RESEARCH ARTICLE

A comparative study on the effect of propolis and dentine bonding agent in treating dentine hypersensitivity

Ather Akber,[1] Shahbaz Ahmed,[2] Syed Muhammad Umer Hasan[3]

Abstract

Objective: To find out if there is a difference in the efficacy of propolis and seventh-generation dentine bonding agent in reducing dentine hypersensitivity.

Method: The randomised, single-blind study was conducted at the Department of Periodontology, Dow International Dental College, Dow University of Health Sciences, Karachi, from December 2018 to November 2019, and comprised patients with complaint of dentine hypersensitivity who were divided in group A which received 30% ethanolic extract of propolis, and group B which received dentine bonding agent. Recordings of dentine hypersensitivity were obtained at baseline, before and after the application of experimental agents, and on days 7, 15 and 30. The response was measured using the Schiff Cold Air Sensitivity Scale. Data was analysed using SPSS 20.

Results: Of the 52 patients, 19 (36.5%) were males and 33 (63.5%) were females. The overall mean age was 29.9 ± 6.5 years. Majority of the subjects were students i.e. 16 (30.8%) and housewives i.e. 11 (21.2%), while drivers, teachers, businessmen etc. constituted of 25 (48%) subjects. Significant reduction of dentine hypersensitivity was observed in both groups ($p<0.05$). Intergroup comparison showed non-significant differences ($p>0.05$).

Conclusion: Propolis and dentine bonding agent had significant effect in reducing dentine hypersensitivity. The difference between the two was not significant.

Keywords: Dentine hypersensitivity, DH, Propolis, Dentine bonding agent, Schiff cold air sensitivity scale.

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Introduction

Dentine hypersensitivity (DH) can be defined as short-acting, sharp pain that arises from exposed dentine due to various stimuli, like thermal, evaporative, osmotic, chemical and tactile, and this pain cannot be attributed to any other form of dental defect, disease or pathology. DH has multifactorial aetiology and it is initiated by denudation of dentinal tubules. Several factors cause DH, like gingival recession, pocket formation, para-functional habits, gastric regurgitation and acidic dietary components. Faulty and overzealous tooth brushing and periodontal procedures, especially scaling and root planning, also cause dentine sensitivity.[1,2]

A number of theories have been put forward to describe DH mechanism. Direct neural stimulation theory and odontoblast transduce mechanism / transduction mechanism are amongst them. Brannstorm's hydrodynamic theory is the most widely acceptable one. According to the theory, various stimuli cause changes in fluid movements in dentinal tubules either outwards or inwards which result in the activation of nociceptors in pulpodentinal border, which ultimately lead to the characteristic short, sharp pain of DH.[1,3]

Variation in DH prevalence exists worldwide, ranging from 1.34% to 98%.[1] Based on the mechanism of action, different agents have been widely used all around the world for DH treatment. Potassium nitrate is used as a nerve desensitising agent. Gluteraldehyde, silver nitrate, zinc chloride, strontium chloride hexahydrate are used as protein precipitating agents. Strontium chloride, stannous fluoride, sodium fluoride, bioactive glasses, calcium carbonate and calcium phosphate are also used as dentinal tubules plugging agents. Oxalic acid, resin, fluoride varnishes, dentine bonding agents (DBAs), composites and glass ionomer cements are used as dentine adhesive sealers. Lasers nowadays are also used for DH treatment. There is no standard treatment to date for DH.[1,4]

Naturally, saliva seals patent tubules by transporting calcium and phosphate ions into dentinal tubules. It also exerts it action by creating surface protective layer of salivary glycoproteins with calcium and phosphate. However, this natural tubular sealing process is very slow and this plug is easily removed with dietary acids and physical insult. Therefore, it is not reliable in providing long-lasting relief in DH reduction. Therefore, successful treatment regimens are required which may produce immediate and long-term relief from DH and are also

[1]Department of Periodontology, [3]Department of Oral Medicine, Dow International Dental College, Dow University of Health Sciences, Karachi, [2]Department of Operative Dentistry, Dr. Ishrat Ul Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, Pakistan.

