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Original Article

Dentistry Section

White Spot Lesions on Teeth during or Postorthodontic Treatment: A Knowledge Based Cross-sectional Survey of Dentists

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ABSTRACT

Introduction: White Spot Lesions (WSLs) observed during or after fixed orthodontic therapy has known to cause several dental problems clinically and aesthetically. It becomes imperative to understand the perception of treating dentists of the paediatric dentists to whom the children first visit, and also of the treating orthodontists and restorative dentists.

Aim: To assess the knowledge, attitude, and practices of dentists regarding WSLs related to orthodontic treatment, and also to assess the preferences of these dentists regarding its management.

Materials and Methods: A cross-sectional survey was planned for a period of two months (15th August 2020 to 15th October 2020) using a close ended, multiple choice questionnaire directed to evaluate the perspective of 260 dentists of Saudi Arabia towards white spot lesions associated with orthodontic treatment. The self designed validated questionnaire was prepared and mailed to dentists across the Kingdom of Saudi Arabia. Descriptive statistics followed by Chi-sqaure test was done to compare variables in the questionnaire.

Results: A total of 52 paediatric dentists, 53 orthodontists, 51 restorative dentists, and 104 general dentists participated in the study. Out of 260 dentists, 236 (90.8%) of them have observed WSLs in their patients during/after orthodontic treatment. Adolescent patients more commonly complained of undesirable aesthetics due to WSLs. Incisors were the most commonly affected teeth. All dentists except orthodontists believed that they were proficient in diagnosing superficial or deep WSLs (p-value=0.005). Most dentists preferred professional application of high concentration topical fluorides. Most patients demanded an instant correction of these WSLs as reported by all groups of dentists.

Conclusion: WSLs are commonly observed by dentists during the initial 7 to 12 months period of starting orthodontic therapy, more commonly on incisor teeth among the adolescent age group. The dentists recommended maintaining good oral hygiene as the most effective way of preventing WSLs. They also believed that high concentration fluoride agents are well suited for treating superficial lesions and composite resin restorations for deeper lesions.

Keywords: Fixed orthodontic therapy, Initial caries lesion, Subsurface demineralisation

INTRODUCTION

People opting for orthodontic treatment for improvement of their smile generally tend to have an improvement in their self confidence [1]. This treatment period is not devoid of minor symptoms such as pain, root resorption, caries, speech problems, and enamel damage [2]. Development of demineralisation or WSL in the enamel during or postorthodontic treatment with fixed appliances remains a well known clinical problem for dental specialists. These lesions are caused because banding or bonding of teeth facilitates retention of biofilms. The WSLs manifest as the earliest sign of dental caries within enamel that is visible to the naked eye. Its white, chalky appearance with increased opaqueness is related to an optical phenomenon caused by loss of minerals from the enamel surface or subsurface, which becomes more evident by drying [3]. As refraction of light through tooth enamel is related directly to the amount of mineralisation, WSLs appear visibly as white opacities [4].

These lesions can be halted by establishing appropriate oral cleansing habits and the regular use of topical fluorides in the form of dentifrices, varnishes, mouth rinses, gels, bonding agents, and ligatures. Other promising approaches to prevent or treat these WSL's include the self application of Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP), fissure sealants, resin infiltration, microabrasion, and composite resin restorations [5]. However, the literature does not support the effectiveness of one particular agent over the other, and the perception of the treating dentist can play a vital role in their prevention and/or treatment [6].

The available literature suggests that there are no studies comparing the preference of dentists residing in Saudi Arabia, regarding the WSLs and its management. Further, to reduce the prevalence of development of these WSLs and to diagnose/treat them early, it becomes imperative to understand the perception of treating dentists, the paediatric dentists to whom the children first visit, and also of the treating orthodontists and restorative dentists. Keeping this in mind, authors had planned a study to assess the knowledge, attitude, and practices of dentists regarding WSLs related to orthodontic treatment, and also to assess the preferences of these dentists regarding the management of white spot lesions related to orthodontic treatment.

MATERIALS AND METHODS

The cross-sectional survey was planned for a period of two months (15th August 2020 to 15th October 2020) using a close ended, multiple choice questionnaire directed to evaluate the perspective of dentists of Saudi Arabia towards white spot lesions associated with orthodontic treatment and their management. The Ethical Clearance was obtained from the Institutional Ethical Committee (IEC Ref No.: H-12-13082020).

Inclusion and exclusion criteria: The general dentists, orthodontists, paediatric dentists, and restorative dentists who were residing in Saudi Arabia and willingly filled the questionnaire, were included in the study. However, those dentists who did not fill the questionnaire completely were excluded from the study.

Sample size calculation: A convenient sample of 50 paediatric dentists, 50 orthodontists, 50 restorative dentists, and 100 general dentists was decided based on the sample calculation considering a 95% confidence level and 80% power, accounting for a non response rate of 20%.

