Journal of Oral Medicine and Dental Research

Genesis-JOMDR-5(2)-69
Volume 5 | Issue 4
Open Access
ISSN: 2583-4061

Impact of Disinfection Protocols on Dentin Bond Strength: Chlorhexidine vs. Sodium Hypochlorite

Zakaria Awad[1*]

[1]DDS Faculty of Dentistry Damascus University, Postgraduate High Dip in Prosthodontics Faculty of Dentistry Damascus University, Syrian Board in Prosthodontics Damascus University, Saudi Arabia

[*]**Corresponding author:** Zakaria Awad, DDS Faculty of Dentistry Damascus University, Postgraduate High Dip in Prosthodontics Faculty of Dentistry Damascus University, Syrian Board in Prosthodontics Damascus University, Saudi Arabia

Citation: Awad Z. (2024) Impact of Disinfection Protocols on Dentin Bond Strength: Chlorhexidine vs. Sodium Hypochlorite. J Oral Med and Dent Res. 5(4):1-11.

Received: August 01, 2024 | **Published:** August 15, 2024

Abstract

Achieving a strong and durable bond between dental restorations and dentin is critical for successful clinical outcomes. Disinfection of the cavity before bonding procedures is a vital step that aims to eliminate bacteria and contaminants from the dentin surface. These bacteria can not only compromise the bond strength but also contribute to the development of postoperative complications such as pulpal inflammation and peri-apical abscesses. However, the choice of disinfectant can significantly influence bonding by affecting the dentin surface. This review investigates the impact of commonly used disinfictants - Chlorhexidine (CHX) and Sodium Hypochlorite (NaOCl) on dentin bonding, incorporating recent research findings.

Review article: *Awad Z. J Oral Med Dent Res. 2024, 5(4)-69*
DOI: *https://doi.org/10.52793/JOMDR.2024.5(4)-69*

CHX demonstrates potential for improved long-term bond strength by inhibiting enzymes that degrade the adhesive interface. However, optimal application protocols (concentration, time) and interaction with diverse adhesives require further exploration. Conversely, NaOCl exhibits a detrimental effect on bond strength, likely due to interference with resin adhesive polymerization. Future research should focus on optimizing CHX application for maximizing bond strength, evaluating combined disinfection strategies, and conducting clinical trials to confirm laboratory findings on the long-term effectiveness of CHX in dental restorations. This review sheds light on the complexities of dentin disinfection By Sodium Hypochlorite while highlighting CHX's potential as a promising agent for enhancing the longevity of dental bonding procedures.

Keywords

Dentin bond strength; Durability; Disinfection; Chlorhexidine; Sodium Hypochlorite; Dental restorations; Adhesive dentistry; Cavity disinfection; Microtensile bond strength; Matrix metalloproteinases (MMPs)

Introduction

Achieving a strong and long-lasting bond between dental restorations and dentin, the underlying hard tissue beneath enamel, is paramount in restorative dentistry. This crucial interface ensures the success of various procedures like fillings, crowns, and bridges, allowing them to withstand daily wear and tear, prevent bacterial infiltration, and ultimately contribute to a healthy and functional dentition [1]. Longitudinal studies have demonstrated a progressive decrease in the bond strength between adhesive systems and dentin. This weakening is attributed to the degradation of the hybrid layer, the critical interface formed by the interaction of the dentin collagen matrix and the resin adhesive [2]

Establishing a successful bond involves a meticulous sequence of steps, with disinfection playing a vital role. Disinfection after acid etching, a process that roughens the dentin surface for better adhesion, is essential to eliminate bacterial contamination and prevent future problems like secondary caries1. However, achieving optimal disinfection presents a challenge, as some disinfectants might compromise the bond strength between the restoration and the tooth structure [2].

The search for optimal cavity disinfectants has intensified in recent years, with numerous products proposed. However, the impact of most disinfectants on adhesion to dentin remains unclear. Unlike adhesion to enamel, dentin presents a unique challenge due to its inherent moisture and structural heterogeneity. Consequently, a thorough evaluation of the effects of disinfectants on dentin bond strength is crucial [3].

Current research findings on the impact of commonly used disinfectants on dentin bonding present a complex picture. While Chlorhexidine (CHX) has emerged as a promising candidate due to its antimicrobial properties and potential for improved long-term bond strength [1,2, 4-6]. studies have shown conflicting Results regarding its effects on initial bond strength [7]. On the other hand, Sodium Hypochlorite (NaOCl), commonly known as disinfectant, generally exhibits a detrimental effect on bond strength [8].

