

Microbiological and clinical periodontal effects of fixed orthodontic appliances in pediatric patients

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SUMMARY

The aim of this study was to evaluate changes of microbiota in ten patients undergoing orthodontic treatment. For each patient clinical examination of gingival index (GI) and plaque index (PI) were performed at the first molars at: baseline (T1), 2 (T2), 4 (T3) and 12 weeks (T4). At the same time subgingival plaque and tongue samples were taken for the microbiological study. Clinical results showed that at T4, the mean PI score was significantly lower than T1 and the GI was markedly reduced. Microbiological results showed that at T1 and T4 facultative aerobic bacteria were prevalent, whereas anaerobic bacteria were more common at T2 and T3.

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The placement of orthodontic appliances in subjects undergoing orthodontic treatment provokes adverse changes in gingival microflora with the development of gingivitis and consequently periodontitis (Huser *et al.* 1990, Orru *et al.* 2005). Several clinical and microbiological studies demonstrate that, in the absence of good oral hygiene, the placement of orthodontic bands in children results in the formation of increased pocket probing depths concomitantly with a quantitative increase and shifts of the microbial composition of the sub-gingival plaque which resembles the plaque usually found in periodontal dis-

eases, where *Tannarella forsythia*, *Porphyromonas gingivalis* and *Treponema denticola* are prevalent (Blandino *et al.*, 2004; D'Ercole *et al.*, 2006; Haffajee *et al.*, 2006; Huser *et al.*, 1990; Latronico *et al.*, 2007; Socransky *et al.*, 2002; Ximenez-Fu-je *et al.*, 2000).

Furthermore, Petti *et al.* (1997) demonstrated that, in patients who were motivated to oral hygiene, orthodontic therapy with fixed appliances did not cause the development of gingivitis and periodontal disease. Identification of specific bacteria around bands may mean that any treatment of problems arising in this area may be more easily and selectively treated (Atack *et al.*, 1996).

This study recruited ten patients (6 females and 4 males) aged from 10 to 17 years (mean 13.1), who needed dental hygiene treatment before orthodontic therapy at the Department of Periodontology of Catania University. At baseline (T1), after oral hygiene and before placement of the orthodontic appliance, clinical examination

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(gingival and plaque index) of the patients was performed on the first molars, which are the first permanent teeth that appear in the oral cavity and that give less erroneous information on probing depth. The examination was carried out using a Michigan periodontal probe which helps to avoid puncturing the epithelial attachment during probing. (American Academy of Periodontology, 1992). Informed consent was obtained from the parents of patients prior to the beginning of the study. Clinical examination was repeated 2 (T2), 4 (T3), and 12 weeks (T4) after the application of the orthodontic appliance. For the microbiological study sub-gingival plaque samples were collected from all first molars using a sterile paper strip inserted into the gingival crevice after the isolation of the site with cotton rolls and a gentle air stream. At the same time samples were collected from the dorsal surface of the tongue with sterile cotton. Immediately the paper strips and the cotton were inserted into 2 mL of reduced transport fluid in a chamber containing an atmosphere of 5% CO₂, 10% H₂, and 85% N₂, transported to the microbiologic laboratory within 40 min and analyzed as previously described (Lo Bue *et al.* 1999). Differences in gingival index and plaque index and prevalence of bacterial species were analyzed using Student's paired t test. P values <0.05 were assumed as statistically significant. Correlations between bacte-

ria and clinical parameters (plaque index and gingival index) were verified by Pearson's test. P values below 0.050 were considered significant for the relationship between the two variables.

Clinical results showed that all patients showed the presence of dental plaque at the beginning of the study. The mean plaque index score (PI) at baseline (T1) was 3.1 ± 0.81 . After two weeks (T2) PI was significantly increased (3.9 ± 0.80 , $p=0.016$ vs T1 by t test). Surprisingly the PI score progressively decreased. In fact, at T4 the mean PI was significantly lower than baseline (1.90 ± 0.93 ; $p=0.003$). A similar trend was observed in the mean gingival index (GI) at the observed sites.

