ORIGINAL ARTICLE

COMPARISON OF FREQUENCY OF POST OPERATIVE SENSITIVITY IN AMALGAM RESTORATIONS USING COPAL VARNISH AND DENTIN ADHESIVE LINER

Kiran Saba, Anser Maxood, Saeeda Abdullah, Amna Riaz, Shahab-ud-Din

Department of Operative Dentistry, Pakistan Institute of Medical Sciences, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad-Pakistan

Background: Micro leakage around the margins of a restoration is believed to be one of the main causes of postoperative sensitivity. Dental amalgam is a non-insulating material and has the potential to transfer heat and cold causing irritation of the pulp. Different dentin tubule sealers are used under amalgam restoration to compensate for this post-operative sensitivity. This study was conducted to compare the frequency of sensitivity in amalgam restorations using copal varnish and dentin adhesive liner (dentin bonding agent). **Methods:** A total of 60 patients of either gender, aged 18–40 years having class 1 carries in posterior teeth were included. Teeth with restorations, dentinal sensitivity and patients taking analgesic drugs for chronic pain conditions were excluded. The selected patients were placed randomly into Group A (copal varnish) & Group B (dentin adhesive liner), by using computer generated table of random numbers. Restored teeth were evaluated 1-month post operatively for sensitivity. **Results:** Mean age was 25.63±5.42 years. Out of 60 patients, 68.0% were females and 32.0% were males with a female to male ratio of 2:1. The mean post-operative pain score was 2.83±2.79 in Group A and in Group B, it was 1.43±2.14 with a *p*-value of 0.03. There was no pain on application of a cold stimulus in 14 (46.7%) patients in Group A (copal varnish) while in Group B (Dentin adhesive), no pain was seen in 23 (76.7%) patients with *p*-value of 0.02. **Conclusion:** This study concluded that dentin adhesive liner (dentin bonding agent) is better than copal varnish in reducing postoperative sensitivity in amalgam restorations.

Keywords: Dental caries; Amalgam; Microleakage; Dentin adhesive liner; Copal varnish; Postoperative sensitivity

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INTRODUCTION

Dentin sensitivity is seen as a result of dentinal tubules exposed to external stimuli. It is characterized by pain of short duration but sharp in nature when a stimulus is applied.[1] Microleakage at the tooth-restoration interface is believed to be one of the main causes of postoperative sensitivity following placement of restorations.[2] The most accepted explanation for tooth sensitivity is the hydrodynamic theory. According to this theory, fluid movement in the dentinal tubules is interpreted as pain by pulpal mechanoceptors.[3] Amalgam is a non-insulating material and has the potential to transfer heat and cold causing irritation of the pulp.[2] Postoperative sensitivity following the routine placement of an amalgam restoration is not unknown.[3] A variety of sealers are used to protect pulp, seal the dentinal tubules and compensate for postoperative sensitivity.

Cavity varnishes have been routinely used under amalgam restorations.[3] They were thought act as a barrier against bacteria and toxins and a two-coat application was theorized to reduce the dentin permeability by 69%.[4] But these cavity varnishes have been criticized for providing an uneven film, poor insulation, lack of biologic properties, lack of adhesion between tooth and amalgam and high solubility over time.[5] More recently, dentine bonding agents (DBA) have gained popularity and are introduced as a new way of sealing dentinal tubules.[3] DBA are thought to have a superior sealing ability as compared to varnishes.[6]

Amalgam restorations are commonly done in general dental practice and sensitivity is a common sequel of these restorations especially in the immediate post restoration period. It is quite distressing to the patients and has an adverse impact on patient's satisfaction. Although varnishes have been used as dentin sealers in the past, they are thought to degrade over time and hence do not provide any sealing effect for greater than one month. This effect is beneficial with low copper alloys in which corrosion products formed after one month seals the microleakage gap reducing the post sensitivity. The high copper alloys used nowadays take twice as long for the corrosion products to seal the microleakage gap compared to the low copper alloys. Hence the search for a better sealing agent under amalgam continues. Dentin bonding agent has the benefits of bonding to enamel and dentin as well as amalgam, if proven to be effective in the treatment of postoperative sensitivity, it will be a more suitable material for sealing the tubules under amalgam restorations than copal varnish. This study was

conducted to compare the frequency of sensitivity in amalgam restorations using copal varnish and dentin bonding agent as dentine tubule sealers.

