DENTIN ADHESIVE LINER VS COPAL VARNISH FOR THE PREVENTION OF POSTOPERATIVE SENSITIVITY IN AMALGAM RESTORATIONS

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ABSTRACT

Objective: To compare the efficacy of dentin adhesive liner with Copal varnish for the prevention of postoperative sensitivity in amalgam restorations.

Study Design: Quasi experimental study.

Place and Duration of Study: The study was conducted at operative dentistry department, 28 Military Dental Centre, Lahore for nine months, from Nov 2017 to Jun 2018.

Methodology: Two Hundred and Six patients of 18 to 40 years age group, requiring class 1 restorations in their teeth. The subjects were randomly divided into two equal groups. The test teeth were isolated and assessed for sensitivity by the application of ethyl chloride. Class 1 cavities, not exceeding 2mm in depth were prepared. Two coats of Copal varnish (Copalite, Cooley & Cooley Ltd. USA.) were applied on enamel and dentin surfaces in group A. In group B, the surfaces were acid etched and dentin adhesive liner (Adper™ Single Bond Plus Adhesive 3M ESPE) was applied and cured for 10 seconds. The prepared cavities were restored with admixed amalgam using Ultracaps S capsules, and evaluated for sensitivity at 24 hour and one week interval post-operatively. Data were analyzed by SPSS version 21.

Results: Comparing both groups after the procedure, group B showed statistically significant lower mean VAS score than group A, at 24 hour (p<0.001) and seven days (p=0.001) intervals postoperatively.

Conclusion: Dentin adhesive liner was more effective than Copal Varnish in reducing postoperative sensitivity when used under amalgam restorations.

Keywords: Dentin adhesive, Dental amalgam, Postoperative sensitivity.

INTRODUCTION

Amalgam has successfully been used as most popular posterior tooth restorative material for over 150 years[1-3]. It accommodates approximately 75% of the restorative materials used by the dentists[4]. It is popular because of its superior qualities, such as easy manipulation, good wear resistance, low technique sensitivity, acceptable life expectancy and low cost. However, it has some disadvantages including inferior aesthetic appearance, local degradation, occasional allergic responses to some of its components, toxicity of mercury and most importantly, postoperative sensitivity, that has a serious adverse impact on patient satisfaction[1,5].

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Micro leakage is considered to be one of the main causes of the postoperative sensitivity in amalgam restorations[6]. Brannstrom explained it with the help of his well-known hydrodynamic theory of pulpal sensitivity[7]. According to this theory, fluid movements with in the dentinal tubules stimulate pulpal mechano-receptors resulting in pain. He concluded that sealing of the dentinal tubules in the cavity walls, should prevent micro leakage, thereby reducing or eliminating postoperative sensitivity. When amalgam is initially applied, a micro space does exist between the restoration and the cavity walls. The size of this space and the permeability of dentin are the main factors that allow free movement of fluid within the dentinal tubules, which is interpreted as pain by the pulpal mechano-receptors. However, this sensitivity disappears within a few weeks after placement of amalgam restorations. Sealing of the margins of the

restoration by corrosion products and organic aggregates is the possible mechanism for the resolution of this problem[8]. Though it resolves itself with time, it still is considered a significant issue in the spectrum of dental health care, which can potentially influence patient's attitude towards continued dental care. To overcome this problem, over the years, dental clinicians have been using various insulating materials including cements and varnishes. Ben-Amer *et al*. and Going, for the first time, noted considerable reduction in postoperative sensitivity, when Copal Varnish was used as a sealer on freshly cut dentin[9].

Varnishes are not stable in oral environment and demonstrate some breakdown in oral fluids. Nevertheless, they worked well with the traditionally used low copper amalgam alloys that inherited higher tendency for corrosion. The corrosion products would fill the gap created by the dissolution of varnish and thus would prolong the seal of the restorations. In the present day dentistry, due to its superior properties, high copper amalgam alloys are used that have low corrosion tendency, and would eventually produce a partial seal at the tooth restoration interface[4]. A number of materials, other than Copal Varnish, have been used which include calcium hydroxide cements, zinc oxide and eugenol bases, zinc phosphate bases and many more[4,10-12]. Copal vanish is routinely used under non-insulating amalgam as barrier against bacteria, toxins and temperature. Its two coat application has been theorized to reduce dentine permeability by 69%. At the same time these varnishes have been reported to provide low insulating, uneven film, low biological properties, high solubility over time and lack of adhesion between amalgam and dentine.

