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Effect Of Bamboo Salt On Bond Strength Of Bleached Enamel - An In Vitro Analysis

Research Article

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Abstract

Aim: The aim of this study was to comparatively evaluate the effect of various antioxidants on the bond strength of bleached enamel and etched enamel surfaces.
Materials and Methods: Labial enamel surfaces of 30 extracted single rooted teeth were randomly divided into six groups as follows: Group 1- No bleaching, Group 2- bleaching with 38% hydrogen peroxide, Group 3: bleaching and 10% sodium ascorbate; Group 4: bleaching and 25% Bamboo salt; Group 5: bleaching and 5% proanthocyanidin. Groups 6- etched enamel surfaces treated with 25% bamboo salt. Universal testing machine was used to determine the shear strength values. The data were tabulated and statistically analyzed.
Results: The mean shear bond strength values were compared and there was statistically significant differences present among all the groups ($p<0.05$). The shear bond strength values were highest in unbleached teeth followed by 25% bamboo salt. Among the bleached groups, highest shear bond strength was observed with 25% bamboo salt followed by 5% proanthocyanidin, 10% sodium ascorbate. The bleached group without the use of antioxidants had the least shear bond strength.
Conclusion: The antioxidants significantly improved the shear bond strength of the bleached enamel surfaces. The shear bond strength of unbleached controls was the highest. Among the bleached groups, 25% Bamboo salt had higher bond strength followed by 5% proanthocyanidin and 10% sodium ascorbate.
Clinical significance: The use of antioxidants improves the shear bond strength and enables immediate bonding and adhesive restoration of bleached teeth.

Keywords: Bleaching; Bond Strength; Bamboo Salt; Sodium Ascorbate; Proanthocyanidin.

Introduction

Tooth-bleaching has become increasingly popular and plays a pivotal role in esthetic dentistry [1, 2]. The mechanism of bleaching involves oxidation of organic pigments in the teeth to simpler molecules with the release of free radicals such as oxygen [3]. Knowledge of interactions between tooth-bleaching and adhesive restorations is critical for the successful esthetic rehabilitation of the teeth [4]. The micro structural changes in enamel and dentin, induced by high concentration of bleaching agents have been studied [5]. Piemjai et al, concluded that bleached teeth with 38% hydrogen peroxide does not reliably bond with self etch or total etch adhesives and acts as a communication channel for external stimuli reaching the pulp [6].

Shear bond strength of composite resin restorations that were bonded to tooth surfaces immediately after bleaching was significantly lower than those of non-bleached tooth surfaces due to presence of residual peroxide, which interfered with the resin attachment and inhibited the resin monomers polymerization [7, 8]. Cavalli et al, stated that the enamel bond strength of bleached enamel returns to normal after 3 weeks [9].

Delayed bonding along with antioxidants helps in improving the

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shear bond strength of bleached enamel with composite resin and resin modified glass ionomer [10]. Unlu et al, concluded from his study that composite resin bonding to bleached enamel should be delayed for 24 hours for 10% carbamide peroxide and 1 week for 35% hydrogen peroxide [11]. Reversal of the compromised bond strength of bleached enamel have been studied using antioxidants such as grape seed extract, cranberry extract[12], sodium bicarbonate, sodium ascorbate[13, 14], pine bark extract solution, pomegranate extract [15]. Immediate bonding would avoid multiple visits as well as prevent microleakage during inter appointments.

Bamboo salt has been studied for its anti-cancer, anti-oxidant, anti-inflammatory and anti-microbial effects [16]. The main ingredient of bamboo salt is sodium chloride salt and processed at high temperatures using normal salt, bamboo, pine tree wood, pine resin, and yellow soil. Manufacturers claim that dentifrices containing bamboo salt can reduce plaque and gingivitis [17], whiten teeth, strengthen tooth enamel, and decrease mineral loss [18].

Choi et al. conducted a study to evaluate the laboratory remineralisation effects of a dentifrice with bamboo salt and NaF on artificial caries-like enamel lesions, at both the surface and deep areas. The authors concluded that there was a significant increase in the level of the surface hardness and decreased mineral loss and decreased lesion depth of the artificial caries-like enamel lesions [19].

