

Clinical Evaluation of Silorane-based Resin Composites in the Posterior Teeth: An 18 Months Follow-up Study

Mohammed Almuhaiza

ABSTRACT

The silorane-based resin composites have low polymerization shrinkage and stress, good stability in aqueous environments and insolubility in biological fluid stimulants compared with conventional dimethacrylate based composites. The aim of this study was to clinically evaluate the performance of silorane-based resin over a period of 18 months. The study was conducted in ten posterior restorations performed with silorane. Clinical evaluations were done periodically to evaluate the success of the restorations using predefined criteria. Eight out of ten restorations fulfilled all criteria up to 18 months. Two restorations had marginal chipping of the composite material. From this short-term clinical study, it can be concluded that siloranes can be used as an alternative to other posterior restorative composites. Further research over longer periods with larger samples are required to substantiate the current observations.

Keywords: Composite, Polymerization shrinkage, Silorane-based composite.

How to cite this article: Almuhaiza M. Clinical Evaluation of Silorane-based Resin Composites in the Posterior Teeth: An 18 Months Follow-up Study. *World J Dent* 2016;7(2):69-72.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

The quest for tooth-colored dental restorations have undergone tremendous development in the past and the modern composite resins has led to remarkable improvements in terms of optical properties, biocompatibility, physical strength, wear resistance and stability.¹ Siloranes, a new category of tooth colored restorative material has been recently introduced to overcome the problems related to polymerization shrinkage of the

composite resin restorations.² Silorane composites have chemical and mechanical properties comparable to traditional methacrylate composites, with some improved properties including decreased leachability, better dimensional stability, and greater hydrophobicity.^{3,4} The silorane matrix is formed by the cationic ring-opening polymerization of the silorane monomers in contrast to linear chain reaction of methacrylate, which crosslink via radicals. This change has resulted in significant reduction in the polymerization shrinkage to less than 1.0% of the total volumetric shrinkage, in comparison to 2.0 to 3.5% for methacrylate-based resin composites.⁵

Studies done so far demonstrated that silorane resins have decreased shrinkage cuspal deformation and contraction stress, variable marginal leakage, increased hydrophobicity, low toxicity, stability in oral fluids and similar photo polymerization efficiency compared to methacrylate composites.⁶⁻⁹ Most of the studies are done in *in vitro* conditions. Only limited studies are available evaluating the clinical performance of silorane.^{2,10} Hence, the present study is done to evaluate the performance of the silorane restoration in posterior teeth.

