

## The Effect of Fixed Orthodontic Appliances on Gingival Health

Hadeel Mazin, B.D.S., M.Sc.<sup>1</sup>, Periodontics, Suzan Ali, B.D.S., M.Sc.<sup>2</sup>  
Periodontics, Rasha Salah B.D.S.<sup>3</sup>.

---

### **Abstract:**

**Background:** fixed orthodontic appliances have a great effect on the gingival health and the plaque accumulation due to the presence of fixed appliance components (bands, bonds, wires and auxillary attachment)

**Aim of study:** This study was designed to compare periodontal health of patients with and without orthodontic treatment with fixed orthodontic appliance

**Material & Method:** The study sample was composed of 70 subjects with age ranged between (18-30) years old. The subjects were divided into two groups: Group I was composed of 30 subjects (15 females and 15 males) who were not wearing orthodontic appliances. Group II was composed of 40 patients (20 females and 20 males) who were wearing fixed orthodontic appliances at least for three months before conducting our study. Plaque index, gingival index and bleeding on probing were measured for all groups

**Results:** the plaque index, gingival index and the bleeding scores were significantly higher in the group of subjects with orthodontic appliances for both males and females.

**Conclusion:** The results of this study suggest that orthodontic appliance increase the plaque accumulation and may lead to gingival inflammation. Patients wearing fixed orthodontic appliances should maintain a good oral hygiene.

**Keyword:** fixed orthodontic appliance, gingivitis, plaque index.

---

### I. Review of literature

Periodontal diseases can affect one or more of the periodontal tissues (e.g. alveolar bone, periodontal ligament, cementum and gingiva). While there are many different periodontal diseases that can affect these supporting tissues, by far the most common ones are plaque-induced inflammatory conditions, such as gingivitis and periodontitis<sup>1</sup>. Gingivitis is a non-destructive periodontal disease<sup>2</sup>. The most common form of gingivitis, and the most common form of periodontal disease overall, is in response to bacterial plaque, termed plaque-induced gingivitis. Gingivitis is reversible with good oral hygiene. However, in the absence of treatment, or if not controlled it can progress to periodontitis, where the inflammation results in tissue destruction and alveolar bone resorption and ultimately tooth loss, While in some sites or individuals gingivitis never progress to periodontitis<sup>3</sup> Fixed orthodontic appliances are fixed to the teeth and thus are capable of a greater range of tooth movements.

The fixed appliance is composed from: Bands, bonds, orthodontic adhesives, auxiliaries and arch wires, importance of oral hygiene in orthodontic patients is always intensified to prevent any further periodontal disease. In the absence of oral hygiene maintenance, plaque accumulation on orthodontic appliance components is paving way to destruction of periodontal tissues to greater tooth area covered and the complex nature of orthodontic appliance make it difficult to maintain oral hygiene<sup>4</sup>. Maintaining oral hygiene during orthodontic treatment will help in good gingival health, which reflects in final orthodontic outcome. But the level of gingival health knowledge

among orthodontic patients is not adequate, poor maintenance of oral hygiene is due to either lack of knowledge or negligence by patients themselves. Patients are not given with proper instructions maybe one big reason for patient's noncompliance. However, despite receiving appropriate instructions, many individuals fail to follow instructions; also many of them lack knowledge on maintenance. It's important to motivate them to compile the instructions and maintain oral health. It's always needed to assess the patient's knowledge on gingival health<sup>5,6</sup>.

Gingivitis may develop in patients who do not institute proper oral hygiene measures Patients often exhibit gingival hypertrophy, bleeding, increased plaque accumulation and calculus formation during orthodontic treatment<sup>7</sup>. Thus oral hygiene measures are recommended because bands, brackets, ligatures wires and elastics encourage the accumulation of microbial flora and food residuess.

The plaque accumulation around orthodontic appliances may cause periodontal disease and caries<sup>9</sup>, following placement of fixed appliance there is gingival inflammation in almost all orthodontic patients fortunately, and this inflammation is transient and does not lead to attachment loss<sup>10</sup>.

