

Neue Begriffe in der restaurativen Zahnerhaltung

New concepts in restorative dentistry

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Literaturverzeichnis

1. Abo-Hamar SE, Hiller KA, Jung H, Federlin M, Friedl KH, Schmalz G: Bond strength of a new universal self-adhesive resin luting cement to dentin and enamel. Clin Oral Investig 2005;9:161–167
2. Alves LS, Fontanella V, Damo AC, Ferreira de OE, Maltz M: Qualitative and quantitative radiographic assessment of sealed carious dentin: a 10-year prospective study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010; 109:135–141
3. Barkmeier WW, Erickson RL: Shear bond strength of composite to enamel and dentin using Scotchbond Multi-Purpose. Am J Dent 1994;7:175–179
4. Bjorndal L, Kidd EA: The treatment of deep dentine caries lesions. Dent Update 2005;32:402–10, 413
5. Blatz MB, Mante FK, Saleh N, Atlas AM, Mannan S, Ozer F: Postoperative tooth sensitivity with a new self-adhesive resin cement-a randomized clinical trial. Clin Oral Investig 2013;17: 793–798
6. Blum IR, Nikolinakos N, Lynch CD, Wilson NH, Millar BJ, Jagger DC: An in vitro comparison of four intra-oral ceramic repair systems. J Dent 2012;40:906–912
7. Blunck U, Knitter K, Jahn KR: Six-month clinical evaluation of XP BOND in noncarious cervical lesions. J Adhes Dent 2007;9(Suppl2):265–268
8. Blunck U, Zaslansky P: Enamel margin integrity of Class I one-bottle all-in-one adhesives-based restorations. J Adhes Dent 2011;13:23–29
9. Bouschlicher MR, Reinhardt JW, Vargas MA: Surface treatment techniques for resin composite repair. Am J Dent 1997;10:279–283
10. Bowen RL: Adhesive bonding of various materials to hard tooth tissues – solubility of dentinal smear layer in dilute acid buffers. Int Dent J 1978;28:97–107
11. Bowen RL, Eick JD, Henderson DA, Anderson DW: Smear layer: removal and bonding considerations. Oper Dent 1984;3(Suppl):30–34
12. Cardoso MV, de Almeida NA, Mine A et al.: Current aspects on bonding effectiveness and stability in adhesive dentistry. Aust Dent J 2011;56 (Suppl1):31–44
13. Carvalho RM, Santiago SL, Fernandes CA, Suh BI, Pashley DH: Effects of prism orientation on tensile strength of enamel. J Adhes Dent 2000;2:251–257
14. Chen HY, Manhart J, Hickel R, Kunzelmann KH: Polymerization contraction stress in light-cured packable composite resins. Dent Mater 2001;17:253–259
15. Chu CH, Ou KL, Dong dR, Huang HM, Tsai HH, Wang WN: Orthodontic bonding with self-etching primer and self-adhesive systems. Eur J Orthod 2011;33:276–281

16. Clementino-Luedemann TN, Dabanoglu A, Ilie N, Hickel R, Kunzelmann KH: Micro-computed tomographic evaluation of a new enzyme solution for caries removal in deciduous teeth. *Dent Mater J* 2006;25:675–683
17. Corralo DJ, Maltz M: Clinical and ultrastructural effects of different liners/restorative materials on deep carious dentin: A randomized clinical trial. *Caries Res* 2013;47:243–250
18. Dammaschke T, Rodenberg TN, Schafer E, Ott KH: Efficiency of the polymer bur SmartPrep compared with conventional tungsten carbide bud bur in dentin caries excavation. *Oper Dent* 2006;31:256–260
19. de Almeida NA, Coutinho E, Cardoso MV, Lambrechts P, Van Meerbeek MB: Current concepts and techniques for caries excavation and adhesion to residual dentin. *J Adhes Dent* 2011;13:7–22
20. De Munck J, Van Meerbeek MB, Yoshida Y et al.: Four-year water degradation of total-etch adhesives bonded to dentin. *J Dent Res* 2003;82:136–140
21. De Munck J, Van Meerbeek MB, Yoshida Y, Inoue S, Suzuki K, Lambrechts P: Four-year water degradation of a resin-modified glass-ionomer adhesive bonded to dentin. *Eur J Oral Sci* 2004;112:73–83
22. De Munck J, Vargas M, Van Meerbeek LK, Hikita K, Lambrechts P, Van Meerbeek MB: Bonding of an auto-adhesive luting material to enamel and dentin. *Dent Mater* 2004;20:963–971
