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ORIGINAL ARTICLE

Effect of Golchai Prophylactic Paste on Dentin Hypersensitivity Following Manual and Ultrasonic Scaling and Root Planning: A Randomized Split-Mouth Clinical Trial

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Abstract

Background: Calculus removal during scaling and root planning (SRP) is typically performed using either manual or ultrasonic instrumentation. Dentin hypersensitivity (DH) is a common post-treatment complaint, often managed with fluoride-containing prophylactic pastes. This study evaluated the efficacy of Golchai prophylactic paste in reducing dentin hypersensitivity following manual and ultrasonic SRP.

Materials and Methods: In this randomized, split-mouth, controlled clinical trial, 24 patients with mild-to-moderate periodontitis received four intervention protocols across four quadrants: manual scaling with/without Golchai paste, and ultrasonic scaling with/without the paste. DH was assessed using tactile (Michigan probe) and evaporative (air-syringe) stimuli at baseline, immediately post-SRP, and at 1 day, 1 week, and 4 weeks post-treatment. Pain intensity was recorded using a Visual Analog Scale (VAS). Data were analyzed using Wilcoxon signed-rank tests and Linear Mixed-Effects Models (LMM) ($\alpha = 0.05$).

Results: Following SRP, no statistically significant differences in sensitivity were observed between scaling methods or between experimental and control quadrants ($p > 0.05$). LMM analysis for probe-measured sensitivity revealed a significant main effect of Time ($P = 0.001$). However, neither the scaling method ($P = 0.721$) nor the application of prophylactic paste ($P = 0.979$) showed a statistically significant impact on DH reduction

Conclusion: Dentin hypersensitivity following SRP decreases progressively over time as part of the natural healing process. Manual and ultrasonic instrumentation are comparable regarding post-operative sensitivity. The adjunctive use of Golchai prophylactic pastes a conventional fluoride-containing agent lacking specific bioactive desensitizers does not provide an additional measurable reduction in hypersensitivity compared to scaling alone.

Keywords: Dental Scaling; Ultrasonics; Dentin Sensitivity

Introduction

The presence of calculus on the tooth surface negatively affects the oral health status of the patients. Dental calculus consists of inorganic and organic components that are products of bacterial metabolism. The inorganic component includes calcium carbonate, calcium phosphate, and magnesium phosphate, whereas the organic component is composed of various bacterial species. The accumulation of bacteria on the tooth surface is strongly associated with the development of clinical signs and symptoms of periodontal diseases (1, 2).

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Scaling and root planning (SRP) are non-surgical periodontal treatment procedures that involve the complete mechanical removal of plaque, accumulated calculus, and bacteria from the tooth surface. This treatment can be performed using either manual or ultrasonic instruments (1, 3–5).

Recent studies have shown that dentin hypersensitivity may occur following the removal of calculus deposits. Dentin hypersensitivity is a common condition characterized by pain in response to thermal, mechanical, or chemical stimuli due to exposed dentinal tubules (3, 6, 7). The hydrodynamic theory, proposed by Brännström, is the most widely accepted explanation for this phenomenon. According to this theory, movement of fluid within the dentinal tubules in response to external stimuli leads to deformation of nerve fibers inside the tubules, resulting in nerve stimulation that patients perceive as pain (8–10).

Patient complaints of pain due to post-scaling sensitivity may discourage them from seeking periodontal treatment in the future. Therefore, patient satisfaction with the SRP procedure is of considerable clinical importance (11, 12).

After scaling and root planing, polishing is routinely performed to complete mechanical debridement and remove stains. Currently, various polishing materials and instruments are used in dental practice, including brushes, rubber cups, and pastes with different chemical compositions, commonly marketed as “prophylactic pastes” (13, 14).

Although the use of prophylactic paste may increase surface roughness, some studies suggest that polishing with fluoride-containing pastes may help reduce dentin hypersensitivity by occluding exposed dentinal tubules (9, 10, 14).

