ORIGINAL RESEARCH

Adaptation of Different Compomers to Primary Teeth Cavities

Sumanth M Shetty, Rashmi G Shetty

ABSTRACT

Background: Compomers remain the material of choice for restoration of primary teeth as they combine the best of GIC and composites. However, as it is a resinous material, attention is focused on polymerization shrinkage causing gaps at restoration cavity interface. Gaps represent decreased efficacy of adaptation.

Aim: To evaluate the marginal adaptation of compomers (Dyract, Compoglass, and F-2000) in class I and V cavities in primary molars.

Materials and methods: Sixty noncarious primary molars were divided for three compomers (20), which were subdivided to two groups. Standard class I and V cavities (10 each) were prepared and restored. The cavity interface was examined and observations analyzed. The cavities were etched prior to restoration and margins were exposed. The cavosurface margins were inspected under stereomicroscope for surface gaps. Then buccolingually sectioned, they were examined for marginal gaps. Two specimens each were selected for SEM. Chi-square test was used to determine statistical significance ($p < 0.05$).

Results: All compomers showed good adaptation at cavosurface, with class I better than V. Compoglass and Dyract were better adapted to cavity walls than F-2000. SEM revealed close interlaced adaptation of filling material to etched cavity.

Conclusion: This study has shown that compomers provide good adaptation at cavity margins with compules (Compoglass and Dyract) being a better mode of dispensing than syringe tubes (F-2000). SEM showed gaps and pooling of adhesive and air in few samples.

Keywords: Compomer, Dyract, Adaptation, Class I, Class V, Primary teeth, Compoglass, F-2000.

How to cite this article: Shetty SM, Shetty RG. Adaptation of Different Compomers to Primary Teeth Cavities. J Orofac Res 2012;2(1):27-32.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

Over the past 50 years, many changes have occurred in the development and availability of restorative materials for children. The practitioner was limited to amalgam, crowns, silicate cement, acrylic or other esthetically less than desirable restorations. Today, many choices are available to the pediatric dental practitioner.[1]

Glass ionomer (GI) restorative materials were introduced in the late 1970s, as adhesive restorations for nonretentive cervical cavities. These materials were superseded by resin modified glass ionomer cements, which are light curable and offer improved cosmetic qualities.[2] More recently, a hybridization of composite and glass ionomer cement classified as polyacid modified composite resins (compomer) are available. They have better physical properties and bonding abilities of glass ionomers, with the high esthetics of composite resin. These materials are indicated for restoring primary teeth cavities, release fluoride and adhere to tooth structure.[3-5]

As compomers are resinous, attention should be focused on polymerization shrinkage.[6] If great, then failure of the bond occurs, resulting in gap formation between the tooth and restoration. The extent of gap represents the efficacy of attachment of restorative material to the tooth.[7] The gap predisposes a tooth to discoloration, recurrent decay and postoperative sensitivity with pulpal inflammation.[8-11]

The objective of this study was to evaluate the marginal adaptation of Dyract, Compoglass and F-2000 in class I and class V restorations at cavosurface margins and within margins.

MATERIALS AND METHODS

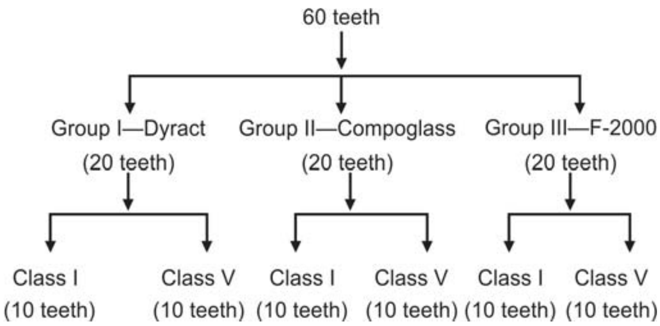
This *in vitro* study was carried out in the Department of Pedodontics and Preventive Dentistry, in association with Department of Metallurgy, Indian Institute of Sciences, Bengaluru. Ethical clearance was obtained from Ethical Committee of Institute.

