Effectiveness Of Fluoride Varnish In Treatment Of Dentin Hypersensitivity

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ABSTRACT: Background: Hypersensitivity of dentin is a common dental problem with a varied effectiveness of the different available treatment modalities. **Aim of the work:** Clinical evaluation of the effectiveness of different fluoride containing varnishes in treating dentinal hypersensitivity of exposed dentin. **Materials and methods:** A clinical trial was conducted on 108 teeth prepared for fixed prosthodontics divided into three equal groups according to the varnish used. Clinpro XT, Sliver diamine fluoride and Bifluoride -10 varnishes were used to protect the dentin after teeth preparation. Thermal and evaporated stimulus were used, and dentin hypersensitivity was evaluated using Visual Analogues Scale. Intraclass coefficient was performed to ensure the reliability between the data of the testing methods. One-way and repeated ANOVA were used for comparison among the different tested materials at different follow up intervals measurements. **Results:** The three groups showed significantly decrease on dentin hypersensitivity after immediate application and after one week ($p < 0.000$). Varnish XT and Silver diamine fluoride showed lower significant mean values than bifluoride varnish with no significant difference between them. **Conclusion:** All tested varnishes were significantly effective for reducing dentin hypersensitivity. Clinpro XT and Sliver diamine fluoride have nearly similar effect which was significantly better than Bifluoride -10 varnish.

Key words: Dentin hypersensitivity, Bifluoride 10, Varnish XT, Silver diamine fluoride, Visual Analogues Scale.

1 INTRODUCTION

Dentinal hypersensitivity (DHS) is a dental disease which characterized by short and sharp pain arising after external stimulation either; chemical, mechanical, thermal and osmotic stimuli [1]. The prevalence of DHS has a lot of varieties among different studies where it is ranging from one to 98%, which may affect the quality of life of patients through the negative impact on their daily oral activities [2], [3]. DHS is associated with the exposure of dentin which may be is due to several factors such as physical, biological, chemical, pathological factors and/or developmental abnormalities. Other predisposing factors such as periodontal disease and gingival recession may expose the cervical and root dentin to external stimuli [4]. Additional factors such as aging, soft tissue dehiscence, including aggressive brushing may lead to dentinal exposure which subsequently developing DHS [5]. According to the hydrodynamic theory, the flow of fluid within dentinal tubules stimulates baroreceptors leads to neural discharge which transmitted as a painful sensation [6]. Dentinal permeability was classified into two types: intratubular (within the dentinal tubules), and inter-tubular (between the tubules in dentinal matrix). The permeability of sensitive dentin occurs through its thickness, dentinal sensitivity can be reduced through any treatment that reduces dentinal permeability [7]. Effective sealing of dentinal tubules usually reduces DHS, but it sometimes persists, thus, further mechanisms may be involved in nerve activation instead of or in addition to hydrodynamic theory. The DHS sometimes persists despite of the effective sealing of the tubules indicating that further mechanisms may be involved in nerves activation instead of or in addition to the hydrodynamic mechanism [8]. In order for the individual to experience pain; there were two conditions must be present, the first termed “lesion localization” where the dentine surface of a tooth must be exposed with enamel or cementum removal, the second termed “lesion initiation” where several dentinal tubules, in close proximity to each other, must be patent from the pulp to the oral environment [9], [10], 11]. Tubular occlusion whatever its nature is the most favored current mode of treatment action [12]. The diagnosis for DHS can be obtained through exclusion of other conditions (dentinal exposure, dental pulp hyperemia, dental nerve sensitization and neuropathy) as they have similar symptoms but need varieties of treatment options, therefore need to be distinguished [1]. The management of DHS including different strategies: 1) Improvement of oral hygiene and education for good brushing technique; 2) Controlling or removing etiological factors; 3) Pain relief through occluding dentinal tubules, 4) Restoration or surgical treatments for dental hard and soft tissue defects [13], [14]. Many in-office DHS treatment options have been reported to date, such as fluoride cavity varnishes, potassium-based agents, glutaraldehyde-based agents, oxalates, calcium phosphates, strontium or acetate chlorides, resin-based sealants and laser therapy [15]. The principal action of sodium fluoride varnish to reduce DHS takes place through occlusion of dentinal tubules and increasing the stability of the dentin and shifting the equilibrium at the dentinal surface level in direction of no sensitivity. Sodium fluoride commercially available in different varnishes forms, bifluoride 10 varnish which contains a combination of two fluoride salts (5% sodium fluoride and 5% calcium fluoride). The combination of those two fluoride salts produces immediate and high release of fluoride from sodium fluoride and sustained release of fluoride from calcium fluoride salt [16]. A new fluoride varnish containing fluoride, calcium, and phosphate (Clinpro XT varnish) which is a light-cured glass ionomer-based material, available in a liquid/paste system used for in-office treatment of DHS because it is acts as a dentinal adhesive sealer [17], [18]. Diamine silver fluoride (DSF) was used in treatment of DHS and previous studies concluded that, DSF is a clinically effective and safe desensitizing agent used for treatment of DHS [19], [20], [21]. The effectiveness of one fluoride varnish over another in treatment of DHS not evaluated until now due to disparities in the trial designs, the etiology of DHS, method of painful sensation evaluation and the composition of the varnish. The gold standard treatment modality for dentine hypersensitivity has not yet been established. Thus, the aim of the current study was to clinically assess the role of three different fluoride releasing varnishes in the treatment of DHS and compare between their effectiveness in management of DHS under standard circumstances.

