DENTSPLY
DETREY

xeno® III

Single Step Self-Etching Dental Adhesive

The Perfect Synthesis of Performance and Speed

2002-10-14 (Individual Attention Only)

With the compliments of

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SCIENTIFIC COMPENDIUM

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1 Introduction

With the introduction of the first total-etch one-bottle adhesive Prime&Bond® DENTSPLY has set a milestone in the development of dental adhesives. Now DENTSPLY opens the next chapter of this success story by introducing the single-step self-etching adhesive **Xenoâ III**.

Self-etching adhesives make a separate etching step, typically applying a phosphoric acid gel followed by a rinsing and drying step, obsolete. The application of self-etching adhesives therefore simplifies the bonding procedure and thus reduces the technique sensitivity especially with regard to dentine bonding.

2 Product Description - Xeno®III

2.1 Xenoâ III: Components and Their Functions

Xeno®III is a universal self-etching dental adhesive designed to bond light-cured restorative materials to the tooth substrate. Xeno®III is a two-part single-step self-etching comprising a LIQUID A and a LIQUID B. The two liquids are mixed in a 1:1 ratio prior to application in order to obtain the self-etching adhesive which has three functions, effective in one application step: etching, priming and bonding. The Xeno®III components and their specific functions are given in Tables 1 and 2 below.

Table 1: Xeno®III Liquid A: components and their specific functions

Component	**Function**
2-Hydroxyethyl methacrylate (HEMA)	Primer
Purified water	Solvent
Ethanol	Solvent
2,6-Di-tert-butyl-p hydroxy toluene	Stabiliser
Nanofiller	Contributes to tackiness towards 1st layer of uncured restorative

Table 2: **Xeno® III Liquid B: components and their specific functions**

Component	**Function**
Tetramethacryloxyethyl pyrophosphate (Pyro-EMA)	Acidic, polymerisable monomer ➔ etching and adhesive function
Pentamethacryloxyethyl cyclo-phosphazen mono fluoride (PEM-F)	Fluoride releasing polymerisable monomer ➔ enhances the etching effect by scavenging Calcium-ions
Urethane dimethacrylate (UDMA)	Contributes to cohesive strength
2,6-Di-tert-butyl-p-hydroxy toluene (BHT)	Stabiliser
Camphorquinone	Photoinitiator
p-Dimethylamino ethyl benzoate (EPD)	Co-Initiator

Xeno®III is a water/ethanol based self-etching adhesive. The two solvents are contained only in Liquid A. The resins in Liquid B are solvent-free and hence any hydrolytic degradation during storage can be ruled out. The use of water/ethanol as low volatile solvents has the advantage that solvent loss during storage or use is minimised thus removing a source of variability.

The incorporation of specially treated nanofiller enhances the tackiness between the cured adhesive and the 1st layer of uncured restorative during placement.

Xeno®III contains the mono- and bi-functional monomers HEMA and UDMA. The prior is proven to be an excellent priming molecule and the latter is contributing to cohesive strength. Beside these two well-known monomers, Xeno®III contains two new monomers patented by DENTSPLY: **Pyro-EMA** and **PEM-F**. Both monomers contribute to the etching and adhesive function. Details and functionality of the latter monomers are described in the following chapter.

2.2 Xeno® III: How does its chemistry work?

Both molecules Pyro-EMA-SK and PEM-F become active only when exposed to water (from Liquid A). The monomer Pyro-EMA (“masked acid”) forms free phosphoric acid groups immediately when contacted with water, as illustrated in Figure 1.

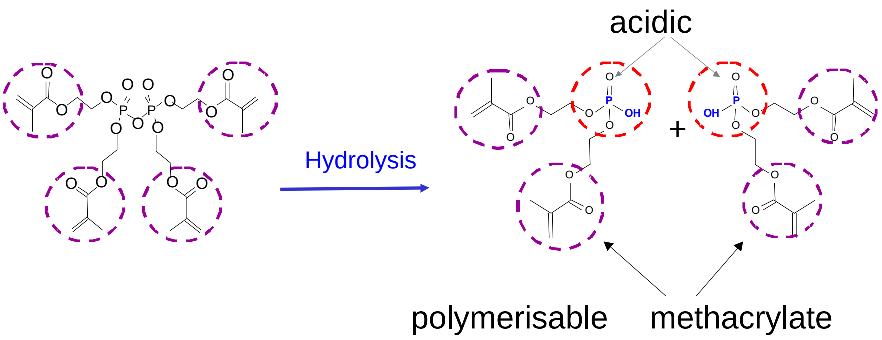

Figure 1 Formation of free phosporic acid groups after contact of Pyro-EMA with water (from Liquid A)

Due to the formation of the free phosphoric acid groups the mixture of Xeno®III Liquid A and Liquid B is strongly acidic. The acidity of Xeno®III has been compared with two commercial self-etching adhesives by measuring the respective pH values. Results (internal data) are given in Table 3.

Table 3 pH of Xeno®III compared to other self-etching adhesives

Adhesive	pH
Clearfil® SE (Kuraray)	2.0
Prompt L-Pop® (3M ESPE)	1.3
Xeno®III (DENTSPLY)	< 1.0

Xeno®III is more acidic than the two reference materials.

Upon contact with the tooth substrate the free phosphoric acid groups of the hydrolysed Pyro-EMA demineralise hydroxy apatite of the tooth substrate (etching). Calcium ions are released from the hydroxy apatite resulting in the complete neutralisation of phosphoric acid groups via ionic interaction of the Calcium ions with the phosphoric acid (Figure 2). After removal of solvent and light activation the neutralised Pyro-EMA is being co-polymerised via methacrylate groups.

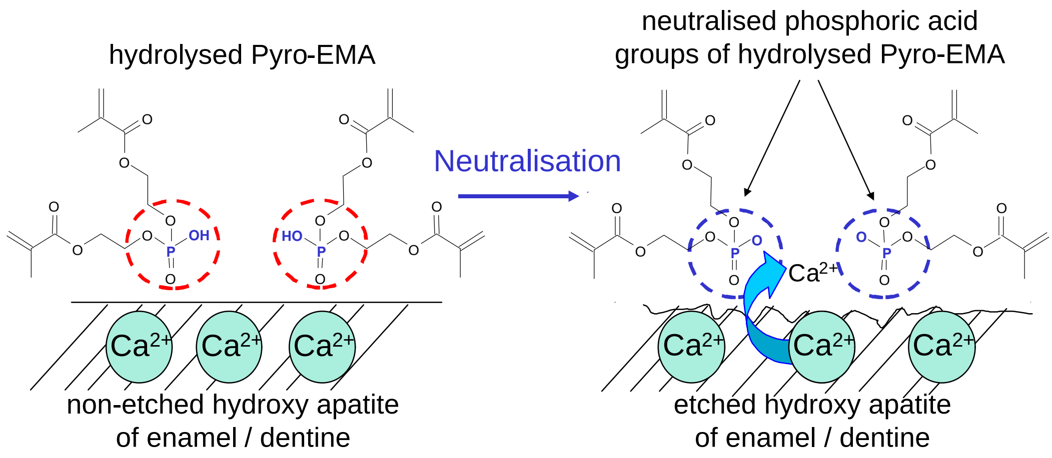

Figure 2 Neutralisation of hydrolysed Pyro-EMA

PEM-F is a multi-functional monomer. The molecular structure of PEM-F is given in Figure 3.

