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Dental Cavity Liners for Class I and Class II Resin-Based Composite Restorations

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ABSTRACT
Background: Dental cavity liners are commonly used in Class I and Class II RBC restorations to protect the pulp, promote healing, and improve restoration success.
Aim: This meta-analysis study aimed to evaluate the comparative effectiveness of different dental cavity liners in Class I and Class II resin-based composite restorations, with a focus on their role in reducing post-operative hypersensitivity and preventing long-term restoration failure.
Methods: A comprehensive investigation has been performed in databases involving PubMed, Embase, Cochrane Library, and Google Scholar, utilizing a combination of textual terms and medical subject headings related to dental cavity liners and postoperative hypersensitivity. Additional searches were performed on ClinicalTrials.gov, and references from selected investigations were reviewed to determine relevant observational research.
Results: The meta-analysis discovered statistically insignificant differences between groups regarding postoperative hypersensitivity and restoration outcomes. Specifically, POH by patient report (Y/N) ($Z = 1.60$, $P = 0.11$), POH evaluated utilizing the visual analog scale ($Z = 1.47$, $P = 0.14$; mean difference: 0.39, 95% CI: 0.11 to 1.37), and POH measured by cold response (CRM) at 1-week ($Z = 0.86$, $P = 0.39$) and 1-month follow-ups ($Z = 1.50$, $P = 0.13$) all showed no significant differences. Restoration failure at 1-year follow-up also demonstrated no significant difference between groups ($Z = 0.00$, $P = 1$).
Conclusion: This meta-analysis concluded that the use of dental cavity liners in Class I and Class II resin-based composite restorations did not significantly impact postoperative hypersensitivity or long-term restoration failure. These results suggest that modern adhesive systems may offer sufficient protection without the need for cavity liners. Future research should explore specific clinical contexts and newer liner materials to better inform restorative practices.

Keywords: postoperative hypersensitivity (POH), Class I restorations, Class II restorations, dental cavity liners, resin-based composite restorations.

INTRODUCTION

Dental caries indicates both the illness and the resulting lesion. The caries process happens within the biofilm, that remains permanently active with every pH fluctuation, resulting in lesions manifesting in the dental hard tissues **(1)**.

The biofilm microbiota that typically resides in the oral cavity in homeostasis changes to an acidogenic, aciduric, and cariogenic population as a result of frequent intake of sugars, which is the cause of dental caries. This shift may have a clinically invisible effect or lead to a visible carious lesion by causing a net mineral loss in the tooth's hard structures. Caries, the process, could be present in the absence of caries, the visible lesion **(1, 2)**.

Consequently, dental caries is classified as a dietary-microbial illness that necessitates a cariogenic biofilm and regular exposure to fermentable carbohydrates (fructose, glucose, sucrose, and maltose) from the foods we eat. It

is widely recognized that fluoride has the capacity for preventing caries, and it is additionally important to note that insufficient fluoride exposure is a contributing factor within the process of illness **(3, 4)**.
Dental caries is the most common illness on the globe, making it a significant healthcare problem. Although the illness is easily preventable, its occurrence has not significantly decreased over the past 30 years, and it is most prevalent in groups with poor socioeconomic status **(5, 6)**.
Dental cavity liners play an essential role in restorative dentistry, particularly in Class I and Class II RBC restorations. These liners are thin layers of material placed under the final restorative composite to provide a protective barrier for the pulp, promote healing, and enhance the overall success of the restoration. Cavity liners are selected for their ability to reduce microleakage, thereby decreasing the risk of postoperative sensitivity and secondary caries. Materials commonly used as liners include calcium hydroxide, which is noted for its antibacterial properties and capacity to stimulate dentin formation, and glass ionomer cements, appreciated for their chemical adhesion to dentin and fluoride-releasing ability that supports remineralization **(7, 8)**.
This meta-analysis research aimed to assess the comparative efficiency of variant dental cavity liners in Class I and Class II RBC restorations, focusing on their impact on reducing postoperative sensitivity and long-term prevention of secondary caries. The study will also explore the clinical decision-making process for selecting appropriate liners, considering recent advancements in adhesive technology.

PATIENTS AND METHODS

Search strategy: A comprehensive literature investigation has been performed across multiple databases, involving PubMed, Embase, Google Scholar, and the Cochrane Library. The investigation utilized both text terms and medical subject headings such as Class I restorations, Class II restorations, dental cavity liners, postoperative hypersensitivity, and resin-based composite restorations. Additional searches were performed in ClinicalStudies.gov, and the references of selected investigations and reviews have also been examined for identifying relevant observational research.

