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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF LASER, CYANOACRYLATE AND LASER WITH CYANOACRYLATE IN THE TREATMENT OF DENTINE HYPERSENSITIVITY – A CLINICAL STUDY

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ABSTRACT

Aim: To evaluate and compare the clinical efficacy of laser, cyanoacrylate and laser with cyanoacrylate in the treatment of dentine hypersensitivity.

Materials and Methods: The study sample comprised of 150 sites out of which 50 sites were assigned to the group 1 (laser and cyanoacrylate), 50 sites were assigned to the group 2 (soft tissue laser irradiation) and 50 sites were assigned to group 3 (cyanoacrylate). Clinical parameters were recorded at the baseline, at 1 day and at 1 month following therapy using VAS SCALE.

Results: Change in the scores of pain of air blast test was observed in all the groups from baseline to follow up. At baseline 7.44 mean was observed, 4.20 at 01 day which was changed to 3.58 at follow-up. Whereas in group II, 7.28 mean was observed, 3.80 at 01 day and changed to 3.26 at follow-up and in group III at baseline 7.28 mean was observed, 4.12 at 01 day and changed to 3.50at follow-up. Change in the scores of pain of cold spray test was observed in all the groups from baseline to follow up. At baseline 7.44 mean was observed, 4.36 at 01 day which was changed to 3.66 at follow-up. Whereas in group II, 7.28 mean was observed, 4.02 at 01 day and changed to 3.16 at follow-up and in group III at baseline 7.36 mean was observed, 4.34 at 01 day and changed to 3.62 at follow-up. It was found to be statistically significant. (p= 0.00)

Conclusion: According to the results, all the groups registered significant improvements of discomfort from dentinal hypersensitivity. No statistically different results were observed between Cyanoacrylate glue and the low-intensity laser in the reduction of dentinal hypersensitivity but if they both used together their results were high.

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INTRODUCTION

Dentin hypersensitivity has been defined as a "short, sharp pain arising from exposed dentin in response to stimuli typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other form of dental defect or pathology." (Dowell and Addy, 1983) A modification of this definition was suggested by the Canadian Advisory Board on Dentin Hypersensitivity in 2003, which suggested that 'disease' should be substituted for 'pathology'. (Canadian Advisory Board on Dentin Hypersensitivity, 2003) Dentin hypersensitivity is a painful clinical condition that affects 8 to 57% of the adult population and is associated with the dentin exposure to the oral environment. (Mantri *et al*., 2011) The most affected patients are in the 20-50 years of age interval, with a peak between 30-40 years of age. It affects women more often than men. The most frequently affected teeth are premolars (68.8%), followed by molars, canines and incisors. (Assis *et al*., 2011) The aetiology of dentin hypersensitivity is multi-factorial. Dentin exposure may be the result of abfraction, abrasion, erosion and denudation of the root surface. Most common etiologic factor is gingival recession exposing the root surface due to gingival diseases, aging, incorrect tooth brushing, periodontal treatment, surgical /dental operative procedures and association of two or more of these factors. (Addy, 2005) Other factors include patient's deleterious habits, poor oral hygiene, chewing tobacco, excessive occlusal force, premature occlusal contact, and gastroesophageal reflux. (Orchardson and Gillam, 2006) Cold and air stimulation are known to be the commonest stimuli while dietary acid is also shown to have a significant potential in evoking dentin hypersensitivity. (Chabanski *et al*., 1996) Various theories have been put forward to explain the mechanism of dentin hypersensitivity which includes Odontoblastic transduction theory, Neural theory, Hydrodynamic theory. The most widely accepted theory is

