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FLUORIDE IONTOPHORESIS VERSUS TOPICAL FLUORIDE APPLICATION IN THE TREATMENT OF DENTINE HYPERSENSITIVITY

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ABSTRACT:

Objective: To compare the effectiveness of topical fluoride application and fluoride iontophoresis on tooth hypersensitivity.

Material and Methods: Test teeth received a 2% neutral solution of sodium fluoride using Desensitron II Iontophoresis device with current and the control teeth received the solution on the device without current. Thirteen patients comprising eight females and five males who complained of tooth hypersensitivity participated in the body.

Results: The test teeth (with iontophoresis), showed a significant improvement in the reduction of hypersensitivity than the control teeth at Day 7 and at Day 14, $P<0.05$.

Conclusion: Fluoride desensitization with iontophoresis is more effective than topical fluoride application.

INTRODUCTION

The prevalence of dentine hypersensitivity varies greatly depending on how researchers define 'hypersensitive'. While some use a passive approach, relying on patients complaints, others employ active tests involving mechanical stimulating devices and temperature variations[1]. Dentine hypersensitivity remains a continuing concern for both dentists and patients and as yet, nobody is exactly sure what the aetiological factor could be. It represents a major clinical problem only partially solved[2]. But whatever the frequency of hypersensitive dentine in the overall population, it is certainly much higher among patients with dentin surfaces exposed by cervical abrasion, erosion, gingival recession, hypoplasia or post periodontal surgery, where there is a loss of normal protective soft tissue. These teeth are often subject to hypersensitive responses which may limit effective plaque control[3].

Dentine exhibiting symptoms of dentine hypersensitivity has tubules open at the dentine surface and patent to the pulp[4].

Thermal, chemical or mechanical stimulation of hypersensitive dentine or root surface can produce painful dental sensations. Several hypotheses have been proposed to explain how these stimuli may influence nerve fibres though nerve branches contact the pulpal ends of the odontoblasts and may even extend into the predentin, the bulk of the dentine seems as devoid of nerve tissue[5].

The presence of exposed open dentinal tubules has been demonstrated to increase the dentine permeability and has been found to be responsible for pain and sensitivity[2]. A blast of air on exposed dentine causes movement of the tubular fluid. This fluid movement is transferred to the odontoblasts which stimulates the nerve fibres either directly or indirectly to cause a spike of exquisite pain - this is the hydrodynamic theory. All of these concepts must still be viewed as hypothetical and the exact mechanisms of the stimulus-pain response on exposed dentine or root surfaces remain unproven. The requirements of an ideal desensitizing technique or material as reported by Lutin[3] should (1) be painless, (2)not unduly irritate the pulp (3) be easily applied, (4) be permanently effective, (5) be quick acting, (6) be consistently effective and (7) produce no discolouration.

The process of influencing ionic motion by electrical current has been termed iontophoresis, electophoresis or cataphyoresis. Iontophoresis therapy is based on the simple principle that similar electromagnetic charges repel each other when sodium fluoride dissolves in solution, the fluoride molecule forms an anion with an extra electron-thus becoming negatively charged. In iontophroresis, it is believed that fluoride ion is electrically driven deeper into the dentinal tubules. Topical fluoride on the other hand causes fluoride uptake from the surface.

Lutin[3] described the use of an elctrode iontophoresor (Phoresor model C-2 Dentelect Corp, Augusta, GA) on 11 subjects and assessed the patients for mechanical and thermal stimulation for a period of 7 days with a FTS Direct-Contact Probe which provided a precise temperature to quantitatively evaluate patient response to cold stimulation. The purpose of the present study was to assess the reduction of dentinal hypersensitivity to tactile (scraping) and hydrodynamic (blast of air) stimuli using the Desenstron II Iontophoresis device (Parkell Electronic Div.

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155 Schmitt Blrd. Farmingdale NY 11735) with sodium fluoride with and without the use of a direct current over a period of 14 days.

MATERIALS AND METHODS

Thirteen patients with a history of hypersensitive teeth referred to the periodontology clinic of the University College Hospital, Ibadan were recruited into the study. This number comprised eight females and five males with age range 23 years to 58 years. The criteria for inclusion were:

1. A history of tooth hypersensitivity
2. Absence of caries
3. No recent treatment of any type of desensitization
4. Absence of systemic disease
5. Desire to participate in the study for a period of 14 days.

