**Development of Functionally Graded Composite for Fabrication of Dental Post**

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Ideally, dental post should have varying stiffness along its length. Specifically, the coronal end of the post should have higher stiffness for better retention and rigidity of the core, and this stiffness reduced apically. **Objectives:** To fabricate the functionally graded composites for fabrication dental post. To determine the fracture resistance and failure mode of endodontically treated teeth restored with prototype functionally graded dental posts (FGSPs) and compared with the titanium and cast-made posts. **Methods:** Functionally graded composites were fabricated using pressureless sintering and hot isostatic press. SEM, EDX and XRD techniques were used for characterization of compositions and microstructure. The physical and mechanical properties were then characterized. Prototype FGSPs were then fabricated utilizing hot isostatic pressing. Seventy bovine incisors were instrumented, irrigated, filled and then divided into seven equal groups. They were root restored as follows: FGSP (ZrO₂-Ti-HA), FGSP (Al₂O₃-Ti-HA), FGSP (HA-Ti-HA), cast-made post, titanium post, endodontically treated teeth without post and no filled teeth. The fracture resistance and failure mode were then evaluated. **Results:** SEM, EDX and XRD analyses from different areas of the microstructures confirmed the presence and gradual change of Ti-HA-ZrO₂-Al₂O₃ elements and phases in the all specimens. The physical and mechanical properties changed gradually which this confirms functionally graded structure design of the post. For fracture resistance, there were no significant different among cast-made, titanium posts and FGSP (ZrO₂-HA-Ti), FGSP (Al₂O₃-HA-Ti), FGSP (Ti-HA-Ti) (p>0.05). However, for failure mode, FGSP (ZrO₂-HA-Ti), FGSP (Al₂O₃-HA-Ti), FGSP (Ti-HA-Ti) was significantly higher than cast-made and titanium posts (p<0.05). **Conclusions:** FGM with the optimum graded composition has been fabricated. There was no significant difference in the mean fracture loads of endodontically restored teeth among the prototype FGSPs, titanium and cast-made posts. Titanium and cast-made posts resulted in an irreparable fracture mode whilst the FGSPs and endodontically restored without posts had reparable fractures.

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**Microbial Assessment of Dental Unit Waterline System (DUWS)**

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**Objective:** To determine the sanitary level of output water from dental chair units and assess the effectiveness of silver-coated tubing used in dental chair units (DCU) in reducing microbial counts in DUWS water. **Methods:** Water from sources which include the air-water syringe, low speed handpiece, high speed handpiece and distilled water (control) were sampled from 13 DCUs. The temperature and pH of each sample were measured and the microbial counts of the total aerobic bacteria, total coliform, faecal coliform, Escherichia coli, faecal streptococci and *Pseudomonas aeruginosa* were determined using conventional microbiological procedures. Based on PCR products, the 16S rDNA gene sequence of bacteria isolated from the water samples were determined and used for identification. An *in vitro* model simulating the tubing of a DCU was setup in the laboratory using silver-coated and conventional polyurethane tubes. A microbial suspension comprising of similar bacteria earlier identified in the DUWS outgoing water was passed through the tubing in cycles of stagnation and flushing to mimic the routine operation of a DUWS. The effectiveness of the tubing in preventing biofilm formation was compared and assessed by the counts of adhering bacteria and SEM. **Results:** The average pH of the outgoing water was slightly acidic at pH 5.4-5.5 at an average temperature of 23°C. The outgoing water was found free of pathogenic contaminant but highly loaded with four types of bacteria identified as *Sphingomonas rhodesian* (17.9%), *Sphingomonas dokdonensis* (79.3%), *Sphingomonas mucoides* (1.1%) and *Methylobacterium radiotolerans* (1.5%). The interior surface of both polyurethane and silver-coated tubes showed extensive biofilm formation and the outgoing water was heavy with bacterial counts. No significant difference in biofilm formation and bacterial contamination in the outgoing water were found in both types of tubing (p>0.05). **Conclusion:** The microbial load in the outgoing water from DUWS in the clinic under study was high and failed to meet the recommendation by ADA. Silver-coated tubing was not effective in preventing biofilm formation nor reducing microbial load in DUWS water.