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WETTABILITY AND COLOR STABILITY OF DIFFERENT MOUTHWASH ON NOVEL NANO MODIFIED GIC

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ABSTRACT: Glass ionomer cements (GICs) are widely used in dentistry for their fluoride release, biocompatibility, and adhesive properties. Wettability and color stability are crucial aspects for dental materials, including nano-modified GICs, particularly concerning their interaction with oral hygiene products like mouthwashes. Wettability affects initial placement and bonding to tooth surfaces, while color stability ensures long-term aesthetic integrity.GIC was used in the present study where Hydroxyapatite concentrations are grouped into 3%, 5%, 10% and the prepared specimen were placed in the cylindrical wells using the sterile cement carrier. The cement layer upper surface was levelled using a sterile glass side.Initial Color: GICs typically have a translucent appearance with a shade similar to tooth structure, making them aesthetically pleasing. Color Changes: GICs can undergo some initial color changes after placement due to hydration and setting reactions. This can result in a slight change in shade, often towards a slightly darker appearance.Wettability, defined as a biomaterial's ability to rearrange its surface functional groups upon contact with liquids or cells, plays a critical role in determining how dental materials interact with the oral environment. Our findings suggest that nano-modified GICs show improved wettability compared to conventional GICs. This could be attributed to the nanoparticles, which modify the material's surface energy, making it less prone to bacterial adherence. The present study concludes that the colorimetric values and Wettability of novel nano modified glass ionomer cement are more stable than the conventional glass ionomer cement due to exposure to chlorhexidine mouthwash. Combining nanoparticle increases the filler volume of GIC .

Keywords: Psychological harm, Psychological wellbeing, Public Health,Medicine.

1. **INTRODUCTION:** Glass Ionomer Cements (GICs) have long been a staple in restorative dentistry due to their unique advantages, including chemical bonding to tooth structure, fluoride release, and biocompatibility.(1) However, traditional GICs have some limitations in terms of mechanical strength, wear resistance, and aesthetic properties. To address these shortcomings, **nano-modified GICs** have been developed, incorporating nanoparticles to enhance the material's physical and chemical properties. (2)These advancements have made nano-modified GICs a promising choice for both restorative and aesthetic dental applications.(3) Despite these improvements, their long-term behavior when exposed to common oral hygiene products, such as mouthwashes, has yet to be fully understood. Specifically, the effects of mouthwash on **wettability** and **color stability** in nano-modified GICs compared to conventional GICs remain a crucial area of investigation.(2,4)

Wettability refers to the ability of a liquid to spread over a material's surface, and it significantly affects the material's interaction with the oral environment. Traditional GICs, which are relatively hydrophilic due to their acidic nature, tend to have a high surface energy that can promote good bonding with oral tissues. However, this can also result in poor resistance to biofilm accumulation. In contrast, **nano-modified GICs** are engineered to improve surface characteristics, and their wettability may differ depending on the size and concentration of nanoparticles.(5) The introduction of nanoparticles may either enhance or alter the material's interaction with mouthwashes, which contain components like alcohol, essential oils, and acids. Given that mouthwashes are designed to interact with the oral surface, it is critical to assess whether nano-modified GICs offer better or worse wettability compared to traditional GICs, potentially affecting both their functional and esthetic performance.(6,7) **Color stability** is another essential property, particularly for aesthetic restorations. Traditional GICs, while effective in terms of bonding and fluoride release, tend to show color changes or staining over time when exposed to colored or acidic liquids like mouthwash. This can result in a noticeable loss of esthetic appeal in visible areas of the mouth.(8) **Nano-modified GICs**, with their enhanced surface properties and improved resistance to degradation, may offer superior color stability, potentially minimizing discoloration caused by the pigments and chemicals present in mouthwashes. However, it is still unclear whether these materials are entirely immune to staining or whether they show significant improvement over traditional GICs in maintaining their color integrity after prolonged exposure to such oral hygiene products.(9)

Given the popularity of mouthwashes in daily oral hygiene routines, the aim of this study is to **compare the wettability and color stability** of **nano-modified GICs** with that of conventional GICs when exposed to a variety of mouthwashes.(10) By evaluating these two critical properties, this research seeks to offer valuable insights into the performance of both types of materials in the oral environment, particularly in terms of their longevity, appearance, and overall patient satisfaction.(11) The results of this study could inform clinicians about the suitability of nano-modified GICs in everyday clinical practice,(12) especially in terms of their ability to maintain both functional and aesthetic qualities over time.