Recently, dentin bonding agents (DBA) have gained popularity, owing to its additional benefits of superior adhesion to amalgam and sealing of dentinal tubules thereby reducing sensitivity. A recent study has reported that DBA reduce post-operative sensitivity on long term basis, however its immediate effects are yet to be tested[10]. If proven to be effective in treatment of immediate postoperative sensitivity, it would be a more suitable material for lining under amalgam restorations than Copal Varnish.

METHODOLOGY

This quasi experimental study was conducted at the department of operative dentistry, 28 Military Dental Centre, Lahore for nine months from November 2017 to June 2018. Approval of the ethical review committee was obtained prior to the start of work. 206 Patients of either gender, aged 18-45 years having pits and fissure caries detected on clinical examination in posterior teeth (requiring class 1 restorations) were selected using Consecutive (non-probability) technique. A written informed consent was obtained from the patients. Digital periapical and bitewing radiographs were taken and vitality of the subject teeth was tested using EPT (Electric pulp tester Sybron Endo, Orange CA). Patients having pre-existing generalized or localized hypersensitivity, history of bruxism or allergy to dental restorative material were excluded. Teeth with any kind of defect, pre-existing restoration, non-vital, having cavity deeper than 2mm (on bitewing radiograph) or taking analgesic medicines were also excluded.

The subjects were randomly divided into two equal groups with the help of computer generated table of random numbers, group A signifying Copal Varnish and group B signifying dentin adhesive liner. Total expenditure of the study was paid by 28 Military Dental Centre. Prior to any operative procedure, test tooth was isolated with the help of rubber dam. Patients were educated and advised to mark on the VAS according to intensity of their sensitivity in test tooth, when cold stimulus (Ethyl Chloride Spray on cotton pellet) was applied. The stimulus was applied maximally for 5 seconds using stop watch. Class l cavities not exceeding 2 mmin depth, were prepared with round diamond bur in air turbine hand-piece with copious irrigation of water, keeping in mind all the principles of hygienic cavity preparation.

Enamel and dentin surfaces of group A preparation were lined with Copal varnish. (Copalite, Cooley & Cooley Ltd. USA.) Two coats were applied using applicator brush. After each coat the cavity was gently air dried. In group B preparation, the enamel and dentin surfaces were acid etched with ScotchbondTM etchant for 15 seconds and rinsed for 10 seconds with water from the three-way dental unit syringe. After removing excess water with a cotton pellet, dentin adhesive liner (Adper™ Single Bond Plus Adhesive 3M ESPE) was applied for 15 seconds and then thinned with a gentle stream of air using three-way dental unit syringe. Light curing was done for 10 seconds.

Prepared cavities of both group A and B were restored with high copper amalgam (Ultra-caps S, SDI Dental Limited Dublin Ireland). Restored teeth were evaluated, 24 hours and 7th day post-operatively, for sensitivity as evaluated at first visit with the help of VAS scale, and the patient response was recorded in Proforma. Phone contacts were taken and follow up was ensured.

The data were analysed by SPSS (version 21). Descriptive statistics were calculated for both qualitative and quantitative variables. Paired samples t-test was used to compare pre and post-operative sensitivity with cold application for group A and B at base line, 24 hours and one week. Independent samples t-test was used to compare VAS score at 24 hour and one week between two groups. The *p*-value of ≤0.05 was considered as statistically significant.

RESULTS

The study subjects were 206 patients requiring restorations for class I cavities. Each treatment group had 103 patients. According to the laid out protocol, a single operator (principal investigator: An operative dentist) evaluated all the patients at baseline and performed the procedure. The patients were recalled at 24 hour and 7th day, for postoperative evaluation by the same operator.

