An Experimental and Artificial Neural Network Prediction of Cross Section and Activation Distance Effect on T-spring Force System

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ABSTRACT

Many orthodontic treatments involve segmental (sectional mechanics) during teeth retraction, especially the canine. The segmental technique involves usage of different sectional retraction springs that differ in their force system production according to their properties.

This in vitro study evaluates the effect of cross section and activation distance of the stainless steel T-spring on their force system (force, moment, moment to force ratio). Three cross sections (0.016 x 0.022, 0.017x0.025, and 0.018x0.025 inch) of prefabricated symmetrical sectional T-spring of 10 mm long was prepared, each spring activated for 1, 2, 3 mm and the resultant force system evaluated by using a testing apparatus which was specially designed for this study, the horizontal forces and force of moment can be obtained by the static equilibrium equations.

The results showed that when the cross section and activation distance increased the horizontal force and moment increased, while for the moment to force ratio the lowest mean value was at the first activation distance of the first group and the highest mean values were at the third activation distance of the third group. All the three groups at all activation distance insufficient to produce bodily tooth movement. T-springs of (0.016 x 0.022 inch) cross section and with frequent activation provide the best in force system production.

After the results were obtained, they had been used in an artificial neural network modeling to evaluate its ability in the prediction process of the T-spring force system. The model was trained by Levenberg-Marquardt algorithm for the analysis and simulation of the correlation between input parameters 'spring cross section and activation distance'

and the outputs 'spring force system', while the optimization was done by changing the neural network architecture.

Training and testing of the optimized network reveal that network has prediction ability with low mean error of force prediction (5.707%), and for the moment is (4.048%) and it can successfully reflect the results that obtained experimentally with less cost and efforts.