

*Original Research Article*

**Evaluation The Effects of Fixed Orthodontic Appliances and Gender on Dental Plaque Accumulation and Gingival Inflammation**

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**Abstract**

Fixed orthodontic appliances consider as a host for dental plaque accumulations which lead to subsequent gingivitis.

O'Leary plaque index and gingival index by Loe and Silness of 60 repeated observations (before and after first stage of orthodontic treatment) which taken from 30 patients (13 male & 17 female) with age range (17-30) years old.

According to ANOVA, there was highly significant difference in plaque index before and after treatment in both males (p value=0.00) and females (p value=0.00), but there was no gender difference in plaque index before and after treatment. The present study showed that there was highly significance difference in the gingival index before and after treatment in both males (p value=0.00) and females (p value=0.00).

Plaque accumulation and gingival inflammation obviously increased in orthodontic patients, so good oral hygiene program must be followed during orthodontic treatment in order to overcome these side effects.

**Key Words:** dental plaque, gingivitis, gender, fixed orthodontic appliances.

**الخلاصة**

جهاز التقويم الثابت يعتبر كمضيف لتجمع طبقة البلاك على الاسنان وبالتالي تؤدي الى التهاب اللثة. باستخدام المقياس الخاص بتجمع البلاك على الاسنان (وليري) والمقياس الخاص بالتهاب اللثة (ليو وسيلنس) لثلاثين مريض (17 من الاناث و 13 من الذكور) تتراوح اعمارهم بين 13-17 سنة. اجريت 60 قراءة (قبل وبعد انتهاء المرحلة الاولى للعلاج باستخدام جهاز التقويم الثابت). اظهرت النتائج الإحصائية بان هناك زياده واضحه بتجمع البلاك والتهابات اللثة قبل وبعد العلاج في كلا الجنسين من الذكور والاناث ولكن ليس هناك اختلاف بين الجنسين حسب المقاييس المستخدمه حيث لا يوجد تأثير لاختلاف الجنس على هذه المقاييس. هناك زياده واضحه في مقياس البلاك ومقياس التهابات اللثة في المرضى الذين يستخدمون جهاز التقويم الثابت, لذلك يجب على المرضى العناية بصحة الفم بشكل عام خلال استخدامهم لجهاز التقويم الثابت لتجنب هذه التأثيرات الجانبية.

**الكلمات المفتاحية:** بلاك الاسنان, التهابات اللثة, الجنس, جهاز التقويم الثابت.

**Introduction**

Orthodontic treatment through the better aesthetics provision and a more attractive smile, can improve the patients self-image and confidence. Additionally, orthodontic treatment can provide life long-term benefit for patients, since crowded and crooked teeth are lead to difficulty in cleaning and maintaining good oral hygiene [1]. Despite that, like any other

treatment, the orthodontic treatment can be associated with undesirable side effects [2]. Fixed orthodontic appliances mostly induce increasing in the volume of dental plaque, [3] resulting from complex components and accessories of fixed appliances would anchorage retention of bacterial plaque and impede maintenance of good oral hygiene [4,5]. These factors responsible of pathogenic bacterial colonization, which in

role lead to gingival inflammation, periodontal support destruction [4-7]. So redness and swelling of gingival tissue are commonly observed during orthodontic treatment with fixed appliance [8].

Even after maintaining excellent oral hygiene, patients usually exhibit mild to moderate gingivitis during the first two months of wearing fixed appliance with bands said by Zachrisson [9].

Periodontic-orthodontic interrelationship still controversial issue, although it has been subject to a many investigation until today [10]. Some studies found that plaque aggregation increases by fixed orthodontic treatment, [11,12] some studies have not found it increases [13,14].

Plaque scoring systems applied in most previous studies was the Loe and Silness plaque index, [15,16] the Turesky modification of the Quigley and Hein index, [17] or the Navy index [18,19] which applied to unbracketed dentitions, while in orthodontic patients are difficult to use due to focusing on plaque accumulation along the gum line reported a nonlinear scale; even after modifications, when applied to orthodontic patients, they lack sensitivity [11]. So this study evaluate the dental plaque by using the O'Leary plaque index [20] and gingival inflammation by using Loe and Silness gingival index [21] patients wearing fixed orthodontic appliance in order to assess oral hygiene in those patients and to examine if there are gender difference in dental plaque and gingival inflammation before and after treatment.

### **Materials and Methods**

This study were done in Iraq/ Najaf. The patients were collected from three different private clinics by the same subject. The sample of this study composed of 60 repeated observations (before and after orthodontic treatment) which taken from 30 patients (13 male and 17 female). The age of the patients were between (17-30) years old. All the patients in the study was informed and agree to participate in it. The dental and general health history were recorded for each patient to exclude any complicated dental problems or any other systemic disease. The important points that

checked in the patient include: oral and gingival health prior to receiving fixed orthodontic appliance (no gingival bleeding or inflammation, no periodontitis).

