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One year clinical follow up of a silorane-based versus a methacrylate-based composite resin

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Abstract

Purpose: To report one year clinical performance of two types of composite (silorane based versus methacrylate based) in class I preparations.
Materials and methods: A total of 15 patients (9 female and 6 male aged 20–40 years) participated in this study where 30 class I cavities were restored with either Filtek silorane (P90) or a methacrylate based composite (Tetric EvoCeram) representing two main groups ($n = 15$). Each patient received at least one pair of restoration. The cavity design was restricted to eliminate primary carious lesions. All restorations were subjected to a clinical follow up schedule representing (baseline, 6 months and 12 months) during which, two investigators rated the restorations according to the modified USPHS criteria evaluating marginal integrity, surface roughness, marginal discoloration, color match, anatomic form (wear), recurrent caries, retention of restoration and postoperative sensitivity. The data were collected, tabulated and statistically analyzed at a level of significance ($P \leq 0.05$) using Friedman test, Chi-square and Fisher's exact test.
Results: Regarding the clinical performance of the tested materials there was no statistical significant difference among the different recall periods in all the tested criteria in both materials and no statistical significant difference between group I versus group II at all follow up periods ($P > 0.05$). In addition Kappa test revealed a statistical agreement between marginal discoloration as well as color match and both marginal integrity and surface roughness ($P < 0.05$).
Conclusion: 1-The clinical performance of silorane based composite (Filtek P90) was deemed acceptable after one year; with no obvious advantage compared to methacrylate based composite. 2-The low shrinkage associated with (Filtek P90) may not be a determinant factor for its high clinical performance.

Keywords: Clinical follow up; Silorane; Methacrylate based composite; Replica; Abrasion

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1. Introduction

Esthetic considerations play a great role in the treatment planning of dental care in addition to the significant improvement of the biomechanical properties of restorative materials. Thus, direct composite resin restorations became routinely used as a metal free alternative for posterior restorations [1].They offer

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improved esthetics, do not contain mercury [2,3], thermally nonconductive, and they match the shade of natural teeth and bonded to tooth structure readily with the use of adhesive systems [4]. Besides, this procedure allows maximum preservation of tooth structure, which concurs with the modern concept of a conservative approach to restorative dentistry [1].

Basically, a dental composite consists of four major components: an organic polymer matrix, inorganic filler particles, a coupling agent and an initiator accelerator system. The most widely used monomers are, bisphenol A glycol dimethacrylate (Bis-GMA), triethylene glycol dimethacrylate (TEGDMA) and urethane dimethacrylate (UDMA). It is noteworthy that the monomer matrix strongly influences the mechanical properties, water sorption and polymerization reactivity [5].

The reaction created when the monomer converts to the polymer produces a volume reduction in the polymer with a resulting decrease in molecular vibration and intermolecular distances [6]. As the polymer is formed, the resin matrix changes from a paste or pregel to a viscous solid state and these contract by about 1.5%—5%. The gel point is the point at which the resin changes from a viscous paste to an elastic solid. When the gel point is reached, stress is transmitted from the composite resin to the surrounding tooth structures [7].

Polymerization shrinkage and the associated stresses have continued to present major challenges in the clinical performance of dental composites. During polymerization, the kinetics of resin-based composites, the initial double-bond concentration of the monomer, and the degree of conversion achieved during polymerization affect the final shrinkage resulting in gaps and stresses [8]. Throughout the years, manufacturers have worked diligently to minimize polymerization shrinkage. In addition, dentists have developed a multitude of clinical techniques to overcome this problem [9] .

In contrast to the methacrylate-based materials which polymerize through an addition reaction of the double bonds in the functional group, the synthesis of a new monomer system named "silorane" was reported [10,11]. This is obtained from the reaction of oxirane and siloxane molecules. It polymerizes by a ring-opening polymerization process of the oxirane groups in contrast to the methacrylate-based materials which polymerize through an addition reaction of the double bonds in the functional group [12].

It was reported that silorane-based composite exhibits low polymerization shrinkage due to the ring-opening oxirane monomer and increased hydrophobicity due to the presence of the siloxane species [12]. It was also claimed that silorane-based composite is stable and insoluble in biological fluids [13].

In addition, the filler used in dental resins directly affects their radio-opacity, wear resistance and elastic modulus .Therefore, resin composites have usually been classified according to filler features, such as type, distribution or average particle size [14].

Classical resin composite material comprises hybrid types containing blends of microscopic (1—5 μm) and submicroscopic (0.04—0.8 μm) glass particles, and microfill materials, typically containing silica particles (0.04—0.05 μm) mostly added in prepolymerized fillers [15,16].

Based on the definition "nanoscale bulk technology" new classes of resin composite restorative materials, so-called nanocomposites have been developed. Nanocomposites are claimed to combine the good mechanical strength of the hybrids and the superior polish of the microfills [17—19].

However; it was demonstrated that the clinical abrasion process produced by oral hygiene methods can adversely affect the surface characteristics of restoratives and degree of surface roughness [20]. Therefore, this process could interfere with both health and esthetics, as rough surfaces may predispose to biofilm accumulation and extrinsic staining [21]. In addition, surface roughness interferes with a patient's comfort in terms of tactile perception, esthetic appearance and stain resistance of dental resin composites [22]. Additionally, the bonded interface is subjected to a variety of different stresses and more challenging situations over time in vivo. For these reasons, clinical evaluation is recommended to substantiate and corroborate the data obtained from the in vitro studies [23,24].

It has been reported that the overall clinical success of dental composites is multi-factorial and therefore is unlikely to be predicted by even a battery of in vitro test method. Laboratory assessments alone cannot be used to predict the clinical success of composites [20,22,24].

The current study comprised one year clinical evaluation of the performance of two tested composite materials.

2. Materials & methods

15 patients, aged between 20 and 40 years old (9 female and 6 male), were selected to participate in the current study from those attending the Conservative Dentistry Clinic, Faculty of Dentistry; according to detailed exclusion and inclusion criteria. Nature,