Recently, Kumar et al studied that 6.5% proanthocyanidin and 25% Bamboo salt were capable of reversing the compromised Push out bond strength of AH Plus sealer to sodium hypochlorite treated dentin [20, 21].

The aim of this study was to comparatively evaluate the effect of 5% proanthocyanidin solution, 25% bamboo salt solution, 10% Sodium ascorbate solution on improving the shear bond strength of bleached enamel and etched enamel surfaces. The effect of 25% bamboo salt solution on etched enamel surfaces was also evaluated.

Material and Methods

Sample preparation

Thirty teeth extracted for periodontal reasons with single roots and canals were collected and stored in distilled water until use. Only intact teeth without fracture and dental caries were included for the study. The tooth specimens were divided into six groups containing five specimens each. Their roots were embedded in an acrylic resin block, keeping only the coronal portion exposed.

Preparation of anti oxidant solutions

Preparation of 10% Sodium ascorbatesolution(SA)

About 10 g of Sodium ascorbate was dissolved in 100 ml of distilled water to make 10% SA solution.

Preparation of 25% bamboo salt solution (BS).

About 25 g of BS was dissolved in 100 ml of distilled water to make 25% BS solution.

Preparation of 5% proanthocyanidin solution (PA).

About 5 g of PA in the form of powder was dissolved in 100 ml of distilled water to make 5% PA solution.

Experimental study groups (Table 1)

Group-1: Normal tooth (n=5) The enamel surfaces were treated with 37% phosphoric acid (Total Etch etching gel, IvoclarVivadent, Schaan, Liechtenstein) for 15 seconds, rinsed with water for 20 seconds, gently air dried to avoid collagen fibril damage and bonded with Adper Single Bond (3M ESPE, Dental Products, St Paul, MN, USA) and light cured for 20 s using a Coltolux 50(Coltene, Whaldent, USA) with intensity of 480 mW/cm-2. This process was followed by composite build-up of 2 mm diameter and 4 mm height (Filtek Z350, 3M ESPE, Dental Products).

Group-2: (n=5) The teeth were bleached with Opalescence Xtra Boost (38% hydrogen peroxide gel, Ultradent Products, Inc, South Jordan, UT) for 10 minutes according to manufacturer's instructions. The bleaching was completely rinsed off with water. After bleaching the surfaces were treated with 37% phosphoric acid and bonded with Adper Single Bond and composite build up done.

Group-3: (n=5) Immediately after bleaching and rinsing, the enamel surfaces of teeth were treated with 10% sodium ascorbate solution for 10 minutes and rinsed. 37% phosphoric acid was used to etch the tooth surfaces. Bonding was done using Adper Single bond and composite build up done.

Group-4: (n=5) Immediately after bleaching and rinsing, the enamel surfaces of teeth were treated with 25% Bamboo salt solution for 10 minutes and rinsed. 37% phosphoric acid was used to etch the tooth surfaces. Bonding was done using Adper Single bond and composite build up done.

Group-5: (n=5) After bleaching and rinsing, the enamel surfaces of teeth were treated with 5% proanthocyanidin solution for 10 minutes and rinsed. 37% phosphoric acid was used to etch the tooth surfaces. Bonding was done using Adper Single bond and composite build up done.

Group-6: (n=5) The surfaces were etched with 37% phosphoric acid and treated with 25% bamboo salt. No bleaching was done.

All specimens were stored in distilled water for 24 hours before shear bond strength testing was performed in a universal testing machine (Instron) with a 50 kg load cell, at a speed of 1.0 mm/min. The chisel was positioned parallel to the surface of the tooth interface. The results obtained were converted to megapascals (MPa) by dividing the debonding force (in Newton) by the bracket base area (10.64 mm2). The SBS was calculated at a crosshead speed of 1 mm/min in shear mode until fracture occurred.

