Antioxidant agents on bond strength of bonded bleached teeth: Literature review

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INTRODUCTION

Previous studies have shown that Hydrogen Peroxide (HP) and Carbamide Peroxide (CP) used as bleaching agents may adversely affect the bond strength of composite resin bonded to the tooth surface when adhesive procedures are performed immediately after the bleaching treatment.[5]
This reduction on bond strength of composite resin after bleaching is related with the presence of oxygen, a break down product of HP, because the residual oxygen might interfere with resin infiltration into the dentinal tubules and inhibit the polymerization of resin monomers.[4]
To avoid the weakening effects of bleaching, it is recommended to wait 1-3 weeks until the restoration procedure after the tooth bleaching.[4]
Recently many antioxidant agents has been investigated for its potential capability to reverse the temporary weakening effects of bleaching agents on the adhesion of the composite resin.[5]

OBJECTIVE

To review and to research *in vitro* studies that evaluate the effect of antioxidant agents on the bond strength of bonded bleached teeth.
This review may answer the following question: "Do antioxidant agents have effect on bond strength of bonded teeth after bleaching?"

METHODS

The research strategy was performed using the *PubMed / MEDLINE* electronic database, using the keywords: "antioxidant agent", "bond strength", "dental bleaching" and "composite restoration".
Inclusion criteria included in vitro studies published between 2011 and 2017. The exclusion criteria consisted in systematic or narrative reviews and case studies. The selection process followed the *PRISMA statement flowchart* method, having been carried out by two independent reviewers.

