

Antibacterial Orthodontic Adhesive Incorporating Polyethyleneimine Nanoparticles

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INTRODUCTION

Bonding of orthodontic brackets to teeth is important to enable effective and efficient treatment with fixed appliances. Unfortunately, prolonged treatment is likely to increase the risk for irreversible enamel decalcification caused by cariogenic bacteria. In the present study we evaluated the antibacterial effect of quaternary ammonium polyethyleneimine (QPEI) nanoparticles incorporated in an orthodontic adhesive. Additionally, polymerization and mechanical properties were tested.

MATERIALS AND METHODS

QPEI nanoparticles were added into an orthodontic adhesive at 0, 1 or 1.5% wt./wt. concentration (samples a, b and c respectively). Antibacterial activity was tested using the direct contact test (DCT). Degree of monomer conversion (DC) was measured using Fourier transform infra-red (FTIR) spectroscopy. Measurements were taken before light polymerization, after 20 sec and then each 60 sec for an additional 10 min. Shear Bond Strength (SBS) was tested on bovine teeth etched enamel.

RESULTS

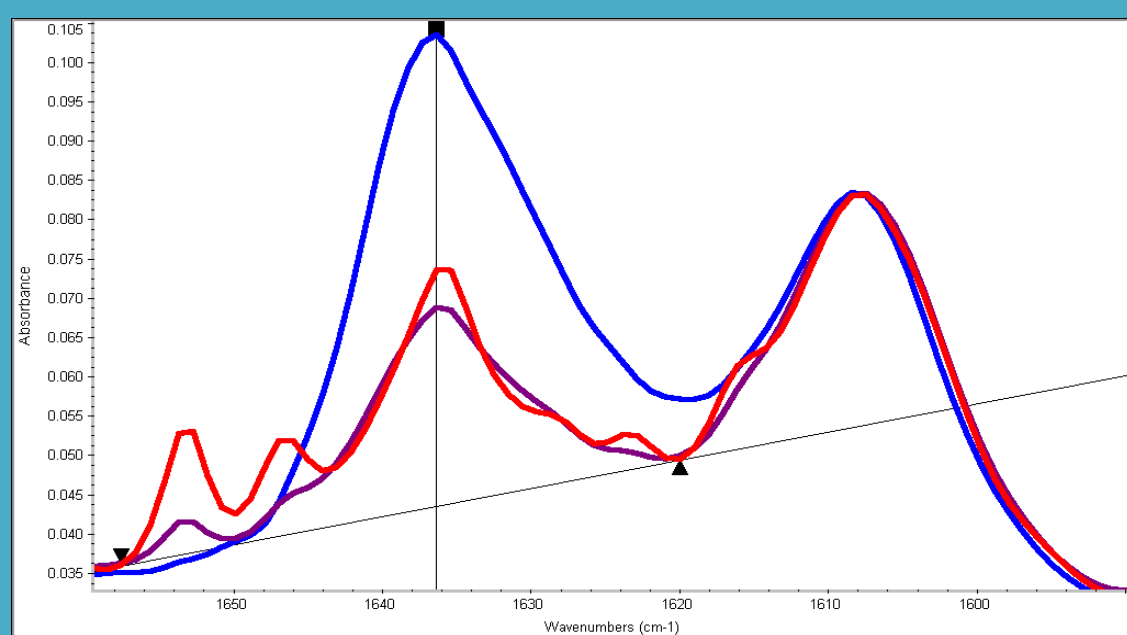


Fig. 1: FTIR spectra of acrylic C=C bonds at 1637cm-1 and aromatic C=C bonds at 1608cm-1

