

Evaluation of microleakage after restoration with different posterior tooth coloured restorative materials- An in vitro study

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Abstract

Aim: The objective of this study was to compare the micro leakage in Class I cavity preparations restored with different tooth colored materials.

Materials and Method: Standardized Class I cavity were made in 30 human premolar teeth. Specimens were randomly divided into four groups comprising of 10 samples each (n=10). Group I: Teeth were without any restorative material (Control). Group II: Restored with a nano ionomer, Group III: Restored with a silorane composite, Group IV: Restored with SDR. All specimens were immersed in 2% methylene blue dye. The specimens were sectioned and evaluated for microleakage under stereomicroscope.

Results: Group IV (SDR) showed lesser microleakage than P90 followed by Ketac N100.

Conclusion: It was concluded that SDR (Smart Dentin Replacement) had the lowest level of micro leakage amongst all the groups.

Keywords: Microleakage, Stereomicroscope, Dentin

Introduction

Microleakage is a phenomenon where oral micro-organisms, chemical substances and fluids are diffused through the interface between tooth structure and restorative material. Fluids may progress through dentin into pulp, causing recurrent caries, post-operative sensitivity, pulp inflammation and finally failure of restorations.⁽¹⁾ The search for restorative materials with the ability to promote sealing is leading to constant introduction of new products in the market. Two types of restorative materials have emerged, glass-ionomers and composites, where each have fulfilled most of the requirements of a successful restorative material.⁽²⁾

High-polymerization shrinkage generates stresses and continues to be the major disadvantage of composites leading to bond failure and microleakage.⁽³⁾ A new generation of light cured bulk flowable composite resin, smart dentin replacement (SDR) is introduced having reduced polymerization stresses.⁽⁴⁾ The scientific breakthrough of silorane chemistry with ring opening monomers has led up to the innovation of silorane based composite P90.⁽⁵⁾ A whole new category of esthetic glass ionomer is Ketac N100 which is a light curing Nano-Ionomer having higher wear resistance when tested against competitive resin modified GIC making them an ideal esthetic posterior GIC.⁽⁶⁾ The purpose of the study was to evaluate microleakage after restoration with Ketac N100, P90 and SDR in Class I tooth preparation.

Materials and Method

Forty premolar teeth were taken. Teeth were divided into four groups, three experimental groups and one control group with ten teeth in each group.

Standardized Class I cavity were then made in all four groups which was 1.5 mm deep and width was one-fourth of the intercuspal distance.

In group I (control group), class I cavity prepared was without any restorative material. In group II, teeth were restored with nano ionomer, In Group III, teeth were restored with P90 (Silorane) and in Group IV teeth were restored with Smart Dentin Replacement (SDR). All the teeth in experimental groups were restored according to the manufacturer's instructions. Teeth in all groups were stored in distilled water for 24 hrs.

Nail varnish was then coated on all the teeth in each experimental group not extending on to the restorative material and 1 mm away from the cavosurface margins. However, in the control group, no nail polish was applied. All the teeth were immersed in 2% methylene blue dye for 24 h and then sectioned longitudinally through the centre of the restoration using a sectioning disc. The sectioned restorations were examined under a stereomicroscope and scoring was done according to the given criteria.

Scoring Criteria

Dye penetration was recorded as follows:

- Score 0 (no leakage): No dye penetration at all
- Score 1 (mild leakage): Dye penetration upto 1/3rd of the cavity
- Score 2 (moderate leakage): Dye penetration upto 2/3rd of the cavity
- Score 3 (severe leakage): Dye penetration reaching pulpal floor

Results

Group I showed the highest leakage followed by Group II, Group III and lastly that of Group IV.

