Effect of cavity size on degree of conversion and mechanical properties of bulk-fill composites in small cavities

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-Background-

Cavity preparation for resin composite is driven by principle of minimal intervention, in order to maintain the strength of the tooth, as a result, resin composite cavity sizes are smaller than in the past .However, the depth of proximal caries, which is usually found at or near a contact point, remains unchanged. It means that even if the cavity size is small down, the depth of the cavity remains constant. so the aim of this study was to investigate the effect of the size of small cavities on degree of conversion and mechanical properties of bulk-fill RBCs

-Objective-

To investigate the effect of small cavity size on the degree of conversion and mechanical properties of bulk-fill RBCs.

-Statistical analyses-

The degree conversion and microhardness were analyzed using a repeated three-way ANOVA. Within-subject factors included curing time (20 and 40 s) in degree of conversion and surface (top and bottom) in microhardness. The BFS and BFM were analyzed using one-way ANOVA. The significant level was set at 0.05.

-Keywords-

Small cavity, Light curing, Degree of conversion, Mechanical properties, Bulk-fill composite

-Results-

Table 2 Degree of conversion

		Depth 2 mm				Depth 5 mm			
		2×2 mm		2×5 mm		2×2 mm		2×5 mm	
Filtek bulk one	20 s	44.18 (5.07)	abc	55.48 (17.83)	a	30.46 (9.52)	bcd	34.62 (3.73)	abcd
	40 s	62.04 (0.35)		79.59 (19.43)		54.68 (13.2)		61.01 (25.09)	
Surefil SDR flow+	20 s	52.65 (4.69)	* abc	59.14 (2.79)	* ab	54.19 (2.85)	* ab	58.36 (0.80)	* ab
	40 s	57.19 (3.52)		62.93 (2.71)		61.65 (2.51)		63.68 (0.91)	
Filtek Z350 XT	20 s	43.71 (11.27)	abc	44.18 (5.54)	abcd	29.58 (5.04)	cd	24.12 (8.49)	d
	40 s	66.56 (17.55)		56.18 (8.64)		42.04 (6.45)		38.85 (10.11)	

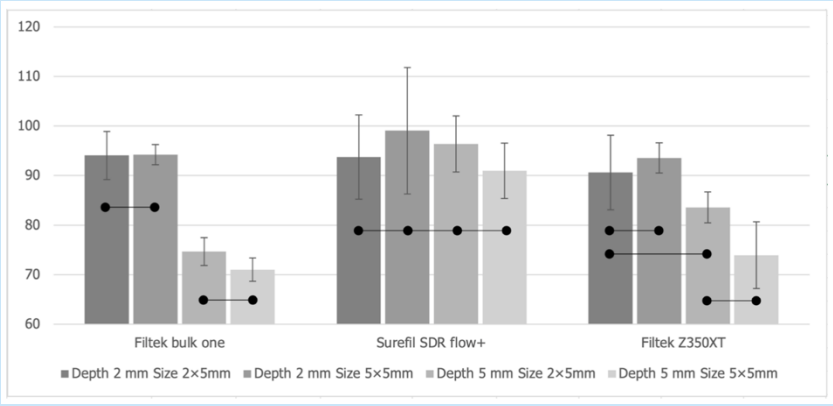
mean (SD); same letter indicates no statistical difference (p>0.05); * indicates no statistical difference between 20 s and 40 s.

Table 3 Biaxial flexural strength and Biaxial flexural modulus

	Flexural strength (MPa)	Elastic modulus (GPa)
Filtek bulk one	220 (29.86) a	4.85 (0.42) B
Surefil SDR flow+	189.7 (24.55) a	3.67 (0.51) C
Filtek Z350 XT	231.2 (43.82) a	5.53 (0.65) A

mean (SD); same alphabet indicates no statistical difference (p>0.05)

Figure 1 Vickers hardness



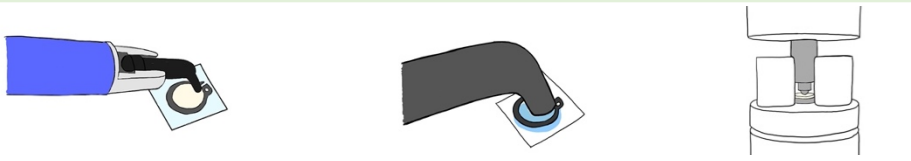
Bottom/top% ; Horizontal line indicate no statistical difference at significant level 0.05

