

EVALUATION ABOUT ANTIMICROBIAL ACTIVITY OF SILVER IN ORTHOSHIELD SAFE-T-TIE® LIGATURES USED IN ORTHODONTIC PATIENTS

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Purpose: to value efficacy of anti microbic propriety of silver ligatures Orthoshield Safe-T-Tie® on periodontal tissues in orthodontic patients. **Materials and methods:** 50 orthodontic patients between 11 and 20 years old with permanent teeth were selected in this study. We evaluated periodontal health of maxillary and mandibular lateral incisors and canines at T0 before the substitution of elastomeric ligatures with Orthoshield Safe-T-Tie® ligatures and at T1 (one month after substitution of ligatures). We used PI (Periodontal Index), GI (Gingival Index) and PRC-real-time to analyze periodontal health. **Results:** there was an improvement of gingival inflammation and a reduction of periodontal pathogens. **Conclusions:** Orthoshield Safe-T-Tie® ligatures improve periodontal health in orthodontic patients.

The moment you place brackets, bands and orthodontic fixed appliances there is accumulation of plaque that causes a generalized gingivitis in patients with good oral hygiene, with no loss of attachment. There's a gingival hypertrophy which induces an increase in the depth of probing determining a pseudo-socket. The orthodontic appliances create an environment favorable to the accumulation of food residue and microorganisms that can cause tooth decay or periodontal disease; in scientific literature there are many studies evaluating the effect of orthodontic appliances on periodontal health (1-3). In particular the influence of different ligatures (steel ligatures against elastomeric ligatures) on the bacterial flora intraoral and periodontal health (4). Others studies showed that the most critical point for the accumulation of plaque is the excess of composite around the brackets because it presents rough and with small gaps in the interface enamel-composite (5). In addition to physical problems given by orthodontic appliances is important cooperation from the patient to maintain adequate oral hygiene. From this the need to try materials that can reduce the problem such as ligatures release of silver (OrthoShield Safe-T-Tie®). The characteristic antimicrobial of silver is based on its ability to destabilize the bacterial cell wall, interrupting the cellular metabolism and inhibit the

production of the same, reducing the number of certain organisms of 99.9% over just a few hours. Ligatures provide continuous protection for all the time in which the material remains in contact with the microbes and is effective for 30 days. In particular this method adopts the porous ceramic that controls the release of silver to the surface of the elastomeric ring.

The purpose of this research is to assess the effects of this technique on periodontal health, in particular the effects on inflammation and gingival bacterial flora in a sample of adolescent patients.

MATERIALS AND METHODS

In our study we have selected 50 consecutive orthodontic patients aged between 14 and 20 years at the afferent Polyclinic of Monza – Istituto Clinico Universitario of Verano Brianza (MB). Each patient signed an informed consent to be enrolled in the study according to the ethical standards of the Declaration of Helsinki of 1964.

We included all patients in permanent dentition, plaque-free, motivated to proper oral hygiene and care with orthodontic fixed appliance on both arches. Patients with systemic diseases or antibiotic treatment were

Key words: periodontal health, periodontal pathogens, orthodontic ligatures, silver, orthodontic treatment.

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Table I. *PI evaluates the presence of plaque deposits associating an increasing score from 0 to 3 based on the amount of the same.*

| PI – PLAQUE INDEX(Silness e Løe 1964) | |
|--|--|
| 0 | ABSENCE of plaque |
| 1 | THIN film of plaque recognizable only by removal with the probe |
| 2 | MODERATE presence of plaque along the gingival margin, interproximal spaces free, recognizable to the naked eye. |
| 3 | MASSIVE presence of plaque along the gingival margin, interproximal spaces covered with plaque. |

Table II. *GI detects the presence of gingival inflammation through probing providing an increasing score from 0 to 3 depending on the severity of inflammation.*

| GI- GINGIVAL INDEX(Løe 1967) | |
|-------------------------------------|--|
| 0 | ABSENCE of inflammation, swelling and bleeding |
| 1 | SLIGHT inflammation, swelling and surface alteration in the ABSENCE of bleeding. |
| 2 | BLEEDING POST PROBING with moderate inflammation, redness and swelling. |
| 3 | BLEEDING TENDENCY TO SPONTANEOUS, severe inflammation, redness and swelling. |

excluded. In all 50 patients were given information on proper oral hygiene techniques, but has not performed full mouth hygiene at T0 to determine the real effect on the periodontium of silver ligatures. As a method of evaluation we have adopted the PI (Periodontal Index) (Table I) (6), GI (Gingival Index) (Table II) (7) and real-time PCR for the microbiological examination performed by a single operator.

The Periodontal and gingival indices were measured on lateral incisors and canines left and right of the maxilla and mandible at about 6 months after banding (T0) before replacing the standard elastomeric ligatures with elastomeric ligatures release of silver and one month by substitution (T1).