Inclusion criteria: The investigation involved in the analysis has been randomized controlled clinical studies comparing the utilization of cavity liners in Class I and Class II posterior resin-based composite restorations within permanent teeth. The two split-mouth and parallel study designs were eligible. Participants were required to be either children or adults with at least one posterior permanent tooth receiving a Class I or Class II resin-based composite restoration.

Exclusion criteria: Studies were excluded if they focused on the following: bases, amalgam or metallic restorations, indirect restorations, anterior restorations, or in vitro studies.

Data extraction: Two researchers conducted separate assessments of the titles and abstracts of all the papers generated to determine their relevance. We thoroughly examined each trial that was discovered and decided about whether to include it or not. Researchers also independently extracted the data into a standardized data extraction form. The two reviewers established a consensus on decisions about the inclusion of research and data extraction. The 3rd researcher (JJS) would have the final authority to determine trial eligibility and extract data where discrepancies have been discovered.

Outcome measures

Primary outcomes: 1. After the intervention, the case suffered from postoperatively hypersensitivity to cold, biting, heated, sweets, and/or chewing in one month. 2. Postoperative hypersensitivity could be assessed by a visual analog scale, absent as tested by the dentist or case self-report, or by hypersensitivity present. 3. Restoration failure. 4. The resin-based composite restoration's survival time (measured in months) from the time of placement with at least monitoring of one year.

2ry outcomes: 1. Cost of materials. 2. Negative consequences: tooth fracture, pulpal involvement, any other adverse event described in any of the studies, hypersensitivity reactions to the materials, etc.

Statistical analysis: All data analysis was conducted with Review Manager version 5.4.1. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014. We computed the odds ratio with a 95% confidence interval for binary results. We computed the mean variance with a 95% confidence interval for continuous results. To determine the overall impact and calculate the 95% confidence interval, we utilized a fixed-impact model utilizing the Mantel-Haenszel technique in the absence of heterogeneity between the investigations. A random- impact model utilizing the DerSimonian and Laird approaches was selected. The heterogeneity among investigations was assessed utilizing the Q statistic and I^2 test, that indicate the percent of variability in the impact estimations. A P-value of less than 0.05 was represented as significant.

RESULTS

A total of 7 studies were selected for the current analysis, including a total of 705 cases. The publication year ranged from 2001 to 2013. 1 study was carried out in Saudi Arabia, 1 study was carried out in Thailand, and 1 study was conducted in each of the following: Turkey, Thailand, USA, Germany, and USA. Baseline features of the involved investigation are shown within Table 1.

Table 1. Study characteristics

Author, year	year	Sample Size		
		liner	no liner	Total
Akpata 2001	2001	44	44	88
Burrow 2009	2009	51	52	103
Efes 2006	2006	54	54	108
Banomyong 2013	2013	31	31	62
Strober 2013	2013	168	176	344
Boeckler 2012	2012	-	-	-
Browning 2006	2006	-	-	-

Meta-analysis of Outcome

Postoperative hypersensitivity by case report (Y/N)

Three studies reported by patient report (Y/N) can be used. No significant heterogeneity was detected. Therefore, a random-impact model has been utilized for analysis (I^2 = 0%, P-value = 0.84). The combined mean difference and 95% confidence intervals were -0.46 (0.18 to 1.19). The combined result demonstrates statistically insignificant variance among groups regarding POH by case report (Y/N) (Z-value = 1.60, P-value = 0.11).

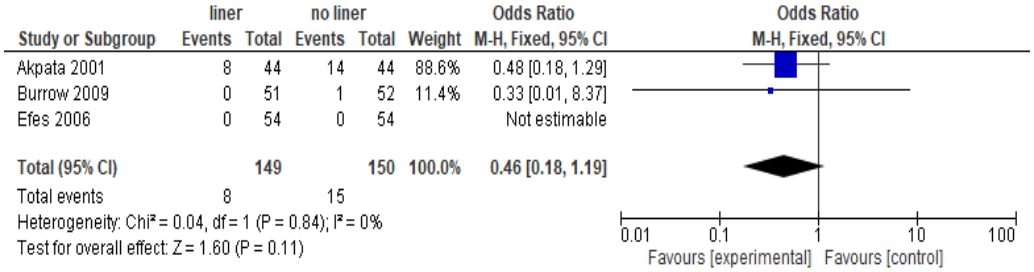

Fig. 1. Forest plot of POH shows statistically insignificant variance among groups.

