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COMPARATIVE EVALUATION OF BOND STRENGTH OF ENAMEL WITH AND WITHOUT NEUTRALIZER AFTER BLEACHING USING POLA OFFICE

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Type of Study: Original Study.

Running Tile: Shear bond strength evaluation of enamel with and without sodium ascorbate as neutraliser post bleaching with Pola office

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ABSTRACT:

Introduction: Tooth bleaching is the lightening of the colour of a tooth through the application of a chemical agent to oxidise the organic pigmentation in the tooth. The bleaching process is based on the REDOX reaction. Before the bleaching process, the tooth is the reducing agent and the bleaching agent is the oxidising agent. After bleaching , the tooth is oxidised and bleaching material is reduced. Application of neutraliser post bleaching enhances the bonding strength of enamel.

Aim: The aim of this study is to evaluate the bond strength of enamel with and without neutraliser after bleaching using Pola office.

Materials and methods: Two groups of six natural anterior teeth were selected and bleached with the Pola office. In one group, sodium ascorbate was applied as a neutraliser while the other group did not have a neutraliser. Both the groups were then etched, bonded and restored with composite. Both groups were then subjected for shear bond strength evaluation using Instron.

Results and discussion: Based on the results analysed it has been observed that bond strength has been increased significantly after application of neutraliser sodium ascorbate. Better bleaching is achieved by the action of free radicals like nascent oxygen and perhydroxyl which reduces the bond strength of enamel. Application of neutraliser like sodium ascorbate counteracts the activity of free radical improving bond strength.

Conclusion: The data obtained and graphical analysis showed that the samples with neutraliser had better shear bond strength and required higher amounts of force and compressive strength to debond the composite from enamel.

Keywords: Tooth bleaching**,** compressive strength, shear bond strength, Pola office, sodium ascorbate

INTRODUCTION:

Importance given to the aesthetic appearance of one's teeth and smile by this generation has paved the way for aesthetic dentistry to conquer such heights(Liu, 2001). Dental bleaching, a part of aesthetic dentistry, aims at removing any stains or discoloration and establishing a shade that matches the individual(Rao and Kumar, 2018). Tooth bleaching is the lightening of the colour of a tooth through the application of a chemical agent to oxidise the organic pigmentation in the tooth(Felicita, 2017). The bleaching process is based on the REDOX reaction. Before the bleaching process, the tooth is the reducing agent and bleaching agent is the oxidising agent. After bleaching , the tooth is oxidised and bleaching material is reduced(Jain, 2017). Vital bleaching is the most conservative way of bleaching which utilises hydrogen peroxide, carbamide peroxide or sodium perborate(*Website*, no date).

When bleaching agents are applied to the dental structures there is release of free radicals like nascent oxygen and hydroxyl or per hydroxyl ions(*Website*, no date; Kumar, 2017). These free radicals react with the electron-rich regions of the pigments inside the dental structure and convert large pigmented molecules into smaller, less pigmented molecules(Sivamurthy and Sundari, 2016). According to a theory, the peroxides and their by-products are capable of interfering with the polymerization process of the adhesive material(Kumar *et al.*, 2006). As after bleaching , the tooth is oxidised and bleaching material is reduced, the application of neutraliser post bleaching enhances the bonding strength of enamel usually where there is reduced bond strength(Azeem and Sureshbabu, 2018). The entrapment of residual bleach by-products in the collagen matrix and dentinal tubules is a suggested reason behind the reduction in bond strength upon bleaching(Krishnan and Lakshmi, 2013; Azeem and Sureshbabu, 2018). In studies of failed bonded specimens, residual oxygen was found to be trapped within the tooth structure preventing resin tags from fully penetrating and interlocking the tubules(Sekar *et al.*, 2019).

Application of neutraliser like sodium ascorbate will counteract the activity of free radical improving bond strength(Felicita, Chandrasekar and Shanthasundari, 2012). Ascorbic acid and its sodium salt are well-known antioxidants with the capacity of reducing oxidative compounds, especially free radicals(Neelakantan *et al.*, 2011; Felicita, Chandrasekar and Shanthasundari, 2012). Sodium ascorbate allows free-radical polymerization of the adhesive resin to proceed without premature termination by restoring the altered redox potential of the oxidised bonding substrate thus reversing the compromised bonding(Jain, Kumar and Manjula, 2014).