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hydrodynamic theory given by Gysi in 1900 and later explained by Brannstrom in 1963. This postulates a flow of fluid through the tubule as the transducing mechanism for hydrodynamic stimuli. Rapid fluid flow across the dentinal tubules activates the pain fibers at the pulpal wall and causes pain. The presence of open dentinal tubules, patent all the way to the pulp, seems to be a prerequisite for dentin sensitivity to occur. (Brannstrom, 1986; McAndrew and Kourkouta, 1995) Hence, occlusion of the tubules is supposed to block the hydrodynamic mechanism and reduce dentin sensitivity. Dentin hypersensitivity can be treated by different ways; first by reducing the dentinal tubules hypoconduction by occluding them; second, by reducing the nerve fibers excitability and/ or by a combination of these two approaches (Gilliam *et al*., 2006). Substances capable of forming a crystalline precipitate that occludes the dentinal tubules are found in solutions and dentifrices or can be applied through iontophoresis as stannous fluoride and strontium chloride. Iontophoresis causes a microprecipitation of calcium fluoride that may block the hydrodynamically mediated stimuli that induce pain. Wilson *et al*. demonstrated that the surface of iontophoresis-treated dentin contained two to four times more fluoride than did topically treated teeth and 24 to 30 times more fluoride than did control teeth. (McBride *et al*., 1991) Potassium nitrate, potassium bicarbonate and potassium chloride are active agents that can reduce nerve excitability, while the combination treatments as the use of bipotassium oxalate that has an obstructive mechanism and also has a direct action on pain receptors. Also protein denaturing substances such as formaldehyde, glutaraldehyde, zinc chloride, zinc iodide, phenols, concentrated alcoholic solutions and strong or weak acids, act directly on the nerves and cause precipitation of dentinal fluid proteins that can occlude the dentinal tubules. (Al-Tayeb, 2008) With the advancement of laser technology and its easy and advanced utilization in dentistry, an additional therapeutic option is available for the treatment of dentinal pain. The laser by interacting with the tissues causes different tissue reactions according to its active medium, wavelength and power density and to the optical properties of the target tissue. The effectiveness of dentin hypersensitivity with diode laser, with different wavelengths, has been reported in various clinical studies. The immediate analgesic effects in the treatment of dentin hypersensitivity with diode laser was reported by Brugnera Junior *et al* in 2001. Cyanoacrylate's immediate desensitizing effect on hypersensitive dentin, has been shown to be biocompatible and used to treat hypersensitive teeth. It blocks the dentinal tubules, prevents displacement of fluids within the tubules, and results in little or no response to stimuli. A commercial presentation of cyanoacrylate in the form of glue has proven to be biocompatible. It has the advantage of being easily available, applicability, effectiveness and safety (Kimura *et al*., 2000). Thus, the aim of present study is to compare of effectiveness of Laser and cyanoacrylate in the treatment of dentinal hypersensitivity.

MATERIALS AND METHODS

The study was carried out on patients visiting the out patient clinic of the Department of Periodontology and Oral Implantology, D.J college of dental sciences and research, Modinagar, Distt. Ghaziabad, U.P having dentine hypersensitivity. A total no. of 150 sites was included in the study

Study design

A randomized controlled clinical trial was conducted.

Subject population - The study sample comprised of 150 sites out of which 50 sites were assigned to the group 1, 50 sites were assigned to the group 2 and 50 sites were assigned to group 3.

1. **Group 1 -** Patients in this group were treated with laser and cyanoacrylate.
2. **Group 2 -** Patients in this group were treated with soft tissue laser irradiation.
3. **Group 3 -** Patients in this group were treated with cyanoacrylate.

Inclusion criteria

1. Subjects between 18 and 45 years of age.
2. Subjects with at least 2 hypersensitive teeth assessed using Visual Analogue Scale (VAS) in response to air-blast stimulus or cold test stimulus.

Exclusion criteria

1. Current desensitizing therapy.
2. Allergies and idiosyncratic responses to any of the products being used.
3. Systemic conditions which are etiologic or predisposing to dentine hypersensitivity (e.g. chronic acid regurgitation).
4. Excessive dietary or environmental exposure to acids.
5. Teeth or supporting structures with any other painful pathology or defects.
6. Carious teeth or teeth having any restorations.
7. Abutment teeth for fixed or removable prostheses.
8. Pregnancy or breast feeding.

Data collection

- Detailed case history of the patients was recorded; written and informed consent taken from all the subjects.
- Air blast and cold water stimuli were used to elicit the hypersensitivity response.
- VAS (Visual Analogue Scale) to measure the clinical parameters.

Standardized clinical parameters

Following clinical parameters were recorded at the baseline, at 1 day and at 1 month following therapy.