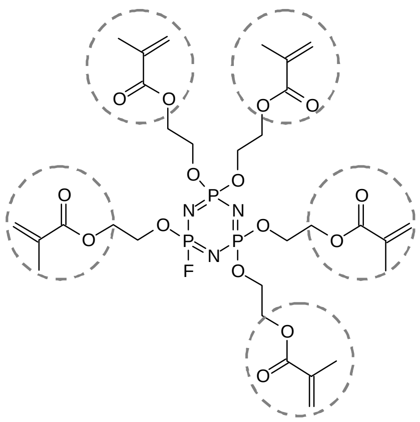

Figure 3 Penta-methacryloxy-ethyl-cyclo-phosphazene-mono-fluoride (PEM-F)

Upon contact with water (from Liquid A) PEM-F releases fluoride ions which act as calcium-ion scavengers, enhancing the etching effect of Pyro-EMA. In addition PEM-F is a strong cross-linking monomer due to the five methacrylate groups attached to the phosphazene ring and thus contributing also to the cohesive strength of Xeno® III.

2.3 Xeno®III: How does it interact with the tooth substrate?

The adhesion mechanism of Xeno®III is illustrated based on its interaction with dentine (Figure 4 - 6).

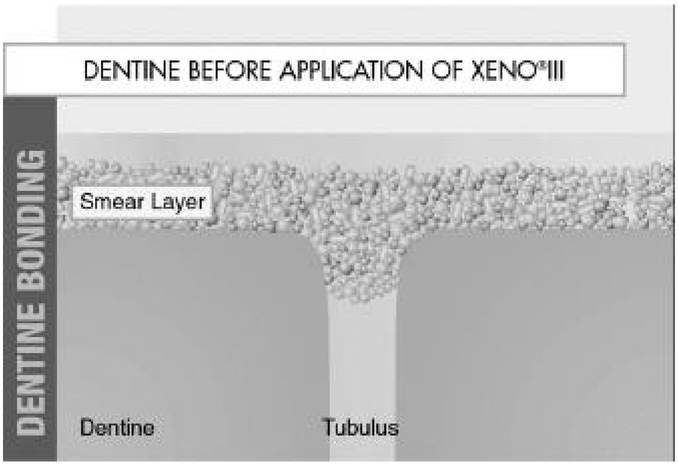

Figure 4: Dentine before application of Xeno

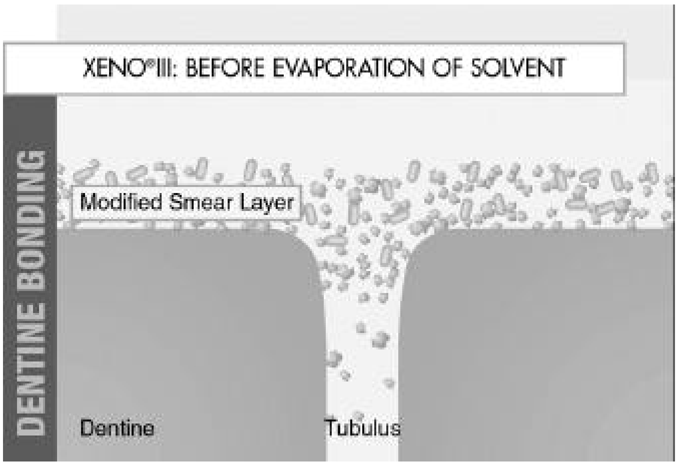

Figure 5: Dentine immediately after application of Xeno

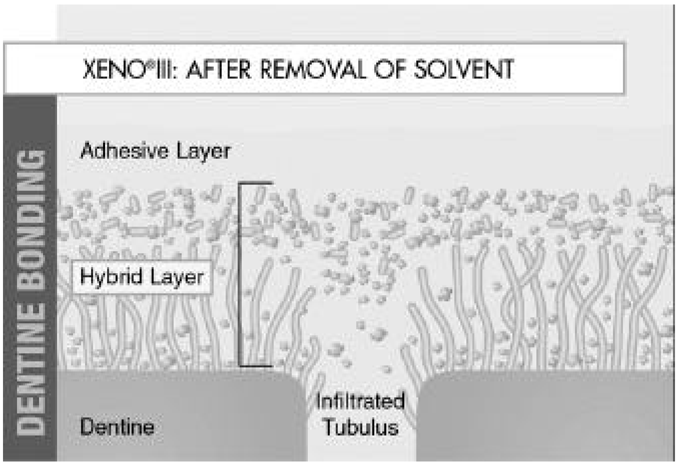

Figure 6: Demineralised dentine 20 s after application of Xeno

Once Xeno®III has partially dissolved and penetrated the smear layer (**Figure 5**) it will than demineralise the dentine underneath the smear layer resulting in formation of a homogeneous hybrid layer (**Figure 6**). Simultaneously the dentine tubules are filled with Xeno®III resulting in the formation of retentive resin tags (**Figure 6**).

3 Performance of Xeno®III

3.1 Micro-Morphology Investigation

The mechanism illustrated in chapter 2.3 is based on micro-morphological studies conducted by Pioch (Heidelberg) using Confocal Laser Scanning Microscopy (CLSM) and Scanning Electron Microscopy (SEM). The investigation of the interface between Xeno®III and dentin using CLSM (**Figure 7**) and SEM (**Figure 8**) shows, that Xeno®III is penetrating the smear layer as well as the smear plugs resulting in the formation of a homogeneous hybrid layer and complete formation of resin tags.

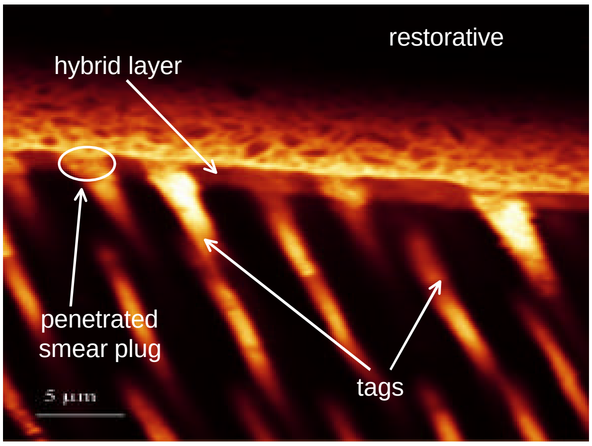

Figure 7 CLSM image of a cross-section of the interface between Xeno®III and dentin. The hybrid layer appears homogeneously along the junction within the whole specimen. Tags are very well established.

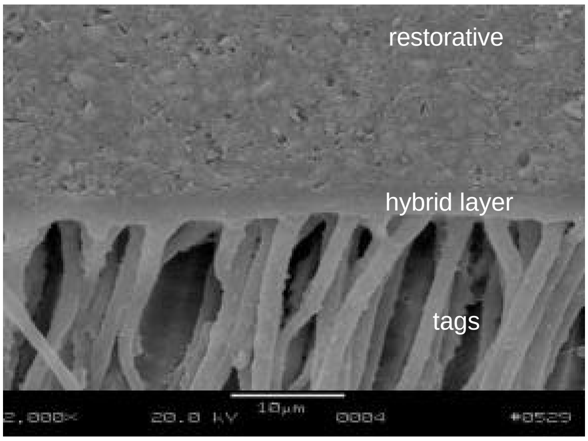

Figure 8 SEM image of a cross-section of the interface between Xeno®III and dentin substrate. Tags are very well established.

