Elsevier Editorial System(tm) for Journal of Dentistry

Manuscript Draft

Manuscript Number:

Title: Long-term evaluation of cantilevered versus fixed-fixed resin-bonded fixed partial dentures

Article Type: Full Length Article

Keywords: patient satisfaction, longevity, oral health related quality of life, survival, resin bonded fixed partial denture

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Abstract: Objectives: To evaluate the long-term longevity and patient-reported outcomes of a clinical trial that compared two-unit cantilevered (CL2) and three-unit fixed-fixed (FF3) resin-bonded fixed partial dentures (RBFPDs) for the replacement of a single maxillary permanent incisor.
Materials and Methods: Twenty-eight subjects were recruited and randomly assigned to receive either a CL2 or FF3 RBFPD placed by one operator. After 18-year average service life, twenty-two subjects were reviewed. 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 and oral health-related quality of life (OHRQoL) were assessed with 15-item questionnaire and Oral Health Impact Profile (OHIP-49) respectively. Outcomes were analysed with t-test/Mann-Whitney U test (continuous), chi-square (categorical) and log-rank (Kaplan-Meier) at significance level α=0.05.
Results: 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). General satisfaction of CL2 group was 77.8±19.9 and FF3 group was 77.4±20.2. OHIP-49 summary score for CL2 and FF3 group was 14.0±12.5 and 29.5±30.1 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 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.

Journal of Dentistry

Original Research Reports

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 and oral health-related quality of life (OHRQoL) were assessed with 15-item questionnaire and Oral Health Impact Profile (OHIP-49) respectively. Outcomes were analysed with t-test/Mann-Whitney U test, chi-square and log-rank test at significance level α=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 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.

Keywords: patient satisfaction, longevity, oral health related quality of life, survival, resin bonded bridge

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 has good resistance form and covering maximum tooth surface for bonding (1). The advantages of RBFPDs include conservative tooth preparation and elimination of iatrogenic pulpal injuries as well as simplified clinical and laboratory procedures.

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. Despite prosthesis design has been suggested as a major factor that determines the clinical longevity of RBFPDs (1), many clinical studies (2-4) and therefore later systematic review (5) reported the survival of RBFPDs with heterogeneous designs which do not allow assessment the superiority of a particular design.

At present there appear to be no long-term prospective studies that directly compare CL2 and FF3 metal-ceramic RBFPDs. This study reports the 18-year longevity of a clinical trial that initially demonstrated CL2 designs was as successful as FF3 design in replacement of a maxillary incisor (14 to 45 months) (6). It is the aim of this study to compare the long-term longevity of CL2 and FF3 design RBRPDs to the replacement of maxillary central and lateral incisors from the above initial cohort. Moreover, patient-reported outcome measures (PROMs) are equally important in formulating the selection criteria of a particular dental prosthesis (7) and it is also our aim to investigate the PROMs of CL2 and FF3 design of RBFPDs over the long-term.

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 to 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 (Figure 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 in initial report (6). 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 with 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 50μm aluminium oxide powder at a pressure of 520kPa 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 5mm, 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. The dates of occurrence of these complications were collected and the RBFPDs' success and survival time intervals were calculated (8).

Subjects' satisfaction was assessed using a 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 100mm straight line with one end (0) denotes totally unsatisfied and another end (100) denotes totally satisfied. 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 Oral Health Impact Profile (OHIP) questionnaire with 49 questions (9). 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) (10). Individual scores can then be summed up and the smaller the summary scores the less negative impacts the subject had experienced and therefore the better OHRQoL. Subjects with multiple anterior RBFPDs or their RBFPDs were lost or replaced with other treatment (e.g. implant) were excluded from the OHRQoL assessment as they may not be able to distinguish between the difference or the impact was not from RBFPDs.

Normality of continuous data were checked with 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 replacement) curves and compared with log-rank test. Effect sizes of subject satisfaction and OHIP scores between CL2 and FF3 groups were calculated by dividing the mean difference with its standard deviation. Effect size of 0.2 to 0.3 was regarded as small effect, 0.5 as medium effect and 0.8 or more as large effect (11).

The level of significance was set at 0.05. All data were analysed with SPSS 20.0 (IBM, NY, USA).

