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Original Article

Comparison of the Clinical Effectiveness of Self-Etch Adhesive and Fluoride Varnish in Reducing Dentin Hypersensitivity in Patients with Gingival Recession: A Randomized Clinical Trial

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Abstract

Background: Dentin hypersensitivity (DH) is a frequent and distressing clinical condition, particularly among patients with gingival recession, where exposed dentin reacts painfully to thermal, tactile, and evaporative stimuli. Despite the availability of numerous desensitizing agents, no single treatment has been universally accepted as the gold standard, and evidence comparing commonly used modalities remains limited.

Objective: To compare the clinical effectiveness of a self-etch dentin adhesive and sodium fluoride varnish in reducing dentin hypersensitivity in patients with gingival recession.

Methodology: This double-blinded randomized clinical trial was conducted at the Department of Operative Dentistry and Endodontics, Peshawar Dental College. A total of 150 patients with dentin hypersensitivity associated with gingival recession were enrolled and randomly allocated into two treatment groups. After accounting for losses to follow-up, 142 patients completed the study and were included in the final analysis. Group 1 received sodium fluoride varnish, while Group 2 was treated with a self-etch dentin adhesive. Pain intensity was assessed using a Visual Analog Scale (VAS) following tactile and evaporative stimuli at baseline, immediately after treatment, at one week, and at one month.

Results: The mean age of participants was 32.5 ± 7.21 years, with 38% males and 62% females. Baseline characteristics were comparable between groups ($p > 0.05$). Repeated-measures ANOVA demonstrated a significant reduction in pain over time in both groups ($p < 0.001$), with a significant time × treatment interaction ($p < 0.001$). Fluoride varnish showed significantly greater immediate pain reduction ($p = 0.004$), whereas the self-etch adhesive demonstrated superior pain reduction at one month ($p = 0.001$). No significant difference was observed at the one-week follow-up.

Conclusion: Both sodium fluoride varnish and self-etch dentin adhesive were effective in reducing dentin hypersensitivity. Fluoride varnish provided superior immediate relief, while the self-etch adhesive offered more sustained pain reduction at one month, suggesting its potential advantage for long-term management of dentin hypersensitivity.

Keywords: Dentin Hypersensitivity, Self-Etch Dentin Adhesive, Sodium Fluoride Varnish.

Introduction

Dentin hypersensitivity (DH) is a prevalent clinical condition and one of the most commonly reported complaints in dental practice, characterized by a short, sharp pain arising from exposed dentin in response to thermal, evaporative, tactile, osmotic, or chemical stimuli that cannot be attributed to any other dental pathology [1–3]. The condition not only causes considerable discomfort but also adversely affects oral hygiene practices and overall quality of life, presenting diagnostic and therapeutic challenges for clinicians. The reported prevalence of DH varies widely, ranging from 4% to 57%, depending on population characteristics and diagnostic criteria [4]. Adults in their third and fourth decades of life are most frequently affected, particularly those aged between 29 and 49 years [5]. Gingival recession is one of the most significant predisposing factors for DH, as it leads to exposure of cervical and root dentin, increasing susceptibility to external stimuli.

The most widely accepted explanation for the mechanism of DH is the hydrodynamic theory proposed by Brännström and Åström. According to this theory, external stimuli induce rapid movement of fluid within the dentinal tubules, which in turn activates mechanoreceptors at the pulp–dentin interface, resulting in pain [6,7]. The density and patency of dentinal tubules play a critical role in determining the severity of hypersensitivity. Under normal conditions, dentin is protected by enamel coronally and cementum radicularly. However, physical, chemical, biological, or pathological factors such as periodontal disease, aggressive tooth brushing, erosion, or gingival recession can compromise these protective layers, leading to dentin exposure [8]. Consequently, various treatment modalities have been developed to manage DH, aiming either to occlude dentinal tubules or to reduce neural transmission.

Fluoride-based agents have been used as desensitizing treatments since the early 1940s. Sodium fluoride varnishes act by forming calcium fluoride and fluorapatite precipitates that occlude dentinal tubules and reduce dentin permeability [9,10]. Due to their ease of application and immediate effect, fluoride varnishes remain a widely used option in clinical practice.

More recently, self-etch dentin adhesives have gained attention for their ability to form a durable hybrid layer, effectively sealing dentinal tubules and reducing dentin permeability [10]. Studies have shown that single-bottle self-etch adhesives can provide effective relief from DH, particularly in terms of longer-term outcomes [11]. However, comparative evidence evaluating the short- and long-term effectiveness of these two commonly used treatment modalities remains limited.

