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Comparative Evaluation of Three Desensitizing Agents in the Reduction of Dentinal Hypersensitivity: An in Vivo Study

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KEYWORDS
Dentinal hypersensitivity, desensitizing agents, teeth, dental treatments.

ABSTRACT:

Aim: The aim of this in vivo study was to compare the efficacy of three desensitizing agents in reducing dentinal hypersensitivity. The investigation focused on assessing the immediate and lasting effects of the three agents on relieving discomfort associated with dentinal hypersensitivity.

Methods: A randomized controlled trial was conducted on a cohort of patients presenting with dentinal hypersensitivity. In this study, a total of 25 patients with at least three teeth exhibiting dentin hypersensitivity (78 teeth in total) were assessed. Three groups were randomly assigned to receive different treatments for the teeth: Group 1 received D/Sense Crystal treatment, Group 2 received Fluorprotector vivampuole therapy, and Group 3 received Single Bond Universal dentin bonding agent. Using a visual analogue scale (VAS), dentin hypersensitivity levels were measured based on the patients' reactions to touch, air blast, and cold water stimuli. Before and after treatment, at particular intervals (one, seven, fourteen, sixty, and ninety days), pain levels were noted.

Results: Initially, the baseline sensitivity measurements were similar across the three groups (Group-1: 9.2 ± 0.35, Group-2: 8.8 ± 0.46, Group-3: 8.9 ± 0.39) with a non-significant p-value of 0.15. However, significant differences in sensitivity reduction were observed immediately after treatment, with Group-3 exhibiting the most substantial decrease (5.3 ± 0.43) and Group-2 showing a moderate reduction (6.5 ± 0.45) with a p-value of 0.03. Over the 1-week, 1-month, and 3-month follow-ups, although differences persisted, they were not statistically significant (p-values of 0.09, 0.12, and 0.45, respectively). This study underscores the variable impacts of the dental agents on sensitivity reduction, emphasizing the need to consider both short-term and long-term effects when assessing dental treatments.

Conclusion: To summarize, this clinical trial successfully showcased a considerable reduction in dentin hypersensitivity (DH) across all three groups, with no reported side effects. After a single direct topical treatment, the Single Bond Universal dentin bonding agent administration resulted in an initial decrease in DH. Notably, at the 3-month follow-up, comparable DH scores were observed among all three groups.

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Introduction:

Dentinal hypersensitivity is defined as pain from exposed dentin that is frequently induced by chemical, thermal, tactile, or osmotic stimuli and it cannot be defined under any other dental defect or pathology [(1)]. The Canadian Advisory Board on Dentin hypersensitivity has replaced the term "pathology" with the more fitting term "disease". Currently, periodontal disease and associated treatment-related sensitivity are referred to as "Root Sensitivity" (RS) [(2)]. Dentin hypersensitivity has been characterized by a number of terminology. This terminology, which include the phrases sensitivity and hypersensitivity, are depending on the location of the hypersensitivity and include cervical, root, dentine, and cemental [(3,4)].Despite their differences, both phrases can be used interchangeably to refer to the same clinical idea.

