Enamel Etching

N. Talic

Acid Etching of Enamel

- In 1955, Buonocore proposed that acids can be used to alter the surface of enamel to “make more receptive to bonding”
- He used 85% phosphoric acid for 30 seconds

Michael Buonocore

Enamel Etching

- 37% phosphoric acid typically dissolve 5-10 μm of enamel surface and creates a zone of ethched enamel rods of 15-25 μm
- Etching process creates calcium monophosphate and calcium sulfate that must be removed by water rinse

Enamel Etching

- Variables affecting bond strength

1. Fluorosis
2. Type and concentration of acid
3. Duration of etching
4. Use of pumice with or without fluoride

Fluorosis

- Teeth with fluorosis are more resistant to acid etch
- Bond strength to a group fluorotic teeth even with additional time for acid etch are about 40% lower than bond strengths to normal teeth

Type and Concentration of Acid

- Ethching with 37% phosphoric acid produces the highest bond strength (28 MPa)
- Etching with 10% maleic acid results in lower bond strength (18MPa)
- No etching produces lower bond strength

Duration of Etching

- No difference in bond strength was detected between 30 seconds and 60 seconds etching with 37% phosphoric acid
- Shorter etching time causes less enamel damage on debonding
- Etching with 37% phosphoric acid for at least 30 seconds produce more optimal etching patterns than etching for 15 seconds

Side Effects of Etching

- Enamel surface roughness and color alterations were found to be affected similarly by both etching and non-etching mediated (glass ionomer) bonding
- Surface structure and the optical properties of enamel were affected mainly by the debonding process involving rotary instruments and not by the infiltration of enamel by resin

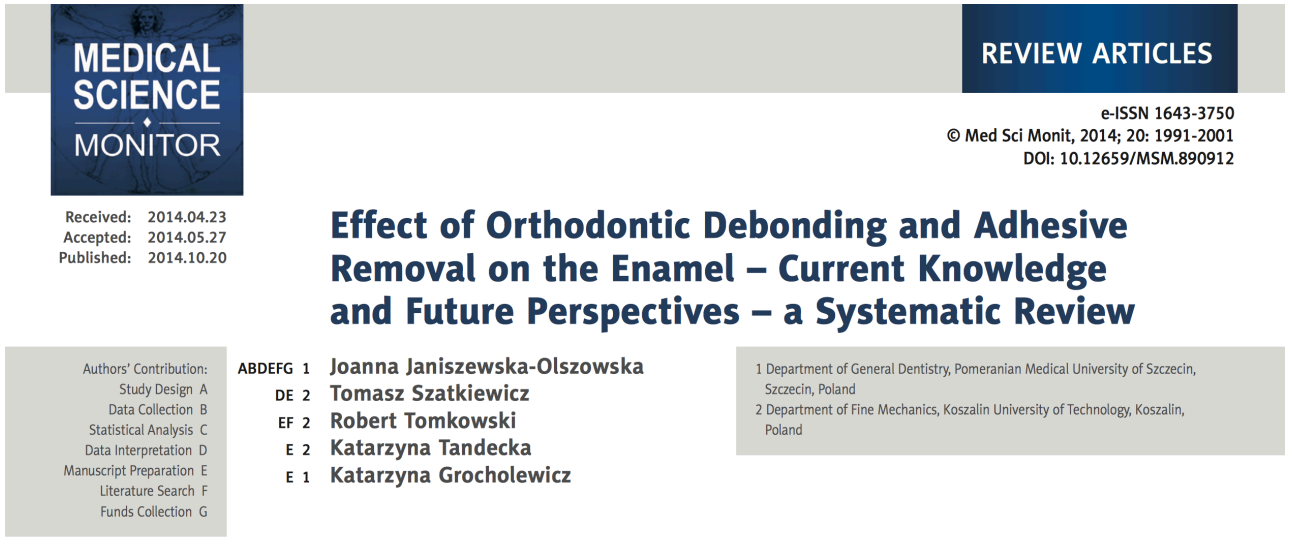
Theodore Eliades
American Journal of Orthod. Dentofacial Orthop. 2006; Volume 130, *Number* 4

