Clinical outcome of posterior cantilever resin-bonded fixed dental prostheses using two different luting agents

Dear Editor,

Resin-bonded fixed dental prostheses (RBFDPs) were firstly introduced in the 1970s to replace incisors[1]. The well-known disadvantages as limited aesthetics or debonding of these restorations were overcome with the introduction of cantilever all-ceramic RBFDPs[2]. Today, cantilever RBFDPs made from densely sintered zirconia show high survival rates[3] and are considered a standard for anterior RBFDPs.

Different attempts were made to replace posterior teeth using a less invasive preparation design compared to a full-crown preparation for FDPs[4]. The most common complications for these bonded restorations were framework fractures, chipping of the veneering material or debonding of the restoration[4].

In a recent retrospective investigation, 27 cantilever zirconia RBFDPs replacing canines, premolars or molars were evaluated[5]. After an observation period of 13 to 151 months no debonding occurred (100% survival rate).

However, a prospective clinical trial with cantilever posterior zirconia RBFDPs has not been conducted yet. Therefore, this clinical trial investigated the short-term outcome of posterior cantilever RBFDPs for replacement of premolars and molars using different luting agents. The study hypothesis is, that there will be no difference in clinical outcome between the two luting agents.

The Institutional Review Board of the University of Kiel approved the study design and study participants and, if younger than 18 years, their legal guardians provided written informed consent before enrollment. The trial followed the CONSORT guidelines and is registered at the “Deutsches Register Klinischer Studien” under the registration number: DRKS00028883.

Participants, respectively the restoration, were randomized to one of the two phosphate monomer containing bonding systems Panavia 21 or Panavia V5 (both Kuraray Noritake Dental, Tokyo, Japan) by flipping a coin. If one restoration were inserted in one patient, both bonding systems were used.

The abutment preparation was minimally invasive limited to enamel with supragingivally finishing lines. It was extended to the gingival-proximal area and an occlusal rest was prepared in areas with no antagonistic contacts, serving as an occlusal rest and increasing the bonding area. All sharp edges and surfaces were carefully smoothed, as required for all-ceramic restorations. A minimum bonding area of 30 mm² had to be achieved. In order to examine the minimal bonding area prior to treatment, the potential bonding surface was first marked on the situation model and then covered with tin foil cut to size. The tin foil was then placed on graph paper and the covered millimeter boxes were counted. After abutment tooth preparation, impressions were either taken conventionally using a polyether material or digitally. As the tooth preparation was limited to enamel no temporary restoration was fabricated for the abutment. However, patients received an occlusal splint with a replacement for the missing tooth, if necessary. All monolithic RBFDPs were designed digitally and milled out of pre-sintered 3Y-TZP zirconia ceramic disks (Katana Zirconia HTML, Kuraray Noritake Dental) and then densely sintered. The retainer wing had a minimal thickness of 0.7 mm and the connector dimension was at least 9 mm² (3x3 mm). All restorations were inserted under rubberdam isolation. The bonding area of the zirconia retainer wing was air-abraded with 50 μm alumina particles at 0.1 MPa pressure and then ultrasonically cleaned in 99% isopropanol for three minutes. The bonding area of the abutment tooth was etched with 37% phosphoric acid for 30 seconds, rinsed with water spray and carefully dried. Depending on the randomization, restorations were bonded with one of the aforementioned bonding systems (Figs. 1a, b).

Patients were recalled 6 to 12 months after insertion and then annually. “Survival” of restoration was defined as the restoration being in place.

The present clinical trial is still ongoing. So far, 24 posterior RBFDPs with a mean follow-up period of 22.5 ± 13.5 months have been inserted. Twelve patients received 1 RBFDP and 6 patients received 2 RBFDPs. Of these, 22 replaced premolars and 2 replaced one first lower molar. Eight RBFDPs where inserted in the maxilla and 16 in the mandible. Twelve restorations each were inserted with Panavia 21 or Panavia V5.

The survival rate of cantilever RBFDPs replacing premolars and molars was 100% over the mean initial observation period of 22.5 months irrespective of the bonding system used. The result of this investigation corresponds well with a retrospective investigation on posterior all-ceramic RBFDPs, which also revealed a 100% survival rate over a mean observation period of 53 ± 39 months[5].

In the present investigation, no debonding occurred. In a long-term investigation on posterior fixed-movable long span RBFDPs, the most frequent complication was debonding, which occurred in 33.7% of the cases[6]. It has to be considered, that this investigation had a mean observation time of more than 10 years. The present investigation had a mean observation period of 22.5 months. However, in the aforementioned investigation, RBFDPs with a metal framework were evaluated, which is more flexible than a monolithic zirconia RBFDP. This might have led to a higher bending and flexing impact on the metal retainer, compared to a retainer made from monolithic zirconia, resulting in a higher debonding rate of the restorations. This assumption corresponds well with the results of another investigation from Botelho et al. over an observation period of 12 months comparing two-unit cantilever and three-unit fixed-movable RBFDPs for replacement of single molar-sized spans using metal frameworks[7]. The survival rate was 100% for both types of restorations, but in both groups, one restoration debonded within 12 months of observation.
The gold standard for replacement of missing premolars and molars is still considered the three-unit FDP with estimated 5-year survival rates between 94.4% for metal-ceramic and 90.4% for densely sintered zirconia[8]. However, these survival rates do not seem to be superior to the survival rate of the monolithic zirconia RBFDPs of the present investigation.

The posterior RBFDP alters the anatomic shape of the abutment-tooth and one might assume that periodontal or occlusal problems could occur. However, the same tooth preparation-design was used in another investigation on RBFDP replacing canines and posterior teeth[5]. No periodontal or occlusal problems occurred over a mean observation period of 53 ± 39 months. The limited esthetic appearance of the restoration in the posterior region has never been critized by the patients who were all informed about the design prior to inclusion in the trial.

In the present trial, patients were included if they were 14 years of age or older. That results in a study cohort with teenagers as well as older adults. So far, no age-related negative effects of the treatment have been observed. Other investigations on RBFDPs also included patients with a large age difference and did also not report any negative effects related to the age of the participants[5,9].

According to a systematic literature review, the estimated 5-year survival rate of implant supported crowns is 98.3% for metal-ceramic and 97.6% for single zirconia crowns[10], which is an alternative for replacement of posterior teeth. When interpreting these results, it has to be considered that a surgical intervention is required for implant placement. Especially for young patients, in whom implants should only be considered with extreme caution, cantilever zirconia RBFDPs can be an excellent alternative. They do not hinder the still ongoing jaw growth and due to their minimally invasive character they still offer every other restoration option for later stages in life.

The short observation period can be considered as a limitation of the present investigation. A follow-up investigation five years after insertion of the RBFDPs will give further information on the mid-term outcome. Clinical investigations with a follow-up period of at least 5 years are necessary to further analyze the concept of RBFDP for replacement of posterior missing teeth.

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