Review Article

A thorough assessment of 10-MDP primers in modern dental adhesive systems

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Abstract: Background**:** Dental primers are pivotal in achieving durable and reliable bonding between dental adhesives and tooth structures. Among the various primers' components, the functional monomer 10-methacryloyloxydecyl dihydrogen phosphate is gaining significant attention owing to its unique chemical properties and bond-enhancing capabilities. Aims: This paper comprehensively reviewed current knowledge on the functional monomer 10-methacryloyloxydecyl dihydrogen phosphate. We focus on its chemistry, interactions with tooth substrates, interactions with zirconium and other metals, adhesive's longevity, clinical applications, and potential drawbacks. Sources: Our sources are the Internet, such as Google Scholar and PubMed. Study selection: Studies investigating the efficacy of 10-MDP primers were included. Conclusions: The emergence of 10-MDP primers has significantly advanced the field of dental adhesives by providing reliable bonding solutions to enamel and dentin. The chemical interaction between 10-MDP and tooth substrates demonstrates remarkable adhesive strength and longevity.

Keywords: 10-methacryloyloxydecyl dihydrogen phosphate, 10-MDP, bonding, dental adhesive, primer.

Introduction

Dental-adhesive systems have undergone considerable advancements over the years. The introduction of novel adhesive monomers contribute to improvements in bonding efficacy and durability (1). Adding functional monomers into dental-adhesive systems facilitates the establishment of chemical bonds with dental substrates, leading to enhanced adhesive forces compared with solely relying on micromechanical adhesion (2). Adhesives containing functional monomers can establish chemical hydrogen bonds with metal oxides at the interface between the resin and zirconia (3). In 1981, the Japanese company Kuraray achieved a notable breakthrough in self-etch adhesive technology by successfully synthesizing and obtaining a patent for the functional monomer 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) (4).

10-MDP can establish a chemical bond with the dental structure, a feature attributed to the monomer's capacity to create robust ionic bonds with calcium (Ca) (5). The chemical composition of 10-MDP also exhibits polar characteristics that endow it with adhesive properties. Indeed, adhesives formulated using 10-MDP demonstrate superior bonding efficacy over those containing monomers such as 4-methacryloxyethyl trimellitate anhydride (4-META), 6-methacryloyloxyhexyl dihydrogen phosphate (6-MHP), PENTA, 4-MET, esters of pyrophosphate, or sulfonic acid monomers (6). This review explores the chemistry and mechanisms of 10-MDP's adhesive potential and its applications in contemporary dental procedures.

Chemistry and structure of 10-MDP

10-MDP has an amphiphilic structure comprising a hydrophobic vinyl group and a hydrophilic phosphate group [7]. The structure of 10-MDP includes a methacrylate polymerizable end, a long hydrophobic 10-carbon chain, and a short hydrophilic functional phosphate component that can ionize and interact with the hydroxyapatite (HAp) half [8], as shown in Figure 1.

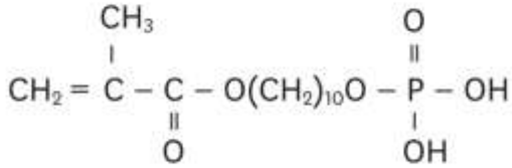

Figure 1: 10-Methacryloyloxydecyl dihydrogen phosphate (10-MDP) chemical structure [9].

Interactions with Tooth Substrates

The carboxylic and phosphate functional groups in 10-MDP can ionically bond with Ca in HAp to provide adequate chemical bonding to dentin [10]. Strong chemical bonds are created between 10-MDP monomer and HAp by stable 10-MDP–Ca salts [11]. These Ca salts are formed through a process known as nano-layering. According to Yoshihara et al. [12], the compound of 10-MDP can spontaneously arrange itself into nano-layers that are approximately 3.5 nm in size. These nano-layers comprise two sub-layers of 10-MDP monomers oriented in parallel but in opposite directions. Each nano-layer is connected to the next by forming a stable ionic bridge facilitated by Ca ions. This bridge in turn connects the phosphate groups of adjacent 10-MDP molecules, ensuring the overall stability of the nano-layer structure (Figure 2).

