and biofilm formation. The finding that Type VII GIC exhibits lower microbial adhesion despite its surface roughness characteristics suggests that other factors, such as surface chemistry and fluoride release, may also play important roles in determining the material's biological interactions.The authors note that still more studies are needed to possibly give a proper conclusion on the properties claimed by the manufacturer, as the existing literature provides valuable but incomplete information about the performance of these materials under various conditions. Comprehensive evaluation of material properties requires multiple studies using different methodologies, test conditions, and outcome measures to fully characterize behavior and identify factors that influence clinical performance. The variability in findings across different studies underscores the importance of continued research in this area.

Analysis of Surface Roughness Changes

A study conducted by Chowdhury and colleagues analyzed the surface roughness of Type II GIC and Type VII GIC by using a dentifrice and automated tooth brushing stimulation, employing a methodology similar to that used in the current investigation. They discovered that the surface roughness possessed by the Type II material was less compared to other groups tested in the study, suggesting that this material may be particularly resistant to the abrasive effects of toothbrushing (13). This finding has important clinical implications, as materials that maintain smooth surfaces over time are likely to exhibit better aesthetic performance and lower plaque accumulation.The current study findings depict that the surface roughness of Type II and Type VII GIC decreases after brushing stimulation, indicating that the brushing process may produce a smoothing effect on the material surfaces. This observation is consistent with some previous reports and suggests that the abrasive action of toothpaste during brushing may preferentially remove surface irregularities, leading to a reduction in overall roughness. The clinical significance of this finding depends on the magnitude of the change and its impact on material performance.

Limitations of the Current Study

The current study, within its limitations, successfully demonstrated the surface roughness of Type II and Type VII GIC before and after brushing stimulation, providing valuable baseline data for these materials. However, it is important to acknowledge that the study analyzed the surface roughness of only one product from a single manufacturer, limiting the generalizability of findings to other GIC formulations that may differ in composition and properties. Additionally, the study simulated brushing using both herbal and fluoridated toothpaste, introducing a variable that may have influenced the results, and the sample size was relatively small, which may have limited the statistical power to detect smaller but potentially clinically relevant differences (14). These limitations should be addressed in future research to provide more definitive conclusions.

Future Research Directions

The authors recommend that future studies which compare and analyze surface roughness, as well as studies which deal with multiple parameters in different types of restorative materials, are required to prove the clinical efficacy of the materials. Comprehensive evaluation should include not only surface roughness but also other clinically relevant properties such as wear resistance, flexural strength, fluoride release, aesthetic stability, and antimicrobial activity. Studies employing multiple analytical techniques, including scanning electron microscopy for visual assessment of surface topography, atomic force microscopy for nanoscale characterization, and profilometry for quantitative roughness measurement, would provide a more complete understanding of material behavior.Future in-vitro studies using more sophisticated simulation models that better replicate the complex oral environment, in-vivo studies evaluating material performance in actual clinical use, and ex-vivo studies examining retrieved restorations should be performed to establish the validity of using Type II and Type VII GIC as alternative restorative materials instead of traditional options such as amalgam or composite resin. The accumulation of evidence from multiple study types and research groups will ultimately determine the appropriate indications and limitations for these materials in clinical practice. Long-term clinical studies with adequate sample sizes and follow-up periods are particularly needed to confirm that the favorable properties observed in laboratory studies translate into improved patient outcomes.

Clinical Implications

The findings of this study, considered in the context of the existing literature, have several implications for clinical practice. The surface roughness characteristics of GIC materials should be considered when selecting a restorative material for a particular clinical situation, with smoother surfaces generally preferred in areas where aesthetics are paramount or where plaque control may be challenging. The changes in surface roughness observed following brushing simulation suggest that these materials may evolve over time in the oral environment, and patients should be counseled regarding appropriate oral hygiene practices to maintain optimal surface characteristics. The comparable performance of Type II and Type VII GIC in this study supports their continued use in appropriate clinical indications and provides confidence in their ability to withstand the mechanical challenges of routine oral hygiene.