Pola office is a single use, simple in-office system of teeth bleaching(Johnson *et al.*, 2020). It uses a 35% hydrogen peroxide formula with potassium nitrate, a known desensitising agent(Keerthana and Thenmozhi, 2016). It acts on the nerve endings by blocking transmission of sensitive nerve impulses and providing a calming effect(Lakshmi *et al.*, 2015). The aim of this study is to evaluate the bond strength of enamel with and without neutraliser.

MATERIALS AND METHODS:

This in vitro study was conducted in Saveetha dental college at department of Conservative and Endodontics after obtaining ethical clearance from the research department. 12 human natural anterior teeth samples that were removed owing to periodontal issues were collected from the oral and maxillofacial surgery department of Saveetha Dental College and Hospital. Soft tissue, bone around the teeth, stains and calculus were removed and then segregated into 2 groups.

Inclusion criteria: Single rooted anterior teeth that were removed for orthodontic treatment or due to periodontal issue

Exclusion criteria: Presence of dental caries, root caries, fractured tooth, non vital tooth and restored tooth

Grouping: Group 1 - Pola office followed by sodium ascorbate; Group 2 - Pola office only

Baseline preparation: In group 1, six teeth were treated with the Pola office and rinsed after 15 minutes. Then freshly prepared neutraliser sodium ascorbate was coated onto the bleached enamel surface and then selective etching was done. It was then rinsed for one minute and a bonding agent was applied after which, composite was bonded to the tooth surface. In group 2 the enamel was treated with the Pola office for 15 minutes and directly etched. Then bonding was done without application of neutraliser .

Shear bond strength analysis: Then the samples were tested for shear bond strength using universal tester instron. The results were tabulated based on maximum force at which the composite gets debonded.

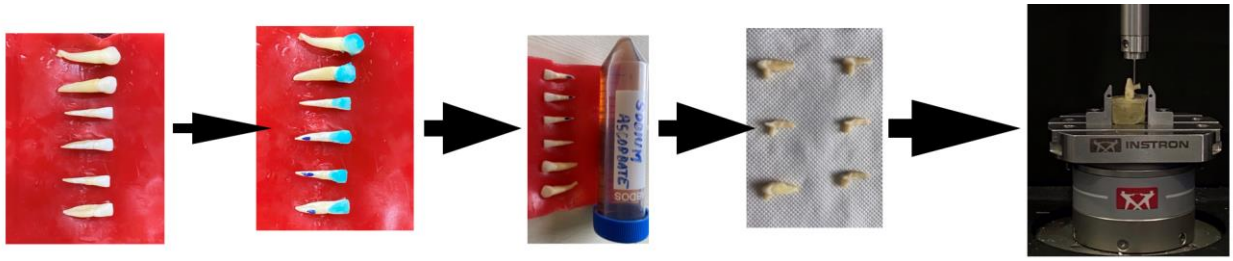


Figure 1 : Sequence of steps followed- six teeth collected for each group —> application of Pola office bleaching agent —> sodium ascorbate (neutraliser) application in one group —> composite restoration done on both groups —> shear bond strength evaluation using Instron.

