Comparative evaluation of effect of antioxidant sodium Ascorbate and new homeopathic agent on the push out bond strength of fibre post to root dentin treated with and without laser: an *in vitro* study

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Abstract

The Fibre post most frequently fails at adhesive interface between resin cement and dentin. The objective of this study is to evaluate the effect of antioxidant sodium ascorbate and a new homeopathic agent on the pushout bond strength of fibre post to root dentin treated with and without LASER. Extracted hundred (100) single rooted teeth were collected, decoronated and working length was determined. Instrumentation and irrigation were performed using irrigants with 2 ml NaOCl and 0.5 ml of 17% EDTA for 3 min. After obturation post spaces were prepared. The specimens were divided into 5 groups (n=20) and post spaces were irrigated; G1= normal saline 5ml for 2 min, G2=10% Sodium ascorbate 5 ml for 2 min, G3= Hypericum perforatum 5ml for 2 min, G4= Laser with 10% Sodium ascorbate 5 ml for 2 min, G5= Laser with Hypericum perforatum 5 ml for 2 min. The post spaces were dried with absorbent paper points. Bonding agent was applied in the post space and posts were luted. The teeth underwent thermocycling for a week and from each sample 2mm thick horizontal slices were obtained from cervical third of root. The pushout bond strength test was carried out using Universal testing machine. The data was statistically analysed using Student's Unpaired "t" and ANOVA test.

Keywords-Fibre post, Sodium Ascorbate, Hypericum Perforartum, Diode Laser, Pushout Bond Strength

1.Introduction

One of the most commonly seen cases in day-to-day clinical practice are extensively destructed endodontically treated teeth. To encounter this situation, Posts and cores are frequently used in endodontically treated teeth that have suffered excessive loss of coronal tooth structure. With the evolving time the choice of materials used in these cases has changed from rigid materials, such as gold and zircon dioxide to materials that have mechanical characteristics that more closely resemble dentin such as fiber posts and composite resins. Use of these materials diminishes the probability of root fracture, because these failures occur particularly in the post, allowing for tooth recovery [7]. Fiber posts have many favourable properties including:

1. aesthetic advantages
2. biocompatibility,
3. an elastic modulus which is close to dentin
4. compatibility with Bis-GMA-based resin
5. resistance to corrosion
6. high flexural strength [8].

Adhesive resins have been widely used for cementation of these posts in root canals [2]. However there have been reports about failures of adhesion. The most commonly faced problem is failure of bond of resin cement from intracanal dentin [1]. This could be attributed to irrigation with sodium hypochlorite (NaOCl), which is the most commonly used irrigant and other agents such as acid etchant during endodontic treatment [1]. They have a dentin deproteinizing effect and have shown to decrease the microhardness of intracanal dentin. The by-products of NaOCl have also shown to hamper the polymerization of adhesive resin [1]. To overcome this problem different techniques were proposed to treat intracanal dentin [1]. Additionally, it has been reported that the irrigant solution used during and after endodontic treatment and conditioning techniques on both the dentinal surface and the post can influence the bond strength quality of the interfaces [17]. Therefore, to reverse the effects of these products on dentine and reduce the number of visits by our patients, the application of an antioxidant solution has been proposed prior to the adhesive procedure[17].Several researchers have studied the effects of antioxidants on increasing the bond strength in the past decade. Some examples of antioxidants used in endodontics are Vitamin E, flavonoids, catechins, gallic acid derivatives, salicylic acid derivatives, cinnamic acid derivatives chlorogenic acid, resveratrol, folate, curcumin, caffeine, anthocyanins and tannins. These are examples of polyphenolic natural antioxidants derived from plant sources. Non-phenolic secondary metabolites such as melatonin, carotenoids, retinal, thiols, jasmonic acid, ei-cosapentaenoic acid, ascopyrones and allicin, show excellent antioxidant activity. Commonly used antioxidants in endodontics are lycopene (tomato extract), Alpha tocopherol (Vit E), Proanthocyanidin (Grape seed extract), Ascorbate (Vit C).

However, the most commonly used antioxidant in dentistry is Sodium Ascorbate. Sodium ascorbate have been demonstrated to reverse the negative effects of irrigants and hence preserve resin dentin bond integrity. Therefore, properties of different antioxidants have been widely studied in dentistry. Although, Sodium ascorbate has certain drawbacks, that is, it is unstable in environment therefore it needs to be freshly prepared before each procedure; which led researchers to find alternatives for it.