Dentin hypersensitivity is one of the most common complaints reported by patients following calculus removal during SRP (4, 6). Bae et al. evaluated the effect of prophylactic pastes with different levels of abrasiveness on enamel and dentin surfaces and reported that polishing increased surface roughness (5). Other studies have demonstrated that fluoride-containing prophylactic pastes may reduce dentin hypersensitivity and improve patient comfort after scaling (7, 15).

Given the importance of patient satisfaction following SRP and the inconsistent findings of previous studies regarding the effect of prophylactic paste on dentin hypersensitivity, the present study aimed to evaluate the effect of Golchai prophylactic paste on dentin hypersensitivity after manual and ultrasonic scaling.

The clinical importance of this research lies in clarifying whether the routine use of a fluoride-containing prophylactic paste after scaling and root planing provides measurable benefits in reducing post-treatment dentin hypersensitivity. Although polishing is widely performed as part of periodontal therapy, evidence regarding its additional desensitizing effect remains inconclusive. Furthermore, limited data are available comparing manual and ultrasonic instrumentation within a split-mouth design while simultaneously evaluating the adjunctive role of a commercially available prophylactic paste. By addressing this gap, the present study contributes to evidence-based decision-making in periodontal practice, helping clinicians determine whether the additional time and cost associated with prophylactic paste application are justified in terms of patient comfort and clinical outcomes.

Materials and Methods

This randomized, split-mouth, controlled clinical trial was conducted on 24 patients with mild to moderate chronic periodontitis who were referred to Qom University of Medical Sciences between 2020 and 2021. The study protocol was approved by the Ethics Committee of the Faculty of Dentistry (IR.MUQ.REC.1400.235) and registered in the

Iranian Registry of Clinical Trials (IRCT20210808052108N1). Written informed consent was obtained from all participants after they had been fully informed about the study procedures, potential risks, and expected benefits.

Mild to moderate periodontitis was defined according to the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions (AAP/EFP). Patients were classified as having Stage I or Stage II periodontitis based on clinical attachment loss (CAL) and radiographic bone loss. Stage I periodontitis was defined as interdental CAL of 1–2 mm, probing pocket depth (PPD) ≤4 mm, and radiographic bone loss limited to the coronal third (<15%). Stage II periodontitis was defined as interdental CAL of 3–4 mm, PPD ≤5 mm, and radiographic bone loss extending to the coronal third (15–33%), without tooth loss attributable to periodontitis. Disease extent was determined based on the involvement of multiple teeth in at least two non-adjacent quadrants (18,19).

Eligible participants were 20–50 years of age and had mild-to-moderate periodontitis requiring non-surgical periodontal treatment in all four quadrants, with homologous or contralateral teeth present. Exclusion criteria were systemic conditions that could affect periodontal response, use of medications affecting periodontal healing within the previous 6 months, treatment for dentin hypersensitivity within the previous 3 months, changes in pulpal or periapical status during the study period, ongoing orthodontic treatment, smoking or use of tobacco products, and pregnancy. Patients with severe gingival recession and root exposure, as well as those with three or more root canal-treated teeth, were also excluded.

After enrollment, but before quadrant randomization and before initiation of scaling and root planing (SRP), all participants underwent a baseline clinical assessment to confirm eligibility. Individuals found to have extensive calculus deposits inconsistent with the predefined eligibility criteria were excluded before treatment and replaced with newly screened eligible participants. No participant was replaced after randomization or after initiation of the intervention.

At the first visit, the Gingival Index and clinical attachment level were assessed using a Michigan periodontal probe. For each participant, the four dental quadrants were labeled in a standardized clockwise order solely for identification and documentation. The four intervention conditions—manual scaling with Golchai prophylactic paste polishing, manual scaling without prophylactic paste polishing, ultrasonic scaling with Golchai prophylactic paste polishing, and ultrasonic scaling without prophylactic paste polishing—were assigned to the four quadrants using a computer-generated random allocation sequence. Specifically, an independent random permutation of the four intervention conditions was generated for each participant, ensuring that each participant received each intervention once across the four quadrants. Therefore, the clockwise order was used only for labeling and not as an allocation rule.

