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Comparative Clinical Evaluation Of Two In-Office Desensitizing Agents In Reducing Dentin Hypersensitivity- A Randomised Split Mouth Clinical Trial

Umrana Faizuddin[1], M S Ranga Reddy[2], Paneeru Shanti P[3], Basa Srinivas Karteek[4], Chigurupati Swetha[5], Juttu Shirisha[6*]

[1]*MDS, Professor, Department of Conservative Dentistry and Endodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India*

[2]*MDS, Professor, Department of Conservative Dentistry and Endodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India.*

[3]*MDS, Reader, Department of Conservative Dentistry and Endodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India*

[4]*MDS, Reader, Department of Conservative Dentistry and Endodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India*

[5]*MDS, Senior lecturer, Department of Conservative Dentistry and Endodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India*

[6*]*PG II MDS, Post graduate student, Department of Conservative Dentistry and Endodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India*

Abstract:

Background: *Dentin hypersensitivity triggers sharp pain; in-office desensitizers provide rapid relief by occluding dentinal tubules or blocking nerve response.*

Aim: *To assess the efficiency of 2 in-office desensitising agents in alleviating mild to moderate dentin sensitivity in patients, with follow-up evaluations conducted after one month.*

Materials and Methods: *The study included forty participants diagnosed with cervical dentinal hypersensitivity. Each participant in a split-mouth randomized clinical trial was exposed to both thermal and evaporative (air-blast) stimuli in order to produce pain, which was assessed using the Schiff Scale during the baseline visit. Two in-office desensitising agents, Shield Force Plus (Tokuyama Dental, Japan) and MI Varnish (GC Dental, India), were applied. Following the application, the responses were assessed immediately, as well as one week and one month later, using the same stimuli and the order of administration as the baseline assessment.*

Results: *The average Schiff scores indicated greater sensitivity to cold stimuli compared to blasts of air in both groups. Shield Force Plus consistently showed significantly lower mean Schiff scores than MI Varnish at all time intervals, except at baseline. Post hoc analysis revealed significant reductions in Schiff scores for Shield Force Plus from baseline onward ($P < 0.001$), except between the immediate and one-week intervals, where no significant change was observed.*

Conclusion: *Shield Force Plus varnish is more effective than MI Varnish at all time points, regardless of the type of stimulus, in relieving dentin hypersensitivity both immediately and after a 1-month follow-up.*

Keywords: *Dentinal hypersensitivity, Shield Force Plus varnish, MI varnish, Schiff scale.*

INTRODUCTION

The condition of dentin hypersensitivity is commonly experienced by patients and often presents as a painful issue in routine dental care. [1] It may greatly impact a patient's daily well-being, as it is triggered by everyday tasks like eating and brushing teeth, making it one of the chief frequent criticisms among dental clinic patients. [2]

Dentin hypersensitivity is typically characterized by a sudden, intense pain that is generated by exposed dentin and cannot be linked to any other kind of tooth defect or pathology. This pain usually occurs in reaction to external stimuli like thermal, evaporative, tactile, osmotic, or chemical forces. [3]

Its prevalence ranged from 8% to 98%. The symptoms of dentin hypersensitivity range from mild discomfort to intense pain, which can interfere with normal oral hygiene practices and disrupt the daily tooth-brushing routine due to the pain. [4]

The frequency of Dentin hypersensitivity increases with age; the majority of patients affected by Dentin hypersensitivity are between their second and fifth decades of life, with the incidence peaking from 30 to 40 years of age. Females are more frequently affected by dentin hypersensitivity. [5] The condition typically affects the labial surfaces of teeth at the cervical region, with the cuspids and bicuspids being the most commonly affected. [3]

A number of theories have been suggested to understand the process that causes dentin hypersensitivity, with the fluid dynamics theory being the most widely accepted, introduced by Aström and Brännström. [6] Brännström et al. proposed that when physical stimuli are applied to the dentin, it triggers the expulsion of dentinal fluids via capillary movement, which then stimulates A- A-fibres, leading to dentinal sensitivity. [7] This occurs simultaneously with dentin exposure and the widening of the dentinal tubules, both of which contribute to the development of dentin hypersensitivity. Hence, the optimal approach to treating dentin hypersensitivity aims to reduce the fluid movement within dentinal tubules, impede the nerve response in the pulp, or address these factors simultaneously. [1]