Sixty noncarious human primary molars, extracted at the time of exfoliation or for orthodontic treatment were stored in distilled water.[12-14] These were randomly divided into three groups of 20 teeth each—Group I: Dyract; Group II: Compoglass and Group III: F-2000.

These were further divided into two subgroups of 10 teeth each. Standardized class I cavity of 4 mm in length, 2 mm width and 1.5 mm depth was prepared in the first subgroup[15,16] and standardized class V cavity of 4 mm length, 2 mm width and 1 mm depth in the second subgroup (Graph 1).[17]

Group I (Dyract)

The teeth were etched with 37% phosphoric acid for 15 seconds, washed and dried with cotton pellets. Prime and Bond 2.1 adhesive was applied and left undisturbed for 30



Graph 1: Grouping of samples for the study

seconds, excess solvent removed with oil-free air and light cured for 20 seconds.

Group II (Compoglass)

In this subgroup, the cavity was etched, rinsed and dried similarly to Dyract group. Excite adhesive was applied in a manner similar to that of Prime and Bond adhesive for Dyract.

Group III (F-2000)

Etching was done similarly as in the Dyract group. The cavity was rinsed, air dried and Scotchbond was applied following the same procedural steps as with excite for Compoglass.

After adhesive application, all cavities were filled with respective compomers as per manufacturer's instructions.

They were filled with compules of Compoglass and Dyract and from the tube in case of F-2000, in one increment for the shallow class V cavities and in two increments for Class I. The material was packed with slight overfilling and light cured for 40 seconds. The cavities were finished with finishing diamond stones and true cavity margins were exposed. Polishing was done using Politip-P polishers.

The samples were stored in distilled water for 24 hours at room temperature. All specimens were subjected to stereomicroscope examination of cavosurface margins and surfaces with gaps were recorded. The specimens were then sectioned buccolingually with a diamond disk and smoothened with #300 grit silicon carbide paper. The inner cavity restoration interface (2 walls, 1 floor and 2 angles) was stereomicroscopically examined and margins showing gaps were recorded.

Observations were later statistically analyzed. Two specimens from each subgroup were randomly selected for SEM observation for presence of gaps at inner margins of the cavity. Chi-square test was used to determine statistical significance ($p < 0.05$).

RESULTS

Tables 1 and 2 show adaptation of the three different compomers on the cavosurface margins, floor, two walls and two angles of class I and V restoration. Statistically, Chi-square test was used to determine significant differences in the cavosurface margins and inner cavity restoration interface in various groups. Statistical significance was predetermined at a probability value of 0.05 or less.

For class V cavities, out of the 10 samples showing gaps at cavosurface in class V fillings, eight were on enamel and two on cementum. Statistical analysis of gaps recorded on the floor of class V cavities of the three different compomers showed that Dyract had significantly better adaptation than F-2000 in the nonetched group (Fig. 1). The others showed no significant correlation (Fig. 2).

Of all of the three compomers in class I as well as class V showed more number of gaps at angles. However, the results were not statistically significant. On analysis of marginal

Table 1: Descriptive results for marginal adaptation—teeth showing gaps

Area of observation	*Group I Dyract (n = 20)*		*Group II Compoglass (n = 20)*		*Group III F-2000 (n = 20)*	
	Class I (n = 10)	*Class V (n = 10)*	*Class I (n = 10)*	*Class V (n = 10)*	*Class I (n = 10)*	*Class V (n = 10)*
Cavosurface	2	4	0	2	2	4
Floor	3	1	5	4	5	5
Angles	4	8	9	5	6	6
Walls	2	1	4	1	7	8

Table 2: Statistical comparison between the different groups using Chi-square test

Area of observation	*Dyract/Compoglass*		*Dyract/F-2000*		*Compoglass/F-2000*	
	Class I	*Class V*	*Class I*	*Class V*	*Class I*	*Class V*
Cavosurface	NS	NS	NS	NS	NS	NS
Floor	NS	NS	NS	S (p = 0.04)	NS	NS
Angles	NS	NS	NS	NS	NS	NS
Walls	NS	NS	NS	S (p = 0.02)	NS	S (p = 0.04)

S: Significant; NS: Not significant

adaptation to walls of the cavity, significant difference was observed statistically between Dyract and F-2000 ($p = 0.02$) and between Compoglass and F-2000 ($p = 0.02$) in the etched group. Compoglass and Dyract were better adapted than F-2000 on the walls of class V cavity in the etched group (Fig. 3).

