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Clinical audit of posterior three-unit fixed-movable resin-bonded fixed partial dentures – A retrospective, preliminary clinical investigation

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ABSTRACT

Background: Two-unit cantilevered resin-bonded fixed partial dentures (RBFPDs) have higher retention rates over longer span fixed–fixed RBFPDs. It has been hypothesized that interabutment stresses associated with fixed–fixed designs cause prosthesis debonds therefore for the replacement of molar-sized and longer spans, non-rigid connectors have been used to allow independent movement between two abutment teeth.
Objectives: This preliminary study evaluates the clinical longevity and subjects' satisfaction of three-unit fixed-movable (FM3) RBFPDs provided at a dental teaching hospital.
Materials and methods: Subjects who had received FM3 RBFPD(s) in the posterior region were clinically reviewed for complications. History of any debonds and subjects' satisfaction to the prosthesis was recorded. Time-to-debond (retention rate) and time-to-loss (survival rate) of these prostheses were presented in life tables.
Results: Ninety-eight prostheses in 84 subjects were examined. Their mean service life was 31.8 months (SD 11.5, range 3–67 months). Twenty-two prostheses had a history of debond, resulting in a retention proportion of 77.6%; seventeen of these were rebonded and still present at the time of review. One prosthesis was lost after extraction of a periodontally-involved abutment tooth, giving a survival proportion of 93.9%. High subject satisfaction and no adverse outcome were reported.
Conclusion: Three-unit fixed-movable RBFPDs have a shorter success than two-unit cantilevered RBFPDs. However, non-rigid connectors allow the possibility of rebonding giving satisfactory short-term survival rate. Further research is needed to investigate their long-term efficacy.
Clinical significance: Three-unit fixed-movable RBFPDs incorporating non-rigid connectors may be a feasible option for replacement of molar-size pontic in the posterior region.

1. Introduction

While the first generation of resin-bonded fixed partial dentures (RBFPDs) with perforated retainers showed high debonding rates, their subsequent developments have demonstrated enhanced clinical outcomes. This improvement has been attributed to the use of non-perforated retainers [1] and increased framework extension on the abutment [2,3], abutment tooth preparation and resistance features [4–6] as well as improvement in bonding protocol [7]. While the dental literature shows good clinical retention rates for shorter span two-unit cantilevered (CL2) RBFPDs of both metal-ceramic [8–11] and all-ceramic prostheses [12–14], higher debonding rates have been associated with RBFPDs with fixed–fixed (FF) designs and with a greater number of units [8,11,15–19].

At the Faculty of Dentistry, University of Hong Kong, a series of clinical audits have showed high retention rates for CL2 RBFPDs of 86.7% up to more than 9 years [20–26]. These prostheses have been recommended for replacing single missing anterior or posterior teeth of premolar-sized and their success has been attributed to the free-standing nature of a single-abutment, single-pontic prosthesis as there are no interabutment stresses [21,22,27,28]. For molar-sized and longer edentulous spans, cantilevered design RBFPDs may not be possible for supporting the prostheses. However, the longevity of three-unit FF prostheses has been reported to be less favourable than CL2, especially anteriorly and over the longer term [21,26]. This is considered to be due to the differential movements between abutment teeth causing

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increased stresses on the bonding interface of the FF prosthesis, such interabutment stress is not possible with CL2 designs [29,30]. In addition, occlusal contacts on the abutment teeth is not fully controlled by a partial coverage FF RBFPD retainer. While this design is conservative to tooth tissue, occlusal contacts on the tooth tissue of the abutment tooth rather than on the retainer of a FF prosthesis may load one abutment tooth apically relative to the another FF abutment tooth and cause a "bite-out" effect [31–33]. Over repeated forces debond may occur in one abutment tooth only such that the prosthesis will still be retained in the mouth which may have the possibility of caries over time under the debonded retainer.

Non-rigid fixed-movable (FM) connectors have been used for RBFPDs to accommodating abutments with different mobility [34–37]. To allow independent movement between the prosthesis abutments in both horizontal and vertical planes, modified FM connectors have been advocated for three-unit and longer RBFPDs to act like an exaggerated stress breaker [38–40]. This is thought to reduce interabutment stresses and therefore improve retention rate and if a debond were to occur it may allow rebonding of the loose retainer. The aim of this clinical audit was to investigate the clinical longevity and subject satisfaction of three-unit fixed movable (FM3) RBFPDs in replacing a molar-sized posterior edentulous spans.