N. Talic

Adhesive Removal After Debonding

Rotary instruments used for residual adhesive removal cause enamel abrasion in an amount dependent on

- ✓Size and composition of the abrasive particles
- ✓Rotational speed
- ✓Pressure against enamel surface
- ✓The age of the carbide bur



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Effect of Orthodontic Debonding and Adhesive Removal on the Enamel – Current Knowledge and Future Perspectives – a Systematic Review

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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- The most popular tool tungsten carbide burs
- They remove substantial layer of enamel and roughen its surface, but less destructive than green stones, diamond burs, steel burs, and lasers
- Green stones, diamond burs, steel burs, and lasers should not be used for adhesive removal
- The use of carbide bures require multistep polishing

Enamel surface evaluation after bracket debonding and different resin removal methods

Michele Machado Vidor[1], Rafael Perdomo Felix[2], Ernani Menezes Marchioro[3], Luciane Hahn[4]

Dental Press J Orthod. 2015 Mar-Apr;20(2):61-7

N. Talic

30 blades carbide bur

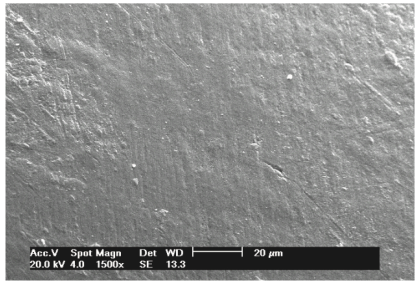


Figure 3 - Micrography of enamel surface after resin removal with tungsten drill without polishing (Group 1a).

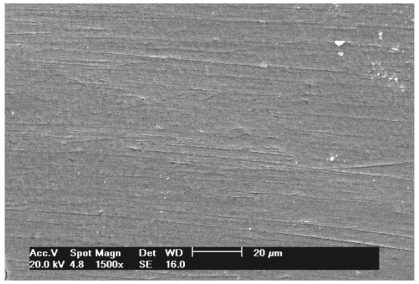


Figure 4 - Micrography of enamel surface after resin removal with tungsten drill and polishing with aluminum oxide (Group 1b).

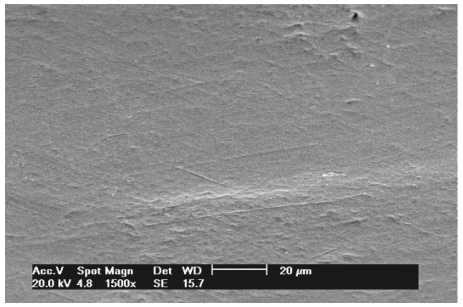


Figure 5 - Micrography of enamel surface after resin removal with tungsten drill and polishing with pumice (Group 1c).

30 blades carbide bur + Sof-lex discs

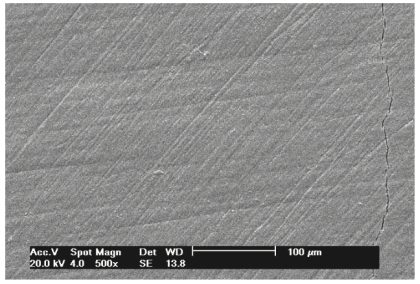


Figure 2 - Micrography of enamel surface after resin removal with Tungsten drill + Sof-lex® discs without polishing (Group 2a).

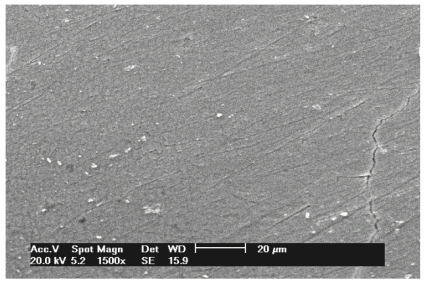


Figure 6 - Micrography of enamel surface after resin removal with tungsten drill + Sof-lex discs and polishing with aluminium oxide (Group 2b).