23. De Munck J, Van Meerbeek LK, Peumans M et al.: A critical review of the durability of adhesion to tooth tissue: methods and results. *J Dent Res* 2005;84:118–132
24. De Munck J, Braem M, Wevers M et al.: Micro-rotary fatigue of tooth-biomaterial interfaces. *Biomaterials* 2005;26:1145–1153
25. De Munck J, Mine A, Poitevin A et al.: Meta-analytical review of parameters involved in dentin bonding. *J Dent Res* 2012;91:351–357
26. Dörfer CE, Staehle HJ, Wurst MW, Duschner H, Pioch T: The nanoleakage phenomenon: influence of different dentin bonding agents, thermocycling and etching time. *Eur J Oral Sci* 2000;108:346–351
27. Elekdag-Turk S, Cakmak F, Isci D, Turk T: 12-month self-ligating bracket failure rate with a self-etching primer. *Angle Orthod* 2008;78:1095–1100
28. Ericson D, Kidd E, McComb D, Mjor I, Noack MJ: Minimally invasive dentistry – concepts and techniques in cariology. *Oral Health Prev Dent* 2003;1:59–72
29. Frankenberger R, Krämer N, Pelka M, Petschelt A: Internal adaptation and overhang formation of direct Class II resin composite restorations. *Clin Oral Investig* 1999;3:208–215
30. Frankenberger R, Krämer N, Petschelt A: Long-term effect of dentin primers on enamel bond strength and marginal adaptation. *Oper Dent* 2000;25:11–19
31. Frankenberger R, Krämer N, Petschelt A: Technique sensitivity of dentin bonding: effect of application mistakes on bond strength and marginal adaptation. *Oper Dent* 2000;25:324–330
32. Frankenberger R, Krämer N, Sindel J: Repair strength of etched vs silica-coated metal-ceramic and all-ceramic restorations. *Oper Dent* 2000;25:209–215
33. Frankenberger R, Perdigao J, Rosa BT, Lopes M: „No-bottle“ vs „multi-bottle“ dentin adhesives – a microtensile bond strength and morphological study. *Dent Mater* 2001;17:373–380
34. Frankenberger R, Krämer N, Ebert J, Lohbauer U, Kappel S, ten WS et al.: Fatigue behavior of the resin-resin bond of partially replaced resin-based composite restorations. *Am J Dent* 2003;16:17–22
35. Frankenberger R, Roth S, Krämer N, Pelka M, Petschelt A: Effect of preparation mode on Class II resin composite repair. *J Oral Rehabil* 2003;30:559–564
36. Frankenberger R, Garcia-Godoy F, Lohbauer U, Petschelt A, Krämer N: Evaluation of resin composite materials. Part I: in vitro investigations. *Am J Dent* 2005;18:23–27

37. Frankenberger R, Tay FR: Self-etch vs etch-and-rinse adhesives: effect of thermo-mechanical fatigue loading on marginal quality of bonded resin composite restorations. *Dent Mater* 2005;21:397–412
38. Frankenberger R, Krämer N, Lohbauer U, Nikolaenko SA, Reich SM: Marginal integrity: is the clinical performance of bonded restorations predictable in vitro? *J Adhes Dent* 2007;9(Suppl1): 107–116
39. Frankenberger R, Lohbauer U, Roggendorf MJ, Naumann M, Taschner M: Selective enamel etching reconsidered: better than etch-and-rinse and self-etch? *J Adhes Dent* 2008;10:339–344
40. Frankenberger R, Reinelt C, Petschelt A, Krämer N: Operator vs. material influence on clinical outcome of bonded ceramic inlays. *Dent Mater* 2009;25:960–968
41. Garcia-Godoy F, Krämer N, Feilzer AJ, Frankenberger R: Long-term degradation of enamel and dentin bonds: 6-year results in vitro vs. in vivo. *Dent Mater* 2010;26:1113–1118
42. Garcia-Godoy F, Frankenberger R, Lohbauer U, Feilzer AJ, Krämer N: Fatigue behavior of dental resin composites: flexural fatigue in vitro versus 6 years in vivo. *J Biomed Mater Res B Appl Biomater* 2012;100:903–910
43. Gerth HU, Dammaschke T, Zuchner H, Schafer E: Chemical analysis and bonding reaction of RelyX Unicem and Bifix composites—a comparative study. *Dent Mater* 2006;22:934–941