Results and Discussion

Results were expressed as mean ± SD (Table 2). Statistical significance was determined by one-way analysis of variance (ANOVA) using SPSS software (version 22.0)and post hoc least-significant

Table 1- Study design.

Study groups	Treatment	Antioxidant	Etchant	Immediate Bonding	Immediate composite restoration
Group 1	None	None	37% phosphoric acid (Total Etch Etching Gel)	Adper single bond (3M ESPE)	Filtek Z350 (3M ESPE)
Group 2	38% hydrogen peroxide (Opalescence Xtra Boost)	None	37% phosphoric acid (Total Etch Etching Gel)	Adper single bond (3M ESPE)	Filtek Z350 (3M ESPE)
Group 3	38% hydrogen peroxide (Opalescence Xtra Boost)	10% sodium ascorbate	37% phosphoric acid (Total Etch Etching Gel)	Adper single bond (3M ESPE)	Filtek Z350 (3M ESPE)
Group 4	38% hydrogen peroxide (Opalescence Xtra Boost)	25% Bamboo salt	37% phosphoric acid (Total Etch Etching Gel)	Adper single bond (3M ESPE)	Filtek Z350 (3M ESPE)
Group 5	38% hydrogen peroxide (Opalescence Xtra Boost)	5% proanthocyanidine	37% phosphoric acid (Total Etch Etching Gel)	Adper single bond (3M ESPE)	Filtek Z350 (3M ESPE)
Group 6	37% phosphoric acid (Total Etch Etching Gel)	25% Bamboo salt	none	none	none

Table 2- Shear bond strength values of all the groups.

GROUPS	Mean	N	Std. Deviation
Control	52.4200	5	1.80000
38%H202	22.7280	5	1.65660
Bleach + 10% SA	38.0200	5	1.28953
Bleach + 25% BS	33.3200	5	1.00556
Bleach + 5% PA	44.0460	5	0.37173
25% BS	47.3560	5	0.64825
Total	39.6483	30	9.98476

SA- Sodium ascorbate; BS-Bamboo salt; PA-Proanthocyanidin; H202- Hydrogen peroxide.

difference test was carried out. P values less than 0.05 were considered significant.

The mean shear bond strength values were compared in all the groups and there was a statistically significant difference present among the groups ($p<0.05$). The shear bond strength values were significantly higher in unbleached teeth (Group 1) followed by 25% bamboo salt in the unbleached group (Group 6). Among the bleached groups, highest shear bond strength was observed with 25% bamboo salt (Group 4) followed by 5% proanthocyanidin(Group 5), 10% sodium ascorbate(Group 3). The bleached group without the use of antioxidants(Group 2) had the least shear bond strength among all the groups (Figure 1).

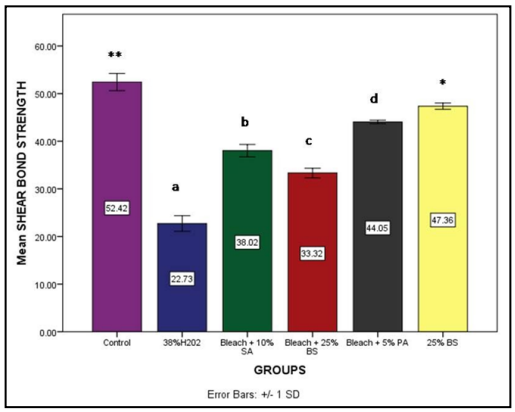
Bleaching with hydrogen peroxide results information of free radicals on the enamel surface, such as nascent oxygen, hydroxyl radical, per hydroxyl and superoxide anions [10]. Hydroxyl radicals in apatite lattice are substituted by peroxide ions - formation of peroxide - apatite [22, 23]. The reduced bond strength of bleached enamel has been related to the presence of residual free radicals and surface alterations in the enamel composition and structure following the bleaching treatment [7]. The residual oxygen in the interprismatic spaces interferes with resin infiltration and inhibits resin polymerization [5].