Treatment options for dentin hypersensitivity include in-office interventions, home-based remedies, and over-the-counter desensitizing products. [8] Desensitizing agents are the most frequently utilized conservative in-office treatment, particularly in cases where there is minimal loss of tooth structure or no visible cervical dentin exposure. The active compounds in these desensitizing agents work by either blocking the opening of tubular channels to isolate the intratubular substances or by desensitizing the pulpal nerve. [9]

Newer agents with remineralization properties and enhanced bond strength have since been developed. Examples of such desensitizing agents include Shield Force Plus (resin-based) and MI Varnish (sodium fluoride-based). [1]

Shield Force Plus is a light-activated, single-component, self-etch adhesive that utilizes Self-Reinforcement technology. It features a self-reinforcing monomer unit that permeates the tooth matrix, enabling multiple points of interaction with calcium apatite and promoting three-dimensional network formation. This results in a fine, uniform, and durable film on the tooth, providing superior bond strength to the tooth structure. [10]

MI varnish is a calcium phosphate-based varnish, works by occluding the dentinal tubules. It contains 5% sodium fluoride and Casein phosphopeptides (CPP), these stabilize the amorphous calcium phosphate form. This allows the varnish to deliver bioavailable ions like calcium, phosphate and fluoride onto the enamel, enhancing the remineralisation of the tooth structure. [11]

This study aims to evaluate the efficacy of two in-office desensitising agents in alleviating dentin hypersensitivity in individuals with mild to moderate levels of sensitivity, with follow-up evaluations conducted after one month. The null hypothesis is that both Shield Force Plus and MI varnish show the same efficacy in reducing dentin hypersensitivity.

MATERIALS AND METHODOLOGY

In this randomized, split-mouth trial, two desensitizing agents were applied in two distinct quadrants.

This is a double-blind clinical trial in which both the practitioner and the patient were unaware of the agent being used.

Ethical approval

The methods used in this study with human subjects adhered to the Institutional Ethical Committee's moral guidelines. The Clinical Trial Registry of India has the trial listed

Informed consent

Before the study started, all patients received an explanation of the study design and given their informed consent.

Forty subjects, aged 30–60 years, with a history of dentin hypersensitivity and excellent systemic health, were recruited for the study. The preoperative Schiff scale was employed to evaluate the severity of dentin hypersensitivity. The insertion and exclusionary standards are stated in Table 1.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• History of dentin hypersensitivity • Adults aged 30 to 60 years • Healthy systemic condition • Presence of a minimum of two lesions across two separate quadrants of the mouth • Preoperative Schiff scale score of ≥1	• Individuals who have previously used anti-sensitivity toothpaste within the last three months • Patients undergoing periodontal treatment • Cervical lesions >1 mm in horizontal dimension • Fractured or cracked teeth • Individuals with known allergies to the study ingredients • Prolonged use of NSAIDs • Pregnant or lactating women • Uncontrolled chronic health conditions – diabetes, hypertension

Two teeth with mild-to-moderate sensitivity from different quadrants of each patient were included in the study. A dental practitioner blinded to the treatment assessed both initial and final sensitivity readings. Additionally, all patients were unaware of which desensitizing agent was applied to each tooth.

Initial sensitivity levels were noted during the baseline evaluation. To elicit sensitivity, each tooth was subjected to both evaporative (air blast) and thermal (ethyl chloride spray) stimuli. A suction device and cotton rolls were used to establish isolation. A triple syringe was used to air blast the exposed tooth's buccal cervical region for one second at a pressure of 40–60 psi from 1-3 mm distant. The spray was aimed at a right angle to the tooth surface. An ethyl chloride-soaked cotton swab used to apply cold stimuli to the central region of the showing buccal cervical region of the chosen tooth 10 minutes after the evaporative test.