The questionnaire was then mailed to dentists across the Kingdom of Saudi Arabia and they were asked to make their choices for each question from the options available. It was informed to the participating dentists that their identity would be kept strictly confidential and participation would be voluntary. After confirming that participants have given responses to all questions, the total samples selected for the study were 52 paediatric dentists, 53 orthodontists, 51 restorative dentists, and 104 general dentists.

The self designed questionnaire (based on study done by Hamdan AM et al., in 2012) [7], consisting of a total of 21 questions, related to dentists' general information (3), their knowledge (4), attitude (5) and practices (9), was prepared [Annexure-1]. The questionnaire was validated and its construct, face, and content validities were carried out by five dentists/specialists, with good clinical expertise and rich teaching experience. Efforts were put to understand the difficulty of each question; its interpretation and correctness were critically analysed. The modifications suggested by the experts were accordingly done to finalise the study questionnaire.

STATISTICAL ANALYSIS

The responses obtained were entered on Microsoft Excel (Microsoft, Redmond, WA, USA). Descriptive statistics followed by Chi-sqaure test was done to compare variables in the questionnaire using IBM Statistical Package for the Social Science (SPSS) version 22.0. The level of significance chosen for comparisons in the study was p-value of less than 0.05.

RESULTS

The demographic data of the participating dentists are shown in [Table/Fig-1]. Out of 260 dentists, 236 (90.8%) of them have observed WSLs in their patients during/after orthodontic treatment.

Demographic characteristics		Number (%)
Dentist speciality	General dentist	104 (40)
	Orthodontist	53 (20.4)
	Paediatric dentist	52 (20)
	Restorative dentist	51 (19.6)
Carrier focus	Clinician	180 (69.2)
	Academician	80 (30.8)
Years of experience	1 to 5	129 (49.6)
	6 to 10	71 (27.3)
	11 to 20	47 (18.1)
	> 20	13 (5)
Percentage of Dentists who observed WSLs during/ after Orthodontic treatment		236 (90.8)

[Table/Fig-1]: Demographic data of participating dentists.

[Table/Fig-2-4] describe the association between the dentists' speciality, career focus and years of experience respectively with their behaviour regarding WSLs postorthodontic treatment. Regarding, how early the WSLs were observed during/after orthodontic treatment, there was a statistically significant difference between the responses of the participating dentists (p-value=0.001). General dentists (40.4%) reported that they have observed WSLs earlier (2 to 6 months after orthodontic treatment has been initiated) in contrast to other groups (7 to 12 months). Dentists with less than 10 years of experience have observed WSLs earlier (2 to 6 months) when compared to dentists with more than 11 years of experience (7 to 12 months) (p-value=0.001).

Question	Variables	Dentists' speciality				Chi-square, p-value
		General Dentist (104)	Ortho-dontists (53)	Pae-diatric dentist (52)	Restor-ative dentist (51)	
How early have you observed WSLs in an individual undergoing fixed orthodontic treatment?	1 month	32 (30.8)	0	3 (5.8)	1 (2.0)	72.355, p-value= 0.001*
	2 to 6 months	42 (40.4)	11 (20.8)	17 (32.7)	17 (33.3)	
	7 to 12 months	13 (12.5)	26 (49.1)	19 (36.5)	28 (54.9)	
	>12 months	17 (16.3)	16 (30.2)	13 (25.0)	5 (9.8)	
Did you notify the patient that there is a chance to get WSLs after treatment?	No	29 (27.9)	9 (17.0)	6 (11.5)	4 (7.8)	12.032, p-value= 0.061
	Some-time	24 (23.1)	12 (22.6)	13 (25)	14 (27.5)	
	Yes	51 (49.0)	32 (60.4)	33 (63.5)	33 (64.7)	
In your practice, do you encounter any specific age group of patients who complain of undesirable aesthetics due to WSLs?	Adole-scent	52 (50.0)	30 (56.6)	29 (55.8)	23 (45.1)	43.428, p-value= 0.001*
	Adults	35 (33.7)	18 (34.0)	5 (9.6)	26 (51.0)	
	Children	10 (9.6)	1 (1.9)	16 (30.8)	2 (3.9)	
	No comp-laints	7 (6.7)	4 (7.5)	2 (3.8)	0	
In which teeth have you most commonly observed WSLs during or postor-thodontic treatment?	Canines	8 (7.7)	2 (3.8)	8 (15.4)	5 (9.8)	27.458, p-value= 0.001*
	Incisors	86 (82.7)	34 (64.2)	39 (75)	31 (60.8)	
	Molars	5 (4.8)	5 (9.4)	4 (7.7)	4 (7.8)	
	Prem-olars	5 (4.8)	12 (22.6)	1 (1.9)	11 (21.6)	

[Table/Fig-2]: Association between dentists' speciality and their behaviour regarding WSLs postorthodontic treatment.
*significant