SEM examination confirmed the stereomicroscopic findings. Compoglass and Dyract showed close adaptation of filling material to the etched cavity while gaps were seen in F-2000. Pooling of adhesives at the angle and incorporation of air bubbles were seen in some specimens.

DISCUSSION

Compomers are greatly popular particularly in pediatric dentistry for children because of their composite like esthetics, ease of placement, light cure and good handling characteristics. As a single component material, compomers are available in a variety of delivery forms including syringe (screw) tubes, compules and most recently in Aplicaps. It is likely that the success of compomers will continue for the foreseeable future, mainly because of their ease of use.[1] Manufacturers of compomers claim that they are indicated in class III and V cavities, small class I and II cavities of permanent teeth and all cavity classes in deciduous teeth.

A major goal in restorative dentistry is the control of marginal leakage seen because of dimensional changes or lack of adaptation to cavity during placement. These may lead to postoperative sensitivity, staining or recurrent caries.[18-20] As no dental material is exempt from microgaps, adaptation information is critical for comparative assessment of different materials.

The marginal integrity of polymeric restorative materials depends on several factors including polymerization shrinkage, adhesion to tooth structure, water sorption, co-efficient of thermal expansion, mechanical loading and marginal degradation.[21] So, the study was carried out to evaluate the marginal adaptation of Dyract, Compoglass and F-2000 compomers. Class I and V cavities were evaluated as their standardization can be done easily. The samples were stored in distilled water, since it does not affect the dentin permeability as compared to saline.[22,23]

The samples were evaluated for marginal adaptation under stereomicroscope as it has three-dimensional effect, great depth of focus, long working distance and simplicity of operation.[24] Scanning electron microscope was also observed for a more accurate picture and direct visual observation of adaptability that provides more valid data directly related to microleakage.[25]

Micromechanical retention for the restoration is said to be provided through porosities created by etching.[26] So, in this study 37% phosphoric acid gel was used due to its superior clinical handling qualities.[27]

All the materials considered in our study showed gaps (Fig. 4). But F-2000 had shown statistically significant gaps than Compoglass and Dyract. This may be due to the form in which the material is dispensed, i.e in screw tubes unlike the compules with gun of Dyract and Compoglass. Screw tubes do not allow the material to be dispensed under pressure.

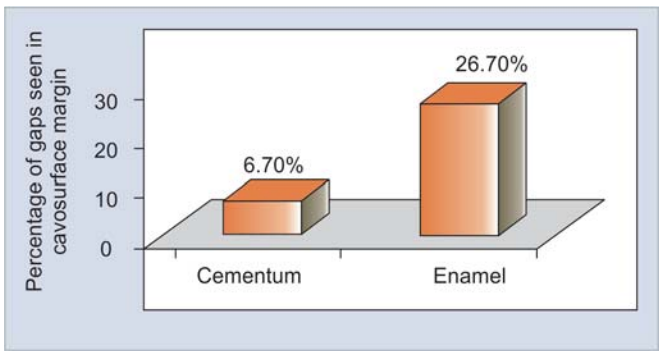
Also adaptation of class I was better than class V in cavosurface margin (Fig. 5). This is in agreement with El-Kalla[22] (1999). This could have been due to (1) difference in outline form—Class I that follows the fissures in multidirections, resisting polymerization contraction in one basic direction as in class V restorations. (2) Less cavity width of class I at the cavosurface margins. (3) Incremental technique followed in class I cavities. In our study, the adaptation to cementum was better than to enamel (Graph 2). This is in agreement with El-Kalla (1999) and Hakimeh et al.[28] This could be due to the different quality of mineralization of the various dental substrates.