Comparison of the two treatment groups was carried out for baseline characteristics to assess for effectiveness of randomization and assessment of bias. Mean of ages in group A was 29.86 ± 5.74 years, and in group B was 28.82 ± 6.35 years (table-I). There was no statistically significant difference between the ages of the treatment groups (*p*=0.215). The distribution of male and female patients in the treatment groups was almost equal. There were 60 male (58.3%) and 43 female (41.7%) patients in group A, and 62 male (60.2%) and 41 female (39.8%) patients in group B. Both the groups were comparable with respect to gender (*p*=0.777). Comparison of sensitivities to cold application (mean VAS score) before the treatment for group A and B was 2.08 ± 0.518 and 2.11 ± 0.625 respectively. There was no statistically significant difference between the sensitivities of the two groups at baseline (*p*=0.716) (table-I).

Table-I: Comparison of age and VAS at different times.

Variable	Group A	Group B	*p*-value
Age	29.86 ± 5.74	28.82 ± 6.35	0.215
VAS at baseline	2.08 ± 0.518	2.11 ± 0.625	0.716
VAS at 24 hours	3.77 ± 0.920	2.57 ± 0.775	<0.001
VAS at 7th day	3.53 ± 0.850	3.14 ± 0.841	0.001

Table-II: Time wise comparison group A.

Variable	Mean difference	*p*-value
Baseline - 24 hours	-1.834	<0.001
24 hours - 7th day	0.002	<0.001
Baseline - 7th day	-1.608	0.048

Table-III: Time wise comparison group B.

Variable	Mean difference	*p*-value
Baseline - 24 hours	-0.47	<0.001
24 hours - 7th day	-0.563	<0.001
Baseline - 7th day	-1.029	<0.001

At post treatment evaluation group A showed mean VAS score of 3.77 ± 0.920 and 3.53 ± 0.850 at 24 hours and one week interval respectively. Whereas group B showed mean VAS score

of 2.57 ± 0.775 and 3.14 ± 0.841 on likewise evaluation (table-I). Comparing both groups after the procedure, group B showed statistically significant lower mean VAS score than group A, at 24 hour (p<0.001) and one week interval (p=0.001) (table-I). Time-wise comparison of sensitivities of group A and group B were carried out which showed statistically significant differences, p<0.05 (table-II & III).

The main outcome of our study was that Dentin adhesive liner (Adper™ Single Bond Plus Adhesive 3M ESPE) is more effective than Copal varnish (Copalite, Cooley & Cooley Ltd. USA) in reducing postoperative sensitivity when used with amalgam restorations.

DISCUSSION

Brannstrom and Nordenvall were the pioneer researchers who, for the first time, investigated the effects of micro-leakage on the pulp. Brannstrom concluded that pulp was damaged by infection which may occur from two sources: Bacteria in the smear layer and the ingress of bacteria via micro-leakage. Thus he emphasized on the removal of smear layer which would eliminate the bacteria present at tissue restoration interface[13]. Some scholars claimed that proper adaptation of the restorative material to the preparation walls and intact marginal seal were crucial for the long-term performance of the restoration[14]. Failure to stop micro-leakage may result in postoperative pain, recurrent caries, marginal staining and possible pulpal pathology[4]. Many investigators have demonstrated that dentin etching was the best method of smear layer removal and likewise dentin adhesive liners reduce micro-leakage by blocking dentinal tubules[15]. Liners and bases have been commonly used to make a marginal seal against micro-leakage. According to a study 50% of the study subjects experienced mild to moderate pain after dental restorations with conventional liners and cavity varnishes[13].

Sepetcioglu F and Ataman BA tested and compared the sealing ability of a cavity varnish and dental adhesive for reducing the micro-leakage when used with high copper amalgam restorations by chemical diffusion technique. They concluded that employing dental adhesive as an inter-facial sealer had significant advantages to decrease micro-leakage when compared with conventional Copal varnish[16]. In our study, we compared pulpal response in Copal Varnish and dentin adhesive liner under amalgam restorations, to a cold stimulus before the operative procedure and at a fixed interval after the procedure i.e. 24 hours and 7th day. The results clearly support the hypothesis that dentin adhesive is more effective than Copal varnish in the prevention of sensitivity in immediate post-operative period.

