Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2023 Feb 24; 11(D):44-49.
https://doi.org/10.3889/oamjms.2023.11436
eISSN: 1857-9655
Category: *D - Dental Sciences*
Section: *Dental Pathology and Endodontics*

Effect of Combining Minimal Invasive Modalities on Treating Mild Dental Fluorosis: An *In vivo* Study

Orkeed Ghanem*, A. F. Abo Elezz, A. F. Ghoniem

Department of Restorative Dentistry, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

Edited by: Filip Koneski
Citation: Ghanem O, Abo Elezz AF, Ghoniem AF. Effect of Combining Minimal Invasive Modalities on Treating Mild Dental Fluorosis: An *In vivo* Study. Open Access Maced J Med Sci. 2023 Feb 24; 11(D):44-49. https://doi.org/10.3889/oamjms.2023.11436
Keywords: Dental fluorosis; Power bleaching; Microabrasion; Resin infiltration; VITA Easyshade® spectrophotometer
***Correspondence:** Orkeed Ghanem, Demonstrator of Restorative Dentistry, Faculty of Dentistry, Suez Canal University, Egypt. E-mail: orkeed_ghanem@yahoo.com
Received: 25-Dec-2022
Revised: 15-Feb-2023
Accepted: 20-Feb-2023

Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Fluorosis is intrinsic tooth discoloration which compromises esthetics depending on its severity.

AIM: The aim of the study was to assess the efficiency of various treatment modalities in esthetic improvement of mild fluorosed teeth.

MATERIALS AND METHODS: Four patients with 48 mild fluorosed teeth were randomly assigned to four treatment modalities (n = 12). The modalities included M_1: power bleaching, M_2: microabrasion and power bleaching, M_3: power bleaching and resin infiltration and M_4: microabrasion, power bleaching and resin infiltration. Color parameters (L, a, b) and visible color change (ΔE) were measured by spectrophotometer (VITA Easyshade®) at baseline, immediately after the treatment, after 3, 6, and 9 months.

STATISTICAL ANALYSIS: Two-way ANOVA was applied to test the interaction between different variables. ANOVA repeated measures were followed by Duncan multiple range tests (DMRTs) to compare between groups.

RESULTS: All the treatment modalities showed significant color change (ΔE) at all-time points compared to baseline. The highest color change was recorded in the resin infiltration treatment modalities compared to the other treatment modalities. Bleaching alone had the lowest change.

CONCLUSION: Resin infiltration treatment modalities were more effective in the esthetic improvement of dental fluorosis compared to either power bleaching alone or combination of microabrasion and power bleaching.

Introduction

Fluoride plays an important role in the prevention of dental caries. However, if the total amount of ingested fluoride exceeds the optimal limits, it results in dental fluorosis [1]. Dental fluorosis is intrinsic tooth discoloration which is caused by high fluoride absorption (>0.05 mg/kg/BW/day) during tooth development in the maturation stage of amelogenesis. Accidental ingestion of fluoride-containing dental products and >1 ppm of fluoride in drinking water are considered possible risk factors for the development of fluorosis [2], [3]. Thus with the worldwide decline of caries, the prevalence of dental fluorosis has increased in the last two decades [4].

Fluorosis is an esthetic disturbance, where enamel development is disrupted and the resulting enamel is hypomineralized. Fluoride reduces calcium ion concentration in the matrix, thus indirectly interfering with protease activity, inhibiting enamel matrix protein degradation. An abnormal growth of apatite crystals is seen, which consequently has optical and physical tooth surface changes [4]. Beneath a sound surface, the enamel structure is characterized by microporosities, which leads to air and water inclusions. These inclusions change the refractive index which results in a change in internal reflection and increased opacity of tooth enamel [2].