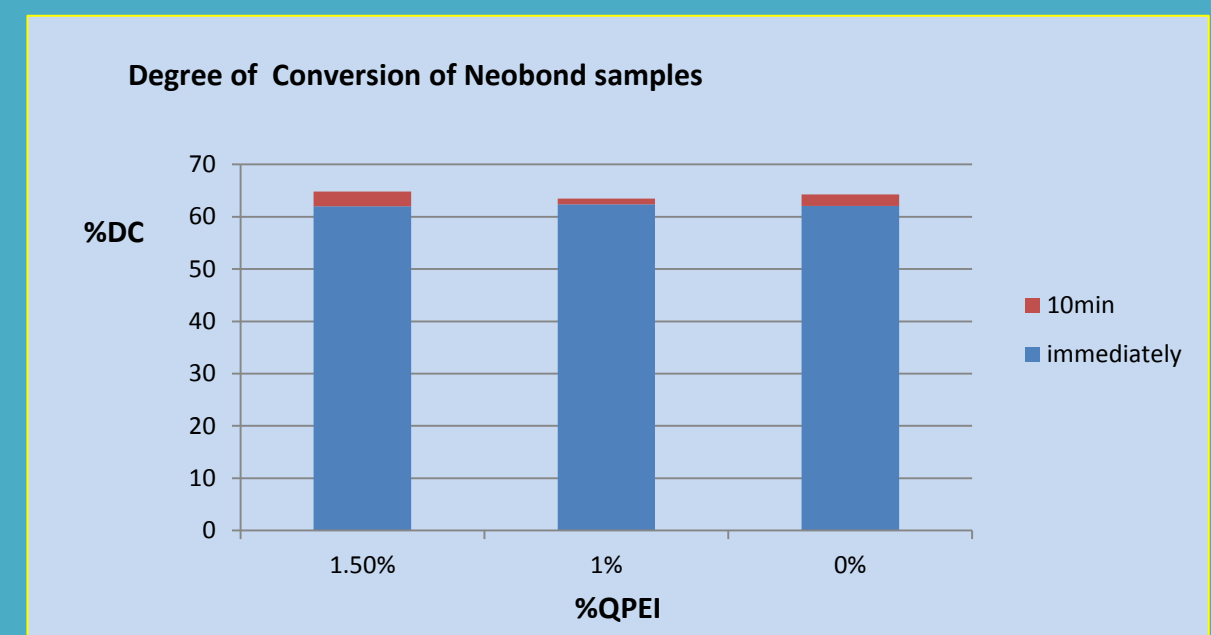


Fig. 2: %DC of Neobond with various concentrations of QPEI immediately after light cure and after 10min post curing

Degree of Conversion for samples a, b and c measured immediately and after 10 min was: 62.1 – 64.3%, 62.4 – 63.5% and 62.0 – 64.8% respectively.