Question	Variables	Dentists' career focus		Chi-square, p-value
		Academician (80)	Clinician (180)	
How early have you observed WSLs in an individual undergoing fixed orthodontic treatment?	1 month	6 (7.5)	30 (16.7)	7.218, p-value= 0.065
	2 to 6 months	29 (36.3)	58 (32.2)	
	7 to 12 months	33 (41.3)	53 (29.4)	
	>12 months	12 (15.0)	39 (21.7)	
Did you notify the patient that there is a chance to get WSLs after treatment?	No	10 (12.5)	38 (21.1)	3.240, p-value= 0.198
	Sometime	23 (28.7)	40 (22.2)	
	Yes	47 (58.8)	102 (56.7)	
In your practice, do you encounter any specific age group of patients who complain of undesirable aesthetics due to WSLs?	Adolescent	45 (56.3)	89 (49.4)	1.921, p-value= 0.589
	Adults	25 (31.3)	59 (32.8)	
	Children	6 (7.5)	23 (12.8)	
	No complaints	4 (5.0)	9 (5.0)	
In which teeth have you most commonly observed WSLs during or postorthodontic treatment?	Canines	8 (10.0)	15 (8.3)	7.506, p-value= 0.057
	Incisors	53 (66.3)	137 (76.1)	
	Molars	4 (5.0)	14 (7.8)	
	Premolars	15 (18.8)	14 (7.8)	

[Table/Fig-3]: Association between Dentists' Career Focus and their behaviour regarding WSLs postorthodontic treatment.

Regarding notifying their patients regarding the chance of getting WSLs after orthodontic treatment, most dentists have notified their patients and there were no significant differences between the groups whether it was their specialty, career focus, or years of experience.

Although most dentists reported that adolescent age group patients were the ones who more commonly complained of undesirable

Question	Variables	Dentists' experience in years				Chi-square, p-value
		1 to 5 (129)	6 to 10 (71)	11 to 20 (47)	>20 (13)	
How early have you observed WSLs in an individual undergoing fixed orthodontic treatment?	1 month	33 (25.6)	2 (2.8)	1 (2.1)	0	32.266, p-value= 0.001*
	2 to 6 months	41 (31.8)	25 (35.2)	16 (34.0)	5 (38.5)	
	7 to 12 months	36 (27.9)	25 (35.2)	19 (40.4)	6 (46.2)	
	>12 months	19 (14.7)	19 (26.8)	11 (23.4)	2 (15.4)	
Did you notify the patient that there is a chance to get WSLs after treatment?	No	29 (22.5)	9 (12.7)	8 (17.0)	2 (15.4)	7.044, p-value= 0.317
	Sometime	30 (23.3)	22 (31.0)	7 (14.9)	4 (30.8)	
	Yes	70 (54.3)	40 (56.3)	32 (68.1)	7 (53.8)	
In your practice, do you encounter any specific age group of patients who complain of undesirable aesthetics due to WSLs?	Adolescent	67 (51.9)	36 (50.7)	26 (55.3)	5 (38.5)	13.897, p-value= 0.126
	Adults	39 (30.2)	24 (33.8)	18 (38.3)	3 (23.1)	
	Children	13 (10.1)	10 (14.1)	3 (6.4)	3 (23.1)	
	No complaints	10 (7.8)	1 (1.4)	0	2 (15.4)	
In which teeth have you most commonly observed WSLs during or postor-thodontic treatment?	Canines	10 (7.8)	8 (11.3)	5 (10.6)	0	9.692, p-value= 0.376
	Incisors	101 (78.3)	50 (70.4)	29 (61.7)	10 (76.9)	
	Molars	6 (4.7)	4 (5.6)	7 (14.9)	1 (7.7)	
	Premolars	12 (9.3)	9 (12.7)	6 (12.8)	2 (15.4)	

[Table/Fig-4]: Association between Dentists' years of experience and their behaviour regarding WSLs postorthodontic treatment.
*significant

aesthetics due to WSLs, restorative dentists in contrast to others, observed that 51% of adults more commonly complained. This difference was statistically significant (p-value=0.001). Incisors were the most commonly affected teeth as reported by most dentists, especially the general dentists (p-value=0.001).

[Table/Fig-5] highlights the dentists' practices and attitudes regarding WSLs postorthodontic treatment. All dentist groups except orthodontists believed that they were proficient in diagnosing superficial or deep WSLs and this difference was statistically significant (p-value=0.005). There were no significant differences in their preference of assessment criteria for diagnosis and determining the success of treatment of WSLs (p-value=0.203). All the groups of dentists preferred either exploration of the lesion or followed ICDAS II criteria in this regard.

While planning treatment of superficial, visible WSL on the labial surface of anterior teeth, most dentists preferred applying fluorides of high concentration professionally when compared to wait and watch approach, performing microabrasion procedure or application of CPP-ACP or resin infiltration. This difference was statistically significant (p-value=0.001).