The severity of fluorosis varies depending on the duration and amount of fluoride uptake [4]. Mild fluorosis are seen as narrow white lines following the perikymata that lack a clear border with the unaffected enamel [1]. The white opaque appearance of fluorosed enamel is caused by a hypomineralized enamel subsurface [5]. While in moderate fluorosis, yellow to light brown staining is frequently a disfiguring feature. In severe cases, the major diagnostic sign is pitting of the surfaces which leads to secondary brown staining [1], [5]. Several indices have already been used to characterize the clinical appearance of dental fluorosis such as Dean's fluorosis index and Thylstrup and Fejerskov index (TF index) which was used in the study [2].

The choice of treatment options available for fluorosis depends on fluorosis severity. In reference to TF index, various treatment options include minimal invasive methods for TF scores 1–4. Minimal invasive methods include teeth bleaching, microabrasion, resin infiltration, and combination approaches. These treatment modalities have shown varying degrees of success and have been used with different combinations and techniques [1]. Thus, this study was

concerned with assessment of efficiency of different treatment modalities in esthetic improvement of mild fluorosed teeth. The null hypothesis is that there is no significant difference between the treatment modalities of the study in esthetic improvement of mild fluorosis.

Methods

Study design and participants

This study is a randomized and clinical trial with four parallel arms with 1:1 allocation ratio followed the guidelines of the Consolidated Standards of Reporting Trials (CONSORT) [6]. The study was carried out after the approval of Ethical Committee of the Faculty of Dentistry, Suez Canal University. Before participating in the study, each participant signed a written consent that detailed the study protocol and role of each participant in the study. The participants were allocated in four treatment modalities using block randomization. The website http://www.randomization.com was used to generate the random sequence generation [1].

The study was conducted on forty eight mild fluorosed anterior teeth (TFI 1-3). Patients aged from 18–30 years with good oral and general health having no caries or restoration on the teeth to be treated were included in the study. Patients with any fixed appliances, hypersensitive or tetracycline-stained teeth, smoking habit, and symptoms of pulpitis were excluded from the study.

Sample size calculation

A minimum total sample size of 44 samples will be sufficient to detect the effect size of 0.25, a power ($1-\beta = 0.90$) of 90% at a significance level of $p < 0.05$ partial eta squared of 0.06. A total sample size of 48 samples would be applied. Each group would be represented by 12 samples. The sample size was calculated according to G*Power software version 3.1.9.2. [7], [8].

Interventions

Four interventions included power bleaching (M_1), enamel microabrasion and power bleaching (M_2), power bleaching and resin infiltration (M_3), and microabrasion, power bleaching, and resin infiltration (M_4). Before the interventions, ultrasonic scaling was performed for patients followed by polishing with a polishing paste and polishing brushes. In M_1, power bleaching was performed. Teeth were subjected to light-activated in-office bleaching with 37.5% hydrogen peroxide (Pola office plus®, SDI products, victoria, Australia). Gingival barrier gel (Opaldam®, SDI products, victoria, Australia) was applied on gingival margin of both arches and light cured. LED light was applied by a whitening accelerator (COXO C- Bright. Medical Instrument Co. Ltd, Foshan, China) [9]. The light intensity and time buttons of the whitening accelerator were adjusted to high+ and 8 min respectively. The bleaching gel was directly applied to labial surfaces of teeth. Three applications of gel, each for 8 min were done [10]. After the last application, all the gel was suctioned off and rinsing was done.

In M_2, microabrasion was performed followed by power bleaching. Slurry composed of 6.6% hydrochloric acid and silicon carbide microparticles (Opalustre, Ultradent Products, Inc., South Jordan, UT, USA) was used for microabrasion. Rubber dam was applied. A 1 mm thick layer of the slurry was applied to labial surfaces of teeth. OpalCups™ (Ultradent Products, Inc.) were used to microabrade teeth surfaces using slight pressure for 60 s for each tooth at a low speed. This procedure was repeated 3 times [11]. Following each application, the teeth were rinsed and evaluated. Then, power bleaching was done as in M_1. Teeth were polished with a polishing paste and polishing brushes at the end of the procedures.

