COMPARATIVE EVALUATION OF MARGINAL MICROLEAKAGE IN AMALGAM RESTORATIONS OF PERMANENT AND PRIMARY TEETH– A STEREOMICROSCOPIC STUDY

Kotha Ravichandra Sekhar, **Aron Arun Kumar Vasa, ***Suzan Sahana, * Vijaya Prasad K.E.**

* Professor and Head
** Sr. Lecturer
*** Sr. Lecturer
**** Professor
Department of Pedodontics and Preventive Dentistry, St. Joseph Dental College, Eluru. India

ABSTRACT

Microleakage and lack of adhesion to the tooth structure are shortcomings that have limited dental amalgam's use in certain clinical conditions. Studies have shown that the use of adhesive resins as liners under amalgam will create greater retention than mechanical undercuts. The objective of this study is to evaluate the sealing ability of a dentin bonding agent when used as a liner around dental amalgam restorations of both the permanent and the primary teeth.

KEYWORDS: - ***Dental amalgam, Dentin bonding agent, Varnish, Marginal leakage.***

INTRODUCTION

Dental Amalgam has survived for nearly two centuries enduring a pattern of rises and falls with the dental profession and the public. Amalgam has many advantages including ease of manipulation, good wear resistance, long clinical service life and reasonable cost to the patient.[1] However, lack of adhesion and early microleakage are significant disadvantages to its use as a restorative material.

Microleakage is defined as the passage of fluid, bacteria, molecules or ions and air between a restorative material and a prepared cavity wall of a tooth. Microleakage of amalgam restorations can lead to tooth discoloration, marginal breakdown, dentinal sensitivity, secondary caries and pulpal irritation.[2] This microleakage poses a particular problem in the child patient in whom the floor of the cavity preparation may be close to the pulp.[3]

The use of cavity varnish to help control initial microleakage is an age old technique, but the solubility of varnish in oral fluids limits its effectiveness to about six months.[4] Since the mid-1980s adhesive resin systems have been advocated for use in bonding amalgam to tooth structure. Dentin adhesives, used as liners in amalgam restorations reduce microleakage, improve retention and strengthen restored teeth.[5]

This in-vitro study was undertaken to evaluate the sealing ability of a dentin bonding agent (3M Scotchbond™) and a fluoride varnish (Duraflur®) between cavity walls and amalgam restorations in both the permanent and primary teeth.

MATERIALS and METHOD (Fig. 1)

This study comprises of 30 non-carious human premolars and 30 non-carious human primary molars that were extracted. All the teeth were stored in normal saline at 37^0 C till the day experiment began. Class 1 cavities were prepared on the occlusal surfaces of all the teeth and the cavosurface walls were prepared to a butt joint. The prepared samples were randomly divided into 6 groups of 10 teeth each. Groups 1 and 2 cavities were lined with Dentine Bonding agent. Groups 3 and 4 were lined with fluoride varnish. Group 5 and 6 received no liner. Silver amalgam restorations were placed in all teeth. The restorations were left unburnished and unpolished since burnishing and polishing leads to a clear reduction of marginal leakage.[6]

The specimens were thermally stressed for 3000 cycles between 5^0 C and 55^0 C. Dwell time in each bath was 30 seconds. After thermocycling, teeth were dried followed by two coats of nail polish to within 1mm of the margin of the restorations. Root

apices were sealed with sticky wax and the teeth were kept in 2% methylene blue dye in a plastic tray at 37^0 C for 24 hours. After 48 hours, teeth were removed from 2% methylene blue dye and washed under tap water. Nail polish was removed and each tooth was sectioned buccolingually and each section was then viewed under a stereomicroscope at 10X magnification and scored for microleakage by two examiners. Microleakage scores were based on the degree of dye penetration according to the following scale.[2] (Fig. 2 & 3)

0 = No leakage

1 = Dye penetration less than halfway to the axial wall

2 = Dye penetration greater than halfway to the axial wall

3 = Dye penetration along the wall including pulpal wall

RESULTS

Pair-wise comparisons between groups were made with student - t test. To test whether the mean of 6 groups differ significantly or not f- test or analysis of variance has to be applied. Since the computed f – ratio > than the table f- ratio (critical ratio), the mean leakage of 6 groups differ significantly.

