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Original article

Tissue response during self-ligating treatment

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ABSTRACT

Introduction: Orthodontic tooth movement is characterized by tissue reactions, which consist in an inflammatory response in periodontal ligament, depending on the forces applied. Self-ligating brackets are able to minimize the sliding resistance and to reduce the forces necessary to move a tooth, with a better tissue response.

Objectives: The purpose of this study was to evaluate the activity of the lactate dehydrogenase (LDH) in gingival crevicular fluid (GCF) during orthodontic tooth movement using self-ligating brackets.

Materials and methods: Forty patients were selected and treated with two kinds of self-ligating brackets, Quick 2.0 and Smart Clip, and superelastic or thermoactive archwires. Patients' lower arches were bonded and GCF was collected at one side for each tooth at baseline, one hour after bonding and on the 7th, 28th and 42nd day. Test teeth were 4.1, 4.3 and 4.5. Control teeth were 1.1, 1.3 and 1.5. Samples were analyzed with a specific assay for LDH activity.

Results: The statistical analysis showed no significant differences in the LDH activity between test and control teeth in the selected groups.

Conclusions: There are no significant differences, in terms of tissue response, between superelastic and thermoactive archwires.

1. Introduction

Orthodontic movement is characterized by a sequence of tissue reactions, which consist in an inflammatory response in the periodontal ligament[1–3].

When teeth are subjected to masticatory loads, a fast displacement in the space of the periodontal ligament occurs, event anyway hindered by the presence of the gingival crevicular fluid (GCF). GCF is contained in the gingival sulcus and it is rapidly expelled when a force is applied on the tooth and it moves into the periodontal ligament space, compressing the walls of the adjacent bone. GCF composition depends on the quality and quantity of dental plaque, inflammatory cells from the host tissue and serum composition.

Responses are different according to the force exerted on the tissue. If the orthodontic force is low (less than 30 g) there is a partial compression of the vessels of the periodontal ligament and the production of mediators responsible for a frontal bone resorption[4]. A complete obstruction of the blood vessels of the periodontal ligament, a lack of oxygen and sterile necrosis occur when the applied force is rather heavy (more than 100 g).

In this case an indirect resorption takes place and it is possible to shift teeth without the reorganization of tissue: the presence of hyaline tissue does not allow a proper control over

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the orthodontic tooth movement. This leads to an increase in treatment time.

Whitley and Kusy[5] claimed that the ideal force is the one which draws the best biological response with minimal tissue alterations and the least discomfort for the patient. The use of a low and continuous force leads to direct resorption, greater control of tooth movements and reduction of treatment duration.

In order to apply a low force, the resistance to sliding has to be reduced, which means neutralizing forces that oppose the sliding of the wire into the bracket slot. Resistance to sliding depends on various parameters, such as friction between bracket and archwire, archwire curvature and its limit of deformation[6].

In case of high friction between archwire and bracket, the force applied must be sufficient to overcome the frictional force and allow the desired tooth movement. In order to obtain a rapid orthodontic tooth movement it is important to minimize the friction forces that oppose the sliding motion of the bracket on the archwire. Matarese *et al.*[7] showed that friction can be reduced through the use of self-ligating brackets and elastic archwires during the alignment phase. The force required by orthodontic archwire to overcome the resistance to sliding is reduced. Even Cacciafesta *et al.*[8] showed less resistance to sliding of self-ligating brackets compared to conventional brackets. Self ligating brackets may therefore be considered low friction devices[9].

Reicheneder *et al.*[10] demonstrated that the friction considerably varies on the basis of what type of archwire is being used. A low resistance to sliding also allows the archwire to exploit its mechanical characteristics more efficiently. Ni-Ti archwires are characterized by superelasticity and shape memory that allow to achieve great deformations with low forces to better control orthodontic movements. Thermoactive archwires are able to recover their initial configuration, in response to heating above their transition temperature.

GCF is produced for osmotic gradient in the gingival crevice, and many authors[11–18] monitored its components and correlated them to periodontal response during orthodontic treatment. Alkaline phosphatase activity is a component of GCF and it is normally associated with bone metabolism and particularly with bone deposition by osteoblasts. The alkaline phosphatase activity increases when orthodontic forces are applied to teeth[18], both in tension and compression areas, although, according to Takimoto *et al.*[19] and Embery *et al.*[20] its increase is not indicative.

