FLUORIDE RELEASE FROM GLASS IONOMER CEMENTS CORRELATES WITH THE NECROTIC DEATH OF HUMAN DENTAL PULP STEM CELLS

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ABSTRACT

Glass ionomer cements (GICs) are commonly used as restorative materials. The effect of GICs on different cell types varies. Stem cells from Human Exfoliated Deciduous teeth, SHED are a source for dental tissue regeneration. The necrosis and inflammation that eventually follows necrosis can disturb this regenerative process.

We tested seven GICs including Fuji I, Fuji II, Fuji VIII, Fuji IX, Fuji plus, Fuji triage and Vitrebond for their necrotic induction potential in human SHEDs. We also correlated these effects with eluate fluoride release. The toxicity of GICs was tested via a lactate dehydrogenase assay and flow cytometric analysis of propidium iodide and Annexin V stained cells. The concentration of fluoride was measured by HPLC. The Fuji I and Fuji II GICs had a significantly lower cytotoxic effect on SHEDs compared to other tested GICs, as evaluated by the LDH assay. The results obtained from the flow cytometric analyses were similar. The Fuji I and Fuji II eluates released the lowest concentrations of fluoride and induced the lowest percentages of SHED death. Fluoride release correlated with GIC cytotoxicity.

Keywords: *glass ionomer cements, cytotoxicity, fluoride, Stem cells from Human Exfoliated Deciduous teeth*

INTRODUCTION

Pulp has an important role in the formation of dentin. Dentin formation begins when dental pulp mesenchymal stem cells differentiate into odontoblasts and start the deposition of collagen matrix and subsequent mineralisation [1]. Dentin formation continues through life due to tooth aging, as well as in response to physical and/or chemical injuries [2]. The main goal of restorative dentistry is to restore teeth using adequate treatments that will protect pulp function. To avoid any additional damage to pulp tissue during operative procedures caused by the toxicity of restorative materials or the penetration of bacteria, several layers of a specific material between the restorative material and the dental tissue must be applied [3, 4]. Calcium hydroxide-based products, adhesive systems and glass ionomer cements (GICs) are typically used for this purpose. GICs were introduced by Wilson and Kent in 1971 as a mixture of a calcium or strontium alumino-fluoro-silicate glass powder (base) and a water-soluble polymer (acid) [5]. Several variations of glass-ionomer materials were subsequently developed. Later variants of GICs demonstrated enhanced flexural strength, diametral tensile strength, elastic modulus and wear resistance, but their main disadvantage is higher cytotoxicity in comparison with conventional GICs. The responses to GICs differ by cell type. Thus, it is important to evaluate the cytoxicity of GICs to SHEDs [6-9].

It has been suggested that the pattern of cell death pattern could be an important method of evaluating the irritation potential of dental materials. Apoptotic cells are removed by phagocytosis and with little inflammatory response, in contrast to the inflammation and injury to the surrounding tissues induced by the necrotic process [10]. As dental pulp stem cells are the main source for dental tissue regeneration, it is important to evaluate the potential of GICs to induce necrosis of SHEDs and subsequent inflammation in the surrounding tissue. We evaluated the potential of seven commonly used biomaterials, Fuji I, Fuji II, Fuji VIII, Fuji IX, Fuji Plus, Fuji Triage and Vitrebond, to the induce necrosis of human SHEDs.

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