Table 1 – Pair wise Comparison between the groups

Groups	D.F	"t" Value	"P" Value	Significance
1 and 2	18	0.5	>0.1	NS
3 and 4	18	0.51	>0.1	NS
5 and 6	18	0.6	>0.1	NS
1 and 5	18	13.9	<0.001	HS
3 and 5	18	8.36	<0.001	HS
1 and 3	18	2.51	<0.05	S
2 and 6	18	14.2	<0.001	HS
4 and 6	18	5.47	<0.001	HS
2 and 4	18	1.91	0.05	S

DF – Degree of Freedom
HS – Highly Significant
S – Significant
NS – Not Significant

Table 2 - Analysis of Variance

Source of Variation	DF	Sum of Squares	Mean Sum of Squares	F. Ratio	Value
Between the Groups	5	73.53	14.71	40.11	<0.001
With in the Groups	54	19.8	0.37		

DISCUSSION

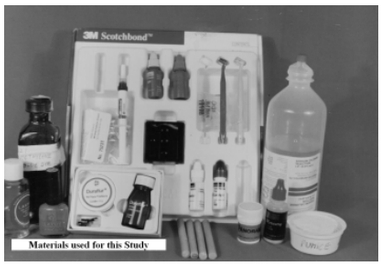
The purpose of the present study was to evaluate the microleakage of silver amalgam with two different liners, a dentin bonding agent and a fluoride varnish under class1 restorations in both the permanent and primary teeth. 2% methylene blue dye was employed due to its advantages of better penetration, less number of variables, diffusability, hard tissue non-reactivity over the radioisotopes and autoradiography which is an indirect measuring system, which in turn include more number of variables.[7]

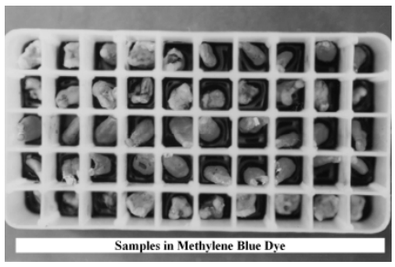
The dentin bonding agent used in this study is a third generation bonding agent (HEMA), a bifunctional hydrophilic molecule that is an outstanding adhesion promoter.[8] Addition of fluoride to amalgam definitely protects the tooth from recurrent caries by releasing small amounts of fluoride ions[9], but compressive strength is significantly reduced[10] Therefore fluorides in the cavity before the filling insertion seems to be a safe and approved method against secondary caries and this is considered whenever possible.[11]

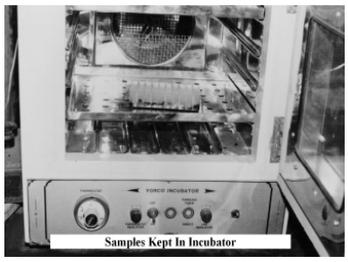
Comparing the pattern and extent of microleakage, in case of dentin bonding agent and fluoride varnish lined restorations, a more restricted pattern of microleakage is seen.

In contrast, dye is observed to penetrate into dentinal tubules and invade towards the pulp in unlined restorations.

Pair- wise comparisons between groups in this study proved that the dentin bonding agent lined restorations reduced microleakage significantly in both the permanent and primary teeth than either the fluoride varnish or unlined restorations.[12] Varnish lined restorations reduced microleakage significantly when compared to unlined groups but not that much effective as the bonded amalgam restorations. Studies have proved that varnish is effective in preventing microleakage till the corrosion products form. This coupled with the benefit of anticariogenic properties of fluoride varnish may be beneficial in preventing recurrent caries till the corrosion products form to seal the cavity margins totally.[11]







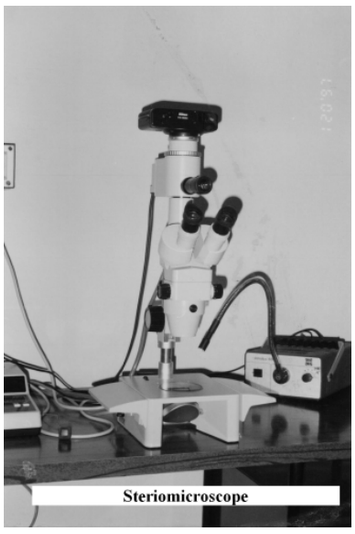


Fig. 1. **Materials and Equipments used in the study**

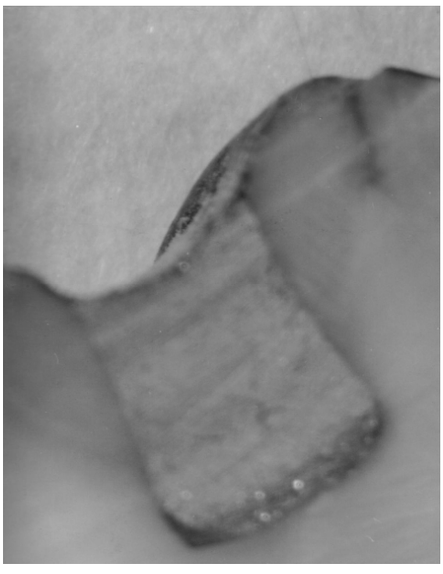


Fig.2. **Stereomicroscopic picture of Group 1 cavity- lined with Dentin Bonding Agent**.

