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Assessment of Microleakage and Shear Bond Strength of Conventional GIC, Nanocomposite and RMGIC Restorative Materials

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1. **Dr. Pratiksha Sahare**
Assistant Professor, Department of Prosthodontics and Crown & Bridge, Bharati Vidyapeeth Dental College and Hospital, Sangli, Maharashtra, India
2. **Dr. Parvaze Ahmad Parvaze**
Dental Restorative Specialist, Primary Healthcare Corporation, Qatar.
3. **Dr. Varad R Hiremath**
Professor, Department of Conservative Dentistry and Endodontics, Dayanad Sagar Dental College, Kumara Swamy Layout, Bangalore, Karnataka, India
4. **Dr. Vardharajula Venkata Ramaiah**
Assistant Professor, Department of Dental Hygiene, College of Applied Health Sciences in ArRass, Qassim University, Saudi Arabia
5. **Dr. Shreyas N Shah**
Associate Professor, Department of Oral Maxillofacial Pathology and Oral Microbiology, Government Dental College and Hospital, Jamnagar, Gujarat, India.
6. **Dr. Mahesh Melkundi**
Professor, Department of Oral and Maxillofacial Pathology, College of Dental Sciences, Rau, Indore, MP, India

Corresponding author

Dr. Parvaze Ahmad Parvaze
Dental Restorative Specialist, Primary Healthcare Corporation, Qatar.
E-mail: drparvaizdar@gmail.com

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glass ionomer cements, microleakage, shear bond strength, nanocomposite

Abstract
Objectives: To assess microleakage and shear bond strength of conventional GIC, RM GIC and nanocomposite restorative materials.
Materials and method: Occlusal portion of crowns were flattened. Prepared Class II cavities were restored with respective restorative materials; Group A- Conventional GIC, Group B- RMGIC and Group C- nanocomposites. Shear bond strength was assessed using universal testing machine (INSTRON). Microleakage was examined with stereomicroscope. Obtained data was statistically analysed.
Results: Results showed that nanocomposite had superior shear bond strength followed by resin modified GIC and leat with conventional GIC. Nanocomposites and conventional GIC had good microleakage compared to RM GIC.
Conclusion: Nanocomposit had higher shear bond strength and least microleakage in comparition to other groups.

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1. Introduction

Recent developments in adhesive dentistry have limited the size and shape of cavities to those that are only minimally invasive. [1] Glass ionomer cements have a great deal of room for improvement and can now make up for the majority of the drawbacks of other restorative materials.[2] The "sandwich technique" calls for the use of conventional Glass ionomer cement (GIC), which is regarded as the gold standard. The main drawback of this material is that it is susceptible to moisture, which causes water absorption and hygroscopic expansion, which results in crack formation, cement deterioration, and microleakage.[3]

For the longevity of restorative material, a good marginal seal and better bond strength are crucial.[2] Success of restoration depends on good physical properties (shear, compressive and tensile strength) and good adaptability with lower microleakage. The passage of bacteria, fluids, molecules, or ions that is clinically undetectable between a cavity wall and the restorative material that has been applied to it is known as microleakage.[1]

The most frequently used dental restorative material in the modern era is composite resin. It has benefits like great aesthetics and simplicity of use. It is also characterised by the possibility of complications brought on by the material's incomplete polymerization and the occurrence of polymerization shrinkage. The study of producing substances on a nanoscale is known as nanotechnology.[3,4,5]

Composites have been widely used in dental practise as a result of the rising demand for aesthetic restorations. However, these resins outperform amalgams as restorative materials in terms of aesthetics, functionality, and biocompatibility. Recently, hydroxyapatite reinforced GIC cements were introduced to address these limitations. To increase GIC's fluoride ion release, compressive strength, and antibacterial activity, hydroxyapatite nanoparticles have been added.[3]

Ormocers, bioactive materials, and nanocomposites were created in the search for a better restorative material. To achieve the best restoration result, the composite resins are altered over time. [4] Nano fillers are used to create nano composites. GIC that has been modified with resin to enhance its physical characteristics. Nano composites are superior to traditional glass fibre composite resin in many ways. Due to the nanometer size of the clay platelets versus the 10-15 diameter of the glass fibres, the surface finish of the nanocomposite is significantly better than that of the glass fibre composite. [5]

The current research was done to assess the microleakage and shear bond strength of conventional GIC, RMGIC and nanocomposite restorative materials.