The etching ability of Xeno®III with regard to enamel is similar compared to phosphoric acid and results in a pronounced etching pattern as shown in **Figure 9**.

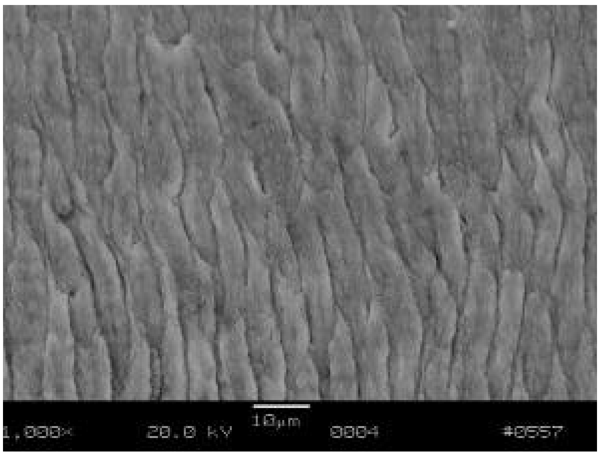

Figure 9 Enamel treated with Xeno®III (20 s) and then rinsed with ethanol. Etching pattern is similar to phosphoric acid treated enamel.

3.2 Adhesion Results

The adhesion performance has been investigated by external experts and by DENTSPLY researchers. The results of an external comparison study of Xeno®III versus Prompt L-Pop® are given in Figure 10 and Figure 11.

Bond strength values with Xeno®III on dentine are significantly higher than achieved with Prompt L-Pop. On enamel 3 out of 4 investigators obtained better results with Xeno®III compared to Prompt L-Pop.

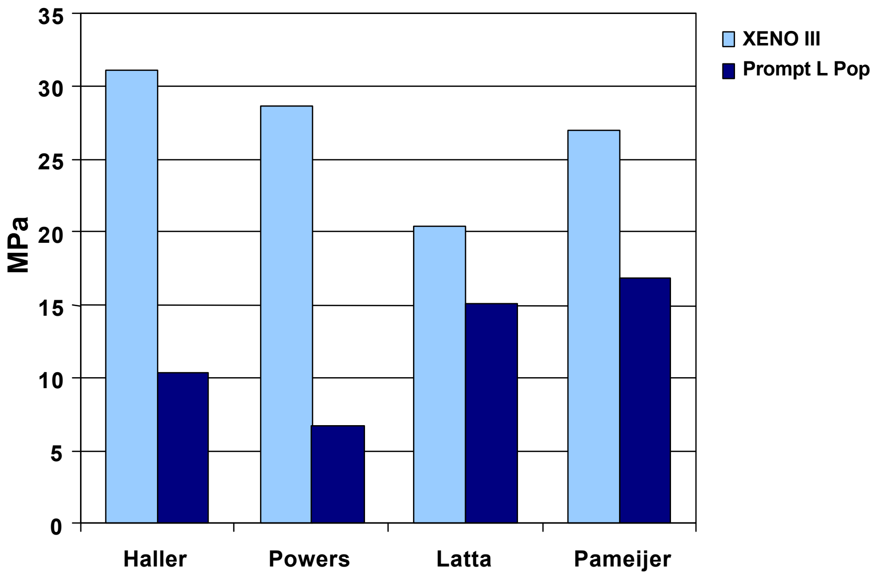

Figure 10 External dentin adhesion results (after 1800 thermocycles at 5 and 55 °C) of Xeno®III compared to Prompt L-Pop

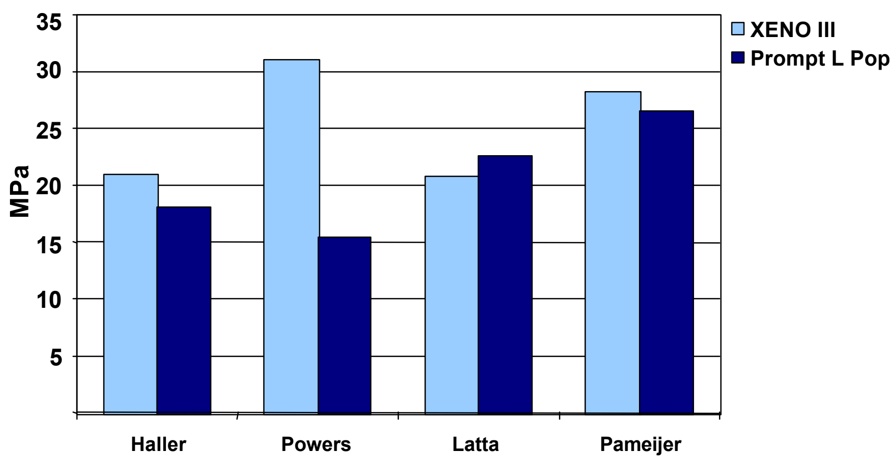

Figure 11 External enamel adhesion results (after 1800 thermocycles at 5 and 55 °C) of Xeno®III compared to Prompt L-Pop

The external results have been confirmed by internal investigations. Xeno®III gave better adhesion results in comparison to Prompt L-Pop and Clearfil SE (Figure 12). Especially with Prompt L-Pop the adhesion to dentine was very low.

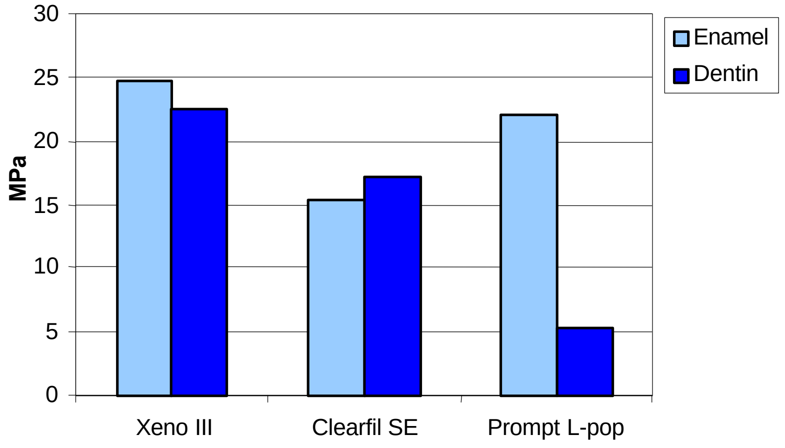

Figure 12 Internal adhesion results (after 1800 thermocycles at 5 and 55 °C) of Xeno®III compared to Clearfil SE and Prompt L-Pop

In addition, the adhesion of Xeno®III has also been compared to other total-etch and self-etch adhesives. The results are given in Figure 13.