Fig.3. **Stereomicroscopic picture of Group 6 cavity- No liner.**

Successful sealing with a dentin bonding agent can be explained by adhesive bond formation to the calcium ions in the dentin and to the calcium ions in the dentin smear layer surface.[13] Fluoride varnish does not bond to the tooth or amalgam which can explain differential sealing ability of these two materials.

Results from this study demonstrate the effectiveness of dentin bonding agent in sealing the cavity walls of the amalgam restorations in comparison to either fluoride varnish or no liner in both the permanent and primary teeth.[14] However, many variables influence the microleakage. Stresses as a result of thermocycling and amalgam shrinkage may cause separation of the amalgam from the liner. The type of alloy selected, method of trituration, method of cavity preparation, amalgam finishing, technique of application of varnish, the type of cavity, the type of liner used and the technique sensitivity are some of the many variables that influence the study. This study does not address the above mentioned variables. Further investigation of the mechanical properties of the amalgam-resin layer and its clinical implications are warranted. Clinical trials are also required to evaluate the long term in-vivo performance of resin lined amalgam restorations in the oral environment. [15]

CONCLUSION

The results showed that the dentin bonding agent reduced microleakage significantly in both the permanent and primary teeth than either the fluoride varnish or the unlined restorations. When comparing the permanent and the deciduous teeth, a higher degree of microleakage was seen in the deciduous teeth than in the permanent teeth. However, statistically no significant differences in leakage patterns between the permanent and primary teeth was observed. Eventhough in-vitro studies provide evidence for the sealing ability of dentin adhesive liners around amalgam restorations, clinical trials are required to document long term clinical performance.

REFERENCES

1. Jordan RE, Suzuki M, Boksman L. The new generation amalgam alloys: Clinical considerations. Dent Clin North Am 1985;29:341-58.
2. Saiku JM, St Germain HA Jr, Meiers JC. Microleakage of a dental amalgam alloy bonding agent. Oper Dent 1993;18:172-8.
3. Myaki SI, Rodrigues CR, Raggio DP, Flores TA, Matson MR. Micro leakage in primary teeth restored by conventional or bonded amalgam technique. Braz Dent J 2001;12:197-200.
4. Ben-amar A. Reduction of micro leakage around new amalgam restorations. J Am Dent Assoc 1989;119:725-8.
5. Gwinnett AJ, Baratieri LN, Monteiro S Jr, Ritter AV. Adhesive restorations with amalgam: guidelines for the clinician. Quintessence Int 1994;25:687-95.
6. Arcoria CJ, Fisher MA, Wagner MJ. Microleakage in alloy-glass ionomer lined amalgam restorations after thermocycling. J Oral Rehabil 1991;18:9-14.
7. Going RE, Massler M, Dute HL. Marginal penetration of dental restorations by different radioactive isotopes. J Dent Res 1960;39:273-84.
8. Nakabayashi N, Takarada K. Effect of HEMA on bonding to dentin. Dent Mater 1992;8:125-30.
9. Skartveit L, Tveit AB, Ekstrand J. Fluoride release from a fluoride-containing amalgam in vivo. Scand J Dent Res 1985;93:448-52.
10. Buonocore MG, Tani Y. Comparison of marginal leakage of conventional and spherical alloy amalgams with and without stannous fluoride. N Y State Dent J 1968;34:541-9.
11. Jahn KR, Schmiedeknecht U. Clinical controlled trial for secondary caries preventive effect of Duraphat on cavity walls. Dtsch Stomatol. 1990;40:420-2.
12. Berry FA, Parker SD, Rice D, Munoz CA. Microleakage of amalgam restorations using dentin bonding primers. Am J Dent 1996;9:174-8.
12. Van Meerbeek B, Inokoshi S, Braem M, Lambrechts P, Vanherle G. Morphological aspects of the resin-dentin interdiffusion zone with different dentin adhesive systems. J Dent Res 1992;71:1530-40.
13. Royse MC, Ott NW, Mathiew GP. Dentin adeesive superior to copal varnish in preventing microleakage in primary teeth. Pediatr Dent 1996;18:440-3.
14. Staninec M, Artiga N, Gansky SA, Marshall GW, Eakle S. Bonded amalgam sealants and adhesive resin sealants: five-year clinical results. Quintessence Int 2004;35:351-7.

Corresponding Author :

Dr. K. Ravichandra Sekhar **MDS**

Professor and HOD, Department of Pedodontics and Preventive Dentistry,
St. Joseph Dental College, Eluru. India
kotharavi@rediffmail.com
Ph: -+91-98490-49668
Ph: - +91-8812-277634