Original Article

Knowledge and Practice of Orthodontists Regarding Prevention and Treatment of White Spot Lesions during Fixed Orthodontic Treatment Course in Kurdistan Region-Iraq: A Cross Sectional Study

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Abstract

Objectives: White spot lesions (WSL) are considered the most frequent complication during fixed orthodontic treatment. The aim of the present study was to assess the knowledge and practice levels of orthodontic professionals regarding the prevention and treatment of WSL in the Kurdistan region-Iraq.

Methods: This cross-sectional study was conducted by distributing a validated self–administered questionnaire among orthodontic professionals and dentists practicing orthodontics. The questionnaire included ten questions about the knowledge and nine for the practice with regard to the prevention and treatment of WSL. Data were analyzed by descriptive tests, Kruskal-Wallis test, and the Mann Whitney test.

Results: Sixty orthodontists and dentists practicing orthodontics participated in the study. Most participants (78.3%) had intermediate knowledge, and 66.7% recorded high practice scores. The knowledge and practice scores in female orthodontists and participants with postgraduate orthodontics degrees were significantly higher than in male orthodontists and those without a postgraduate degree (P = 0.0001).

Conclusions: Participants exhibited good knowledge and experience and good practice in the prevention and treatment of WSL. It is recommended to have special practice guidelines for the prevention of WSL.

Keywords: *White spot lesions, Fixed orthodontic appliance, Orthodontist, Knowledge, Practice.*

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Introduction

Fixed orthodontic appliances are considered as foreign artificial intra-oral devices facilitating both plaque and food debris accumulation that influences oral health to a great extent. The substantial proliferation of cariogenic and periodontal pathogens has been significantly noticed[1]. Orthodontic brackets, ligatures, elastics, and other parts act as barriers against the plaque removing forces of mastication and salivary flow reaching the tooth surface, resulting in poor oral hygiene[2]. Consequently, microbial colonization and settlement of Streptococcus, Lactobacillus, and Candida species within the dental plaque will be enhanced. A fixed orthodontic appliance favors the colonization of cariogenic bacteria such as *Streptococcus mitis, Streptococcus sobrinus* that eventually lead to decentralization of the inorganic component of the tooth structure, organic dissociation, and dental caries initiation[3].

The first clinical evidence of demineralization is white spot lesions (WSL), which are subsurface porosities of the enamel that change the light scattering, rendering them white-milky in appearance[4]. Despite many advances and research approaches for preventing WSL, this undesirable treatment outcome remains the most common complication during fixed orthodontic treatment. The incidence of WSL was reported to be up to 90%[5]. Patients undergoing orthodontic treatment, their parents, and orthodontists need to be aware of the potential risk of WSL development following orthodontic treatment and that this will reduce the overall appearance of straight teeth[6]. At least one WSL will develop in 72.9% of patients undergoing orthodontics, 2.3% of which will become cavitated[7].

Various preventive measures to decrease the occurrence of WSL have been reported, such as frequent daily tooth brushing, mouth rinsing with fluoridated toothpaste, and professional fluoride application (fluoride varnish)[5]. Other advanced techniques, such as the use of enzyme dentifrices, e.g., amyloglucosidase and glucose oxidase, instead of fluoride-containing dentifrices, were also proposed[8]. Also, the CPP-ACP application as a remineralization agent is another example of novel preventive measures[9]. Despite these preventive measures, orthodontic professionals still have to confront the WSL issue[6].

Orthodontists were mainly responsible for preventing WSL by continuously advising their patients about the importance of maintaining good dietary compliance and an excellent oral hygiene regime[6]. Therefore, orthodontists must improve their knowledge and practice to take on active responsibility for this task. To the best of our knowledge, there is a scarcity of studies regarding the knowledge and practice of orthodontists on the prevention and treatment of WSL in the Kurdistan region-Iraq. Therefore, this study aimed to evaluate the knowledge and practice of prevention and treatment of WSL among orthodontists and dentists practicing orthodontics.