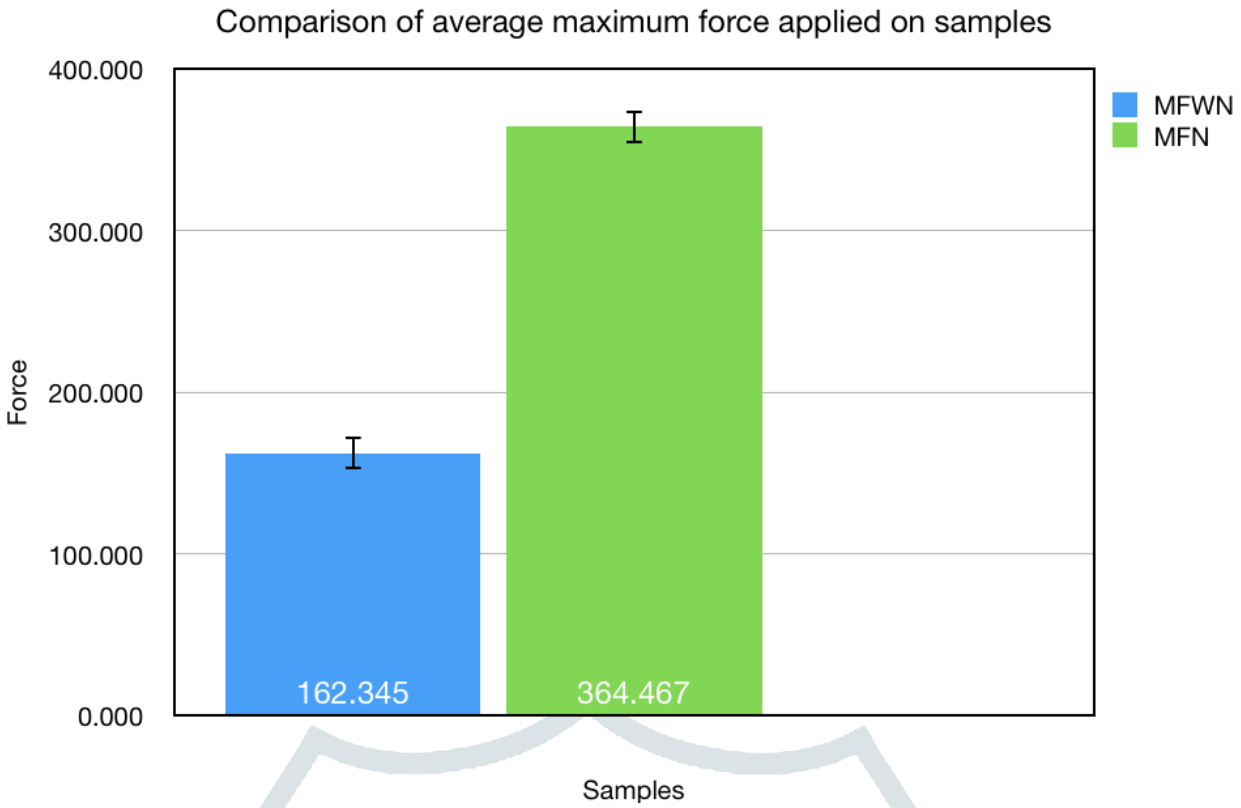
RESULTS:

Table 1 demonstrates the average values of maximum force at which the composite debonded and average compressive strength applied on the teeth samples which underwent bleaching using Pola Office followed by composite restoration with and without sodium ascorbate as neutraliser. 364.47 N is the average maximum force applied for the composite to debond the composite in teeth samples with neutraliser and 162.345N for samples without neutraliser. The average compressive strength for the teeth samples with neutraliser was found to be 24.14 Mpa while the samples without neutraliser had an average compressive strength of 10.855 Mpa.

Table 1: The above table shows the average values of maximum force and compressive strength on teeth which underwent Pola Office bleaching followed by composite restoration with and without sodium ascorbate as neutraliser

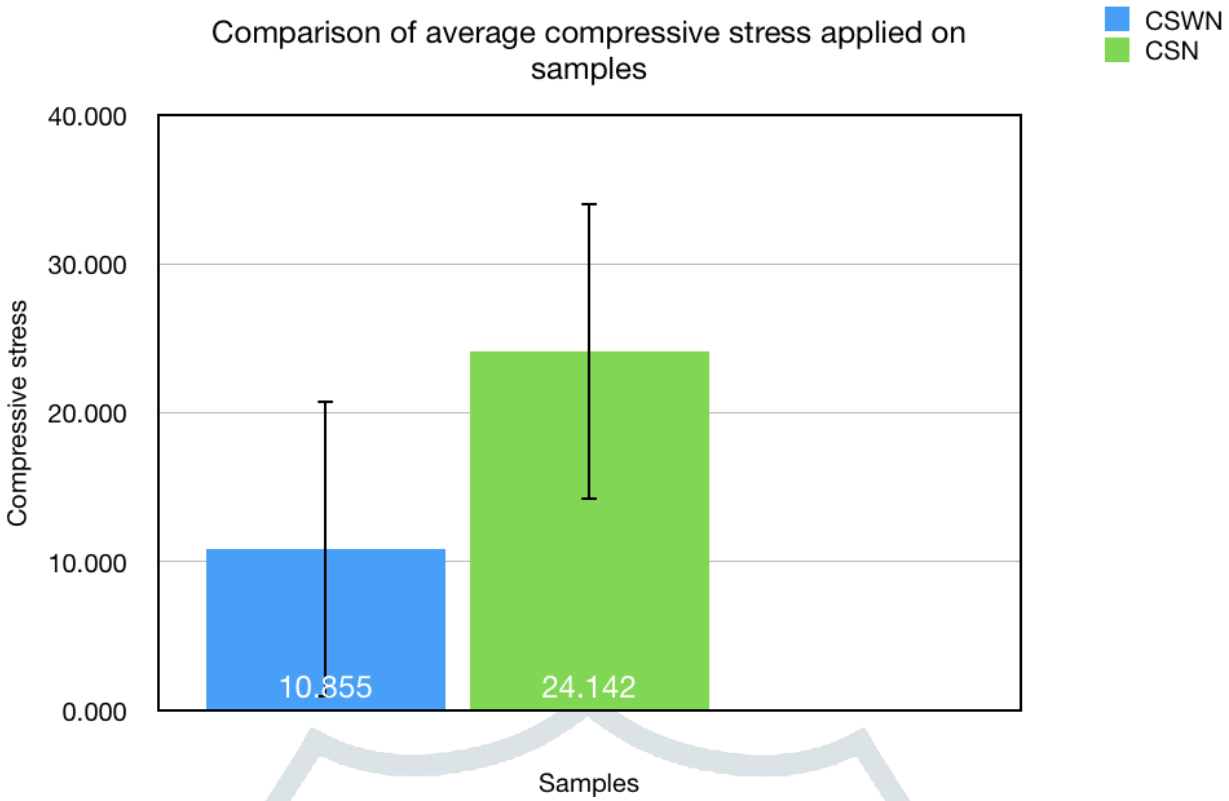
Samples	**Average Maximum force**	**Average compressive strength**
With neutraliser	**364.4671429 N**	**24.14166667 Mpa**
Without neutraliser	**162.345 N**	**10.855 Mpa**