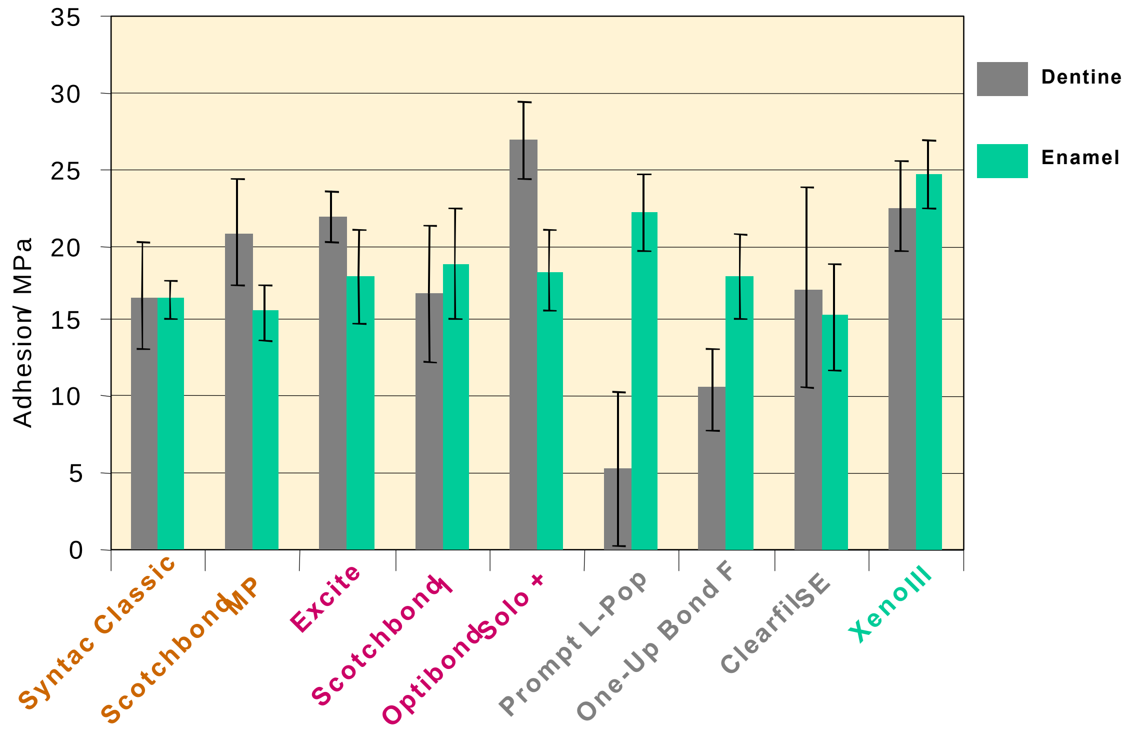

Figure 13 Internal adhesion results (after 1800 thermocycles at 5 and 55 °C) of Xeno®III compared to other total-etch and self-etch adhesives.

The results show that Xeno®III achieves better adhesion results in comparison to most of the tested competitive products.

3.3 Marginal Quality

The sealing ability of Xeno III in comparison to Prompt L-Pop and Clearfil SE Bond was evaluated by Rosales in standardised Class V cavities. The specimen were thermocycled 250 times between 5ºC and 55ºC, immersed in a 0.5% water solution of basic fucsine for 24 hours, embedded in acrylic resin and cut into bucco-lingual sections. The in-vitro microleakage of the occlusal and gingival cavity walls was evaluated using an optical microscope. The extent of microleakage along the restoration was ranked between 0 (hermetic seal) and 3 (massive microleakage). The results of this study are shown in Figure 14.

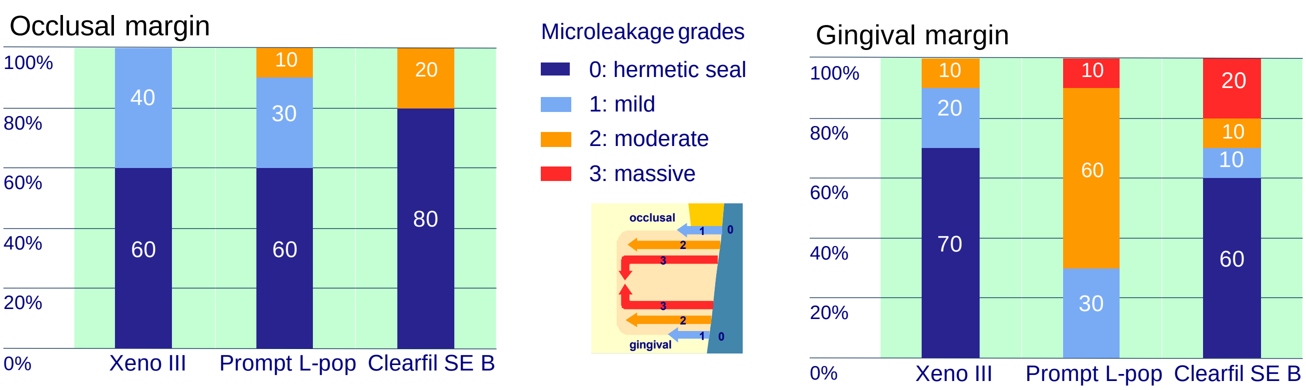

Figure 14 Marginal quality of class V restorations prepared with Xeno®III compared to Prompt L-pop and Clearfil SE

For all self-etching adhesives tested, the sealing obtained in the occlusal wall was better than in the gingival wall. Xeno®III-treated occlusal cavity walls were – other than with Prompt L-Pop and Clearfil SE – hermetically sealed or showed only mild microleakage. In the gingival wall, the best sealing was obtained for Xeno®III, followed by Clearfil SE Bond. With Prompt L-Pop, the lowest sealing was obtained.

4 Clinical Investigations

At present (October 2002) clinical data on Xeno III are available from:

- A clinical investigation by Dr. T. Yamada at Toranomon Hospital. Tokyo Medical and Dental University
- Post-marketing surveillance by DENTSPLY-Sankin in Japan since September 2001
- A field monitoring study under the scientific guidance of Prof. E. Hellwig in Germany.

Three additional clinical investigations are under way:

- An investigation on the use of Xeno III as adhesive for the restoration of cervical lesions.
- Two investigations on the use of Xeno III as adhesive for occlusal load bearing class I and II restorations.

4.1 Clinical Investigation of Xeno III for Class V Restorations at the Department of Dentistry, Toranomon Hospital, Tokyo Medical and Dental University

Principle investigator:

Dr. Toshimoto Yamada DDS, PhD

Design:

The study is a longitudinal, prospective, uncontrolled clinical investigation (Figure 15) under consideration of the requirements of the Revised ADA Clinical Protocol Guidelines for Dentine and Enamel Adhesive Materials (1994). 30 cervical (class V) restorations were placed in 30 patients. All teeth restored were reported to be vital at the time of placement of the restoration. The following Ryge criteria to measure performance and safety were used: Retention, cavo-surface margin discoloration, margin adaptation, recurrent caries and pulpal response. The restorations are evaluated at baseline and at 3-, 6- and 18-month recalls.