Manual scaling was performed using D&P instruments (1) and ultrasonic scaling was performed using a WOODPECKER ultrasonic device (2). In the prophylaxis conditions, Golchai prophylactic paste was applied for 10 seconds to the exposed cervical areas using a medium-hard rubber cup mounted on a low-speed handpiece (7,8). No prophylactic paste was applied in the non-prophylaxis conditions. All clinical procedures were performed by a single calibrated operator to minimize procedural variability. The examiner who assessed dentin hypersensitivity was blinded to the intervention assigned to each quadrant.

Golchai prophylactic paste (Golchai Co., Iran) is a fluoride-containing polishing paste composed primarily of hydrated silica as an abrasive agent, sodium fluoride (approximately 0.2% w/w; 1000 ppm

fluoride) as the active anti-caries component, glycerin and sorbitol as humectants, purified water as a solvent, cellulose gum as a thickening agent, flavoring agents, and permitted coloring agents. The paste does not contain calcium sodium phosphosilicate, arginine, strontium salts, or other specific bioactive desensitizing compounds.

Participants were instructed to continue using their usual toothpaste and to avoid desensitizing toothpastes or mouthwashes during the study period. Oral hygiene instructions were standardized using the Modified Bass brushing technique (14).

Dentin hypersensitivity was assessed using a Michigan probe and a standard air-syringe test at baseline, immediately after SRP, and at 1 day, 1 week, and 4 weeks after treatment (3,5,6).Pain intensity was recorded by the participants on a visual analog scale (VAS) ranging from 0 (no pain) to 10 (severe pain).

The sample size was determined using a two-sided significance level of 0.05 and 80% statistical power. Previous similar studies investigating dentin hypersensitivity after non-surgical periodontal therapy, manual or ultrasonic scaling, and prophylactic paste application were reviewed for full understanding of clinical pattern and approximate magnitude of change (9,14,16). Because these studies differed substantially in their outcome measures, intervention protocols, follow-up schedules, and reported statistical parameters, a directly transferable effect size and within-subject standard deviation were not available. Accordingly, an approximate study-specific sample size of 24 participants was selected. All 24 enrolled participants completed the study and were included in the final analysis.

Data were analyzed using SPSS version 22. Given the randomized split-mouth design and repeated follow-up measurements, linear mixed-effects models (LMMs) were used as the primary inferential framework.

Each participant contributed measurements from four quadrants assessed repeatedly at five time points, resulting in a hierarchical longitudinal data structure with time points nested within quadrants and quadrants nested within participants. The unit of analysis was the quadrant-level VAS score at each time point.

Because VAS scores are bounded (0–10) and may deviate from normality, data distributions and model residuals were assessed using visual methods, including histograms and Q–Q plots, together with the Shapiro–Wilk test. When assumptions were not fully met, inference primarily relied on the relative robustness of mixed-effects models to moderate deviations from normality.

The primary model was specified as a three-way within-subject factorial LMM including fixed effects for Time (5 levels), Scaling Method (manual vs ultrasonic), Prophylactic Paste Application (paste vs no paste), and their interaction terms (Time × Method, Time × Paste, Method × Paste, and Time × Method × Paste). Participant ID was included as a random intercept to account for within-participant correlation. In addition, a random intercept for quadrants nested within participants was evaluated during model specification to account for repeated measurements from the same quadrant over time. Models were fitted using restricted maximum likelihood (REML), and alternative optimizers were explored when necessary.

For probe-measured hypersensitivity, the prespecified factorial LMM was fitted as the primary model. For air-syringe hypersensitivity, the maximal prespecified model including higher-order interactions did not converge after standard optimization attempts; therefore, a more parsimonious model retaining the main effects and lower-order interaction terms, where appropriate, was fitted and reported.

