Three-body Wear of Restorative Composite Materials

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Introduction:

The aim of this study was to compare and rank the wear of 25 restorative composite materials and a veneering composite reference. The wear resistance was determined in a three-body abrasion test. Correlations with fracture toughness, Vickers hardness and filler content were investigated.

Materials and Methods:

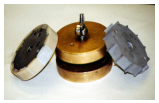


Figure 1: Sample wheels

Figure 2: wheels, ACTA, Willytec, G

Figure 3: ACTA, Willytec, G

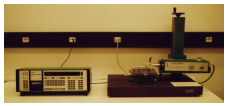


Figure 4: Perthometer SP6, Mahr-Feinprüf, G

Figure 5: Vickers hardness tester, Zwick, G

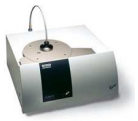


Figure 6: TG 209 F3 Tarsis, Netzsch, G

Composite specimens were made of each material according to the manufacturer's instructions. Three-body wear testing was performed for 200,000 cycles (ACTA; Willytec, G: sample 60 rpm, antagonist 120 rpm; 20N) using a mixed millet shells - rice food bolus.

The wear trace was measured in comparison to the non-worn surface (Perthometer SP6; Mahr, G). Relative wear was calculated in relation to a laboratory veneering composite control (Sinfony, 3M Espe, USA).

Vickers hardness (Zwick, G; 0.2 kg/60 sec) and the inorganic filler content (up to 600°C, TG 209 F3 Tarsus; Netzsch, G) were determined.

restorative composites					
material	Ceram·x™ duo?	Clearfil Majesty™ Esthetic	Enamel G.E. 2	Estelite Posterior	experimental composite
	Ceram·x™ mono?	Esthetic	Enamel Plus HRI	Estelite Ó Quick	Filtek™ Silorane
	Esthet·X® HD		GDF Hybrid Composite		Filtek™ Supreme XTE
	Spectrum® TPH® 3				Z100™ MP Restorative
manufacturer	*Dentsply*	*Kuraray Medical Inc.*	*GDF*	*Tokuyama Dental*	*3M ESPE*
material	Grandioso	GC Kalore	IPS Empress® Direct	Miris®2	Venus®
	X-tra fil	Gradia® Direct Anterior	Tetric EvoCeram®	Synergy® D6	Venus® Diamond
		Gradia® Direct Posterior			
manufacturer	*Voco*	*GC Corporation*	*Ivoclar Vivadent*	*Coltène whaledent®*	*Heraeus Kulzer*
reference material: Sinfony™; 3M ESPE					

Tab.1: Materials

Statistics: one-way ANOVA (α=0.05).

Results:

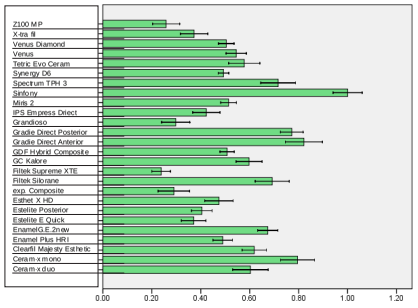


Fig. 7: Relative wear

material	relative wear*	std. deviation	material	relative wear*	std. deviation
Ceram·x™ duo?	0.6	0.07	GDF Hybrid Composite	0.5	0.03
Ceram·x™ mono?	0.8	0.07	Gradia® Direct Anterior	0.8	0.08
Clearfil Majesty™ Esthetic	0.6	0.05	Gradia® Direct Posterior	0.8	0.05
Enamel HFO G.E. 2	0.5	0.04	IPS Empress® Direct	0.4	0.06
Enamel Plus HRI	0.7	0.04	Miris®2	0.5	0.03
Estelite Posterior	0.4	0.05	Spectrum® TPH® 3	0.7	0.07
Estelite Ó Quick	0.4	0.04	Synergy® D6	0.5	0.02
Esthet·X® HD	0.5	0.06	Tetric EvoCeram®	0.6	0.06
Experimental Composite	0.3	0.06	Venus®	0.6	0.04
Grandioso	0.3	0.06	Venus® Diamond	0.5	0.03
Filtek™ Silorane	0.7	0.07	X-tra fil	0.4	0.06
Filtek™ Supreme XTE	0.2	0.04	Z100™ MP Restorative	0.3	0.06
GC Kalore	0.6	0.05	Sinfony™	1	0.06

Tab.2: Relative wear (*:related to Sinfony, veneering composite)

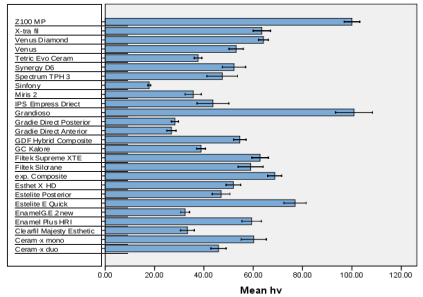
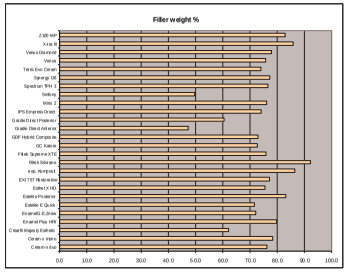


Fig. 8: Vickers hardness (HV)



Tab.3: Filler content (%)

Conclusion:

Filtek Supreme XTE exhibited lowest wear rate followed by Z100 MP, the experimental composite, Grandioso and Estelite Posterior. No statistically significant correlation could be determined between Vickers hardness, filler content and wear rate.