2 MATERIALS AND METHODS

2.1 Study design and sample size calculation:

This clinical trial was carried out to assess the effect of three desensitizing agents (Clinpro varnish XT extended, Sliver Diamine Fluoride and Bifluoride -10) on the prepared teeth for fixed partial prosthodontics immediately after preparation and later before cementation. Sample size was calculated using https://clincalc.com/stats/samplesize.aspx on-line calculator, the anticipated means for the groups was 3.56 and 2.39 with standard deviation of 1.4 (recorded from previous studies), at alpha error 0.05 and sample power 80% the calculated sample size was 22 teeth and more in each group.

2.2 Subject:

A total of 109 patients of both genders were recruited and examined over a period of four months at fixed prosthodontic clinic at Umm Al-Qura University, Makkah, KSA. Patients with at least two posterior teeth indicated for crown preparation were selected. Patients taken anti-inflammatory or any drugs, pregnant women, smokers or those with periodontal diseases were not participate in the present study. Patients' abutments were examined and carious, filled and/or endodontically treated abutments were excluded. A final total of (54 patients 39 females and 15 males with 108 teeth) were included in this study, the sample size was increased to avoid patient withdrawal. The participants were classified randomly into three groups, each group contain 18 patients with 36 teeth (13 females with 26 tooth and 5 males with 10 teeth). The clinical procedure was explained in detail to all patients and informed consents were obtained from them before starting the study.

2.3 Clinical procedure:

During tooth preparation procedure, one trained examiner was present to perform the clinical steps after the prosthodontist finished the tooth preparation procedure. All teeth treated with warm water first day after finished tooth preparation. Next day, varnishes were applied on the teeth according to assigned group. **Group I:** Bifluoride - 10 (VOCO Bifluoride 10) single dose was applied on dried dentin by brush and was dried for 10 -20 sec then the teeth were dried. **Group II:** Clinpro XT varnish (3M™ Clinpro™ XT Varnish Durable Fluoride-Releasing Coating) was applied according to the manufacture guide, the varnish was applied on dentin by mixing it for 15 min, applied thin coat, cured it for 20 min then wiped the coating with a moist cotton applicator. **Group III**: Sliver Diamine Fluoride (SDF) varnish (Riva Star® Silver Diamine Fluoride 38%), SDF varnish was available in capsules for one use, it was two steps technique where the SDF was applied first followed by application of potassium iodide solution.

2.4 Measurements of hypersensitivity:

Each tooth was tested by thermal stimulus and evaporative stimulus and the response was recorded in Visual Analog Scale (VAS) (from 0 – 10) [22]. Frozen anaesthetic carpule was used as cold thermal stimuli, it was applied to the occlusal tooth surface for two seconds then record the patient pain degree. After 10 min from the cold stimuli test, an evaporative stimulus was used. The teeth were isolated with cotton rolls. A blast of air from the three-way syringe at 60 psi was applied perpendicular to the labial surface of the tooth for one second, then the VAS score was recorded. The pain was recorded at three points, **Point I:** Next day of teeth preparation and before the varnish's application. **Point II:** After the varnish's application (before the temporary crown cementation). **Point III**: After one week (after removal of temporary crown and before cementation of permanent one).

2.5 Validity of the clinical procedures:

The clinical procedures were done by two trained examiners, one examiner was responsible for the application procedures for all varnishes used and the other examiner was responsible for examining and recording teeth hypersensitivity among patients in all groups. During recording hypersensitivity, the examiner was blind to detect the patient's group to ensure data validity. The examiner explains to the patients the scores meaning and color code of each score in the scale to ensure objective scoring process.

