White Spot Lesions Among Patients Treated With Fixed Orthodontic Appliance at Different Time Intervals

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ABSTRACT

Background:- White spot lesions are common esthetic problem that compromise the success of orthodontic treatment. This study aimed to assess white spot lesions in patients with fixed orthodontic appliance at different time intervals.

Materials & Methods:- Thirty two patients (24 females and 8 males) were included in this study and they underwent clinical examination for white spot lesions using enamel decalcification index at four time intervals: (2-3 weeks after appliance insertion, 2, 4 and 6 months).

Results:- The patients were free of white spot lesions at the appliance insertion visit. The mean of white spot lesions was 2.22 which were increased significantly during six months to reach 24.59 at the end of study. There was a significant difference between the maxillary and the mandibular arches, however, there was no significant difference found between the right and the left sides in both arches. The total numbers of teeth affected by white spot lesions were 74.61% after six months of treatment. Maxillary second premolar and mandibular canine were the most affected teeth; whereas the gingival area around the orthodontic brackets was the most affected area.

Conclusion:-Orthodontic patients had a high risk for development of white spot lesions.

Key words:- White spot lesions, Orthodontic patients, Fixed orthodontic appliance. **(J Bagh Coll Dentistry 2017; 29(1):177-182)**

INTRODUCTION

White spot lesion (WSL) known as iatrogenic side effect observed in patients undergoing orthodontic treatment especially those who treated with fixed appliances and associated with poor oral hygiene [(1,2)] or when no preventive programs were used [(3)].

The white spot lesions had been defined as "subsurface enamel porosity that presents itself as a milky white opacity which is most commonly seen on the visible facial surfaces of teeth, but it also occurred on the occlusal and proximal surfaces" [(2,4)]. The white spot lesions are also defined as "the first sign of caries formation on enamel that can be recognized by naked eye. It can occur on any tooth crown surface in both primary and permanent teeth" [(4,5)].

The appearance of white spot lesions on the enamel surface is due to a multiplicity of factors [(6)]. Conjunction of the four factors: plaque, fermentable carbohydrates, host factor (susceptible tooth surface and saliva) and sufficient time period are essential for white spot lesions to develop [(6,7)].

White spot lesions represent enamel demineralization which is the process of dissolution of calcium and phosphate ions from dental hydroxyapatite crystal into plaque and saliva. This process is stopped by remineralization which is the process of restoring minerals from saliva to the hydroxyl apatite's latticework structure.

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These processes occur simultaneously, but lesion formation occurs when the rate of demineralization exceeds the rate of remineralization [(8)].

The most common areas that liable to demineralization are: Cervical areas, areas located under the bands and enamel near cemented brackets [(9)].

The prevalence of white spot lesion associated with orthodontic treatment showed various reports ranging from 2% to 97% [(10-12)]. The extent of white spot lesions varied from 4.9 to 84% of the tooth surface, depending on the examination technique used [(11, 13)].

Many studies reported that white spot lesions can become visible around the orthodontic appliance within 1 month of bonding [(13-15)].

Most studies focused on development of white spot lesions at the end of orthodontic treatment, but the presence of these lesions at different times during orthodontic treatment had taken little consideration from researchers. As a result, this longitudinal study was conducted to evaluate white spot lesions occurrence among patients underwent fixed orthodontic treatment at different time intervals during orthodontic treatment.

MATERIALS ANDMETHOD

Study Sample:-

A longitudinal study was done in the specialist health Centre for orthodontics and prosthodontics in Bab Al-Muadham/Baghdad city for 8 months period. The sample was selected from patients

who underwent orthodontic treatment with fixed orthodontic appliances.

Thirty two patients (24 females, 8 males) with age range between (18-25 years) diagnosed with skeletal class I relation, Class I malocclusion (mild to moderate crowding). Patients with previous orthodontic treatment and/or already had white spot lesions before orthodontic treatment were excluded from study.

Patients were followed for six months and underwent a systematic clinical evaluation of white spot lesions related with fixed orthodontic appliance using enamel decalcification index [16] as following:-

1st visit:- (2-3) weeks after orthodontic appliance insertion.

2nd visit:- (2 months ±2weeks) after orthodontic appliance insertion.

3rd visit:- (4 months ±2weeks) after orthodontic appliance insertion.