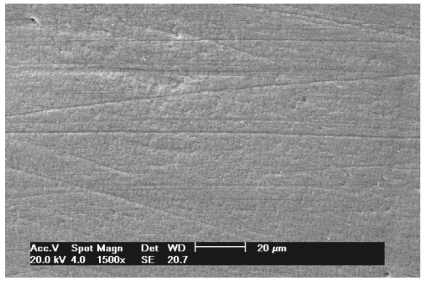


Figure 7 - Micrography of enamel surface after resin removal with tungsten drill + Sof-lex discs and polishing with pumice (Group 2c).

30 blades carbide bur+ Enhance finishing tips

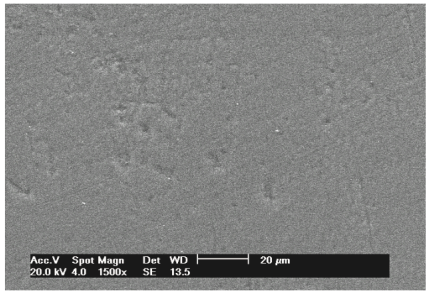


Figure 8 - Micrography of enamel surface after resin removal with tungsten drill + Enhance finishing tips without polishing (Group 3a).

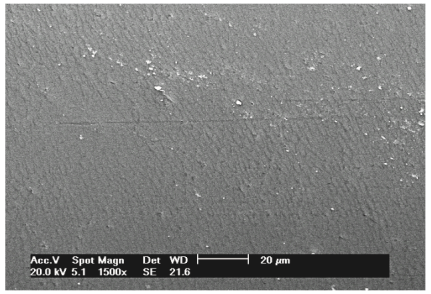


Figure 9 - Micrography of enamel surface after resin removal with tungsten drill + Enhance finishing tips and polishing with aluminium oxide (Group 3b).

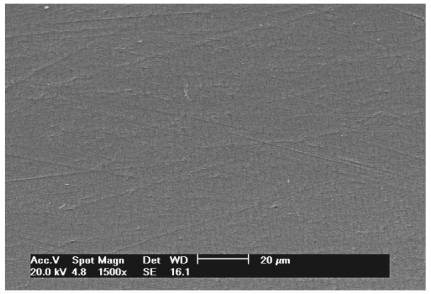


Figure 10 - Micrography of enamel surface after resin removal with tungsten drill + Enhance finishing tips and polishing with pumice (Group 3c).

N. Talic

Are acid gels preferable to solutions?

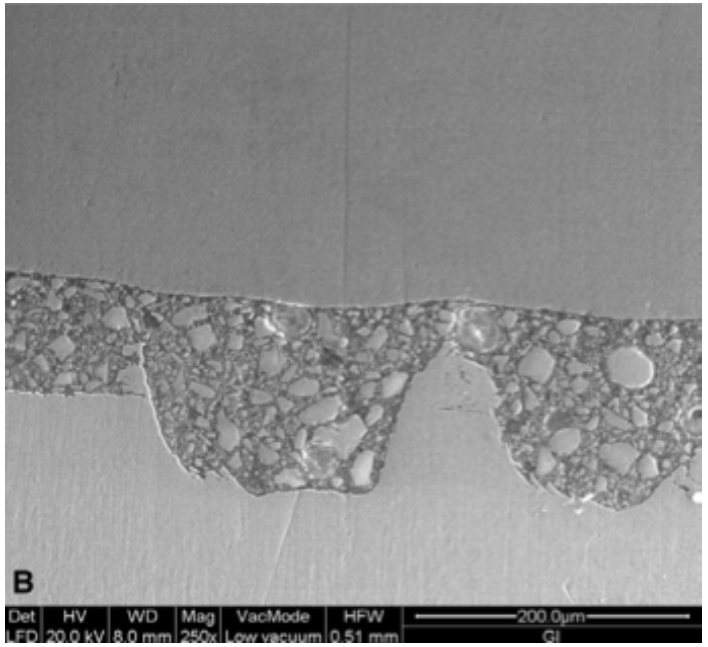
- **There is no difference in etching**
- **Gels provides better control, but require more rinsing afterwards**

