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Research Article

A COMPARATIVE STUDY: MICROLEAKAGE IN RELATION TO FOURTH AND FIFTH GENERATION DENTIN BONDING AGENTS

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ABSTRACT

Aim: To determine the micro leakage of fourth and fifth generation dentin bonding agents.
Materials and Methods: Standardized Class V cavities were prepared on cervical area of facial surfaces of seventy-five human premolars. According to the generation of bonding agent used, the samples were divided into three groups. Fourth generation bonding agent (Scotch Bond Multipurpose) was used in group A, Fifth generation bonding agent (Single Bond) was used in group B and no bonding agent was used in group C. The samples were restored with hybrid composite and underwent dye penetration test. Samples were sectioned and evaluated under 45X stereomicroscope. Statistical analysis using independent sample t-test. The significance level was at $P < 0.001$.
Results: The results of present study depicted that Group A in which Scotch Bond Multipurpose dentin bonding agent was applied showed amicroleakage mean of 2.12 and standard deviation of 1.2356.The teeth in which Single Bond adhesive was applied showed a mean of 1.6 and standard deviation of 1.3844. The specimens on which dentin bonding agent was not used showed the highest mean 3.6 and standard deviation of 1.7321. On comparison of groups statistical difference was seen among the groups.
Conclusion: There was no statistical difference in between the micro leakage exhibited by fourth and fifth generation dentin bonding agents, both performed equally well. Also use of dentin bonding agent significantly reduce the micro leakage.

INTRODUCTION

The performance of a tooth coloured restorations depends on the reliability of the seal formed at the tooth/material interface. For the restoration to be successful, the seal must prevent the percolation of oral fluids and in turn, bacterial leakage[1].The visible light cured composite resins continue to be the material of choice for conservative anterior restorations; also their use as posterior restorative material is becoming more acceptable. The major shortcoming of composite resin is their inherent polymerization shrinkage[2] which results in gap formation particularly at the dentin interface[3]. This phenomenon leads to microleakage[4]with ingress of bacteria, fluids, molecules or ions between the cavity walls and the restorative material[5]and further leads to pulpal damage[6].

Previous studies have demonstrated that etched and bonded enamel produces a more consistent hermetic seal compared withdentin[7,2,8,9,10,11].The clinical behaviour of composite material is enhanced by maximizing adhesion through a reduction in interfacial micro leakage by the application of adhesives[12,13].Adhesion to dentin is much more complicated because of its composition and histologic structure. The high organic content and tubular structure, the odontoblastic processes and outward flow of fluid make dentin bonding difficult to attain[14, 15, 16, 17].

The foundation of adhesive restorative dentistry was laid in 1955 when Buonocore[8] proposed that acids could be used to alter the surface of enamel to render it more receptive to adhesion via micromechanical retention. However the bond strength of this early method of adhesion were very low and involved bonding to enamel but none to dentin. To overcome

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this problem introduced the first generation of Dentin bonding agents[2].

First generation Dentin Bonding Agent focussed on developing chemical adhesion to dentin by chelating the surface calcium of tooth structure was found to have poor adhesion resulting in low bond strengths no higher than 2.0 M Pa to dentin. It was common to see dentinal debonding within several months[18]. In addition an adequate surface of enamel was required to give the bond sufficient strength and there was no micro leakage advantage when it was compared to conventional unfilled resins. To overcome the obvious inadequacies of this early bonding material, a second generation of bonding system was developed. These adhesive agents attempted to use the smear layer for bonding[19]. These systems bad a weak bond to dentin (4.0-6.0 M Pa) and did not significantly reduce the post-operative sensitivity and they also permitted extensive marginal micro leakage. The third generation bonding agents either modified or removed the smear layer before placement of adhesive resin.

