ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 6, Issue – 4, August - 2023, Page No. : 57 - 69

Evaluate the tubule occluding ability of four desensitizing agents amine fluoride, calcium sodium phospho silicate, pro-arginin and CPP-ACP (casein phosphopeptide-amorphous calcium phosphate) using scanning electron microscope.

[1]Rahul Bhartia, MDS, Professor, Department of Conservative and Endodontics, Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh.

[2]Prachi Sijeria, MDS, Associate Professor, Department of Paediatrics and Preventive Dentistry , Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh.

[3]Anupama Ahirwar, MDS, Assistant Professor, Department of Conservative and Endodontics, Rishiraj College of Dental Sciences & Research Centre, Bhopal Madhya Pradesh

[4]Brajendra S. Tomar, MDS, Associate Professor, Department of Prosthodontics, Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh

[5]Shubhra Singh MDS, Associate Professor, Department of Periodontology, Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh.

[6]Medha Bhushan, MDS, Associate Professor, Department of Conservative and Endodontics, Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh

Corresponding Author: Rahul Bhartia, MDS, Professor, Department of Conservative and Endodontics, Rishiraj College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh.

Citation of this Article: Rahul Bhartia, Prachi Sijeria, Anupama Ahirwar, Brajendra S. Tomar, Shubhra Singh, Medha Bhushan, “Accuracy of Teledentistry in Diagnosing Dental Diseases”, IJDSIR- August - 2023, Volume – 6, Issue - 4, P. No. 57 – 69.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Dentin hypersensitivity is characterized by short, sharp pain arising from exposed dentin in response to stimuli, typically thermal, evaporative, tactile, osmotic, or chemical, and which cannot be ascribed to any other form of dental defect or disease. Traditionally, the term dentine hypersensitivity was used to describe this distinct clinical condition; however, several authors have also used the terms cervical dentine sensitivity (CDS) or cervical dentine hypersensitivity (CDH) or dentine sensitivity (DS), and root dentine sensitivity (RDS)/root dentine hypersensitivity (RDH).Several studies showed that casein phosphopeptide- amorphous calcium phosphate (cpp-acp) and arginine are effective in occluding dentinal tubules but information regarding dentinal tubule occluding ability of Novamin (Calcium sodium phospho silicate) and Amine fluoride is less. Therefore the present study aim to evaluate the tubule occluding ability of four desensitizing agents.

Material and Method: An in vitro study comparing Occluding ability of Amine fluoride, Calcium sodium phospho silicate, Pro-arginin & CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) using Scanning Electron Microscope.

Result: Among the treated groups the specimens brushed with CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) containing agent Recaldent GC tooth mousse dentifrice showed the highest percentage of tubule occlusion, as it precipitated the hydroxycarbonate apatite over the entire dentin surface followed by Amine fluoride containing agent (Amflor), Pro-Argin containing agent(Colgate sensitive) Oral-B sensitive, Calcium sodium phospho silicate containing agent (Shy-NM).

Keyword: Tubule Occluding Ability, Dentine Hypersensitivity, Desensitizing Agents.

Introduction

Dentin hypersensitivity is characterized by short, sharp pain arising from exposed dentin in response to stimuli, typically thermal, evaporative, tactile, osmotic, or chemical, and which cannot be ascribed to any other form of dental defect or disease.[(1,2)] Traditionally, the term dentine hypersensitivity was used to describe this distinct clinical condition; however, several authors have also used the terms cervical dentine sensitivity (CDS) or cervical dentine hypersensitivity (CDH) or dentine sensitivity (DS), and root dentine sensitivity (RDS)/root dentine hypersensitivity (RDH) [(1, 3–8).]

Dentin hypersensitivity is a common oral condition that affects as many as 4-69% [(1,2)] of patients. Females appear to suffer more than males presumably due to their overall health care and better oral hygiene awareness[8]. It has been described as the “common cold of dentistry”[9] by some and “toothbrush disease” by others, when it occurs in the presence of gingival recession.[10]

Gysi attempted to explain “the sensitiveness of dentin,” and described the phenomenon of fluid movement in dentin tubules.[11] More than sixty years later, Brännström proposed the “hydrodynamic theory” as a mechanism to explain the transmission of pain-producing stimuli of the dentin.[12,13] Other theories have been proposed as potential mechanisms by which pain transmission can occur, but these have largely been discounted.[1,14]

The hydrodynamic theory suggests that dentin hypersensitivity is a result of inward or outward movement of fluid within the dentin tubules. This results in a pressure change across the dentin which activates intra-dental nerve fibers, via a mechanoreceptor response, to cause pain.[15]

Most pain-producing stimulus requires that dentin tubules are open at the dentin surface and patent to the pulp. Several studies of exfoliated teeth, with clinically characterized “sensitive” and “non-sensitive” areas of exposed dentin, have shown that tubules are greater in number (eight times), larger in diameter (two times), and are open in “sensitive” teeth, whereas tubules are fewer in number, smaller in diameter, and are usually blocked in their “non-sensitive” counterparts.[16,17]

As the rate of fluid flow through dentin tubules is proportional to the fourth power of the tubule radius, it is highly likely that the difference in tubule diameter between “sensitive” and “non-sensitive” teeth is of clinical relevance to the treatment of dentin hypersensitivity.[1]

Today, dozens of in-office sensitivity treatments and mass market sensitivity relief toothpastes are available worldwide.[15] Various chemical have been used for the occlusion of open dentinal tubules like strontium chloride, silver nitrate, sodium fluoride, potassium oxalate, stannous fluoride, calcium hydroxide, ferrous oxide etc.[18]

Recently calcium sodium phosphosilicate, casein phosphopeptide- amorphous calcium phosphate (cpp-acp) arginine and amine fluoride are available as an desensitizing agent.