Alternatives to Etching

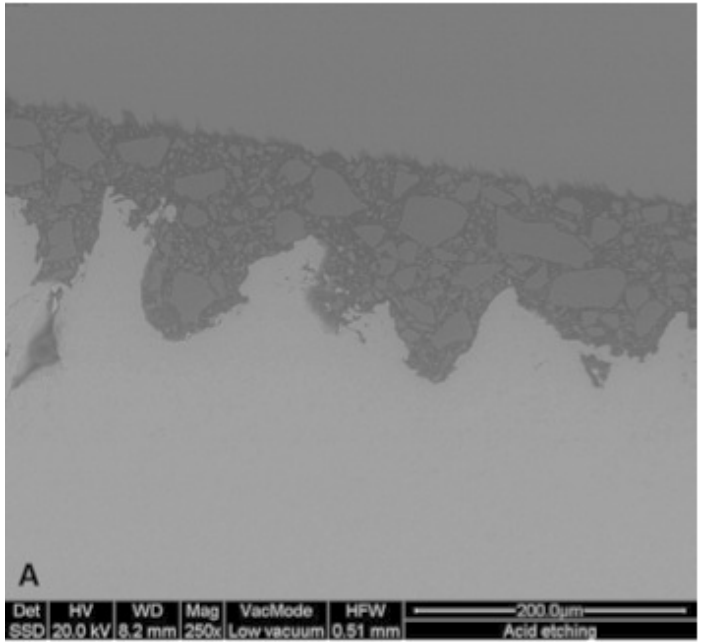
- Self etching primers:

- 3M/Unitek (Transbond) and GAC (Ideal 1)
- Expensive
- Moisture in- sensitive
- Comparable bond strengths are found
- The phosphate group on the methacrylated phosphoric acid dissolves the calcium from the hydroxyapatite
- Scanning electronic microscopic studies showed that self-etching yields shorter resin tags, which is adequate for orthodontic bonding