Dentin hypersensitivity was assessed using the Schiff scale. Scores were from 0 to 3 which represent: [4]

0- The air stimulus elicited no reaction from the participant.

1- The person reacted to the air stimulation without asking for the stimulus to be stopped.

2- The individual moved away from the air stimulus or sought termination after responding to it.

3- The patient reacted to the air stimulation, considered it to be sore, and asked for it to break.

Responses to both stimuli were recorded using this scoring system.

The contributors were arbitrarily allocated to the research groups following the recording of their baseline scores groups using the sequential labeling and sealed envelope randomization technique, as recommended by Doig and Simpson. All tooth surfaces were thoroughly cleaned, rinsed with water, and then fully isolated following the appropriate isolation procedures. Group 1- The teeth had treatment with Shield Force Plus, and Group 2- teeth received treatment with MI varnish. A single operator performed the application of both agents.

METHOD OF APPLICATION:

Shield Force Plus varnish

After being moved to a sterile well, a thin, even layer of Shield Force Plus varnish was spread to the buccal cervical area of the teeth in one quadrant using an applicator tip. The teeth were light-cured for 15 seconds in agreement with the manufacturer's instructions, as shown in Figure 1.

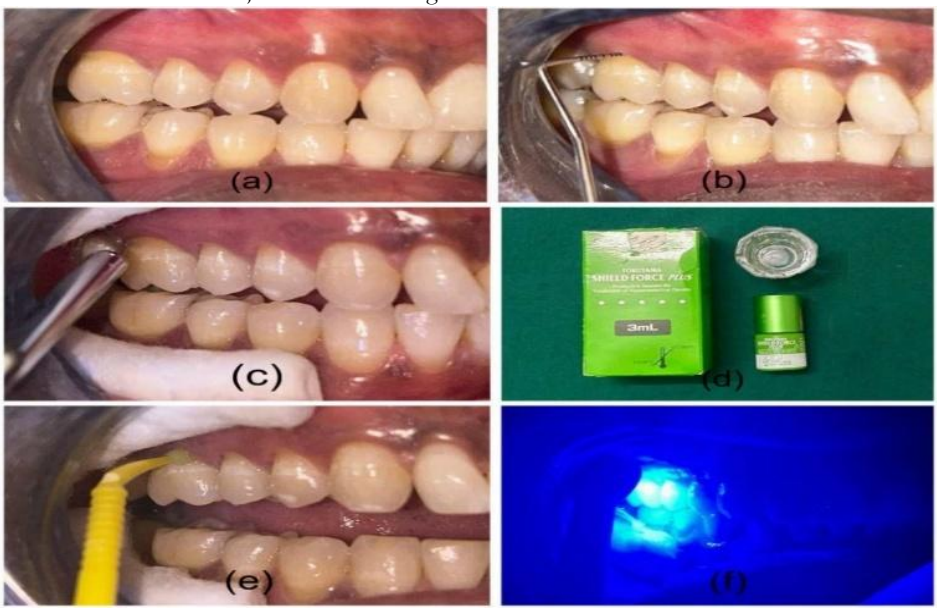

Figure 1. (a) Cervical abrasions in relation to 14,15,16 (b) Measuring the defect using Williams periodontal probe (c) Baseline assessment (d) Application of Shield Force Plus varnish (e) Light curing the varnish for 15 seconds.

MI varnish application

MI in a single-use container with the use of an applicator tip, a thin, uniform coat of varnish was applied to the teeth. Ten minutes were given for the varnish to set. As illustrated in Figure 2, patients were advised to follow the manufacturer's instructions and refrain from brushing or flossing for four hours after the procedure, as well as from using oral rinses and hard, hot, or sticky foods.