Whereas for a deep visible WSL, cavity preparation followed by restoration was the approach preferred by most dentist groups except for paediatric dentists who liked to do resin infiltration procedure and this difference was statistically significant (p-value<0.001). Application of fluorides of high concentration professionally was less commonly practiced for deep lesions by most dentists. CPP-ACP application and microabrasion were less commonly attempted by most dentists.

Most patients demanded an instant correction of these WSLs (p-value=0.103) as reported by all groups of dentists. Most dentists believed that topical application of high concentration fluorides (p-value=0.095) and CPP-ACP (p-value=0.001) are well suited for treatment of superficial WSLs, whereas, they believed that resin infiltration treatment should be reserved for deeper lesions

Question	Variables	General dentist	Orthodontist	Paediatric dentist	Restorative dentist	Chi-square, p-value
Do you believe that you are proficient in diagnosing deep or superficial WSLs?	Strongly agree	46 (44.2)	20 (37.7)	26 (50)	25 (49)	28.550, 0.005
	Agree	7 (6.7)	1 (1.9)	0	0	
	Neutral	32 (30.8)	11 (20.8)	8 (15.4)	5 (9.8)	
	Disagree	18 (17.3)	21 (39.6)	18 (34.6)	21 (41.2)	
	Strongly disagree	1 (1)	0	0	0	
Which assessment criteria do you consider for diagnosis and determining success of treatment of WSLs of anterior teeth	DIAGNOdent	20 (19.2)	8 (15.1)	9 (17.3)	8 (15.7)	12.189, 0.203
	Exploration of the lesion	39 (37.5)	29 (54.7)	18 (34.6)	23 (45.1)	
	ICDAS II criteria	34 (32.7)	12 (22.6)	23 (44.2)	19 (37.3)	
	QLF	11 (10.6)	4 (7.5)	2 (3.8)	1 (2)	
What do you most commonly advocate if you observe a superficial but visible white spot lesion on labial surface of anterior teeth?	Wait and observe	26 (25)	17 (32.1)	6 (11.5)	6 (11.8)	39.599, p<0.001
	Professionally applied high concentration fluorides	46 (44.2)	23 (43.4)	25 (48.1)	33 (64.7)	
	Home application CPP-ACP paste	8 (7.7)	5 (9.4)	15 (28.8)	5 (9.8)	
	Resin infiltration	14 (13.5)	2 (3.8)	4 (7.7)	5 (9.8)	
	Microa-brasion	9 (8.7)	2 (3.8)	1 (1.9)	1 (2)	
	Cavity preparation and restoration	1 (1)	4 (7.5)	1 (1.9)	1 (2)	
What do you most commonly advocate if you observe a deep but visible white spot lesion on labial surface of anterior teeth?	Cavity preparation and restoration	27 (26)	37 (69.8)	13 (25)	18 (35.3)	65.948 p<0.001
	Home application CPP-ACP paste	9 (8.7)	1 (1.9)	8 (15.4)	1 (2)	
	Microabrasion	10 (9.6)	4 (7.5)	6 (11.5)	3 (5.9)	
	Professionaly applied high concentration fluorides	23 (22.1)	3 (5.7)	5 (9.6)	17 (33.3)	
	Resin infiltration	15 (14.4)	5 (9.4)	15 (28.8)	12 (23.5)	
	Wait and observe	20 (19.2)	3 (5.7)	5 (9.6)	0	
Do your patients commonly ask for instant correction of these WSLs?	Yes	59 (56.7)	35 (66)	31 (59.6)	39 (76.5)	6.194, 0.103
	No	45 (43.3)	18 (34)	21 (40.4)	12 (23.5)	
Which WSLs do you believe are more effectively treated by high concentration topical fluorides?	Superficial	92 (88.5)	52 (98.1)	50 (96.2)	48 (94.1)	6.374, 0.095
	Deep	12 (11.5)	1 (1.9)	2 (3.8)	3 (5.9)	

