Comparative Evaluation of Diode Laser and Conventional Desensitizing Agents for the Treatment of Dentinal Hypersensitivity

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Abstract :

An in Vivo Study, to compare the Evaluation Of Diode Laser **(Fig A)** and Conventional Desensitizing Agents For The Treatment Of Dentinal Hypersensitivity. Do patients were clinically diagnosed with cervical dentin hypersensitivity and divided into two groups. Group I were treated with 05% sodium fluoride, whereas Group II were treated with Diode laser irradiation. The assessment of pain and discomfort was by a visual analog scale (VAS) after patient's visits on weeks 1, 2, 3 & 4. A statistical significance of data for all clinical and VAS scores within and between groups was determined by using the paired t test. The VAS scores for pain at the 4-week examination showed significant improvements of discomfort immediately after treatment in the laser group as composed to the fluoride group.

Key words: Diode laser, 5% Sodium fluoride.

Introduction:

Dentin hypersensitivity **(Fig B)** is a common symptomatic problem characterized by a short and sharp pain that causes complaints of discomfort in patients.[1] Dentinal hypersensitivity exhibits a high prevalence, ranges from 14% up to 30% in the adult population, and can be particularly uncomfortable with unpleasant sensations for many patients during diet, tooth brushing, and some other activities.[2]

Scientific investigations of tooth hypersensitivity began in the 1860's, and the currently accepted theory, known as 'hydrodynamic theory[3,6], states that the painful symptoms are commonly associated with the outward fluid movement within the pulp-dentin complex. It is usually dependent on the presence of widely open dentinal tubules at the exposed dentin surfaces in response to thermal, mechanical, or chemical stimuli.[3,4]

Under normal conditions, dentin is covered by enamel or cementum and does not suffer direct stimulation. Only with the exposure of the peripheral terminations of dentinal tubules is a situation of strong dentinal sensitivity manifested, termed hypersensitivity. Occlusion of the exposed dentinal tubules can reduce the intensity of dentinal sensitivity. This can be accomplished through calcium phosphate inside the dentinal tubules, adsorption of plasma proteins and saliva constituents, as well by active mechanisms such as deposit of intra canalicular crystalline material and secretion of protein material from the interior of the tubules, diminishing dentinal permeability and sensitivity.[5]

Type A fibers are responsible for dentinal sensitivity and are probably activated by the hydrodynamic mechanism. Therefore, their activation is directly associated to the presence of opened or occluded tubules. However, hypersensitivity sometimes remains inspite of the effective blocking of the tubules, suggesting that other mechanisms contribute to nerve activation instead of or in addition to the hydrodynamic mechanism. Dentin hypersensitivity may occur as a result of sensitization induced by nerve inflammation in the dentine-pulpal boundary of teeth with opened dentinal tubules. This partially explains the large sensitivity variation of exposed dentin and, furthermore, nerve activation may result in the release of neuropeptides from the activated nervous terminations and, consequently, induce neurogenic inflammation. The symptoms of dentin hypersensitivity would, up to a certain point, be self-sustainable.[6]

Dentin exposure can occur as a result of abrasion, erosion, incorrect tooth brushing, gingival recession, occlusal disharmony, inappropriate diet, as an effect of acids in the oral cavity i.e. hyper acidity, cavity preparations in teeth with pulp vitality that expose the dentin, as well as improperly controlled dentinal acid conditioning.[7]

Treatments up to now have been directed towards blocking open dentinal tubules with sealing agents such as topical application of fluoride and, hence reducing permeability and hypersensitivity.[8] The effectiveness of dentin hypersensitivity treatment with Er:YAG laser has been reported in various clinical studies.[9] The laser, by interacting with the tissue, causes different tissue reactions, according to its active medium, wavelength and power density and to the optical properties of the target tissue.[10] The purpose of this study was to compare the immediate and 1month desensitizing efficacy of diode laser and topical fluoride application in reducing cervical dentin hypersensitivity by considering the degree of pre- and post-treatment pain, discomfort, and functional complications.