Nakabayashi[20] employed a hybrid reinforce layer concept which was acid resistant and mixture of polymeric and tooth structure component creating a resin / dentin composite. These Fourth generation Dentin Bonding Agents had have numerous components in their systems. These numerous components and the clinical complexity of restorative procedure as well as the time required to complete the procedure caused some degree of confusion for the dentists. The perception of the complexity led the manufacturers to develop the current Fifth generation Dentin Bonding Agents. These one bottle dentin adhesive combine both primer and adhesive resin into a single solution. Thus, their use in clinic is simpler and less time consuming which makes them user-friendly. Latta et al.[21] have reported that both fourth generation as well as fifth generation dentin bonding agents gave equivalent performance in micro leakage and dentin bond strength testing. Castelnuovo et al.[22]have reported that fourth generation dentin bonding agent was inferior to fifth generation dentin bonding agent when subjected to micro leakage testing.

Thus the aim of this in vitro study was to compare the ability of recently introduced one bottle; fifth generation dentin bonding agents with their preceding multi step fourth generation dentin bonding agents in preventing or reducing micro leakage around Class V resin composite restoration.

MATERIALS AND METHODS

This study was conducted in the Department of Conservative dentistry and Endodontics, Institute of Dental Sciences, Jammu with an objective to compare the micro leakage between 4th generation and fifth generation dentin bonding agents.

A total of seventy five non carious unrestored extracted human permanent maxillary and mandibular premolar teeth were selected. They were scaled and cleaned with a slurry of pumice powder and stored in saline at normal room temperature. Facial Class V cavities were prepared with a flat end tapered Fissure Tungsten Carbide bur in an air turbine at cemento enamel junctions using water spray. Cavities were prepared with standardized dimensions with a depth of 2mm, mesio-distal width of 4mm and occlusal cervical height of 2mm. The margins of the prepared cavity were measured by a graduated probe.

All prepared teeth were than randomly divided into 3 equal groups of twenty five teeth each that differed by the adhesive system used.

Group A (Scotch Bond Multipurpose dentin bonding adhesive system. (3M) Fourth generation dentin bonding agent was used.

Group B Single Bond dental adhesive system (3M) Fifth generation dentin bonding agent used.

Group C (Negative Control) No dentin bonding agent used.

The bonding agents were applied according to manufacturers' instructions followed by restoration of all the seventy five cavities byhybrid composite Z-l00 (3M) cured for 40 seconds with visible light curing unit (Acta Satelac) from a distance of 1 mm from its outer surface in two increments. The increments were placed with teflon coated composite filling instrument.

Restorations were finished and poured with coarse, medium; fine and ultrafine soflex disks (3M). The apices of all the teeth were sealed with autopolymerizingacrylic resin. All the outer surface of tooth, except the restorations and 1 mm from the margins of restoration were coated with 2 layers of nail polish. All specimens were then stored in saline at room temperature for 7 days. Teeth later were subjected to ther mocycling for 200 cycles between 5°C and 60°C (± 2°C) with a dwell time of 30 seconds.

50% silver nitrate staining procedure was performed by placing the specimens in the stain for a period of 2 hours in the absence of light. The specimens were thoroughly rinsed with distilled water. The test samples were then placed in photo developer solution under a fluorescent light for 12 hours to develop the penetration pattern and rinsed again thoroughly by distilled water.

All teeth were cut facio-lingually passing through the bulk of the restoration by a diamond disk. There sections of each specimens were kept separately in different small bottles which were labelled. The evaluation of microleakage was done with the help of reflected light binocular stereomicroscope.
The most severe degree of dye penetration for each section was recorded. Dye penetration at the composite /tooth interface was scored for both occlusal and cervical margins on a non-parametric scale from 0-5.

0. No microleakage
1. Leakage equal to or less than enamel thickness or the equivalent depth in cementum.
2. Microleakage past enamel and upto 50% of the depth of the axial wall.
3. Microleakage greater than 50% of the depth of the axial wall.
4. Microleakage involving the axial wall and spreading along with it.
5. Microleakage beyond the axial wall in to the dentinal tubules.

