IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 25, Issue 1 Ser. 4 (January. 2026), PP 46-51
www.iosrjournals.org

To Compare And Evaluate The Efficacy Of Minimizing Agents Used To Reduce The Oxygen Inhibition Layer Formation And Its Effect On Microhardness Of Composite Resin: An In-Vitro Study.

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Abstract:
Background*: The surface layer is exposed to air during polymerization when dentists light cure resin composite restorations in increments or after using an hand instrument to shape the surface layer. Clinical performance may be impacted by the existence of an oxygen-inhibited resin surface layer.*
Materials and Methods*: 80 composite resin discs of dimension 10mm x 10mm were prepared using a Teflon mould. Nanohybrid composite resin was used with an initial shade A1. Light-curing was performed using a light emitting diode (LED) according to the manufacturer's instructions (20 sec), with the light at 1 mm of distance and perpendicular to the surface of the specimens. The specimens were divided into 4 main groups. Group A: thick mylar strip. Group B: a thin layer of glycerine over the composite specimen. Group C: a uniform layer of K-Y Jelly. Group D: cured in open air. This was the control group. All the specimens were subjected to microhardness assessment. Vicker's microhardness testing was done. Data obtained was recorded, tabulated and statistically analysed.*
Results*: Mylar strip has highest value of Vicker's hardness (85.82), followed by KY Jelly (77.32), Glycerine (76.54) and the control group i.e., Air has lowest microhardness (48.6).*
Conclusion: *Within the limitations of the present study, it can be concluded that Mylar strip has the most superior performance in terms of specimen hardness and K-Y Jelly performs similar to glycerine application.*
Key Word: *Nanohybrid composite, glycerine, mylar strip, KY jelly, Vicker's microhardness.*

Date of Submission: 21-01-2026 Date of Acceptance: 31-01-2026

I. Introduction

Dental composites are becoming increasingly popular due to rising patient demands for aesthetics and concerned about environmental conditions from amalgam fillings. Dental composites polymerize through free radical induced chain reactions. Exposing the composite to air during the process reduces the photo initiator's excitability and stabilize free radicals, resulting in polymerization interference or delay. As a result, cured composites produce an oxygen inhibition layer (OIL) on their surfaces. [1-4]

The thickness of the oxygen inhibition layer might range from 10 to 200 μm, depending on the composite employed. Because it decreases the surface hardness, wear resistance, and marginal adaption of composite restorations, oxygen inhibition layer has a negative impact on their prognosis. [4-6]

After curing, occlusal correction, finishing, or polishing techniques cannot totally eliminate the oxygen inhibition layer, and the residual oxygen inhibition layer lowers the final restoration's quality. Therefore, curing the composite after preventing oxygen contact—either by using a Mylar strip or by applying glycerin or KY jelly to the composite surface—can decrease the creation of the oxygen inhibition layer as much as feasible. [4-6]

When applied to the resin's surface before to the light-curing processes, mylar strip and glycerin can serve as physical barriers to stop its production. The commercial lubricant K-Y Jelly is another substance that is well-known among practitioners these days. [7,8]

Therefore, the aim of this study is to compare and evaluate the efficacy of different oxygen inhibition layer minimising agents on composite resin in terms of microhardness.

The Vicker's microhardness test is an appropriate technique for measuring hardness. The null hypothesis was that using three of the oxygen inhibition layer inhibiting agents prior to the resin's final cure would have no effect on hardness.

II. Material And Methods

This study was carried out in the Department of Conservative Dentistry and Endodontics. 80 composite resin discs of dimension 10mm x 10mm were prepared using a Teflon mould. Prime Restorite, a nanohybrid composite resin, was utilized with an initial hue of A1. A light-emitting diode (LED) (Dentmark) was used for light-curing in accordance with the manufacturer's instructions (20 seconds), with the light perpendicular to the specimens' surface and at a distance of 1 mm.

