Manila Central University
Master of Science in Dentistry- Orthodontics

Evaluation of the Tensile Strength and Surface Topography of Stainless Steel Wires under Various Heat Treatment Methods and Its Implication in Orthodontics

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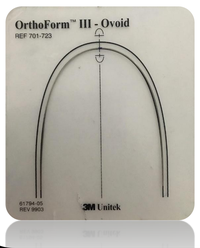
INTRODUCTION

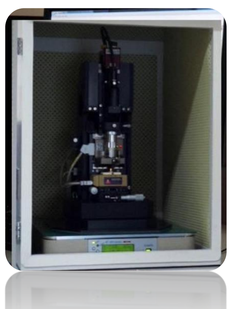
Ideal physical and structural properties of wires are required in the progress and outcome of an orthodontic case. Heat treatment is a procedure that provides stress- relief and improves the mechanical properties and the surface finish of the stainless steel wires. The aim of the study was to evaluate the effects of various heat treatment methods in the tensile strength and surface topography of stainless steel wires.

MATERIAS AND METHODS

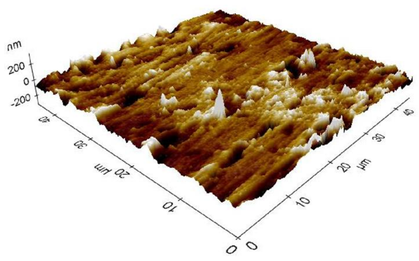


.016x.022 straight-length stainless steel wires were purchased from Ormco. A total of 80 wires were formed into arch by a single operator using the 3M Ovoid mandibular arch template, with 20 wires in each group

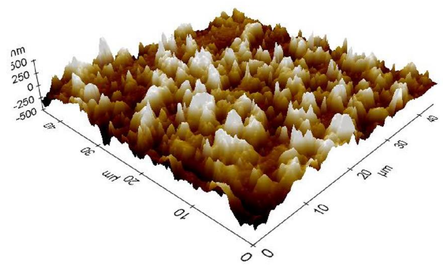
Four treatments groups were assigned: A. Conventional Cigarette lighter, B. Spot welding machine, C. Boiling water bath (100° Celsius) and D. Control group with no treatment.



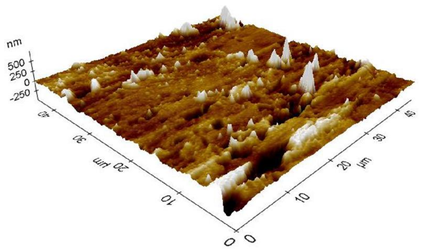
All samples were subjected to tension test by the Universal Testing Machine with a crosshead speed of 3mm per minute, and surface topography analysis through the Atomic Force Microscope.



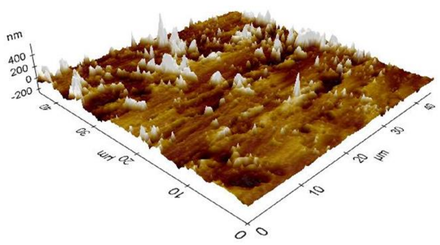
A. Conventional cigarette lighter



B. Spot Welding Machine



C. Boiling water bath 100° Celsius



D. No treatment

Three-Dimensional Image and Surface Roughness using Atomic Force Microscopy on Stainless Steel Wires

RESULTS

Analysis of Variance revealed that there was a significant difference in the mean scores of tensile strengths of the stainless steel wires being subjected to the different heat treatment methods at $p<.05$ level of significance. The heat treatment using the spot welding machine on stainless steel wires had the highest tensile strength (2116.45 MPa), followed conventional cigarette lighter group (2111.20 MPa), no treatment group (1994.90 MPa), and the boiling water group with the lowest tensile strength (1938.75).

Spearman correlation analysis revealed that there was no relationship between the tensile strength and surface roughness at a $p<.05$ level of significance. The heat treatment through spot welding machine yielded the highest surface roughness (97.0575 nm), followed by boiling water bath (37.815 nm) and no treatment (33.056 nm). The heat treatment through conventional cigarette lighter (22.3595 nm) yielded the lowest surface roughness value.

CONCLUSION

The use of spot welding machine is still recommended since it yields the highest value in terms of tensile strength, but further research should be done regarding its cytotoxicity, friction and corrosion of wires. The use of boiling water bath does not significantly affect the tensile strength, but surface topography results showed lesser roughness compared to the spot welding machine.

The use of conventional cigarette lighter is recommended since it yields the second place in the tensile strength values and was proved to have statistically significant homogenous results with the spot welding machine according to the Scheffe test at $p<.05$ level of significance. This treatment group has the least surface roughness values in the surface topography analysis. It is also readily available in the market, portable and more economical than the spot welding machine.