The magnification used was 45 X for the reflected light binocular stereo microscope (Figure 1).

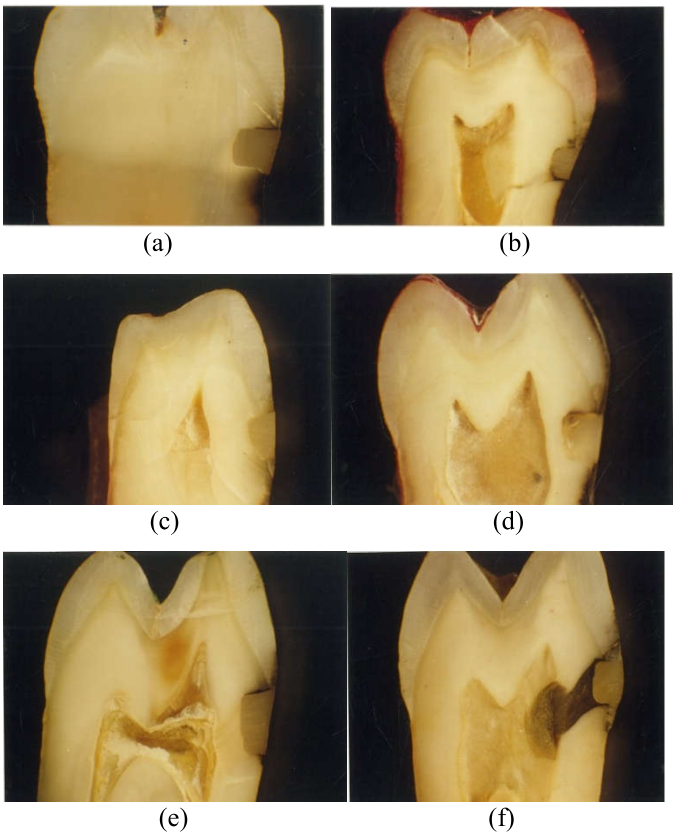


Figure 1 Microphotograph showing dye leakage

(a) Minimum leakage in Group A
(b) Maximum leakage in Group A
(c) Minimum leakage in Group B
(d) Maximum leakage in Group B
(e) Minimum leakage in Group C
(f) Maximum leakage in Group C

Statistical Analysis

Results of evaluation of leakage were subjected to statistical analysis using independent sample t-test. The significance level was at P < 0.001.

RESULTS

The results of present study depicted that Group A in which Scotch Bond Multipurpose dentin bonding agent was applied showed a micro leakage mean of 2.12 and standard deviation of 1.2356.The teeth in which Single Bond adhesive was applied showed a mean of 1.6 and standard deviation of 1.3844.The specimens on which dentin bonding agent was not used showed the highest mean 3.6 and standard deviation of 1.7321 (Table 1).

Table 1 The mean leakage values and standard deviation of different groups

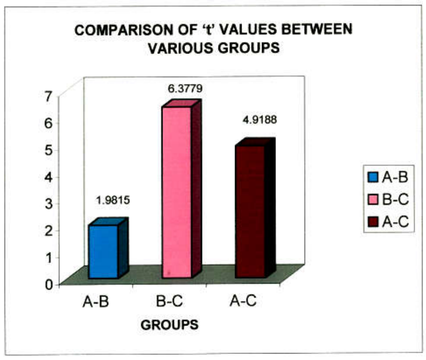
Groups	Mean	Standard deviation
A	2.12	1.2356
B	1.6	1.3844
C	3.6	1.7321

On comparison of various groups by't- test' it was revealed that the't' value for Group A and B is 1.9815. The group B shows mean micro leakage less than group A and the difference was significant (p<0.05) [Table 2].

Table 2 The comparison of micro leakage values between various groups by Student's't' test.