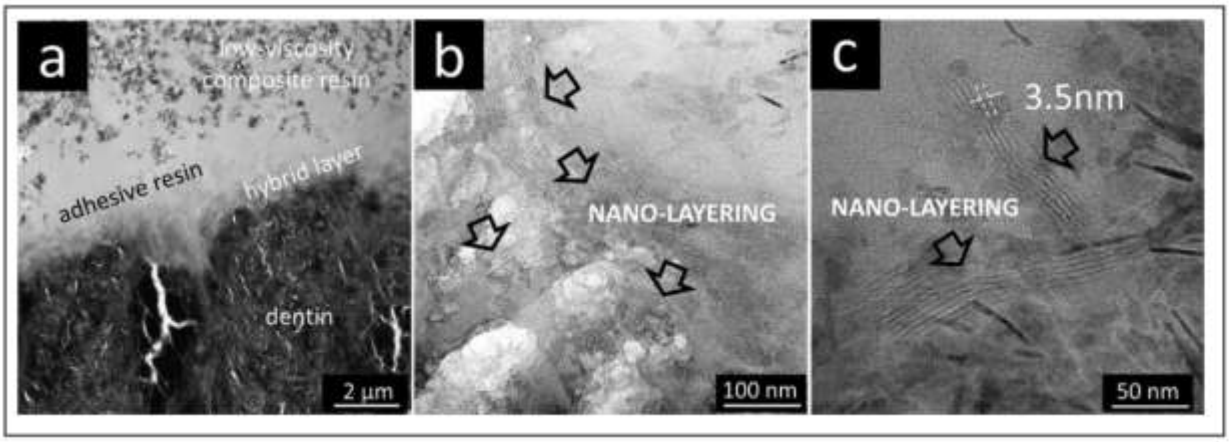

Figure 2: Photomicrographs of the interface of 10-MDP adhesive bonded to dentin and imaged at different magnifications by transmission electron microscopy. (A) A submicron hybrid layer forms at the interface between dentin and the adhesive resin. (B) The uppermost region of the hybrid layer has structures characterized by regular longitudinal layering and occasional curvature. (C) These structures represent nano-layers with a periodicity of approximately 3.5 nm [13].

The process of nano-layering helps explain why this adhesive performs effectively on dentin and on enamel, even without selective enamel etching [14]. Results of X-ray diffraction analysis demonstrate that

HAp enamel exhibits the formation of monomer–Ca salts in the form of nano-layering, exclusively, when treated with 10-MDP. Conversely, all monomers induce nano-layering on dentin but with varying degrees of intensity. 10-MDP exhibits the highest intensity, followed by 6-MHP and 2-methacryloyloxy-ethyl-dihydrogen phosphate (2-MEP) (8).

In addition to nano-layering capability, incorporating a long carbon chain (the spacer chain) has been documented as a key factor contributing to the remarkable adhesive properties observed in universal adhesives [15].

Previous studies have demonstrated that the endogenous matrix metalloproteinases present in dentin can degrade the hybrid layer, consequently reducing the durability of resin–dentin bonds; 10-MDP and 10-MDP-Ca salts have inhibitory effects on these enzymes [16]. Generating MDP–Ca salts also facilitates the protection of collagen fibers [2]. Functional monomers enhance adhesive-system interactions with dental substrates but may decrease camphor quinone/amine-curing adhesive conversion, and this depends on monomer type and concentration [17].

Interaction with zirconium and other metals

Nagaoka et al. [18] explained the bonding to zirconium through three mechanisms. First, the adsorption of 10-MDP monomer onto the zirconia surface occurs by establishing hydrogen-bonding interactions between the P=O (oxo) and Zr-OH groups (Figure 3A). Second, possible ionic bonding occurs between the 10-MDP monomer and zirconia (Figure 3B). Third, one non-deprotonated P-OH and the P=O (oxo group) of the PO3H2 group of 10-MDP may form hydrogen bonds with zirconia or nearby phosphate groups (Figure 3C).