Effect estimates were reported as regression coefficients (beta) with 95% confidence intervals.

Degrees of freedom and p-values were obtained using the Satterthwaite approximation. Statistical significance was set at ($p < 0.05$).

Results

All twenty-four patients completed the study protocol. Dentin hypersensitivity (DH) was assessed using probe and air-syringe tests at five intervals: baseline, immediately after scaling and root planing (SRP), and at 1 day, 1 week, and 4 weeks post-treatment.

Baseline and Immediate Post-Treatment Analysis

To address the split-mouth design and non-normal distribution of early scores, Wilcoxon signed-rank tests were employed for bivariate comparisons (Tables 1 and 2). At baseline, a statistically significant difference was observed in air-syringe sensitivity between manual and ultrasonic scaling ($Z = -2.062$, $p = 0.039$; Table 1), with the manual group showing slightly higher initial scores. However, no significant baseline difference was found for probe-measured sensitivity ($p = 0.731$). Notably, a high frequency of ties was observed in all baseline measurements (e.g., 36 out of 48 pairs for probe), indicating a prominent "floor effect" where a large number of sites exhibited zero or near-zero sensitivity prior to intervention.

Table 1. Descriptive Statistics and Baseline/Immediate Comparisons between Scaling Methods (N=24)

Assessment	Timepoint	Manual Scaling Median (IQR)	Ultrasonic Scaling Median (IQR)	Ties (n)	Z-value	P value
Air-Syringe	Baseline	2.0 (0.0–3.0)	1.0 (0.0–2.0)	33	-2.062	**0.039***
	Immediate	2.0 (0.0–3.0)	2.0 (0.0–2.5)	31	-0.656	0.512
Probe	Baseline	1.0 (0.0–2.0)	1.0 (0.0–2.0)	32	-0.344	0.731
	Immediate	1.0 (0.0–2.0)	1.0 (0.0–2.0)	36	-0.080	0.936

*Note. Data reported as Median (Interquartile Range). The high number of ties indicates a baseline floor effect. p-values calculated via Wilcoxon signed-rank test. *Significant at $p<0.05$.*

Immediately after treatment, no significant differences were found between manual and ultrasonic scaling for either air-syringe ($p = 0.512$) or probe ($p = 0.936$) assessments. Similarly, comparing quadrants treated with Golchai prophylactic paste versus control quadrants revealed no significant differences at baseline or immediately post-SRP (all $p > 0.4$; Table 2).

Table 2. Comparison of Sensitivity between Prophylactic Paste and Control Quadrants (N=24)

Assessment	Timepoint	Prophylaxis Median (IQR)	Control Median (IQR)	Ties (n)	Z-value	P value
Air-Syringe	Baseline	1.5 (0.0–2.5)	1.5 (0.0–3.0)	37	-0.275	0.783
	Immediate	2.0 (0.0–3.0)	2.0 (0.0–2.5)	35	-0.719	0.472
Probe	Baseline	1.0 (0.0–2.0)	1.0 (0.0–2.0)	33	-0.501	0.616
	Immediate	1.0 (0.0–2.0)	1.0 (0.0–2.0)	38	-0.833	0.405

Longitudinal Analysis via Linear Mixed-Effects Models (LMM)

To robustly account for the baseline imbalance in the air-syringe outcome and the nested structure of the data (timepoints within quadrants within patients), Linear Mixed-Effects Models (LMM) were utilized.

For probe-measured sensitivity, the LMM revealed a significant main effect of duration (beta = -0.45, SE = 0.12, p = 0.001; Table 3), confirming a gradual reduction in DH over 4 weeks. The main effects for Scaling Method (p = 0.721) and Prophylactic Paste (p = 0.979), as well as all two-way and three-way interactions (e.g., Time \times Method, p = 0.610), were not statistically significant. This indicates that the decline in sensitivity was independent of the instrument type or application of paste.

