Technical report

Dental Materials Journal 20(2) : 164−171, 2001

Clinical Evaluation of an Electron-ionizing Toothbrush with a Tooth Paste Containing Stannous Fluoride in Treatment of Dentine Hypersensitivity Following Periodontal Surgery

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Received December 6, 2000/Accepted April 3, 2001

The purpose of this study was to examine the effect of an electro-ionizing toothbrush with stannous fluoride in the treatment of dentin hypersensitivity following periodontal surgery.

Thirty-two volunteers with dentin hypersensitivity were divided in two equal groups each using different methods : (Group I) stannous fluoride dentifrice and hyG Brnde ionizing brush without a battery and (Group II) stannous fluoride dentifrice and hyG Brnde ionizing brush with a battery. The volunteers brushed their teeth for 3 minutes twice a day for 12 weeks following one either of the test protocols.

Mechanical (No 23 dental explorer), chemical (lemon juice) and thermal (dental air-water syringe) tests were used for the evaluation of the degree of dentin hypersensitivity. A subjective assessment of the degree of hypersensitivity for each stimulus was recorded. The evaluations were repected at 4, 8 and 12 weeks after surgical treatment.

The second group showed significantly less sensitivity than the first group. The findings appear to suggest that the ionizing brush may be an effective adjunct for the treatment of dentin hypersensitivity in post-periodontal surgery.

Key words : Dentin sensitivity, Electro-ionizing toothbrush, Stannous fluoride

INTRODUCTION

Dentin hypersensitivity is a frequently encountered problem in dentistry and for the most part presents a very troublesome clinical complaint[1]. The etiology of dentin hypersensitivity remains obscure. However, the condition is associated with the exposure of the dentin due to attrition or abrasion, and the exposure of the root surface as a consequence of periodontal disease or surgery, and with developmental lack of a protective covering of cementum at the cementoenamal junction[2,3]. Even where the cementum is present, it is only 20 to 50μm thick and is sometimes removed by overzealous toothbrushing or root planing[4].

The reduction of the gingival protective barier can be seen following periodontal therapy because of curretage or excision of tissue, exposing the root surfaces, while root planing may remove cementum exposing the dentin to external stimuli[5]. When the exposed dentin is subjected to mechanical, thermal, chemical or osmotic stimuli, a painful response may occur[2,6]. Even though the exact mechanism by which the stimulus is transmitted from the dentin surface to the pulp is not clear, several theories have been proposed[1]. There are currently four hypotheses of pain transmission

through dentin: the modulation theory[7], the transducer theory[7], the direct nerve stimulus theory[7], and the hydrodynamic theory[8]. Currently, the most widely accepted theory is that of Brannström[8] who proposed that pain-producing stimuli were transmitted to the pulp by a hydrodynamic mechanism, a rapid movement of the fluid in the dentinal tubules. The application of heat to the tooth would cause the fluid in the tubules to expand and move pulpward. In contrast, cold stimuli, scraping, drilling, and high osmotic forces would contract the fluid and move it outward. Such fluid movement stimulates the nerves in the pulp[2].

Despite the considerable amount of research on the problem of dentin hypersensitivity, there is no universally accepted treatment. Many methods of treatment have been proposed such as calcium hydroxide[9,10], magnesium hydroxide[10], potassium nitrate[9], sodium monofluorphosphate[11] sodium fluoride[12], strontium chloride[1], and iontophoresis with and without a fluoride paste or solution[13]. In some of the studies the efficacy of stannous fluoride dentifrice has been reported[14–16]. However, Johnson *et al.*[16] advocated that stannous fluoride with the ionizing brush provided significantly greater relief than did the stannous fluoride alone. The present study was designed to investigate the effects of the electro-ionizing toothbrush with stannous flourids dentifrice in patients with high levels of dentin hypersensitivity following periodontal surgery.

MATERIALS AND METHODS

Thirty-two patients (19 females and 13 males) with periodontal surgery involving gingivectomy and/or flap procedures were included in this study. These patients regularly attended each control session. The ages ranged from 22 to 65 years with a mean age of 29.5 years. The volunteers were randomly divided into two equal groups. The first group was made up of 10 females and 8 males, Whose ages varied from 23 to 65 years with a mean age of 31.2 years. The second group were composed of 9 females and 5 males. The ages ranged from 22 to 61 years with a mean age of 27.8 years. Post-surgical examinations located 96 hypersensitive areas among the 32 subjects who suffered from dentin hypersensitive. The teeth with suspected pulpitis, wedge-shaped defects in the cervical region, cervical caries or cervical resin filling were excluded from the study.