Herbal and natural products have been used in dentistry and medicine for thousands of years due to their strong antimicrobial properties, biocompatibility, antioxidant, and anti-inflammatory properties and have only grown in popularity in recent years [6].

Hypericum perforatum is one such Homeopathic medicine has been researched upon in this study. Phytotherapy has gained popularity in the dental practice as it is economical, effective and has good patients' compliance. Phytotherapy involves the use of plants as medicine, and it is widely used in the treatment of various diseases [8]. Hypericum perforatum L. (HPL), also known as St. John's wort, is one of the mostly used medicinal plants in the pharmaceutical industry worldwide.

Hypericum Perforatum is one of the most frequently mentioned herbal remedies for pain conditions in dental practice and several clinical studies and case reports have examined the use of SJW in dental pain conditions [15]. Hypericum Perforatum was proposed for wound healing and tooth hypersensibility (Wicht, 1953), hemorrhagic diathesis and dry socket (Steinlechner, 1976), acute pain conditions, stabbing pain and neuralgic pain after tooth extraction (Steinlechner, 1985), as prophylactic before and after tooth extraction (Raspe, 1978), in traumatic nerve injury after operation and for neuralgic pain control after tooth extraction (Vogel, 1980; Stay, 1996; Bath, 2005; Freihöfer, 2004). Damlar et al. used the extracts of Hyper. for healing of bone defects filled with xenografts in rabbits and found favourable results suggesting it regenerative potential. Another study evaluated wound healing of two species of Hyper. on cultured NIH3T3 fibroblasts and found that HP has healing capacity [16]. Several researchers [9,10]suggested that HPL could exert therapeutic effects by acting as a natural free-radical scavenger/antioxidant and might play a role in improving oxidative stability in biological systems. The possible antioxidant therapeutic efficacy of HPL on oxidized dental structures has been investigated in a study, where reversal of post bleaching reduced bond strength was studied by Yilmaz et al. [3]. Therefore, we used this particular homeopathic agent in our study.

Another alternative method to modify compromised intracanal dentin and removing residual smear layer from dentinal tubules, is laser treatment. For this purpose, laser seems to be the most appropriate [1]. During, the last few years, the use of laser techniques has dominated the operative world as an alternative to different traditional methods. Lasers emit light energy that can interact with biologic tissues, such as tooth enamel, dentin, gingiva, or dental pulp. The interaction is the effect of the particular properties of laser light including monochromaticity, coherence, and collimation. Most researchers found significantly higher bond strength values for total etch and SE systems receiving Nd:YAG before polymerization. However, Diode Laser has also shown to enhance the bond strength to dental structures in a study by Ramachandruni, et al. Diode laser is most frequently used in dentistry due to its reliability, versatility, and convenience. It can be used for a multitude of dental procedures which are predominantly soft-tissue surgeries, periodontal pocket therapy, peri-implantitis and can also be used in endodontics for root canal disinfection, in laser-assisted tooth whitening and for increasing bond strength [4].

Bonding to dentin is a greater challenge and has been extensively studied because of the difficulty of a less reliable substrate [17,18]. All resin cement systems' adhesion to root canal walls depends on the interface with dentin, regardless of whether it is mediated or not by an adhesive system. The adhesive-dentin bond depends on the micro-retentions created by the demineralization of dentin surfaces and posterior diffusion of monomers into the collagen network. These monomers are polymerized, and micromechanical interlocking is created [12]. Therefore, the treatment of dental tissues before adhesive restorative procedures is an extremely important step in the bonding protocol and determines the clinical success of restorations [4]. To evaluate the bond strength of the resin cement–root canal dentin complex, the push-out test is the most commonly used method [11].

To the best of the authors' awareness, there hasn't been any research conducted to date to assess the push-out bond strength of FIBRE POST TO ROOT DENTIN when irrigated with homeopathic agent Hypericum perforatum and Sodium ascorbate and when treated with Diode Laser.

Therefore, the aim of this in vitro study is to evaluate and compare the effect of antioxidant Sodium ascorbate and new homeopathic agent on the pushout bond strength of fibre post to root dentin treated with and without laser.

The null hypothesis is that there is no difference in the adhesion of resin based cement when using Sodium Ascorbate, Hypericum Perforatum (an homeopathic agent) and Diode laser inside the root canal.

2.Materials and methods

Hundred single rooted, non-carious, freshly extracted human teeth; indicated for extraction were collected. Their crowns were removed and roots were trimmed coronally to achieve a standardized length of 15mm.