Table 3. Linear Mixed-Effects Model Estimates for Probe-Measured Sensitivity (Longitudinal Analysis)

Fixed Effect Source	Estimate (β)	Std. Error	95% CI	T value	P value
Intercept	2.14	0.32	[1.51, 2.77]	6.68	< 0.001
Time (Weeks)	-0.45	0.12	[-0.68, -0.22]	-3.75	**0.001***
Scaling Method	0.08	0.15	[-0.21, 0.37]	0.53	0.721
Prophylactic Paste	0.02	0.15	[-0.27, 0.31]	0.13	0.979
Time × Method	0.11	0.18	[-0.24, 0.46]	0.61	0.610
Time ×Paste	0.05	0.18	[-0.30, 0.40]	0.28	0.820

Note. Patient ID included as random effect (Variance = 0.84). Reference categories: Manual scaling, No-paste control.

For the air-syringe outcome, the full factorial model failed to achieve numerical convergence due to the high prevalence of tied zero-scores. A simplified LMM was therefore applied, which showed no significant effect for duration (F = 1.62, df = 4, p = 0.181), Scaling Method (F = 0.81, df = 1, p = 0.441), or Prophylactic Paste (F = 0.01, df = 1, p = 0.965; Table 4). The non-significant results for scaling method suggest that both manual and ultrasonic techniques are comparable in their post-operative sensitivity profiles.

Table 4. Type III ANOVA Results for Air-Syringe Sensitivity (Simplified LMM)

Source of Variation	Num. df	Den. df	F-value	p-value	Partial η^2
Time	4	345	1.62	0.181	0.018
Scaling Method	1	345	0.81	0.441	0.002
Prophylactic Paste	1	345	0.01	0.965	< 0.001
Time × Method	4	341	0.74	0.565	0.009
Time ×Paste	4	341	0.38	0.823	0.004
Time × Method ×Paste	4	341	0.24	0.911	0.002

Graphical Overview of Sensitivity Trends

As shown in Figure 1, probe-measured sensitivity changed over time in both manual and ultrasonic scaling groups, with no consistent visual separation between the groups. Figure 2 shows the trends for probe and air-syringe sensitivity in prophylaxis and control areas; although some differences are visible at individual time points, the curves generally declined by week 4. In Figure 3, probe sensitivity followed a similar pattern in the prophylaxis and non-prophylaxis groups, with no clear visual advantage for paste application. Figure 4 likewise shows broadly comparable probe-sensitivity trends following manual and ultrasonic scaling. Overall, the figures visually support the model findings: sensitivity decreased over

time, while no clear additional effect of scaling method or prophylactic paste was evident.

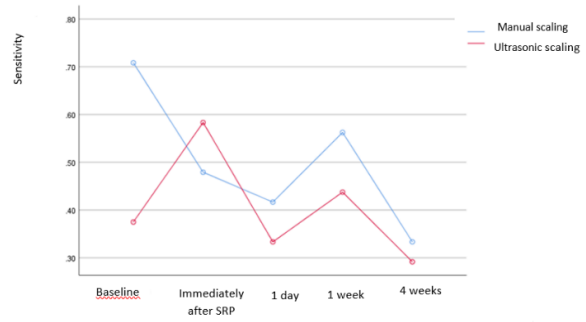


Figure 1. Comparison of manual and ultrasonic SRP at baseline, immediately after treatment, 1 day, 1 week and 4 weeks using probe and air-syringe tests

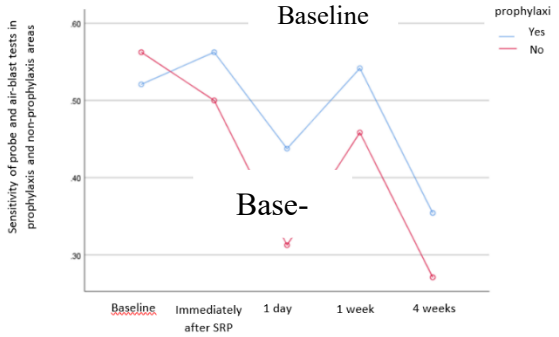


Figure 2 .Comparison of probe and air-syringe sensitivity tests in prophylaxis and non-prophylaxis areas at baseline, immediately after SRP, 1 day, 1 week and 4 weeks