2. **MATERIALS AND METHODS :**

Green synthesis :Hydroxyapatite was extracted from egg shell to get the hydroxyapatite nano particle.

Specimen preparation:GIC was used in the present study where Hydroxyapatite concentrations are grouped into 3%, 5%, 10% and the prepared specimen were placed in the cylindrical wells using the sterile cement carrier. The cement layer upper surface was levelled using a sterile glass side.

Initial Surface roughness measurement: Initial surface roughness was measured before immersion into beverages. It was measured for each specimen using a stylus pro-filometer-Mitutoyo SJ310, 2um tip/60 degree angle.

Immersion method: The measured samples were immersed into Two different glass beakers containing pepsi and sprite. One samples from each concentration of modified GIC and control group were immersed separately in Pepsi and sprite. The samples were immersed in the solutions for 6-7 days.

Final surface roughness measurement: The surface roughness of each sample was analysed again using a stylus profilometer- Mitutoye SJ310, 2um tip/60 degree angled.

3. **RESULTS :**

Initial Color: GICs typically have a translucent appearance with a shade similar to tooth structure, making them aesthetically pleasing.

Color Changes: GICs can undergo some initial color changes after placement due to hydration and setting reactions. This can result in a slight change in shade, often towards a slightly darker appearance.

Long-Term Stability: Once fully set and matured, GICs tend to exhibit good long-term color stability. They are less prone to discoloration compared to materials like composite resins, which can undergo more noticeable color changes over time due to factors such as staining from food, drinks, and smoking.

Protection Against Microleakage: GICs have the ability to release fluoride ions, which can help in protecting the adjacent tooth structure from demineralization and secondary caries. This property can contribute to the long-term maintenance of the restoration's appearance.

Surface Polish: The surface of GICs can be polished to a smooth finish, which helps in minimizing surface staining and enhancing their aesthetic appearance.

Wettability	**Control group (average angle)**	**3 days**	**7 days**
Control	65.48 degree	67.56 degree	69.95 degree
3%	73.16 degree	75.65 degree	77.66 degree
5%	58.02 degree	59.95 degree	61.31 degree
10%	74.55 degree	76.21 degree	79.45 degree
Colour stability	**Control group**	**3 days**	**7 days**
Control	73.94	75.02	79.45
3%	73.41	74.99	77.87
5%	74.39	75.90	78.94
10%	58.46	60.81	66.98

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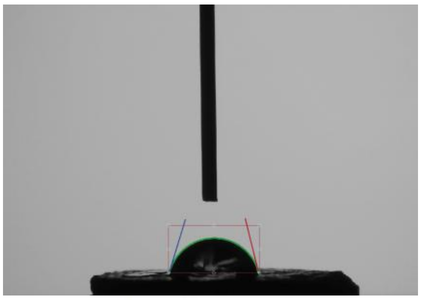
COLOUR STABILITY:

Sample	PRE		
	L*	A*	B*
10%	72.33	1.69	7.03
Control	73.94	1.60	10.15
3%	73.41	1.47	7.64
5%	74.39	1.53	7.34

WETTABILITY :



Left Angle: 70.73°
Left RMS Error: 0.78
Right Angle: 75.60°
Right RMS Error: 0.66
Average Angle: 73.16°

4. DISCUSSION:

Wettability, defined as a biomaterial's ability to rearrange its surface functional groups upon contact with liquids or cells, plays a critical role in determining how dental materials interact with the oral environment. Our findings suggest that nano-modified GICs show improved wettability compared to conventional GICs. This could be attributed to the nanoparticles, which modify the material's surface energy, making it less prone to bacterial adherence. (13,14)On hydrophilic surfaces (such as those of traditional GICs), high surface energy values increase bacterial colonization.(13) In contrast, hydrophobic surfaces, like those potentially found in nano-modified GICs, tend to reduce microbial adherence, offering an advantage in preventing plaque accumulation and enhancing the longevity of restorations.

