EGYPTIAN DENTAL JOURNAL

VOL. 65, 587:598, JANUARY, 2019

I.S.S.N 0070-9484

FIXED PROSTHODONTICS, DENTAL MATERIALS, CONSERVATIVE DENTISTRY AND ENDODONTICS

www.eda-egypt.org • Codex : 171/1901

THE EFFECT OF TWO DIFFERENT ANTIOXIDANTS ON THE SHEAR BOND STRENGTH OF RESIN BONDED GLASS CERAMICS TO BLEACHED ENAMEL

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ABSTRACT

Aim of the work: The aim of this study was to evaluate the effect of antioxidant agents and delayed bonding on the shear bond strength (SBS) of glass ceramic veneers bonded to the bleached enamel.

Materials & Methods: A total number of sixty extracted maxillary central incisors with intact labial enamel were collected and randomly divided to six groups of ten teeth each. Ten teeth were remain without bleaching and the remaining fifty teeth were bleached using 35% hydrogen peroxide, (SDI Polaoffice tooth whitening system). Sixty lithium disilicate glass ceramic discs of 4mm diameter and 5mm height were fabricated from IPS e.max Press and divided to six groups of ten discs each. Group I glass ceramic discs bonded to the unbleached enamel surface. Group II glass ceramic discs immediately bonded the bleached enamel after bleaching procedure without antioxidant. Group III glass ceramic discs immediately bonded to the bleached enamel after 10% ascorbic acid antioxidant application to the bleached enamel. Group IV glass ceramic discs immediately bonded to the bleached enamel after 20% ascorbic acid antioxidant application to the bleached enamel. Group V glass ceramic discs immediately bonded to the bleached enamel after 2% green tea antioxidant application to the bleached enamel. Group VI glass ceramic discs bonded to the bleached enamel after 2 weeks waiting period. The tested specimens, were tested for shear bond strength using a universal testing machine at a crosshead speed of 0.5mm/min until failure. The failure load was then recorded and statistically analyzed.

Results: Analysis of the mean SBS between all groups it was found that the highest mean SBS for the control group CG of 30.22 ±0.92 MPa followed by group VI, with a mean of 26.90 ±1.27 MPa and group V with a mean of 26.0 ±1.80 MPa then group III, with a mean of 25.0 ±1.60 MPa and group IV with a mean of18.99±1.69 MPa the lowest mean fracture loads of 13.25± 0.36 MPa was for group II.

Conclusions : Within the limitations of this study, it was concluded that antioxidant agents neutralize the effect of bleaching agents and considered a viable alternative to delayed waiting period.

KEYWORDS: Antioxidant, Shear bond strength, Bleaching agent.

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INTRODUCTION

In the context of growing aesthetic awareness many procedures have been proposed to remove the surface stains as microabrasion, macroabrasion, bleaching, laminate veneers and porcelain crowns to restore maximum esthetics. [1,2]

Tooth bleaching is a well-accepted procedure, for the treatment of intrinsic staining of teeth, that can be performed at home and in the dental office. Among bleaching agents, are the carbamide peroxide and a high concentration of hydrogen peroxide (30–35%). [3]

The oxygen present in bleaching agents remove some organic matter from the tooth by diffusion without affecting the enamel matrix, leading to tooth whitening. Although bleaching can successfully give a good result, but sometimes the final color may not be clinically accepted in few cases. [4]

Consequently after bleaching procedure, additional aesthetic interventions are recommended, as ceramic laminate veneers, to restore the aesthetic deficiencies however many studies reported a reduction in bond strengths of these restorations. [5,6]

Laminate veneers (LV) are indicated as minimal invasive treatment option alternative to full coverage crowns. The durable adhesion of laminate veneers is critical for long-term clinical success since retention of the restorations does not rely on mechanical retention principles. [7]

Bonding of veneer restorations to tooth structure immediately after bleaching is challenging as the bond strength is reduced after bleaching procedures as a result of the presence of residual peroxide, that inhibit the resin polymerization, consequently decrease the bond strength of composite to bleached enamel. [9,8]

