ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 4, Issue – 2, April - 2021, Page No. : 191 - 199

Comparison of Microleakage in Deep Class II Composite Restorations using Endosequence BC RRM fast set putty as Gingival increment with Total etch/Self-etch adhesive-An in vitro study

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Citation of this Article: Dr. Chandrakant Velip, Dr. Manoj Agarwal, Dr. Shahina Parvez, Dr. Rohit Kumar Khatri, Dr. Lalit Kumar Likhyani, Dr. Deepak Goel, "Comparison of Microleakage in Deep Class II Composite Restorations using Endosequence BC RRM fast set putty as Gingival increment with Total etch/Self-etch adhesive-An in vitro study", IJDSIR- April - 2021, Vol. – 4, Issue - 2, P. No. 191 – 199.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aims and Objective: To evaluate and compare gingival microleakage at tooth restoration interface in deep class II composite open sandwich restorations using Endo sequence BC RRM fast set putty as gingival increment using Total etch/self-etch adhesive system - an in-vitro study.

Materials & Methodology: Ninety intact extracted human maxillary 1st premolars were collected, standardized box preparations were made on the mesial surface of these teeth using No 245 bur with an airotor hand piece. Tofflemire matrix band retainer was adapted to the preparation to prevent gingival overhang of the restoration. The samples were then randomly divided into six groups of 15 teeth in each group. After the restorations

were completed, apical foramen was sealed with composite resin and 2 coats of nail varnish applied.. The specimens were then subjected to thermocycling, then stored in humidor and immersed in 0.5% aqueous solution of Rhodamine B dye for 24 hours. Specimens were sectioned mesio-distally through the centre of restoration. Buccal half of the tooth sections were retained & was observed for the extent of dye penetration using Fluorescent microscope at 10X magnification and scored according to the study done by CJ Tredwin et al. Data were then subjected to statistical analysis.

Results: There was a statistically significant/highly significant difference seen for the frequencies between the groups

Conclusion: In deep class II composite open sandwich restorations, Endosequence RRM Fast set putty liner resulted in less microleakage.

Keywords: Endosequence BC RRM Fast set putty, Microleakage, Fluorescent microscope, Rhodamine B dye.

Introduction

The substitution of dentine and enamel that is lost either by caries or as a result of mechanical removal, with a restorative material is always a challenge to the clinician[1.] Composites are the commonly used restorative materials but adhesion of composite resin to deeper dentine is much less as compared to enamel and superficial dentin due to difficulty to access, more number and wider dentinal tubules with less inter-tubular dentine present and difficulty to control moisture / blood especially when the gingival seat is placed below CEJ[2,3,4]. This leads to post operative sensitivity, marginal discoloration, secondary caries and even failure of the restoration.

Clinically, various techniques have been followed to overcome this problem. Placement of cavity liner is one such procedure, where a flexible intermediary liner of lower elastic modulus is sandwiched between the tooth and composite restoration. GIC, RMGIC, flowable composite resin have been tried to build up the gingival seat under composite restoration with varying success rate[5,6,7].

Endosequence RRM Fast Set Putty (ERRM; Brasseler, Savannah, GA) is a new bioceramic material, which is hydrophilic and radiopaque and has a high pH conferring some antimicrobial properties. It comes in 2 premixed consistencies: flowable in a syringe and putty. The materials exhibit a mechanical bonding upon setting as a result of the small size of the particles, which allow ERRM particles to penetrate into the dentinal tubules[8].

In deeper preparations Endosequence gingival increment is allowed to undergo initial setting for 20 min followed by an immediate composite restoration and there are studies showing less micro-leakage & Endosequence showed superior sealing ability compared to MTA[9]. But then, the effect of using different bonding systems - self etch v/s total etch to Endosequence is not evaluated.

