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Nanofilled and microhybrid composite restorations: Five-year clinical wear performances

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ABSTRACT

Objectives. To compare the clinical wear performance of nanofilled restorations (Filtek Supreme) against microhybrid restorations (Z100) in a 5-year randomized clinical trial to evaluate the wear rate and the influence of subject-, operator- and restoration-related variables on wear rate.

Materials and methods. 18 Filtek Supreme and 17 Z100 restorations were placed in human molars (split-mouth-model) and bonded with Single Bond/Scotch Bond Adhesive. Restorations were recalled at baseline, 6-, 12-months and at annual intervals until 5-years of clinical service. The gypsum replicas at each recall were used for 3D-Pro-laser scanning to quantify wear and the epoxy resin replicas were observed under SEM for microwear patterns. Linear-mixed-models were used to study the influence of the different variables on the vertical and volume loss.

Results.

		Z100	Filtek Supreme
Vertical wear (μm/month)	Generalised	0.870	0. 925
	0–6 m/running-in wear	5.563	6.987
	6–36 m/early stage	0.974	1.288
	36–60 m/steady state	0.486	0.263
Volume loss (mm^3/month)	Generalised	0.014	0.011
	0–6 m/running-in wear	0.017	0.011
	6–36 m/early stage	0.006	0.005
	36–60 m/steady state	0.031	0.023

Volume wear, but not the vertical wear rate of the two restorative materials were significantly influenced ($p < 0.05$) by the factors such as operator, cavity type, as well as combination of operator–cavity type and quadrant type. The variations in the occlusal surface microwear patterns over time reflect the effect of biomechanics of mastication on the restorative composite.

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The rate of vertical and volume loss of both the restoratives appear, on average, not to be constant even after the early stage wear, under the influence of certain clinical variables.

1. Introduction

Long-term clinical performances of resin composite restorations have been improving year by year [1]. However, the occurrence of a high percentage of wear in the first five years of clinical service and the relatively scarce information available in literature over the clinical wear resistance is suggestive of wear resistance being one of the prime concerns in large stress-bearing restorations [2]. With the promise of substantially reducing in vivo wear based on in vitro wear simulator studies [3], several manufacturers have introduced nanocomposites fabricated by different approaches [4]. Few comparative studies of nanocomposites against the conventional composites have shown controversial results regarding the beneficial effects of nanofills on the wear resistance of nanocomposites [5,6].

The clinical results and in vivo wear performance of a nanofilled composite, Filtek Supreme compared against a microhybrid, Z100 placed in Class I and Class II cavities in a three year randomized clinical trial (RCT) were published recently [7]. Reporting of in vivo wear involved both vertical and volume loss as recommended previously [8]. As part of the clinical follow-up protocol of the RCT, the study participants were encouraged to return for annual follow-up visits during the fourth and fifth year following the restoration placement. Having gathered the wear data from baseline to five years for all patients in the prospective RCT, the present study sought to assess the progression of in vivo wear among all of the nanofilled and microhybrid restorations.

Although the long-term temporal pattern of resin composite restoration wear has not been thoroughly characterised,it is generally accepted that the wear curve appears non-linear with three stages. A period of rather rapid initial "running-in" wear and early stage wear with slightly increased wear rate lasting for a period of two years before the transition to a rather slower steady state wear have been observed in clinical studies [9,10], which is also consistent with the results of in vitro studies [11,12]. Several factors related to the patient [13,14], operator [15] and the restorative materials [16,17] have been suggested to influence clinical wear.

This study had two objectives. The first objective was to comparatively assess the running-in wear, early stage and steady state wear rates for vertical and volume wear among the nanofilled and microhybrid restoration groups that had five-year follow-up in a RCT study. With the quantified wear rate, the next goal was to investigate the effect of material-, clinician-, and tooth-related variables on the clinical wear rates.

2. Materials and methods

2.1. Study population

The subjects in the present study were selected from a group of 30 dental student volunteers, by applying strict inclusion and exclusion criteria as mentioned before [7]. 16 subjects in need of a minimum of two Class I and/or Class II restorations of comparable size involving failed restorations and primary caries perwere invited to join the study. Each subject signed an informed consent to participate in the study, which was approved by the medical ethics committee of the Catholic University of Leuven.

Table 1 – Description of materials used in this study.

Material	Type	Polymer*	Fillers*	Filler size*		Filler content (% by volume)*
				Range	Mean	
Z100	Microhybrid	Bis-GMA, TEGDMA	Zirconia, silica	0.01–3.5 μm	0.6 μm	66%
Filtek Supreme (translucent)	Nano	Bis-GMA, UDMA, Bis-EMA, TEGDMA	SiO_2 nanoclusters and nanomers	0.6–1.4 μm	75 nm 75 nm	57.7%
Filtek Supreme (D/E/B)	Nano	Bis-GMA, UDMA, Bis-EMA, TEGDMA	ZrO_2/SiO_2 nanoclusters SiO_2 nanomers	0.6–1.4 μm	ZrO_2-5 nm SiO_2-20 nm 20 nm	59.5%

Columns with the superscript (*) contain data as disclosed in the technical product file [13,14] by manufacturers.