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Flowable composites for restoration of non-carious cervical lesions: Three-year results

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ABSTRACT

Objectives. To evaluate the clinical performance of two flowable composites for restoring Class-V non-carious cervical lesions (NCCLs), one with novel (ND; N'Durance® Dimer Flow, Septodont) and one with modified conventional matrix composition (FS; Filtek™ Supreme XTE Flow, 3M-ESPE). The null hypothesis was that both flowable composites perform equally regarding clinical quality and survival.

Methods. 50 patients received one ND and one FS restoration of NCCLs in premolars using Clearfil Protect Bond (Kuraray) as an adhesive. Restorations were evaluated by two examiners at baseline (BL), 18 and 36 months employing FDI criteria. Non-parametric statistical analyses and χ^2 tests were applied ($\alpha = 0.05$).

Results. 48 patients with both restorations under risk participated in the 36-mo recall. One patient terminated participation after the 18-mo recall. One ND restoration failed at the 18-mo recall (fracture). One FS restoration failed during clinical examination at the 36-mo recall (debonding). 95.8% of restorations each were rated clinically acceptable at 36-mo. No significant differences for all selected FDI criteria were recorded between ND and FS at each examination time point except for the criteria surface staining at 36-mo and marginal staining at 18-mo and 36-mo, where FS showed significantly better results. For each material, no significant differences over time were detected, except for loss of surface lustre for FS (BL to 18 months).

Significance. Within the limitations of the study, the null hypothesis that materials perform equally could not be rejected. Both flowable composites performed equally regarding survival and similarly regarding clinical performance.

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1. Introduction

Non-carious cervical lesions (NCCLs) are defined as loss of dental hard tissue at the cemento-enamel junction [1]. The etiology of NCCLs is considered to be rather multifactorial with erosion, abrasion and abfraction (occlusal stress, tooth flexure) being main factors, conditioned by physical or chemical but not by microbiological processes [2,3]. Their prevalence has been reported to vary between 5 and 85% with a strong tendency to increase with age [1]. Therefore, considering the demographic change and an ageing population, the prevalence of NCCLs is likely to rise considerably in the future. NCCLs can affect tooth sensitivity, plaque retention, incidence of cervical caries and pulp vitality. Nonetheless, operative interventions in terms of restorative procedures should be carefully considered [4].

Currently, mainly methacrylate-based composites are used for restoration of NCCLs due to their esthetic and mechanical benefits as compared to glass ionomer cements [5]. However, all current methacrylate-based composites exhibit a volumetric shrinkage during photo-polymerization creating stress, which is transmitted through the restoration upon the adhesive interfaces between tooth and restoration [6]. Another drawback of conventional hybrid composites is the low ability of these materials to flex when the tooth structure is deformed under mechanical load due to their high elastic modulus [5]. Consequently, the use of flowable composites has been proposed for restoration of NCCLs because of their considerably lower elastic modulus, suggesting that they may partly absorb the stress generated by shrinkage during polymerization and allow for the material to flex with the tooth during function [5,7,8]. However, clinical studies failed to show a significant impact of differences in elastic moduli on retention rate [9]. Meanwhile, flowable composites have become highly popular in general dental practice, in particular for minimally invasive restoration of NCCLs, due to their good rheological properties and their ease in handling [10], but also as a result of extended marketing efforts [11].

In general, the reduced viscosity in flowable composites is achieved by either reducing the filler content or by increasing the proportion of diluent monomers like triethylene glycol dimethacrylate (TEGDMA) in the composite paste [11–13]. As a consequence, polymerization shrinkage is considerably raised since it is known that total shrinkage increases as the proportion of dimethacrylates increases [14]. Therefore, creation of more stress on the adhesive interface is suggested [11], which may raise a concern about marginal sealing especially for restoration of larger NCCLs [8]. To compensate for this drawback, in some novel flowable composites the conventional matrix composition is modified by substituting TEGDMA with high weight monomers with low viscosity, *e.g.* Procrylat (2,2-bis-4-(3-hydroxy-propoxy-phenyl)propane dimethacrylate) in Filtek™ Supreme XTE Flow (3M-ESPE, Seefeld, Germany).

Furthermore, recently composites with novel matrix technologies have been marketed, where conventional monomers like bisphenol A glycidyl methacrylate (bis-GMA), urethane dimethacrylate (UDMA) or TEGDMA are either partially or even completely replaced by new monomers [15]. For example, dimer acid-based monomers have been introduced with higher molecular weights and lower initial double bond concentrations than conventional dimethacrylate monomers [16]. These dimer acid-based monomers exhibit a higher degree of conversion, decreased volumetric shrinkage during polymerization due to phase separation and nearly negligible water sorption values in comparison with conventional monomers [16]. Furthermore, dimethacrylates based on dimer acid lead to polymers with good flexibility and low elastic modulus due to their relatively low crosslink density [16]. As a commercially available representative, N'Durance® Dimer Flow (Septodont, Saint-Maur-des-Fossés, France) is a flowable nano-hybrid composite, which also has conventional monomers like bis-GMA, UDMA and dicarbamate included in its matrix composition [15]. Consequently, especially for the restoration of NCCLs, this material may combine the benefits mentioned above, *i.e.* good handling due to flowable application as well as low polymerization shrinkage and low elastic modulus, thus potentially absorbing the stress generated by polymerization shrinkage to a greater extent and flexing with the tooth during mechanical load. However, since clinical data is scarce, only a well-controlled clinical trial can provide proof of clinical effectiveness.

Therefore, the aim of this randomized controlled clinical split-mouth study was to evaluate the three-year clinical performance of two flowable composites, one with novel (N'Durance® Dimer Flow; ND) and one with modified conventional matrix composition (Filtek™ Supreme XTE Flow, 3M-ESPE, Seefeld, Germany; FS) for restoration of NCCLs (selected physical parameters for both materials are shown in Table 1). The null hypothesis was that the material with the new matrix technology (ND) providing lower polymerization shrinkage shows a clinical performance equal to the conventional material (FS).

2. Material and methods

2.1. Study design

The present study is a three-year follow-up examination of a controlled randomized prospective clinical split-mouth study investigating the clinical performance of two flowable composites for restoration of NCCLs in premolars, one with modified conventional (FS) and one with novel matrix composition (ND) for reduction of polymerization shrinkage stress.

The study design followed the requirements outlined in the CONSORT 2010 statement [17] and was approved by the Internal Review Board (IRB) of the University of Regensburg (IRB 11-101-0001) in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Written informed consent was obtained from all individual participants included in the study.

2.2. Patient selection

52 patients were recruited in a private practice by an experienced general dentist (S.M.) in the city of Amberg (Bavaria, Germany). Patients gave their informed consent after receiving a detailed description of the proposed treatments and agreed to participate in a six-month recall program for three years.