REVISTA DE ODONTOLOGIA DA UNESP

CLINICAL REPORT

Rev Odontol UNESP, Araraquara. set./out., 2010; 39(5): 317-322

A new system of adhesive fixed partial denture

João Carlos Antunes SAMPAIO-FERNANDES[a], César Leal SILVA[a], Artur PINHO[a], Pedro Ferrás FERNANDES[b]

[a]Professor of Fixed Prosthodontics, Faculty of Dentistry of Porto, Portugal
[b]Assistant of Fixed Prosthodontics, Faculty of Dentistry of Porto, Portugal

Sampaio-Fernandes JCA, Silva CL, Pinho A, Fernandes PF. Um novo sistema de prótese parcial adesiva. Rev Odontol UNESP. 2010; 39(5): 317-322.

Resumo

A substituição de dentes ausentes pode ser alcançada de várias formas, tais como prótese parciais fixas convencionais cerâmicas ou metalocerâmicas, próteses sobre implantes ou prótese parciais fixas adesivas. Uma vez que as soluções existentes nem sempre são eficazes, descrevemos uma nova abordagem que assegura retenção adequada e estética satisfatória em um caso de prótese fixa adesiva de três elementos. Os autores apresentam um caso clínico realizado na Faculdade de Medicina Dentária do Porto – Portugal, que demonstra a reabilitação de um segundo pré-molar esquerdo com um novo sistema de prótese parcial fixa adesiva baseado na utilização de dois componentes protéticos segmentados entre si. A substituição de um dente posterior com este tipo de prótese parcial fixa adesiva possibilitou a restauração do dente perdido com preparos menos invasivos, restabelecendo a função e a estética ao paciente.

Palavras-chave: Prótese parcial fixa; prótese adesiva; prótese dentária.

Abstract

The replacement of missing teeth can be accomplished in different ways such as ceramic or metal-ceramic fixed partial dentures, dental implants or resin-bonded fixed partial dentures. Since the existing solutions are not always effective, a new approach is described to ensure adequate retention and satisfactory aesthetics for resin-bonded fixed partial denture with only one element. The authors present a clinical case of the Faculty of Dentistry of Porto – Portugal, showing the rehabilitation of a missing left second premolar with a new two-component system of resin-bonded fixed partial denture, which is bonded to the adjacent teeth. The replacement of one posterior tooth with this two component resin-bonded fixed partial denture may be more efficient and retentive than the classic ones.

Keywords: Denture partial fixed; resin-bonded; dental prosthesis.

INTRODUCTION

The replacement of a missing tooth can be accomplished with removable partial dentures (RPD), a dental implant, ceramic or metal-ceramic fixed partial dentures (FPD) or resin-bonded fixed partial dentures (RBFPD). When the adjacent teeth present perfect condition, adequate position, occlusion and aesthetics, dental implants or adhesive fixed partial dentures have been the most recommended treatment. However, FPDs are commonly used, owing to their considerable durability, aesthetics, cost effective, adequate retention and no need for a surgical procedure.

Retention has been critical for the success of conventional RBFPD. The conservative preparations, such as partial veneer crowns, are less retentive, difficult to manufacture and eventually unaesthetic, so they were replaced by metal ceramic crowns or complete ceramic restorations. These restorations have a tooth preparation that is more destructive and potentially iatrogenic (destruction of dental structures), and the occlusal ceramic may lead to excessive wear of antagonistic teeth[1-4]. However, these restorations can be more retentive and aesthetic than adhesive fixed partial dentures and even than dental implants in some cases[5].

While dental implants are preferred by some clinicians, others choose adhesive partial dentures in order to minimize some of the above-referred inconvenient. Dental implants have been a proven, efficient and secure prosthetic rehabilitation, avoiding the post extraction bone resorption, but minimal surgery and a certain period to enable osseointegration are needed.

The use of RBFPD has become a popular treatment option when the abutments are relatively intact or when preservation of tooth structure is needed[6-8].