Several studies showed that casein phosphopeptide-amorphous calcium phosphate (cpp-acp) and arginine are effective in occluding dentinal tubules[15,19] . But information regarding dentinal tubule occluding ability of Novamin (Calcium sodium phospho silicate) and Amine fluoride is less.

Hence the aim of the study is to evaluate the tubule occluding ability of four desensitizing agents Amine fluoride, Calcium sodium phospho silicate, Pro-arginin & CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) using Scanning Electron Microscope.

Aims and objectives

The objective of the present study was to Evaluate the tubule occluding ability of four desensitizing agents Amine fluoride, Calcium sodium phospho silicate, Pro-arginin & CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) using Scanning Electron Microscope.

Methodology:

Specimens were obtained from 60 sound premolars extracted for orthodontic purpose from the patients of age group 15 to 25 years. All the teeth were stored in 10% neutral buffered formaline NBF (freshly prepared) at room temp for no longer than one month prior to the use.

Inclusion Criteria

Intact human permanent premolar teeth (maxillary or mandibular),Freshly extracted teeth, Non carious teeth and Teeth with no sign of fracture teeth.

Exclusion Criteria

Carious teeth, Grossly destructed teeth, Teeth with any anomalies and Fractured teeth.

Dentine Specimen Preparation

Dentine specimens of size 3x3x2mm were prepared from the cervical 1/3rd each premolar using double-sided diamond disk attached to water-cooled air motor (NSK TH88625) and straight handpeice (NSK. ONX90715). The specimens were randomly divided into 6 groups of 10 dentin blocks. These dentin blocks were mounted on 2mm thick plastic plate by using Cyanoacrylate adhesive (super glue).Each dentine block was polished with of lex polishing discs of coarse, medium, fine, extra fine disks and final polishing was done with prismagloss fine and extra fine polishing pastes containing 1 and 0.2 micron alumina abrasives. All the specimens were ultrasonicated (at 42000 Hz, 5 cycles) for 12 min in distilled water to remove residual smear layer and to open the dentine tubule to simulate hypersensitive cervical dentin.

Experimental groups and treatments

Specimens were randomly divided into six groups each with ten dentine specimens

Group-1 control: Specimens were immersed in artificial saliva for 7 days. The artificial saliva contained (mmoles/L): distilled water 700ml, caoH2 1.56mM, Kcl 150.00mM, Hcl 36.00mM, H3po4 0.088mM, buffer 99.7mM, pH 7.2.

Group-2 control: Specimens were brushed with distilled water, for 2 min twice per day for 7 days.

Group-3: Specimens were brushed with CPP-ACP (Casein Phosphopeptide - Amorphous Calcium

Phosphate) containing agent (Recaldent GC tooth mousse) for 2 min twice per day for 7 days.

Group-4: specimens were brushed with Pro-Argin containing agent(Colgate sensitive) for 2 min twice per day for 7 days.

Group-5: specimens were brushed with Amine fluoride containing agent (Amflor) for 2 min twice per day for 7 days.

Group-6: specimens were brushed with Calcium sodium phospho silicate containing agent (Shy-NM) for 2 min twice per day for 7 days.

Specimens of groups 3, 4, 5, and 6 were brushed with dentifrices slurries prepared by diluting 2gm of dentifrice with 6 ml of distilled water. Brushing was performed with Oral B powered brush which is a battery powered toothbrush with soft round bristle at an oscillation speed of 8000/min. Brushing was done for 2min for each dentine block from equidistance by attaching bristle protector to the toothbrush shaft. After each brushing session specimens were washed under running tap water and then kept in artificial saliva filled plastic container.

SEM analysis

After the last brushing session, dentine specimens were washed with distilled water, after drying thin layer of gold sputter coating was done (QUORUM Q 150R ES, UK) Photomicrographs were taken using Scanning Electron Microscope (ZEISS GEMINI SUPRA 55, Germany) from the centre of 3x3x2mm dentine block at 1000X magnification.

Statistical analysis

Percentage of occluded tubules was obtained by dividing the total number of occluded tubules by total number of tubules in each photomicrography. This result was then multiplied by 100 to obtain the percentage of occluded tubules for each photomicrography. Results were statistically analyzed by one-way Analysis of Variance (ANOVA) and Tukey test.

Results:

The analysis of the study were evaluated and tabulated as follows

SEM photomicrograph

Fig-1, shows the SEM photomicrograph (at 1000x) of Group-1 dentin specimen where specimens were kept in artificial saliva for 7 days without brushing.

Fig-2, shows the SEM photomicrograph (at 1000x) where dentin specimens were brushed with distilled water.

Fig-3, shows the SEM photomicrograph (at 1000x) where dentin specimens were brushed with CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) containing agent (Recaldent GC tooth mousse) for 2 min twice per day for 7 days.

Fig-4, shows the SEM photomicrograph (at 1000x) where dentin specimens were brushed with Pro-Argin containing agent(Colgate sensitive) for 2 min twice per day for 7 days.

Fig-5, shows the SEM photomicrograph (at1000x) where dentin specimens were brushed with Amine fluoride containing agent (Amflor) for 2 min twice per day for 7 days.

Fig-6, shows the SEM photomicrograph (at1000x) where dentin specimen were brushed with Calcium sodium phospho silicate containing agent (Shy-NM) for 2 min twice per day for 7 days.

