Original Article

DOI: 10.7860/JCDR/2026/88057.23640

Dentistry Section

The Effect of Contamination in Different Stages of Composite Resin Restoration Adhesion and Decontamination Methods on Leakage, Bond Strength and Marginal Adaptation: A Scoping Review

GHAIDA RAJA ALTHEBETI

ABSTRACT

Introduction: Composite resin restorations require isolation and precise adhesive procedures to achieve durable bonding. Contamination may affect the bond strength and marginal integrity. However, effective decontamination protocols under different contamination conditions remains unclear.

Aim: To explore the effect of contamination at different stages of adhesion, and decontamination on the bond strength, leakage, and marginal adaptation of direct composite resin restorations.

Materials and Methods: A literature search was conducted in two databases (PubMed and Scopus) to include studies published between January 1, 2015, and December 31, 2025. The search was conducted at Umm Al-Qura University, Saudi Arabia, to identify relevant studies. Original English-language studies investigating the effect of contamination with saliva, blood, or haemostatic agent on direct composite resin restorations bonded to enamel, dentin, or between composite layers, with reported outcomes of bond strength, marginal/internal adaptation, or microleakage, were included.

Results: A total of 1,041 articles were initially identified, and 36 studies were finally included. Saliva, blood, or haemostatic agents adversely affected the bonding performance of direct composite resin restorations. Evidence regarding microleakage and marginal adaptation was limited. Decontamination strategies demonstrated variable effectiveness in restoring bond strength, depending on the type of contaminant.

Conclusion: The stage at which contamination occurs and the adhesive system may affect the bond strength of composite resin restorations. Blood contamination showed a more negative effect on bond strength when it occurred after adhesive curing, whereas the effect of saliva at different adhesive stages remains variable. Decontamination of saliva through water rinsing, followed by air drying and reapplication of adhesive, demonstrated favorable outcomes with Self-Etch (SE) adhesives.

Keywords: Blood, Dental bonding, Haemostatic, Saliva

INTRODUCTION

Composite resin materials are the most popular and frequently selected material by dental practitioners for direct tooth restorations across a broad range of countries. The placement of a durable composite restoration is considered a clinical challenge by many dentists and is reported to be a complex, multi-step procedure where maintaining a dry cavity during composite bonding is regarded critical for success and durability [1]. Total isolation during direct adhesive composite resin placement, therefore, is a key factor in increasing bond strength, as supported by existing evidence [2]. Salivary contamination during adhesive procedures has been shown to significantly reduce the bond strength of SE Adhesive Systems [3]. In addition, saliva contamination has been shown to impair marginal and internal adaptation, particularly when contamination occurs after adhesive placement, resulting in significant deterioration of marginal and internal adaptation of the composite restoration in dentin [4]. Saliva may further compromise composite restorations. As it has been shown to increase microleakage in composite restorations when contamination occurred within the first 10 seconds of light curing [5]. Blood contamination may also adversely affect bond strength. Studies demonstrate that contamination with blood significantly reduced the bond strength of universal adhesive systems when applied in both Etch-and-Rinse (ER) and SE strategies [6].

The stage at which contamination occurred is another important factor influencing bond strength. Saliva contamination has been shown to affect bond strength differently according to the step at which the contamination occurred [7]. Similarly, the use of ferric sulfate haemostatic agents has been reported to compromise the Shear Bond Strength (SBS) of universal adhesives bonded to dentin. Therefore, thorough removal of haemostatic agents prior to dentin bonding is critical to maintaining durable adhesion [8].

To re-establish bond strength following contamination, a decontamination step is recommended [3]. Various decontamination methods have been investigated, including ethanol application, acid etching, and water rinsing. However, the current literature remains inconclusive regarding the effective decontamination protocols for specific contaminants and at different stages of the adhesive procedure.

Therefore, this review aimed to explore the effects of contamination with saliva, blood, and haemostatic agents at different stages of composite resin restoration adhesion and the effect of decontamination methods on the bond strength, leakage, and marginal adaptation of direct adhesive composite resin restorations.

MATERIALS AND METHODS

Search strategy: A literature search was conducted in two databases (PubMed and Scopus) to include articles published between January 1, 2015, and December 31, 2025. The final search of both databases was conducted on January 12, 2026. No additional databases or other sources were searched. The reference lists of the included articles were not manually screened for additional studies. All retrieved records were screened by a single reviewer based on titles and abstracts, followed by full-text assessment for eligibility according to a predefined inclusion and exclusion criteria. No automation tools were used during the screening process. This scoping review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) framework; however, this review was not prospectively registered. No protocol was submitted to a public registry prior to conducting the review.

Inclusion criteria:

1. Original research articles;
2. Published in English;
3. Published from 2015 to 2025;
4. Articles evaluating contamination effect with these contaminants: Saliva, Blood, or Haemostatic agents, with or without the application of a decontamination protocol;
5. Articles involving a decontamination protocol being used, all reported decontamination approaches were considered;
6. Outcomes assessed: bond strength, marginal and internal adaptation, and microleakage;
7. Articles involving direct composite resin restorations;
8. Articles involving adhesion to enamel, dentine, and between composite layers.

Exclusion criteria:

1. Articles that are not original research;
2. Articles that are not in English;
3. Articles that do not involve contamination or decontamination processes;
4. Articles that evaluate materials other than direct composite restorations;
5. Articles that assess features other than bond strength, microleakage, or marginal and internal adaptation;
6. Articles on orthodontic appliances;
7. Articles on fissure sealants.

Study Procedure

Data extraction was performed by the same reviewer using a pre-determined extraction form developed prior to this review. The extracted information included the publication year, authors, study title, aim, type of contaminant, substrate (dentin, enamel, between composite layers), sample type and size, the measured outcome or feature, the decontamination protocol applied, and the main results reported in the included studies. Study investigators were not contacted to obtain or confirm additional data. The full search strategy in PubMed and Scopus is shown in [Table/Fig-1].

RESULTS

A total of 1,041 records were identified; after title screening, 972 were excluded. Of 69 records assessed by abstract, 33 were excluded. Of 39 reports sought for retrieval, 3 were not retrieved. A total of 36 studies were included. The screening process followed the the PRISMA 2020 flow diagram and is shown in [Table/Fig-2]. A total of 36 articles were included in the review [3,6-40]. The included articles are summarised in [Table/Fig-3-5] [3-40].