Between Groups	Degree of Freedom	't' value	P significance
A-B	48	1.9815	P<0.05
B-C	48	6.3779	P<0.001
A-C	48	4.9188	P<0.001

The't' value for group B and C is 6.3779. The Group B shows less mean micro leakage value than Group C. The difference is highly significant (p<0.001).



Graph 1 Graphical representation of comparisons between different groups

The't' value for Group A and C is 4.9188. The Group A shows less, mean micro leakage value than Group C. The difference in highly significant (P<0.00l)

DISCUSSION

The prevention of microleakage depends largely on the maintenance of a seal between the restorative material and the toothstructure[22]The restorative system must produce a bond to the cavity walls of sufficient strength in order to resist the stresses generated during polymerization shrinkage of the restorative resin, as well as those occurring during normal occlusal function[22].

Micro leakage has been defined by Sidhu and Henderson[23] as "The clinically undetectable passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material applied to it". Micro leakage occurs due to dimensional changes in the restorative material attached to the cavity walls. These changes involve: polymerization shrinkage or contraction; difference in coefficient of thermal expansion and hygroscopic absorption of materials[24]**.** Such alteration of materials produce forces that result in gap formation at the tooth-material interface leading to micro leakage followed by sensitivity, recurrent caries & possible pulpal pathosis[69]**.** Many dental materials fail as a result of these applied forces[24]**.**According to Wieczhowshi et al., [25] the ability of a restorative material / adhesive to seal the interface with tooth structure is the most significant factor in determining resistance to the formation of future caries.

In Class V cervical lesions, the margins can be in dentin or cementum as well as in enamel. Since Buonocore[2] introduced the acid etching technique in 1955, bonding of tooth structure to dental filling materials has seen a remarkable increase. Resin bonding preceded by enamel etching has proven to be a reliable clinical procedure in sealing the material tooth interface[26]**.** Dentin etching and adhesion has been a challenging because the composition and structure nature of dentin[26,17]**.** Early studies indicated that detinning caused pulpal inflammation[27, 28, 29, 30]**.**

Fusayama[31] believed that inflammation was caused by bacterial ingress through the dentin into the pulp. As a result Fusayama[31] proposed total etching of dentin to open dentinal tubules and remove the smear layer of debris caused by cutting on the den al surface to promote more complete, mechanical bonding of material to tooth structure.

Dentin adhesion is more complicated because dentin is 50% organic material and water (by volume) [6]. Dentin also has a lower surface energy than enamel[32].Adhesion is also affected by adequate appropriate wetting ability of the dentin, which is related to the density and size of the dentinal tubules and possibly the amount of the moisture (water) on the dentinal surface. Newer bonding system etchants alter or penetrate the smear layer of the tooth through various types and percentages of acids, providing for increased mechanical or possible chemical bonding of the material to tooth structure[24, 26]. Initially Scotch Bond Multipurpose achieved enamel and dentin etching with the 10% maleic acid to produce the classical etch pattern in the enamel for micromechanical retention. For dentin, the surface was demineralized, leaving collagen fibrils which could be impregnated by the primer to a depth of 3-5 μm[33].

Now 35-37% phosphoric acid is used which is advocated by Fusayama and Kanca by total etching to tooth structure[31, 34,35]. Hydrophilic monomers (primers) then penetrate the surface of dentin to produce micromechanical retention from resin tags in and around dentinal tubules and distended collagen fibres[24, 36]. These primers contain ethanol and water as solvents. These solvents carry the resin primers into the dematerialized dentin by displacing water from the collagen network. It is considered that acetone and ethanol effectively displace water and are therefore better facilitators of resin primer infiltration into the collagen network compared to water based adhesive systems[34].This area "the hybrid layer" polymerizes with the adhesive resin in each systems[37].

The data collected in this study shows that single bond dentin bonding agent (Group B) recorded the least values of dye penetration compared to other test groups - Group A in which Scotch Bond Multipurpose was used and Group C in which dentin bonding agent was not used at all. Single Bond dentin adhesive system (Group B) recorded a mean of 1.6 as compared to Scotch Bond Multipurpose dentin bonding agent (Group A) of 2.12.