Oral examinations were carried out on patients with a view of diagnosing the hypersensitive teeth by scraping with a metal probe and blowing a blast of air on all teeth surfaces to determine the patient's pretreatment (initial) responses. All examinations and treatments were carried out in dental chairs using standard operating lights. Gentle scaling and polishing of the whole mouth was done at day 0 and 7 before applications of the desensitizing solution for each of the patients. Although fluoride ion is known to penetrate dental plaque readily, gentle scaling and polishing was done in order to remove bias that might be introduced by different thicknesses of plaque on the sampled teeth, since this study is a clinical trial comparing two (2) clinical methods of desensitization.

A total of 62 teeth (40experimental and 22 controls) were tested. The experimental teeth were adjacent to control teeth in each patient as much as possible to negate any placebo effects. In some patients, there were single hypersensitive tooth in some quadrants of the mouth. Two (2) of the patients presented with enamel chips (Ellis class I fracture) of the hypersensitive teeth.

The Parkell Desensitron II device was used with cotton wool pledget in plastic applicator tubes saturated with 2% sodium fluoride solution. The only difference was that the experimental teeth had current while no current was applied for the control teeth. The author wore a pair of gloves for each of the patients.

The method of application was as follows:

1. One of the autoclavable probes selected
2. The forked end was inserted into the socket at the front of the power unit
3. Cotton wool pledget was inserted into disposable white plastic applicator tube, ensuring that the probe end touches the cotton wool.
4. Several drops of 2% sodium fluoride solution was applied to saturate the cotton
5. The patient's ground bar was plugged into the socket on the side of the Desensitron
6. Patients' palm was moistened with saline solution in order to assure conduction and patient was instructed to hold the ground bar firmly during the treatment.
7. For the experimental teeth, the current control knob was turned fully clockwise to preset the unit to the clinically indicated iontophoresis current of 0.5 mA. For the control teeth, this step was not taken
8. The saturated cotton tip was applied to the area of sensitivity for one minute as stated by the manufacturer. For the experimental teeth, as soon as the probe tip touched the teeth surfaces a green light indicating functioning of the Desensitron (with short beeps heard every few seconds). The teeth were wiped free of saliva before the commencement of treatment.
9. After each treatment, the pledget and applicator tube were thrown away and the probe tip autoclaved before being used for another patient.

After the treatment, the patients were called at day 7 when sensitivity tests: scraping with a metal probe, and blast of air were performed on the test and control teeth. Response by the patient were noted and recorded as Presence of pain or Total abolition of pain. All teeth were tested in the same sequence. The treatment was then repeated at day 7 and patients called again at day 14. The same stimuli were applied and response recorded. No further treatment was applied at this visit.

STATISTICAL ANALYSIS

The data were analysed using the chi-squared test.

RESULTS

At day 7, with the blast of air (hydraulic) testing, 10% of the test teeth had total abolition of pain while 0% of the control teeth had total abolition of pain (Table 1). The difference was statistically significant ($P<0.05$). At day 14, 31 teeth (77.5%) of the test group were totally asymptomatic as against only 2 (9.1%) of the control teeth, this was also statistically significant. The result also revealed a better degree of desensitization with a double application at Day 14 than at Day 7, after only one application – although this was not statistically significant $P<0.05$.

Table 1: **Response to Hydraulic Pressure (blast of air) of Test and Control Teeth**

	At Day 7 Presence of pain	Abolition of pain	At Day 14 Presence of pain	Abolition of pain
	n(%)	n(%)	n(%)	n%
Test	36(90)	4(10)	9(22.5)	31(77.5)
Control	22(100)	0(0)	20(90.9)	2(9.1)

X^2 = 18.55 *X^2 = 12.65*
P = 0.0001 *P = 0.0001*

Abolition of pain at Day 7 versus Abolition of pain at Day 14
X^2 = 0.44
P = 0.506

The response to mechanical stimulation (scraping with metal probe) showed similar results as the response to hydraulic pressure (blast of air) Table 2. At Day 7, 4 teeth (10%) was totally asymptomatic whereas none (0%) of the control group had complete abolition of pain - P<0.05. At Day 14, 29 teeth (72.5%) of the test group were totally asymptomatic while 2 (9.1%) of the control group were asymptomatic. The difference between Test and Control group was also significant P<0.05. Table 2.

