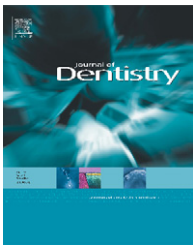
available at www.sciencedirect.com

ScienceDirect

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



Nine-year evaluation of a polyacid-modified resin composite/resin composite open sandwich technique in Class II cavities

Anders Lindberg [a,*], *Jan W.V. van Dijken* [a], *M. Lindberg* [b]

[a] *Department of Odontology, Dental School Umeå, Umeå University, 901 87 Umeå, Sweden*
[b] *Public Dental Health Clinic Seminariegatan, Skellefteå, Sweden*

ARTICLE INFO

Article history:
Received 27 April 2006
Received in revised form
8 June 2006
Accepted 13 June 2006

Keywords:
Clinical
Resin composite
Compomer
Sandwich
Restoration

ABSTRACT

Objectives: The aim of this study was to evaluate in an intraindividual comparison the durability of a polyacid-modified resin composite/resin composite open sandwich restoration in a 9 years follow-up. A polyacid-modified resin composite (PMRC; compomer, Dyract) was placed as an intermediate layer and covered with resin composite (RC, Prisma TPH). A direct RC restoration was used as control.

Methods: Each of 57 patients, received at least one pair of Class II restorations, one open sandwich and one resin composite control. In total 75 pairs of Class II restorations, 68 premolars and 82 molars, all in occlusion, were placed by two dentists. Most of the cavities were surrounded by enamel. The restorations were evaluated at baseline, 6, 12, 24, 36 months and 9 years by slightly modified USPHS criteria. Survival of restorations grouped on the two different techniques was determined using Kaplan–Meier survival curves.

Results: After 9 years, 14 of 135 evaluated restorations were estimated as unacceptable, 6 in the sandwich group and 8 in the control group. Over all annual failure rate during the 9-year period was 1.1%. The survival rate was not significant different between the two techniques ($p = 0.604$). Reasons of failure were: secondary caries (8), fracture of tooth (1), fracture of restoration (2), endodontic treatment (3).

Conclusions: Both restorative techniques showed good durability during the 9-year period. No clinical advantage was observed for the sandwich technique.

1. Introduction

Polymerization of a resin composite (RC) restoration always induces a stress, both in the restoration itself and at the interface of restoration and the cavity walls. This stress may result in debonding from the cavity walls or cohesive fractures of the restoration material or tooth structure.[1] The magnitude of the stress is claimed to depend on the resin matrix formulation, amount of filler used in the RC, configuration factor (C-factor) of the cavity and the type of curing light used.[2–5] To reduce the shrinkage stress effects, different restorative-techniques have been suggested. Among these are different types of sandwich restorations, different placements techniques of the RC increments and different light-curing regimes.[6–9] In the conventional sandwich restoration a substantial part of the resin composite is replaced with glass ionomer cement (GIC). The open sandwich technique was preferably recommended in high-caries-risk patients because of the fluoride release from the material.[10,11] The GIC covered most of the exposed dentin and extended to the periphery of the proximal box to form the cervical seal. Clinical

* *Corresponding author*. Tel.: +46 91010429.
E-mail address: anders.lindberg@skelleftemail.se (A. Lindberg).
0300-5712/$ – see front matter
doi:10.1016/j.jdent.2006.06.003

failure rates of this technique have been reported between 13 and 35% after 2 years and 75% after 6 years.[12,13] Partial or total dissolution of the GIC part and fracture of the RC were main reasons for failure. Modified open sandwich techniques, using a resin-modified glass ionomer cement (RMGIC), polyacid-modified resin composite (PMRC), or low viscosity (flowable) RC have also been suggested.[13–16]

The PMRC, developed in the early 1990s, showed fluoride release and low solubility.[17] It was suggested that due to its low modulus of elasticity could act as a stress absorbing barrier in the sandwich technique and in this way may reduce stress at the bonding interface.[15]

In a short time follow-up of Class II PMRC/RC open sandwich restorations, which were compared intraindividually with a direct RC restoration, no significant differences were observed between the two techniques.[18] A failure rate of 3.3% was observed after 3 years. The aim of this study was to evaluate the durability of the open sandwich restoration and the direct RC restorations after 9 years. The null hypothesis tested was that when placed in Class II preparations in adults, the durability of direct placement PMRC/RC open sandwich restorations and RC restorations will not be significantly different after 9 years'.