Both the T0 to T1, which was performed a PCR-Real-Time type mix, to identify, quantify and subtype pathogens present and evaluate any changes after the use of ligatures microbiological releasing silver.

When taking samples of plaque for microbiological testing (PCR real-time) was performed in the gingival sulcus mesial to the canine in each quadrant and in a control site in the lateral sulcus of the fourth quadrant, using the sterile paper points. The examination is simple

and painless for the patient after inserting a mouth opener; you manually delete the supra-gingival plaque, dries with air jet donor site, and then enter the sterile paper points with tweezers in selected sites. The tips are left in situ for about one minute, then removed and inserted into a sterile container for sending in the laboratory. The examination of type mix involves taking into five sites, one per quadrant, and a control site.

RESULTS

Plaque Index (PI) at T0 of 400 teeth analyzed showed that 82 teeth (20,5%) presented PI 0, 128 teeth (32%) presented PI 1, 128 teeth (32%) presented PI 2, 62 teeth (15,5%) showed PI 3. Gingival Index (GI) at T0 of all teeth analyzed showed that 128 teeth (32%) presented GI 0, 142 (35,5%) GI 1, 107 teeth (26,75%) GI 2, 23 teeth (5,75%) GI 3. Evaluation of Plaque Index at T1 showed that 114 teeth (28,5%) showed PI 0, 194 teeth (48,5%) showed PI 1, 80 teeth (20%) showed PI 2 and 12 teeth (3%) PI 3. Evaluation of Gingival Index (GI) at T1 presented that 230 teeth (57,5%) showed GI 0, 137 teeth (34,25%) had GI 1, 33 teeth (8,25%) presented GI 2.

The analysis of microbiological test (PCR-realtime) with both conventional elastomeric ligatures (T0) and after replacing them with ligatures release of silver (T1) noted the presence of periodontal bacteria: *Actinobacillus Actinomycetem Comitans*, *Porphyromonas Gingivalis*, *Tannerella Forsythensis*, *Treponema Denticola*, *Peptostreptococcus micros*, *Prevotella Intermedia*, *Fusobacterium Nucleatum*, *Campylobacter rectus*.

The percentage of pathogenic bacteria at T0 ranged between 3.8% and 8.6%, while at T1 ranged between 1.9% and 4.3%. There was an increase of about 10% of the teeth with PI 0, an increase of about 20% of the teeth with PI 1, a reduction of more than 10% of the teeth with PI 2, and a reduction of about 12% of the teeth with PI 3 between T0 and T1. The data showed that the ligatures release of silver reduced plaque compared to conventional elastomeric ligatures.

There was a significant increase (25%) of the teeth with bleeding index 0, a reduction of about 18% of the teeth with bleeding index 2 and an absence of elements with bleeding index 3, this demonstrated the capacity of silver to reduce gingival inflammation. These data are in agreement with results of microbiological tests (PCR), where we found a decrease of approximately 50% of pathogenic bacteria between T0 and T1.

DISCUSSION

The scientific literature shows fixed orthodontic appliances increase accumulation of plaque, bacterial colonization and decalcification of enamel (1) (8, 9). However, only few studies have assessed that composition of ligatures increase plaque, especially Forsberg et al. (10) have estimated the microbial colonization of 12 patients treated with fixed orthodontic appliances and reported that the lateral incisor in which there was elastomeric ring exhibited a larger number of microorganisms in plaque compared incisive wire tied. Moreover, they reported a significant increase of *S. Mutans* and *Lactobacilli* in saliva after insertion of fixed appliances.

Türk kahraman et al. (4) evaluated the influence of different ligatures (steel ligature against elastomeric rings) on the bacterial flora intraoral and periodontal health. Despite the teeth with elastomeric rings presented a higher number of *S. Mutans* and *Lactobacilli* in plaque than those with steel wires, the differences were not statistically significant, there were no differences in Plaque Index or probing pocket depth of the teeth. However gingival around the teeth bonded with elastomeric rings were more prone to bleeding.

In the present study we wanted to evaluate the effect of a particular method of ligatures (release of silver) had on periodontal health. The protocol started six

months after beginning of fixed orthodontic treatment to avoid transient changes induced by an improvement of malocclusion (crowded) and oral hygiene in the early stages of therapy may be better (11, 14, 15). The results obtained are consistent with the scientific literature as regards the increase of plaque following the application of the brackets and bands; in fact between 400 teeth examined in the 50 patients, only 82 teeth at T0 and 114 teeth at T1 presented PI 0. In no case was reported formation of periodontal pockets, but only gingival hypertrophy resulting in pseudopockets and gingivitis. GI suggest an interesting variation between two kinds of ligatures: 128 teeth with GI 0 at T0 to T1 teeth have become 230, showing the ability of the ligatures to release silver to influence the formation of plaque bacterial and the local inflammatory response. From comparison of the PCR at T0 and T1 is found not to a qualitative variation of the microbes components of subgingival plaque, but to a halving of the charge of pathogenic bacteria. In both ligatures, the plaque is formed by the same pathogens: *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*,

Tannerella forsythensis, *Treponema denticola*, *Peptostreptococcus micros*, *Prevotella intermedia*, *Fusobacterium nucleatum*, *Campylobacter rectus*: composition consistent with data collected from the international literature (2, 3, 12, 13, 16, 17) which explains the presence of gingivitis after placement of attacks, without microbiological differences depending on the type of ligatures. In this study the improvement of gingival indices after the application of ligatures release of silver is exclusively due to the halving of the load of pathogenic bacteria than standard elastomeric ligatures.