RBFPD are extremely conservative and provide unparallel biological and aesthetic harmony[9]. These prostheses may also be preferable for young patients with big pulpal chambers[10]. In addition, the RBFPDs have been attractive for patients and dentists because of the minimal loss of tooth structure during tooth preparation[7] and in some cases the manufacture of provisional restorations might be unnecessary. Anaesthesia can be avoided in some patients. RBFPDs also enable vitality tests and/or endodontic treatment of the abutments after its insertion[9].

The minimal clinical chair time and cost effectiveness are another of the advantages of the RBFPDs[11]. However, their poor aesthetics (incisal enamel gets grey caused by metallic recovering of lingual or palatal surface of translucent abutments)[12-15] and frequent loss of retention[5,13] are the main drawbacks.

As Besimo et al.[9] concluded in their study, the RBFPD technique can be currently considered as a clinically reliable treatment if the tooth preparation design provides suitable mechanical retention, and if the alloy and bonding agents are carefully selected and used.

Appropriate mechanical retention of the resin-bonded retainers with tooth enamel micropreparation is crucial; nevertheless, specific tooth preparation, better composite luting agents with improved bonding to metals and tooth structure allow a significant reduction in failures. According to Rochette[16], these RBFPDs should be perforated to allow greater mechanical retention of composite cement to the metal. Currently, the new cementing materials and techniques for etching metal have increased the adhesive strength of the cement to the metal of the internal surface of retainers. Aluminium oxide blasting, electrochemical treatment, etching, silanization or tin plating (for precious alloy[17-22]), ensure an efficient union to various materials, including enamel, dentine and metals. This fact enlarges the indications for RBFPDs.

Initial clinical studies reported a 25% failure rate because of loss of retention of these type of prosthesis, which was extremely high (Kerchbaum et al. cit. by Rammelsberg et al.[23]). In 1993, Rammelsberg et al.[23] reported in a six-year longitudinal study at the University of Munich-Germany the clinical factors that affect RBFPDs. A total of 82.9% were in function after six years. According to the same study, the success of RBFPDs was neither related with anterior or posterior quadrants, maxillary or mandibular arch, but was statistically connected with tooth preparation of the abutments. This was performed with 1.0 mm deep parallel grooves and rest seats. The study reported 4.0% of failure in RBFPDs with retentive abutments' preparation and 63% in RBFPDs without tooth preparations.

The abutments' preparation has been recommended by numerous authors[24-30]. Most researches[26,30-34] have suggested rest seats, parallel grooves and parallel adjacent teeth so that the RBFPD can be inserted in a unique axis and in a longitudinal direction of abutments. The mechanical retention was critical for success of restorative treatment because it restrains the retention of the RBFPDs according to the axis of rest seats. Flexure of lingual metal of proximal teeth causes fatigue of cement and loss of retention[26,30-34].

The objective of this case report is to describe a new procedure of manufacturing a RBFPD that ensures a minimal preparation of teeth, adequate retention and satisfactory aesthetics.

CASE DESCRIPTION

This is a clinical case of the Faculty of Dentistry of Porto - Portugal, showing the rehabilitation of a missing left second premolar with a new two-component system of resin-bonded fixed partial denture, which is bonded to the adjacent teeth.

The system of two independent structures (Figure 1) are the goal for adequate retention. The first independent structure has an insertion transversal axis (from lingual to vestibular) that perfectly fits in two parallel grooves in the proximal and lingual surfaces of the abutments. The other independent structure is inserted in a perpendicular direction to the first structure (from occlusal to gingival surface). It consists in a pontic with two rest seats prepared in the abutments. The first independent structure, beyond retention permitted by grooves, is cemented with composite resin. This structure is made to provide the saddle pontic adequate anatomy without irregularities to allow acceptable finishing.