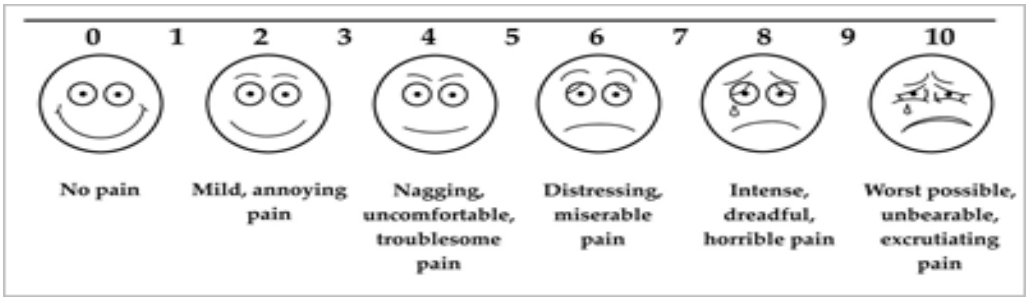
VAS:

The subjects placed a mark on a 10cm long line on the VAS that is labelled from "no pain" (0) to "intolerable pain" (10).

➢The scoring criteria for the VAS scale was as follows

0	No pain
1-3	Light pain
4-6	Moderate pain
7-9	Strong bearable pain
10	Intolerable pain

Vas scale



To record subject's response to stimuli, teeth were isolated with cotton rolls and wiped with a cotton pellet to remove any debris. At each evaluation, subjects were recorded on the VAS scale.

Air blast test

A blast of air was directed onto the affected area of the tooth for 1 sec from a distance of 10mm using a standard dental unit syringe of 40-65 psi at a temperature of 17-21^{o}C, while the adjacent teeth were isolated using cotton rolls.

Cold water test

A pre-cooled 1cmdisposable syringe was filled with freshly melted ice-cold water. After isolating the specific tooth, 0.2ml of the water was slowly expelled from the syringe onto the tooth surface.

These stimuli tests were applied in the above order, with a minimum 5-min gap between the applications of different stimuli.

Preparation phase

Prior to the therapy all patients received thorough supragingival and subgingival scaling and root planing, and oral hygiene instructions were given to the patient. Subsequently, patients showing signs and symptoms of dentin hypersensitivity were subjected to the air blast test and cold spray test. Only patients having a VAS score of more than 3 were included in the study.

Treatment procedure

Group 1: The selected sites were isolated and diode laser followed by cyanoacrylate application was performed
Group 2: For each patient, the sensitive sites were lased with a diode laser having a wavelength of 810nm in no contact pulse mode with a power wattage of 0.5 W. Each site received 3 applications of 1 minute each.
Group 3: The selected sites were isolated with cotton rolls and the cyanoacrylate was applied in 3 consecutive application after a interval of 5 seconds using a microdisposable applicator in a paint brush method.

One day recall visit

At one day recall visit dentin hypersensitivity was assessed on the Visual Analogue Scale using-

- Air test
- Cold water test

One month recall visit

At one month recall visit dentin hypersensitivity was assessed on the Visual Analogue Scale using-

- Air test
- Cold water test

RESULTS

A total of 150 sites from the patients visiting the outpatient clinic of the Department of Periodontology and Oral Implantology, D.J college of Dental Sciences and Research, Modinagar, Distt. Ghaziabad, U.P with complain of dentine hypersensitivity were selected.

Table 1, 2 and 3 VAS scores of air blast test of study subjects at baseline, 01 day and at follow-up

There were more numbers of sites with moderate bearable pain at the baseline which was 38(76%) in Cyanoacrylate + Laser group, 40(80%) in Laser group 39(78%) in Cyanoacrylate group and slightly reduced at 01day in all of the study groups but more number of reduction in pain has been seen in group I (Cyanoacrylate + Laser) than other groups at follow-up, which was found to be statistically significant. (p= 0.03)

Table 4, 5 and 6 VAS scores of cold blast test of study subjects at baseline, 01 day and at follow-up

There were more numbers of sites with moderate bearable pain at the baseline which was 38(76%) in Cyanoacrylate + Laser group, 40(80%) in Laser group39 (78%) in Cyanoacrylate

group and reduced at 01day which was changed from moderate bearable pain to moderate pain in all of the study groups but more number of reduction in pain has been seen in group II (Laser) i.e.66% than other groups at follow-up, which was found to be statistically significant. (p= 0.01)