Angles in the cavities showed high incidence of gaps and are more susceptible to air entrapment (Fig. 6). Hence, care should be taken to avoid the air entrapment at the angles while placing the material. Pooling of adhesives was also observed, so care should be taken while placing adhesive inside the cavity.

Two specimens from each subgroup which were randomly selected for SEM observation confirmed the findings of stereomicroscopic observation (Figs 7 and 8).

The results obtained from this study may not directly be extrapolated to clinical situations but they provide some information about the performance of the compomer systems evaluated.

Further investigations involving a large sample and a more detailed interfacial micromorphological study is needed before definite conclusion can be drawn.



Graph 2: Percentage of gap present at cementum or enamel to restoration interface at cavosurface margin

STEREOMICROSCOPIC EXAMINATION

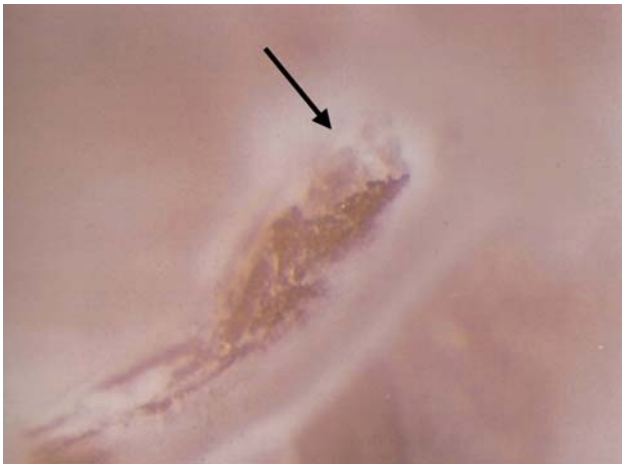


Fig. 1: Specimen showing gap in cavosurface margin of class V cavity restored with Dyract

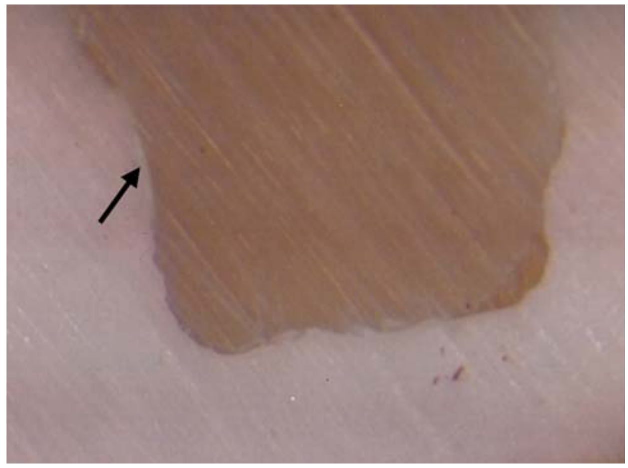


Fig. 4: Specimen showing gap in the walls of class I cavity restored with Compoglass