This narrative review aims to address these knowledge gaps by analyzing recent research published between 2011 and 2023 on the impact of CHX and NaOCl on dentin bonding. Specifically, we aim to:

1. Evaluate the effects of CHX, NaOCl application protocols on both initial and long-term dentin bond strength.
2. 2.Investigate the interaction between CHX and various adhesive systems used in dentin bonding.

By analyzing these factors, this review seeks to provide a clearer understanding of how CHX and NaOCl influence the delicate dance between disinfection and bonding strength and durability, This knowledge will ultimately translate into improved clinical decision-making and enhanced outcomes in restorative dentistry.

Methods

A literature search was conducted to identify relevant studies on the effects of apply Chlorhexidine (CHX) and Sodium Hypochlorite (NaOCl) after etching on dentin bonding. The search was performed using the following databases:

1. Google Scholar
2. PubMed

Inclusion Criteria

1. Studies investigating the effect of CHX or NaOCl on dentin bond strength were included.
2. Articles published in English were included.
3. Studies between 2011 and tp to date were included.

Exclusion Criteria

1. Studies not directly related to the effect of CHX or NaOCl on dentin bond strength were excluded.
2. Studies published in languages other than English were excluded.
3. Studies before 2011 were excluded.

Selection Process

The search results were screened based on titles and abstracts. Studies that met the inclusion criteria were retrieved and reviewed in full.

Data Synthesis

The extracted data were synthesized to provide a comprehensive overview of the current research on the effects of CHX and NaOCl on dentin bonding. The review highlights both the potential benefits and drawbacks of using CHX and discourages the use of NaOCl for disinfection before bonding. The need for further research to optimize CHX application and to definitively determine its long-term effectiveness is emphasized.

Results

1-Chlorhexidine (CHX)

CHX is a broad-spectrum antimicrobial agent with cationic properties, and its antibacterial performance is comparable to that of sodium hypochlorite1.

Recent Studies on CHX

Potential benefits:

Increased bond durability by inhibiting MMP enzymes and increased microtensile bond strength of restoration

Kiuru O, et al. This systematic review and meta-analysis investigate the impact of MMP inhibitors on dentin bond strength. MP (matrix metalloproteinase) inhibitors are enzymes that might influence the bonding process between dental restorations and dentin by breaking down the adhesive interface over time. There are some inhibitory factors which prevent the activity of MMPs2; for instance, chlorhexidine (CHX) digluconate has been known to be an inhibitor of MMPs .This systematic review and meta-analysis demonstrated that studies strongly indicate the benefits of collagen-degrading enzyme inhibition on the preservation of dentin bond strength. Since CHX does not have any adverse effects on the immediate bond strength, the clinical use of CHX can be recommended to increase the longevity of resin-dentin bonds [2]. further research to determine the definitive role of MMP inhibitors like CHX in enhancing dentin bonding for restorative dentistry procedures are required [1].

Loguercio, et al. Investigated minocycline, another MMP inhibitor, supporting the concept that inhibiting MMP activity can enhance bond durability, potentially explaining the observed benefits of CHX in some studies [4].

Stanislawczuk, et al. A 2-year in vitro evaluation investigated the impact of adding CHX to phosphoric acid or using a CHX solution on the durability of the resin-dentin interface. The researchers found that using CHX resulted in a more stable bond after two years, with less degradation and leakage compared to the control group, suggesting CHX might be beneficial for dental adhesives [5].

Boutsiouki, et al. This study investigated the impact of incorporating chlorhexidine (CHX) into dental adhesives on the bond strength between composite restorations and dentin. They also assessed the bond strength after simulating wear and tear in the mouth. Study founded regarding Baseline Bond Strength Compared to a control group without CHX, adhesives with CHX admixed (added) by the researchers or containing CHX by the manufacturer all had a weaker initial bond strength to dentin. But regarding bond Strength After Simulated Wear the bond strength of the control group significantly decreased. In contrast, Groups using CHX adhesives maintained their bond strength. After simulated wear, CHX adhesives (except for the one admixed into the bonding agent) showed fewer adhesive fractures compared to the control group. This suggests a potential benefit for preventing secondary caries (new decay) around the restoration. Study concluded that adding CHX to the primer seems to offer an advantage as it protects the bond strength from weakening after simulated wear. This might be helpful clinically in preventing Secondary caries. However, using a separate 2% CHX pre-treatment before applying the adhesive resulted in a stronger initial bond compared to all CHX-containing adhesives. This suggests a potentially safer approach to avoid compromising the initial bond due to interactions between CHX and the adhesives. Overall, the study suggests that incorporating CHX into dental adhesives might be beneficial for long-term bond strength and caries prevention, but a separate CHX pre-treatment might be safer for initial bonding [6].