Previous studies recommended a waiting period ranged from 24 hours to 4 weeks after bleaching procedures to gain strong bond strength of the veneers which is impossible in many situations. Thus it is necessary to find new techniques to reduce the waiting period after bleaching. [10]

Several studies were suggested to solve the clinical problem of the post-bleached compromised bond strength, moreover demonstrated that the reduced bond strength can be improved immediately after bleaching by the use of antioxidants such as sodium ascorbate, ascorbic acid, butylhydroxianisole, catalase, ethanol, acetone, glutathione peroxide, alpha-tocopherol, sodium bicarbonate, grape seed extract (proanthocyanidin) and green tea extract. [11]

Ascorbic acid and its sodium salts are potent antioxidants that have the ability to overcome reactive free radicals of the bleaching agent safely. [12]

Increase in bond strength of ceramic veneer to the bleached enamel surface after application of antioxidant can reverse the reduction in bond strength, and may be considered an alternative to the delayed bonding procedure. [13,14]

Green tea is a natural product, with an extended shelf life which can be used after bleaching procedure and investigated by several studies. Green tea possesses a potent antioxidant activity that is several times higher than that of vitamins C and E. [15]

The aim of this study was to evaluate the effect of antioxidant agents and delayed bonding on the shear bond strength (SBS) of glass ceramic veneers bonded to the bleached enamel.

The hypothesis was that the antioxidant has a little effect in improvement of the shear bond strength of indirect restorations to the bleached enamel

MATERIALS AND METHODS

Materials

IPS e-max press material, a Luting resin cements, and bleaching agent were used in this study.

A total number of sixty extracted maxillary central incisors with intact labial enamel were

collected from the Oral Surgery Department at the Faculty of Dentistry, Alexandria University.

The teeth were examined to exclude those with surface cracks and developmental anomalies. Hypoplasia, hypocalcification, and caries on labial surface .

Teeth were cleaned and washed under running tap water. The roots were separated from the crowns using a high speed diamond stone under constant water cooling at the cement-enamel junction and the crowns were embedded in an auto polymerizing acrylic resin block using customized copper mold of dimensions (15 X 20 mm), The labial surfaces were placed facing upwards and were flattened using sandpaper disc at low speed under running water.

Methods

Teeth grouping

The teeth were randomly divided to six groups of ten teeth each. Ten teeth were left without bleaching and the remaining fifty teeth were bleached using 35% hydrogen peroxide, (SDI Polaoffice tooth whitening system) and divided into five groups.

Bleaching of enamel

The polaoffice powder was mixed with hydrogen peroxide liquid by small brush and about 1-2 mm thick layer of gel was applied on the surface of the enamel and left for 15 minutes. Then the gel was removed from the teeth by suction and rinsed with water spray.

Glass ceramic discs fabrication

Sixty lithium disilicate glass ceramic discs of 4mm diameter and 5mm height were fabricated from IPS e.max Press (IvoclarVivadent. Benderestrasse 29494 Schann, Liechtenstein, Switzerland). Ceramic specimens were prepared using a specially designed copper mold consisting of the following parts.

1- A copper rectangular base 12cm x 4cm.

2- Two split rectangular plats 5mm in height fit on each other on the top of the copper base both split plates incorporate four identical cylindrical split molds of 4mm in diameter each. Both split plates were fixed to each other and to the copper base by six screws.

The split mold was paint with separating medium, (IPS Ceramic Separating Liquid, Ivoclar Vivadent AG, Schaan, Liechtenstein) filled with molten wax and after the wax disc became hard the split mold was disassembled then the wax was adjusted, sprued, invested by IPS Press VEST Speed Investment ma¬terial (IPS Press VEST Speed-Ivoclar vivadent, Schaan Liechtenstein) and pressed from IPS e- max ingot in Press furnace - Programat EP 3000. A digital caliper was used to verify the discs measurements.