At T1 the mean GI was 1.1 ± 0.56 , while at T2 and at T3, GI slightly increased (1.6 ± 0.38 and 1.4 ± 0.67 respectively). At T4, the GI was, vice versa, markedly and significantly reduced (0.35 ± 0.41) when compared with the previous time point ($p=0.012$ vs T1; $p<0.0001$ vs T2 and T3 by t test, (Figure 1). In patients who were motivated to oral hygiene, orthodontic therapy with fixed appliances did not cause an increment of dental plaque; on the contrary a marked reduction was observed. As a result of this improved oral hygiene the GI was also significantly improved.

For microbiological results the four sub-gingival plaque sites and the tongue surface were analyzed in each of the ten patients. Four different time points and a total of 200 clinical samples were

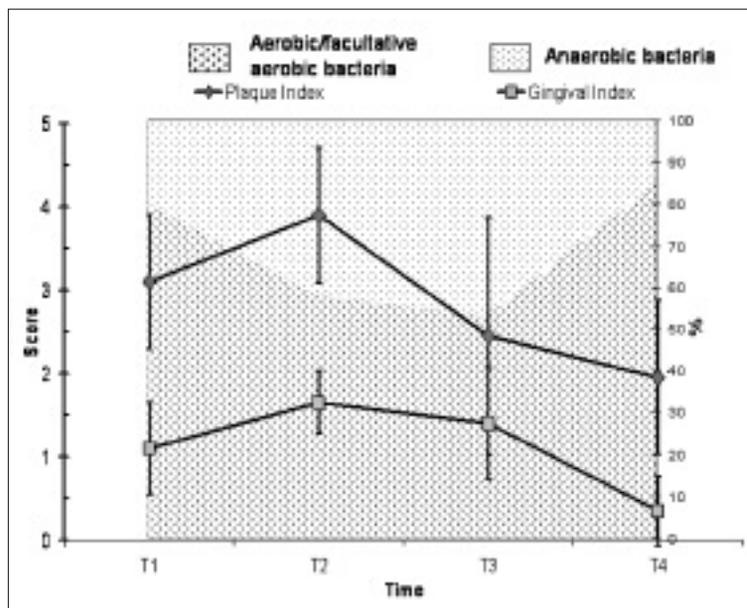


FIGURE 1 - Gingival and plaque index (lines) scored on ten subjects at baseline (T1) and 2 (T2), 4 (T3) and 12 weeks (T4) after the placement of orthodontic appliances and percentage of aerobic/aerobic facultative and anaerobic bacteria (areas) isolated from the same patients from sub-gingival plaque sites.

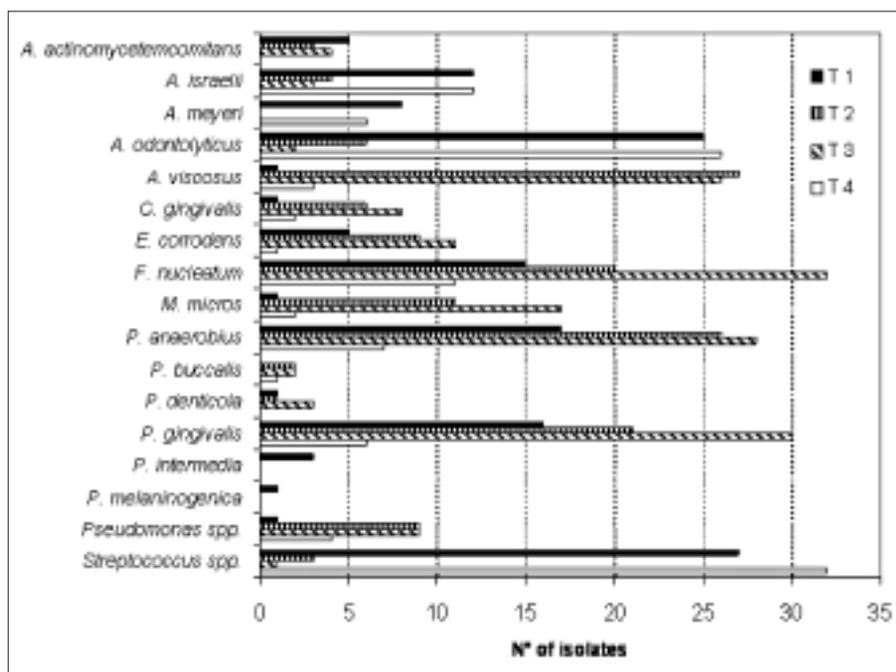


FIGURE 2 - Microorganisms isolated from sub-gingival plaque sites of ten subjects at baseline (T1) and 2 (T2), 4 (T3) and 12 weeks (T4) after the placement of orthodontic appliances.