RESULTS

STUDY	OBJETIVES	GROUPS	RESULTS	CONCLUSIONS
Dabas *et al.*, 2011 (1)	To evaluate the effect of different concentrations of **Sodium Ascorbate (SA)** on the shear bond strength of bleached enamel with 17% Carbamide Peroxide (CP) - **varying periods of time**	**A (n=5)**: Control (Untreated) **B (n=5)**: Only bleaching with 17% CP **C (n=30)**:17% CP + 10% SA **D (n=30)**: 17% CP + 20% SA In C and D, the samples were further subdivided into 3 subgroups of 10 teeth each depending on the duration of application of Sodium Ascorbate: **C1/D1:** 30 minutes **C2/D2:** 60 minutes **C3/D3:** 120 minutes	Sodium Ascorbate application following bleaching **increased the resin-enamel bond strength** and was **directly proportional to its duration of application.** (**A**-24.23 MPa; **B**-18.01 MPa; **C1**-19.34 MPa; **C2**-24.30 MPa; **C3**-28.30 MPa; **D1**-19.36 MPa; **D2**-24.42 MPa; **D3**-28.22 MPa) ($p < 0.05$) **There was no difference in bond strength with an increase in the concentration of** Sodium Ascorbate.	The use of Sodium Ascorbate following bleaching, increased the composite resin-enamel bond strength and the shear bond strength **is directly proportional to the duration of the application.** However, **there was no difference in bond strengths on increasing the concentration** of Sodium Ascorbate.
Vidhya *et al.*, 2011 (2)	To assess the neutralizing effect of **grape seed extract** on the shear bond strength of bleached enamel with 38% Hydrogen Peroxide(HP)	**I (n=20)**: 38% HP - without antioxidant **II (n=20)**: 38% HP + 10% Sodium Ascorbate – 10 minutes **III (n=20)**: 38% HP + 5% grape seed extract – 10 minutes **IV (n=10)**: Control – no bleaching Groups I, II, e III were further subdivided into 2 subgroups of 10 teeth each: **A** – restoration immediately **B** – restoration after 2 weeks	**10% Sodium Ascorbate (Group II) and 5% grape seed extract (Group III) >** control group (Group IV). Grape seed extract **>** Sodium Ascorbate, **both when bonding is performed immediately and after delay of 2 weeks.** (IIA-34.51 MPa; IIB-38.29 MPa; IIIA-43.44 MPa; IIIB-47.96 MPa) ($p < 0.05$)	The use of **grape seed extract** prior to bonding procedures on enamel bleached with 38% Hydrogen Peroxide (for 10 minutes) **could completely neutralize the effect of bleaching agents and increase significantly the bond strength.**
Sharafeddin *et al.*, 2014 (3)	To assess the effect of **different antioxidants** on the shear bond strength of composite resin to home-bleached with 15% Carbamide Peroxide (CP)	**A (n=10):** Control – 15% CP – untreated **B (n=10):** 15% CP + 10% Sodium Ascorbate solution - 10 minutes **C (n=10):** 15% CP + 10% Pomegranate Peel solution - 10 minutes **D (n=10):** 15% CP + 10% Grape Seed extract - 10 minutes **E (n=10):** 15% CP + 5% Green Tea extract - 10 minutes **F (n=10):** 15% CP + Aloe vera leaf gel - 10 minutes	**No significant difference was observed** between the SBS of control group and the groups treated with antioxidants: (**A**-12.14 MPa; **B**-13.37 MPa; **C**-13.49 MPa; **D**-13.49 MPa; **E**-13.76 MPa; **F**-13.48 MPa) ($p < 0.05$)	Different antioxidants used in this study had the same effect on the SBS of home-bleached enamel, and **none of them caused a statistically significant increase in its value.**
Kadiyala *et al.*, 2015 (4)	To compare and evaluate the effect of **Aloe Vera** and **10% Sodium Ascorbate** on the shear bond strength of composite resin to bleached enamel com 35% Carbamide Peroxide (CP)	**I (n=10)**: Control (no bleaching) **II (n=10)**: 35% CP and delayed composite resin bonding, after 1 week **III (n=10)**: 35% CP + 10% Sodium Ascorbate (10 minutes) and composite resin bonding immediately **IV (n=10)**: 35% CP + Aloe Vera (10 minutes) and resin composite bonding immediately **V (n=10)**: Control (Bleached with 35% CP and immediate bonding)	Grupo **V** (11,600 MPa) - **lower** bond strengths than other groups: (**I** -19.080 MPa; **II** -18.150 MPa; **III** -16.040 MPa; **IV** – 16.260 MPa) ($p < 0.05$). **There was no statistically** significant difference between the shear bond strength values of groups I, II, III, IV.	Treatment of the bleached enamel surface with **Aloe Vera and 10% Sodium Ascorbate provided consistently better bond strength.** **Aloe Vera may be used as an alternative to 10% Sodium Ascorbate**
Carvalho *et al.*, 2016 (5)	To evaluate the antioxidant activity of **Green Tea (GT)** and **Sodium Ascorbate (SA)** gel in three concentrations (10%, 20% and 30%), and their influence on the microshear bond strength (μ-SBT) values of bleached enamel with 10% Carbamide Peroxide (CP)	**G1 (n=10):** Positive control – no treatment **G2 (n=10):** Negative control – bleached with CP **G3 (n=10)**: CP + 10% GT – 60 minutes **G4 (n=10)**: CP + 20% GT - 60 minutes **G5 (n=10)**: CP + 30% GT - 60 minutes **G6 (n=10)**: CP + 10% SA - 60 minutes **G7 (n=10)**: CP + 20% SA - 60 minutes **G8 (n=10)**: CP + 30% SA - 60 minutes	The **higher the concentration**, **the lower** the **μ-SBT** values: (**10% - G3** – 19.65 MPa; **G6** – 19.58 MPa **20% - G4** – 17.02 MPa; **G7** – 18.15 MPa **30% - G5** – 13.33 MPa; **G8** – 14.39 MPa) ($p = 0.007$) There was a **significant difference among the concentrations** but no significant difference between the antioxidants evaluated. ($p = 0.625$)	Sodium Ascorbate and Green Tea **are more effective in a concentration of 10%**, and both presented high values of antioxidant activity, which can be used to overcome the values of reduced bond strength in bleached enamel.
Ismail *et al.*, 2017 (6)	To assess the effect **of 35% Sodium Ascorbate (SA)** during **2 minutes** on the microtensile bond strength of dentin immediately after bleaching with 35% Hydrogen Peroxide (HP)	**I (n=5):** 35% HP + immediate bonding of composite **II (n=5):** 35% HP + delayed bonding (1 week after bleaching) **III (n=5):** 35% HP + 35% SA (2 applications – 1 minute) + immediate bonding of composite **IV (n=5):** 35% HP + 35% SA (2 applications – 1 minute) + delayed bonding (1 week after bleaching) **V (n=5):** Negative Control – only bonding	The mean microtensile bond strength of **Group I** (34.17 MPa) was **significantly decreased** when compared to the values from all other groups: **Group II** (45.36 MPa) **showed similar values** to the **Group V** (45.83 MPa) The mean microtensile bond strength values for the **Group III** (45.06 MPa) was significantly **higher than the Group I.** ($p < 0.05$)	Treatment with **35% Sodium Ascorbate** immediately following bleaching with 35% Hydrogen Peroxide **restores** the original bond strength of the composite resin–dentin interface. Therefore, treatment with a **35% sodium ascorbate solution** (**2 applications for 1 minute** each) is an **effective and time-efficient solution to reverse the compromised bonding** that results from bleaching with 35% hydrogen peroxide.

