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Prevalence of "White Spots" Around Orthodontic Brackets: A Clinical Study

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الخلاصة

ألاهدف: تهدف الدراسة الى بيان مدى تفشي البقع البيضاء في اسنان المرضى المعالجين بأجهزة تقويم الاسنان الثابتة على فترات علاجية مختلفة مع توضيح اي الاسنان اكثر تأثرا بالبقع البيضاء. المواد وطرق العمل: شملت عينة الدراسة ثمان واربعين مريضا (احدى وثلاثون انثى وسبعة عشر ذكرا) خضعوا لعلاج تقويم الاسنان بالأجهزة الثابتة . تم فحص اسنان المرضى سريريا لوجود البقع البيضاء من عدمها قبل تثبيت جهاز التقويم الثابت وبعد ازالته. النتائج: اظهرت الدراسة ازديادا معنويا في تفشي البقع البيضاء بازدياد فترة العلاج بالنسبة للذكور بينما لم تسجل اية فروقات معنوية بالنسبة للاناث. كما اظهرت النتائج ان الضرس الاول كان الاكثر تأثرا متبوعا بالناب والضاحك الثاني. الاستنتاجات:الاسنان في المنطقة الشدقية كانت الاكثر تأثرا بالبقع البيضاء من القواطع، كما ان تفشي البقع البيضاء يزداد بازدياد فترة العلاج.

ABSTRACT

Aim: To determine the prevalence of white spot lesions in orthodontic patients treated with fixed orthodontic appliances at different treatment periods and to reveal the teeth most commonly affected by white spot lesions. **Materials and Methods:** Forty eight patients (31 females and 17 males) treated with fixed orthodontic appliance were included in this study. The patients were examined for the presence of white spot before insertion of the appliance and after its removal using visual examination. **Results:** This study showed that there was a significant increase in the formation of white spot lesions along with the increase in treatment duration in male group, while females showed no significant difference in white spots at different durations. The first molars were the most affected teeth by white spots followed by canines and second premolars. **Conclusion:** This clinical study showed that the teeth in buccal segment were affected by white spots more than incisors and the prevalence of white spots increased when the duration of treatment increased.

Key words: enamel demineralization, white spots

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INTRODUCTION

The decalcification of enamel, which is clinically observed as unaesthetic white spots or larger unsightly areas of decalcification around orthodontic brackets during fixed appliance treatment, remains a significant clinical problem associated with a continual poor oral hygiene status.(1) The white appearance is caused by an optical phenomenon and increases in whiteness when dried by air.(2)

Enamel demineralization is an undesirable side effect of orthodontic treatment with fixed Appliances.(3) The presence of fixed orthodontic appliances makes tooth cleaning more difficult, so an increased prevalence of food impaction around brackets and underneath bands may occur.(4) White spot lesions develop as a result of prolonged plaque accumulation on the affected surface, commonly due to inadequate oral hygiene.(5) In addition, when brackets are placed adhesively, dissolution of the highly calcified prismless enamel by acid-etching may contribute to increased caries susceptibility.(6)

The development of white spots seems to be related to: the retention of plaque on the gingival side of the brackets or bands, oral hygiene effectiveness, and the inherent resistance of the individuals.(7) In addition the presence of fixed orthodontic

appliances lead to an increase in the absolute number of salivary streptococcus mutans as well as an increase in their percentage which might be responsible for decalcification or white spot formation associated with orthodontic therapy.[8]

The development of iatrogenic caries lesions on the facial surfaces of teeth detracts from the aesthetic improvement produced by orthodontic treatment. If the demineralization is sever and extensive it may negate any aesthetic benefit gained from treatment of a malocclusion.[9] It is important to assess the risks of treatment as well as the potential gain and balance these aspects of treatment before deciding to treat a malocclusion. [10]

The present study tries to investigate the occurrence and distribution of enamel decalcifications or the so called white spots formation that may be found around orthodontic brackets following their removal.

MATERIALS AND METHODS

Patients purchasing fixed orthodontic therapy were selected for the present study. Each patient received a thorough scaling and polishing prior to the application of bands and brackets. The teeth were thoroughly examined for the presence of any white spot on their labial surfaces. Any patient showing any presence of white spots on his or her teeth was excluded from the study. Forty eight patient were selected, 31 females and 17 males. The patients were instructed to ensure good dietary habits, and how to brush their teeth to maintain good oral hygiene during orthodontic treatment only by using proper brushing technique.