-Materials and methods-

Table 1 RBCs used in this study

Material	Manufacture	Type	Organic	Inorganic matrix	% filler	Lot number
Filtek™ Z350XT	3M ESPE	Nanofill composite	UDMA, Bis-GMA, Bis-EMA, TEGDMA	Silica clusters, zirconia/silica aggregated particle (20nm silicaparticles compined with 4-11nm zirconia)	72.5 % w/w	NE02970
Filtek™ bulk one	3M ESPE	Bulk-fill composite	UDMA, 1,12-DDMA, AFM, AUDMA	20 nm silica, 4–11 nm zirconia, ytterbium trifluoride filler consisting of agglomerate 100 nm particles	76.5 % w/w	NE02999
Surefil SDR flow+	Dentsply Sirona	Bulk-fill flowable composite	Modified UDMA, TEGDEMA, EBPDMA	Barium alunio-fluoro-silicate glasses, strontium alumino-fluoro-silicate glasses, silicon dioxide, strontium, aluminosilicate glass	68.0 % w/w	2002000310

Biaxial flexural strength (BFS) and Biaxial flexural modulus (BFM)

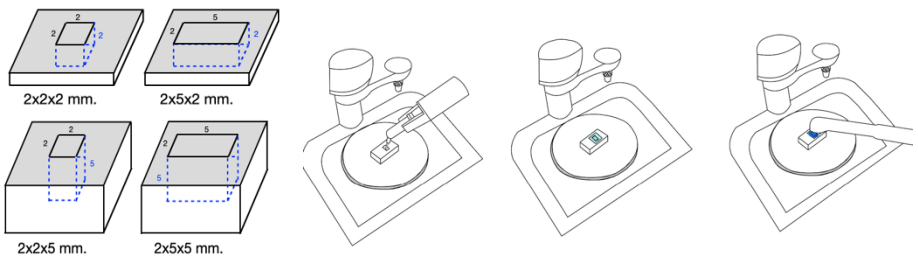


The materials were prepared and placed in a metal circlip(10 mm in diameter and 1 mm in thickness).

They were then light-cured for 40s on the top and bottom surfaces using an LED light-curing unit.

Testing was carried out on a universal machine with a ball-on-ring jig. The load was applied until thematerials fractured.

Degree of conversion (DOC)



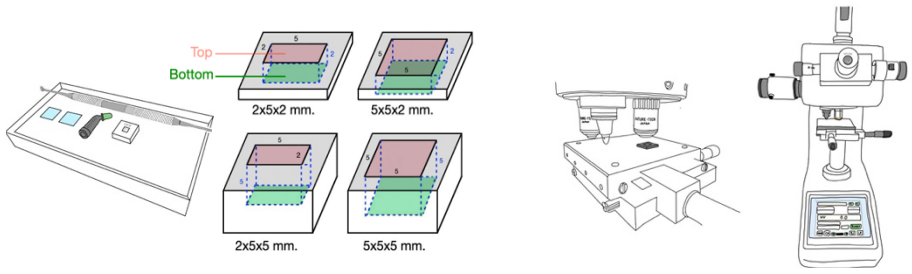
Cavities were stimulated in the 4 molds

Place mold center to ATR diamond and composite filling

Cover with acetate sheet and measure the DOC before light curing

Light curing and measure the DOC at after 20s and 40s

Vickers microhardness (VHN)



A square split-mold, filling with resin composite, the resin composite was light-cured for 20 seconds. And stored for 24 hours in double distilled deionized water at 37.8°C.

VHN of each top and bottom surface was measured at five different points on each surface, with a 50 N load for 15 seconds.

-Conclusion-

The different size of cavities had an effect on microhardness and the bottom/top percent of Filtek bulk one and Filtek Z350 XT, but had no effect on degree of conversion. There was an effect of the type of RBCs on flexural modulus of elasticity but no effect on flexural strength. At a depth of 2 mm, the small cavity reduces mechanical properties. Increased degree of conversion in small cavity by increasing curing time to 40s.

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