Lactate dehydrogenase (LDH) is an enzyme normally confined to the cytoplasm of cells and released outside cells only after their necrosis. Increased LDH extracellular levels are related to inflammation and tissue destruction. LDH may be regarded as an index of tissue destruction and, during orthodontic treatment, an increase in LDH activity can be justified.

Despite what has been said so far, no study has demonstrated yet the specific role played by this enzyme during orthodontic treatment[13,16].

Another enzyme that can be used as an index of cellular damage is aspartate aminotransferase (AST). Basal levels of all these enzymes can be considered as a consequence of physiological bone turnover, but an increase in their activity could be a sensitive marker of periodontal metabolism during orthodontic treatment[14,15]. The activity of these enzymes reflects the biological activity of the periodontium during orthodontic treatment and its increase may be searched for as a factor able to monitor tooth movement and periodontal health.

The purpose of this study was to analyze the concentration of LDH in GCF of patients treated with self-ligating brackets, to assess the type and extent of orthodontic movement in four different bracket-archwire combinations, as well as the differences in LDH activity between various groups and teeth.

2. Materials and methods

From a database of 162 patients of the Department of Orthodontics of the University of Insubria, 40 patients, 19 males and 21 females, were selected.

Inclusion criteria were:

- Age: 12-18 years;
- Presence of second molars in the arches;
- Absence of third molars in the arches;
- Class I skeletal relationship: ANB = 2 degrees ± 2 degrees;
- SN to GoGn of 33 degrees ± 5 degrees;
- Class I molar relationship;
- Crowding in the lower arch between 3 and 6 mm;
- No extraction cases;
- Good general health;
- Good oral hygiene: plaque score $\leq$ 2 and bleeding score $\leq$ 30%.
- No use of nonsteroidal anti-inflammatory drugs and antibiotics in the month before and during our trial;
- No radiographic evidence of periodontal bone loss, evaluated with panoramic radiograph.

The study protocol was approved by the scientific Committee of the Department of Reconstructive Surgery Sciences and Advanced Technologies, University of Insubria, Varese, Italy and it was carried out in accordance with the ethical standards. An informed consent was obtained from all the parents of the participants prior to their enrolment in the study.

All patients underwent bonding of the lower arches. Plaque score and bleeding score were recorded two weeks before the lower bonding. "Quigley Hein index"[21,22] was used to assess visual plaque. This index considers the quantity and distribution of plaque on the surface of the crown of the teeth. The bleeding score was detected through "Eastman interdental bleeding score"[23], recorded 15 seconds after removing a wooden interdental cleaner Woodsticks Dental (Oral B, Rome, Italy) positioned on the interproximal papilla.

Patients underwent oral hygiene with supra and subgingival ultrasonic scaling two weeks before the placement of the appliance. All selected patients received oral hygiene instructions for the use of toothbrush, dental floss, and interdental brush.

Patients were divided into four study groups of 10 subjects each (Table 1):

- Group 1: self-ligating brackets Quick 2.0, 0.022-inch slot, with MBT prescription (Forestadent, Pforzheim, Germany), coupled with 0.014-inch and 0.018-inch Titanol superelastic archwires (Forestadent, Pforzheim, Germany) (Fig. 1).

Table 1 – Orthodontic appliances used for each group of patients.

Group	Self-ligating bracket	First Archwire	Second Archwire
1	Quick 2.0 Slot 0.022-inch x 0.025-inch (Forestadent)	0.014-inch Titanol superelastic (Forestadent)	0.018-inch Titanol superelastic (Forestadent)
2	Quick 2.0 Slot 0.022-inch x 0.025-inch (Forestadent)	0.014-inch Biostarter (Forestadent)	0.018-inch Thermoactive Nitinol (3M Unitek)
3	Smart Clip APC PLUS Slot 0.022-inch x 0.028-inch (3M Unitek)	0.014-inch Superelastc Nitinol (3M Unitek)	0.018-inch Superelastc Nitinol (3M Unitek)
4	Smart Clip APC PLUS Slot 0.022-inch x 0.028-inch (3M Unitek)	0.014-inch Thermoactive Nitinol (3M Unitek)	0.018-inch Thermoactive Nitinol (3M Unitek)