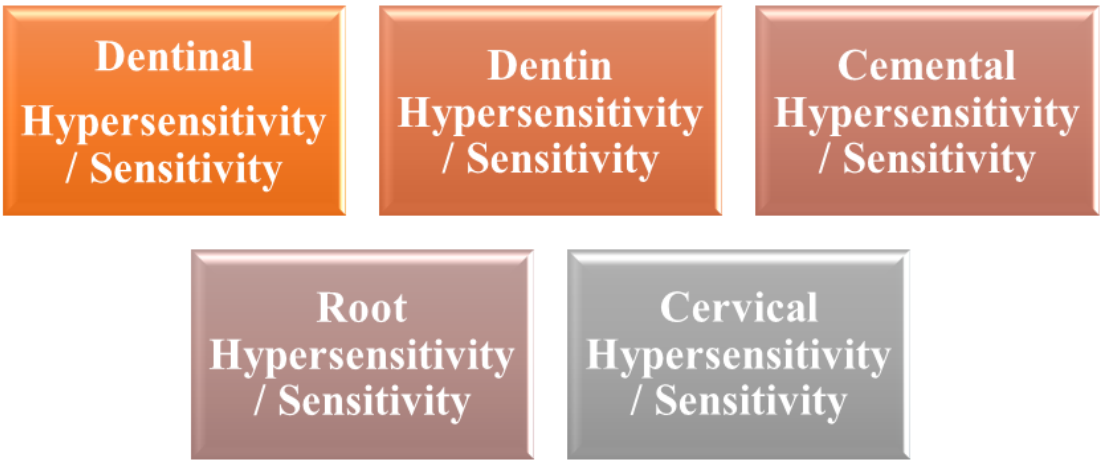

Figure 1: Common terms which are used refer to dentin hypersensitivity.

Dentin hypersensitivity typically affects adults, primarily in their 30s, although it can also affect individuals ranging from 29 to 49 years of age and has female predominance. It is significantly more common among people with periodontal diseases, accounting for as much as 47% of the general population [(5)].

Dentin hypersensitivity commonly affects the buccogingival areas of the anterior sextants, including the canines and premolars, which are susceptible to gingival recession [(6,7)]. Among the various theories proposed for dentinal hypersensitivity, Brännström's hydrodynamic theory of tooth sensitivity is the most widely accepted explanation. According to this idea, external stimuli applied to exposed dentinal tubules cause dentinal tubular fluid to flow, which in turn stimulates intradental nerves and causes pain. According to earlier research, the dentin tubules in teeth that are sensitive are around eight times more in number and twice as broad as those in teeth that are in control group [(8)]. Dentin hypersensitivity is thought to develop in two stages, according to the literature: lesion localization and lesion initiation [(9)].Lesion localization is the process by which dentin is exposed to the outside world as a result of the protecting enamel being worn away by wear and tear, erosion, abfraction, or attrition. Moreover, lesion localization may also be influenced by gingival recession brought on by periodontal disorders, pocket reduction surgery, crown preparation, excessive flossing, or toothbrush abrasion [(10)].

Despite being a prevalent issue among dental professionals, universally recognized guidelines for distinguishing diagnoses and selecting effective treatment approaches for dentin hypersensitivity are currently unavailable. Following Grossman's criteria, desensitizing agents should meet the following standards:

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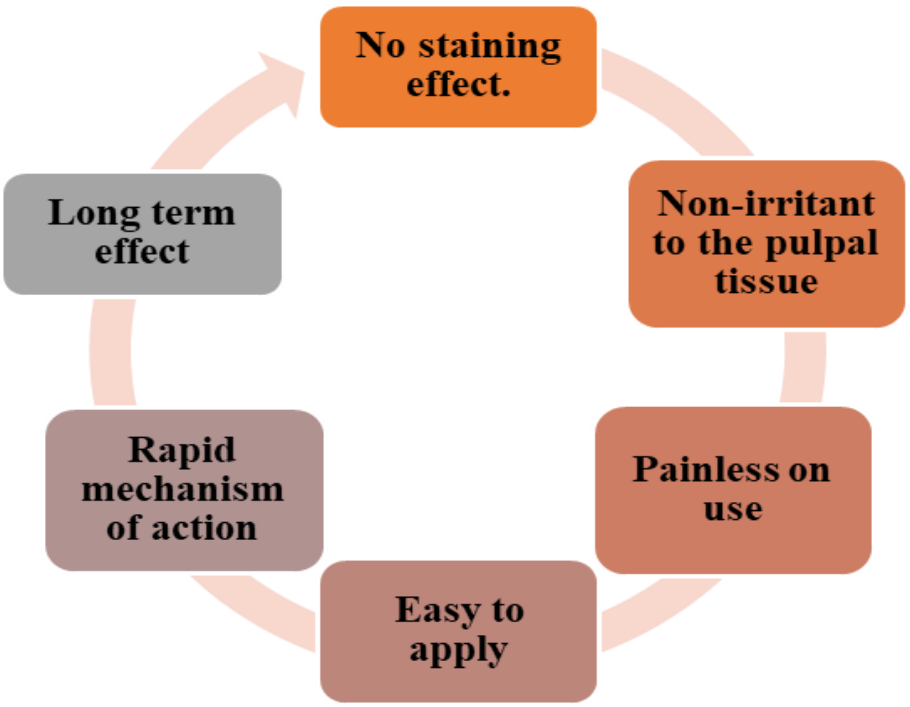

