ABSTRACT # 1263

Flexural Strength Degradation of New Cubic-Containing Zirconia Materials

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INTRODUCTION

Newer cubic-containing zirconia materials are being marketed for use with improved esthetics when compared to traditional zirconia materials. Although many of these materials report high flexural strength, they may also have greater strength degradation under cyclic fatigue due to the increased yttria and cubic content. Limited research has been published evaluating the strength degradation of these materials.

OBJECTIVE

The purpose of this study was to evaluate the flexural strength degradation of newer zirconia materials: 4Y-PSZ Katana STML (Kuraray), 5Y-PSZ Katana UTML (Kuraray), and 5Y-PSZ Lava Esthetic (3M ESPE) compared to more traditional tetragonal zirconia materials: 3Y-TZP Katana ML (Kuraray) and 3Y-TZP Lava Plus (3M ESPE).

MATERIALS and METHODS

Beam specimens were designed using DS SolidWorks software (SolidWorks, Waltham, MA) and the file was imported into Sum 3D, iCAM V5 milling software (I-Mes, iCore). Beam specimens were milled out of zirconia disks (Fig 1.) by a CAM machine (I-Mes iCore 450i, Eiterfeld, Germany) with a final size of 4.0 mm in width, 1.3 mm in depth, and 18.0 mm in length after sintering in a furnace (Programat S1 1600, Ivoclar Vivadent). The properties of the zirconia were also compared to a lithium-disilicate material, IPS e.max CAD (Ivoclar Vivadent). IPS e.max CAD beams were crystallized in the Programat P500. Flexural strength was determined on 10 beam specimens by subjecting them to a three-point bend test in a universal testing machine (Instron). Flexural fatigue strength (Fig 2.) was then measured on 20 beam specimens per group using the staircase method for 6000 cycles at 2 hertz. Data was analyzed with one-way ANOVAs/Tukey post hoc tests (alpha=0.05).

Figure 1: Beam specimens milled in disk

Figure 2: Flexural fatigue strength testing

RESULTS

A significant difference was found between groups ($p<0.001$) per property. The 3Y-TZP zirconia materials had the greatest flexural and flexural fatigue strength. The cubic-containing zirconia materials performed more moderately. The lithium disilicate material had the lowest strength values. The percent degradation in flexural fatigue strength of the 3Y-TZP zirconia materials was less than the 5Y-PSZ, Katana UTML, and the 4Y-PSZ, Katana STML, cubic-containing materials, but similar to the 5Y-PSZ cubic-containing Lava Esthetic.

Material	Property (mean, st dev)		
	Flexural Strength MPa	Flexural Fatigue Strength MPa	Strength Degradation (%)
IPS e.max CAD $Li_2Si_2O_5$	262.9 (27.1) a	146.4 (24.0) a	44.3
Katana UTML 5Y-PSZ	470.2 (42.9) b	232.2 (19.4) b	50.6
Lava Esthetic 5Y-PSZ	485.0 (63.1) b	336.2 (48.1) c	30.7
Katana STML 4Y-PSZ	534.3 (63.6) b	304.4 (37.3) bc	43.0
Katana ML 3Y-TZP	777.9 (101.1) c	536.6 (158.8) d	31.0
Lava Plus 3Y-TZP	870.6 (145.8) c	640.2 (129.8) e	26.5

Groups with the same letter per column are not significantly different ($p>0.05$)

CONCLUSIONS

The amount of strength degradation was material dependent, with the 4Y-PSZ or 5Y-PSZ cubic-containing zirconia materials demonstrating greater or similar strength degradation compared to the primarily tetragonal 3Y-TZP materials.