44. Goracci C, Margvelashvili M, GioVan Meerbeeknetti A, Vichi A, Ferrari M: Shear bond strength of orthodontic brackets bonded with a new self-ad-hering flowable resin composite. *Clin Oral Investig* 2012
45. Gordan VV, Riley JL, III, Blaser PK, Mondragon E, GarVan Meerbeek CW, Major IA: Alternative treatments to replacement of defective amalgam restorations: results of a seven-year clinical study. *J Am Dent Assoc* 2011;142:842–849
46. Gugrani N, Pandit IK, Gupta M, Josan R: Caries infiltration of noncavitated white spot lesions: A novel approach for immediate esthetic improvement. *Contemp Clin Dent* 2012;3(Suppl2):S199–S202
47. Gwinnett AJ, Ripa LW: Penetration of pit and fissure sealants into conditioned human enamel in vivo. *Arch Oral Biol* 1973;18:435–439
48. Gwinnett AJ: Acid etching for composite resins. *Dent Clin North Am* 1981; 25:271–289
49. Gwinnett AJ: Smear layer: morphological considerations. *Oper Dent Suppl* 1984;3:2–12
50. Hamano N, Chiang YC, Nyamaa I et al.: Effect of different surface treatments on the repair strength of a nanofilled resin-based composite. *Dent Mater J* 2011;30:537–545
51. Hamano N, Chiang YC, Nyamaa I et al.: Repair of silorane-based dental composites: influence of surface treatments. *Dent Mater* 2012;28:894–902
52. Heintze SD, Blunck U, Gohring TN, Rousson V: Marginal adaptation in vitro and clinical outcome of Class V restorations. *Dent Mater* 2009;25:605–620
53. Hickel R, Manhart J, Garcia-Godoy F: Clinical results and new developments of direct posterior restorations. *Am J Dent* 2000;13(Spec No):41D–54D
54. Hickel R, Manhart J: Longevity of restorations in posterior teeth and reasons for failure. *J Adhes Dent* 2001;3:45–64
55. Hickel R, Heidemann D, Staehle HJ, Minnig P, Wilson NH: Direct composite restorations: extended use in anterior and posterior situations. *Clin Oral Investig* 2004;8:43–44
56. Hickel R, Kaaden C, Paschos E, Buerkle V, Garcia-Godoy F, Manhart J: Longevity of occlusally-stressed restorations in posterior primary teeth. *Am J Dent* 2005;18:198–211
57. Hickel R, Roulet JF, Bayne S et al.: Recommendations for conducting controlled clinical studies of dental restorative materials. *Int Dent J* 2007;57:300–302

58. Hickel R, Peschke A, Tyas M et al.: FDI World Dental Federation – clinical criteria for the evaluation of direct and indirect restorations. Update and clinical examples. *J Adhes Dent* 2010;12:259–272
59. Hickel R, Brushaver K, Ilie N: Repair of restorations – criteria for decision making and clinical recommendations. *Dent Mater* 2013;29:28–50
60. Hikita K, Van Meerbeek MB, De MJ et al.: Bonding effectiveness of adhesive luting agents to enamel and dentin. *Dent Mater* 2007;23:71–80
61. Ilie N, Hickel R: Resin composite restorative materials. *Aust Dent J* 2011;56 (Suppl1):59–66
62. Inoue S, Abe Y, Yoshida Y et al.: Effect of conditioner on bond strength of glass-ionomer adhesive to dentin/enamel with and without smear layer interposition. *Oper Dent* 2004;29:685–692
63. Kanca J, III: The all-etch bonding technique/wetbonding. *Dent Today* 1991;10:58, 60–58, 61
64. Kanca J, III: Resin bonding to wet substrate. 1. Bonding to dentin. *Quintessence Int* 1992;23:39–41
65. Kanemura N, Sano H, Tagami J: Tensile bond strength to and SEM evaluation of ground and intact enamel surfaces. *J Dent* 1999;27:523–530
66. Kern M: Clinical long-term survival of two-retainer and single-retainer all-ceramic resin-bonded fixed partial dentures. *Quintessence Int* 2005;36:141–147
67. Kidd EA: How 'clean' must a cavity be before restoration? *Caries Res* 2004;38:305–313
68. Kirkpatrick JJ, Enion DS, Burd DA: Hydrofluoric acid burns: a review. *Burns* 1995;21:483–493
