

Comparative Evaluation of Dentinal Tubule Occlusion and Desensitizing Efficacy of Two SDF Containing Desensitizers: An *In Vitro* Study

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Abstract

Original Research Article

Background: Dentin hypersensitivity (DH) is a common clinical condition caused by exposed dentinal tubules. Silver diamine fluoride (SDF)-based desensitizers are widely used due to their tubule-occluding ability. This study aimed to compare the efficacy and durability of SDI Rivastar (SDI Ltd., Bayswater, VIC, AUS) and CariCure SDF (Prevest Denpro Limited) in dentinal tubule occlusion. **Materials and Methods:** Fifty dentin specimens were prepared from twenty-five extracted premolars and treated with 17% EDTA. Samples were divided into control, Rivastar and CariCure SDF groups. SEM analysis was performed immediately and after 30 days of simulated brushing. Data were analyzed using Kruskal–Wallis and Mann–Whitney U tests. **Results:** Both agents significantly occluded dentinal tubules compared to control ($p < 0.001$). CariCure SDF showed superior immediate occlusion. After 30 days, both agents maintained significant tubule occlusion with no statistically significant difference. **Conclusion:** CariCure SDF (Prevest Denpro Limited) demonstrated better immediate occlusion, while both agents showed comparable long-term effectiveness.

Keywords: Dentinal tubules, occlusion, extracted, desensitizing agents.

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INTRODUCTION

Dentin hypersensitivity (DH) is characterized by a short, sharp pain arising from exposed dentin in response to thermal, tactile, osmotic or chemical stimuli [1]. It is a prevalent condition that significantly affects patients' quality of life and daily oral function [2]. The most widely accepted explanation for DH is the hydrodynamic theory proposed by Brännström, which attributes pain to the movement of fluid within dentinal tubules, stimulating pulpal nerve endings [3]. Exposure of dentinal tubules may occur due to enamel loss, gingival recession, erosion, abrasion, or periodontal therapy [4,5]. Various treatment modalities have been proposed for DH management, broadly classified into nerve desensitization and tubule occlusion strategies. Among these, tubule occlusion is considered the most effective approach as it directly reduces dentinal permeability [6]. Common desensitizing agents include fluorides, oxalates, bioactive glasses, adhesives, and lasers [7,8]. Silver diamine fluoride (SDF) has emerged as a promising agent due to its combined effects of remineralization, antimicrobial action, and tubule

occlusion [9]. It forms insoluble precipitates such as silver phosphate and calcium fluoride within dentinal tubules, effectively reducing fluid movement [10]. Additionally, SDF has been shown to inhibit cariogenic bacteria and enhance dentin hardness [11]. SDI Rivastar (SDI Ltd., Bayswater, VIC, AUS) is a two-step SDF system containing silver fluoride followed by potassium iodide, which forms silver iodide precipitates to occlude tubules and reduce discoloration [12]. CariCure SDF (Prevest DenPro Limited) is a cleansing two step system, comprised of silver, fluoride and potassium iodide used to disinfect, desensitize, arrest or prevent dental decay, though limited evidence exists regarding its performance. Previous studies have demonstrated the effectiveness of SDF-based agents in reducing dentinal hypersensitivity and providing durable tubule occlusion [13,14]. However, comparative data between different SDF formulations remain limited. Thus, this study aimed to compare the immediate and long-term dentinal tubule occlusion efficacy of Rivastar and CariCure SDF.

MATERIALS AND METHODOLOGY

This in vitro study was conducted on 25 freshly extracted, non-carious human premolars following institutional ethical approval. Teeth with cracks, caries, or structural defects were excluded. Samples were stored in saline until use. Standardized Class V cavities (2 mm depth × 3 mm width) were prepared on buccal and lingual surfaces. Teeth were sectioned mesiodistally to obtain 50 dentin specimens. Specimens were polished and treated with 17% EDTA for 40 minutes to remove smear layer and expose dentinal tubules.

The samples were randomly divided: into 3 groups (n=15) in each group. 5 samples were kept as reserve

Group I (Control): No treatment

Group II (SDI Rivastar):

- IIa: Immediate
- IIb: After 30 days brushing

Group III (CariCure SDF):

- IIIa: Immediate
- IIIb: After 30 days brushing

SDI Rivastar was applied according to manufacturer instructions (silver diamine fluoride followed by potassium iodide). CariCure SDF was applied using a microbrush and allowed to react in similar manner. Specimens in subgroups IIb and IIIb underwent simulated brushing twice daily for 30 days under standardized load (250 g). Between cycles, samples were stored in artificial saliva. SEM analysis was performed at 3000× magnification. Tubule occlusion was scored using West *et al.*, criteria:

1. Complete occlusion
2. >50% occlusion
3. 25–50% occlusion
4. <25% occlusion
5. No occlusion

Statistical analysis was performed using SPSS version 31. Kruskal–Wallis ANOVA and Mann–Whitney U tests were applied ($p < 0.05$ significant).