Table 7 Intergroup comparison of change in VAS scores of air blast test of study subjects at baseline, 01 day and at follow-up

There was more number of changes in the scores of pain i.e.53.94 % in group II (Laser) than group I (Cyanoacrylate + Laser) i.e. 52.62 among these two groups which was found to be statistically significant. (p= 0.00). Whereas in case of group II and III 53.94 % reduction has been seen in group II where reduction was 51.27 %, it was found to be statistically significant. (p= 0.04), among group I and III, 52.62 pain reduction was seen in group I and this was statistically significant. (p= 0.01)

Table 8 Intragroup comparison of change in VAS scores of air blast test of study subjects at baseline, 01 day and at follow-up

Change in the scores of pain was observed in all the groups from baseline to follow up. At baseline 7.44 mean was observed, 4.20 at 01 day which was changed to 3.58at follow-up. Whereas in group II, 7.28mean was observed, 3.80 at 01 day and changed to 3.26 at follow-up and in group III at baseline 7.28 mean was observed, 4.12 at 01 day and changed to 3.50at follow-up. It was found to be statistically significant. (p= 0.01)

Table 9 Intergroup comparison of change in VAS scores of cold spray test of study subjects at baseline, 01 day and at follow-up

There was more number of changes in the scores of pain i.e.50.68% % in group II (Laser) than group I (Cyanoacrylate + Laser) i.e. 55.10 among these two groups. Whereas in case of group II and III, 55.10 % reduction has been seen in group II where reduction was 51.27 %, it was found to be statistically significant. (p= 0.04), among group I and III, 50.68 pain reduction was seen in group I and this was statistically significant. (p<0.05)

Table 10 Intragroup comparison of change in VAS scores of cold spray test of study subjects at baseline, 01 day and at follow-up

Change in the scores of pain was observed in all the groups from baseline to follow up. At baseline 7.44mean was observed, 4.36 at 01 day which was changed to 3.66 at follow-up. Whereas in group II, 7.28 mean was observed,4.02 at 01 day and changed to 3.16 at follow-up and in group III at baseline 7.36 mean was observed, 4.34 at 01 day and changed to 3.62 at follow-up. It was found to be statistically significant. (p= 0.00)

DISCUSSION

The ever changing profiles of human disease in mankind's history have not left the dentistry untouched. The improvement of the oral health status of population has brought impressive benefits, but at the same time raised the awareness of other oral and dental health problems. Following the decline of the caries the management of painful dental problems like dentine hypersensitivity stepped forward. Dentinal hypersensitivity (DH) is characterized by short sharp pain arising from exposed dentin in response to stimuli that may be thermal, evaporative, tactile, osmotic or chemical, and which cannot be ascribed to any other form of dental defect or pathology. Prevalence data shows that up to 57% of the general population suffers from this condition. The non carious reasons for dentine hypersensitivity is mainly loss of tooth structure due to attrition erosion, abrasion, abfraction, etc. even though several theories have been put forward over many years to explain the sensitivity of the dentine, circumstantial and direct evidence disproved the theories of dentine innervations and odontoblastic transducer mechanism. This left the hydrodynamic theory for which significant evidence has occurred during 1950s and 1960s as most widely accepted theory to date. Dentinal hypersensitivity satisfies all the criteria to be classified as a true pain syndrome. It mostly affects individuals at the end of their third decade of life, causing great discomfort. In severe cases, it may lead to emotional alterations and behaviour changes. It is mostly found in permanent canines and premolars in both dental arches. The cervical region of the vestibular face of teeth is the most affected region. ChronicDentinal hypersensitivity subjects feel an intense pain/burning when teeth come in contact with hot, cold, chilled, acidic or sweet liquid and food. Choice of the correct treatment is based on the premise of proven clinical efficacy both in terms of effectiveness and duration of desensitizing effect. Currently there is no proven therapy that can always reduce the pain at satisfactory levels, even with the combination of different protocols. The treatment of chronic dentinal hypersensitivity is based on the concept of reducing fluid movement inside the dentin tubules by narrowing or occluding of tubule openings. The occlusion of dentin tubules leads to the reduction of dentin permeability to decrease the feeling of pain from Chronic Dentinal hypersensitivity.

