

## Comparative estimation of the hybrid layer while using adhesive systems of the fifth and sixth generations

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### Summary

Clinical efficiency of application of dental materials in many respects is determined by the mechanism of connection with a tooth. The *purpose* of this study was the comparative analysis of parameters of a hybrid layer formed in dentin after application of adhesive systems of the fifth and sixth generations.

*Materials and methods.* The bonding systems selected were Gluma Comfort Bond, Solo-bond M, and Prompt L-Pop. The six non-carious human molars were divided into three groups. Cavities on mesial, distal and occlusal surfaces of teeth were prepared. Adhesive systems were applied according to the instruction of the manufacturer; defects were restored by light-curing composite. Teeth sections 5-6 microns thick were prepared for evaluation by optical microscopy with magnification of 200x, 400x, 1000x.

*Results.* The results demonstrated morphological differences at the interface between dentin and filling. Average thickness of the hybrid layer in dentin was 4.05  $\mu\text{m}$ , 5.07  $\mu\text{m}$ , 1.77  $\mu\text{m}$  accordingly for Gluma Comfort Bond, Solobond M and Prompt-L-Pop. The average depth of penetration in dentinal tubules was 9.86  $\mu\text{m}$ , 10.97  $\mu\text{m}$ , 0.84  $\mu\text{m}$  accordingly for investigated samples.

*Conclusion.* On the basis of this *in vitro* study, the thickness of the hybrid layer in dentin and the depth of penetration of Prompt-L-Pop in dentinal tubules were much less than those of adhesive systems of the fifth generation (Gluma Comfort Bond, Solobond M).

**Keywords:** total-etch and self-etch bonding system, hybrid layer, resin tag, dentinal tubules.

### Introduction

Modern adhesive systems provide micromechanical fixing of various stomatologic materials in a tooth through a hybrid layer. The hybrid layer in dentin represents the structure, formed after removal or modification of the smear layer, demineralization of the superficial layer of dentin and infiltration of microspaces between collagenic fibres and dentinal tubules components by bonding systems, which are completely cured [1,2,3]. Parameters of the hybrid layer influence the durability of restorations and the quantity of complications. The urgency of the problem has proved true in plenty of

publications over the last years [4,5,6,7,8], however a small amount of works is devoted to the comparative characteristics of parameters of the hybrid layer for systems of different generations.

The purpose of our study was the comparative analysis of parameters of the hybrid layer, formed in dentin after application of three adhesive systems of the fifth and sixth generations.

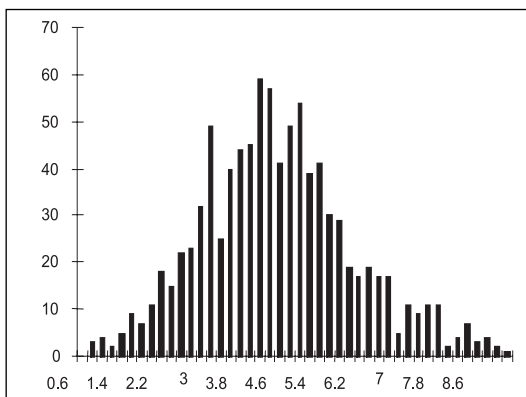
### Materials and methods

For research three bonding systems Gluma Comfort Bond, Solobond M and Prompt-L-Pop were used (*Table 1*).

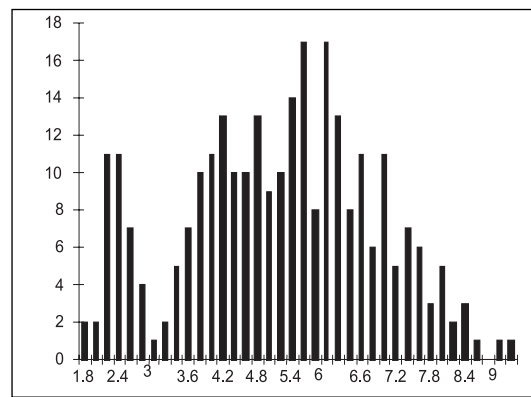
**Table 1.** The characteristics of bonding systems under research