Table 2: **Response to Mechanical Stimulation (scraping) of Test and Control Teeth**

	At Day 7 Presence of pain	Abolition of pain	At Day 14 Presence of pain	Abolition of pain
	n(%)	n(%)	n(%)	n%
Test	36(90)	4(10)	11(27.5)	29(72.5)
Control	22(100)	0(0)	20(90.9)	2(9.1)

X2 = 28.55 X2 = 12.6531.60
P = 0.0001 P = 0.000

Abolition of pain at Day 7 versus Abolition of pain at Day 14
X2 = 0.439
P = 0.782

DISCUSSION

There is no doubt that patients self-report discomfort arising from various stimuli, but the highly subjective nature of the condition makes it extremely difficult to evaluate dentine hypersensitivity objectively[6].

Lutins et al.,[3] in their study, employed mechanical and thermal stimulation which precisely quantitate patients' response in measurable values using appropriate scales. West et al[4] assessed dentine hypersensitivity with tactile and cold air stimulus together with an overall subjective assessment. Due to lack of resources, the highly sensitive methods could not be used for the present study and such tactile and blast of cold air were employed in an overall subjective manner.

There are many desensitizing methods that may be classified from simplest to most complex, ranging from simple ones such as topical application to intermediate ones like iontophoresis and to complex ones such as glass-ionomer cements and dentine bonding agents[1]. Several hypotheses have been proposed to explain the mechanism by which fluoride iontophoresis produces desensitization of the dentine. According to current concepts, dentinal pain results when fluid movement in open tubules hydraulically stimulates the odontoblasts and nerve fibres at the dentin-pulp inter face. One thing is however certain, for dentine to be painful, it must be exposed to the oral environment and that surface sensitivity does not occur if the tubules are protected by enamel or cementum. It seems probable that the hydrodynamic mechanism is the one operating in dentine sensitivity and the condition of dentine, with either blocked or open dentinal tubules, is a decisive factor in the degree of dentine sensitivity[7]. Numerous studies have shown that iontophoresis drives the fluoride ions much deeper into the tubules thereby causing greater fluoride uptake than is possible with topical application[1,8]. Lambrechts et al[9] reported that intensive fluoride therapy with or without iontophoresis can be used as a preventive therapeutic measures for non-carious abrasive and erosive lesions. Whereas, topical application of fluoride acts from the surface of the dentine into the dentinal tubules, in Iontophoresis, it is believed that fluoride is electrically driven into hypersensitive dentinal tubules. The fluoride ions react with calcium in the hydroxyapatite to form fluorapatite. The CaF2 then precipitates thereby blocking the dentinal tubules with insoluble compound[10]. With the resultant plugging of the dentinal tubules and restriction of fluid movement, iontophoresis and topical fluoride have been found to reduce the hydraulic transmission of stimuli to the odontoblasts and the neurons below them. In iontophoresis, this has resulted in an immediate significant and for many patients, a permanent reduction in hypersensitivity[3].

Iontophoresis has been found to cause significant improvement in 70% - 80% of the patients[3], and has been found to meet most of the criteria of an ideal desensitizing agent[1]. This present study has shown similar findings with 75.5% of teeth examined showing total abolition of pain at the end of 14 days and 10% showing total abolition of pain after 1 week (Table 1). With topical fluoride no tooth showed abolition of pain after 1 week and only 9.1% showed abolition of pain after 2 weeks, this study further showed that there was a better result after a second applications than after only one application, although this is not statistically significant. Even though, it has been suggested that application of fluoride at 1 week interval provides maximum fluoride uptake[3] this study has revealed that a longer period of time is quite beneficial to the patients.

The highly subjective nature of the condition makes it extremely difficult to evaluate dentine hypersensitivity objectively[6]. Similarly, in a study by West et al[6] dentine hypersensitivity was assessed with tactile and cold air stimuli. Subjective assessment of response obviously lacks standardized measurability and this may also be a limitation in this present study. Similar responses were obtained with both blast of air (hydraulic pressure) and scraping (mechanical stimulation) (Tables 1 & 2).

It may be suggested that these two methods exhibit some degree of reliability. The results of the present study suggest that fluoride iontophoresis provides relief for the majority of patients suffering from dentine hypersensitivity and that the therapy has clinical significance because it is fast, economical and safe. It is therefore suggested that fluoride iontophoresis be used as a first line treatment, before more dramatic steps like resin primers and low laser treatment[1] are considered for the treatment of dentine hypersensitivity. Future studies in this environment should however look into the possibility of quantifying the degree of dentine hypersensitivity using appropriate scales.

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