Intergroup comparison shows least microleakage with Group IV (SDR) when compared to all the groups tested ($p < 0.02$). (Table 1, 2, Graph 1)

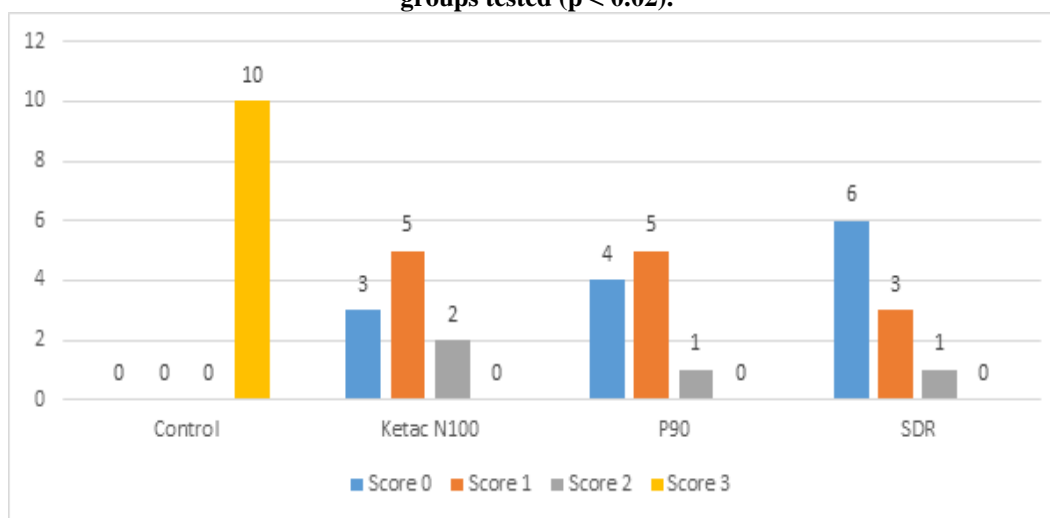
Table 1: Micro leakage scores of all the groups

Material	Leakage Scores			
	No Leakage (Score 0)	Mild Leakage (Score 1)	Moderate Leakage (Score 2)	Severe Leakage (Score 3)
Group I (control group)	0	0	0	10
Group II	3	5	2	0
Group III	4	5	1	0
Group IV	6	3	1	0

Table 2: Mean and standard deviation

	Ketac N100	P90	SDR
Mean	2.10	1.20	.70
n	10	10	10
Std. Deviation	.568	.632	.823
Median	2.00	1.00	.50

Graph 1: Intergroup comparison shows least micro leakage with Group IV (SDR) as compared to all the groups tested ($p < 0.02$).



Discussion

Microleakage is the clinically undetectable passage of bacteria, fluids, molecules, or ions between a restorative material and the cavity wall. Micro-leakage at the tooth-restoration interface is considered a major factor affecting the longevity of dental restoration.⁽⁷⁾ It may hasten breakdown of restoration margins, cause staining, hypersensitivity, recurrent caries and pulpal pathology. Composites and GIC are tooth coloured restorative materials that fulfill the requirements of a successful restorative material. However, polymerization shrinkage in composites has posed a challenge in achieving lasting marginal integrity whereas poor esthetics and low wear resistance of GIC have led to search for a better GIC product.⁽⁸⁾

Some of the recently introduced composite are SDR & P90. A urethane based dimethacrylate modulator included in SDR helps the monomers to form a more relaxed network causing reduced polymerization stresses. P90 composite incorporates “ring opening” monomers which connects by opening, flattening and extending towards each other during polymerization, resulting in less shrinkage as compared to methacrylate based composites.⁽⁹⁾ A whole new category of esthetic GIC is Ketac N100, a resin modified glass ionomer developed with nanotechnology called as “nano-ionomer”. It offers unique characteristics of wear & polish.⁽⁶⁾ Till now no study has been done to compare microleakage with these newer composites and GIC. Hence, this study was formulated to evaluate and compare microleakage after

restoration with Ketac N100, P90 and SDR. Least microleakage was seen with Group IV (SDR) as compared to groups I, II & III.

This may be attributed to the fact that SDR has the lowest level of shrinkage stress, longest pre-gel time and low shrinkage rate (Llie et al.) The chemistry of SDR is designed to slow the polymerization rate, that reduces the polymerization shrinkage stress (*Burgess et al*). In light of the present study, it is tempting to speculate that SDR can be the esthetic restorative material of choice with reduced microleakage and a simplified bulk fill technique.

Conclusion

In this study, different tooth coloured materials were used to study and evaluate microleakage in Class I restorations. Within the limitations of this study, it was concluded that SDR had the lowest level of microleakage amongst all the groups.

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