The results of our study were in consistent with a recent study conducted by Saba *et al*. who compared the post opearative sensitivity in amalgam restorations using copal varnish and DBA[10]. The data in their study was only 60 subjects while our study has large data (n=206). Secondly they compared the postoperative sensitivity only one time i.e. after one month (Long term) while we noted sensitivity 24 hours and one week postoperatively (short term). Therefore on comparing both studies this can be concluded that dentin adhesive is more effective than Copal varnish in the prevention of sensitivity in both short term and long term period.

Royse MC, Ott NW, Gregory P. Mathieu compared dentin adhesive liner (ProBond) with Copal varnish for micro-leakage under amalgam restorations in primary teeth[17]. Their study included sixty class V amalgam restorations divided into three equal groups. In one group Dentin adhesive liner was used, Copal varnish was used in other group, and the remaining 20 teeth were left unlined. All the teeth were thermo-cycled in 0.5% basic fuschin dye and were examined for micro-leakage. Except dentin adhesive liner, all the specimens demonstrated micro-leakage. This study was different from our study in several aspects. It was in vitro study on primary teeth with class V amalgam restorations as compared to our study which was in vivo study on permanent teeth with class I amalgam restorations.

Nevertheless, the findings of this study are entirely consistent with the results of our study.

Gallato A, Angnes G, Reis A and Loguercio AD evaluated the effect of amalgam type, liner type, and storage period on micro-leakage. They used high copper amalgam (admixed and spherical types) and three liner options (no liner, varnish, and dentin adhesive) to restore class V preparations in two hundred and seventy bovine incisors[18]. They observed significantly superior sealing for both the amalgams admixed and spherical types when the adhesive was used. For the no liner groups, the admixed alloy demonstrated better performance in comparison to spherical alloy. In the short term (one day and one week), the lowest degree of leakage was detected when dentin adhesive was used. In the long term (after one year), they observed no differences, regardless of the amalgam type and liner used. In the light of this study, sealing the amalgam restorations with dentin adhesive was useful in preventing the short term postoperative sensitivity till the corrosion products of amalgam fill the inter-facial gap and stop micro-leakage permanently. Spherical amalgams showed significantly high tendency for micro-leakage as compared to admixed andlathe-cut. The course surface texture of spherical amalgam may leave the surface channels open for micro-leakage[18]. In order to exclude this variable we used the same type of amalgam (admixed amalgam) for both of the study groups.

Willium D. Browning, Willium W. Johnson, and Paul N. Gregory highlighted the clinical performance of dentin adhesives used with amalgam restorations[19]. In their study, they compared dentin adhesive (Optibond, Kerr) with traditional basing techniques: Copal varnish and bulk base materials (Fleck's Mizzy) in large restorations, and concluded that placement of amalgam restorations with adhesive liners produced results equivalent to that of conventional methods over a 42 month period[19].

The evidence from this clinical study, and other clinical trials cited, supports the routine use of dentin adhesives as liner for amalgam restorations for the prevention of postoperative sensitivity. No toxic effects on the pulp have been reported[15].

This was a quasi experimental study and its strength can be judged from the quality control as it was maintained by single operator placing all the restorations in standardized clinical cases selected. Control group was not included in this study, so placebo effect could not be ruled out. Furthermore, it was a single blind study and bias of the operator could not be excluded. We recommend that double blind studies with other available DBA may be carried out. We also recommend that some device with digital thermometer may be used for evaluation of sensitivity to show the exact temperature of the stimulus.

CONCLUSION

Dentin adhesive (AdperTM Single Bond Plus Adhesive 3M ESPE) was more effective than Copal varnish (Copalite, Cooley & Cooley Ltd. USA.) in reducing postoperative sensitivity when used under amalgam restorations.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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