

Article

Influence of Alumina Air-Abrasion on Flexural and Shear Bond Strengths of CAD/CAM Composite

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Abstract: The purpose of this study was to clarify the influence of alumina air-abrasion on flexural and bond strengths of CAD/CAM composites. The flexural strength (FS) of two brands of commercial CAD/CAM composites was investigated by the three-point bending test using two specimen designs: the single-bar according to the ISO standard and the bonded-double-bar fabricated by bonding two bars with a resin cement. The bond strength between the composites and the resin cement was measured by a conventional shear bond strength (SBS) test. The FS of single-bar specimens was significantly decreased by the air-abrasion. For the FS of the bonded-double-bar specimen, on the other hand, there was no significant difference between the specimens with/without air-abrasion. The SBS for the composites was significantly increased by air-abrasion. The results suggest that alumina air-abrasion improves the SBS of the composites while weakening its FS. Contrarily, the FS of the air-abraded composite did not decrease when the composites were bonded with the resin cement.

Keywords: composite resin; alumina air-abrasion; adhesion; cementation; computer-aided design/computer-aided manufacturing (CAD/CAM)

1. Introduction

Computer-aided design/computer-aided manufacturing (CAD/CAM) is gaining more popularity amongst dental fields around the world. Unlike in the past, now the precision of the CAD/CAM system is comparable to other fabrication techniques [1–4]. The materials used for the CAD/CAM system have also developed, there are varieties of material to choose from. Recently, tooth-colored esthetic materials used for the CAD/CAM system were categorized into two types including ceramic and resin composite (thereafter composite) [5–7]. Since the first introduction of CAD/CAM composites in the market, Paradigm MZ100 (3M ESPE) in 2010, the materials have been improved so far in every aspect including their mechanical properties [5,6,8,9]. Large amounts of filler content and highly converted resin matrix, compared to composites for direct restoration, are the major reasons for their improved properties. Some of the CAD/CAM composites have flexural strength reaching 300 MPa. Such excellent properties allow us to use the CAD/CAM composite for single crown restoration up to the molar region [9,10]. However, some critical issues have been pointed out on restoration using the CAD/CAM composite; fracture and debonding failures of the crown after delivery within a short time period [10–13]. Although many fundamental and clinical researches have been conducted to overcome these issues [14–23], it still remains an open research problem.

Regarding the protocol for surface pretreatment of the CAD/CAM composites for cementation, although there is still no definite conclusion, some researchers and manufacturers recommend an alumina air-abrasion followed by silane primer application to the bonded (fit) surface before cementation [24,25]. Nonetheless, there is an issue considering possible undesirable consequences