Patients were examined to determine the hypersensitivity of the teeth by stimulating the buccal or labial surfaces of the exposed roots with each of three stimuli:

1. Mechanical stimulation with a No. 23 dental explorer
2. Thermal stimulation with a dental air-water syringe
3. Chemical stimulation with lemon jucie

After following the hypersensitive area, the degree of sensitivity was scored for each stimules according to the following scale:

"0"- no significant discomfort
"1"- discomfort but no severe pain
"2"- severe pain during application of the stimulus

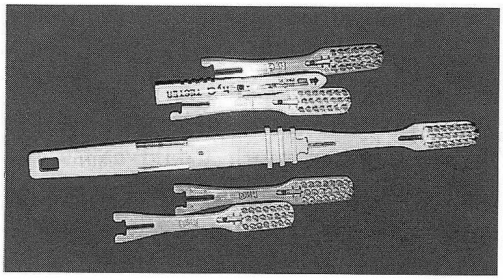


Fig. 1 The hyG brand electro-ionizing toothbrush.

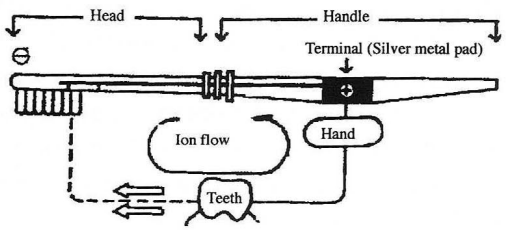


Fig. 2 The hyG brand electro-ionizing toothbrush works by ẏonic action.

"3"- severe pain during and after application of the stimulus

A "pain score" was calculated for each hypersensitive tooth by adding the scores for the three stimuli.

Desensitization treatment procedure were started 1 week after surgery and continued for 12 consecutive weeks. Patients were randomly divided into two equal groups, each using different methods; (I) stannous flouride dentifrice and hyG brand ionizing-brush without battery, (II) stannous flouride dentifrice and hyG brand ionizing-brush with a battery. Patients were instructed to brush at least twice daily with the stannous fluoride dentifrice and hyG brand Electro-ionizing toothbrush, containing a 3 volt battery, using a sulculer technique (roll, bass).

Toothbrush regimen: Each participant received randomly a hyG Brnde Electronic Toothbrush (The hyG Brnde Electronic Toothbrush In Japan., Hukuba Dental Corp. 914-1 Nazukari, Nagareyama Chiba, 270-01 Japan) (Fig. 1). (The power source of the ionizing brush was a 3 volt lithium battery). The volunteers were instructed to apply a ribbon of stannous fluoride paste, were told to brush their teeth using the sulcular methods for 3 minutes (using a timepiece) on two occasions per day in accordance with the manufacturer's instructions. The subjects were advised to concentrate on the test tooth especially at the start of each session when there was an abundant amount of dentifrice on the toothbrush. To permit current flow the subject was asked to hold their finger on the metal strip running along the back of the brush (Fig. 2)

Participants were re-examined for sensitivity following the use of the stannous fluoride dentifrice (Sensodyne-Block Drug Company (Canada) Ltd, Toronto, Ontario M4B 3E3) with the ionizing brush at 1, 4, 8, and 12 weeks. The test for the difference between two populations was used for statistical analysis.