In M_3, power bleaching was performed as in M_1 followed immediately by resin infiltration. Rubber dam was applied. The labial enamel was etched by 15% HCL acid gel (ICON-Etch, DMG, Hamburg, Germany). Three etching cycles for 2 min each were done. After each cycle, the etching gel was then washed away for 30 s and air dried. 99% ethanol (ICON-Dry, DMG, Hamburg, Germany) was then applied to etched enamel and was left for 30 s, followed by air drying. A low-viscosity resin (ICON-Infiltrant DMG, Hamburg, Germany) was applied to etched enamel surfaces and was left for 3 min allowing it to penetrate. Excess material was removed with gentle air drying and dental flossing before light curing for 40 s with an intensity of 1500 mw/cm^2 using COXO LED Curing Light Wireless DB-686 DELI® (COXO, China). A second layer of infiltrating resin was applied, left for 1 min and light cured for 40 s. Surfaces were polished with polishing rubber points (KENDA, USA) and with diamond impregnated polishing brushes, high-luster polishing pastes using goat-hair brushes, and aluminium oxide paste using felt wheels from ENA HRI polishing system (ENA HRI, Italy).

To perform resin infiltration immediately after bleaching, an antioxidant must be applied. About 10% of alpha tocopherol solution was prepared by diluting 10 g alpha tocopherol (Puritan' Pride, INC. Ronkonkoma, USA) in 100 ml ethanol to make 10% solutions [12]. It was applied on labial surfaces of teeth for 10 min by microbrushs and then rinsed with ethanol for 30 s [13].

In M_4, microabrasion was performed followed by power bleaching and resin infiltration as described for the previous treatment modalities. All modalities were performed in a single visit. Patients were instructed to decrease the consumption of colored food and drinks with adequate tooth brushing in all the modalities.

Evaluation

Color change was evaluated by Spectrophotometer (VITA Easyshade V®) based on Commission Internationale de l'Eclairage (CIE Lab) color system. Measurements were taken in daylight for standardization. They were performed in the middle region of labial surfaces of tooth. For each tooth, measurements were repeated 3 successive times and the mean was taken. The obtained values were translated to the manufacturer's L, a, and b values at each time. Measurements were based on CIE Lab color system involving three parameters to define color: L (lightness), a (red/green chromaticity), and b (yellow/blue chromaticity). Teeth were clinically evaluated 5 times (T): Baseline (T_0), immediately after treatment (T_1), after 3 months (T_2), after 6 months (T_3) and after 9 months (T_4). Color change was calculated from the formula of $\Delta E = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$, where ΔL, Δa, and Δb were the difference between mean values of readings at different timepoints from baseline readings [14].

Statistical analysis

Data were be subjected to normality statistical test. ANOVA repeated measures were be followed by Duncan multiple range tests (DMRTs) to compare between groups. Data analyses were carried out using computer software Statistical Package for the Social Science SPSS (IBM-SPSS ver. 26.0 for Mac OS).

Results

The ΔE values of different treatment modalities (M_1-M_4) and different timepoints (T_1-T_4) were evaluated by two-way ANOVA (Table 1). Two-way ANOVA revealed that treatment modalities and time induced highly significant changes in ΔE, and the interaction between treatment modalities (M_1-M_4) and time (T_1-T_4) were statistically significant ($p<0.001$***). Differences were assessed using one-way ANOVA. Data represented as mean ± SD standard deviation (Figure 1).

Table 1: The ΔE values of different treatment modalities (M_1-M_4) at different time-points (T_1-T_4)

Modality	ΔE				Sign.
	ΔE_1	ΔE_2	ΔE_3	ΔE_4	
M_1	$12.99^{h} \pm 0.25$	$9.91^{j} \pm 0.60$	$9.15^{k} \pm 0.62$	$7.87^{l} \pm 0.506$	<0.001***
M_2	$15.28^{fg} \pm 0.59$	$12.07^{i} \pm 0.50$	$9.11^{k} \pm 0.98$	$7.85^{l} \pm 1.058$	<0.001***
M_3	$20.52^{b} \pm 0.58$	$15.08^{g} \pm 0.70$	$15.72^{f} \pm 0.84$	$16.72^{e} \pm 0.906$	<0.001***
M_4	$21.92^{a} \pm 0.56$	$16.92^{e} \pm 0.38$	$18.37^{d} \pm 0.44$	$19.54^{c} \pm 0.62$	<0.001***
Sign.	<0.001***	<0.001***	0.001***	<0.001***	
Two-way ANOVA for ΔE					
Source	Df	F	p-value		
Corrected model	15	574.6	<0.001***		
Intercept	1	88441.7	<0.001***		
Modality (M)	3	216869.0	<0.001***		
Time (T)	3	547.6	<0.001***		
M * T	9	52.2	<0.001***		

