

STUDY OF MARGINAL LEAKAGE OF THREE CERVICAL RESTORATIVE MATERIALS WITH AND WITHOUT APPLICATION OF BONDING AGENT DYE PANETRATION METHOD – AN IN VITRO STUDY

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INTRODUCTION

Marginal leakage is a major weakness inherent in filling materials used in clinical dentistry. Most restorative materials show varying degrees of marginal leakage because of dimensional changes and lack of adaptability to the cavity walls. Class V cervical restoration is quite demanding on restorative materials because of the presence of two different types of tissues.

So far, no restorative material is available which truly adheres to the tooth structure and completely eliminates microleakage.

Current research has been directed toward combining the advantageous characteristics of bonded resin composite and conventional glass ionomer cement. Recently, resin modified glass ionomer materials and polyacid modified resin composite materials have been introduced.

The purpose of this study was to evaluate the marginal leakage of three cervical restorative systems and also to evaluate the effect of dentin bonding agent on microleakage when it is applied on the completed restorations.

MATERIALS AND METHOD

Thirty extracted non-carious human maxillary molars were used in the present study. Standardized Class V cavities were prepared on the buccal and palatal surfaces of each tooth, such that the occlusal margins were in enamel, and the cervical margins were in dentin and cementum. All the preparations were cleaned with water-pumice slurry, washed and air-dried.

The preparations were then randomly divided into three groups. Each group consisted of 10 teeth (i.e. 20 cavities).

Group I : Was restored with polyacid modified resin composite cement (Dyract)

Group II : Was restored with resin modified glass ionomer cement (Fuji II LC)

Group III : Was restored with hybrid resin composite (Spectrum)

In each group, ten cavities (i.e. cavities on the palatal surfaces) were conditioned, primed and restored. While the other ten cavities (i.e. cavities on the buccal surfaces) were

conditioned, primed and restored, and after finishing the restorations of these cavities, they were coated with bonding agent.

From each group, five teeth were stored in saline solution at 37°C for one day while the other five teeth were stored for seven days. These subgroups were designated as Subgroup A and Subgroup B and each consisted of 15 teeth.

All the specimens were thermally stressed, then coated with nail varnish and were immersed in 0.5% aqueous basic Fuschian dye for 24 hours. The teeth were then sectioned longitudinally through the restorations in a bucco-palatal plane and observed under the LEICA Wild M3Z stereomicroscope for marginal leakage and dye penetration.

The following scoring criteria were used for the depth of dye penetration along the margins of the restorations (Fig. 1)

Score 0: No evidence of dye penetration

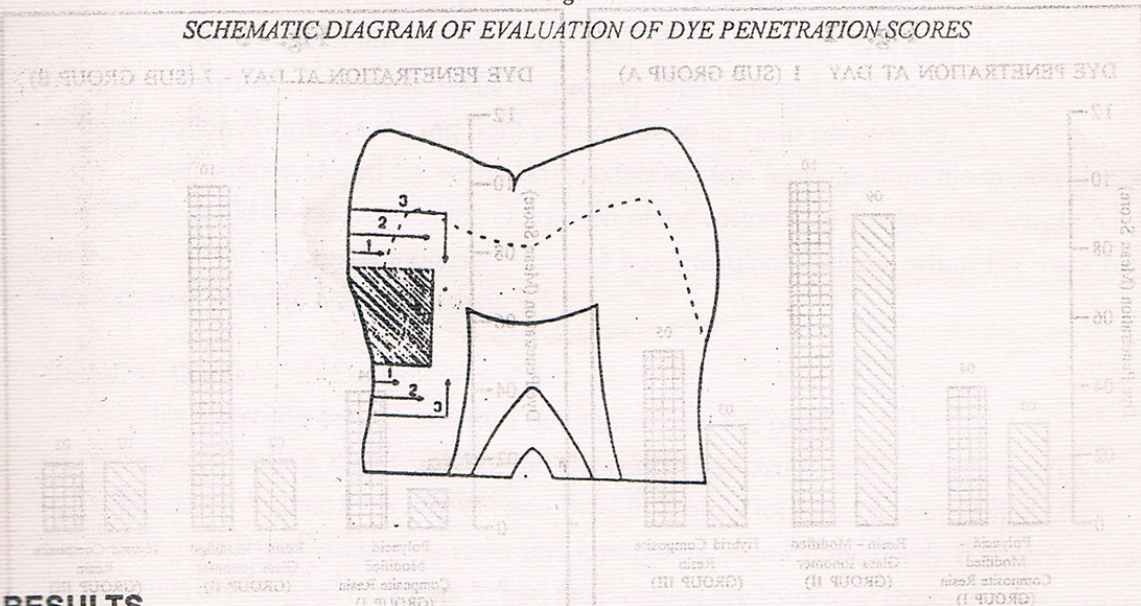
Score 1: Dye penetration to less than half the cavity depth

Score 2: Dye penetration to full cavity depth

Score 3: Dye penetration to axial wall and beyond

Fig. - 1

SCHMATIC DIAGRAM OF EVALUATION OF DYE PENETRATION SCORES



RESULTS

The results of the present study showed that no restorative material completely resisted microleakage at the occlusal or cervical margins. Resin-modified glass ionomer showed significantly more leakage than composite resin and compomer. The bond achieved with the acid-etch technique and resin composite was found to result in less leakage at enamel margin than compomer. However, no significant difference in this marginal sealing ability in dentin was found between composite resin and compomer.