Methodology:

Twenty patients with clinically diagnosed cervical dentin hypersensitive teeth were included and divided into two groups, the hypersensitive teeth of patients in group 1 [n=10] were treated with 5% sodium fluoride, whereas those in group 2 [n=10] were treated with diode laser irradiation.**(Fig C)** The assessment of pain and discomfort was by a visual analog scale after an air blast at baseline, immediately after treatment, and at patient visits on weeks 1, 2, 3, and 4. After baseline parameters were recorded, all patients underwent oral hygiene instructions and ultrasonic scaling. Group 1 was treated with 5% sodium fluoride applied over the vestibule areas of the teeth using foam pellets one time weekly for 3 wks. After application, the patients were explicitly instructed to omit tooth brushing during the following 12 hrs. Group 2 patients, were treated using a diode laser [doctor smile, wiser, Italy; free running pulsed-wave laser with a wavelength of 980nm under air cooling] with the following irradiation parameters: power output 2w energy 100mJ; frequency 20Hz; emission mode, pulsed; and time 60sec; optical fiber with 320micrometers. Outcome measures included the evaluation of pre- and post-treatment pain and patient preferences. A visual analog scale [VAS] was used to assess these outcomes. Patients were asked to rate separately their degree of hypersensitivity and functional complications (discomfort during drinking cold fluid and brushing) on a 10-cm VAS by marking the position between two fixed end points. The left end-point of the scale designated "no pain/ no discomfort", and the right end-point designated " worse pain/ severe discomfort". Levels of post treatment pain and functional complications were assessed at patients visits on day 1 and on weeks 1, 2, 3 and 4. The Statistical significance of data for all clinical and VAS scores within and between groups was determined by using the paired t test. Multiple significance test was used to determine the VAS scores at different times. Changes with p values <0.05 were considered statistically significant.

Fig. A: Diode Laser (Doctor smile wiser Italy)

Fig. B: Showing Hypersensitive Teeth.

Fig. C: Leaser Treatment of Hypersensitive Teeth.

Results:

All 20 patients completed the study. VAS scoring results are presented in the **(Table 1)**. Mean hypersensitivity score was well matched in both groups at study entry [$p< 0.005$], but laser treatment resulted in significant improvements of discomfort immediately after treatment and after 1 week [$p < 0.001$]. At the 2-3, and 4-week examination, the discomfort in group 5% sodium fluoride decreased up to nearly 75% to 85% of baseline scores, whereas the effect of the laser stayed nearly unchanged. The VAS scores for pain at the 4-week examination were significantly lower in the fluoride group compared with those in the laser group [$p< 0.005$]. **(Table 1)** At the end of the study, all teeth remained vital after treatment, with no adverse reactions reported or any clinically detectable complications.

Table 1: Comparison of the Mean Standard Deviation VAS Scores of Patients' Perceptions in the 2 Treatment Groups

Follow up visits	Group1 5% Sodium Fluoride	Group2 Diode Laser	P - Value
Hypersensitivity after provoking with air blast			
Baseline	7.09 ± 0.98^{a}	7.02 ± 1.01^{a}	NS
After the treatment			
1 Day	5.06 ± 1.18^{b}	2.34 ± 0.99^{b}	*
1 weeks	4.08 ± 1.02^{c}	2.21 ± 0.86^{b}	*
2 Weeks	2.09 ± 1.15^{d}	2.25 ± 0.79^{b}	NS
3 Weeks	2.02 ± 0.78^{d}	2.34 ± 0.82^{b}	*
1 Month	2.04 ± 0.80^{d}	2.40 ± 0.80^{b}	*
Discomfort During Drinking cold fluid			
Baseline	8.66 ± 1.40^{a}	8.59 ± 1.56^{a}	NS
After the treatment			
1 Day	5.01 ± 1.03^{b}	1.36 ± 1.66^{b}	*
1 weeks	3.90 ± 0.81^{c}	1.41 ± 1.00^{c}	*
2 Weeks	1.93 ± 0.87^{d}	1.42 ± 0.99^{c}	*
3 Weeks	1.14 ± 0.85^{e}	1.38 ± 0.81	*
1 Month	1.17 ± 0.86^{f}	1.38 ± 0.83	*
Discomfort during Tooth brushing			
Baseline	4.13 ± 1.63^{a}	5.01 ± 1.72^{a}	*
After the treatment			
1 Day	3.01 ± 0.71^{b}	0.58 ± 0.88^{b}	*
1 weeks	2.16 ± 1.00^{c}	0.57 ± 0.80^{b}	*
2 Weeks	0.56 ± 0.66^{d}	0.59 ± 0.65^{b}	NS
3 Weeks	0.51 ± 0.50^{d}	0.52 ± 0.60^{b}	NS
1 Month	0.50 ± 0.47^{d}	0.50 ± 0.63^{b}	NS
Satisfaction	8.02 ± 0.71	9.04 ± 0.91	*