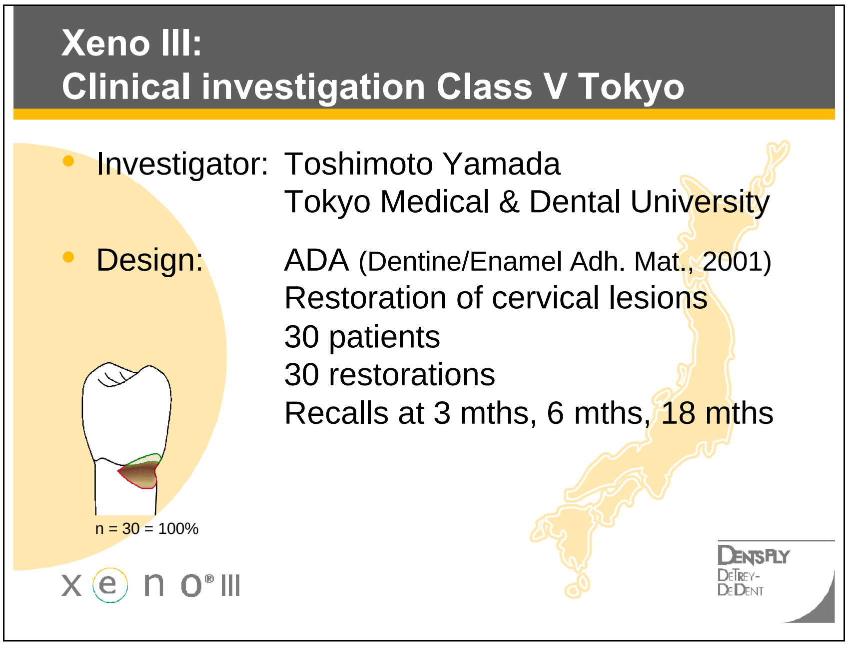

Figure 15 Design of clinical investigation at Tokyo Medical and Dental University

6-Month Results:

All patients included into the investigation were available for the recall examination. No postoperative hypersensitivity or pain or soft tissue irritation or other side or adverse events were reported. All restorations included in the investigation performed clinically satisfactory and were rated Alpha for all performance criteria selected (Figure 16). The investigators concluded that Xeno III has been demonstrated to be a satisfactory adhesive for cavities not providing macromechanical retention and restored with a minimal-invasive technique.

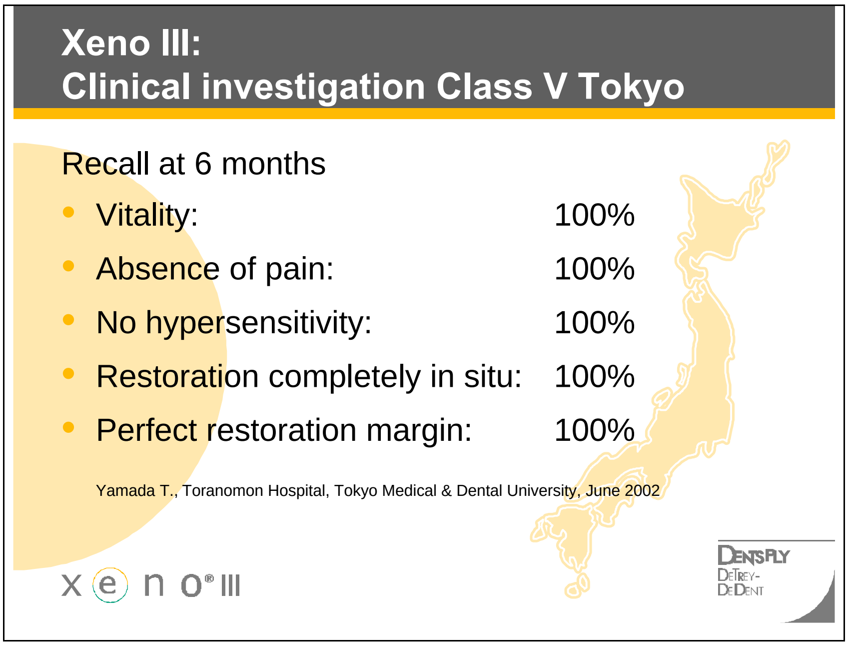

Figure 16 6-months results clinical investigation at Tokyo Medical and Dental University

4.2 Post-marketing surveillance data from Japan

Based on sales figures the Quality Assurance Department of DENTSPLY-SANKIN estimated in August 2002, that approximately 69.000 teeth have been treated with the adhesive so far. No reports on adverse events (systemic or local) or lack of performance (as retention or marginal failures) have been received.

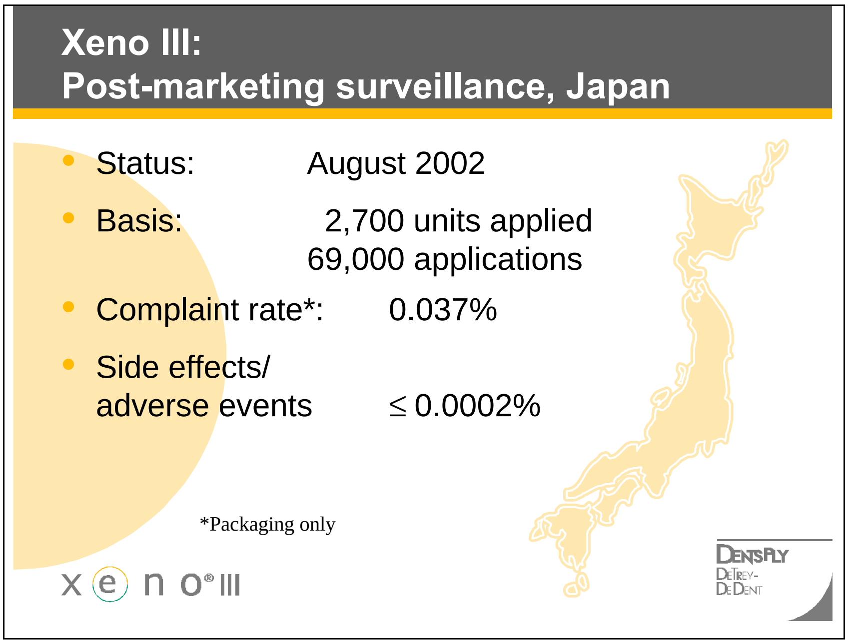

Figure 17 Post-marketing surveillance data from Japan (status August 2002)

4.3 Practitioner Product Assessment (PPA) of Xeno III, Lake of Constance Area, Germany

Scientific Consultant:

Professor Elmar Hellwig, Freiburg

Objectives and Design:

The PPA concept, developed by DENTSPLY De Trey, is a new approach to investigate:

1. customer satisfaction,
2. product performance under the condition of a general dental practice,
3. the survival time of dental restorations placed in general dental practice

within a single research project.

The principles of the PPA concept are listed in Figure 18. The responsibilities of the four different parties involved in a PPA study are given in Figure 19.

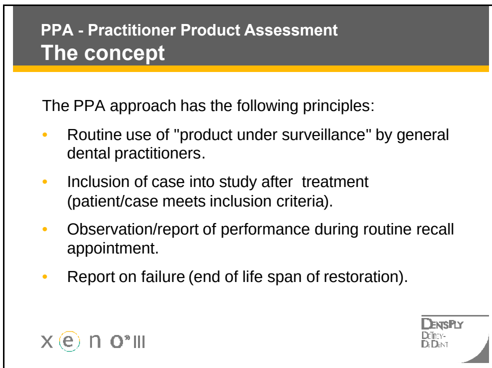

Figure 18 PPA, the principles

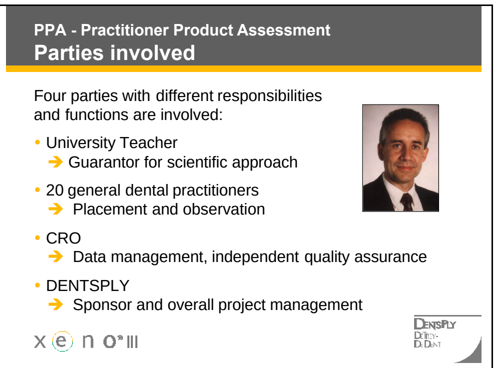

Figure 19 PPA, parties and responsibilities

In the PPA study on Xeno III 22 general dental practitioners (investigators) placed 10 cervical restorations each. The lesions to be restored should not provide any micromechanical retention. The investigators evaluate the handling properties of the adhesive at the end of the treatment period by means of a questionnaire.