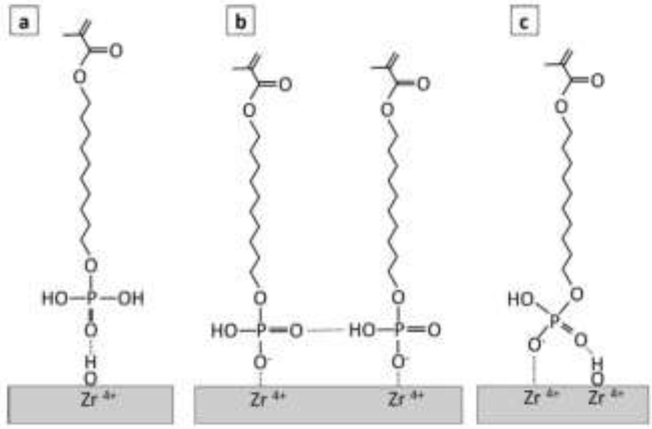

Figure 3: Schematic showing how 10-MDP can interact with zirconium and the hydrated layer on the zirconia surface [18].

Researchers have speculated on the potential explanation for the enhanced bond strength to titanium alloy and Amalgam fillings achieved using adhesives containing 10-MDP. This speculation suggests that the bond-strength endurance may be attributable to the interaction between the hydrophobic divalent phosphate and the metal oxides [19].

Adhesive's longevity

When addressing adhesive solutions, the interaction with collagen is a key factor because dentin bonding's long-term durability can adversely affect the breakdown of collagen fibrils within the hybrid layer. The Ca nano-layers bonded to the MDP in 10-MDP adhesive strengthen the adhesive interface's resistance to biodegradation, thereby preventing collagen fibers from hydrolyzing [20]

The nano-layered structures and the stable MDP-Ca salts on enamel and dentin give 10-MDP-containing adhesive systems higher adhesive stability, higher biodegradation resistance, and bond longevity [21, 22].

The capacity of 10-MDP monomer to generate a zone on the adhesive interface that is resistant to acid–base interactions enhance its capability to counteract acid–base challenges effectively. Thus, a stable adhesion is created over time [2].

Clinical Applications

10-MDP has emerged as a versatile, functional monomer in dental-adhesive systems. Its ability to form chemical bonds with dental substrates including enamel, dentin, and various restorative materials makes it valuable for achieving reliable adhesion in various clinical situations.

In orthodontics, incorporating 10-MDP in adhesives for bonding orthodontic brackets is a promising development; it provides satisfactory shear bond strength (SBS) and minimizes enamel damage [23]. Beketova et al. [24] concluded that luting cement containing 10-MDP has higher SBS values than resin-modified glass ionomer cement and luting cement containing 4-META. Based on a clinical trial, Abduljawad et al. [25] concluded that hydrophilic primers containing 10-MDP may boost orthodontic molar tubes' survival rates and decrease bond failures, particularly in poorly isolated settings. The favorable SBS exhibited by adhesive systems incorporating 10-MDP when used to bond buccal tubes onto zirconia surfaces highlights its applicability in bonding procedures involving diverse materials [26]. A study by Mauwafak and Al-Dabagh [27] came to the conclusion that stainless steel and sapphire brackets can be successfully bonded to zirconium surfaces using 10-MDP primer. Another application in orthodontics is the use of MDP- and silane-containing 3M™ Single Bond Universal on etched polyetheretherketone fixed retainers which demonstrated high SBS [28].

In prosthodontics, when combined with 10-MDP on various metal and metal-oxide surfaces, the improved bonding durability of acrylic resin indicates its potential in prosthetic dentistry. This property can lead to more reliable and long-lasting restorations [19, 29].

In the operative dentistry, the improved adhesion to amalgam restorations using 10-MDP further underscores its broad utility in restorative dentistry [30]. Furthermore, the repair bond strength of composite restorations is enhanced with 10-MDP. This enhancement is possible through its ability to penetrate old composite material and form bonds with inorganic filler particles through the polarity of the phosphate groups [31]. The incorporation of 10-MDP establishes a chemical integration with dentin, leading to longer-lasting adhesion and reduced postoperative sensitivity. This activity is essential for ensuring patient comfort and the longevity of dental restorations [32].