Postoperative hypersensitivity by patient report (VAS)

Three studies reported (POH) by patient report (VAS) can be used. A no significant was detected. Therefore, a random-effects model was used for analysis. The combined mean difference and 95% confidence intervals were 0.39 (0.11 to 1.37). The combined outcome demonstrates statistically insignificant variance among groups regarding POH by case report (VAS) (Z-value = 1.47, P-value = 0.14).

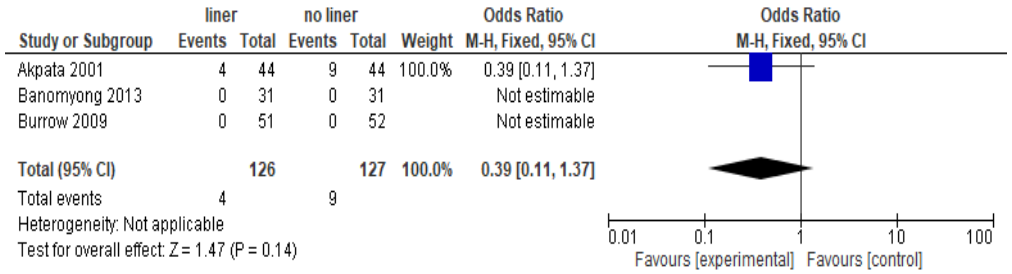

Fig. 2. A forest plot of POH by patient report (VAS) shows statistically insignificant variance among groups.

Postoperative hypersensitivity (POH) by patient report cold response measurement (CRM) (VAS) at 1 week follow-up

Two studies reported (CRM) (VAS) 1 week follow-up and be used. No significant heterogeneity was detected. Therefore, a random-impact model has been utilized for analysis (I^2 = 0%, P-value = 0.94). The combined mean difference and 95% confidence intervals were -0.20 (-0.66 to -0.26). The combined result demonstrates

statistically insignificant variance among groups regarding (CRM) (VAS) 1 week follow-up (Z-value = 0.86, P-value = 0.39).

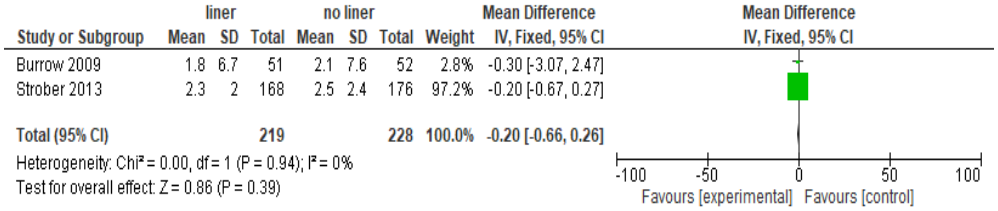

Fig. 3. Forest plot of POH by patient report (CRM) (VAS) at 1 week of monitoring demonstrates statistically insignificant variance among groups.

Postoperative hypersensitivity (POH) by patient report cold response measurement (CRM) (VAS) at 1 month follow-up

Two studies reported (CRM) (VAS) 1 month follow-up and be used. No significant heterogeneity was detected. Therefore, a random-impact model has been utilized for analysis (I^2 = 0%, P = 0.45). The combined mean difference and 95% confidence intervals were -0.33 (-0.76 to -0.010). The combined result demonstrates statistically insignificant variance among groups regarding (CRM) (VAS) one-month follow-up (Z-value = 1.50, P-value = 0.13).

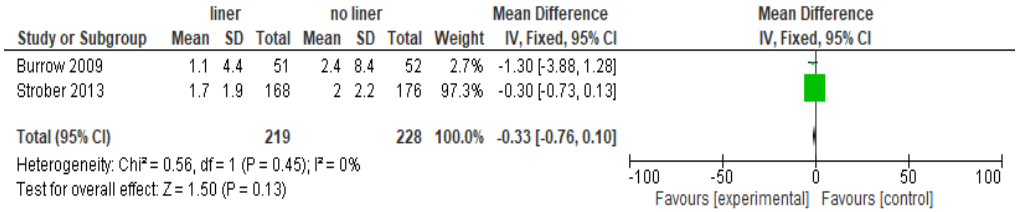

Fig. 4. Forest plot of POH by patient report (CRM) (VAS) at 1 month monitoring demonstrates statistically insignificant variance among groups.

