An In Vitro Assessment Of Microleakage For Conventional GIC & Resin Modified Glass Ionomer Cement Restorative Material

Dr. S Bhuvaneshwari 1, Dr. Priyalatha Suvvati* 2, Dr. Dhaval Charan 3, Dr. Abhigyan Manas 4, Dr. Amrit Anand 5, Dr. Azhar Mohammed 6, Dr. Atul Anand Bajoria 7

1Professor and HOD, Department of Oral Medicine and Radiology Kalinga institute of dental sciences, KIIT University Bhubaneshwar, Orissa -751024, India

2Department of Prosthodontics Government Dental College & Hospital, Afzulganj, Hyderabad, Telangana, India

3Senior Resident, Department of Dentistry, UP University of Medical Sciences, Saifai, Uttar Pradesh- 206130, India

4Senior Resident, Department of Dentistry, UP University of Medical Sciences, Saifai, Uttar Pradesh- 206130, India

5Sen Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Hazaribagh Dental College, Hazaribagh, Jharkhand, India

6Reader, Department of Orthodontics and Dentofacial Orthopedics NITTE (Deemed to be University) AB Shetty Memorial Institute of Dental Sciences (ABSMIDS), Mangalore, Karnataka, India

7Lecturer, Department of Oral Medicine and Radiology Kalinga Institute of Dental Sciences, KIIT University Bhubaneswar Odisha, India

Corresponding author: Dr. Priyalatha Suvvati, Department of Prosthodontics Government Dental College & Hospital, Afzulganj, Hyderabad, Telangana, India
E-mail: priyalathasuvvati16284@gmail.com

ABSTRACT

Introduction: The use of GIC as a luting agent, restorative material and base resulted in its popularity among dentists.

Aim: To assess the microleakage of conventional GIC with RMGIC material.
**Materials & Methods:** The present *in vitro* study was conducted on 40 freshly extracted maxillary second premolars. Teeth were categorized into two groups of 20 each. In group A, conventional GIC restorative material was used and in group B, RM-GIC material was used. By dye penetration test microleakage was evaluated at labial and lingual surfaces of teeth with stereomicroscope.

**Results:** The mean microleakage in group A was 0.58± 0.12 and in group B was 0.92± 0.13. The mean difference in both groups found to be -0.56. Independent t- test showed significant difference between both groups (P< 0.01).

**Conclusion:** The RMGIC exhibited higher microleakage as compared to conventional GIC.

**Key words:** Dye penetration, Glass ionomer cement, Microleakage

**Introduction**

Microleakage is the most common causes of failure of almost all restorative materials. Hence the ideal requisites for a restorative material are that it should have a biocompatibility, good color stability, and have a coefficient of thermal expansion are similar to that of natural tooth structure, with lower microleakage.\(^1\) Glass ionomer cement (GIC) has been widely used since decades. With the progression of time there have been multiple modifications in its structure and composition which has increased its utility in endodontics.\(^1\)

The greatest advantage of GIC is the tooth colored restoration which is demanded by patients. They are concerned about their esthetics and hence are the material of choice. It is not only useful in permanent but also in primary teeth.\(^2\) The presence of fluoride in GIC is beneficial in many terms. It helps in preventing progression of dental caries by releasing fluoride ions and by forming fluorapatite crystals which are more resistance to attack by bacteria. Thus in deciduous teeth which are more vulnerable to get dental caries, there use has been proved as boon. It is relatively easy to use and possess excellent bonding to both dentin and enamel. However, despite innumerable advantages, opacification, poor wear resistance and microleakage are among few disadvantages. The biggest failure of any restoration is its ability to prevent microleakage.\(^3\)

RMGIC are developed to overcome the drawback of conventional GIC. Resin-modified glass ionomer cements showed higher bond strength, reduced brittleness, lower moisture
sensitivity, reduced solubility and wear resistance and it has antibacterial characteristics. The present study was conducted to evaluate the microleakage of conventional GIC with RMGIC restorative material.

**Materials & methods**

The study comprised of 40 freshly extracted maxillary second premolars. Inclusion criteria were caries free without any pathology and indicated in case of orthodontic treatment. Exclusion criteria were fracture or abraded teeth.

Immediately after extracted all teeth were cleaned, disinfected and preserved in distilled water. In all teeth, cavity preparation was performed in the size of 3mm X 3mm X 2 mm in both lingual and labial side.