Tables

Table 1: Table depicting the percentage of dentinal tubule occlusion of each dentin specimen in each group.

Table 2: Mean, Standard Deviation, minimum and maximum numbers of occluded tubules per 100 dentinal tubules on the dentin surface in each experimental group.

Table 3: Comparison of occluded tubules per 100 dentinal tubules on the dentin surface between experimental group using one way ANOVA.

Table 4: Comparison of Artificial saliva and Distilled water for percentage of occluded tubules using Tukey Post Hoc test.

Table 5 :Comparision of Artificial saliva and Test groups for percentage of occluded tubules using tukey post hoc test.

Table 6: Comparision of Distilled water and Test groups for percentage of occluded tubules using tukey post hoc test.

Table 6: Comparision of Test groups for percentage of occluded tubules using tukey post hoc test

Graphs

Graph 1: Mean numbers of occluded tubules per 100 dentinal tubules on the dentin surface in each experimental group.

Graph 2: Mean numbers of occluded tubules per 100 dentinal tubules on the dentin surface in Artificial saliva and Distilled water.

Statistical analysis

Data collected by experiments were computerized and analyzed using the Statistical Package for Social Sciences (SPSS version 16.0).

Since the data were continuous type, parametric tests were used for analysis. Mean, Standard Deviation, minimum and maximum numbers of occluded tubules per 100 dentinal tubules on the dentin surface in each experimental group were calculated. One way Analysis of Variance (ANOVA) test was used for multiple group comparisons followed by Tukey post hoc for group wise comparisons. p-value <0.05 was considered statistically significant. The null hypothesis (H0) stated for present study was as follows:

There is no significant difference between the groups in percentage occlusion of dentinal tubules on the dentin surface.

The alternate hypothesis (H1) stated was: The experimental groups differs significantly in percentage occlusion of dentinal tubules on the dentin surface.

Fig. 1: shows the SEM photomicrograph (at 1000x) of Group-1 dentin specimen where specimens were kept in artificial saliva for 7 days without brushing.

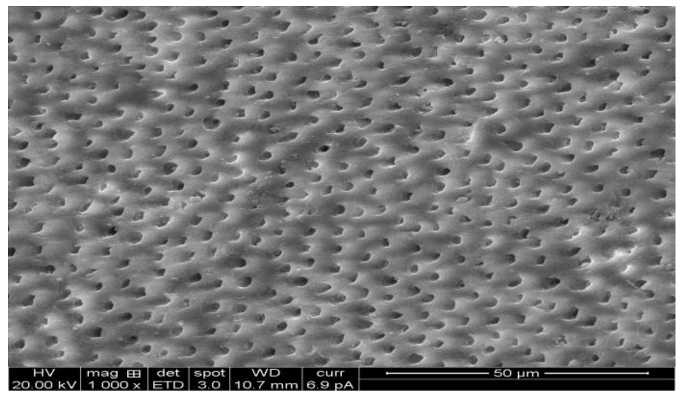


Fig. 2: Shows the SEM photomicrograph (at 1000x) where dentin specimens were brushed with distilled water.

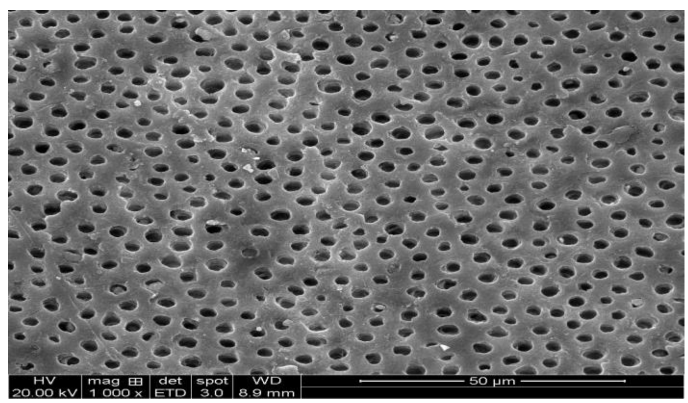


Fig.3: Shows the SEM photomicrograph (at 1000x) where dentin specimens were brushed with with CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) containing agent (Recaldent GC tooth mousse) for 2 min twice per day for 7 days.

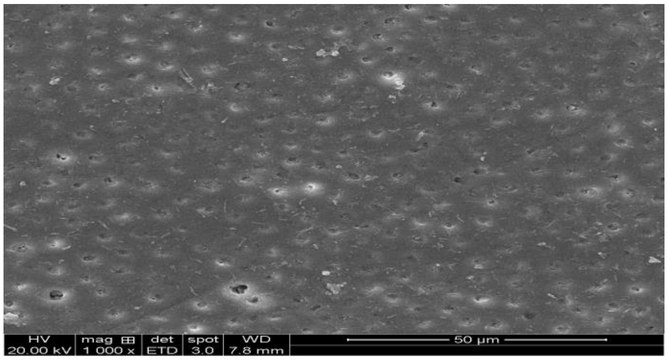


Fig. 4: Shows the SEM photomicrograph (at 1000x) where dentin specimens were brushed with Pro-Argin containing agent(Colgate sensitive) for 2 min twice per day for 7 days.