Power estimation

Based on a hypothesis that a 5 percent annual difference in the success/survival rate between CL2 and FF3 would be clinically significant (8), after 18-year 58.2 percent ($1 - 0.95^{n-1}$) difference would be expected. 15-year survival probability of CL2 RBFPDs was reported as 0.84 (12) and assuming FF3 has lower survival probability than CL2, its survival probability was 0.84-0.58=0.26. The standardized difference was then 1.16 and with 80 percent power, the total sample size required for both groups would be 24.

Results

Of the twenty-eight recruited subjects, twenty-two were clinically reviewed. Thirteen of fifteen CL2 RBFPDs and ten of fourteen FF3 RBFPDs were examined (79.3 percent response rate) with a mean service life of 216.5±20.8 months. For the CL2 group, there was 6 male and 9 female with mean age of 50.5±12.4. For FF3 group, there was 8 male and 6 female with mean age of 50.8±11.5. No significant difference was found for subject's gender nor age ($P>0.05$) between treatment groups.

For subjects who received CL2 RBFPD and attended review, 77 percent (10) of them have received secondary school or above education and had 13.8±1.2 functional occluding pairs (natural tooth and fixed restoration). For subjects who received FF3 RBFPDs, all of them (13) have received secondary school or above education and had 13.6±1.0 functional occluding pairs. There was no significant difference between CL2 group and FF3 group in their education status nor number of functional occluding pairs ($P>0.05$).

All (100 percent) of the CL2 RBFPDs were successful (i.e. absence of complications requiring intervention beyond routine periodontal maintenance) and survived (retention of the original prosthesis) while only 10 percent (one) of FF3 were successful and 50 percent (five) survived (both $P=0.000$). Longevity details of the CL2 and FF3 design RBFPDs were presented in table 2

and 3 respectively. Eighty percent (eight) of the reviewed FF3 RBFPDs debonded with a total of 19 debondings recorded during the observation period. One prosthesis debonded five times. Of the eight debonded FF3 RBFPDs, all were rebonded and five failed (loss or remade) at the 18-year review due to repeated debonding. Debonding was the first occurrence complication (i.e. ends the success of a prosthesis) in eight of nine "not success" FF3 RBFPDs. The only complication that terminates the survival of a prosthesis observed in this study was debonding and was only seen in FF3 RBFPDs. The average time to the first debonding was 71 months after prosthesis insertion and ranged from 3 to 176 months among these debonded RBFPDs. The five rebonded FF3 RBFPDs failed from 75 to 214 months after prosthesis insertion. Caries on the abutment tooth/teeth was found in three of the debonded cases representing 30 percent of all FF3 RBFPDs in this study. Two subjects presented with mild increased probing depth (5mm) on their abutment teeth of FF3 RBFPDs. For both test groups, none of abutment teeth were lost, extracted or required endodontic treatment.

The two-unit cantilevered RBFPDs had a significantly longer mean success time (210.5±21.4 months) than the FF3 RBFPDs (109.2±87.2 months) (P=0.008). Furthermore, the CL2 RBFPDs had a longer mean survival time (212.2±22.5 months) than FF3 RBFPDs (195.7±51.3 months) but this was not significant (P>0.05). One CL2 was electively removed and replaced with a dental implant, while this was certainly considered to have survived it is not known if it was successful, therefore the mean survival time of the CL2s was longer than their mean success time. Significant better longevity of CL2 design RBFPDs over FF3 design was found in log-rank test of their success rate (P=0.000, figure 2) and survival rate (P=0.008, figure 3) in Kaplan-Meier analysis. Six of the reviewed FF3 RBFPDs that had debonded were converted to a CL2 but they were still included in the FF3 group in the Kaplan-Meier analysis using the "intention to treat" approach(13).

General satisfaction of the CL2 group was 77.8±19.9 and FF3 group was 77.4±20.2 (effect size 0.02). OHIP-49 summary score for CL2 and FF3 group was 14.0±12.5 and 29.5±30.1 respectively (Effect size 0.51) (Table 4). There was no significant difference in the different aspects of subjects' satisfaction and different domains of OHIP-49 (effect sizes ranges from 0.01 to 0.78) apart from the subjects of CL2 group had a higher satisfaction in cleaning of the prosthesis (84.1±13.6) than FF3 group (72.6±11.7) (P=0.05) (effect size 0.85).

