Republic of Iraq
Ministry of Higher Education
and Scientific Research
University of Baghdad
College of Dentistry

EVALUATION OF THE MECHANICAL PROPERTIES OF TITANIUM-NIOBIUM-TANTALUM-ZIRCONIUM ARCH WIRE

(An *in-vitro* study)

A thesis submitted to the council of the College of Dentistry / University of Baghdad, in partial fulfillment of the requirements for the degree of the Master science in Orthodontics

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ABSTRACT

Introduction: titanium-niobium-tantalum-zirconium arch wire is a new niobium based β-titanium alloy wire. It is named Gummetal, and characterized by being nickel free, highly elastic and formable wire. The objectives of this study were to evaluate the load deflection properties and frictional forces of small diameter Gummetal arch wire, in comparison with superelastic nickel titanium and copper nickel titanium arch wires. In addition to evaluating surface roughness of these arch wires, both in the as-received and after testing friction conditions.

Material and methods: a total of 60 wire segments (20 from each type) were used, all of 0.014-inch in diameter. The load deflection properties of these wire segments were evaluated, using three-point bending test, at 2 and 4 mm deflections. Their frictional forces were measured using three-unaligned bracket setups. Both tests were performed in the wet condition, using the Instron machine. The surface roughness of the wires were examined by the atomic force microscopy. The data for all tests were analyzed statistically using one-way analysis of variance test. Paired t-test was used only to compare between surface roughness of the wires, in their as-received and after testing friction conditions.

Results: the present study showed a statistical significance (p-value<0.05) between Gummetal and the control wires, regarding their unloading forces, both at 2 and 4 mm deflections. Gummetal showed the highest frictional forces; however, there was no statistical significance between Gummetal and copper nickel titanium wires (P-value>0.05). Paired t-test showed no significant difference (P-value>0.05) in surface roughness of Gummetal wire, before and after testing friction.

Conclusion: Gummetal arch wire exhibited higher but more rapid loss of its unloading forces in comparison with either superelastic nickel titanium or copper nickel titanium arch wires, and the high frictional forces of Gummetal may in part account for this behavior. However, in this study the surface of Gummetal wire appeared to be more resistant to wear due to friction as compared with superelastic nickel titanium or copper nickel titanium arch wires.

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