شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

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

Cyclic Fatigue Resistance and Differential Scanning Calorimetric Analysis of Three Different Nickel-Titanium Rotary File Systems

(An In-vitro study)

Thesis submitted to Faculty of Dentistry, Ain Shams University

In Partial Fulfillment of the requirement for the master degree in Endodontics

By

Mohamed Salah Abd El Aziz Mohamed El Wakeel

B.D.S. (Faculty of Dentistry, Ain Shams University, 2013)

(Ain Shams University)

2020

Supervised by

Prof. Dr. Ahmed Abd El Rahman Hashem

Head of Endodontic Department,

Faculty of Dentistry, Ain Shams University

Dr. Sara Hossam Fahmy

Lecturer, Endodontic Department,

Faculty of Dentistry, Ain Shams University

Dedication

This work is dedicated to…

To my parents the reason for what I become today. Thanks for your great support and continuous care.

To my family who has been a constant source of emotional and moral support in every aspect of my life, this thesis would certainly not have existed without them.

Acknowledgments

All praise be to ALLAH the most gracious, the most merciful…

I would like to express my deepest gratitude to **Prof. Ahmed Abd El Rahman Hashem,** Head of the Endodontic Department, Faculty of Dentistry, Ain Shams University for his kind guidance, sincerity, extraordinary supervision, and unlimited support and help throughout my academic and clinical work.

I would also like to thank **Dr. Sara Hossam Fahmy,** lecturer of Endodontics, Faculty of Dentistry, Ain Shams University for her excellent advice, valuable stimulating guidance and help during this study, and meticulous revision throughout this work.

List of contents:

List of figures:

List of Tables:

List of abbreviations

Ni-Ti	Nickel-titanium
EDM	Electrical discharge machining
CM	Control memory
TF	Twisted file
EDS	Energy dispersive x-ray spectrophotometry
ESEM	Environmental scanning electron microscope
Rpm	Rotation per minute
EDTA	Ethylene diamine tetraacetic acid
EDXA	Energy dispersive x-ray analysis
XRD	X-ray diffraction
DSC	Differential scanning calorimetry
CNC	Computer numerical control
St. Dev.	Standard deviation
NCF	Number of cycles for fracture
M	Martensitic
A	Austenitic
As	Austenitic phase start
Af	Austenitic phase finish
Ms	Martensitic phase start
Mf	Martensitic phase finish
Rs	R phase start
Rf	R phase finish
St-St	Stainless steel
SEM	Scanning electron microscopy
NaOCl	Sodium hypochlorite
CF	Cyclic fatigue

Walia et al introduced Nickel-titanium (Ni-Ti) root canal files in 1988 to overcome the rigidity of stainless steel files[1]. The greater flexibility and superelasticity of Ni-Ti have improved the mechanical preparation of the root canal space, decreasing problems associated with stainless steel instruments, such as ledges, zips, perforations, and root canal transportation. However, as rotary instrumentation involves more rotation of files inside the canal the susceptibility to fracture due to torsional and fatigue failure is increased.

When the rotating instrument inside the canal is exposed to a large number of compression-tension cycles in the area of maximum root curvature a cyclic fatigue failure occurs. That type of failure is known to occur unexpectedly without any sign of previous permanent deformation. Several approaches have been adopted to enhance the resistance to cyclic fatigue including new alloys, different kinematics, and different file designs. As instrument fracture could jeopardize endodontic treatment, it is important to assess the fatigue resistance of newly introduced NiTi rotary instruments (Ha et al.).[2]

Furthermore, it has become crucial to understand the structural properties of Ni-Ti endodontic files and their impact on instrument performance (Elnaghy & Elsaka)[3]. Several factors influence the clinical failure of NiTi instruments. Including factors related to root morphology, the technique used during cleaning and shaping, and factors related to instrument design and structure.

NiTi alloy has a reversible solid-state phase transformation known as martensitic/austenitic transformation. This phase transformation is temperature associated and can affect the mechanical properties of the material. Given that the intracanal temperature is higher than the room temperature, it is recommended to evaluate the effect of the change in temperature on the cyclic fatigue resistance of rotary instruments.

Rotary instrumentation is recommended to be used with a maximum of 1-3 mm pecking motion; which makes dynamic cyclic fatigue testing more relevant to the clinical situation. However, only a few studies utilize dynamic cyclic fatigue tests while the major utilize static fatigue tests. Taking into consideration that there is no standardized method for dynamic fatigue testing, it was thought that it would be of value to fabricate a new cyclic fatigue model.