Table 1: Synthesis of studies included in this review

CONCLUSION

The use of antioxidant agents after bleaching neutralizes the deleterious effects of bleaching and increases bond strength values, closer to the usual values. However, this effect is dependent on the type of antioxidant, concentration and duration of the application.
Therefore, antioxidant treatment can be considered a successful technique to improve the bond strength of bonded teeth after bleaching.

CLINICAL IMPLICATIONS

The application of antioxidant agents could be an advantage for the clinical and for the patient because it will decrease the waiting time between the bleaching and restorative procedure, also decreasing the time required to complete the treatment.

REFERENCES

1. Dabas D, Patil AC, Uppin VM. (2011). Evaluation of the effect of concentration and duration of application of sodium ascorbate hydrogel on the bond strength of composite resin to bleached enamel. *J Conserv Dent*
2. Vidhya, S., Srinivasulu, S., Sujatha, M. & Mahalaxmi, S. (2011). Effect of Grape Seed Extract on the Bond Strength of Bleached Enamel. *Operative Dentistry, 36-4, 433-438*
3. Sharafeddin, F. & Farshad F. (2014). The Effect of Aloe Vera, Pomegranate Peel, Grape Seed Extract, Green Tea, and Sodium Ascorbate as Antioxidants on the Shear Bond Strength of Composite Resin to Home-bleached Enamel. *Dent ShirazUnivMed Sci, 16(4): 296-301.*
4. Kadiyale, A., Saladi, H. K., Bollu, I. P., Burla, D., Ballullaya, S. V., Devalla, S., Maroli, S. & Jayaprakash, T. (2015). Effect of Different Anti-Oxidants on Shear Bond Strength of Composite Resins to Bleached Human Enamel. *Journal of Clinical and Diagnostic Research, Vol-9(11): ZC40-ZC43.*
5. Carvalho, H. C., Guiraldo, R. D., Poli-Frederico, R. C., Maciel, S. M., Moura, S. K., Lopes, M. B. & Berger, S. B. (2016). Correlation between antioxidant activity and bonding strength on bleached enamel. *Acta Biomaterialia Odontologica Scandinavica, 2:1, 102-107*
6. Ismail, E. H., Kilinc, E., Hardigan, P. C., Rothrock, J. K., Thompson, J. Y. & Garcia-Godoy, C. (2017). Effect of Two-minute Application of 35% Sodium Ascorbate on Composite Bond Strength following Bleaching. *The Journal of Contemporary Dental Practise, 18(10):874-880.*