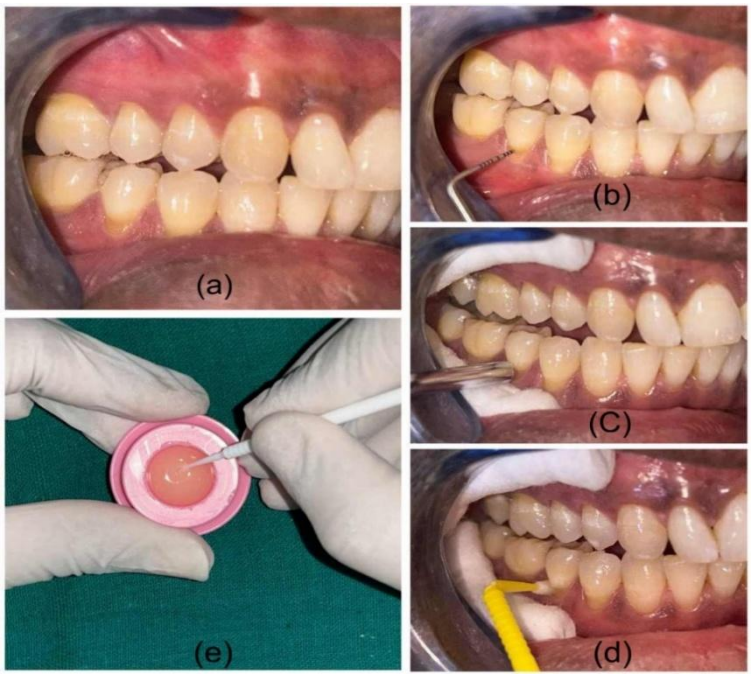

Figure 2. (a) Cervical abrasions in relation to 44,45,46 (b) Measuring the defect using Williams periodontal probe (c) Baseline assessment (d) Dispensing the MI varnish (e) Application of MI varnish

Schiff scores were recorded immediately following the application. The contributors were arranged for follow-up assessments one week and one month after the application of the agents. The same stimuli and sequence were applied to record the responses, following the Schiff scoring system.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 22.0 was used to analyze the data. With a significance level of $P < 0.05$, an independent t-test was used to compare the Schiff scores between the two groups. Bonferroni post hoc tests and repeated measures ANOVA were used to examine the changes in Schiff scores within each group at various time points, with a significance level of $P < 0.05$.

RESULT

Table 2 highlights a significant difference in Schiff scores at various time points in both groups, measured employing both air blast and cold stimuli ($P < 0.05$).

Table 2. Comparison of Mean Schiff Scale scores at different time intervals using repeated measures ANOVA

Group	Stimuli	Interval	Mean ± SD	P value
Shield Force Plus varnish	Airblast	Baseline	1.92 ± 0.04	0.001*
		Immediate	0.18 ± 0.08	
		1 week	1.04 ± 0.03	
		1 month	1.35 ± 0.02	
	Cold stimuli	Baseline	2.0 ± 0.00	0.001*
		Immediate	0.87 ± 0.07	
		1 week	1.27 ± 0.04	
		1 month	1.71 ± 0.14	
MI varnish	Airblast	Baseline	1.87 ± 0.03	0.001*
		Immediate	1.44 ± 0.07	
		1 week	1.11 ± 0.03	
		1 month	1.86 ± 0.04	
	Cold stimuli	Baseline	1.96 ± 0.02	0.001*
		Immediate	1.48 ± 0.01	
		1 week	1.21 ± 0.05	
		1 month	1.92 ± 0.03	

Repeated Measure ANOVA was conducted, considering results statistically significant if $p<0.05$.

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Table 3 illustrates the Bonferroni post hoc investigation, revealing that in Shield Force Plus group, significant differences in Schiff scores were found in all pairwise comparisons, except for the comparison between the immediate and 1-week post-treatment evaluations, for both air blast and cold stimuli (P > 0.05). In Shield Force Plus group, significant differences were observed in all pairwise comparisons, except for the baseline vs. 1-month and immediate vs. 1-week intervals, when both air blast and cold stimuli were applied. Results are further illustrated in Figure 3, which graphically compares the mean Schiff Scale scores for both groups across different time intervals.

