

The logo for Espertise, featuring the word "Espertise" in a black, italicized serif font with a red swoosh underneath. A vertical bar on the left side of the page is divided into blue and red sections.

Espertise[™]

Products in the Focus
of International Science

A large graphic with a gold background. It features the text "Scientific Facts" in a large, black, serif font. The background is decorated with faint, light-colored lines and shapes, including circles, arcs, and a chemical structure with two hydroxyl groups (OH). There are also some faint numbers scattered around, such as "01AA22", "0083", "336478589009", "74672 8", and "484756290284759345".

Scientific Facts

82nd IADR Meeting

Honolulu, Hawaii, USA March 10–13, 2004

3M ESPE

Dear reader,

3M ESPE has long had a strong tradition in R&D. Continuous scientific support and close contact with our customers and their needs have always been a driving source, leading to highly innovative products of outstanding quality. Moreover, clinical and in vitro studies at renowned universities and scientific institutions worldwide have proven the clinical performance and high quality of 3M ESPE products.

For 5 years, the latest and most interesting scientific results of our 3M ESPE products have been summarized on the occasion of the annual meeting of the International Association for Dental Research. You, as our customer, have pointed out that you appreciate the *Expertise* Scientific Facts brochure as a valuable tool that provides the latest scientific information. We are happy to present this new issue 2004 to you as the result of both our intensive discussions and broad research. In this *Expertise* issue, our focus is again on the recently launched products.

One-and-a-half years ago, 3M ESPE launched the very innovative, first self-adhesive universal resin cement, RelyX Unicem. With the development of a cement equally suited for luting ceramics and metal restorations, without having to use multi-step adhesives, a dream became true. Since then, RelyX Unicem has made a big impact on the dental community and became the market leader (by market share) among resin cements in many countries. Over the last months, quite literally dozens of further scientific studies and publications have poured out and continue to support what dentists worldwide appreciate already. RelyX Unicem cement offers excellent adhesion, high strength and dimensional stability, durable marginal integrity and easy handling. First results of independent long-term clinical studies are cited here, too. Moreover, RelyX Unicem received excellent ratings from The Dental Advisor, Reality and CRA Newsletter.

Additionally, with the introduction of the Lava system in 2001, 3M ESPE has made another important and innovative step in the exciting and steadily growing field of all-ceramic dentistry and CAD/CAM technology. Since then, Lava has convinced the dental community by its materials' strength and longevity, in combination with the possibility of already staining the Zirconia core material which provides a highly aesthetic outcome. Scientific data in this issue focus on the strength in combination with aesthetics and on the good performance of Lava Zirconia material together with different cementation systems.

Moreover, ongoing research with the other indirect 3M ESPE restoration materials, Paradigm MZ100 and Sinfony, underline their good clinical performance as well as their outstanding material properties.

As for 3M ESPE's restorative products, more than 300 abstracts have been submitted this year. This enormous number reflects the importance of these products in daily research and the high interest of the scientific community in innovative restorative materials. In this *Expertise* edition however, only a small selection of these abstracts could be presented. Nevertheless, you'll find a good overview of the performance and reliability of our current restorative product line. With abstracts on Siloranes being included, it also provides a fascinating outlook into the near future of restorative dentistry.

You will also find news related to our core competency of impression materials. We have introduced a disposable tray optimizing the flow properties of the impression material. This CAD designed, self-retentive tray makes the clinical procedure of impression taking easier and more reliable. These features facilitate the generation of excellent impressions from the dentist's as well as from the dental technician's point of view.

Last, but not least, you will find a chapter about our new and innovative products in prevention and diagnosis (Clinpro Cario L-Pop, Clinpro Cario Diagnosis, Clinpro Prophy Powder, Clinpro Sealant). Many studies are still ongoing; further results will be covered in the next issues.