Gingival hyperplasia can be a problem around orthodontic bands, leading to pseudopocketing and giving the illusion of attachment loss. However, this usually resolves within weeks of debanding<sup>11</sup>. Adult patients may be at risk of periodontal problems, particularly those with pre-existing periodontal disease. Orthodontic treatment is not contraindicated in these patients, provided the disease is controlled and the patient is sufficiently motivated. Three-monthly periodontal checks and routine scaling and polishing are advisable. The orthodontist will often modify the mechanics for these patients by keeping the forces light in view of the shortened root support<sup>12</sup>.

Orthodontic treatment accelerates the accumulation of bacterial plaque through difficulties in maintaining adequate oral hygiene, the frequency of *T.Forsythia*, *C.rectus* and *P.niger* significantly increased after placement of orthodontic appliances<sup>13</sup>.

Orthodontic treatment is a double-action procedure, regarding the periodontal tissues, which may be sometimes very significant in increasing periodontal health status, and sometimes a harmful procedure which can be followed by several types of periodontal complications. Recent studies show that the most important etiological factor of periodontal disease is plaque deposition around gingival margin<sup>14,15</sup>.

Three periodontal pathogens that are known to inhabit the plaque and contribute to periodontal disease are *Porphyromonas gingivalis*, *Treponema denticola*, and *Tannerella forsythia*<sup>16</sup>. These bacteria are anaerobic periodontal pathogens capable of initiating periodontal destruction. In many studies the presence of these bacteria has been correlated with the common forms of adult periodontitis<sup>17</sup>.

Although most patients undergoing orthodontic therapy tend to be younger and are less likely to experience periodontal disease, the host resistance to bacteria is compromised in orthodontic patients due to appliances on the teeth. These bacteria are termed the "red complex" among five bacterial complexes that group bacteria together based on relationships and associations. These three bacteria have a symbiotic relationship in a highly ordered system or biofilm, which serves as a protection, facilitates communication and promotes adhesion to oral environment<sup>18</sup>.

Orthodontic treatment produces a local change in the oral ecosystem, with changes in the composition of bacterial plaque and consequently the development of gingivitis<sup>19,20</sup>.

A study showed that fixed orthodontic appliance alter the ecology of oral cavity by introducing new stagnant areas available for colonization of bacteria, and it showed that fixed orthodontic appliance have a direct effect on plaque index and total bacterial count<sup>21</sup>.

Verdine et al, in 2013 found that patients undergoing orthodontic therapy have increased plaque accumulation, probing depth and microbial activity that may be associated with periodontal destruction, month after removal of the orthodontic appliance, the plaque score, probing depth and microbial activity returned to baseline level<sup>22</sup>.

#### **Aim of the study:-**

This study was designed to compare periodontal health of patients with and without orthodontic treatment with fixed orthodontic appliance.

## **II. Materials and methods**

#### **Study design:**

The study sample was composed of 70 subjects with age ranged between (18-30) years old. The subjects were divided into two groups: Group I was composed of 30 subjects (15 females and 15 males) who were not wearing orthodontic appliances. Group II was composed of 40 patients (20 females and 20 males) who were wearing fixed orthodontic appliances at least for three months before conducting our study. Subjects in both groups were systemically healthy, non-smoker and did not use antibiotic at least the last six months.

#### **Method:**

A thorough periodontal examination was carried out under good artificial light, and parameters selected for the study were carefully recorded. Plaque index, gingival index and bleeding on probing all were measured using these specific indices and recorded on a case-sheet designed for this study.

#### **Periodontal examination:**

Plaque index (PLI) by Silness and Loe 1964 Used together with the gingival index GI, and should be preceded the gingival examination. All teeth were examined except the wisdom teeth. This index measures the thickness of plaque on the gingival one third.