OrthoShield Safe-T-Tie® release of silver can be a valuable tool for plaque control in orthodontic patients uncooperative, they reduce the amount of bacterial pathogens in plaque and gingival inflammation.

CONFLICT OF INTEREST

There are no conflicts of economic or other interest in article presented.

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REFERENCES

1. Sadowsky C, BeGole EA. Long-term effects of orthodontic treatment on periodontal health. *Am J Orthod* 1981;

- 80:156-72.
2. 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. *Am J Orthod Dentofacial Orthop* 2006; 130:275 e17-22.
 3. Huser MC, Baehni PC, Lang R. Effects of orthodontic bands on microbiologic and clinical parameters. *Am J Orthod Dentofacial Orthop* 1990; 97:213-8.
 4. Turkkahraman H, Sayin MO, Bozkurt FY, Yetkin Z, Kaya S, Onal S. Archwire ligation techniques, microbial colonization, and periodontal status in orthodontically treated patients. *Angle Orthod* 2005; 75:231-6.
 5. van Gastel J, Quirynen M, Teughels W, Coucke W, Carels C. Influence of bracket design on microbial and periodontal parameters in vivo. *J Clin Periodontol* 2007; 34:423-31.
 6. Silness J, Loe H. Periodontal Disease in Pregnancy. II. Correlation between Oral Hygiene and Periodontal Condition. *Acta Odontol Scand* 1964; 22:121-35.
 7. Loe H. The Gingival Index, the Plaque Index and the Retention Index Systems. *J Periodontol* 1967; 38:Suppl:610-6.
 8. Davies TM, Shaw WC, Worthington HV, Addy M, Dummer P, Kingdon A. The effect of orthodontic treatment on plaque and gingivitis. *Am J Orthod Dentofacial Orthop* 1991; 99:155-61.
 9. Glans R, Larsson E, Ogaard B. Longitudinal changes in gingival condition in crowded and noncrowded dentitions subjected to fixed orthodontic treatment. *Am J Orthod Dentofacial Orthop* 2003; 124:679-82.
 10. Forsberg CM, Brattstrom V, Malmberg E, Nord CE. Ligature wires and elastomeric rings: two methods of ligation, and their association with microbial colonization of *Streptococcus mutans* and *Lactobacilli*. *Eur J Orthod* 1991; 13:416-20.
 11. Petti S, Barbato E, Simonetti D'Arca A. Effect of orthodontic therapy with fixed and removable appliances on oral microbiota: a six-month longitudinal study. *New Microbiol* 1997; 20:55-62.
 12. Lee SM, Yoo SY, Kim HS, Kim KW, Yoon YJ, Lim SH, Shin HY, Kook JK. Prevalence of putative periodontopathogens in subgingival dental plaques from gingivitis lesions in Korean orthodontic patients. *J Microbiol* 2005; 43:260-5.
 13. Ristic M, Vlahovic Svabic M, Sasic M, Zelic O. Effects of fixed orthodontic appliances on subgingival microflora. *Int J Dent Hyg* 2008; 6:129-36.
 14. Perillo L, Femminella B, Farronato D, Baccetti T, Contardo L, Perinetti G. Do malocclusion and Helkimo Index ≥ 5 correlate with body posture? *J Oral Rehabil*. 2011 Apr;38(4):242-52.
 15. Perillo L, Padricelli G, Isola G, Femiano F, Chiodini P, Matarese G. Class II malocclusion division 1: a new classification method by cephalometric analysis. *Eur J Paediatr Dent*. 2012 Sep;13(3):192-6.
 16. Annunziata M, Guida L, Perillo L, Aversa R, Passaro I, Oliva A. Biological response of human bone marrow stromal cells to sandblasted titanium nitride-coated implant surfaces. *J Mater Sci Mater Med*. 2008 Dec;19(12):3585-91.
 17. Paolantonio M, D'Ercole S, Pilloni A, D'Archivio D, Lisanti L, Graziani F, Femminella B, Sammartino G, Perillo L, Tetè S, Perfetti G, Spoto G, Piccolomini R, Perinetti G. Clinical, microbiologic, and biochemical effects of subgingival administration of a Xanthan-based chlorhexidine gel in the treatment of periodontitis: a randomized multicenter trial. *J Periodontol*. 2009 Sep;80(9):1479-92.