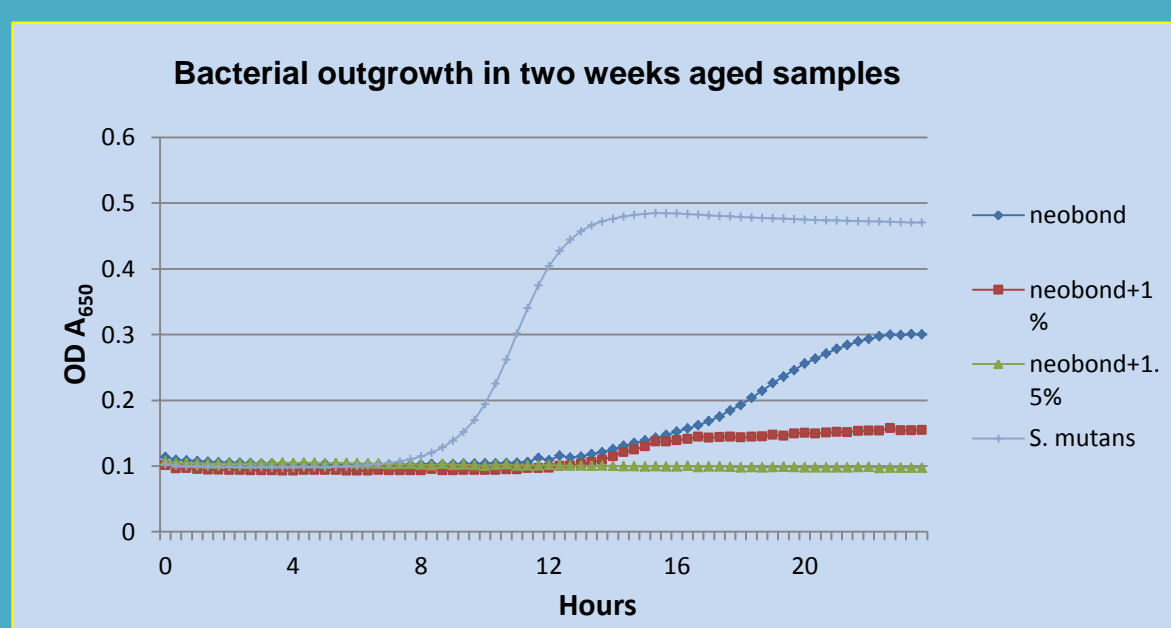


Fig. 3: antibacterial activity of neobond with different conc. of QPEI

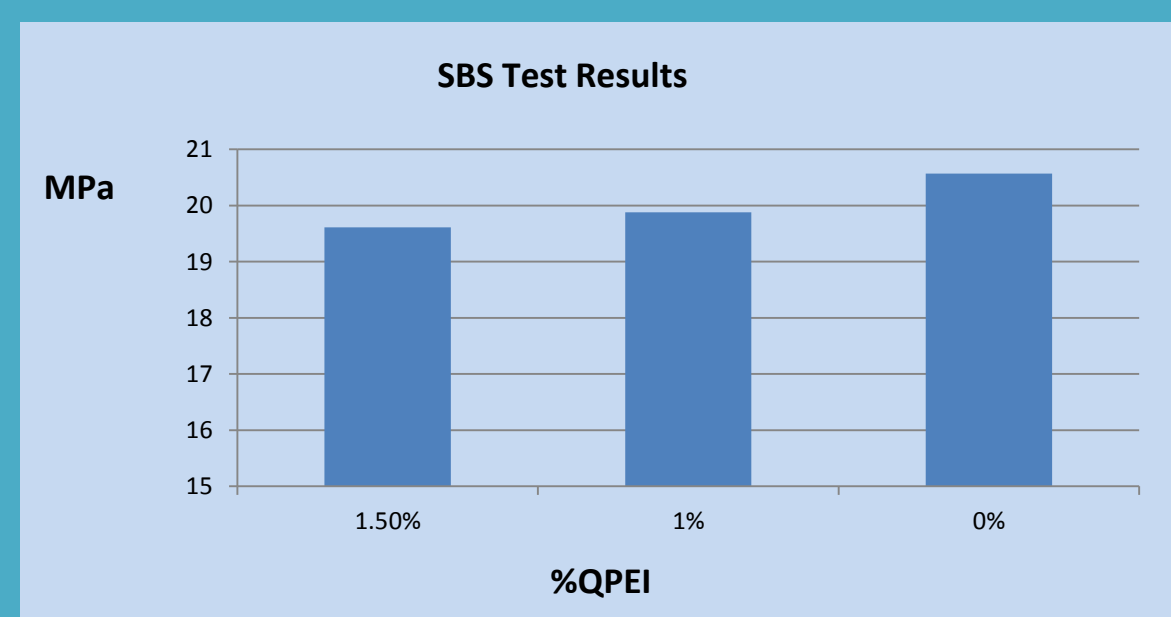


Fig. 4: shear bond stress test for bracket adhesion to bovine enamel

DCT results showed a strong antibacterial effect in the 1 and 1.5% wt/wt test groups (samples b and c). Shear Bond Strength results for samples a, b and c were: 19.88 MPa, 19.61 MPa and 20.57 MPa, respectively.

CONCLUSIONS

Incorporation of QPEI nanoparticles into Neobond orthodontic cement is desirable for providing antibacterial activity without reducing the adhesion strength or the degree of double bond conversion during the polymerization process.