Specimens preparation

Group I, unbleached enamel surfaces (control group).

Teeth specimens were not bleached and the glass ceramic discs were bonded to the treated enamel surfaces as follow.

Pre-treatment of the enamel surface

Phosphoric acid gel (37%) was applied to the enamel surface with a disposable syringe tip, for20 seconds. All etchant gel was removed with a vigorous water spray for at least 10 seconds then dried with oil free compressed air for 10 seconds, subsequently, bond was applied and gently agitated for at least 10 seconds and light cured for 20 seconds using a light curing (LED) unit (Bluephase, Ivoclar Vivadent Benderestrasse 29494 Schann, Liechtenstein, Switzerland.

Discs surface treatment and resin cementation

The discs were etched using 5% hydrofluoric acid (IvoclarVivadent. Benderestrasse 29494

Schann, Liechtenstein, Switzerland) for 20 seconds then rinsed off by water then a silane coupling agent, Monobond Plus was applied for 60 seconds then air dried with oil free compressed air. A choice 2 veneer light cured resin cement (Bisco Inc. Schaumburg, IL 60193 U.S.A.) was used to cement the discs to the unbleached labial enamel surface under a custom made load of 2 Kg.

Specimens were cured for 3 seconds and the excess cement was remove by scaler then cured for 40 seconds using a light curing (LED) unit (Bluephase, Ivoclar Vivadent Benderestrasse 29494 Schann, Liechtenstein, Switzerland).

Group II, Immediate bonding after bleaching without antioxidant

The glass ceramic discs were bonded to the enamel surface immediately bonded after bleaching without antioxidant agent application as previously mentioned in group I.

Group III Immediate bonding after bleaching, with10% ascorbic acid antioxidant

Teeth specimens were bleached using 35% hydrogen peroxide, and an antioxidant agent of 10% ascorbic acid (Faculty of Pharmacy, Alexandria University, Egypt) was then applied to the teeth specimens immediately following bleaching using a disposable brush. The Ascorbic acid was left for 15 minutes then rinsed with water spray for 30 seconds and dried with oil free compressed air.

The glass ceramic discs were then bonded to the enamel surface as previously mentioned.

Group IV Immediate bonding after bleaching, with 20% ascorbic acid antioxidant

Teeth specimens were bleached using 35% hydrogen peroxide, and an antioxidant agent of 20% ascorbic acid was then applied to the specimens immediately following bleaching using a disposable brush. The Ascorbic acid was left for 15 minutes then rinsed with water spray for 30 seconds and dried with oil free compressed air.

The glass ceramic discs were then bonded to the enamel surface as previously mentioned.

Group V Immediate bonding after bleaching, with 2% green tea extract antioxidant

After bleaching procedure was completed 2% green tea extract antioxidant solution was prepared from 300 mg of green tea extract [4] tablet, (Arab company for pharmaceutical and medicinal plant MEPACO-MEDIFOOD Enshas – sharkeya EGYPT) dissolved in 15 ml of distilled water then applied to the enamel surface and left for 15 minutes then rinsed with water spray for 30 seconds and dried with oil free compressed air.

The treated glass ceramic discs were then bonded to the enamel surface as previously mentioned.

Group VI delayed bonding

Specimens were bleached using 35% hydrogen peroxide then placed in artificial saliva in a glass container for 14 days. [16]. The artificial saliva solution was changed twice daily during the 14-days time period. The Specimens were removed from artificial saliva and the enamel surfaces were rinsed with water spray dried with oil free air for 30 seconds. The treated glass ceramic discs were then bonded to the enamel surface as previously mentioned.