Table 3. Post Hoc Analysis of the mean difference in Schiff scores at different time intervals

Group	Stimuli	Pair 1	Pair 2	Mean difference	P value
Shield Force Plus varnish	Airblast	Baseline	Immediate	1.74	0.001*
			1 week	0.88	0.002*
			1 month	0.57	0.04*
		Immediate	1 week	-0.86	0.003*
			1 month	-1.17	0.001*
		1 week	1 month	-0.31	0.08
	Cold stimuli	Baseline	Immediate	1.13	0.001*
			1 week	0.73	0.01*
			1 month	0.29	0.09
		Immediate	1 week	-0.40	0.06
			1 month	-0.84	0.003*
		1 week	1 month	-0.43	0.05*
MI varnish	Airblast	Baseline	Immediate	0.43	0.05*
			1 week	0.76	0.01*
			1 month	0.01	0.957
		Immediate	1 week	0.33	0.07
			1 month	-0.42	0.05*
		1 week	1 month	-0.75	0.01*
	Cold stimuli	Baseline	Immediate	0.48	0.04*
			1 week	0.75	0.01*
			1 month	0.04	0.847
		Immediate	1 week	0.27	0.09
			1 month	-0.44	0.05*
		1 week	1 month	-0.71	0.01*

Post Hoc Analysis; p<0.05 considered statistically significant

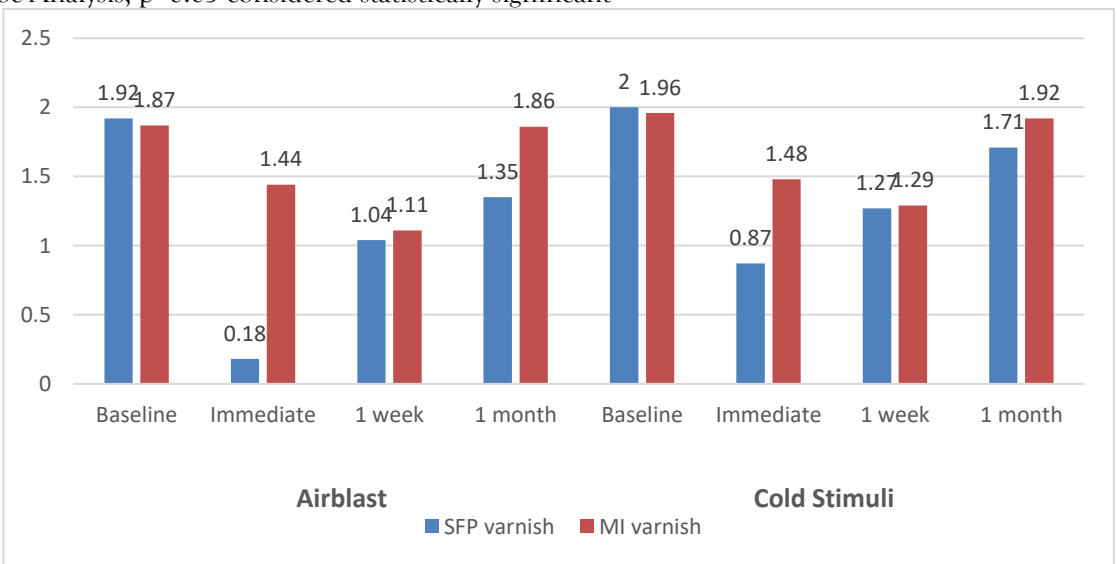

Figure 3. Comparison of Mean Schiff Scale scores at different time intervals

Figure 3, shows a statistically significant decrease in dentinal hypersensitivity in both groups. The Shield Force Plus varnish group proved to be more effective compared to MI Varnish at all time points, irrespective of the

stimulus type, throughout the 1-month follow-up period. Pairwise comparisons also showed that the Shield Force Plus group consistently outperformed the MI varnish group.

