

# COMPARISON OF MICROLEAKAGE IN RESIN MODIFIED GLASS IONOMER CEMENTS AND POLY ACIDS MODIFIED COMPOSITES (COMPOMERS)

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## ABSTRACT

*Microleakage of oral fluids and microbial components is a dynamic factor occurring at the tooth-restoration interface. Different restorative materials show different values of microleakage depending upon their composition, setting reaction and nature of physical and/or chemical bonds with the dental tissues. The aim of this study was to compare the microleakage of Resin modified Glass Ionomer (Fuji II.LC) and Polyacid modified Composite Resins (Dyract).*

*It was a comparative cross sectional study which was carried out in the Department of Dentistry, Pakistan Institute of Medical Sciences (PIMS) Islamabad. Fifty healthy, unrestored extracted premolar teeth allocated randomly in to two groups.*

*Class V cavities were prepared at the cemento-enamel junction in all fifty teeth, and restored with Fuji II.LC (GC America) and Dyract (Dentsply), 25 teeth in each group. All the teeth were placed in 2% basic fuchsin dye for 24 hrs at 37 C. Teeth were then embedded in cold cure acrylic resin, resectioned longitudinally in – ISOMETA, and the dye penetration at the enamel and cementum margin were scored at 10 X magnification stereo microscope and distinct leakage patterns were recorded. Data was analyzed using SPSS version 10.0.*

*The resin-modified glass ionomers showed less microleakage than the polyacid modified composite resin especially at gingival margins.*

**Key words:** *Microleakage, Restorative Materials, Resin Modified Glass Ionomers, Polyacid Modified Composite Resins.*

## INTRODUCTION

Marginal Micro-leakage is a dynamic phenomenon, which allows an exchange of fluid and bacteria along the tooth restoration interface.<sup>1</sup> Microleakage includes capillary attraction, marginal fraction, interfacial pressure changes and the alternating contrac-

tion and expansion of the restorative material when subjected to thermocycling. Microleakage of oral fluid has been associated with post-operative sensitivity, pulpal irritation, pulp necrosis, and secondary caries<sup>2</sup>.

Several factors accounts for the occurrence of microleakage at the tooth/restoration interface. Poly-

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merization shrinkage of resin composites induce stresses at the tooth/restoration interface which disrupt the restoration/tooth bond, resulting in the formation of gaps at these interfaces. Hygroscopic expansion counteracts some of the shrinkage, but it does not eliminate gap-formation.<sup>3</sup>

Temperature changes and biting forces also contribute to the stresses induce at the tooth/restoration interface, however little attention has been given in laboratory studies to the effect of thermal and mechanical stresses on microleakage.<sup>4</sup>

Photoelastic studies found that the stresses at the apex of the notches are reduced following the restoration of the lesion but that new concentrations of force then develop in the area of the occlusal and gingival margins of the restoration.<sup>5</sup> These stresses have an effect on the interface between the tooth and a restoration placed in a cervical lesion. The constant exertion of compressive and tensile stresses on the tooth restoration interface may lead to an increase in the amount of microleakage because of a deterioration of marginal integrity or the actual dislodgment of the restorative material.<sup>6</sup>

Dental amalgam has long been the restorative material of choice due to its ability to adequately fill cavities with self-sealing margins over time, when properly used, but Public concern for esthetic dentistry and the potential of mercury leakage from amalgam has chronologically popularized tooth colored restoration since introduction.<sup>6</sup>

The development of glass-ionomer cements and other adhesive restorative materials have been advocated for the restoration of class V cervical abrasion lesions. These materials are capable of forming strong bonds to enamel and dentine, release fluoride over prolonged periods, have good bio-compatibility, and have a co-efficient of thermal expansion close to that of tooth structure.<sup>7</sup>

But they have higher solubility in the oral cavity, relatively unaesthetic and have poorer physical properties. In addition, the prolonged setting time makes finishing relatively difficult in the first 24 hours.<sup>7</sup>

To overcome these problems of moisture sensitivity and low early mechanical strength associated with

the conventional glass-ionomer cements and at the same time to maintain their clinical advantages, some hybrid versions of glass-ionomer cements were introduced using resin components.<sup>8</sup> But still they have certain limitations.

A number of studies are available on comparison of marginal microleakage of different restorative materials.<sup>9</sup>

The purpose of our study was to compare this property between Resin Modified Glass Ionomer Cements and Poly Acids Modified Composites (Compomers) in normal conditions.