Which WSLs do you believe are more effectively treated by CPP-ACP?	Superficial	63 (60.6)	49 (92.5)	48 (92.3)	43 (84.3)	32.318, p<0.001
	Deep	41 (39.4)	4 (7.5)	4 (7.7)	8 (15.7)	
Which WSLs do you believe are more effectively treated by resin infiltration?	Superficial	50 (48.1)	25 (47.2)	15 (28.8)	14 (27.5)	10.004, 0.019
	Deep	54 (51.9)	28 (52.8)	37 (71.2)	37 (72.5)	
Which WSLs do you believe are more effectively treated by microabrasion	Superficial	73 (70.2)	27 (50.9)	22 (42.3)	28 (54.9)	12.852, 0.005
	Deep	31 (29.8)	26 (49.1)	30 (57.7)	23 (45.1)	
Which method of treating WSLs do you believe has best aesthetics and patient satisfaction?	CPP-ACP paste	14 (13.5)	3 (5.7)	10 (19.2)	7 (13.7)	30.152, 0.003
	Fluorides	29 (27.9)	13 (24.5)	14 (26.9)	24 (47.1)	
	Microabrasion	16 (15.4)	7 (13.2)	2 (3.8)	3 (5.9)	
	Resin infiltration	25 (24)	6 (11.3)	13 (25)	8 (15.7)	
	Restoration	20 (19.2)	24 (45.3)	13 (25)	9 (17.6)	
Which method of prevention of WSLs would you prefer to use in an individual undergoing orthodontic treatment?	Chlorhexidine varnish	6 (5.8)	1 (1.9)	1 (1.9)	1 (2)	28.289, 0.005
	CPP-ACP paste	13 (12.5)	3 (5.7)	14 (26.9)	6 (11.8)	
	High concentration fluorides	29 (27.9)	17 (32.1)	6 (11.5)	19 (37.3)	
	low concentration fluorides	18 (17.3)	6 (11.3)	15 (28.8)	12 (23.5)	
	Observe good oral hygiene	38 (36.5)	26 (49.1)	16 (30.8)	13 (25.5)	
How long have you followed-up for the treated WSLs?	No follow-up	41 (39.4)	12 (22.6)	6 (11.5)	6 (11.8)	40.388, p<0.001
	3 months	44 (42.3)	14 (26.4)	19 (36.5)	15 (29.4)	
	6 months	13 (12.5)	15 (28.3)	15 (28.8)	18 (35.3)	
	12 months	6 (5.8)	12 (22.6)	12 (23.1)	12 (23.5)	
Have you noticed any undesired effects of treating WSLs?	No	82 (78.8)	48 (90.6)	48 (92.3)	48 (94.1)	10.236, 0.017
	Yes	22 (21.1)	5 (9.4)	4 (7.7)	3 (5.9)	

[Table/Fig-5]: Association between Dentists' knowledge, attitude and practices regarding WSLs postorthodontic treatment.

(p-value=0.019). Concerning microabrasion, general dentists and restorative dentists thought it was more effective in treating superficial WSLs in contrary to the other two groups (p-value=0.05).

The majority of the dentists thought that fluoride treatment has the best aesthetic and patient satisfaction followed by the restoration of teeth and resin infiltration (p-value=0.03). The less preferred options in this regard were microabrasion and CPP-ACP application.

However, in individuals who are undergoing orthodontic treatment, most dentists advocated that proper oral hygiene maintenance and use of high concentration fluoride in contrast to the application of low concentration fluorides, CPP-ACP paste, and chlorhexidine varnish (p-value=0.005).

The follow-up period of 3 months was most commonly observed by most general dentists and paediatric dentists whereas orthodontists and restorative dentists preferred a six month follow-up period (p-value <0.001). Although a majority of the dentists did not observe any undesirable effects after treating WSLs (p-value= 0.017), few reported brown staining with the use of high concentration fluoride.

DISCUSSION

The reported wide prevalence of WSL in the range of 2-96% has been attributed to its inconsistent definitions published in different studies as well as the method that is chosen to detect it [5,8]. A higher prevalence of WSLs has been reported with the use of Quantitative Light Induced Fluorescence (QLF) than with visual inspection [9]. The prevalence of WSLs from pre to postorthodontic treatment periods increases from 15.5-40% to 30-70%, respectively [10]. This is because the fixed orthodontic appliances interfere with oral hygiene maintenance and cause decreased salivary flow thereby enhancing microbial adhesion in the biofilm, acid production, and subsequently enamel demineralisation or WSL formation. This process can occur within one month after initiation of fixed appliance therapy and may persist for five years after its removal, affecting aesthetic appearance [11]. However, it is also reported that WSLs are 1.6 times more likely to develop in patients with treatment duration greater than two years than among those with less than two years duration [12]. The present study reported that 90.8% of dentists observed WSLs during or after orthodontic treatment.

Intratreatment evaluation for WSL is important as there is a possibility of overlooking early WSL unless ligatures or arch wires are removed so that the teeth are devoid of plaque and debris. The existing gingivitis can limit the visibility of enamel between the gingival margin and the orthodontic bracket thereby making the diagnosis of WSL difficult. Hence, the majority of WSL go un-noticed until fixed appliances have been removed [13].

The traditional methods of detecting WSLs such as air drying, visual inspection, and tactile examination by dental probe have the limitations of being subjectivity and lack reproducibility. Hence, the newer methods of better accuracy are gaining importance such as QLF, Transillumination, DIAGNOdent, and imaging techniques like conventional and digital bitewing radiography. In the present study, all the groups of dentists preferred either exploration of the lesion or followed ICDAS II criteria in this regard [14].

Although all teeth pose a certain risk, the most commonly affected are the maxillary anterior teeth. Lateral incisors, followed by canines, premolars, central incisors are the order of incidence [15]. The dentists of present study too reported that the incisors were the most commonly affected teeth due WSL formation during or after orthodontic treatment.

