

Characterisation of a remineralising Glass Carbomer® ionomer cement by MAS-NMR spectroscopy

ABSTRACT

Objectives: The purpose of this study was to characterize commercial glass polyalkenoate cement (GPC) or glass ionomer cement (GIC), Glass Carbomer®, which is designed to promote remineralization to fluorapatite (FAp) in the mouth. The setting reaction of the cement was followed using magic angle spinning nuclear magnetic resonance (MAS-NMR) spectroscopy.

Methods: Glass Carbomer® initial glass powder and cements were subjected to ^{27}Al , ^{31}P , ^{19}F and ^{29}Si MAS-NMR analysis. X-ray powder diffraction (XRD) was employed to determine the presence of crystalline phases.

Results: ^{27}Al MAS-NMR showed the Al to be predominantly four coordinate, Al(IV), and the presence of $\text{Al}_2\text{O}_3\text{P}$ species in the glass. The proportion of Al(IV) was reduced with setting reaction of the cement and significant amount of six coordinate Al, Al(VI), was found in the cement. The ^{31}P MAS-NMR spectra showed clearly a decrease of the orthophosphate peak of apatite on initial setting. ^{19}F MAS-NMR showed only a small fraction of FAp. ^{29}Si MAS-NMR demonstrated the presence of largely Q4(2Al) in the glass which changed only little in the aged cement.

Significance: This study also demonstrated how the setting reaction in Glass Carbomer® cement and other GICs can be followed by ^{27}Al MAS-NMR examining the conversion of Al(IV) to Al(VI). Our data revealed that the apatite in this cement was not FAp but largely hydroxyapatite, which was partially consumed during the cement formation.

Keyword: Glass ionomer cement; Setting reaction; MAS-NMR spectroscopy; Remineralization; Apatite; Dental material