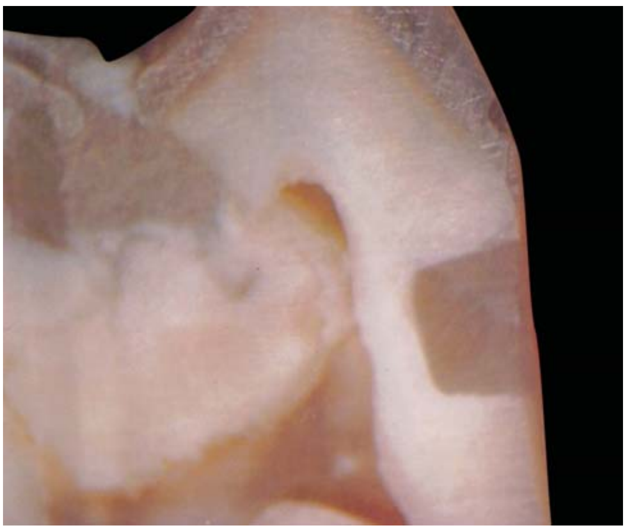


Fig. 2: Specimen showing good adaptation in class V cavity restored with Dyract

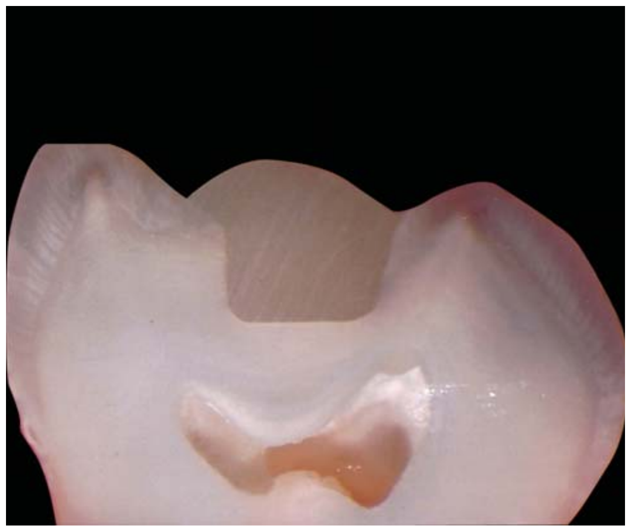


Fig. 5: Specimen showing good adaptation in class I cavity restored with Compoglass

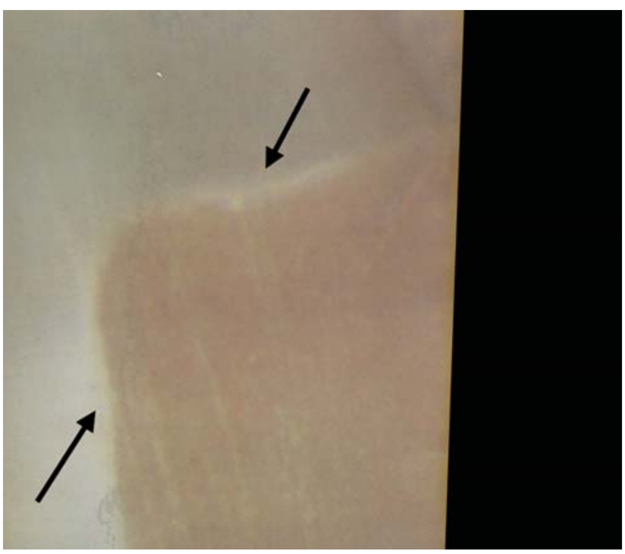


Fig. 3: Specimen showing gap in the walls and floor of class V cavity restored with F-2000

