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Original Research

In-vitro Assessment of Microleakage in Class-V Cavities: Comparing ORMOCER – Admira and Micro filled Composite

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ABSTRACT:

Aim: The primary goal of this study is to evaluate the adhesive bonding of restorative materials to cavity walls, minimizing microleakage—a crucial factor for the performance and durability of dental restorations. The objective is to compare microleakage levels among newer composite materials. **Material and Method:** An in-vitro study was conducted using 20 human extracted premolars, divided into two groups of 10: Group I utilized conventional microfilled composite resin, while Group II used ORMOCER – Admira for restoring Class-V cavities. Following restoration, the teeth underwent thermocycling and were subsequently immersed in a 1% methylene blue dye solution. The teeth were then sectioned buccolingually, and microleakage was evaluated under a stereomicroscope. Data analysis was performed using an unpaired t-test with a significance level set at $P < 0.001$. **Result:** The findings indicated that the ORMOCER – Admira exhibited the least microleakage compared to the conventional microfilled composite resin. **Conclusion:** The study demonstrates that ORMOCER – Admira provides superior adhesive bonding and significantly reduces microleakage in restored Class-V cavities, suggesting it may enhance the longevity of dental restorations in the oral cavity. Further research is warranted to explore the long-term performance of these materials in clinical settings.

Keywords: Microleakage, Restoration, Ormocer

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INTRODUCTION

The longevity and success of dental restorations are largely influenced by the adhesive bonding of restorative materials to tooth structures. Microleakage, defined as the seepage of fluids and bacteria at the interface of the cavity walls and the restorative material, poses a significant threat to the integrity of dental restorations. It can lead to secondary caries, pulpal inflammation, and ultimately, restoration failure.[1]

In recent years, the development of advanced composite materials has provided dentists with a range of options that claim to enhance bonding strength and reduce microleakage. Among these materials, ORMOCER (Organically Modified Ceramics) has gained attention for its unique properties, combining the benefits of ceramics and polymers. ORMOCER – Admira is one such material that has been introduced as a promising alternative to conventional microfilled composite resins.[2-4]

This study aims to evaluate the adhesive properties of ORMOCER – Admira compared to traditional microfilled materials, specifically assessing their performance in terms of microleakage when used in Class-V cavity restorations. Through an in-vitro methodology, this research will provide insights into the efficacy of these newer composite materials, potentially contributing to improved clinical practices in dentistry. By systematically measuring microleakage through standardized procedures, our findings will help clarify the benefits of adopting modern restorative materials and may influence future choices in restorative dentistry.

MATERIAL AND METHOD

In this study, a total of twenty healthy premolars were extracted for orthodontic purposes. These teeth were kept in normal saline prior to the preparation of cavities. Using #245 carbide burs (SS White Burs Inc., New Jersey, USA) and a high-speed handpiece with abundant water coolant, standard Class V cavities were meticulously created on the buccal surface of each of the thirty premolars. The cavities were specifically designed to have a mesiodistal width of 3 mm, an occlusogingival height of 2 mm, and a depth of 2 mm. To ensure precision, the dimensions of the cavities were measured using a Williams probe, and all the cavity preparations were consistently completed by the same operator.

The prepared teeth were categorized into two groups based on the type of restorative material used: Group I comprised conventional microfilled composite (Tetric Ceram) combined with Tetric N Bond, while Group II consisted of ORMOCER (Admira-Vocodent) paired with Admira Bond. Each group included 10 teeth. The teeth in each group were meticulously dried and restored with the specified materials using Teflon-coated tools, cured in stages, and polished and finished according to the manufacturer's guidelines. To protect the surfaces of the root and crown, except for a 1mm area around the restoration, two coats of nail varnish were applied. The samples underwent thermocycling, consisting of 500 cycles that involved alternating immersion in water at temperatures of 5°C and 55°C, with a dwell time of 30 seconds and transfer times of 30 seconds for each bath. Following this, the specimens were immersed in a 1% methylene blue dye solution, and the depth of dye penetration was assessed under a stereomicroscope using specific scoring criteria to evaluate microleakage.

Assessment of Microleakage

The level of dye penetration at the tooth restoration interface was assessed using the scoring criteria established by Jessudas et al. (2014)[5] The scores were as follows: Score 0 indicated no dye penetration; Score 1 signified that the dye penetrated to less than half the cavity depth; Score 2 represented full cavity depth penetration; and Score 3 indicated dye penetration extending to the axial wall and beyond.

Statistical Analysis

The collected data was organized in a Microsoft Excel spreadsheet; 2022 and analyzed statistically. As the data exhibited a normal distribution, an unpaired t-test, a parametric test, was employed for comparing the groups.

