# Cytotoxic Effects of Glass Ionomer Cements on Human Dental Pulp Stem Cells Correlate with Fluoride Release

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**Abstract:**

*Objectives:* Glass ionomer cements (GICs) are commonly used as restorative materials. Responses to GICs differ among cell types and it is therefore of importance to thoroughly investigate the influence of these restorative materials on pulp stem cells that are potential source for dental tissue regeneration.

Eight biomaterials were tested: Fuji I, Fuji II, Fuji VIII, Fuji IX, Fuji Plus, Fuji Triage, Vitrebond and Composit. We compared their cytotoxic activity on human dental pulp stem cells (DPSC) and correlated this activity with the content of Fluoride, Aluminium and Strontium ions in their eluates.

*Methods:* Elution samples of biomaterials were prepared in sterile tissue culture medium and the medium was tested for toxicity by an assay of cell survival/proliferation (MTT test) and apoptosis (Annexin V FITC Detection Kit). Concentrations of Fluoride, Aluminium and Strontium ions were tested by appropriate methods in the same eluates.

*Results*: Cell survival ranged between 79.62% (Fuji Triage) to 1.5% (Fuji Plus) and most dead DPSCs were in the stage of late apoptosis. Fluoride release correlated with cytotoxicity of GICs, while Aluminium and Strontium ions, present in significant amount in eluates of tested GICs did not.

*Significance:* Fuji Plus, Vitrebond and Fuji VIII, which released fluoride in higher quantities than other GICs, were highly toxic to human DPSCs. Opposite, low levels of released fluoride correlated to low cytotoxic effect of Composit, Fuji I and Fuji Triage.

**Keywords:** Glass ionomer cements, cytotoxicity, fluoride, human dental pulp stem cells.

## INTRODUCTION

In restorative dentistry, the protection of the dentin-pulp complex consists of the application of one or more layers of specific materials (varnishes, calcium hydroxide-based products, glass ionomer cements (GICs) and adhesive systems) between the restorative material and dental tissue to avoid additional damage of pulp tissue caused by operative procedures, toxicity of restorative materials and bacteria penetration due to microleakage [1-2]. GICs, invented and originally described by Wilson and Kent [3], are consisted of basic glass powder (calcium or strontium aluminofluorosilicate) and a water-soluble acidic polymer, such as polyacrylic acid [4]. GICs are classified into three categories: conventional, metal-reinforced and resin modified GICs [5-6]. Metal-reinforced GICs are strengthened by the inclusion of finely divided metal powers, typically the silver-tin alloy of dental amalgams [7].

Although conventional GICs, because of their biocompatibility, elasticity similar to dentin and ability to release fluoride, have advantages in comparison with other materials used in restorative dentistry, they have several limitations such as susceptibility to dehydration and poor physical properties (high solubility and slow setting rate) [1, 8-9].

The incorporation of polymerizable water-compatible monomers such as 2-hydoxyethyl methacrylate (HEMA) led to the introduction of hybrid versions of conventional GICs, named resin-modified GICs (RMGICs) [1, 7]. In comparison with conventional GICs, RMGICs show enchanced flexular strength, diametral tensile strength, elastic modulus and wear

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