MATERIAL AND METHODS

This Randomized controlled trial was done in Department of Operative Dentistry, Pakistan Institute of Medical Sciences (PIMS), Shaheed Zulfiqar Ali Bhutto Medical University (SZAMBU), Islamabad from January 2016 to June 2016, after approval from ethical committee. Total 60 patients of either gender, aged 18-40 years with class 1 carries in posterior teeth, detected on clinical (when an explorer sticks in the occlusal pits and fissures, visible caries on the occlusal surface, caries not involving the marginal ridge) and radiographic examination (showing lesions involving not more than middle third of dentine) were selected. Teeth with restorations, hypersensitivity, and patients taking analgesic drugs for chronic pain conditions were excluded. Sample size was calculated by taking level of significance as 5% and power of study as 80% using WHO formula:

$$Ss= Z^2 \times P_1 \times (1-P_2) \div C^2$$

Z=Confidence level, P_1 =Population 1, P_2 =Population 2 and C =Level of significance

Informed, written consent was taken from each patient. History, clinical examination and pulp vitality tests were performed. Total of 60 subjects were randomly divided into two equal groups with the of help of computer generated table of random numbers, Group A signifying copal varnish (Copalite, Cooley & Cooley Ltd. USA.) and Group B signifying dentin bonding agent (AdperTM Single Bond plus Adhesive 3M ESPE). Prior to any operative procedure, test tooth was isolated with a rubber dam. Patient was educated and advised to mark on a visual analogue scale (VAS) according to intensity of his sensitivity in test tooth when cold stimulus (Ethyl Chloride Spray on cotton pellet) was applied to the tooth. The stimulus was applied maximally for 5 seconds using stop watch. Class 1 cavities according to the inclusion criteria (i.e, radiograph showing lesions involving not more than middle third of dentine) were prepared with 245 carbide (inverted cone) bur (tip diameter 0.8 mm) in an air turbine handpiece with copious irrigation of water, keeping in mind all the principles of hygienic cavity preparation.

Enamel and dentin surfaces of Group A preparation was 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 and then restored with Amalgam (high copper alloy). In group B preparation, the enamel and dentin surfaces were acid etched with Scotchbond TM etchant for 15 seconds and rinsed with water for 10 seconds from a triple syringe. After dabbing with a cotton pellet to remove excess of water, dentin bonding agent (AdperTM Single Bond plus Adhesive 3M ESPE) was applied for 15 seconds and then thinned with a gentle stream of air using a triple syringe. Light curing was done for 10 seconds and the cavity was restored with amalgam (High Copper Alloy). The restorations were properly carved, burnished and were checked for proper occlusion. Restored teeth were evaluated 1-month post operatively for sensitivity as evaluated at first visit using ethyl chloride spray and the patient response was recorded using the VAS score. Final outcome was measured at 1 month.

The patient response on VAS score was categorized as 0–3= no pain while 4–10=pain.

The data was analysed by SPSS (version 20). Mean±S.D were calculated for quantitative variables age and pain at one month. Independent sample t test was used to compare mean pain score (i.e., cumulative pain score in each group as measured on VAS divided by the total number of patients in each group) between the two groups at one month. Frequencies and percentages were presented for gender. Chi square test was used to compare pain between two groups in terms of percentage of patients having post-operative sensitivity when a cold stimulus is applied. The difference was considered significant at $p<0.05$ level. Effect modifiers like age, gender and base line pain were controlled by stratification.