Morphological and compositional changes in enamel include porosity, loss of enamel prismatic form, loss of calcium, and changes in organic substances that weakens the adhesive interface and reduces bond strength [3]. Hence bonding procedures are performed after a waiting period of 1-3 weeks[2].

Remineralising agents containing fluoride, bioactive glass, CPP-ACP (Caseinphosphopeptide- Amorphous calcium phosphate), probiotics might help in reducing post operative sensitivity following bleaching [24, 26]. Adhesion of composites plays a vital role in clinical success of the restoration avoiding microleage, discoloration or post operative sensitivity [27]. Incases of traumatic injuries, chances for developing a lesion due to necrosis would require root canal treatment with intracanal medication [28, 32]. Proper case history about the etiology of discoloration would pave the way to accurate diagnosis and treatment planning [33, 34]. Effective pain management is very important for clinical success [35]. Incases of pulp therapy, concentrated growth factors improved the chances of maintaining pulp vitality [36]. Antioxidants and laser irradiation, neutralize the free radicals and enhance the micro retention of resin tags in enamel thus reversing the reduced bond strength between the composite resin and bleached enamel [37, 38].

Lai et al stated that there was 25% reduction in bond strength of enamel when bleached with carbamide peroxide solution [39]. Application of 10% sodium ascorbate and one week delay promoted good bond strength of composite resin and resin modified glass ionomer cement to bleached enamel [10]. Tam et al observed

Figure 1- This graph depicts the shear bond strength values (Mpa) of all the experimental and control groups. Results were expressed as Mean ± SD. ap<0.001; bp<0.05; cp<0.01; dp<0.05 statistically significant as compared with Control group and 25% BS group*. Control group** p<0.05 statistically significant as compared with 25%BS group*.**



that 10% carbamide peroxide decreased the flexural strength, flexural modulus and fracture resistance of bovine dentin [40]. Micro Computerized topographical studies on bleached enamel using 10% carbamide peroxide has shown demineralisation up to a depth of 50 µm [41]. Microleakage studies proved that tooth bleaching did not damage the tooth restorative interface in composite restorations [42, 43].

Mukka et al studied the shear bond strength of bleached enamel to composite resin after subjecting them to herbal irrigants namely 5% pine bark extract, 5% grape seed extract, 5% pomegranate extract. The strength of unbleached enamel was better followed by 5% pine extract [15, 44]. Free radical polymerization of adhesive occurs with sodium ascorbate, that reinforces the compromised bonding of adhesive restorations. Use of grape seed extract as an antioxidant yielded greater enamel bond strength than that of 10% sodium ascorbate which might be attributed to the specificity of proanthocyanidins for hydroxyl free radicals and superoxide radicals [45]. Immediate bonding of composite resin to bleached teeth was possible after application of sodium ascorbate hydrogel [46].

Feiz et al, did a systematic review on the effect of antioxidants in improving the bond strength of bleached enamel. The concluding remarks were as follows

Use of antioxidant can be adopted as a technique for improving shear bond strength of bleached teeth.

Delaying the adhesive bonding for at least 7 days after bleaching can result in almost the same shear bond strength as that obtained after antioxidant treatment [47].

Various in vitro studies have studied the effect of antioxidants in improving the bond strength of bleached enamel in bovine teeth [40]. The use of human teeth would result in more appropriate clinically applicable results as in our study.

The use of Bamboo salt in improving bond strength has been tried for the first time for bleached teeth. Also the results have been compared to the other commonly used anti oxidants such as proanthocyanidine and sodium ascorbate. In our study, the strengthening effect of bamboo salt on etched enamel surfaces have also been tried.

The limitations of the study include a smaller sample size. Also further research on the aspect of antioxidant and re mineralising potential of bamboo salt must be undertaken to provide more clear clinical translation of placement of adhesive restorations immediately after bleaching procedures.

Conclusion

The antioxidants significantly improved the shear bond strength of the bleached enamel surfaces. The shear bond strength of unbleached controls was the highest. Of the bleached groups, the shear bond strength of teeth treated with 25% Bamboo salt had higher bond strength followed by 5% proanthocyanidin and 10% sodium ascorbate. Single visit adhesive restorations reduces the number of appointments and microleakage with use of intermediary restorations are also avoided.