Therefore, the present study was conducted to directly compare the clinical effectiveness of sodium fluoride varnish and a self-etch dentin adhesive in reducing dentin hypersensitivity among patients with gingival recession. By generating robust comparative data, this study aims to inform evidence-based clinical decision-making and improve patient-centered management of dentin hypersensitivity.

Methodology

Study Design

This study was designed as a single-center, prospective, double-blinded randomized clinical trial, conducted to compare the clinical effectiveness of a self-etch dentin adhesive and sodium fluoride varnish in reducing dentin hypersensitivity among patients with gingival recession. The trial was registered with ClinicalTrials.gov (Identifier: NCT05895526) and followed CONSORT guidelines for randomized controlled trials. The study duration extended from December 2023 to May 2024, encompassing recruitment, intervention, and follow-up phases.

Ethics

Ethical approval for the study was obtained from the Institutional Review Board of Prime Foundation, Peshawar (Approval No. Prime/IRB/2023-372). All procedures were conducted in accordance with the Declaration of Helsinki. Participants were informed in detail about the study objectives, procedures, potential risks, and benefits. Written and verbal informed consent was obtained prior to enrollment, and confidentiality of participant data was strictly maintained throughout the study period.

Setting

The study was conducted at the Department of Operative Dentistry and Endodontics, Peshawar Dental College and Hospital, Riphah International University, Islamabad, Pakistan. All clinical assessments and interventions were performed in an outpatient clinical setting under standardized conditions by trained dental professionals.

Participants

Patients presenting to the outpatient department with complaints of dentin hypersensitivity were screened for eligibility. Inclusion criteria comprised adults aged 20–45 years with dentin hypersensitivity secondary to Miller's Class

l gingival recession, absence of other periodontal pathology, no root-filled teeth, and willingness to participate. Exclusion criteria included severe gingival recession, presence of cervical restorations or crowns, pregnancy or lactation, and teeth requiring complex restorative or periodontal interventions. Each participant contributed only one sensitive tooth to ensure statistical independence.

