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Knowledge and perception of dental students and practitioners towards treatment of dental fluorosis

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ABSTRACT

Introduction: Dental fluorosis in the anterior teeth may raise esthetic concerns in many patients. There are several methods in dentistry to correct esthetic alterations caused by staining. Hence this study aimed to assess the knowledge of dental students, dental interns, general practitioners, and postgraduates towards the treatment of dental fluorosis in Saudi Arabia. *Materials and Methods:* This was a descriptive cross-sectional study conducted among 1600 clinical dental trainees and practitioners (dental students, dental interns, general practitioners & postgraduates). An online structured, close-ended, self-administered questionnaire consisting of demographic information and four figures showing different grades of dental fluorosis (mild, moderate, and severe) and respective treatment modalities were shared on social media platforms to assess knowledge and perception towards resin infiltration. Descriptive statistics and Chi-square tests were applied to compare different categorical variables. *Results*: The age of the sample ranged between 21- 24. The grading and treatment responses showed statistically significant differences ($p<0.0001$). In addition, gender showed significant differences regarding the treatment responses for the moderate dental fluorosis, wherein 53.7% of males chose veneers and 56.6% of females chose micro-abrasion ($X^2=14.159$, $p=0.003$). *Conclusion*: Minimally invasive esthetic dentistry modalities were effective treatments. In addition, a combination of resin infiltration or micro-abrasion in combination with in-office/home bleaching can always be an option in different fluorosis cases.

Keywords: Dental fluorosis, macro-abrasion, microabrasion, minimally invasive dentistry

1. INTRODUCTION

Esthetics has a major role to play in dental profession. For example, in many countries smile reflects a person's inner self and is considered a good-looking appearance if teeth are bright white natural-looking with proper alignment

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and defined anatomical shapes (Sundfeld et al., 2011). Nowadays, patients are getting progressively aware of the esthetic considerations and outcomes in dental treatment planning. Dental Fluorosis is one of the main impediments affecting esthetics, especially in particular tropical regions, India and China (Aoba and Fejerskov 2002). Worldwide, the prevalence of enamel fluorosis has increased in the last two decades (Bharath et al., 2014; Bronckers et al., 2009). It is a public health problem caused by the consumption of fluoride ions (F) through water, food, excess ingestion of fluoride originating from caries prevention measures like toothpaste, mouth rinses, gels, or varnishes that are incorporated in the enamel during tooth development leading to a disturbed enamel formation and a variety of other sources (Atukorala and Chang 2014; Mondal, 2018). It can be considered as a developmental commotion in the dental enamel, the cause of the same is attributed to successive and multiple exposure to elevated fluoride concentrations during tooth development, leading to enamel with lower mineral content and increased porosity (Abanto Alvarez et al., 2009). Fluorosis' severity differs, and it depends mostly on the time and duration of overexposure to fluoride. Mild type of dental fluorosis can be characterized in various ways like it could be bilateral, diffuse in nature, can be either opaque or can have white striations which runs horizontally usually and across the enamel, it then follows the perikymata, and gives the appearance of cuspal snow capping, or and a snow-flaking.

Furthermore, enamel may become discolored and pitted in more severe forms, and there will be substantive defects of enamel (Nakornchai et al., 2016; Chankanka et al., 2010). The optimal level for daily fluoride intake is 0.05 to 0.07 mg F/kg/day, and the risk of developing dental fluorosis increases if the daily consumption was beyond that, which results in a chalky-white appearance or possibly brown patches on the enamel. The development of the permanent anterior teeth, in general, begins at approximately ages 15 to 30 months. Therefore, this is a crucial time to avoid excess fluoride exposure for the esthetic appearance of the anterior teeth (Wiener et al., 2018). Fluorosis, especially within the anterior teeth, may raise esthetic concern in many patients. There are several resources in dentistry to correct esthetic alterations caused by staining, either with the use of porcelain laminate veneers, which are capable of providing a reproduction of natural teeth with minimal or no preparation (Morita et al., 2016).

Crowns, in which a significant amount of tooth reduction, allow for a minimum thickness of core material, development of internal shade characterization, and biologically acceptable contours (Shillinburg et al., 2012), or restorations with direct resin composite. However, all these procedures are considered invasive since they require significant wear of the dental structure (Sundfeld et al., 2014). Nowadays, more conservative techniques are available to improve the esthetic appearance of teeth with fluorosis. Therefore, Micro-abrasion should be considered the first treatment option and improve esthetics (Benbachir et al., 2007; Wray et al., 2001), and it may reduce the need for enamel wear in a non-conservative restorative procedure.

