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Antibacterial Efficacy and Characterisation of Single Syringe Hydraulic Calcium Sealers

V. Raman¹, W. Palin¹, S. Kuehne², J. Camilleri¹

¹School of Dentistry, Institute of Clinical Sciences, College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom, Birmingham, -- None--, United Kingdom, ²Nottingham Trent University, School of Science and Technology, Nottingham, United Kingdom, Nottingham, United Kingdom

Objectives To characterise the physical and antimicrobial properties of single syringe hydraulic calcium silicate sealers.

Methods Single syringe hydraulic cement sealers, AH Plus Bioceramic (Dentsply) and BioRoot Flow (Septodont) were compared with hand mixed sealers - AH Plus and BioRoot RCS. The microstructure and composition of the sealers were assessed using scanning electron microscopy (SEM) and energy dispersive spectroscopy. Crystalline phases and compositional changes were assessed by X-ray diffraction analysis and Fourier transform infrared spectroscopy. The pH was also monitored. Antimicrobial properties of the materials were assessed using a direct contact assay with *Enterococcus faecalis* and *Fusobacterium nucleatum*. All tests were performed at 0, 28 and 90 days (n=3). ANOVA followed by Tukey post-hoc tests were applied to parametric data, and Kruskal-Wallis applied to non-parametric data.

Results All sealers exhibited the presence of zirconium, calcium, and silicon. SEM images revealed porosity and cracks in all sealers after 28 and 90 days. BioRoot RCS displayed calcium hydroxide peaks at later time points. No significant changes were observed in single-syringe hydraulic sealers and AH Plus. BioRoot Flow had a significantly higher pH than AH Plus at 28 days (p=0.01) and 90 days (p<0.05). BioRoot RCS demonstrated the highest calcium release (p<0.05), followed by single-syringe hydraulic sealers. AH Plus displayed the lowest calcium release and showed increased bacterial attachment compared to single syringe TCS sealers however, BioRoot RCS displayed significant (p<0.05) antimicrobial properties against *E. faecalis* and *F. nucleatum* growth. AH Plus resulted in the least bacterial colony reduction.

Conclusions Single syringe hydraulic sealers exhibited slower hydration, reduced release of calcium hydroxide compared to BioRoot RCS resulting in lower antimicrobial activity. BioRoot RCS emerges as the most effective antimicrobial sealer, while AH Plus displays the least efficacy. These findings underscore the importance of considering both physical and antimicrobial characteristics when selecting endodontic sealers.