According to the hydrodynamic theory, the effectiveness of dentin desensitizing agents is directly related to their capacity of promoting the sealing of the dentin canaliculi. Conventional therapies for the treatment of Dentinal hypersensitivity comprehend the topical use of desensitizing agents, either professionally or at home such as nerve desensitizers (potassium nitrate), protein precipitators (glutraldehyde, silver nitrate, zinc chloride, strontium chloride, dentinal tubule pluggers (sodium fluoride, stannous fluoride, strontium chloride, potassium oxalate, calcium phosphate, calcium carbonate, bioactive glasses), dentin adhesive sealers (fluoride varnishes, oxalic acid and resin, glass ionomer cements, composites, dentin bonding agents) and recently lasers that include neodymium:yttriumaluminium garnet laser, gallium-aluminium –arsenide laser, erbium-YAG laser. Considerable evidence has been accumulated to support the hydrodynamic theory. This theory proposes that stimulus on the exposed dentin surface causes a displacement of the fluid inside the tubules that activates the nerve terminals in the dentin and pulp, causing pain. Taking into consideration that the application of desensitizing agents is a non-invasive treatment

and also its potential in reducing the fluid movement through the narrowing or occlusion of tubule openings, its use is strongly recommended as observed.

Several studies describe a synergistic action of lasers in association with desensitizing agents. In fact, the laser system can favor the permanence of the desensitizer for longer time than when they are used alone. For this reason, if laser device is used in addition to a conventional desensitizing agent, the latter remains above the tooth surface for 60 seconds before the irradiation. The present study aimed at the evaluation of comparison of the clinical efficacy of laser, cyanoacrylate with the combination of laser and cyanoacrylate in the treatment of dentinal hypersensitivity. Focusing on the effectiveness of the sole diode laser, Matsumoto *et al*. (1990) performed a clinical study on hypersensitive dentine by 60 mWgallium- aluminium –arsenide laser (GaAlA) Laser and found an 85% improvement in teeth treated with laser while another study on the treatment of dentinal hypersensitivity with diode laser by Aun *et al*. (1989) reported success in laser-irradiated teeth in 98% of their cases. Yamaguchi *et al*. (1990) performed a clinical study on the treatment of hypersensitive dentin bygallium- aluminium–arsenide laser(GaAlAs) using the double blind testand noticed an effective improvement index of 60% in the group treated with laser compared to the 22.2% of the control nonlased group. Although speculative, the mechanisms proposed for the effects of low intensity laser require serious considerations and new experiments. It can be stated that the diode laser is an effective method for the treatment of dentin hypersensitivity, considering the treatment to be predictable, reliable and simple.

Cyanoacrylate's immediate desensitizing effect on hypersensitive dentin, has been shown to be biocompatible and used to treat hypersensitive teeth. It blocks the dentinal tubules, prevents displacement of fluids within the tubules, and results in little or no response to stimuli. A commercial presentation of cyanoacrylate in the form of glue has proven to be biocompatible. It has the advantage of being easily available, applicability, effectiveness and safety (Kimura *et al*., 2000). In the study by Javid *et al*. (1987) 33% sodium fluoride (NaF) paste was compared to cyanoacrylate in patients with Dentinal hypersensitivity. They concluded that cyanoacrylate had an immediate desensitizing effect on hypersensitive dentin and was statistically more effective than NaF in reducing sensitivity to cold-air stimulation. This is justified by the different modes of action of the two products. Cyanoacrylate obliterates the entry of dentinal tubules, whereas the NaF causes a granular precipitation in peritubular dentin. In the another study on effectiveness and safety of Tisuacryl in treating Dentin Hypersensitivity by Perez M de L *et al* (2010)[22]it was observed that the treatment was considered successful in 96.7% of patients (81.5% with severe Dentinal hypersensitivity and 100% with mild-to-moderate Dentinal hypersensitivity) and it was concluded that tissue adhesive based on N-butyl-2-cyanoacrylate was shown to be an effective, safe treatment of Dentinal hypersensitivity, especially for moderate and mild cases. The use of laser and cyanoacrylate may be advantageous in the treatment or the modulation of hypersensitive response. Therefore, present study was conducted to compare the clinical efficacy of laser, cyanoacrylate with the combination of laser and cyanoacrylate in the treatment of dentin hypersensitivity.

