Original Research Paper

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Comparison of four treatment modalities in treatment of dentinal hypersensitivity-an in vivo study

Dental Science

KEYWORDS:

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INTRODUCTION

Pain is considered as one of the most debilitating diseases of modern world. Dentinal Hypersensitivity or Cervical Dentine Sensitivity is characterised by a short, sharp pain arising from exposed dentine in response to thermal, tactile, evaporative, osmotic or chemical stimuli, which cannot be ascribed to any other dental defect or pathology[1]. The condition affects 8-57% of the adult population and is associated with chronic exposure to the oral environment[2].

The alternate term Cervical Dentine Hypersensitivity, though not frequently used, describes accurately the most common location of the pathology, which is the cervical border of the facial surfaces of premolars and canines. The condition most frequently affects women and is prevalent in the age group of 20-50 years[3].

Dentine Hypersensitivity can occur due to loss of enamel from the cervical aspect of the tooth, where it is the thinnest, from constant exposure to oral acids, dietary acids, poor oral hygiene, improper tooth brushing habits, premature occlusal contacts leading to abfractions or periodontal therapy leading to root exposure[4]. These factors bring about both lesion localization and lesion initiation to cause Dentinal Hypersensitivity. The loss of enamel characterises the lesion localisation while the further action of the acids on the exposed dentine, removes the protective smear layer and brings about opening of the dentinal tubules[5].

Various theories have been proposed to explain the mechanism of Dentinal Hypersensitivity, which include, the dentinal receptor mechanism theory[6], the odontoblast transducer mechanism theory proposed by Rapp et al.[7]and the Hydrodynamic Theory proposed by Brannstorrn and Astrom in 1964[8]. The most accepted of the three is the Hydrodynamic Theory according to, which the Type A fibres, both A delta and A beta, are responsible for bringing about the hydrodynamic process leading to the characteristic short, sharp pain. Anatomically, dentine consists of fluid filled canals within, which rest the odontoblastic processes. According to the hydrodynamic theory, centrifugal movement of this fluid, brought about by mechanical or chemical stress, sensitises the neural cells at the pulp-dentine complex via the odontoblastic processes[9]. As stated before, the "hypersensitive" dentin has more widely open tubules and thin/under calcified smear layer as compared with "non-sensitive" dentine. The wider tubules increase the fluid movement and thus the pain response[10,11].

Due to the debilitating nature of this condition, it becomes imperative to treat it at the earliest. Two aspects exist for the effective treatment of dentine hypersensitivity, one aiming at the aetiology of the lesion and the second towards treating the symptoms. Due to the pathologically wide dentinal tubules, treatment till now, has aimed at blocking these tubules to prevent fluid movement. Grossman has put forth a number of requirements for an ideal therapeutic agent. Therapy should be non-irritating to the pulp, relatively painless on application, easilycarried out, rapid in action, effective for a long period,without staining effects, and consistently effective[12]. Some of the therapeutic agents that have been used are Fluorides, Oxalates, Potassium nitrate, Adhesive agents, Bioglass, Portland Cement, Laser and CPP-ACP[9]. However, West, in a recent review, hinted that conclusive evidence of successful treatment regimens of dentin hypersensitivity remains elusive, despite a multitude of products available for treatment[13]

The aim of this study is to compare the effectiveness of a diode laser, topical fluoride application; fluoride iontophoresis and arginine-calcium carbonate desensitizing paste on dentin hypersensitivity.

METHODOLOGY

This 15 days clinical trial was conducted in the department of Conservative and Endodontics, MR Ambedkar Dental College and Hospital.

The exclusion criteria for the patient selection included all patients below the age of 20 and above the age of 50, patients with dental pathology causing pain similar to that associated with DH such as caries, fractured tooth, extensive restorations or gingival recession, pregnant or lactating mother, patients with systemic disorders, patients who have undergone professional treatment with desensitizing agents or who have a H/O vital tooth bleaching.

Patients were only included for the study if they had read and signed the informed consent.

160 teeth from 20 patients were included in the study. The patients selected belonged to the age group of 20-50 years as studies have shown this age group to be most affected by Dentinal Hypersensitivity.Each quadrant of each patient had a minimum of two hypersensitive teeth and a split mouth design was utilised for the study. The split mouth design was adopted as it conferred the advantages of same pain perception, oral hygiene habits, dietary habits and psychosomatic factors.