### MATERIALS & METHODS

The objective of this study was to compare the marginal microleakage of resin modified glass ionomer and compomers. This study was conducted in the Department of Dentistry, Pakistan Institute of Medical Sciences, Islamabad.

Sample size was 50 extracted human premolar teeth randomly allocated in Group-I, II.

**Inclusion Criteria:** Healthy, un-restored human premolar teeth.

**Exclusion Criteria:** Carious teeth, Fractured teeth, Previously restored teeth.

	Material	Manufacturer
1	Fuji II LC	GC America
2	Dyract AP	Dentsply/Caulk

All the teeth were scaled and cleaned with slurry of pumice flour and stored in distilled water. Facial class V cavities 2mm in height, (occlusogingival) 4mm in length (mesiodistal direction) and 2mm in depth were prepared with a No.330 tungsten carbide bur in an air turbine at the cemento-enamel junction (CEJ). Occlusal margins were cut in enamel and the cervical margins in cementum.

Group-I Included 25 teeth filled with “Fuji II LC glass ionomer”. Group-II Included 25 teeth filled with “Dyract” compomer.

After 24 hours the teeth were finished to contour, flush with the cavosurface margins, with a No.7901

carbide finishing burr with air and water spray in a high speed handpiece and medium, fine and super fine Sof-Lex disks, which was first lubricated with water and used in sequence with air – water spray in a low speed handpiece.

All the surfaces, except the restoration and 1mm from the margins, were coated with 2 layers of nail varnish. Teeth were embedded upto 2mm apical to the cervical wall of the restorations in acrylic resin in an aluminum cylindrical mold. All specimens were stored in 37°C water for 7 days. Then all the specimen were alternatively thermocycled between 4°C and 55°C water bath for 100 cycles, the dwelling time in each bath was 1 minute with 10 seconds transit time between baths.

All the teeth were immersed in a solution of 2% basic fuchsin dye for 24 hours at room temperature.

After removal of specimen from the dye solution, the superficial dye was removed with pumice slurry and rubber cup. Teeth were sectioned longitudinally in 6mm thickness with a low speed diamond saw using a glycerine water irrigation. The cut surfaces corresponding to the most mesial, central and the most distal portion of the tooth restoration interface were examined at the occlusal and gingival margin with a light-microscope at x10 magnification. Three teeth cracked and were excluded. The presence of dye penetration at the interface of the restorative material and the tooth was considered as an indicator of marginal microleakage. Degree of microleakage at the occlusal and cervical margins were represented according to the following criteria: <sup>9</sup>

- Degree-0: No penetration of dye.
- Degree-1: Penetration of dye alone half the distance of axial wall.
- Degree-2: Penetration of dye beyond half the distance to the axial wall but not along the pulpal wall.
- Degree-3: Penetration of dye along the pulpal axial wall.

**DATA ANALYSIS**

SPSS version 10 was used for computation analysis of the data.

Means and SD for Microleakage in both groups was calculated.

**RESULTS**

The materials were compared to each other for incisal and gingival margin. For the gingival margin, the mean microleakage score was greater for dyract than Fuji II LC. However, at the incisal margin, there was no significant statistical difference between two materials.

No restorative material evaluated in our study completely resisted microleakage at the incisal or gingival walls of the tooth. From the two products evaluated Fuji II. LC glass ionomer cement revealed a statistically significant difference in microleakage with dyract resin composite at gingival margins.

TABLE 1: MICROLEAKAGE FREQUENCY SCORE

Material	Incisal				Gingival			
	0	1	2	3	0	1	2	3
Fuji II LC n=23	12	6	4	1	10	7	4	2
Dyract n=24	14	5	3	–	7	10	4	3

TABLE 2: MEAN MICROLEAKAGE

Material	Incisal			Gingival		
	Mean	Std. Dev.	Std. error	Mean	Std. Dev.	Std. Error
Fuji II	0.33	0.21	0.81	0.46	0.19	0.74 (p<0.05)
Dyract	0.33	0.15	0.61	0.73	0.24	0.96 (p>0.05)

