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Original Research

Awareness of oxygen inhibited layer effects on composite resins and how to prevent: A survey-based study

Yasmine Tarek Ahmed [1], Haya Marwan Abouseedou [2], Fatimah Mohammed Hamza [3], Maisa Mamdouh AlQalam [4], Yaqeen Mohammed Naser [5]

[1] Lecturer, Riyadh Elm University, Riyadh, Saudi Arabia
[2,3,4,5] Dental intern, Riyadh Elm University, Riyadh, Saudi Arabia

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ABSTRACT

Aim: The purpose of this study to evaluate the knowledge and the understanding of REU dental students about the oxygen inhibition layer and how to prevent it.

Materials and Methods: This is a cross-sectional survey-based study. An online questionnaire containing 15 closed-ended questions was distributed among the REU female campus targeting dental students from level 8 to 12. The data collected were entered and analyzed using SPSS version 25. Descriptive and inferential statistics were applied.

Results: Adequate levels of understanding and knowledge of the OIL and its management technique were found amongst REU students. Senior students in level 12 showed the highest levels of knowledge.
Conclusion: The majority of REU students showed proper knowledge of oxygen inhibited layer, its management techniques, and its effects on composite resin restorations longevity.

INTRODUCTION

Increased demand for aesthetic restorations has led to the wide use of composite resin restorations. Polymerization of dental composites occurs through a chain reaction that is induced by free radicals. If composite is exposed to air during this process, oxygen in the air decreases the excitability of the photoinitiator and stabilizes the free radicals, causing polymerization interference or delay. Clinically the resin leaves a soft, sticky layer during curing, and this layer is referred to as an oxygen inhibited layer (OIL).[1] Based on multiple studies, the thickness of this layer depends on the type of composite used and ranges between 10 and 200 μm.[2]

The presence of an OIL enhanced the interlayer shear bond strength of all investigated materials, but its absence resulted in cohesive and mixed failures only with the short-fiber-reinforced composite. Moreover, OIL components are similar to the components of the uncured composite with a consumed or reduced amount of photoinitiator.[3] The OIL received much attention in the literature, both positive[4-5] and negative.[6-8] One of the positive effects of OIL was that it enhanced the interlayer shear bond strength of all investigated materials, but its absence resulted in cohesive and mixed failures only with the short-fiber-reinforced composite.[3] However, there were other negative effects such as decreased surface hardness of restorations that could affect longevity.[9]

A study that investigated the effect of the OIL on the degree of conversion (DC) reported that the presence of an OIL reduced the DC of the adhesives by 64%. This study suggests that there are differences among the OIL present for the adhesives tested.[10] Another study tested the role of the oxygen inhibited layer on the shear bond

* Corresponding author*:* Yasmine Tarek Ahmed,Lecturer, Riyadh Elm University, Riyadh, Saudi Arabia

strength of composites. No significant difference in shear bond strength of composites cured with and without OIL. The presence or absence of OIL made no significant difference in the shear bond strength of composite resins.[11] This study evaluates the knowledge of REU undergraduate dentistry students of the oxygen inhibited layer and its management techniques.

Materials and Methods

This is a cross-sectional survey conducted at the dental clinics of the Riyadh Elm University (REU). Ethical approval was obtained from the Institutional Review Board (IRB), REU with the IRB approval number FUGRP/2020/172/185/154. An online survey using the google form, containing 15 close-ended questions were distributed aiming to assess the knowledge of REU dental student from level 8-12 toward the oxygen inhibition layer. The survey was conducted for 6 weeks. The questionnaire is based on the awareness of oxygen inhibited layer effects on composite resins and how to prevent it. Descriptive statistics of frequency distribution and percentages were calculated for the categorical variables. Association between categorical variables and knowledge of oxygen inhibition layer was assessed by applying the Chi-Square test. A p-value of $\leqslant 0.05$ was considered statistically significant. All the data were analyzed by using SPSS version 25.