Group C recorded a mean of 3.6 which clearly showed maximum dye penetration. While comparing Group A and Group B student't' test value of 1.9815 was recorded and (p<O.05) shows the difference is significant.

The present study has shown that fifth generation bonding systems perform better and exhibit lesser micro leakage when compared to its predecessors - Fourth generation bonding systems which is in agreement with the studies by L. Setembrini et al.[38] and J. Castelnuovo et al.[22]. L. Setembrini et al.[38] found out that one step dentin bonding system has the ability to prevent micro leakage effectively at both composite enamel and composite dentin tooth surfaces. Similarly J. Castelnuovo et al.[22] while comparing three pairs of multi-step and simplified step dentin bonding systems Opti Bond versus Optibond FL, All Bond 2 Vs One Step and Tenure Vs Tenure Quik. He showed that OptiBond FL and One Step both fifth generation dentin bonding systems showed less micro leakage at the cementum margins compared to their multistep versions. At the enamel margins Tenure Quik (fifth generation dentin bonding systems) showed less micro leakage compared to Tenure (fourth generation dentin bonding agents). It was concluded that all Dentin bonding systems prevent micro leakage at enamel margins and less in cementum. However, the fifth generation Dentin Bonding Systems prevent micro leakage in both at enamel as well as at cementum margins.

The main purposes of fifth generation single bottle enamel /dentin bonding agents are to simplify the bonding procedures, which allows the simultaneous and similar treatment of dentin and enamel and are less time-consuming[39].Good wetting of the dentin surface maintains the plasticity and permeability of the dematerialized collagen fibrillar network which is critical for optimal hybridization[40].

For single bond the presence of water in its component is beneficial. It has been suggested that the water present in the composition of some adhesives would be able to reopen the collapsed network of collagen fibres on dry spots inadvertently left on the surface and prevent the formation of "Ghost" hybrid layers[41].Because water has a plasticizing effect on collagen fibrils the shrunken collagen coagulate wouldre-expand and allow monomers to infiltrate the filigree of fibres[42].

Nonetheless one study done by J. Perdigao et al[43] found that 3%-8% water concentration in a single Bond might not be sufficient to expand the collapsed collagen fibrils and allow a complete penetration of the adhesive. However the water concentration may be sufficient to result in bond strength to dried dentin that are statistically similar to those of dentin that was dried and rewetted[43]. A critical concentration of water may be needed to decrease the modulus of elasticity of the collapsed network to its original level[44].

The polyakenoate salt formed by single Bond has been claimed to provide water stability to the adhesive system by a dynamic potential of breaking and renewing the bonding between the carboxyl groups and calcium forming a stress-relaxation zone at the bonded interface[43]. The formation of electron dense layer on the dentin surface after treatment with Polyalkenoic acid based adhesives reacting with residual calcium has also been reported by various authors[45].

While comparing Group A, fourth generation Dentin Bonding Agent with Group C negative control group in which no bonding agent was used; he 't' value was 4.9188 and Group A showed less mean micro leakage value of 2.12 as compared to a Group C which showed a mean micro leakage value of 3.6 which clearly proves the se of dentin bonding agents prevents micro leakage. The difference in Group A and C was highly significant (p<0.001).

When Group B fifth generation Dentin bonding agent was compared to negative control group C, the student't' value of Groups B & C was 6.3779. Group B showed a mean micro leakage value of 1.6 as compared to mean micro leakage value of 3.6 of Group C. The results clearly showed that the application of fifth generation Dentin bonding agents prevented micro leakage to a considerable extent. The difference in Group B and C was highly significant (p<0.001). Some specimen fourth and fifth generation dentin bonding agents had leakage at cemental and dentinal walls. These findings are in agreement with studies done by C. B. Phair[46], P. D. Hammesfarh[47] and M. Gordan et al[48].