Selection criteria of the patients included:

1. No systemic disease or risk factors which can affect their oral health conditions during orthodontic treatment.
2. No history of taking any NSAID medication.
3. No hospitalization or hormone therapy during the past 6 months prior to the study, or any other hormonal imbalances such as hyperthyroidism or goiter.
4. The patients should be non-smoker or alcohol drinker.
5. Having no more than 2 extraction sites.
6. No history of previous treatment with any type of orthodontic appliances.
7. Female should not be pregnant, nursing, contraceptives, in menses women not take the sample day or two before the start of the period until the end of period.[20]

### **Orthodontic treatment:**

The treatment with fixed orthodontic appliance were done and light orthodontic force were applied by frictionless round nickel titanium arch wires. The initial phase of fixed orthodontic treatment (The levelling and alignment phase) lasted for 4-6 months.

### **O'Leary Plaque Index (PI):**

This precise index 21 base on the presence of supra-gingival plaque on all 4 tooth surfaces. The test were done by disclosing the plaque, If there is plaque the positive mark recorded on the specific simple chart and if there is no plaque the negative mark were recorded, and the percentage of plaque incidence in the oral cavity was calculated

Scores:

- ✓ Negative mark: indicate no plaque at the marginal gingiva.
- ✓ Positive mark: indicate the presence of Plaque at the marginal gingiva.

The examination of plaque were done on all the 4 surfaces (Facial, lingual and proximal surfaces) of teeth. The total number of examined surfaces was calculated by multiplying the number of teeth by 4.

The examination were done after using special staining solution to stain the plaque and the surfaces which take the stain were

recorded. The disclosing agent was used according to the instructions given by the manufacturer. The staining agent were used by direct application with a cotton pellet, tell the patient to rinse his mouth after minute.

All the surfaces of the teeth should be examined. The tooth surfaces which covered with plaque must be pointed on the tooth diagram. Record all plaque-covered sites and start calculating the plaque percentage. This procedure done by sharing patient using a small mirror, to raise patient awareness of his\her oral status.

The O'Leary plaque index (PI) was measured for 30 patients before placing the fixed orthodontic appliance (first records) and after the initial phase of active treatment (the second record) which lasted between 4 and 6 months from the treatment.

Our Calculations:

Plaque index = Nom. of surfaces with plaque /Nom. of evaluated surfaces x 100

#### **Gingival Index (GI)**

The Gingival Index according to Loe and Silness [22],

The interproximal and marginal tissues were scored separately based on the following scores from 0 to 3. The criteria are:

Zero: Indicate normal gingiva.

1: indicate mild gingival inflammation represented by simple change in colour and slight oedema but there was no bleeding during probing.

2: indicate moderate gingival inflammation represented by redness, oedema and glazing associated with bleeding during probing.

3: indication of severe gingival inflammation represented by redness and oedema, ulceration associated with spontaneous bleeding.

By using periodontal probe the bleeding was assessed through gentle probing along the gingival sulcus. The gingival index of each person was obtained by dividing the summation of each tooth on the number of teeth examined. The scoring were done for selected teeth or all surfaces of all teeth or for selected areas of all or selected teeth.

**Note:** Gingival and plaque index for those patient before treatment were zero.

**Table 1:** Gingival and plaque indices (%) in the all patients after treatment

Gender	Gingival index	Plaque index
Male	1.5	53
	1.45	50
	1.25	64
	1.33	42
	1.66	36
	1.14	71
	1.77	62
	0.83	34
	1.02	31
	1.41	31
	1.97	71
	1.08	52
Female	1.5	46
	0.9	45
	1.14	48
	1.64	45
	1.27	53
	0.93	35
	1	70
	1.06	66
	0.75	62
	0.72	52
	2.08	38
	1.37	76
1.25	44	
1	35	

	0.91	30
	0.64	45
	0.81	46
	0.6	43

### Results

Gingival and plaque index for those patient before treatment were zero so the statistical comparison were done depending on this.

According to our measurement the mean of plaque index after treatment ranged between (49.00 for male and 49.4 for female), and for total sample it ranged (49.2 ± 13.3) (Table 2).

After statistical analysis of the result the ANOVA test show that there was increase in plaque index between before and after treatment groups in both males and females.

There was non-significant difference between male & female after treatment (P value (0.927) (Table 3).

Regarding the gingival index mean value of gingival index (1.3) for male and (1.06) for female after treatment, and for total sample it ranged (1.19 ± 0.38) (Table 4).

After statistical analysis of the result, the ANOVA test show that there was increase in the gingival index after treatment in both males and females.

There was significant difference between male and female after treatment in gingival index, P value (0.23) (Table 5).