In general dentistry, 10-MDP addition plays a pivotal role in self-etch adhesives by contributing to their acidic quality [2]. Unlike traditional etching methods that fully demineralize dentin, self-etch adhesives partially demineralize it, allowing HAp to remain attached to collagen. This unique property enables 10-MDP to form chemical bonds with HAp through nano-layering (Figure 4). Such adhesives are essential for cases where minimal dentin removal is preferred [22].

Hydrophilic monomers such as 2-hydroxyethyl methacrylate (HEMA) can enhance adhesive strength by producing favorable conditions for the combination of hydrophobic and hydrophilic bonding components. However, their efficacy depends on the presence of functional MDP monomers in the bonding agent; otherwise, being a hydrophilic monomer is bound to cause decreased bond strength over the long run [33]. A study by Yoshida et al. [34] concluded that HEMA dramatically decreases nano-layering because it slows down the rate of HAp-demineralization, which is necessary for the production of MDP-Ca salts. HEMA hinders but does not prevent MDP from chemically reacting with HAp. Another advantage of 10-MDP primers added to hydrophilic primers to counteract wet conditions is the ability of the 10-MDP monomer to improve wetting on moist tooth surfaces and the formation of intense and stable chemical bonds with HAp [35]. Yoshihara et al. [36] found that hydrophilic spacer carbon chains improve dentin wettability, whereas the functional group is better suited to counteract the effects of hydrolytic breakdown.

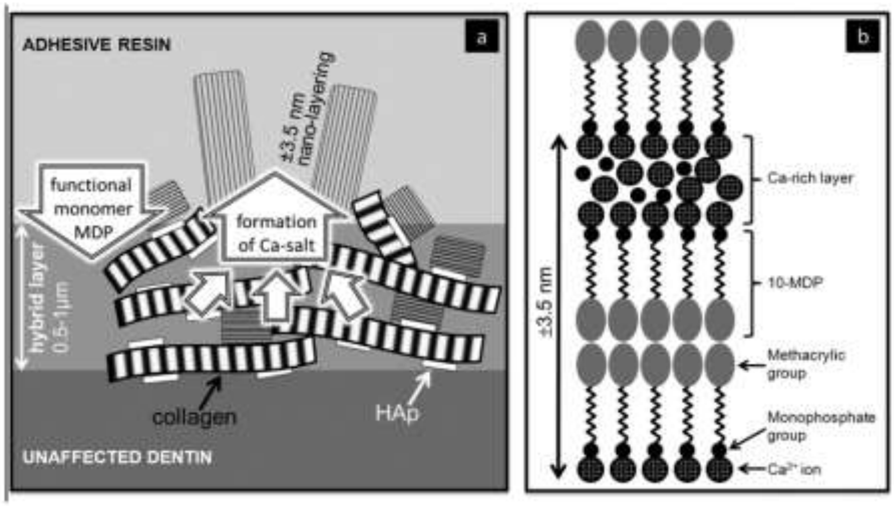

Figure 4: Diagram illustrating interfacial nano-layering and MDP-Ca salt production. (A) Dentin is partially demineralized up to a depth of 0.5–1 µm when the MDP-containing adhesive is applied to it. Owing to the creation of MDP-Ca salt, the partial breakdown of HAp releases Ca ions that diffuse inside the hybrid layer and combine MDP molecules into nano-layers. (B) One nanolayer has a measured size of roughly 3.5 nm [22].

Optimal 10-MDP ratio within resin adhesives and special technical manipulation

Shibuya et al. [9] noticed that self-adhesive resin cement containing 6.6 wt% of 10-MDP exhibits enhanced characteristics compared with formulations with 3.3 wt% or 9.9 wt% of 10-MDP. SBS test results demonstrate a concentration-dependent relationship with 10-MDP, where a minimum concentration of 1-ppb 10-MDP is required [18]. Conversely, Llerena et al. [26] found that different 10-MDP monomer concentrations on resin adhesives have little effect on zirconium bond strength.

