بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

MONA MAGHRABY

The effect of temperature change on the cyclic fatigue resistance of Three Rotary Nickel Titanium instruments with different Heat Treatment

Thesis
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Dedication

I would like to dedicate this thesis to

My Dear Father & Mother

My Beloved Husband and Son

My Lovely Sister

For their endless support and encouragement. This accomplishment would have been impossible without you.

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Introduction

The goal of biomechanical root canal preparation is to remove all the root canal content. This is achieved by enlarging and shaping the canal to allow sufficient introduction of the irrigants for cleaning the root canal with the preservation of its anatomy. Root canal shaping should produce continuously tapered preparation from the crown to the apex retaining the original canal path and keeping the canal foramen as small as practical.

Traditionally, cleaning and shaping the root canal was done using stainless steel hand files. During the last decade, the use of rotary nickel-titanium (NiTi) instruments in the root canal preparation has become popular. Owed to the super-elastic behavior of NiTi material, NiTi instruments are highly flexible and efficient in root canal preparation following the original root canal path.

Although endodontic instruments have been improved, fracture during treatment is a continuous challenge for clinicians. The fracture of NiTi files usually occurs through two mechanisms: torsional failure and cyclic fatigue. Torsional failure occurs when the stress exceeds beyond the elastic limit of the file. On the other hand, in cyclic fatigue, the file fractures due to repetitive compression and tension stresses at the maximum curvature point of the canal.

The manufacturers try to enhance the resistance of the files using different alloys during production, applying different heat treatments, and changing the file design.

Thermomechanical processing and heat treatment are the most fundamental methods to control the transition temperature of the NiTi files that improve the flexibility and the fatigue resistance of the NiTi instruments.

RaCe files (FKG Dentaire SA, Switzerland) super elastic file, has a triangular cross-section. It possesses variable helical angles and a variable pitch. Alternating cutting edges avoid the threading effect. Electrochemical treatment of RaCe file improves resistance to torsion and metal fatigue.

2Shape files (Micro-Mega, Besancon, France) is a new generation file system produced with a novel heat treatment (T-wire) which is according to the manufacturer, aims to enhance both flexibility and cyclic fatigue resistance. [1]

M-pro files (IMD, Shanghai, China) are NiTi instruments made of X wire, a CM alloy with a special heat treatment to enhance strength and flexibility.[2] They showed a convex triangular cross-section with three cutting edges and large core and a progressively increasing pitch along with the blades.

Cyclic fatigue test is performed in either a static or a dynamic model. In the static test, the instruments rotate in the artificial canal at fixed length with no axial motion. While in the dynamic test the instruments move axially inside the artificial canal representing the brushing motion of the instrument in the clinical aspect.

Cyclic fatigue has traditionally been tested at room temperature. However, these studies did not consider the newer alloys which present transformation temperatures much higher than those of conventional austenitic materials[3] that may in fact transform close to body temperature. [4]

So, this study was conducted to evaluate the effect of temperature change on the cyclic fatigue resistance of the RaCe, 2Shape, and M-pro rotary NiTi instruments. It was hypothesized that there will be difference in the cyclic fatigue resistance of the tested NiTi instruments with the temperature change.

I- Factors affecting cyclic fatigue resistance

Although instrument flexibility and cutting efficiency have increased, instrument fracture is a great concern in endodontics. Fractures may occur through either torsional or flexural cyclic fatigue[5]. Torsional fracture occurs when the binding forces inside the canal locks part of the file while the motor continue to exert torque on the file. Fracture takes place when the torque exceeds the ultimate strength of the file. This type of fracture is usually accompanied by some sort of plastic deformation of the instrument[6]. Flexural cyclic fatigue occurs when a metal is subjected to repeated cycles of tension and compression that causes surface crack formation resulting in breakage[7]. Because NiTi instruments may show no visible signs of permanent deformation during cyclic fatigue, it has an unpredictable clinical incidence. Several studies focus on enhancing the fatigue resistance of NiTi instruments by improving the cross-sectional design, the manufacturing process, or the surface treatment, as well as by introducing new alloys[8,9].

A- Effect of file microstructure on cyclic fatigue

Shen et al.[10] examined the fatigue behavior of NiTi instruments from a controlled memory NiTi wire (CM