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Comparative evaluation of desensitizing Dente 91 tooth paste and Dente 91 mouthwash in the occlusion of dentinal tubules. In- vitro study

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ABSTRACT

Background: Dentine hypersensitivity is one of the most painful long-term problems of the teeth and has the lowest success rate.[1] Dentine hypersensitivity (DH) is defined as a "short sharp pain arising from exposed dentine most commonly at the tooth cervical area in response to thermal, tactile evaporative, osmotic or chemical stimuli but which cannot be ascribed to any other dental defects, diseases or restorative treatments".[2]

Aim

The aim of the present is to evaluate and compare the desensitizing Dente 91 tooth paste and Dente 91 mouthwash in the occlusion of dentinal tubules under scanning electron microscope (SEM).

Materials and Methods

Extracted premolars were collected and stored in 10% formalin. Dentin blocks measuring 8 mm × 5 mm× 2 mm were prepared from the crown part adjacent to CEJ. The specimens were randomly divided into 3 groups. Group1 -Dente 91 Toothpaste group, Group 2 – Dente 91 Mouthwash group and Group 3 - Combination group. The samples were treated twice daily as per the assigned group for 21 days. The percentage of the occluded dentinal tubules and the open area of tubules was assessed at baseline, 7th, 14th and 21st day by subjecting the samples for electro micrograph through scanning electron microscope.

Results

Combination group (Dente 91 tooth paste and Dente 91 mouthwash) showed higher percentage of blocked dentinal tubules and least area of open tubules as compared to toothpaste group alone followed by mouthwash group at 7th, 14th and 21st day respectively.

Conclusion

The study concluded that toothbrushing twice daily with dente 91 toothpaste along with usage of dente 91 mouthwash for duration of 21 days effectively block the open dentinal tubule in order to decrease dentinal hypersensitivity.

Keywords: Dentinal tubules, Dentine hypersensitivity, Mouthwash, Toothpaste

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INTRODUCTION

Dentine hypersensitivity has the lowest success rate and is one of the most excruciating long-term dental issues.[1]Dentinal hypersensitivity (DH) has been defined as a short, sharp pain arising from exposed dentine as a result of various stimuli such as heat, cold, chemical, or osmotic, that cannot be ascribed to any other pathology **(Orehardson & Collins 1987a, Addy 1992)** .[2] About 30,000 tubuli per mm² of 1-2 µm in diameter present in dentine that extends at angle of 90° from the dentine surface to the tooth pulp.[3] Usually, canines and premolars are the teeth affected by dentine hypersensitivity. Wasting disease, recession of gingiva and inappropriate brushing techniques are the main etiologic factor for dentin hypersensitivity.[4] There are three major theories of dentine hypersensitivity. The direct stimulation theory[5] states that nerve terminals pass via pulp and dentin and merge with the dento-enamel junction. Odontoblasts acts as a receptors and transfer signal to a nerve ending explained by the odontoblast receptor theory[6]. A more recent idea has come in existence due to the drawbacks of these two theories, which states that sensitivity develops because of the movement of fluid within the dentinal tubules that stimulates mechanoreceptors on the pulpal nerve ending known as the fluid flow theory[7.]

There are two methods to reduce hypersensitivity that includes occlusion of the dentinal tubules physically and chemically blockage of neural transmission due to altered nerve synapses.[8] The recently developed interest in nanotechnology introduced the application of nano-hydroxyapatite in the field of dentistry.[9] Wide variety of toothpaste have been developed to decrease tooth hypersensitivity. Toothpastes contains potassium ions depolarise sensory pulpal nerves and interrupt the transmission of pain stimuli.[10] In comparison of the traditional toothpaste with nanohydroxyapatite is suggested to inhibit tooth sensitivity more successfully because it biochemically binds both collagen and hydroxyapatite from dentine and easily occlude the dentinal tubules because of its nano-sized diameters.[11] in this context, This study has been taken to evaluate and compare the efficacy of commercially available nano-hydroxyapatite (n-HAP) containing toothpaste/mouthwash and the combination of both to block dentinal tubule under scanning electron microscope (SEM).