The brackets were bonded to teeth directly using Biofix® orthodontic adhesive following the manufacturer instructions. The labial surfaces of teeth to be bonded were first etched with 37% phosphoric acid for 60 seconds. Particular care was taken during the etching procedure to ensure that only the area where the bracket would be placed would be etched.[11] Then the composite was applied to the bracket base and pressed on the labial surface firmly with the excess composite being removed from around the bracket. The first molar teeth were banded with Voco® orthodontic glass ionomer cement. Following dryness, the bands, with their cement on the inside, were applied to the first molar teeth and the excess cement removed.

The patients were seen regularly every 3-4 weeks for the orthodontic follow up visits. In each visit the patients were motivated to perform proper tooth brushing techniques and maintain good oral hygiene. When orthodontic treatment was finished, the bands and brackets were removed, the remaining cement and composite was removed using sharp hand instruments and all teeth were polished. The facial surfaces of the teeth were examined in order to detect white spot formation using a mirror and an explorer.[12, 13] Even in non extraction cases the first premolars were excluded from the study. The patients sample, in males and females, was divided according to the duration of fixed orthodontic appliance treatment into three groups:

D1 group: in which treatment time ranged from 1 to 1.5 year.

D2 group: in which treatment time ranged from 1.5 to 2 years.

D3 group: in which treatment time ranged from 2 to 2.5 years.

The following white spots scoring was used :[14]

- Score 0, no white spot lesion.
- Score 1, white spot lesion covering less than one third of the surface.
- Score 2, white spot lesion covering more than one third of the surface.
- Score 3, white spot lesion with cavitation.

The data were statistically analyzed using descriptive analysis and by Kruskal-Wallis and Mann-Whitney Tests. The data were analyzed by SPSS statistic program.

RESULTS

Table (1and 2) show the descriptive statistics of white spots in upper and lower jaws for male and female groups. The tables reveal that there was an increase in the scores of white spots as the duration time of the treatment increased. The first molars were affected by white spots formation more often than other teeth followed by the second premolars and canines.

Table (1): Descriptive Analysis of White Spots of Male Group.