Specimens Thermal Cycling

The thermal cycling was done using a custom made machine (**Dental Biomaterial Department, Alexandria University)** .Thermal cycles were 1200 cycles between 5C°55/C° water baths with a dwell time of 2 minutes. The thermal cycles parameters were represented one year of oral simulation. [17,18] The specimens were placed in special container that was fixed to a cord circulating around two metal wheels controlled by a motor drive. The container with specimens was allowed to pass through each tank with 2 minutes dwell time. The dwell time represented the amount of time the specimens were

immersed in particular bath temperature. A counter was attached to the cord to count the number of cycles.

Shear bond strength test

After Thermal Cycling the tested specimens, were tested for shear bond strength using a Universal Testing Machine (Comten Industries Inc., Florida, USA). The load of the universal testing machine was applied parallel to the long axis of the specimen's surface close to the bonded area, at a crosshead speed of 0.5mm/min until failure.

The failure load was then recorded and statistically analyzed. Shear bond strength (B) values was calculated according to the following equation. [19]

$B = F \times S - 1$

Where:

B: Shear bond strength in MPa

F: The load in N

S: The bonded area of the disc in mm2

$S = \pi r2$

Where:

S: The bonded area of the disc in mm2

π: 3.14159

r: Radius of the disc in mm

Stereomicroscope test

After the shear bond strength testing, all the specimens were examined using a stereomicroscope (Olympus SZ-CTV, Japan) and linked digital camera (Panasonic WV-CP 230/ G, Japan) at 20X magnification.

Failure mode

Adhesive: failure at the enamel-cement interface.

Cohesive: failure in the enamel alone or the resin cement alone.

Mixed: a combination of adhesive and cohesive failures.

RESULTS

Data were fed to the computer using IBM SPSS software package version 20.0. Quantitative data were described using mean and standard deviation for normally distributed data. For normally distributed data, comparison between more than two population were analyzed F-test (ANOVA) to be used.

Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

Analysis of the mean SBS between all groups it was found that the highest mean SBS for the control group CG of 30.22 ±0.92 MPa followed by group VI, with a mean of 26.90 ±1.27 MPa and group V with a mean of 26.0 ±1.80 MPa then group III, with a mean of 25.0 ±1.60 MPa and group IV with a mean of18.99±1.69 MPa the lowest mean of 13.25± 0.36 MPa was for group II.

Analysis of the SBS of the 6 group by using ANOVA (F) test, it was found that there was a significant difference in SBS between the 6 groups, on comparing the control group with other groups, it was found that there was a significant difference between control and group II, III, IV and V, with high SBS in control group while group VI show insignificant difference with control. Analysis of the SBS between group II and IV it was found that there was no significant difference. On comparing group III and IV, it was found that there was a significant difference with high SBS values in group III. Comparison between group III and V show no significant difference. Comparison between group IV and V show significant difference with high SBS values in group V.

Stereomicroscope examination results

The shear bond strength results of all the specimens using a stereomicroscope (Olympus SZ-CTV, Japan) at 20X magnification. Group I revealed

that adhesive failure in one specimen (10%), 5 specimens cohesive failure (50%) (4 specimens within the enamel surface and one specimen within the resin cement) and 4 specimens (40%) mixed failure. Group II revealed 8 specimens adhesive failure between the resin cement and enamel surface (80% of specimens), two specimens (20%) mixed failure and no cohesive failure. Group III revealed that 3 specimens adhesive failure (30%) between the resin cement and enamel surface, 2 specimens (20%) cohesive failure within the resin cement and 5 specimens (50%) mixed failure. Group IV revealed that 5 specimens adhesive failure (50%) between the resin cement and enamel surface, 2 specimens (20%) cohesive failure within the resin cement and 3 specimens (30%) mixed failure. Group V revealed that 2 specimens adhesive failure (20%), between the resin cement and enamel surface, 2 specimens (20%) cohesive failure within the resin cement and 6 specimens (60%) mixed failure. Group VI revealed that 2 specimens adhesive failure (20%) between the resin cement and enamel surface, 3 specimens (30%) cohesive failure within the resin cement and 5 specimens (50%) mixed failure. Fig (2)

The numbers and percent of different types of bonding failure for each group according to stereomicroscopic imaging are summarized in table 2.