4th visit:- (6 months ±2weeks) after orthodontic appliance insertion.

For standardization, each patient received a package consists of tooth paste (Colgate, China) and manual two headed tooth brush (Ortho Technelogy, China) especially designed for orthodontic patients: one head is used for brushing around the brackets and the other head is an interdental tooth brush for brushing arch wires and between teeth. They received general oral hygiene instruction in addition to advisements about dietary habits and other oral hygiene measures.

White Spot Lesions Examination:-

Enamel decalcification index proposed by Banks and Richmond in 1994 [16] was used to determine the white spot lesions around the orthodontic brackets. This index based on the facial surfaces examination that measure white spot lesions presence or absence, extent, severity and distribution of white spot lesions around orthodontic brackets. The facial surface of the tooth was divided into four areas: gingival, mesial, distal and incisal\occlusal areas around the bracket. A score was allocated for each area as followed: 0, no decalcification; 1, decalcification covering less than 50% of the area; 2, Decalcification covering more than 50% of the area; 3, Decalcification covering 100% of the area, or severe decalcification with cavitation. Total scores per tooth were calculated by summation of the individual areas scores for each tooth, total scores ranges from 0-12.

The teeth considered for examination were second premolar to second premolar in both maxillary and mandibular arches. Molars were excluded from the study as they were banded obviating the visibility of white spot lesions. The teeth were visually examined on the facial surface after removing plaque with the help of instruments (HK SUPRA\ China), removal of wires and auxiliaries' attachments and air drying.

T- Test was used to assess the significance of observation bias in inter and intra –calibration, general linear model repeated measures procedure affords determination of variance when same measurement is invented several times on each case or subject. The GLM repeated measures procedure provides both univariate and multivariate analyses for the repeated measures data.

RESULTS

The results revealed that there was a wide variation of the mean value of white spot lesions at the end of study 24.59 increased more than ten times compared to the first visit after appliance insertion 2.22. Additionally, the differences were statistically highly significant between orthodontic visits, Table 1.

Table 1: Mean and standard deviation values of white spot lesions during four time intervals

Cumulative white spot lesions	Mean	SE	F	Sig.
1st visit	2.22	0.67	82.00	0.00 **
2nd visit	14.84	1.88		
3rd visit	19.91	2.14		
4th visit	24.59	2.36		

** High significant when P<0.01

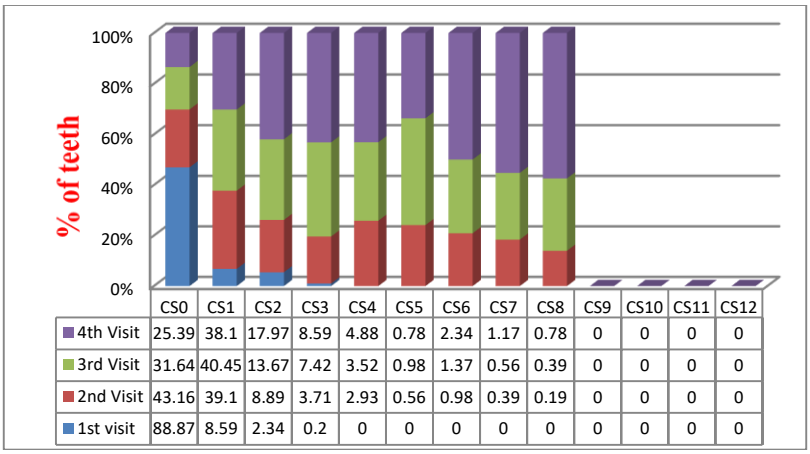
Table 2 demonstrated that white spot lesions increased with a high significant difference during time. Furthermore, there was a high significant difference of white spot lesions occurrence between arches with time, but there were no significant difference in white spot lesions between the right and left sides of maxillary and mandibular arches during visits.

