



بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى

مسئولية عن محتوى هذه الرسالة.

ملاحظات : لا يوجد



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

فَالْوَيْلُ لِمَنْ جَانَدَ لِعَالَمِنَا
إِنَّمَا أَنْتَ الْعَلِيمُ الْحَكِيمُ

صِدْقَ اللَّهِ الْعَظِيمِ

Effect of incorporation of Nanoparticles on setting time, bond strength and fracture resistance of two endodontic sealers: an In-Vitro study

Thesis submitted to the faculty of dentistry, Ain Shams University for partial fulfillment of the requirements of master degree in Endodontics

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B.D.S

University of Science and Technology, 2009

Ain Shams University

Faculty of Dentistry

2022

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Acknowledgement

I am greatly honored to express my thankful gratitude to **Dr. Medhat Taha El-Faramawy**, Associate Professor of Endodontics, Faculty of Dentistry, Ain Shams University for his encouragement, guidance, support and help.

I would like to offer my special thanks to **Dr.Tarek Moustafa Abdel Aziz**, Lecturer of Endodontics, Faculty of Dentistry, Ain Shams University, for his cooperation.

Personal appreciation and thanks to all the staff members of the Endodontic Department for their effort and help whenever asked.

Dedication

To my great **Father** and my lovely **Mother** ... the source of encouragement and inspiration to me throughout my life.

To my lovely **Wife & Children** for being in my life and for the great support.

To my dear **Sisters** for their special & great support and help.

List of Contents

| Title | Page No. |
|------------------------------|-----------------|
| List of Figures | ii |
| List of Tables | v |
| Introduction | 1 |
| Review of Literature | 4 |
| • <i>Bond strength</i> | 5 |
| • <i>Fracture resistance</i> | 11 |
| • <i>Setting time</i> | 19 |
| • <i>Nanoparticles</i> | 23 |
| Aim of the study | 33 |
| Materials and Methods | 34 |
| Results | 59 |
| Discussion | 79 |
| Summary & conclusions | 93 |
| References | 97 |
| Arabic summary | |

List of Figures

| No. | Title | Page No. |
|------------------|--|----------|
| Figure 1 | AH Plus Jet endodontic sealer, Dentsply Sirona, Germany. | 34 |
| Figure 2 | Bioceramic sealer, Sure-Seal Root sealer. | 34 |
| Figure 3 | Showing the decoronated sample with 13 mm root length | 36 |
| Figure 4 | Diagram of samples classification of experimental groups. | 38 |
| Figure 5 | Sliver Nanoparticles 200 ppm (Gel form) | 39 |
| Figure 6 | TEM image of prepared AgNPs. | 40 |
| Figure 7 | Incubator, samples were kept for 7 days to confirm complete setting of sealers. | 42 |
| Figure 8 | Left: Prepared sample with acrylic resin. Right: Parallelometer. | 43 |
| Figure 9 | Custom made double diamond disc (2mm inter-discal distance). | 44 |
| Figure 10 | Digital caliper. | 44 |
| Figure 11 | Specimen section; the cutting sequence followed to obtain the slices. | 44 |
| Figure 12 | Slices with indelible marker to differentiate the coronal and apical side of each slice. | 45 |
| Figure 13 | Measurement of samples (via Digital microscope). | 45 |
| Figure 14 | Dino-lite digital microscope | 46 |
| Figure 15 | Teflon support plate | 46 |
| Figure 16 | Plungers of different diameters that were used to dislodge the filling materials (from left to right 0.9, 0.7 and 0.5 mm). | 47 |
| Figure 17 | Universal testing machine (Lloyd instrument LR 5K, England). | 48 |

