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Effect Of Proanthocyanidin Rich Grape Seed Extract On Dentinbond Strength: A Systematic Review

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ABSTRACT

Aim: To appraise the effect of proanthocyanidin rich grape seed extract on the bond strength between the tooth dentin and various restorative material.

Materials and Methods: Database search was done in PubMed, Scopus, Cochrane Library, Ovid Medline, Elsevier science direct, Wiley online library, Grey literature, Embase. Five in-vitro studies of extracted human teeth were included evaluating the effect of grape seed extract (GSE) proanthocyanidin on bond strength between the dentin and various restorative material. PICO model and PRISMA guidelines was used. Cochrane risk assessment tool was used for bias analysis.

Results: Five studies were reviewed. In four studies, proanthocyanidin rich grape seed extract produced better shear bond strength to the restorative material. One study stated that long term storage decreases the bond strength of the dentin.

Conclusion: This study concludes that the proanthocyanidin rich grape seed extract showed greater shear bond strength when compared to other chemical cross-linkers.

Keywords: grape seed extract, dentin, bonding, bond strength, proanthocyanidin

INTRODUCTION

Proanthocyanidin (PA)is a bioflavonoid and extensively present in grape seeds, elm tree, pine bark. PA is present in high concentrations in seeds of red and white grapes. PA is also generally available in fruits, vegetables, nuts, flowers and bark, in fewer concentrations. PA is a powerful antioxidant than vitamin E, C or beta carotene. The biological properties of proanthocyanidin are anti-viral, antibacterial, anti-inflammatory, antiallergic and vasodilatory actions. [1][2] In dentistry, grape seed extract possesses various benefits like antibacterial (bactericidal and bacteriostatic), antiplaque activity, anti-erosive capacity, remineralizing potential, cross-linker, dentin biomodification, endodontic irrigant,therapeutic drug in periodontitis and anticarcinogenic against oral cancer. [3]

Even with the improvements in dental adhesive technology and bonding knowledge, bonding to dentin is still a challenge.[4]Grape seed extract's salient uses in conservative dentistry are a cross-linking agent and in the bonding of restoratives and adhesives. Management of dental caries is mainly on excavating the infected enamel and dentin through cavity preparation, followed by restoration with a biocompatible material.[5]The accomplishment of a stable and efficient bond between composite and dentin remains a challenge in restorative dentistry. Effective dentin bonding depends on the formation and integrity of the hybrid layer. Increased bond strength may be attributed to improved dentin collagen stability due to the predominance

of collagen cross-links. There are four proposed mechanisms of interaction between proanthocyanidin and proteins. They are covalent, ionic, hydrogen bonding, and hydrophobic interactions. G.V. Macedosaid that the application of grape seed extract to dentin significantly improved micro tensile bond strength to caries-affected and sound dentin.[6] Bond strength variation not only depends on the restorative materials but also on dentin depth, age, calcium concentrations, surface wetness, caries-affected dentin, relative humidity, sclerotic cervical erosion or polymerization stress related to cavity configuration.

Tooth dentin is a complex hydrated biological composite structure with a highly oriented microstructure dominated by tubules that converge towards the predentin from the DEJ and cementum in the crown and root, respectively. This arrangement leads to variation in dentin tubular size, number, direction and quantity of intertubular matrices. The structural difference may also influence bond strength between the resin and dentin.[7]Pre-treating the demineralized dentin by proanthocyanidin-based agents for 10 minutes was effective in increasing the dentin matrix's mechanical properties, strengthening the resin-dentin micro tensile bond, and minimizing the enzymatic degradation.[8]This systematic review evaluates the effect of proanthocyanidin rich grape seed extract on the bond strength between the tooth dentin and various restorative materials.

MATERIALS AND METHOD

STUDY DESIGN

This study is a systematic literature review of the effect of grape seed extract in dentin bond strength with a various restorative material.

SEARCH STRATEGY

Electronic databases used to find the effect of grape seed extract in bond strength are PubMed,Scopus, Cochrane Library, Ovid Medline, Elsevier science direct, Wiley online library, Grey literature, Embase. MeSH terms were used in the databases to identify the articles. The MeSH terms used were grape seed extract AND dentin bonding strength.