Six subjects refused to come back for the review due to time conflict and were excluded, otherwise there was no missing data in the longevity of RBFPDs. Hospital treatment records of these excluded subjects were reviewed for any complications associated with the RBFPDs and its abutment teeth, and there was no obvious difference in the longevity between these who attended and not attended (excluded) review (Table 2 and 3). For subjects' satisfaction, a male in FF3 group did not answer if he will recommend RBFPDs to others. One female in CL2 group did not answer her satisfaction in "treatment time for completion". For OHIP-49, one male in CL2 group missed item-10 OHIP question and another female in the CL2 group give two answers in each of four OHIP questions (items 12, 27, 28 and 30). These were regarded as missing data and remaining data was analysed.

Discussion

This prospective study appears to be the only long-term evaluation of FF3 and CL2 RBFPDs that clearly and unequivocally shows the advantage of CL2 prostheses over FF3 designs. Random allocation of subjects to either CL2 or FF3 groups reduces possible confounding factors between the two groups. The focused replacement of missing maxillary incisor only and the fact that these RBFPDs were made and inserted by a single operator and technician reduced possible clinical and technical variables.

There are limitations in recruiting sufficient subjects with a lone standing upper incisor tooth in the aesthetic zone which limits the sample size of this prospective study. However, the long-term differences in the longevity between CL2 and FF3 groups reduce the sample size required at a particular power/significance level. However for the patient-reported outcome measures (PROMs), a sample size of 84 was required for a moderate magnitude of difference (Effect size 0.5) with 2-tailed t-test between the means of two independent samples of equal size of 80 percent power and 0.05 significance level (11). A larger sample size thus is required to reject the null hypothesis that subjects received CL2 or FF3 RBFPDs have no difference in their

satisfaction (apart from ease of cleaning) and oral health related quality of life (OHRQoL) with regard to the prosthesis.

The potential bias in comparing the CL2 and FF3 design RBFPDs in this study was minimized by the clinical assessment by an independent assessor and the use of PROMs questionnaires. The most frequent complications occurred in RBFPDs was debonding as reported in systematic review (5) and debonding was responsible for the difference observed in Kaplan-Meier success and survival analysis in this study. Assessment of debonding was objective and this diagnosis was reached by the dislodgement of the whole prosthesis or one of retainers. In many cases these were noticed by the subjects and diagnosed by clinicians/dental students other than the operator who inserted the RBFPDs.

The present study has shown a superior long-term clinical longevity of the CL2 RBFPDs in replacement of a maxillary permanent incisor compared to FF3. The success of CL2 design RBFPDs over FF3 design is thought to be due to the differential movements of the abutment teeth that stress the bonding interface of the FF3 prosthesis to the abutment teeth, such interabutment stress is not possible with CL2 designs (14). In addition, if an occlusal contact is possible on the tooth tissue of an abutment which is not fully controlled by a partial coverage retainer, this tooth may be loaded along its periodontal ligament relative to the other fixed-fixed abutment tooth which will cause a possible “bite-out” effect (15-17). These actions over time may fatigue and deteriorate the resin cement bonding interface of the prosthesis to the tooth and lead to ‘de-bonding’ of the prosthesis and dislodgement from the abutment teeth. Such adverse contacts are not possible on CL2 designs. Two-unit cantilevered RBFPDs therefore have been proposed as a simpler and better alternative to FF3 designs for a single missing tooth (1) and there are a range

of clinical audits that have reported on the success of these prostheses with 86-100 percent of prostheses survived (retention of original prosthesis) up to 113.2 months (12, 18-22). They have even been reported to be as successful to implant-supported crowns over 100 months (8).

In this study, the retention of all original CL2 prostheses without any detectable complication is even better than any previous reports of CL2 RBFPDs from this centre which already show some of the highest and longest retention rates in the literature with 0.84 survival probability at 15 years (6, 12, 23-25). The additional success of CL2 RBFPDs seen in this study may be attributed to: placement by one experienced clinical operator, strict case selection (e.g. exclusion of bruxism subjects) and confined location of the prosthesis (anterior) where the occlusal loading is lower and easier isolation of the field for predictable bonding. In this centre RBFPDs in the mandibular posterior region had found to have lowest survival however similar RBFPDs retention rates between student groups and academic staff has been reported (12).

