

# To Evaluate the Effect of Primer and Two Different Curing Times of Primer on Shear Bond Strength of Orthodontic Brackets Bonded to Tooth Surface: An Invitro Study

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## Abstract:-

**Aim:** The aim of the study isto evaluate the effect of primer and two different curing times of primer on shear bond strength of orthodontic brackets bonded to tooth surface

**Materials and methods :** 33 extracted first Premolar teeth was embedded in auto-polymerizing acrylic resin till cervical region. They were randomly divided into three groups (each of 11 premolar). All teeth were etched in same manner using 37% orthophosphoric acid Etchant gel and after thatit was divided into 3 groups

**Group 1:** Primer was not applied, Transbond XT Adhesive Light Cure Paste was applied and the bracket was light cured for 20 second with standard intensity curing light.**Group 2:**Transbond XT Primer was applied and cured with high intensity LED Light(2500mW/cm<sup>2</sup>) for 1 second.Transbond XT Adhesive Light Cure Paste was applied and the bracket was light cured for 20 second with standard intensity curing light**Group 3:** . Transbond XT Primer was applied and cured with normal intensity LED Light(1200mW/cm<sup>2</sup>) for 10 seconds.Transbond XT Adhesive Light Cure Paste was applied and the bracket was light cured for 20 second with standard intensity curing light.After bonding,each specimen was loaded into a Universal Testing Machine for testing. A computer connected with Universal Testing Machine recorded the results of each test. The readings were recorded in Newton(N). And it was converted into Mega Pascal Units for statistical analysis.

**Results :** In the present study the mean SBS of no primer group was 12.20MPa, SBS when primer was cured for 1 sec with high intensity curing light was 15.54 MPa and SBS when primer was cured for 10 sec with normal intensity curing light was 16.60MPa, all the three value were more than the clinically acceptable values

**Conclusion:** The result of our study showed that use of primer by curing for 1sec with high intensity LED light, curing for 10sec with normal intensity LED light and not using primer all three-condition produced SBS which was clinically acceptable, but by using primer and curing it for 1sec with high intensity LED light we can eliminate the disadvantages which are caused by not using primer and we can save our chair side time also by reducing the curing time. Further studies can be done considering the

above aspects. Further research by doing a scanning electron microscopy (SEM) study of the debonded tooth surface to check for the enamel cracks and resin tag formation in the various groups can be conducted to evaluate the results better.

## I. INTRODUCTION

The bonding of brackets to enamel surfaces is the most crucial part of orthodontic treatment because adequate and stable bonding between brackets and enamel is decisive for treatment success. Bracket failure means longer treatment time for the patient and has economic consequences for the orthodontist because it requires increased resources<sup>1</sup>.

Orthodontic bonding has evolved significantly since it was first introduced by Buonocore in the 1950's<sup>2</sup>

The use of primer in orthodontic bonding is recommended by manufacturers, and it is postulated that enamel adhesion is ensured by mechanical interlocking between the etched enamel prisms and the polymerized liquid primers.<sup>3</sup>

Limited literature is available regarding the efficacy of light curing the primer before placement of the bracket adhesive. When curing an orthodontic adhesive, light is not applied directly to the composite material but is rather reflected below the base of the bracket. This mostly creates an area of uncured composite resin adhesive below the bracket, which results in a decreased bond strength. Curing the primer separately increases the amount of total light delivered to theresin system and, therefore, can have a positive effect on the bondstrength.<sup>4</sup>

Several *in vitro* studies have shown a comparable tensile bond strength with or without the use of a primer.

If a primer could be avoided during bonding brackets, this would represent a potential time saving by missing a step in the bonding process.<sup>5</sup>

But a primer is necessary to improve resistance to microleakage, after primer coating moisture control may not be extremely important, it permits easier bracket removal & protect against enamel tear outs during debonding.<sup>6</sup>

In order to get the above advantages of primer coating and also to save the time we can use the technique of curing the primer for 1 second with high intensity curing light.

So, the aim of the present study is to evaluate the effect of primer and two different curing times of primer on shear bond strength of orthodontic brackets bonded to tooth surface.

## II. AIM & OBJECTIVES

The aim of the study isto evaluate the effect of primer and two different curing times of primer on shear bond strength of orthodontic brackets bonded to tooth surface.