RESULT

The dye penetration test showed that in Group I, three out of ten specimens received a score of 0, four scored 1, two scored 2, and one scored 3. In Group II, six specimens had a score of 1, three also received a score of 1, and one recorded a score of 2. **(Table 1)** When comparing the groups, the average dye penetration was significantly lower in Group II (0.5±0.10) than in Group I (1.1±0.15), with a statistically significant difference observed ($p<0.05$). **(Table 2)**

Table 1: Scores For Microleakage Under Stereo Microscope

Specimen Number	Group I	Group II
1	0	0
2	0	0
3	0	0
4	2	0
5	3	0
6	2	0
7	1	1
8	1	2
9	1	1
10	1	1

Table 2: Intergroup Comparison of Mean Microleakage Score

Group	N	Mean ± SD	T value	P value
Group 1	10	1.1±0.15	- 10.53	0.05*
Group 2	10	0.5±0.10		

*Significant, SD Standard Deviation

DISCUSSION

The primary aim of restorative dentistry is to bring the tooth back to its original shape and function. A crucial factor in achieving this is to ensure a proper fit and seal around the cavity walls, which is essential for the restoration's durability.[6] There has long been a strong focus on how well dental restorative materials bond to these walls and their effectiveness in preventing the infiltration of oral fluids and bacteria. Microleakage around restorative materials is a significant concern in clinical practice, characterized by the undetectable flow of bacteria, fluids, or molecules between the cavity walls and the applied materials. This leakage can lead to several issues, including tooth sensitivity, discoloration, the return of decay, damage to the pulp, and faster degradation of some materials.[7] Microleakage around dental restorative materials poses a significant challenge in clinical dentistry. It is defined as the undetectable movement of bacteria,

fluids, molecules, or ions between the cavity walls and the restorative materials. This leakage can result in various issues, including tooth sensitivity, discoloration, recurrent decay, damage to the pulp, and faster wear of certain materials. Despite the availability of numerous new materials, such as GICs, composites, compomers, giomers, and the latest ceromers and ormocers, only a few truly bond well to the tooth surface. Changes in size and poor adaptation of restorations to cavity walls can cause marginal leakage, allowing fluids, molecules, and bacteria to infiltrate. Therefore, achieving a perfect seal between the restoration and the tooth interface remains a key objective in restorative dentistry to prevent the entry of microorganisms and other harmful substances.[8]

The present research seeks to assess how effectively ORMOCER can minimize microleakage.

ORMOCER, which stands for organically modified ceramic, is an innovative material suitable for a variety of filling applications in both the front and back teeth, offering a modern and superior alternative to amalgam, composites, and compomers.

In this study, we observed some level of microleakage with nearly all dental restorative materials. However, the ORMOCER groups exhibited the lowest levels of microleakage when compared to conventional composite groups. Previous research by Gladys S et al. (2001)[9] indicated that microleakage is a common issue with all dental restorative materials developed to date. Our findings confirmed that ORMOCER had the least microleakage. This aligns with the research by Yazici AR et al. (2003)[10], who examined the microleakage in class V cavities restored using three different types of flowable resin materials. They reported that ORMOCER outperformed both flowable composite and flowable compomer.

The suggested reason for this observation is that ORMOCERs possess an inorganic backbone composed of silicon dioxide, enhanced with polymerizable organic units to create a three-dimensional polymer compound. The reduced microleakage observed in the ORMOCER group may be attributed to its structure, which consists of a biocompatible polysiloxane network that exhibits low shrinkage even before light curing. The formation of the inorganic network begins with hydrolysis and continues through the polycondensation of Si(OR)3 groups. By starting with silane, polysiloxanes containing polymerizable groups are generated. ORMOCERs achieve complete polymerization due to their preformed structure and extremely high molecular weight, resulting in significantly less shrinkage compared to composites or compomers. This lower microleakage may be explained by their three-dimensional structure and low modulus of elasticity, both of which likely contribute to reduced polymerization shrinkage. Additionally, Hickel R et al. (1998)[11] and Jain P et al. (2001)[12] noted that decreased shrinkage leads to a lower need for adhesive bonding strength, which, over time, can result in a smaller marginal gap.

While this study provides valuable insights, certain limitations should be acknowledged. The in-vitro nature of the study may not fully replicate the complexities of the oral environment. Factors such as saliva, oral bacteria, and patient-specific anatomical variations can alter the performance of restorative materials in vivo. Future studies could involve long-term clinical trials to observe the performance of these materials over time and in diverse populations.

CONCLUSION

In conclusion, this study reinforces the notion that material selection plays a crucial role in the performance of dental restorations. ORMOCER – Admira, with its superior bonding capabilities, demonstrates reduced microleakage when compared to conventional microfilled composite resin in the context of Class-V restorations. As the dental field continues to evolve, identifying and utilizing such advanced materials can lead to improved patient care and outcomes in restorative dentistry.

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