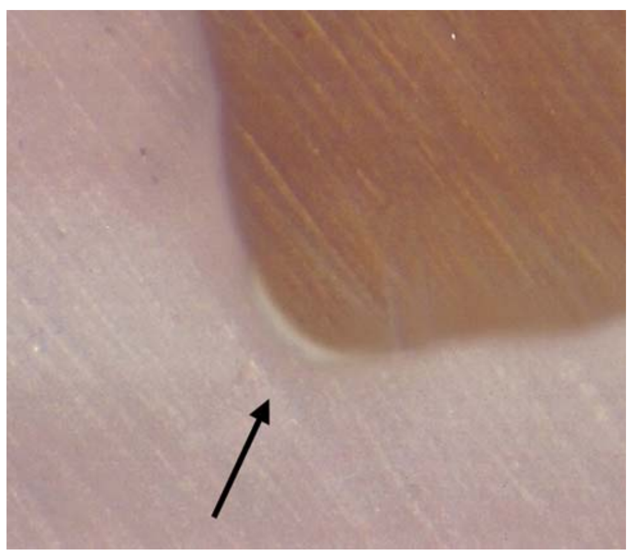


Fig. 6: Specimen showing gap at the angle of class I cavity restored with Dyract

SCANNING ELECTRON MICROSCOPIC EXAMINATION

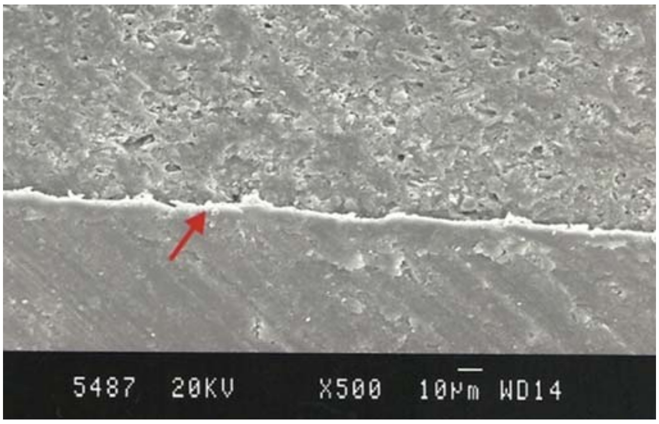


Fig. 7: SEM showing good adaptation in the walls of class I cavity restored with Dyract

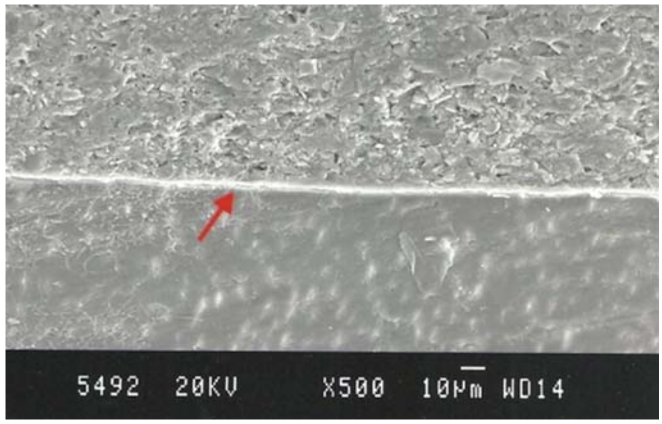


Fig. 8: SEM showing good adaptation in the walls of class I cavity restored with Compoglass

CONCLUSION

Considering the aims with which the present study was undertaken, it can be concluded that:

- All the three compomers in this study showed presence of gaps at all the margins observed.
- Of the compomers used Dyract and Compoglass were significantly better adapted to the cavity walls than F-2000.
- The observation done under SEM confirmed the presence of gaps and also revealed pooling of adhesive and air entrapment in few samples.