RESULTS

Both SDI Rivastar and CariCure SDF showed significant occlusion compared to control ($p < 0.001$). CariCure SDF demonstrated superior immediate occlusion.

Table 1: Immediate Tubule Occlusion

Group	Mean ± SD
Control	4.60 ± 0.52
SDI Rivastar (IIa)	1.20 ± 0.42
CariCure SDF (IIIa)	1.00 ± 0.00

Both agents-maintained tubule occlusion with no statistically significant difference.

Table 2: Tubule Occlusion After 30 Days of Brushing

Group	Mean ± SD
SDI Rivastar (IIb)	1.60 ± 0.52
CariCure SDF (IIIb)	1.50 ± 0.53

($p = 0.62$, not significant)

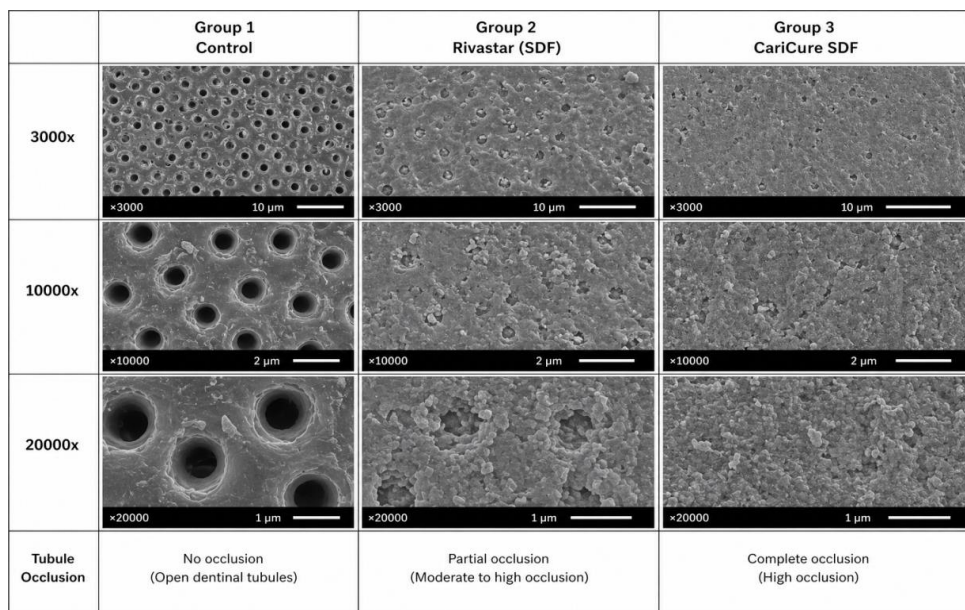


Figure 1: Scanning Electron Microscope (SEM) images of different SDF Desensitizers

DISCUSSION

The present study demonstrated that both SDI Rivastar and CariCure SDF effectively occlude dentinal tubules immediately after application, supporting previous findings on SDF-based desensitizers [15,16]. CariCure SDF showed superior immediate occlusion, which may be attributed to improved formulation characteristics allowing deeper penetration and rapid precipitation. Similar observations have been reported with modified SDF formulations showing enhanced tubule sealing [17]. After simulated brushing, both agents maintained significant occlusion, indicating good durability. This is consistent with studies reporting that SDF forms stable, low-solubility precipitates resistant to mechanical stress [18]. The slight reduction in occlusion after brushing aligns with findings from West et al. and Wang et al., who reported partial loss of tubule sealing due to abrasion while maintaining clinical effectiveness [19,20]. Compared to resin-based desensitizers, SDF agents demonstrate superior longevity due to their intrinsic tubule-penetrating mechanism rather than surface coating [21]. Clinically, CariCure SDF may provide faster relief due to superior immediate occlusion, while both agents are effective for long-term desensitization.

Limitations:

In vitro conditions do not fully replicate oral environment factors such as pH variations, saliva, and microbial activity. Further clinical studies are required.

CONCLUSION

Within the limitations of this in vitro study, both SDI Rivastar and CariCure SDF demonstrated significant efficacy in occluding dentinal tubules and thereby reducing dentin hypersensitivity. CariCure SDF exhibited superior immediate performance, producing more uniform and complete tubule occlusion, which suggests its potential advantage in providing rapid relief from hypersensitivity. However, following simulated brushing over a 30-day period, both agents maintained their desensitizing effect with no statistically significant difference between them, indicating comparable long-term durability. The sustained occlusion observed with both materials can be attributed to the formation of stable, insoluble precipitates within the dentinal tubules that resist mechanical challenges. Clinically, this suggests that while CariCure SDF may be preferred in situations requiring immediate symptom relief, both SDI Rivastar and CariCure SDF are reliable options for long-term management of dentin hypersensitivity. Further in vivo studies and randomized clinical trials are recommended to validate these findings under dynamic oral conditions and to assess patient-centered outcomes.

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