Fig. 1: Materials Used In The Study

The specimens were divided into 4 main groups:
Group A: Specimens polymerized after placing a 0.05mm thick mylar strip.
Group B: Specimens polymerized after placing a thin layer of glycerine over the composite specimen. After polymerization glycerine was removed using ethanol.
Group C: Specimens polymerized after placing a uniform layer of K-Y Jelly. After curing the jelly was removed using a spray of water as it is water soluble.
Group D: Specimens cured in open air. This was the control group.

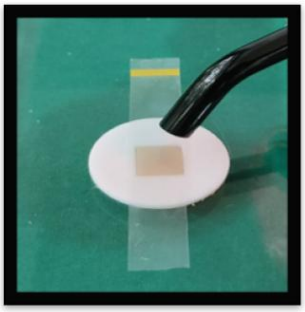


Fig. 2: GROUP A MYLAR STRIP

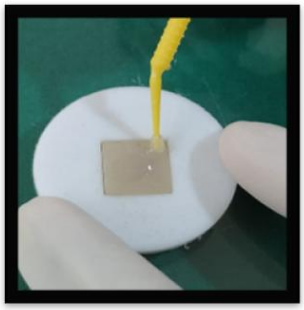


Fig. 3: GROUP B GLYCERINE

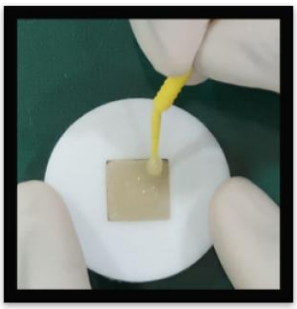


Fig. 4: GROUP C KY JELLY

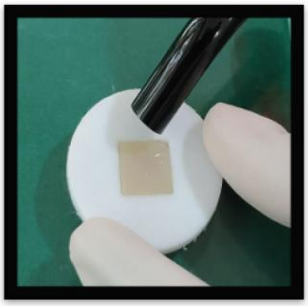


Fig. 5: GROUP D AIR

Microhardness Assessment

- All the specimens were subjected to microhardness assessment.
- Vicker's microhardness testing was done under 200g load, at 40X magnification.
- Mean value of three indentations was recorded.
- Data obtained was recorded, tabulated and statistically analysed.

III. Result

The data was tested for normality by Shapiro Wilk test, which confirmed that the data is normally distributed, hence ANOVA test was used to compare the difference in hardness between the various groups.

Table no 1. Statistical descriptives for Vicker's hardness of the groups

Group	Mean	Standard Deviation	Standard Error	Minimum	Maximum
MYLAR STRIP	85.82	1.56	0.35	84.1	89.1
GLYCERINE	76.54	1.63	0.36	74.3	79.1
KY JELLY	77.32	1.75	0.39	74.7	80.1
AIR	48.6	1.75	0.39	45.7	52.1

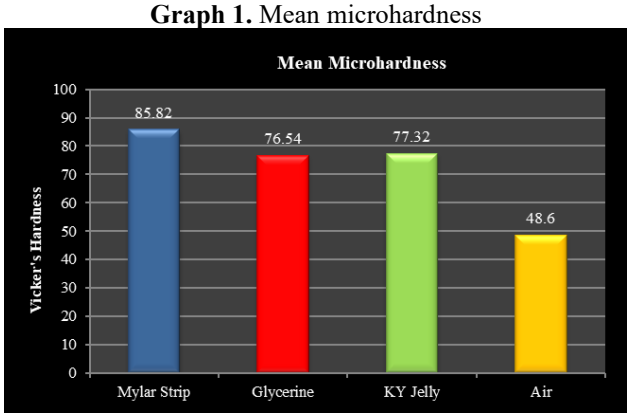
Table no 2. Comparison of Vicker's hardness between the groups (ANOVA)

	Sum of Squares	df	Mean Square	**f**	Significant
Between Groups	15746.99	3	5249	1875.32	0.000
Within Groups	212.72	76	2.8		
Total	15959.72	79			