The performance of the restorations is reported on at baseline and when the patients revisit the practice for further treatment or routine check-ups. The investigators are also asked to report on any side or adverse events and when the restoration finally failed.

Results regarding user acceptance:

Results on the evaluation of the handling properties are given by Figure 20. The vast majority of the investigators preferred Xeno III to their previously used product and would recommend the product to their colleagues.

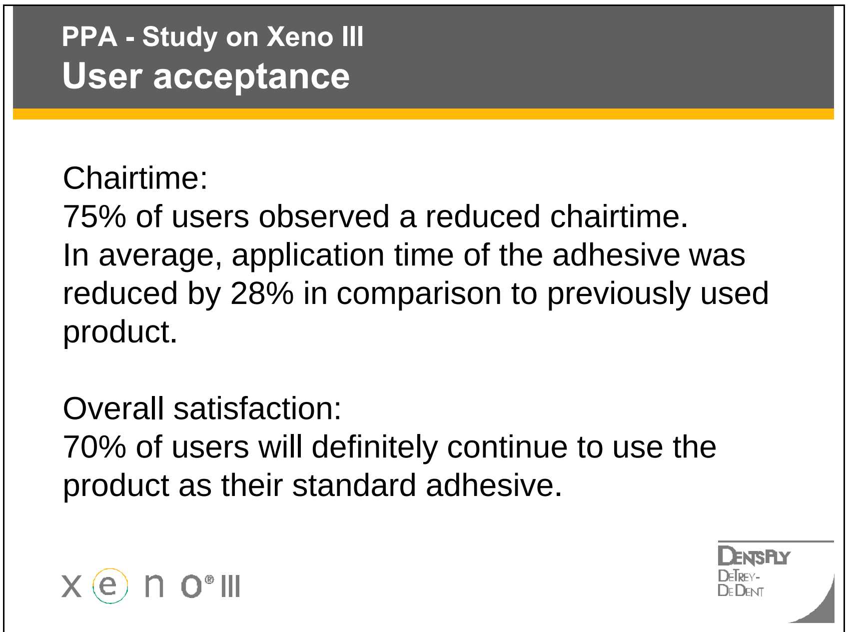

Figure 20 Results of user evaluation

Performance data as received by mid-October 2002:

By end of August 2002, the baseline data of 218 restorations had been received. One case of transient sensitivity and one transient gingival change were documented. No side or adverse events were reported.

By mid-October 2002, 102 restorations placed two to four months before have become available for evaluation during routine appointments. All restorations were retained and well in function. The only negative findings were Bravo-type (clinically acceptable) changes. For details see Figure 21.

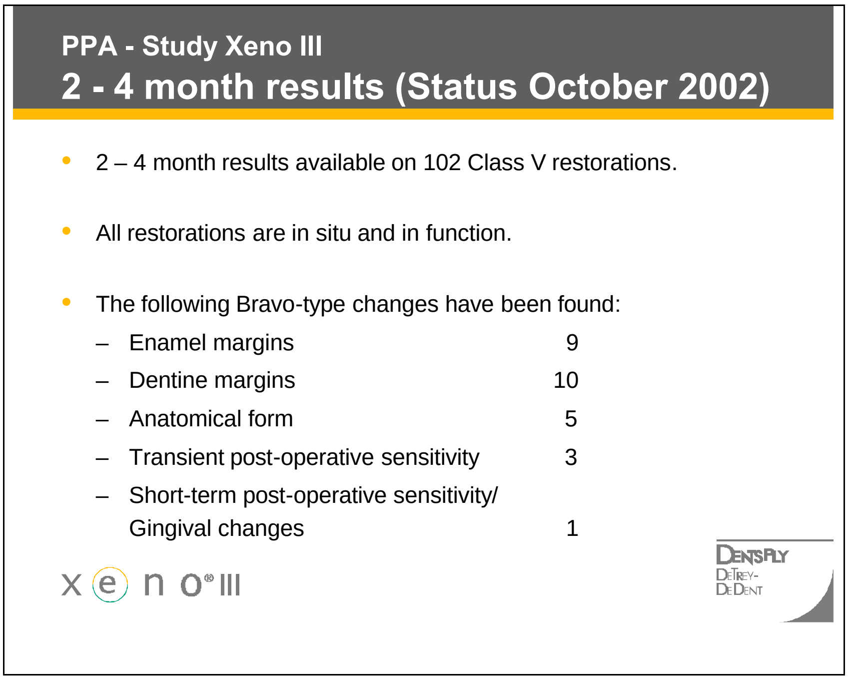

Figure 21 2- to 4-months recall data from the Xeno III PPA investigation (status October 2002)

4.4 Other clinical investigations

3-months data from the additional three clinical investigations mentioned above are expected to become available soon and will be reported on in the update version of this Scientific Compendium; as well as reports on upcoming recall reports from all investigations in progress.

5 Directions for Use

5.1 INDICATIONS

Single step self-etching adhesive for **direct, light-cured** composite, compomer and ormocer restorative materials.

5.2 CONTRAINDICATIONS

- Use with patients who have a history of severe allergic reactions to methacrylate resins or any other of the components.
- Direct or indirect pulpcapping.
- Use with chemical or dual-cure materials

5.3 WARNINGS

1. **Eye contact:** Xeno III contains methacrylates, which may be irritating to eyes. Before using this product wear protective glasses as well as covering the patient's eyes to protect from splashing material. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
2. **Skin contact:** Xeno III contains polymerisable monomers which can cause skin sensitisation (allergic contact dermatitis) in susceptible individuals. If contact with skin, immediately wipe off thoroughly with cotton and alcohol and then wash well with soap and water after contact. If skin rash and sensitisation or other allergic reaction occurs, discontinue use and consult a physician.
3. **Oral mucosa contact**: Avoid contact with oral soft tissues. If accidental contact occurs, remove adhesive with cotton pellet and rinse as soon as the clinical situation allows this. After prolonged contact with the adhesive the alveolar mucosa may turn white and/or numb due to the contact of the adhesive. This is a temporary phenomenon and should

disappear within a day. If it lasts longer, the patient should contact his dental professional.

4. **Ingestion**: Xeno III is acidic. Use caution from the patient accidentally swallowing the product. If accidental swallowing occurs, drink lots of water.

5.4 PRECAUTIONS

1. Xeno III is a light-cured material. Proceed immediately once the liquids have been placed into the mixing well or protect from ambient light.

2. Xeno III is less effective on unground, unprepared, or uncut enamel. Overfilling of restorative onto unetched, unground, or uncut enamel could cause marginal discoloration.

3. Avoid excessive contact of the adhesive with gingival tissues, as this may cause a transient whitening and/or numbness of the alveolar mucosa (see Warning Section).

4. Interactions with dental materials

4.1 Insufficient data exist to support the use of Xeno III with indirect restorations.

4.2 Eugenol containing dental materials should not be used in conjunction with this product because they may interfere with hardening and cause softening of the polymeric components of the material.