Duration	Jaw and Sides	Teeth	N	Min.	Max.	Mean	SD.	Frequency of Scores (%) 0	1	2	3	Jaw and Sides	Teeth	N	Min.	Max.	Mean	SD.	Frequency of Scores (%) 0	1	2	3
D1	Upper Right	1	7	0	0	0	0	100	-	-	-	Lower Right	1	7	0	0	0	0	100	-	-	-
		2	7	0	0	0	0	100	-	-	-		2	7	0	0	0	0	100	-	-	-
		3	7	0	0	0	0	100	-	-	-		3	7	0	1	0.14	0.38	85.7	14.3	-	-
		5	7	0	1	0.14	0.38	85.7	14.3	-	-		5	7	0	0	0	0	100	-	-	-
		6	7	0	1	0.28	0.49	71.4	28.6	-	-		6	7	0	1	0.42	0.53	57.1	42.9	-	-
	Upper Left	1	7	0	0	0	0	100	-	-	-	Lower Left	1	7	0	0	0	0	100	-	-	-
		2	7	0	0	0	0	100	-	-	-		2	7	0	0	0	0	100	-	-	-
		3	7	0	0	0	0	100	-	-	-		3	7	0	0	0	0	100	-	-	-
		5	7	0	0	0	0	100	-	-	-		5	7	0	0	0	0	100	-	-	-
		6	7	0	1	0.28	0.49	71.4	28.6	-	-		6	7	0	1	0.14	0.38	85.7	14.3	-	-
	Total upper		70	0	1	0.071	0.26	92.9	7.1	-	-	**Total lower**		70	0	1	0.071	0.26	92.9	7.1	-	-
D2	Upper Right	1	7	0	0	0	0	100	-	-	-	Lower Right	1	7	0	0	0	0	100	-	-	-
		2	7	0	0	0	0	100	-	-	-		2	7	0	0	0	0	100	-	-	-
		3	7	0	0	0	0	100	-	-	-		3	7	0	0	0	0	100	-	-	-
		5	7	0	1	0.14	0.38	85.7	14.3	-	-		5	7	0	0	0	0	100	-	-	-
		6	7	0	2	0.42	0.79	71.4	14.3	14.3	-		6	7	0	1	0.28	0.49	71.4	28.6	-	-
	Upper Left	1	7	0	0	0	0	100	-	-	-	Lower Left	1	7	0	0	0	0	100	-	-	-
		2	7	0	1	0.14	0.38	85.7	14.3	-	-		2	7	0	0	0	0	100	-	-	-
		3	7	0	1	0.14	0.38	85.7	14.3	-	-		3	7	0	0	0	0	100	-	-	-
		5	7	0	0	0	0	100	-	-	-		5	7	0	1	0.28	0.49	71.4	28.6	-	-
		6	7	0	1	0.14	0.38	85.7	14.3	-	-		6	7	0	1	0.14	0.38	85.7	14.3	-	-
	Total upper		70	0	2	0.1	0.35	91.4	7.1	1.4	-	**Total lower**		70	0	1	0.071	0.26	92.9	7.1	-	-
D3	Upper Right	1	3	0	0	0	0	100	-	-	-	Lower Right	1	3	0	0	0	0	100	-	-	-
		2	3	0	1	0.33	0.58	66.7	33.3	-	-		2	3	0	0	0	0	100	-	-	-
		3	3	0	1	0.33	0.58	66.7	33.3	-	-		3	3	0	0	0	0	100	-	-	-
		5	3	0	1	0.33	0.58	66.7	33.3	-	-		5	3	0	0	0	0	100	-	-	-
		6	3	0	1	0.33	0.58	66.7	33.3	-	-		6	3	0	1	0.33	0.58	66.7	33.3	-	-
	Upper Left	1	3	0	1	0.33	0.58	66.7	33.3	-	-	Lower Left	1	3	0	0	0	0	100	-	-	-
		2	3	0	1	0.33	0.58	66.7	33.3	-	-		2	3	0	0	0	0	100	-	-	-
		3	3	0	1	0.33	0.58	66.7	33.3	-	-		3	3	0	1	0.33	0.58	66.7	33.3	-	-
		5	3	0	1	0.33	0.58	66.7	33.3	-	-		5	3	0	0	0	0	100	-	-	-
		6	3	0	0	0	0	100	-	-	-		6	3	0	0	0	0	100	-	-	-
	Total upper		30	0	1	0.27	0.44	73.3	26.7	-	-	**Total lower**		30	0	1	0.066	0.25	93.3	6.7	-	-

D1: treatment time ranged from 1 -1.5 years, D2: treatment time ranged from 1.5-2 years,
D3: treatment time ranged from 2 -2.5 years.

Table (2): Descriptive Analysis of White Spots of Female Group.

