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Nanohybrid vs. fine hybrid composite in Class II cavities: Clinical results and margin analysis after four years

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ABSTRACT

Objectives. This controlled prospective split-mouth study evaluated the clinical behavior of two different resin composites in extended Class II cavities over a period of four years.
Methods. Thirty patients received 68 direct resin composite restorations (Grandio bonded with Solobond M: $n = 36$, Tetric Ceram bonded with Syntac: $n = 32$) by one dentist in a private practice. All restorations were replacement fillings, 24 cavities (35%) revealed no enamel at the bottom of the proximal box, in 33 cavities (48%) the proximal enamel width was less than 0.5 mm. The restorations were examined according to modified USPHS criteria at baseline, and after six months, one, two, and four years. At each recall, impressions were taken for replica preparation. Replicas of 44 select subjects were assessed for marginal quality under a stereo light microscope (SLM) at 130× and 22 replicas were assessed under a scanning electron microscope (SEM) at 200×.
Results. Both recall rate and survival rate were 100% after four years of clinical service. No significant difference was found between the restorative materials ($p > 0.05$; Mann–Whitney *U*-test). Hypersensitivities were significantly reduced over time ($p < 0.05$; Friedman test). A significant deterioration over time was found for the criteria marginal integrity (66% bravo after four years), tooth integrity (15% bravo), filling integrity (73% bravo) and proximal contact ($p < 0.05$; Friedman test). SLM and SEM analysis of restoration margins revealed differences in the amount of perfect margins, in favor of Tetric Ceram ($p < 0.05$).
Significances. Both materials performed satisfactorily over the four-year observation period. Due to the extension of the restorations, wear was clearly visible after four years of clinical service with 50% bravo ratings.

1. Introduction

Both anterior and posterior restorations are today predominantly made by use of resin composites [1–4]. Successful adhesion to tooth hard tissues is a fundamental prerequisite for pit and fissure sealings, direct resin composites, and bonded ceramics [5–9]. However, without successful adhesion, gap formation and finally recurrent caries have a

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potentially negative effect on clinical success of restorations [10–13].

Bonding to phosphoric acid etched enamel is clinically durable [1,6,12,14–16], dentin still remains the weaker adhesion substrate due to intrinsic wetness [8,9,13,17–20], but clinically acceptable sealing of dentin in order to reduce postoperative hypersensitivities is achievable [4,6,7,11,12,21,22]. Although dentin adhesives are able to durably seal dentin, especially with multi-step adhesives [14,17,19,23–25], it has not been fully evaluated whether the adhesives are able to retain marginal seal in Class II cavities with proximal margins below the cementoenamel junction. Several *in vitro* studies report varying outcomes after thermomechanical loading and long-term storage with advantages for conventional two- or three-step adhesives compared to simplified adhesive systems of recent generations [23,24,26–28]. However, a prospective clinical trial remains the ultimate instrument to clarify these major questions. Nevertheless, preclinical *in vitro* investigations are still needed, especially when experimental questions or a potential for optimizing procedures arise [17,26,29].

The main problem with clinical trials, although they give valuable results after many years of clinical service, is that the adhesive and/or resin composite studied may not be in the market anymore, like in this study for the case of Tetric Ceram which is replaced by Tetric EvoCeram since several years [1,11,12,15,16,30,31]. On the other hand, clinical reports have revealed catastrophic outcomes when adhesive performance per se is neglected [15]. Furthermore it was shown that, e.g. amalgam may be superior to resin composites for restoration of extended defects [21].

Beside conventional hybrid resin composites, also fine hybrid composites or even nanohybrid resin composites entered the market claiming less polymerization shrinkage and higher wear resistance [32–37]. In most of the cases, a truly better clinical outcome is not proven.

Therefore, the aim of this clinical trial was to investigate two different restorative material systems (i.e. adhesive and resin composite) in extended Class II cavities over time in order to observe differences between conventional and partially nanofilled resin composites. The null-hypothesis tested was that there would be no difference between the different resin composites with their respective adhesives under investigation.

2. Methods and materials

Patients selected for this study met the following criteria: (1) absence of pain from the tooth to be restored; (2) possible application of rubber dam during luting of restoration; (3) no further restorations planned in other posterior teeth; (4) high level of oral hygiene; (5) absence of any active periodontal and pulpal disease; (6) restorations required in two different quadrants (split-mouth design).

Thirty patients (23 females and 7 males, mean age 32.9 (24–59) years) with a minimum of two fillings to be replaced in different quadrants received at least two different restorations in a random decision according to recommendations of the CONSORT statement [38]. Thirty-six Grandio fillings were bonded with Solobond M (Voco, Cuxhaven, Germany) and 32 Tetric Ceram restorations were bonded with Syntac (Ivoclar Vivadent, Schaan, Liechtenstein). All fillings (only Class II, 52 MO/OD, 16 MOD or more surfaces, no cusp replacements) were re-restorations made by one dentist in a private practice (31 upper bicuspids, 12 upper molars, 14 lower bicuspids, and 11 lower molars). Reasons for replacement were caries ($n=19$), insufficient esthetics ($n=2$), and secondary caries ($n=47$). For all teeth receiving restorations, current X-rays (within six months of the procedure) were present. After evaluating the radiographs, 53 cavities (78%) were treated as caries profunda. Twenty-four cavities (35%) revealed no enamel at the floor of the proximal box, while 33 cavities (49%) exhibited a proximal enamel width of <0.5 mm.

All fillings were inserted in permanent vital teeth without pain symptoms. An extension for prevention was disregarded for maximal substance protection; however, the majority of restorations were previously prepared with undercuts for amalgam retention. The cavities were cut using coarse diamond burs under profuse water cooling (80 μm diamond, Komet, Lemgo, Germany), and finished with a 25-μm finishing diamond. Inner angles of the cavities were rounded and the margins were not beveled. After cleaning and drying under rubber dam isolation (Coltene/Whaledent Inc., Altstätten, Switzerland), adhesive procedures were performed with Solobond M (two-step etch-and-rinse adhesive) and Syntac (four-step etch-and-rinse adhesive). The resin composite materials were applied into the cavity in layers of approximately 2-mm thickness and adapted to the cavity walls with a plugger. Each layer was light cured for 40 s (Elipar Trilight, 3M Espe, Seefeld, Germany). The occlusal region was modeled as exactly as possible under intraoral conditions, avoiding visible overhangs. The light-emission window was placed as close as possible to the cavity margins. The intensity of the light was checked periodically with a radiometer (Demetron Research Corp., Danburg, CT, USA) and was found to be constantly above 650 mW/cm^2.

As soon as polymerization was completed, the surface of the restoration was controlled for defects and corrected when necessary. Visible overhangs were removed with a scaler and the rubber dam was removed. Contacts in centric and eccen-

Table 1 – Evaluated clinical codes and criteria.

Modified criteria	Description	Analogous USPHS
"Excellent"	Perfect	"Alpha"
"Good"	Slight deviations from ideal performance, correction possible without damage to tooth or restoration	
"Sufficient"	Few defects, correction impossible without damage to tooth or restoration. No negative effects expected	"Bravo"
"Insufficient"	Severe defects, prophylactic removal for prevention of severe failures	"Charlie"
"Poor"	Immediate replacement necessary	"Delta"