Turp et al. [37] proposed that using the etch-and-rinse method increases success in the early clinical period for conventional and self-adhesive resin cement containing 10-MDP. In particular, success is increased in instances when adhesion primarily occurs in dentin tissues, such as with big inlay or onlay restorations and excessively prepared teeth for fixed dental prostheses. Meanwhile, Yoshihara et al. [38] noticed that rubbing the primer on the surface for 20 s improves nano-layering compared with enamel and dentin specimens dipped in the primer for 30 min.

Potential drawbacks

Popular 10-MDP-containing adhesives may reach the pulp through dentinal tubules, especially for deep-cavity restoration. Current studies on the cytotoxicity of these materials are limited owing to the difficulty in mimicking clinical conditions. Some studies suggest that minimally toxic concentrations of 10-MDP promote inflammation and suppress the odontoblastic differentiation of dental pulp cells [39].

Owing to the formation of specific phosphate deposits on the dentine surface after applying zinc-doped MDP solutions, zinc should be avoided in self-etching adhesives containing MDP. One can hypothesize that these specific deposits may have formed through ionic binding between MDP, Zn^{2+}, and Ca^{2+} [40].

The long storage of 10-MDP-containing adhesives should be avoided owing to MDP hydrolysis, which causes acidity of adhesive solutions. The chemical characteristics of MDP-containing adhesives may be altered over storage [41].

Future Perspectives and suggestions

As dental adhesives evolve, interest in exploring new formulations and modifications of 10-MDP primers is growing. The review outlines potential areas of innovation, including nanotechnology, bioactive additives, and alternative application techniques. Exploring these areas may further enhance the adhesive properties of 10-MDP-containing systems.

We further suggest that a comparison be made regarding the efficacy of 10-MDP-containing adhesives in bonding orthodontic attachments when saliva contamination occurs before primer application and before adhesive application and under contamination with blood in patients with gingivitis.

Conclusion

The emergence of 10-MDP primers has significantly advanced the field of dental adhesives by providing reliable bonding solutions to enamel and dentin. The chemical interaction between 10-MDP and tooth substrates demonstrates remarkable adhesive strength and longevity. The diverse range of applications and benefits of 10-MDP in dental adhesives highlights its pivotal role in modern dentistry. Although challenges remain, the continued exploration of 10-MDP-based adhesives holds promise for improving the quality and longevity of dental adhesives.

Conflict of interest

The authors have no conflicts of interest to declare.

Author contributions

HSA; have made a substantial contribution to the concept and design of the article. AAA; data collection, reviewing, and writing the original draft. HSA; oversight and leadership responsibility for the research activity planning, execution, and supervision. Both AAA and OFT made the writing - review & editing of the manuscript. All authors reviewed and approved the final version of the manuscript to be published.

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References

1. Cadenaro M, Josic U, Maravić T, Mazzitelli C, Marchesi G, Mancuso E, et al. Progress in dental adhesive materials. J Dent Res. 2023;102(3):254-62. https://doi.org/10.1177/00220345221145673

2. Carrilho E, Cardoso M, Marques Ferreira M, Marto CM, Paula A, Coelho AS. 10-MDP Based Dental Adhesives: Adhesive Interface Characterization and Adhesive Stability—A Systematic Review. Materials. 2019;12(5):790. https://doi.org/10.3390/ma12050790

3. Ihsan H, AlDabagh DJ. Comparison of Shear Bond Strength of Sapphire Bracket Bonded to Zirconium Surface after Using Different Surface Conditioning Methods (In Vitro Study). J Bagh Coll Dent. 2017;29(3):85-91. https://doi.org/10.12816/0041187

4. Yoshihara K, Nagaoka N, Okihara T, Kuroboshi M, Hayakawa S, Maruo Y, et al. Functional monomer impurity affects adhesive performance. Dent Mater. 2015;31(12):1493-501. https://doi.org/10.1016/j.dental.2015.09.019

5. Al-Taee L, Banerjee A, Deb S. In-vitro adhesive and interfacial analysis of a phosphorylated resin polyalkenoate cement bonded to dental hard tissues. J Dent. 2022;118:104050. https://doi.org/10.1016/j.jdent.2022.104050