- Group 2: self-ligating brackets Quick 2.0, 0.022-inch slot, with MBT prescription (Forestadent, Pforzheim, Germany), coupled with 0.014-inch Biostarter archwires (Forestadent, Pforzheim, Germany) and 0.018-inch Thermoactive Nitinol archwires (3M Unitek, Monrovia, CA, USA).
- Group 3: self-ligating brackets Smart Clip APC PLUS, 0.022-inch slot, with MBT prescription (3M Unitek, Monrovia, CA, USA), coupled with 0.014-inch and 0.018-inch Superelastic Nitinol archwires (3M Unitek, Monrovia, CA, USA)" (Fig. 2).
- Group 4: self-ligating brackets Smart Clip APC PLUS, 0.022-inch slot, with MBT prescription (3M Unitek, Monrovia, CA, USA), coupled with 0.014-inch and 0.018-inch Thermoactive Nitinol archwire (3M Unitek, Monrovia, CA, USA).

Orthodontic brackets were placed on the buccal surfaces of the mandibular teeth, on incisors, canines and premolars. Bands were placed on first molars.

Patients underwent GCF sampling. Test teeth were 4.1, 4.3 and 4.5. Control teeth were 1.1, 1.3 and 1.5.

Samples were collected from the buccal gingival sulcus of each tooth at baseline, two weeks before the placement of the appliance (T00), immediately before the bonding of the lower arch (T0), an hour after bonding (T1), and on the 7th, 28th and 42nd day after the orthodontic bonding (T7, T28, T42). 1,440 samples were collected in total.

The Quigley Hein Plaque Index was registered in a score ranging from 0 to 5 before GCF collection. Any supragingival plaque was carefully removed with cotton pellets and a gentle airstream was directed toward the teeth surface for 5 seconds to dry the area.

The GCF was collected with #30 standardized sterile paper strips (Inline, Torino, Italy) inserted 1 mm into the buccal gingival crevice of test and control teeth for 30 seconds. The same operator collected the GCF. After collection, paper points were immediately transferred into plastic vials (Eppendorf AG, Hamburg, Germany) and stored at -30°. GCF total volume was determined for each sample.

Eastman bleeding score was recorded after each collection.

LDH activity was determined spectrophotometrically.

In each vial, 50 μl of saline PBS were introduced and then placed on a mixer (Thermomixer Comfort) at 4-6 °C for 10 minutes.

Samples were analyzed by using 96-well plates. 4.320 tests were carried out. A first analysis was necessary to assess the amount of total proteins in the buffer solution, measured by Bradford method and analyzed through an Elisa reader plate. Two subsequent analyses were done to assess the amount of LDH, by using an LDH Cytotoxicity Assay Kit (Catalogue N. 10008882, Cayman Chemical, Ann Arbor, Michigan, USA). The absorbance of each well was read at 620 nm with a spectrophotometer Elisa plate reader. The absorbance of each sample was converted into LDH total activity.

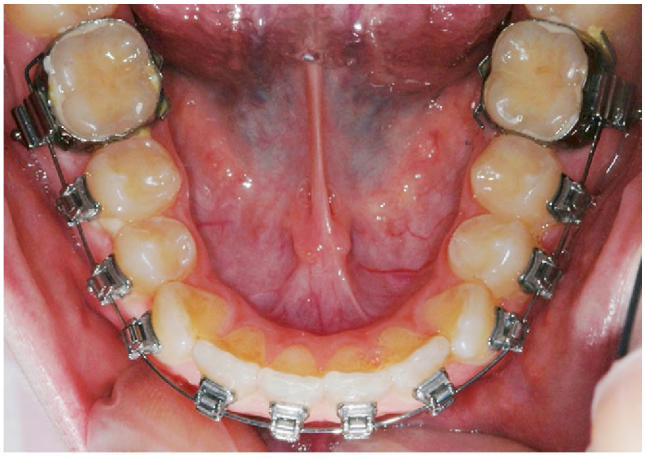

Fig. 1 – Lower arch bonded with self-ligating brackets Quick 2.0, 0.022-inch slot, with MBT prescription.

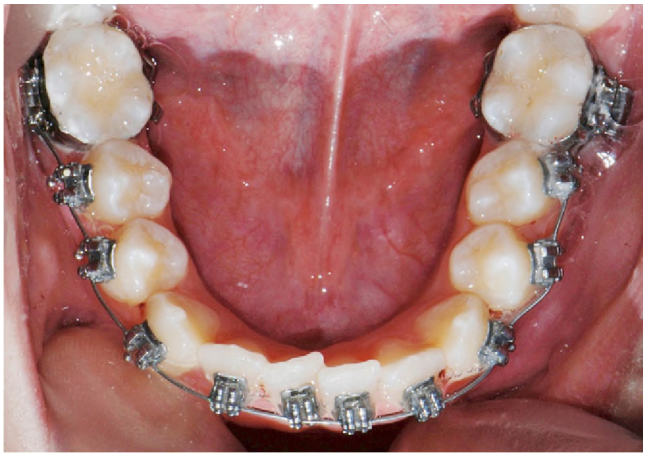

Fig. 2 – Lower arch bonded with self-ligating brackets Smart Clip APC PLUS, 0.022-inch slot, with MBT prescription.