RESULTS

In this study age range was from 18 to 40 years with mean age 25.63±5.42 years. Out of 60 patients, 41 (68.0%) were females, with a female to male ratio of 2:1. The mean post-operative pain score (i.e., cumulative pain score in each group as measured on VAS divided by the total number of patients in each group) was 2.83±2.79 in Group A while it was 1.43±2.14 in Group B with a *p*-value of 0.03. Figure-1 shows post-operative pain in both groups at one-month interval in terms of percentage of patients having post-operative sensitivity when a cold stimulus is applied. The *p*-value was 0.02.

Percentage of individuals having different pain score on VAS is

- Pain score 0 was seen in 47% patients in Group A, 67% in Group B
- Pain score 3 was seen in 10% patients in Group A, 0% in Group B
- Pain score 4 was seen in 13% patients in Group A, and 7% patients in Group B.
- Pain score of 5 was seen in 17% patients in Group A, 13% in Group B.
- Pain score 6 on VAS was seen in 17% patients in Group A, 3% in Group B.

- Score of 7 was seen in 7% patients in Group A, 0% in Group B.

Table-1 shows pain distribution at one month according to gender with significant difference between both the sealers with less post-operative sensitivity with DBA compared to copal varnish in the females only (*p*-value 0.04). Table-2 shows pain distribution at one month according to age. There is no significant difference of pain between the two sealers at one month in age categories <25, 26–30 and 31–35. At the age Group 36–40 years there is a significant difference between both the sealers with less post-operative sensitivity with DBA compared to copal varnish (*p*-value 0.01)

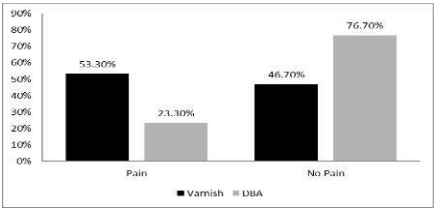

Figure-1: Post-operative pain in both Groups at one month (n=60). (*p*-value is 0.02)

Table-1: Pain at one month according to demographic data (Gender)

Gender	Sealer	No Pain (0-3)	Pain (4-10)	*p*-Value
Male	Varnish	54.55%	45.45%	0.12
	DBA	87.50%	12.50%	
Female	Varnish	42.11%	57.89%	0.04
	DBA	72.73%	27.27%	

Table-2: Pain at one month according to demographic data (Age)

Age Categories	Sealer	No Pain (0-3)	Pain (4-10)	*p*-value
<25	Varnish	55.6%	44.4%	0.22
	DBA	76.9%	23.1%	
26–30	Varnish	42.9%	57.1%	0.45
	DBA	62.5%	37.5%	
31–35	Varnish	25.0%	75.0%	0.27
	DBA	66.7%	33.3%	
36–40	Varnish	0.0%	100.0%	0.01
	DBA	100.0%	0.0%	

DISCUSSION

Postoperative sensitivity following the routine placement of an amalgam restoration is not uncommon even at the hands of expert clinicians. In this study, the frequency of post-operative sensitivity in amalgam restorations was compared between copal varnish and dentin adhesive liner.

A research conducted by Hajizadeh H, *et al*, in 2008 concluded that both copal varnish and dentin bonding agent reduced post-operative sensitivity to cold in amalgam restorations as compared to the control group where no sealer was applied ($p<0.05$). There was no significant difference between groups receiving copal varnish and dentin bonding agent (DBA) ($p>0.05$). On the other hand, the current study concluded that there is a significant difference between the dentin bonding and varnish group with less sensitivity to cold stimulus in the dentin bonding group at one month. The most probable reason could be the fact that Hajizadeh H *et al* included teeth with a cavity no deeper than 2mm. In such superficial cavities, the huge amount of remaining dentin acts as a confounding factor in reducing post-operative sensitivity. Furthermore, the study used cold water to measure post-operative sensitivity which is a less reliable method of measuring sensitivity as compared to ethyl chloride. The study conducted by Hajizadeh H *et al* also had another significant result which is comparable to the current study and proves dentin bonding to be an effective dentin tubule sealer as compared to varnish. It states that teeth lined with dentin bonding agent experienced no more sensitivity to cold at 1 month than they did at base line while teeth lined with copal varnish showed an increasing sensitivity to cold over time.[7] This finding is because of the fact copal varnish has a tendency to break down over time.[8]