Shadman, et al. This article investigated the effect of CHX on the immediate shear bond strength of a universal adhesive system. The aim of this study was to evaluate the effect of chlorhexidine on 6-month water storage bond strength of adhesive systems. They found CHX usage did not have a significant effect on the immediate shear bond strength. This study investigated the impact of chlorhexidine (CHX) on the long-term bond strength of two dental adhesive systems (Scotchbond Universal and Scotchbond Multi-Purpose) used with dentin. Study founded that that the "etch-and-rinse" version of Scotchbond Universal (SBU) had significantly better long-term bond strength compared to the "self-etch" version after 6 months of simulated storage and using CHX before bonding did not affect the initial bond strength of either adhesive system. However, it prevented a decrease in bond strength over the 6-month storage period for both adhesives [9].

Hajizadeh, et al. Based on this in-vitro study, using a 2% CHX solution as a dentin disinfectant before placing resin composite fillings may be a more suitable option than using 5.25% sodium hypochlorite because [1]:

1. CHX did not significantly reduce the microtensile bond strength (μTBS) between the dentin and composite resin compared to the control group after both 24 hours and 6 months.
2. Sodium hypochlorite significantly reduced μTBS after 6 months compared to the control group.
3. While not statistically significant, the group treated with both CHX and sodium hypochlorite showed a slight increase in μTBS after 6 months compared to 24 hours, whereas all other groups showed a decrease.

Sampaio de-Melo, et al. Within the limitations of this in vitro study, they found that the application of a self-etch adhesive system on CHX-treated sound dentin or artificially caries-affected dentin did not change the bond strengths, although additional dentin demineralization may increase the bond strength of a mildly acidic (pH ≥ 2) self-etch adhesive system to sound dentin [10].

Tasneem Hamdan-Nassar, et al. This conducted a meta-analysis to evaluate the effect of using 2% chlorhexidine (CHX) after acid etching on the microtensile bond strength of resin restorations. Their analysis of multiple studies revealed that applying 2% CHX following acid etching significantly increased The microtensile bond strength of resin restorations, particularly for restorations evaluated after 6 months or longer. The type of adhesive system used apparently did not significantly influence the positive effect of CHX on bond strength. However The results of the present study were based on in-vitro studies and they would not necessarily apply to in vivo conditions [11].

Dalkilic, et al. This study investigated the impact of various disinfection methods on the initial bond strength between a self-etch adhesive and dentin. This study suggests that while ozone may negatively affect the bond strength of a self-etch adhesive, Ndoye laser and 2% chlorhexidine appear suitable for disinfecting dentin before applying the adhesive [12].

Potential Drawbacks

Reduced initial bond strength

Some studies based on systemic review like **Jamal, et al.** suggest that using 2% CHX had no significant positive effect on bond strength either immediately or over the longer term and Pretreatments with 2% CHX for either 30 or 60 seconds do not improve the bond strength5. This inconsistency highlights the need

for further investigation into factors like optimal CHX concentration, application time, and interaction with different adhesives [7].

Dionysopoulos. This review analyzed the effects of CHX on bond strength between dental adhesives and dentin. The studies included showed varying results, with some reporting decreased bond strength with CHX and others finding no significant difference. This highlights the need for further research to definitively determine the impact of CHX, which might depend on factors like the specific adhesive system used and CHX application duration [13].

Furtado, et al. Investigated the effect of applying 2% chlorhexidine (CHX) on dentin before using self-etch adhesives. They evaluated the microtensile bond strength of the adhesives to the dentin.Their findings indicated that pre-treatment with CHX might decrease the microtensile bond strength of self-etch adhesives, particularly when applied using the self-etching technique (without separate acid etching).The study suggests that CHX use might require further investigation regarding its interaction with self-etch adhesives and the optimal bonding technique for achieving strong adhesion [14].

2-Sodium Hypochlorite (NaOCl)

Consensus: Avoid NaOCl for disinfection before bonding due to its detrimental effect on bond strength.