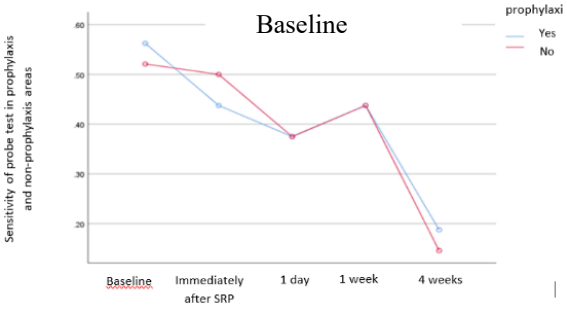


Figure 3 Comparison of probe sensitivity tests in prophylaxis and non-prophylaxis areas at baseline, immediately after SRP, 1 day, 1 week and 4 weeks

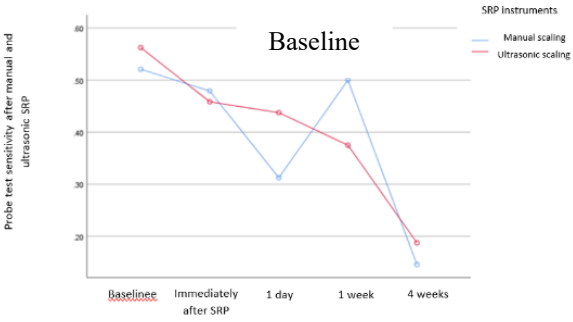


Figure 4 .Comparison of probe sensitivity tests between manual and ultrasonic at baseline, immediately after SRP, 1 day, 1 week and 4 weeks

Discussion

This randomized split-mouth clinical trial evaluated the effect of Golchai prophylactic paste on dentin hypersensitivity following manual and ultrasonic scaling and root planing (SRP). The findings showed that in all studied groups, dentin hypersensitivity generally decreased in the 4-week study period. Neither the type of scaling instrument nor the application of Golchai prophylactic paste had a statistically significant effect on hypersensitivity levels of dentin. In the linear mixed-effects analysis, a significant effect of duration was observed for probe-measured hypersensitivity, whereas no significant temporal effect was identified for the air-syringe outcome in the simplified model

Manual and ultrasonic instrumentation

The absence of a significant difference between manual and ultrasonic instrumentation is consistent with previous studies. Ribeiro et al. (14) reported no meaningful difference in dentin hypersensitivity after non-surgical periodontal therapy performed manually or using ultrasonic instruments. Similarly, Bateni et al. (6) found that both methods were associated with comparable post-treatment hypersensitivity patterns, despite the transient discomfort reported immediately after treatment. In the present study, a baseline difference was observed for air-syringe sensitivity

between manual and ultrasonic quadrants, whereas probe-measured sensitivity did not differ significantly at baseline. However, immediately after treatment and through follow-up, the overall analyses did not support a significant effect of scaling modality on dentin hypersensitivity. This suggests that, from a clinical perspective, the choice between manual and ultrasonic SRP may be based primarily on operator preference, access, and efficiency rather than concern about differential post-treatment sensitivity.