**Table 2 :** Descriptive statistic for O'Leary plaque index

Gender	No.	Mean	SD	SE	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
					Lower Bound	Upper Bound			
Male	13	49.4615	14.39106	3.99136	40.7651	58.1580	31.00	71.00	
Female	17	49.0000	12.85982	3.11896	42.3881	55.6119	30.00	76.00	
Total	30	49.2000	13.30388	2.42894	44.2323	54.1677	30.00	76.00	-12.33183-

**Table 3 :** Gender difference in plaque index after treatment

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Before treatment	Between Groups	0.229	1	0.229	0.006	0.941
	Within Groups	1150.471	28	41.088		
	Total	1150.700	29			

**Table 4 :** Descriptive statistic for gingival index

Gender	No.	Mean	SD	SE	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
					Lower Bound	Upper Bound			
Male	13	1.3777	0.31784	0.08815	1.1856	1.5698	0.83	1.97	
Female	17	1.0629	0.37863	0.09183	.8683	1.2576	0.60	2.08	0.04104
Total	30	1.1993	0.38218	.06978	1.0566	1.3420	0.60	2.08	

**Table 5 :** Gender difference in gingival index after treatment

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
After treatment	Between Groups	0.730	1	0.730	5.828	0.023
	Within Groups	3.506	28	0.125		
	Total	4.236	29			

### **Discussion**

Dental plaque is a biofilm found on a tooth surface as the diverse community of microorganisms, embedded in an extracellular matrix of polymers of host and bacterial origin.[23,24] Dental plaque accumulation is associated with caries and periodontal diseases which is two of the most prevalent diseases affecting oral health [25].

Gingival inflammation (also termed Gingivitis) is a non-destructive periodontal disease causes redness, swelling and irritation [26]. Most commonly, gingival inflammation is occurs in response to plaque accumulation on tooth surfaces. When good oral hygiene maintained, the gingivitis is reversible. However, gingivitis can progress to periodontitis if not treated or controlled. Periodontitis is a progressive destructive disease which results in destruction of tissue and resorption of alveolar bone, which produce tooth mobility and can ultimately lead to tooth loss [27] in spite of gingivitis in some cases never progress to periodontitis [28], the periodontitis is sequential stages in gingivitis [29].

The benefits of orthodontic treatment to the patients includes helps to produce more pleasing dental and facial appearance [30], make teeth in proper alignment, improve dental occlusion, healthier mouth and which ultimately results in a good functioning of dentition [31]. Together with these benefits, it has many complications which are faced by the patients undergoing orthodontic treatment [32]. Difficulties of plaque removal (due to food accumulation under brackets and archwires) and maintaining proper oral hygiene which consequently affect the dental and gingival health are the

most common problems faced the orthodontic patients [33,34].

The present study find that there was a highly statistically significant difference in plaque index between before and after treatment groups in both males and females. This increasing in plaque index after treatment can be explained as the components of fixed orthodontic appliance protect the dental plaque form self-cleaning technique of mouth by saliva and mastication. Additionally, it will protect them from cleaning by tooth brush [35]. Previous study also use O'Leary plaque index find same result [36]. Other study find a significant increase in plaque samples after application of fixed orthodontic appliances and constantly present during treatment then ultimately decrease after appliance removal [37]. In a previous systematic review on the influence of orthodontic fixed appliances on the oral microbiota find that there is moderate evidence that the presence of fixed appliances influences the quantity and quality of oral microbiota [38].

The present study find that here is no gender difference before and after treatment in plaque index. This result can be explained as the male has larger salivary gland than female [39], so greater effect in self-cleaning of mouth and female has more interest in cleaning her mouth and teeth brushing. This result agree with previous study [36] but disagree with some other previous study [40,41].

Regarding the gingival index, this study find that there was highly significance difference in the gingival index between before and after treatment groups in both males and females. This significant increasing in gingival index can be

explained as during orthodontic treatment the bacterial plaque will increased leading to increase the t inflammatory cell infiltration in the gingival tissue (increase in the number and size) which leading to swelling, bleeding of gingival tissues and become edematous [42]. This result come in agreement with previous study which find that the plaque index, gingival index, bleeding on probing increased after treatment, indicating that plaque aggregation might be the main reason for the gingivitis noticed in these patients.[34] Also this result agree with previous review of literature was find that there is a very close inter-relationship between the periodontal health and orthodontic treatment [43].

The present study find that there was a statistically significant difference in the Loe and Silness gingival index according to the gender either before or after treatment with higher value observed in male. This result may belong to the effect of high androgens (testosterone) hormone level in young male as the testosterone hormone stimulate oral epithelial growth through receptors located within the oral tissues, particularly in the gingival tissue. Additionally, testosterone hormone stimulate leukocyte and fibroblast migration that may participate in gingival inflammation [44]. In female, there is an increase in the production of sex steroid hormones during puberty, ovulation and pregnancy, taking oral contraceptives results in increased gingival inflammation, characterized by gingival enlargement, increased gingival bleeding and crevicular fluid flow and microbial changes [45]. So in this study we exclude the pregnanet, taking oral contraceptives female and in menses women not take the sample day or two before the start of the period until the end of period.

Most previous studies done to compare the gingival inflammation in male and female observed that the gingival inflammation more prevalent in male than in female [46-48].

In conclusion, the present study revealed that the plaque accumulation and gingival inflammation obviously increased in orthodontic patients, so good oral hygiene

program must be followed during orthodontic treatment in order to overcome these side effects.

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