| No. | Title | Page No. |
|------------------|---|-----------------|
| Figure 18 | Diagram; representation of deboned area | 48 |
| Figure 19 | During push-out bond strength test. | 48 |
| Figure 20 | Diagram for the push-out bond strength test. | 49 |
| Figure 21 | A copper mold (block former & perpendicular arm). | 51 |
| Figure 22 | The sample luted vertically in the copper arm. | 52 |
| Figure 23 | The sample fixed in acrylic block | 52 |
| Figure 24 | Showing the metal rod attached to the upper compartments & the sample fixed to the lower compartments of Universal testing machine. | 53 |
| Figure 25 | Fracture resistance test. | 54 |
| Figure 26 | Diagram for fracture resistance test | 54 |
| Figure 27 | A Teflon tray | 55 |
| Figure 28 | A Teflon tray before and after pouring plaster of paris (gypsum). | 56 |
| Figure 29 | A gypsum mold after being separated from the Teflon tray. | 56 |
| Figure 30 | A gypsum mold filled with tested sealer. | 57 |
| Figure 31 | A custom-made device containing the indenter. | 58 |
| Figure 32 | Bar chart showing average bond strength (MPa) for different types of sealers | 59 |
| Figure 33 | Bar chart showing average bond strength (MPa) for different root sections | 60 |
| Figure 34 | Bar chart showing average bond strength (MPa) with and without Silver nanoparticles. | 62 |

| No. | Title | Page No. |
|------------------|---|----------|
| Figure 35 | Bar chart showing average bond strength (MPa) for different types of sealers within each root section | 64 |
| Figure 36 | Bar chart showing average bond strength (MPa) for different root sections within each sealer | 66 |
| Figure 37 | Bar chart showing average bond strength (MPa) with and without nanoparticles within each root section | 68 |
| Figure 38 | Bar chart showing average fracture resistance (N) for different types of sealers | 70 |
| Figure 39 | Bar chart showing average fracture resistance (N) with and without Silver nanoparticles | 71 |
| Figure 40 | Bar chart showing average setting time (minutes) for different types of sealers | 73 |
| Figure 41 | Bar chart showing average setting time (minutes) with and without silver nanoparticles. | 74 |
| Figure 42 | (Type I) adhesive failure; sealer-dentin interface | 75 |
| Figure 43 | (Type II) adhesive failure; sealer-gutta percha interface | 75 |
| Figure 44 | Mixed failure; Type III. | 76 |

List of Tables

| No. | Title | Page No. |
|-----|---|----------|
| 1 | Mean, Standard deviation (SD) values of bond strength (MPa) for different types of sealers | 59 |
| 2 | Mean, Standard deviation (SD) values of bond strength (MPa) for different root sections | 60 |
| 3 | Mean, Standard deviation (SD) values of bond strength (MPa) with and without nanoparticles | 61 |
| 4 | Mean, Standard deviation (SD) values of bond strength (MPa) for different types of sealers within each root section | 64 |
| 5 | Mean, Standard deviation (SD) values of bond strength (MPa) for different root sections within each sealer | 66 |
| 6 | Mean, Standard deviation (SD) values of bond strength (MPa) with and without silver nanoparticles within each root section | 68 |
| 7 | Mean, Standard deviation (SD) values of fracture resistance (N) for different types of sealers | 69 |
| 8 | Mean, Standard deviation (SD) values of fracture resistance (N) with and without silver nanoparticles | 71 |
| 9 | Mean, Standard deviation (SD) values of setting time (minutes) for different types of sealers | 72 |
| 10 | Mean, Standard deviation (SD) values of setting time (minutes) with and without nano-particles | 74 |
| 11 | Distribution of failure modes found in the coronal, middle and apical thirds of (AH Plus) group after the push-out test | 76 |
| 12 | Distribution of failure modes found in the coronal, middle and apical thirds of (AH Plus & AgNPs) group after the push-out test | 77 |
| 13 | Distribution of failure modes found in the coronal, middle and apical thirds of (Bioceramic) group after the push-out test | 77 |
| 14 | Distribution of failure modes found in the coronal, middle and apical thirds of (Bioceramic & AgNPs) group after the push-out test. | 78 |
| 15 | Distribution of failure modes found in the coronal, middle and apical thirds of each group after the push-out test. | 78 |

The successful endodontic treatment is achieved by a three-dimensional filling of the root canal system, which provides adequate sealing of the dentin structures after chemo-mechanical preparation. Gutta-percha cones are the first choice as filling material due to their suitable physical, chemical and biological properties. However, gutta-percha cones do not bond to the root canal walls and, therefore, a sealer is necessary to attach them to the dentin and fill the empty spaces between the filling and root canal dentin.

Different types of endodontic sealers are categorized according to their main chemical constituents have been used in clinical practice, including zinc oxide eugenol, calcium hydroxide, glass ionomer, silicone, resin-based sealers and bioceramic sealers.