6. Fehrenbach J, Isolan CP, Münchow EA. Is the presence of 10-MDP associated to higher bonding performance for self-etching adhesive systems? A meta-analysis of in vitro studies. Dent Mater. 2021;37(10):1463-85. https://doi.org/10.1016/j.dental.2021.08.014

7. Kim J, Chae S, Lee Y, Han G, Cho B. Effects of multipurpose, universal adhesives on resin bonding to zirconia ceramic. Oper Dent. 2015;40(1):55-62. https://doi.org/10.2341/13-303-L

8. Yoshihara K, Yoshida Y, Nagaoka N, Hayakawa S, Okihara T, De Munck J, et al. Adhesive interfacial interaction affected by different carbon-chain monomers. Dent Mater. 2013;29(8):888-97. https://doi.org/10.1016/j.dental.2013.05.006

9. Shibuya K, Ohara N, Ono S, Matsuzaki K, Yoshiyama M. Influence of 10-MDP concentration on the adhesion and physical properties of self-adhesive resin cements. Rest Dent Endo. 2019;44(4):0-. https://doi.org/10.5395/rde.2019.44.e45

10. Yoshida Y, Inoue S. Chemical analyses in dental adhesive technology. Japa Dent Sci Rev. 2012;48(2):141-52. https://doi.org/10.1016/j.jdsr.2012.03.001

11. Rangappa A, Srinivasulu J, Rangaswamy V, Eregowda S, Lakshminarasimhaiah V, Lingareddy U. Comparative evaluation of bond strength of self-adhering flowable composites to the dentin prepared with different burs: An in vitro study. J Cons Dent Endo. 2018;21(6):618. https://doi.org/10.4103%2FJCD.JCD_71_18

12. Yoshihara K, Nagaoka N, Yoshida Y, Van Meerbeek B, Hayakawa S. Atomic level observation and structural analysis of phosphoric-acid ester interaction at dentin. Acta Biomater. 2019;97:544-56. https://doi.org/10.1016/j.actbio.2019.08.029

13. Yoshihara K, Nagaoka N, Nakamura A, Hara T, Yoshida Y, Van Meerbeek B. Nano-Layering Adds Strength to the Adhesive Interface. J Dent Res. 2021;100(5):515-21. https://doi.org/10.1177/0022034520979133

14. Yoshihara K, Hayakawa S, Nagaoka N, Okihara T, Yoshida Y, Van Meerbeek B. Etching efficacy of self-etching functional monomers. J Dent Res. 2018;97(9):1010-6. https://doi.org/10.1177/0022034518763606

15. Yoshihara K, Yoshida Y, Nagaoka N, Hayakawa S, Okihara T, De Munck J, et al. Adhesive interfacial interaction affected by different carbon-chain monomers. Dent Mater. 2013;29(8):888-97. https://doi.org/10.1016/j.dental.2013.05.006

16. Breschi L, Maravic T, Cunha SR, Comba A, Cadenaro M, Tjäderhane L, et al. Dentin bonding systems: From dentin collagen structure to bond preservation and clinical applications. Dent Mater. 2018;34(1):78-96. https://doi.org/10.1016/j.dental.2017.11.005

17. Matsui N, Takagaki T, Sadr A, Ikeda M, Ichinose S, Nikaido T, et al. The role of MDP in a bonding resin of a two-step self-etching adhesive system. Dent Mater. 2015;34(2):227-33. https://doi.org/10.4012/dmj.2014-205

18. Nagaoka N, Yoshihara K, Feitosa VP, Tamada Y, Irie M, Yoshida Y, et al. Chemical interaction mechanism of 10-MDP with zirconia. Sci Rep. 2017;7(1):45563. https://doi.org/10.1038/srep45563

19. Wada T, Koizumi H, Hiraba H, Hanawa T, Matsumura H, Yoneyama T. Effect of luting system with acidic primers on the durability of bonds with Ti-15Mo-5Zr-3Al titanium alloy and its component metals. Dent Mater. 2023;42(3):418-25. https://doi.org/10.4012/dmj.2022-184