Enamel micro-abrasion can eliminate enamel irregularities in buccal aspects caused by amelogenesis imperfecta or defects acquired after removal of orthodontic appliances. These appear as white spot lesion and discoloration defects, intrinsic enamel stains of any etiology, and color improving the appearance of teeth (Celik et al., 2013). It removes a small amount of tooth structure (Not over a tenth of a millimeter in depth) by a mixture of pumice and acid to eliminate the superficial enamel discoloration defects caused by fluorosis that are not successfully removed bleaching techniques. This surface is more resistant to caries than the initial surface. Furthermore because enamel micro-abrasion is a non-invasive technique, it can be supplemented with bleaching procedures (Reston et al., 2011; Sundfeld et al., 2014; Sundfeld et al., 2014).

Hence, this study aimed to assess the knowledge of dental student's dental interns, general practitioners, and postgraduates towards treatment of Dental Fluorosis.

2. MATERIAL AND METHODOLOGY

Study design

A descriptive cross-sectional study was carried out among clinical dental practitioners including dental students, dental interns, general practitioners, and postgraduates towards dental treatment of dental fluorosis in Saudi Arabia.

Ethical approval

The proposal was registered at the research center of Riyadh Elm University, and ethical approval was obtained from the institutional board of the university (IRB: FUGRP/2020/160). The study was conducted for the period of 4 months from January – April 2020.

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Sample size calculation

A minimum sample of (N=1600) was considered based on the acceptable margin of error of less than 5%, a confidence level of 95%, and a likely hood of response distribution of 50%, assuming 16000 registered dental professionals with Saudi Commission for health specialties.

Study instrument

A structured, close-ended, self-administered questionnaire consisting of demographic information (gender, age, region, and educational level) and four figures showing different grades of dental fluorosis (one mild, two moderate, and one severe) and respective treatment modalities (micro-abrasion, macro abrasion, veneers, and crowns) were evaluated among study participants. These clinical figures were obtained from the patients having different grades of dental fluorosis (figure 1 -4).

Figure 1 Showing Mild dental fluorosis

Figure 2 Showing Moderate dental fluorosis

Figure 3 Showing Moderate dental fluorosis

Figure 4 Showing Severe dental fluorosis

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Questionnaire Administration

An online version of the questionnaire was prepared using Google forms, and the survey link was distributed through social media platforms (Twitter and WhatsApp) of dental professionals and students in Saudi Arabia. All the questionnaire responses were made mandatory to the participants. It took five minutes for each participant to respond to the online questionnaire.

Data collection

All the responses collected through the online questionnaire were downloaded in the excel sheet and coded accordingly for statistical analysis.

Statistical analysis

Data were analyzed using SPSS 24.0 version statistical software (IBM Inc., Chicago USA). Descriptive statistics (frequencies and percentages) were used to describe the categorical outcome variables. Pearson's Chi-square test was used to compare the distribution of responses of grading and treatment modalities of study subjects. A p-value of ≤ 0.05 was used to report the statistical significance of the tests.

3. RESULTS

Out of 1600 study subjects, 65% females, nearly half 784 (49%) were in age range of 21-24 years, 64.4% belong to the Central region, and about 47.9%were undergraduates. The characteristics of the study participants are shown in (Table 1).

Table 1 Characteristics of the study participants (N=1600)

Characteristics	n (%)
Age groups	
18-20	
21-24	60 (3.6)
24-40	784 (49.0)
Gender	756 (46.4)
Male	
Female	560(35.0)
Region	1040(65.0)
Centre	
East	1030(64.4)
West	227(14.2)
South	155 (9.7)
North	86(5.4)
Educational Level	102(6.3)
Undergraduate	
Intern	766 (47.9)
General	227(14.2)
Practitioner	401(25.1)
Postgraduate	206(12.8)

The responses towards treating dental fluorosis are shown in Table 2. For the question "what is micro-abrasion,"59.5% responded saying 'removal of tooth discoloration by hydrochloric acid and pumice," followed by 23.6% and 16.8% said 'removal of tooth discoloration by finishing burs' and 'removing tooth discoloration by Chemical oxidized organic pigmentation.' For the item, 'when to use micro-abrasion, 47% responded for 'external discoloration,' 41% for 'white spot lesion' and remaining mentioned for 'internal discoloration' and 'incipient lesion.'

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About 61% said that only 0-4 patients with dental fluorosis visited their clinic. Most (71%) of the participants treated 1-5 patients with fluorosis in their clinics. Almost 78.9% and 86% responded negatively to the questions, 'Do you think that micro-abrasion may work with all the grades of fluorosis?' and 'Did you see any recurrences of tooth discoloration after your treatment?' (Table 2).