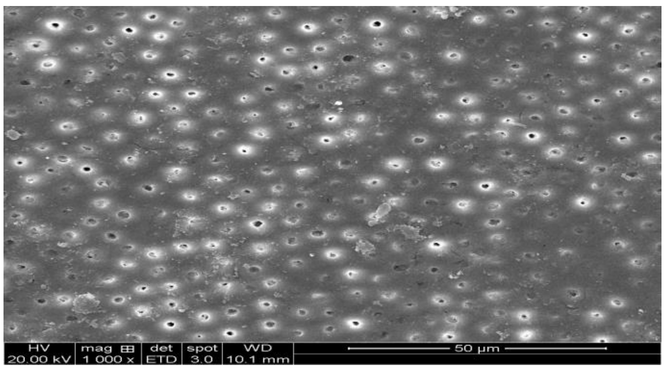


Fig. 5:Shows the SEM photomicrograph (at1000x) where dentin specimens were brushed with Amine fluoride containing agent (Amflor) for 2 min twice per day for 7 days.

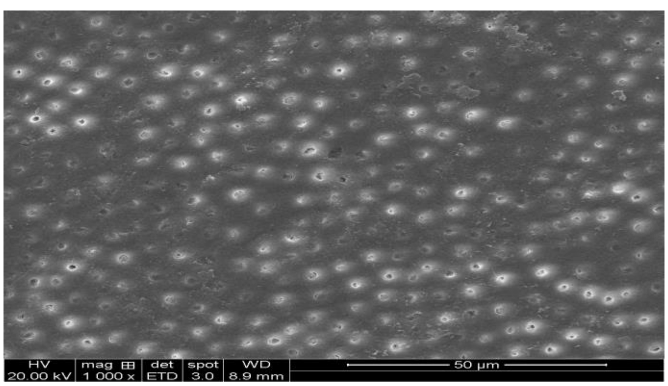


Fig. 6: Shows the SEM photomicrograph (at1000x) where dentin specimen were brushed with Calcium sodium phospho silicate containing agent (Shy-NM) for 2 min twice per day for 7 days.

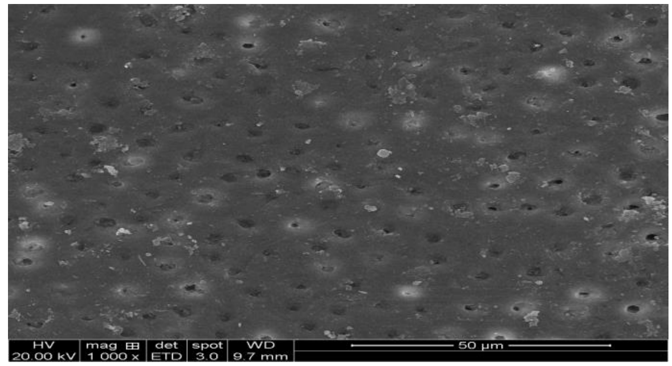


Table 1: Table depicting the percentage of dentinal tubule occlusion of each dentin specimen in each group.

Sn.	Group 1 Control	Group 2 Control	Group 3	Group 4	Group 5	Group 6
1	11	4.46	86.2	41.16	71.12	24.01
2	10.75	5.61	90.12	46.81	68.12	28.11
3	12.23	4.98	91.86	41.8	69.11	31.76
4	11.18	7.12	89.21	39.01	70.26	24.17
5	14.1	4.19	92.2	46.45	88.12	29.01
6	10.21	4.86	96.12	48.16	86.1	20.04
7	11.21	5.87	91.82	44.18	61.97	44.18
8	18.96	9.12	94.81	40.24	71.28	26.48
9	10.54	6.18	91.26	41.25	77.82	21.16
10	12.08	4.02	93.62	32.12	71.12	32.33

Table 2: Mean, Standard Deviation, minimum and Maximum numbers of occluded tubules per 100 dentinal tubules on the dentin surface in each experimental group.

Experimental Groups	N	Mean	SD	Minimum	Maximum
Artificial saliva	10	12.23	2.62	10.21	18.96
Distilled water	10	5.64	1.56	4.02	9.12
CPP-ACP containing agent	10	91.72	2.83	86.20	96.12
Pro-Argin containing agent	10	42.12	4.67	32.12	48.16
Amine fluoride containing agent	10	73.50	8.16	61.97	88.12
Calcium sodium phospho silicate containing agent	10	28.12	6.98	20.04	44.18

Table 3: Comparison of occluded tubules per 100 dentinal tubules on the dentin surface between experimental group using one way ANOVA.

Sum of Squares	df	Mean Square	F value	P value
58653.542	5	11730.708	455.770	0.000 (<0.001) Significant Difference

Table 4: Comparison of Artificial saliva and Distilled water for percentage of occluded tubules using Tukey Post Hoc test.

Experimental Groups	N	Mean	SD	Minimum	Maximum
Artificial saliva	10	12.23	2.62	10.21	18.96
Distilled water	10	5.64	1.56	4.02	9.12
Mean Difference	6.58				
P value	0.057 (>0.05), Not Significant				

Table 5: Comparision of Artificial saliva and test groups for percentage of occluded tubules using Tukey Post Hoc test.

	N	Mean difference	P value	Inference
Group 1- group 3	20	-79.50	0.000	Significant
Group 1- group 4	20	-2989	0.000	Significant
Group 1- group 5	20	-61.28	0.000	Significant
Group 1- group 6	20	-15.90	0.000	Significant

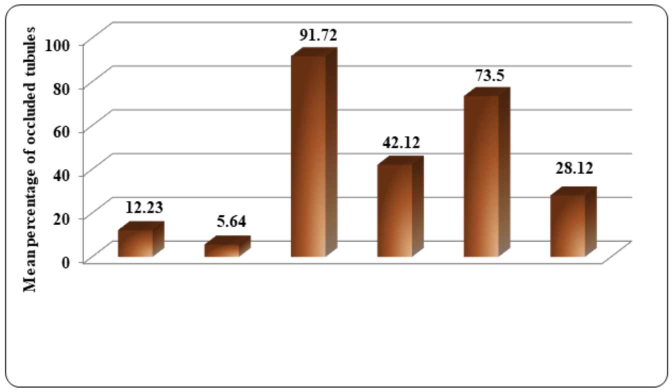
Table 6: Comparision of Distilled water and test groups for percentage of occluded tubules using Tukey Post Hoc test.