Duration	Jaw and Sides	Teeth	N	Min.	Max.	Mean	SD.	Frequency of Scores (%) 0	1	2	3	Jaw and Sides	Teeth	N	Min.	Max.	Mean	SD.	Frequency of Scores (%) 0	1	2	3
D1	Upper Right	1	6	0	0	0	0	100	-	-	-	Lower Right	1	6	0	0	0	0	100	-	-	-
		2	6	0	0	0	0	100	-	-	-		2	6	0	0	0	0	100	-	-	-
		3	6	0	1	0.17	0.4	83.3	16.7	-	-		3	6	0	3	0.5	1.22	83.3	-	-	16.7
		5	6	0	0	0	0	100	-	-	-		5	6	0	1	0.67	0.4	83.3	16.7	-	-
		6	6	0	2	0.67	0.81	50	33.3	16.7	-		6	6	0	2	1	0.89	33.3	33.3	33.3	-
	Upper Left	1	6	0	0	0	0	100	-	-	-	Lower Left	1	6	0	0	0	0	100	-	-	-
		2	6	0	0	0	0	100	-	-	-		2	6	0	0	0	0	100	-	-	-
		3	6	0	1	0.17	0.4	83.3	16.7	-	-		3	6	0	1	0.33	0.51	66.3	33.3	-	-
		5	6	0	0	0	0	100	-	-	-		5	6	0	1	0.67	0.4	83.3	16.7	-	-
		6	6	0	1	0.17	0.4	83.3	16.7	-	-		6	6	0	2	0.67	0.81	50	33.3	16.7	-
	Total upper		60	0	2	0.11	0.37	90	8.3	1.7	-	Total lower		60	0	3	0.28	0.64	80	13.3	5	1.7
D2	Upper Right	1	17	0	1	0.058	0.24	94.1	5.9	-	-	Lower Right	1	17	0	0	0	0	100	-	-	-
		2	17	0	0	0	0	100	-	-	-		2	17	0	0	0	0	100	-	-	-
		3	17	0	0	0	0	100	-	-	-		3	17	0	0	0	0	100	-	-	-
		5	17	0	1	0.18	0.39	82.4	17.6	-	-		5	17	0	1	0.058	0.24	94.1	5.9	-	-
		6	17	0	3	0.59	0.79	52.9	41.2	-	5.9		6	17	0	1	0.29	0.47	70.6	29.4	-	-
	Upper Left	1	17	0	0	0	0	100	-	-	-	Lower Left	1	17	0	0	0	0	100	-	-	-
		2	17	0	1	0.058	0.24	94.1	5.9	-	-		2	17	0	0	0	0	100	-	-	-
		3	17	0	0	0	0	100	-	-	-		3	17	0	0	0	0	100	-	-	-
		5	17	0	1	0.11	0.33	88.2	11.8	-	-		5	17	0	1	0.058	0.24	94.1	5.9	-	-
		6	17	0	3	0.82	1.01	47.1	35.3	5.9	11.8		6	17	0	2	0.35	0.60	70.6	23.5	5.9	-
	Total upper		170	0	3	0.18	0.51	85.9	11.8	0.6	1.8	Total lower		170	0	2	0.076	0.29	92.9	6.5	0.6	-
D3	Upper Right	1	8	0	1	0,25	0.46	87.5	12.5	-	-	Lower Right	1	8	0	0	0	0	100	-	-	-
		2	8	0	1	0,25	0.46	75	25	-	-		2	8	0	0	0	0	100	-	-	-
		3	8	0	1	0.12	0.35	87.5	12.5	-	-		3	8	0	1	0.12	0.35	87.5	12.5	-	-
		5	8	0	1	0.12	0.35	87.5	12.5	-	-		5	8	0	1	0.12	0.35	87.5	12.5	-	-
		6	8	0	1	0.37	0.51	62.5	37.5	-	-		6	8	0	2	0.5	0.75	62.5	25	12.5	
	Upper Left	1	8	0	1	0.12	0.35	87.5	12.5	-	-	Lower Left	1	8	0	0	0	0	100	-	-	-
		2	8	0	1	0,25	0.46	75	25	-	-		2	8	0	0	0	0	100	-	-	-
		3	8	0	1	0.12	0.35	87.5	12.5	-	-		3	8	0	1	0,25	0.46	75	25	-	-
		5	8	0	0	0	0	100	-	-	-		5	8	0	0	0	0	100	-	-	-
		6	8	0	1	0.12	0.35	87.5	12.5	-	-		6	8	0	3	0.75	1.03	50	37.5	-	12.5
	Total upper		80	0	1	0.16	0.37	83.8	16.3	-	-	Total lower		80	0	3	0.17	0.5	86.3	11.3	1.3	1.3

D1: treatment time ranged from 1 -1.5 years, D2: treatment time ranged from 1.5-2 years,
D3: treatment time ranged from 2 -2.5 years.

Table (3) shows a comparison of white spots among teeth at each duration of time, right dental side versus left, upper teeth versus lower and male versus female in each treatment duration time. There were significant differences in the frequency of white spots between teeth in upper and lower right quadrant at duration (1) in female group, the first molar shows the highest frequency of white spots followed by the canine in the upper jaw. In the lower right quadrant the first molars were most commonly affected followed by canines and second premolars. The females show significantly higher white spots than males. In duration (2) significant difference was found in the distribution of white spot among teeth in the lower right and left quadrant in females with the highest frequency found at the lower first molars

followed by second premolars. The upper teeth showed significantly higher frequency of white spots than the lowers in females.

In duration (3) in male group the upper arch shows significantly higher frequency of white spots than the lower. In females the lower left quadrant shows significant difference in the distribution of white spots among teeth and again the first molars were affected by white spots more than other teeth followed by the canines.