The cleaning and shaping were done using initially K files till #20 followed by canal preparation with protaper till F2, within between usage of 3% sodium hypochlorite and normal saline as an irrigant and a final rinse with 0.5 ml of 17% EDTA for 3 min. Then, prepared canals were irrigated with 1 ml of distilled water and dried with paper points. The root canals were obturated using gutta percha and Endoseal sealer using lateral condensation. After 24 hrs, post space preparation was done.

The roots were then divided into five groups according to intraradicular treatment (n=20).

Group 1- The final irrigation was done with distilled normal saline 5 ml for 2 min.
Group 2- The final irrigation was done with 10% Sodium Ascorbate solution 5 ml for 2 min.
Group 3- The final irrigation was done with Hypericum Perforatum solution 5 ml for 2 min.
Group 4- The final irrigation was done with Laser with Sodium Ascorbate 5 ml for 2 min.
Group 5- The final irrigation was done with Laser with Hypericum Perforatum 5 ml for 2 min.

The Diode laser was delivered in a pulsed mode in a noncontact mode. The tip was inserted into the root canal in a helicoidal movement (from cervical to apical to cervical again). Then canals were dried with absorbent paper points.

2.1. Preparation of Sodium Ascorbate

10% SA solution was freshly prepared in the department. It was done by adding 10g of powder of sodium ascorbate in 100ml of distilled water and stirring it (figure 1).

2.2 Preparation of Hypericum Perforatum

A 100 g of the dried flower was transferred into a beaker, and 250 mL distilled water was added. The mixture was shaken at 120 rpm with a benchtop shaker (Remi Mini Rotary Shaker, Prime Health Care,India) in dark at room temperature for 2 hours. The solution was filtered through a black ribbon filter paper. The residue was treated with 250 mL distilled water and shaken for 2 hours again. The filtration procedure was repeated once more, and the residue was left to shake for 24 hours with 250 mL distilled water. The filtrate was collected, and the last extraction step was applied for 2 hours. The filtrates were pooled and kept at +4 °C until the solvent removal process. The solution obtained after extraction with water was frozen at –20 °C and dried by lyophilization using a lyophilizer at –50 °C, and 0.04 mbar for 72 hours. The dried extract was collected and stored at –12 °C until used. Based on the findings of a previous pilot study (unpublished), the HPL-derived antioxidant solution at a concentration of 10% was decided to be prepared. To prepare the 10% HPL extract solution, 10 g of HPL extract was dissolved in 100 mL distilled water by stirring at +40 °C for 15 minutes.

(Figure 1)-showing freshly prepared sodium ascorbate solution in a beaker in the right image and Hypericum Perforatum extract solution in the left image.

Fifth generation bonding agent was used as an adhesive agent which was applied on the canal wall with a microbrush and cured for 20s. Fibre posts of size #2 were used. The self-adhesive resin cement (Luxacore) was manipulated according to the manufacturer's instructions and was applied to the post surface, and this was seated to full depth in the prepared spaces with standardize finger pressure. After initial chemical polymerization, excess resin cement was removed with a microbrush, and it was light polymerized. the specimens were stored at 100% humidity at 37 °C for 24 h. After 24 h, the specimens were subjected 1000 thermal cycles at a temperature ranging from 5 and 55 °C. The roots were horizontally sectioned into 2 mm thick slices with a diamond blade from the coronal third of root. The pushout bond strength test was carried out on each sample using Universal Testing Machine (figure 2)(Computerized, Software Based) Company: ACME Engineers, India., Model : UNITEST 10 System Accuracy of the Machine : ± 1%, C/h
Speed : 0.5 mm/minute.
Plunger Dia.: 1 mm., at a crosshead speed of 1 mm/min.
Pushout bond strength was calculated using formula:

$$\text{Push out bond strength (MPa)} = F/A = \frac{\text{Push out Force (N)}}{\text{Area of bonded interface (sq/mm)}}$$

Where, Area of bonded interface (sq/mm) = $2\pi rh$

$\pi = 3.1416$, h = Thickness of the sample in mm, r=Radius.

(Figure 2) showing horizontal disc of root for testing in the left image and Universal testing machine testing the bond strength in the right image.

2.3. STATISTICAL ANALYSIS

Data of the push-out bond strength was evaluated using to Statistical Package for the Social Sciences software (SPSS 19). For bond strength data, ANOVA and Tukey's post hoc test were performed.

