Friction force on brackets generated by stainless steel wire and superelastic wires with and without IonGuard

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Abstract

Objective: The aim of this study was to evaluate the friction forces on brackets (Roth, Composite, 10.17.005, 3.2 mm, width 0.022x0.030-in, torque -2º and angulation +13º, Morelli®, Brazil), with stainless steel orthodontic rectangular wire (Morelli®, Brazil) and nickel-titanium superelastic Bioforce wires with and without IonGuard (Bioforce, GAC®, USA). **Methods:** Twenty-four brackets/segment of wire combinations were used, distributed into 3 groups according to the orthodontic wire. Each bracket/segment of wire combination was tested 3 times. The tests were performed in a universal testing machine EMIC DL2000®. The data was submitted to ANOVA one way followed by Tukey's post hoc test ($p<0.05$). **Results:** The rectangular orthodontic Bioforce wire with IonGuard presented significantly lower resistance to sliding than Bioforce without IonGuard. There was no statistical difference among the other groups. However, the coefficient of variation of Bioforce with and without IonGuard was lower than that of the stainless steel wire. **Conclusion:** The rectangular orthodontic Bioforce wire with IonGuard presented lower resistance to sliding than Bioforce without IonGuard, with no difference to the stainless steel wire.

Keywords: Orthodontic appliance design. Friction. Orthodontic wires.

Editor's abstract

Friction may be defined as resistance to movement when an object moves over another object with which it is in contact. Friction in sliding orthodontic mechanics is a clinical difficulty for the orthodontist because high friction levels decrease mechanical effectiveness, reduce the speed of tooth movement, and make anchorage control difficult. Therefore, orthodontic wires and brackets should have the lowest friction coefficient possible.

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To reduce friction between the bracket and orthodontic wires, alternative surface treatments have been prescribed for these alloys, such as ion implantation. The objective of the authors in conducting this study was to evaluate friction forces of stainless steel wires and nickel-titanium wires with and without surface treatments inserted in the slots of the metal brackets.

For this purpose, segments of 0.019x0.025-in orthodontic stainless steel and nickel-titanium wires with and without IonGuard (surface treatment) were used. To evaluate sliding mechanics of a fixed orthodontic appliance, a specific device was built to simulate the distal movement of a canine in a previously established area (Fig 1). For the sliding and friction trial, samples were divided into 3 groups according to the wire used. Each group had 8 bracket/wire segment sets; each set was tested 3 times and the mean value was calculated. The sliding and friction forces between the brackets and the different types of wires was evaluated using a universal testing machine.

Results showed a higher friction coefficient for the nickel-titanium wire without surface treatment (no IonGuard), and the results for these groups were statistically different from those found for the groups of nickel-titanium wires with IonGuard and of stainless steel wires.

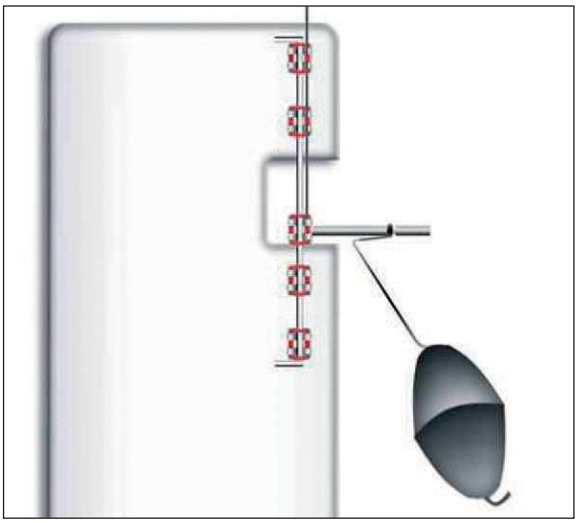

FIGURE 1 - Plate with wire segment and test bracket that simulated canine in sliding mechanics.

There were no statistically significant differences between groups of wires with IonGuard and stainless steel wires ($p>0.05$).

According to the results found, the authors concluded that the type of wire has an effect on the results of friction forces. They further suggest that the Bioforce wire with IonGuard is a good alternative when greater sliding is required in tooth movement.

Questions to the authors

1) The results that you found were obtained in tests with wires that had new surface treatment. Do you believe that the same results might be obtained if the tests included ageing of the specimens?

The process of ion implantation forms a thin layer over the wire surface. We believe that thermal ageing (thermal cycling) would not be capable of changing the wire surfaces and, therefore, would not change the results found in this study. However, any other form of ageing that removes the superficial layer of the wire may increase friction with the brackets.

2) According to Wichelhaus et al,[1] after 4 weeks of clinical use, there is a significant increase of friction in wires with ion implantation, and the advantages of these materials are limited to the initial periods of use. Our question is: Would the use of nickel-titanium alloy wires with IonGuard in cases of visits distant apart increase or decrease total orthodontic treatment time?

The results reported by Wichelhaus et al[1] showed that there was significant wire friction after 4 weeks. This increase was greater for the wires with surface treatment than for wires without any treatment. However, after 4 weeks there were no significant differences between the wires. Based on these results, we may suggest that the prolonged use of wires with surface treatment might increase the friction coefficient even more when compared with wires without treatment, and might increase total treatment time, and would be a contraindication when visits are distant in time. It is important to stress that we do not know at which point in this time interval (initial and 4 weeks) there was this significant change in friction. Moreover, it has not been investigated whether the friction coefficient after the first 4 weeks is significantly lower, similar or greater than that of wires without surface treatment.

3) Do the authors believe that the results would be the same if self-ligating brackets were used instead of conventional brackets?

The results of friction found in the literature indicate that the greater friction coefficient of conventional brackets is assigned to the elastic ligatures, and not the bracket itself. Therefore, although the friction coefficient for self-ligating brackets might be lower than those found in this study, the differences between wires would probably be the same.

REFERENCES

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