Negative effects: Studies like **Hajizadeh, et al.** Report a significant decrease in bond strength when a NaOCl solution was used compared to other disinfectants (CHX and control group). This negative impact is likely Because 10% NaOCl removes collagen fibrils, the bonding is formed in absence of collagen fibrils and only by the contact between adhesive monomer and dentil [15]. or due to the oxidizing action of NaOCl, potentially interfering with proper resin adhesive polymerization [16].

Di Francescantonio, et al. Investigated the effect of sodium hypochlorite (NaOCl) on the bond strength of different adhesive systems to dentin and the formation of an acid-resistant zone. They likely evaluated The force required to break the bond between the adhesive and dentin, along with examining the development of a specific dentin layer resistant to acidic challenges. The research focused on both bond strength and the formation of an acid-resistant zone at the dentin-adhesive interface. Their findings might indicate that NaOCl application can affect the bond strength of some adhesives and potentially influence the formation of the acid-resistant zone depending on the adhesive system used [15].

Yuan, et al. Investigated the effect of applying sodium hypochlorite (NaOCl) on the bonding performance of universal adhesives to dentin within the pulp chamber. They evaluated the microtensile bond strength between the adhesive and the dentin. Their findings show that NaOCl treatment of the dentin reduces the microtensile bond strength of universal adhesives compared to untreated dentin. The impact of NaOCl might differ depending on the type of universal adhesive used [16].

Abou Neel et al. This systematic review analyzed studies on the effect of NaOCl on adhesive characteristics of dentin. Findings from low or high-risk bias studies revealed no effect of NaOCl on bond strength, While that from medium risk studies showed a reduction in bond strength of dentin [17].

Esmaeel, et al. Investigated the effect of sodium hypochlorite (NaOCl) on the shear bond strength of two different generations of dental adhesives to coronal dentin. They evaluated the force required to break

the bond between the adhesive and the dentin. Their research focused on fifth- and seventh-generation adhesives. The findings indicate that NaOCl application reduces the shear bond strength of both generations of adhesives to coronal dentin [18].

Discussion

This review aims to evaluate the effects of Chlorhexidine (CHX) and Sodium Hypochlorite (NaOCl) on dentin bond strength in dental restorative procedures. All included studies utilized in vitro methodologies to assess the impact of these disinfectants on bond strength outcomes.

Chlorhexidine (CHX)

The findings regarding CHX application for dentin disinfection before bonding procedures demonstrated some complexity:

Potential Long-Term Benefit: Several studies suggested a potential benefit of CHX for long-term bond strength [1-12]. This might be attributed to CHX's ability to inhibit matrix metalloproteinases (MMPs), which are enzymes that can degrade the adhesive interface over time [1-2].

Inconsistent Effects on Initial Bond Strength: However, some studies observed a decrease in initial bond strength with CHX compared to control [7, 13-14].

This inconsistency highlights the need for further investigation into factors influencing CHX effectiveness, such as:

- Concentration
- Application time
- Compatibility with different adhesive systems

Factors Influencing CHX Effectiveness

- Concentration (as seen in differing results between (2 and 0.2 % CHX)2 and (adding CHX to phosphoric acid) and according to meta-regression analysis for the association between the concentration of chlorhexidine and the bond strength is apparently not linear. Therefore, future large-scale studies should be developed to investigate the association between the chlorhexidine concentration and hybrid layer preservation [5, 19].
- Application time as seen in many studies and systemic review and studies methods mentioned above like systemic review and study for soares et al20 (2008) which Researchers applied 0.12% or 2% CHX solutions for 15 seconds at different points during the procedure (before, during, and after acid etching).according to this study There were no significant differences in microtensile bond strength (μTBS) between any of the CHX treatment groups and the control group (no CHX).and regarding CHX Concentration and Timing The study suggests that neither the concentration (0.12% or 2%) nor the timing of CHX application of CHX for 15 seconds (before, during, or after etching) significantly affected the bond strength [7, 20].
- Adhesive system used (universal adhesive) (total etch adhesive), (self etch adhesive) and Dionysopoulos' review. Type of bonds as some studies like showed that The group treated with 2% chlorhexidine before applying universal bond I exhibited the lowest bond strength value. In conclusion, the study suggests that additional CHX or ethanol application might not directly affect

the bond strength of universal adhesives when using a single-step self-etch mode. However, the authors recommend that clinicians refrain from using 2% CHX or higher concentrations with universal adhesive systems containing CHX [9, 10 ,13, 21].

