Palatal expansion screws and connection arms: analysis of the force expressed by 8 different configurations

The treatment of young adults and adults with transverse skeletal deficits of the upper jaw, in which skeletal maturation is too advanced to use tooth-borne solutions, is represented by miniscrew assisted rapid palatal expansion (MARPE). However, since this is an innovation of recent development, the scientific evidence to support it is poor and there are many configurations and variables to be taken into account.

Aim

The purpose of this study is to analyze some of these variables by measuring the force expressed by eight different configurations of orthodontic expansion screws, produced by Leone®, HDC® and Tiger Dental®, through an in vitro investigation.

Materials and Methods

The study used an experimental model reproducing the maxillary dental arch with the palate to fit all screws and standardize the position.

All screws tested had 1.5 mm diameter arms laser-welded to the body. To estimate the stiffness of the screws, a Zwick testing machine with a 0.5 kN load cell was used to record the forces generated by the expander. The expander was placed in the Zwick machine by gripping the arms with the upper and lower clamps of the machine, trying to keep the expander as aligned as possible in the vertical plane. The screw was activated a quarter turn (0.2 mm of expansion for the Leone® and HDC® screws) or a sixth turn (0.17 mm of expansion for the Tiger Dental® screw) and the resulting compressive force was recorded. Activations were performed by a stainless steel Leone® wrench of 1.2 mm of diameter (30 total activations, with a resulting expansion of 6 mm). For the Tiger® screw, the 8 cm stainless steel Tiger flat wrench was used (35 total activations, with a resulting expansion of 5,95 mm). The test was repeated 3 times for each configuration.

Results and Conclusions

The results shows maximum developed force values of 184.2 N, obtained by the 11 mm Leone® TAD screw, and minimum force of 91.83 N, developed by the 12 mm Leone® standard screw. The values obtained are lower than those of the study conducted by Camporesi et al. in 2013, which reached almost 230N with Leone® A2620 screw and just over 200N with Hyrax® screw. The most effective device results in the one with a more rigid structure and less bending on its connection arms. This justifies the better performance of devices with customized arms, where folding of the arms does not occur through a mechanical process that would weaken their structure and therefore their mechanical properties.