Clinical Significance

Bleaching agents in higher concentrations or when used for prolonged durations, have been studied to cause surface alterations in both enamel and dentin. They have the potential to release free radicals that inhibits the bonding of adhesive restorations. Literature suggests a waiting period of 1 to 3 weeks for placing composite restorations post bleaching. This increases the patient's appointments and the clinician is also not sure about the reliability of bonding of the adhesive restorations placed.

The clinician has a dilemma of when to recall the patient for permanent restoration to achieve good bond strength. The use of antioxidants have shown good results in reversing the compromised bond strength of bleached teeth and would allow for efficient bonding of bleached teeth. Also bamboo salt has shown to influence the strength of etched enamel. More research is needed to confirm its mechanism of action.

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References

[1]. Kelleher M.(2019) Dental Bleaching. Quintessence Publishing Company Limited; 127 p.
[2]. Perdigão J, editor. Tooth whitening: An evidence-based perspective. Springer; 2016 Aug 3:268.
[3]. Goldstein RE, Garber DA. Complete Dental Bleaching. Quintessence Publishing (IL); 1995. 165 p.
[4]. Klein CA Jr, da Silva D, Reston EG, Borghetti DL, Zimmer R. Effect of At-home and In-office Bleaching on Marginal Microleakage in Composite Resin Restorations using Two Adhesive Systems. J Contemp Dent Pract. 2018 Mar 1;19(3):248-252.Pubmed PMID: 29603692.
[5]. Soares DG, Pastana JV, de Oliveira Duque CC, Dias Ribeiro AP, Basso FG, Hebling J, et al. Influence of adhesive restorations on diffusion of H2O2 released from a bleaching agent and its toxic effects on pulp cells. J Adhes Dent. 2014 Apr;16(2):123-8.Pubmed PMID: 24102064.
[6]. Piemjai M, Lenglerdphol S. Effect of strong tooth-bleaching with 38% hydrogen peroxide on marginal seal of dental restorations using self-etch and total-etch adhesives. J Esthet Restor Dent. 2018 Mar;30(2):153-159.Pubmed PMID: 29243397.
[7]. Teixeira EC, Hara AT, Turssi CP, Serra MC. Effect of nonvital tooth bleaching on resin/enamel shear bond strength. J Adhes Dent. 2002 Winter;4(4):317-22.Pubmed PMID: 12666751.
[8]. Briso AL, Rahal V, Sundfeld RH, dos Santos PH, Alexandre RS. Effect of sodium ascorbate on dentin bonding after two bleaching techniques. Oper Dent. 2014 Mar-Apr;39(2):195-203.Pubmed PMID: 23848067.
[9]. Cavalli V, Reis AF, Giannini M, Ambrosano GM. The effect of elapsed time following bleaching on enamel bond strength of resin composite. Oper Dent. 2001 Nov 1;26(6):597-602.
[10]. Danesh-Sani SA, Esmaili M. Effect of 10% sodium ascorbate hydrogel and delayed bonding on shear bond strength of composite resin and resin-modified glass ionomer to bleached enamel. J Conserv Dent. 2011 Jul;14(3):241-6.Pubmed PMID: 22025826.
[11]. Unlu N, Cobankara FK, Ozer F. Effect of elapsed time following bleaching on the shear bond strength of composite resin to enamel. J Biomed Mater Res B ApplBiomater. 2008 Feb;84(2):363-8.Pubmed PMID: 17626292.
[12]. Eggula A, V P, K S D, G N, Shaik N, Fatima M. Reversal of Compromised Bond Strength of Bleached Enamel Using Cranberry Extract as an Antioxidant: an In Vitro Study. Cureus. 2019 Nov 18;11(11):e6188.Pubmed PMID: 31890392.