2. Materials and Method

In the current research, 36 premolar extracted due to orthodontic purpose free from any pathologies were collected and cleaned and stored in distilled water until use. By making a flat cut perpendicular to the long axis of the tooth with a fine diamond disc at high speed and a lot of water spray, the mid-coronal dentin of the occlusal surfaces was exposed. Then, samples were evenly divided into 3 groups, each containing 12 samples, with Group A representing conventional GIC, Group B representing RMGIC, and Group C representing nanocomposite restorative materials.

Following standard class II cavity preparation, each sample was restored with respective restorative materials and subjected for Shear bond strength assessment using Universal Testing Machine. The microleakage was evaluated using streriomicroscope. The obtained data was statistically analysed using SPSS software version 23.0 using

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3. Result

Nano composite showed highest shear bond strength followed by RM GIC and least with conventional GIC (Table 1). Microleakage was found lower in conventional and nao composites compared to RM GIC (Table 2).

4. Discussion

In current study we found the maximum average value in Nano-composite, followed RMGIC and least with conventional GIC. The SBS test is the most popular way to measure bond strength because testing in the shear mode is more clinically applicable, relatively straightforward, repeatable, and widely accepted. 5

By assessing the percolation of a dye along the various interfaces under study, the dye penetration (Methylene blue) method, one of the most popular methods for evaluating the interfacial seal in vitro, was used to assess microleakage. In the current study, microleakage was assessed using a stereomicroscope.

Raju et al. assessed the shear bond strength and microleakage of glass ionomer cement (Fuji IX GP) and tricalcium silicate-based restorative material (Biodentine) in primary and permanent teeth. They came to the conclusion that in both primary and permanent teeth, glass ionomer cement (Fuji IX GP) had a higher shear bond strength than tricalcium silicate-based restorative material (Biodentine). [2] Alkhudhairy et al. compared the activa restorative to other bulk-fill restorative materials like surefil (SDR), Biodentine, and ever X posterior for shear bond strength and microleakage properties. They came to the conclusion that composites with flowability and fibre reinforcement had superior shear bond strength and microleakage characteristics. [6]

In premolar teeth treated with nano-composites using Cention N and Hydroxyapatite reinforced Glass ionomer cement as a base, Albadah and Khan evaluated microleakage in class one cavities. They came to the conclusion that Nanocomposite was the base material that showed the most microleakage, followed by Cention N. The least amount of microleakage was seen in GIC with hydroxyapatite as the base material. [3]

El Halim compared the shear bond strength of the nano-composite and adhesive versions of the activa bioactive restorative. They discovered that Bioactive Composite with Adhesive was followed by Nanocomposite in terms of shear bond strength, while Bioactive Composite without Adhesive displayed the lowest value.[7]

The impact of two self-adhesive composite resins on shear bond strength and microleakage was assessed by Panchal et al. They came to the conclusion that there were significant differences between the Prime fill flow and Dyad flow in terms of in vitro microleakage and shear bond strength.[8]

We found that, Nanocomposites had better properties. Further studies are needed to validate the results.

5. Conclusion

It can be stated that nanocomposite have good shear bond strength and lower microleakage.

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Table

Table 1: Average shear bond strength of various restorative materials

Groups	**Mean±SD**
Group A- Conventional GIC	2.342±0.324
Group B- RMGIC	3.316±1.764
Group C- Nanocomposite	6.486±2.543

Table 2: Average microleakage of various restorative materials

Groups	**Mean±SD**
Group A- Conventional GIC	1.43±1.11
Group B- RMGIC	0.75±0.67
Group C- Nanocomposite	0.52±0.94