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Correlating cutting efficiency and debris retention of endodontic files to their design features using AutoCAD measurements

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ABSTRACT

This study aims at evaluating the deformation changes on three types of root canal rotary instruments with different designs; the Pro-Taper Universal, the V-Taper, and the Liberator systems after clinical use. Measurements were made before and after the instruments were used for treating four human root canals by developing stereo-microscopic images for a number of instruments from the three systems at the same position. All images were transformed to AutoCAD to evaluate changes in measurements before and after use. The results showed that the majority of the tested instruments were subjected to significant deformations along the length of the working parts of the instruments. These deformations were only detected by the AutoCAD program but went unnoticed by either visual or microscopic examinations. The results suggest that AutoCAD could be a ground of developing a chair side "computer image analysis program" to predict and justify discarding of a piece before or during operation. In addition, considerations should be given to the material of construction and new approaches of ion implants, such as electro-polishing, that could improve or at least assist in enhancing the wear resistance of the instruments against the dentine surface.

1. Introduction

Root canal cleaning and shaping tools are geometrically designed drills that cut within the dentine of the human root canal. Similar to other drilling instruments, rotary root canal nickel titanium instruments are subjected to working conditions including bending and torsion that causes bending and angular deflections that may end up with fracture of the piece. They are also subjected to frictional conditions during cutting in the hard structured human dentin, which is composed from a 75% mineral hard structure, leading to wear. Wear and deformation of the instruments may lead to a multiple number of errors during operating in the clinic including pre-mature failure and debris retention. Accurate measurements, at an early stage, of these deformations may be used for predicting the pre-mature failure of these tools. Moreover, these deformations that occur on the surface blades will affect the cutting efficiency as well as the life of the tools. Though the design of these nickel titanium root canal instruments is progressively developed to improve their cutting efficiency, the instrument rotation in hard structures, as the dentin, still induces friction levels and vibration (according to the encountered speeds) that will alter their surfaces.

The aim of the present research is to identify and develop a new method based on precise measurements of the deformations and deflections that occur on three different instruments of nickel titanium rotary root canal systems with different

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