MATERIALS AND METHODS

This study was carried out in periodontology department, Rama Dental College, Hospital and Research Center, Kanpur, Uttar Pradesh, India. Ethical certificate has been obtained from institutional ethical committee.
Required extracted premolars were collected from Department of Oral surgery and from some private clinics.
Inclusion criteria include Caries free crown and root, Teeth free from periodontal disease, Teeth without any attrition, abrasion and erosion. Exclusion criteria was Teeth with restoration, Teeth with external resorption and developmental anomalies, Teeth with fractures, Hypoplastic teeth**,** Endodontically treated teeth.

METHODOLOGY

Premolars stored in 10% formalin after extraction. Gross debris have been removed from teeth and stored in distilled water. Then the teeth were sectioned mesiodistally in horizontal manner by using a diamond disc bur and straight micromotor hand piece. For 30 seconds, the treated samples were thoroughly rinsed with distilled in order to eliminate remaining debris. Then, sample teeth were randomly allocated into 3 groups with 7 specimens in

each, Group 1 – with application of Dente 91 tooth paste**,** Group 2 – with application of Dente 91 mouth wash And Group 3 – with application Combination of both.

The baseline recordings for each group have been done on 1st day and act as control. In group 1 all the specimens were brushed with toothpaste for 2 minutes twice daily for 21 days and After brushing, the samples were washed with distilled water. In group 2 specimens were vigorously shaked in the mouthwash for 1 minutes twice daily for 21 days and in group 3 specimens were brushed with toothpaste for 2 minutes and after 30 minutes rinsed with mouthwash for 1 minute twice daily for 21 days. Re-evaluate the all specimens of each group at baseline, 7th, 14th and 21st day. The blocks were stored in distilled water during the experimental period and sent for SEM analysis.

DENTINAL TUBULAR OCCLUSION ESTIMATION

By observing in the SEM images, dentinal tubule occlusion has been calculated and expressed in percentages. The dentinal tubules were segregated into three categories depending on the percentage of occlusion: -[12]

1. Unoccluded (when the occlusion was 0%)
2. Partially occluded (when the occlusion was < 75%)
3. Completely occluded (when the occlusion was ≥75%)

Results: The data was recorded in MS Excel sheet and was further subjected to statistical analysis using SPSS software 24. Statistical significance was recorded at $P \leq 0.05$. The Results of present study showed that 39.43, 53.11, 80.84 percentage of occluded dentinal tubules at 7th, 14th and 21st day respectively. Percentage of occluded dentinal tubules was higher in combined group followed by toothpaste and mouthwash group. Table 1

Discussion

The current in vitro study aimed to establish the degree of dentinal tubule occlusion on the dentin surface among commercially available desensitizing toothpaste, mouthwash and the combination of both under scanning electron microscope (SEM). In our study group found complete occlusion of the dentinal tubules but group 3 i.e. combination of toothpaste and mouthwash have showed maximum occlusion in dentinal tubules. in accordance to present study,

The Previous study done by Poggio et al. revealed the partial closure of the dentinal tubules after an acid attack when using Biorepair Plus Sensitive toothpaste.[12] A study that tested n-HAp toothpaste Renamel (Sangi, Tokyo, Japan) had also demonstrated partial occlusion of dentinal tubules. In contrast to our study results study done by Dundar et al. A reported the total closure of dental tubules when an experimental pure n-HAp desensitizing toothpaste was tested.[13]

Kulal et al.[10] also conducted a study for 7days to evaluate and compared the effects of nano hydroxyapatite, novamin and proargin containing desensitizing agents on dentinal tubule occlusion and said that nano hydroxyapatite containing desensitizing agents showed 97.62% occlusion of dentinal tubules on the 7th day as compared to baseline. A 14 days study done by Jena et al24 who investigated and compared the efficacy of occluded dentinal tubules by four different dentifrices i.e. potassium salts, bioactive glass, fluoride and 15% n-