Table 2 – Arithmetic mean ± standard deviation of the LDH activity in each group over time.

Group	Time											
	00		0		1		7		28		42	
	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr
1	0.027 ± 0.031	0.032 ± 0.034	0.029 ± 0.016	0.026 ± 0.010	0.018 ± 0.007	0.018 ± 0.006	0.020 ± 0.006	0.019 ± 0.004	0.022 ± 0.010	0.020 ± 0.008	0.015 ± 0.007	0.015 ± 0.007
2	0.030 ± 0.025	0.029 ± 0.030	0.024 ± 0.010	0.025 ± 0.009	0.020 ± 0.008	0.023 ± 0.007	0.020 ± 0.005	0.019 ± 0.004	0.019 ± 0.008	0.018 ± 0.008	0.023 ± 0.039	0.016 ± 0.004
3	0.024 ± 0.007	0.030 ± 0.018	0.023 ± 0.007	0.022 ± 0.007	0.018 ± 0.011	0.019 ± 0.007	0.017 ± 0.006	0.016 ± 0.005	0.017 ± 0.007	0.017 ± 0.005	0.014 ± 0.003	0.014 ± 0.003
4	0.020 ± 0.012	0.021 ± 0.012	0.026 ± 0.014	0.022 ± 0.008	0.017 ± 0.006	0.017 ± 0.007	0.015 ± 0.004	0.016 ± 0.004	0.021 ± 0.009	0.021 ± 0.009	0.017 ± 0.007	0.018 ± 0.006

Table 3 – P values of LDH activity levels among test and control teeth of each group over time.

Group	Time					
	00	0	1	7	28	42
1	0.52	0.26	0.78	0.22	0.17	0.27
2	0.89	0.19	0.10	0.70	0.56	0.39
3	0.11	0.76	0.64	0.62	0.29	0.26
4	0.88	0.21	0.44	0.55	0.40	0.35
Mean Value	0.60	0.36	0.49	0.52	0.36	0.32

Statistical analysis was performed using MedCalc software (Mariakerke, Belgium).

Differences between LDH activity in μg / mL in GCF of test teeth and control teeth were assessed with Student's *t*-test comparing paired data.

A paired comparison was also made between incisors and canines, canines and premolars and incisors and premolars, to evaluate differences in LDH activity between dental elements.

The difference in LDH activity between group 1 and group 2, and between group 3 and group 4, was evaluated with ANOVA.

Variation over time of plaque score and bleeding score was evaluated with ANOVA Test.

When $P < 0.016$ (Bonferroni correction for multiple comparison) dependence between values could be considered statistically significant.

3. Results

Statistical analysis showed no statistically significant differences between LDH activity of test and control teeth when analyzing data, not considering the type of tooth ($P > 0.016$).

For each group of values the arithmetic means and standard deviations were calculated (Table 2) and P values were reckoned to analyze the dependence between LDH activity of test and control teeth (Table 3).

Since no value of P was smaller than the threshold of 0.016, the difference between LDH activity levels was not statistically significant.

The same analysis was performed considering central incisors (Tables 4 and 5), canines (Tables 6 and 7) and second premolars (Tables 8 and 9) separately. No value of P was smaller than the threshold of 0.016. Even taking into account all kind of teeth, the difference in LDH activity level between pairs of values was not statistically significant.

By comparing the P values for the canines and premolars, the first ones were smaller than the second ones (Fig. 3).

Visual plaque score over time showed a statistically significant reduction (Fig. 4).

Bleeding score increased, although minimally, with statistical significance (Fig. 5).

4. Discussion

Differences in LDH activity between test and control teeth were not statistically significant in any research groups.

Table 4 – Arithmetic mean±standard deviation of the LDH activity of incisors in each group over time.