We very much hope that this issue, which was developed in the spirit of a long tradition of *Expertise Scientific Facts*, will stand, like the previous issues, as a valuable tool of scientific information and inspiration. Please feel free to contact us any time.

valuable

Enjoy reading *Expertise*!
Yours sincerely,



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Bond Strength of Resin Adhesive Systems to Enamel and Dentin

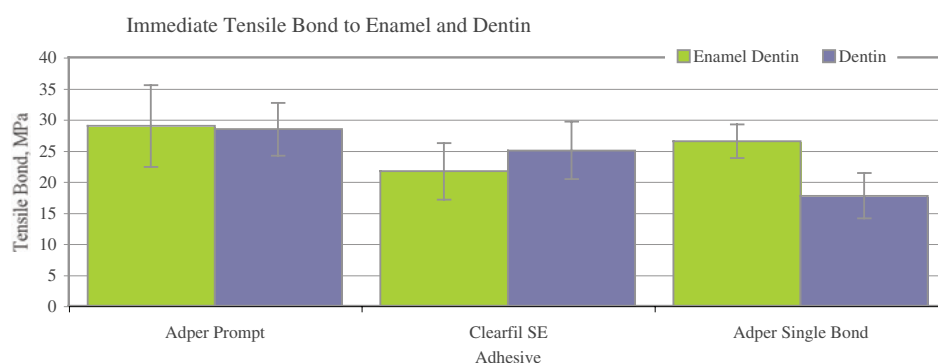
T. Kimishima¹, Y. Nara¹, T. Eguro¹, T. Maseki¹, and I.L. Dogon², ¹ Nippon Dental University, Tokyo, Japan, ² Harvard University, Forsyth Institute, Boston, MA, USA

Objectives: The purpose of this study was to examine the tensile bond strength of one-step Adper Prompt L-Pop (3M ESPE), two-step self-etching adhesive systems [Clearfil SE Bond (Kuraray)], and one-bottle priming adhesive system [Single Bond (3M ESPE)]; to enamel and dentin of extracted human premolars using an original Portable Adhesion Tester (Nara Y et al., J. Dent Res. 75, SI #2943, 1996 etc.).

Methods: A standardized wedge shaped cavity was prepared in the cervical buccal side of the tooth. Dentin bond strength (DBS) test; was performed at the gingival dentine wall (n=8). Enamel bond strength (EBS) test; was performed at the beveled enamel (n=8). The test was performed immediately, after the system was applied to dentin or enamel, following manufacturer's direction, and combined with the original made composite resin (Kuraray) for PAT. The data were statistically analyzed using ANOVA, Tukey's q-Test and Weibull analysis.

Results: Mean values (standard deviation) of EBS/DBS in MPa were; AL; 28.92 (6.57) / 28.39 (4.23), SE; 21.64 (4.56) / 25.00 (4.59), SB; 26.47 (2.72) / 17.68 (3.64). [EBS]; AL was statistically higher than SE (p<0.05). [DBS]; SB was lower than SE(p<0.05) and AL(p<0.01). EBS was higher than DBS in SB (p<0.01). Weibull modulus against EBS/DBS were; AL; 4.75 / 7.10, SE; 4.18 / 5.29, SB; 10.27 / 4.94. There was statistical difference between SB and the other two materials at enamel (p<0.01).

Conclusion: Although the EBS of each system showed equivalent in value, SB seemed to have better bonding quality, compare to the other systems. On the other hand, AL and SE DBS were higher than SB; however the quality of bonding were equivalent among the three systems.



Aim of the Study: The immediate bond value of adhesive systems is critical in counter-acting the contraction forces induced by polymerization shrinkage of dental composites. In this study the immediate tensile bond to enamel and dentin was tested using a novel methodology.

Result of the Study: Today's adhesives display excellent immediate bond values to both enamel and dentin.

Shear Bond Strength of Three Different Adhesive Systems

D. Re, D. Augusti, S. Semeraro, and M. Gagliani, University of Milan, Milano, Italy

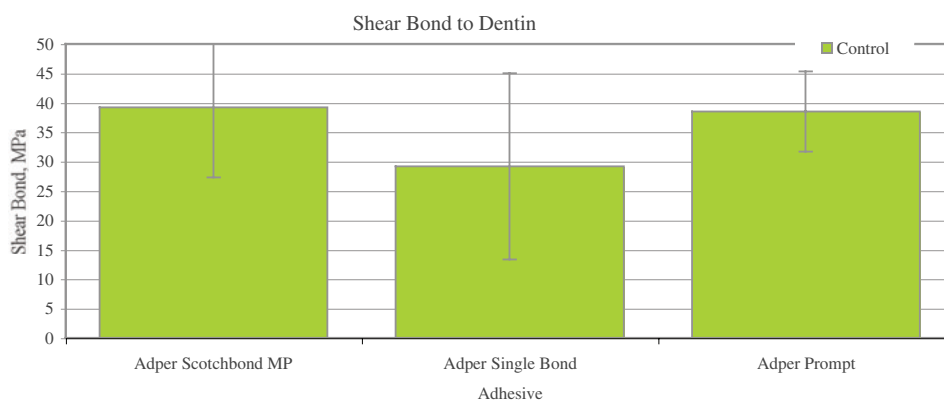
Objectives: The aim of this study was to evaluate the in vitro bond strength to dentin of three adhesive systems.