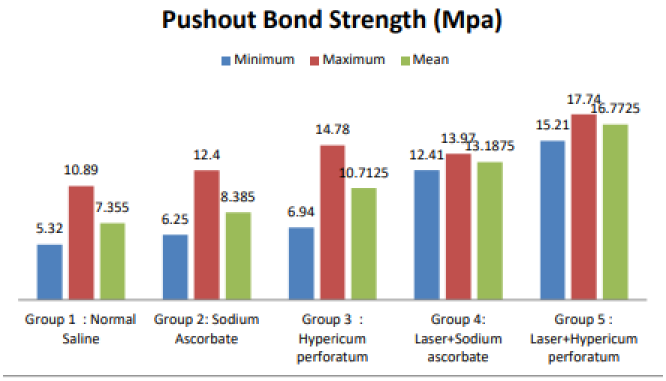
3.RESULTS

The minimum, maximum and mean pushout bond strength values along with standard deviation among five groups are presented in Table 1. It was observed that among the five groups Group 5 where final irrigation was done with Hypericum Perforatum in combination with laser; showed the highest mean pushout bond strength i.e.16.7725 (±1.16254)MPa. A graphical representation of the same data is presented in Graph 1; where we can clearly observe that Group 5 has the Highest Pushout bond strength. In canals irrigated with Normal saline (Group 1), the bond strength value of fibre post along with radicular dentin were 7.3550 (± 2.51627); which was least among the five groups. In canals irrigated with Sodium Ascorbate (Group 2), the bond strength value of fibre post along with radicular dentin were 8.3850 (± 2.76744). In canals irrigated with Hypericum Perforatum (Group 3), the bond strength value of fibre post along with radicular dentin were 10.7125 (± 3.66429). In canals irrigated with Sodium Ascorbate and irradiated with Diode laser (Group 4), the bond strength value of fibre post along with radicular dentin were 13.1875 (± 0.82123)

TABLE 1- Mean and Standard deviation value of all five groups.

Groups	Minimum	Maximum	Mean	Std. Deviation
Group 1 : Normal Saline	5.32	10.89	7.3550	2.51627
Group 2: Sodium Ascorbate	6.25	12.40	8.3850	2.76744
Group 3 : Hypericum perforatum	6.94	14.78	10.7125	3.66429
Group 4: Laser+Sodium ascorbate	12.41	13.97	13.1875	.82123
Group 5 : Laser+Hypericum perforatum	15.21	17.74	16.7725	1.16254

Graph 1 Descriptive statistics for Pushout Bond strength (Mpa) among five groups.



3.1 INTRAGROUP ANALYSIS

On intragroup comparisons for mean pushout bond strength between all five groups at Coronal level, it was observed that there was statistically significant difference among five groups for Pushout bond strength (Mpa) among five groups with $p<0.001$*. However, pairwise comparisons of Pushout Bond strength was done among all the five groups using Tukey's Post Hoc test.

Table 2 Comparison of Pushout Bond strength (Mpa) between five groups by Analysis of variance (ANOVA).

ANOVA					
Pushout Bondstrength (Mpa)					
	Sum of Squares	df	Mean Square	F	Sig. p value
Between Groups	231.659	4	57.915	9.835	<0.001*
Within Groups	88.330	15	5.889		
Total	319.989	19			

Statistically significant*

Table 3 Pair wise Comparison of Pushout Bond strength (Mpa) between five groups by Tukey's Post Hoc Test.

Multiple Comparisons						
Dependent Variable: Pushout Bondstrength (Mpa) Tukey HSD						
(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig. P value	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Group 1 : Normal Saline	Group 2: Sodium Ascorbate	-1.03000	1.71590	.973	-6.3286	4.2686
Group 1 : Normal Saline	Group 3 : Hypericum perforatum	-3.35750	1.71590	.332	-8.6561	1.9411
Group 1 : Normal Saline	Group 4: Laser+Sodium ascorbate	-5.83250*	1.71590	.028*	-11.1311	-.5339
Group 1 : Normal Saline	Group 5 : Laser+Hypericum perforatum	-9.41750*	1.71590	.001*	-14.7161	-4.1189
Group 2: Sodium Ascorbate	Group 3 : Hypericum perforatum	-2.32750	1.71590	.662	-7.6261	2.9711
Group 2: Sodium Ascorbate	Group 4: Laser+Sodium ascorbate	-4.80250	1.71590	.085	-10.1011	.4961
Group 2: Sodium Ascorbate	Group 5 : Laser+Hypericum perforatum	-8.38750*	1.71590	.002*	-13.6861	-3.0889
Group 3 : Hypericum perforatum	Group 4: Laser+Sodium ascorbate	-2.47500	1.71590	.612	-7.7736	2.8236
Group 3 : Hypericum perforatum	Group 5 : Laser+Hypericum perforatum	-6.06000*	1.71590	.022*	-11.3586	-.7614
Group 4: Laser+Sodium ascorbate	Group 5 : Laser+Hypericum perforatum	-3.58500	1.71590	.274	-8.8836	1.7136