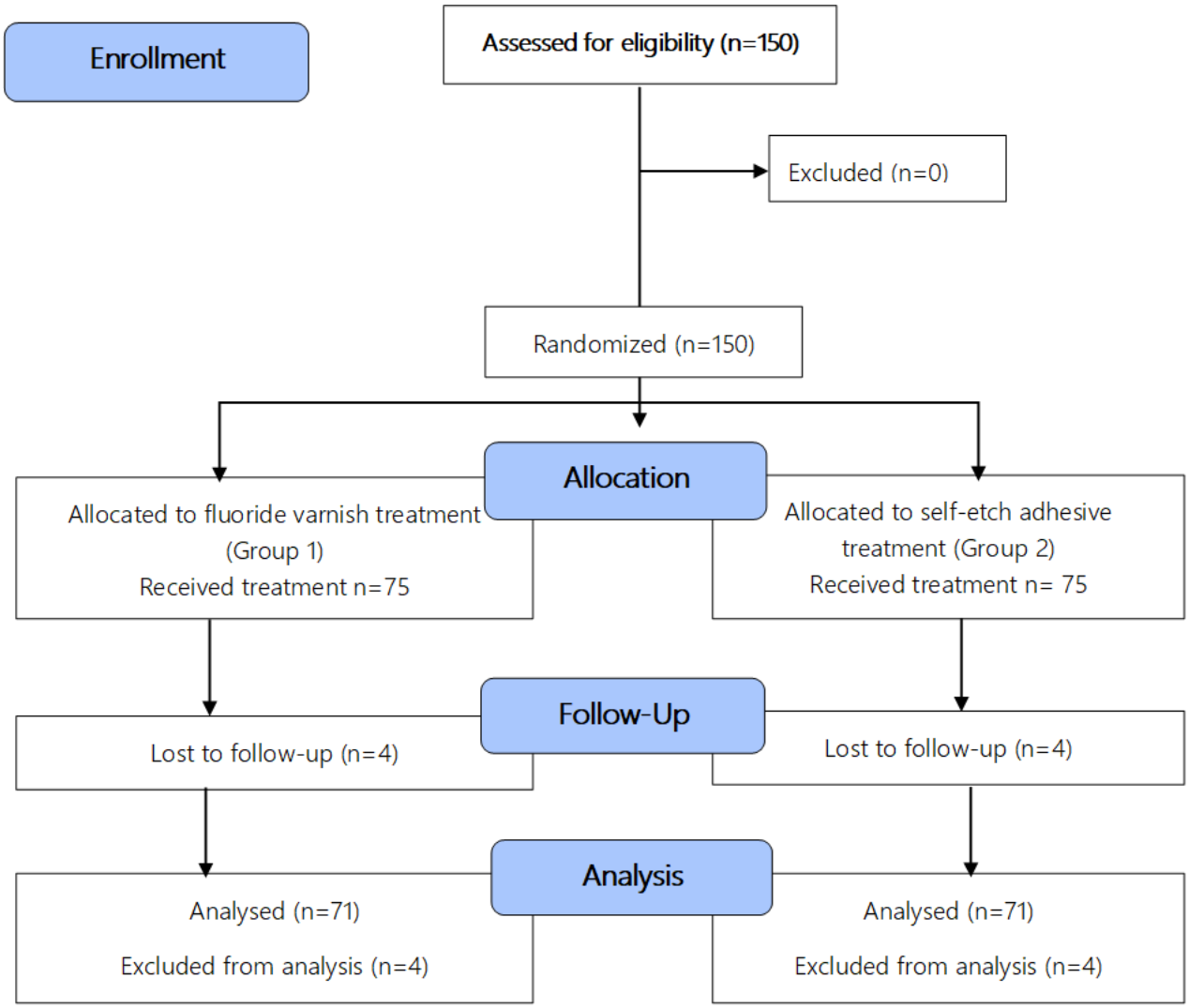


Figure 1: Study Flow.

Variables

The primary outcome variable was pain intensity, measured using a Visual Analog Scale (VAS). The main independent variable was the type of desensitizing treatment (sodium fluoride varnish versus self-etch dentin adhesive). Secondary variables included age, gender, baseline pain severity, and time points of assessment (baseline, immediately post-treatment, one week, and one month).

Data Sources/Measurement

Pain response was assessed using both tactile stimulation (gentle probing of the cervical area) and evaporative stimulation (air blast for 1–2 seconds using a dental unit syringe). Pain intensity was recorded using a 10-cm Visual Analog Scale, where 0 represented no pain and 10 indicated the worst possible pain. Measurements were taken at baseline (T0), immediately after treatment (T1), at one week (T2), and at one month (T3). All assessments were performed by a single trained outcome assessor blinded to treatment allocation to minimize inter-observer variability.[12]

Bias

Randomization was performed using a computer-generated random sequence with a 1:1 allocation ratio. Allocation concealment was ensured using sealed, opaque envelopes. Both participants and outcome assessors were

blinded to group assignment, reducing selection and assessment bias. Standardized application protocols were followed for both treatment modalities to limit performance bias.

Study Size

Sample size estimation was performed using OpenEpi software, based on mean pain scores reported in a previous study. With an assumed power of 80% and a 95% confidence level, a minimum sample size of 142 participants was required. To compensate for potential attrition, 150 participants were initially enrolled. After accounting for losses to follow-up, 142 participants completed the study and were included in the final analysis.

Quantitative Variables

VAS pain scores were treated as continuous quantitative variables and summarized using means and standard deviations. Pain severity categories (no pain, mild, moderate, severe) were additionally reported as frequencies and percentages for descriptive interpretation.

Statistical Methods

Data analysis was conducted using SPSS version 23.0. Descriptive statistics were used to summarize demographic and baseline characteristics. To evaluate changes in pain scores over time and differences between treatment groups, a repeated-measures analysis of variance (ANOVA) was applied, with time as the within-subject factor and treatment group as the between-subject factor. Bonferroni correction was used for post-hoc comparisons. Categorical data were analyzed using the chi-square test. Statistical significance was set at $p \leq 0.05$.

Results

Participants

A total of 150 patients with dentin hypersensitivity associated with gingival recession were enrolled and randomized equally into two treatment groups: sodium fluoride varnish and self-etch dentin adhesive (75 participants per group). During the follow-up period, four participants from each group were lost to follow-up, resulting in 142 patients (71 per group) completing the study and being included in the final analysis (Figure 01).

All participants contributed one treated tooth for outcome assessment, ensuring statistical independence of observations.

Descriptive Data

The mean age of participants was 32.5 ± 7.21 years, with a gender distribution of 38% males and 62% females. Baseline pain severity, measured using the Visual Analog Scale (VAS), was comparable between the two treatment groups, with no statistically significant differences observed ($p > 0.05$). Similarly, gender distribution and categorical pain severity levels at baseline did not differ significantly between groups, confirming appropriate randomization and baseline equivalence (Table 1).