4.3 If H_2O_2 has been used to clean the cavity, proper rinsing is essential. Higher concentration H_2O_2 may interfere with the setting of polymerisable material and should not be used prior to the application of Xeno III.

5. Xeno III bottles should be tightly closed immediately after use. Do not interchange caps.

6. This product is intended to be used only as specifically outlined in the Directions for Use. Any use of this product inconsistent with the Directions for Use is at the discretion and sole responsibility of the practitioner.

5.5 INTERACTIONS WITH DENTAL MATERIALS

5.6 ADVERSE REACTIONS

1. Corneal damage may result with prolonged eye contact and/or exposure to Xeno III.

2. Allergic contact dermatitis and other allergic reactions may occur in susceptible individuals to Xeno III. (See Contra-indications, Warnings, and Precautions sections).

3. Transient whitening and/or numbness of the alveolar mucosa may occur after contact with Xeno III.

5.7 STEP-BY-STEP INSTRUCTIONS

1. Cleaning and Preparation

Cavity cleanliness is paramount for the development of adhesion.

In cases where no cavity preparation has been made, clean the tooth surface with a rubber cup and pumice or a prophy-paste (e. g. Nupro®).

Preparing a fresh surface with a finishing bur will significantly increase bond strength to enamel. In all situations where maximum retention is required instrument enamel (e.g. with a finishing diamond bur) to achieve optimal bonding results.

Wash surface thoroughly with air/water spray.

Remove rinsing water by blowing gently with an air syringe or blot-dry with a cotton pellet. Do not desiccate the dentine structure.

2. Pulp Protection

For direct or indirect pulp capping cover the dentine close to the pulp (< 1mm) with a hard-setting calcium hydroxide liner (e. g. Dycal®), leaving the rest of the cavity surface free for bonding with Xeno III.

3. Application

3.1 Dispense an equal amount of Liquid A and Liquid B into a clean mixing well (Figure 22).

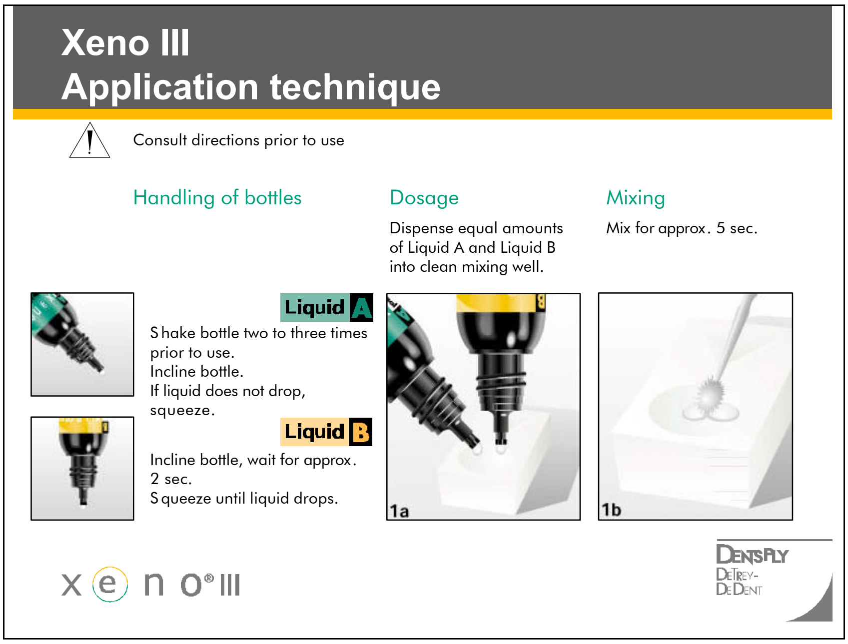

Figure 22 Dosage and mixing

For optimum dosage, proceed as follows:

Liquid A:

Shake bottle two to three times prior to use.

Incline bottle. If liquid does not drop, squeeze.

After use, close bottle with green cap.

Liquid B:

Incline bottle; wait for approx. two seconds. Squeeze until liquid drops.

After use, close bottle with black cap.

3.2 Mix liquid thoroughly for approx. five seconds with the applicator tip supplied.

If protected from ambient light, the mixed material stays functional for up to 60 minutes!

3.3 With the applicator tip provided, apply generous amounts of Xeno III to thoroughly wet all cavity surfaces (Figure 23).

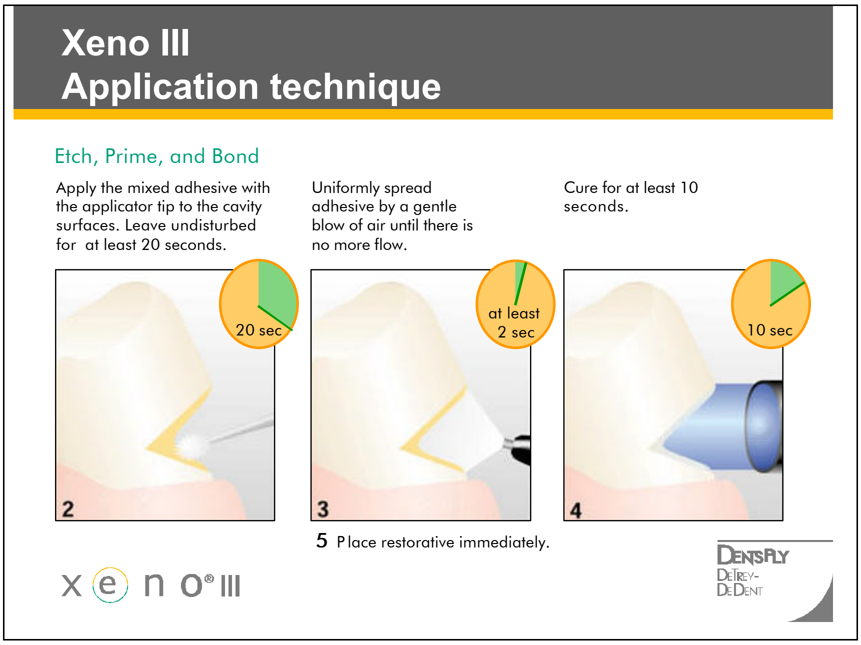

Figure 23 Application

3.4 Leave undisturbed for at least 20 seconds.

3.5 Uniformly spread the adhesive using a gentle stream of oil free air for at least 2 seconds until there is no more flow of the adhesive to ensure proper removal of solvent. Avoid thinning the adhesive layer by excessive air-drying.

Do NOT water rinse.

3.6 Cure[1] the adhesive with a light-curing unit for at least 10 seconds.

3.7 Place restorative immediately following manufacturer's instructions.

5.8 STORAGE

Keep out of direct sunlight and protect from moisture.

Refrigerate at temperatures between 2 °C and 8 °C when not in use.

Close caps tightly after use.

[1] Check curing light for minimum curing output of at least 500 mW/cm^2.

6 Technical Terms, Definitions and Abbreviations

The most important technical terms and abbreviations used in the subsequent chapters are explained below. The list also contains a number of definitions taken from the ISO Technical Report 11405:1994 - Guidance on testing of adhesion to tooth structure.

