MECHANICAL PROPERTIES OF DENTAL RESTORATIVES AND THEIR COMPARATIVE FLOWABLES

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 # 1844

Objectives:

The purpose of this investigation was to compare the wear performance and the resistance to crack propagation (K_{ic}) of seven commercial restorative materials and their flowable (F) variations.

Methods:

The tested materials were:

	restoratives							reference
Material	Admira	Grandio	Dyract AP	Filtek Z250	Tetric Ceram	Enamel Plus HFO	Nanopaq	Sinfony
	Admira F	Grandio F	Dyract F	Filtek F	Tetric F	Enamel Plus HFO F	Nanopaq F	
Manufacturer	Voco, G	Voco, G	Dentsply DeTrey, G	3M Espe, G	Ivoclar- Vivadent, FL	Schütz Dental Group, G	Schütz Dental Group, G	3M Espe, G

Wear:

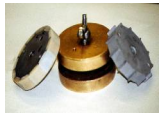

Figure 1: Sample wheels

Figure 2: wheels ACTA Willytec, G

Figure 3: ACTA Willytec, G

The 12 moulds of the metal sample holding wheelwere filled with the different composite resins, polymerized in a light curing unit (Elipar Trilight, 40 sec.; veneering composite: Visio Alpha, Visio Beta, 15 min., 3M Espe, G) according to the manufactures instructions.
The specimens (n=6) were adhesively fixed onto the sample holder (Rocatec, 3M Espe, G; Variolink II, Ivoclar-Vivadent, FL).

Three-body testing was performed (ACTA-Willytec, G): sample wheel 60 rpm, antagonist wheel 130 rpm, force 15N. The third medium was a food bolus made of 30g millet sheet and 120g rice. Both were mixed in a grinding machine (...a Moulinette, Moulinex, G) .

The wear trace was quantified by profilometry (Perthometer S6P, Mahr- ®einprüf,G) in comparison to the non- worn surface after 50.000, 100.000, 150.000 and 200.000 load cycles.

Statistics: Mann-Whitney-U-test (p=0.05).

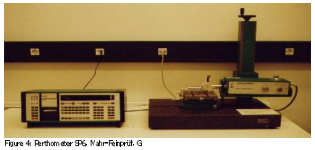

Figure 4: Perthometer S6P, Mahr-Feinprüf, G

Fracture Toughness (K_{ic}):

Fracture toughness (K_{ic}) was determined according to ASTM Designation E 399-83 using 10 single-edge notched-bend specimens of each material.

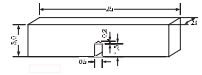

Figure 5: specimen

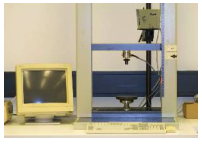

Figure 6: universal testing machine, Zwick, G

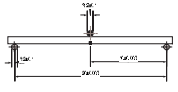

Figure 7: threepoint bending test device

The specimens (25mm length x 5mm height x 2,5 mm width) were made by inserting the material into a steel mould and polymerized as mentioned above. A notch (0.3mm, 1.7mm depth) was machined for each specimen with a diamond saw (Mutronic, G) and sharpend by a razor blade (Wilkinson, GB).

All specimens were stored in distilled water at 37°C for 7 days.

The specimens were loaded to fracture on a three-point bending test device (span S=20mm distance between the supports) with the universal testing machine (Zwick, G) at a crosshead speed of 0.5mm/min at room temperature (23°C).

Load-deflection curves were recorded. Fracture toughness (K_{ic}) was calculated from the measurements.

Statistical analysis was performed using Mann-Whitney-U-test (p=0.05).

Results:

Material	Admira	Dyract AP	EP HFO Plus	Filtek Z250	Grandio	Nanopaq	Tetric Ceram	Sinfony
Wear [µm] ±std	84.7⊥17.2	103.5⊥24.9	29.6⊥9.0	32.3⊥5.1	17.1⊥5.9	39.9⊥11.8	71.8⊥22.8	91.9⊥20.9
K_{ic} [MPam$^{1/2}$]	1.19⊥0.18	2.39⊥0.67	1.55⊥0.42	1.73⊥0.37	1.86⊥0.30	3.64⊥0.87	1.72⊥0.22	1.25⊥0.30

Material	Admira flow	Dyract flow	EP HFO Plus flow	Filtek flow	Grandio flow	Nanopaq flow	Tetric flow
Wear [µm] ±std	79.3⊥16.3	66.0⊥2.5	72.0⊥16.7	75.5⊥21.8	58.6⊥26.1	78.2⊥12.3	84.1⊥19.0
K_{ic} [MPam$^{1/2}$]	1.61⊥0.51	2.05⊥0.41	1.88⊥0.46	2.28⊥0.53	2.55⊥0.43	2.05⊥0.30	2.15⊥0.29

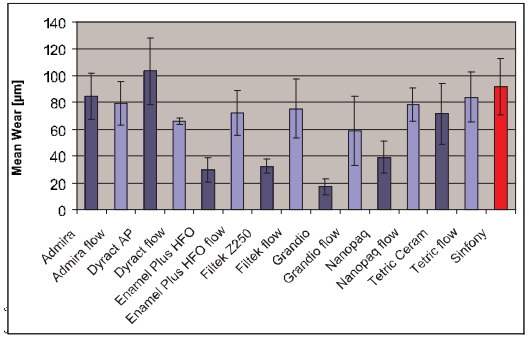

Figure 8: mean and standard deviation of wear

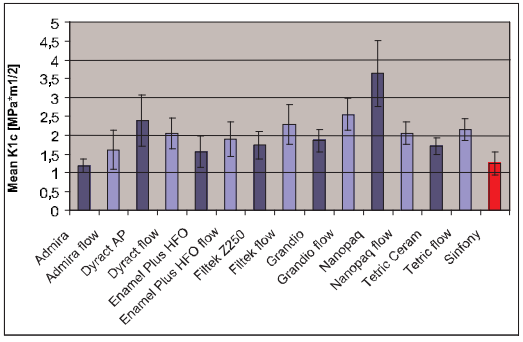

Figure 9: mean and standard deviation of fracture toughness

Conclusions:

Contrary to expectations the tested restorative materials exhibit lower fracture toughness as the flowables. Only Nanopaq and Dyract show higher K_{ic} -values than their flowable variations.
Possible explanations of the high K_{ic} -values for the flowables might be related to plastic deformation caused by the higher amount of organic matrix or insufficient notching of the crack.

Lowest wear values could be determined for the composites Grandio, Enamel Plus HFO and Filtek Z250.
Generally composites show higher wear resistance as their flowable variations.

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