Although the average time to first debonding of FF3 RBFPDs in this study was 71 months, debonding occurred from 3 months to 176 months after prosthesis insertion. However, Hussey and Linden reported a high proportion of debond cantilevered RBFPDs were found in the first year of function (21). Debonding is a technical complication that may occur more over time (5) and this may be related to the interabutment stress, occlusal factors, framework biomechanics, quality of bonding, and fatigue loading (14). Success of CL2 design has been observed in alumina-based and zirconia-based RBFPDs as well (26, 27), however fracture of the connector was seen instead of debonding in two-retainers design in weaker alumina-based RBFPDs.

Some of the debonded FF3 RBFPDs in this trial were converted to a CL2 by removing one of retainers before recementation. However, unlike the original CL2, most of these converted "CL2" RBFPDs debonded again. This is in contrast to Briggs et al. (20) and Botelho et al. (12) who reported a predictable long-term survival after recementation of debonded CL2 RBFPDs. The reduced survival time of a "CL2" RBFPDs converted from a debonded FF3 may be related to distortion of the partially debonded framework during functional loading that may lead to a poorer fit to the abutment teeth and in turn an increased cement thickness after recementation. Thicker luting cements have been shown to have a lower tensile strengths (28). Clinical rebonding of a RBFPD should only be considered if the framework fits well to the abutment tooth and has sufficient resistance and retention features for accurate seating of the prosthesis.

Resin-bonded fixed partial dentures (RBFPDs) are a biologically conservative treatment option for replacement of missing maxillary incisor tooth as in this trial no abutment tooth was lost or suffered from severe biological complications such as severe periodontal complications or endodontic treatment. This success makes RBFPDs a more biologically favourable option than other treatment modalities including fixed partial dentures (29) and even single tooth implants (8).

Patient-reported outcome measures (PROMs) revealed subjects generally satisfied with the performance and treatment procedure of RBFPDs and little negative impact of RBFPDs to their oral health related quality of life (OHRQoL). CL2s is easier to clean than FF3s since they utilized one abutment tooth only, which allow the use of dental floss to clean the interproximal areas. Complications of the fixed prosthesis in replacement of single missing tooth has been found to have negative impact on OHRQoL, this may explained the trend of poorer OHRQoL observed in subjects received FF3 RBFPDs in this study (10).

The result of this well-controlled prospective study clearly highlights the clinical superiority of CL2 design RBFPDs over the FF3 design. However, while the effectiveness of RBFPDs has been demonstrated by this study, their efficacy may be better demonstrated by studies including multiple operators and prosthesis locations (7, 12).

Conclusions

This long-term prospective study (mean observation time 216.5±20.8 months) has shown the superiority of two-unit cantilevered (CL2) resin bonded fixed partial dentures (RBFPDs) in replacement of a lone missing permanent incisors. No debonding or other complication occurred and all CL2 RBFPDs survived. No abutment tooth was lost or endodontically involved showing the conservative nature of RBFPDs. The results of this clinical study showed the use of CL2 RBFPDs to be a durable and successful prosthetic replacement in long-term and have favourable patient-reported outcomes.

Acknowledgements

The authors would like to express appreciation for the technical support provided by Miss S.C. Wong, Dental Technician, Dental Technology, the Prince Philip Dental Hospital, Hong Kong.