Mouth rinsing daily with either 0.05% NaF Listerine or Corsodyl has been recommended as they prevent WSL formation by inhibiting biofilm formation [16]. A recent study reported that periodic application of fluoride varnish prevents white spot lesion formation but results were not statistically significant among individuals who maintain their oral hygiene well [17]. Patients who exhibited poor oral hygiene during preorthodontic treatment have been reported to be 6.5 times more likely to develop WSLs than their counterparts with good oral hygiene. Hence, patients undergoing orthodontic treatment with aligners are less likely to develop WSLs than those with traditional braces, due to shorter treatment duration and a better possibility of maintaining oral hygiene [12].

A combination of multiple approaches has the greatest success in preventing these WSLs. For individuals who are at low risk of developing these lesions, an oral hygiene maintenance protocol is recommended that includes oral prophylaxis (six monthly), diet counselling, patient education, and fluoridation. However, for

individuals with high risk, the protocol should include frequent prophylaxis (three monthly), chlorhexidine, and fluoride application [18]. Although there is no golden standard, the management of WSLs depends on the degree and activity level of the lesion. Remineralisation of the lesion is the most preferred approach that should be tried by either increasing the level of fluoride, calcium, and phosphate in saliva and/or plaque. Self applied topical fluorides either as mouth rinses or dentifrices have been used widely to prevent and remineralise WSLs. The efficacy of these agents demands long term patient compliance and is determined by the frequency and the amount of use. Despite being frequently used, the use of fluoridated dentifrices in preventing new early WSLs during fixed orthodontic treatment needs more evidence [19]. Professional topical fluorides available as gels, foams, and varnishes deliver higher fluoride concentrations on enamel and prevent demineralisation or help in remineralisation. Postorthodontic WSLs take over eight weeks to remineralise after debonding, however, these lesions may persist for long if timely and appropriate intervention is not provided [11].

Although compliance is considered as a shortcoming of a mouth rinse, it has been reported that patients who exhibited poor oral hygiene but followed rinsing strictly with 0.5% sodium fluoride, showed a significant reduction in the incidence of WSL [20]. The patients lacking motivation for oral hygiene maintenance during orthodontic treatment pose a challenge and are ideal candidates for the use of fluorides and antimicrobial agents [21]. A recommended treatment is to topically apply fluoride varnish on the labial surface of anterior teeth especially around the orthodontic brackets on every appointment. This simple but frequent therapy works well even when minimal plaque is present on the tooth surface and prior professional tooth cleaning is not required [22]. Although the use of fluoride with high concentrations would seem more effective to treat WSL, undesirable aesthetic consequences are frequently encountered in practice. These high concentration fluorides when applied immediately after orthodontic treatment may cause remineralisation of the most superficial layer of enamel only but the deeper layer of demineralised enamel crystals are not remineralised in the process. Hence, for aesthetic and complete recovery from demineralisation, it is advisable to apply lower concentrations of fluorides, which cause slower penetration of calcium and fluoride ions from saliva into the WSLs, thereby filling all the voids. Further, they prevent hypermineralisation of the outer enamel surface, which might obstruct further remineralisation of deeper enamel lesions [21]. A contrasting finding suggests that low concentration fluoride treatment has a positive clinically aesthetic outcome on the WSLs but the stability is comparable to the effect of remineralisation of enamel by saliva [23].

Alternative to fluorides, CPP-ACP has been reported to promote remineralisation and maintain a supersaturated level of calcium and phosphate in saliva and thereby decreasing demineralisation and enhancing remineralisation of WSLs. The remineralising potential of CPP-ACP on WSL postorthodontic treatment when compared with placebo/fluoridated toothpaste and fluoride varnish revealed no statistically significant difference which necessitates further clinical comparisons to improve the level of evidence [24]. The efficacy of CPP-ACP in remineralising white spots lesions is enhanced when used along with fluoride and so was the demineralisation inhibitory potential [25,26]. It has also been reported that for remineralisation of postorthodontic WSLs, the use of CPP-ACP could be more beneficial than fluoride rinse [27]. If the use of low concentration fluoride does not improve aesthetic results, approaches such as resin infiltration or microabrasion should be considered which causes camouflage of WSLs. Resin infiltration has recently emerged as a popular modality to aesthetically treat WSLs. A low viscosity resin of refractive index similar to sound enamel is made to flow into the previous demineralised enamel matrix (up to 400 μm) thereby displacing air or water and filling the porous voids of WSLs as well as restoring the normal refractive index of enamel. The procedure involves rubber dam isolation, etching these lesions with hydrochloric acid (15%) for two minutes, rinsing, applying ethanol drying agent to dessicate the surface, and then applying low viscosity resin, removing gross