Group	Time											
	00		0		1		7		28		42	
	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr
1	0.016 ± 0.010	0.021 ± 0.011	0.027 ± 0.010	0.016 ± 0.005	0.016 ± 0.005	0.015 ± 0.003	0.019 ± 0.004	0.017 ± 0.005	0.021 ± 0.009	0.019 ± 0.007	0.014 ± 0.005	0.014 ± 0.005
2	0.022 ± 0.010	0.020 ± 0.013	0.023 ± 0.010	0.019 ± 0.004	0.019 ± 0.004	0.021 ± 0.003	0.019 ± 0.004	0.019 ± 0.005	0.018 ± 0.008	0.018 ± 0.006	0.016 ± 0.005	0.018 ± 0.005
3	0.022 ± 0.007	0.028 ± 0.023	0.022 ± 0.005	0.017 ± 0.004	0.017 ± 0.004	0.020 ± 0.008	0.019 ± 0.007	0.016 ± 0.005	0.016 ± 0.009	0.019 ± 0.009	0.015 ± 0.005	0.015 ± 0.005
4	0.017 ± 0.009	0.013 ± 0.006	0.021 ± 0.008	0.017 ± 0.004	0.017 ± 0.004	0.017 ± 0.005	0.015 ± 0.005	0.015 ± 0.004	0.020 ± 0.009	0.020 ± 0.007	0.018 ± 0.008	0.018 ± 0.006

Table 5 – P values of LDH activity levels among test and control incisors of each group over time.

	Time					
Group	00	0	1	7	28	42
1	0.34	0.55	0.81	0.18	0.28	0.34
2	0.63	0.55	0.19	1	0.90	0.32
3	0.41	0.75	0.12	0.28	0.13	0.83
4	0.46	0.96	1	0.95	0.93	0.65
Mean Value	0.46	0.70	0.26	0.36	0.56	0.46

Table 6 – Arithmetic mean±standard deviation of the LDH activity of canines in each group over time.

	Time											
Group	00		0		1		7		28		42	
	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr
1	0.025 ± 0.010	0.041 ± 0.050	0.027 ± 0.010	0.024 ± 0.011	0.019 ± 0.005	0.019 ± 0.006	0.020 ± 0.007	0.018 ± 0.003	0.020 ± 0.007	0.019 ± 0.007	0.017 ± 0.008	0.017 ± 0.008
2	0.028 ± 0.023	0.038 ± 0.047	0.021 ± 0.008	0.021 ± 0.009	0.019 ± 0.007	0.023 ± 0.009	0.019 ± 0.006	0.017 ± 0.004	0.019 ± 0.007	0.019 ± 0.009	0.016 ± 0.009	0.016 ± 0.007
3	0.022 ± 0.009	0.033 ± 0.017	0.021 ± 0.007	0.019 ± 0.007	0.017 ± 0.005	0.015 ± 0.003	0.015 ± 0.006	0.015 ± 0.005	0.017 ± 0.008	0.019 ± 0.005	0.015 ± 0.008	0.016 ± 0.008
4	0.021 ± 0.003	0.025 ± 0.015	0.022 ± 0.008	0.022 ± 0.011	0.015 ± 0.005	0.016 ± 0.005	0.015 ± 0.004	0.016 ± 0.004	0.020 ± 0.008	0.023 ± 0.010	0.019 ± 0.009	0.020 ± 0.009

Table 7 – P values of LDH activity levels among test and control canines of each group over time.

	Time					
Group	00	0	1	7	28	42
1	0.32	0.25	0.90	0.29	0.73	0.59
2	0.55	0.70	0.080	0.54	0.79	0.81
3	0.16	0.52	0.29	0.74	0.29	0.20
4	0.64	0.74	0.30	0.34	0.22	0.48
Mean Value	0.42	0.55	0.39	0.48	0.51	0.52

Table 8 – Arithmetic mean±standard deviation of the LDH activity of premolars in each group over time.