## III. OBJECTIVES

- To evaluate shear bond strength of metal brackets bonded to tooth in which primer is not applied.
- To evaluate the shear bond strength of metal brackets bonded to tooth in which primer is cured for 10 seconds with normal intensity LED light.
- To evaluate shear bond strength of metal brackets bonded to tooth in which primer is cured for 1 second with high intensity LED light.
- To compare shear bond strength of metal brackets bonded to tooth without primer application and with primer application cured with different curing times and different intensities of light.

## IV. MATERIAL AND METHODS

- Source of data  
First Premolar teeth that are extracted for orthodontic purpose was collected from Department of Oral and Maxillofacial Surgery, KVG Dental College and Hospital Sullia, Dakshina Kannada.

- Sample size determination  
Using the formula,

$$n = 2(SD)^2(Z_{1-\alpha/2} + Z_{\beta})^2$$

$$(d)^2$$

where, SD = STANDARD DEVIATION - 3.41

$Z_{1-\alpha/2}$  = 1.96 AT 95% CONFIDENCE INTERVAL

$Z_{\beta}$  = 0.84 AT 80% power

d = MEAN DIFFERENCE- 4.1

SUBSTITUITING THE VALUES, WE GET

$$n = 10.84$$

**Therefore, the total sample size is 11 per group.**

**Overall sample size is 33**

Sample size : 33

Type of study : In vitro study

Period of study : 2 Months

Place of study : The study was conducted in the Department of Orthodontics, KVG Dental College and Hospital, Sullia, Dakshina Kannada and IISC Bangalore.

### ➤ INCLUSION CRITERIA

- Extracted first premolar teeth
- Teeth without any caries, developmental defects and cracks
- Teeth with intact buccal surfaces

### ➤ EXCLUSION CRITERIA

- Teeth with caries
- Teeth with restorations
- Teeth having cracks
- Teeth undergone any chemical treatment
- Teeth that have been previously bonded by bracket
- Fractured teeth

### ➤ Materials required:

- Sodium hypochlorite (Chemdent)
- Selfcure acrylic resin (DPI-RR)
- Pumice
- Etchant Gel (Scotch bond,3M, Monrovia,CA)
- Transbond XT Primer (3M Unitek, Monrovia,CA )
- Etchant and Primer applicator brush (3M Unitek, Monrovia,CA)
- Transbond XT Light Cure Adhesive Paste (3M Unitek, Monrovia,CA)
- LED curing Light with varying intensity (Woodpecker LED Light cure I LED Plus)
- MBT brackets - 0.022”slot (3M UnitekMonorovia, California)
- Hand scaler
- Artificial saliva

## V. METHODOLOGY

33 extracted first Premolar teeth was cleaned with sodium hypochlorite to remove blood or any tissue debris. The buccal crown surface of each tooth was rinsed and dried and after 15 seconds polished with fluoride free pumice slurry. Each tooth was embedded in auto-polymerizing acrylic resin till cervical region. They were randomly divided into **three groups (each of 11 premolar)**.All teeth were etched in same manner using 37% orthophosphoric acid (Scotch bond,3M,Monrovia,CA) Etchant gel and after that

**Group 1:** Primer was not applied, Transbond XT Adhesive Light Cure Paste was applied and the bracket was lightly placed onto the tooth surface and positioned parallel to the long axis of the tooth in the middle third of the buccal surface and pressed firmly. Excess adhesive around the appliance base was gently removed with a sharp scaler and was light cured for 20 second with standard intensity curing light.

**Group 2:** Transbond XT Primer was applied and cured with high intensity LED Light(2500mW/cm<sup>2</sup> ) for 1 second. Transbond XT Adhesive Light Cure Paste was applied and the bracket was lightly placed onto the tooth surface and positioned parallel to the long axis of the tooth in the middle third of the buccal surface and pressed firmly. Excess adhesive around the appliance base was gently removed with a sharp scaler and was light cured for 20 second with standard intensity curing light.

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After bonding, all specimens were stored in artificial saliva for 24 hours.

