Momentary Pretreatment by 35 % HEMA Solution Combined with Five Marketed Bonding Agents

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The effect of momentary pretreatment by 35 % HEMA solution on the adaptation between dentin and resin material was investigated by measuring wall-to-wall polymerization contraction in a cylindrical dentin cavity.

Five marketed bonding agents tested in this study exhibited improved marginal seal when the dentin cavity wall was pretreated by 35 % HEMA for a few seconds with the exception of Pyrofil Light Bond. It is concluded that the dentin cavity wall should be treated by HEMA prior to the application of a marketed bonding agent.

Key words: HEMA, Bonding agent, Contraction gap

INTRODUCTION

In a previous study, Gluma which is composed of glutaraldehyde and hydroxyethylmethacrylate (HEMA) diluted in water exhibited high bond strength between dentin and composite resin1). However, we found that the Gluma caused slight irritation to the dog pulp2) and the glutaraldehyde in this bonding agent had no effect on the adhesion3). Therefore, pretreatment with 35 % aqueous solution of HEMA should be performed to improve marginal seal between the dentin cavity wall and resinous materials.

The application time of Gluma in these studies was 60 s, which is considered to be too long in the clinical setting. Recently, we reported that the momentary application of HEMA was as effective as 60 s pretreatment4).

In the present work, the effect of a few seconds application of 35 % HEMA solution combined with marketed bonding agents on the marginal adaptation of composite to dentin cavity wall was investigated by measuring wall-to-wall contraction in a cylindrical dentin cavity.

MATERIALS AND METHODS

The proximal surface of extracted human molar was ground and the exposed dentin surface was flattened on the wet carborundum paper No. 220. A cylindrical dentin cavity, approximately 3 mm in diameter and 1.5 mm in depth, was prepared in the dentin. The cavity including the surrounding dentin surface was treated with neutralized 0.5M EDTA (pH 7.4) in a small sponge pellet for 60 s followed by spraying water and air blasting. The cavity was then treated with 35 % aqueous solution of HEMA* for a few seconds and dried completely.

* E. Merck, Darmstadt, W. Germany
with compressed air. In the next step, one of five marketed bonding agents listed in the table was applied in the cavity and the excess of these bonding agent was removed by air blasting. A visible light cured composite** was slightly overfilled and the resin surface was covered with a plastic matrix. The resin was polymerized by using of a lamp unit*** ensuring the tight attachment between tip window of the lamp unit and plastic matrix.

After storing the specimen in water for 10 min, the excess composite was removed with wet carborundum paper No.1000 and the resin and dentin surface was polished using linen with aqueous slurry of alminium oxide.

The width of the possible contraction gap was measured by a screw micrometer mounted on the ocular lens of an optical microscope**** at a magnification of $\times 1024$. The maximum contraction gap was given as per cent of the cavity diameter.

Ten specimens were prepared with and without HEMA pretreatment for every five bonding agents.

** Silux, 3 M Co., Minneapolis, MN, USA  
*** Heliomat, Vivadent, Schaan, Liechtenstein  
**** Orthoplane, Leitz, Wetzlar, W. Germany
RESULTS

The maximum contractions observed are presented in Fig. 1. The adhesion of the marketed bonding agent except Pyrofil Light Bond were improved significantly when they were treated with 35 % HEMA solution. The one-way analysis of variance by ranks5) showed that two bonding systems (Clearfil New Bond and Pyrofil Bond both combined with HEMA pretreatment) exhibited the best marginal adaptation in the bonding systems employed in this investigation. Two and four specimens out of ten were gap free in the tested group of Clearfil New Bond and Pyrofil Bond combined with 35 % HEMA respectively.

As reported previously, contraction gap was always observed at the cervical margin (Fig. 2) whereas tight adaptation was obtained at the occlusal margin (Fig. 3).

![Fig. 2](image1.png) The contraction gap observed at gingival dentin cavity margin.

![Fig. 3](image2.png) The tight adaptation between resin and dentin observed at occlusal cavity margin.

