University of Toronto

THE MECHANICAL AFFECTS OF FLAMING NICKEL-TITANIUM ORTHODONTIC ARCHWIRES

Dr. Matt MacLeod*
University of Toronto

Background: This study was conducted to assess the mechanical effects of archwire flaming and to determine whether these effects are isolated to the region of wire immersed in the flame.

Objective: Questionnaires on sleep and day-time behavior have been administered to 168 subjects at two time points: at the screening session, when they were admitted for treatment at the University of Montreal, and four years later, when most of them were on retention, but some subjects were still in active treatment or growth follow-up. The mean age of the subjects at the time of the first evaluation was 13 years. Data analysis involved (i) exploratory data analysis to identify the main patterns; (ii) Bivariate analysis using $\chi 2$ tests to examine the association between nominal/ordinal variables; (iii) Multivariate analysis using linear logistic regressions for continuous and binary outcomes. In all these statistical models, potential confounding factors have been controlled for.

Methodology: Two sizes of pre-formed austenitic nickel-titanium archwires (0.014" and 0.019" x 0.025" in dimensions) were tested (n=10 per group). Using a ceramic heat shield, the 5mm-long terminal end of all experimental wires was heated for five seconds using a diffusion-type butane lighter (max temp 1657 °C). Changes in Knoop micro-hardness values along a midline transect were used to determine the heat-affected zone for both wire gauges. Cantilever bending was then performed, using an Instron® testing machine, to assess the mechanical properties of heated wires both within and outside of the heat-affected zone.

Results: The heat-affected zone for the 0.014" wires extended 1mm past that of the 0.019" x 0.025" wires, terminating at distances of approximately 7mm and 6mm from the flamed tip respectively. The 5mm-wide flamed zone for each wire size was characterized by a lower force threshold to reach the super-elastic plateau, a flatter super-elastic plateau and an increased tendency for plastic deformation compared to controls.

Conclusions: The heat-affected zone of austenitic nickel-titanium wires extended no more than 1-2mm past the flame boundary for the wire gauges tested. Flamed areas of wire displayed a lower force threshold to reach the super-elastic plateau and a slight flattening of the super-elastic plateau. These results do not indicate a need to alter current clinical practice, due to the limited ability of austenitic wires to conduct heat past the boundary of the flame.