2.6 Statistical analysis:

Data was analyzed using SPSS version 23, Intraclass Coefficient Correlation (ICC) was performed to test the reliability between data from the two different stimuli. One-way ANOVA test was performed to compare between the three varnishes at each time point, repeated ANOVA was performed to test the difference between the time factor for each type of varnish. Post hoc Tukey test made the pairwise comparison. P value less than 0.05 was considered significant. The reliability of the data for VAS recorded by cold stimuli and evaporated stimuli was tested using intraclass coefficient correlation (ICC) and interpretated according to the guidelines reported by Koo et.al. 2016 [23].

3 RESULTS

Regarding the cold stimuli at point I, before the varnish's application, the mean values of pain showed no significant difference (p= 0.206) among the three examined groups. Immediately after the varnishes application the mean pain values were decreased among varnish XT and SDF groups it was nearly the same (0.98 and 0.99) which were significantly lower than that among bifluoride group (2.07). After one week, the pain showed low statistically significant (p < 0.000) mean values among varnish XT group (1.13) and SDF group (1.09) compared with (2.22) the mean value among Bifluoride group. Repeated ANOVA test showed statistically significant difference (p < 0.000) between the mean pain value at point I with mean pain values at point II and III for the three groups (Table 1).

Table (1): Comparison of Visual Analogue Scale (VAS) scores for the three varnishes groups at different measures point times using thermal stimuli

Varnish / Follow up	Bifluoride 10		Varnish XT		SDF		P value#
	Mean± SD	Mean rank	Mean± SD	Mean rank	Mean± SD	Mean rank	
Point I	6.16± 0.13	4.20	5.98±0.73	3.71	6.12± 0.35	4.0	0.206
Point II	2.07± 0.34	2.11	0.98± 0.28	1.0	0.99± 0.31	1.21	< 0.000
Point III	2.22± 0.57	1.98	1.13± 0.21	1.52	1.09±0.54	1.33	< 0.000
P value##	< 0.000		< 0.000		< 0.000		

SD: standard deviation #: one-way ANOVA test ##: Repeated ANOVA test

Table (2), showing the pairwise comparison using post hoc Tukey test, there were significant differences between both varnish XT and SDF compared with bifluoride varnish at point II and III (p< 0.000) but not significant at point 1 (p= 0.204 and 0.774 respectively). Varnish XT group showed non-significant difference from SDF varnish group all over the three measures time points.

Table (2). Pairwise comparison for thermal stimuli pain mean values between the three varnishes groups at different measurement time point using post hoc Tukey test

	Point I		Point II		Point III	
	Mean diff	p value	Mean diff	p value	Mean diff	p value
Bifluoride 10 Vs Varnish XT	0.18	0.204	1.09	< 0.000	1.09	< 0.000
Bifluoride 10 Vs SDF	0.04	0.774	1.08	< 0.000	1.13	< 0.000
Varnish XT Vs SDF	- 0.14	0.344	- 0.01	0.362	0.04	0.452

p-value was calculated using post hoc Tukey test

Regarding the mean pain values recorded by VAS using evaporated stimuli**,** there were no significant differences (p = 0.060) among the three groups at point 1. At point II time measurement, varnish XT and SDF groups showed statistically significant (p < 0.000) means of pain values less than bifluoride group. At point III, the pain mean value was (2.01) at bifluoride group which was higher than the mean values of varnish XT group (1.56) and that of SDF group (1.47) and the difference was significant among them (P < 0.000). (table 3) Repeated ANOVA test showed significant differences among the three-time measurement point I, II and III for Bifluoride varnish group & varnish XT and SDF group (P < 0.000 for all).

Table (3): Comparison of Visual Analogue Scale (VAS) for the three varnishes groups at different measures point times using evaporated stimuli

Varnish / Follow up	Bifluoride 10		Varnish XT		SDF		P value#
	Mean± SD	Mean rank	Mean± SD	Mean rank	Mean± SD	Mean rank	
Point I	6.21±0.53	5.3	6.15±0.91	5.1	6.14±0.65	5.4	0.060
Point II	1.94±0.39	2.8	0.92±0.11	1.7	0.96±0.38	1.3	< 0.000
Point III	2.01±0.42	2.9	1.56±0.36	2.1	1.47±0.59	2.0	< 0.000
P value##	< 0.000		< 0.000		< 0.000		

SD: standard deviation. #: one-way ANOVA test. ##: Repeated ANOVA test

The comparison between each two groups at different measure time was showed in table (4), bifluoride group showed significant higher mean pain values than varnish XT and SDF groups at point II and point III measurements (P < 0.000). On the other hand, varnish XT and SDF group showed non – statistically significant differences for the mean pain values recorded at point I, II and III measurement times.