[13]. Alencar MS, Bombonatti JF, Maenosono RM, Soares AF, Wang L, Mondelli RF. Effect of Two Antioxidants Agents on Microtensile Bond Strength to Bleached Enamel. Braz Dent J. 2016 Sep-Oct;27(5):532-536.Pubmed PMID: 27982229.
[14]. Anil M, Ponnappa KC, Nitin M, Ramesh S, Sharanappa K, Nishant A. Effect of 10% sodium ascorbate on shear bond strength of bleached teeth-an in-vitro study. J ClinDiagn Res. 2015 Jul;9(7):ZC31-3.
[15]. Mukka PK, Komineni NK, Pola S, Soujanya E, Karne AR, Nenavath B, et al. An In-vitro Comparative Study of Shear Bond Strength of Composite Resin to Bleached Enamel using three Herbal Antioxidants. J ClinDiagn Res. 2016 Oct;10(10):ZC89-ZC92.Pubmed PMID: 27891467.
[16]. Chongtham N, Bisht MS. Bamboo Shoot: Superfood for Nutrition, Health and Medicine. CRC Press; 2020 Oct 25:264.
[17]. Lee HJ, Choi CH. Anti-inflammatory effects of bamboo salt and sodium fluoride in human gingival fibroblasts--An in vitro study. Kaohsiung J Med Sci. 2015 Jun;31(6):303-8.Pubmed PMID: 26043409.
[18]. Sidhu P, Kannan S, Muthusamy S, Muthu K. Oral health: bamboo salt. Br Dent J. 2014 Jul;217(2):54.Pubmed PMID: 25060430.
[19]. Choi CH, Ha MO, Youn HJ, Jeong SS, Iijima Y, Sohn W, et al. Effect of bamboo salt-NaF dentifrice on enamel remineralization. Am J Dent. 2012 Feb;25(1):9-12.Pubmed PMID: 22558684.
[20]. Kumar PS, Meganathan A, Shriram S, Sampath V, Sekar M. Effect of proanthocyanidin and bamboo salt on the push-out bond strength of an epoxy resin sealer to sodium hypochlorite-treated root dentin: An in vitro study. J Conserv Dent. 2019 Mar-Apr;22(2):144-148.Pubmed PMID: 31142983.
[21]. Pimentel AH, Valente LL, Isolan CP, Münchow EA, Piva E, de Moraes RR. Effect of waiting time for placing resin composite restorations after bleaching on enamel bond strength. Appl. Adhes. Sci. 2015 Dec;3(1):23.
[22]. Torres CR, editor. Modern operative dentistry: Principles for clinical practice. Springer Nature; 2019 Dec 14:715.
[23]. Eliades G, Watts DC, Eliades T. Dental Hard Tissues and Bonding: Interfacial Phenomena and Related Properties. Springer Science & Business Media; 2005;198 p.
[24]. Rajendran R, Kunjusankaran RN, Sandhya R, Anilkumar A, Santhosh R, Patil SR. Comparative evaluation of remineralizing potential of a paste containing bioactive glass and a topical cream containing casein phosphopeptide-amorphous calcium phosphate: An in vitro study. Pesqui. Bras. OdontopediatriaClín. Integr. 2019;19:1-10.
[25]. Nandakumar M, Nasim I. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis. J Conserv Dent. 2018 Sep-Oct;21(5):516-520.Pubmed PMID: 30294113.
[26]. Poorni S, Srinivasan MR, Nivedhitha MS. Probiotic Streptococcus strains in caries prevention: A systematic review. J Conserv Dent. 2019 Mar-Apr;22(2):123-128.Pubmed PMID: 31142979.
[27]. Azeem RA, Sureshbabu NM. Clinical performance of direct versus indirect composite restorations in posterior teeth: A systematic review. J Conserv Dent. 2018 Jan-Feb;21(1):2-9.Pubmed PMID: 29628639.
[28]. Siddique R, Sureshbabu NM, Somasundaram J, Jacob B, Selvam D. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. J Conserv Dent. 2019 Jan-Feb;22(1):40-47.Pubmed PMID: 30820081.
[29]. Teja KV, Ramesh S, Priya V. Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study. J Conserv Dent. 2018 Nov;21(6):592.
