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Comparison of incidence of complications and aesthetic performance for posterior metal-free polymer crowns and metal–ceramic crowns: Results from a randomized clinical trial

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ABSTRACT

Objectives: The purpose of this randomized clinical study was to evaluate the clinical performance of posterior, metal-free polymer crowns after follow-up for up to six years, and to compare it with the performance of metal–ceramic crowns.

Methods: Eighty single crowns, manufactured from a polymer composite resin, were set on posterior teeth. Half of these received a glass–fibre framework (group 1) whereas half were prepared without framework stabilization (group 2). As the control group, 40 conventional metal–ceramic crowns were inserted. Primary endpoints were incidence of complications, investigated on a time-to-event basis, plaque status, and aesthetic performance.

Results: Thirty clinically relevant complications occurred after a median time of 2.3 years. Median follow-up time was four years. The most frequent complications were delamination ($n = 24$) and root-canal treatment ($n = 4$) of the crowns; the incidence of complications was not significantly different among crown materials ($p = 0.60$). Twenty crowns had to be replaced (six polymer crowns in group 1, nine polymer crowns in group 2, four crowns in the control group, and one tooth (in group 1) had to be extracted). Mean plaque and gingival indexes for the test groups did not differ from those for the control group.

Conclusions: Within a median follow-up period of four years, the clinical performance of posterior polymer crowns with and without a glass–fibre framework was not significantly different from that of metal–ceramic crowns, although the number of catastrophic failures of composite crowns was higher than that of the metal–ceramic crowns.

Clinical significance: On the basis of the study results, posterior polymer crowns may be an alternative to metal–ceramic crowns, although additional research is needed before they can be recommended, without reservation, as permanent restorations.

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1. Introduction

Although favourable clinical results have been obtained for metal and metal–ceramic crowns,[1,2] the desire for aesthetic metal-free crowns has led to increased research into tooth-coloured materials.

Because the incidence of failure was high for early all-ceramic restorations,[3] especially chipping of zirconia restorations,[4,5] composite resin materials were used as alternatives. Although promising results were obtained for class I or class II restorations, on which most clinical studies are based,[6–8] composite resin complete crowns had a bad reputation and were not recommended for permanent restorations,[9,10] primarily because of their unstable aesthetics[11] and high wear,[11–13] compared with all-ceramic crowns, and the tendency of plaque to accumulate.[13,14]

Recent advances in composite resin materials have improved their properties, however, and it seemed possible that polymer composites resin could be an interesting alternative for permanent restorations, with such advantages as simple laboratory procedure and the possibility of repair.

Although initial, promising, results from clinical studies of metal-free polymer crowns have been reported,[15] other results still suggest limited use in permanent restorations because of the high incidence of complications[13] with the most common mode of failure being fracture of the crowns.

Because in vitro results suggest fracture resistance is greater for glass–fibre reinforced posterior single molar crowns,[16] it may be possible to reduce the incidence of fractures of composite resin crowns.

Lack of randomized control groups prevents unbiased comparison with conventional metal–ceramic crowns, however. Thus, the objective of this prospective clinical study was assessment of the clinical performance of a microfilled polymeric material (Trend HP®), with or without fibre network stabilization, for manufacture of posterior crowns, compared with a metal–ceramic crown control group, after up to six years of follow-up. The tested null hypothesis was equal incidence of complications in the three groups.

2. Materials and methods

Study participants were included on the basis of a clinical need for replacement of single teeth with complete-coverage restorations. All patients in the study group gave informed consent and the university's review board approved the study (L-317/2002). Criteria for excluding patients from the study were: being under the age of 18, being incapable of taking out a contract, pregnancy or lactation, clenching or grinding of teeth, or known allergic reaction to the materials used, all evaluated from answers to specific questions by the examiner. Constant unacceptable oral hygiene status (plaque index = 3) was also defined as an exclusion criterion. Root-filled teeth were included in the study.

The study group consisted of 66 patients (37 females and 29 males) aged between 22 and 73 years (mean age 46 years).

The 66 patients received a total of 120 posterior single crowns, divided into three groups: 40 polymer crowns with framework stabilisation (group 1), 40 polymer crowns without framework stabilisation (group 2), and 40 metal–ceramic crowns (control group). Patients received a maximum of three crowns. If three crowns were inserted in one patient, one crown from each of the two test groups and from the control group was randomly assigned to the abutment teeth. For patients receiving two posterior crowns, crowns from different groups were randomly assigned to the abutment teeth. The groups were not age or sex-balanced.

Clinical treatment and laboratory procedures were standardized and all commercial products were used in accordance with the manufacturers' recommendations. Damaged teeth were restored with the core-build up material Rebilda SC® (Voco GmbH, Cuxhaven, Germany).

Reduction of the occlusal surface was a minimum of 1.5 mm, and axial reduction (chamfer design) was set at 0.8 mm. Impressions of the prepared teeth were taken with polyether material (Impregum®; 3MEspe, Seefeld, Germany).

The polymer crowns were made of a polymeric material (Trend HP®; Ivoclar Vivadent, Ellwangen, Germany). Polymer crowns of group 1 received a glass–fibre framework (Vectris®; Ivoclar Vivadent), whereas polymer crowns of group 2 were made without additional stabilization.

As control group, metal–ceramic crowns (IPS d.Sign96®; IPS d.Sign®; Ivoclar Vivadent) were made. Manufacturing procedures and clinical steps are described in detail in the previous publication reporting one-year results.[17]

The polymer crowns were cemented with resin cement (Variolink® II; Ivoclar Vivadent) and the metal–ceramic crowns were cemented by use of a hybrid cement (Protec cem®; Ivoclar Vivadent).

After cementation, all patients received brief instruction on oral hygiene. Recalls were scheduled after two weeks (recorded as "baseline") and then yearly up to six years. Clinical evaluation was performed by a dentist who was not involved in original treatment of the patient.

Documentation included sensitivity and percussion tests, gingival index (GI) and plaque index (PI),[18] wear of remaining teeth, static and dynamic contacts, antagonistic material, antagonistic support, and dentists' subjective evaluation of surface gloss.

Complications, for example caries, endodontic treatment, fractures of the facing or core material, debonding, and discolouration, were recorded on the basis of USPHS criteria.[19] The aesthetic performance of the crowns was subjectively evaluated by use of visual rating scales (VAS), from 0 (completely inadequate) to 10 (perfect). Patients and examiners were unaware of the previous results.

2.1. *Statistical analysis*

The effect of crown material on PI, GI, and aesthetic performance was investigated by use of Wilcoxon two-sample tests. These three outcome variables were investigated at baseline and after 48 months. Survival time was calculated from the insertion date to the date of any or repairable complications. For patients without complications, survival time was censored at last contact. Multivariate Cox regression analysis was used to identify risk factors for any complications