REFERENCES

1. Berg JH. The continuum of restorative material in pediatric dentistry: A review for the clinician. Pediatr Dent 1998;20: 93-100.
2. EI-Kalla IH, Godoy FG. Compomers adaptations to Class I and Class V cavities in permanent teeth. J Dent Child 2000; 29-36.
3. Dentsply, Dyract. Light cured compomer restorative system. Dyract, Direction for Use. Available from: URL: http://www.dentsply.es/DFU/eng/Dyract_DFU_eng.pdf
4. Vivadent; Compoglass: Instruction for Use. Available from: URL: http://www.ivoclarvivadent.com.br/en/products/restorative-materials/compomers/compoglass-f
5. 3M;F -2000: Instruction for Use. Available from: URL: http://solutions.3m.com/wps/portal/3M/en_US/3M-ESPE-NA/dental-professionals/products/espe-catalog/~/3M-ESPE-F2000-Compomer-Restorative-Refill-20-0-2g-Capsules-B2?N=4294873018+5144829&Nr=AND(hrcy_id%3AQ4QG274W3Hgs_5F2TK26VND_N2RL3FHWVK_GPD0K8BC31gv)&rt=d. http://www.dentalcompare.com/4439-Compomers/33957-F2000-Compomer-Restorative/
6. Davidson CL, Gil DC, AJ FetIzer A. A competition between the composite dentin bond strength and the polymerization contraction. J Dent Res 1984;63:1396-99.
7. Asmussen E, Jorgensen KD. A microscopic investigation of the adaptation of some filling materials to dental cavity walls. Acta Odontol Scand 1972;30:3-21.
8. Bergenholtz G, Cox CF, Loesche WJ. Bacterial leakage around dental restorations. Its effect on the dental pulp. J Oral Pathol 1962;11:439-50.
9. Browne RM, Tobias RS. Microbial microleakage and pulpal inflammation. A review. Endod Dent Traumatol 1986;2:177-83.
10. Torskenson B, Brannstrom M. Contraction gap under composite resin restoration, effect of hygroscopic expansion and thermal stress. Oper Dent 1988;13:24-31.
11. Ferrari M, Vichi A, Mannocci F, Davidson CL. Sealing ability of two compomers applied with and without phosphoric acid treatment for Class V restorations in vivo. J Prosthet Dent 1998;79:131-35.
12. Nordenvall KJ, Brennstrom M, Malmgren O. Etching of deciduous teeth and young and old permanent teeth. Am J Ortho 1980;78:99-108.
13. Cortes O, Garcia C, Perez L, Perez D. Marginal microleakage around enamel and cementum surfaces of two compomers. J Clin Pediatr Dent 1998;22(4):307-15.
14. Tate WB, You C, Powers JM. Bond strength of compomers to human enamel. Oper Dent 2000;25:283-91.
15. Ziad D Baghdadi. Bond strengths of Dyract AP compomer material to dentin of permanent and primary molars: Phosphoric acid versus non-rinse conditioner. J Dent Child 2003;2:145-52.
16. Annunziata Morabito, Patrizia Defatanis. The marginal seal of various restorative materials in primary molars. J Clin Pediatric Dent 1997;22(1):51-54.
17. William W Brackett, Timothy D Gunnan, Russel O. Class V, microleakage of Class V compomer and light-cured glass ionomer restorations. J Prosthet Dent 1998;79(1):261-63.
18. Harris RK, Phillips RW, Swartz MJ. An evaluation of two resin systems in restoration of abraded areas. J Prosthet Dent 1974;31: 537-41.
19. Kidd EAM. Secondary caries. Dent Update 1981;8:253-60.
20. Brainstrom M. Communication between the oral environment and the dental pulp associated with restorative treatment. Oper Dent 1984;9:57-68.
21. Mazer RB, Leinfelder KF, Russell CM. Degradation of microfilled posterior composite. Dent Mater 1992;8:185-89.
22. EI-Kalla IH, Godoy FG. Compomers adaptations to Class I and Class V cavities in primary teeth. American Journal of Dentistry. 1999;12(1):37-43.
23. Goodies HE, Marshall GM, White JM, Gee L, Hornberger B, Marshall SJ. Storage effect on dentin permeability and shear bond strenght. Dent Mater 1993;9:79-84.

24. Stereomicroscope. Manual for Leica Stereomicroscope. Available from: URL: http://www.leica-microsystems.com/products/stereo-microscopes-macroscopes/
25. Shortall AC. Microleakage, marginal adaptation and composite resin restoration. British Dental Journal 1982;21:153-223.
26. Simonsen RJ. Preventive aspects of clinical resin technology. Dent Clin North Am 1981;25:291-305.
27. Mills RW, Ball IA. A clinical trial to evaluate the retention of silver cermet-ionomer cement used as a fissure sealant. Oper Dent 1993;18:148-54.
28. Hakimeh S Vaidyanathan, J Houpt MI, et al. Microleakage of Dyract restorative system in Class V applications. J Dent Res 1996;77:227.

ABOUT THE AUTHORS

Sumanth M Shetty (Corresponding Author)

Associate Professor, Department of Pedodontics, Sri Aurobindo Institute of Medical Sciences, Ujjain State Highway, Near MR 10 Crossing, Indore, Madhya Pradesh, India, Phone: +91-9886644249 e-mail: drsumanthshetty@gmail.com

Rashmi G Shetty

Assistant Professor, Department of Conservative Dentistry and Endodontics, Sri Aurobindo Dental College, Indore, Madhya Pradesh India