**Group 3:** Transbond XT Primer was applied and cured with normal intensity LED Light(1200mW/cm<sup>2</sup> ) for 10 seconds. Transbond XT Adhesive Light Cure Paste was applied and the bracket was lightly placed onto the tooth surface and positioned parallel to the long axis of the tooth in the middle third of the buccal surface and pressed firmly. Excess adhesive around the appliance base was gently

After 24 hours each specimen was loaded into a Universal Testing Machine for testing. Occluso-gingival load will be applied to the bracket at the wing, producing a shear force at the bracket-tooth interface using an attachment to the cross head of Universal Testing Machine. Bond strength was determined in a shear mode at a crosshead speed of 1mm/minute until fracture occurs. A computer connected with Universal Testing Machine recorded the results of each test. The readings were recorded in Newton(N). And it was converted into Mega Pascal Units for statistical analysis.



Fig. 1: Photograph of Materials used for the study



1. Selfcure acrylic resin
2. Etchant Gel
3. Transbond XT Primer
4. Transbond XT Light Cure Adhesive Paste
5. Etchant and Primer applicator brush
6. Pumice

7. Sodium hypochlorite
8. Hand scaler
9. Explorer
10. LED curing Light with varying intensity
11. Artificial saliva
12. MBT brackets - 0.022”slot