Table (3): Comparison Of White Spot Among Teeth at each duration Of Time

Durations	Sex	Dental arch	sides	N	Chi-Square	Z-value
D1	Male	Upper	Right	7	5.67	–––
			Left	7	8.24	–––
			Right vs. Left	14	–––	- 0.46
		Lower	Right	7	9.32	–––
			Left	7	4	–––
			Right vs. Left	14	–––	- 1.38
		Upper vs. Lower		14	–––	0
	Female	Upper	Right	6	9.63*	–––
			Left	6	3.1	–––
			Right vs. Left	12	–––	-0.88
		Lower	Right	6	10.37*	–––
			Left	6	7.08	–––
			Right vs. Left	12	–––	-0.14
		Upper vs. Lower		12	–––	-0.158
	Male vs. Female			13	–––	-2.109*
D2	Male	Upper	Right	7	5.76	–––
			Left	7	2.12	–––
			Right vs. Left	14	–––	-0.36
		Lower	Right	7	8.24	–––
			Left	7	5.67	–––
			Right vs. Left	14	–––	-0.46
		Upper vs. Lower		14	–––	0
	Female	Upper	Right	17	21.88	–––
			Left	17	28.05	–––
			Right vs. Left	34	–––	-0.06
		Lower	Right	17	16.66*	–––
			Left	17	16.72*	–––
			Right vs. Left	34	–––	-0.21
		Upper vs. Lower		34	–––	-2.14*
	Male vs. Female			24	–––	-1.2
D3	Male	Upper	Right	3	1.27	–––
			Left	3	1.27	–––
			Right vs. Left	6	–––	0
		Lower	Right	3	4	–––
			Left	3	4	–––
			Right vs. Left	6	–––	0
		Upper vs. Lower		6	–––	-2.06*
	Female	Upper	Right	8	2.44	–––
			Left	8	2.23	–––
			Right vs. Left	16	–––	-0.9
		Lower	Right	8	6.89	–––
			Left	8	12.39*	–––
			Right vs. Left	16	–––	-0.32
		Upper vs. Lower		16	–––	-0.37
	Male vs. Female			11	–––	0.27

*Significant Difference at $P \leq 0.05$.

Table (4) compare the frequency of white spots between different durations in male and female group, significant difference was found in the frequency of white among different durations in male group while no significant difference was found in female group.

Table (4): Comparison of White Spot Among different duration Time

Durations	Sex	N	Z-value
1,2,3	Male	200	0.4*
1,2,3	Female	280	0.92

*Significant Difference at $P \leq 0.05$.

DISCUSSION

The result of this study showed that there was an increase in white spot formation around orthodontic brackets when the duration time of the treatment increased, this result comes in agreement with Zavareh *etal*.[12] who found that duration of treatment had a significant effect on the occurrence of white spots. Likewise Tufekcia *etal*.[15] reported a sharp increase in the number of white spot lesions during the first 6 months of treatment that continued to rise at a slower rate to 12 months.

The comparison of white spot among teeth in each quadrant showed that the first molars were most affected by white spot lesion followed by the canines and second premolars. The high incidence of white spots on first molars could be attributed to the banding of these teeth and their role in food accumulation and difficulties in maintaining good oral hygiene on banded molars. The canines and second premolars came in the second place regarding white spots formation, this may be due to the presence of hook at canine and premolar brackets and the use of force accessories such as elastic chains and coil springs aiding in plaque retention and lead to more white spot formation in addition the patients usually concentrate their brushing on anterior teeth more than posterior; this result comes in agreement with Øgaard[14] who found that the teeth most commonly affected are molars, maxillary lateral incisors, mandibular canines and premolars. While Gorelick *etal*.[16] found that the highest incidence of lesions was found at the labio-gingival area of the maxillary lateral incisors, and the lowest incidence was in the maxillary posterior segment.

No sex difference was found in prevalence of white spot in duration II and III while the females showed significantly higher white spot scores in duration I only. Similarly Tarawneh and Hyasat[17] found no significant sex difference in white spot formation. While Mizrahi[18] found that incidence of white spots formation was higher in males and he attributed this finding to poorer oral hygiene in males.

CONCLUSION

The results of the study showed an increase in the prevalence of white spots formation as the duration of orthodontic treatment increased. This finding should encourage orthodontists to finish orthodontic treatment with fixed appliances as soon as possible to reduce the risk of white spots occurrence. Since the buccal segments were affected more than anterior segment, the orthodontists should educate their patients to perform and maintain good oral hygiene through proper brushing techniques including all teeth and not emphasizing on anterior teeth only.

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