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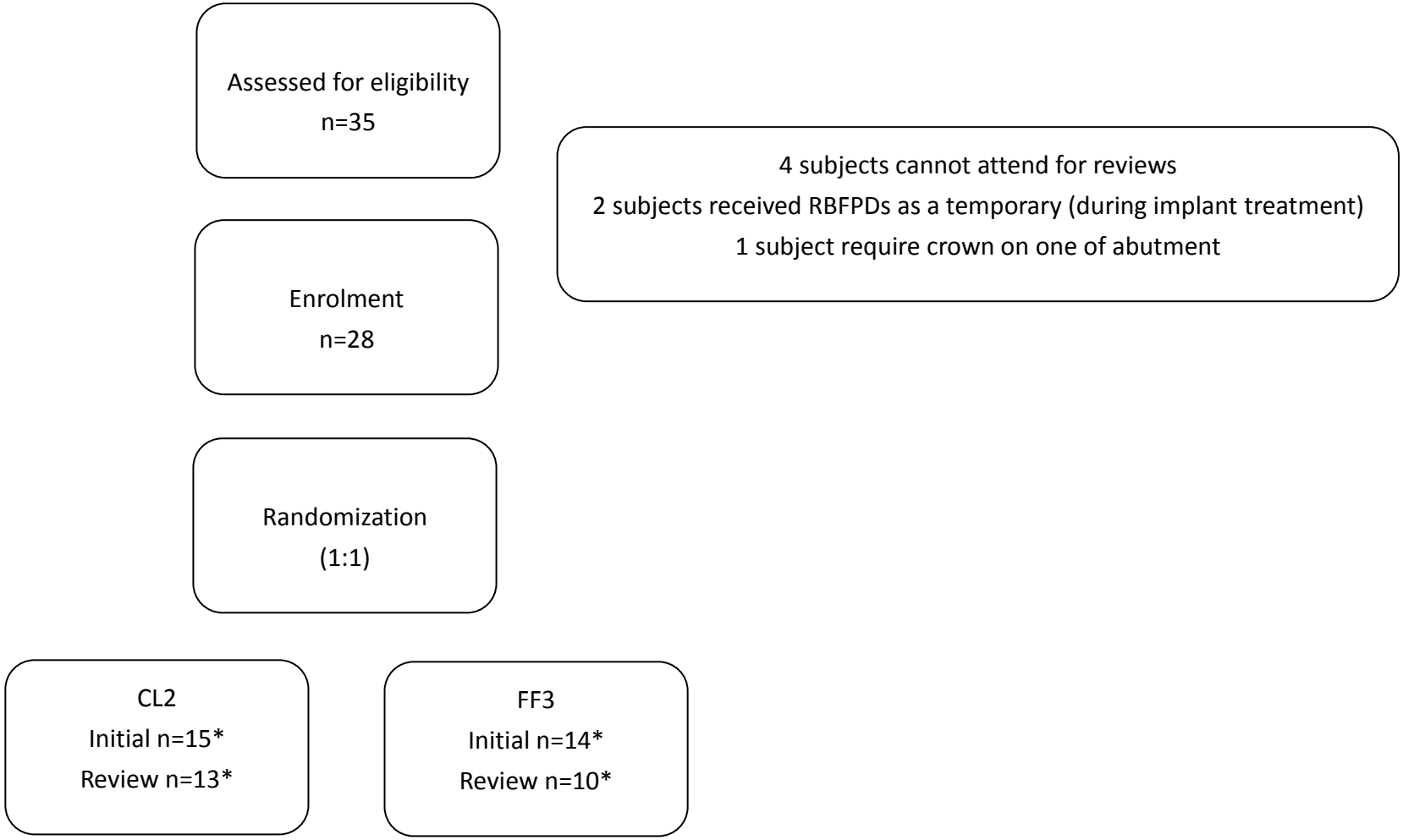
Table 1. Inclusion and exclusion criteria of this prospective study in replacement of a maxillary incisor with resin bonded fixed partial dentures (RBFPDs).

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

Figure 1. Flowchart of patient recruitment of this prospective study in replacement of a maxillary incisor with resin bonded fixed partial dentures (RBFPDs).



* One subject has received both CL2 and FF3

Table 2. Longevity details of the two-unit cantilevered (CL2) resin bonded fixed partial dentures (RBFPDs) in this prospective study.

Tooth replaced	Abutment tooth	Observation time (months)	Longevity [complications]	Success time (months)	Survival time (months)
Included					
21	11	266	**Success and survived**[+]	213	236
*12	11	237	**Success and survived**	237	237
22	21	235	**Success and survived**	235	235
11	21	235	**Success and survived**^	235	235
12	11	221	**Success and survived**	221	221
21	11	220	**Success and survived**	220	220
12	13	220	**Success and survived**	220	220
11	21	208	**Success and survived**	208	208
21	11	207	**Success and survived**	207	207
21	11	197	**Success and survived**	197	197
11	21	194	**Success and survived**	194	194
11	21	185	**Success and survived**	185	185
21	11	164	**Success and survived**	164	164
Excluded		Inserted			
12	11	23/3/1995	Success and survived in last visit on 17/5/2000	N/A	N/A
11	21	16/11/1995	Success and survived in last visit on 25/1/2010	N/A	N/A

* One subject has received both CL2 and FF3

[+] This RBFPD was reviewed on 213 months, but subject decide to replaced it with an implant on 236 months

^ Abutment tooth 21^{M} has arrested caries but no treatment is needed

Table 3. Longevity details of the three-unit fixed-fixed (FF3) resin bonded fixed partial dentures (RBFPDs) in this prospective study.