[30]. Rajakeerthi R, Nivedhitha MS. Natural Product as the Storage medium for an avulsed tooth–A Systematic Review. Cumhur. Dent. J. 2019;22(2):249-56.
[31]. Siddique R, Nivedhitha MS. Effectiveness of rotary and reciprocating systems on microbial reduction: A systematic review. J Conserv Dent. 2019 Mar-Apr;22(2):114-122.Pubmed PMID: 31142978.
[32]. Manohar MP, Sharma S. A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists. Indian J Dent Res. 2018 Nov-Dec;29(6):716-720.Pubmed PMID: 30588997.
[33]. Ramarao S, Sathyanarayanan U. CRA Grid - A preliminary development and calibration of a paper-based objectivization of caries risk assessment in undergraduate dental education. J Conserv Dent. 2019 Mar-Apr;22(2):185-190. Pubmed PMID: 31142991.
[34]. Janani K, Sandhya R. A survey on skills for cone beam computed tomography interpretation among endodontists for endodontic treatment procedure. Indian J Dent Res. 2019 Nov-Dec;30(6):834-838.Pubmed PMID: 31939356.
[35]. Jenarthanan S, Subbarao C. Comparative evaluation of the efficacy of diclofenac sodium administered using different delivery routes in the management of endodontic pain: A randomized controlled clinical trial. J Conserv Dent. 2018 May-Jun;21(3):297-301.Pubmed PMID: 29899633.
[36]. MalliSureshbabu N, Selvarasu K, V JK, Nandakumar M, Selvam D. Concentrated Growth Factors as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Report of Two Cases. Case Rep Dent. 2019 Jan 22;2019:7046203.Pubmed PMID: 30805222.
[37]. Wheeler CR. Surface Modification of Enamel Using Near-UV Laser Irradiation. UCSF; 2002:200.
[38]. Convissar RA. Principles and Practice of Laser Dentistry - E-Book. Elsevier Health Sciences;2010; 352 p.
[39]. Kayatt FE. Aplicação dos Sistemas CAD/CAM naOdontologia. Elsevier Brasil; 2013 Feb 15:312.
[40]. Tam LE, Lim M, Khanna S. Effect of direct peroxide bleach application to bovine dentin on flexural strength and modulus in vitro. J Dent. 2005 Jul;33(6):451-8.Pubmed PMID: 15935264.
[41]. Efeoglu N, Wood D, Efeoglu C. Microcomputerised tomography evaluation of 10% carbamide peroxide applied to enamel. J Dent. 2005 Aug;33(7):561-7.Pubmed PMID: 16005795.
[42]. Silva L, Thedei Jr G, Menezes-Oliveira MA, Nogueira RD, Geraldo-Martins V. Tooth bleaching effects on the adhesive interface of composite restorations. Int J Esthet Dent. 2017 Jan 1;12(1):96-106.
[43]. Khandelwal A, Palanivelu A. Correlation between dental caries and salivary albumin in adult population in Chennai: An in vivo study. Braz. Dent. Sci. 2019 Apr 30;22(2):228-33.
[44]. Govindaraju L, Neelakantan P, Gutmann JL. Effect of root canal irrigating solutions on the compressive strength of tricalcium silicate cements. Clin Oral Investig. 2017 Mar;21(2):567-571.Pubmed PMID: 27469101.
[45]. Vidhya S, Srinivasulu S, Sujatha M, Mahalaxmi S. Effect of grape seed extract on the bond strength of bleached enamel. Oper Dent. 2011 Jul;36(4):433-8.
[46]. Dabas D, Patil AC, Uppin VM. 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. 2011 Oct;14(4):356-60.
[47]. Feiz A, Mosleh H, Nazeri R. Evaluating the effect of antioxidant agents on shear bond strength of tooth-colored restorative materials after bleaching: A systematic review. J MechBehav Biomed Mater. 2017 Jul;71:156-164.Pubmed PMID: 28327437.