DISCUSSION

Little is known about the mechanism involved in the improved adhesion by 35 % HEMA pretreatment. Experimentally, however, the contraction gap of the marketed bonding agent to dentin cavity wall was significantly decreased by momentary application of 35 % HEMA solution.

In the clinical procedures for composite resin restoration, such steps as acid etching of enamel cavity wall, bonding agent application and composite resin filling showed be carried out continuously because a long interval might increase the chance of undesirable contamination of cavity wall by humidity in the oral environment and saliva.

Thus it is recommended to treat the dentin cavity wall with 35 % HEMA solution for only a few seconds prior to application of a marketed bonding agent.

The contraction gap between resin and dentin cavity wall, however, could not be prevented completely even when the most improved bonding system was employed in this study. Further studies are needed to obtain tight adaptation of resin to dentin cavity wall especially at the gingival cavity margin.
CONCLUSIONS

The effect of momentary pretreatment of 35% HEMA solution on the marginal adaptation of five marketed bonding agents was examined by measuring the wall-to-wall contraction gap around a cylindrical dentin cavity margin prepared in the extracted human teeth.

The marginal adaptation of marketed bonding agent was improved significantly by 35% HEMA solution with one exception, Pyrofil Light Bond. The dentin cavity wall should be treated with 35% HEMA solution for a few seconds prior to application of the marketed bonding agents.

Complete seal between dentin and resin could not be obtained even when the best bonding system was employed in this examination particularly at gingival cavity margin.

REFERENCES

35％HEMA 水溶液による瞬間的な前処理と
5 種の市販 bonding agent の併用について

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35％HEMA 水溶液によって数秒間齦歯を前処理する
ことが象牙質とレジン材料の適合性にいかなる影響を及
ぼすかを検討するために，象牙質円柱窓周辺での wall-
to-wall contraction gap を比較計測した。本研究で用い
た5種類の市販 bonding agent は，1種の例外（Pyrofil
Light Bond）を除き，35％HEMA 水溶液によって瞬間
的抑制面を前処理することにより，辺縁適合性は有意に
改善した。したがって，市販 bonding agent を適用する
に先立ち，窓壁を HEMA により前処理することが推奨
される。

可視光線重合型コンポジットレジンの重合速度と象牙質窓壁適合性

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可視光線重合型の Bis-GMA-HEMA 系のレジンモノ
マーを調製し，還元剤や促進剤の添加量を変化させて重
合度および重合速度を調節した。重合度は赤外吸光分析
器を用いて残留 C＝C 量を測定することにより算出し，
重合速度は，照射時間を順次変化させた試料の重合度か
らその傾向を推測した。一方，EDTA および Gluma で処
理された象牙質窓壁に，上記のレジンモノマーにガラス
フィラーを75wt ％混入して得られたコンポジットレジ
ンを充満し，硬化後，窓壁適合性を調べた。

この結果，レジンの重合速度が大きくなるに従い，窓
壁適合性が有意に劣化することがわかり，重合中のレジ
ンの粘弾性，とりわけレジン表面から窓溝内部への充填
剤の流れが重合収縮を補償することが示唆された。

各種条件下におけるコンポジットレジンの曲げ強さについて

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市販の化学重合型コンポジットレジン3種および光重
合型コンポジットレジン5種の曲げ強さを経時的に測定
し，高濃アマルガムのそれと比較した。またフィラー配
合形態と曲げ強さとの関連性を検討するために，各種コ
ンポジットレジン表面の反射電子像を SEM 観察した。さ
らに化学重合型レジンを熟気泡練和した場合の曲げ強
さを従来の手練和の場合と比較すると共に，同種レジン
を熟気泡練和した場合の接合部における曲げ接着強さを測
定した。その結果，高密度充満型コンポジットレジンの
曲げ強さはマクロフィラー型あるいは MFR 型レジンの
それと比べ著しく高く，アマルガムに匹敵していた。ま
た化学重合型レジンを無気泡練和した場合，曲げ強さが
若干上昇した。さらに同種レジンを熟気泡練和した際の接
合部の曲げ接着強さは本来の曲げ強さの値に比べて低下
しており，特に高密度充満型レジンにおいては，本来の
値の約1/2の著しく低い値を示していた。