analyzed. Microbiological results for sub-gingival flora disclosed different bacterial species, including facultative aerobic and anaerobic bacteria (Figure 2). Microflora changes were observed at different collection time points. At T1 facultative aerobic species such as *Streptococcus* species, *Actinomyces odontolyticus*, *Actinomyces israelii* were the most frequently detected. At T2 and T3 either facultative aerobic species such as *Actinobacillus actinomycetemcomitans*, *Actinomyces viscosus*, *Capnocytophaga gingivalis*, or anaerobic species such as *Eikenella corrodens*, *Fusobacterium nucleatum*, *Micrococcus micros*, *Peptostreptococcus anaerobius*, *Porphyromonas gingivalis*, were more frequently detected. *Pseudomonas* species was also found.

Interestingly at T4 *Actinomyces* species (*A. odontolyticus* and *A. israelii*) and *Streptococcus* species were again the most representative microorganisms in sub-gingival plaque.

On the tongue surface at T1 and T4 the microbiological test disclosed both aerobic facultative (*Streptococcus* species and *A. israelii*) and anaerobic species (*P. gingivalis*, *F. nucleatum*, *P. anaerobius*). At T2 and T3, facultative aerobic bacteria such as *A. odontolyticus*, *A. meyeri* and *A. actinomycetemcomitans*, were the most representative species together with *Pseudomonas* species. *E. corrodens* was almost always present at the dif-

ferent sampling times. *C. gingivalis*, *M. micros*, and the different species of *Prevotella*, found in sub-gingival plaque were always absent in the tongue.

The correlation between the gingival index and the anaerobic/aerobic plus aerobic facultative bacteria ratio showed a positive correlation at T4 ($p=0.02$). Because of an increment of aerobic and aerobic facultative bacteria and a decrement of anaerobic bacteria.

Recent studies reported that orthodontic appliances can compromise the periodontal health of gingival tissue because of qualitative changes in the microbiota that surround orthodontic bands which is often associated with gingival inflammation and gingival damage (Orru *et al.*, 2005). Our study showed that at T4 87.5% of the observed sites scored 0 or 1 on the plaque index, and only 12.5% scored 2 or 3 on the plaque index, thus demonstrating that oral hygiene does not cause the development of dental plaque during orthodontic therapy with fixed appliances and, on the contrary, a marked reduction of both GI and PI was observed. These microbiological results confirm that the bacteria can translocate among different oral niches. As regards the plaque index, some authors found a significant reduction in the plaque index after orthodontic treatment and correlated those data with the cure

of periodontal damage (Sallum *et al.*, 2004; Roberts *et al.*, 2000). But to evaluate the effective damage of gingival tissue, it is also useful to consider the gingival index that is a very important parameter to demonstrate the eradication of clinical periodontal signs. Our study showed a significant difference between the GI at T4 when compared to data obtained at T1 and T2. Indeed all patients showed higher values of GI at T2 and T3, against values of GI at T1 and T4. When the GI was correlated with bacteria isolated at different time points from subgingival sites, the GI increased at T2 and at T3 in relation to aerobic facultative and anaerobic bacteria. These data confirm the different pathogenetic role of oral flora. The aerobic facultative Gram positive bacteria can protect the gingival better than other bacteria, while anaerobic bacteria can be considered responsible for damage to periodontal tissue. However, appropriate oral hygiene certainly exerts a beneficial effect, as a consequence of the change in microflora of the oral cavity against the species that represent the physiological micro-flora such as aerobic facultative bacteria. In addition we suggest a pathogenetic role for anaerobic bacteria as responsible of gingivitis and periodontal damage during orthodontic therapies. Thus monitoring anaerobic bacteria is highly recommended following the placement of orthodontic appliances.

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