*Statistically significant

There was statistically insignificant difference present for Pushout bond Strength between Group 1 (Normal saline)Vs Group 2 (Sodium Ascorbate)(p=0.973), Group 1 (Normal saline)Vs Group 3 (Hypericum Perforatum)(p=0.332), Group 2 (Sodium Ascorbate)Vs Group 3 (Hypericum Perforatum)(p=0.662), Group 2 (Sodium Ascorbate) Vs Group 4 (Laser + Sodium Ascorbate)(p=0.085), Group 3 (Sodium Ascorbate)Vs Group 4 (Laser + Sodium Ascorbate) (p=0.612), Group 4 (Laser + Sodium Ascorbate)Vs Group 5 (Laser +Hypericum Perforatum) (p=0.274). There was statistically significant difference between Group 1 Vs

Group 4(p=0.028*), Group 1 Vs Group 5(p=0.001*), Group 2 Vs Group 5(p=0.002*), Group 3 Vs Group 5(p=0.022*). In the present study, Group 5 is having highest pushout bond strength with statistically significant difference among Group 5 Vs Group1/2/3. Though there was statistically insignificant difference between Group 4 and Group 5. However, much higher value for pushout bond strength (16.7725 ±1.16254) in Group 5 replicates it is the better group in terms of Push out strength.

4.DISCUSSION

Long-term survival of the destructed tooth depends on the post retention. Clinical study done by Ebert J *et al*. showed a success rate of 95%–97% when glass or quartz fiber-reinforced resin posts were used [12]. One of the factors to increase the retention of fiber posts and improve the fracture resistance of the bonded structures, is the use of resin cements. Most failures involving the reconstruction of post-and-core restorations are due to the bond strength failure between resin-based cement and dentin interface. The bond strength between the cement and dentin is affected by many factors such as moisture contamination, root canal dentin hydration, unfavourable root canal configuration, the smear layer, cementation approach, and endodontic irrigant solutions [24]. The luting process relies on the formation of resin tags in the dentin and depends on the treatment of the dentinal surface. Resin cements are more likely to be adversely affect by the presence of free radicals present in the intracanal space which is present due to different irrigating solutions and thus affecting its bonding.

Antioxidants helps in scavenging or removing these free radical and hence increasing the bonding of restorative resin-based cements and intracanal dentin. The increase in bonding could be due to one of the below mentioned following mechanisms:

1.Reduction of free radicals from intracanal dentinal tubules and matrix

2. Reversing the denaturing effect of acid etching and NaOCl and H2O2 on collagen.

3.Inhibits Matrix Metalloproteins (MMPs) offering protection against the long-term degradation of the adhesive material-dentin surface.

The most commonly used antioxidant used in dentistry in Sodium ascorbate. It is used in different concentrations (5%, 10%, 20%, 35%)], but oligomeric proanthocyanidin complexes (OPCs), present in grape seed extracts and pomegranate peel extract, green tea, alpha-tocopherol, aloe vera and licopene were also used [18,19,20]. The antioxidant considered to be the gold standard is Sodium Ascorbate and is used in most studies. However, Prasansuttiporn et al. stated that SA did not significantly increase the bond strength of adhesives to dentin [23]. This inconsistency might be attributed to the different application time and concentration of SA. Therefore, further researches are required to confirm the exact application protocol of SA. Also, Sodium ascorbate has certain drawbacks, that is, it is unstable in environment therefore, it needs to be freshly prepared. Therefore, in this study we used an anti-oxidants which remains stable in environment once prepared; i.e. Hypericum Perforatum.