TABLE (1) Means and slandered deviation of the tested groups.

Shear bond strength	Group I (CG)	Group II Immediate bond	Group III 10% ascorbic acid	Group IV 20% ascorbic acid	Group V 2% green tea extract	Group VI delayed bonding	F	P
Min- Max	**29.30** **31.14**	**11.61** **15.52**	**23.40** **26.60**	**17.30** **20.68**	**24.30** **27.10**	**25.30** **28.20**	22.1	0.001*
Mean ±SD	30.22 0.92	13.25 0.36	25.0 1.60	18.99 1.69	26.0 1.80	26.90 1.27		
Median	30.22	13.2	25.0	18.99	26.0	26.40		
All # control		0.001*	0.046*	0.001*	0.048*	0.062		
II # IV	0.105 N.S.							
III # IV III#V IV#V	0.0021* 0.652 0.013*							

: Statistically significant at p ≤ 0.05.

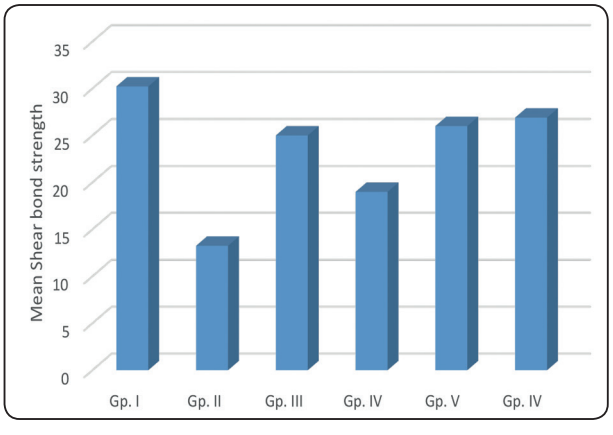
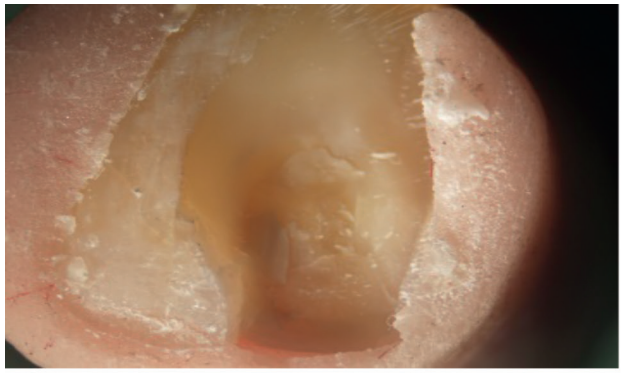
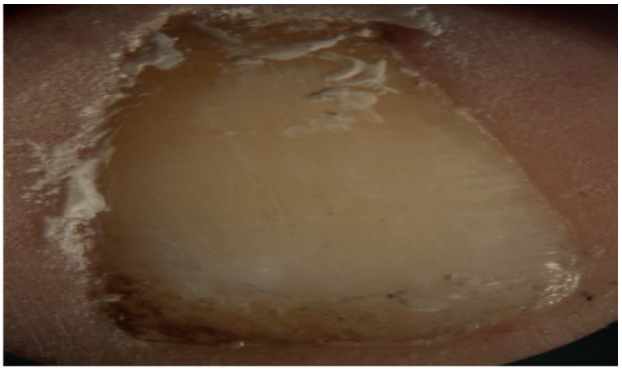