- In the context of luting cementation, the study showed that Incorporating 1% CHX into the self-etching primer offered antibacterial benefits without compromising bond strength to dentin before luting cementation. However, a higher concentration (2%) weakened the bond [22].

A comprehensive review of existing research, including underscores the need for further exploration in cavity disinfectants. While chlorhexidine (CHX) remains a popular choice due to its positive impact on adhesion and antibacterial properties, further studies are crucial to optimize disinfection protocols.These investigations should delve into the efficacy of alternative disinfectants against cariogenic bacteria, optimal application times and concentrations, compatibility with various dental materials, and the ideal timing relative to acid etching [23].

Sodium Hypochlorite (NaOCl)

In contrast to CHX, the studies consistently demonstrated a negative impact of NaOCl on dentin bond strength:

Reduced Bond Strength: Compared to CHX or control groups, studies reported significantly lower microtensile bond strength values in NaOCl groups15,18. This suggests a detrimental effect of NaOCl on the bonding interface, likely due to its oxidizing action that can disrupt resin adhesive polymerization16.
Comparison with Existing Literature:

Our findings regarding CHX's potential long-term benefit align with previous research suggesting its positive effects on bond durability. However, the observed decrease in initial bond strength with CHX in Some studies necessitates further investigation, as highlighted elsewhere. The detrimental effect of NaOCl on bond strength strongly supports the growing consensus against its use.

Feature	Chx	Naocl
Long-Term Bond Strength	Potential benefit (inhibits MMPs)	Not recommended
Initial Bond Strength	Inconsistent effects (needs optimization)	Not recommended
Mechanism of Action	May inhibit MMP activity	Disrupts resin adhesive polymerization
Study Findings	Varied (some positive, some negative on initial strength)	Consistently negative impact
Overall Recommendation	Further research needed to optimize protocol	Avoid for dentin disinfection

Table 1: summary of the studies and research included in the review.

Potential Mechanisms

The potential benefit of CHX for long-term bond strength might be attributed to its ability to inhibit MMPs, as demonstrated by some studies [1, 2].

Limitations: This review has limitations. The included studies varied in quality, and some lacked crucial details on CHX application protocols. Additionally, the review focused on in vitro studies, and clinical trials are needed to confirm these findings on in vivo setting.

Conclusion

This review suggests that CHX might be a promising option for dentin disinfection before bonding procedures due to its potential for improved long-term bond strength. Based on current research, applying a 2% chlorhexidine (CHX) solution for 60 seconds after etching and before the adhesive application in total-etch adhesive systems might offer improved outcomes for composite restorations. However, further research is needed to optimize CHX application protocols (concentration, time) to avoid compromising initial bond strength. In contrast, the review highlights the detrimental effects of NaOCl on bond strength and supports the growing consensus against its use for dentin disinfection before bonding procedures.