20. Moncada G, Fonseca RG, de Oliveira OB, Fernández E, Martín J, Vildósola P. Rol del 10-metacriloxidecilfosfato dihidrogenado en el cambio de paradigma de los sistemas adhesivos integrados en la dentina. Revista clínica de periodoncia, implantología y rehabilitación oral. 2014;7(3):194-9. https://doi.org/10.1016/j.piro.2014.09.008

21. Hiraishi N, Tochio N, Kigawa T, Otsuki M, Tagami J. Monomer-collagen interactions studied by saturation transfer difference NMR. J Dent Res. 2013;92(3):284-8. https://doi.org/10.1177/0022034512474310

22. Yoshida Y, Yoshihara K, Nagaoka N, Hayakawa S, Torii Y, Ogawa T, et al. Self-assembled nano-layering at the adhesive interface. J Dent Res. 2012;91(4):376-81. https://doi.org/10.1177/0022034512437375

23. Proença MA, Silva KT, Costa e Silva A, Carvalho EM, Bauer J, Carvalho CN. Shear Strength of Brackets Bonded with Universal Adhesive Containing 10-MDP after 20,000 Thermal Cycles. Inter J Dent. 2020;2020(1):4265601. https://doi.org/10.1155/2020/4265601

24. Beketova A, Tzanakakis E-GC, Vouvoudi E, Anastasiadis K, Rigos AE, Pandoleon P, et al. Zirconia Nanoparticles as Reinforcing Agents for Contemporary Dental Luting Cements: Physicochemical Properties and Shear Bond Strength to Monolithic Zirconia. Int J Mol Sci. 2023;24(3):2067. https://doi.org/10.3390/ijms24032067

25. Abduljawad A, Mohammed-Salih H, Jabir M, Almahdy A. The Effectiveness of a 10-Methacryloyloxydecyl Dihydrogen Phosphate (10-MDP)-Containing Hydrophilic Primer on Orthodontic Molar Tubes Bonded under Moisture Contamination: A Randomized Controlled Trial. Coatings. 2023;13(9):1635. https://doi.org/10.3390/coatings13091635

26. Llerena-Icochea AE, Costa RMd, Borges AFS, Bombonatti JFS, Furuse AY. Bonding polycrystalline zirconia with 10-MDP–containing adhesives. Oper Dent. 2017;42(3):335-41. https://doi.org/10.2341/16-156-l

27. Mauwafak S, Al-Dabagh DJ. Comparison of Shear Bond Strength of Three Different Brackets Bonded on Zirconium Surfaces (In Vitro Study). J Bagh Coll Dent. 2016;28(3):142-8. https://doi.org/10.12816/0031122

28. Ruwiaee RA, Alhuwaizi AF. Optimization of CAD/CAM Fabricated PEEK Orthodontic Fixed Lingual Retainer Adhesion to Enamel. J Bagh Coll Dent. 2021;28. https://doi.org/10.26477/jbcd.v34i2.3147

29. Magne P, Paranhos MP, Burnett Jr LH. New zirconia primer improves bond strength of resin-based cements. Dent Mater. 2010;26(4):345-52. https://doi.org/10.1016/j.dental.2009.12.005

30. Wongsamut W, Satrawaha S, Wayakanon K. Surface modification for bonding between amalgam and orthodontic brackets. J Ortho Sci. 2017;6(4):129. https://doi.org/10.4103/jos.jos_25_17

31. Shahdad SA, Kennedy JG. Bond strength of repaired anterior composite resins: an it>/it> study1Previously presented at a research meeting of the Faculty of Medicine, Queen's University of Belfast.1. J Dent. 1998;26(8):685-94. https://doi.org/10.1016/S0300-5712(97)00044-4

32. Yuan X, Wang Q, Han F, Chen C, Xie H. Chemical interaction between 10-methacryloyloxydecyl dihydrogen phosphate and methacryloxypropyltrimethoxysilane in one-bottle dental primer and its effect on dentine bonding. J Mech Beha Bio Mater. 2021;121:104610. https://doi.org/10.1016/j.jmbbm.2021.104610

33. Sharifian A, Esmaeili B, Gholinia H, Ezoji F. Microtensile Bond Strength of Different Bonding Agents to Superficial and Deep Dentin in Etch-and-Rinse and Self-Etch Modes. Front Dent. 2023;20. https://doi.org/10.18502/fid.v20i9.12608