	N	Mean difference	P value	Inference
Group2- group 3	20	-67.86	0.000	significant
Group2- group 4	20	-22.48	0.000	significant
Group2- group 5	20	49.6	0.000	significant
Group2- group 6	20	18.22	0.000	significant

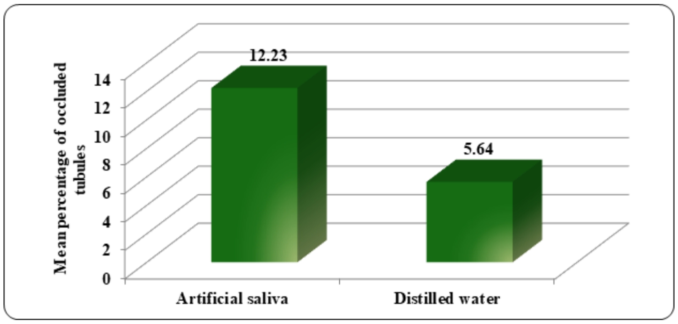
Table 7: Comparision of test groups for percentage of occluded tubules using Tukey Post hoc test.

	N	Mean difference	P value	Inference
Group3- group 4	20	49.6	0.000	significant
Group3- group 5	20	18.22	0.000	significant
Group3- group 6	20	63.60	0.000	significant
Group4- group 5	20	-31.38	0.000	significant
Group4- group 6	20	14.00	0.000	significant
Group5- group 6	20	45.38	0.000	significant

Graph 1: Mean numbers of occluded tubules per 100 dentinal tubules on the dentin surface in each experimental group.



Graph 2: Mean numbers of occluded tubules per 100 dentinal tubules on the dentin surface in Artificial saliva and Distilled water.



Discussion

The oral cavity presents an assorted variety of diseases, among which dentinal hypersensitivity are one of the most common. Dentinal hypersensitivity has been recorded for over two millennia, and the earliest documented treatment method was opium therapy, which dates back to 400 BC, being advocated as recently as 1000 AD.[20]

Studies of the prevalence of dentin hypersensitivity have reported widely differing levels, ranging from4–57%in individuals within general dental practice settings.[1, 21, 22, 23] These wide variations have been attributed to a number of factors, including the method of assessment or diagnosis, the population base and setting, and behavioral factors, such as oral hygiene habits and intake of acidic foods and drinks. There is a slightly higher incidence of dentin hypersensitivity in females than in males, which may reflect oral hygiene and dietary practices.[1]

Dentin hypersensitivity is typically experienced when the root of the tooth has been exposed to the oral environment as a result of gingival recession. Gingival recession may occur naturally, compounded by poor oral hygiene habits, especially overzealous tooth brushing, or it may result from surgical or non-surgical periodontal treatment. Dentin hypersensitivity occurs more frequently in the cervical area of the roots, where the cementum is very thin. Periodontal procedures such as scaling and root planing, may entirely remove this thin cementum layer and induce root hypersensitivity. As people live longer, healthier lives and maintain their dentitions, there will be an increased demand on dental professionals to manage the sensitivity of cervical exposed dentin, as well as any secondary issues that may arise from the discomfort associated with dentin hypersensitivity. In particular, dentin hypersensitivity may render tooth brushing more difficult in some individuals, with the result that persistent and continued accumulation of dental plaque may increase the incidence of caries, gingivitis, and more serious periodontal problems.[24]

Several theories have been proposed to explain the mechanism of dentin hypersensitivity, including the odontoblast transducer theory, the dentin receptor theory, and the hydrodynamic theory.[25,26] Scientific evidence supports the hydrodynamic theory and, for this reason, it is generally favored by the dental community. The hydrodynamic theory[1] (modified by Brännström6 in 1963) assumes that fluid movement within the dentin tubules is the basis for the transmission of painful sensations. Specifically, it proposes that non-noxious stimuli at the tooth surface cause fluid movement within the dentin tubules, affecting the pulpal mechanoreceptors and resulting in the sensation of pain. In 1994, Nähri, et al.[27] provided an addendum to the hydrodynamic theory, suggesting that the perception and sensation of pain was directly related to the stimulation of the nerves within the pulp via electrical current.

Regardless of the Etiology, the problem needs to be addressed in order to provide patients with improved oral comfort and quality of life. To this end, a number of agents have been proposed to help control dentin hypersensitivity and relieve discomfort; some can be used by the patient at home, others must be applied in the dental office by a dental professional. One approach by which this can be achieved is to reduce the diameter of open dentin tubules in order to limit the displacement of fluids within them (decreased hydrodynamic flow), thereby blocking neurotransmission and decreasing the response to painful stimuli. According to Trowbridge and Silver,[28] this could be achieved by forming a smear layer on the exposed dentin, using topical agents that form insoluble precipitates within the tubules, or by blocking the entrance to tubules with plastic resins. This approach has been most extensively applied in professionally administered products.