*Significant at $p < 0.05$; **,***highly significant at $p < 0.010$, 0.001, non-significant at $p > 0.05$. Data represented as mean ± SD standard deviation. Means followed by different letters either vertically or horizontally are significantly different according to DMRTs at 0.05.

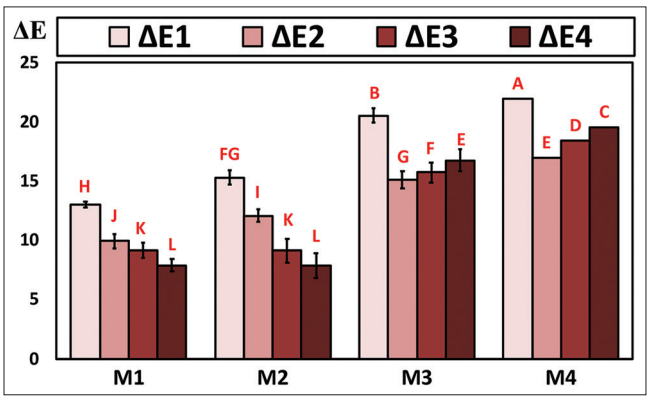

Figure 1: The ΔE values of different Treatment modalities (M_1-M_4) at different time-points (T_1-T_4). Differences were assessed using one-way ANOVA. Data represented as mean ± SD standard deviation, error bars represent the standard deviation

Regarding evaluation time

A significant difference was observed in all treatment modalities at all evaluation times from baseline.

Immediately after treatment (T_1)

The highest ΔE mean values were recorded in M_4 followed by M_3 and M_2 with significant difference between them. The lowest ΔE mean value was recorded in M_1.

After 3 months (T_2)

The highest ΔE mean values were recorded in M_4 followed by M_3 and M_2 with significant difference between them. The lowest ΔE mean value was recorded in M_1.

After 6 months (T_3)

The highest ΔE mean values were recorded in M_4 followed by M_3 with significant difference between them. The lowest ΔE mean values were recorded in M_2 and M_1 with no significant difference between them.

After 9 months (T_4)

The highest ΔE mean values were recorded in M_4 followed by M_3 with significant difference between them. The lowest ΔE mean values were recorded in M_2 and M_1 with no significant difference between.

Regarding treatment modality

The highest ΔE mean value was recorded at T_1 in all the treatment modalities. The lowest ΔE mean

value was recorded at T_4 in M_1 and M_2 while in M_3 and M_4 the lowest ΔE mean value was recorded at T_2.

Power bleaching (M_1)

The highest ΔE mean values were recorded at T_1 followed by T_2 and T_3 with significant difference between them. The lowest ΔE mean value was recorded at T_4.

Microabrasion and power bleaching (M_2)

The highest ΔE mean values were recorded at T_1 followed by T_2 and T_3 with significant difference between them. The lowest ΔE mean value was recorded at T_4.

Power bleaching and resin infiltration (M_3)

The highest ΔE mean values were recorded at T_1 followed by T_4 and T_3 with significant difference between them. The lowest ΔE mean value was recorded at T_2.

Microabrasion, power bleaching, and (M_4)

The highest ΔE mean values were recorded at T_1 followed by T_4 and T_3 with significant difference between them. The lowest ΔE mean value was recorded at T_2.

Discussion

Conditions like dental fluorosis are known to affect esthetics of teeth. It has an esthetic concern to many people particularly in the anterior region where it is more visible to others [3]. Many researchers reported that even the mild forms of fluorosis can cause deviations in the esthetic appearance of teeth [1].