Restoration failure after 1 year of follow-up between liner and no liner

Four studies reported restoration failure with 1 year of follow-up and should be used. The combined mean difference and 95% confidence intervals were 1.00 (0.06 to -17.07). The combined outcome demonstrates statistically insignificant variance among groups regarding restoration failure one-year follow-up (Z = 0.00, P = 1).

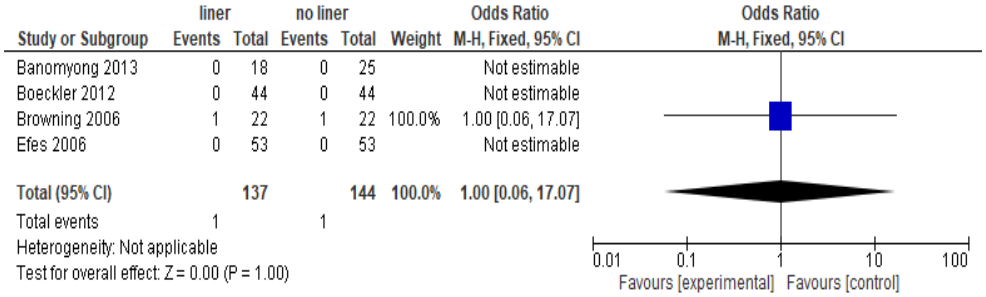

Figure 5. Forest plot of restoration failure after 1 year follow-up between liner and no liner demonstrates statistically insignificant variance among groups.

DISCUSSION

At present, resin-based composite (RBC) is recognized as a viable material for the restoration of caries in posterior permanent teeth that necessitate surgical management. Postoperative hypersensitivity persists occasionally, regardless of the reality that the thermal conductivity of the RBC restorative material closely approximates that of natural tooth structure. In the past, dental cavity liners were utilized for protecting the pulp from the harmful effects of certain dental restorative materials and for preventing the pain associated with thermal conductivity. This is achieved by establishing an insulating layer among the remaining tooth structure and the restorative material **(16)**.

In the current meta-analysis study, the combined results demonstrated statistically insignificant variance among groups regarding POH by case report (Y/N), patient report (VAS), (CRM) (VAS) 1 week follow-up, (CRM) (VAS) 1 month follow-up, and restoration failure 1 year follow-up.

These results were consistent with Akpata ES et al. (9) who found that regarding cold response measurements after a one-month following surgery duration, insignificant variance ($P > 0.05$) was discovered among the occurrence of sensitivity following surgery if the restored teeth received a lining of either adhesive bonding system or glass-ionomer.

Also, Burrow MF et al. (10) measured POH via a yes/no CRM. Again, no difference between cavities prepared with and without liners was shown at either one week.

Additionally, these results were supported by Browning WD et al. (15) who revealed that in terms of restoration failure, no variance in restoration failure rates was demonstrated at 1-year monitoring, with no failures stated within either group.

An additional study Wegehaupt F et al. (17) instructed patients to record "whether any hypersensitivity, pain, or discomfort occurred following treatment." Nine of 75 patients in the liner group and 12 of 48 patients that did not receive a liner responded "yes" when asked if any hypersensitivity, pain, or discomfort occurred after the restoration was placed. Based on these data, they concluded that the prevalence of hypersensitivity or pain isn't influenced by the restorative system, calcium hydroxide lining, or remaining dentin thickness. There was no information regarding when this POH occurred.

In contrast with our study, a previous systematic review conducted by Schenkel AB et al. (16) included 8 investigations, recruiting more than 700 subjects, comparing the utilization of dental cavity liners to the absence of liners for Class I and Class II resin-based composite restorations. They found that the evidence according to hypersensitivity following surgery was inconsistent, with a benefit observed at certain time points yet not at others (poor-quality evidence). This was assessed utilizing either the cold response or case-reported data.

CONCLUSION

These findings suggest that the utilization of cavity liners in Class I and Class II resin-based composite restorations may not confer additional clinical benefits in terms of reducing POH or enhancing restoration durability over time. This insight challenges traditional practices and underscores the importance of considering recent advancements in adhesive technology that may provide adequate sealing and protection without the need for liners. Further research focusing on specific clinical scenarios and newer liner formulations may help refine the selection criteria and decision-making process in restorative dentistry.

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