Methods: Thirty freshly extracted human teeth were mounted in acrylic molds and the facial surfaces were ground to expose middle dentin, which was polished to 600-grit. Teeth were randomly assigned to three groups (n=10), according to the bonding agent used: Scotchbond Multi-Purpose (3M ESPE); Scotchbond 1 (3M ESPE); Adper Prompt L-Pop (3M ESPE). Then the adhesive systems were applied by a single operator according to the manufacturer's instructions; the teeth were restored with composite resin Z100 (3M ESPE) and stored in distilled water at 37°C for 24 hours. SBS tests were performed using an Instron Machine at a cross head speed of 1mm/minute. The values were calculated in MPa and statistical analysis was performed using ANOVA.

Results:

SBS (MPa) n=10	Scotchbond Multi-Purpose	Scotchbond 1	Adaper L-Pop
Mean	39.2	29.16	38.48
SD	11.89	15.81	6.83
ANOVA		p<.05*	p=.0871

Conclusions: The multi-bottle SBM showed significantly (p<.05) higher bond strengths compared to SB1. No differences were found between the group SBM and LP. The self-etched adhesive LP showed the lowest standard deviation value.



Aim of the study: In this study the dentin bond values of three generations of adhesive by 3M ESPE were compared.

Result of the Study: All three generations displayed shear bond values to dentin in excess of 25 MPa.

Micro-Shear Bond Strengths of All-in-one Adhesives to Enamel and Dentin

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Objectives: Nowadays all-in-one adhesives, which are combined with etching, priming and bonding, have been clinically utilized for restorations of cavities with enamel-dentin margin. The purpose of this study is to compare the bond strengths of all-in-one adhesives to enamel and dentin substrate using micro-shear bond test (Shimada et al., JDR abstract, 2000).

Methods: The enamel or dentin disks were prepared by flat-grinding the occlusal surface of extracted human third molars. Three commercially available bonding systems and one experimental bonding system were used in this study; AQ Bond Plus (Sun Medical), Adper Prompt L-Pop (3M ESPE), XENO III (Dentsply-Sankin), and OBF-2 (Tokuyama). These adhesives were applied on the enamel or dentin surfaces according to manufacturers' instructions. Resin composite (Clearfil AP-X, Kuraray) was then mounted and light-cured for 40 seconds. After 24 hours immersion in water, a micro-shear bond test with a wire loop was carried out at a crosshead speed of 1.0 mm/minute to assess the micro-shear bond strength. Results were analyzed by one-way ANOVA and Tukey's HSD test ($p < 0.05$).

Results: Micro-shear bond strengths (mean±standard deviation, in MPa) of tested adhesives were:

Adhesive	Adaper			
	AQ Bond Plus	Prompt L-Pop	Xeno III	OBF-2
Enamel	33.5±8.7	36.8±13.5	41.2±20.1	31.1±10.9
Dentin	37.4±10.7	28.4±6.9	29.9±7.5	32.5±14.7

There was no statistically significant difference in the bond strength among all groups tested in this study.

Conclusions: The all-in-one adhesives used in this study showed the equivalent bond strength both for enamel and dentin.

Aim of the study: Many new self-etch systems are introduced to the market each year. This study compared the shear values of several of the most current systems.

Result of the Study: All of the systems displayed high shear bond values to enamel and dentin. Furthermore, bond values to enamel and dentin were very similar.