Figure 2: Characteristics of ideal desensitizing agents.

Nowadays, dentin desensitizers and adhesives are used to either seal the open dentinal tubules or depolarize the intradental nerves on exposed dentin surfaces [(11)]. A range of techniques and materials, including both natural and commercially available treatments, are used to treat dentin hypersensitivity. Despite extensive research on this matter, a definitive "gold standard" treatment for dentin hypersensitivity has yet to be established. Most common therapies only provide short-term respite. Among these materials and techniques are fluorine, hydroxyapatite, zinc chloride, strontium chloride, potassium oxalate, dental adhesives, and glass-ionomer cements. Dental adhesives and bonding agents effectively seal dentinal tubules, providing a durable resolution for dentin hypersensitivity. In order to prevent the hydrodynamic process that causes dentin hypersensitivity, these medicines work by coagulating the proteins in the dentinal fluid and creating pegs inside the tubules.

The current study set out to assess and contrast the in vivo performance of the dentin bonding agents Single Bond Universal, Fluorprotector vivampuole, and D/Sense Crystal. The goal of the study was to determine whether, to some degree, all dental materials under evaluation would show a considerable reduction in dentin hypersensitivity.

Materials and methods:

The Department of Conservative Dentistry and Endodontics at Dr. R.R. Kambe Dental College conducted the study using a double-blind, randomised, controlled clinical trial methodology. The project was approved by the research ethics committee's institutional review board. Every single participant in the study gave their informed consent for this kind of investigation. In this study, a total of 25 patients with at least three teeth exhibiting dentin hypersensitivity (78 teeth in total) were assessed. The teeth were randomly assigned to three groups: Group 1 received treatment with D/Sense Crystal, Group 2 with Fluorprotector vivampuole, and Group 3 with Single Bond Universal dentin bonding agent. Dentin hypersensitivity levels were gauged based on the patients' responses to tactile, air blast, and cold water stimuli using a visual analog scale (VAS). Pain levels were recorded both before treatment and at specific intervals after treatment, including at 1, 7, 14, 60, and 90 days.