Fig. 2: Acid etching

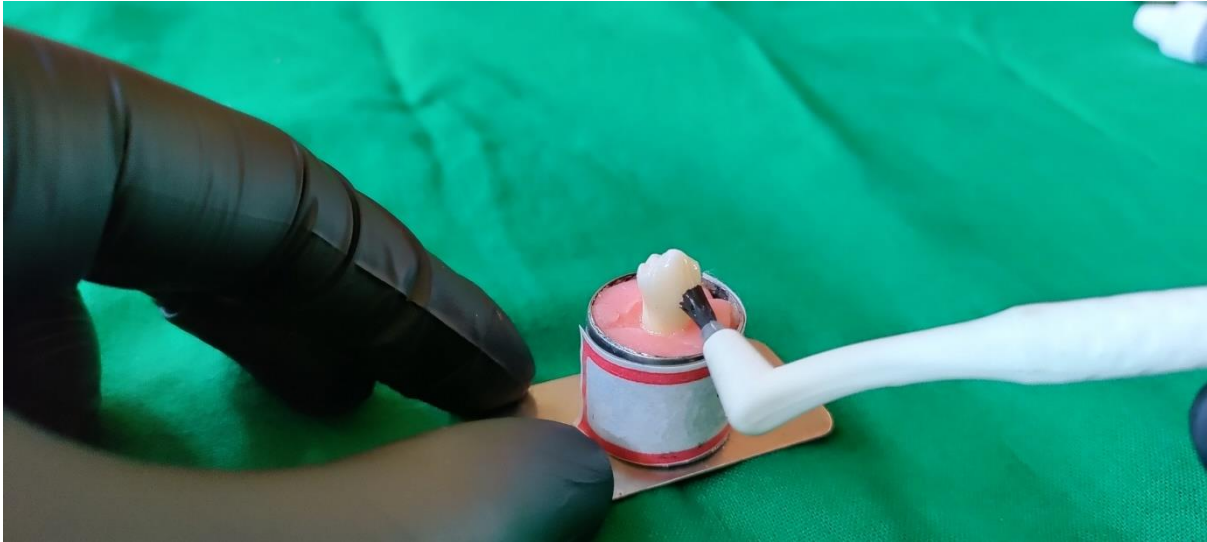


Fig. 3: Application of primer



Fig. 4: Light Curing of Primer



Fig. 5: Positioning of Bracket



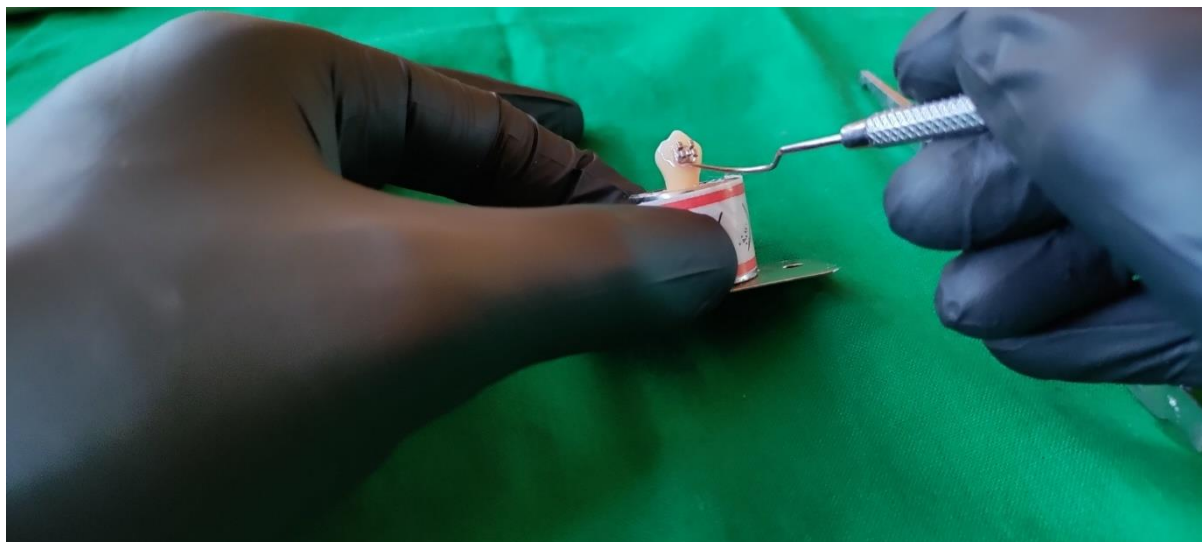


Fig. 6: Removal of flash



Fig. 7: Curing of Adhesive



Fig. 8: LED Curing Light capable of producing different intensities of light



Fig. 9: Universal testing machine



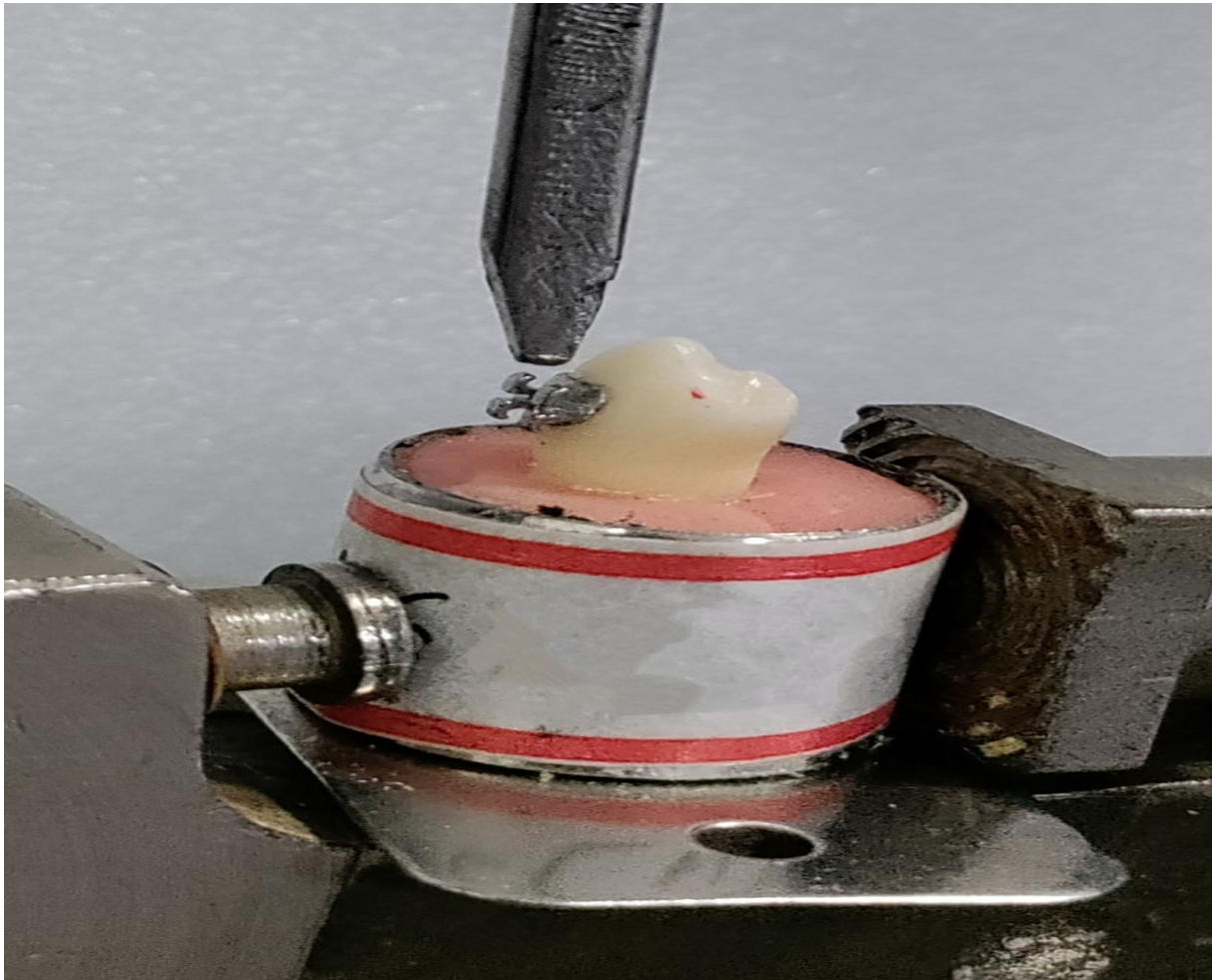


Fig. 10: Close up view of sample in universal testing machine

**VI. STATISTICAL ANALYSIS**

All statistical analysis will be performed by using the SPSS software.

The mean and the standard deviation will be calculated for each variable.

ANOVA will be used to test the significance between the groups

P < 0.05 was considered as statistically significant.

**VII. RESULTS**

The highest mean bond strength calculated was for group 3 (16.60 MPa), while it was lowest for group 1 (12.20 MPa) -Table no. 1

Time	Number of samples tested	Shear bond strength (in Mpa)	P value
No primer	11	12.20± 0.85	<0.05
primer cured for 1 sec with high intensity led light	11	15.54±0.92	
primer cured for 10 sec with normal intensity led light	11	16.60±0.91	

Table 1: Comparison of bond strength among 3 different groups using ANOVA

P<0.05 was considered as statistically significant

Data from Table 2 suggested that there was a statistically significant difference when group 1 was compared to group 2 and 3 and when group 3 was compared to group 2



Pair wise comparison	M.D(95% C.I of difference)	P value
Primer cured for 1 sec with high intensity led light - No Primer	3.34 (2.40, 4.29)	<0.05
Primer cured for 10 sec with normal intensity led light - No Primer	4.40 (3.45, 5.34)	<0.05
Primer cured for 10 sec with normal intensity led light - Primer cured for 1 sec with high intensity led light	1.05 (0.10, 1.99)	0.0262

Table 2: Pair wise comparison of shear bond strength between the 3 groups using post-hoc test

