Bonding orthodontics brackets to enamel using experimental composites with an iodonium salt


*Department of Restorative Dentistry, Dental Materials Division, Piracicaba Dental School, University of Campinas, São Paulo, **Department of Orthodontics, Graduate Program in Orthodontics, University of Araras, São Paulo, ***Department of Pediatric Dentistry, Piracicaba Dental School, University of Campinas, São Paulo, ****Materials Engineering School, and *****Department of Restorative Dentistry, School of Dentistry, Federal University of Pelotas, Rio Grande do Sul, Brazil

Correspondence to: Lourenço Correr-Sobrinho, Piracicaba Dental School, University of Campinas, Avenue Limeira 901, Piracicaba, São Paulo 13414-903, Brazil. E-mail: sobrinho@fop.unicamp.br

SUMMARY
OBJECTIVES: This study investigated whether the addition of diphenylidonium chloride (DPC) to experimental resin bonding agents would allow fixation of brackets to enamel using shorter light exposure times.

METHODS: Photoactivated dimethacrylate-based composites were prepared containing DPC molar concentrations of 0 (control), 0.5 (R05), or 1 per cent (R1). Metallic brackets were bonded to bovine incisors and the bond strengths were evaluated using a shear test. In total, 18 groups were tested (n = 15 per group) defined by three bonding materials (control, R05, or R1), three light-activation time (8, 20, or 40 seconds), and two storage periods (10 minutes or 24 hours). The adhesive remnant index (ARI) was scored under magnification. Data were statistically analysed at a 5 per cent significance level.

RESULTS: At 10 minutes, the control composite showed lower bond strengths than the DPC-modified bonding agents for all light-activation times. Differences in bond strengths between both DPC-modified agents were not significant. Lower bond strengths at 10 minutes were generally observed for groups light activated for 8 seconds compared with groups light activated for 20 and 40 seconds. At 24 hours, no significant differences were observed among the light-activation times. The bond strengths at 24 hours were higher than the bond strengths at 10 minutes for all groups. A predominance of ARI scores 2 and 3 was generally observed.

CONCLUSION: The use of a ternary photoactivation system containing an iodonium salt in bonding composites may allow bonding brackets to enamel using reduced light exposure times.

Introduction

Light-cured materials are routinely used for bonding orthodontic brackets. The main advantage of light-cured materials is the set on demand, which offers to the clinician sufficient time to position the brackets accurately before photoactivation. Complete polymerization may not be feasible when considering the light exposure times used clinically unless extremely high light irradiance is used (Staudt et al., 2006); however, adequate early polymerization is necessary for the bonding material to resist debonding when the initial archwire is placed.

The polymerization of methacrylate-based resin materials requires sufficient light irradiance and a suitable wavelength (between 400–500 nm) to activate the photosensitizer camphorquinone (CQ), which reacts with a reducing agent (amine, co-initiator) to trigger the curing mechanism (Rueggeberg, 1999; Stansbury, 2000). A major clinical drawback of light-cured materials is that light exposure times between 20 and 40 seconds are required to bond each bracket, according to the manufacturers' instructions. Long curing times are uncomfortable for patients, impractical with children, and have disadvantages for the clinician.

Methods used in an endeavour to reduce the light-curing time necessary for bonding orthodontic brackets are reported in the literature (Lalani et al., 2000; Oosterlee et al., 2001; Sfondrini et al., 2001; Staudt et al., 2005). Among these, the most popular method is the use of light-curing units with high irradiance levels (e.g. xenon plasma arc and argon lasers), which may provide sufficient light energy within reduced exposure times. However, these units are usually not cost-effective. An alternative is the development of more effective photoinitiator systems for orthodontic bonding agents. The use of an iodonium salt has shown satisfactory results for dental adhesives (Ogliari et al., 2007) when used with CQ. The theory is that the CQ, after excited by light