2. Materials and methods

The sample population was identified from the computer records of patients attending the dental teaching hospital of the University of Hong Kong, Prince Philip Dental Hospital (PPDH). Inclusion criteria are subjects who had received three-unit fixed-movable (FM3) resin-bonded fixed partial denture(s) (RBFPDs) in the posterior region and are medically fit to attending the review appointment. Ethics approval was obtained from the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster, Hong Kong (IRB UW 15-445). Informed consent was obtained from all subjects.

2.1. Design and fabrication of 3-unit fixed-movable RBFPDs

At the Prince Philip Dental Hospital, metal-ceramic RBFPDs are usually the first line of choice for fixed-prosthesis tooth replacement [41]. Following the control of active dental disease, patients would have been selected for FM3 RBFPD treatment based on the need to replace one posterior tooth of molar size (mesial-distal width 8–11 mm) and their wish for a tooth-supported fixed replacement. The abutment teeth would have been sound or minimally restored with sufficient enamel for bonding, having clinical crown height of at least 3 mm occluso-gingivally, and healthy periodontal tissues. Design of FM3 RBFPDs would follow the standard teaching philosophy of such prostheses [38]. The abutment tooth with a better resistance form and larger surface area for bonding (usually molar) would be selected as the major abutment tooth supporting the retainer and the pontic. The pontic is designed to receive light or no occlusal contacts in both static and dynamic occlusions. The other abutment tooth would support the minor retainer. The patrix part of the FM joint usually connected to the minor retainer extra-coronally.

Tooth preparation would confine to lowering the height of contour of the tooth axially to allow apical extension of the framework to no less than 1 mm above the gingival margin and allow wraparound greater than 200° so as to maximize the surface area and resistance form for bonding. The use of an FM joint would allow separate paths of insertion of the major and minor retainers and thereby allow a more conservative tooth preparation usually confined to enamel. If dentine is exposed, this will be sealed with dentine-bonding agent during framework cementation.

The Nickel-Chromium (Ni-Co) framework was designed to be at least 0.8 mm thick and extended over at least two-axial surfaces (usually lingual and edentulous proximal) of the abutment tooth. This has been the historical material of choice [42] for well over 30 years and there have been no known cases of nickel allergy in patients requiring an RBFPDs in the past 20 years. An occlusal bar also 0.8 mm thick would be prepared to allow joining of the ends of retainer to give a geometrically rigid D-shaped retainer or alternatively the lingual cusp be covered if there was interocclusal clearance – particularly on the mandibular premolars. If a proximal tooth contact was present on the abutment tooth, extension onto this proximal surface of the abutment tooth would not routinely be prepared. If the contact point was open, the retainer framework would be extended to allow three-axial surfaces wraparound. The use of auxiliary resistance features such as grooves, slots or pin-holes was not routinely recommended for short span single molar prosthesis (Fig. 1).

All RBFPDs were fabricated by in-house dental technicians in the Dental Technology Unit of the PPDH following a standard procedure [38,39]. To ensure adequate thickness of the retainer, preformed casting wax sheets of 0.8 mm thick (Dentaurum; Ispringen, Germany) were laid down on refractory cast (V.H.T. refractory die material; Whip Mix Corp., Louisville, Kentucky, USA), sprued and invested. Nickel chromium alloy (Optimum; Matech Inc, Sylmar, California, USA) was used to cast the frameworks. The fixed movable connector was either custom made in resin (GC Pattern Resin, GC Dental Industrial Corp, Tokyo, Japan) or cast using a preformed plastic pattern (Mini Rest; J.M. Ney Dental, Bloomfield, Connecticut, USA). After casting, both the patrix and matrix connectors were trimmed with a tapered tungsten carbide fissure bur (No. 170) in an air-turbine handpiece to allow pitching and rolling movement in both vertical and horizontal planes between the abutments during loading to act like an exaggerated stress breaker. Porcelain (Vita-Omega; Vita Zahnfabrik, Bad Säckingen, Germany) was build-up on the metal framework. The fitting surfaces of the retainers were abraded using 50 μm aluminum oxide at a pressure of 520 kPa. All RBFPDs were cemented with

Fig. 1. Examples of posterior three-unit fixed movable RBFPDs.

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