INFLUENCE OF THE LIGATION METHOD, METALLIC ALLOY AND TIPPING IN SLIDING MECHANICS

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OBJECTIVES

To evaluate, *in vitro*:

a. the **resistance to sliding** of **conventional** ligated brackets and **self-ligating** brackets when using stainless steel and nickel-titanium archwires

b. the effect of **tipping** on the resistance to sliding mechanics.

MATERIALS and METHODS

The 0.022-inch slot brackets Damon® Q™, Prodigy SL™(Sybron Dental Specialties Ormco™, Orange, Califórnia, USA), Smart-Clip™SL3, Victory Series™(3M Unitek Orthodontic Products, Monrovia, Califórnia, USA), Morelli® Roth Standard and Morelli® Roth SLI (Morelli Ortodontia, Sorocaba, São Paulo, Brazil) were tested. The brackets were ligated to 0.016x0.022 inch stainless steel (Dentaurum GmbH, Ispringen, Germany) and nickel-titanium (DM Ceosa, Madrid, Spain) archwires. A tipping of 0º or 5º was added to the wires. For each combination of bracket/ archwire, 10 sliding tests were performed with the Shimadzu AG-1 5kN testing instrument (Shimadzu Corporation, Tokyo, Japan) (Figure 2). Maximum registered resistance to sliding was measured throughout 5 mm translation of the archwire, at a crosshead speed of 10mm/min.

RESULTS

Table 1 – Resistance to sliding registered for each type of bracket, according to archwire alloy and tipping.

* Elastomeric ligation

Archwire Alloy	Tipping	Conventional Brackets			Passive Self-ligating Brackets			Active Self-ligating Brackets		
		Mean (σ)	Minimum	Maximum	Mean (σ)	Minimum	Maximum	Mean (σ)	Minimum	Maximum
Stainless Steel	0 degrees	3.85 (1.46)	2.19	6.00	0.10 (0.02)	0.08	0.14	0.11 (0.03)	0.07	0.17
	0 degrees*				2.42 (0.31)	2.08	2.76	3.05 (0.59)	1.99	3.98
	5 degrees	3.20 (1.01)	1.71	5.15	0.47 (0.39)	0.08	1.23	0.18 (0.05)	0.10	0.24
Nickel-Titanium	0 degrees	4.24 (0.87)	2.83	5.28	0.11 (0.02)	0.08	0.15	0.13 (0.05)	0.08	0.26
	5 degrees	3.38 (0.90)	2.03	4.70	0.14 (0.03)	0.10	0.20	0.11 (0.02)	0.07	0.15

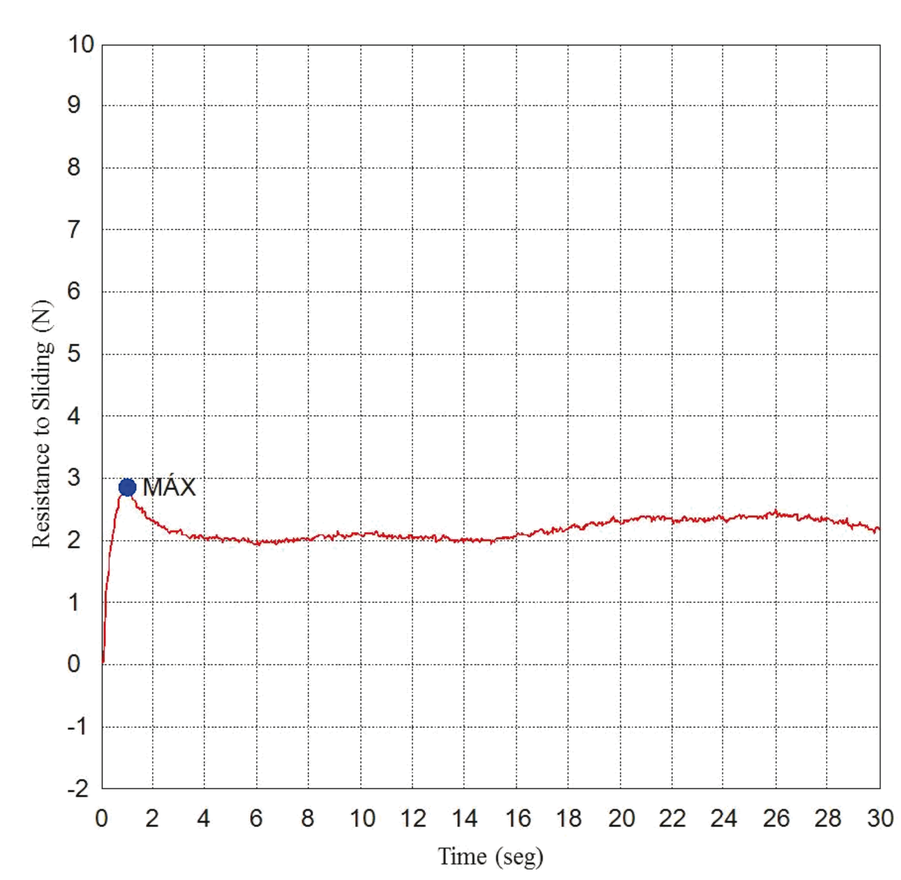

Figure 1 – Resistance to sliding test graphic obtained by Shimadzu AG-1 5kN testing instrument.

Figure 2 – Shimadzu AG-1 5kN testing instrument.

- Conventional brackets show higher resistance to sliding when comparing to active or passive self-ligating brackets ($p<0{,}001$) (Kruskal-Wallis and Mann-Whitney *post-hoc tests*).
- No statistically significant differences were found between the resistance to sliding of active and passive self-ligating brackets (Student t-test for independent samples).
- No statistically significant differences were found between archwire alloys at 0 degrees angulation (Non-parametric Mann-Whitney test for independent samples).
- For 5 degrees angulation stainless steel archwires show statistically significant higher resistance to sliding ($p=0{,}004$) (Non-parametric Mann-Whitney test for independent samples).
- No statistically significant differences were observed between 0º and 5º of tipping (Student t-test for independent samples).

CONCLUSIONS

Self-ligating brackets are an useful tool in orthodontic mechanics when low friction levels are needed. If coupled with small diameter archwires, the resistance to sliding is not affected by small angulations and low degrees of tipping. Nevertheless, different metallic alloys present dissimilar behavior when tipping angulations are present.