The Effect of Contamination

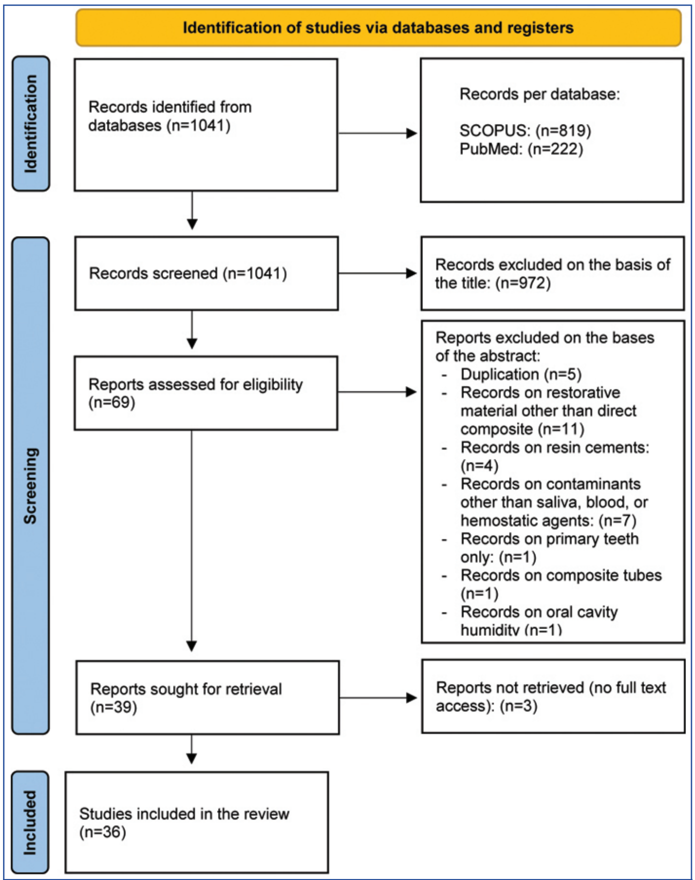
Among the reviewed articles, 29 evaluated the effect of contamination on bond strength of tooth structure [3,6-9,14-29,31,32,35-40], two of them evaluated the effect of contamination on both bond strength and leakage [11,12], one article was on microleakage alone [10], one assessed its impact on marginal adaptation [13], and three articles evaluated the effect of contamination on the bond strength between composite layers and demonstrated that saliva and blood contamination significantly reduced it [30,33,34].

The effect of saliva contamination on bond strength was investigated in 21 articles [3,6,7,9,12-19,29-33,37-40] with 20 reporting a reduction in bond strength following saliva contamination [3,6,7,9,12,13,15-19,29-33,37-40], while one found no significant difference [14]. One article evaluated the effect of severe saliva contamination on leakage and reported that it increased microleakage [12]. No studies evaluated the effect of saliva contamination on marginal adaptation.

Eleven articles evaluated the effect of saliva and/or blood contamination at different adhesive stages [7,15-19,27,31,35,36,39] six of them reported that the stage at which contamination occurred

Database	PubMed	Scopus
#1	"Decontamination/methods"(Mesh) OR "Saliva"(Mesh) OR "Blood"(Mesh) OR "Haemostatics"(Mesh) OR "Vasoconstrictor Agents"(Mesh) OR "ferric sulfate" OR "ferric chloride" OR "aluminum chloride" OR "haemostatic agent" OR contamin*(Title/Abstract) OR decontamin*(Title/Abstract) OR blood*(Title/Abstract) OR saliva*(Title/Abstract) OR haemostat*(Title/Abstract)	contamin* OR decontamin* OR blood* OR saliva* OR haemostat* OR vasoconstrict* OR "ferric sulfate" OR "ferric chloride" OR "aluminum chloride" OR "haemostatic agent*"
#2	"Composite Resins"(Mesh) OR "Dental Restoration, Permanent"(Mesh) OR "Dental Enamel"(Mesh) OR "Dentin"(Mesh) OR composite*(Title/Abstract) OR resin*(Title/Abstract) OR dentin*(Title/Abstract) OR enamel*(Title/Abstract)	"composite resin*" OR "restor*" OR composite* OR resin* OR dentin* OR enamel*
#3	"Dentin-Bonding Agents"(Mesh) OR "Adhesives"(Mesh) OR "Dental Cements"(Mesh) OR adhesives*(Title/Abstract) OR bond*(Title/Abstract) OR "dental bonding"(Title/Abstract) OR "bonding efficacy" OR "bond strength"(Title/Abstract) OR "bonding performance" OR "bonding effectiveness" OR "bond performance" OR "adhesive properties" OR "microtensile strength"(Title/Abstract) OR "micro-tensile strength" OR "microtensile bond strength"(Title/Abstract) OR "shear bond strength" OR "micro shear bond strength"(Title/Abstract) OR "dentin bonding agents"(Title/Abstract) OR "Dental Marginal Adaptation"(Mesh) OR "Dental Leakage"(Mesh) OR "microleakage"(Title/Abstract) OR "marginal adaptation"(Title/Abstract) OR "marginal seal"(Title/Abstract) OR "marginal integrity"(Title/Abstract) OR "gap formation"(Title/Abstract) OR "internal adaptation"(Title/Abstract) OR "internal"(Title/Abstract) OR leakage*(Title/Abstract) OR fitting*(Title/Abstract) OR margin*(Title/Abstract) OR gaps*(Title/Abstract) OR adapt*(Title/Abstract)	"dentin-bonding agent*" OR adhesive* OR bond* OR "dental bond*" OR "bond efficacy*" OR "bond strength*" OR "bond perform*" OR "bond effect*" OR "adhesive properties*" OR "microtensile strength*" OR "micro-tensile strength*" OR "microtensile bond strength*" OR "shear bond strength*" OR "micro shear bond strength*" OR margin* OR gap* OR adapt* OR internal* OR "marginal adapt*" OR "dental leakage*" OR "microleakage" OR "marginal seal*" OR "marginal integrity*" OR "gap form*" OR "internal adapt*" OR leakage* OR fit*
	#1 AND #2 AND #3	#1 AND #2 AND #3
Filters applied	Adaptive Clinical Trial, Classical Article, Clinical Study, Clinical Trial, Comparative Study, Consensus Development Conference, Controlled Clinical Trial, Corrected and Republished Article, Equivalence Trial, Evaluation Study, Government Publication, Observational Study, Pragmatic Clinical Trial, Randomised Controlled Trial, Randomised Controlled Trial, Veterinary, English	Limited to Dentistry Limited to Article Limited to English Limited to Journal Publication stage Limited to Final
Publication year	From 2015 to 2025	From 2015 to 2025

[Table/Fig-1]: Full search strategy in the databases.



[Table/Fig-2]: Flowchart of the selection process following the PRISMA 2020 flow diagram.

may influence the bond strength [15,17-19,35,39] while five reported it may not [7,16,27,31,36]. No article evaluated haemostatic agent contamination effect at different adhesive stages.

Blood contamination effect on bond strength was investigated in 13 articles [6,11,14-16,26,28-31,34-36] All but one of these studies reported a significant reduction in bond strength following blood contamination; one study found no statistically significant difference [14]. One article evaluated the effect of blood contamination on leakage in addition to bond strength [11]. No articles evaluated the effect of blood contamination on marginal adaptation.

The effect of haemostatic agent contamination on bond strength was evaluated in 11 articles [6,8,14,20-26,28]. Ferric sulfate was reported to reduce bond strength in three articles [6,8,20], but showed no significant effect in another three [14,21,22]. Aluminum chloride reduced bond strength in eight articles [6,14,20,21,23-26], while one article reported no significant effect [8]. One article evaluated the effect of three types of haemostatic agents contamination on leakage [10] while no articles evaluated the effect of haemostatic agent contamination alone on marginal adaptation. One article assessed the combined effect of blood and haemostatic agent contamination on marginal adaptation and reported no significant effect [13].