The patients were divided into 3 groups:

Group I: Patients treated with cyanoacrylate and laser
Group II: Patients treated with laser
Group III: Patients treated with cyanoacrylate

The teeth were evaluated at baseline, immediately after 1 day and 1 month.

The VAS reduction percentage was valued for each group between the baseline, 1 day and 1 month.

Clinical observations

Acc. To VAS Scale and As per the applied stimuli the reduction in dentinal hypersensitivity in percentage for group I (laser plus cyanoacrylate – G1) was:

- Air stimulus, the reduction percentage :G1- 52.62%
- Cold water blast stimulus : G-1 50.68%

Till date no studies have been performed on the evaluation of laser in combination with cyanoacrylate for the treatment of dentin hypersensitivity. The present shows that there is statistically significant reduction in VAS scores from baseline to 1 month for both air blast and cold water blast test. Thus, laser in combination with cyanoacrylate may be considered advantageous in reducing the dentin hypersensitivity

As per the applied stimuli the reduction in dentinal hypersensitivity in percentage for group II (G2)(laser) was:

- Air stimulus, the reduction percentage was G2; 53.94%
- Cold water blast stimulus, G2; 55.10%

In the present study, laser also showed statistically significant reduction in the Dentinal Hypersensitivity when used alone. This was in accordance with the study of Gerschman *et al*. (1994) investigated the effect of Low level laser therapy for dentinal tooth hypersensitivity using low level laser gallium-aluminium –arsenide laser [GaAlAs] against placebo and found significant reduction in the laser-treated group. In fact, sensitivity to thermal stimuli was reduced by 67%, whereas the placebo group had a reduction of 17%, sensitivity to tactile stimuli was reduced by 65%, while the placebo group showed a reduction of 21%. They concluded that low level laser gallium-aluminium–arsenide laser [GaAlAs] is an effective method for the treatment of both thermal and tactile hypersensitivity. A study carried out by Brugnera *et al*. (1989) on treatment of dentinal hypersensitivity with diode lasershowed the immediate analgesic effect using a diode laser. In contrary, a study by Lier *et al*. (2002) on the treatment of dentin hypersensitivity by Nd:YAG lasershowed that patients treated with laser did not show any difference than those treated with placebo. On the other hand, a study by Corona *et al*. (2003) on the clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity showed that both lasers and sodium fluoride

varnish are equally effective in providing relief to patients suffering from cervical dentinal hypersensitivity.

As per the applied stimuli the reduction in dentinal hypersensitivity in percentage for group III (cyanoacrylate – G3) was:

- Air stimulus, the reduction percentage was G3; 51.27%
- Cold water blast stimulus, G3; 49.46%

In the present study, cyanoacrylate also showed statistically significant reduction in the DH when used alone. This was in accordance with the study by Olga D. Flecha *et al*. (2013) on Cyanoacrylate Versus Laser in the Treatment of Dentin Hypersensitivity in which laser was compared with cyanoacrylate and concluded that cyanoacrylate is as effective as low-intensity laser in reducing Dentinal hypersensitivity. In addition, it is a more accessible and low-cost procedure and can be safely used in the treatment of Dentinal hypersensitivity. Intragroup comparison shows that there is statistically significant reduction in Dentinal hypersensitivity from baseline to 1 day and 1 month with respect to cold test and air blast test in all the 3 groups. Intergroup comparison shows that there is statistically non significant difference in reduction of VAS scores in 3 groups. Thus, laser plus cyanoacrylate, laser alone and cyanoacrylate alone are equally effective in reducing dentinal hypersensitivity. Further studies are needed to evaluate the long-term stability of improvement in the cervical dentin hypersensitivity.

Conclusion

According to the results, all the groups registered significant improvements of discomfort from dentinal hypersensitivity. Cyanoacrylate glue is as effective as low-intensity laser in the reduction of dentinal hypersensitivity. In the short, medium, and long term, in addition to being a low cost and more accessible procedure. It may be safely used in the treatment of dh. If they both used together their results are high. These results have to be confirmed by greater samples of patients and by longer follow-up periods (e.g., 3 and 6 months) to confirm the long-lasting action of laser and cyanoacrylate together.

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