2. Material and methods

2.1. Experimental design

One hundred and fifty Class II restorations were placed in 57 patients, 26 men and 31 women, mean age 34.6 years (range: 17–68). These patients were selected from the clinical pool at the Public Dental Health Clinic Seminariegatan (Skellefteå, Sweden). Every patient who at the yearly examination needed two or four Class II restorations of matching size and in matching teeth was invited to join the study. All patients invited, participated in the study. No consideration was taken to caries activity, periodontal condition or parafunctional habits. Each patient provided informed consent to participate in the study, which was approved by the ethics committee of the University of Umeå. Reasons for placement were primary or secondary caries and replacements of old amalgam restorations. All teeth were in occlusion. Each patient received at least one pair of restorations, an open sandwich (PMRC/RC) and a RC control restoration. Seventy-five pairs of restorations were placed by two dentists. Teeth and surface distribution are shown in Table 1. Most of the cavities were surrounded by enamel. No beveling of the cavity margins was performed. To anaesthetize the teeth, 3% Citanest-Octapressin (Astra, Södertälje, Sweden) was used. Thin metal matrix bands were placed in combination with careful application of wooden wedges. No rubberdam was used. The operative field was isolated with cotton rolls and suction device.

Table 1 – Distribution of teeth in the study, by type and number of restorations (No. (%))

	No. (%) of restorations, by no. of surfaces			
Total	Two surface	Three surface	≥Four surface	Total
Premolar	31 (20)	33 (22)	4 (3)	68 (45)
Molar	55 (36)	18 (12)	9 (6)	82 (55)
Total	86 (57)	51 (34)	13 (9)	150 (100)

All materials were applied according to the manufacturer's instructions. The cavities were acid-etched with 35% phosphoric acid (Ultradent etch, Ultradent, USA) for 15 s, starting with the enamel margins during the first 10 s. They were carefully rinsed with water for 15 s and dried for 2–3 s (wet technique). A self-etching primer (Prime & Bond 2.1, DeTrey/Dentsply, Konstanz, Germany) was placed into the cavity for 30 s. To remove the acetone from the primer, the surface was carefully air-dried, followed by a light-cure for 10 s. A second layer was placed, immediately air-dried and light-cured for 10 s.

One cavity, randomly chosen in each pair of experimental teeth, was filled with a PMRC/RC open sandwich technique. A PMRC (Dyract, Dentsply/DeTrey) was placed as first layer in the cervical part of the cavity, while the following layers were placed with a hybrid resin composite (Prisma TPH, Dentsply/DeTrey). The thickness of each layer was less than 2 mm. Each layer was light-cured for 60 s with a regularly controlled light-curing unit with an irradiance of 500 mW/cm^2 (VCL 400, Kerr/Demetron, Danbury, CT, USA). After removal of wedges and matrices the restorations were light-cured from buccal and lingual directions for 60 s each.

The other cavity was filled with the RC only, which was inserted in 2 mm layers, cured and post-cured as described earlier. The restorations were finished with fine diamond finishing burs followed by the Enhance finishing system (Dentsply/DeTrey).

2.2. Evaluation

The restorations were evaluated direct after placement (baseline), 6, 12, 24 and 36 months and 9 years. Each restoration was evaluated with slightly modified USPHS criteria for the following characteristics: anatomical form, marginal adaptation, color matching, marginal staining, surface texture and secondary caries (Table 2).[19] Post-operative sensitivity was noted. The caries risk for each patient was estimated by the treating clinician by means of clinical and sociodemographic information routinely available at the annual clinical examinations, e.g. incipient caries lesions and former caries histories.[20,21] The dentists were calibrated before start of the evaluation. At different recalls, parts of the restorations were evaluated by two dentists without knowledge of earlier assessments. In case of different scores, the restoration was re-evaluated and a joint scoring agreed upon. Radiographs were taken for assessments of proximal marginal integrity and presence of recurrent caries. Color slides were taken of part of the restorations.

2.3. Statistical analysis

The SPSS 13.0 (Statistical Package for the Social Sciences; SPSS, Chicago, IL, USA) was used to process the data. Statistical evaluation was carried out by means of descriptive statistics and the Kaplan–Meier survivor estimation of cumulative survival including the logrank test for equality of survival distribution ($p = 0.05$).