Patients and methods

Study design

This cross-sectional survey was conducted on orthodontists (specialists and dentists practicing orthodontics) in public and private sectors throughout the Kurdistan region, Iraq, from July 2020 to September 2020. Approval from the ethics committee (number: 376) of the Medical Colleges, University of Sulaimani, was obtained before conducting the survey. A multi-stage sampling technique was followed in the three large cities of the Kurdistan region to gather information from the participants. Assessment of orthodontists' knowledge and practice regarding the prevention and treatment of WSL was the primary outcome of the study.

Elements of the questionnaire and scoring methods

A specially constructed self-administered questionnaire was prepared for the current study following a Likert-scale research design (Table 1). The questionnaire was mailed via post to the participants, with a covering letter illustrating the project's purpose. The researchers promptly collected the completed questionnaires. Participation was voluntary, and all potential respondents were informed that participants' identities would remain anonymous. A team of 5 specialist orthodontists verified questionnaire validity. Their comments were taken into consideration. Afterward, the questionnaire reliability was tested in a pilot study by 25 orthodontists (Cronbach's $\alpha = 0.615$).

The questionnaire was divided into three sections: section one involved questions related to participants' socio-demographic characteristics and practice. This included the participant's age, gender, years of experience, and postgraduate orthodontic specialty if present. Section two (questions 1-10) focused on the orthodontists' knowledge regarding WSL. Section three (questions 11-19) concentrated on the orthodontists' practice involving clinical preventive measures, both

conventional and novel techniques, regarding WSL occurrence during the orthodontic treatment course (Table 1).

Calculation of knowledge and practice scores

The responses to the questions were scored as follows: 4 points for "totally agree", 3 points for "agree", 2 points for "disagree" and 1 point for "totally disagree". By summing the degree of orthodontists' knowledge obtained from answers to related questions, the orthodontists' knowledge was assessed. Accordingly, three-level (low, intermediate, high) index scores for knowledge and practice were created, according to Daniels (1987). This methodology was followed by creating a total score for knowledge of 40 points and 36 points for practice.

In the case of knowledge scores, the final levels were classified into three groups:

A. Group 1: ≤20 (Low knowledge score)

B. Group 2: 21-30 (Intermediate knowledge score)

C. Group 3: 31-40 (High knowledge score)

In the case of practice score, the final levels were classified into three groups:

A. Group 1: ≤ 18 (Low practice score)

B. Group 2: 19-27 (Intermediate practice score)

C. Group 3: 28-36 (High practice score)

Sample size calculation

The number of officially registered specialists and practitioners with licenses from the Kurdistan Dental Association to practice orthodontics in the Kurdistan region was 70. The sample size was determined according to the following formula: $n = p\ (100-p)\ z2/E2$

Where n is the required sample size, P is the percentage occurrence of a state or condition, E is the percentage maximum error required, Z is the value corresponding to the level of confidence required. The calculated sample was equal to 60, which was rounded to 67 (taking 10% dropout rate).

Statistical analysis

The demographic data were analyzed in terms of mean, standard deviation, range, frequency, and distribution. The sum of each question in both the knowledge and practice part of the questionnaire was calculated and then compared with gender, postgraduate orthodontics degree (yes or no) by Mann Whitney test. Furthermore, the Kruskal-Wallis test was used to compare the sum of the questions in both parts of the study with years of experience (≤ 4, 5-10, 11-15, and 16-20). The significant difference was set at $p< 0.05$. All statistical analysis was performed using GraphPad Prism software (version 8.4.3).

Results

Characteristics of the study population

Sixty orthodontists (50 female and ten male) returned the questionnaire and were included in the final analysis. This response rate was equal to 90% of the calculated sample size, which was considered representative of the targeted population. The mean age of participants was 40.9 ± 6.4 years old, and the majority of them had postgraduate degrees in orthodontics (68.3%) with 5-15 years of experience in the field (53.4%), summarized in Table 2.