	Time											
Group	00		0		1		7		28		42	
	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr	Test	Ctr
1	0.041 ± 0.050	0.035 ± 0.031	0.033 ± 0.025	0.026 ± 0.007	0.019 ± 0.011	0.020 ± 0.008	0.021 ± 0.007	0.021 ± 0.004	0.024 ± 0.014	0.021 ± 0.009	0.016 ± 0.006	0.016 ± 0.007
2	0.034 ± 0.034	0.024 ± 0.011	0.024 ± 0.011	0.026 ± 0.011	0.022 ± 0.011	0.025 ± 0.007	0.020 ± 0.005	0.020 ± 0.003	0.019 ± 0.009	0.017 ± 0.007	0.040 ± 0.061	0.018 ± 0.006
3	0.025 ± 0.005	0.025 ± 0.014	0.023 ± 0.010	0.021 ± 0.007	0.021 ± 0.018	0.022 ± 0.008	0.017 ± 0.005	0.017 ± 0.004	0.019 ± 0.007	0.017 ± 0.005	0.015 ± 0.006	0.015 ± 0.007
4	0.022 ± 0.007	0.022 ± 0.009	0.030 ± 0.021	0.020 ± 0.007	0.018 ± 0.007	0.018 ± 0.009	0.015 ± 0.003	0.015 ± 0.004	0.021 ± 0.010	0.021 ± 0.009	0.019 ± 0.007	0.019 ± 0.007

Table 9 – P values of LDH activity levels among test and control premolars of each group over time.

	Time					
Group	00	0	1	7	28	42
1	0.70	0.35	0.72	0.97	0.39	0.75
2	0.36	0.48	0.58	0.89	0.16	0.32
3	0.94	0.56	0.86	1	0.28	0.81
4	0.97	0.16	0.67	1	0.90	0.63
Mean Value	0.74	0.39	0.71	0.97	0.43	0.63

A comparative study between groups with the same brackets and different Ni-Ti orthodontic archwires, superelastic or thermoactive, showed no statistically significant differences in terms of tissue response.

Biomechanical principles of orthodontic movement have been extensively studied and discussed in the literature and some studies have shown that LDH or other indices of tissue destruction may vary according to the type of orthodontic treatment[13,14,16].

LDH is a cytoplasmic enzyme released into the extracellular environment after cell death. Its extracellular presence is related to cell necrosis and consequently to tissue injury. LDH

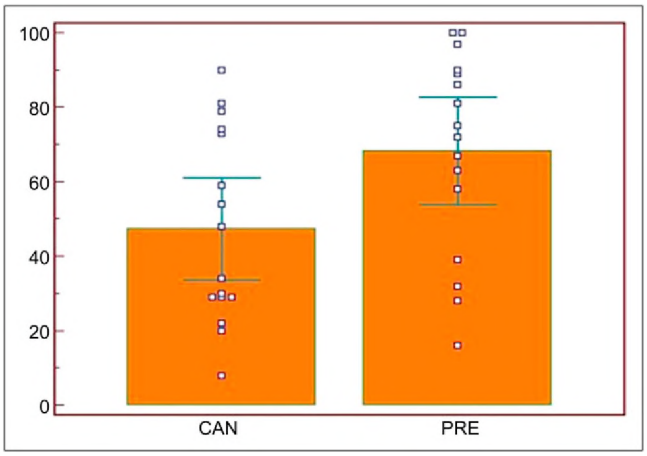

Fig. 3 – Differences in P values for the canines and for the premolars. The difference in the distribution of P values is index of a different behavior of different teeth.

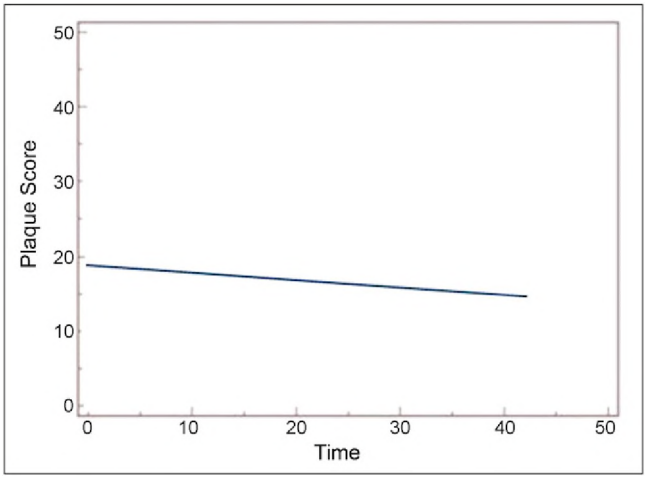

Fig. 4 – Regression line representing the dependence of plaque score (y) by time (x).