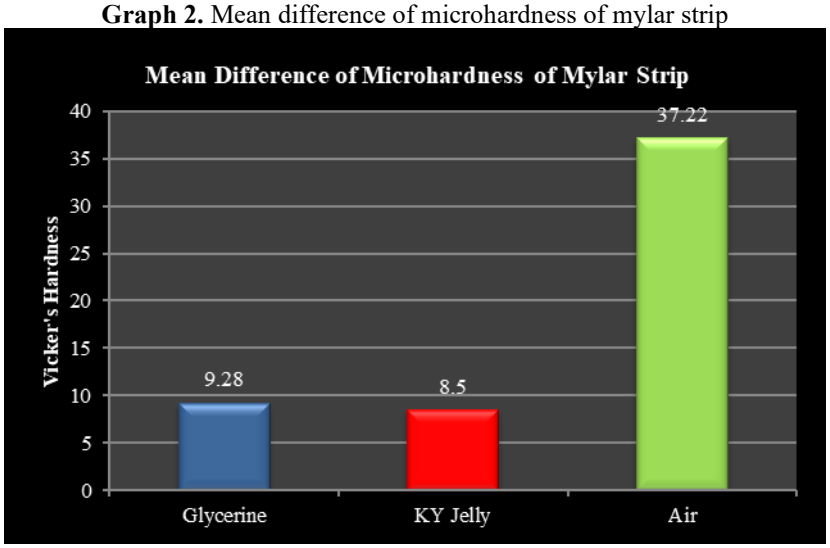
Table no 3. Pairwise comparison between the groups (POST HOC TUCKEY'S TEST**)**

Group (I)	Group (J)	Mean Difference (I-J)	P Value
MYLAR STRIP	Glycerine	9.28	0.000
	KY Jelly	8.5	0.000
	Air	37.22	0.000
GLYCERINE	Mylar Strip	-9.28	0.000
	KY Jelly	-0.78	0.458
	Air	27.93	0.000
KY JELLY	Mylar Strip	-8.5	0.000
	Glycerine	0.78	0.458
	Air	28.72	0.000
AIR	Mylar Strip	-37.22	0.000
	Glycerine	-27.93	0.000
	KY Jelly	-28.72	0.000