Knowledge level

The majority of participants achieved intermediate knowledge scores (78.3%), and 21.7% achieved high knowledge scores (Table 3). The sum of participants who totally agreed and only agreed that WSL is a major issue in orthodontics was 78.4%. Those who totally agreed and only agreed that WSL could be prevented and treated accounted for 83.3%. Half of the participants considered WSL as a reversible condition, and 31.7% of them believed that WSL could occur as early as four weeks; in addition, 86.7% thought that duration of orthodontic treatment is associated with increased occurrence of WSL. Male (55%) and permanent maxillary teeth (68.3%) were thought to be affected by most of the study participants. In total, the percentages of those who totally agreed or only agreed with the knowledge section questions were 15.5% and 54.8%, respectively (Table 4).

Practice level

Two-thirds of the study population achieved high practice scores, and one third achieved intermediate practice scores (Table 3). The orthodontists' practice regarding prevention and treatment of WSL can be classified into three strategy stages: pretreatment instruction to the patients and their parents (questions 11, 12, and 13), during treatment (questions 14 and 15), and post-treatment interventions (questions 16, 17, 18 and 19) (Table 5).

Regarding the pretreatment strategy, 83.3% and 60% of the orthodontists agreed with informing the patients of the probability of caries development during treatment and would provide instructions to the patients, respectively. Furthermore, 48.3% agreed with the prescription of fluoridated mouthwash plus fluoridated toothpaste to combat WSL. None of the participants disagreed with the pretreatment strategy questions (Table 5). During treatment, 55% of them agreed with strategies of regular checking for caries and WSL, whereas 70% of them agreed with regular repetition of oral hygiene instructions and home care prescription (Table 5). As post-treatment strategies, most of the study population (68%) only agreed that professional fluoride therapy is one of the most ideal, practical ways to defeat WSL, and half of them disagreed with using micro-abrasion as a tool for WSL treatment. Resin infiltration was more preferred than bleaching as a post-treatment modality for WSL. The responses that totally agreed and only agreed with the practice questions amounted overall to 438 (81.1%) (Table 5).

Gender and having a postgraduate orthodontics degree were found to have a statistically significant effect on the study population's knowledge ($p= 0.0001$). At the same time, this was not the case with years of experience ($p>0.05$) (Table 6). Similarly, gender and academic degree were found to have a statistically significant impact on participants' practice levels. Again, years of practice did not show any impact on practice levels (Table 6).

Discussion

White spot lesion is the most common complication of fixed orthodontic treatment, and 72.9% of orthodontic appliance wearers will potentially develop at least one or more WSLs during treatment[7]. Orthodontists play an important role in the prevention and management of this problem by instructing their patients on oral health care. Orthodontists are considered as having the main responsibility for the prevention of WSL[6]. Therefore, enhancing their knowledge and practice for the prevention of WSL should be encouraged. This is the first study to examine the knowledge and practice levels regarding WSL among orthodontists and dentists practicing orthodontics in Kurdistan region-Iraq. The results showed that the majority of participants have intermediate knowledge and high practice levels. Those who totally agreed or only agreed with knowledge and practice questions were 70.3% and 81.1%, respectively.

Regarding the participants' knowledge of the research problem, most of them (78%) agreed or agreed that the development of WSL is a major issue. This implies an imperative concern among the orthodontists toward updating their knowledge to protect their patients against this undesirable condition. Interestingly, most of the participants believed that WSL could be prevented in the first place, and once it develops can be treated. However, only half of the participants agreed on the reversibility of WSL. Duration of orthodontic treatment is associated with an increase in the prevalence of WSL[10]. In the present study, most of the respondents (57%) agreed that the duration of orthodontic treatment is significantly associated with the occurrence of WSL. This may be due to prolonged exposure to the accumulated plaque around the bracket leading to an increase in the prevalence of WSL. This is well reported in a meta-analysis study by Sundararaj et al. (2015)[11]. Other studies also reported the relationship between increasing WSL incidence and increasing treatment duration[12].