Table 2 Distribution responses towards the treatment of dental fluorosis

Knowledge items	n (%)
What is microabrasion?	
Remove tooth discoloration by finishing bur	378(23.6)
Remove tooth discoloration by hydrochloric acid and pumice.	952(59.5)
Removing tooth discoloration by Chemical oxidized organic pigmentation.	270(16.8)
When it's applicable to use microabrasion	
External discoloration	752(47.0)
Internal discoloration (the ENDO treatment)	82(5.1)
White spot lesion	656(41.0)
Incipient lesion	110 (6.8)
How many patients came to your clinic have fluorosis in their teeth	
0-4	976(61.0)
5-7	318 (19.9)
8-11	123(7.7)
12+	183(11.4)
Have you ever treated Fluorosis case?	
Yes	488(30.5)
No	1112(69.5)
If yes how many? (n=488)	
(1-5)	346(71.0)
(6-10)	87(17.8)
(11-+)	55(11.2)
Do you think that micro-abrasion may works with all the grade of fluorosis?	
Yes	337(21.1)
No	1263(78.9)
Did you see any recurrences of tooth discoloration after your treatment?	
Yes	224(14.0)
No	1376(86.0)

Four different figures (1 mild, moderate 1, moderate 2, and 1 severe) related to dental fluorosis were used to extract the responses towards its grading and treatment. For the severe (1): the distribution of grading and treatment responses differed significantly, where higher proportion 56.7% of the subjects responded by 'moderate' for grading ($p<0.0001$) with treatment options of 'micro-abrasion 48.1% and Veneers 47.6% ($p<0.0001$). For Moderate (2): the distribution of grading and treatment responses showed a statistically significant difference, where 37.9% and 46.2% responded by 'very mild' & 'moderate' ($p<0.0001$) grading. Furthermore, for treatment, 62.4% responded as 'micro-abrasion' ($p<0.0001$). For moderate 3, the distribution of grading and treatment responses showed a statistically significant difference, where 34.8% & 37.3% responded as moderate and severe ($p<0.0001$) grades. For treatment, 49.6% & 43% responded as 'micro-abrasion and 'veneers' ($p<0.0001$). For mild dental fluorosis 4, the distribution of grading and treatment responses differed significantly, where 74.1% had responded as 'mild' ($p<0.0001$,) and for a treatment option, 95.2% agreed with 'micro-abrasion ($p<0.0001$), (Table 3).

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Table 3 Responses towards grading and treatment of four different figures of dental fluorosis

Type and options of grading & treatment	No (%)	X^2- value	p-value
1 (Severe) Grading			
Normal	14(0.9)		
Questionable	150(9.4)		
Very mild	197(12.3)	331.01	<0.0001
Moderate	907(56.7)		
Severe	332(20.8)		
1 (Severe) treatment			
Micro-abrasion	770 (48.1)		
Macro-abrasion	0		
Veneers	762 (47.6)	133.40	<0.0001
Crown	68(4.3)		
2 (Moderate) grading			
Normal	18(1.1)		
Questionable	187(11.7)		
Very mild	606 (37.9)	300.72	<0.0001
Moderate	739 (46.2)		
Severe	50 (3.1)		
2 (Moderate) treatment			
Micro-abrasion	998(62.4)		
Macro-abrasion	342 (21.4)		
Veneers	219 (13.7)	286.85	<0.0001
Crown	41(2.6)		
3 (Moderate) grading			
Normal	18(1.1)		
Questionable	165(10.3)		
Very mild	264 (16.5)	172.09	<0.0001
Moderate	556(34.8)		
Severe	597 (37.3)		
3 (Moderate) treatment			
Micro-abrasion	794(49.6)		
Macro-abrasion	5(0.3)		
Veneers	688 (43.0)	261.00	<0.0001
Crown	113 (7.1)		
4 (Mild) grading			
Normal	82(5.1)		
Questionable	214 (13.4)		
Very mild	1186 (74.1)	656.31	<0.0001
Moderate	109 (6.8)		
Sever	9 (0.6)		
Picure 4 (Mild) treatment			
Micro-abrasion	1523 (95.2)		
Macro-abrasion	0		
Veneers	77 (4.8)	286.29	<0.0001
Crown	0		

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The distribution of treatment responses of 4 s differed significantly between male and female genders regarding 3 (moderate), where 53.7% of male subjects preferred 'veneers' and 56.6% of females would like to treat with micro-abrasion (X^2=14.159, p=0.003) (Table 4).