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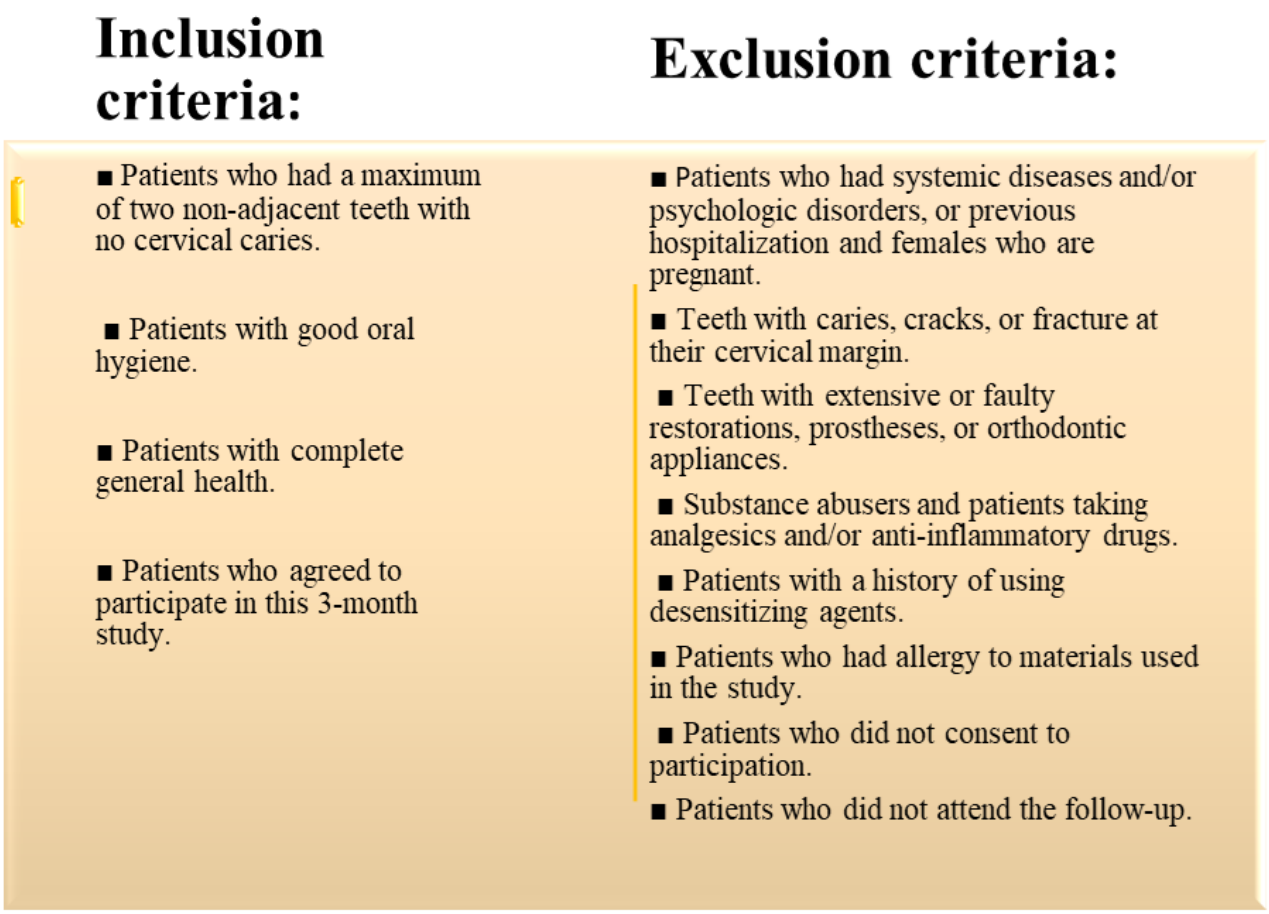

Figure 3: Inclusion and exclusion criteria.

After receiving their informed written agreement, patients from the outpatient Conservative Dentistry and Endodontics department were chosen to be part of the study. Light tactile pressure was applied along the teeth's cervical margin as part of the inspection. A total of 78 teeth were randomly divided into three groups: Group 1 (25 teeth) received treatment with D-Sense desensitizer, Group 2 (26 teeth) received treatment with Fluorprotector vivampuole, and 26 teeth were assigned for Universal Single Bond. The experiment employed three different test stimuli, conducted after isolating the teeth with cotton rolls. The following tests were administered in sequential order: A) Tactile test: A sharp dental explorer was used to precisely apply mechanical stimulation along the cervical region. The tooth's long axis was perpendicular to the damaged area, and the explorer was softly moved across it. Before utilizing a discomfort scale to score the results, the test was administered three times, and the results were recorded. B) Air blast test: A dental syringe isolated with cotton rolls was used to deliver a blast of air onto the tooth's afflicted area for one second at a standard distance of 10 mm, which was determined by taping the scale to the syringe. The score was recorded using the discomfort scale. C) Cold water test: In just one to two minutes, freshly melted cold water was ready, and it was then put into a disposable, precooled 1 ml syringe. 0.2 cc of this icy-cold water was progressively put from the syringe onto the suspected tooth surface after isolating the particular tooth. The three test stimuli were given in increasing order of degree of discomfort: the least upsetting was the tactile test; next was the air blast test; and last was the cold water test, which was the most upsetting. The following scale was used to capture the patient responses:

0: No discernible discomfort or awareness of the stimuli;

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1: Some discomfort but not severe pain;

2: Severe pain while the stimulus is being applied; and

3: Severe pain both during and after the stimulus is being applied.