Table (4). Pairwise comparison for evaporated stimuli pain mean values between the three varnishes groups at different measurement time point using post hoc Tukey test

	Point I		Point II		Point III	
	Mean diff	p value	Mean diff	p value	Mean diff	p value
Bifluoride 10 Vs Varnish XT	0.06	0.06	1.02	< 0.000	0.45	< 0.000
Bifluoride 10 Vs SDF	0.07	0.09	0.98	< 0.000	0.54	< 0.000
Varnish XT Vs SDF	0.01	0.621	-.0.04	0.582	0.09	0.114

All the recorded ICC values for the three groups were above 0.90 which interpreted as excellent agreement between the results of the two pain testing methods. (Table 5)

Table (5). Reliability of the measurements by thermal (cold) stimuli and evaporated stimuli for the three varnishes groups at point I, II and III

	ICC	CI 95%
Bifluoride 10		
Point I	0.991	0.979 – 0.996
Point II	0.976	0.899 – 0.998
Point III	0.992	0.981 – 0.997
Varnish XT		
Point I	0.919	0.897 – 0.994
Point II	0.995	0.989 – 0.998
Point III	0.996	0.990 – 0.998
SDF		
Point I	0.983	0.981 – 0.989
Point II	0.986	0.983 – 0.991
Point III	0.997	0.991 – 0.998

4 DISCUSSION

The study was designed as clinical trial to test the effect of different varnishes on dentin hypersensitivity, the sample was patients undergo fixed prosthodontics procedure to ensure presence of exposed dentin allowing valid measures of DHS as the previous studies indicated different causes of it and may affect the effectiveness of the varnish [4], [5]. The distribution of sample by equal number of male and female patients in each group prevent the gender as confounder in the study. Visual Analogue Scale was used to record the pain before and after the varnish's application although its subjectivity because many studies have been shown its accuracy for recording the responses of the patients to painful stimuli [13]. Within the current study, an air blast was used in combination with cold stimulation to confirm the results and compare their sensitivity in diagnosis of hypersensitivity. The present trial was designed to determine which professionally applied varnish is more effective clinically in treatment of DHS as the previous studies have been reported that, fluoride releasing varnishes had reduced the pain of DHS when compared with control groups but the relative effectiveness of each professionally applied varnish was not confirmed and has limited evidence [11], [12]. The results indicated that, the Varnish XT and SDF were more effective than sodium bifluoride varnish at all different follow up periods either evaluated by thermal or air blast stimuli (Table 1 and 3) and these results matched with the results reported by Yilmaz et al.

2011 [24]. Both SDF and varnish XT had similar effect in reducing pain of DHS as there were no significant differences between them at all follow up points (Table 2 and 4). Clinpro XT varnish was shown to reduce the DHS better than bifluoride varnish, these results were not in consistency with the results obtained by Sharma et al [18]. The current results indicated highly significant effect of SDF in reducing DHS pain and these results confirm the results of previous studies which has been shown caries arrest in animal models [25] and its clinical effectiveness and safety for treatment of tooth sensitivity [19]. The high desensitizing effect of SDF may be due to its high concentration of fluoride (38% SDF) contains 44,800 ppm of fluoride [26]. In the present study, potassium iodide was applied after SDF varnish to reduce the discoloration of the tooth surface as potassium iodide reacts with free silver ions to form silver iodide [27]. This study showed excellent agreement between the results of the two pain testing methods as all recorded ICC values for the three groups were above 0.90. (Table 5)

5 CONCLUSIONS

According to the findings of the current study could concluded that:

- All tested varnishes were significantly effective for reducing dentin hypersensitivity.
- Both Clinpro XT and sliver diamine fluoride have nearly similar effect which was significantly better than Bifluoride -10 varnishes.
- Both methods for diagnosing DHS show excellent agreement and can be used separately or in combination for diagnosis of dentin hypersensitivity.

6 LIMITATIONS OF THE STUDY

According to the design of the present study, there were some limitations as.

1- Difficulties in follow up for long term effect of the tested materials in the present study.
2- Difficulties to exclude the effect of temporary cementation at point III follow up.

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