CONCLUSION

The following conclusions can be derived from this study

1. There was no statistical difference in between the micro leakage exhibited by fourth and fifth generation dentin bonding agents, both performed equally well.
2. Use of dentin bonding agent significantly reduce the micro leakage.
3. The fifth generation Dentin bonding agents are less technique sensitive when compared to fourth generation Dentin bonding agents.

References

1. Owens BM. Microleakage of cervical restoration etched with a weak organic acid. *J Canadian Dent. Assoc*.1997; 63:(6):445-447.
2. Bowen RL, Rapson JE, Dickson G. Hardening shrinkage & Hydroscopic expansion of composite resins. *J Dent Res*. 1982; 61:645-658.
3. Davidson CL, DeeGree AJ,Feilzer AJ. The competition between composite dentin bond strength & polymerization contraction stresses. *J Dent Res*. 1984; 63:1396-1399.
4. Jensen ME & Chan DCN. Polymerization shrinkage & microleakage Int: Vanherle G, Smith DC: Proceedings of the Interaural symposium or posterior composite resin dental restorative material. (1982) Chapel Hill, NC Netherlands. Peter Szule Publishing Co; 1985.p.243-262.
5. Swartz MC. Research in Dental materials. *J Am Dent Assoc*. 1969; 91:901-907.
6. Myers HM. Dental pharmacology is the scientific bases of Dentistry. Ed. Shapiro M 1. Philadelphia: W. B. Saunders; 1966.
7. Asmussen E. Marginal adaptation of Restorative Resin in Acid etched cavities. Acta Odontol Scand. 1997; 35:125-134.
8. Buonocore MG.A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. *J Dent Res*. 1955; 34:894-853.
9. Perdigao J et al. The interaction of adhesives systems with human dentin. *Am J Dent*. 1996; 9:167-173.
10. Stanley HR, Going RE, Chauncey HH. Human pulp response to acid Pretreatment of dentin to composite restoration. J Am Dent Assoc. 1975; 91:817:825.
11. Swift EJ, Perdigao J and Heymann HO. Bonding to enamel and dentin: A brief history and state of Art.Quint Int. 1995; 26:95-110.
12. Hembree J.Marginal leakage of microfilled composite resin restoration. *J Prosthet Dent*. 1983; 50:632-635.
13. Zidan OGM,Suchiya TT. A Comparative study of the effects of dentinal bonding agents and application techniques on marginal gaps in class V cavities. *J Dent Res*. 1987; 66(3):716-721.
14. Branstrom M. The cause of Post-operative sensitivity and its prevention. *J Endodont*. 1986; 12:475-481.
15. Pashley DH. Interaction of dental materials with dentin.Trans Am Acad Dent. Mater. 1990; 3; 55-73.
16. Torney D.The retentive ability of the acid-etched dentin. *J Prosthet Dent*. 1970; 39.169-172.
17. Vargas MA, Deborah S, Denehy GE. Interfacial micromorphology shear bond strength of single bottle primer adhesive. *J Dent Mater*. 1997; 13:316-324.
18. Harris RK, Phillips RW, Swartz ML. An evaluation of two resins system for restoration of abraded areas. *J Prosthet Dent*. 1974; 31:537-546.
19. Causlon BE. Improved Bonding to composite resin to dentin. Br Dent. 1984; 1:156-193.
20. Nakabayashi N, Kojima K, Musuhara E. The promotion of adhesion by the infiltration of monomers into tooth substrates. *J Biomed Mater Res*. 1982; 16:265-273.
21. Latta MA et al. Laboratory evaluation of one component dental adhesive. J Dent Res. 1997; 76:186.
22. Castelnuova J,Tjan AH, Liu P.Microleakage of multiple step and simplified step bonding systems. *Am J Dent*. 1996;9(6):245-248.
23. Sidhu SK and Henderson LJ. Dentin adhesion and microleakage in cervical resin composite. *Am J Dent*. 1992; 240-244.
24. Reaves GW et al. Microleakage of new dentin bonding systems using human and bovine teeth. *J Operative Dent*. 1995; 20:230-235.
25. Wieczhowshi G et al. Microleakage in various dentin / bonding agent /composite resin system. *J Operative Dent*. 1992; 5:62-67.
26. Heymann HO and Bayne SC. Current concept in dentin bonding: Focusing on dentinal adhesive factors. JADA. 1993; 124:27-35.
27. Macko DJ, Rutberg M, Langeland K. Pulpal response to the application of phosphoric acid to dentin. Oral Surg. 1978; 45.930-946.
28. Retief DH, Austin JC, Fatti LP. Pulpal response to phosphoric acid. *J Oral Pathol*. 1974; 3:114-122.
29. Retief DH et al. Phosphoric acid as a dentin etchant. Am J Dent. 1992; 5:24-28.
30. Stanley HR, Going RE, Chauncey HH. Human pulp response to acid Pretreatment of dentin to composite restoration. *J Am Dent Assoc*. 1975; 91:817:825.
31. Fusayama T. Factors & prevention of pulp irritation by adhesives composite resin restorations. Quint. int. 1987; 18:633-640.
32. Barkmeier WW, Cooley RL.Current status of adhesive resin system. *J Am Dent* 1991; 58:36-39.
33. Meerberk BV et al. Morphological aspect of the resin- dentin inter diffusion zone with different dentin adhesive systems. *J Dent Res*. 1992; 71:1530-1540.
34. Kanca J III. Bonding to tooth structure: a rational rationale for a clinical protocol. *J Esth Dent*. 1989; 1:135-136.
35. Kanca J III. One year evaluation of a dentin-enamel bonding system. *J Esth Dent*. 1990; 2:100-103.
36. Owens BM, Halter TK, Brown DM. Microleakage of tooth-coloured restorations with a beveled gingival margin.Quint int. 1998; 29:356-361.
37. Joynt RB et al. Dentin bonding agents and the smear layer. J Operative Dent. 1991; 16:186-191.
38. Settembrini L et al. A single-component bonding system microleakage study.Gen Dent. 1997; 45(4):341-343.
39. Pilo R and Ariel Ben Amar. Comparison of microleakage of three one bottle and three multiple step dentin bonding agents. *J Prosthet Dent*. 1999; 82(2):209-213.