Table 4 Comparison grading and treatment of four of dental fluorosis between genders

type and options of grading & treatment	Gender		X^2- value	p-value
	Male	Female		
Figure 1 (Severe) Grading				
Normal	5(0.8)	9(0.9)	5.913	0.206
Questionable	77(13.8)	73 (7.0)		
Very mild	73(13.0)	122(11.8)		
Moderate	414(56.1)	593(57.0)		
Severe	09 (16.3)	243 (23.3)		
1(Severe) treatment				
Micro-abrasion	250(44.7)	520(50.0)	1.715	0.424
Macro-abrasion	00	00		
Veneers	291(52.0)	470(45.2)		
Crown	19(3.3)	50(4.8)		
Figure 2(Moderate) grading				
Normal	7(1.0)	9(0.9)	1.898	0.754
Questionable	77(13.8)	109(10.5)		
Very mild	196(35.0)	410(39.5)		
Moderate	264(47.2)	474(45.6)		
Severe	16(2.4)	38(3.5)		
2(Moderate) treatment	360(65.0)	634(61.0)	3.012	0.390
Micro-abrasion	100(17.9)	241(23.2)		
Macro-abrasion	73(13.0)	145(14.0)		
Veneers	23(4.1)	20(1.8)		
Crown				
Figure 3(Moderate) grading				
Normal	9(1.6)	13(0.9)	8.737	0.068
Questionable	69(12.2)	96(9.2)		
Very mild	59(10.6)	205(19.7)		
Moderate	173(30.9)	382(36.8)		
Severe	250(44.7)	344(33.3)		
3 (Moderate) treatment				
Micro-abrasion	204(36.6)	589(56.6)	14.159	0.003
Macro-abrasion	6(0.8)	0(0.0)		
Veneers	301(53.7)	387(37.3)		
Crown	49(8.9)	64 (6.1)		
Figure 4(Mild) grading				
Normal	41 (7.3)	40(3.9)	6.008	0.199
Questionable	77(13.8)	137(13.2)		
Very mild	391(69.9)	796(76.3)		
Moderate	41(7.3)	67(6.6)		

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Severe	2(1.6)	0(0.0)		
4 (Mild) treatment				
Micro-abrasion	528(94.3)	994(95.6)	0.295	0.587
Macro-abrasion	--	--		
Veneers	32 (5.7)	46(4.4)		
Crown	--	--		

The treatment and grading responses of 4 s concerning the educational level of study subjects showed a statistically significant difference. The treatment responses to 1 (severe) included 52.4% of undergraduates and 60% of interns opting for 'micro-abrasion, whereas 59.1% and 57.8% of general practitioners and postgraduates preferred 'Veneers' as part of treatment (X^2=17.181, p=0.009). The grading responses of 3 (moderate) differed significantly across different educational levels with 33.3% & 20% of undergraduate and interns responded its 'severe' compared to 42% & 62.2% of general practitioners and postgraduates (X^2=27.794, p=0.006). Similarly, treatment responses differed significantly across educational levels with 56% & 64% of undergraduates & interns had preferred ' micro-abrasion when compared with to 51.1% & 66.7% of general practitioners & postgraduates who would like to treat with ' Veneers' (X^2=27.721, p=0.001) (Table 5).

Table 5 Comparison grading and treatment of four of dental fluorosis among different educational levels

type and options of grading & treatment	Educational level				X^2	p-value
	Undergraduate	Intern	General practitioner	Post graduate		
1(Severe) Grading						
Normal	14(1.8)	0	0	0	19.873	0.070
Questionable	68(8.9)	32(14)	45(11.4)	5(2.2)		
Very mild	51(16.7)	18(8)	32(8)	18(8.9)		
Moderate	383(50.0)	154(68)	264(61.4)	124(60)		
Severe	250(22.6)	23(10)	60(19.3)	59(28.9)		
1(Severe) treatment						
Micro-abrasion	401(52.4)	136 60)	160(39.8)	73(35.6)	17.181	0.009
Macro-abrasion	0	0	0	0		
Veneers	314(41.1)	91(40)	236(59.1)	119(57.8)		
Crown	51(6.5)	0	5(1.1)	14(6.7)		
2(Moderate) grading						
Normal	9(1.2)	0	0	9(4.4)	18.551	0.100
Questionable	91(11.9)	27(12)	50(12.5)	18(8.9)		
Very mild	273(35.7)	127(56)	141(35.2)	64(31.1)		
Moderate	360(47)	64(28)	200(50)	115(55.6)		
Sever	33(4.2)	9(4)	10(2.3)	0		
2(Moderate)treatment						
Micro-abrasion	455(59.5)	141(62)	260(64.8)	142(68.9)	11.063	0.271
Macro-abrasion	182(23.8)	36(16)	73(18.2)	11(2.4)		
Veneers	98(12.5)	41(18)	68(17)	53(26.7)		
Crown	31(4.2)	9(4)	0	0		
3(Moderate) grading						
Normal	14 (1.8)	5(2)	0	0	27.794	0.006