In terms of gender, male patients tend to develop more WSL than females[10]. In the current study, more than half of the respondents (53.3%) agreed that the prevalence of WSL is higher in males than females. This may be due to the fact that females engage better with oral hygiene measures, having a greater interest in oral health and perceiving their oral health to be good to a higher degree than males[13]. Most of the participants (60%) disagreed with the early occurrence of WSL in the first four weeks after fixed orthodontic treatment. This is not in line with a finding from the literature[7,10,14], but could be related to the fact that during fixed orthodontic treatment, it is difficult to notice the formation of WSL due to the enamel surface needing to be desiccated to visualize the WSL at early stages and this is further obscured by the presence of plaque[15].

Regarding participants' practice levels, novel approaches, techniques, and materials have been developed to improve the prevention and management of WSL, which include CPP-ACP, probiotics, antiseptics, polyols, sealants, and lasers before and during treatment. Additionally, tooth bleaching, resin infiltration, and micro-abrasion have also been recommended after debonding. Despite the previously mentioned advanced techniques, daily oral hygiene measures are still at the forefront of prophylactic measures to prevent WSL development in fixed orthodontic appliance wearers[16]. Accordingly, the crucial role of the orthodontists and oral health care

Table 1: Survey questionnaire.

Age:					
Gender: Male Female					
Orthodontic post graduate degree: Yes No					
Years of practice: 0-4 5-10 11-15 16-20					
No.	Questions	Totally agree	Agree	Disagree	Totally disagree
1	White spot lesion (WSL) is a major issue with orthodontics				
2	White spot lesion can be prevented				
3	White spot lesion can be treated				
4	White spot lesion is a reversible condition				
5	WSL is a sub-surface decalcification of enamel				
6	The teeth most commonly affected by decalcification during orthodontic courses are: Maxillary Lateral incisor followed by mandibular canine				
7	Duration of orthodontic treatment is associated with significant increase in the occurrence of WSL				
8	Clinically, formation of WSL around orthodontic attachments can occur as early as 4 weeks after treatment				
9	Males are more affected than females				
10	The maxillary posterior segments are the sites least commonly affected by WSL				
11	The patients should be informed about caries development during treatment courses				
12	Orthodontist is more preferred to give instructions to the orthodontic patients about oral health care during treatment				
13	Prescription of fluoridated mouthwash is essential for orthodontic patients because fluoridated toothpaste alone is not enough to combat WSLs				
14	I perform check-ups for caries and white spot lesions on a regular basis				
15	Repeating instructions to the patients about oral hygiene and home care prescription are the best ways for intervening in WSL				
16	Professional fluoride therapy is one of the most ideal, practical ways to defeat WSL				
17	Microabrasion is considered to be one of the treatment methods for WSL				
18	Bleaching is considered to be one of the treatment methods for WSL				
19	Resin infiltration is a minimally invasive restorative treatment for post-orthodontic WSL				

Table 2: Demographic variables and details of the study population.

Variable	Mean and SD		
Age (years)	40.9 ± 6.4		
		Frequency	Percentages
Years of practice	0 – 4 years	18	30
	5 - 10 years	16	26.7
	11 – 15 years	16	26.7
	16 – 20 years	10	16.7
Gender	Males	50	83.3
	Females	10	16.7
Orthodontic post graduate degree	Yes	41	68.3
	No	19	31.7

Table 3: Knowledge and practice scores of the study population.

Assessment	Scores	Frequency	Percentage
Knowledge	Low (≤20)	0	0
	Intermediate (21 - 30)	47	78.3
	High (31-40)	13	21.7
Practice	Low (≤18)	0	0
	Intermediate (19 - 27)	20	33.3
	High (28- 36)	40	66.7

Table 4: Participants' responses to knowledge related questions.