TABLE - 1
SAMPLES STORED FOR ONE DAY (SUBGROUP A)

SCORE	GROUP I		GROUP II		GROUP III	
	BUCCAL PALATAL		BUCCAL PALATAL		BUCCAL PALATAL	
	O C	O C	O C	O C	O C	O C
0	4	3 3	2	0 3	0	5 3 4 2
1	1	2 2 1	3	4 1 4	0	1 1 3
2	0	0 0 1	0	1 1 1	0	1 0 0
3	0	0 0 0	0	0 0 0	0	0 0 0 0

O - OCCLUSAL
 C - CERVICAL

TABLE - 2
SAMPLES STORED FOR 7 DAY (SUBGROUP B)

SCORE	GROUP I		GROUP II		GROUP III	
	BUCCAL PALATAL		BUCCAL PALATAL		BUCCAL PALATAL	
	O C	O C	O C	O C	O C	O C
0	5	4 5 2	5	3 3 1	5	3 5 3
1	0	1 0 2	0	2 1 2	0	2 0 2
2	0	0 0 1	0	0 1 1	0	0 0 0 0
3	0	0 0 0	0	0 0 1	0	0 0 0 0

O - OCCLUSAL
 C - CERVICAL

Restorations coated with a bonding agent showed less leakage compared to those restorations which were not coated with the bonding agent. Restorations, which were stored for seven days, exhibited less leakage than those stored for one day. However, the difference was significant for only resin-modified glass ionomer, while it was not significant for the other two materials.

Fig. - 2

DYE PENETRATION AT DAY - 1 (SUB GROUP A)

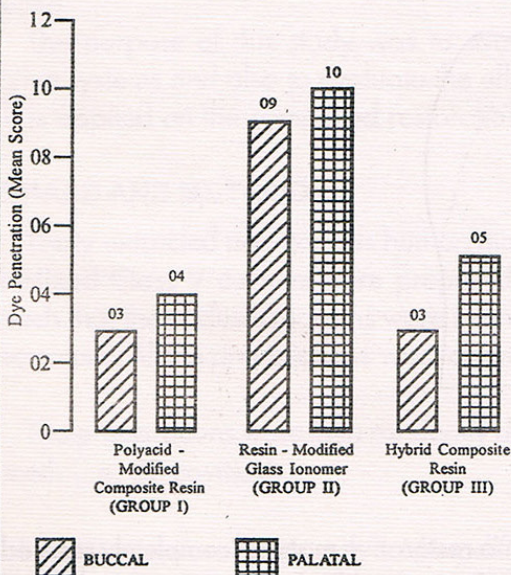
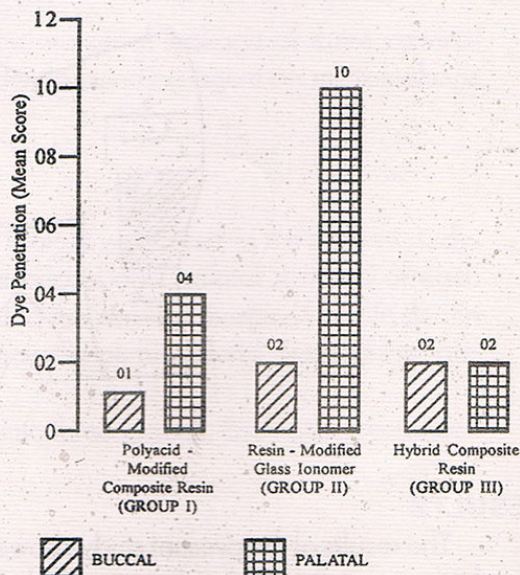


Fig. - 3

DYE PENETRATION AT DAY - 7 (SUB GROUP B)



DISCUSSION

In the present study Dyract and Spectrum exhibited no significant difference in the marginal leakage. While Fuji II LC showed significantly more leakage. The results of this

study are in accordance with those by Adrian et. al (1995).²

The minimal leakage observed with Dyract (Group I) could be due to the availability of the material in a single paste system with proper consistency which results in a very dense restoration with no detectable voids. The working characteristics of the material are excellent since it is putty like in consistency and non-sticky. The application of prime & bond 2.1 improved the bonding efficacy of the material to the cavity walls. The restoration exhibits good dimensional stability.

However, the leakage that has been observed with this material could be because of relatively high coefficient of thermal expansion.

Superior marginal sealing observed with Spectrum (Group III) also could be due to the reasons mentioned above. However, the minimal leakage observed could be due to the polymerization shrinkage and the high coefficient of thermal expansion that can exert significant force at the restorative material/tooth interface, resulting in bond failure and gap formation.^{3,4,12}

More leakage observed with Fuji II LC (Group II) could be attributed to the inconsistency in physical properties of the material due to hand proportioning and mixing of the powder and liquid. Voids within the material may occur during mixing. Working characteristics are poor because the material is sticky in nature. This material undergoes different rates of polymerization shrinkage during light curing due to its resin component.¹

Restorations stored for seven days exhibited less leakage than those stored for one day, which could be because of the expansion of the restoration due to water sorption by the resin.^{6,7,9,10} All the three materials showed less marginal leakage when two restorations were coated with the bonding agent.^{5,8,11}

CONCLUSION

The following conclusions can be drawn from the present study;

- Marginal sealing ability of composite resin (Spectrum) and compomer (Dyract) is significantly higher than that of resin-modified glass ionomer cement (Fuji II LC).
- Sealing ability of composite resin and compomer is not significantly different when the margins are located in dentin. When the margins are located in enamel, composite resin provides a better seal.
- Marginal leakage is reduced when the finished restorations are coated with bonding agent.
- Moisture contact reduces the marginal leakage; however, the difference is not statistically significant for composite resins and compomer. While resin-modified glass ionomer shows a significant reduction in leakage upon prolonged moisture contact.

Thus it can be concluded that compomers are promising for the restorations of cervical lesions when the margins are located in enamel, dentin or cementum.

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