Tooth replaced	Abutment teeth	Observation time (months)	Longevity [complications]	Success time (months)	First occurrence complication	Survival time (months)	Complication terminate survival	Current Prosthesis
Included								
11	12, 21	255	**Success and survived** [+]	255	N/A	255	N/A	FF3
'Mesioden'	11, 21	237	**Survived [Debond (1 time), 5mm probing depth 21^{MP}]**	48	Debond	237	N/A	FF3
21	11, 22	237	**Failed [Debond (5 times)]** Converted to CL2 at first debond, debonded two more times before **remade** CL2. Two more debond after remade and replace with **implant**.	3	Debond	164	Debond (converted to CL2)	Implant
*22	21, 23	237	**Failed [Debond (2 times)]** Converted to CL2 at first debond, debond one more time before **remade** CL2.	68	Debond	75	Debond (converted to CL2)	CL2
12	11, 13	229	**Failed [Debond (3 times), caries 13^{M}]** Debonded two times and converted to CL2, debonded later and **loss.**	13	Debond	189	Debond (converted to CL2)	Loss
12	11, 13	226	**Failed [Debond (3 times), caries 11]** Debonded two times and converted to CL2, debonded later and replaced with **implant**.	176	Debond	214	Debond (converted to CL2)	Implant
21	11, 22	221	**Survived [5mm probing depth 11$^{ML, DL}$ and 22^{ML}]**	221	Perio	221	N/A	FF3
21	11, 22	219	**Survived [Debond (2 times)]** Debonded two times and converted to CL2.	75	Debond	219	N/A	CL2
21	11, 22	217	**Survived [Debond (1 time)]**	78	Debond	217	N/A	FF3

11	12, 21	211	**Failed [Debond (2 times), caries 12, 21]** Debonded and converted to CL2. Debonded again and **remade** CL2.	155	Debond	166	Debond (converted to CL2)	CL2

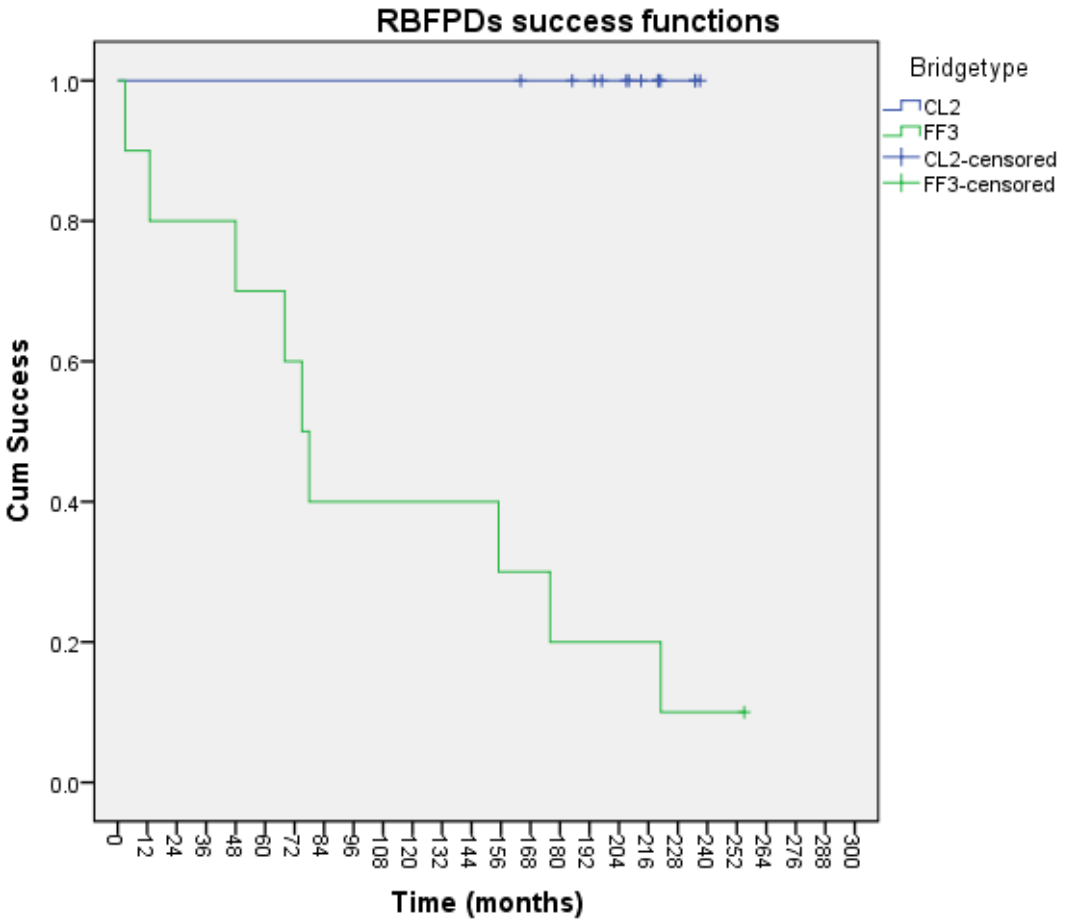
Excluded		Inserted						
11	12, 21	30/8/1994	Debonded on 13/7/2001 and converted to CL2 on 7/3/2003	N/A	N/A	N/A	N/A	N/A
22	21, 23	15/2/1996	Success and survived in last visit on 2/5/1996	N/A	N/A	N/A	N/A	N/A
11	12, 21	12/11/1996	Debonded on 8/8/2012 and remade CL2 on 16/4/2014	N/A	N/A	N/A	N/A	N/A
11	13, 21	15/4/1997	Success and survived in last visit on 29/5/1997	N/A	N/A	N/A	N/A	N/A