No.	Knowledge related questions	Responses no. (%)			
		Totally agree	Agree	Disagree	Totally disagree
1	White spot lesion (WSL) is a major issue with orthodontics	13 (21.7)	34 (56.7)	13 (21.7	0
2	WSL can be prevented	8 (13.3)	42 (70)	10 (16.7)	0
3	WSL can be treated	6 (10)	44 (73.3)	8 (13.3)	2 (3.3)
4	WSL is a reversible condition	2 (3.3)	28 (46.7)	28 (46.7)	2 (3.3)
5	WSL is a sub-surface decalcification of enamel	12 (20)	46 (76.6)	2 (3.3)	0
6	The teeth most commonly affected by decalcification during orthodontic courses are: Maxillary Lateral incisor followed by mandibular canine	6 (10)	36 (60)	18 (30)	0
7	Duration of orthodontic treatment is associated with significant increase in the occurrence of WSL	34 (56.7)	18 (30)	8 (13.3)	0
8	Clinically, formation of WSL around orthodontic attachments can occur as early as 4 weeks after treatment	3 (5)	16 (26.7)	36 (60)	5 (8.3)
9	Males are more affected than females	1 (1.7)	32 (53.3)	23 (38.3)	4 (6.7)
10	The maxillary posterior segments are the sites least commonly affected by WSL	8 (13.3)	33 (55)	19 (31.7)	0
Total		93 (15.5)	329 (54.8)	165 (27.5)	13 (2.2)

Table 5: Participants' responses to practice related questions.

No.	**Practice related questions**	Responses no. (%)			
		Totally agree	Agree	Disagree	Totally disagree
11	The patients should be informed about caries development during treatment courses	50 (83.3)	10 (16.7)	0	0
12	Orthodontist is more preferred to give instructions to the orthodontic patients about oral health care during treatment	36 (60)	22 (36.7)	2 (3.3)	0
13	Prescription of fluoridated mouthwash is essential for orthodontic patients because fluoridated toothpaste alone is not enough to combat WSLs	29 (48.3)	27 (45)	4 (6.7)	0
14	I perform check-ups for caries and white spot lesions on a regular basis	33 (55)	24 (40)	1 (1.7)	2 (3.3)
15	Repeating instructions to the patients about oral hygiene and home care prescription are the best ways for intervening in WSL	42 (70)	12 (2)	4 (6.7)	2 (3.3)
16	Professional fluoride therapy is one of the most ideal, practical ways to defeat WSL	12 (20)	41 (68)	7 (11.7)	0
17	Microabrasion is considered to be one of the treatment methods for WSL	9 (15)	20 (33.3)	30 (50)	1 (1.7)
18	Bleaching is considered to be one of the treatment methods for WSL	0	21 (35)	35 (58.3)	4 (6.7)
19	Resin infiltration is a minimally invasive restorative treatment for post-orthodontic WSL	12 (20)	38 (63.3)	10 (16.7)	0
Total		223 (41.3)	215 (39.8)	93 (17.2)	9 (1.7)

Table 6: Comparison of Knowledge and Practice with participants' sociodemographic characteristics.

	Demographical variables		Mean ± SD	p-value
Knowledge	Gender	Male	28.18±2.685	**0.0001**[a]
		Female	29.3 ± 2.983	
	Postgraduate orthodontic degree	Yes	28.70 ± 2.31	**0.0001**[a]
		No	27.63 ± 3.45	
	Years of experience	≤ 4	128.55 ± 3.63	0.347 [b]
		5-10	28.93 ± 2.48	
		11-15	28.43 ± 2.23	
		16-20	27.00 ± 1.63	
Practice	Gender	Male	28.6 ± 2.91	**0.0001**[a]
		Female	30.2 ±1.87	
	Postgraduate orthodontic degree	Yes	29.65 ± 2.25	**0.0001**[a]
		No	27.16 ±3.2	
	Years of experience	≤ 4	28.16 ± 2.93	0.673[b]
		5-10	28.81±3.29	
		11-15	29.31±2.62	
		16-20	29.5 ±2.12	

a significance at $p<0.05$ by Mann Whitney test
b significance at $p<0.05$ by Kruskal-Wallis test

instructors regarding the prevention of this unfavorable lesion cannot be ignored[15]. In the present study, 83% of the participants agreed with providing instructions about the development of WSL during fixing of orthodontic appliances. It is acknowledged in the literature that orthodontists have to motivate their patients to implement and maintain good oral health[17].