Adhere	Be in a state of adherence
Adherence	State in which two surfaces are held together by interfacial forces
Adherent	Body that is held, or is intended to be held, to another body by an adhesive
Adhesion	State in which tow surfaces are held together by chemical or physical forces or both with the aid of an adhesive
Adhesive	Substance capable of holding materials together by adhesion
Bond strength	Force per unit area required to break a bonded assembly with failure occurring in or near the adhesive/adherent interface
CLSM	Confocal Laser Scanning Microscopy
Nanofiller	Extremely fine filler with a primary particle size below 10 nm
SEM	Scanning Electron Microscopy
Substrate	Material upon the surface of which an adhesive-containing substance is spread for any purpose, such as bonding or coating.
TEM	Transmission Electron Microscopy

7 References

Haller B (2002). Report to DENTSPLY DeTrey.

Latta M (2002). Report to DENTSPLY DeTrey

Pameijer CH (2002). Report to DENTSPLY DeTrey

Pioch T (2002). Report to DENTSPLY DeTrey.

Powers JM (2002). Report to DENTSPLY DeTrey.

Rosales Leal JI (2002). Report to DENTSPLY DeTrey

8 Literature List

- selected literature - September 2002

1. Apostolopoulos C, Lagouvardos P, Oulis CJ (1996). Three point bend strength of repaired resin modified ionomers. Abstract for EAPD Bruges; O-4.
2. Arellano A, Pires Lopes LM, Bernardo M, Lopez-Areal B, Leitao J (1999). Shear bond strength of self-etching dentin bonding adhesives. J Dent Res 78:SI;3430.
3. Bouillaguet S, Gysi P, Wataha JC, Ciucchi B, Cattani M, Godin C, Meyer JM (2001). Bond strength of composite to dentin using conventional, one-step, and self-etching adhesive systems. J Dent 29:1;55-61.
4. Brackett WW, Covey DA, St. Germain HA (2001). Clinical performance of a combined etchant/adhesive in Class V resin composite restorations. J Dent Res 80:SI(AADR);233.
5. Cardoso PEC, Braga RR, Carrilho MRO (1998). Evaluation of micro-tensile, shear and tensile tests determining the bond strength of three adhesive systems. Dent Mater 14:6;394-398.
6. Chigira H, Yukitani W, Hasegawa T, Manabe A et al (1994). Self-etching dentin primers containing phenyl-P. J Dent Res 73:5;1088-1095.
7. Christensen GJ (2002). Preventing postoperative tooth sensitivity in Class I, II and V restorations. JADA
8. Code JE, Antonucci JM, Bennett PS, Schumacher GE (1998). Photoactivated dentin bonding with N-phenyliminodiacetic acid. Dent Mater 13:4;252-257.
9. Ernst CP, Cortain G, Spohn M, Willershausen B (2000). Marginal adaptation of modern resin restorative systems for
10. posterior teeth. Abstract for CED of IADR 167;160.
11. Feigal RJ, Quelhas I (2001). Clinical study of self-etching adhesive for sealant

application. J Dent Res

12. Frankenberger R, Perdigao J, Rosa BT, Lopes M (2001). 'No-bottle' vs 'multi-bottle' dentin adhesives - a microtensile bond strength and morphological study. Dent Mater 17:5;373-380.
13. Gole J, Neme AL, Yaman P, Wagner WC, Pink FE (2001). Comparison of 5th and 6th generation dentin bonding agents. J Dent Res 80:SI(AADR);1574.
14. Haak R, Fritz UB, Faber FJ, Noack MJ (1999). Influence of chemomechanical caries removal on dentin bonding. J Dent Res 78:SI;2111.
15. Hayakawa T, Kikutake K, Nemoto K (1998). Influence of self-etching primer treatment on the adhesion of resin composite to polished dentin and enamel. Dent Mater 14:2;99-105.
16. Herter M, Haller B, Moll K (2001). Schmelzrandschluss von selbstkonditionierenden Bondingsystemen im In-vitro-Langzeittest. Autorenreferat DGZ-Tagung Gürzenich, Köln; 76.
17. Inoue S, Van Meerbeek B, Abe Y, Yoshida Y, Lambrechts P, Vanherle G, Sano H (2001). Micro-tensile bond strength of eleven modern adhesive systems to enamel. J Dent Res 80:SI;0132.
18. Jung H, Friedl KH, Hiller KA, Lichtblau J, Schmalz G (2001). Clinical evaluation of Class V composite restorations using a one-step or a multiple-step adhesive system. Abstract for CED of IADR 62;8.
19. Kaaden C, Powers JM, Friedl KH, Schmalz G (2001). Bond strength of self-etching systems to dental hard tissues. J Dent Res 80SI(AADR);900.
20. Karas J, Jodkowska E (2000). Shear bond strengths between dentine, composites and compomeres. Abstract for CED of IADR 134;100.
21. Koibuchi H, Yasuda N, Nakabayashi N (2001). Bonding to dentin with a self-etching primer: the effect of smear layer. Dent Mater 17:2;122-126.
22. Lorenzi R, Anselmi M, Dondi Dall'Orologio G (2000). Clinical evaluation of Class II restored with Definite and amalgam: 12 month-results. Abstract for AIC VII Congresso, Bologna.
23. Luchterhandt T, Frey O, Hansen M, Richter R (2001). Comparison of micro - and macro tensile bond strength tests. J Dent Res 80:SI;0012.
24. Luo Y, Lo ECM, Wei SHY, Tay FR (2002). Comparison of pulse activation vs conventional light-curing on marginal adaptation of a compomer conditioned using a total-etch of a self-etch technique. Dent Mater 18:1;36-48. [1]
25. Manhart J, Hickel R (1999). Klinische Studie zum Einsatz eines All-in-one-Adhäsives. Erste Ergebnisse nach 6 Monaten. Quintessenz 50:12;1277-1288.
26. Moll K, Wörle P, Haller B (2000). Microleakage of Class V composite restorations: Effect of dye. J Dent Res 79:SI;25.
27. Palaghias G, Kakaboura A, Eliades G (1997). Bonding mechanism of compomer restoratives with dentine: An in vitro study. J Dent Res 76:5;1145/411.
28. Peutzfeldt A, Asmussen E (2001). Bonding of composites with 1-, 2-, and 3-bottle adhesives. Abstract for NOF of IADR 50/O-30.
29. Rosa BT, Perdigao J (2000). Bond strengths of nonrinsing adhesives. Quintessence Int 31:5;353-358.
30. da Silva Telles PD, Aparecida M, Machado M, Nor JE (2001). SEM study of a self-etching primer adhesive system used for dentin bonding in primary and permanent teeth. Pediatr Dent 23:4;315-320.

31. Tay FR, Itthagarun A, Mak YF, Pashley EL, Pashley DH (2001). Nanoleakage in single-step adhesives: what are we really testing?. J Dent Res 80:SI;0898.

32. Toledano M, Fernandes C, Ceballos L, Fuentes MV, Tay F, Osorio R, Carvalho RM (2001). Microtensile bond strength of several adhesive systems to different dentin depths. J Dent Res 80:SI;0015.

33. Urban AD (2001). Untersuchungen zum Einfluss der Polymerisationsschrumpfung auf die Randdichtigkeit dentinbegrenzter Restaurationen bei licht- und chemischhärtenden Restaurationsmaterialien. Dissertation.

34. Van der Vyver PJ, Van Rensburg JMJ, De Wet FA (2000). Bond strength of composite to dentine using compomer adhesives. J Dent Res 79:5;1311/61.

35. Yamada T (1999). Basic properties and clinical applications of the fluoride-releasing esthetic restorative system XENO CF. Dental Platz Vol. 4 '99.