Two teeth from each quadrant were taken up for study. One tooth was the experimental tooth and the other used as a control. The study was also double blinded whereby neither the evaluator nor the patient was aware of the treatment rendered. This was done to avoid any bias that may arise.

All the teeth to be treated were isolated and dried with cotton rolls. The numerical 0-10 Visual Analogue Scale (VAS) was used to assess the pain/sensitivity response. Pre-treatment test stimuli were applied and the baseline set for each tooth based on the pain response. Two different test stimuli were adopted, the tactile or mechanical method and the air blast test. In the tactile method, a sharp dental explorer (17\23) was passed lightly across the affected area, perpendicular to long axis of tooth. The test was repeated three times before the score was recorded. For the air blast test, air blast from dental syringe at 60-pound/inches^2 pressure was directed on to the tooth for 1second from a distance of 10 mm. After treatment with different agents, the post treatment VAS score was evaluated through the different test stimuli immediately after, at the 7th day and on the 15th day.

Each tooth was subjected to thorough oral prophylaxis before any treatment was done.

Drug application:

- **GROUP I: CALCIUM CARBONATE ARGININE PASTE [SHY-NM]**

A commercially available product with 8% arginine and calcium carbonate was used. The paste was applied over the tooth surface using a slow speed hand-piece and a rubber cup for a minute. The paste was rinsed off after a minute of application.

- **GROUP II: LASER**

A diode laser [PICASA] with a 680 nm wavelength at 0.5 watts was used for three cycles of 1 min each. An interval of 10 seconds was given between each exposure per tooth.

- **GROUP III: IONTOPHORESIS – APF GEL**

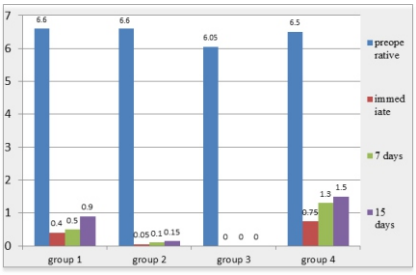
Iontophoresis was performed by using a commercially available instrument; Jonofluor (ParkellInc, Farmingdale, USA). An autoclaved tray acted as a cradle for holding a sponge soaked in APF gel (12,300 ppm F). An electrode was connected to the tray and another placed in the patient's hand. This completed the circuit for the current to flow. A DC current of 1 mA was supplied for three minutes for the process to complete.

- **GROUP IV: 2% TOPICAL (ACIDIFIED) SODIUM FLUORIDE SOLUTION**

The 2% sodium fluoride solution was prepared freshly each time by dissolving 200 mg of medical grade sodium fluoride powder (DNS Fine Chemicals, Mumbai, India) in 10 ml of distilled water (Nirmal Prime Health Care, Ahmedabad, India) in a sterile plastic bottle. A cotton pledget soaked in 2% NaF (9000 ppm fluoride) solution was placed on the exposed cervical dentin of the tooth for period of three minutes.

STATISTICAL ANALYSIS

In the current study, the descriptive statistics were given as mean +/- standard deviation and numbers. The Post hoc Tukey's test was conducted to study the differences in mean between the four treatment groups. Statistical analyses were performed using SPSS 11.0 program (SPSS Inc., Chicago, IL) for Windows. The value $p<0.01$ was considered "statistically significant".



GRAPH : MEAN SCORES OF ALL GROUPS

RESULTS

A total of 160 teeth were treated in 20 patients aged between 20-50 years. These included 40 teeth being treated agent for Group I, 40 with Group II agents, 40 with Group III agents and 40 with Group IV agents. Out of the 40 teeth in each group, 20 were used as control and 20 as experimental. Randomization was carried out with the use of Sequentially Numbered Opaque Sealed Envelopes (SNOEs) whereby the teeth were designated as control or experiment by a unrelated third individual based on prior numbering.

The maximum decrease in perception of pain was observed to be immediately after each treatment with Group I showing a mean value of 0.6, Group II & III of 0 and Group IV of 1.1 on the VAS from 6.45, 6.8, 6.6 and 6.35 respectively. However, Group I and Group IV show a gradual increase in the VAS scoring on the 7th day and 15th day implying a greater pain perception. Group I shows an increase from 0.6 to 0.8 in the 7th day and a final recording of 1.22 on the 15th day. Group IV shows an increase from 1.1 to 1.4 on the 7th day and finally an increase to 2 on the 15th day. The Group III scores do not show any increase on the 7th day but do rise to 0.2 on the 15th day. Group IV shows absolutely no increase in the pain perception and hence, the VAS score, from immediately after treatment to the 15th day after treatment.

