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Long-term evaluation of cantilevered versus fixed–fixed resin-bonded fixed partial dentures for missing maxillary incisors

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ABSTRACT

Objectives: To evaluate the long-term longevity and patient-reported outcomes of two-unit cantilevered (CL2) and three-unit fixed–fixed (FF3) resin-bonded fixed partial dentures (RBFPDs) for the replacement of a maxillary permanent incisor.

Materials and methods: Twenty-eight subjects were randomly assigned to receive either a CL2 or FF3 RBFPD placed by one operator. Prosthesis longevity was determined by clinical examination and history. Success was defined as absence of complications requiring intervention and survival as retention of the original prosthesis in mouth. Subjects' satisfaction was assessed using visual analogue scale (VAS) and oral health-related quality of life (OHRQoL) using Oral Health Impact Profile (OHIP-49). Outcomes were analysed with *t*-test/Mann–Whitney *U* test, chi-square and log-rank test at significance level $\alpha = 0.05$.

Results: Twenty-two subjects were reviewed. Thirteen of fifteen CL2 and ten of fourteen FF3 RBFPDs were examined (79.3 percent response rate) with a mean service life of 216.5 ± 20.8 months. All CL2 RBFPDs survived with no complications while only 10 percent of FF3 experienced no complications and only 50 percent of them survived (both $P = 0.000$). CL2 had a significantly better success and survival rate than FF3 ($P = 0.000$ and $P = 0.009$, respectively). There was no significant difference in subjects' satisfaction and OHRQoL apart from CL2 group subjects had a higher satisfaction in cleaning of the prosthesis (84.1 ± 13.6) than FF3 group (72.6 ± 11.7) ($P = 0.05$).

Conclusions: Two-unit cantilevered RBFPDs were observed to have a significantly better success and survival than the FF3 design for the replacement of a maxillary incisor. Good patient-reported outcomes have been found for RBFPDs in single-tooth replacement in aesthetic zone.

1. Introduction

Resin-bonded fixed partial dentures (RBFPDs) have traditionally been metal-ceramic tooth-supported prostheses that partially cover the abutment tooth and are retained by resin cement to acid etched enamel. The abutment teeth are usually minimally prepared lingually and occlusally within enamel to allow a path of insertion in which the retainers have good resistance form and cover the maximum tooth surface for bonding [1]. The advantages of RBFPDs include simplified clinical and laboratory procedures as well as conservative tooth preparation and elimination of iatrogenic pulpal injuries [2].

In the replacement of a single missing tooth in a bounded saddle, the possible RBFPDs designs that can be selected would be either a two-unit cantilevered (CL2) or 3-unit fixed–fixed (FF3) designs. Prosthesis design has been suggested as a major factor that determines the clinical longevity of RBFPDs [1]. However many clinical studies [3–5] and systematic review [6] report the survival of RBFPDs with heterogeneous designs as a single entity, which do not permit an assessment of the performance of a particular design.

At present there appear to be no long-term prospective studies that directly compare CL2 and FF3 metal-ceramic RBFPDs. Earlier three-year result of this cohort has demonstrated CL2 design was as successful as FF3 design in the replacement of a maxillary incisor [7]. The aim of the present study was to compare the eighteen-year longevity of CL2 and FF3 design RBRPDs in the same

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cohort. Patient-reported outcome measures (PROMs) are reports coming directly from patients about how they feel or function in relation to a health condition and its therapy without interpretation by healthcare professionals or anyone else [8]. This is equally important in formulating the selection criteria of a particular dental prosthesis [9] and this work also investigate the PROMs of CL2 and FF3 design of RBFPDs over the long-term.

2. Materials and methods

This prospective study recruited subjects from the patients attending a university teaching hospital (Prince Philip Dental Hospital, PPDH) who requested replacement of a missing maxillary incisor during the period of 1/1/1992–31/12/2000 (Table 1), twenty eight subjects were enrolled and informed consent was obtained. They were randomly allocated to receive either a CL2 or FF3 RBFPDs by tossing a coin immediately before tooth preparation (Fig. 1). All tooth preparations were performed by one operator (AC). Ethics approval was obtained for the clinical review by Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster, Hong Kong (IRB UW 13–730).