#### **Score criteria:**

0 --- No plaque

1--- A film of plaque adhering to the free gingival margin and adjacent area of the tooth, which

cannot be seen with the naked eye, but only by using disclosing solution or by using probe.  
 2--- Moderate accumulation of deposits within the gingival pocket, on the gingival margin and/or adjacent tooth surface, which can be seen with naked eye.  
 3--- Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

**Gingival index (GI) (Silness and loe 1964):**

Could be used on all teeth or selected teeth and in all surfaces or selected surfaces.  
 The examination done by blunt probe.

**Score criteria:**

- 0 --- no inflammation/ normal gingiva
- 1 --- Mild inflammation, slight change in color, slight edema, no bleeding on probing.
- 2 --- Moderate inflammation, moderate glazing, redness, bleeding on probing.
- 3 --- Severe inflammation, marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

**Bleeding on probing (BOP)**

Bleeding on probing which is also known as bleeding gingiva or gingival bleeding is a term used when referring to bleeding that is induced by gentle manipulation of the tissue at the depth of the gingival sulcus, or interface between the gingiva and the tooth. Bleeding on probing, often abbreviated BOP, is a sign of inflammation and indicates some sort of destruction and erosion to the lining of the sulcus or the ulceration of sulcular epithelium. The blood comes from lamina propria after the ulceration of the lining<sup>23</sup>.

**Score criteria:**

- 0 – no bleeding on probing
- 1—there's bleeding on probing

**III. Results**

Table 1 shows the descriptive statistics of the plaque index and the gingival index in both groups. The mean of the plaque index in group I (people not wearing fixed orthodontic appliance) was 0.932 while in group II (patients wearing fixed orthodontic appliance) was 1.348. The mean of the gingival index was 0.983 in group I and 1.253 in group II.

Groups	PLI		GI	
	Mean	Standard deviation	Mean	Standard deviation
Group I	0.932	0.284	0.983	0.186
Group I (females)	0.895	0.253	1.026	0.169
Group I (males)	0.9704	0.315	0.94	0.198
Group II	1.348	0.229	1.253	0.166
Group II (females)	1.345	0.185	1.29	0.133
Group II (males)	1.352	0.271	1.217	0.189

TABLE 1 descriptive statistics of the plaque index and the gingival index.