The test of significance demonstrates there is a significant difference in the mean scores of all the groups except between Group II and Group III. Group IV has demonstrated a significant rise in pain perception on the 15th day as compared to Groups I, II & III (TABLE 1).

TABLE 1: ON APPLYING POST HOC TUKEY HSD

Treatment pair	Tukey HSD Inference
Group 1 vs 2	P <0.01
Group 1 vs 3	P <0.01
Group 1vs 4	P <0.01
Group 2 vs 3	Insignificant
Group 2 vs 4	P <0.01
Group 3 vs 4	P <0.01

DISCUSSION

Dentine Hypersensitivity is a very uncomfortable condition of the oral cavity affecting a wide age group. Studies have shown the overall prevalence of DH to be 26% in Southern India and the most common teeth to be affected are the lower premolars and anteriors[14].

The lack of sufficient clinical data on the most effective treatment for hypersensitivity makes it essential to study the different options available. Keeping this in mind, the four most commonly used techniques of Calcium carbonate-arginine paste, LASER, Iontophoresis and Sodium Fluoride gel were compared through a randomised, double blind, split mouth design study.

The VAS scoring is commonly used in human clinical and psychological trials to assess subjective states. It is based on a 100mm scale, with the extreme right indicating maximal pain and the extreme left, zero pain. Subjects involved in the research are asked to state their perception on pain by marking a certain point on the scale[15,16].

The 8% arginine/calcium carbonate desensitizing paste contains a combination of arginine and calcium carbonateto mimic the natural process of plugging and sealing patent dentin tubules. The essential components of this new technology are arginine, an amino acid which is positively charged at physiological pH,i.e., pH 6.5-7.5, bicarbonate, a pH buffer, and calciumcarbonate, a source of calcium[17, 18]. Wolff et al reported a 71.7% reduction in sensitivity measured by air blast and 84.2% reduction by the "scratch" test immediately following product application[19]. In our study, though the use of calcium carbonate paste did show a decrease in pain and sensitivity, but the decrease was temporary and followed by an increase in pain over the next 15 days.

Diode LASER is a soft tissue LASER with wavelength ranging from 655nm to 980nm. Very few studies have evaluated the efficacy of a 680nm diode LASER on dentinal hypersensitivity. Diode leads to bio-stimulation and thus secondary dentine deposition. It helps in increasing the pain threshold of the free nerve endings, provides analgesic effect through increase in b-endorphine and inhibition of cyclo-oxygenase enzyme that is responsible for the formation of prostaglandin and hence the increase in pain transmission[20]. According to this study, there is a significant decrease in the pain perception to nil immediately following treatment. This decrease remains consistent and even after 15 days, there is no significant increase in the pain perception following treatment. Our results are supported by many earlier studies notably the one done by Romeo et al in 2012 supports this result, where he compared 2% NaF+ diode laser with NaF and diode laser and found that maximum reduction in sensitivity wasin group of diode laser combined to 2% NaF. Thus he concludedthat diode laser is a useful device for DH treatment[22].

Iontophoresis therapy is based on the simple principle that similar electromagnetic charges repel each other whensodium fluoride dissolves in solution, the fluoride molecule formsan anion with an extra electron-thus becoming negatively charged.In iontophroresis, itis believed that fluoride ion is electricallydriven deeper into the dentinal tubules[22]. There are many theories that explain the mechanism of iontophoresis, which include formation of dead tracts by the electric current leading to reparative dentine formation, paraesthesia through altering the sensory mechanism of the nerves

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or hydrodynamically stimulated electrical charge mediated deposition of calcium fluoride into the dentinal tubules[23]. In our study, we used iontophoresis in combination with APF gel and the results were significantly better than all the other groups. There was absolutely no perception of pain even 15 days after treatment. Our results are in concurrence with the study conducted by Aparna et al in 2010, which studied efficacy of iontophoresis with APF and concluded that it is effective for treating Dh[23].

The fourth group of only sodium fluoride solution applied topically, proved the most ineffective of all the treatment modalities. Immediate post-operative pain persisted and increased significantly over the next15 days. Highest pain perception on 15th day was reported with Sodium fluoride gel treatment.

The conclusion to be made from this study is that Iontophoresis and Laser are the most ideal treatment modalities for Dentine Hypersensitivity. They provide persistent, long term relief from this grossly debilitating condition.

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