Microleakage at tooth- Endosequence BC Root Repair Material (Fast Set Putty) liner-composite resin restoration interfaces needs to be checked as the adhesion between the liner-composite resin restoration can affect the bonding of liner to the tooth.Hence, the purpose of this in-vitro study was to evaluate and compare the gingival microleakage at Tooth- Endosequence BC Root Repair Material (Fast Set Putty) -Composite resin restoration interfaces in deep class II Open Sandwich restorations using Prime and Bond NT, an acetone based Total etch adhesive and Swiss-Tech, an alcohol based Self etch adhesive to Endosequence BC Root Repair Material (Fast Set Putty).

Materials and methodology

Ninety intact extracted human maxillary 1st premolars were collected, cleaned of calculus, debris & were immersed in 10% formalin for seven days (Fig 2).

Standardized box preparations were made on the mesial surface of these teeth using No 245 bur with an airotor hand piece. The dimensions of these preparations were 3mm bucco-lingually, with the gingival seat placed 1mm below CEJ and 2mm deep axially, verified using a periodontal probe. No 245 bur was changed after every five preparations (Fig 3). Tofflemire matrix band retainer was adapted to the preparation to prevent gingival overhang of the restoration.

The samples were then randomly divided into six groups of 15 teeth in each group.

Restorative Procedure

Group 1 (Negative Control) - The preparations were etched with 37% phosphoric acid for 15 seconds, rinsed with water for 15 seconds and blot dried. Prime and Bond NT was applied with an applicator tip and light cured for 20 seconds. Cavities were then restored with composite resin in 2mm oblique increments & light cured for 30 seconds.

Group 2 (Positive Control) -After cavities preparations, cavities were then restored with composite resin in 2mm oblique increments & light cured for 30 seconds.

Group 3 - The preparations were etched with 37% phosphoric acid for 15 seconds, rinsed with water for 15 seconds and blot dried. Prime and Bond NT was applied with an applicator tip and light cured for 20 seconds. Cavities were then restored with composite resin in 2mm oblique increments & light cured for 30 seconds.

Group 4 - One coat 7.0 adhesive (Coltene) applied to the preparation and cured for 20 seconds. Cavities were then restored with composite resin in 2mm oblique increments & light cured for 30 seconds.

Group 5 - 2mm thick liner of Endosequence BC Root Repair Material (Fast Set Putty) was applied to the gingival seat upto the axial wall. The tooth preparation was etched, rinsed, Prime and Bond NT applied and light cured for 20 sec followed by restoration with composite resin as in group 3.

Group 6 - 2mm thick liner of Endosequence BC Root Repair Material (Fast Set Putty) was applied to the gingival seat upto axial wall, followed by One coat 7.0 adhesive (Coltene) application and cured for 20 seconds and the preparation was restored with composite resin as in group 1.

Specimen Preparation for Microleakage Testing

After the restorations were completed, excess proximal flash was removed with a sharp hand scaler. The apical foramen was sealed with composite resin and 2 coats of nail varnish applied to the entire tooth, except for the restoration and 1mm around it in groups 3, 4, 5 & 6 (Fig 4). Nail varnish was not applied to tooth surface and restoration in group 2, whereas 2 coats of nail varnish was applied to the entire tooth surface and to restoration in group 1. The specimens were then subjected to thermo cycling at temperatures 5-/+1˚C and 55+/- 1˚C for 1000 cycles with 30 seconds dwell time to simulate oral conditions.

The specimens were then stored in humidor and immersed in 0.5% aqueous solution of Rhodamine B dye for 24 hours. The dye was then rinsed off with water to remove excess dye (Fig 5). The tooth roots were severed-off at mid root level. Specimens were sectioned mesio-distally through the centre of restoration with a diamond disc under copious water spray. Buccal half of the tooth sections were retained, discarding the lingual half (Fig 6).

The tooth- Endosequence BC Root Repair Material (Fast Set Putty) -composite restoration interfaces was observed for the extent of dye penetration using Flurescent microscope at 10X magnification and scored according to the study done by CJ Tredwin et al (Fig 1).