* One subject has received both CL2 and FF3

+ Cement wash out at incisal part of 21 retainer but no treatment is needed; abutment tooth 21 root treated before insertion of RBFPD

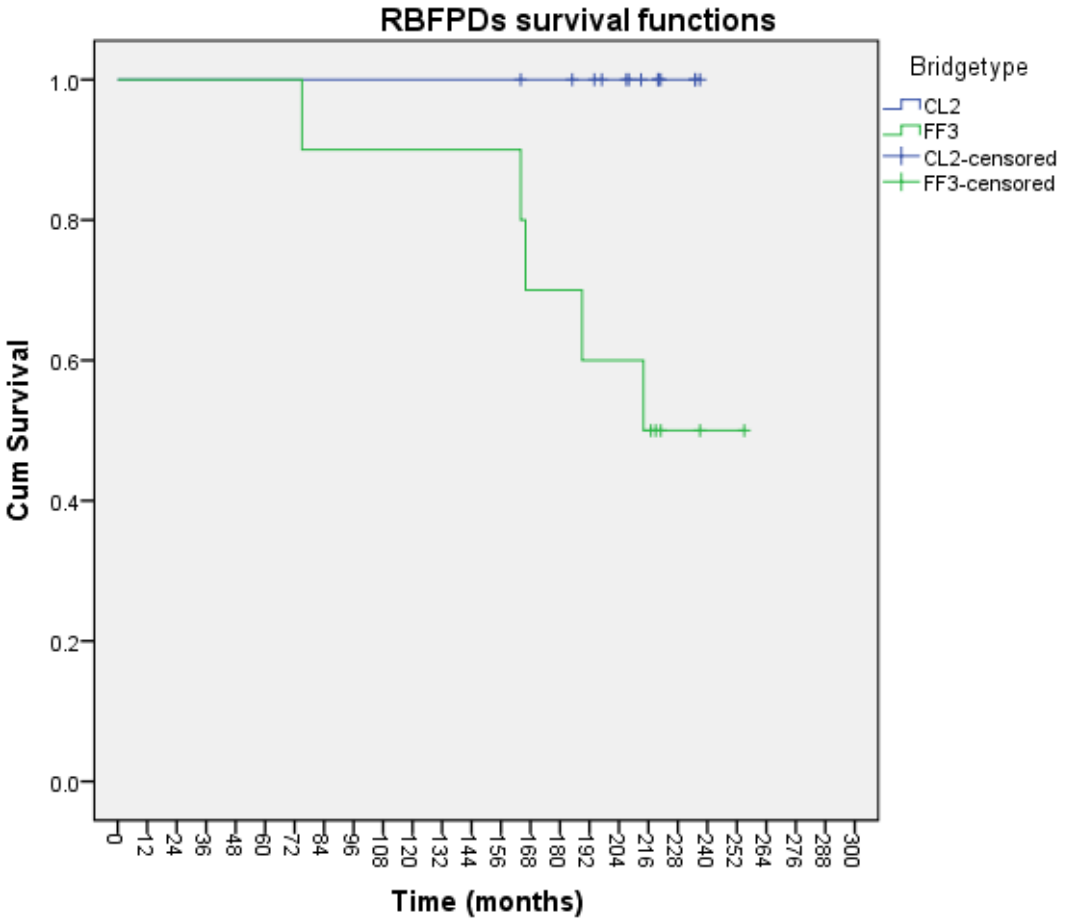
Figure 2. Kaplan Meier curve of a) success (absence of complications) and b) survival (retention of original prosthesis in mouth) of two-unit cantilevered (CL2) and three-unit fixed-fixed (FF3) resin bonded fixed partial dentures (RBFPDs).