Medicinal plants have been investigated extensively in biomedical and pharmaceutical research since they constitute natural sources of antioxidant compounds acting as free-radical scavengers and less toxic than synthetic antioxidants such as hydroxyanisole or butylated hydroxytoluene. Hypericum Perforatum has shown to increase the pushout bond strength of fibre post when used as a final irrigant in (Group 3) when compared to Sodium ascorbate (Group 2) in this investigation. It has also been proved in a study by Yilmez et al. that the antioxidant property of Hypericum Perforatum is greater than Sodium Ascorbate [3].Significant antioxidant activity demonstrated by Hypericum Perforatum has been evaluated by DPPH Radical scavenging Activity. According to DPPH essay, Hypericum Perforatum shows Scavenging capacity of 89 % for 1g of product. The antioxidant activity of the Hypericum Perforatum extracts is mainly attributed to its rich content of phenolic compounds. Quantity and variety of phenolic compounds in plants or plant products are generally related to their antioxidant effectiveness [3]. Several classes of phenolic compounds such as flavonoids, phenolic acids, naphthodianthrones, and phloroglucinols have been identified in the Hypericum perforatum plant extracts [3]. Among those phenolics, flavonoids (quercetin, kaempferol glycosides, aglycones, and biflavonoids) and phenolic acids (caffeoylquinic acids) have been specifically linked to the antioxidant properties of the plant.

Another treatment performed on intracanal dentin was using laser. Laser has been used for various applications in dentistry. In recent years, the use of laser for cavity preparation as well as for dentinal and enamel surfaces conditioning as an alternative method for acid etching is increasing. In the present study, the applications of laser gave better results in terms of pushout bond strength (Group 4 and 5) when compared to the non lased groups (Group 1,2 and 3). The most commonly used laser in such cases is Nd: YAG laser, however in this present study we used diode laser as an alternative as it provides a near-infrared irradiation with parameters similar to those provided by Nd:YAG but with more attractive usage and availability, such as lower size, weight, and cost. Diode laser irradiation has been proposed for endodontic therapy and has been shown to increase the level of disinfection even the lateral and accessory canals. Another very important observation seen is; Diode laser caused morphological effects on the intra-canal dentin and dentinal tubule openings causing melting of intracanal dentin and partial to complete obliteration of dentinal tubules. This was in accordance with the results reported by Saghiri *et al.*[21] and Alfredo *et al.*[22] It has been proposed that photo-ablative effects of laser causes fusion and re-solidification of dentin and thus reduce dentin permeability. Diode lasers are available in four different wavelengths of 810–830 nm, 940 nm, 980 nm, 1064 nm. According to the Franke et al. the immediate increase in bond strength could be because of the heat provided directly by laser irradiation, which could favour adhesive penetration and solvent evaporation.[15] It was also found that a warm air stream can also provide immediate increase in bond strength values which could explain the favourable results obtained with the laser irradiation technique.[13]

Hence, in the present study, when the diode laser was applied over the adhesives before polymerization, there must have been a formation of new layer where in both the dentin and adhesive are fused, resulting in enhanced bond strength when compared to the nonlased group. Local heat generation caused by laser irradiation may also cause a higher degree of conversion of the adhesives already infiltrating the dentin, especially if the diode laser wavelength is well absorbed by the adhesives.[4]

During the intergroup comparison we observed that there was no significant difference between Group 4 (Laser + Sodium Ascorbate) Vs Group 5 Laser +Hypericum Perforatum) with($p=0.274$); which shows that irradiation with Diode laser highly increases the pushout bond strength irrespective of the final irrigant used in combination with it.

The advantages of diode lasers are many if used with proper specifications mentioned by the manufacturer. However, lasers also have the potential to cause harmful hazards. Further clinical research is required to determine optimal power and exposure time specifications of diode lasers to achieve maximum benefit on intra-canal dentin and least risk to surrounding tissues.

Although in this study, root canal therapy was performed and then posts were cemented to simulate the clinical conditions, our study is an *in vitro* investigation and does not fully replicate oral conditions. In addition, factors like thermal, load cycling, and water storage aging methods that challenge the adhesive interface should be investigated in further studies.

Therefore, the null hypothesis that there is no difference in the adhesion of resin-based cement when using Sodium Ascorbate, Hypericum Perforatum (an homeopathic agent) as final irrigant and treatment with Diode laser inside the root canal is rejected.

5. CONCLUSIONS

Under the constraints of this in vitro study, it is possible to draw the conclusion that root canal irrigated with Hypericum Perforatum as final irrigation increases the push out bond strength. When combined with Diode laser used to irradiate the canal after the final irrigation it enhanced the property of antioxidant and showed the highest pushout bond strength.

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