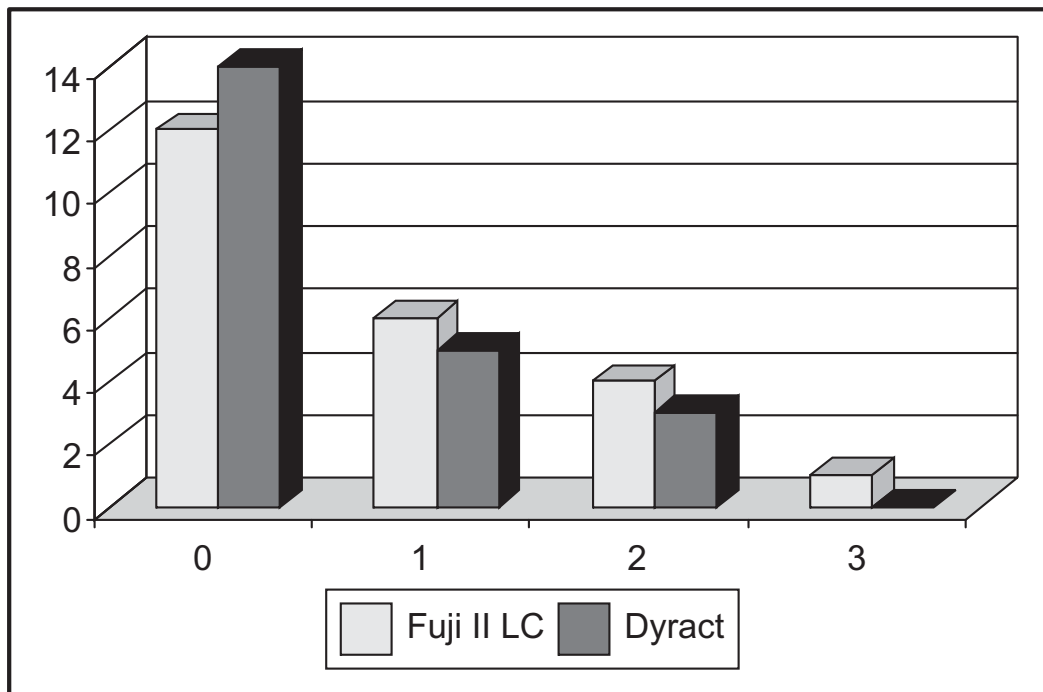


Fig 1: Graph comparing the Microleakage Frequency of two materials tested for the Incisal Margin

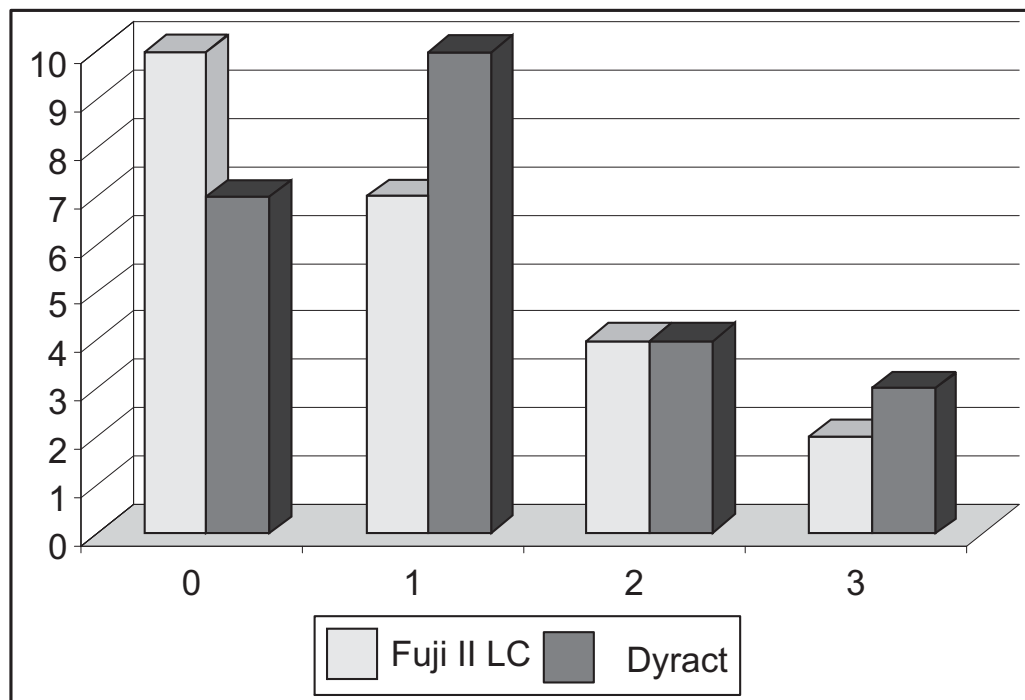


Fig 2: Graph comparing the Microleakage Frequency of two materials tested for the Gingival Margin