69. Koshiro K, Inoue S, Sano H, De Munck J, Van Meerbeek MB: In vivo degradation of resin-dentin bonds produced by a self-etch and an etch-and-rinse adhesive. *Eur J Oral Sci* 2005;113:341–348
70. Krämer N, Lohbauer U, Frankenberger R: Adhesive luting of indirect restorations. *Am J Dent* 2000;13(Spec No):60D–76D
71. Krämer N, Garcia-Godoy F, Frankenberger R: Evaluation of resin composite materials. Part II: in vivo investigations. *Am J Dent* 2005;18:75–81
72. Krämer N, Frankenberger R: Clinical performance of bonded leucite-reinforced glass ceramic inlays and onlays after eight years. *Dent Mater* 2005;21:262–271
73. Krämer N, Kunzelmann KH, Garcia-Godoy F, Haberlein I, Meier B, Frankenberger R: Determination of caries risk at resin composite margins. *Am J Dent* 2007;20:59–64
74. Krämer N, Reinelt C, Garcia-Godoy F, Taschner M, Petschelt A, Frankenberger R: Nanohybrid composite vs. fine hybrid composite in extended class II cavities: clinical and microscopic results after 2 years. *Am J Dent* 2009;22:228–234
75. Krämer N, Reinelt C, Richter G, Frankenberger R: Four-year clinical performance and marginal analysis of pressed glass ceramic inlays luted with ormocer restorative vs. conventional luting composite. *J Dent* 2009;37:813–819
76. Krämer N, Reinelt C, Richter G, Petschelt A, Frankenberger R: Nanohybrid vs. fine hybrid composite in Class II cavities: clinical results and margin analysis after four years. *Dent Mater* 2009;25:750–759
77. Krämer N, Garcia-Godoy F, Reinelt C, Feilzer AJ, Frankenberger R: Nanohybrid vs. fine hybrid composite in extended Class II cavities after six years. *Dent Mater* 2011;27:455–464
78. Krejci I, Lieber CM, Lutz F: Time required to remove totally bonded tooth-colored posterior restorations and related tooth substance loss. *Dent Mater* 1995;11:34–40
79. Kugel G, Arsenault P, Papas A: Treatment modalities for caries management, including a new resin infiltration system. *Compend Contin Educ Dent* 2009;30(Spec No 3):1–10
80. Lohbauer U, Nikolaenko SA, Petschelt A, Frankenberger R: Resin tags do not contribute to dentin adhesion in self-etching adhesives. *J Adhes Dent* 2008;10:97–103
81. Loomans BA, Cardoso MV, Opdam NJ et al.: Surface roughness of etched composite resin in light of composite repair. *J Dent* 2011;39:499–505

82. Loomans BA, Cardoso MV, Roeters FJ et al.: Is there one optimal repair technique for all composites? *Dent Mater* 2011;27:701–709
83. Lührs AK, Guhr S, Günay H, Geurtsen W: Shear bond strength of self-adhesive resins compared to resin cements with etch and rinse adhesives to enamel and dentin in vitro. *Clin Oral Investig* 2010;14:193–199
84. Lührs AK, Gormann B, Jacker-Guhr S, Geurtsen W: Repairability of dental siloranes in vitro. *Dent Mater* 2011;27:144–149
85. Manhart J, Chen HY, Mehl A, Weber K, Hickel R: Marginal quality and microleakage of adhesive class V restorations. *J Dent* 2001;29:123–130
86. Manhart J, Chen HY, Neuerer P, Scheibenbogen-Fuchsbrunner A, Hickel R: Three-year clinical evaluation of composite and ceramic inlays. *Am J Dent* 2001;14:95–99
87. Manhart J, Schmidt M, Chen HY, Kunzelmann KH, Hickel R: Marginal quality of tooth-colored restorations in class II cavities after artificial aging. *Oper Dent* 2001;26:357–366
88. Manhart J, Chen H, Hamm G, Hickel R: Buonocore memorial lecture. Review of the clinical survival of direct and indirect restorations in posterior teeth of the permanent dentition. *Oper Dent* 2004;29:481–508
- 88b. Martin et al: New terms and definitions in restorative dentistry. *Oper Dent* 2013;38:125–133
89. Mehl A, Kunzelmann KH, Folwaczny M, Hickel R: Stabilization effects of CAD/CAM ceramic restorations in extended MOD cavities. *J Adhes Dent* 2004;6:239–245
90. Meller C, Welk A, Zeligowski T, Splieth C: Comparison of dentin caries excavation with polymer and conventional tungsten carbide burs. *Quintessence Int* 2007;38:565–569