Secondary electron images of enamel-adhesive interface



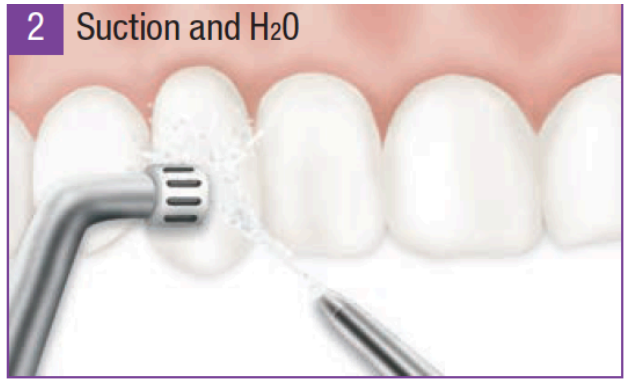
Self etching Primer

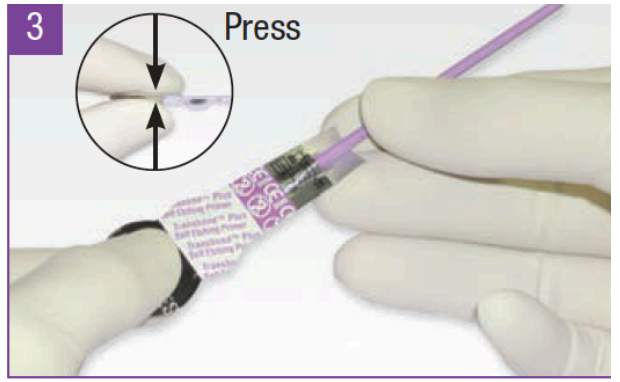


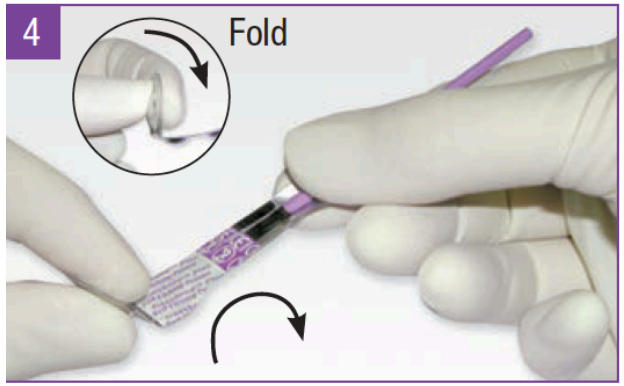
Conventional acid etch

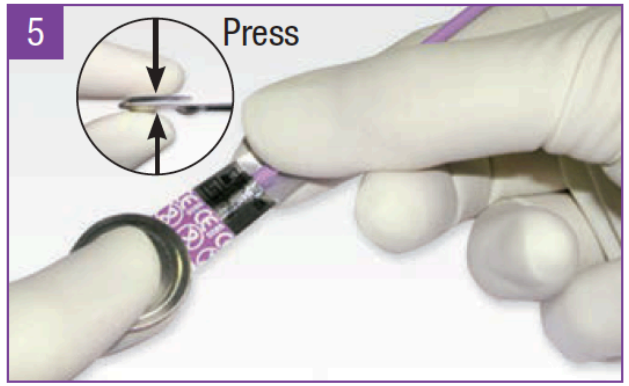
N. Talic

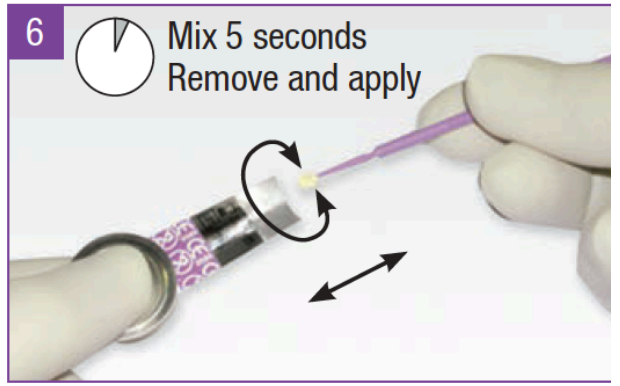

1
Clean teeth

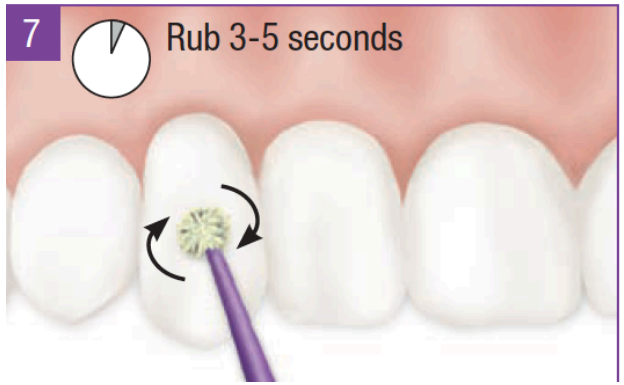

2
Suction and H20

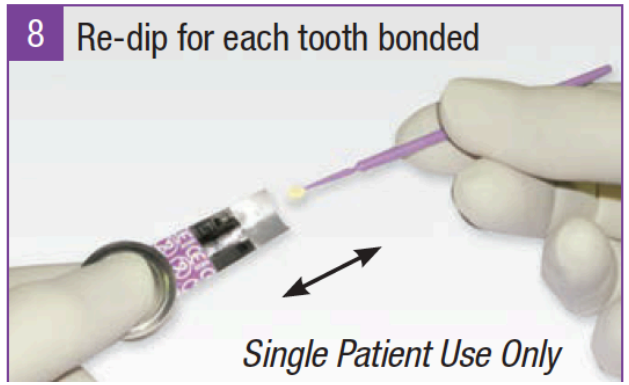

3
Press

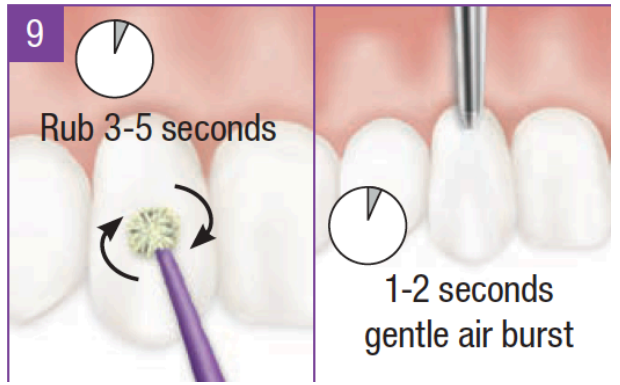

4
Fold


5
Press


6
Mix 5 seconds
Remove and apply

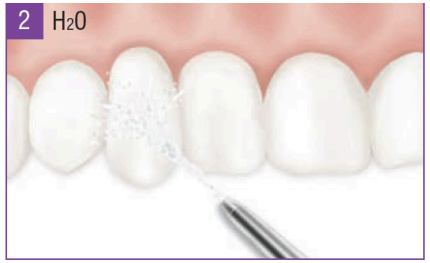

7
Rub 3-5 seconds


8
Re-dip for each tooth bonded
Single Patient Use Only

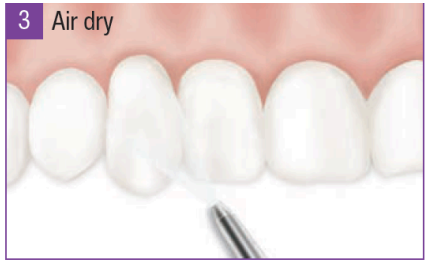

9