RESULTS

Improvements in numerical explanations are shown in Table 1. In addition the distribution of subjective improvement is given in Table 2. After 12 weeks of treatment, the type of improvement was investigated. Full improvement in the second group

Table 1 The numerical explanation of the degree of improvement

Evaluation	Decrease in the degree of pain
Full improvement	3→0, 2→0, 1→0
Little improvement	3→2, 3→1, 2→1
No improvement	3→3, 2→2, 1→1

Table 2 Distribution of subjects responding to mechanical, thermal, and chemical stimuli all given at the same time 12 weeks after the operation

Type of improvement	First group			Second group			
	N	Total relief	Per cent	N	Total relief	Per cent	Z Value
Full improvement	44	2	4.5	52	33	63.4	−5.97***
Little improvement	44	8	18.2	52	16	30.8	−1.42
No improvement	44	34	77.3	52	3	5.8	7.17***

Statistical significance ***$p<0.001$

Table 3 The statistical analysis of pain scores obtained at each examination period in both groups

Time	First group				Second group			
	N	Total relief	Per cent	Z value	N	Total relief	Per cent	Z value
1 week postoperatively	44	0	†		52	0	†	
4 weeks postoperatively	44	2	4.5	−1.13	52	12	24.5	−3.68***
8 weeks postoperatively	44	5	11.3	−1.42	52	35	68.2	−7.26***
12 weeks postoperatively	44	6	13.6	−1.53	52	42	81.4	−8.39***

Statistical significance ***$p<0.001$
† Treatment starts.

was observed with a success rate of 63.4% ($p<0.001$). The first group also showed an increase in the full improvement rate, but the increase was not found to be significant ($p>0.05$). Table 3 shows the pain scores at each examination period for the 96 teeth treated with stannous fluorid dentifrice and the electro-ionizing toothbrush without or with a battery. Pain scores declined steadily after stannous fluoride with the ionizing brush was started. After 12 weeks of treatment (13 weeks postoperatively) a pain score with an 81.4% reduction ($p<0.001$) was observed. The first group also showed a decrease in pain scores, but the reduction was not found to be statistically significant ($p>0.05$).

A subjective assessment of the degree of hypersensitivity for each stimulus was improved in the second group (Tables 4-6). Stannous fluoride with the ionizing brush

Table 4 The statistical analysis of dentine hypersensitivity scores evaluated by means of mechanical stimuli

Answer	WEEK 1			WEEK 4			WEEK 8			WEEK 12		
	First group	Second group		First group	Second group		First group	Second group		First group	Second group	
	Per cent	Per cent	Z value	Per cent	Per cent	Z value	Per cent	Per cent	Z value	Per cent	Per cent	Z value
0	–	–	–	4.5	34.6	−3.61***	6.8	34.6	−3.28***	4.5	67.3	−6.29***
1	11.4	19.2	−1.06	11.4	32.7	−2.48**	29.5	23.1	0.72	11.3	7.7	0.61
2	11.4	0	2.49*	43.2	9.6	3.78***	18.2	3.8	2.29*	25.0	1.9	3.41***
3	77.3	80.8	−0.42	40.1	23.1	1.87	45.4	38.5	0.69	59.1	23.1	3.59***

Statistical significance *$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 5 The statistical analysis of dentine hypersensitivity scores evaluated by means of thermal stimuli

Answer	WEEK 1			WEEK 4			WEEK 8			WEEK 12		
	First group	Second group		First group	Second group		First group	Second group		First group	Second group	
	Per cent	Per cent	Z value	Per cent	Per cent	Z value	Per cent	Per cent	Z value	Per cent	Per cent	Z value
0	18.2	11.5	0.92	38.6	42.3	0.36	38.6	23.1	1.65	18.2	63.5	−4.46***
1	11.4	11.5	−0.20	15.9	17.3	−0.18	11.4	30.8	−2.29*	18.2	15.4	0.37
2	52.2	50.0	0.22	29.5	30.8	−0.13	38.6	36.5	0.21	45.5	19.2	2.76**
3	18.2	26.9	−1.02	15.9	9.6	0.93	11.4	9.6	0.28	18.2	1.9	2.72**

Statistical significance *$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 6 The statistical analysis of dentine hypersensitivity scores evaluated by means of chemical stimuli

Answer	WEEK 1			WEEK 4			WEEK 8			WEEK 12		
	First group	Second group		First group	Second group		First group	Second group		First group	Second group	
	Per cent	Per cent	Z value	Per cent	Per cent	Z value	Per cent	Per cent	Z value	Per cent	Per cent	Z value
0	11.4	0.0	2.49*	6.8	65.4	−5.87***	9.1	71.2	−6.12***	9.1	65.4	−5.62***
1	6.8	17.3	−1.55	11.4	21.2	−1.28	11.4	17.3	−0.82	11.4	21.2	−1.28
2	56.8	63.5	−0.66	59.1	3.8	5.93***	54.5	9.6	4.78***	56.8	13.5	4.49***
3	25.0	19.2	0.68	22.7	9.6	1.76	25.0	1.9	3.41***	22.7	0.0	3.63***

Statistical significance *$p<0.05$, **$p<0.01$, ***$p<0.001$

provided significantly greater relief than did the stannous fluoride alone ($p<0.001$).