One article evaluated the effect of a blood-saliva mixture on bond strength and reported a significant reduction [27]. The effect of a mixture of blood and a haemostatic agent on bond strength similarly demonstrated reduced bond strength [29]. Eight articles evaluated the effects of more than one contaminant on bond strength [6,14,15,26,28-31].

Authors/ Year	Contaminant tested	Stage of contamination	Type of adhesive used	Surface tested/Feature evaluated	Decontamination protocol	Effect of contamination	Effect of decontamination
Kucukyilmaz E et al., 2017 [35]	Blood	After adhesive application and light curing After adhesive application before light curing	- Single Bond Universal (3M ESPE, Neuss, Germany) - All-Bond Universal (Bisco Inc., Schaumburg, IL, USA) - Clearfil S3 Bond Plus (one-step SE) (Kuraray Noritake Dental Inc., Tokyo, Japan)	- Dentin/ Microtensile Bond strength (μTBS)	- Air-drying - Rinsing followed by drying - Air-drying followed by adhesive reapplication - Rinsing and drying followed by adhesive reapplication	Blood reduced μTBS when contamination occurred after light curing.	Decontamination by air drying, followed by adhesive reapplication or by water rinsing, followed by adhesive reapplication, restored the bond strength when contamination occurred before adhesive light curing.
Abu-Nawareg MM et al., 2024 [8]	Haemostatic agents: 20% ferric sulphate 25% aluminum chloride	Before starting the adhesive protocol	Single Bond universal adhesive (3 M ESPE, Deutshland GmbH, Neuss, Germany)	- Dentin/ - (SBS)	- Water rinsing - 35% phosphoric acid - Katana Cleaner - Air abrasion with 27 μ aluminum oxide particles	- Ferric sulfate significantly reduced bond strength. - Aluminum chloride didn't significantly reduce bond strength.	Phosphoric acid restored the SBS in aluminum Chloride contamination. With Ferric Sulfate, none of the cleaning methods restored the SBS. Katana Cleaner and air abrasion had inferior results.
El-Safty MMM et al., 2024 [16]	Saliva	- After adhesive application and light curing - After adhesive application before light curing	All-Bond Universal adhesive single step (SE adhesive) (Bisco Inc., Schaumburg, IL, USA)	- Dentin/ - Microshear bond strength (μSBS)	- Water rinsing followed by drying, and adhesive reapplication - Grinding with sandpaper, followed by water rinsing, drying, and adhesive reapplication - Ethanol followed by rinsing, drying, and adhesive reapplication	Saliva significantly reduced the bond strength at both bonding stages.	- All tested decontamination protocols restored the bond strength when contamination occurred before adhesive light curing - Only ethanol was able to restore the bond strength when contamination occurred after adhesive light curing.
Etiennot L et al., 2025 [9]	Saliva	Before starting the adhesive protocol	Two-step SE adhesive: Clearfil SE Bond 2 (Kuraray Noritake Dental Inc., Tokyo, Japan) One-step SE adhesive: Clearfil Universal Bond Quick (Kuraray Noritake Dental Inc., Tokyo, Japan)	- Dentin/ - (μTBS)	- 10-Methacryloyloxydecyl Dihydrogen Phosphate (10-MDP)-containing Katana Cleaner (Kuraray Noritake) (KC) - 10-MDP containing primer (Clearfil SE Bond 2 Primer) (CSE2p)	- Saliva reduced the bond strength significantly with the one-step universal adhesive. - Saliva didn't reduce the bond strength with the two-step SE adhesive.	- KC and CSE2p restored the bond strength in the one-step SE universal adhesive. - For the two-step SE adhesive, decontamination was not needed.

Moharam LM et al., 2023 [27]	A mixture of blood and saliva	- After adhesive application and light curing - After adhesive application before light curing	2 Universal adhesives in SE mode: - Clearfil Bond Universal Quick (Kuraray Noritake Dental Inc., Tokyo, Japan). - All-Bond-Universal (Bisco Inc., Schaumburg, IL, USA)	- Dentin (Sound and Caries-affected)/ - (µSBS)	- Water rinsing. - Water rinsing followed by adhesive reapplication - Ethylenediaminetetraacetic Acid (EDTA) followed by water rinsing and adhesive reapplication - Chlorhexidine (CHX) followed by water rinsing and adhesive reapplication	Contamination significantly reduced bond strength regardless of contamination stage.	- No decontamination protocol applied was able to restore the µSBS. - The CHX application showed the highest µSBS and was significantly better than EDTA.
Noppawong S et al., 2022 [24]	Racestryptine Haemostatic agent (Contains aluminum chloride)	- Before acid etching in the E&R adhesive system - Before adhesive application in the SE adhesive system	3 universal adhesives were used in 2 etching mode SE or E&R: - Single Bond Universal (3M Oral Care; St Paul, MN USA) - OptiBond Universal (Kerr Corporation, Orange, CA, USA) - Clearfil Universal Bond Quick (Kuraray Noritake Dental Inc., Tokyo, Japan)	- Dentin/ - (µTBS)	- No decontamination method was tested	- Bond strength was significantly lower in the SE mode. - No significant effect in the E&R mode.	None
Tehlan H and Garg A 2022 [3]	Saliva	After adhesive application and light curing	One-step SE adhesive: Tetric N-Bond (Ivoclar Vivadent)	- Dentin/ - (SBS)	- Water rinsing followed by air drying and adhesive - Water rinsing followed by air drying, acid etching, and adhesive reapplication - Water rinsing followed by ethanol and adhesive reapplication	Saliva contamination significantly reduced the bond strength.	- No decontamination method restored the bond strength. - Ethanol showed the most effective decontamination.
Goncu TB and Yilmaz NA. 2022 [28]	- Blood - Ankaferd Blood Stopper (Ankaferd Drug, Istanbul, Turkey) - Mixture of Blood and Ankaferd Blood Stopper	Before starting the adhesive protocol	Single Bond Universal (3M Oral Care, St. Paul, MN, USA) with three application protocols: (No preconditioning or preconditioning with the 35% phosphoric, or 1% gallic acid).	- Dentin/ - (SBS)	- No decontamination method was tested	All evaluated contaminants reduced bond strength significantly	None
Mohan MC et al. 2023 [38]	Saliva	After adhesive application and light curing	- 7th generation SE adhesive: Adper EasyOne (3M ESPE, St. Paul, MN, USA). - 8th generation universal adhesive used in SE mode: Futurabond DC (VOCO GmbH, Cuxhaven, Germany).	- Dentin/ - (SBS)	- Air drying alone - Air drying followed by reapplication of adhesives	Saliva contamination reduced SBS in both adhesives.	- Air-drying didn't restore bond strength. - Adhesive reapplication after air drying restored bond strength in the 8th generation adhesives, but not the 7th.
Kim S et al., 2023 [23]	Haemostatic agent: Traxodent Haemodent Paste Retraction System (Premier Dental Products Co., Plymouth Meeting, PA, USA) (Containing 15% aluminum chloride)	Before adhesive application	E&R mode: - Scotchbond Multi-Purpose (3M ESPE, St. Paul, MN, USA) - All-Bond Universal (Bisco, Schaumburg, IL, USA) SE mode: - Clearfil SE Bond (Kuraray, Osaka, Japan) - All-Bond Universal (Bisco, Schaumburg, IL, USA)	- Dentin/ - (SBS)	No decontamination method was tested	- Contamination significantly reduced SBS after thermocycling when using All-Bond Universal adhesive in the SE mode, but not in the E&R mode. - Haemostatic agent contamination didn't reduce SBS with other adhesives.	None
Bahari M et al., 2021 [6]	- Blood - Saliva - Aluminium chloride - Ferric sulphate - Caries disclosing agent	- Before acid etching in the E&R mode - Before adhesive application in the SE mode	Universal adhesive used in E&R and SE mode: All Bond Universal (Bisco, Schaumburg, IL, USA)	- Dentin/ - (SBS)	No decontamination method was tested	All tested contaminants, except the caries-disclosing agent, significantly decreased SBS in both modes.	None