MATERIALS AND METHODS

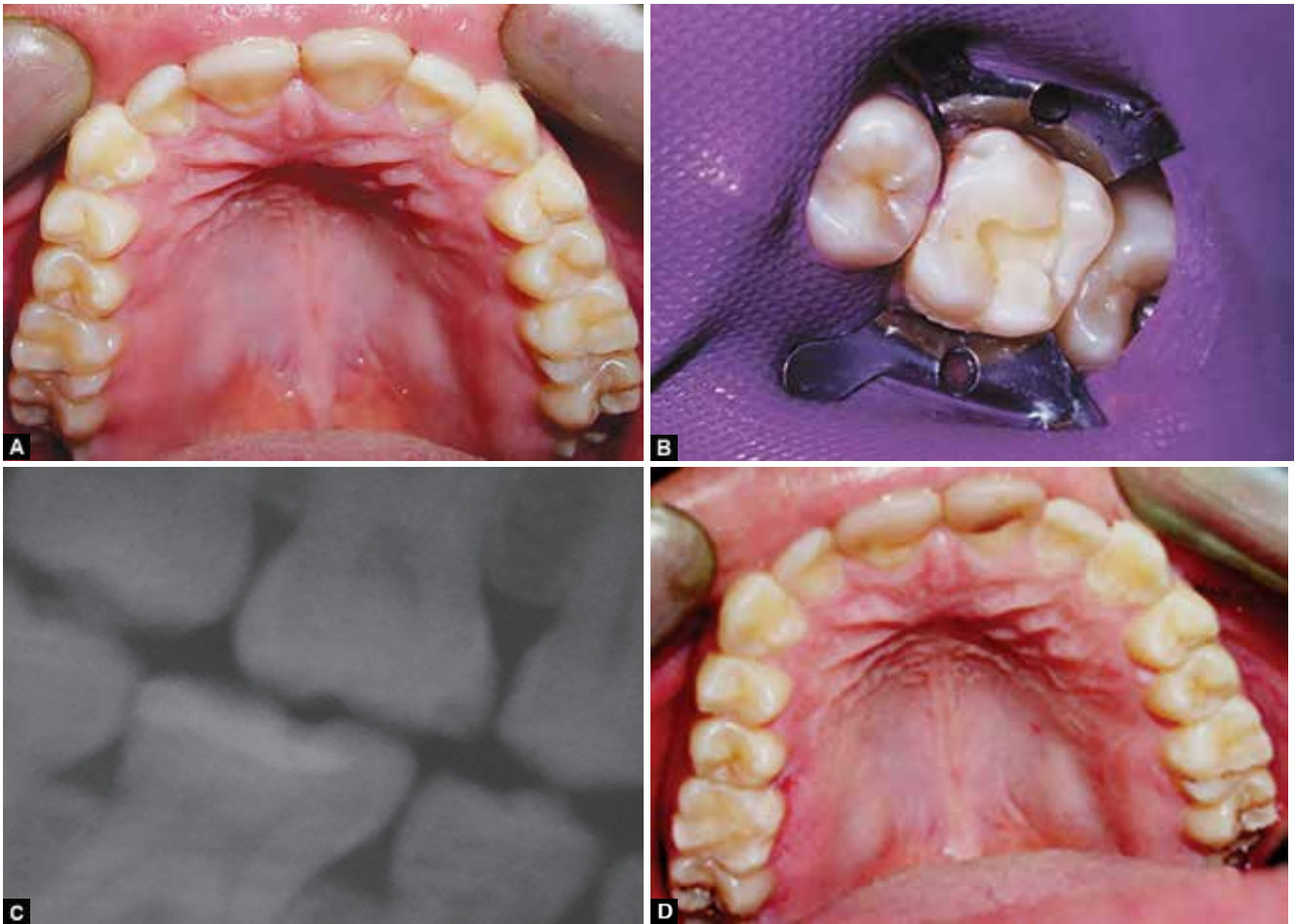
The study was approved by the institutional review board. An informed consent was obtained from all the patients. Ten patients were enrolled in the study. Cavities were prepared using diamond burs with no intentional bevels on enamel cavosurface margins (Figs 1A to D). The restorations were placed as per the recommendations by the manufacturer. All restorations were done using Filtek Silorane Restorative System (Filtek P90 + P90 System Adhesive, 3M ESPE AG, ESPE Platz, 82229 Seefeld, Germany).

Clinical evaluation of the restorations were done on 0 day, 6 and 18 months. The following parameters were evaluated: Color match, retention, marginal adaptation, anatomic form, surface roughness, marginal staining and secondary caries. Two clinicians evaluated the restorations blindly at each recall using modified criteria for evaluation of restorations (Table 1).¹¹ Standardized clinical photographs and bitewing radiographs were also obtained to help the evaluation process.

Assistant Professor and Dean

Department of Restorative Dental Sciences, College of Dentistry Prince Sattam Bin Abdulaziz University, Al-Kharj, Kingdom of Saudi Arabia

Corresponding Author: Mohammed Almuhaiza, Assistant Professor and Dean, Department of Restorative Dental Sciences College of Dentistry, Prince Sattam Bin Abdulaziz University PO Box: 153 Al-Kharj-11942, Al-Kharj, Kingdom of Saudi Arabia e-mail: ksucod@gmail.com/dralmuhaiza1@gmail.com



Figs 1A to D: (A) The caries on the molar, (B) cavity preparation, (C) bite wing X-rays, and (D) the restoration after 18 months

Table 1: Modified criteria used to evaluate the clinical success of the restoration