HAP, reported that 15% n-HAP containing toothpaste showed 68.015 mean percentage of occluded tubule at 14th day from the baseline. In addition to causing enamel loss, gingival recession and wasting disorders including attrition, erosion, abrasion, and abfraction also expose the dentinal tubules through the cementum, making teeth sensitive. According to Grossman's 1935 statement, the ideal desensitising agent should function quickly, be long-lasting, safe for pulp, easy to apply, and not discolour teeth.[14]

The most common desensitising agents used to reduce hypersensitivity are toothpaste and mouthwash due to their affordability, ease of use, and at-home use.[15]

Since their discovery in Japan in 1980,[16] toothpastes based on n-HAP have been utilised as oral care products to successfully obstruct dentinal tubules. It readily binds to the dentinal tubules, obstructing them and reduce DH as a result. Its biological activity, chemical reactivity, and larger surface area allow it to bind with dental enamel and dentine apatite.[17]

The results for the mouthwash group is supported by the study done by Hill R.G et al[24] and Saini N et al[18]. Hill R.G et al[25] performed a study to evaluate the occlusion of dentinal tubules and reduced fluid flow by using five desensitizing oral rinse containing either nanohydroxyapatite, zinc substituted HA, potassium oxalate, arginine and potassium nitrate and found that after 30 seconds treatment, nanohydroxyapatite containing desensitizing oral rinse showed that most of the dentinal tubules were occluded. Also, Saini N et al[18] in their 14 days study with n-HAP containing mouthwash reported 75% completely occluded dentinal tubules at 14th day from baseline. Also, the combined group showed better dentinal tubules occlusion (85.12%) than toothpaste group (80.84%) followed by mouthwash group (71.03%) at 7^{th}, 14^{th} and 21^{st} day respectively in the present study.

Due to the dual effect of mouthwash and toothpaste, the combined group demonstrated the best results. Using toothpaste and shaking the dentinal disc samples vigorously in mouthwash every day would have allowed for more n-HAP crystals to deposit in the dentinal tubules.[18]

CONCLUSION

The Result of this study concluded that using combination of n-HAP-containing toothpaste i.e. Dente91and mouthwash i.e. Dente91 twice a day for 21 days resulted in good dentinal tubule occlusion and promote mineral deposition on the dentin surface which could be helpful in treating dentinal hypersensitivity. In order to demonstrate the stability of occluded dentinal tubules following the use of toothpaste and mouthwash containing n-HAP, more longer duration studies are required.

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LEGENDS

Table 1. Intergroup comparison of percentage of unoccluded, partially occluded and completely occluded tubules at different time intervals.

Interval		Toothpaste		Mouthwash		Combined		p value
		Mean (%)	**SD**	**Mean (%)**	**SD**	**Mean (%)**	**SD**	
Baseline	**Unoccluded**	100	0.00	100	0.00	100	0.00	----
	Partially occluded	0	0.00	0	0.00	0	0.00	----
	Completely occluded	0	0.00	0	0.00	0	0.00	----
7th day	**Unoccluded**	34.47	8.28	52.24	7.63	25.87	5.73	<0.001*
	Partially occluded	38.92	4.21	33.16	5.70	34.47	8.28	0.392
	Completely occluded	27.00	6.38	14.88	2.91	39.43	7.46	<0.001*
14th day	**Unoccluded**	22.56	3.61	33.20	4.23	14.16	6.20	<0.001*
	Partially occluded	32.70	9.62	33.16	5.70	28.22	2.63	0.534
	Completely occluded	44.84	6.45	35.25	4.74	53.11	8.41	0.002*
21st day	**Unoccluded**	14.46	4.68	23.00	4.66	3.34	2.50	<0.001*
	Partially occluded	27.00	6.38	26.07	6.30	15.82	9.08	0.579
	Completely occluded	76.36	6.14	71.03	4.68	80.84	8.06	<0.001*

- One-way ANOVA test; * indicates statistically significant difference at $p \leq 0.05$