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Load deflection characteristics and surface roughness of esthetic archwires

(An *ex vivo* a comparative study)

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Abstract

The current study was conducted to evaluate load/deflection properties and surface characteristics of initial aesthetic orthodontic wires after clinical use as appose to as-received form. Eighty orthodontic arch-wires were used from four commercial brands (Conventional NiTi, Dentaaurum, Germany; Epoxy coated, Orthotechnology, USA; Rhodium coated, IOS, USA and fiber-reinforced polymer composite, FRPC, Pearl, Dentaaurum,). Each wire was allocated randomly to be used either for a patient, at proper alignment stage, or for laboratory tests.

Wires were placed in the maxillary arch bonded with metal fixed braces with conventional elastic ligation. After 6 weeks, the retrieved arch-wires cleaned using ultrasonic cleaner with distilled water and stores in labeled Petri dish.

The straight distal portions of the as-received and retrieved archwires underwent testing procedures using the Universal Testing Machine (Computerized Instron H50KT) for three point bending test. Moreover, surface roughness and topography was assessed using atomic force microscopy (AFM). Analysis of variance test (ANOVA), and Turkey's (HSD) test were used to identify the differences among the studied groups. while, Student's t-test was used to evaluate the significant difference between the as-received and retrieved condition of the same category.

The results revealed that, apart from FRPC wires, the retrieved arch-wires showed a non-significant increase in the loading force values compared to as-received wires. However, FRPC wires showed significant decrease in the loading force values. Furthermore, there was no significant difference between as-received and retrieved conditions regarding the unloading force expression of conventional NiTi, epoxy coated and FRPC arch-wires. However, rhodium coated wires showed a significantly lower unloading force in the retrieved form.

Furthermore, the plateau gap and hysteresis loop of conventional NiTi, Epoxy coated and rhodium coated wires did not show changed after clinical use suggesting that these wires' retain their super elastic properties. However, FRPC wires did not show these super elastic characteristics. Indeed FRPC wires were incapable of withstand deflections more than 2mm.

Regarding the surface roughness of the wires, the as-received forms showed comparably smooth surface, however, in retrieved wires, only the conventional NiTi arch-wire and the rhodium coated wires retain their smooth texture whereas, the surface roughness average (Ra) of Epoxy coated and FRPC arch-wires showed a significant increase after 6 week of use. Additionally, the three dimensional representation of the AFM of retrieved FRPC wires revealed the presence of surface crevices and exposure of the core microfibers.

In conclusion, the oral environment neglected influence on the mechanical properties of the tested initial aesthetic arch-wires apart from the FRPC wires. Epoxy coated and FRPC arch-wires showed a significant increase in surface roughness. FRPC wires should be used with caution under specific circumstances.