Mechanical and Antibacterial Effect of Different Herbal Extracts on The Root Canal Dentin.

(An in vitro study)

Thesis

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Dedication

To my great ***mother*** and my lovely ***father***…the source of encouragement and inspiration to me throughout my life.

And

To ***Alaa Amr*** my wife for being in my life and for her great support.

❖ List of contents:

❖ List of tables:

❖ List of figures:

Introduction

The main aim of endodontic treatment is to destroy and remove the microorganisms form root canal, and to prevent the reinfection [1]. Despite the removal of most of the root canal irritants via chemo-mechanical cleaning and shaping, the complexity of the root canal systems, with the presence of accessory canals and communications hinders the complete debridement, and disinfection. Thus, the usage of intracanal medications is recommended for provoking root canal system disinfection [2].

Many intracanal medications are traditionally used as calcium hydroxide, chlorhexidine gel, triple antibiotic paste for their antibacterial properties.[2-3] Calcium hydroxide is the most commonly used between visits in root canal treatment due to its antibacterial, and tissue dissolving properties which is attributed to its high pH (12.8). However, it fails to eliminate *Enterococcus feacalis* bacteria in secondary infected cases that represent, the most commonly isolated bacteria in failed cases.[3] Despite The antibacterial, and hard tissue inductive effect of its high pH,[4] it adversely affects the mechanical properties of root canal dentin as fracture resistance.[5]

Recently, phytotherapeutics has gained a great attention as an attempt to overcome the side effects of the commercial chemical

interacanal medications [2]. *Morinda Citrifolia*, Triphala, *German Chamomile*, and Lemon herbal are examples of herbs used in endodontic treatment owing to their antioxidant, anti-inflammatory, and antibacterial properties, in addition of being used in the removal of smear layer formed during root canal treatment.[6]

Morinda Citrifolia fruit (Indian mulberry) grows in south East Asia or Australia. It contains different phytochemicals as, oligo-polysaccharides, flavonoids, catechin, L-asperuloside and alizarin that have an effective antibacterial property. Triphala is an ayurvedic rasayana consisting of *Amulaki (Emblica Officinalis), Bibhitaki (Terminalia Bellirica) and Halituki (Terminalia chebula).* Being rich in citric acid promote its usage as chelating agent for removal of smear layer. *German Chamomile* flower contains a wide variety of active chemical components (chamazolene, capric acid and caprylic acid, chlorgenic acid) that have an antibacterial and chelating actions. Lemon solution (pH=2.21) is a natural source of citric acid (pH=1.68) with lower acidity. it is used as root canal medicament because of its wide antibacterial efficiency including *E.faecalis* .[7]

Therefore, based on the pervious; this study was conducted to assess the effect of these four herbal extracts as intracanal medicaments on the mechanical properties of root canal dentin in

terms of fracture resistance and micro-hardness. Additionally, it aimed at evaluating their antibacterial effect.

Review of literature

Endodontic or root canal treatment involved removal of infected tissue and microorganisms from within the root canal space to prevent further infection of the periradicular tissues as well as to allow healing of these tissues. This critical process involves the use of some chemical substances for disinfection of the root canal space. Several studies have shown that contemporary chemical agents [both proteolytic and acidic] do not achieve complete disinfection, and have other disadvantages like weakening of the tooth structure, predisposing to fracture of the tooth. Recently, there has been a growing trend to seek natural remedies as part of dental treatment.

- **Mechanical effect of different herbal extract on root canal dentin:**

Andreasen et al. 2002[8] conducted a study to examine the effect of calcium hydroxide on that dentin fracture strength after a certain period of time. Immature mandibular bovine incisors were used and assigned randomly into two test groups. Group1: the pulps were extirpated via the apical foramen, then root canals were filled with calcium hydroxide (Calasept) and sealed with IRM cement, and the teeth were stored in saline at room temperature for 0.5,1, 2, 3, 6, 9, or 12 months. Group 2: the pulps were extirpated

and the root canals were filled with saline and sealed with IRM cement. The teeth were then stored in saline for two months. Intact teeth served as controls and were tested immediately after extraction. All teeth were tested for fracture strength in an Instron testing machine at the indicated observation periods. The study results showed a significant decrease in fracture strength with increasing storage time for group1 (calcium hydroxide dressing), indicating that the fracture strength of calcium hydroxide-filled immature teeth will be halved in about a year due to the root filling.

White et al. 2002[9] conducted a study to determine the effect of calcium hydroxide, mineral trioxide aggregate, or sodium hypochlorite on the force required to fracture root dentin. Ten bovine central and lateral incisors were machined to prepare cylinders of dentin with a 6.0-mm outer diameter 3.5-mm inner diameter and a length of 10 mm. Those cylinders were cut lengthwise into four symmetrical pieces. The canal sides of the sections were then placed into Petri dishes containing a 1-mm depth of calcium hydroxide, mineral trioxide aggregate, sodium hypochlorite, or physiologic saline (control). The samples kept in the dishes for five weeks and were then shear tested by using an Instron machine. ANOVA test was used to analyze data for comparison of the groups as a whole. while a t test was used to compare each quarter section with its control from the same tooth. A 32% mean decrease in strength was discovered for calcium

hydroxide, a 33% decrease in strength for mineral trioxide aggregate, and a 59% decrease for sodium hypochlorite. All decreases in strength were statistically significant: $p < 0.001$ for calcium hydroxide, $p < 0.027$ for mineral trioxide aggregate, and $p < 0.001$ for sodium hypochlorite. The study showed that root dentin was weakened after 5 weeks of exposure to calcium hydroxide, mineral trioxide aggregate, or sodium hypochlorite.