Table2: Effect of time, arch and sides of arch on cumulative white spot lesions

Effect	Multivariate Tests	Value	F	Sig.
Time	Pillai's Trace	0.69	91.93	0.00 H.S.
Time * Arch	Pillai's Trace	0.13	6.18	0.00 H.S.
Time * Side	Pillai's Trace	0.02	0.97	0.41 N.S.
Time * Arch * Side	Pillai's Trace	0.02	0.74	0.53 N.S

high significant at P<0.01, no significant at P>0.05

Figure1 demonstrated the cumulative white spot lesions per teeth during four time intervals. The results revealed that teeth with cumulative scores equal to zero (free of white spot lesions) were high in the first visit 88.87%. This declined during six months of treatment to reach 25.39%. Additionally the data revealed that the most predominant cumulative white spot lesions scores were equal one (CS1) that reached 38.1% and CS2 that reached 17.97%.

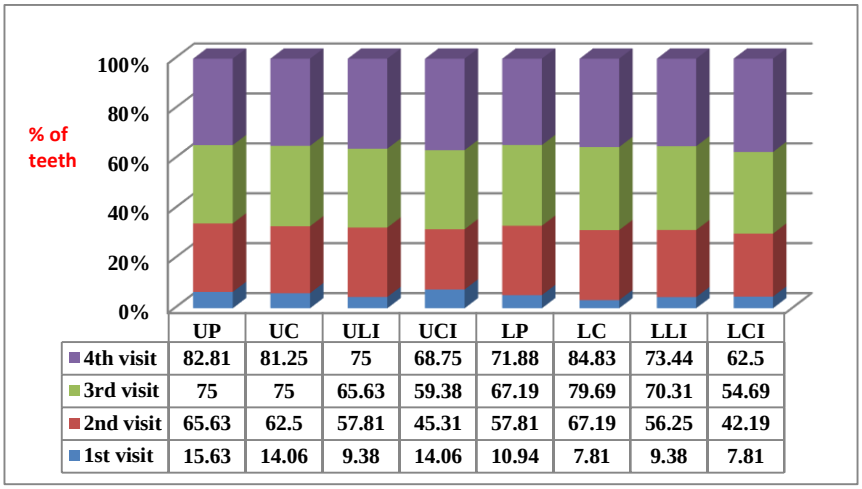


	CS0	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	CS11	CS12
4th Visit	25.39	38.1	17.97	8.59	4.88	0.78	2.34	1.17	0.78	0	0	0	0
3rd Visit	31.64	40.45	13.67	7.42	3.52	0.98	1.37	0.56	0.39	0	0	0	0
2nd Visit	43.16	39.1	8.89	3.71	2.93	0.56	0.98	0.39	0.19	0	0	0	0
1st visit	88.87	8.59	2.34	0.2	0	0	0	0	0	0	0	0	0

Figure 1: Distribution of cumulative white spot lesions per teeth during four time intervals

Figure2 illustrated the distribution of white spot lesions among teeth in maxillary and mandibular arches during four time intervals. The most affected teeth in maxillary arch were the second premolar 82.81% followed by the canine 81.25% and the lateral incisors 75%; while the least affected teeth were the central incisors teeth 68.75%.

In mandibular arch, the most affected teeth were the canine 84.83% followed by the lateral incisor 73.44% and the second premolar 71.88%; while the least affected teeth were central incisors teeth 62.5%.