References

1. Hajizadeh H, Bojarpour M, Boruziniat A, Namdar SF. (2020) The effect of chlorhexidine application on the microtensile bond strength and durability of a total-etch adhesive. European Journal of General Dentistry. 9(1):17-22.
2. Kiuru O, Sinervo J, Vähänikkilä H, Anttonen V, Tjäderhane L. (2021) MMP Inhibitors and Dentin Bonding: Systematic Review and Meta-Analysis. International Journal of Dentistry. 9(1):17.
3. Coelho A, Vilhena L, Antunes M, Amaro I, Paula A, et al. (2022) Effect of Different Cavity Disinfectants on Adhesion to Dentin of Permanent Teeth. J Funct Biomater. 13(4):209.
4. Loguercio AD, STANISLAWCZUK Sr R, Malaquias P, Gutiérrez MF, Reyes A, et al. (2016) Effect of Minocycline on the Durability of Dentin Bonding Produced with Etch-and-Rinse Adhesives. Operative Dentistry. 41(5):511-19.
5. Stanislawczuk R, Reis A. (2011) Loguercio AD. A 2-year in vitro evaluation of a chlorhexidine-containing acid on the durability of resin-dentin interfaces. J Dent. 39(1):40-7.
6. Boutsiouki C, Frankenberger R, Lücker S, Krämer N. (2023) Effect of Chlorhexidine-containing Etch-and-Rinse Adhesives on Dentin Microtensile Bond Strength after Biological Loading. J Adhes Dent. 25(1):13-22.
7. Jamal H, Yaghmoor R, Abed H, Young A, Ashley P. (2023) Impact of Dentine Pretreatment with Matrix Metalloproteinase Inhibitors on Bond Strength of Coronal Composite Restorations: A Systematic Review and Meta-analysis of In Vitro Studies. Eur J Dent. 17(4):974-99.
8. Uceda-Gómez N, Reis A, Carrilho M, Loguercio AD. (2003) Effect of sodium hypochlorite on the bond strength of adhesive systems to superficial and deep dentin. J Appl Oral Sci. 11(3):223-8.
9. Shadman N, Farzin-Ebrahimi S, Mortazavi-Lahijani E, Jalali Z. (2018) Effect of chlorhexidine on the durability of a new universal adhesive system. J Clin Exp Dent. 10(9):e921-e926.
10. Sampaio de-Melo MA, Goes DC, Rodrigues de-Moraes MD, Santiago SL, Rodrigues LA. (2013) Effect of chlorhexidine on the bond strength of a self-etch adhesive system to sound and demineralized dentin. Oper Dent Braz Oral Res. 27(3):222-8.
11. Hamdan-Nassar T, Bellot-Arcís C, Paredes-Gallardo V, García-Sanz V, Pascual-Moscardó A, et al. (2019) Effect of 2% Chlorhexidine Following Acid Etching on Microtensile Bond Strength of Resin Restorations: A Meta-Analysis. Medicina. 55(12):769.
12. Dalkilic EE, Arisu HD, Kivanc BH, Uctasli MB, Omurlu H. (2012) Effect of different disinfectant methods on the initial microtensile bond strength of a self-etch adhesive to dentin. Lasers Med Sci. 27(4):819-25.

13. Dionysopoulos D. (2016) Effect of digluconate chlorhexidine on bond strength between dental adhesive systems and dentin: A systematic review. J Conserv Dent. 19(1):11-6.
14. Furtado CODA, Baroudi K, Amaral M, Amorim TN, Devito KL, et al. (2024) Microtensile Bond Strength of Self-Etch Adhesives on Dentin Treated with Chlorhexidine. Eur J Prosthodont Restor Dent. 32(1):133-41.
15. Di Francescantonio M, Nurrohman H, Takagaki T, Nikaido T. (2015) Sodium hypochlorite effects on dentin bond strength and acid-base resistant zone formation by adhesive systems. Braz J Oral Sci. 14(4):334-40.
16. Yuan Y, Intajak P, Islam R, Ting S, Matsumoto M, et al. (2023) Effect of sodium hypochlorite on bonding performance of universal adhesives to pulp chamber dentin. J Dent Sci. 18(3):1116-24.
17. Abou Neel EA, Knowles JC, Bozec L. (2019) Effect of sodium hypochlorite on adhesive characteristics of dentin: A systematic review of laboratory-based testing. International Journal of Adhesion and Adhesives. 95(3):10241
18. Ebrahimi Chaharom ME, Kahnamoii MA, Kimyai S, Moghaddam MRH. (2011) Effect of sodium hypochlorite on the shear bond strength of fifth- and seventh-generation adhesives to coronal dentin. Afric J Bio. 10(59):12697-701.
19. Collares FM, Rodrigues SB, Leitune VC, Celeste RK, Borba de Araújo F, et al. (2013) Chlorhexidine application in adhesive procedures: a meta-regression analysis. J Adhes Dent. 15(1):11-8.
20. Soares CJ, Pereira CA, Pereira JC, Santana FR, do Prado CJ. (2008) Effect of chlorhexidine application on microtensile bond strength to dentin. Oper Dent. 33(2):183-8.
21. Kaynar ZB, Kazak M, Donmez N, Dalkilic EE. (2021) The effect of additional chlorhexidine and/or ethanol on the bond strength of universal adhesives. J Adhesion Sci Tec. 35(4):375-85.
22. Hiraishi N, Yiu CK, King NM, Tay FR. (2010) Effect of chlorhexidine incorporation into a self-etching primer on dentine bond strength of a luting cement. J Dent. 38(6):496-502.
23. Coelho A, Amaro I, Rascão B, Marcelino I, Paula A, et al. (2021) Effect of Cavity Disinfectants on Dentin Bond Strength and Clinical Success of Composite Restorations—A Systematic Review of In Vitro, In Situ and Clinical Studies. Int J Molecular Sci. 22(1):353.