Effect of a Second Coat of Adhesive on Bond Strength

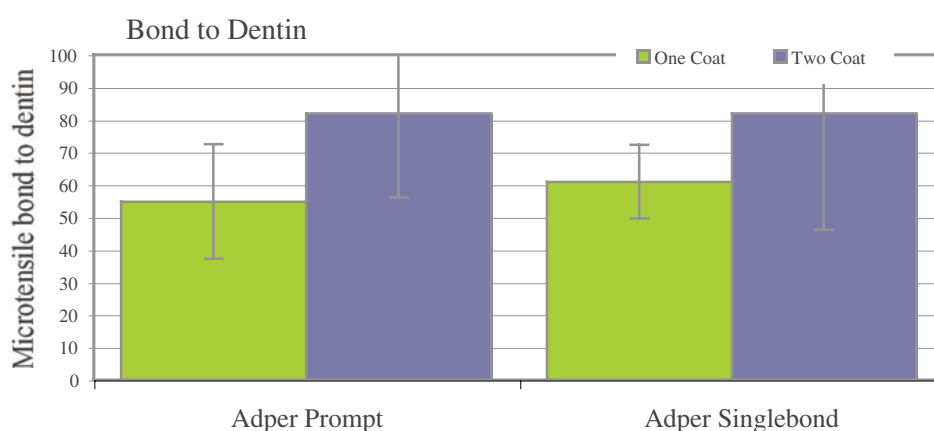
D. Carmona, and D. Lafuente, Universidad de Costa Rica, School of Dentistry, San Pedro, Costa Rica

Purpose: To evaluate and compare the shear bond strength to superficial dentin of two different dentin adhesives, using two different application techniques.

Methods: A total of 20 healthy, recently extracted human molars were selected, embedded in acrylic, and polished using 600 grit SiC paper until superficial dentin was exposed. The following groups were established (n=5): (1.1) 3M ESPE Adper Prompt Self Etching System following manufacturer's instructions (1.2) 3M ESPE Adper Prompt Self Etching System two coats applied as before. (2.1) 37% Phosphoric acid and 3M ESPE Singlebond system 2 coats brushed over the dentin surface each light cured for 20 seconds. (2.2) 37% Phosphoric acid and 3M ESPE Singlebond system, two coats rubbed over the dentin surface each light cured for 20 seconds. Then composite Z250 was light cured over the surface to form a 1mm diameter cylinder. The specimens were stored in a heating chamber in water at 37°C for a week before being tested in shear in the Universal Testing Machine (Instron 1000) at a crosshead speed of 0.1 cm/minute. Data was recorded in MPa and analyzed using a two way analysis of variance calculated at a 0.05 significance level. Tukey-Kramer intervals were 2.9 for comparisons between bonding agents and 22.4 between application techniques, also calculated at a 0.05 significance level.

Results: Means and standard deviation in MPa using the suggested application technique were Adper Prompt 54.8 (17.6) and Singlebond 60.9 (11.3), and using a second coat the results were Adper Prompt 81.9 (25.8) and Singlebond 81.9 (35.8). If the application technique is changed, an increase in the bond strength was significant for both bonding agents. When compared by bonding agent, Singlebond showed a statistically higher bond strength than Adper Prompt.

Conclusions: A second application of the dentin bonding agent increases significantly the shear bond strength.



Aim of the study: This is another study that underscores the value of a second application of adhesive.

Result of the Study: A second application of adhesive improved the dentin bond value for both 5th generation (Adper Singlebond) and 6th generation (Adper Prompt) products.

Effect of Double-Application of All-in-One Adhesives to Dentin Bonding

Y. Nakaoki¹, F. Nagano¹, S. Horiuchi¹, W. Sasakawa¹, T. Ikeda¹, S. Inoue¹, S. Uno¹, H. Sano¹, T. Ide², Y. Shimada², T. Nikaido², and J. Tagami², ¹ Hokkaido U Dent, Sapporo, Japan, ² Tokyo Medical & Dental University, Japan

Objectives: The clinical step of dentin bonding has been simplified with the development of all-in-one adhesives. Some of these adhesives are instructed as double application in bonding procedure and reported to show high bond strength to dentin. This study aims to evaluate the effect of double application of all-in-one adhesives to human dentin using micro-shear bond test (Shimada et al., JDR abstract, 2000).