Bolme J et al., 2022 [7]	Saliva	- After acid etching (In total-etch system) - After primer (In total etch system) - Before adhesive application (in the SE system) - After adhesive application and light curing (In the SE system)	The total-etch-approach with three-step E&R system: - Optibond FL (Kerr Corporation, Orange, CA, USA). The one-step SE system: - Scotchbond Universal (3M ESPE, St. Paul, MN, USA)	- Dentin/ - (µTBS)	- Air drying - Water rinsing followed by air drying	Saliva significantly reduced bond strength, except in the group in which contamination occurred after acid etching and was followed by air drying only.	Neither decontamination method restored bond strength, except for air drying in the total etch approach when contamination occurred after acid etching.
Mempel CA et al., 2022 [21]	Haemostatic agents: 20% Ferric sulfate- 25% Aluminum chloride.	Before adhesive application	Two Universal adhesives in SE mode: - Scotchbond Universal Adhesive (3M Oral Care; St Paul, MN, USA) - Prime and Bond Active (Dentsply Sirona; Konstanz, Germany)	- Dentin/ - (µTBS)	20% EDTA solution followed by water rinsing and air drying	After thermocycling, both haemostatic agents reduced the bond strength, (reduction was significant only with aluminum chloride).	Decontaminating with EDTA didn't restore the bond strength.
Chaudhari RR et al., 2021 [17]	Saliva	- Before adhesive application - After adhesive application and light curing	Self-Etch (SE) Adhesive System	- Dentin/ - (SBS)	No decontamination method was tested	Saliva significantly reduces SBS. Contamination before adhesive application reduced the SBS more.	None
Nair P and Ilie N 2020 [19]	Saliva	- After tooth surface preparation - After primer (In the 2 step (SE) system) - After adhesive application and light curing	Clearfil SE Bond 2 (Kuraray Noritake Dental Inc., Tokyo, Japan) a 2 step SE adhesive (Primer and adhesive) Clearfil Universal adhesive (used in SE mode) (Kuraray Noritake Dental Inc., Tokyo, Japan)	- Dentin/ - (SBS)	- Water rinsing and air-drying - Water rinsing, air-drying, and reapplying the adhesive (or primer in the 2-step SE adhesive)	Saliva reduced SBS after primer application. A significant reduction in SBS at 1 week in the universal adhesive used in SE mode.	Water rinsing followed by air-drying and reapplication of primer regained the bond strength (In the 2-step SE system). Decontamination after light curing the adhesive didn't restore bond strength.
Atalay C and Meral E 2021 [18]	Saliva	- After etching (In the E&R mode) - After adhesive application and light curing (In the E&R and SE mode) - Before adhesive application (In the SE mode)	Universal adhesive used in E&R and SE mode: Clearfil Universal Bond Quick (Kuraray Noritake; Tokyo, Japan)	- Dentin (bovine)/ - (µSBS)	No decontamination method was tested	In E&R mode: Saliva reduced SBS when contamination occurred after acid etching. In SE mode: Saliva reduced SBS when contamination occurred after adhesive light curing.	None
Khamverdi Z et al., 2021 [20]	Haemostatic agents: 25% Aluminum chloride (ViscoStat Clear; Ultradent, South Jordan, Utah, USA) 20% ferric sulfate (ViscoStat; Ultradent Product Inc., Utah, USA)	Before adhesive application	2 Universal adhesives in SE mode: - G-Premio universal adhesive (GC Corp., Tokyo, Japan) - Single Bond Universal (3M ESPE, St. Paul, MN, USA)	- Dentin/ - (SBS)	No decontamination method was tested	Haemostatic agents significantly decreased bond strength (reduction was greater with iron sulfate).	None

Saati K et al., 2020 [25]	Haemostatic agent: 25% aluminum chloride gel (ViscoStat Clear)	Before acid etching	Scotchbond Multi-Purpose (3M ESPE, St. Paul, MN, USA)	- Dentin/ - (SBS)	The control group was contaminated with saliva, with no decontamination performed. - Water spraying - Particles of aluminum oxide - Pumice and water slurry - GC dentin conditioner - Phosphoric acid - 2% Sodium Hypochlorite (NaOCl) - 2% CHX	Aluminum chloride reduced the bond strength.	CHX and NaOCl showed the highest bond strength. The lowest SBS was related to the GC dentin conditioner.
Faisal AF and Mathew ST 2020 [26]	- Blood - Haemostatic agent: (Dharma, 25% Aluminium Chloride)	After adhesive application and light curing	SE adhesive: - Prime and bond select (Dentsply Sirona, Konstanz, Germany) Total-etch adhesive: - Prime and bond etch and rinse (Dentsply Sirona, Konstanz, Germany)	- Dentin/ - (SBS)	- Air drying - Water rinsing followed by air drying - 10% NaOCl rinsing followed by air drying	Blood and haemostatic agents reduced the SBS in both adhesives.	Decontaminating blood by air-drying resulted in the highest SBS in both adhesives. Decontaminating haemostatic agent with NaOCl showed the highest SBS in both adhesives.
Hoorizad M et al., 2019 [22]	Haemostatic agent: Astringedent (Containing 15.5% ferric sulfate)	Before adhesive application	Total-etch and SE adhesives: - Scotchbond Multi-Purpose (3M ESPE, St. Paul, MN, USA). - Adper Single Bond (3M ESPE, St. Paul, MN, USA). - Clearfil SE Bond (Kuraray Noritake Dental Inc., Tokyo, Japan). - Single Bond Universal (3M ESPE, St. Paul, MN, USA).	- Dentin/ - (µSBS)	No decontamination method was tested	Ferric sulfate reduced the bond strength, but not significantly, in both systems.	None
Lund RG et al., 2019 [36]	Blood	- After acid etching - After adhesive application before light curing	Two-step E&R adhesive: - Single Bond (3M ESPE, St Paul, MN, USA)	- Dentin (bovine)/ - (µTBS) at 24 hr and 6 months	- Water rinsing - Water rinsing followed by acid etching and adhesive application	Blood contamination significantly reduced the µTBS of an E&R adhesive to dentin.	No decontamination protocol recovered the bond strength. After 6 months of aging, bond strength decreased (no significant difference between control and tested samples).
Chasqueira AF et al., 2019 [37]	Saliva	After adhesive application and light-curing	Scotchbond universal adhesive (3M ESPE, St. Paul, MN, USA)	- Dentin/ - (SBS) at 24 hr and 6 months	- Water rinsing - Water rinsing followed by reapplication of adhesive. - Ethanol - Ethanol followed by reapplication of adhesive.	Salivary contamination decreases bond strength.	At 6 months of aging, decontamination with ethanol, followed by reapplication of adhesive or water, followed by reapplication of adhesive, recovered bond strength.
Putri AM et al., 2018 [29]	- Saliva - Blood	After adhesive application and light curing	Two-step adhesive system (etch and bond): Magic Bond (Coltene, Altstätten, Switzerland).	- Enamel/ - (SBS)	- Water rinsing followed by drying. - Alcohol swabbing followed by drying.	Saliva and blood reduced the SBS. Blood resulted in a lower bond strength than saliva.	In saliva-contaminated samples, water rinsing restored bond strength. In blood-contaminated samples, bond strength was not restored.
Taneja S et al., 2017 [15]	- Saliva - Blood	- After adhesive application before light curing - After adhesive application and light curing	5th generation: OptiBond Solo Plus (Kerr Corporation, Orange, CA, USA). 7th generation: OptiBond All-In-One (Kerr Corporation, Orange, CA, USA). 8th generation: Futurabond DC (VOCO GmbH, Cuxhaven, Germany)	- Dentin/ - (SBS)	No decontamination method was tested	- Saliva and blood reduced bond strength. - Saliva reduced SBS more when it occurred before adhesive curing, except in the 5th generation. - Blood reduced SBS more when it occurred after adhesive curing except in the 5th generation.	None
Fallahzadeh F et al., 2018 [32]	Saliva	After acid etching	Single bond adhesive (3M ESPE, St. Paul, MN, USA). P60 adhesive (3M ESPE, St. Paul, MN, USA).	- Enamel/ - (SBS)	No decontamination method was tested	Saliva contamination reduced bond strength.	None