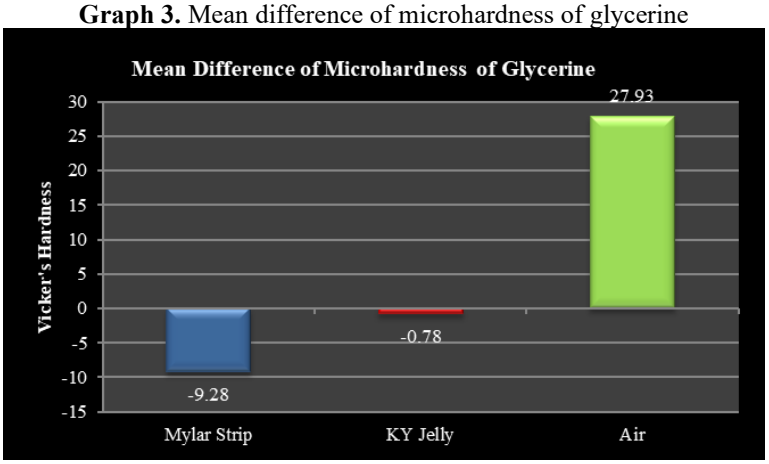
Graph 1. Mean microhardness



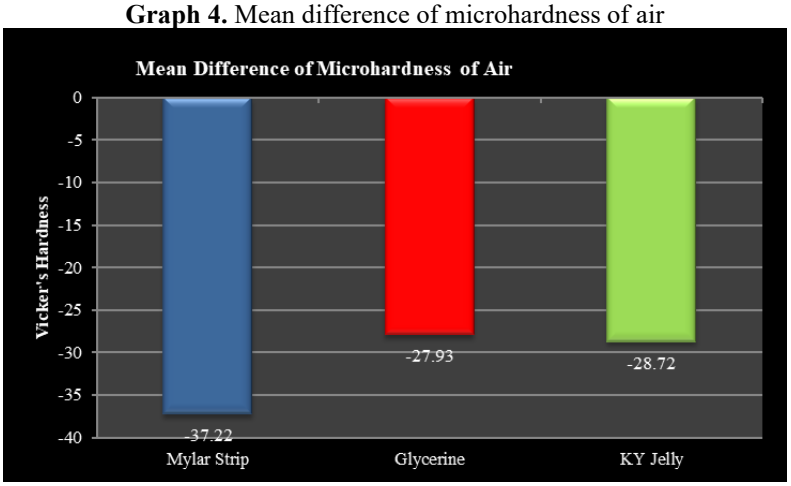
Graph 2. Mean difference of microhardness of mylar strip



Graph 3. Mean difference of microhardness of glycerine



Graph 4. Mean difference of microhardness of air



Mylar strip has highest value of Vicker's hardness (85.82), followed by KY Jelly (77.32), Glycerine (76.54) and the control group i.e., Air has lowest microhardness (48.6).

The difference between the hardness between the groups is statistically significant with P Value 0.000 ($P < 0.01$) as indicated by the ANOVA test.

The multiple comparison via Post Hoc Tuckey test shows that Mylar strip hardness has significant difference as compared to Glycerine, KY Jelly and Air.

KY Jelly microhardness is significantly different with respect to Air

There was no significant difference between Glycerine and KY Jelly.

IV. Discussion

The purpose of this study was to find efficient methods that might stop or lessen the production of oxygen inhibition layer during the curing process. An indirect way to assess the degree of polymerization in composites is to evaluate their surface hardness. Oxygen is a powerful inhibitor which retards or even terminates polymerization. [9,10]

Consequently, the amount of oxygen inhibition layer formation in this investigation was assessed using the composites' surface hardness measurement. Oxygen inhibition layer boosts surface material adsorption by expanding the available contact area. [11,12]

To create a surface that is tougher, more resilient, and more aesthetically pleasing, the outer layer of resin composites impacted by oxygen inhibition polymerization must often be removed. Numerous research demonstrate that employing a mylar matrix to cure composites without oxygen results in a tougher surface. [13-15]

Numerous parameters, including initiator, filler size and composition, color, light intensity, and curing time, influence the degree of polymerization and OIL formation. For the Hardness test the group with Mylar strip performed the best followed closely by the K-Y jelly and glycerine group. It is speculated that since Mylar strip blocks any contact with air, only the oxygen already present within the composite contributes to OIL formation, thus minimizing OIL formation. [16-18]

However, when glycerin is utilized, the development of an OIL may be supported by minute quantities of oxygen in the glycerin in addition to the oxygen already present on the composite surface, resulting in a higher quantity of OIL creation than that seen with the Mylar strip technique. Initiators left in the OIL may be transformed into free radicals when glycerin is added to previously cured composites and further cured, encouraging further polymerization in an oxygen-restricted condition. [14,15]

K-Y Jelly's performance may be explained by the same phenomena. This water-based gel, which contains hydroxymethylcellulose and glycerol, offers more control over usage without coming into touch with the restoration's surface.

In addition to being beneficial in obtaining an acceptable surface and marginal adaptation, polishing produces a better surface hardness than that created when a matrix is utilized. It also effectively prevents discoloration.

In a clinical setting, however, the OIL might not be entirely eliminated and might persist in deep crevices and pits even after polishing. [16-18]

Therefore, it is recommended to use a Mylar strip for proximal and bucco-lingual cavities and to use glycerin or K-Y Jelly for occlusal surfaces and difficult-to-reach cavities during curing in order to minimize the quantity of OIL on composites.

V. Conclusion

According to the study's constraints, Mylar strip performs the best in terms of specimen hardness, whereas K-Y Jelly functions similarly to glycerine application.

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