91. Meyer-Lückel H, Paris S: Improved resin infiltration of natural caries lesions. *J Dent Res* 2008;87:1112–1116
92. Meyer-Lückel H, Bitter K, Paris S: Randomized controlled clinical trial on proximal caries infiltration: three-year follow-up. *Caries Res* 2012;46:544–548
93. Milia E, Pinna R, Castelli G et al.: TEM morphological characterization of a one-step self-etching system applied clinically to human caries-affected dentin and deep sound dentin. *Am J Dent* 2012;25:321–326
94. Mine A, De Munck J, Van Meerbeek M et al.: Enamel-smear compromises bonding by mild self-etch adhesives. *J Dent Res* 2010;89:1505–1509
95. Nayif MM, Shimada Y, Ichinose S, Tagami J: Nanoleakage of current selfetch adhesives bonded to artificial carious dentin. *Am J Dent* 2010;23: 279–284
96. O’Keefe KL, Pinzon LM, Rivera B, Powers JM: Bond strength of compo-site to adstringent-contaminated dentin using self-etching adhesives. *Am J Dent* 2005;18:168–172
97. Oliveira SS, Pugach MK, Hilton JF, Watanabe LG, Marshall SJ, Marshall GW, Jr.: The influence of the dentin smear layer on adhesion: a self-etching primer vs. a total-etch system. *Dent Mater* 2003;19:758–767
98. Omar H, El-Badrawy W, El-Mowafy O, Atta O, Saleem B: Microtensile bond strength of resin composite bonded to caries-affected dentin with three adhesives. *Oper Dent* 2007;32:24–30
99. Opdam NJ, Bronkhorst EM, Loomans BA, Huysmans MC: 12-year survival of composite vs. amalgam restorations. *J Dent Res* 2010;89:1063–1067
100. Ozel BO, Eren D, Akin EG, Akin H: Evaluation of a self-adhering flowable composite in terms of micro-shear bond strength and microleakage. *Acta Odontol Scand* 2012
101. Paris S, Hopfenmuller W, Meyer-Lückel H: Resin infiltration of caries lesions: an efficacy randomized trial. *J Dent Res* 2010;89:823–826
102. Paris S, Meyer-Lückel H: Inhibition of caries progression by resin infiltration in situ. *Caries Res* 2010;44:47–54
103. Pashley DH, Michelich V, Kehl T: Dentin permeability: effects of smear layer removal. *J Prosthet Dent* 1981;46:531–537

104. Pashley DH: Mechanistic analysis of fluid distribution across the pulpodentin complex. *J Endod* 1992;18:72–75
105. Pashley DH, Tay FR: Aggressiveness of contemporary self-etching adhesives. Part II: etching effects on unground enamel. *Dent Mater* 2001;17:430–444
106. Perdigao J, Lambrechts P, Van Meerbeek MB et al.: The interaction of adhesive systems with human dentin. *Am J Dent* 1996;9:167–173
107. Perdigao J, Lambrechts P, Van Meerbeek MB, Tome AR, Van Meerbeekherle G, Lopes AB: Morphological field emission-SEM study of the effect of six phosphoric acid etching agents on human dentin. *Dent Mater* 1996;12:262–271
108. Perdigao J, Frankenberger R, Rosa BT, Breschi L: New trends in dentin/enamel adhesion. *Am J Dent* 2000;13 (Spec No):25D–30D
109. Perdigao J, Frankenberger R: Effect of solvent and rewetting time on dentin adhesion. *Quintessence Int* 2001;32:385–390
110. Peschke A, Blunck U, Roulet JF: Influence of incorrect application of a water-based adhesive system on the marginal adaptation of Class V restorations. *Am J Dent* 2000;13:239–244
111. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G: The 5-year clinical performance of direct composite additions to correct tooth form and position. I. Esthetic qualities. *Clin Oral Investig* 1997;1:12–18
112. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G: The 5-year clinical performance of direct composite additions to correct tooth form and position. II. Marginal qualities. *Clin Oral Investig* 1997;1:19–26
113. Peumans M, Van Meerbeek B, Lambrechts P, Vuylsteke-Wauters M, Vanherle G: Five-year clinical performance of porcelain veneers. *Quintessence Int* 1998;29:211–221