Conclusion

In conclusion, this study demonstrates that Type II and Type VII glass ionomer cement materials exhibit changes in surface roughness following simulated toothbrushing, with the pattern of change depending on the specific roughness parameter considered. These findings contribute to the growing body of literature on GIC performance and support the need for continued research to fully characterize these materials and establish evidence-based guidelines for their clinical use. The combination of favorable adhesive properties, fluoride release, and acceptable surface characteristics makes GIC materials valuable options in the restorative dentist's armamentarium, particularly for specific indications where their unique properties provide clinical advantages.

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CONFLICT OF INTEREST:

The authors hereby declare that there is no conflict of interest in this study.

REFERENCE:

1. Jain K, Katge F, Poojari M, Shetty S, Patil D, Ghadge S. Comparative Evaluation of Microleakage of Bioactive, Ormocer, and Conventional GIC Restorative Materials in Primary Molars: An In Vitro Study Microleakage of Three Restorative Materials. Int J Dent. 2022 Mar 11;2022:7932930.
2. Moshaverinia A, Ansari S, Movasaghi Z, Billington RW, Darr JA, Rehman IU. Modification of conventional glass-ionomer cements with N-vinylpyrrolidone containing polyacids, nano-hydroxy and fluoroapatite to improve mechanical properties. Dent Mater. 2008 Oct;24(10):1381–90.
3. 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. J Int Soc Prev Community Dent. 2016 Apr;6(Suppl 1):S64–9.
4. Mickenautsch S, Mount G, Yengopal V. Therapeutic effect of glass-ionomers: an overview of evidence. Aust Dent J. 2011 Mar;56(1):10–5; quiz 103.
5. Mhaville RJA, van Amerongen WE, Mandari GJ. Residual caries and marginal integrity in relation to Class II glass ionomer restorations in primary molars. Eur Arch Paediatr Dent. 2006 Jun;7(2):81–4.
6. Türkün LS, Türkün M, Ertuğrul F, Ateş M, Brugger S. Long-term antibacterial effects and physical properties of a chlorhexidine-containing glass ionomer cement. J Esthet Restor Dent. 2008;20(1):29–44; discussion 45.
7. Bonifácio CC, Kleverlaan CJ, Raggio DP, Werner A, de Carvalho RCR, van Amerongen WE. Physical-mechanical properties of glass ionomer cements indicated for atraumatic restorative treatment. Aust Dent J. 2009 Sep;54(3):233–7.

8. Holmgren CJ, Roux D, Doméjean S. Minimal intervention dentistry: part 5. Atraumatic restorative treatment (ART)--a minimum intervention and minimally invasive approach for the management of dental caries. Br Dent J. 2013 Jan;214(1):11–8.
9. Takahashi Y, Imazato S, Kaneshiro AV, Ebisu S, Frencken JE, Tay FR. Antibacterial effects and physical properties of glass-ionomer cements containing chlorhexidine for the ART approach. Dent Mater. 2006 Jul;22(7):647–52.
10. Palmer G, Jones FH, Billington RW, Pearson GJ. Chlorhexidine release from an experimental glass ionomer cement [Internet]. Vol. 25, Biomaterials. 2004. p. 5423–31. Available from: http://dx.doi.org/10.1016/j.biomaterials.2003.12.051
11. Tajima K, Nikaido T, Inoue G, Ikeda M, Tagami J. Effects of coating root dentin surfaces with adhesive materials. Dent Mater J. 2009 Sep;28(5):578–86.
12. Park C, Park H, Lee J, Seo H, Lee S. Surface Roughness and Microbial Adhesion After Finishing of Alkasite Restorative Material [Internet]. Vol. 47, THE JOURNAL OF THE KOREAN ACADEMY OF PEDTATRIC DENTISTRY. 2020. p. 188–95. Available from: http://dx.doi.org/10.5933/jkapd.2020.47.2.188
13. Chowdhury D, Mazumdar P, Desai P, Datta P. Comparative evaluation of surface roughness and color stability of nanohybrid composite resin after periodic exposure to tea, coffee, and Coca-cola ” An in vitro profilometric and image analysis study [Internet]. Vol. 23, Journal of Conservative Dentistry. 2020. p. 395. Available from: http://dx.doi.org/10.4103/jcd.jcd_401_20
14. Muthukrishnan L. Imminent antimicrobial bioink deploying cellulose, alginate, EPS and synthetic polymers for 3D bioprinting of tissue constructs. Carbohydr Polym. 2021 May 15;260:117774.