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Corrosion Behavior of Coated and Uncoated Nickel-Titanium Orthodontic Wires in Artificial Saliva with Short-term Prophylactic Fluoride Treatment

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The objective was to evaluate and compare the corrosion stability of nickel-titanium (NiTi) wires with various coatings in the course of a weekly prophylactic regime. Uncoated (uNiTi), nitride (NNiTi) and rhodium (RhNiTi)-coated nickel-titanium archwires were immersed in artificial saliva for 28 days. Once per week, for five minutes, the wires were immersed in different topical fluoride gels. Wires from every experimental group were subjected to electrochemical testing (open circuit potential, electrochemical impedance spectroscopy (EIS) and cyclic polarization). The corrosion resistance of the uNiTi and NNiTi wires did not differ, regardless of the immersion media. The corrosion resistance of the RhNiTi wires decreased after prolonged exposure to artificial saliva and repeated exposure to re-mineralizing agents with low HF concentration. In contrast, the resistance to corrosion increased after repeated exposure to re-mineralizing agents with high HF concentration. EIS testing showed that uNiTi and NNiTi in all media and RhNiTi in the highest HF media displayed a surface oxide coating, whereas RhNiTi in all other media showed an outer porous oxide layer above the compact oxide layer. Repeated application of prophylactic agents with high fluoride concentrations decreases the barrier properties of the surface coating on uNiTi and NNiTi wires and disrupts formation of the porous layer of corrosion products inside the pores of the noble coating on RhNiTi wires.

Keywords: cyclic polarization scan; electrochemical impedance spectroscopy; nickel-titanium wire; surface coating; topical fluoride.

FULL TEXT