In the current study, most participants (55%) performed WSL check-ups regularly, and likewise, the literature encourages the documentation of all WSL using intraoral photographs prior to commencing treatment[18]. Instruction on oral hygiene measures by orthodontists effectively reduces WSL, and it was found that most orthodontists themselves provide such instruction to their patients[19]. Frequent reminders have been found to be effective in reducing the incidence of WSL among orthodontic patients[20]. Nearly 98.2% of the orthodontists in the current study stated that instruction on oral health care is given to their patients by themselves or by their staff, indicating that orthodontists and orthodontic practitioners implement good practice in this regard.

Several methods have been demonstrated in the literature to prevent WSL, such as applying highly concentrated fluoride varnish[5]. In this study, a large majority of the participants agreed (68%) or agreed (20%) that professional fluoride application is an ideal practice for the treatment of WSL. Additionally, most of the participants agreed (46%) or agreed (47%) that fluoridated toothpaste alone is not enough to prevent WSL, and a fluoridated mouthwash should accompany it. Researchers have found the daily application of fluoridated mouthwash in addition to fluoridated toothpaste is effective in reducing the incidence of WSL because increasing the fluoride level in the oral fluid leads to better dental caries control[11,21].

Post-treatment interventions for WSL management fall into two categories: Firstly: natural remineralization of enamel to a certain degree in addition to the generation of more ecologically friendly conditions[22]. According to a systematic review, the application of fluoride varnish is an effective intervention in the treatment of post-orthodontic WSL[23]. Further interventions involve the use of remineralizing agents such as CPP- and topical fluoride[9]. The benefit of the daily use of fluoridated toothpaste in promoting remineralization

cannot be forgotten. In this study, 68% of the participants agreed that professional fluoride application is an ideal practice for the treatment of WSL. Secondly, a Korean in vitro study revealed that alleviation of the white spot conspicuity via tooth bleaching with fluoridation is considered to be another invasive approach in the treatment of WSL[24]. Moreover, the whitish manifestation of WSL can be minimized with micro-abrasion and resin-infiltration treatments[25].

In the current study, most of the participants (80%) agreed or agreed that they considered resin infiltration as a minimally invasive restorative treatment for the treatment of WSL. Whereas, half of the participants disagreed with considering micro-abrasion as one of the methods for the treatment of WSL, which could be attributed to their lack of awareness in this regard. Meanwhile, bleaching is known as a method for treating WSL[24]; due to its effect, it diminishes the contrast between the WSL and the rest of the enamel surface. In the current study, the majority of participants (58.3%) disagreed on considering bleaching to be one of the treatment methods for WSL, which is in line with a systematic review published in 2020 that found no solid data supporting the application of bleaching as an effective method for management of post-orthodontic WSL[26].

There was also a strong relationship between high knowledge and practice scores and gender. Females' practice scores were significantly higher than men's, and a similar result was found in a study on Iranian orthodontists' practice[4]. This may be due to the fact that females have a higher awareness of and interest in oral health than males[13]. Further, the survey showed no relationship between years of experience and knowledge and practice; this is also reported in a study by Charalambous et al. (2013), where no significant relationship was found between the dentists' age and their efficacy[27]. Also, a significant relationship was observed between high levels of practice and knowledge and having a postgraduate degree in orthodontic. So, increasing the level of awareness to WSL by intensive seminars and workshops to orthodontists to increase the level of knowledge is crucial.

This study is limited by the fact that the prevalence of WSL among patients managed by the studied population was not examined to find the relation between knowledge and practice levels of orthodontists on WSL and the occurrence of WSL among their patients. Moreover, patients' views on the occurrence of WSL were not examined.

Conclusions

Iraqi Kurdistan orthodontists showed moderate-high knowledge and practice regarding the prevention and treatment of WSL. Gender and having a postgraduate orthodontic degree were significantly related to levels of knowledge and practice. Further studies are recommended to investigate patients' and parents' views on WSL. The results of this study need to be verified by relating the incidence of WSL within-subjects treated by these orthodontists to their knowledge and practice level.

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