Correspondence: Ather Akber. Email: ather.akber@duhs.edu.pk

resistant to dietary acids and physical insult.[5]

Adhesive restoration materials and dentinal adhesives are considered dentinal tubule sealers and are, therefore, used in DH treatment. Adhesive resin effectively seals the dentinal tubules by forming transitional hybrid layer which is an interface between dentine and adhesive resin. Reduction in DH with the application and penetration of resins for the occlusion of dentinal tubules has been suggested.[6]

The seventh-generation DBA is the easiest and the most advanced adhesive system which is one step self-etch system that combines the etchant, primer and bonding resin in a single application. It was introduced between 1999 and 2005. This all-in-one adhesive system contains acidic functional monomers, hydrophobic and hydrophilic monomers, organic solvents and water into a single solution. Less postoperative sensitivity, reduced technique sensitivity and simplified clinical application are the advantages that made the self-etching system a favourable system than etch-and-rinse system.[7]

Propolis is naturally occurring, resinous, non-toxic honey bee (Apis mellifera) product, collected from living plants. The word 'propolis' is derived from Greek word 'pro (in front of, at the entrance to) and 'polis' (city or community) which means defender of a city or community. It is generally composed of a mixture of 50-60% resins and vegetable balsam, 35% waxes, 5-10% essentials and aromatic oils, 5-10% pollen, and 10-15% other constituents.[8] There are various in vitro and in vivo studies showing the effect of propolis in DH reduction.[9-12]

The current study was planned to find out whether there is a difference in the efficacy of propolis and seventh-generation DBA in reducing DH.

Patients and Methods

The randomised, single-blind study was conducted at the Periodontology Department of Dow International Dental College (DIDC), Dow University of Health Sciences (DUHS), Karachi, from December 2018 to November 2019. Approval was taken from institutional ethics review board. The Power of study was calculated using PASS version 11,[13] taking analysis of variance (ANOVA) with 95% confidence interval (CI). The calculated power of the study was based on Schiff Cold Air Sensitivity Scale (SCASS) score and was found to be 100% at 3.39 intergroup square root of mean square error (RMSE) and 0.97 intragroup RMSE.

The sample was raised using consecutive sampling technique. Those included were outpatients of either gender aged 20-45 years presenting with DH who were systemically healthy and were having at least 2 vital teeth with DH. Besides, the patients had sensitivity on facial surfaces to air stimulus, had a Silness and Loe Plaque Index (SLPI) score 1, and those who were using fluoride dentifrices for hypersensitivity, but still could not get relief.

Those excluded were patients with carious, cracked or restored teeth, abutment teeth used of removable or fixed prosthesis and tooth with any other dental pathology; those who used analgesics or mood-alteration drugs during the preceding six months, those who were smokers, pregnant or nursing mothers; those who used tooth whitening or bleaching agents in the preceding six months; and those who were undergoing orthodontic therapy or had a history of periodontal surgery during the preceding six months. Patients were enrolled after taking informed written consent from the subjects and a detailed demographic and clinical history was noted on a proforma.

A Definitive DH diagnosis was made by using air blast stimulus from triple dental syringe on the sensitive surface. The participants were then randomised into two equal groups using the sealed envelope method. Group A subjects received propolis, while group B subjects received seventh-generation DBA (Scotchbond™ Universal Adhesive, 3M ESPE Dental Products, St. Paul, MN, United States). It was only disclosed at the time of the application of desensitising agent by the operator.

At baseline, thorough oral prophylaxis was done for all the patients, including scaling and root debridement with polishing, and detailed oral hygiene instructions were given. The subjects were provided with a kit containing standard toothpaste (Colgate® Maximum Cavity protection PLUS Sugar Acid Neutralizer™) and toothbrush (Colgate® 360 Sensitive Pro-Relief™) for oral hygiene during the study period. Relevant tooth brushing technique for each patient was explained and demonstrated. Dietary counselling was also done in order to avoid intake of excessive acids during the study period.

After debridement, pre-treatment assessment was done. To evaluate DH, evaporative stimulus (controlled air blast stimulus) was used from dental triple syringe or air water syringe which was directed onto the affected area from a distance of 10mm for up to 2 seconds with complete isolation of the adjacent teeth by cotton roll. SCASS[14] was used to measure response. Grade 0 represented the subject did not respond to the air stimulus; grade 1 meant the subject responded to the air stimulus but did not request discontinuation of the stimulus; grade 2 meant the subject responded to the air stimulus and requested

discontinuation or moves from the stimulus; and grade 3 meant the subject responded to the air stimulus, considered the stimulus to be painful, and requested the discontinuation of the stimulus. Responses from all patients were recorded by a single researcher who was blind to the applied desensitising agent.