Color match	+++	Restoration matches adjacent tooth structure in color and translucency.
	++	Mismatch is within an acceptable range of tooth color and translucency.
	+	Mismatch is outside the acceptable range.
Retention	+++	Full retention.
	++	Partial retention.
	+	Restoration is lost.
Marginal adaptation	+++	Restoration closely adapted to the tooth. No crevice visible. No explorer catch at the margins, or there was a catch in one direction.
	++	Explorer catches. No visible evidence of a crevice into which the explorer could penetrate. No dentin or base visible.
	+	Explorer penetrates into a crevice that is of a depth that exposes dentin or base.
Anatomical form	+++	Restorations continuous with existing anatomic form.
	++	Restorations discontinuous with existing anatomic form but missing material not sufficient to expose dentin base.
	+	Sufficient material lost to expose dentin or base.
Surface roughness	+++	Surface of restoration is smooth.
	++	Surface of restoration is slightly rough or pitted
	+	Surface is fractured or flaking.
Marginal staining	+++	No staining along cavosurface margin.
	++	<50% of cavosurface affected by stain (removable, usually localized).
	+	>50% of cavosurface affected by stain.

Table 2: Clinical observations in the study group

Criteria		Case # 1	Case #2	Case #3	Case #4	Case #5	Case #6	Case #7	Case #8	Case #9	Case #10
Color match	0 day	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	6 months	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	18 months	+++	++	+++	+++	++	+++	+++	++	+++	+++
Retention	0 day	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	6 months	+++	++	+++	+++	+++	+++	+++	++	+++	+++
	18 months	+++	++	+++	+++	+++	+++	+++	++	+++	+++
Marginal adaptation	0 day	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	6 months	+++	+	+++	+++	+++	+++	+++	+	+++	+++
	18 months	+++	+	+++	+++	+++	+++	+++	+	+++	+++
Anatomical form	0 day	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	6 months	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	18 months	+++	++	+++	+++	+++	+++	+++	++	+++	+++
Surface roughness	0 day	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	6 months	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	18 months	+++	+++	++	+++	+++	+++	++	+++	+++	++
Marginal staining	0 day	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	6 months	+++	++	+++	+++	+++	+++	+++	++	+++	+++
	18 months	+++	++	+++	++	+++	++	+++	++	+++	++

RESULTS

A total of 10 restorations were followed up to 18 months. Out of 10 restorations 8 fulfilled all the criteria up to 18 months, 2 of them showed cracks at the margins of the restorations. All the parameters evaluated are depicted in Table 2 (Fig. 1). Qualitative analysis showed a success rate of 80%. Only 2 restorations showed marginal cracks. However, other properties were fulfilled.

DISCUSSION

Resin composite technology has undergone major developments over the last two decades. Polymerization shrinkage of resin composites plays a major role in the clinical survival of direct restorations due to the transfer of stresses to the adhesive interface. The major advantages of silorane composites are the low polymerization shrinkage, lower microleakage, improved marginal adaptation and reduced cuspal deflection. During the 18 months follow-up of the restorations, the performance was satisfactory according to the modified clinical criteria used.^{12,13} In this study no comparison is made with another material. Since it is not easy to control the cavity preparation and restorations in a standardized manner in clinical cases, it is not desirable to use a control group.¹⁴

Defective marginal adaptation and presence of secondary caries are predictors of the failure of posterior resin based composites and the reason for the replacement of the restoration.¹⁵ Silorane composites have chemical and mechanical properties comparable to traditional methacrylate composites, with some improved properties

including decreased leachability, better dimensional stability, and greater hydrophobicity.^{16,17}

Marginal adaptation, which depends on polymerization shrinkage and resulting stress, should be assessed at baseline because both shrinkage and resulting stress take place during the placement of the restoration.¹⁸ Other clinical factors, such as wear and the integrity of the adhesive interface, may have induced changes in marginal adaptation over 18 months. Siloranes are inherently hydrophobic and are a combination of siloxane and oxirane chemical moieties on each monomeric unit, where the siloxane provides a hydrophobic and chemically stable backbone, and the oxirane provides reactive groups that allow polymerization.³ The distinctive feature of siloranes is the ring-opening polymerization reaction of the oxirane moiety, which inherently leads to less polymerization shrinkage than the well-known polymerization reaction of methacrylates.

From this clinical study it can be concluded that siloranes can be used as a better alternative to other tooth colored posterior restorative material. Further research over longer periods are required to substantiate the current observations.