Elkassas D and Arafa A 2016 [31]	- Saliva - Blood	- After etching - After adhesive application before light curing - After adhesive application and light curing	E&R adhesive: - Adper Single Bond Plus (3M ESPE, St. Paul, MN, USA)	- Dentin/ - (µSBS)	Contaminated etching, decontaminated with: - Rinsing - Rinsing and re-etching - Rinsing followed by 5.25% NaOCl Contaminated unpolymerised adhesive was decontaminated with: - Rinsing and rebonding the adhesive - Rinsing followed by 70% ethyl alcohol and rebonding Polymerised adhesive was decontaminated with: - Rinsing - Rinsing and rebonding - Rinsing and re-etching - Rinsing followed by re-etching and rebonding	Saliva and blood reduced the SBS regardless of the affected step. Blood had a more negative effect than saliva.	No decontamination method restored SBS. Re-etching followed by rebonding enhanced the SBS in contaminated etching or polymerised adhesive, while acetone application followed by rebonding enhanced SBS in contaminated, unpolymerised adhesive.
Dey S et al., 2016 [14]	- Saliva (Artificial) - Blood - Viscostat (20% ferric sulfate) - Viscostat Clear (25% aluminum chloride)	Before starting the adhesive protocol	SE adhesives: - Adper Easy One - Clearfil SE Bond (Kuraray Noritake Dental Inc., Tokyo, Japan) (primer and bond) Total-etch adhesive: - Adper Single Bond 2 (3M ESPE, St. Paul, MN, USA).	- Dentin/ - (SBS)	No decontamination method was tested	Blood, saliva, and Viscostat had no significant effect on SBS. Viscostat Clear reduced SBS of SE adhesive but did not affect the total-etch adhesive.	None
Bhatia TK et al., 2015 [40]	Saliva	After adhesive application before light curing	7th generation adhesives: - Adper Easy One (3M ESPE, St. Paul, MN, USA). - Xeno V (Dentsply Sirona, Konstanz, Germany)	- Dentin/ - (SBS)	No decontamination method was tested	Saliva significantly affected the SBS in both adhesives.	None
Santschi K et al., 2015 [39]	Saliva	- After adhesive application and light curing - After adhesive application before light curing	SE adhesives: - Xeno V+ (Dentsply Sirona, Konstanz, Germany). - Scotchbond Universal (3M ESPE, St. Paul, MN, USA)	- Dentin/ - (SBS)	- Air drying - Water rinse, spraying, and air drying - Water rinse spraying, air drying, and adhesive reapplication	Saliva reduced the SBS of Xeno V+. Saliva showed no significant effect on Scotchbond Universal.	Water rinsing, followed by air drying and reapplying adhesive, restored bond strength.

[Table/Fig-3]: Included articles on bond strength between tooth structure and composite resin [3-9, 14-29, 32, 35, 36-40].

Authors/ Year	Contaminant tested	Stage of contamination	Type of adhesive used	Surface tested/Feature evaluated	Decontamination protocol	Effect of contamination	Effect of decontamination
Liu T et al., 2024 [11]	Blood	After adhesive application and light curing	Singlebond Universal adhesive (3 M, ESPE, St. Paul, MN, USA)	- Dentin/ - Nanoleakage - (µTBS)	- Water spray rinsing - Reprepare dentin surface with diamond burs - Phosphoric acid - NaOCl - Phosphoric acid or NaOCl followed by polyphenols (resveratrol or myricetin) A new layer of bond was reapplied after each decontamination method	Not clearly explained	- All decontamination protocols were able to restore bond strength except water spray rinsing. - Spray rinsing resulted in the highest nanoleakage. - Applying polyphenols after phosphoric acid or NaOCl, followed by a layer of bond, improved the bond strength and decreased nanoleakage
Shimazu K et al., 2020 [12]	Saliva (Artificial)	After adhesive application and light curing	Total-etching adhesive: - OptiBond Solo Plus (Kerr Corporation, Orange, CA, USA) SE primer: - Scotchbond Universal Adhesive (3M ESPE, St. Paul, MN, USA)	- Enamel, Dentin, Cementum (Bovine)/ - Microleakage - (µTBS)	No decontamination method was tested	Severe saliva contamination significantly reduced µTBS Severe salivary contamination increased cementum microleakage	None

Groddeck S et al., 2017 [13]	First blood was applied, followed by three haemostatic agents: - Aluminum chloride (Racestyptine), - 15.5% ferric sulfate (Astringedent) - 20% ferric sulfate (ViscoStat)	Before starting the adhesive protocol (Blood was applied first then treated with haemostatic agent)	Three steps E&R: - OptiBond FL (Kerr Corporation, Orange, CA, USA) One step SE: - OptiBond all in one (Kerr Corporation, Orange, CA, USA)	- Enamel, Dentin/ - Marginal adaptation	No decontamination method was tested	Contamination did not compromise the marginal adaptation	None
Khoroushi M et al., 2016 [10]	Haemostatic agents: - ViscoStat (20% ferric sulfate) - ViscoStat Clear (25%aluminum chloride) - Trichloracetic acid	- After acid etcing (In E&R system) - After P90 primer (In SE system)	E&R adhesive: - Adper Single Bond (3M ESPE, MN, USA) SE adhesive: - Filtek P90 Adhesive (3M ESPE, USA)	- Enamel, cementum/ - Marginal Microleakage	No decontamination method was tested	All tested haemostatic agents had no significant effect on microleakage except for trichloracetic acid when used with Filtek P90 composite	None

[Table/Fig-4]: Included articles on leakage and adaptation to tooth structure [10-13].