a)



P=0.000

b)


RBFPDs survival functions
Cum Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
12
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
240
252
264
276
288
300
Time (months)
Bridgetype
CL2
FF3
CL2-censored
FF3-censored

P=0.008

Table 4. a) Subjects' satisfaction and b) Oral health impact factor (OHIP) of the two-unit cantilevered (CL2) and three-unit fixed-fixed (FF3) resin bonded fixed partial dentures (RBFPDs) in this prospective study.

a) Subjects' satisfaction

		CL2 (n=12[#]) Mean (Standard deviation)	FF3 (n=9[#]) Mean (Standard deviation)	Effect size[+]
1.	General	77.8 (19.9)	77.4 (20.2)	0.02
2.	Appearance	75.3 (26.2)	78.0 (19.9)	0.10
3.	In comparison with natural tooth	76.8 (18.6)	74.2 (16.4)	0.14
4.	Comfort	82.2 (15.1)	79.4 (14.0)	0.19
5.	Chewing ability	73.3 (19.9)	68.1 (13.6)	0.26
6.	Speech	87.8 (14.1)	86.1 (11.6)	0.12
7.	Ease of cleaning	84.1 (13.6)*	72.6 (11.7)*	0.85
8.	Firmness of prosthesis	84.6 (13.6)	75.6 (12.9)	0.66
9.	Confidence with that prosthesis	84.3 (16.6)	78.2 (10.6)	0.37
10.	Treatment time for completion	77.0 (16.1)	76.0 (13.8)	0.06
11.	Treatment comfort	80.9 (16.0)	81.0 (12.6)	0.01
12.	Cost	87.1 (18.4)	87.7 (8.5)	0.02
13.	Operator	93.4 (8.5)	93.7 (8.4)	0.04
		Percentage (number)	**Percentage (number)**	
14.	Select again (Yes)	91.7 (11)	100 (9)	
15.	Recommend to others (Yes)	75.0 (9)	100 (8[++])	

* *P* value < 0.05 obtained from independent t-test

[#] One subject received both CL2 and FF3 in this study was excluded

[+] Effect size is the mean difference in score divided by standard deviation of score

[++] missed data

b) Oral Health Impact Profile

	CL2 (n=13^) Mean (Standard deviation)	FF3 (n=4^) Mean (Standard deviation)	Effect size[+]
Overall (summary scores)	14.0 (12.5)	29.5 (30.1)	0.51
Functional limitation	3.2 (3.3)	7.8 (5.9)	0.78
Physical pain	6.0 (3.7)	8.0 (6.1)	0.33
Psychological discomfort	1.3 (2.2)	2.5 (3.8)	0.24
Physical disability	1.6 (2.1)	4.3 (5.3)	0.51
Psychological disability	1.0 (2.0)	1.7 (3.7)	0.28
Social disability	0.3 (1.1)	1.3 (2.5)	0.71
Handicap	0.5 (1.0)	3.0 (3.6)	0.69

[^] Subjects whose FF3 RBFPD replaced with implant were excluded, one in CL2 and two in FF3 group (i.e. CL2 group minus one and FF3 group minus two); one subject received both CL2 and FF3 in this study was excluded (i.e. both CL2 and FF3 groups minus one); one subject from FF3 RBFPDs loss original prosthesis and did not replace (i.e. FF3 group minus 1); Three FF3 RBFPDs were converted/remade into CL2, however one of FF3 was in subjects with both CL2 and FF3 (i.e. CL2 group plus two and FF3 group minus two)

[+] Effect size is the mean difference in score divided by standard deviation of score