34. Yoshida Y, Yoshihara K, Hayakawa S, Nagaoka N, Okihara T, Matsumoto T, et al. HEMA Inhibits Interfacial Nano-layering of the Functional Monomer MDP. J Dent Res. 2012;91(11):1060-5. https://doi.org/10.1177/0022034512460396

35. Valsan D, Bhaskaran S, Mathew J, Hari K, Joy J. Comparative Evaluation of the Bonding Efficacy of Multimode Adhesive, Two-Step Self-Etch Adhesive, and a Total-Etch System to Pulpal Floor Dentin–An In vitro Study. Cont Clin Dent. 2023;14(2):104. https://doi.org/10.4103/ccd.ccd_754_21

36. Yoshihara K, Yoshida Y, Hayakawa S, Nagaoka N, Torii Y, Osaka A, et al. Self-etch monomer-calcium salt deposition on dentin. J Dent Res. 2011;90(5):602-6. https://doi.org/10.1177/0022034510397197

37. Turp V, Sen D, Tuncelli B, Özcan M. Adhesion of 10-MDP containing resin cements to dentin with and without the etch-and-rinse technique. J Adv Prosthodont. 2013;5(3):226-33. https://doi.org/10.4047/jap.2013.5.3.226

38. Yoshihara K, Yoshida Y, Hayakawa S, Nagaoka N, Irie M, Ogawa T, et al. Nanolayering of phosphoric acid ester monomer on enamel and dentin. Acta Biomater. 2011;7(8):3187-95. https://doi.org/10.1016/j.actbio.2011.04.026

39. Kim EC, Park H, Lee SI, Kim SY. Effect of the acidic dental resin monomer 10-methacryloyloxydecyl dihydrogen phosphate on odontoblastic differentiation of human dental pulp cells. Basic Clin Pharm Toxi. 2015;117(5):340-9. https://doi.org/10.1111/bcpt.12404

40. Feitosa VP, Pomacóndor-Hernández C, Ogliari FA, Leal F, Correr AB, Sauro S. Chemical interaction of 10-MDP (methacryloyloxi-decyl-dihydrogen-phosphate) in zinc-doped self-etch adhesives. J Dent. 2014;42(3):359-65. https://doi.org/10.1016/j.jdent.2014.01.003

41. Teshima I. Degradation of 10-methacryloyloxydecyl dihydrogen phosphate. J Dent Res. 2010;89(11):1281-6. https://doi.org/10.1177/0022034510379018

مراجعة شاملة للاصقات السنية المحتوية على المركب MDP-10 في أنظمة اللاصقات السنية المعاصرة

احمد عبدالاله عبدالجواد، حراء صباح عبدالامير، عمر فاروق توفيق

المستخلص:
الخلفية: تعتبر أنظمة اللاصقات السنية أمرًا حيويًا في تحقيق تماسك دائم وموثوق بين المواد السنية وهياكل الأسنان. من بين مكونات اللاصق المتنوعة، اكتسب المونومر الوظيفي 10-ميثاكريلويلوكسيديسيل دايهيدروجين فوسفات (MDP-10) اهتمامًا كبيرًا بسبب خصائصه الكيميائية الفريدة وقدراته في تعزيز التماسك. الأهداف: تقوم هذه الورقة بمراجعة شاملة للمعرفة الحالية حول إعدادات MDP-10، مركزة على الكيمياء الخاصة بها، وتفاعلاتها مع أسطح الأسنان، وأدائها اللاصق، وتطبيقاتها السريرية. المصادر: مصادر عبر الإنترنت مثل Google Scholar وPubMed. اختيار الدراسة: دراسات تبحث في فعالية إعدادات MDP-10. الاستنتاجات: ظهور إعدادات MDP-10 قد قدم تقدمًا كبيرًا في مجال اللاصقات السنية من خلال توفير حلاً موثوقًا للتماسك بين المينا والعاج. أظهر التفاعل الكيميائي بين MDP-10 وأسطح الأسنان قوة لاصقة رائعة ومتانة..