**ID-13-P-1580 Morphology of glass ionomer cement by incorporating hydroxyapatite-silica nano-powder composite: Sol-gel synthesis and SEM evaluation**

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**Introduction**

Glass ionomer cement (GIC), classified as acid-base reaction cement, consists of an aqueous solution of polyacrylic acid and an acid-decomposable fluoro-aluminosilicate glass powder. GIC is widely used in clinical dentistry as tooth colored restorative material. Hydroxyapatite (HA) possesses a chemical composition and crystal structure similar to bone thus suitable for bone substitution and reconstruction. HA has improved the compressive strength, flexural strength, diametral tensile strength, toughness, bonding and fluoride release properties of GIC, has been reported. However, incorporation of HA-silica nano-composite to GIC is not yet reported.

The present study aims to synthesize HA-silica nano-composite by one-pot sol-gel technique and to assess the effect on the hardness of GIC.

**Materials and Methods**

Nanohydroxyapatite was produced by using the in situ sol-gel technique. Calcium hydroxide and phosphoric acid were the main sources of calcium and phosphorus.

\[ 5\text{Ca(OH)}_2 + 3\text{H}_3\text{PO}_4 \rightarrow \text{Ca}_5(\text{PO}_4)_3\text{OH} + 9\text{H}_2\text{O} \]

The suspension was stirred 48 hour to get a white viscous sol. 5 ml of TEOS (99%, Fluka) diluted in 10 ml of ethanol was added drop wise after 12 h of stirring. The sol was filtered; freeze dry and calcinated at 600 °C for 1 h. The same procedure was repeated for addition of 10ml and 20ml TEOS. The percentage of silica in each 5 ml, 10 ml, 20 ml addition of TEOS were found to be 11%, 21%, 35 % respectively and were labeled as HA-11SiO₂, HA-21SiO₂ and HA-35SiO₂.

Nano-HA-silica was mixed with a commercial GIC (Fuji IX GP, GC International Japan) at various percentages (by wt): 1%, 3%, 5%, 7%, 9%, 15%, and 20% of each respectively and were mixed according to the manufacturer instructions. Cements were covered with moisten gauze after completion of initial reaction and left undisturbed for 24 hours to enable complete setting reaction. Three specimens were made for each percentage of material.

**Results and Discussion**

SEM characterization revealed that the morphology of HA-silica nano composite was a mixture of spherical silica particles embedded within elongated HA. Silica particles not only fill the void between the elongated shaped of HA particles, but they also occupy the empty spaces between the glass ionomer glass particles and act as a reinforcing material in the composition of the GIC.

The new Sol-Gel method provides a simple route for synthesis of HA-silica nanocomposites powder. Higher the content of nanosilica, resulted in denser cement and produced a stronger GIC. Application of HA-silica-GIC with improved hardness property might lead to extended clinical indications, especially in stress bearing areas.

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Fig. 1: SEM images showing different pattern of HA-Silica with different solvents (Ethanol).

Fig. 2: SEM appearance when solvent is Ethanol (A and B).

Fig. 3: SEM appearance when solvent is Methanol (C).

Fig. 4: SEM appearance when solvent is Methanol (D).