Hypersensitivity was deemed to be indicated by values of 2 and 3. The teeth were chosen using this sensitivity measure if they received a score of two or higher for a minimum of two test stimuli. In order to maintain records, discomfort scores were entered into a tabular format. Hypersensitive symptoms were considered to have improved when the score went from 2 or 3 to 1 or 0, whereas symptoms were said to have disappeared when the value went from 2 or 3 to 0.

Figure 4: Single Bond Universal dentin bonding agent.

Figure 5: Fluorprotector vivampuole**.**

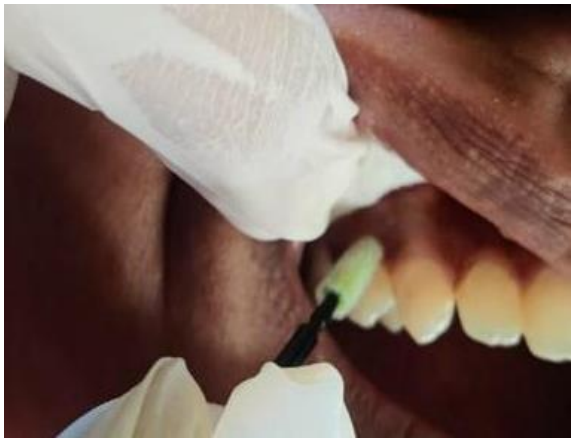

Figure 6: Application of desensitizing agent with applicator tip.

Statistical Analysis - Data was entered in Microsoft Excel and was analysed by using SPSS Software and categorical data were calculated by Chi square test also to compare two sample data we used t test and p value <0.05 consider as significant.

Results:

Among the 25 individuals included in the study, it is noteworthy that the male participants, totaling 17 individuals or 68.00%, significantly outnumbered their female counterparts, who accounted for 8 individuals or 32.00%. This observation indicates a gender imbalance within this particular dataset, with a clear majority of male participants.

Meanwhile, the "Age (years)" variable serves to categorize the study participants into various age groups, namely "20-29," "30-39," and "40-49." Among these age brackets, the most prominently represented group was the "30-39" category, which encompassed 12 individuals, comprising 48.00% of the total cases. In contrast, the "20-29" age group consisted of 7 participants, constituting 28.00% of the entire dataset, while the "40-49" age group included 6 individuals, accounting for 24.00% of the total cases. (Table 1) At the beginning, before any treatments were given, the baseline sensitivity measurements were quite similar across the three groups. Group-1 had a sensitivity level of 9.2 ± 0.35, Group-2 measured 8.8 ± 0.46, and Group-3 exhibited 8.9 ± 0.39 in sensitivity. The calculated p-value at this stage, which assesses statistical differences between the groups, was 0.15. This result suggests that there was no statistically significant distinction in

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sensitivity levels among the groups before any treatment was administered. However, a significant difference in sensitivity reduction became apparent immediately after the treatments were given. Group-3 experienced the most substantial decrease in sensitivity, measuring at 5.3 ± 0.43, while Group-2 showed a more moderate reduction at 6.5 ± 0.45. The computed p-value at this point was 0.03, indicating a statistically significant variation in sensitivity reduction between the groups right after the treatment As the observation period extended to the 1-week, 1-month, and 3-month follow-up intervals, fluctuations in sensitivity levels were observed, with no single group consistently outperforming the others. While differences in sensitivity reduction persisted among the groups during these intervals, the corresponding p-values (0.09, 0.12, and 0.45, respectively) indicated that these distinctions did not reach statistical significance. (Table 2) To summarize, this investigation suggests that the three dental agents under examination exerted varying influences on sensitivity reduction immediately following treatment. However, as time progressed, their effectiveness seemed to converge, emphasizing the importance of considering both short-term and long-term impacts when evaluating dental materials or treatment modalities.