Sr. No.	Author's name and year	Place of study	Sample size	Prevalence of WSL	Conclusion
1.	Hamdan AM et al., (2012) [7]	Virginia, Maryland and North Carolina.	Orthodontists=305, General dentists=191	NA	WSLs result in a general dentist having a negative perception of the orthodontist. Hence, both need to work synchronously to reduce the incidence of lesions. Treatment after debonding should include the topical application of low concentrations of fluoride.
2.	Tufekci E et al., (2011) [10]	Richmond	Orthodontic patients=400	46%	Evaluating the patient's oral hygiene during the initial treatment period and implementing preventive treatment can prevent the incidence and severity of WSLs.
3.	Dimova E et al., (2020) [32]	Bulgaria	General dentists and any two specialty dentists=200	NA	The caries risk assessment should be performed before placement of the fixed orthodontic appliances on the teeth to keep a check of factors promoting WSLs.
4.	Azeem M and Hamid WU, (2017) [33]	Pakistan	Orthodontic patients=25	2.85%	Clear aligner orthodontic therapy led to the development of fewer new WSLs suggesting it as a preferred choice in patients who are at risk.
5.	Eslamipour F et al., (2017) [34]	Iran	Orthodontists=109	NA	Orthodontists (94.4%) followed good practice, especially women who had significantly higher scores than men. The commonly advocated methods were in-home instructions and flouride containing toothpastes.
6.	Akin M et al., (2013) [35]	Turkey	Orthodontic patients=150	65%	Gender and duration of orthodontic therapy were not associated with WSL development, whereas the age of the patient when treatment had initiated and oral hygiene had a strong influence on it.
7.	Maxfield BJ et al., (2012) [36]	Richmond	Orthodontic patients=315, Parents=279, Orthodontists=305, General dentists=191	NA	All four groups had similar perceptions regarding the significance, prevention, and treatment of WSLs. Regarding the prevention of WSLs, patients felt self responsible for these lesions more often than any other group (p-value<0.05)
8.	Richeter AE et al., (2011) [37]	Michigan	Orthodontic patients=350	72.9%	The extensive fixed orthodontic treatment increased the incidence of WSL and even the preventive dental treatment resulted in limited improvement.
9.	Enaia M et al., (2011) [38]	Germany	Orthodontic patients=400	73.5%	The WSL that develops during treatment can show improvement during the retention period. Those individuals with good oral hygiene developing WSLs tend to show improvement often.
10.	Present Study	Jeddah	Paediatric dentists (52), Orthodontists (53), Restorative dentists (51), General dentists (104).	90.8%	Dentists commonly observe WSLs during the initial 7 to 12 months period of starting orthodontic therapy, more commonly on incisor teeth among the adolescent age group. The dentists recommended maintaining good oral hygiene as the most effective way of preventing WSLs.

[Table/Fig-6]: Findings of related studies that have been published [7,10,32-38].

excess, and light curing for 40 seconds. This approach appears to be more successful in completely masking WSL lesions that have not been completely arrested [28]. The camouflage effect, as well as the colour and lightness of the resin infiltrant, do not alter significantly up to 12 months, and hence can be recommended as an aesthetic alternative to fluorides in postorthodontic WSLs [29]. All the dentists of the present study especially the paediatric dentists and restorative dentists believed that the resin infiltration procedure is more effective and should be reserved for deeper WSLs.

Microabrasion is a more invasive treatment with prompt results for the management of postorthodontic WSLs which are limited to the outer enamel layer [30]. It removes the discoloured surface enamel mechanically and is performed using hydrochloric acid containing abrasive slurry or abrasive powders applied with high pressurised air [7]. If these remineralisation techniques of preventing WSLs fail to improve aesthetics within the desired time frame, the use of microabrasion on the enamel surface can be considered to eliminate localised WSLs. Microabrasion is an effective treatment for cosmetic improvement of long-standing WSLs [21], but there is evidence that the rough surface still could exist following treatment and therefore prone to discolour [31]. Infiltration and microabrasion significantly improve the whitish appearance of these lesions and create substantial colour improvement visibly [23]. The orthodontists and paediatric dentists of the present study believed that microabrasion works well in deeper lesions in contrast to the opinion of general dentists and restorative dentists.

For deep visible WSLs, cavity preparation followed by restoration was the approach preferred by most dentist groups in the present study. The last resort to restore aesthetics for such WSLs would be the use of composite resin restorations or porcelain veneers but they require the removal of sound enamel and are less economic [21].

Although multiple options are available, it would be wise to identify these WSLs early and plan preventive management which has better aesthetic results and is economical. It is recommended that for prevention of the WSLs, the fluorides and CPP-ACP are desirable whereas for treating long term WSLs after orthodontic treatment microabrasion, resin infiltration or restoration are the available treatment options. However, these lesions need to be monitored by regular follow-ups for determining the effectiveness of treatment, also check for the development of newer lesions, and also initiate any alternate treatment to arrest them. Hence, the practicing dentists should motivate their patients to follow good oral hygiene practices to reduce caries risk and reporting to regular follow-ups. In the present study, the specialty dentists recommended longer time follow-up duration of three, six and 12 months when compared to general dentist who advocated 3 months follow-up period. However, most dentists did not observe any undesirable effects related to the treatment of WSLs. A summary of findings of studies that have been published related to WSLs is shown in [Table/Fig-6] [7,10,32-38].