Methods: The occlusal surfaces of extracted human third molars were ground perpendicular to the long axis of the tooth to expose a flat dentin surface. Three commercially available systems and one experimental bonding system were used in this study; newly developed OBF-2 (Tokuyama), Adper Prompt L-Pop (3M ESPE), REACTMER BOND (Shofu), and XENO III (Dentsply-Sankin). These adhesives were applied on the dentin surfaces according to the following each method; manufacturers' instruction (single application) or experimental method (double application). Resin composite (Clearfil AP-X, Kuraray) was then mounted and light-cured for 40 seconds. After 24 hours immersion in water, a micro-shear bond test with a wire loop was carried out at a crosshead speed of 1.0 mm/minute to assess the micro-shear bond strength. Results were analyzed by one-way ANOVA and Tukey's HSD test (p<0.05).

Results: Micro-shear bond strengths (mean ± standard deviation in MPa) of tested adhesives were as follows.

Adhesive	OBF-2	Adaper Prompt L-Pop	REACTMER BOND	Xeno III
Single-application	34.6±4.9	22.7±8.7	28.3±6.7	30.3±7.1
Double-application	32.5±6.4	29.5±9.2	27.2±6.1	29.6±6.4

The bonding strengths of OB2 (single-application and double-application) were significantly higher than single-application of PL.

Conclusions: Micro-shear bond strengths of all-in-one adhesive used in this study showed no significant difference between the single-application method and double-application method.

Aim of the study: Adhesion protocols often specify that the dentinal surface should have a shiny appearance after completion. Often, this calls for additional coats of adhesive. In this study, the effect of a second application of several adhesive systems was measured.

Result of the Study: Results varied between the tested products. For Adper Prompt, application of a second layer proved beneficial. Application of a second coat has been incorporated into the instructions for Adper Prompt. This second layer is applied and dried immediately after the first layer has been dried. A single light-cure is performed after the second layer has been dried.

In Vitro Bonding to Nd:YAG Laser-Treated Dentin

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Objectives: This study examined the bond strength of different adhesive systems to dentin treated with an Nd:YAG laser.

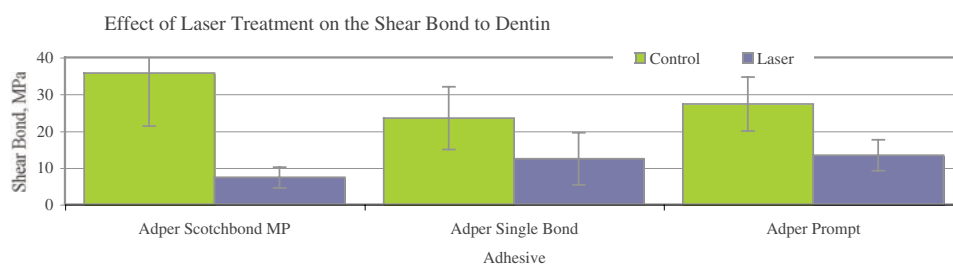
Methods: Sixty freshly non carious human molars were grounded to expose middle dentin, which was polished to 600-grit. Half of the samples was prepared with an Nd:YAG laser for 20 seconds at 10Hz and 80mJ (Laser); the other half was maintained as a control (Control). Three dentin adhesive systems were applied, according to manufacturer's instructions, to the laser irradiated surfaces and to the control surfaces: Scotchbond Multi-Purpose (3M ESPE), Scotchbond 1 (3M ESPE), Adper Prompt L-Pop (3M ESPE). For Scotchbond Multi-Purpose and Scotchbond 1 groups dentin surface was etched with 35% phosphoric acid gel for 15 seconds. A 5mm metal ring was used to set the resin composite (Z100, 3M ESPE) and specimens were stored in water at 37°C for 24 hours. Shear Bond Strength was conducted by means of a universal testing machine with a cross head speed of 1mm/minute. The results were statistically analyzed with two-way ANOVA and Fisher's PLSD test (p<0.05).

Results: Means and standard deviation are shown in the table below.

Scotchbond Multi-Purpose (MPa)	Scotchbond Multi-Purpose	Scotchbond 1	Adaper Prompt L-Pop
Laser	7.3 ±2.8	12.4±7.1	13.3±4.2
Control	35.7±14.4	23.4±8.5	27.3±7.3

The bond strengths of the Control group was significantly higher than that of the Laser group (p<0.05). Scotchbond Multi-Purpose obtained the highest Shear Bond Strength values in the Control group and showed the lowest values in the Laser group.