REFERENCES

1. Perez MM, Ghinea R, Ugarte-Alvan LI, Pulgar R, Paravina RD. Color and translucency in silorane-based resin composite compared to universal and nanofilled composites. *J Dent* 2010;38(Suppl 2):e110-116.
2. Yaman BC, Dogruer I, Gumustas B, Efes BG. Three-year randomized clinical evaluation of a low-shrinkage silorane-

- based resin composite in non-carious cervical lesions. *Clin Oral Investig* 2014;18(4):1071-1079.
3. Lien W, Vandewalle KS. Physical properties of a new silorane-based restorative system. *Dent Mater* 2010;26(4):337-344.
 4. Ilie N, Hickel R. Silorane-based dental composite: behavior and abilities. *Dent Mater J* 2006;25(3):445-454.
 5. Ivanovas S, Hickel R, Ilie N. How to repair fillings made by silorane-based composites. *Clin Oral Investig* 2011;15(6):915-922.
 6. Tantbirojn D, Pfeifer CS, Braga RR, Versluis A. Do low-shrink composites reduce polymerization shrinkage effects? *J Dent Res* 2011;90(5):596-601.
 7. Borges AF, Santos Jde S, Ramos CM, Ishikiriama SK, Shinohara MS. Effect of thermo-mechanical load cycling on silorane-based composite restorations. *Dent Mater J* 2012;31(6):1054-1059.
 8. Yesilyurt C, Yoldas O, Altintas SH, Kusgoz A. Effects of food-simulating liquids on the mechanical properties of a silorane-based dental composite. *Dent Mater J* 2009;28(3):362-367.
 9. Labib LM, Nabih SM, Baroudi K. Evaluation of cuspal deflection in premolar teeth restored with low shrinkable resin composite (in vitro study). *J Int Soc Prev Community Dent* 2015;5(6):470-475.
 10. Walter R, Boushell LW, Heymann HO, Ritter AV, Sturdevant JR, Wilder AD Jr, et al. Three-year clinical evaluation of a silorane composite resin. *J Esthet Restor Dent* 2014;26(3):179-190.
 11. Baracco B, Perdigao J, Cabrera E, Giraldez I, Ceballos L. Clinical evaluation of a low-shrinkage composite in posterior restorations: one-year results. *Oper Dent* 2012;37(2):117-129.
 12. Hickel R, Peschke A, Tyas M, Mjor I, Bayne S, Peters M, et al. FDI World Dental Federation - clinical criteria for the evaluation of direct and indirect restorations. Update and clinical examples. *J Adhes Dent* 2010;12(4):259-272.
 13. Hickel R, Peschke A, Tyas M, Mjor I, Bayne S, Peters M, et al. FDI World Dental Federation: clinical criteria for the evaluation of direct and indirect restorations-update and clinical examples. *Clin Oral Investig* 2010;14(4):349-366.
 14. Ozarslan MM, Buyukkaplan US, Barutcgil C, Arslan M, Turker N, Barutcgil K. Effects of different surface finishing procedures on the change in surface roughness and color of a polymer infiltrated ceramic network material. *J Adv Prosthodont* 2016;8(1):16-20.
 15. Cenci MS, Pereira-Cenci T, Cury JA, Ten Cate JM. Relationship between gap size and dentine secondary caries formation assessed in a microcosm biofilm model. *Caries Res* 2009;43(2):97-102.
 16. Brandt WC, Lacerda RF, Souza EJ Jr, Sinhoreti MA. Effect of photoactivation mode on the hardness and bond strength of methacrylate- and Silorane monomer-based composites. *J Adhes Dent* 2013;15(1):33-39.
 17. Pires-de-Souza Fde C, Garcia Lda F, Roselino Lde M, Naves LZ. Color stability of silorane-based composites submitted to accelerated artificial ageing—an in situ study. *J Dent* 2011;39 Suppl 1:e18-24.
 18. Shabayek NM, Hassan FM, Mobarak EH. Effect of using silorane-based resin composite for restoring conservative cavities on the changes in cuspal deflection. *Oper Dent* 2013;38(2):E1-8.