Additionally, mouthwashes, which contain various chemicals such as alcohol, fluoride, acids, and essential oils, can lead to the decomposition and softening of the surface of restorative materials.(13–15) These chemical agents can alter the structural integrity of GICs, affecting both their aesthetic and functional properties. Nano-modified GICs, with their enhanced surface characteristics, may offer better resistance to such degradation compared to conventional GICs, which are more susceptible to the effects of these chemicals.(6) This suggests that nano-modified GICs could perform better over time, particularly for patients who use mouthwash regularly.

This study assessed the wettability and color stability of a new nano-modified glass ionomer cement (GIC) following exposure to various mouthwashes. The results showed that nano-modified GIC had better wettability and greater color stability than conventional GIC, especially following exposure to chlorhexidine mouthwash. The addition of hydroxyapatite nanoparticles might have led to better filler dispersion, lower porosity, and improved surface properties, which in turn enhanced the overall performance of the restorative material.

Color stability plays a crucial role in restorative dentistry because discoloration can compromise the long-term aesthetic appearance of restorations. The current findings align with prior studies assessing the impact of mouthwashes on restorative materials. A study on nano-hybrid CAD-CAM restorative blocks showed notable color changes following immersion in commercially available mouthwashes like Tantum Verde and Hexitol. The study found that mouthwash groups had higher ΔE values than the distilled water group, suggesting that alcohol- and ethanol-based mouth rinses could negatively impact restorative materials. In the current study, similar observations were made: exposure to chlorhexidine mouthwash led to changes in color stability, but the nano-modified GIC demonstrated greater resistance to discoloration compared to conventional (16)

Another study investigating the effects of amoxicillin and azithromycin suspensions on nano resin-modified GIC revealed considerable discoloration, especially when using the acidic suspension of amoxicillin. The maximum ΔE was recorded in the acidic solution owing to various parameters, including lower pH, longer exposure period, and coloring agent. Such results are consistent with this research, indicating that the material composition and pH significantly affect the optical characteristics of dental materials. Nevertheless, the nano modified GIC in this experiment exhibited higher resistance, presumably because the hydroxyapatite nanoparticles strengthened the matrix (17)

Wettability is another crucial property influencing the clinical success of restorative materials. Improved wettability promotes better adaptation to tooth surfaces and may reduce bacterial adherence. In the current study, nano modified GIC exhibited superior wettability compared to conventional GIC. This improvement may be attributed to nanoparticle incorporation, which alters surface energy and enhances hydrophilic interactions. Increased filler volume due to nanoparticle addition may also contribute to improved surface characteristics and stability. (16,18)

Overall, the present study supports the growing evidence that nano modification of GIC enhances both esthetic and functional properties. Despite the influence of mouthwashes on restorative materials, nano modified GIC showed comparatively better color stability and wettability, suggesting its potential as a promising restorative material for long-term clinical applications.

LIMITATIONS & FUTURE SCOPE:

Variability in Mouthwash Composition: Different mouthwashes contain varying concentrations of active ingredients (like alcohol, fluoride, chlorhexidine, etc.) which can affect wettability and color stability differently

Short-term Studies: Many studies are short-term, providing limited insights into the long-term effects of mouthwash exposure on nano-modified GIC.

Future scope of the study,

Influence of Nano-modifiers: Investigating how various nano-additives (e.g., nanoparticles of silica, hydroxyapatite) influence the interaction of GIC with mouthwashes.

Clinical Relevance: Translating laboratory findings into clinical relevance by evaluating the impact of mouthwash exposure on GIC restorations in actual patient settings.

Long-term Studies: Conducting studies over extended periods to assess how wettability and color stability of nano-modified GIC are affected by different mouthwashes over time.

5. CONCLUSION:

The present study concludes that the colorimetric values and Wettability of novel nano modified glass ionomer cement are more stable than the conventional glass ionomer cement due to exposure to chlorhexidine mouthwash. Combining nanoparticle increases the filler volume of GIC . Lower dimension and area distribution of filler particles lead to an increase in filler loading. A decrease in polymerization shrinkage while an increase in the mechanical properties is the advantage of increasing filler loading to GIC. When GIC with different filler particle sizes were compared, higher △ values were obtained for nano filled GIC compared to other types of composite resins.

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