Results

A total of 91 questionnaires were answered by the respondents. Thirty-seven (41.1%) respondents were level 12 students. Thirty-four (37.8%) responded that oxygen inhibition is a sticky, soft layer. The majority (61.1%, n=55) appropriately responded that wear, discoloration, and fracture as disadvantages of the oxygen inhibition layer. Most (88.9%, n=80) of the respondents appropriately responded that oxygen composite restoration led to the formation of the oxygen inhibition layer. Furthermore, the majority appropriately reported glycerine (74.4%, n=67) as the material used for preventing oxygen inhibited layer, after curing of composite (74.4%, n=67) is the best time to apply glycerine to prevent the formation of oxygen inhibited layer on composite restoration, and 20 seconds (57.8%, n=52) as the time of curing glycerine (Table 1). There was a statistically significant association between student level and knowledge ($p<0.05$).

Discussion

Taking into consideration the high demand for affordable esthetic restorations in dental practice, there was an international adjustment in undergraduate restorative teaching starting in early 2000. Dental schools in Spain estimated that the pre-clinical teaching of posterior composite restorations will increase by 134% concerning the number of hours. On the other hand, the pre-clinical teaching of amalgam restorations was predicted to decline by 50%. These estimations were similar in other countries such as United Kingdom, Ireland, Japan, and Canada.[12-16] Composite resin restorations have become a routine clinical procedure in REU clinics. Based on the findings of our study, the majority of REU students have adequate knowledge of OIL formation, its adverse effects on different mechanical and physical characteristics, and the overall longevity of composite resin restorations. This suggests that the undergraduate teaching methods in handling composite restorations and its placement technique are of excellent levels.

We have found an association between student level and knowledge of OIL. Level 12 students were more likely to

Table 1. Descriptive statistics of questionnaire items

Questionnaire items		n	%
Levels of students	Level 8	14	15.6
	Level 9	11	12.2
	Level 10	17	18.9
	Level 11	11	12.2
	Level 12	37	41.1
Knowledge of oxygen inhibition layer	Yes	63	70.0
	No	27	30.0
What is the oxygen inhibition layer?	A sticky, soft layer	34	37.8
	A sticky, hard layer	20	22.2
	A non-sticky, soft layer	23	25.6
	non sticky , hard layerN	13	14.4
The disadvantages of the oxygen inhibition layer are	Wear	7	7.8
	Discoloration	21	23.3
	Fracture	7	7.8
	All of the above	55	61.1
Type of restoration does oxygen inhibition layer happens	Amalgam restoration	4	4.4
	Gold restoration	3	3.3
	Composite restoration	80	88.9
	Temporary restoration	3	3.3
Can the oxygen inhibition layer happen with resin-modified GIC?	Yes	39	43.3
	No	51	56.7
Material that inhibits the oxygen inhibition layer	Bonding	8	8.9
	Etching	11	12.2
	Fissure sealant	4	4.4
	Glycerine	67	74.4
After which step of restoring the tooth do we add glycerine?	Before etching	7	7.8
	After etching	5	5.6
	After bonding	11	12.2
	After curing of composite	67	74.4
Use incremental technique, do we add glycerine between each layer?	Yes	17	18.9
	No	73	81.1
Apply glycerine after finishing your restoration or you have never done that before	Yes, I did	37	41.1
	No, I didn’t	53	58.9
Do you etch before applying the glycerine?	Yes	23	25.6
	No	67	74.4
Do you cure the glycerine layer after applying it?	Yes	58	64.4
	No	32	35.6
For how many seconds should you cure the	15	22	24.4

glycerine?	20	52	57.8
	30	9	10.0
	40	7	7.8
Can we use vaseline as glycerine?	Yes	64	71.1
	No	26	28.9
Use celluloid strip instead of glycerine	Yes	37	41.1
	No	53	58.9

answer correctly ($p<0.05$). However, regarding the disadvantages of OIL, 38.9% of students selected a single adverse effect: 23.3% discoloration, 7.8%fracture, and 7.8%wear. This urges for refresher sessions and tutorials to be conducted regularly for all clinical levels so that they could link their theoretical knowledge and clinical practice. The management technique of OIL with a material to prevent its formation by using vaseline or glycerin was easily identified by the senior-level clinical students (11 and 12) ($p<0.05$). These findings reflect that in higher clinical levels, increased clinical practice of students improves their knowledge of handling composite resins, their placement, and finishing and polishing techniques.

Conclusion

Within the limitations of the study, we have found the knowledge of OIL and its management technique to be satisfactory. However, regular workshops are directed towards linking dental materials knowledge with clinical practice through big sisters students' activities.

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