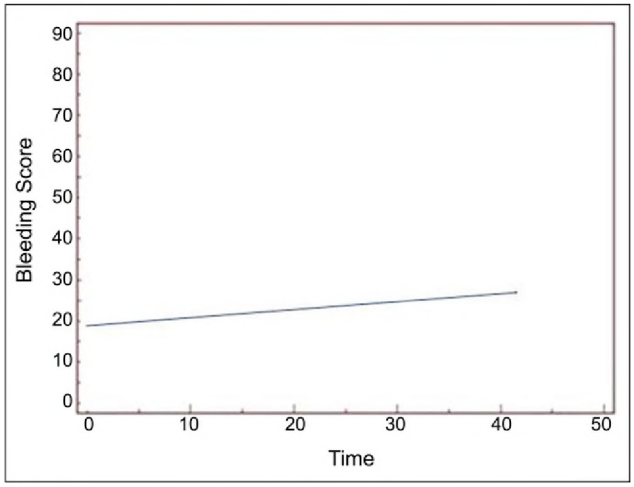

Fig. 5 – Regression line representing the dependence of Eastman index (y) by time (x).

activity is therefore considered an index of tissue destruction during orthodontic treatment[13,16].

LDH activity is also linked with inflammation caused by gingivitis or periodontitis[21,23].

The patients involved in this study showed general visible steady gingival conditions. Visual plaque score decreased over time, probably due to their good oral hygiene. Bleeding score showed a slight increase in the early stages of orthodontic treatment. This behavior was probably to be traced back to the orthodontic treatment in progress and to changes induced within the tissue. An increase in bleeding highlighted a rise in tissue inflammation; this was presumably related to gingival enlargement, during orthodontic treatment[24].

A comparison between correlation indices of different teeth showed their different behavior.

There was a statistically significant difference between LDH activity of different teeth, as it can be drawn from P values, which represented the dependence between the enzyme activity of test and control teeth. The probability that the difference between test and control teeth was random (inferable from the values of P) was significantly different in canines and premolars. Values of incisors increased between values of canines and premolars, but without any statistically significant difference. This result was in accordance with literature. Levels of biological markers in gingival crevicular fluid depends on different sampling sites[13,16].

Serra *et al.*[13] and Perinetti *et al.*[15] maintained that an increase in LDH activity during orthodontic treatment may be due to changes such as resorption and tissue destruction, hyalinization on root areas most submitted to compression, following obstruction of the vessels of the ligaments and necrosis. In these areas focal sterile necrosis occurred and tissue responded releasing LDH outside the cells. Hyalinization and sterile necrosis depend on force intensity generated from the appliance used.

Serra *et* al.[13] analyzed LDH activity in a period between the second and the twelfth week of treatment, without distinguishing precise timing of sampling, and without identifying tissue response over time.

The absence of statistically significant differences in LDH activity between test and control teeth in the current study, might be the result of the use of a low orthodontic force responsible for direct bone resorption. These statements might support the lack of statistically significant differences in LDH activity in low friction appliances. Therefore, the lack of an increase in LDH activity was related to the use of low forces on various teeth, which is responsible for a physiological tooth movement. The lack of increase in LDH activity also agreed with what had been previously said about periodontal scores.

These statements might support the lack of statistically significant differences in terms of LDH activity in low mechanical friction. It was therefore likely that the lack of an increase in LDH activity was related to action of a low force on various teeth, responsible for a physiological movement.

It is to be hoped that future scientific research be encouraged to study the several mediators involved in frontal bone resorption, not yet sufficiently investigated in literature, in order to assess and quantify the different behavior of various bracket-archwire combinations. Furthermore, it would be

of the uttermost importance to appraise the action of such combinations on different teeth taking into account their root surface with regard to the force exerted by the appliance, so as to better adjust the ideal force necessary to shift every single dental element.

5. Conclusions

In the first stages of orthodontic treatment there are no statistically significant differences between LDH activity in GCF of teeth treated with self-ligating brackets and superelastic or thermoactive archwires.

Orthodontic treatment with self-ligating brackets and superelastic or thermoactive archwires determines a good tissue response.

LDH can certainly be proposed as a marker of tissue metabolism in high friction appliances or mechanical systems responsible for an orthodontic movement characterized by hyalinization and sterile necrosis, but not for low mechanical friction, which makes it necessary to search for other mediators responsible for direct bone resorption.

Conflict of interest

The authors have no conflict of interests to disclose.