	<b>Generation, type of etch</b>	<b>Solvent</b>	<b>Step of work</b>	<b>pH</b>
1. Gluma Comfort Bond	fifth, total etch	alcohol	Two steps, three applications of material	4.5
2. Solobond M	fifth, total etch	acetone	Two steps, one application of material	3.7
3. Prompt-L-Pop	sixth, self-etch	water	One step, 1-3 applications of material	0.9

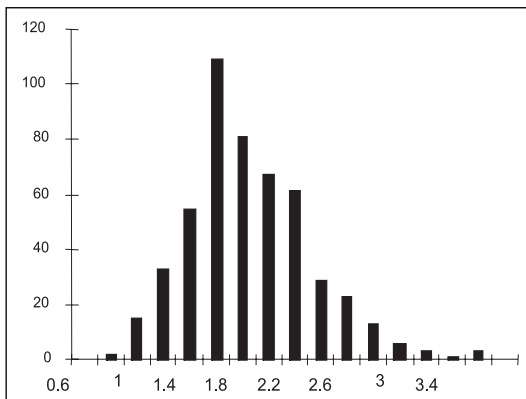
**Figure 1.** Fluctuations of thickness of the hybrid layer on the cavity perimeter



Gluma Comfort Bond



Solobond M



Prompt-L-Pop

On absciss axis – thickness of the hybrid layer in micrometers  
 On axis of ordinates – number of measurements

The experiment was carried out on removed healthy molars, on two teeth on each researched sample. In a tooth, cavities on mesial, distal and occlusal surfaces were prepared. Adhesive systems were applied according to the instruction of the manufacturer; defects were restored by light-curing composite. Teeth were prepared by a standard technique, with cut thickness of 5-6

microns. After fixing on glass, samples were stained with eosin. The study of parameters of the hybrid layer (average thickness, depth of penetration in dentinal tubules) was performed with the help of light microscopy at increase of 200x, 400x, 1000x.

The images received at digital photography were analyzed with the help of Scion Image program. Statistical analyzing of results was carried out with the help of

Microsoft Excel 2003 and included definition of average value, standard deviation (SD), standard error (SE), two-selective t-test with 5% confidence interval.

## Results

Average thickness of the hybrid layer in dentin was  $4.05 \pm 1.53 \mu\text{m}$  ( $\pm\text{SE} = 0.77$ ),  $5.07 \pm 2.75 \mu\text{m}$  ( $\pm\text{SE} = 0.1$ ),  $1.77 \pm 0.47 \mu\text{m}$  ( $\pm\text{SE} = 0.27$ ) accordingly for Gluma Comfort Bond, Solobond M and Prompt-L-Pop (*Figure 1*).

Distinctions between Gluma Comfort Bond and Solobond M are doubtful ( $p > 0.5$ ) and distinctions in thickness of a hybrid layer between bonding systems of the fifth and sixth generations are statistically significant ( $p < 0.005$ ). The average depth of penetration in dentinal tubules was  $9.86 \pm 2.48 \mu\text{m}$  ( $\pm\text{SE} = 0.49$ ),  $10.97 \pm 3.06 \mu\text{m}$  ( $\pm\text{SE} =$

$0.51$ ),  $0.84 \pm 0.47 \mu\text{m}$  ( $\pm\text{SE} = 0.1$ ) accordingly for Gluma Comfort Bond, Solobond M and Prompt-L-Pop. Depth penetration of Prompt-L-Pop in dentinal tubules appeared much less, than in adhesive systems of the fifth generation ( $p < 0.001$ ).

## Conclusion

On the basis of results of the research conducted it is possible to draw the following conclusions:

1. Thickness of a hybrid layer in dentin after application of bonding systems of the fifth generation, Gluma Comfort Bond, Solobond M was  $4.5 \mu\text{m}$  in average, that is much more than after application of self-etching system Prompt-L-Pop ( $1.8 \mu\text{m}$ ).

2. Depth of penetration of Prompt-L-Pop in dentinal tubules (averages less than  $1 \mu\text{m}$ ) is much less than in systems of the fifth generation (about  $10 \mu\text{m}$ ).

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