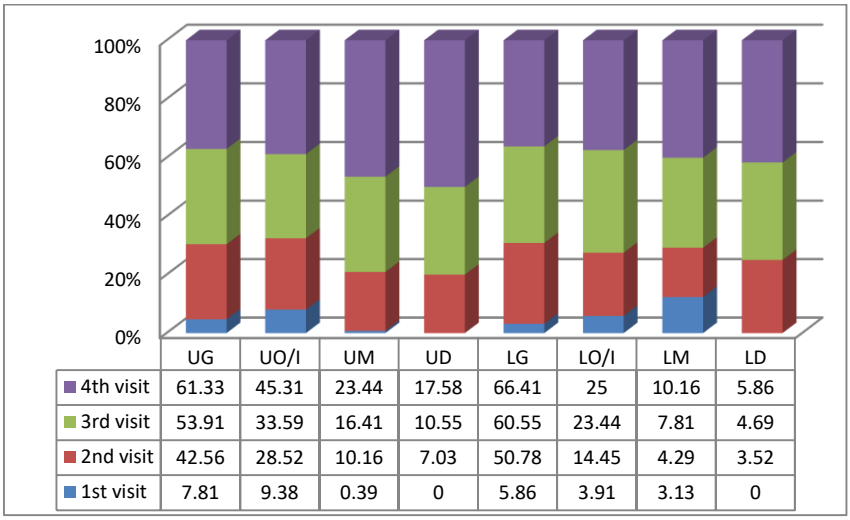


	UP	UC	ULI	UCI	LP	LC	LLI	LCI
4th visit	82.81	81.25	75	68.75	71.88	84.83	73.44	62.5
3rd visit	75	75	65.63	59.38	67.19	79.69	70.31	54.69
2nd visit	65.63	62.5	57.81	45.31	57.81	67.19	56.25	42.19
1st visit	15.63	14.06	9.38	14.06	10.94	7.81	9.38	7.81

Figure2: The distribution of white spot lesions among teeth in the maxillary and mandibular arches during four time intervals

Figure 3 demonstrated the distribution of white spot lesion around the brackets in maxillary and mandibular arches during four time intervals. The gingival area was the most affected area in the maxillary and the mandibular

arches (61.33, 66.41% respectively) during six months of study.



	UG	UO/I	UM	UD	LG	LO/I	LM	LD
4th visit	61.33	45.31	23.44	17.58	66.41	25	10.16	5.86
3rd visit	53.91	33.59	16.41	10.55	60.55	23.44	7.81	4.69
2nd visit	42.56	28.52	10.16	7.03	50.78	14.45	4.29	3.52
1st visit	7.81	9.38	0.39	0	5.86	3.91	3.13	0

Figure 3: Distribution of white spot lesions around the brackets in maxillary and mandibular arches during four time intervals [UG= gingival area in upper teeth, UO/I= occlusal or incisal area in upper teeth, UM= mesial area in upper teeth, UD= dostal area in upper teeth, LG= gingival area in lower teeth, LO/I= occlusal or incisal area in lower teeth, LM= mesial area in lower teeth, LD= distal area in lower teeth]

DISCUSSION

Statistical analysis was done by using Statistical Package for social Sciences (SPSS version 18). According central limit theorem and law of large numbers which are fundamental theorems of probability that stated the distribution of sum of a large number (>30 or 40) of independent variables will be approximately normal, regardless of the shape of data and the underlying distribution, thus many statistical procedure work according to this theorem [17].

White Spot Lesions during Orthodontic Visits

Most of the studies that searched for white spot lesions during and after orthodontic treatment used the white spot lesion index by Gorlick et al. [18], but few studies used the enamel decalcification index by Banks and Richmond [17] however, these studies used the latter index to compare the effect of prevented programs on white spot lesions.

Detecting white spot lesions during active orthodontic treatment can be challenging for the clinician. The clinical crown must be free from plaque and debris, and the presence of excess gingival tissue can make visualization of white spot lesions difficult. Gingival surfaces in premolar teeth were generally covered by inflamed gingiva. This was probably due to gingival hyperplasia and inflammation that resulted from the difficulty in accessing this region and poor oral hygiene.

The results obtained from the present study indicated that white spot lesions were a considerable problem during fixed orthodontic treatment. This agreed with Hadler-Olsen et al. [19] who reported that orthodontic patients had significant higher risk for development of white spot lesions compared to non-orthodontic patients and this attributed to the fixed appliances which served as plaque retention sites. The increase in the accumulation of dental plaque and in the absence of good oral hygiene marked demineralization occurred.

White spot lesions preventive system was dependent primarily on patient compliance and oral hygiene instructions. It was very difficult to control variables such as dietary habits, oral hygiene practices, and exposure to fluorides in this clinical study.

Effect of Treatment Duration on White Spot Lesions:-

This study revealed an increase in white spot formation around orthodontic brackets when the duration of treatment increased. This result comes in agreement with Abdulmawjood et al. and Shrestha and Shrestha [20, 21] who found that duration of treatment had a significant effect on the occurrence of white spots, but Lovrov et al. [22] were unable to find association between the treatment length and the white spot lesions development.

In the current study, white spot lesions developed as early as 2-3 weeks after the beginning of orthodontic treatment, this was in accordance to Øgaard [23] who found white spot lesions became noticeable around the brackets within one month after bonding.