In 1982, dentin hypersensitivity was described as an enigma, because it was frequently encountered and poorly understood. The past twenty-five years have witnessed an evolution in the scientific understanding of this condition. Largely based on a suggestion in 1983[26]. the term "dentin hypersensitivity" was formally defined in 1997 in the guidelines for clinical trials.[30] This definition was officially accepted in 2003, with one minor change, by the Canadian Advisory Board on Dentin Hypersensitivity in their consensus-based recommendations for the diagnosis and management of dentin hypersensitivity.[2] Clearly, the condition is no longer the enigma that was once described. Nonetheless, there is a need for continued basic and clinical research that will lead to improved prevention and management of dentin hypersensitivity.[1]

Today, dozens of in-office sensitivity treatments and mass market sensitivity relief toothpastes are available worldwide. Clinical studies demonstrate the effectiveness of some in-office products, e.g., 5% sodium fluoride varnish;[31] nonetheless, there is a paucity of data on the majority of these products.[1,21] There appears to be a significant body of clinical data to support the efficacy of potassium-based dentifrices, and these products have been acknowledged to provide relief to their users.[59] However, some authors have concluded that the data are equivocal.[29,33] Despite the reported prevalence of dentin hypersensitivity, it is noteworthy that a relatively small percentage of sufferers seek professional treatment to alleviate their condition and/or use an everyday sensitivity relief toothpaste.[2]

Hence the aim of the study is to evaluate the tubule occluding ability of four desensitizing agents Amine fluoride, Calcium sodium phospho silicate, Pro-arginin & CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) using Scanning Electron Microscope.

To determine the dentinal tubule occluding ability of each of dentifrice dentine specimen of size 3x3x2mm were prepared from the cervical 1/3rd each premolar using double-sided diamond disk attached to water-cooled air motor (NSK TH88625) and straight handpiece (NSK. ONX90715). The specimens were randomly divided into 6 groups of 10 dentin blocks. These dentin blocks were mounted on 2mm thick plastic plate by using Cyanoacrylate adhesive (super glue).Each dentine block was polished with of lex polishing discs of coarse, medium, fine, extra fine disks and final polishing was done with prismagloss fine and extra fine polishing pastes containing 1 and 0.2 micron alumina abrasives. All the specimens were ultrasonicated (at 42000 Hz, 5 cycles) for 12 min in distilled water to remove residual smear layer and to open the dentine tubule to simulate hypersensitive cervical dentin.

Specimens of groups 3, 4, 5, and 6 were brushed with dentifrices slurries prepared by diluting 2gm of dentifrice with 6 ml of distilled water. Brushing was performed with Oral B powered brush which is a battery powered toothbrush with soft round bristle at an oscillation speed of 8000/min to as to maintain the constant speed. Brushing was done for 2min for each dentine block from equidistance by attaching bristle protector to the toothbrush shaft so as to apply equal pressure on all specimens. After each brushing session specimens were washed under running tap water and then kept in artificial saliva filled plastic container to create the condition like of oral environment.

After the last brushing session, dentine specimens were washed with distilled water, after drying thin layer of gold sputter coating was done Photomicrographs were taken using Scanning Electron Microscope from the center of 3x3x2mm dentine block at 1000X magnification.

Percentage of occluded tubules was obtained. Results were statistically analyzed by one-way Analysis of Variance (ANOVA) and Tukey test.

The specimens brushed with dentifrices exhibited higher percentage of tubule occlusion than G-1 and G-2 control groups. The specimens immersed in artificial saliva (G-1) without brushing and the specimens brushed with distilled water without dentifrice (G-2) were not significantly different (Fig-11 & 12). These specimens showed the mean tubule occlusion percentage of 12.23 % and 5.64 %. Saliva plays a role in naturally reducing dentin hypersensitivity; first, by transporting calcium and phosphate into dentin tubules to induce tubule plugging; and second, by forming a surface protective layer of salivary glycoprotein with calcium and phosphate.[32] The tubule occlusion in these groups can be due to the calcium phosphate precipitate on the dentin surface since artificial saliva is supersaturated with respect to the dentin hydroxyapatite .The results obtained are similar to the results of the study in which dentin specimens immersed in artificial saliva initially there will be decrease in the concentration of calcium and phosphate ions then the increase in their concentration indicates the precipitation followed by the partial dissolution of hydroxyapatite leading to the subsequent tubule occlusion, and the lower percentage in the G-2 specimens may be due to the smear layer formed by the brushing process.[28,34,35] Despite a reduction in the tubule lumen and complete occlusion of some tubules (Figs. 11 and 12), specimens from control groups still had most of the tubular orifices opened.

Other treatment groups G-3, G-4, G-5 & G-6 showed the significantly greater percentage of tubule occlusion when compared to the control groups G-1 and G-2.

In Group-3 the samples were brushed with CPP-ACP containing agent (Fig-13). The mean percentage of tubule occlusion seen in these groups is 91.72%. Tukey post hoc test for pairwise comparison of occluded tubules per 100 dentinal tubules on the dentin surface showed Significant Differences in which group 3> 1, 2,4,5,6.

Reynolds EC showed that the casein phosphopeptide (CPP) contains phosphoseryl sequences which get attached and stabilized with amorphous calcium phosphate (ACP). This stabilized CPP–ACP prevents the dissolution of calcium and phosphate ions and maintains a supersaturated solution of bioavailable calcium and phosphates.[36]

The peptides of CPP-ACP bind to the dentine surface, then promote the deposition of mineral deposits within dentine tubules. This process has been shown to significantly decrease dentine permeability by creating precipitates on the dentine surface that reduce the diameter of dentinal tubules.[36-39]

Lauren J walsh[40] and Shalini gugnani[15] in their controlled study also showed decrease dentinal sensitivity however in their study they had not mentioned about their apparent mechanism of action.