**DISCUSSION**

A large variety of methods have been described to compare the sealing efficiency of restorative systems. Dye penetration test are usually used because they are generally simple and fast methods.<sup>10</sup>

These studies show that restorative materials may not bond to enamel or dentine with sufficient strength to resist the forces of contraction on polymerization, wear, mechanical loading or thermal cycling. When debonding occurs, bacteria, food debris or saliva may be drawn into the gap between the restoration and the

tooth by capillary action. This effect has been termed microleakage.<sup>10</sup>

Polymerization shrinkage of resin – containing restorative material may result in marginal discrepancies that lead to microleakage, marginal discoloration and sensitivity. Hygroscopic expansion can compensate, to some degree for polymerization in shrinkage. Water sorption can help to reduce marginal gaps<sup>11</sup>.

Attin et al<sup>12</sup> reported that Fuji II LC glass ionomer cement expanded after curing and immersion in water, whereas Dyract resin composite and Vitremer glass ionomer cement revealed a total volumetric loss. Thus, they concluded that water expansion is 1 factor that reduces the leakage. Our present study showed differences in microleakage at gingival margins, which differ from those of Yap et al.<sup>13</sup>

Thermocycling may also contribute to the dislodgement of the restoration from the cavity walls. Thermocycling causes contraction and expansion of the tooth and the restoration and because they have different co-efficient of thermal expansion, the adhesion between them may be broken.<sup>4</sup>

The increase in leakage of Dyract AP resin composite also could be attributed to thermal expansion mismatched with tooth substance, which is reported to be significantly higher than that of conventional cement and also less than that of composites. Mitra and Conway<sup>14</sup> reported that Fuji II LC had co-efficient of thermal expansion of 31.5 PPM/°C. Dyract has a composite closely related to the microfilled composites and has a co-efficient of thermal expansion of 40.52 PPM/°C. This may explain why Dyract resin composite is more susceptible to thermal stresses than the other materials. Also, because the resin component of the material adheres poorly to the cervical dentine than to enamel. This justifies in part, that Dyract resin composite revealed more leakage at the gingival margin than at the incisal margin.<sup>14</sup>

No restorative material evaluated in present study completely resisted microleakage at the occlusal or gingival walls of the tooth. Of the two products evaluated, Fuji II LC glass ionomer cements revealed a statistically significant difference in microleakage with Dyract resin composite at gingival margin. This leakage was likely the result of gaps created from the

shrinkage of the resin during polymerization, with the amount of shrinkage directly related to the amount of the resins present in the material and adhesion of the material to the tooth<sup>15</sup>. The amount of resin in the final set restoration is between 4.5% to 6% for Fuji II LC glass ionomer cements. Dyract polyacid modified resin composite have a resin content of approximately 28%.

Because the resin component is responsible for the polymerization shrinkage, and Dyract resin has more resin than Fuji II LC glass ionomer in its composition, it is possible that this is the reason for the greater microleakage at the gingival margin with Dyract resin compomer. Another possibility for the compomer exhibiting more gingival leakage was the fact that the dentine was primed but not etched with phosphoric acid following the manufacturer's instructions. In a study, comparing etched and non-etched human molar dentin in trapezoidal class V restorations, the etched Dyract AP specimens demonstrated significantly less microleakage compared to the non-etched Dyract AP<sup>16</sup>.

Differences observed between two materials might be due to differences in maturation of setting reactions. Other studies have pointed out that significant dimensional changes and surface hardening can occur after initial light curing of the resin component of resin-modified glass ionomer and further contraction continue for the first 24 hours as the material matures.<sup>17,18</sup>

Although the results obtained from this study may not be directly extrapolated to the clinical situation, they provide some information regarding the performance of the restorative system. In vitro microleakage testing of dental materials is a commonly accepted evaluation technique of margin integrity. The practice of thermocycling specimens in hot/cold baths and lateral cyclic loading by a machine simulates thermal and fatigue stresses in the oral environment. The present study adhered to procedures followed in previous in vitro microleakage studies. Laboratory studies attempt to reproduce clinical situation but not entirely reflect variables encountered with in-vivo performance.

## CONCLUSION

Present study concluded that:

None of the restorative materials tested completely sealed the tooth/restoration interface at cervical/gingival margins.

The resin-modified glass ionomers showed less microleakage than the polyacid modified composite resin tested especially at gingival margin under the effect of thermocycling.

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