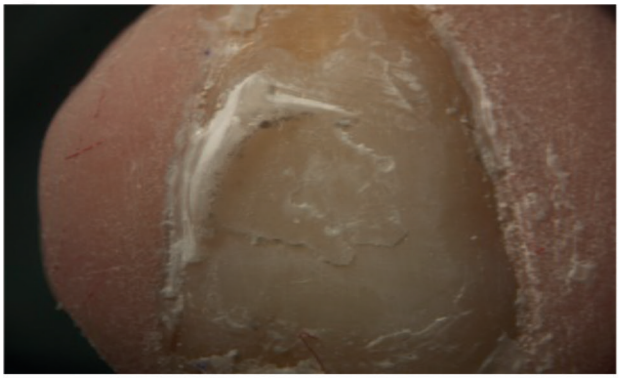
Fig (1) Comparison between SBS in different groups



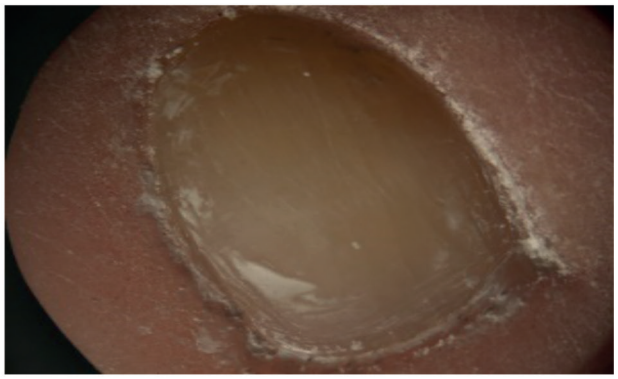
Cohesive failure within the tooth structure in Group I (control group).



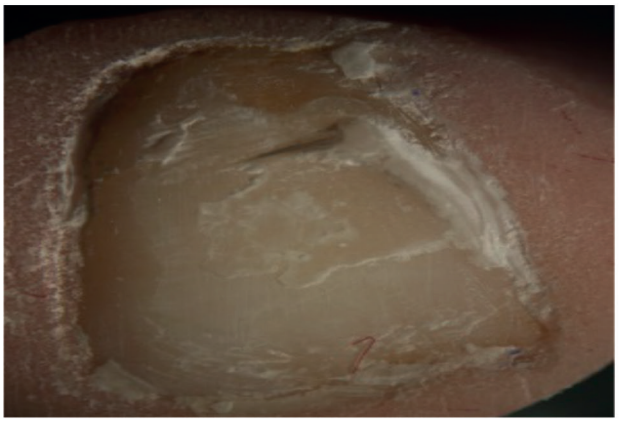
Adhesive failure in Group II



Cohesive failure within resin cement III



Adhesive failure in Group IV



Mixed failure in Group V

Mixed failure in Group VI

Fig (2): Failure modes of tested groups .

TABLE (2): Comparison between the failure modes of tested groups in percent.

Mode of failure / Groups	Adhesive (n=10)		Cohesive (n=10)		Mixed (n=10)	
	No	%	No	%	No	%
Group I	1	10 %	5	50%	4	40%
GroupII	8	80%	0	0%	2	20%
GroupIII	3	30%	2	20%	5	50%
GroupIV	5	50%	2	20%	3	30%
GroupV	2	20%	2	20%	6	60%
GroupVI	2	20%	3	30%	5	50%

DISCUSSION

The initial bond strength to enamel surface after bleaching is important to be investigated as patients may require an additional aesthetic rehabilitation.[20]

Previous studies showed that the bond strengths of indirect restorations to tooth structure were decreased when the tooth was bleached with carbamide peroxide or hydrogen peroxide.Many reports suggested a waiting period ranged from 1 day to 3 weeks are mandatory to proceed with an adhesive procedure. [21]

Clinical success of bonded restorations depend on adequate adhesion to tooth surface and any disturbance of adhesion of such restorations can affect its longevity and its failure. [10]

Immediate bonding of indirect restorations after bleaching procedures decreases the bond strength as a result of a delayed release of oxygen that could interfere with resin infiltration into the etched enamel or inhibit polymerization of resins. If the oxygen-rich surface layer of enamel is removed, the bond strength of resin to enamel returns back near to the normal values.[22]

The use of antioxidants to eliminate the residual oxygen in the enamel structure immediately after bleaching to enable the bonding procedure, was studied.