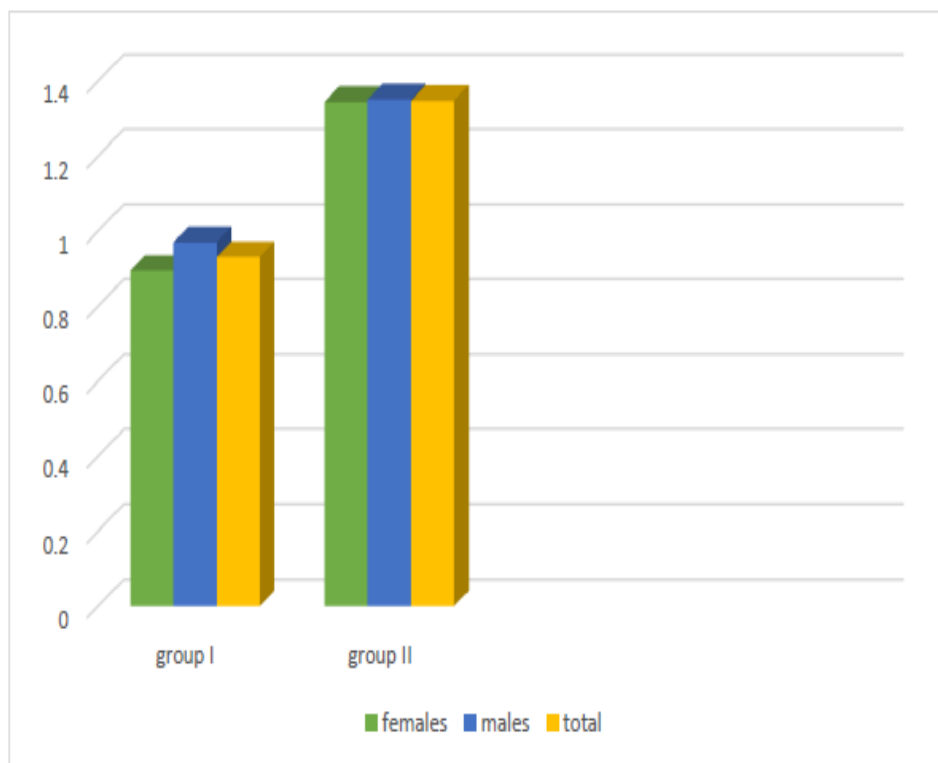


Figure 1. Mean of the plaque index in both groups.

Percentage of bleeding on probing score 1 and 0 are shown in table 2. Score 1 in group I was 3.162% while it was 15.827% in group II. BOP score 1 was significantly higher in group II as shown in table 4.

Groups	BOP(total count)		BOP(percentage)	
	Score 1	Score 0	Score 1	Score 0
Group I	106	3246	3.162%	96.838%
Group I (females)	59	1621	3.512%	96.488%
Group I (males)	47	1625	2.811%	97.189%
Group II	647	3441	15.827%	84.173%
Group II (females)	388	1686	18.708%	81.292%
Group II (males)	259	1755	12.86%	87.14%

Table 2. Bleeding on probing for both groups.

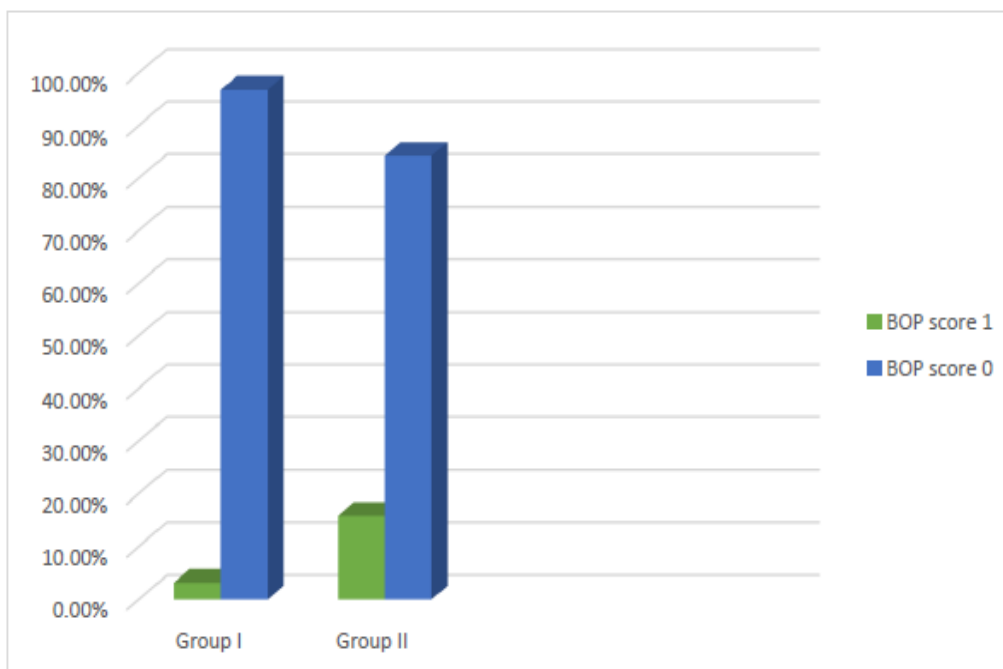


Figure 2. Percentage of bleeding on probing in both groups.

Plaque index and gingival index between the groups and the subgroups ( $p < 0.001$ ).

Groups	PLI		GI	
	P value	Significance	P value	Significance
Group I & II	<0.001	HS	<0.001	HS
Group I & II (females)	<0.001	HS	<0.001	HS
Group I & II (males)	0.0005	HS	0.0001	HS

TABLE 3. P value of the t-test between groups and subgroups.