The preparation of abutment teeth and fabrication of RBFPDs has been described full in our initial report [7]. The selection of the preferred abutment tooth for the CL2 group was based on its resistance form and surface area for bonding. Retainers on the abutment teeth were designed to maximize enamel coverage and have supragingival margins. Rest seats and proximal grooves were conservatively prepared on the abutment teeth following the tooth anatomy contour. All RBFPDs were constructed by one dental technician from the Dental Technology Unit of the hospital. The wax-up pattern was directly laid on the refractory cast (V.H.T. refractory die material; Whip Mix Corp., Louisville, Kentucky, USA), sprued and invested with a phosphate-bonded investment material (DVP investment; Whip Mix Corp., Louisville, Kentucky, USA). Nickel–chrome (Ni–Co) alloy (Optimum; Matech Inc., Sylmar, California, USA) was used for casting. Porcelain (Vita-Omega; Vita Zahnfabrik, Bad Säckingen, Germany) was build-up on the metal framework. The prostheses were sandblasted with 50 μm aluminium oxide powder at a pressure of 520 kPa and cemented with Panavia (Kuraray, Osaka, Japan) under rubber dam isolation.

Clinical reviews to identify any complications associated with the RBFPDs and its abutment teeth were completed by a single independent assessor in the Oral Rehabilitation clinic, PPDH. Treatment records were reviewed and subjects were asked to recall any remedial treatment received outside the hospital. Afterwards the prosthesis and the abutment teeth were examined clinically and radiographically. Success was defined as absence of complications requiring intervention beyond routine periodontal maintenance (i.e. time to repair) and survival as retention of the original prosthesis in mouth (i.e. time to retreatment). Complications related to the prosthesis including debonding of the prosthesis, fracture of framework or veneering material. Complications related to the abutment teeth including caries associated with the retainer, a probing depth greater than 5 mm, loss of pulpal vitality evidenced by apical radiolucency and negative responsive to pulpal sensitivity tests, loss of the abutment tooth. Prostheses were classified as (1) success or not success, and (2) survive or fail. A complication may end the success of a prosthesis but it may not affect the prosthesis survival i.e. a debonded original prosthesis can be recemented and classified as “not success” and “survived”. The dates of occurrence of these complications were collected and the RBFPDs’ success and survival time intervals, i.e. “time to repair/first occurrence complication” and “time to replace/complication terminate survival” were calculated [10].

Subjects’ satisfaction was assessed using a visual analogue scale (VAS) questionnaire with 15 questions. Subjects’ general satisfaction to their RBFPDs was asked. Eight questions related to the prosthesis’s performance including: its appearance in comparison with natural teeth, comfort, chewing ability, speech, ease of cleaning, firmness of prosthesis, confidence with the prosthesis were asked. Subjects’ satisfaction to the treatment procedure including treatment time for completion, treatment comfort, treatment cost and operator were asked as well. Subjects were instructed to draw a line along a 100 mm straight line with one end (0) denotes totally unsatisfied and another end (100) denotes totally satisfied [11]. Subjects were also asked if they would select this prosthesis again and if they would recommend to others (Yes or No).

Oral health-related quality of life (OHRQoL) was assessed using the Oral Health Impact Profile (OHIP) questionnaire with 49 questions [12]. This is one of the most comprehensive tools of OHRQoL measurement and seven domains were assessed including functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. This is based on the theoretical conception that oral conditions can produce physical, social and psychological impacts that can disable and handicap an individual’s quality of life. For each question, subjects were asked if they have suffered negative impacts particularly related to the RBFPD in the last two weeks and indicate their frequency in Likert scale: never *(score 0)*, hardly ever [1], occasionally [2], fairly often [3] and often [4] [13]. Individual scores were then summed up. The smaller the summary scores the less negative impacts the subject had experienced and therefore the better OHRQoL. Subjects whose RBFPDs were lost or replaced by other treatments (e.g. implant) more than two weeks were excluded from the OHRQoL assessment as any impacts reported may not be as a result of a RBFPD. Subjects who received more than one anterior maxillary RBFPD in this cohort were also excluded as any impact may not be well differentiated in such close proximity.

Prior to statistical analysis, the normality of continuous data was checked using the Kolmogorov–Smirnov test. Categorical and continuous data were analysed with chi-square test and parametric independent *t*-test/non-parametric Mann–Whitney U respectively. Longevity of the CL2 and FF3 RBFPDs was presented in Kaplan–Meier success (time to repair) and survival (time to

Table 1
Inclusion and exclusion criteria of this prospective study in replacement of a maxillary incisor with resin bonded fixed partial dentures (RBFPDs).

Inclusion criteria	Exclusion criteria
• A single permanent maxillary central or lateral incisor was missing and its edentulous space was present or minimally loss • Sound or minimally restored abutment(s) with an adequate enamel surface area for bonding were present • Angle Class I or II (division 1) incisal relationships were present with stable posterior support • Opposing unit of the missing teeth was natural teeth with or without restorations	• Subject who was medically unfit for dental treatment and reviews • Subject who was under 18 or unable to give consent • Subject who was pregnant • Uncontrolled caries and periodontal disease • Abnormal oral habits with excessive occlusal function or parafunction, such as pencil chewing or bruxism