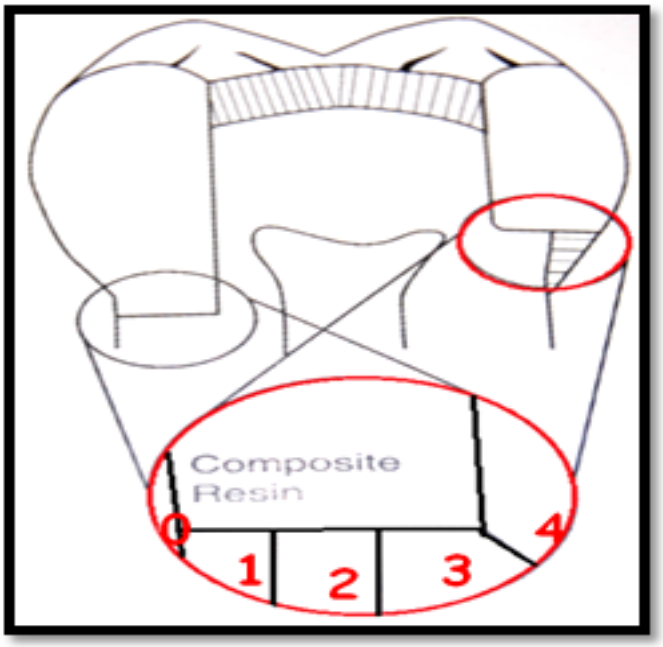


Fig 1: microleakage scores at tooth–liner-composite Resin interfaces based on the depth of dye penetration

Scores

0 - No dye penetration

1 - Dye penetration upto 1/3rd gingival seat axially

2- Dye penetration 1/3rd to 2/3rd gingival seat axially

3 - Dye penetration in excess of 2/3rd gingival seat axially

4 - Extensive dye penetration at the entire gingival seat upto axial wall

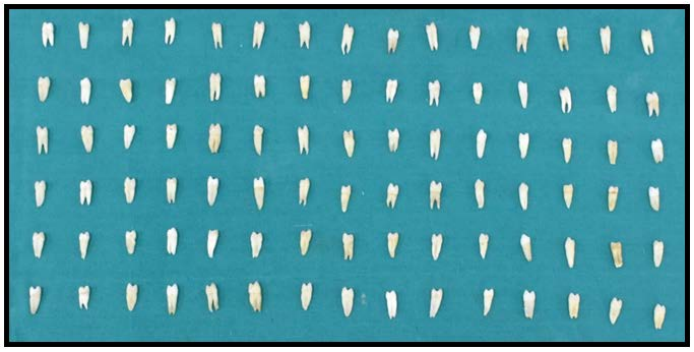


Fig. 2: Extracted Maxillary 1st Premolar Teeth used for The Study

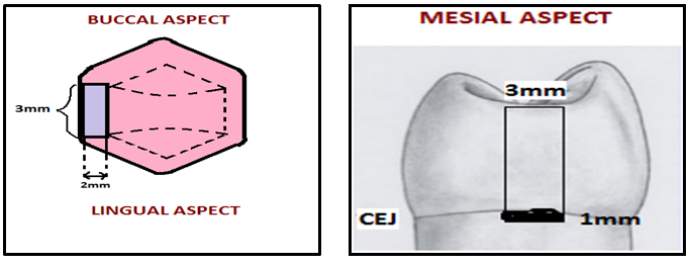


Fig. 3: Dimensions of Standardised Class II Box Preparation

Fig. 4: Root End Sealed and Nail Varnish Applied

Fig 5: Teeth Samples Removed from 0.5% Rodamine B Dye and Rinsed

Fig. 6: Teeth Samples Sectioned Mesiodistally Into two Equal Halves Following Dye Penetration & Thermocycling

Dye Penetration Seen at Tooth-Endosequence BC RRM (Fast Set Putty) -Composite Resin Restoration Interfaces in Various Groups