Groups	BOP		
	Chi square	P value	Significance
Group I & II	324.74	HS	<0.001
Group I & II (females)	204.32	HS	<0.001
Group I & II (males)	121.187	HS	<0.001

**Table 4.** Chi square of BOP between the groups and the subgroups.

The results that are stated above shown that there is marked increase in both plaque and gingival indices and also there is marked increase in bleeding on probing percentage and total count. In the second group (group II: males and females) who were wearing fixed orthodontic appliance for at least three months before conducting our study as compared to the first group (group I: males and females) who were healthy (not wearing orthodontic appliance).

#### IV. Discussion

The study was conducted to compare the periodontal parameters (Plaque index, gingival index and bleeding on probing) between subjects who are wearing orthodontic appliances and those who are not wearing the appliances. The result showed significantly increased plaque index, gingival index and number of bleeding sites in the subjects wearing the fixed orthodontic appliances. The increase in the plaque could be related to the complex components of the appliances like the bands, bonds and wires which make maintain a good oral hygiene is difficult. Fixed orthodontic appliances may impair plaque removal, proper oral hygiene and affect gingival health<sup>24</sup>. This difficulty in plaque control and the raise in the plaque score will lead to the development of gingivitis and it can become quite profound in 21 days<sup>16</sup>. This was shown in our study by the raise in the gingival index score and the high percentage of bleeding sites in the subjects with fixed orthodontic appliances. This is in agreement with the result of Ristic and coworkers<sup>25</sup>, and with the result of Naranjo et al who reported that placement of fixed orthodontic appliances will influence the ecological environment by the accumulation of biofilm at the retentive sites<sup>26</sup>.

#### V. Conclusion

The results of this study suggest that orthodontic appliance increase the plaque accumulation and may lead to gingival inflammation. Patients wearing fixed orthodontic appliances should maintain a good oral hygiene and have regular check ups.

#### References

- [1]. Armitage GC (2004). " Periodontal diagnosis and classification of periodontal diseases". Periodontol 34:9-21.
- [2]. American academy of periodontology. Proceedings of the world workshop in clinical periodontics. Chicago: the American Academy of periodontology; 1989: 1/1-23/24.
- [3]. Ammons WF, Schectman LR, Page RC (1972). "host tissue response in chronic periodontal disease". 1. The normal periodontium and clinical manifestations of dental and periodontal disease in the marmoset". J.periodont. Res. 7 (2):34-131.
- [4]. Kitad R.P., 2009. Increase in detachable opportunistic bacteria in oral cavity of orthodontic patients. Int. J Dent Hyg; 7(2):25-121.
- [5]. Alexander SA. 1999. Effects of orthodontic attachments on the gingival health of permanent second molars. AM J Orthod Dentofacial Orthop; 100(4):337-40.
- [6]. Alstad S, Zachrisson BU. Longitudinal study of periodontal condition associated with orthodontic treatment in adolescents. AM J Orthod 1979; 76(3):277-86.
- [7]. Turkkahraman H, Sayin MO, Bozkurt FY, Yetkin Z, Kaya S, Onal S., 2005. Arch wire ligation techniques, microbial colonization and periodontal status in orthodontically treated patients. Angle Orthod; 75:6-231.
- [8]. kilicoglu H, Yildirim M., Polater H. comparison of the effectiveness of two types of toothbrushes on oral hygiene of patients undergoing orthodontic treatment with fixed appliances. Am. J. Orthod. Dentofacial Orthop. 1997; 111:591-594.
- [9]. Lo BA, Di Marco R, Milazzo I. et al, 2008. Microbial and clinical periodontal effects of fixed orthodontic appliances in pediatric patients. New Microbial; 31:299-302.
- [10]. Artun J. A, 1997. Post treatment evaluation of multibonded ceramic brackets in orthodontics. Eur J Orthod;19: 219-228.