Propolis is collected from the Margalla Hills in Islamabad, Pakistan, by the National Agriculture Research Council (NARC). Acacia modesta is the origin of plant source and propolis is collected by Apis mellifera honeybees. The 30% ethanolic extract of propolis from raw propolis is developed by the Pakistan Council of Scientific and Industrial Research (PCSIR) by dissolving the propolis in 95% ethanol and straining out the precipitate.

The application of desensitizing agents was carried out by trained and experienced operator and it was only disclosed to the operator at the time of application. The operator informed the participants about the intervention before applying the tested agents and patients were not blinded. Desensitising agents were applied on baseline. Propolis and DBA was applied on hypersensitive teeth under isolation using cotton rolls. Hypersensitive teeth surfaces were dried by cotton pellets. Propolis was then applied by disposable micro-brush on that particular sensitive tooth and left undisturbed for 60 seconds to let it dry. DBA on sensitive surfaces was applied single-coated for 20 seconds, gently applied air for 5 seconds and cured for 10 seconds, as per the manufacturer's instructions.

The clinical evaluation of DH was done before and after the application of desensitizing agents at baseline and on days 7, 15 and 30 day.

Data was analysed using SPSS 20. Intragroup comparison was done using Friedman, and for pairwise comparison, Wilcoxon signed ranked test was used. For intergroup comparison, Mann-Whitney U-Test was applied. The level of statically significance was set at $p < 0.05$.

Results

Of the 52 patients, 19 (36.5%) were males and 33 (63.5%) were females. The overall mean age was 29.9 ± 6.5 years. Majority of the subjects were students i.e. 16 (30.8%) and housewives i.e. 11 (21.2%), while drivers, teachers, businessmen etc. constituted of 25 subjects (48%). Significant DH reduction was observed in both groups across all time points compared to the baseline (Table-2). Intergroup comparison showed non-significant differences ($p>0.05$).

Discussion

In the current study, the age ranged 20-44 years with a mean of 29.9 years. The finding is in line with a study which showed that DH primarily affected adults aged 20-29 years.[15] In a study conducted in Karachi, DH was common in those aged 25-34 (26%) years, followed by 35-44 years (24.4%).[1] Also a cross-sectional study in Athens reported a higher DH frequency (27%) in those aged <30 years.[16] But some previous studies reported DH in patients aged 40-50 years and 50-59 years.[17] One recently published study also reported the mean age of the studied patients to be 47 years.[18] The role of aging in DH is still not clear. Acidic and erosive dietary habits may be responsible for increased DH frequency in adult age groups compared to the older age group in which DH reduces due to continued deposition of dentine and subsequent pulp atrophy of teeth.[1,15]

In the present study, DH frequency was significantly higher in female patients (63.5%). This finding is similar to a number of studies carried out in different setups.[1,15] Other studies have presented contrasting result.[19-21] The reason for higher reported DH frequency in females may have been due to their better overall healthcare and oral hygiene awareness which would make them more decisive about seeking treatment than ignoring or

Table-1: Comparison of dentine hypersensitivity using Schiff Cold Air Sensitivity Scale.

	Baseline*		Immediate†		Day 7		Day 15		Day 30		p-value	
	P n= 26 (%)	DBA n= 26 (%)	P n= 26 (%)	DBA n= 26 (%)	P n= 26 (%)	DBA n= 26 (%)	P n= 26 (%)	DBA n= 26 (%)	P n= 26 (%)	DBA n= 26 (%)	P	DBA
Score 0	0 (0)	0 (0)	8 (31)	5 (19)	14 (54)	12 (46)	21 (81)	19 (73)	25 (96)	18 (69)	< 0.001**	< 0.001**
Score 1	14 (54)	14 (54)	9 (34)	16 (62)	11 (42)	11 (42)	4 (15)	4 (15)	1 (4)	6 (23)		
Score 2	6 (23)	7 (27)	8 (31)	2 (8)	1 (4)	2 (8)	1 (4)	2 (8)	0 (0)	2 (8)		
Score 3	6 (23)	5 (19)	1 (4)	3 (11)	0 (0)	1 (4)	0 (0)	1 (4)	0 (0)	0 (0)		

* Before application of desensitising agent
† After application of desensitising agent
**Significant at 1 %
P: Propolis
DBA: Dentine bonding agent.