In power bleaching only (M_1), the highest color change (ΔE) was recorded immediately after treatment. This is may be explained by the breakdown of organic chromophores to non-colored organic compounds increasing lightness (L) [15], [16]. While color relapse was noted after 3-, 6-, and 9-month follow-up. This may be due to teeth being dehydrated immediately after bleaching, especially when light was used. This produced a great whitening effect on the teeth, which decreased after rehydration, as observed after 3-, 6-, and 9-month follow-up [17], [18]. In addition to increased liability of enamel surface to demineralization and adherence of pigments as a result of the microstructural changes and increased surface roughness after bleaching [19], [20].

These results came in agreement with Gupta *et al*., 2017, who found that Inoffice bleaching with 35% hydrogen peroxide (Pola Office®) activated by lightemitting diode (LED) bleaching unit was successful in bleaching and removal of fluorosis stains with 3 months color relapse. [17]. In combination of microabrasion and power bleaching treatment modality (M_2), the highest color change (ΔE) was recorded immediately after treatment which was higher than power bleaching alone. This may be explained by the removal of superficial enamel layer by microabrasion which may increase the success of further treatments such as bleaching as this removal increases the enamel permeability allowing greater penetration of bleaching agent into enamel enhancing its effect [17], [21], [22]. While color relapse was also observed after 3-, 6-, and 9-month follow-up. This may be due to structural changes and surface porosity in the enamel surface caused by microabrasion and bleaching. [19], [20].

These results came in agreement with Román-Rodríguez *et al*., 2020, who reported that the combination of microabrasion and bleaching techniques successfully reduced the appearance of white spots [23]. However, these results came in disagreement with Gupta *et al*. 2017, who found that 35% hydrogen peroxide in-office bleaching activated by LED bleaching unit and the combination of microabrasion and bleaching were equally effective in elimination of fluorosis stains in children. This conflict may be attributed to different methodologies as the study was done on moderate fluorosis in children with 10–17 years of age. [17].

The highest color change (ΔE) was found in combination of microabrasion, power bleaching and resin infiltration treatment modality (M_4), and combination of power bleaching and resin infiltration (M_3). The highest color change (ΔE) was recorded immediately after treatment. This may be explained by infiltration of resin into the microporosities of enamel, masking the white spots because the refractive index of resin (1.52) is very close to that of healthy enamel (1.62) [24], [25], [26]. In addition, the penetrability of enamel increases after bleaching due to the release of free radicals enhancing the masking effect of resin infiltration. Color relapse was noted after 3-month follow-up. This may be explained by increased liability to discoloration after resin infiltration because the chemical composition of the infiltrant may lead to water sorption. Furthermore, the high consumption of colored food and drinks by the patient may contribute to staining [2]. However, slight color improvement was observed after 6- and 9-month follow-up compared to 3 months. This improvement may be explained by water absorption by the resin over time, which was not removed completely by the alcohol. This absorption can result in minimizing the optical interfaces in the light path thus improving the lesion translucency [24], [26], [27].

These results came in agreement with Gugnani *et al*., 2017, who reported that combination of bleaching

and resin infiltration was more effective than bleaching alone in the esthetic improvement of mild-to-moderate fluorosis [1]. Furthermore in agreement with Horuztepe and Baseren, 2017, who found that the combination of bleaching and resin infiltration treatment resulted in the highest color change of white spot lesions compared to either using bleaching alone [20]. Furthermore, in agreement with Saxena *et al*., 2021, who reported that the combination of microabrasion, bleaching and resin infiltration had the best esthetic results compared to resin infiltration alone or combination of microabrasion and resin infiltration in mild to moderare fluorosis [28]. Thus resin infiltration treatment modalities seemed to be very effective in the esthetic treatment of mild fluorosis, despite slight relapse may occur.

Conclusion

Under the limitations of the present study, it was concluded that resin infiltration treatment modalities were more effective in treating mild dental fluorosis with more color stability compared to either power bleaching alone or combination of microabrasion and power bleaching.