NS: not statistically significant; VAS: visual analog score, (*): $p<0.05$ significant difference.

Multiple significance test (the Bonferroni method) was used to determine the difference between the VAS scores at different times, and the differences were shown with different letters.

Discussion:

Cervical dentin hypersensitivity results when a stimulus is applied to the dentin causing a movement of the fluid within patent tubules in the exposed dentin, which then stimulates the nerves producing a pain impulse transmission.[11,16] Obstructing the open tubules of dentin is thought to be an essential procedure to minimize the patient complaints and to prevent severe pulpal damage via bacterial invasion through the denude dentin surface. Various agents have been recommended to occlude dentinal tubules that reduce dentin permeability and hypersensitivity. However, it was revealed that the treatment of hypersensitivity should be non-irritant to the pulp, relatively painless on application, simply carried out, rapid in action, and effective for a long period.[12,13] So far, many materials have been tried with varying degrees of success in the treatment, but most of the therapies have failed to satisfy one or more of these criteria.[9]

Most of the desensitizing procedures or agents used today attempt to inhibit painful stimuli by either sealing the dentinal tubules with coating mechanisms or by altering the tubules contents through coagulation.[10] Topical sealing agents such as 5% sodium fluoride were reported to be effective in reducing the hypersensitivity, but it was effective in the reduction of pain, but its effect was not distinguished from the placebo treatment.[14] Recently, it has been reported that lasers may now provide reliable and reproducible treatment in vitro. Furthermore, it was concluded that the Nd:YAG laser can be used to reduce the pain sensation without detrimental pulpal effects.[10] For this reason, this study was planned to investigate the most rapid and effective treatment alternative for cervical dentine hypersensitivity by comparing VAS outcomes of subjects treated with the diode laser and 5% sodium fluoride.

Dentin hypersensitivity is a pain sensation and is difficult to quantify. However, VAS is widely used and generally accepted for the assessment of pain. Although it has been recommended by some authors to use more than one stimulus.[12] We chose to use a single stimulus, an air blast, because this seemed to be a clinically relevant measure.

The present study showed that the mean hypersensitivity score was well matched in both groups at study entry, but patients treated with 5% sodium fluoride often experienced pain and discomfort at the beginning of treatment that was reduced significantly after 2wks, whereas laser treatment resulted in significant improvements of discomfort immediately after treatment and after 1wk. At the 2nd, 3rd and 4th week examination, the discomfort in group fluoride decreased up to nearly 75% to 85% of baseline scores, whereas the effect of the laser stayed nearly unchanged. If dentin hypersensitivity results from the movement of fluid in the tubules, fusing the tubules should result in a predictable elimination of dentine hypersensitivity.

So treatment focused at decreasing the radius of tubules is a pre-requisite for effective desensitization. Previous clinical studies suggest that the Nd:YAG laser is an effective tool in reducing dentin hypersensitivity to cold air stimuli. It produced an immediate effect to a greater or lesser extent on almost all sensitive teeth.[15] The laser treatment may be considered as very expensive just for the treatment of dentin hypersensitivity, but we still recommend it is an effective and fast treatment option for the dentin hypersensitivity treatment.

Conclusion:

The diode laser is a suitable tool for the immediate successful reduction of dentinal hypersensitivity and has better patient satisfaction, shorter treatment time, and lower rates of pain. More university-based controlled studies are needed to further corroborate these results, but the future use of lasers in dentistry has exciting potential and research should continue on this promising new tool.

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