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Are there universal restorative composites for anterior and posterior teeth?

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ABSTRACT

Objective: This retrospective, longitudinal clinical study investigated the longevity up to 20 years of posterior restorations placed with 3 universal composites (Charisma, Herculite XR, Z100) and of anterior restorations placed with 2 universal composites (Charisma, Herculite XR).

Methods: Records from 90 patients were retrieved from a private practice (374 posterior, 219 anterior restorations). Clinical evaluation was performed by the FDI criteria. Survival analysis was assessed using Kaplan–Meier method and Log-Rank test, and factors associated with failure by multivariate Cox regression with shared frailty.

Results: In the first 10 years, almost 95% of the restorations were satisfactory, showing increased failure thereafter. Charisma showed the most failures in anterior and posterior areas. Annual failure rates varied between 0.3% and 2.5%, with slightly better performance for anterior restorations. Fracture (posterior) and aesthetics (anterior) were the main reasons for failure.

Clinical significance: Differences were observed between restorative materials with different properties, but these became apparent only after more than 10 years of clinical service. The present study provides evidence that in a patient group with low caries risk, anterior and posterior restorations placed with universal composites may have excellent long-term clinical performance.

1. Introduction

Resin-based composites are currently considered materials of choice for direct restorations in posterior and anterior teeth. Anterior restorations, however, have different demands for material characteristics compared to posterior restorations. In anterior teeth, the aesthetic appearance including colour matching and polishability is important. Therefore, anterior composites usually have small filler particles to increase smoothness, but this also reduces fracture strength and Young's-modulus of materials. In posterior teeth, wear resistance and high fracture strength are considered as the most important properties. Composite has been used on

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routine basis to make anterior and posterior restorations already since 30 years. In the 1980s, the microfilled composites were able to deliver the required colour and polishability, but were not strong enough to be used in posterior teeth. Therefore, special posterior composites were developed, defined as fine compact filled composites[1] with high filler loading and larger particles, improving the mechanical properties. These different demands have led to the recommendation of using separate anterior and posterior composites.[2] However, since almost 20 years most composites on the market are universal restoratives, meant for use in either anterior or posterior areas and serving the dentist with only one material to be used universally. These universal composites are mostly defined as ultrafine midway filled composites[1] and combine slightly reduced filler loading with polishability, and their use is widespread among dentists until the present days. Although a rapid introduction of new materials have been taken place in recent years, still some of them are still on the market. Until now, there is no information from clinical studies on the suitability for these universal materials to be used for both indications.

Posterior composites have been tested in clinical studies and show annual failure rates (AFRs) between 2% and 3% on the long term.[3,4] Few studies are available on the short-term clinical performance of anterior restorations,[5–10] showing AFRs not exceeding those of posterior composites. Observation times, however, would have to be longer than 10 years to reveal differences between anterior and posterior materials.[11] Therefore, prospective studies are a real challenge to perform for this purpose, as study populations wear out and recall rates are likely to drop to low levels. Retrospective longitudinal studies have shown to be able to result in observation times of more than 10 years up to 22 years, making it possible to detect slight differences between materials.[11,12] However, the retrospective design offers certain problems to the researchers. To be able to compare the performance of different materials in retrospective studies, it is favourable that patients stay in the same practice during the observation time, operators are the same for all types of restorations, and materials are used consecutively in these practices to avoid confounding by indication. Moreover, a multivariate statistical analysis is demanded to handle datasets properly. As, until now, there is no clinical evaluation of different composites placed in anterior and posterior teeth in the same patient group, this study was designed to compare the clinical performance of 3 universal composites applied in anterior and posterior teeth on the long term. The hypothesis tested was that comparable clinical performances would be observed for the 3 composites.

2. Methods

The research protocol (176/2010) was approved by the Research Ethics Committee, School of Dentistry, Federal University of Pelotas, Brazil. Three ultrafine midway filled hybrid composites with different mechanical properties were evaluated for posterior restorations: Charisma (HeraeusKulzer, Hanau, Germany), Herculite XR (Kerr, Orange, CA, USA), and Z100 (3M ESPE, St. Paul, MN, USA), all regarded as universal restoratives. Table 1 presents the materials properties and characteristics of the composites. For anterior restorations Charisma and Herculite XR were used.

2.1. *Patient's selection*

The patients' records of a private practice located in Pelotas, Southern Brazil, were the source for data acquisition. To be included in the study, patients should have received posterior (class I or II cavities) or anterior (class III or IV cavities) restorations between January 1991 and January 2001 placed with at least one the 3 composites evaluated. The patients should have at least three teeth restored and maintained in the practice for routine visits at least every other year. A total of 120 patients were invited to participate by invitation letters and phone calls, and those that accepted signed an informed consent form. In total, 90 patients (75% of response rate) were included: 79 patients (20 male/59 female; mean age 51 years) having 374 posterior restorations, and 55 patients (12 male, 43 female; mean age 55 years) having 219 anterior restorations. The age range for both genders varied from 24 to 87 years old.

2.2. *Restorative procedures*

One operator (R.A.B.) was responsible for placing all composite restorations under rubber dam. Cavities were prepared with low speed drills for caries removal, diamond bur at high speed for removal of old restorations and high-speed carbide bur and cutting tools for finishing the cavity. Preparation was restricted to removal of caries or unsatisfactory restorations. In very deep cavities the region close to the pulp was protected with calcium hydroxide cement (Dycal; Dentsply, Petrópolis, RJ, Brazil), followed by a thin layer of conventional

Table 1 – Characteristics and properties of the universal composites evaluated.

Material	Filler system			E[b]	FT[a]	FS[c]	DTS[c]	CS[b]	VH[b]
	Morphology[a]	MPS[b]	vol%[b]						
Charisma	Irregular	0.7	50.7	14	0.75	102	27	417	81
Herculite XR	Irregular	1	55.2	16	0.85	122	32	397	74
Z100	Round	1	64.3	21	0.97	135	34	448	120

MPS: mean particle size (μm); vol%: inorganic filler volume percentage; E: elastic modulus (GPa); FT: fracture toughness; K_{IC} (MPa $m^{1/2}$); FS: flexural strength (MPa); DTS: diametral tensile strength (MPa); CS: compressive strength (MPa); VH: Vickers hardness (kg f/mm^2).

[a] Based on Kim et al. (2002).[35]

[b] Based on Willems et al. (1992).[1]

[c] Based on Ilie and Hickel (2009).[36]