- [11]. Zachrisson BU, Skogan O, Hoymyhr S., 1980. Enamel cracks in debonded, debanded and orthodontically untreated teeth. *Am J Orthod*; 77:307-319.
- [12]. Boyd RL, Leggott PJ, Quinn RS, Eakle WS, Chambers D,1989. Periodontal implications of orthodontic treatment in adults with reduced or normal periodontal tissues versus those of adolescents. *AM J Orthod Dentofac Orthop*. Zachrisson et al, 1972. Gingival condition associated with orthodontic treatment. *Angle Orthod*. 42: 26-34.
- [13]. Ai H, Lu HF, Liang HY, Wu J, Li RL, Liu GP, Xi Y ,2005. Influences of bracket bonding on mutans streptococcus in plaque detected by real time fluorescence-quantitative polymerase chain reaction. *Chin Med J (Engl)*; 118: 2005-10.
- [14]. Hirsch DI, Kulbersh R, Kaczynski R., 1997. Assessment of pretreatment orthodontic patients using the BANA test. N-benzoyl-DLarginine-naphthylamide. *AM J Orthop*; 112:154-8.
- [15]. Atack NE, Sandy JR, Addy M. Periodontal and microbiological changes associated with the placement of orthodontic appliances. A review *j. periodontal*; 67:78-85.
- [16]. Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL. Microbial complexes in subgingival plaque. *J Clin Periodontol*. 1998
- [17]. Loesche WJ, Lopatin DE, Giordano J, Alcoforado G, Hujoel P.,1992. Comparison of the benzoyl-DL-arginine-naphthylamide(BANA)test, DNA probes and immunological reagents for ability to detect anaerobic periodontal infections due to *Porphyromonas gingivalis*, *Treponema denticola* and *Bacteriodes forsythus*. *J Clin Microbial*; 30:33-427.
- [18]. Naranjo AA, Trivino ML, Jaramillo A, Betancourth M, Botero JE, 2006. Changes in the subgingival microbiota and periodontal parameters before and 3 months after bracket placement. *Am J Orthod Dentofacial Orthop*; 130:275.17-22.
- [19]. Huser M.C, Baehni P.C. and Lang R., 1990. Effects of orthodontic bands on microbiologic and clinical parameters. *American Journal of orthodontics and dentofacial orthopedics* 97, 213-218.
- [20]. Paolantonio M., DiGirolamo G., Pedrazzoli V., DiMurro C., Picciani C., Catamo G., Cattabriga M. and Piccolomini R., 1996. Occurrence of *Actinobacillus actinomycetemcomitans* in patients wearing orthodontic appliances. A cross sectional study. *Journal of clinical periodontology* 23, 112-118.
- [21]. V.Hagg et al, 2004. The effect of fixed orthodontic appliance on the oral carriage of candida species of enterobacteriaceae. *European journal of orthodontic* 26(2004)623-629.
- [22]. Verdine et al, 2013. Investigation of the periodontal and the microbial status of patients undergoing fixed orthodontic therapy. *urnal of dental and medical sciences* 7:4, 80-85.
- [23]. Caranza 2009. *Clinical periodontology*, Philadelphia. WB Saunders company. Anhoury P, Nathanson D, Hughes CV, Socransky S, Feres M, Chou LL. Microbial profile on metallic and ceramic bracket materials. *Angle Orthod*; 72:338-43.
- [24]. Ristic M. VlahovicSvabic Mm Sasic M, Zelic O. Clinical and microbiological effect of fixed orthodontic appliances on periodontal tissues in adolescents. *Orthod Craniofac Res*2007; 10:187-95.
- [25]. Naranjo AA, Trivino ML. Jaramillo A, Betancourth M, Botero JE. Changes in the subgingival microbiota and periodontal parameters before and 3 months after bracket placement. *AmJ Orthod Dento facial Orthop* 2006; 130:275 e17-22