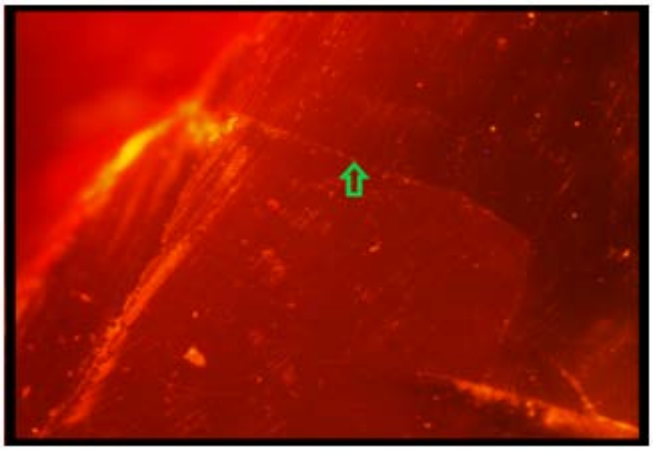


Figure 7: GRP 1

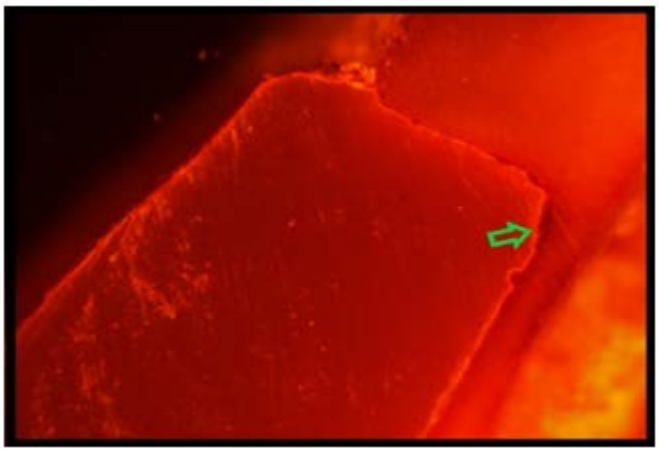


Figure 8: GRP 2

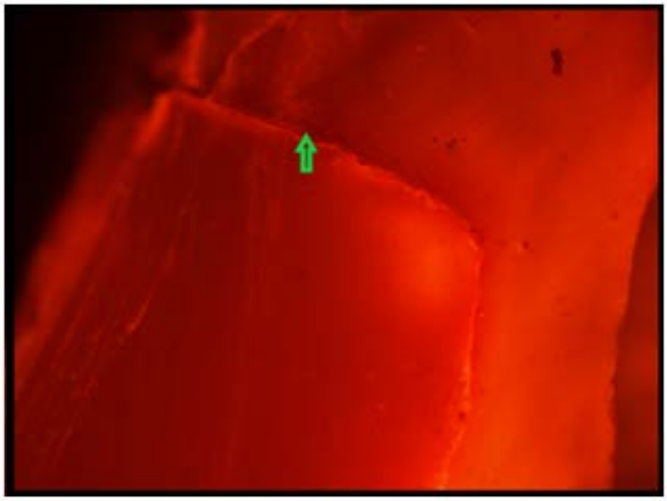


Figure 9: GRP 3

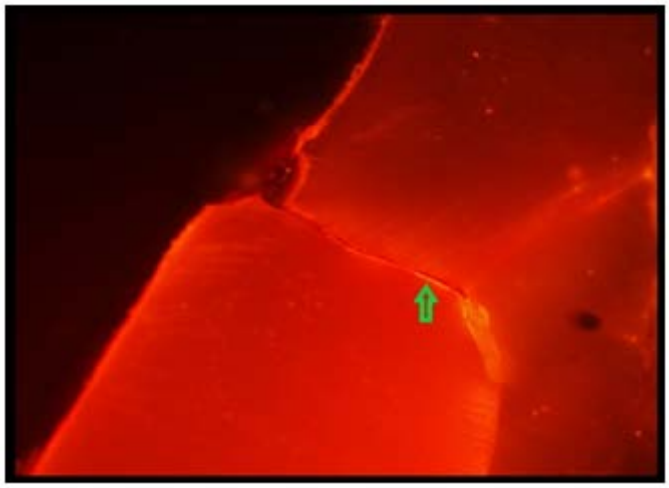


Figure 10: GRP 4

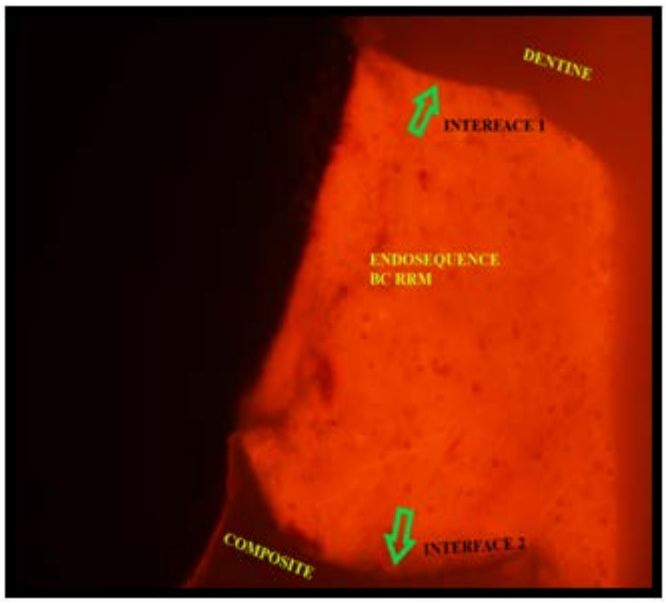


Figure 11: GRP 5

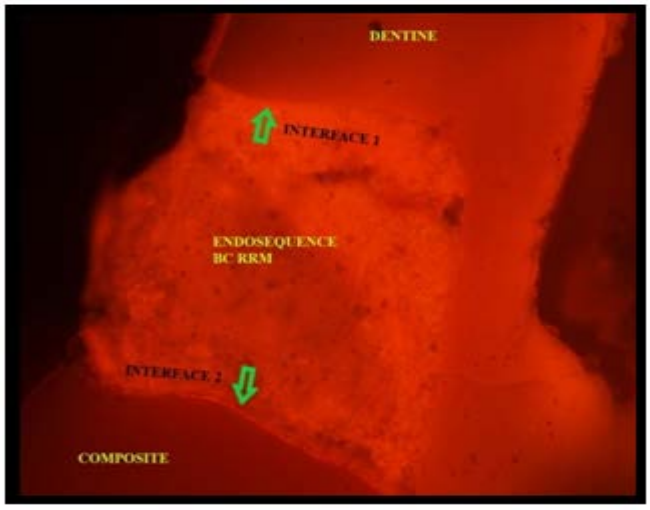


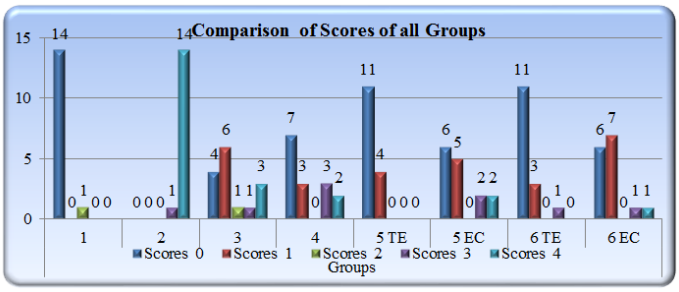
Figure 12: GRP 6

Observation and results

Data obtained was compiled on a MS Office Excel Sheet (v 2010, Microsoft Redmond Campus, Redmond, Washington, United States). Data was subjected to statistical analysis using Statistical package for social sciences (SPSSv21.0,IBM).