40. Tay FR, Gwinnett AJ, Wei SHY. Structure of resin-dentin interface following reversible irreversible rewetting. *Am J Dent*. 1997; 10:77-82.
41. Meerbeek BV et al. A TEM study of two water based adhesive systems bonded to dry and wet dentin. *J Dent Res*. 1998; 77:50-59.
42. Carvelho RM et al. In vitro study on the dimensional changes of dentin after demineralization. Arch Oral Biol. 1996; 41:369-377.
43. Perdigao J et al. The effect of a rewetting agent as dentin bonding. Dent Mater. 1999; 15:282-295.
44. Maciel KT et al. The effect of acetone, ethanol, HEMA & air on the stiffness of human decalcified dentin matrix. *J Dent Res*.1996; 75:185-188.
45. Meerbeek BV et al. Correlative transmission electron Microscopy examination of non-demineralized & demineralized resin dentin interfaces formed by two dentin adhesive systems. *J Den Res.* 1996; 75:879-888.
46. Phair CB, Fuller JL. Microleakage of composite resin restoration with cementum margins. *J Prosthet Dent*. 1985; 53:361-364.
47. Hammeshfarh PD, Huang CT, Shaffer SE. Microleakage and bond strength of resin restorations with various bonding agents. Dent. Mater. 1987; 3:194-199.
48. Gordan M,Plasschaert AJM, Stark MM. Microleakage of several tooth coloured restorative materials in cervical cavities: A comparative study invitro. Dent Mater. 1986; 2:228-231.

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