ELIGIBILITY CRITERIA FOR THE STUDY:

INCLUSION CRITERIA

- Articles on the effect of grapeseed extract in dentin bond strength.
- Full-text articles.
- In-vitro studies.
- Articles that are in the English language.

EXCLUSION CRITERIA

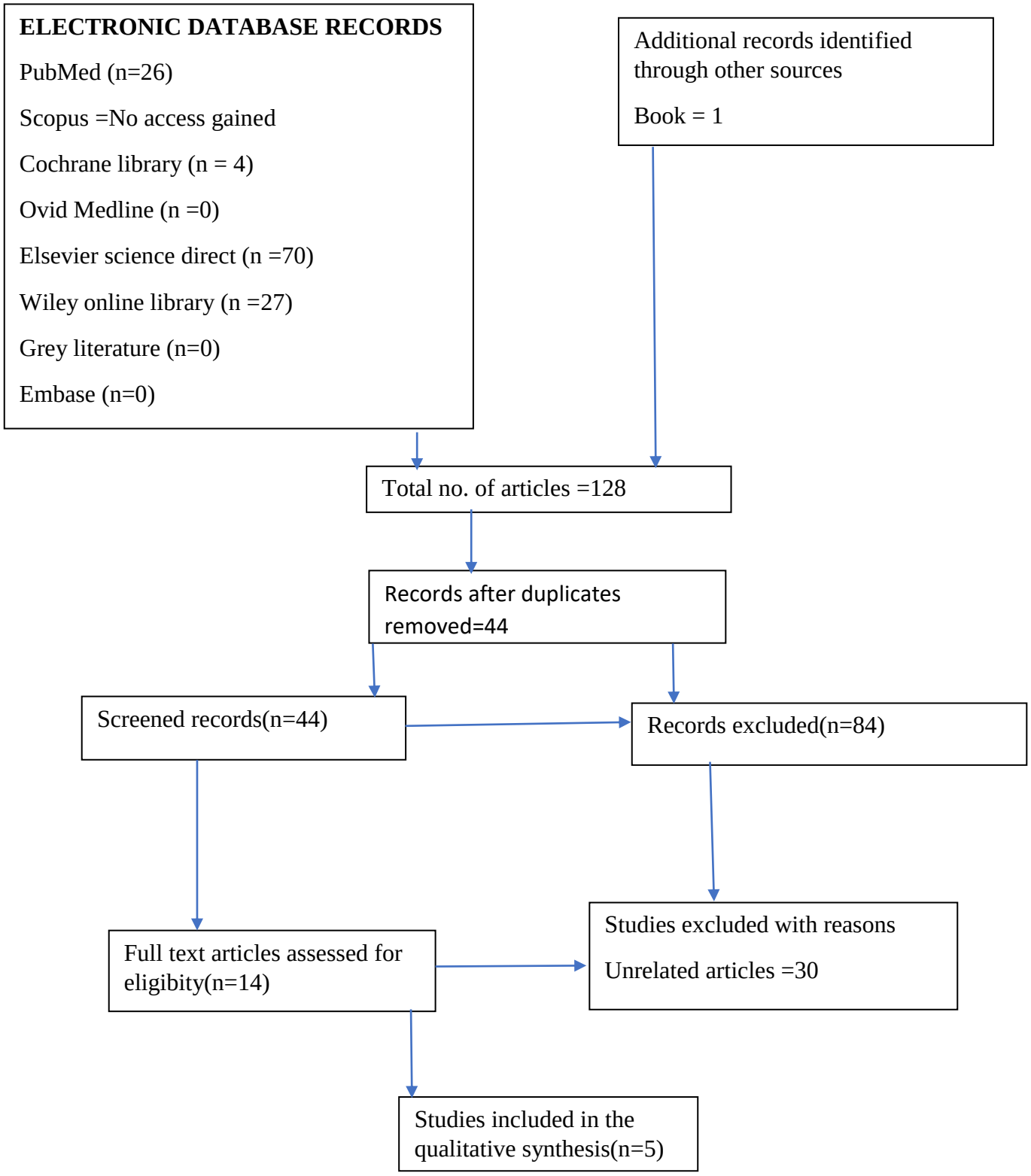
- Only abstracts available.
- Review articles.

