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Contact- and contact-free wear between various resin composites

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ABSTRACT

Objective. Nowadays direct and indirect resin composites are frequently applied to build up the occlusion when extensive tooth wear took place. To achieve long-lasting restorations it is essential to obtain knowledge about their interactions due to occlusal contacts. Therefore, the two- and three-body wear between frequently used direct and indirect resin composites was investigated.

Materials and methods. The two- and three-body wear of three direct resin composites and three indirect resin composites, with Clearfil AP-X, Filtek Z250, and Filtek Supreme XT as antagonists, were measured, using the ACTA wear device. The wear rates were determined and the surfaces were evaluated with SEM.

Results. The most remarkable outcome was that the two-body wear rate of the different composites opposing the Z250 wheel were significantly higher. Furthermore, it was shown that the three-body wear rate was independent on the antagonist and in general higher than the two-body wear rate.

Conclusions. To reduce abrasion of the opposing resin composite surface the resin composite fillers should consist of a softer glass, e.g. barium glass or in case of a harder filler the size should be reduced to nano-size.

1. Introduction

For many years resin composites are considered a viable treatment option for all types of restorations [1,2]. Nowadays direct and indirect resin composites are also frequently applied to build up the occlusion when extensive tooth wear took place [3–7]. The success of such a treatment will depend on the reason for the wear e.g. erosion, bruxism or a combination of both. Reason for failure of direct resin composite restorations appears to be fracture, wear, and secondary caries [2,8,9]. The best correlation of clinical wear, according to a denture model study of 13 experimental hybrid composites, was between wear, fracture toughness, and flexural strength [2]. Subjecting resin composites to dynamical loading prior to fracture testing significantly reduces the fracture strength compared

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Table 1 – Materials properties of materials used according to the manufacturers data.

Code	Material	Matrix/fillers	Filler[d,e]	Batch/exp/color
Z250	Filtek Z250[a]	Bis-GMA, UDMA, bis-EMA, zirconia, silica	78 0.19–3.3 μm	20050727 2008-06 A3
SFY	Sinfony[a]	UDMA, Bis-EMA, borosilicate glass, pyrogenic silica	45 0.5–0.7 μm	216232 2008-12/A2
HM	Heliomolar[b]	Bis-GMA, urethane dimethacrylate, decandiol dimethacrylate, silicon dioxide, ytterbium trifluoride, copolymer	67 0.04–0.2 μm	H24852 2009-08/A3
ADO	Adoro[b]	Cycloaliphatic dimethacrylate, urethane dimethacrylates, decamethylenedimethacrylate copolymer, highly dispersed silicon dioxide	65 10–100 nm	H22320 2008-06/A3
EAD	Estenia C&B[c]	Bis-GMA, UDMA, decandiol dimethacrylate, surface treated alumina, silanated glass ceramics	92 2 μm	219AA 2008-05/A2
APX	Clearfil APX[c]	Bis-GMA, TEGDMA, silanated barium glass filler, silanated silica filler, silanated colloidal silica, DL-camphorquinone	86 3 μm	1098AA 2008-04/A3
APX Antagonist	Clearfil APX[c]	Bis-GMA, TEGDMA, silanated barium glass filler, silanated silica filler, silanated colloidal silica, camphorquinone	86 3 μm	00480A 2014-08/A2
Z250Antagonist	Filtek Z250[a]	Bis-GMA, UDMA, bis-EMA, zirconia, silica	78 0.19–33 μm	N182171 2013-05/A2
FS Antagonist	Filtek Supreme XT[a]	Bis-GMA, UDMA, TEGMA, bis-EMA, zirconia filler, silica filler	73 5–75 nm	N105945 2012-06/A3B

[a] 3M ESPE, Seefeld, Germany.
[b] Ivoclar Vivadent, Schaan, Liechtenstein.
[c] Kuraray Dental, Tokyo, Japan.
[d] In weight%.
[e] Size of fillers.

Table 2 – Mean two- and three body wear and standard deviation in parentheses in micrometers of different combination of materials.

Two-body wear			Three-body wear		
Antagonist	Specimen	Wear rate	Antagonist	Specimen	Wear rate
APX	Z250	3.5 (0.2)deA	APX	Z250	40.7 (0.6)
	SFY	1.1 (0.2)deB		SFY	68.8 (1.5)
	HM	1.9 (0.3)deC		HM	57.5 (2.2)C
	ADO	4.2 (1.1)dD		ADO	51.4 (3.2)
	EST	0.8 (0.2)eE		EST	24.0 (0.8)
	APX	1.5 (0.3)deF		APX	33.0 (0.8)
FS	Z250	2.4 (0.2)cA	FS	Z250	34.7 (1.4)A
	SFY	2.0 (0.2)cB		SFY	71.2 (2.2)B
	HM	2.3 (0.2)cC		HM	56.8 (2.0)C
	ADO	4.0 (0.6)cD		ADO	46.9 (3.6)D
	EST	2.1 (0.2)cE		EST	19.0 (0.6)E
	APX	4.6 (0.5)cG		APX	28.3 (0.8)F
Z250	Z250	25.8 (1.8)b	Z250	Z250	35.6 (1.1)A
	SFY	17.7 (3.9)		SFY	71.4 (3.2)B
	HM	26.3 (7.0)b		HM	59.7 (3.0)C
	ADO	42.3 (4.2)		ADO	50.0 (4.1)D
	EST	17.2 (1.1)		EST	17.5 (0.5)E
	APX	23.8 (1.3)b		APX	26.6 (0.6)F
SS	Z250	7.0 (1.4)	SS	Z250	33.4 (1.3)A
	SFY	3.0 (1.2)aB		SFY	74.3 (5.5)B
	HM	9.6 (3.1)		HM	57.9 (4.9)C
	ADO	17.3 (3.3)		ADO	47.4 (3.8)D
	EST	2.9 (0.4)aE		EST	18.9 (1.0)E
	APX	2.9 (0.3)aFG		APX	28.5 (0.4)F

The two- and three-body wear rates were independent statistically analyzed by two-way ANOVA ($P < 0.01$). The capital characters show the wear rate was not statistical different between the different antagonist materials. The small characters indicate the wear rate was not statistical different within the different antagonist materials.