Outcome Data

Pain intensity, assessed using VAS following tactile and evaporative stimuli, demonstrated a reduction over time in both treatment groups. Mean VAS scores declined progressively from baseline to immediate post-treatment, one-week, and one-month follow-up assessments. Immediately after treatment, the fluoride varnish group showed lower mean VAS scores compared with the self-etch adhesive group. At one week, pain levels were similar between the two groups. At the one-month follow-up, lower mean VAS scores were observed in the self-etch adhesive group compared with the fluoride varnish group. Detailed mean scores with standard deviations and 95% confidence intervals are presented in Table V, while categorical pain severity distributions at each follow-up point are shown in Tables 2-4.

Main Results

Repeated-measures ANOVA revealed a significant main effect of time on pain scores ($p < 0.001$), indicating a significant reduction in dentin hypersensitivity across follow-up periods in both treatment groups. A significant time × treatment interaction was also observed ($p < 0.001$), demonstrating that the pattern of pain reduction differed between the fluoride varnish and self-etch adhesive groups. Post-hoc analyses with Bonferroni correction showed that immediately after treatment, the fluoride varnish group experienced significantly lower pain scores than the self-etch adhesive group ($p = 0.004$). At one week, no statistically significant difference was found between the two treatments ($p = 0.623$). At one month, the self-etch adhesive group demonstrated significantly lower pain scores compared with the fluoride varnish group ($p = 0.001$) (Table 05). These findings indicate superior immediate pain relief with fluoride varnish and more sustained pain reduction with the self-etch adhesive over time.

Table 1: Baseline Pain Severity by Gender and Treatment Group.

Pain Level	Gender	Sodium Fluoride Varnish n (%)	Dentine Bonding Agent n (%)	Total n (%)	p-value
Mild Pain	Male	3 (37.5%)	5 (62.5%)	8 (100%)	> 0.05
	Female	7 (41%)	10 (59%)	17 (100%)	
	Total	10 (40%)	15 (60%)	25 (100%)	
Moderate Pain	Male	11 (42%)	15 (58%)	26 (100%)	
	Female	20 (50%)	20 (50%)	40 (100%)	
	Total	31 (47%)	35 (53%)	66 (100%)	
Severe Pain	Male	12 (54.5%)	10 (45.5%)	22 (100%)	
	Female	18 (62%)	11 (38%)	29 (100%)	
	Total	30 (59%)	21 (41%)	51 (100%)	
Overall	Male	26 (46.4%)	30 (53.6%)	56 (100%)	
	Female	45 (52%)	41 (48%)	86 (100%)	
	Total	71 (50%)	71 (50%)	142 (100%)	

Table 2: Pain Severity Immediately After Treatment.

Group	No pain n (%)	Mild pain n (%)	Total n (%)	p-value
Sodium fluoride varnish	45 (63%)	26 (37%)	71(100%)	0.004*
Self-etch dentin adhesive	28 (39.4%)	43 (60.6%)	71(100%)	
Overall Total	73 (51%)	69 (49%)	142 (100%)	

Chi-square test was applied *p<0.05 is considered statistically significant.

Table 3: Pain Severity at One-Week Follow-Up.

Group	No Pain n (%)	Mild Pain n (%)	Moderate Pain n (%)	Total n (%)	p-value
Sodium fluoride varnish	46 (65%)	19 (27%)	6 (8%)	71 (100%)	0.930
Self-etch dentin adhesive	44 (62%)	21 (30%)	6 (8%)	71 (100%)	
Total	90 (63.4%)	40 (28.1%)	12 (8.5%)	142 (100%)	

Chi-square test was applied *p<0.05 is considered statistically significant.

Table 4: Pain Severity at One-Month Follow-Up.

Group	No Pain n (%)	Mild Pain n (%)	Moderate Pain n (%)	Total n (%)	p-value
Sodium fluoride varnish	33 (46.5%)	33 (46.5%)	5 (7%)	71 (100%)	0.001*
Self-etch dentin adhesive	45 (63.4%)	5 (7%)	21 (29.6%)	71 (100%)	
Total	78 (55%)	38 (26.7%)	26 (18.3 %)	142 (100%)	

Chi-square test was applied *p<0.05 is considered statistically significant.

Table 5: Mean Visual Analog Scale (VAS) Pain Scores at Each Time point between Treatment Groups.