References

1. Gugnani N, Pandit IK, Gupta M, Gugnani S, Soni S, Goyal V. Comparative evaluation of esthetic changes in non-pitted fluorosis stains when treated with resin infiltration, in-office bleaching, and combination therapies. J Esthet Restor Dent. 2017;29(5):317-24. https://doi.org/10.1111/jerd.12312
   PMid:28654721
2. Schoppmeier CM, Derman SH, Noack MJ, Wicht MJ. Power bleaching enhances resin infiltration masking effect of dental fluorosis. A randomized clinical trial. J Dent. 2018;79:77-84. https://doi.org/10.1016/j.jdent.2018.10.005
   PMid:30342902
3. Khairuddin MN, Iskanderdzulkarnein PM, Halil MH. Resin infiltration technique as minimal invasive approach towards mild to moderate dental fluorosis in an adolescent: A case report. IIUM J Orofac Health Sci. 2021;2(2):63-72. https://doi.org/10.31436/ijohs.v2i2.98
4. Di Giovanni T, Eliades T, Papageorgiou SN. Interventions for dental fluorosis: A systematic review. J Esthet Restor Dent. 2018;30(6):502-8. https://doi.org/10.1111/jerd.12408
   PMid:30194793
5. DenBesten P, Li W. Chronic fluoride toxicity: Dental fluorosis. Monogr Oral Sci. 2011;22:81-96. https://doi.org/10.1159/000327028
   PMid:21701193
6. Schulz KF, Altman DG, Moher D, CONSORT Group. CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. BMJ. 2010;340:c332. https://doi.org/10.1136/bmj.c332
   PMid:20332509
7. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, New Jersey: Lawrence Erlbaum Associates; 1988. p. 567.
8. Dupont WD, Plummer WD Jr. Power and sample size calculations. A review and computer program. Control Clin Trials. 1990;11(2):116-28. https://doi.org/10.1016/0197-2456(90)90005-m
   PMid:2161310
9. Ahangar FA, Sajad M, Nabi S, Bhat S, Rashid A, Farooq R. Effect of nanopulsed cold laser (NPCL) light on calcium and phosphate loss from dental enamel during in-office bleaching with high concentrated hydrogen peroxide using atomic absorption spectophotometer. Ann Int Med Dent Res. 2018;5(1):5-8.
10. Garg SA, Chavda SM. Color masking white fluorotic spots by resin infiltration and its quantitation by computerized photographic analysis: A 12-month follow-up study. Oper Dent. 2020;45(1):1-9. https://doi.org/10.2341/17-260-T
    PMid:31567053
11. Romero MF, Babb CS, Delash J, Brackett WW. Minimally invasive esthetic improvement in a patient with dental fluorosis by using microabrasion and bleaching: A clinical report. J Prosthet Dent. 2018;120(3):323-6. https://doi.org/10.1016/j.prosdent.2017.12.024
    PMid:29724552
12. Nari-Ratih D, Widyastuti A. Effect of antioxidants on the shear bond strength of composite resin to enamel following extra-coronal bleaching. J Clin Exp Dent. 2019;11(2):e126-32. https://doi.org/10.4317/jced.55359
    PMid:30805116
13. Thapa A, Vivekananda PA, Thomas MS. Evaluation and comparison of bond strength to 10% carbamide peroxide bleached enamel following the application of 10% and 25% sodium ascorbate and alpha-tocopherol solutions: An *in vitro* study. J Conserv Dent. 2013;16(2):111-5. https://doi.org/10.4103/0972-0707.108184
    PMid:23716960
14. Gençer MD, Kirzioğlu Z. A comparison of the effectiveness of resin infiltration and microabrasion treatments applied to developmental enamel defects in color masking. Dent Mater J. 2019;38(2):295-302. https://doi.org/10.4012/dmj.2018-074
    PMid:30713284
15. Epple M, Meyer F, Enax J. A critical review of modern concepts for teeth whitening. Dent J (Basel). 2019;7(3):79. https://doi.org/10.3390/dj7030079
    PMid:31374877
16. Kwon SR, Wertz PW. Review of the mechanism of tooth whitening. J Esthet Restor Dent. 2015;27(5):240-57. https://doi.org/10.1111/jerd.12152
    PMid:25969131
17. Gupta A, Dhingra R, Chaudhuri P, Gupta A. A comparison of various minimally invasive techniques for the removal of dental fluorosis stains in children. J Indian Soc Pedod Prev Dent. 2017;35(3):260-8. https://doi.org/10.4103/jisppd.jisppd_138_16
    PMid:28762354
18. Moghadam FV, Majidinia S, Chasteen J, Ghavamnasiri M. The degree of color change, rebound effect and sensitivity of bleached teeth associated with at-home and power bleaching techniques: A randomized clinical trial. Eur J Dent. 2013;7(4):405-11. https://doi.org/10.4103/1305-7456.120655
    PMid:24932113
19. Lins RB, de Andrade AK, Duarte RM, Meireles SS. Influence of three treatment protocols for dental fluorosis in the enamel surface: An *in vitro* study. Revista Científica do CRO-RJ (Rio J Dent J). 2019;4(1):79-86. https://doi.org/10.29327/24816.4.1-13