P<0.05 was considered as statistically significant

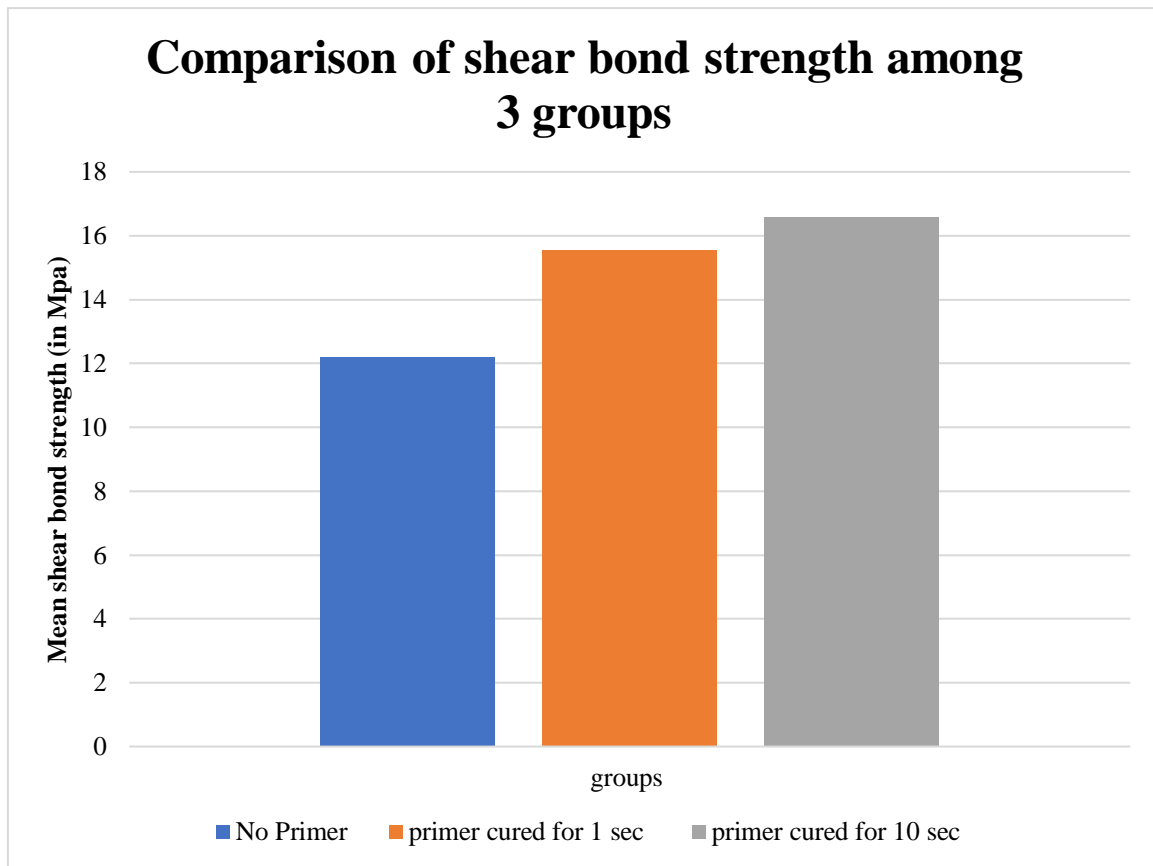


Fig. 11: Graph showing comparison of SBS among 3 groups

**VIII. DISCUSSION**

The study was undertaken in order to evaluate the effect of primer and two different curing times of primer on shear bond strength of orthodontic brackets bonded to tooth surface, thereby to improve the bonding and debonding procedure by minimizing or eliminating the iatrogenic effects of orthodontic bonding and debonding.

Any orthodontic bonding accomplished with adequate retention along with the following features will have superior clinical advantages :

- Easier and quicker debonding with little damage to the enamel surface.
- Minimal effect on the outer, fluoride-containing enamel surface.
- No resin tags left behind in the enamel surface.

The conventional bonding system used to place orthodontic brackets has proven to be reliable over time, but the procedures have changed very little from the introduction by Buonocore and Newman in the 1950s and 1960s. The systems create an etched surface on the enamel, which, when washed and dried, creates a high-energy surface that is readily wetted by the resin. A liquid resin wets the etched surface, creating resin tags that provide mechanical retention, which helps in achieving good bond strength.

Long-term irritation and type IV delayed hypersensitivity have been suggested to account for dermatosis observed on the hands of dental personnel. As Bis-GMA is both an irritant and allergen, abolishing the use of liquid resin from the composite would render the bonding materials more biocompatible, enhancing the speed of orthodontic bonding, and eliminating the iatrogenic effects caused by it.

If a primer could be avoided during bonding brackets, this would represent a potential time saving by missing a step in the bonding process.

But a primer is necessary to improve resistance to microleakage, after primer coating moisture control may not be extremely important, it permits easier bracket removal & protect against enamel tear outs during debonding.

In the present study the mean SBS of no primer group was 12.20MPa, SBS when primer was cured for 1 sec with high intensity curing light was 15.54 MPa and SBS when primer was cured for 10 sec with normal intensity curing light was 16.60MPa, all the three value were more than the clinically acceptable values .

The advantage of saving the chair side time by not applying the primer, can also be achieved to an extent by application of primer and curing it for only 1s with high intensity curing light, this will also eliminate the above-mentioned disadvantages of not using the primer and saves the chair side time by providing the sufficient SBS required.

## IX. CONCLUSION

The result of our study showed that use of primer by curing for 1sec with high intensity LED light, curing for 10sec with normal intensity LED light and also not using primer all three-condition produced SBS which was clinically acceptable, but by using primer and curing it for 1sec with high intensity LED light we can eliminate the disadvantages which are caused by not using primer and we can save our chair side time also by reducing the curing time. Further studies can be done considering the above aspects. Further research by doing a scanning electron microscopy (SEM) study of the debonded tooth surface to check for the enamel cracks and resin tag formation in the various groups can be conducted to evaluate the results better.

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