Teeth were categorised into two groups of 20 each. In group A, 10% polyacrylic acid conditioner was applied to cavity for 10 seconds followed by insertion of GIC materials in the cavity following standardized procedure under manufacturer instruction. Similarly, in group B, after application of 10% polyacrylic acid conditioner, RMGIC was restored.

All teeth were subjected to thermocycling for 500 cycles at the temperature of 5°C–55°C. The nail varnish was applied to external surface of all teeth except a 1 mm wide margin surrounding the restoration. Teeth were then immersed in 2% methylene blue for 24 hours at the temperature of 37°C and then rinsed under running water. All teeth were cut with the help of diamond band saw in the middle of the restoration parallel to the occlusal surface. Each sample was evaluated under stereomicroscope for the detection of marginal leakage of dye starting from the surface margins to the base of cavity preparation.

The degree of marginal leakage scoring was as following-

0 indicates no evidence of dye penetration at tooth- restoration interface, 1 indicates dye penetration along the interface to \( \leq \frac{1}{2} \) depth of cavity, 2 indicates dye penetration to full depth of cavity and 3 indicates dye penetration to base of cavity and beyond. Both labial and lingual surfaces were checked for microleakage.
Statistical analysis: Result thus obtained were analyzed using SPSS version 22.0. Results were expressed in mean± SD. Independent t- test was used for the assessing microleakage. P value less than 0.05 was considered significant.

Results

Table I indicates the mean microleakage among the test groups. The mean microleakage in group A was 0.58± 0.12 and in group B was 0.92± 0.13. The mean difference in both groups found to be -0.56. Independent t- test showed significant difference between both groups (P< 0.01).

Discussion

Microleakage is the biggest drawback with any restorative material. Any restorative material should be capable of preventing micro- leakage. Post- operative sensitivity, penetration of bacteria, secondary caries formation, pulpal inflammation and marginal discoloration are complications among poor restorative material.  

Hussin et al in their study suggested that microleakage of GIC leads post operative sensitivity, secondary caries and poor marginal adaptation and ultimately failure of the restoration. Hussin HM divided freshly extracted mandibular premolars into 2 groups of 40 each. Microleakage was assessed in both groups. Group B in which modified GIC-nanoZrO2-SiO2-HA hybrid material was used possessed higher mean microleakage value as compared to conventional GIC IX.

Chemical trace method, dye penetration and scanning electron microscopy are various methods used for assessing microleakage. In present study we used dye penetration method. Abdelaziz et al also utilized same dye penetration in their study. They evaluated microleakage in contemporary esthetic restorations following cyclic wet-dry storage. Class V cavities were prepared on both labial and lingual surfaces of freshly extracted 100 premolars which were divided into 10 groups. Various restorative materials were used and dye penetration method was employed. There was almost equal amount of microleakage in with all materials.

Najeeb et al concluded that RMGIC doesn’t show significant advantage over conventional GIC in terms of mechanical properties and bonding quality.
To enhance the life of any restorative material, there should be adequate seal at the margins. There is greater ionic bonding between the tooth and cement due to presence of higher mineral content in enamel.\textsuperscript{10}

Conventional GIC exhibits the advantage of a similar linear CTE as the tooth structure. There is production of stress because of difference of volumetric change between tooth and the restoration.\textsuperscript{11} This stress may be exaggerated during the thermo cycling test which ultimately affects the marginal seal. It has been observed that polymerization shrinkage results in failure of adhesion if there is poor bond strength between the tooth and restorative material.\textsuperscript{12}

The limitation of the present study is that small sample size was selected. Further \textit{in vivo} studies are needed to verify the result.

\textbf{Conclusion}

RM exhibited higher microleakage as compared to conventional GIC.

\textbf{Conflict of interest: Nil}

\textbf{References}


**Legends for illustrations**

**Tables & graph**

**Table I Comparison of microleakage between conventional GIC and RM-GIC**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group A</th>
<th>Group B</th>
<th>Mean difference (95% CI)</th>
<th>t-statistics</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
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<tr>
<td>Grade</td>
<td>0.58</td>
<td>0.12</td>
<td>0.92</td>
<td>0.13</td>
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Test used: Independent t-test, \( P < 0.01 \)

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