Fracture Strength of Titanium-based Implant Crowns

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INTRODUCTION

Manufacturers have marketed more esthetic ceramic-based abutment and crown options ranging from leucite and lithium disilicate reinforced glass to polycrystalline materials. Limited laboratory research has been published specifically evaluating combinations of these materials on a titanium-based implant platform.

OBJECTIVE

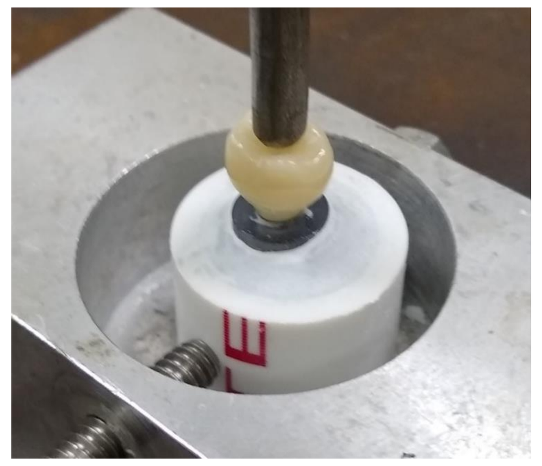
The purpose of this study was to evaluate the fracture strength of titanium-based implant crowns of various restorative and provisional materials.

MATERIALS and METHODS

A standardized template was used to simulate clinical conditions for edentulous site #30 whereby a single implant (Full Osseotite Tapered Certain 5 x 11.5 mm, BIOMET 3i) and ScanPost (BC 5.0L, Sirona) with respective Scanbody was scanned utilizing a chairside CAD/CAM unit (CEREC AC Software version 4.4.4, Sirona). A single full-contour molar restoration was designed and copied for each restorative material to ensure the same dimensions, contours, and minimal thickness values. Six groups of 12 specimens/restorations were milled (CEREC MCXL, Sirona). For each restoration, a new Ti-Base titanium abutment (BC 5.0L) was placed on a new implant body (Full Osseotite Tapered Certain 5 x 11.5 mm, BIOMET 3i) and torqued to 20 N-cm. Then, the restorations were fabricated, polished, and cemented per manufacturer's recommendations for a total of 72 separate implant bodies and restorations. The specimens were cemented into a resin cylinder using a flowable composite, thermocycled (10,000 cycles, 5 – 55° C, 30 secs, Sabri Dental Enterprises) and cyclically loaded (150N, 250,000 cycles, 1Hz, Sabri Dental Enterprises). Specimens were fractured in a material testing device (Instron) using a 6mm-diameter cylindrical piston resting in the central fossa. Fracture load data was analyzed with a One-Way ANOVA/Tukey's (alpha=0.05). Fracture modes were categorized as Ti-Base only; <50% abutment crown; >50% abutment, <50% crown; >50% abutment, >50% crown; and 100% abutment, >50% crown.

MATERIALS and METHODS (cont.)

Figure: Hybrid abutment/crown in a material testing device with cylindrical piston resting in the central fossa ready for loading.

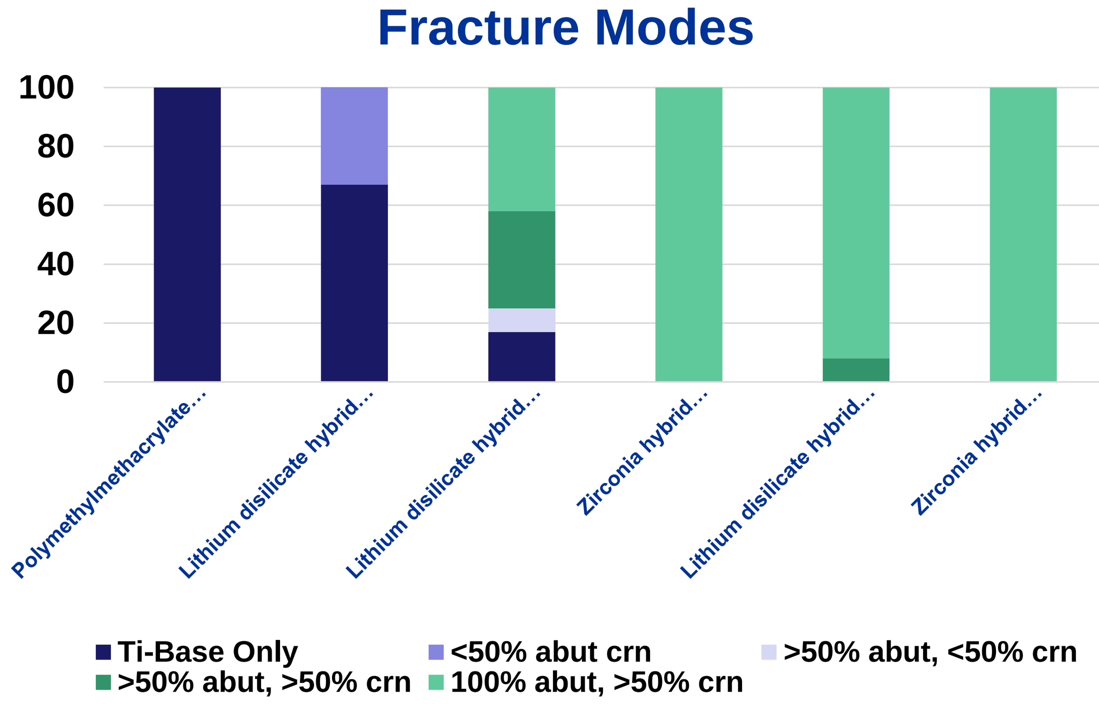


RESULTS

A significant difference was found in fracture strength between groups (p<0.001). See table below.

Groups		Newtons, St Dev
Screw-retained	Polymethylmethacrylate (TelioCAD, Ivoclar Vivadent) hybrid-abutment crown	3278.0 (374.9) a
Screw-retained	Lithium disilicate (IPS e.max CAD, Ivoclar Vivadent) hybrid-abutment crown	2669.4 (344.7) b
Cement-retained	Lithium disilicate (IPS e.max CAD) hybrid abutment/lithium disilicate (IPS e.max CAD) crown	2523.1 (402.5) b
Cement-retained	Zirconia (inCoris ZI, Dentsply Sirona) hybrid abutment/lithium disilicate (IPS e.max CAD) crown	2329.4 (407.4) bc
Cement-retained	Lithium disilicate (IPS e.max CAD) hybrid abutment/leucite-reinforced (Empress CAD, Ivoclar Vivadent) crown	1858.3 (482.4) c
Cement-retained	Zirconia (inCoris ZI) hybrid abutment/leucite-reinforced (Empress CAD) crown	1133.5 (250.2) d %

Groups with the same lower case letter are not significantly different (p>0.05)



CONCLUSIONS

The polymethyl methacrylate material, TelioCAD, had the greatest fracture strength. The lowest fracture strength was seen with the use of the leucite-reinforced (Empress CAD) crown with the zirconia abutment material (inCoris ZI). Groups with greater fracture strength were associated with greater fracture of the crown and abutment.