Table-2: Intragroup comparison of dentine hypersensitivity.

Sensitivity Scale	Baseline*		Immediate†		Day 7		Day 15		Day 30	
	Propolis	DBA	Propolis	DBA	Propolis	DBA	Propolis	DBA	Propolis	DBA
Median (IQR)	1	1	1	1	0	1	0	0	0	0
Q1- Q3	(1-2.5)	(1-2)	(1-2)	(1-1)	(0-1)	(0-1)	(0-0)	(0-1)	(0-0)	(0-1)
Schiff Scale (p- value)	----	----	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**	< 0.001**

* Before application of desensitising agent
† After application of desensitising agent
**Significant at 1 %
DBA: Dentine bonding agent.

Table-3: Intergroup comparison of Schiff Cold Air Sensitivity Scale values with significance set at p<0.05.

Degree of DH	Baseline	Immediate	Day 7	Day 15	D a y 30
Score 0	0.903	0.992	0.443	0.471	0.074
Score 1					
Score 2					
Score 3					

DH: Dentine hypersensitivity.

neglecting the condition.

The application of propolis resulted in highly significant reduction in DH ($p < 0.001$). Increase in the efficacy of propolis was observed over a period of one month, and it was found to be significant. This result of immediate and sustained DH reduction is in agreement with literature.[11] A pioneering study on the effect of propolis as the desensitising agent on DH demonstrated that 85% subjects were found highly satisfied during the study period of four weeks.[22] Rana Al-Haj Hussain et al. also reported that propolis application after tooth bleaching resulted in no signs of DH in 100% of the patients.[12] Similar result was reported in a recent published study.[18] Dentinal tubules occlusion effect of propolis was already reported in in-vitro studies.[9]

Propolis provides a durable dentinal tubule sealing that could be because of its diffusion deep inside dentinal tubules that may be resistant to removal, and, therfore, there is prolonged and sustained pain relief. Also, long-lasting effect from propolis could be due to the stable nature of deposits so formed.[11] Other possible factors could be the existence of natural resinous substance in propolis that shows a bonding mechanism similar to dental adhesive material. The immediate relief in DH by propolis is due to its tubular sealing effect which may be attributed due to the reaction between high contents of flavonoids in propolis and the dentine, forming precipitating crystals that are able to adhere to and prevent flow of dentinal fluid and thus occlude the dentinal tubules. Also, on the other hand, flavonoids by binding with heavy metal ions prevent the formation of free radicals.[23]

Propolis induces reparative dentine formation, and partial dentine bridge formation was observed beneath the pulp capping the material after four weeks. Parolia et al. also reported of reparative bridge formation beneath direct pulp capping of propolis. Thus propolis, especially flavonoids, may stimulate repative dentinogenesis which is believed to be responsible for the process of dentinal tubules occlsuion, reducng DH.[1,12,23]

DBA application resulted in highly significant reduction in DH in the current study. The finding is validated by various studies.[17,24]

Reduction in DH was attributed to decrease in permeability and sealing of dentinal tubules by the action of DBA. Resin in adhesives has the ability of bonding to tooth surface by diffusion and mechanical interlocking in micro-porosities and thus may have the capability to provide surface coverage, sealing dentinal tubules and blocking the movement of fluid. Yadav et al. concluded that occlusion of dentinal tubules occurs because of the formation of hybrid layer and, thus, less postoperative sensitivity. The hybrid layer is a combined dentine-resin layer consisting of penetrating resinous tags. These resinous tags occlude the dentinal tubules, preventing dentine permeability and decreasing DH.[4,18,25]

The result was non-significant between propolis and DBA. These results are validated by a recent study in which propolis extracts and DBA were equally effective in relieving DH in the long term.[18]

Conclusion

Propolis and DBA were found to be equally effective and highly significant in reducing DH in both long and short terms. There was no difference between the two agents in reducing DH at any time point. Both can be successfully

used for DH treatment in an outpatient setting.

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