SEARCHED DATABASES

- PubMed
- Scopus
- Cochrane library
- Ovid Medline
- Elsevier science direct

- Wiley online library
- Grey literature
- Embase

Flow chart:1Flow chart diagram showing the number of studies identified, screened, assessed for eligibility, excluded, and included in the systematic review



RESULTS

TABLE 1: CHARACTERISTICS OF THE STUDIES SELECTED AND INCLUDED IN THE SYSTEMATIC REVIEW

S.no	Author	Year	No of samples	Preparations used	Interventions
1	Gajjela RS et al.[9]	2017	40 extracted human molars	Solution form	**Group I**: No pretreatment done (control group) **Group II**: 2% CHX **Group III**: 6.5% GSE **Group IV:** 1% riboflavin/ chitosan
2	G.V. Macedo et al.[6]	2009	48 extracted molars	Solution form	**Group 1:** control **Group 2:** 5% glutaraldehyde **Group 3:** 6.5% grape seed extract
3	Kalra M et al.[10]	2012	28 single-rooted premolars	Solution form	**Group 1**: PAs rich 6.5% GSE. **Group 2**: control group.
4	Atabek S et al.[11]	2019	180 dentin surfaces of the extracted molar teeth	Solution form	**Group A**: control group **Group B**: 6.5% Pa-rich GSE **Group C:** 12.5% Pa-rich GSE
5	Castellan CS et al.[12]	2013	Coronal dentin of forty molars	Solutionform	**GROUP 1**: 6.5% grape seed extract (GSE) **GROUP 2** 6.5% cocoa seed extract **GROUP 3:** ethanol-water (CSE-ET) **GROUP 4**: 6.5% cocoa seed extract acetone-water (CSE-AC) **GROUP 5**: distilled water (CO)

TABLE 2: OUTCOME OF THE STUDIES INCLUDED IN THE SYSTEMATIC REVIEW

S.NO	AUTHOR	RESTORATIVE MATERIAL USED	ANALYSIS OF BOND STRENGTH	OUTCOME
1	Gajjela RS et al.[9]	Composite restoration	Micro tensile bond strength test using a universal testing	Group III (GSE 6.5%) showed significant bond strength to dentin when

			machine (μ TBS)	compared to group I (control) & IV (1% riboflavin/ chitosan)
2	G.V. Macedo et al. [6]	Composite build-up	Crosshead speed tensile test	Both glutaraldehyde and grape seed extract showed a significant increase in dentin bond strength.
3	Kalra M et al.[10]	Endodontically treated tooth with RealSeal SE sealer and filled with Real Seal core material	Push-out strength testing using a universal testing machine	-PAs rich grape seed extract showed higher bond strength and durability between resin-based sealer and root dentin after short term water storage(1 week) -PAs rich GSE showed decreased bond strength after long term storage (3 months)
4	Atabek S et al.[11]	-resin cement (P) -resin-modified glass ionomer cement (K) -hybrid calcium aluminate glass ionomer cement (C) - glass ionomer cement (G)	Shear bond strength was measured using a universal testing machine (MPa)	-Resin cement (P) showed higher bond strength to dentin than other cement -6.5% PAs rich grape seed extract showed higher dentin bond strength to conventional glass ionomer cement.
5	Castellan CS et al.[12]	-Adper Single Bond Plus, which is ethanol-water based (SB, 3M ESPE) -One Step Plus, which is an acetone-based system (OS, BISCO)	Crosshead speed tensile test	Grape seed extract and ethanol-water showed increased stabilization after long term storage.

