A Comparative Study of the Sealing Ability and Biocompatibility of New Modified Glass-Ionomer/Collagen Hybrid versus Mineral Trioxide Aggregate and Glass Ionomer as Root-End Filling Materials

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بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

" إِنَّ الَّذِينَ أُوتُوا الْعِلْمَ مِنْ قَبْلِهِ إِذَا يُتْلَى عَلَيْهِمْ يَخِرُّونَ لِلأَذْقَانِ سُجَّدًا . ويَقُولُونَ سُبْحَانَ رَبِّنَا إِنْ كَانَ وَعْدُ رَبِّنَا لَمَفْعُولاً "

صَدَقَ اللَّهُ الْعَظِيم

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DEDICATION

To those who shape my mind, educate me, believe in me
....To my teachers

To the man who teaches me how to thank ALLAH, the true meaning of satisfaction and honor
....To my father

To the woman who shows me the beauty of life, gives me the courage to follow my heart, inspires me, and pushes me always to success
....To my mother

To the one who supports me through distance
....To my brother

Finally, to those who share me the road, lightening my life with their friendship
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If anything is good about me, it is because of you all

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LIST OF ABBREVIATIONS

Abbreviation	
AFM	Atomic Force Microscopy.
BHI	Brain Heart Infusion.
BII	Blue India Ink.
CER	Cimento Endodôntico Rápido (fast endodontic cement).
CFP	Capillary Flow Porometry.
CHX	Chlorhexidine.
EBA	Ethoxy Benzoic Acid.
ECMs	Extracellular matrices.
ESEM	Environmental Scanning Electron Microscope.
FTM	Fluid Transport Model.
GI	Glass Ionomer.
GI/C 0.01%	Glass Ionomer/Collagen hybrid 0.01%.
GI/C 1%	Glass Ionomer/Collagen hybrid 1%.
H&E	Hematoxylin & Eosin stain.
HEMA	Hydroxyethyle methacrylate.
IRM	Intermediate Restorative Material.
MTA	Mineral Trioxide Aggregate.
Na_2HPO_4	Disodium Hydrogen Phosphate.
OP	Optical Density.
PC	Portland Cement.
PDL	Periodontal Ligament.
SEM	Scanning Electron Microscope.
WMTA	White Mineral Trioxide Aggregate.
ZOE	Zinc Oxide Eugenol.

I) INTRODUCTION

Endodontic surgery is an important adjunct to conservative root canal treatment and is sometimes the only option for treating some endodontic conditions. Resection of the root end during periradicular surgery results in an exposed apical dentine surface bounded by cementum with central root canal. Following retrograde cavity preparation, a retrograde filling material is used to seal the root-end cavity. Various root-end filling materials include amalgam, resin reinforced zinc oxide-eugenol cements and glass ionomer cement (GI). Nowadays, Mineral Trioxide Aggregate (MTA) is considered a standard for root end-filling materials.

Glass ionomer is a bioactive tooth adhesive material. Despite the strong chemical bond between the GI and tooth structure, the material is brittle and sensitive to moisture during setting. Several modifications have been made to GI in order to improve its properties. Silver particles were mixed with GI powder in order to improve strength and wear resistance of the material. Collagen is the most abundant extracellular matrix component in the human body and periodontal tissue. It serves as the matrix component which may enhance the mechanical properties, allow cell binding and proliferation which starts the repair process and promote tissue interface biocompatibility. The integration of collagen to GI might enhance compatibility, promote wound healing and raise the possibility of using it as a retrograde filling material.

As the materials used in surgical endodontics are placed in intimate contact with the hard and soft tissues of periodontium, root-end filling materials must be tested for biocompatibility. The capacity of sealing the

apical region is an important aspect when choosing a root-end filling material, aiming to prevent apical microleakage, i.e., the passage of bacteria, fluid, molecules or ions between the cavity wall and the filling material. The quality of apical seal obtained by root-end filling materials can be assessed by the dye penetration, radioisotopes, bacteria leakage or electro-chemical means as well as fluid filtration technique and dye extraction method. The efficiency of marginal adaptation and the interface between tooth structure and restorative materials should also be evaluated.

To accept the possibility of using glass ionomer/collagen hybrids as a retrograde filling material, the biocompatibility, sealing ability and marginal adaptation, still need to be investigated.

II) REVIEW OF LITERATURE

A) Conservative endodontic treatment versus surgical treatment

For many years the term conservative treatment has been used as a synonym for nonsurgical treatment. The root canal system has the capacity to harbor several species of microorganism with their toxins and byproducts. Egress of such irritants from the root canal system into the periapical tissue results in the formation of the periapical lesions. Removal of these irritants and three dimensional obturation of root canal system are the major goal of conservative root canal system. [(1)] ***Johnson (1999)*** discussed clinical evidences of success as follows: ***(1)*** absence of symptoms; ***(2)*** absence of swelling, sinus tract, and other signs of infection; ***(3)*** radiographic evidence of healing; and ***(4)*** continued normal functioning of the tooth. [(2)]

Although conservative endodontic treatment is successful in most cases, sometimes shifting to surgical approach is necessary. [(2)] The decision to shift to endodontic surgery may be indicated in the following situations: if there is a strong possibility of failure from nonsurgical treatment, if failure has resulted from nonsurgical endodontic treatment, and retreatment is impossible or would not achieve a better result and if a biopsy is necessary at or near the tooth apex. [(3)]

Steps of endodontic surgery consist of exposure of the involved area, root-end resection (apicoectomy), the preparation of retrograde cavity and finally, the insertion of root-end filling material.