Prophylactic paste

No significant differences were found between groups with and without the prophylactic paste at baseline, immediately after treatment, or over time. The linear mixed-effects analysis likewise showed no significant effect of Golchai prophylactic paste on either probe- or air-syringe-measured hypersensitivity. A systematic review by de Oliveira et al. (10) concluded that the effectiveness of desensitizing interventions applied after non-surgical periodontal therapy remains controversial. In contrast, some previous investigations have reported beneficial effects for specific bioactive prophylactic or desensitizing formulations, particularly those containing calcium sodium phosphosilicate or other active tubule-occluding agents (9,16). A possible explanation for this discrepancy is that Golchai prophylactic paste is a conventional fluoride-containing polishing paste and does not contain established bioactive desensitizing compounds such as calcium sodium phosphosilicate, arginine, or strontium-based agents. Therefore, the absence of a significant additional benefit in the present study may be related to the formulation of the paste rather than to the concept of post-SRP polishing itself.

A significant reduction over time was observed for probe-measured hypersensitivity ($p = 0.001$), indicating that the tactile sensitivity declined gradually during the healing period after SRP which shows that post-treatment dentin hypersensitivity tends to diminish spontaneously as inflammation resolves and dentinal surfaces adapt after instrumentation (6,11). By contrast, in our study the air-syringe findings were less definitive. This difference between probe and air-syringe findings may also reflect the fact that different stimulation methods assess somewhat different dimensions of dentin sensitivity, with tactile and evaporative stimuli not always producing identical response patterns (9,16).

Strengths and limitations of the study

An important strength of this study is the use of a randomized split-mouth design, which reduces inter-individual variability by allowing each patient to serve as their own control. In addition, the use of linear mixed-effects models was appropriate for handling repeated measurements and within-patient correlation by including patient identity as a random effect. This analytical approach provides a more suitable framework than conventional repeated-measures methods for data arising from clustered and longitudinal dental designs.

Nevertheless, several limitations should be acknowledged. First, the sample size was relatively small, which could potentially limit the power of detecting subtle differences between studied groups. Second, the follow-up period was limited to four weeks, and longer-term changes in sensitivity were not assessed. Third, the non-convergence of the full air-syringe model reduced the strength of inference for that outcome and indicates that future studies may benefit from larger samples or alternative modeling strategies. Finally, because the tested paste was a conventional fluoride-containing prophylactic paste, the results cannot be generalized to all prophylactic or desensitizing materials.

From a clinical standpoint, the present findings suggest that post-SRP dentin hypersensitivity decreases mainly as part of the natural recovery process and is not meaningfully altered by the use of Golchai prophylactic paste. Likewise, manual and ultrasonic instrumentation appear comparable in terms of patient-reported sensitivity outcomes. Therefore, when a conventional prophylactic paste without specific bioactive desensitizing ingredients is used, clinicians should not expect a substantial additional reduction in post-treatment hypersensitivity. Future randomized clinical trials with larger sample sizes, longer follow-up periods, and direct comparison of bioactive desensitizing formulations are recommended to better define effective strategies for improving patient comfort after periodontal therapy.

Conclusion

Within the limitations of this randomized split-mouth clinical trial, dentin hypersensitivity following scaling and root planing decreased progressively over the four-week follow-up period. A significant temporal reduction was observed for probe-measured hypersensitivity ($p = 0.001$), indicating that post-treatment sensitivity tended to decline during healing. In contrast, for the air-syringe outcome, the full factorial mixed model did not converge; therefore, the simplified analysis did not show a significant effect of time, and this finding should be interpreted with caution.

Neither scaling method nor Golchai prophylactic paste had a significant effect on dentin hypersensitivity in the mixed-effects analyses. These findings suggest that manual and ultrasonic SRP are broadly comparable with respect to post-treatment sensitivity, and that the use of this conventional fluoride-containing prophylactic paste does not appear to provide an additional measurable reduction in hypersensitivity.

Results showed that post-SRP dentin hypersensitivity appears to improve mainly over time, per se, rather than as a result of scaling modality or Golchai paste application. Further studies with larger sample sizes, longer follow-up, and evaluation of bioactive desensitizing prophylactic pastes are needed to clarify whether adjunctive polishing materials can provide clinically meaningful benefits in reducing post-treatment sensitivity.

Conflict of Interest: Conflict of Interests: The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial, in this article

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