A study conducted by Schwartz compared dentin bonding agent and cavity varnish under amalgam restorations in class V carious lesions in 16 patients. The study concluded that there was less sensitivity in the dentin bonding agent group as compared to the copal varnish group at 24 hrs, 2 weeks and 4 weeks.[9] In the current study class I cavities in a total of 60 patients were treated with either copal varnish or dentin bonding agent. The results were comparable in that there was less sensitivity in the dentin bonding group as compared to the varnish group after a follow up period of one month.

Another study conducted by Browning in 1997, compared copal varnish and dentin bonding agent as sealers under amalgam restorations. Sixty patients with class I/class II cavities were included in the study. The authors measured the time it took the subjects to respond to a standardized stimulus of cold water (cold response measure, or CRM) at baseline and one week after treatment. The study concluded that patients in the copal varnish group had significant decrease in the CRM (signifying less cold sensitivity) as compared to the patients in the dentin bonding group.[10] The results are different for the current study where patients in copal varnish group had more sensitivity to cold at one month as compared to those in the dentin bonding group. This is because of the fact that cold water is a less reliable method of measuring sensitivity as compared to ethyl chloride.

Another research conducted by Gordon VV also compared different liners and sealers under amalgam restoration for post-operative sensitivity. Patients were contacted on day 2, 7, 14, 30 and 90 and asked if the restored teeth were sensitive to any stimulus. Out of 19 patients in each group, 22% patients

in copal varnish group and 19% patients in dentin bonding had sensitivity at day 14. Although the results are similar to the current study with more patients in copal varnish group experiencing sensitivity as compared to the dentin bonding group, but the difference is not statistically significant.[11] The reason for this difference between the two studies is that in the study conducted by Gordon VV no proper vitality testing was employed. Patients were simply asked on phone whether the restored tooth was sensitive or not and if it was, what was the stimulus. This could lead to subjective results; while in the current study objective testing of tooth was done with ethyl chloride spray which leads to more reliable results.

Sensitivity is basically a measurement of microleakage. A research conducted by Cenci MS *et al*, in 2004 concluded that dentin bonding agent causes statistically less microleakage than copalite ($p<0.01$). Microleakage was assessed using dye penetration. The results showed that teeth lined with dentin bonding agent showed significantly less dye penetration as compared to teeth lined with varnish.[12] Similar results were obtained by other researchers who compared copal varnish and DBA for microleakage under amalgam restoration.[13–16] Since dentin bonding agent allows less microleakage, this is the reason why a significant number of patients in the dentin bonding group in the current study experienced less post-operative sensitivity with amalgam restoration.

Limitations of the current study are that cavity depth was not accurately defined since remaining dentine thickness could be a confounding factor in reducing postoperative sensitivity. Furthermore, evaluation of postoperative sensitivity was done at one-month interval only. Further research work is required to assess the effectiveness of both the sealers in the immediate post-operative period.

CONCLUSION

This study concluded that dentin adhesive is better than copal varnish in reducing postoperative sensitivity in amalgam restorations. So, it is recommended that dentin adhesive should be used as compared to copal varnish under amalgam restorations in order to reduce post-operative sensitivity.

AUTHORS' CONTRIBUTION

KS: Data collection, interpretation, Data analysis, article write up. AM: Topic selection, conceptualization of study design, Supervision. SA: Topic selection, conceptualization of study design. AR: Data collection and Data analysis. SUD: Proof reading and Review.

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Address for Correspondence:
Kiran Saba, CMpak Headquarters, Plot # 47, Kuri Road, National Park Area, Chak Shahzad Islamabad-Pakistan
Email: kiransaba5@gmail.com