In Group-4 the samples were brushed with Pro-Argin containing agent (Fig-13). The mean percentage of tubule occlusion seen in these groups is 42.12%. Tukey post hoc test for pairwise comparison of occluded tubules per 100 dentinal tubules on the dentin surface showed Significant Differences in which group 4> 1, 2, 6.

Diane Cummins in his study confirmed with high resolution Scanning Electron Microscopy (SEM) images that the desensitizing prophylaxis paste provides complete occlusion of open dentin tubules, and freeze fracture images have shown that the plug reaches a depth of two microns into the tubule.[15]

In addition, in vitro study by Kleinberg I. on the mechanism of action of arginine have demonstrated tubule occlusion.[32]

In Group-5 the samples were brushed with Amine fluoride containing agent (Fig-14). The mean percentage of tubule occlusion seen in these groups is 73.50%. Tukey post hoc test for pairwise comparison of occluded tubules per 100 dentinal tubules on the dentin surface showed Significant Differences in which group 5> 1,2,4,6.

The principal mechanism of fluoride to relieve DHS is its chemical ability to reduce and block fluid movements in the dentin tubules through formation of calcium–phosphorous precipitates as well as calcium fluoride (CaF_2) and fluorapatite (FAp).[41-43]

T. BACHANEK in his study concludes that Amine fluoride dental rinse and dentifrice effectively occluded dentin tubules (partially or totally) and therefore may reduce patients hypersensitivity symptoms in-vivo.[44]

In Group-6 the samples were brushed with Calcium sodium phospho silicate containing agent (Fig-14). The mean percentage of tubule occlusion seen in these groups is 28.12%. Tukey post hoc test for pairwise comparison of occluded tubules per 100 dentinal tubules on the dentin surface showed Significant Differences in which group 6> 1, 2.

In the studies done by **Ananthakrishna.S et al (2012)** [45] and **Tirapelli C et al (2010)**[46] showed that calcium sodium phospho silicate is an effective agent in dentinal tubule occlusion however results showed that the percentage of tubule occlusion is less than the other treatment groups.

Conclusion

The following conclusions were drawn from the study:

1) All the treatment groups exhibited significantly higher percentage of tubule occlusion compared to control groups.

2) Among the treated groups the specimens brushed with CPP-ACP (Casein Phosphopeptide - Amorphous Calcium Phosphate) containing agent Recaldent GC tooth mousse dentifrice showed the highest percentage of tubule occlusion, as it precipitated the hydroxycarbonate apatite over the entire dentin surface followed by Amine fluoride containing agent (Amflor), Pro-Argin containing agent(Colgate sensitive) Oral-B sensitive, Calcium sodium phospho silicate containing agent (Shy-NM) .

References

1. Addy M. Dentine hypersensitivity: new perspectives on an old problem. Int Dent J 2002: 52(Suppl 1): 367–375
2. Canadian Advisory Board on Dentin Hypersensitivity. Consensus-based recommendations for the diagnosis and management of dentin hypersensitivity. J Can Dent Assoc 2003: 69: 221–226.
3. Addy M. Dentine hypersensitivity: definition, prevalence distribution and aetiology. In: Addy M, Embery G, Edgar WM, Orchardson R, eds. Tooth Wear and Sensitivity. London, UK: Martin Dunitz, 2000: 239–248.
4. Gillam DG, Bulman JS, Jackson RJ, Newman HN. Efficacy of a potassium nitrate mouthwash in alleviating cervical dentine sensitivity (CDS). J Clin Periodontol 1996: 23: 993–997.
5. Chabanski MB, Gillam DG, Bulman JS, Newman HN. Clinical evaluation of cervical dentine sensitivity in a population of patients referred to a specialist periodontology department. J Oral Rehab 1997: 24: 666–672.
6. Sanz M, Addy M. GroupDSummary. J Clin Periodontol 2002: 29(Suppl 3): 195–196.
7. Troll BV, Needleman I, SanzM. A systematic review of the prevalence of root sensitivity following periodontal therapy. J Clin Periodontol 2002: 29(Suppl 3): 173–177.
8. Addy M, Mostafa P, Absi EG, Adams D. Cervical dentine hypersensitivity. Etiology and management with particular reference to dentifrices. In: Rowe NH, ed. Proceedings of Symposium on Hypersensitive Dentin. Origin and Management.

University of Michigan, Ann Arbor, MI, 1985: 147–167.