Antioxidants surface treatment showed improvement in bond strength whereas others showed conflicting results in improving the bond strength values.[24,23]

This study was conducted to evaluate the effect of two types of antioxidant, ascorbic acid and green tea extract, on the shear bond strength of glass ceramics to the bleached enamel surface and compare this bond strength value with the immediate and delayed bond strength.

The result of this current study showed that treatment with 2 % green tea extract (Group V) has a significantly higher bond strength compared with group IV (20% ascorbic acid) and there was no significant difference with group III (10%ascorbic acid). This could be attributed to the hydroxyl groups present in its structure that bind and neutralize the free O_2 radicals.

The 2% green tea extract has the same antioxidant activity as 10% ascorbic acid and both antioxidants had more powerful antioxidant activity than 20% ascorbic acid.

Sharafeddin Fa.[25] et al concluded that, using green tea extract as antioxidant had no significant effects on the SBS of resin composite to enamel bleached with 15% carbamide peroxide gel but it had significant increasing effect on the shear bond strength of resin composite to enamel bleached with38% hydrogen peroxide gel, they related this result to the less amount of residual oxygen molecules produce by carbamide peroxide gel than hydrogen peroxide and they supposed that the effect of the antioxidant on SBS increase as the bleaching agent concentration increased. These results were in agreement with the result of the current study.

In another study they reported that the application of both sodium ascorbate, and green tea on enamel surface bleached with 38% hydrogen peroxide can neutralize the effect of residual oxygen on the bleached enamel and consequently increase the SBS of resin composite. This result was in agreement with the result of the current study.[26]

Hwang JY,[27] et al showed that treatment with 2 % green tea extract increases bond strength significantly to the bleached enamel and attributed this result to that the green tea is a polyphenols antioxidant potential so has hydroxyl groups structure, which bind and neutralize the free radicals, the result of this study is in-agreement with the result of this current study.

Ascorbic acid and its salt sodium ascorbate are antioxidant that allows the free-radical polymerization of the adhesive resin by restoring the altered redox potential of the oxidized substrate thus reversing the compromised bonding in same

time may increase the bond strength as a result of its etching potential.[28]

This study showed the positive effects of 10% ascorbic acid solution as an antioxidant on the bonding capacity to enamel surface bleached with 35% hydrogen peroxide and reported a significant increase in shear bond strength in the group that received the antioxidant for 10 minutes. On the other hand 20% ascorbic acid did not increase the shear bond strength significantly, this indicated that increase in concentration of ascorbic acid has no effect in shear bond strength of resin to the bleached enamel.

Several studies reported that the application of antioxidant on the bleached enamel before bonding procedures can completely neutralizes the deleterious effects of bleaching and increases the bond strength significantly. Anoharan M.[29] studied the effect of 10% sodium ascorbate gel as antioxidant on the bond strength of the resin to bleached enamel and concluded that antioxidants neutralizes the effects of bleaching and increases the bond strength to bleached enamel significantly. This result was in agreement with the result of this study.

Subramonian R et al.[30] evaluated the effect of 10% sodium ascorbate, on the shear bond strength of composite resin to bleached enamel and observed that the use of antioxidants effectively reversed the reduced bond strength of bleached enamel. This result coincide with the result of this study.

Muraguchi K, et al.[31] showed that 10% ascorbic acid has a low pH and when used for 1 or 10 minutes, can create micromechanical retention on bleached enamel which consequently increases the bond strength which is in agreement with this study.

Kunt GE, et al.[32] reported that antioxidant agents can increase the bond strength of resin to the immediately bleached enamel after 10 minutes application of 10% ascorbic acid, which is reasonable time for clinical use.

Lai et al.[23] immersed the bleached specimens in 10% sodium ascorbate solution for 3 h and concluded that sodium ascorbate treatment appeared to restore the reduced bond strength of composite to the bleached enamel samples after certain time not less than 3 H .