Limitation(s)

This was a questionnaire based study and the limitation of this study was that no clinical correlation about prevalence was done.

CONCLUSION(S)

Dentists commonly observe WSLs during the initial 7 to 12 months period of starting orthodontic therapy, more commonly on incisor teeth among the adolescent age group. The dentists recommended maintaining good oral hygiene as the most effective way of preventing WSLs. They also believed that high concentration fluoride agents are well suited for treating superficial lesions and composite resin restorations for deeper lesions.

These findings suggest that it is important to align the preferences of the practicing dentists with that of the orthodontist and with recent evidence based recommendations to successfully prevent or treat these WSLs early during/postorthodontic treatment in a cost effective, aesthetic and patient satisfying way. More longitudinal studies are required that target ethnic groups to ascertain the specific role of each factor causing these WSLs and comparing the various treatment modalities related to the aesthetic and long term success as well as patient satisfaction.

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ANNEXURE 1

White spot lesions on anterior teeth during or postorthodontic treatment: A cross sectional survey

Questionnaire

1. Are you a
   a. General dentist
   b. Orthodontist
   c. Paediatric dentist
   d. Restorative dentist
2. Are you a
   a. Clinician
   b. Academician
3. Years of experience:
   a. 1 to 5
   b. 6 to 10
   c. 11 to 20
   d. > 20
4. Have you encountered any white spot lesions (WSLs) on your patient's teeth during or postorthodontic treatment? (P)
   a. Yes
   b. No
5. How early have you observed WSLs in an individual undergoing fixed orthodontic treatment? (P)
   a. 1 month
   b. 2 to 6 months
   c. 7 to 12 months
   d. More than 12 months
6. Did you notify the patient that there's a chance to get WSLs after treatment? (A)
   a. Yes
   b. No
   c. Sometime
7. In your practice, do you encounter any specific age group of patients who complain of undesirable aesthetics due to WSLs? [P]
   a. Children
   b. Adolescent
   c. Adults
   d. No, all groups complain
8. In which teeth have you most commonly observed WSLs during or postorthodontic treatment? (P)
   a. Incisors
   b. Canines

c. Premolars
d. Molars

9. Do you believe that you are proficient in diagnosing deep or superficial WSLs? (A)
   a. Strongly agree
   b. Agree
   c. neutral
   d. Disagree
   e. Strongly disagree
10. Which assessment criteria do you consider for diagnosis and determining success of treatment of WSLs of anterior teeth (P)
   a. ICDAS II criteria
   b. DIAGNOdent
   c. Exploration of the lesion
   d. QLF
11. What do you most commonly advocate if you observe a superficial but visible WSL on labial surface of anterior teeth? (P)
   a. Wait and observe
   b. Professionally applied high concentration fluorides
   c. Home application Casein Phosphopeptide Amorphous Calcium Phosphate (CPP-ACP) paste
   d. Resin infiltration
   e. Microabrasion
   f. Cavity preparation followed by restoration
12. What do you most commonly advocate if you observe a deep but visible white spot lesion on labial surface of anterior teeth? (P)
   a. Wait and observe
   b. Professionally applied high concentration fluorides
   c. Home application Casein Phosphopeptide Amorphous Calcium Phosphate (CPP-ACP) paste
   d. Resin infiltration
   e. Microabrasion
   f. Cavity preparation followed by restoration
13. Do your patients commonly ask for instant correction of these WSLs? (A)
   a. Yes
   b. No
14. Which WSLs do you believe are more effectively treated by high concentration topical fluorides? (K)
   a. Superficial
   b. Deep
15. Which WSLs do you believe are more effectively treated by CPP-ACP? (K)
   a. Superficial
   b. Deep
16. Which WSLs do you believe are more effectively treated by resin infiltration? (K)
   a. Superficial
   b. Deep
17. Which WSLs do you believe are more effectively treated by microabrasion? (K)
   a. Superficial
   b. Deep
18. Which method of treating WSLs do you believe has best aesthetics and patient satisfaction? (P)
   a. Fluorides
   b. CPP-ACP paste
   c. Resin infiltration
   d. Microabrasion
   e. Restoration
19. Which method of prevention of WSLs would you prefer to use in an individual undergoing orthodontic treatment? (A)
   a. High concentration fluorides
   b. low concentration fluorides
   c. CPP-ACP paste
   d. Chlorhexidine varnish
   e. Observe good oral hygiene
20. How long have you followed-up for the treated WSLs? (A)
   a. No follow-up
   b. 3 months
   c. 6 months
   d. 12 months
21. Have you noticed any undesired effects of treating a WSL? (P)
   a. No
   b. Yes