Rub 3-5 seconds
1-2 seconds
gentle air burst

1 Clean teeth

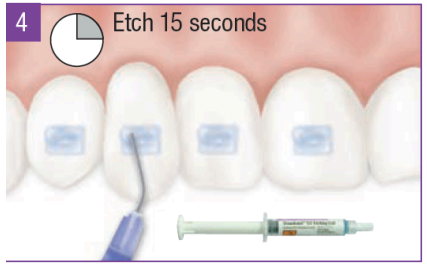
2 H_2O



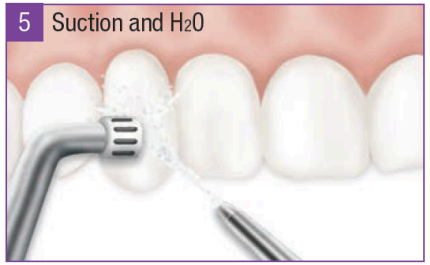
3 Air dry



4 Etch 15 seconds



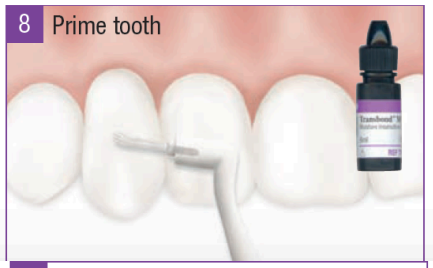
5 Suction and H_2O



6 Transbond™ MIP Moisture Insensitive Primer

7 Transbond™ MIP Moisture Insensitive Primer

8 Prime tooth



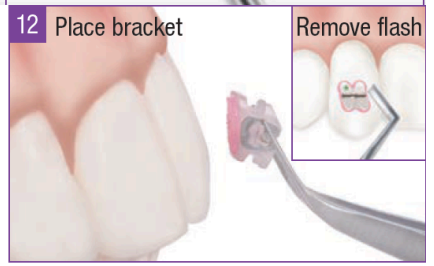
9 2-5 seconds gentle air burst

10

11

12 Place bracket

Remove flash



13

Light Curing Times

Ortholux™ Luminous Curing Light:
Metal Brackets: 3 seconds mesial × 3 seconds distal
Ceramic Brackets: 3 seconds, straight through the bracket
Direct Bond Buccal Tubes: 6 seconds mesial × 6 seconds occlusal