114. Peumans M, Kanumilli P, De Munck J, Van Landuyt LK, Lambrechts P, Van Meerbeek B: Clinical effectiveness of contemporary adhesives: a systematic review of current clinical trials. *Dent Mater* 2005;21:864–881
115. Peumans M, De MJ, Van Landuyt LK, Lambrechts P, Van Meerbeek B: Five-year clinical effectiveness of a two-step self-etching adhesive. *J Adhes Dent* 2007;9:7–10
116. Peumans M, De Munck J, Van Landuyt KL, Poitevin A, Lambrechts P, Van Meerbeek B: A 13-year clinical evaluation of two three-step etch-and-rinse adhesives in non-carious class-V lesions. *Clin Oral Investig* 2012;16:129–137
117. Phark JH, Duarte S Jr, Meyer-Lueckel H, Paris S: Caries infiltration with resins: a novel treatment option for interproximal caries. *Compend Contin Educ Dent* 2009;30(Spec No3):13–17
118. Pioch T, Stotz S, Buff E, Duschner H, Staehle HJ: Influence of different etching times on hybrid layer formation and tensile bond strength. *Am J Dent* 1998;11:202–206
119. Poitevin A, De Munck J, Van Meerbeek EA et al.: Bonding effectiveness of self-adhesive composites to dentin and enamel. *Dent Mater* 2013;29:221–230
120. Prabhakar A, Kiran NK: Clinical evaluation of polyamide polymer burs for selective carious dentin removal. *J Contemp Dent Pract* 2009;10:26–34
121. Rathke A, Tymina Y, Haller B: Effect of different surface treatments on the composite-composite repair bond strength. *Clin Oral Investig* 2009;13: 317–323
122. Sakoolnamarka R, Burrow MF, Tyas MJ: Interfacial micromorphology of three adhesive systems created in caries-affected dentin. *Am J Dent* 2003;16:202–206
123. Sano H, Yoshiyama M, Ebisu S et al.: Comparative SEM and TEM observations of nanoleakage within the hybrid layer. *Oper Dent* 1995;20:160–167
124. Sattabanasuk V, Shimada Y, Tagami J: Bonding of resin to artificially carious dentin. *J Adhes Dent* 2005;7:183–192
125. Saunders WP: Effect of fatigue upon the interfacial bond strength of repaired composite resins. *J Dent* 1990;18:158–162

126. Schenke F, Federlin M, Hiller KA, Moder D, Schmalz G: Controlled, prospective, randomized, clinical evaluation of partial ceramic crowns inserted with RelyX Unicem with or without selective enamel etching. Results after 2 years. *Clin Oral Investig* 2012;16:451–461
127. Scougall-Vilchis RJ, Zarate-Diaz C, Kusakabe S, Yamamoto K: Bond strengths of different orthodontic adhesives after enamel conditioning with the same self-etching primer. *Aust Orthod J* 2010;26:84–89
128. Shetty RM, Bhat S, Mehta D, Srivatsa G, Shetty YB: Comparative analysis of postcementation hypersensitivity with glass ionomer cement and a resin cement: an in vivo study. *J Contemp Dent Pract* 2012;13:327–331
129. Swift EJ, Jr., LeValley BD, Boyer DB: Evaluation of new methods for composite repair. *Dent Mater* 1992;8:362–365
130. Swift EJ, Jr., Cloe BC, Boyer DB: Effect of a silane coupling agent on compo-site repair strengths. *Am J Dent* 1994;7:200–202
131. Taschner M, Krämer N, Lohbauer U et al.: Leucite-reinforced glass ceramic inlays luted with self-adhesive resin cement: a 2-year in vivo study. *Dent Mater* 2012;28:535–540
132. Taschner M, Nato F, Mazzoni A et al.: Influence of preliminary etching on the stability of bonds created by one-step self-etch bonding systems. *Eur J Oral Sci* 2012;120:239–248
133. Tay FR, Pashley DH: Aggressiveness of contemporary self-etching systems. I: Depth of penetration beyond dentin smear layers. *Dent Mater* 2001;17:296–308
134. Tay FR, Pashley DH, Yoshiyama M: Two modes of nanoleakage expression in single-step adhesives. *J Dent Res* 2002;81:472–476
135. Tay FR, Frankenberger R, Krejci I et al.: Single-bottle adhesives behave as permeable membranes after polymerization. I. In vivo evidence. *J Dent* 2004;32:611–621