White Spot Lesions in Arches and Sides of Arch:-

It was found that there was a high significant difference in white spot lesions development between upper and lower jaws during the first six months of treatment and this was in accordance to Abdulmawjood et al. [20]. This could be due to the maxillary teeth (especially the anterior teeth) are exposed to carbohydrate more than other teeth and they less vulnerable to saliva [24], while the lower teeth are less susceptible to enamel deminerlization because of salivary flow is adequate signifying mineralization is common [6].

Distribution of White Spot Lesions among teeth:-

The results revealed that maxillary second premolars and mandibular canines showed the higher percentage regarding white spots formation followed by the maxillary canines and the mandibular lateral incisors, this may be due to the presence of hook at canine which made the brushing maneuver very difficult and lead to insufficient tooth brushing. This agreed with the results reported by Abdulmawjood et al. [20] Lovrov et al. [22] who found that the most common affected teeth were the upper premolars. However, Shrestha and Shrestha [21] reported that lower canines were the most affected teeth by white spot lesions.

In contrast, Tufekci et al. [25] found no significant differences in the distribution of white spot lesions among different types of teeth, indicating that all types of teeth were equally subjected to demineralization. On the othe hand, Chapman et al. and Hadler-Olsen et al. [13, 19] found that the upper anterior teeth were more susceptible to white spot lesions than other teeth. This might be attributed to the use of different bracket size in the current study as the larger the bracket the short the distance between the bracket and the gingiva, especially on the lateral incisors, which makes controlling the oral hygiene difficult. Moreover, Lucchese and Gherlone [26] found that the maxillary lateral incisor and the mandibular second premolar were the most affected teeth.

The least affected teeth with white spot lesions were the central incisors in both arches. This could be due to that the patients are more conscious in keeping the esthetic zone cleaner compared to the posterior region. Additionally, the lower anterior region is more protected due to presence of mandibular salivary glands and the saliva which had a cario-protective role as it regulated the exposure of tooth surface to carbohydrate substrate, plaque acidity and microbial composition of plaque [6] through salivary factors such as flow rate, pH and buffer capacity [27]. This finding agreed with the finding of many studies [13, 21, 26].

In this investigation and according to the distribution of white spot lesions around brackets, the gingival area developed white spot lesions more than other areas around brackets, this could be attributed to the difficulty of tooth brush accessibility gingivally to the brackets due to short clinical crown, excessive adhesives and incorrect positioning of the brackets. This result was in accordance to Shrestha and Shrestha [21].

CONCLUSION

There is a high risk of white spot lesion formation in patient undergoing orthodontic treatment with fixed appliance. The role of oral hygienist should be knowledge and more attention should be paid for selecting patients with good compliance.

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الخلاصة

الخلفية: - البقع البيضاء هي مشكلة جمالية تحدد من نجاح المعالجة التقويمية. الهدف من الدراسة هو تقييم البقع البيضاء في المرضى الذين يضعون الجهاز التقويمي الثابت على فترات زمنية مختلفة.

المواد وطرق البحث:- شملت الدراسة 32 مريضا (24 أنثى و 8 ذكور)، خضعوا للفحص ألسريري للبقع البيضاء باستخدام مؤشر ألمينا زوال الكلس في أربع فترات زمنية: 2-3 أسابيع بعد وضع الجهاز.، 2 شهور، 4 أشهر، 6 أشهر.

النتائج: - أظهرت الدراسة إن متوسط البقع البيضاء 2.22 والتي زادت مع فارق معنوي كبير خلال ستة أشهر لتصل إلى 24.59 في نهاية الدراسة. كان هناك اختلاف كبير بين الفك العلوي والفك السفلي ولا يوجد فرق معنوي بين الجانبين اليمين واليسار في كل من الفكين. بلغ إجمالي الأسنان المتضررة بالبقع البيضاء 74.61٪ بعد ستة أشهر من العلاج. كان الضاحك الثاني في الفك العلوي والناب في الفك السفلي الأكثر تضررا بين الأسنان، وكانت منطقة اللثة حول قوس تقويم الأسنان هي المنطقة الأكثر تضررا.

الاستنتاج: -ان مرضى تقويم الأسنان في مخاطر عالية لحدوث البقع البيضاء.

الكلمات الرئيسية: -البقع البيضاء، مرضى تقويم الأسنان، جهاز تقويم الأسنان الثابت.