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Load-Deflecting Characteristics of a Fabricated Orthodontic Wire with 50.6Ni 49.4Ti Alloy Composition

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Abstract : Aims: The objectives of this study was to determine the load-deflecting characteristics of a fabricated orthodontic wire with alloy composition of 50.6% (atomic weight) Ni and 49.4% (atomic weight) Ti and to compare the results with Ormco, a commercially available pre-formed NiTi orthodontic archwire. Materials and Methods: The ingots alloys with atomic weight ratio 50.6 Ni: 49.4 Ti alloy were used in this study. Three specimens were cut to have wire dimensions of 0.016 inch x0.022 inch. For comparison, a commercially available pre-formed NiTi archwire, Ormco, with dimensions of 0.016 inch x 0.022 inch was used. Three-point bending tests were performed at the temperature 36+1 °C using a Universal Testing Machine on the newly fabricated and commercial archwires to assess the characteristics of the load-deflection curve with loading and unloading forces. The loading and unloading features at the deflection points 0.25, 0.50, 0.75. 1.0, 1.25, and 1.5 mm were compared. Descriptive statistics was used to evaluate each variables, and independent t-test at $p < 0.05$ was used to analyze the mean differences between the two groups. Results: The load-deflection curve of the 50.6Ni: 49.4Ti wires exhibited the characteristic features of superelasticity. The curves at the loading and unloading slope of Ormco NiTi archwire were more parallel than the newly fabricated NiTi wires. The average deflection force of the 50.6Ni: 49.4Ti wire was 304.98 g and 208.08 g for loading and unloading, respectively. Similarly, the values were 358.02 g loading and 253.98 g for unloading of Ormco NiTi archwire. The interval difference forces between each deflection points were in the range 20.40-121.38 g and 36.72-92.82 g for the loading and unloading curve of 50.6Ni: 49.4Ti wire, respectively, and 4.08-157.08 g and 14.28-90.78 g for the loading and unloading curve of commercial wire, respectively. The average deflection force of the 50.6Ni: 49.4Ti wire was less than that of Ormco NiTi archwire, which could have been due to variations in the wire dimensions. Although a greater force was required for each deflection point of loading and unloading for the 50.6Ni: 49.4Ti wire as compared to Ormco NiTi archwire, the values were still within the acceptable limits to be clinically used in orthodontic treatment. Conclusion: The 50.6Ni: 49.4Ti wires presented the characteristics of a superelastic orthodontic wire. The loading and unloading force were also suitable for orthodontic tooth movement. These results serve as a suitable foundation for further studies in the development of new orthodontic NiTi archwires.

Keywords : 50.6 ni 49.4 Ti alloy wire, load deflection curve, loading and unloading force, orthodontic
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