Graph 1 compares the average maximum force applied to the teeth samples to which bleaching was done using Pola office followed by composite restoration with and without sodium ascorbate as neutraliser. It shows that the teeth samples with sodium ascorbate as neutraliser required a higher amount of force - 364.46N to debond the composite from the tooth while the samples without neutraliser were easier to rebound with a lesser force of 162.345 N. This proves that the samples with neutraliser had higher shear bond strength.



Graph 1 : Comparison of average maximum force applied on teeth samples which underwent Pola Office bleaching followed by composite restoration with and without sodium ascorbate as neutraliser

Graph 2 compares the average compressive strength applied to the teeth samples to which bleaching was done using Pola office followed by composite restoration with and without sodium ascorbate as neutraliser. It shows that the teeth samples with sodium ascorbate as neutraliser required a higher amount of compressive strength - 24.142 Mpa to debond the composite from the tooth while the samples without neutraliser were easier to rebound with a lesser force of 10.855 Mpa. This also proves that the samples with neutraliser had higher shear bond strength.



Graph 2 : Comparison of average compressive strength applied on teeth samples which underwent Pola Office bleaching followed by composite restoration with and without sodium ascorbate as neutraliser

DISCUSSION:

The sequence of steps followed in this study are explained in Figure 1. Two groups of six single rooted anterior teeth were collected and bleaching was done using the Pola office. In one group, sodium ascorbate was used as a neutraliser while in the other group neutraliser was not used. Then both the groups were etched, bonded and restored with composite. Both sets of samples were subject to shear bond strength analysis using Instron. The maximum force and compressive strength exerted for the composite restoration to debond from the enamel was recorded and analysed statistically. The results showed that the use of neutraliser increased the shear bond strength

Anil, et al(Anil *et al.*, 2015) in their study evaluated the role of 10% sodium ascorbate on reversing the compromised bond strength and compared enamel shear bond strength of 5th and 6th generation dentine bonding agents on bleached and unbleached teeth. A decrease in bond strength was seen with the 6th generation adhesive system compared to the 5th generation bonding system. Treating the bleached enamel surfaces when treated with 10% sodium ascorbate, which reverses the compromised bond strength and is a good alternative to delayed bonding. This is in accordance with our study.

In a study by Oskoee, et al,(Oskoee *et al.*, 2010) evaluation of the effect of 10% sodium ascorbate on bleached bovine enamel morphology and microhardness considering the possibility of its effect on enamel surface characteristics were analysed. concluded that the use of 35% carbamide peroxide alone or in conjunction with 10% sodium ascorbate does not have any detrimental effect on bovine enamel microhardness. Regarding the surface topography, SEM analysis showed a network of sodium ascorbate adsorbed to the bleached bovine enamel surface and a lost integrity of enamel rods due to the bleaching process.

CONCLUSION:

Based on the results analysed it has been observed that bond strength has been increased significantly after application of neutraliser sodium ascorbate. Better bleaching is achieved by the action of free radicals like nascent oxygen and perhydroxyl

which reduces the bond strength of enamel. Application of neutraliser like sodium ascorbate counteracts the activity of free radical improving bond strength. Various antioxidants solutions like lycopene can be tested to bleached enamel to analyse the bond strength.

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CONFLICT OF INTEREST:

The authors declare no conflict of interest.

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