Doyon et al. 2005[5] Conducted a study assessing the effect of intracanal calcium hydroxide $Ca(OH)_2$ on the fracture resistance of human root dentin. One hundred and two freshly extracted single rooted human teeth were equally assigned into three groups. The root canal of each tooth was prepared then filled with saline solution (group I), USP $Ca(OH)_2$ (group II), or Metapaste (groupIII). Before immersion of the teeth in saline, the access openings and apices were sealed with composite resine. After 30 days, the roots of 17 teeth from each group were sectioned horizontally into 1-mm thick disks and each disk was subjected to fracture load at 2.5 mm/min with a SATEC universal-testing machine. The same procedure was repeated after 180 days on the remaining 17 teeth in each of the 3 groups. The results showed that there was no difference in the peak load for the three groups after thirty days exposure to the test solution. However, the peak load was decreased significantly in the 2nd group after180 days when

compared to thirty days exposure of the three groups and the 180-day groups exposed to saline or Metapaste

Sadr Lahijani et al. 2006[10] Compared the cleaning effectiveness of *German Chamomile* hydroalcoholic extract and tea tree oil to 2.5% sodium hypochlorite (NaOCl) solution as an intracanal irrigation solution for the removal of the smear layer. Forty extracted, single-rooted, mature, permanent, human teeth were randomly assigned into three experimental groups of ten teeth and two control groups of five teeth. The pulp chamber of each tooth was accessed and the root canal was prepared, using a step-back technique; the apical stop was prepared to a size 30 k file. Then each canal was irrigated with one of the following solutions: distilled water (-ve control), 2.5% NaOCl + 17% ethylenediamine tetraacetic acid (EDTA) (+ve control), *German Chamomile* or tea tree oil or 2.5% NaOCl. After splitting Each sample longitudinally, each tooth was examined for smear layer quantity at three different levels (coronal, middle, and apical) by the scanning electron microscopy (SEM) using magnifications of 2000x and 5000x·. The results showed that *German Chamomile* is more efficient in removing smear layer than NaOCl alone, but less than NaOCl combined with EDTA.

Murray et al. 2008[11] conducted an in vitro study comparing the effectiveness of *Morinda Citrifolia* juice (MCJ) to that of

sodium hypochlorite (NaOCl) and chlorhexidine gluconate (CHX) in removing the smear layer from the canal walls. Sixty extracted, single-rooted, mature, permanent, human premolar teeth with a single canal were inoculated with *E.faecalis* at 37°C in a CO_2 atmosphere for thirty days. The teeth were randomly assigned into six experimental groups; the pulp chamber was accessed, and the root canals were cleaned, and shaped by using ProTaper and ProFile rotary instrumentation to a size 35. During instrumentation, the irrigation was provided by MCJ, NaOCl, CHX, and MCJ/CHX, followed by a final flush of 17% ethylene diamine tetraacetic acid (EDTA). MCJ irrigation was also followed by a final flush of saline, and saline irrigation was also used as a -ve control. The samples were then examined by scanning electron microscopy, for the removal smear layer. They result showed MCJ was similar to NaOCl in conjunction with EDTA as an intracanal irrigant. MJC appears to be the first fruit juice that can be possibly used as an alternative to NaOCl as an intracanal irrigant.

Hasheminia et al. 2009[12] evaluated the effect of calcium hydroxide mixed with different vehicles (glycerin, saline and distilled water) on the root canal dentin microhardness after 7 days. Maxillary anteriors were decapitated and prepared via telescopic technique, where the master apical file was size #50 k-file. Distilled water was used for irrigation during instrumentation. The roots were sectioned horizontally to produce dentin discs from the

middle third of the root. The specimens were treated with $Ca(OH)_2$ powder mixed with either Glycerin, saline, or distilled water. Dentin microhardness was measured with a vicker's indenter with a load 200 g for 15 seconds before and after treatment for 7 and 14 days. According to the results, authors concluded that all calcium hydroxide combinations tested led to structural changes as evidenced by the reduction of dentin microhardness.

Prabhakar et al. 2013[13] compared the antimicrobial efficacy of *Morinda Citrifolia* juice (MCJ) to that of chlorhexidine (CHX) as endodontic irrigants and their effect on micro-hardness of root canal dentin. The study was divided into two parts. First part for antibacterial testing consisted of preparing 60 dentin blocks of 4 mm height. All the specimens were infected with Enterococcus fecalis for 21 days. The experimental groups were Group I: 0.2% CHX; Group II: 6% MCJ; Group III: 6% MCJ + 0.2% CHX; Group IV: Saline. After 28 days of medication with the irrigants, the dentin shavings from root canal dentin was harvested and colony forming units counted. Second part for micro-hardness testing consisted of preparing 32 root halves and mounting them on blocks of acrylic resin. Eight samples per group were randomly assigned into the experimental groups. The samples were then treated with the irrigants for a period of 15 min and micro-hardness values were recorded. The results showed that that nearly 0.2% of CHX had the highest antimicrobial activity even after 28 days and 6% of