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Surface Roughness of Fiber-Reinforced Polymer Composite Archwires at Dry and Wet Conditions

(an in Vitro Comparative Study)

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ABSTRACT

The demand for esthetic orthodontic appliances is increasing so that clear labial orthodontics was introduced, composed of esthetic orthodontic archwires together with esthetic brackets. Fiber-reinforced polymer composite (FRPC) archwires have been investigated as a replacement for coated alloy wires promising an ideal esthetic orthodontics. The surface roughness of an orthodontic wire is an essential functional property known to influence the esthetic result, plaque accumulation, biocompatibility, and/or the mechanical characteristics.

This *in vitro* study was designed to evaluate the surface roughness of FRPC archwires compared to coated nickel-titanium (NiTi) archwires estimating the effects of different esthetic archwire types (materials) and different immersion periods in artificial saliva.

Three types of esthetic orthodontic archwires were used: FRPC (Dentaurum), Teflon coated NiTi (Dentaurum) and epoxy coated NiTi (Ortho Technology). They were round (*0.018* inch) in cross-section and cut into pieces of *15* mm in length. Forty pieces from each type were divided into four groups; one group was left at the dry condition and the other three groups were immersed in artificial saliva (pH=*6.75* ± *0.015*) at *37*ºC for *1, 14* or *28* days. The atomic force microscope (AFM) was used to perform the surface analysis of all samples. ANOVA, Kruskal-Wallis, LSD and Mann-Whitney U tests were used to identify and localize the source of differences among the groups.

At each immersion period, FRPC wires exhibited the highest roughness among the study groups, except that at *28* days immersion period where the Teflon coatings were the roughest. On the other hand, the least rough surfaces were the epoxy coatings when compared to analogous archwires, except that at *1* day immersion period where the Teflon coatings were the least rough.

The roughness of FRPC wires increased after *1* day immersion and gradually dropped to the lowest values at *28* days. Whereas, the roughness of Teflon coated wires significantly increased at *28* days immersion. The epoxy coated wires showed minimal decrease in roughness with time which was significant only from *1* day to *14* days immersion.

We can conclude that FRPC archwires are suitable candidates for use as esthetic orthodontic wires even after *1* month, while Teflon coated archwires must be changed before *28* days. Furthermore, epoxy coated archwires are the best and the most appropriate esthetic orthodontic wires in term of the least surface roughness initially and over the course of orthodontic treatment.