Discussion:

Cervical dentinal hypersensitivity is a widespread clinical issue observed globally, exhibiting a gradual rise in both occurrence and intensity across various age groups. This trend might be attributed to the growing proportion of the population retaining their natural teeth owing to the simultaneous increase in life expectancy. The subjective nature of dentinal hypersensitivity makes it challenging to manage. Numerous research studies have been carried out to assess dentinal hypersensitivity, often utilizing the Visual Analogue Scale (VAS) [(12)]. In a study by Mariana Oliveira Cotta Rocha et al, the evaluation of different pain scales revealed that the Schiff scale was determined to be the most precise method for assessing dentinal hypersensitivity in response to cold stimuli.[13] There are numerous desensitizing drugs available, and they all work in different ways, such as by obstructing dentinal tubules, precipitating proteins, or desensitizing nerves. The current range of therapy options includes topical desensitizing treatments, which can be used by dental professionals or by individuals themselves[(14)]. These therapies make use of substances that seal, block, and, more recently, combine the use of lasers with the tubules in the dentition[(15)]. In this randomized, double-blind, controlled clinical experiment, we examined the clinical efficacy of D/Sense Crystal, Fluorprotector vivampuole, and Single Bond Universal dentin bonding agent. In the present study, the group with the highest representation was the "30-39" category, including 12 individuals, accounting for 48.00% of the total cases. Although DH can affect patients at any age, according to a study by Flynn J et al., the majority of affected patients are in the 20–50 age range, with a peak between 30 and 40 years of age [(16)]. A slightly higher incidence of DH is reported in females than in males. Recently, Fluorprotector vivampuole [(17)], containing 0.1% fluoride, has been introduced to the market, featuring a user-friendly snap-off design. Each ampule contains 0.4 ml and is composed of 1 gm Fluor Protector which contains Bis{4-[2-(difluorhydroxysilyl)ethyl]-2- methoxycyclohexyl} [N,N-(trimethylhexane-1,6-diyl) dicarbamate] (9 mg) (fluorsilane). This corresponds to 1 mg fluoride. Auxiliary substances like ethylacetate, isopentyl propionate, and polyuria form the varnish. Varnish has 0.1% fluoride in a homogeneous solution which when dried has its concentration approximately 10× higher than the initial concentration. It has optimal flow and wetting properties allowing it to treat hard to reach areas. It is clear and colorless improving the esthetics and has excellent adhesion property. Topical application of fluoride varnish causes precipitation of CaF2 onto exposed dentin surface which occlude the dentin tubules reducing the dentin permeability and further reducing DH [(18)]. Arends et al [(19)] compared the efficacy of a fluoride varnish and Fluorprotector and confirmed that Fluorprotector has better penetration ability of up to 10 µm depth compared with fluoride varnish which has less than 5 µm penetration depth. According to some research, self-etch dental bonding chemicals can lessen dentin permeability and relieve dentin hypersensitivity by forming an acid-resistant hybrid layer [(20,21)]. It is well recognized that this acid–base resistance zone extends therapeutic efficacy. Adhesive resins from a single bottle are used for seventh generation adhesives (also called one-step self-etch systems or all-in-one adhesives) to apply an acidic primer in a single step. Because of its special ability to demineralize to a depth, sticky glue may lessen postoperative discomfort. This notion was