This result did not coincide with the current study, this may be due to the low pH and etching ability of 10% ascorbic acid, used in this study, that creates micromechanical retention beside its antioxidant effect on bleached enamel.These two factors are considered the main cause of the increase in SBS.

Another study was done by Silva J et al.[31] who concluded that the sodium ascorbate was the only antioxidant agent able to totally reverse the bond strength to enamel immediately after bleaching and in the same time delayed bonding for 1 week after bleaching increased the bond strength to bleached enamel, this result is in agreement with the result of this study.

Suneetha R et al.[34] Analyzed the bond strength of composite resin to bleached enamel using a synthetic and herbal antioxidants and showed that the sodium ascorbate antioxidant agent can reverse the bond strength of composite to enamel immediately after bleaching which is in agreement with the result of this study.

The present study, showed that treatment with 10% of ascorbic acid and 2% green tea antioxidant solutions have the ability to reverse the value of bond strength as unbleached teeth beside that there is no significant difference in bond strength of resin to bleached enamel treated with ascorbic acid and green tea, and both materials were able to neutralize the negative effect of bleaching agent.

Waiting period time after bleaching is required to restore the bond strength to unbleached level is quite controversial. Although, there are variations among the waiting periods, many studies recommended a delayed period before bonding for 1 week after bleaching by immersion in a remineralized solution to restore the enamel properties and optimal adhesion.[34,35]

The present study showed that the shear bond strength of group I (unbleached group) is higher than all tested groups with significant difference between the group I and groups II, III, IV,V and insignificant difference with group VI (delayed bonding). The shear bond strength of the antioxidant treated group, control and delayed bonding groups were much higher than the immediate bonding group, with the control being the highest.

In this study, delayed bonding recovered the bond strength of a resin to enamel.

These results were in agreement with Turkun et al. [36] who reported that there were no statistically significant differences in shear bond strength between the delayed bonding and the unbleached enamel surface. This might be due to the possible structural changes on enamel that were repaired during waiting period while teeth were stored in artificial saliva.

Zhao H, et al[37] explained that the structural alteration of the enamel and the reduction of bond strength in the presence of peroxide related to the replacement of the hydroxyl radicals in the apatite lattice by peroxide ions and produce peroxide–apatite and when peroxide ions decompose, it was substituted again by the hydroxyl radicals which inter the apatite lattice, resulting in the elimination of the structural changes caused by the incorporation of peroxide ions.

Khoroushi et al. [38,39] suggested, a certain waiting period is required to allow a gradual elimination of residual oxygen from the bleached surface before adhesive restoration. This may be due to that immersion in water causes dispersion of residual oxygen that remains within the enamel and dentin matrix. Another explanation is that hydrogen peroxide is extremely unstable and may lose its activity after a period of time.

To minimize the effect of bleaching agent, several techniques were studied as pretreatment of bleached enamel with alcohol, the use of adhesives containing organic solvents, or sodium ascorbate antioxidant, and a post-bleaching waiting period ranging from 24 hours to three weeks.[40] Al-Hassani and Al-Shamma A[41] compared the neutralizing effect of delayed bonding and different antioxidant agents on the microleakage of composite restoration after bleaching with hydrogen peroxide. They concluded that delayed bonding of resin to the bleached teeth up to 14 days was enough to remove of the effect of bleaching also treatment of the bleached teeth with 10% sodium ascorbate, and 10% green tea antioxidant solution neutralize the adverse effect of bleaching material. These conclusions were coinciding with the current study.

The hypothesis of this study was rejected because it was found that different antioxidant agents affect the bond strength of enamel immediately after bleaching.

CONCLUSIONS

Within the limitations of this study, it was concluded that 10 % ascorbic acid and 2% green tea antioxidant agents effectively neutralize the deleterious effect of bleaching agents and increase the resin bond strength of the glass ceramic to the enamel and considered a viable alternative to delayed waiting period.

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