Epoxy resin-based sealer is one of the most commonly used endodontic sealer because of its low solubility, adequate radiopacity, high bond strength to root dentin, adequate expansion and other desirable biological properties.

Calcium silicate-based materials, usually known as Bioceramics have attracted considerable attentions because of their good biocompatibility, bioactivity and high pH which in turn gives bioceramics the properties of antibacterial action. This material originally came from a combination of calcium silicate and calcium phosphate. One of the main advantages of this sealer is possessing a chemical composition and crystalline structure similar to the tooth and bone apatite materials, thereby improving the bonding of this sealer to root dentin. The composition of bioceramic sealers might also contain aluminum, zirconia, bioactive glass, glass ceramics and hydroxyapatite.

The ideal endodontic sealers should have a high bond strength to root canal dentin to create an impermeable seal for the canal system completely in

such a way as to prevent the penetration of tissue fluid, bacteria and/or their products into the canal. In addition, sealer with higher bond strength can improve the resistance of root canal filling materials against dislodgement during subsequent manipulation, e.g., post space preparation. However, Adhesion of sealers to dentin is influenced by several factors such as chemical and physical characteristics of the sealer and its reaction with dentin, irrigation method and the smear layer removal.

Endodontically treated teeth are widely considered to be more susceptible to fracture than vital teeth, and almost always require extraction of the fractured part or entire tooth^{1,2}. Several studies have reported that fracture resistance is directly related to the bond strength of sealer to root dentin^{3,4,5}. Therefore, the use of a root canal sealer possessing an additional quality of strengthening the root against fracture would be of obvious value^{1,6}.

The time for sealers to set is important clinically. It is desirable to have a setting time that is neither too fast nor too slow. A slow setting time has advantages, enabling the placement of sealer in more than one canal as well as the recovering of gutta-percha from a canal at the time of obturation (if correction is necessary). On the other hand, A too slow setting time is a disadvantage, Coronal leakage may occur soon after the root canal treatment^{7,8}. A sealer that is unset, or only partially set, may allow more rapid penetration of irritants, such as bacteria or bacterial byproducts through the obturation. In addition, Unset or partially set sealer may lead to coronal leakage and subsequently results in reduced bond strength to root canal dentin and permit dislodgment of the gutta-percha⁷.

Recently, other material which is Nanoparticles take place in the dental field. For a long time, silver has been known to have a disinfecting effect and

its salts and their derivatives are commercially employed as antimicrobial agents. Silver nanoparticles AgNPs (Nanosilver) are one of the most widely used nanoparticles for antimicrobial purposes in dental applications. In addition, it has been found that incorporation of nanoparticles influences the physical, chemical, optical, mechanical and microbiological properties of the endodontic sealers. including setting time, radiopacity, bond strength and fracture resistance.

Therefore, the aim of this study was to assess the effect of incorporation of silver nanoparticles to bioceramics and epoxy-resin based sealers on bond strength, fracture resistance and setting time.

Root canal instrumentation is an essential state in endodontic treatment. Studies showed that instrumentation alone has been found to significantly weaken the roots. But it is difficult to determine the amount of dentin that can be removed before weakening effect takes place. It would be advantageous if the root canal was obturated with an adequate seal as this would contribute to the reduction in the incidence of root fracture. Furthermore, an effective root filling is required to establish a fluid-tight seal which in turn will provide a microorganisms-free environment and prevent recontamination of the root canal system. It was mentioned that high bond strength is directly related to fracture resistance of weakened endodontically treated teeth. Gutta-percha with an endodontic sealer is the most widely accepted root canal filling material. Different types of endodontic sealers have been used in clinical practice.

Epoxy-resin based root canal sealers such as AH Plus, has been commonly used for comparison because of its good physical and chemical properties and adaptability to root canal walls. However, the epoxy resin sealers lack the bioactivity in comparing to certain endodontic sealers.

Bioceramics are ceramic materials designed specifically for medical and dental use. They include alumina, zirconia, bioactive glass, glass ceramics, hydroxyapatite, and calcium phosphates. Bioactive materials, such as glass and calcium phosphate, interact with the surrounding tissue to encourage the growth of more durable tissues. Bioinert materials, such as zirconia and alumina, produce a negligible response from the surrounding tissue, effectively having no biological or physiological effect.