Authors/ Year	Contaminant tested	Stage of contamination	Type of adhesive used	Surface tested/ Feature evaluated	Decontamination protocol	Effect of contamination	Effect of decontamination
Carneiro DTO et al., 2015 [34]	Blood	After composite was light cured	Adper Scotchbond Multi-Purpose Adhesive (3M ESPE St Paul, MN, USA)	- Between composite surfaces - (μTBS)	- Air drying - Water rinsing and air drying - Water rinsing, air drying, and applying a bonding agent - Water rinsing, air drying, etching with phosphoric acid, and applying of bonding agent	Blood reduced bond strength in all tested groups, except when blood was decontaminated with water rinsing, followed by air drying, phosphoric acid etching, and application of a bonding agent	Decontaminating blood with water rinsing, followed by air drying, phosphoric acid etching, and application of a bonding agent, restored the bond strength
Javan SO et al., 2025 [33]	Saliva	After composite was light cured	- Clearfil Self Etch Bond (Kuraray Noritake Dental Inc., Tokyo, Japan) - All-Bond Universal (Ultradent Products Inc., South Jordan, UT, USA)	- Between composite surfaces - (μSBS)	- Air drying - Water rinsing and air drying - Water rinsing followed by air drying and the Clearfil SE Bond layer - 96% ethanol alcohol - CHX - Water rinsing followed by air drying and All-Bond Universal bond layer	Saliva significantly reduced the μSBS	Decontamination with water rinsing, drying, and applying an All Bond Universal adhesive layer, as well as using 96% ethanol, restored bond strength
Sheikh-Al-Eslamian SM et al., 2015 [30]	- Saliva - Blood	After composite was light cured	Filtek P90 system adhesive (3M ESPE, St. Paul, MN, USA)	- Between composite layers/ - (μSBS)	- Air spraying - Water spraying followed by air spraying - Water spraying followed by air spraying and phosphoric acid etching - Air spraying followed by etching and bonding - Water spraying followed by air spraying, etching, and bonding	Both saliva and blood significantly reduced the bond strength between resin composite increments	Water spray, followed by air spray, etching, and bonding, restored bond strength in both contaminants

[Table/Fig-5]: Included articles on bond strength between composite surfaces [30,33,34].

The Effect of Decontamination

Among the reviewed studies, 12 articles evaluated decontamination following saliva contamination [3,7,9,16,19,29-31,33,37-39] Of these, 10 reported that at least one decontamination method was able to restore bond strength [7,9,16,19,29,30,33,37-39]. However, two studies found that none of the tested decontamination methods restored bond strength [3,31].

Blood decontamination was evaluated in eight articles [11,26,29-31,34-36]. Four reported that bond strength could be restored [11,30,34,35], whereas the remaining four reported it could not be restored [26,29,31,36].

Decontamination of haemostatic agents was evaluated in four articles [8,21,25,26]. Two reported that bond strength could not be restored [21,26]. One reported it could be restored following aluminum chloride contamination but not ferric sulfate contamination [8]. Another reported increased bond strength following decontamination of aluminum chloride [25].

The effectiveness of decontaminating a mixture of saliva and blood was evaluated in one article, reporting that none of the tested decontamination methods restored bond strength [27].

A wide range of decontamination methods was investigated. Drying alone was evaluated in seven articles [26,30,33-35,38,39], water rinsing in 17 articles [3,7,8,11,16,19,25-27,29,30,33-37,39], air abrasion in one article [8], surface re-preparation with a diamond bur in one article [11], sandpaper grinding in one article [16], ethanol in four articles [3,16,33,37], acetone in one article (31), phosphoric acid in six articles [3,8,11,30,31,34], Ethylenediaminetetraacetic Acid (EDTA) in two articles [21,27], Chlorhexidine (CHX) in three articles [25,27,33], sodium hypochlorite (NaOCl) in three articles [11,25,26], polyphenols in one article [11], alcohol swabbing in one article [29], and pumice slurry in one article [25]. Additional approaches included adhesive re-application, which was tested in 11 articles [16,19,27,30,31,33-35,37-39], sandblasting in one article [25], bond primer application in one article [9], GC dentin conditioner in one article [25], and Katana Cleaner in two articles [8,9].

DISCUSSION

Within the 11 articles that evaluated the effect of contamination at different stages of adhesion [7,15-19,27,31,35,36,39], more than half reported that the stage of contamination influences bond strength [15,17-19,35,39]. Blood contamination at different stages of adhesion was investigated in two studies, both showing a greater reduction in bond strength when contamination occurred after adhesive application and light curing rather than before [15,35]. Saliva contamination at different stages of adhesion was examined in five studies [15,17-19,39], with variable findings likely influenced by adhesive type. One study reported that saliva contamination reduced the bond strength of SE adhesives more when it occurred before adhesive application than after [17]. Conversely, another found a greater reduction when contamination occurred after primer application [19].

Saliva contamination before adhesive polymerisation reduced bond strength in seventh- and eighth-generation adhesives but not in fifth-generation systems, while blood contamination produced similar effects after polymerisation [15]. Saliva contamination before light curing reduced bond strength for Xeno V+ adhesive, whereas it showed no significant effect on Scotchbond Universal adhesive [39]. Overall, blood contamination appears to have a more detrimental effect when occurring after adhesive application and curing. In contrast, the impact of saliva contamination remains inconsistent, likely due to differences in adhesive systems and their interaction with salivary components.

Adhesive type may play a role in contamination resilience. A 2025 study demonstrated that two-step SE adhesives performed significantly better than one-step systems, both with and without saliva contamination. Saliva significantly reduced bond strength in one-step SE adhesives but not in two-step systems [9]. Another study found that total-etch systems exhibited higher bond strength than SE systems under both contaminated and uncontaminated conditions. Aluminum chloride contamination significantly reduced bond strength in SE systems but not in total-etch systems [14]. Similarly, two studies reported that aluminum chloride reduced bond strength in universal adhesives used in SE mode but not in E&R mode [23,24].

However, conflicting findings exist. One study showed that severe salivary contamination significantly reduced bond strength in both total-etch and SE primer adhesive systems [12]. At the same time, another reported that saliva, blood, and haemostatic agents significantly reduced bond strength in universal adhesives regardless of application mode [6].

Overall, two-step SE and total-etch systems appear more resistant to contamination than one-step SE and universal adhesives used in SE mode. However, no adhesive system appears entirely immune, as results remain inconsistent across studies.

