Properties of a New Bio-Ceramic Sealer

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Objectives: Many formulations of endodontic sealer have been developed over time in an attempt to improve root canal therapy outcomes. Bioceramics have become a popular choice due to their well-documented physio-chemical and biological properties. A new formulation of sealer, with a trademarked additive, is being investigated and has shown improved antimicrobial effectiveness and the potential for multiple uses in endodontic and restorative dental procedures. This study is designed to investigate the physio-chemical and biological properties of a new bioceramic sealer on single rooted extracted teeth for a duration of three to six months. Such properties include setting time, radiopacity, flow, solubility/leakage, calcium ion release, pH, antibacterial effect, and cytotoxicity. This sealer will be compared to AH Plus, BC Sealer and Endo Direct Sealer. Statistical analysis will be completed by a third party to determine if there is any significant difference in sealer properties.
Experimental methods: Cytotoxicity of the sealers was tested by counting human periodontal ligament fibroblasts (HPDL) using CyQuant XTT cell viability assay, following incubation of cells with sealer elutes for 24 hours. Antimicrobial efficacy was tested in a suspension of *E. faecalis* cultured in brain heart infusion medium, which was then incubated for 24 hours and cultured on agar plates for another 24 hours, followed by determination of colony-forming unit. Leakage was assessed by a cross-sectional split of gutta percha/sealer-obturated teeth following a 7-day ink suspension and microscopic evaluation.
Results: All tested sealers were able to eliminate *E. faecalis* after 24 hours of direct contact and displayed significantly low toxicity to cells. Based on an analysis of deviance, the relationship between the type of sealer and leakage is statistically significant (p value < 0.05).
Conclusion: Overall, our data suggests that this new sealer is as biocompatible and antimicrobial as currently available sealers with improved resistance to leakage.

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EXTRA INFO

MATERAILS AND METHODS

Antibacterial Efficacy

Enterococcus faecalis (ATCC 4083; ATCC, Manassas, VA) was cultured at 37ºC in brain heart infusion (BHI) medium, and a bacterial suspension with an optical density of 0.1 was obtained. Sealers (0.1g, n=3/group) were placed into a 96-well plate with 200 µl of the bacterial suspension. Wells with bacterial suspension only and BHI only were used as positive and negative controls, respectively. A serial dilution of the suspension from the wells was performed after 24 hours of incubation and then cultured on agar plates for another 24 hours. The colony-forming unit (colony-forming unit/ml) was determined. The experiments were repeated twice.

Cytotoxicity

Cell viability was assessed using the CyQuant XTT cell viability assay (Thermo Fisher Scientific). Human periodontal ligament fibroblasts (HPDL, Sciencell, Carlsbad, CA) were cultured in Dulbecco's modified eagle medium (Thermo Fischer Scientific) supplemented with 15% fetal bovine serum (Thermo Fischer Scientific), 100 U/ml penicillin, and 100 mg/ml streptomycin (Thermo Fischer Scientific) and incubated at 37 ºC with 95% humidity and 5% CO_2. Extract media for each sealer consisting of 48-hour sealer elutes were prepared as previously described. HPDL cells were plated at a density of 5000 cells/well in a 96-well plate and incubated for 24 hours before each extract medium was added to the wells and incubated for an additional 24 hours. 0.1% sodium dodecyl sulfate (0.1% SDS, Bio-Rad Laboratories, USA) and fresh media were used as positive and negative controls, respectively. Experiments were performed in triplicate and repeated three times.

RESULTS

Antibacterial Efficacy

There was no growth of *E. faecalis* on agar plates treated with different sealers, indicating that all tested sealers were able to eliminate *E. faecalis after* 24 hours of direct contact.

Cytotoxicity

HPDL cells treated with different sealers showed comparable high levels of cell viability ($P > .05$). In addition, no significant differences were observed between sealer-treated HPDL cells and the negative control ($P > .05$), whereas 0.1% SDS-treated samples showed significantly low levels of cell viability

(11.7% +/- 2.9%, $P < .05$). These results demonstrated that all tested sealers displayed significant low toxicity to cells.