136. Toledano M, Cabello I, Yamauti M, Osorio R: Differential resin-dentin bonds created after caries removal with polymer burs. *Microsc Microanal* 2012;18:497–508
137. Torres CR, Rosa PC, Ferreira NS, Borges AB: Effect of caries infiltration technique and fluoride therapy on microhardness of enamel carious lesions. *Oper Dent* 2012;37:363–369
138. Van Landuyt KL, Kanumilli P, De Munck J, Peumans M, Lambrechts P, Van Meerbeek B: Bond strength of a mild self-etch adhesive with and without prior acid-etching. *J Dent* 2006;34:77–85
139. Van Landuyt KL, Snauwaert J, De Munck J et al.: Origin of interfacial droplets with one-step adhesives. *J Dent Res* 2007;86:739–744
140. Van Landuyt KL, Snauwaert J, De MJ et al.: Systematic review of the chemical composition of contemporary dental adhesives. *Biomaterials* 2007;28:3757–3785
141. Van Meerbeek MB, Lambrechts P, Inokoshi S, Braem M, Vanherle G: Factors affecting adhesion to mineralized tissues. *Oper Dent* 1992;5(Suppl):111–124
142. Van Meerbeek B, Peumans M, Verschueren M et al.: Clinical status of ten dentin adhesive systems. *J Dent Res* 1994;73:1690–1702
143. Van Meerbeek B, De Munck J, Yoshida Y et al.: Buonocore memorial lecture. Adhesion to enamel and dentin: current status and future challenges. *Oper Dent* 2003;28:215–235
144. Van Meerbeek B, De Munck J, Mattar D, Van Landuyt LK, Lambrechts P: Microtensile bond strengths of an etch&rinse and self-etch adhesive to enamel and dentin as a function of surface treatment. *Oper Dent* 2003;28:647–660
145. Van Meerbeek B, Kanumilli PV, De Munck J, Van Meerbeek LK, Lambrechts P, Peumans M: A randomized, controlled trial evaluating the three-year clinical effectiveness of two etch & rinse adhesives in cervical lesions. *Oper Dent* 2004;29:376–385
146. Van Meerbeek B, Peumans M, Poitevin A et al.: Relationship between bond-strength tests and clinical outcomes. *Dent Mater* 2010;26:e100–e121
147. Van Meerbeek B: Dentin/enamel bonding. *J Esthet Restor Dent* 2010;22:157

148. Van Meerbeek B, Yoshihara K, Yoshida Y, Mine A, De Munck J, Van Landuyt KL: State of the art of self-etch adhesives. *Dent Mater* 2011;27:17–28
149. Vichi A, Margvelashvili M, Goracci C, Papacchini F, Ferrari M: Bonding and sealing ability of a new self-adhering flow-able composite resin in class I restorations. *Clin Oral Investig* 2013;17:1497–1506
150. Wajdowicz MN, Vandewalle KS, Means MT: Shear bond strength of new self-adhesive flowable composite resins. *Gen Dent* 2012;60:e104–e108
151. Wang Y, Spencer P: Effect of acid etching time and technique on interfacial characteristics of the adhesive-dentin bond using differential staining. *Eur J Oral Sci* 2004;112:293–299
152. Watson TF: A confocal optical microscope study of the morphology of the tooth/restoration interface using Scotchbond 2 dentin adhesive. *J Dent Res* 1989;68:1124–1131
153. Wei S, Sadr A, Shimada Y, Tagami J: Effect of caries-affected dentin hardness on the shear bond strength of current adhesives. *J Adhes Dent* 2008;10:431–440
154. Wei YJ, Silikas N, Zhang ZT, Watts DC: Diffusion and concurrent solubility of self-adhering and new resin-matrix composites during water sorption/desorption cycles. *Dent Mater* 2011;27:197–205
155. Wei YJ, Silikas N, Zhang ZT, Watts DC: Hygroscopic dimensional changes of self-adhering and new resin-matrix composites during water sorption/desorption cycles. *Dent Mater* 2011;27:259–266
156. White GJ, Beech DR, Tyas MJ: Dentin smear layer: an asset or a liability for bonding? *Dent Mater* 1989;5:379–383
157. Zakirulla M, Uloopi KS, Subba Reddy VV: In vivo comparison of reduction in bacterial count after caries excavation with 3 different techniques. *J Dent Child (Chic)* 2011;78:31–35