9. Strassler HE, Drisko CL, Alexander DC. Dentin hypersensitivity: its inter-relationship to gingival recession and acid erosion. Compend Contin Educ Dent. 2008;29(5 Special Issue):1-9.
10. Bamise CT, Olusile AO, Oginni AO. An analysis of the etiological and predisposing factors related to dentin hypersensitivity. J Contemp Dent Pract. 2008;9(5):52-59.
11. Gysi A: An attempt to explain the sensitiveness of dentin. Br J Dent Sci 43:865–868, 1900.
12. Brännström M: A hydrodynamic mechanism in the transmission of pain produced stimuli through the dentine. In: Sensory Mechanisms in Dentine. Anderson DJ, ed., Pergamon Press, London, pp. 73–79, 1963.
13. Brännström M, Johnson G: Movements of the dentine and pulp liquids on application of thermal stimuli. Acta Odontol Scand 28:59–70, 1970.
14. Markowitz K, Pashley DH: Discovering new treatments for sensitive teeth: The long path from biology to therapy. J Oral Rehab 35:300–315, 2007.
15. Diane C: Dentin Hypersensitivity: From Diagnosis to a Breakthrough Therapy for Everyday Sensitivity Relief. J Clin Dent 20:1–9, 2009.
16. Absi EG, AddyM, Adams D: Dentin hypersensitivity: A study of the patency of dentinal tubules in sensitive and non-sensitive cervical dentine. J Clin Periodontol 14:280–284, 1987.
17. Absi EG, Addy M, Adams D: Dentine hypersensitivity: The development and evaluation of a replica technique to study sensitive and non-sensitive cervical dentine. J Clin Periodontol 16:190–195, 1989.
18. PM Bartold. Dentinal hypersensitivity: a review. Aust Dent J 2006; 51 :(3): 212-218.
19. Maki O, Kanako Y. Effect of CCP-ACP paste on tooth mineralization: an FE-SEM study. Journal of oral science 2007; 49:2. 115-120.
20. Poulsen S, Errboe M, Mevil YL, Glenny AM. Potassium containing toothpastes for dentine hypersensitivity. Cochrane Database Syst Rev 2006;3: CD001476.
21. Dababneh RH, Khouri AT, Addy M. Dentine hypersensitivity – An enigma? A review of terminology, epidemiology, mechanisms, aetiology and management. Br Dent J 1999; 187:606-11
22. Pashley DH, Tay FR, Haywood VB, Collins MC, Drisko CL. Dentin hypersensitivity: Consensus-based recommendations for the diagnosis and management of dentin hypersensitivity. Inside Dent 2008;4 (Spec Iss):1-35.
23. West NX, Lussi A. Dentine hypersensitivity In: Dental Erosion. Karger, Basel,2006; 173-89.
24. Carranza FA, Newman MG, Glickman I. General principles of periodontal surgery In: Clinical Periodontology 1996;8:569-78.
25. Berman LH. Dentinal sensation and hypersensitivity. A review of mechanisms and treatment alternatives. J Periodontol 1985; 56:216-22
26. Dowell P, Addy M, Dentine hypersensitivity-A review. Aetiology, symptoms and theories of pain production, J Clin Periodontol 1983;10:341-50.
27. Brinnström M. Dentin sonsitivity and aspiration of odontoblasts. JADA 1963; 66:366-70.
28. Nähri M, Yamamoto H, Ngassapa D, Hirvonen T. The neurophysiological basis and the role of inflammatory reactions in dentine hypersensitivity. Arch Oral Biol 1994; 39:23-30.

29. Trowbridge HO, Silver DR. A review of current approaches to in-office management of tooth hypersensitivity. Dent Clin North Am 1990; 34:561-81.
30. Markowitz K, Pashley DH. Discovering new treatments for sensitive teeth: The long path from biology to therapy. J Oral Rehab 2007;35:300-15.
31. Holland GR, Närhi MN, Addy M, Gangerosa L, Orchardson R. Guidelines for the design and conduct of clinical trials on dentine hypersensitivity. J Clin Periodontol 1997; 24:808-13.T GC Tootl
32. Gaffar A. Treating hypersensitivity with fluoride varnishes. Compend Contin Educ Dent 1998; 19:1088-097.
33. Kleinberg I. SensiStat, A new saliva-based composition for simple and effective treatment of dentinal sensitivity pain. Dent Today 2002;21:42-47.
34. Cavalli V, Reis AF, Giannini M, Ambrosano GM. The effect of elapsed time following bleaching on enamel bond strength of resin composite. Operative Dentistry 2001;26:597-02
35. Yoshlyama M, Noiri ¥, Ozaki K, Uchida A, lschikava Y, Ishida H. Transmission Electron Microscopic characterization of hypersensitive human radicular dentin. J Dent Res 1990;69(6):1293-97
36. Goldstein GR, Lemner T, The effect of tooth brushing on a hybride composite resin. J Prosthet Dent 1991;66:498-00.
37. Reynolds EC. Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions, Dent Res. 1997;76:1587-95.
38. Reynolds EC. Treatment for sensitive teeth. United States Patent 1999; 5,981,475.
39. Reynolds EC, Walsh LJ. (chapter 2005)
40. Gandolfi MG, Silvia F, Gasparotto G, Carlo P. Calcium silicate coating derived from Portland cement as treatment for hypersensitive dentine. J Dent. 2008;36:565-78.
41. Laurence WJ. The effects f GC Tooth Mousse on cervical dentinal sensitivity: a controlled clinical trial. Int dent 2010; 12(1): 4-12.
42. Brodowski D, Imfeld T. Dentin hypersensitivity- a review. Schweiz Monatsschr Zahnmed 2003;1 13(1):49-58.
43. Ling TY, Gillam DG, The effectiveness of desensitizing agents for the treatment of cervical dentine sensitivity (CDS) a review. J West Soc Periodontol 1996;44(1):5-12
44. Bachanek T, Chalas R, Nowak J, Kuczumow A. The effectiveness of an amine fluoride dentifrice and dental rinse to occlude dentine tubules, and to characterize the nature of the occlusion in an in-vitro study. Clinical Oral Investigations 2012; 10:916-20.
45. Ananthatkristina 5, Right IN Noshy S. Kumar S. Clinical evaluation of the efficacy of bioactive glass and strontium chloride for treatment of dentin.. hypersensitivity Journal of interdisciplinary dentistry 2012; 212) 92-97.
46. Tirapelli C, Panzeri H, Soares RG, Peitl O, Zanotto ED. A novel bioactive glass ceramic for treating dentin hypersensitivity. Braz Oral Res. 2010;24(4):381-87.