Bonding ability of 4-META primer used with 4-META/MMA-TBB resin "Bondfill SB" to enamel and dentin: primary vs. permanent teeth

Yumiko Hosoya [1], Tomoyoshi Taguchi [2], Hideji Otani [3], Tetsuhiro Yukinari [4]

[1] Pediatric Dentistry, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan [2] Taguchi Dental Clinic, Nagasaki
[3] Otani Dental Clinic, Nayoro, Japan [4] Yukinari Pediatric & Orthodontic Dental Clinic, Nagasaki, Japan

Background

To avoid over-demineralization and denature of dentin collagen, mild pretreatment is recommended.

Aim:

This study was evaluate the efficacy of Teeth Primer (TP: 4-META) compared with Red Activator (RA: 65% phosphoric acid) and Green Activator (GA: 10% citric acid with 3% ferric chloride; 10-3 solution) used with 4-META/MMA-TBB resin Bondfill SB to enamel and dentin of primary teeth. Etching efficacy and micro tensile bond strength (MTBS) were compared with permanent teeth.

Materials and Methods

< Specimen Preparation >

- Each of 48 sound primary canines and third molars were used.
- Flat enamel and dentin surfaces were prepared with #180 SiC paper under running water.
- Teeth were divided into 8 groups:

Group 1 (primary enamel with RA) Group 2 (permanent enamel with RA)
Group 3 (primary enamel with TP) Group 4 (permanent enamel with TP)
Group 5 (primary dentin with GA) Group 6 (permanent dentin with GA)
Group 7 (primary dentin with TP) , Group 8 (permanent dentin with TP)

< Micro tensile bond strength test (MTBS)

- Dumbbell shaped specimens with 1.0 mm^2 adhesive area.
- After storage in distilled water at 37° C for 24 hours, tensile load was applied at crosshead speed of 1 mm/min.

< Scanning electron microscopy (SEM) observation >

- Efficacy of pretreatment and bonded interfaces were observed.

Data were statistically analyzed using ANOVA and Fisher's PLSD test at $p<0.05$.

Chemical formations of materials

Material (Batch No)	Components	Protocol
Teeth Primer: TP (0056)	4-META, water, aceton, reducing agent	Apply primer to enamel and dentin for 20 sec and air-dry
Red Activator: RA (TE1)	65% phosphoric acid	Apply activator to enamel for 30 sec., wash with water and air-dry.
Green Activator: GA (SF2)	10% citric acid with 3% ferric chloride	Apply activator to dentin for 10 sec., wash with water and air-dry.
Bondfill SB		
Liquid (10F0629)	4-META, MMA, poly-functional methacrylate	Apply mixture of the polymer powder and monomer-catalyst, using the brush-on technique to the bonded tooth surface.
Powder (10K03173)	PolyMMA, TMPT pre-polymerized filler, pigment	
Catalyst V (TT1)	TBB, TBB-O, hydrocarbon	

4-META: 4-methacryloxyethyl trimellitate anhydride; MMA: methyl methacrylate;
TMPT: trimethylopropane trimethacrylate; TBB: tri-*n*-butylborane; TBB-O: partially oxidized tri-n-butylborane

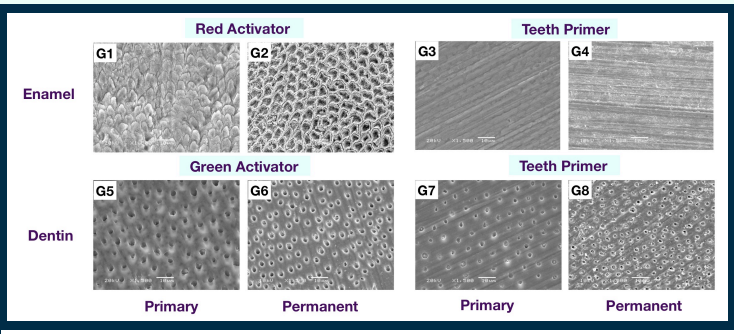
Microtensile Bond Strengts and Fracture Modes