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Riassunto

Introduzione: *Il movimento ortodontico è caratterizzato da reazioni tissutali che consistono in una risposta infiammatoria all'interno del legamento parodontale in funzione delle forze applicate. Gli attacchi autoleganti sono in grado di minimizzare la resistenza allo scorrimento e di ridurre le forze necessarie per muovere gli elementi dentari con una migliore risposta tissutale.*
Obiettivi: *Lo scopo di questo studio è stato valutare l'attività della lattico deidrogenasi (LDH) all'interno del liquido gengivale crevicolare (GCF) durante il movimento ortodontico con l'utilizzo di attacchi autoleganti.*
Materiali e metodi: *Sono stati selezionati 40 pazienti e trattati con due diversi tipi di attacchi autoleganti, Quick 2.0 e Smart Clip, e con archi superelastici e termoattivi. Sono state bondate le arcate inferiori e il GFC è stato prelevato su un sito per ogni elemento dentale al tempo zero, un'ora dal bondaggio e dopo 7, 28 e 42 giorni. Gli elementi test sono stati 4.1, 4.3 e 4.5, gli elementi controllo 1.1, 1.3 e 1.5. I campioni sono stati analizzati con un test specifico per l'attività della LDH.*
Risultati: *L'analisi statistica ha dimostrato differenze non significative nell'attività della LDH tra gli elementi test e quelli controllo nei gruppi selezionati.*
Conclusione: *Non esistono differenze significative in termine di risposta tissutale tra archi superelastici e termoattivi.*

Résumé

Introduction: *Le mouvement dentaire orthodontique est marqué par des réactions tissulaires, ce qui est à l'origine d'une réponse inflammatoire dans le ligament alvéolo-dentaire, sur la base des forces appliquées. Les attaches auto-ligaturantes sont à même de réduire au minimum la résistance au glissement et de diminuer les forces nécessaires pour déplacer une dent, avec une meilleure réponse tissulaire.*
Objectif: *Le but de cette étude est d'évaluer l'activité de la lactate déshydrogénase (LDH) dans le fluide créviculaire gingivale (GCF), pendant le mouvement dentaire orthodontique lorsqu'on utilise les attaches auto-ligaturantes.*
Matériel et méthode: *Quarante patients ont été choisis et traités à l'aide de deux types d'attache autoligaturantes, Quick 2.0 et Smart Clip, et d'arcs thermoactifs ou superélastiques. Les arcs inférieurs des patients ont été collés et le GCF a été collecté sur un côté de chaque dent au stade initial, une heure après le collage et aux jours 7, 28 et 42. Les dents concernées par l'essai ont été les suivantes: 4.1, 4.3 et 4.5, les dents de contrôle étant 1.1, 1.3 et 1.5. Les échantillons ont été analysés à l'aide d'un tableau spécifique pour l'activité LDH.*
Résultats: *L'analyse statistique n'a enregistré aucune différence significative pour ce qui est de l'activité de la LDH entre les dents de l'essai et de contrôle dans les groupes choisis.*
Conclusions: *Aucune différence significative n'existe, en termes de réponse tissulaire, entre les arcs superélastiques et thermo-actifs.*

Resumen

Introducción: *El movimiento dental ortodóncico está marcado por reacciones tisulares que desembocan en una respuesta inflamatoria en el ligamento periodontal, dependiendo lo anterior de las fuerzas aplicadas. Los brackets autoligantes están en condiciones de reducir al mínimo la resistencia al deslizamiento y la fuerza necesaria para mover un diente, siendo la respuesta tisular mejor.*
Objetivos: *El presente estudio pretende valorar la actividad del lactato deshidrogenasa (LDH) en el fluido crevicular gingival (FCG) durante el movimiento dental ortodóncico, con el auxilio de brackets autoligantes.*
Materiales y métodos: *Cuarenta pacientes fueron seleccionados y tratados con dos tipos de brackets autoligantes, Quick 2.0 y Smart Clip y arcos superelásticos y termoactivos. Los arcos inferiores de los pacientes fueron encolados y el FCG fue recogido en un lado de cada diente en el nivel inicial, una hora después del bonding y en los días 7, 28 y 42. Los dientes involucrados en la prueba fueron 4.1, 4.3 y 4.5, siendo los dientes de control 1.1, 1.3 y 1.5. Las muestras fueron analizadas utilizando una matriz específica para la actividad LDH.*
Resultados: *El análisis estadístico no experimentó diferencias significativas en la actividad del LDH entre los dientes de control y del ensayo en los grupos que nos ocupan.*
Conclusiones: *No hay diferencias significativas en términos de respuesta tisular, entre arcos superelásticos y termoactivos.*

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