Ortholux™ LED Light
Metal: 5 seconds interproximally
Ceramic: 5 seconds, straight through the bracket
Direct Bond Tubes: 10 seconds mesial × 10 seconds occlusal

Use of Pumice With or Without Fluoride

- A common practice to use pumice or prophylactic paste before acid etching and bonding
- Bond strength is unaffected whether pumice was used or not
- The use of fluoridated paste does not affect bond strength

N. Talic. Effect of fluoridated paste on the failure rate of precoated brackets bonded with self-etching primer: a prospective split-mouth study.
Am J Orthod Dentofacial Orthop 2011 Oct;140(4):527-30

- A total of 315 brackets were bonded after pumice treatment, and 312 were bonded after paste treatment
- The patients were followed for 6 months to determine the rates of bracket failure.
- The failure rates for pumice and paste were 4.8% and 11.2%, respectively. There was a statistically significant difference between the two groups.
- Preparation of the enamel surface with fluoridated paste before bonding with self-etching primer is not recommended. However, the use of plain pumice is recommended, even if it is time-consuming.

N. Talic

Alternatives to Etching

- **Air abrasion (Microetching):**

☛**Pressured aluminum oxide particles against the surface of enamel**

☛**Bond strength is 50% of the acid etched enamel**

Alternatives to Etching

- Laser Etching

☛Causes localized melting of hydroxyapatite crystals and ablation

☛Laser etching using Nd:YAG laser produces lower bond strength than acid etching

☛CO_2 laser etching produced sufficient bond strength

☛The thermal effect of laser on the tooth should be investigated

Bleaching

- Office bleaching with 35% hydrogen peroxide does not adversely affect the bond strength of brackets bonded immediately after bleaching (Uysal T et. Al. AJODO 2003; 123: 628-632)
- Bleaching with 35% Hydrogen peroxide showed significantly lower bond strength values of Fuji Ortho LC (Cacciafesta V. AJODO 2006; 130: 83-87)
- Discontinue home bleaching at least 1 week before the bonding appointment (Miles P. et. el. AJODO 1994; 106: 371-375) (Bulut H. AJODO 2006; 129: 266-272)

Bleaching

- 10% Carbamide peroxide bleaching does not significantly reduce shear bond strength of brackets bonded with SEP three weeks following bleaching.
- However, 38% Hydrogen peroxide bleaching significantly reduced these values (Akin M. Eur J Dent. 2013; 7: 55-60)
- Bleaching with 35% Hydrogen peroxide reduced the bond strength of of brackets and that could be reversed effectively by the application of antioxidants agents (10% sodium ascorbate) (Yadav D. J Orthod Sci. 2015; 4: 72-76)

Should we etch the whole enamel surface or only a small portion?

- **Etching the whole enamel surface is harmless**

Factors Affecting Bond Strength

- Type of adhesive used
- Filler content
- Adhesive thickness
- Broken mesh areas in a metal bracket
- Pretreatment of brackets
- Tooth Type

The Effect of Tooth Type on the SBS

- The greatest mean SBS found on the lower first molar teeth and lowest on the upper first molar teeth

- The mean SBS was on higher anterior teeth compared to posterior teeth in the upper arch

- It was lower on the anterior teeth compared to posterior teeth in the lower arch.

Hobson RS, McCabe JF, Hogg SD. Bond strength to surface enamel for different tooth types. Dent Mater 2001 Mar; 17(2): 184–9.

Bond Failure

- **Adhesive Failure**

  Failure between the adhesive and the tooth

  Failure between the adhesive and the bracket
- **Cohesive Failure**

  Failure within the tooth

  Failure within the cement

  Failure within the bracket