Saliva contamination significantly reduced the bond strength between composite layers. Effective decontamination methods included water–air spray followed by phosphoric acid etching and bonding agent application [30], as well as water rinsing and drying followed by All-Bond Universal application, and the use of 96% ethanol [33]. Blood contamination also reduced interlayer bond strength; however, phosphoric acid etching followed by Scotchbond Multi-Purpose Adhesive restored bond strength [34].

One study evaluated the effect of blood and haemostatic agent contamination on marginal adaptation and reported no adverse effects on enamel or dentin margins [13]. Severe salivary contamination significantly increased microleakage at cementum-composite margins [12]. Nanoleakage studies showed that cleaning blood with phosphoric acid or NaOCl, followed by polyphenols, significantly reduced leakage [11]. Trichloroacetic acid increased microleakage when used with Z-250 composite resin, whereas aluminum chloride and ferric sulfate did not [10].

Effective decontamination protocol generally require a combination of cleaning and adhesive reapplication. Water rinsing, sandpaper abrasion, or ethanol application each followed by adhesive reapplication restored bond strength when contamination occurred before light curing. After curing, only ethanol combined with adhesive reapplication was effective [16]. Similarly, water rinsing or ethanol alone was ineffective, but both restored bond strength when followed by adhesive reapplication [37]. 10-MDP–containing agents, such as Katana Cleaner and primers, successfully restored bond strength in one-step SE systems [9]. Air drying alone was ineffective, but when followed by adhesive reapplication, it restored bond strength in universal adhesives, though not in SE systems [38]. Alcohol swabbing and 70% ethanol, failed to restore bond strength [29,31]. Water rinsing followed by air drying and adhesive reapplication was effective in SE systems [39]. Overall, multi-step approaches combining cleaning with adhesive reapplication are more effective than single-step methods.

Blood contamination proved more difficult to manage. Alcohol swabbing and water rinsing were ineffective in restoring bond strength after contamination following light curing [29]. Similarly, decontaminating blood with 5.25% NaOCl did not restore bond strength [31]. Combined saliva and blood contamination treated with CHX and EDTA improved but did not fully restore bond strength [27]. However, when contamination occurred before light curing, air drying, or water rinsing, followed by adhesive reapplication, it successfully restored bond strength in SE systems [35]. A 2024 study reported that surface re-preparation using a diamond bur, or treatment with phosphoric acid or NaOCl, followed by adhesive reapplication, effectively restored bond strength [11]. Decontamination of haemostatic agents remains challenging. NaOCl improved bond strength following aluminum chloride contamination but did not fully restore it [26]. GC Dentin Conditioner was less effective than NaOCl or CHX [25], and 20% EDTA failed to restore bond strength [21]. For universal adhesives, phosphoric acid restored bond strength after aluminum chloride contamination, but was not able to successfully restore bond strength following ferric sulfate contamination [8].

Limitation(s)

This review has several limitations, which include its reliance on in-vitro studies, therefore, restricting clinical applicability. The literature search was conducted by a single reviewer and limited to two databases, may have led to the omission of relevant studies. Additionally, the heterogeneity in adhesive systems, contamination stages, and decontamination protocols limit comparability and definitive conclusions. Future research should adopt standardised methodologies, broader search, and multi-reviewer approaches to improve reliability and clinical applicability.

CONCLUSION(S)

The evidence suggests that contamination effects may depend on the stage of adhesion and the adhesive system used. Blood contamination appears more detrimental to the bond strength when it occurs after adhesive curing, while the impact of saliva remains inconsistent. Two-step SE and total-etch systems generally demonstrate greater resilience. Evidence on leakage and adaptation remains limited. Effective decontamination typically requires both surface cleaning and adhesive reapplication procedures, although outcomes vary depending on the contaminant. Haemostatic agent contamination remains particularly difficult to manage, with no consistently reliable decontamination protocol identified.

Collectively, these findings underscore the importance of strict contamination control, and the need for further well-designed studies to establish predictable decontamination protocols.

REFERENCES

[1] Lehmann A, Nijakowski K, Jankowski J, Donnermeyer D, Ramos JC, Drobac M, et al. Clinical difficulties related to direct composite restorations: A multinational survey. Int Dent J. 2025;75(2):797-806.

[2] Falacho RI, Melo EA, Marques JA, Ramos JC, Guerra F, Blatz MB. Clinical in-situ evaluation of the effect of rubber dam isolation on bond strength to enamel. J Esthet Restor Dent. 2023;35(1):48-55.