		Scores					Total	Chi sq value	p value of chi sq test
		0	1	2	3	4			
Groups	1	14	0	1	0	0	15	100.038	0.000**
	2	0	0	0	1	14	15		
	3	4	6	1	1	3	15		
	4	7	3	0	3	2	15		
	5 TE	11	4	0	0	0	15		
	5 EC	6	5	0	2	2	15		
	6 TE	11	3	0	1	0	15		
	6 EC	6	7	0	1	1	15		
Total		59	28	2	9	22	120		

Table 1



Graph 1

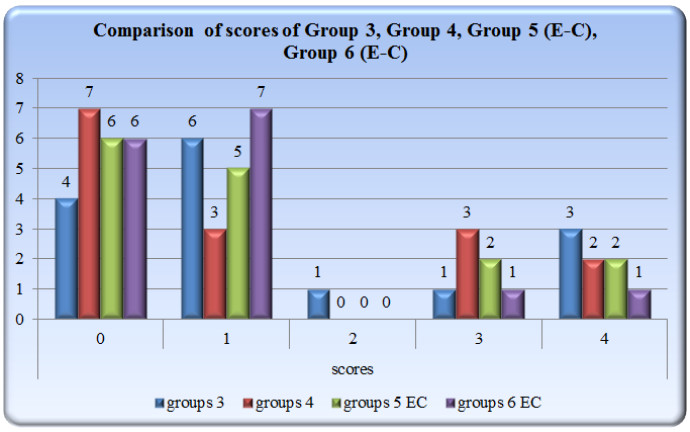
There was a statistically significant/highly significant difference seen for the frequencies between the groups ($p<0.01$, 0.05) with higher freq for score 0 in group 1, 5TE, 6TE, score 4 in group 2, score 1 in group 3.

There was a statistically non significant difference seen for the frequencies between the groups Group 3, Group 4, Group 5 (E-C), Group 6 (E-C) ($p>0.05$). (Table :1 &graph:1)

Comparison of scores of Group 3, Group 4, Group 5 (E-C), Group 6 (E-C)

		Scores					Total	Chi sq value	p value of chi sq test
		0	1	2	3	4			
Groups	3	4	6	1	1	3	15		
	4	7	3	0	3	2	15		
	5 EC	6	5	0	2	2	15	8.064	0.780#
	6 EC	6	7	0	1	1	15		
Total		23	21	1	7	8	60		

Table 2



Graph:2

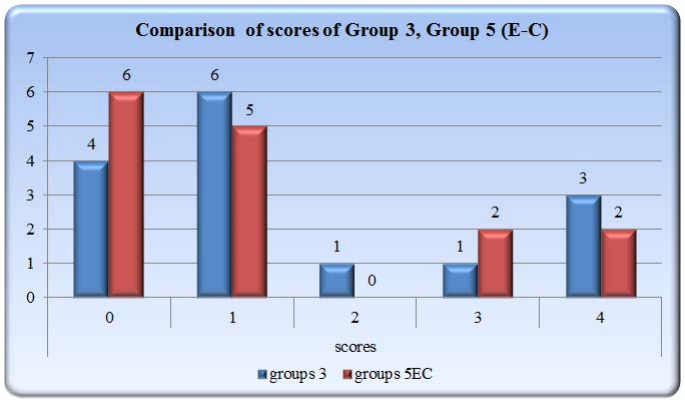
There was a statistically non significant difference seen for the frequencies between the groups ($p>0.05$).

(Table:2 & Graph:2)

Comparison of Scores of Group 3, Group 5 (E-C)

		Scores					Total	Chi sq value	p value of chi sq test
		0	1	2	3	4			
Groups	3	4	6	1	1	3	15		
	5EC	6	5	0	2	2	15	2.024	0.731#
Total		10	11	1	3	5	30		

Table 3



Graph: 3

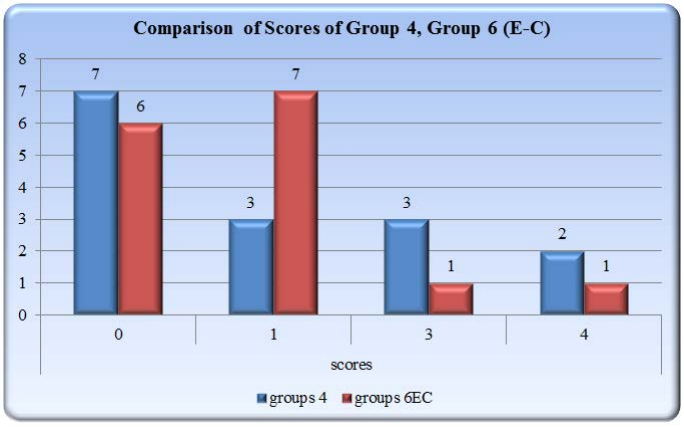
There was a statistically non significant difference seen for the frequencies between the groups (p>0.05)