TABLE 3: BIAS ANALYSIS OF THE STUDIES

S. NO	AUTHOR	RANDOM SEQUENCE GENERATION	ALLOCATION CONCEALMENT	SELECTIVE REPORTING	INCOMPLETE OUTCOME DATA	BLINDING OF OUTCOME ASSESSMENT	BLINDING PARTICIPANTS AND PERSONALS

1	Gajjela RS et al.[9]	+	-	-	-	?	+
2	G.V. Macedo et al.[6]	+	-	-	-	?	+
3	Kalra M et al.[10]	+	-	?	-	?	+
4	Atabek S et al.[11]	+	-	-	-	?	+
5	Castellan CS et al.[12]	+	-	-	-	?	+

The bias is assigned as low risk (-), high risk (+), and unclear (?)

DISCUSSION

In 2017 Gajjela RS et al. evaluated the effect of chlorhexidine, grape seed extract, riboflavin/ chitosan on micro tensile bond strength of composite resin to dentin on 40 extracted human molars. The teeth were divided into four groups. Pretreatment was not done in group I. Before applying self-etch adhesive group II, III, IV was pretreated with 2% CHX, 6.5% GSE, and 1% riboflavin/chitosan respectively and composite build-ups were constructed.The bond strength (μTBS) was evaluated using the universal testing machine and it was inferred that pre-treatment of dentin with CHX and GSE leads to a significant increase in bond strength of composite resin to dentin.[9]

G.V. Macedo et al. in 2009 conducted a study to evaluate the effect of chemical cross-linkers on caries affected dentin bond strength. Forty-eight freshly extracted human molars were divided into three groups.Acid etching was done with 37% phosphoric acid and the dentin bond strength ofcontrol group, group 2(2.5% glutaraldehyde) and group 3(6.5% grape seed extract) was determined. After pre-treatment with respective groups, the composite build-up was done. Micro tensile bond strength was evaluated in crosshead speed tensile. It was found that, both glutaraldehyde and grape seed extract-treated tooth produced a significant increase in dentin bond strength and stability.[6]

Kalra M et al. in 2012 evaluated the effect of a proanthocyanidin rich grape seed extract on the bond strength and durability of resin sealer to root dentin. Twenty-eight single-rooted premolars were divided into proanthocyanidin treated and non treated groups. Resin sealer was placed and subjected to bond strength using the universal testing machine. Proanthocyanidin rich grape seed extracts improved the bond strength and durability between the resin sealer androot dentin after short term water storage.[10]. In 2019,Atabek S et al. conducted a study on the 180 dentin surfaces of the extracted molar teeth, to evaluate the effect of proanthocyanidin surface treatments on shear bond strength of different types of cement. They were divided into three groups, namely group A (control group), group B (6.5% Pa-rich GSE) group C (12.5% Pa-rich GSE). Different restorative materials used wereresin cement (P), resin-modified glass ionomer cement (K), hybrid calcium aluminate glass ionomer cement (C), glass ionomer cement (G). Shear bond strength was measured using the universal testing machine in megapascals (MPa). It was found out that, the application of 6.5% proanthocyanidin increased the dentin shearbond strength to conventional glass ionomer cement.[11] Hence the choice of material plays a crucial role in determining the dentin bond strength.

Castellan CS et al. in 2013 conducted a one-year bond strength study to investigate the long term resin-dentin bond strength by proanthocyanidin-rich agents on coronal dentin of 40 molars and divided into five groups. Group 1, group 2, group 3, group 4 and group 5 were 6.5% grape seed extract, 6.5% cocoa seed extract, ethanol-water (CSE-ET), 6.5% cocoa seed extract acetone-water (CSE-AC), and distilled water (CO) respectively. Pre-treatment was done with respective group agents and the dentin was restored with Adper Single Bond Plus, which is ethanol-water based (SB, 3M ESPE) and One Step Plus, which is an acetone-based system (OS, BISCO). Crosshead speed tensile test was used to evaluate the bond strength (μTBS) and it was concluded that grape seed extract and ethanol-water showed increased stabilization after long term storage. [12]. Bias assessment was done using the Cochrane risk assessment tool. Since, all five studies included in the current systematic review were in-vitro studies, random sequence generation and blinding of participants is not done and there was a high risk for selection bias and performance bias.