[3] Tehlan H, Garg A. Comparative evaluation of different surface treatments of the salivary contaminated dentin on the shear bond strength of self-etch adhesives: An in vitro study. J Conserv Dent. 2022;25:436-39.
[4] Pappa E, Masouras K, Margaritis V, Kakaboura A. Effect of decontamination procedures on marginal and internal adaptation in saliva-contaminated resin composite restorations. Gen Dent. 2022;70(3):22-26.
[5] Sahebalam R, Arian Y, Boruziniat AR, Rangrazi AR. Microshear bond strength and microleakage of a restorative composite resin with salivary contamination at different time intervals. J Dent Mater Tech. 2021;10(1):22-27.
[6] Bahari M, Oskoee SS, Chaharom MEE, Molayi N. The effects of different surface contaminators on the shear bond strength of a universal adhesive system to dentin: An experimental study. J Dent Res Dent Clin Dent Prospects. 2021;15(2):82-86.
[7] Bolme J, Gjerdet NR, Lægreid T. Effect of saliva contamination on bond strength of single-step and three-step adhesive systems. Eur J Oral Sci. 2022;130(5):e12838.
[8] Abu-Nawareg MM, Hajjaj MS, AbuHaimed TS, Ajaj RA, Abuljadayel R, AlNowailaty Y, et al. The effect of hemostatic agents and dentin cleansing protocols on shear bond strength of resin composite using universal adhesive: An in vitro study. BMC Oral Health. 2024;24(1):1413.
[9] Etiennot L, Ordies M, Yao C, Mercelis B, Peumans M, Van Meerbeek B. Effective 10-MDP bonding to saliva-contaminated dentin. J Adhes Dent. 2025;27:65-74.
[10] Khoroushi M, Shirban F, Sahraneshin-Samani M. Marginal integrity of low-shrinkage and methacrylate-based composite resins: Effect of three different hemostatic agents. J Clin Exp Dent. 2016;8(2):e178-e183.
[11] Liu T, Xie H, Chen C. A comparison of different cleaning approaches for blood contamination after curing universal adhesives on the dentine surface. Dent Mater. 2024;40:1786-97.
[12] Shimazu K, Karibe H, Oguchi R, Ogata K. Influence of artificial saliva contamination on adhesion in class V restorations. Dent Mater J. 2020;39(3):429-34.
[13] Groddeck S, Attin T, Tauböck TT. Effect of cavity contamination by blood and hemostatic agents on marginal adaptation of composite restorations. J Adhes Dent. 2017;19(3):259-64.
[14] Dey S, Shenoy A, Kundapur SS, Das M, Gunwal M, Bhattacharya R. Evaluation of the effect of different contaminants on the shear bond strength of a two-step self-etch adhesive system, one-step self-etch adhesive system and a total-etch adhesive system. J Int Oral Health. 2016;8(3):378-84.
[15] Taneja S, Kumari M, Bansal S. Effect of saliva and blood contamination on the shear bond strength of fifth-, seventh-, and eighth-generation bonding agents: An in vitro study. J Conserv Dent. 2017;20:157-60.
[16] El-Safty MMM, Nour KA, Mustafa DS. Effect of saliva contamination and different decontamination protocols on microshear bond strength of a universal adhesive to dentin. Braz Dent Sci. 2024;27(2):e4159.
[17] Chaudhari RR, Srivastava HR, Raisingani D, Prasad AB, Chinchalkar RP, Gattani S, et al. Effect of saliva contamination on shear bond strength of self-etch adhesive system to dentin: An in vitro study. Int J Clin Pediatr Dent. 2021;14(4):443-46.
[18] Atalay C, Meral E. Does rubbing of universal adhesive reduce the negative effect of saliva on adhesion? J Adhes Dent. 2021;23(1):57-65.
[19] Nair P, Ilie N. The long-term consequence of salivary contamination at various stages of adhesive application and clinically feasible remedies to decontaminate. Clin Oral Investig. 2020;24:4413-26.
[20] Khamverdi Z, Karimian N, Farhadian M, Gheitouli H. Effect of contamination with hemostatic agent on shear bond strength of composite to dentin using G-Premio and Single Bond Universal adhesives. Front Dent. 2021;18:27.
[21] Mempel CA, Jacker-Guhr S, Lührs AK. Contamination of dentin with hemostatic agents: Is EDTA a valuable decontaminant before using a self-etch universal adhesive? J Adhes Dent. 2022;24:345-54.
[22] Hoorizad M, Heshmat H, Hosseini TA, Kazemi SS, Tabatabaei SF. Effect of hemostatic agent on microshear bond strength of total-etch and self-etch adhesive systems. Dent Res J (Isfahan). 2019;16(6):361-65.
[23] Kim S, Choi Y, Park S. Effect of an aluminum chloride hemostatic agent on the dentin shear bond strength of a universal adhesive. Restor Dent Endod. 2023;48(2):e14.
[24] Noppawong S, Pratabsingha J, Thamsoonthorn C, Vichathai D, Saikaew P. Bond strengths of universal adhesives to dentin contaminated with a hemostatic agent. J Adhes Dent. 2022;24:421-26.
[25] Saati K, Tabatabaei SF, Etemadian D, Sadaghiani M. Effect of different cleansing protocols on bond strength of composite resin to dentin contaminated with hemostatic agent: An in vitro study. Front Dent. 2020;17:31.
[26] Faisal AF, Mathew ST. Comparative effect of contamination and decontamination of two adhesive systems by blood and haemostatic agent on the bond strength to dentin: In vitro. Annals of Dental Specialty. 2020;8(1):34-43.
[27] Moharam LM, Salem HN, Khadr S, Abdou A. Evaluation of different decontamination procedures on bond strength to sound and caries-affected dentin using "no-wait" universal adhesive. BMC Oral Health. 2023;23:638.
[28] Goncu TB, Yilmaz NA. Universal adhesive application to contaminated/non-contaminated dentin with three different protocols: An in vitro shear bond strength and SEM analysis. Dent Mater J. 2022;41(4):633-42.
[29] Putri AM, Suprastiwi E, Usman M. Effects of cleansing methods on shear bond strength of nanohybrid composite resin to enamel after saliva and blood contamination during bonding. Journal of International Dental and Medical Research. 2018;11(3):888-92.
[30] Sheikh-Al-Eslamian SM, Panahandeh N, Najafi-Abrandabadi A, Hasani E, Torabzadeh H, Ghassemi A. Effect of decontamination on micro-shear bond strength of silorane-based composite increments. J Investig Clin Dent. 2017;8(2):e12196.
[31] Elkassas D, Arafa A. Assessment of post-contamination treatments affecting different bonding stages to dentin. Eur J Dent. 2016;10(3):327-32.
[32] Fallahzadeh F, Atai M, Ghasemi S, Mahdkhah A. Effect of rinsing time and surface contamination on bond strength of silorane-based and dimethacrylate-based composites to enamel. J Clin Exp Dent. 2018;10(11):e1115-22.
[33] Javan SO, Movahedian R, Hosseini Tabatabaei S. Comparative evaluation of different methods of saliva decontamination on microshear bond strength of composite to composite: An in vitro study. Dent Res J (Isfahan). 2025;22:27.
[34] Carneiro DTO, Generoso GM, Ferreira IA, Borges BCD, Freitas CJR, Silva LAAS. Resin-resin microtensile bond strength after different surface treatments to clean blood contamination. Revista portuguesa de estomatologia, medicina dentária e cirurgia maxilofacial. 2015;56(4):215-20.
[35] Küçükyılmaz E, Çelik EU, Akcay M, Yasa B. Influence of blood contamination during multimode adhesive application on microtensile bond strength to dentin. Niger J Clin Pract. 2017;20(12):1644-50.
[36] Lund RG, da Silveira IA, Ribeiro JS, Rubin D, Peralta SL, Cuevas-Suárez CE, et al. Influence of blood contamination and decontamination procedures on bond strength of a two-step etch-and-rinse adhesive system. European J Gen Dent. 2019;8:71-75.
[37] Chasqueira AF, Luís J, Portugal J. Effect of saliva decontamination protocol on adhesion to dentin with a universal adhesive. Revista Portuguesa De Estomatologia, Medicina Dentária E Cirurgia Maxilofacial. 2019;60(2):51-58.
[38] Mohan MC, Geetha P, Soman D, Kunjusankaran RN, Kurup NB, Venugopal K, et al. The effect of salivary contamination on the shear bond strength of seventh- and eighth-generation adhesive systems. Int J Clin Pediatr Dent. 2023;16(S-1):S63-S66.
[39] Santschi K, Peutzfeldt A, Lussi A, Flury S. Effect of salivary contamination and decontamination on bond strength of two one-step self-etching adhesives to dentin of primary and permanent teeth. J Adhes Dent. 2015;17(1):51-57.
[40] Bhatia TK, Asrani H, Banga H, Jain A, Rawlani SS. Influence of salivary contamination on dentin bond strength of two different seventh-generation adhesive systems: An in vitro study. J Conserv Dent. 2015;18(6):467-72.

PARTICULARS OF CONTRIBUTORS:
1. Teaching Assistant, Department of Restorative Dentistry, Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Ghaida Raja Althebeti,
Teaching Assistant, Department of Restorative Dentistry, Faculty of Dentistry, Umm Al-Qura University, Makkah-24381, Saudi Arabia.
E-mail: grthebeti@uqu.edu.sa

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Feb 17, 2026
- Manual Googling: Apr 23, 2026
- iThenticate Software: Apr 25, 2026 (2%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Feb 06, 2026**
Date of Peer Review: **Mar 12, 2026**
Date of Acceptance: **Apr 27, 2026**
Date of Publishing: **Jun 01, 2026**