Evaluation of the Properties of a New Experimental Salvadora Persca (Miswak) Containing Glass Ionomer

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بسم الله الرحمن الرحيم

"قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ"

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Dedication

- *To The memory of my father who emphasized the importance of education and helped me throughout his life.*

- *To my mother who has been my role-model for hard work, persistence and personal sacrifices.*

- *To my husband who has been proud and supportive of my work, and who has shared the many uncertainties, challenges, and sacrifices for completing this thesis.*

- *To my father and mother in law for their tremendous support, help and love.*

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GICs	Glass ionomer cements
PA	Polyacrylic acid
ASPA	Aluminosilicate polyacrylates
SP	Salvadora persica
SPE	Salvadora persica extract
SPG	Salvadora persica modified groups
RMGIs	Resin-modified glass ionomers
HEMA	Hydroxyethyl methacrylate
ISO	International Organization for Standardization
ADA	American Dental Associations
NVP	N –Vinylpyrrolidinone
CS	Compressive strength
SBS	shear bond strength
CHX	chlorhexidine
WHO	World Health Organization
S.Mutans	Streptococcus Mutans
L.Casei	Lactobacillus Casei.
GC-MS	Gas chromatography-mass spectrometry
ISE	Ion selective electrode
TISAB II	Total Ionic Strength Adjustment Buffer
MRS agar	De Man, Rogosa and Sharpe agar
MIC	Minimum inhibitory concentration

1. Introduction

Introduction

Types of indirect restorations have evolved greatly over the last decade and consequently dental cements. The terms “cement”, “luting”, “bond” have different meanings but in literature, they have been used as an interchangeable term. Luting refers to a mechanism in which there is a micromechanical interlocking between objects in close contact to each other. Bond is a term that indicates that there is chemical or physical interaction between two surfaces. Cement is a generic term for a medium joining two surfaces through either adhesion and/or micromechanical interlocking. The proper description of material that provides the link between the restorative material and the tooth should be “dental cement”. [1]

The main function of dental cement is to seal the space between the restorative material (definitive or provisional) and the tooth preparation, as well as to enhance the resistance to dislodgement of the restoration during function. One of the main causes of failure of the restoration is loss of retention, which is heavily dependent on the proper selection and manipulation of dental cements. [2]

Recently, one of the most commonly used water-based cements are glass ionomer cements (GICs). [3] Their usage is determined by their distinct ability to release fluoride and hence participating in the mechanism of inhibition of secondary caries. Moreover, GICs can be used potentially as templates for the release of other active antimicrobial agents. [4]

In order to improve the antimicrobial characteristics of both conventional and resin-modified GICs, different antimicrobial compounds have been added to glass ionomer cements. [5] Most of the studies have been focusing on release of various incorporated low molecular weight antibacterial agents such as: antibiotics,

zinc ions, silver ions, thymol and chlorhexidine that is considered the gold standard for antibacterial applications. [6-12]

The combination of chlorhexidine and other antibacterial substances with GICs has still not been incorporated into their production because it frequently results in changes in the physical and mechanical properties of the cement over time. Besides, short-term effectiveness and possible toxicity to surrounding tissues if the dose or release is not properly controlled. Moreover, the literature lacks sufficient data regarding addition of other natural antibacterial agents in GICs despite that some of them have shown effective results against cariogenic salivary flora when used in mouthwashes or toothpastes. [13,14]

Nowadays, natural and herbal materials are introduced in dentistry including Salvadora persica, a tree that is often used for making 'Miswaks'. Several chemical compounds such as sodium chloride, calcium oxalate, silica, fluoride, sulphated compounds, vitamin C and tannic acid have been found in the extract of Salvadora persica. In addition to saponin, flavonoids, alkaloids and Trim ethylamine. It was claimed that this chemistry aids in strengthening the gum capillaries, preventing gum inflammation and effective in preventing dental caries. [15,16]

Considering that microorganisms are the main cause for the occurrence of dental caries and that glass-ionomer cements are materials of choice as they can potentially be used as a medium for slow release of active antimicrobial components, besides having the knowledge that investigations regarding the incorporation of natural antimicrobial compounds into glass ionomer cements are still scarce, we have defined that the main aim of this study is to evaluate the properties of an experimental glass ionomer cement containing Salvadora persica extract (Miswak).

2. Review of literature

Review of literature

The clinical situation including mechanical forces, preparation design, type of the restoration and oral hygiene combined with the physical, biological, and handling properties usually dictate the choice of the suitable dental cement. Caries and material dislodgment are among the main reasons of failure of indirect restorations. Caries may relate to cement micro fracture and consequent micro leakage while the dislodgment may be related directly to gross mechanical failure of luting cements. [17,18]

In dentistry, adhesion of restorative materials to tooth structure is an important objective. It is believed that a restorative material should bear a resemblance to the tooth structure, possesses similar properties and adheres tenaciously to the surrounding enamel and dentin. Glass ionomer cements are one of the products developed in this direction. [18]

The invention of the glass ionomer cement resulted from previous fundamental studies on dental silicate cements and studies where the phosphoric acid in dental silicate cements was replaced by organic chelating acids. This was assisted by further work on the zinc polycarboxylate cement where it was found that cements prepared from poly acrylic acid exhibited the property of chemical adhesion. Therefore, glass ionomer cement has been described as hybridization between dental silicate cements and zinc polycarboxylates. [19]

2.1. Glass ionomer cements

Glass ionomer cements (GICs) is the generic name applied to a material that hardens through an acid-base reaction between the basic fluoroaluminosilicate glass powder and an acidic solution of polyacrylic