Conclusions: Nd:YAG laser irradiation adversely affects adhesion to dentin for all different dentin adhesive systems tested in this investigation.



Aim of the study: The main objective of this study was to evaluate the effect of laser treatment in bonding, but an interesting secondary objective was direct comparison of fourth, fifth, and sixth generation bonding systems by 3M ESPE.

Result of the Study: Laser treatment dramatically reduced dentin bonding. When looking at the various bonding generations, the Adper Scotchbond Multi-Purpose, Adper Single Bond, and Adper Prompt all displayed shear bond values of over 20 MPa.

Microleakage Evaluation of Enamel and Dentin Surfaces in Composite Restorations

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Objective: Microleakage evaluation on enamel and dentin surfaces of self-etching adhesives in Class V restorations, with and without phosphoric acid etching.

Methods: Standardized Class V preparations were made on buccal and lingual surfaces of 28 human third molars with occlusal margins located in enamel and gingival margins located in dentin. The teeth were restored using Xeno III (Dentsply) and Adper Prompt (3M ESPE) adhesive systems and Filtek A110 (3M ESPE) composite. The teeth were thermocycled for 500 cycles and immersed in 50% silver nitrate solution for two hours. Then teeth were sectioned bucco-lingually through each restoration. The extend of dye penetration at margins were assessed under microscope at 20X power. The samples were divided into eight groups: GI – enamel + Xeno III + Filtek A110; GII – enamel + Phosphoric acid 37% + Xeno III + Filtek A110; GIII - dentin + Xeno III + Filtek A110; GIV – dentin + Phosphoric acid 37% + Xeno III + Filtek A110; GV – enamel + Adper Prompt + Filtek A110; GVI – enamel + Phosphoric acid 37% + Adper Prompt + Filtek A110; GVII dentin + Adper Prompt + Filtek A110 and GVIII – dentin + Phosphoric acid 37% + Adper Prompt + Filtek A110. Data were analyzed using Kruskal-Wallis and Dunn Tests ($p>0.05$).

Results: There were no statistical differences among groups I, II, V, VI or among groups III, IV, VII, and VIII. When compared, groups with dentin and enamel margins displayed significant differences.

Conclusions: Gingival leakage was observed in all restorations while no leakage was observed in enamel margins. There were no significant differences at enamel and dentin margins when phosphoric acid etching was used or not before the self-etchings adhesive systems Xeno III (Dentsply) and Adper Prompt (3M ESPE).

Three Year Clinical Performance of Prompt L-Pop

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Purpose: This investigation evaluated the clinical performance of a new self-etching bonding agent Prompt L-Pop (3M ESPE) over a three-year period.

Methods: Twenty-five Class III and Class V restorations were placed in 17 subjects. Fourteen of the restorations were maxillary and 11 were mandibular restorations. Twenty restorations were evaluated at 36 months. Five restorations were lost to follow-up. Following cavity preparation, the teeth were etched, restored with a hybrid composite, and polished following manufacturer's instructions. Marginal adaptation (MA), adhesive retention (AR), secondary caries (SC), marginal discoloration (MD), and sensitivity (SE) were evaluated.

Results: At 3 years, using a modified USPHS grading system the following results were found in percentage (%) (BL=Baseline):

	MA		AR		SC		MD		SE	
	BL	3Y	BL	3Y	BL	3Y	BL	3Y	BL	3Y
Alpha	72	75	100	95	100	95	100	90	100	100
Bravo	28	20	0	0	0	0	0	10	0	0
Charlie	0	5	0	0	0	5	0	0	0	0
Delta	0	0	0	5	0	0	0	0	0	0