20. Horuztepe SA, Baseren M. Effect of resin infiltration on the color and microhardness of bleached white-spot lesions in bovine enamel (an *in vitro* study). J Esthet Restor Dent. 2017;29(5):378-85. https://doi.org/10.1111/jerd.12308
PMid:28568745
21. Celik EU, Yildiz G, Yazkan B. Clinical evaluation of enamel microabrasion for the aesthetic management of mild-to-severe dental fluorosis. J Esthet Restor Dent. 2013;25(6):422-30. https://doi.org/10.1111/jerd.12052
PMid:24320061
22. Briso AL, Lima AP, Gonçalves RS, Gallinari MO, dos Santos PH. Transenamel and transdentinal penetration of hydrogen peroxide applied to cracked or microabrasioned enamel. Oper Dent. 2014;39(2):166-73. https://doi.org/10.2341/13-014-L
PMid:23802644
23. Román-Rodríguez JL, Agustín-Panadero R, Roig-Vanaclocha A, Amengual J. A tooth whitening and chemical abrasive protocol for the treatment of developmental enamel defects. J Prosthet Dent. 2020;123(3):379-83. https://doi.org/10.1016/j.prosdent.2019.02.015
PMid:31307796
24. Cocco AR, Lund RG, Torre E, Martos J. Treatment of fluorosis spots using a resin infiltration technique: 14-month follow-up. Oper Dent. 2016;41(4):357-62. https://doi.org/10.2341/14-335-S
PMid:27455116
25. Oliveira A, Felinto LT, Francisconi-Dos-Rios LF, Moi GP, Nahsan FP. Dental bleaching, microabrasion, and resin infiltration: Case report of minimally invasive treatment of enamel hypoplasia. Int J Prosthodont. 2020;33(1):105-10. https://doi.org/10.11607/ijp.6232
PMid:31860920
26. Attal JP, Atlan A, Denis M, Vennat E, Tirlet G. White spots on enamel: Treatment protocol by superficial or deep infiltration (Part 2). Int Orthod. 2014;12(1):1-31. https://doi.org/10.1016/j.ortho.2013.12.011
PMid:24503373
27. Owda R, Sancakli HS. Resin infiltration as a minimal invasive esthetic treatment for a mild fluorosis case. Stoma Edu J. 2018;5(3):184-8. https://doi.org/10.25241/stomaeduj.2018.5(3).art.7
28. Saxena P, Grewal MS, Agarwal P, Kaur G, Verma J, Chhikara V. Clinical efficacy of resin infiltration technique alone or in combination with micro abrasion and in-office bleaching in adults with mild-to-moderate fluorosis stains. J Pharm Bioallied Sci. 2021;13(Suppl 1):S301-5. https://doi.org/10.4103/jpbs.jpbs_795_20
PMid:34447098