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validated by Askari and Yazdani's 2019 experiment, which compared the Single Bond Universal dentin bonding agent with desensitizing agents derived from propolis extract. The study found that although the dentin bonding agent was helpful in delivering long-term relief from dentin hypersensitivity, Single Bond Universal offered quick relief [(22)]. D/Sense Crystal (Centrix, Inc. Shelton, CT) is a simple, readily available dentin desensitizer that works in one step. This desensitizing agent is made of potassium binoxalate and nitric acid, which when mixed with the dentin smear layer yields tiny crystals of calcium oxalate and potassium nitrate.[23] These byproducts efficiently seal off the dentinal tubules by forming an acid-resistant barrier three microns thick.[23] D/Sense Crystal works best on a dentinal surface that is clean and dry, while it can also be applied to dentin that is damp. Initially, the baseline sensitivity measurements were comparable among the three groups, with Group-1 at 9.2 ± 0.35, Group-2 at 8.8 ± 0.46, and Group-3 at 8.9 ± 0.39. The calculated p-value was 0.15, indicating no significant difference in sensitivity levels before treatment.

Post-treatment, a notable discrepancy in sensitivity reduction was observed. Group-3 demonstrated the most significant decline in sensitivity, measuring 5.3 ± 0.43, while Group-2 exhibited a more moderate reduction at 6.5 ± 0.45. The calculated p-value was 0.03, signifying a statistically significant difference in sensitivity reduction among the groups after treatment. Dentin sensitivity is decreased by Gluma desensitizer, Clearfil S3 Bond, and a single-bottle bonding agent, according to a 2017 study by Hajizadeh et al [(24)]. Their sample consisted of ninety teeth from thirteen patients who received periodontal therapy. Assessments were conducted at baseline, one day, seven days, and four weeks following application using VAS and air stimuli. Every group experienced an initial considerable decrease in cervical dentin sensitivity, which is consistent with our findings. Dentin sensitivity is decreased by Gluma desensitizer, Clearfil S3 Bond, and a single-bottle bonding agent, according to a 2017 study by Hajizadeh et al. These results are in line with what we investigated [(24)]. Throughout the 1-week, 1-month, and 3-month follow-up periods, fluctuations in sensitivity levels were apparent, with no single group consistently demonstrating superior performance. While variations in sensitivity reduction persisted among the groups during these intervals, the corresponding p-values (0.09, 0.12, and 0.45, respectively) indicated that these differences did not reach statistical significance. In summary, this investigation suggests that the three dental agents analyzed exerted differing effects on sensitivity reduction immediately after treatment. However, over time, their effectiveness appeared to converge, highlighting the significance of considering both short-term and long-term impacts when assessing dental materials or treatment approaches.

Conclusion:

In conclusion, this clinical investigation showed a noteworthy decrease in dentin hypersensitivity (DH) in all three groups without any documented adverse effects. After a single direct topical application. Single bond which is universal dentin bonding agent initially shown a reduction in DH. Nonetheless, after the three-month follow-up, all three groups showed comparable results.

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Table-1: Distribution of patients based on age and sex

25. Variable name		
Sex	**No. of cases**	**Percentage**
Male	17	68.00%
Female	8	32.00%
Total	25	100.00%
Age (years)		
20-29	7	28.00%
30-39	12	48.00%

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40-49	6	24.00%

Table-2: Comparison of cervical hypersensitivity scores between Group 1, Group 2 and group 3..

Cold stimulus Test	D/Sense Crystal (Group-1)	Fluorprotector vivampuole (Group-2)	Single Bond Universal dentin bonding agent (Group-3)	P value
Before	9.2 ± 0.35	8.8 ± 0.46	8.9 ± 0.39	0.15
Immediate	6.2 ± 0.34	6.5 ± 0.45	5.3 ± 0.43	0.03
After 1week	7.2 ± 0.47	6.7 ± 0.7	7.1 ± 0.47	0.09
After 1 month	7.3 ± 0.42	6.9 ± 0.41	7.5 ± 0.48	0.12
After 3 months	7.5 ± 0.49	7.5 ± 0.51	7.6 ± 0.54	0.45