In 2011, S Vidhya et al. conducted a similar in-vitro study in 70 extracted human maxillary central incisors by evaluating the effect of grape seed extract on the bond strength of bleached enamel. Bleaching was done using 38% hydrogen peroxide gel for 10 minutes. Pretreatment was done in group II and group III with 10% sodium ascorbate solution and 5% proanthocyanidin solution, respectively. As a result, the teeth treated with 5% proanthocyanidin extract showed a marked increase in shear bond strength values than those teeth treated with 10% sodium ascorbate.[13]

LIMITATIONS:

Deriving conclusions from all the in vitro studies included in the present systematic review, the dentin bond strength do not directly predict clinical performance. Hence further invivo studies are required to determine the potential clinical effect of grape seed extract in dentin bond strength.

CONFLICTSOF INTEREST: None

CONCLUSION:

In conclusion, the current systematic review proves that the, proanthocyanidin rich grape seed extract significantly increases the dentin bond strength. Though with the use of chemical crosslinking, dentin bond strength varies depending on the restorative material used.

REFERENCES

1. Epasinghe DJ, Yiu CK, Burrow MF, Tay FR, King NM. Effect of proanthocyanidin incorporation into dental adhesive resin on resin–dentine bond strength. Journal of dentistry. 2012;40(3):173-180.
2. Joshi SS, Kuszynski CA, Bagchi D. The cellular and molecular basis of health benefits of grape seed proanthocyanidin extract. Current Pharmaceutical Biotechnology. 2001 Jun 1;2(2):187-200
3. Wu CD. Grape products and oral health. The Journal of nutrition. 2009;139(9):1818S-1823S.
4. Carvalho RM, Manso AP, Geraldeli S, Tay FR, Pashley DH. Durability of bonds and clinical success of adhesive restorations. Dental Materials. 2012;28(1):72-86.
5. Anusuya V, Jena AK, Sharan J. Grape Seed Extracts in Dental Therapy. Natural Oral Care in Dental Therapy. USA. Martin Scrivener, Phillip Carmical. 2020 Jan 30.
6. Macedo GV, Yamauchi M, Bedran-Russo AK. Effects of chemical cross-linkers on caries-affected dentin bonding. Journal of dental research. 2009;88(12):1096-1100
7. Ogata M, Okuda M, Nakajima M, Pereira PN, Sano H, Tagami J. Influence of the direction of tubules on bond strength to dentin. Operative Dentistry. 2001;26(1):27-35.

8. Fang M, Liu R, Xiao Y, Li F, Wang D, Hou R, Chen J. Biomodification to dentin by a natural cross-linker improved the resin–dentin bonds. Journal of dentistry. 2012 ;40(6):458-66.
9. Gajjela RS, Satish RK, Sajjan GS, Varma KM, Rambabu T, Lakshmi BV. Comparative evaluation of chlorhexidine, grape seed extract, riboflavin/chitosan modification on microtensile bond strength of composite resin to dentin after polymerase chain reaction thermocycling: An in vitro study. Journal of conservative dentistry: JCD. 2017 Mar;20(2):120.
10. Kalra M, Iqbal K, Nitisusanta LI, Daood U, Sum CP, Fawzy AS. The effect of proanthocyanidins on the bond strength and durability of resin sealer to root dentine. International endodontic journal. 2013 ;46(2):169-178.
11. Atabek S, Ozden AN. Comparison of the Effect of Proanthocyanidin Surface Treatments on Shear Bond Strength of Different Cements. Materials. 2019 ;12(17):1-10
12. Castellan CS, Bedran-Russo AK, Antunes A, Pereira PN. Effect of dentin biomodification using naturally derived collagen cross-linkers: one-year bond strength study. International journal of dentistry. 2013 ;1-6.
13. Vidhya S, Srinivasulu S, Sujatha M, Mahalaxmi S. Effect of grape seed extract on the bond strength of bleached enamel. Operative dentistry. 2011;36(4):433-438.