DENTAL MATERIALS 31 (2015) 669–675

Available online at www.sciencedirect.com

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journal homepage: www.intl.elsevierhealth.com/journals/dema

18-year survival of posterior composite resin restorations with and without glass ionomer cement as base

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ARTICLE INFO

Article history:
Received 14 October 2014
Received in revised form
11 January 2015
Accepted 18 March 2015

Keywords:
Composite resin
Glass ionomer cement
Permanent dental restoration
Retrospective studies
Survival analysis

ABSTRACT

Objective. Advantages and disadvantages of using intermediate layers underneath resin-composite restorations have been presented under different perspectives. Yet, few long-term clinical studies evaluated the effect of glass-ionomer bases on restoration survival. The present study investigated the influence of glass-ionomer-cement base in survival of posterior composite restorations, compared to restorations without base.

Methods. Original datasets of one dental practice were used to retrieve data retrospectively. The presence or absence of an intermediate layer of glass-ionomer-cement was the main factor under analysis, considering survival, annual failure rate and types of failure as outcomes. Other investigated factors were: patient gender, jaw, tooth, number of restored surfaces and composite. Statistical analysis was performed using Fisher's exact test, Kaplan–Meier method and multivariate Cox-regression.

Results. In total 632 restorations in 97 patients were investigated. Annual failure rates percentages up to 18-years were 1.9% and 2.1% for restorations with and without base, respectively. In restorations with glass-ionomer-cement base, fracture was the predominant reason for failure, corresponding to 57.8% of total failures. Failure type distribution was different ($p = 0.007$) comparing restorations with and without base, but no effect in the overall survival of restorations was found ($p = 0.313$).

Significance. The presence of a glass-ionomer-cement base did not affect the survival of resin-composite restorations in the investigated sample. Acceptable annual failure rates after 18-years can be achieved with both techniques, leading to the perspective that an intermediate layer, placed during an interim treatment, may be maintained without clinical detriment, but no improvement in survival should be expected based on such measure.

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http://dx.doi.org/10.1016/j.dental.2015.03.006
0109-5641/

1. Introduction

The use of resin composites in posterior teeth was introduced about four decades ago [1], being currently a routine procedure in dentistry. The success of this material may be attributed to its adhesive properties, which allow reduced preparation sizes and minimally invasive or none-invasive restorative options, exceeding the possibilities of amalgam in the past [2]. Also, the use of composite resin can reinforce the remaining tooth structure, which is not possible with non-adhesive materials [3]. The esthetic appearance, limited cost involved and acceptable annual failure rates between 1 and 3% [4,5] are other advantages of resin composite restorations.

Nonetheless, methacrylate-based composites present inherent characteristics, such as polymerization shrinkage and stress [6], which may lead to tissue deflection and microleakage [7,8]. The deterioration of bonded interfaces resulting in clinically detectable marginal defects persists as a controversial issue regarding restoration success [9,10]. Thus, substantial effort in research is spent on materials and techniques to prevent clinical failures historically associated with marginal defects, *viz.* secondary caries [11].

To prevent marginal leakage and to compensate for the polymerization stress, an intermediate layer as base or lining underneath composite restorations may be used. Mostly glass ionomer-based or low-elastic-modulus resin-based materials have been used with this purpose. Several in vitro studies have shown that the application of such layer reduces microleakage and leads to an improved marginal quality [12–14]. Glass-ionomer materials would act on strain and marginal leakage reduction [15], presenting additional benefits as adhesion on dentin [16] and fluoride release [17], which may prevent secondary caries formation. On the other hand, from a clinical perspective, it has been suggested that the use cavity bases would have a weakening effect on the overall strength of the restoration, resulting in more fracture of composite restorations [4,18]. Nevertheless, few long-term clinical studies investigated this factor and divergent results were reported [18–20].

The aim of the present study was to investigate the influence of glass-ionomer cement base in the survival of posterior composite restorations up to 18 years. The hypothesis tested was that the use of glass-ionomer cement as intermediate material would have no effect in restoration survival, when compared to restorations without a base material.

2. Materials and methods

2.1. Study characteristics, participants and design

The database with clinical records of one dental office was used in the present evaluation. The survival of resin composite restorations in posterior teeth was determined retrospectively for up to 18 years, and the influence of several variables in the outcome was investigated. The absence or presence of an intermediate layer of glass-ionomer cement underneath composite restorations was the main factor under analysis, considering survival, annual failure rate and types of failure as outcomes. The other evaluated factors were age and gender of participants, jaw, restored tooth, number of restored surfaces and type of composite.

The study was approved by the local Ethics Committee (N. 139.840) and the patients have signed a written informed consent. Original data were obtained from a private dental office in Caxias, RS, Brazil, and a single operator (PARR) placed all restorations. The first dataset refers to restorations placed between 1986 and 1990, whereas the second dataset refers to restorations placed between 1994 and 2002. During the above mentioned periods, all new Class I and II direct restorations were searched, which could include from 1 up to 5 restored surfaces (information present in the patient files), with or without the involvement of cusps (not described in patient files). For inclusion, patients should present full dentition or the restoration should be in occlusion and with at least one adjacent tooth. Patients should have stayed in continuous clinical follow-up, with at least 1 annual recall. In total, 128 patients were selected through the inspection of clinical and radiographic records and invited to visit the dental office. The recruitment was performed by letters and phone calls, and 97 (76%) adult patients agreed to participate in the clinical evaluations. For the present study, the same patient could be part of both datasets.

2.2. Clinical procedures

The terminology may be somewhat confusing when addressing liners and bases [21]. For practical reasons, the term base will be used to describe the placement of intermediate layers covering most of the dentin part of the cavity. Also for practical reasons, the earlier dataset [22] will be referred as S1, and the later [23] as S2. In S1, restorations were placed using two composite resins, a minifilled hybrid composite with inorganic filler loading of 77 vol.% (P-50 APC; 3M ESPE, St. Paul, MN, USA), and a midifilled hybrid composite with inorganic filler loading of 57 vol.% (Herculite XR, Kerr, Orange, CA, USA). Bonding systems used were Scotchbond 2 (3M ESPE) for P-50 APC and XR Prime/XR Bond (Kerr) for Herculite XR. Restorations in S2 were performed using universal microhybrid composites (Z100, 3M ESPE; Tetric Ceram, Ivoclar-Vivadent, Amherst, NY, USA; Charisma, Heraeus Kulzer South America Ltda., São Paulo, SP, BR; or by the combination of these) with no substantial differences regarding filler loading (59, 60 and 56 vol.%, respectively). Bonding systems used were Scotchbond Multi-Purpose or Single Bond (3M ESPE). All restorations were placed under rubber dam isolation. Cavities were prepared using diamond burs, and low-speed steel burs were used to remove carious tissue. No bevels were made, and preparations were restricted to the removal of carious tissue and/or failed restorations. In deep cavities, including both S1 and S2 datasets, a thin layer of calcium hydroxide (Dycal, Dentsply Indústria e Comércio Ltda, Petrópolis, RJ, BR) and conventional glass-ionomer cement (Ketac-Fil, 3M ESPE) were used to cover the deeper parts of the pulpal wall. In S1, the conventional glass-ionomer cement (GI; Ketac-Fil, 3M ESPE) was used as base in a closed sandwich technique, where the dentin was covered with GI, and the outline of the restoration was completely in composite resin. All other procedures were performed in the same way. The cavities