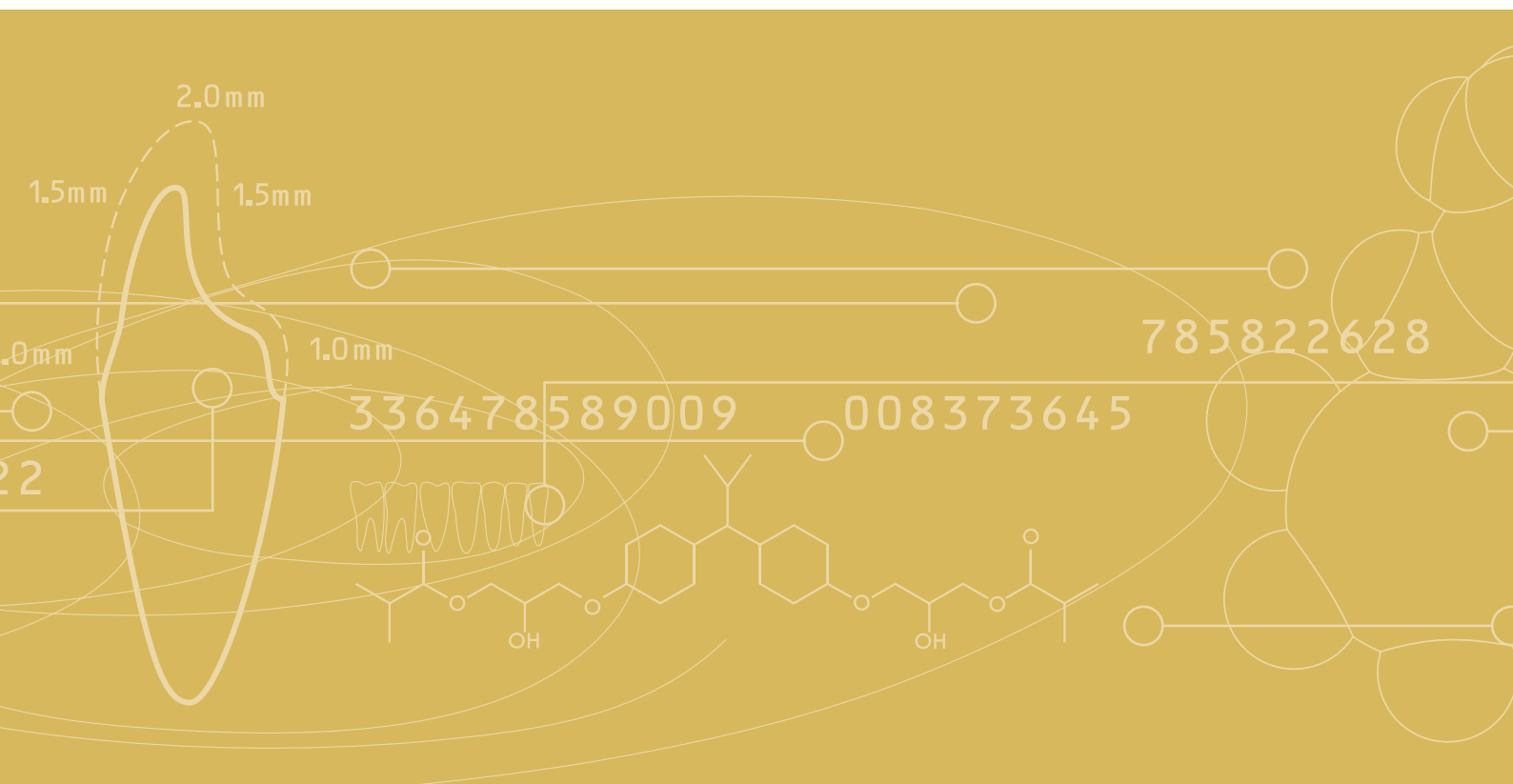
Conclusions: 1) Categories MA, AR, and SC, were unchanged from baseline, with the exception of one restoration that was lost at the two-year recall. 2) MD showed a slight decrease in marginal discoloration. 3) No sensitivity was reported at either baseline or 3 years. 4) Overall clinical use of a self etching adhesive on Class III and V restorations were deemed acceptable for routine clinical use.

Aim of the Study: Clinical performance is the ultimate test for a dental material. This paper presents the 3-year recall data for 3M ESPE Prompt adhesive.

Result of the Study: The Prompt adhesive system displayed very good performance in all criteria at the 3-year recall. It should be noted that this study was conducted with a previous iteration of the Prompt adhesive, before improvements in both chemistry and technique which yielded the current 3M ESPE Adper Prompt adhesive system.

3M ESPE rejects any responsibility for the content of the IADR abstracts (objectives, methods, results, conclusions) which have been collected unchanged in this issue.

The graphics and the "Aim of the Study" and "Result of the Study" (below the graphic in blue) are written by 3M ESPE to summarize the results. They are all based on the corresponding abstracts and reflect the results therein.



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