DISCUSSION

Dentinal hypersensitivity is a universal situation, gradually increasing in magnitude and harshness along various age groups. Every tooth in the experiment was subjected to both cold and air blast stimuli. These physiological stimuli are present in daily life. As a result, they are frequently suggested for evaluating dentinal hypersensitivity. Dentinal fluid flows outward when an air blast is directed at the exposed dentinal tubule, activating pulp receptors and producing pain. Rapid volumetric contraction of dentinal fluid brought on by a cold stimulation results in negative intrapulpal and intradental pressure. These variations induce volumetric changes to activate thermo-mechanoreceptors, which in turn result in pain. [12]

Desensitizing agents and analgesic treatments function by inhibiting neural activity, either by chemically or mechanically sealing the dentinal tubules or through the direct suppression of nociceptive transduction and transmission in the pulp's dentin-odontoblast nerve terminal complex. [9]

Dentin hypersensitivity can be managed with either at-home or in-office treatments. Typically, at-home treatments are the first line of treatment for dentin hypersensitivity. These agents are available in various forms, including mouthwashes, dentifrices, and chewing gums. They mainly contain potassium salts, fluorides, dibasic sodium citrate, etc. [13] When at-home treatments fail to provide adequate outcomes, in-office treatment options are recommended.

There are numerous types of in-office therapies for dentin hypersensitivity, such as dental gels, solutions, varnishes, glass ionomer cement, resin sealants, and dentin adhesives. More advanced techniques, such as lasers, are also used in some cases to address this condition. Typically, treatments should begin with non-invasive, reversible, safe, simple-to-execute, and cost-effective options.

Vittorio Moraschini et al. (2018) stated that recent meta-analyses and systematic reviews demonstrated that the most efficient in-office therapy for dentin hypersensitivity is nerve desensitization and dentinal tubule occlusion, which can be accomplished chemically or mechanically. [9]

Currently, treatments for dentin hypersensitivity utilize adhesives, including varnishes, bonding agents, and restorative materials, as these materials provide enhanced desensitization. [14]

The dentinal tubules are physically sealed by dental adhesives and resin sealants, which prevent dentinal fluid from flowing and protect the odontoblastic processes inside the tubules from outside stimuli. [9]

In this study, Shield Force Plus and MI varnish have been used to reduce dentin hypersensitivity.

Shield Force Plus (Tokuyama) contains a phosphoric acid monomer, which is essential for decalcifying the tooth structure and forming the matrix of the self-reinforcing monomer. It also includes various monomers for building the coating, an alcoholic solvent, water, and camphorquinone as the photopolymerization catalyst. The mechanism of action relies on a double-blocking effect. Upon application to the affected area, the adhesive monomer (3D-SR monomer) reacts with calcium in the tooth structure, and the accumulation of reaction products on the coated surface and inside the dentinal tubules seals the tubules and provides the therapeutic effect.

Exposure to light cures the reaction products both in the dentinal tubules and the thin film on the surface, forming a strong coating and resulting in the double-blocking effect. [10]

Hence, shield force plus varnish exhibits key advantages like excellent binding properties to both enamel and dentin, ensuring long-lasting results, and enhanced remineralization through its fluoride-releasing mechanism which helps to replenish the tooth structure's integrity along with ease of application with minimal chair time.

MI varnish has 5% sodium fluoride and is high in the milk-derived protein casein phosphopeptide amorphous calcium phosphate (CPP-ACP). [15] In order to minimize calcium loss, CPP-ACP increases the number of calcium ion binding sites on the tooth surface. Furthermore, amorphous calcium phosphate (ACP) renders the dentin supersaturated, which favors enamel remineralization by acting as a buffer for free calcium and phosphate ions. In this condition, enamel remineralization is enhanced and enamel demineralization is inhibited.[16] Its application inspires the construction of a crystalline layer on the dentinal tubule openings, advancing protection for the tooth surface and serving as a barrier against outside stimuli. This layer is not completely uniform, though; it has irregular attachments and forms clusters of structures that partially cover the dentinal tubules and fill the interprismatic voids. [17]

Therefore, Shield Force Plus is more efficient in reducing dentinal hypersensitivity due to its ‘self-reinforcing monomer technology’ and double-block effect, compared to MI Varnish.

The null hypothesis was rejected, as Shield Force outperformed MI Varnish in treating dentin hypersensitivity.

CONCLUSION

Based on the limitations of this study, it was observed that the Shield Force Plus varnish group illustrates a significantly higher falling in dentin hypersensitivity related to the MI varnish group in patients with cervical lesions devoid of caries and dentinal hypersensitivity.

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