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Questionable	77(10.1)	41(18)	32(8)	14(6.7)		
Very mild	123(16.1)	64(28)	60(14.8)	19(8.9)		
Moderate	296 (38.7)	73(32)	141(35.2)	46(22.2)		
Severe	256(33.3)	44(20)	168(42)	128(62.2)		
3 (Moderate) treatment						
Micro-abrasion	428(56)	145(64)	177(44.3)	41(20)	27.721	0.001
Macro-abrasion	5(0.6)	0	0	0		
Veneers	273 (35.7)	140(32)	205(51.1)	137(66.7)		
Crown	60 (7.7)	5(4)	19(4.5)	28(13.3)		
4(Mild) grading						
Normal	50(6.5)	5(2)	27 (6.8)	0	13.629	0.325
Questionable	100(13.1)	45(20)	50 (12.5)	18 (8.9)		
Very mild	574(75)	154(68)	296 (73.9)	160 (77.8)		
Moderate	37(4.8)	18(8)	28(6.8)	28(13.3)		
Severe	5(0.6)	5(2)	0	0		
Figure 4 (Mild) treatment						
Micro-abrasion	733(95.8)	209(92)	378(94.3)	201(97.8)	2.053	0.561
Macro-abrasion	0	0	0	0		
Veneers	33(4.2)	18(8)	23(5.7)	5(2.2)		
Crown	0	0	0	0		

4. DISCUSSION

Few articles published evaluation of dental students, dental interns, postgraduates, and general practitioners towards diagnosing and treating dental fluorosis. However, very limited research papers explain the perception and awareness of minimally invasive techniques to treat stains (intrinsic or extrinsic). A combined approach of using resin infiltration and micro-abrasion should be considered one of the first treatment options to improve esthetics (Reston et al., 2011; Shillinburg et al., 2012). In this study, 47% of participants agreed to use micro-abrasion for external discoloration, while 41% choose this treatment for white spot lesions. After evaluating the collected data about the knowledge and perception of the treatment of dental fluorosis, more than half, 59.5%, recommended the use of hydrochloric acid and pumice. At the same time, 23.6 % suggested removing tooth discoloration using finishing bur. Nearly 61% of dental practitioners have seen dental fluorosis cases ranging from 0-4 within a short time. However, this study suggested that 30.5% of participants favored treating the fluoresced teeth, whereas 69.5% would like to leave the fluorosis untreated. It highlights inadequate knowledge of minimally invasive esthetic dentistry. This finding is in line with a previously reported study in which dental professionals showed unsatisfactory knowledge towards the use of resin infiltrates in Saudi Arabia (Alhammad et al., 2020).

Hence, better marketing strategies regarding minimally invasive intervention should be considered to help the dental practitioner's treatment option reach the acquired treatment in the patient's best interest. Impressively, male participants were more likely to choose more aggressive treatment options over females and are more likely to recommend the veneers and crowns to treat mild fluorosis. At the same time, female participants were more inclined towards less invasive treatment for mild fluorosis.

Limitations

Most of the study participants in this study were from the central region that was undergraduate dental students. Hence the study findings should be carefully considered before generalizing to all the dental practitioners in Saudi Arabia. Further investigation is needed to identify why male participants are more willing to go towards invasive treatment in mild fluorosis cases. More clinical trials are recommended to investigate the clinical interpretations towards the action of resin infiltration.

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5. CONCLUSION

Minimally invasive esthetic dentistry is effective treatments that have minimal effects on natural tooth structures. Combining resin infiltration or micro-abrasion with in-office/home bleaching can always be an option in different fluorosis cases.

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Author Contributions

All authors made best contribution for the concept, assessment and evaluation, data acquisition and analysis and interpretation of the data.

Waseem Radwan and Jumana Al Dulijan	- Design of the study and the questionnaire design
Ranya Abubotain and Aynaa Alrifae	- Data acquisition and data entry
Dina Alismail and Linah Alzeghaibi	- Review of Literature and Data analysis
Noura Alawaifi and Jude Alrajhi	– Manuscript writing and final draft Preparation

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Ethical approval

The proposal was registered at the research center of Riyadh Elm University, and ethical approval was obtained from the institutional board of the university (IRB: FUGRP/2020/160).

Data and materials availability

All data associated with this study are present in the paper.

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