Time Point	Sodium Fluoride Varnish (Mean ± SD)	Self-Etch Dentin Adhesive (Mean ± SD)	p-value
Baseline (T0)	5.21 ± 1.63	5.35 ± 1.58	0.482
Immediately After (T1)	1.56 ± 0.89	2.39 ± 1.01	0.004*
One Week (T2)	1.18 ± 0.79	1.26 ± 0.88	0.623
One Month (T3)	1.23 ± 0.91	0.79 ± 0.72	0.001*

*p<0.05 is considered statistically significant.

Discussion

Dentin hypersensitivity (DH) continues to be a common and clinically challenging condition, particularly in patients with gingival recession and exposed root surfaces [13]. The subjective nature of pain perception complicates both diagnosis and the assessment of treatment efficacy, making standardized tools such as the Visual Analog Scale (VAS) essential for reliable outcome evaluation [14]. Despite the wide range of available desensitizing agents, many treatments provide only short-term relief, highlighting the need for comparative clinical trials assessing both immediate and sustained effects.

In the present randomized clinical trial, two commonly used desensitizing modalities; a sodium fluoride varnish and a self-etch dentin adhesive were evaluated for their effectiveness in managing DH [15]. Both agents resulted in a statistically significant reduction in pain scores over time, confirming their clinical usefulness [16]. However, distinct temporal patterns of efficacy were observed. Sodium fluoride varnish demonstrated superior immediate pain reduction, whereas the self-etch adhesive showed greater effectiveness at the one-month follow-up.

The immediate pain relief observed with fluoride varnish aligns with its well-documented mechanism of action. Fluoride varnishes promote the formation of calcium fluoride and fluorapatite precipitates, which temporarily occlude dentinal tubules and reduce fluid movement within the dentin [9,10]. Similar findings have been reported by Afreen et al [12]. and Grover et al. [4], who also documented significant short-term reductions in DH following fluoride varnish application.

In contrast, the diminished relative effectiveness of fluoride varnish at one month observed in this study supports previous reports suggesting that its desensitizing effect may decrease over time due to dissolution or mechanical removal of surface precipitates [17,18]. This finding emphasizes the transient nature of fluoride-based tubule occlusion and underscores the importance of considering long-term outcomes when selecting a desensitizing strategy.

The sustained pain reduction observed with the self-etch adhesive at the one-month follow-up is likely attributable to its ability to form a stable hybrid layer and resin tags within the dentinal tubules, resulting in more durable tubule sealing and reduced dentin permeability [18,19]. Yu et al [11]. and Younus et al [20]. similarly reported superior long-term outcomes with self-etch adhesive systems, particularly when compared with topical agents that rely primarily on surface precipitation.

From a clinical perspective, the observed time × treatment interaction highlights an important practical consideration. Fluoride varnish may be preferable when immediate symptom relief is the primary goal, such as in acute discomfort or during initial management. Conversely, self-etch adhesives may be more suitable for patients requiring longer-lasting symptom control, especially in cases of early gingival recession with exposed root dentin.

The strengths of this study include its randomized, double-blinded design, use of a validated pain assessment tool, and evaluation across multiple clinically relevant time points. Restricting the sample to patients with Miller's Class I gingival recession enhanced internal validity by minimizing confounding periodontal variables and allowed for focused interpretation of treatment effects.

However, several limitations should be acknowledged. The follow-up period was limited to one month, restricting conclusions regarding long-term durability. The single-center design and absence of a placebo control group may limit generalizability and preclude assessment of potential placebo effects. Additionally, the higher proportion of female participants may influence pain perception outcomes, as gender-related differences in pain sensitivity have been reported [15,16]. Future multicenter studies with longer follow-up periods, balanced demographics, and inclusion of emerging desensitizing technologies such as

lasers or bioactive materials would further strengthen the evidence base.

Conclusion

Both sodium fluoride varnish and self-etch dentin adhesive were effective in reducing dentin hypersensitivity in patients with gingival recession. Fluoride varnish provided significantly greater immediate pain relief, while no significant difference was observed between treatments at one week. At one month, however, the self-etch adhesive demonstrated superior sustained pain reduction. These findings suggest that fluoride varnish is well suited for immediate symptom management, whereas self-etch dentin adhesives may offer more durable long-term relief. Selection of a desensitizing agent should therefore be guided by the desired duration of therapeutic effect and individual patient needs. Further long-term and multicenter studies are recommended to validate these findings and refine clinical guidelines.

Authors' Contributions:

All authors meet the ICMJE criteria for authorship.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

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