(Table: 3 & Graph: 3)

Comparison of Scores of Group 4, Group 6 (E-C)

		Scores				Total	Chi sq value	p value of chi sq test
		0	1	3	4			
Groups	4	7	3	3	2	15		
	6EC	6	7	1	1	15	3.010	0.390#
Total		13	10	4	3	30		

Table 4



Graph 4

There was a statistically non significant difference seen for the frequencies between the groups (p>0.05).

(Table: 4 & Graph: 4)

Discussion

Bonding to dentine is one of the major challenges in adhesive dentistry mainly because of dentine's unique characteristics and inherent moisture content[3]. Compromised bonding leaves a microscopic gap that allows the infiltration of bacteria, fluids, molecules and ions between the prepared tooth and the restorative material applied to it [10]. Various studies have shown that it is the colonization of bacteria and their toxins at this interface and not the toxicity of the material which causes pulpal damage[11].

In the present study, Fluorescent Microscope at 10X magnification was used, similar to the studies done by Amish Diwanji, et al[12]. On analysing the microleakage scores of the gingival margin at tooth restoration interface, there was statistically significant reduction in microleakage seen in the groups where ERRM Fast set putty was used as gingival increment with higher frequency for score 0 in group 1, 5TE, 6TE as compared to non liner group 2, group 3 and group 4 as shown in Table 1 and Graph 1, which goes to say that placing a gingival increment of ERRM Fast set putty in deep proximal carious lesions resulted in less leakage as compared to direct placement of composite resin.

This could be due to resin tag-like structures, the Mineral infiltration zone formed by the diffused carbonate ions from the calcium silicate cement in the intertubular dentin, following denaturation by strongly alkaline cement. The nano-sized particles of calcium silicate hydrate gel formed on mixing, also would have helped the material to flow better, diffuse into the open dentinal tubules providing for good adaptation. ERRM Fast set putty also showed slight expansion on hydration providing for good seal[7]. These results are in accordance to the study done by Atmeh AR et al who evaluated the interfacial properties of calcium silicate cement and polyalkenoate cement to human dentine by confocal microscopy and fluorescent microscopy[13]. On comparing Group 3 and group 4 with group 5 (E-C) and group 6 (E-C) samples, it was observed that there was no statistically significant

difference in microleakage in above compared groups as shown in table 2 and graph 2. From the above results we can conclude that Endosequence BC RRM Fast set putty can be used under the composite restoration. Results obtained in table 3 and graph 3 showed statistically no significant difference in microleakage between group 3 and group 5(E-C). Similarly on comparing group 4 and group 6(E-C) gave statistically non significant results as depicted in table 4 and graph 4. Results of the present study showed the efficacy of both the dentin bonding agent is similar when it is used directly on tooth surface as well as when it is used on the surface of ERRM Fast set putty material.

Conclusion

Within the limitations of this in-vitro study, it can be concluded that –

1. In deep class II composite open sandwich restorations, Endosequence RRM Fast set putty liner resulted in less microleakage.
2. There was no statistically significant difference in microleakage seen at tooth –restoration interface (interface 1) with the use of total etch/ self etch adhesive to, Endosequence RRM Fast set putty.
3. At Endosequence RRM Fast set putty -Composite resin interface (interface 2), microleakage in TEA group and SEA group was non significant.
4. One coat 7.0 adhesive is preferred over prime n bond nt adhesive in deep class II open sandwich restorations with liner Endosequence RRM Fast set putty.

Further in vivo studies are required to determine the clinical validity of these techniques and since this is the first time endosequence bc rrm fast set putty is used as a liner under composite restoration in class II open sandwich technique, so results of this study can form basis for future similar studies.

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