Effect of Autoclave Sterilization on The Cyclic Fatigue of Three Ni-Ti Rotary Instruments

Thesis

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By

Laila Mohammed Mukhtar Ahmed Elbatal

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University of Khartoum-Sudan

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وقل رب زدني علما

Supervisors

Dr. Kariem Mostafa El Batouty

Associate Professor in Endodontics

Department of Endodontics,

Faculty of Dentistry, Ain Shams University

Dr. Maram Farouk Obeid

Lecturer in Endodontics

Department of Endodontics,

Faculty of Dentistry, Ain Shams University

Dedication

To my mother, the unique Sarrah,

To my father, the amazing Batal,

To my mother in-low, the lovely Asma

To my Abdelmageid, the love of my life,

To my blessed son, Mohammed,

To my lovely sisters, Fatima and Azza,

To my in-lows, the beautiful sisters & brother,

To my dear friend Wael El Shater.

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Successful endodontic treatment is based on comprehensive knowledge of the complex anatomy and morphology of the root canals, thorough diagnosis, suitable treatment planning, the standardized concepts of debridement, optimized disinfection and a well-sealed root canal system apically as well as coronally.

Endodontic therapy has been compared to a chain, wherein the chain is only as strong as each individual link. Shaping and cleaning of the root canal system is considered a decisive link, because shaping determines the efficacy of subsequent procedures.

Mechanical objectives for canal preparations were brilliantly outlined forty years ago by Dr. Herbert Schilder(1). Mechanical debridement, creation of space for the delivery of medicaments and irrigants and optimized canal geometries for adequate obturation have become easier, faster with more predictable and consistent preparations with less procedural errors since the break-through of rotary endodontic nickel titanium instruments with the beginning of the 1990s.

Although hand-pieces were first introduced for endodontics in 1889 by William H. Rollins, they did not gain any popularity while utilizing the rigid stainless-steel endodontic instruments [1]. Recently, rotary endodontic motors have become an essential armamentarium in endodontic practice. This is owed to the introduction of the exotic nickel titanium alloy (nitinol/ Ni-Ti) by Walia et al in 1988[3]. Ni-Ti alloy exists in two crystalline structures, austenite the mother phase and martensite the twinned daughter phase; transitions from one crystal lattice to the other give Ni-Ti alloy its superelasticity and shape memory character. Its high flexibility is critical for rotary endodontic files for two reasons. It enhances centering ability of the instrument, yet subjects it to cyclic fatigue.

The major concern expressed by dentists using endodontic Ni-Ti rotary instruments is the fear of fracture. The fracture may happen due to cyclic fatigue, torsional failure, both, or as Alapati et al [4] hypothesized, due to a single overload incidence that causes a ductile fracture after a large number of loading cycles rather than causing an alloy fatigue.

It has been suggested that Ni-Ti shape memory and superelastic properties are strongly dependent on the thermo-mechanical processing history of the manufactured product, and consequently it has been reported that the additional heat treatment of Ni-Ti instruments during autoclave sterilization might increase their flexibility [5]. It has also been suggested by Serene et al [6], that sterilization of used rotary Ni-Ti above 125° C might reverse their deformation.

Many researchers have studied the effect of sterilization on the mechanical properties (including cyclic fatigue failure, torsional failure and cutting efficiency) of endodontic rotary Ni-Ti instruments, but only few researches were found regarding the effect of autoclave sterilization on the cyclic fatigue behavior. Therefore the effect of autoclave sterilization on the cyclic fatigue resistance of three of the rotary Ni-Ti systems available in the market (ProTaper, Revo-S and NRT), was thought to be of value.