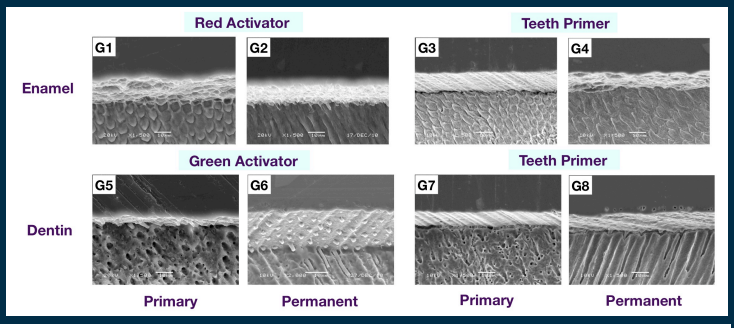
Group	Tooth	Enamel/Dentin	Primer/Activator	Microtensile Bond Strengths Mean (SD) Unit: MPa		Fracture Modes (%) Adhesive	Mix	Cohesive
1	Primary	Enamel	Red Activator	22.6 (7.5)	a		11 (61.1)	7 (38.9)
2	Permanent	Enamel	Red Activator	29.3 (7.4)	b		5 (25.0)	15 (75.0)
3	Primary	Enamel	Teeth Primer	19.5 (3.5)	a		1 (5.6)	17 (94.4)
4	Permanent	Enamel	Teeth Primer	19.4 (4.9)	a		1 (3.6)	27 (96.4)
5	Primary	Dentin	Green Activator	21.6 (6.1)	a	1 (5.3)	7 (36.8)	11 (57.9)
6	Permanent	Dentin	Green Activator	39.1 (9.7)	c		1 (3.7)	26 (96.3)
7	Primary	Dentin	Teeth Primer	22.0 (7.5)	a		1 (5.9)	16 (94.1)
8	Permanent	Dentin	Teeth Primer	28.6 (9.3)	b		13 (41.9)	18 (58.1)

Values with same superscript letters indicate no significant difference at p<0.05.
Fracture modes; Adhesive: adhesive fracture, Mix: mixed with adhesive and cohesive resin fracture,
Cohesive : cohesive resin fracture

Results

- Etching efficacy of TP on enamel was low.
- For enamel, the MTBS of Group 2 was significantly higher than that of other groups in which no significant difference was observed.
- For dentin, the MTBS were Group 6 > Group 8 > Group 7 and Group 5 in order with significant difference among groups except between Groups 7 and 5.
- The MTBS on permanent dentin were significantly higher than that on primary dentin.
- Major fracture mode was cohesive resin fracture except for Group 1.





Discussion and Conclusion

For permanent teeth, the MTBS on enamel etched with RA (high concentrate phosphoric acid) and dentin etched with GA (10-3 solution) were significantly higher than those primed with TP. However, for primary teeth, there was no significant difference of the MTBS among all of 4 groups, As reported in the previous studies, compared to permanent teeth, enamel and dentin of primary teeth are more susceptible to primer and etchants. Thus for primary teeth, etching by 65% phosphoric acid to enamel and 10-3 solution to dentin might cause over-etching and showed lower bond strength than permanent teeth in the same etching time. The 4-META Teeth Primer (pH3) showed mild priming efficacy to dentin. Aceton in Tooth Primer allows sufficient penetration by the adhesive monomer and affects the molecules formed by diffusion in the resin-impregnated layer like other component as reducing agent. Application of Tooth Primer caused less damage to the tooth and displayed excellent polymerization at the adhesive interfaces with high water content because of the presence of TBB polymerization initiator. Teeth Primer used with Bondfill SB was effective for enamel and dentin of primary teeth.

References: 1. Yumiko Hosoya *et al.*, Hardness and elasticity of carious-affected and sound primary tooth dentin bonded with 4-META one-step self-etch adhesive. *Am J Dent 21:223-228, 2008.*
2. Y. Hosoya *et al.*, Influence of Carisolv™ on resin adhesion to sound human primary dentin and permanent dentin using the different adhesive systems. *J Dent* 33: 283-291, 2005.
3. Yumiko Hosoya *et al.*, Fluoridated light-cured bonding resin adhesion to enamel and dentin: primary *vs* permanent. *Pediatr Dent* 22: 101-106, 2000.