شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

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HANAA ALY

Effect of Different Natural Cross-linkers on the Durability of the Resin-Dentin bond and the Stiffness of Dentin: An in Vitro study

Thesis

Submitted to the Faculty of Dentistry, Ain-Shams University

In partial fulfilment of the requirements for the Master's Degree in Dental Biomaterials

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2021

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Acknowledgment

I would like to express my deepest respect, highest appreciation and gratitude to ***Prof. Dr. Dalia Ibrahim El-Korashy*** *Professor and Head of Biomaterials Department, Faculty of Dentistry, Ain-Shams University, for her immense support, extreme generosity and for mentoring and teaching me, I owe her alot.*
Thank you very much Dr. Dalia, I am very proud to be your student.

I wish to express my sincere respect and appreciation to ***Dr. Dalia Ibrahim Sherief*** *Lecturer of Dental Biomaterials, Faculty of Dentistry, Ain-Shams University, for her great effort in guiding me and her continuous encouragement throughout my work. Thank you Dr. Dalia for your guidance.*

My Thanks are extended to all of my professors and colleagues in the Biomaterials Department, Ain-Shams University and my professors and colleagues at Badr University in Cairo for their spiritual support and help throughout my work.

Dedication

To my beloved parents, to whom I owe everything.

To my beautiful wife Dalia, for her endless support and encouragement throughout this journey.

To my sweet little sister, the fun part of life.

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Abbreviation	Expansion
ACP	Amorphous Calcium Phosphate
AFM	Atomic Force Microscopy
CE	Curcumin Extract
CSE	Cacao Seed Extract
DEJ	Dentino-Enamel Junction
DMSO	Dimethyl Sulfoxide
E&R	Etch and Rinse
EDC	1-Ethyl-3-(3-dimethylaminopropyl) Carbodiimide (**Carbodiimide**)
FEA	Finite Element Analysis
FTIR	Fourier Transform Infrared Spectroscopy
GSE	Grape Seed Extract
HL	Hybrid Layer
MMPs	Matrix Metalloproteinases
PAs / PACs	Proanthocyanidins
RF	Riboflavin
SE	Sumac Extract
TPC	Total Phenolic Content
TBS	Tensile-Bond strength
Vol.	Volume
Lys	Lysine
Hys	Hydroxylysine

Introduction

Bonding to dentin has always been a challenge in dentistry. The nature of dentin as a substrate results in a weaker and unstable bond to resin than its homogenous enamel counterpart. Dentin bonding requires acid etching which exposes collagen fibrils allowing resin infiltration and forming what is called a "hybrid layer" of resin and collagen. This hybrid layer is the foundation of the resin-dentin bond.[1]

However, demineralizing dentin not only exposes collagen, but also releases endogenous dentin proteases such as matrix metalloproteinases (MMPs) and cysteine cathepsins. Those released proteases degrade exposed unsheathed collagen inside the hybrid layer over time, weakening the bond, thus compromising its durability.[2]

In order to reduce dentin degradation, dentin biomodification has been recently proposed as a method to increase resistance of collagen to degradation through increasing the extent of cross-links between collagen fibrils. It has been reported that cross-linking increases the stiffness of the triple helical structure and thus prevents it from unwinding and binding to the proteases. Furthermore, some cross-linkers have the ability to bind to the proteases themselves causing their allosteric silencing and inhibiting them from binding to collagen.[3]

Chemical cross-linkers have been previously suggested for dentin biomodification and gluteraldehyde was proposed as a potent collagen cross-linker. However, concerns about its

cytotoxicity have shifted the search towards more safe natural cross-linkers that do not exhibit such cytotoxic effect.[4]

Natural cross-linkers are polyphenolic compounds that are able to stabilize the structure of collagen by forming multiple bonds in-between collagen polypeptides. These polyphenolic compounds can be found in fruits, nuts, vegetables, seeds, leaves and flowers, such as grape seed, sumac berries, cashew nuts, genipin or curcumin. They are cross-linking agents that can decrease biodegradation of collagen and are more biocompatible compared to gluteraldehyde.[5]

Grape seed extract (GSE) and cacao seed extract (CSE) are among the most extensively studied extracts in literature due to their high proanthocyanidin (PA) content. Various studies showed their ability to effectively inhibit endogenous dentin proteases activity such as MMP-2, MMP-9 and cysteine cathepsins, thus, they were able to decrease dentin degradation over time.[5-7] Moreover, GSE was found to be able to enhance the stiffness of demineralized dentin matrix.[3] Curcumin extract (CE) and sumac berry extract (SE) are promising polyphenol-rich extracts that were found to have a strong inhibitory effect on dentin proteases.[8] To the best of our knowledge, no studies were conducted to test the direct influence of sumac and curcumin on the resin-dentin bond strength as well as their effect on dentin matrix stiffness.

Hence, the aim of this study was to investigate the effect of different natural cross-linkers (GSE, CSE, CE and SE) on the durability of resin-dentin micro-tensile bond strength (μTBS)