DISCUSSION

Eliminating periodontal pockets by surgery may expose the anatomic root surface of the teeth[17]. The root surface with its newly exposed dentin is frequently hypersensitive. Exposed dentin can cause the patient discomfort and deter the patient from re-establishing oral hygiene procedures[9].

Different studies have indicated that successful results have been obtained by using various materials in the treatment of dentin hypersensitivity, but it cannot be claimed that the problem has been completely eliminated.

Nishida reported that no agents were needed in the treatment of dentin hypersensitivity. He also suggested that improvement of dentine hypersensitivity following periodontal surgery would occur occasionally, eventually reaching the presurgical level. This state is known as the "natural desensitization process", and the natural reduction of dentin hypersensitivity may be related to the patient's oral hygiene practices[1].

Also plaque removal through regular oral hygiene is an essential part of therapy for hypersensitivity[17]. In the present study, all of the participants were motivated and instructed to use a manual toothbrush and followed for control of adequate oral hygiene.

The present findings suggested that, a desensitizing agent could be used initially following periodontal surgery to reduce the pain so that proper oral hygiene procedures could be reestablished. Therefore in the present study negative fluoride ions were used as a desensitizing agent (Stannous fluoride). In addition several clinical trials demonstrated the desensitizing capabilities of stannous fluoride[14-16].

Some studies have also emphasized the necessity of home remedies for the treatment of dentin hypersensitivity[1,9-14]. In the present study participants were told the importance of the home remedy and given stannous fluoride dentifrice and a hyG brnde ionizing brush.

One of the inherent difficulties which appeared in previous investigations was the variability of human response to painful stimuli[16]. Most frequently, the participants were asked to respond to mechanical, thermal, and chemical stimuli on exposed dentin. Their responses were commonly subdivided into none, mild, moderate and severe, which is similar to the present investigation. Although a review of the literature revealed that a desensitizing agents were often assessed subjectively[7], objective evaluations were also carried out[18]. However, Schaeffer *et al.*[18] found similar correlations between objective and subjective evaluations.

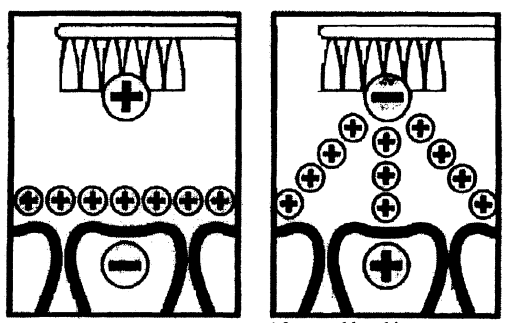


Fig. 3 The use of the ionozing brush creates positive charge at the tooth.

To create a positive charge at the tooth, the hyG brand electro-ionizing toothbrush was used in the present investigation (Fig. 3). This method was intended to attract desensitizing agents to a hypersensitive root and to enhance desensitization. In addition a positive charge was supplied by the 3M brush which was also used in others studies[16,19] and the iontophoretic experiments of Schaeffer *et al.*[18], and Minkov *et al.*[20] However, Gangarosa *et al.*[21] questioned the type of electrical charge delivered to the hypersensitive tooth during iontophoresis. They advocated the use of a negative charge because a positive charge at the tooth surface would oppose the penetration of fluoride in the tooth. In addition Schaeffer *et al.*[18] claimed that the decreased sensitivity observed in their study was due to iontophoresis and not the stannous fluoride in the dentifrice.

It is suggested that, the use of an electric current may result in the formation of reparative dentin which inhibits the transmission of stimuli from the dentinal surface to the pulp. Consequently, the use of the electro-ionizing toothbrush could play a significant role in the treatment of dentin hypersensitivity in post-periodontal surgery.

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