TECHNIQUE

- Study diagnostic casts;
- Mark the proximal and palatine grooves and the rest seats on the cast with a pen. Position the grooves between the gingival margin and contact point leaving enough tooth structure to separate it from the occlusal seat;
- Construct a plastic template on this cast (vacumform);
- Perfurate the template in areas that correspond to grooves and rest seats as evident in the translucency of the vacumform;
- Prepare the grooves and rests on the casts;
- Perform local anaesthesia;
- Hold the reference template in the mouth;
- Mark with a diamond round bur (ISO 029) all the grooves extensions and rest seats areas, guided by template perforations;

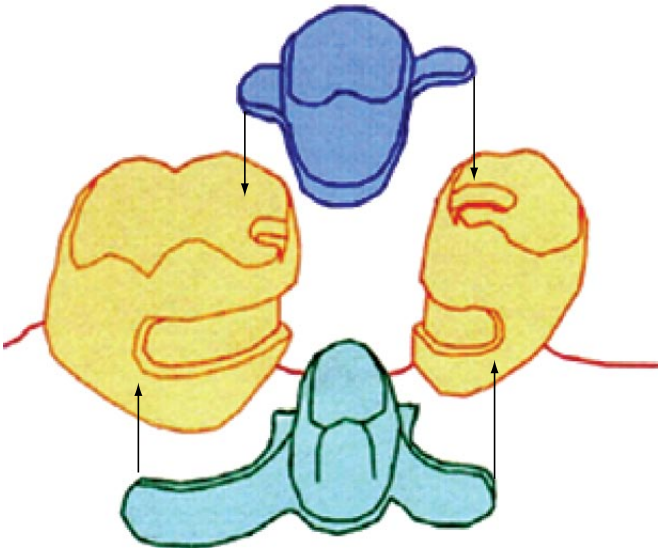

Figure 1. First and second structures.

- Prepare grooves accurately (1.0 mm deep with divergent walls); the occlusal surface must be expanded or bevelled (Figure 2);
- Prepare rest seats (Figure 2) with two diamond round burs, using the first one with a larger diameter (ISO 029), and then a similar bur with a smaller diameter (ISO 021)[35,36], as follows:
  - prepare in a similar way to those recommended for RPDs, with a triangular form (the vertex directed to the centre of the tooth);
  - 2 up to 2.5 mm in the buccal-lingual direction in premolars and molars;
  - 1.5 mm mesiodistal;
  - 1.0 mm deep;
  - the ground rounded without sharp angles and a deeper central portion.
- Etch, prime and bond exposed dentine;
- Make an impression with monophasic addition silicones using a custom resin tray or with a double mixture technique. This is commonly a delicate phase because of enormous inertia during removal and can lead to rupture of the vinyl polysiloxane in the grooves;
- Set provisional cement without eugenol in the grooves as a temporary restoration.
- Trial seating of first (Figure 3) and second metal structures (Figure 4);
- Apply porcelain and finish the prosthesis (Figures 5, 6, 7, 8);
- Lute with a resin-based luting agent (Panavia EX; Kuraray Co. Ltd, Osaka, Japan). Etch, wash and dry enamel, and blasting the metal with a 50 µm aluminium oxide;
- Adjust occlusion, polish margins, evaluate RBFPD and demonstrate oral hygiene procedures.

DISCUSSION

The adhesive partial dentures are commonly selected, but the problems of poor retention have hindered its universal application. This type of prosthesis has become more popular because reliable resin-metal bonding can be achieved by electrolytic acid etching of cast base metal alloys[37].

In order to increase the adhesive strength of RBFPDs[30], the areas that support the metal on the lingual surfaces should be as wide as possible[38], which emphasize the need of tooth preparation with a correct convergence. This convergence in metal-ceramic crowns must not be exceeded. Sarafianou, Kafandaris[39] reported that when convergence is 10 up to 15 degrees, retention decreases between 15.4 and 17.4%, which is critical because

Figure 2. Grooves and rest seats.

Figure 3. First structure (occlusal view).

Figure 4. First and second structures (lingual view).

Figure 5. Final first and second structures (occlusal view).

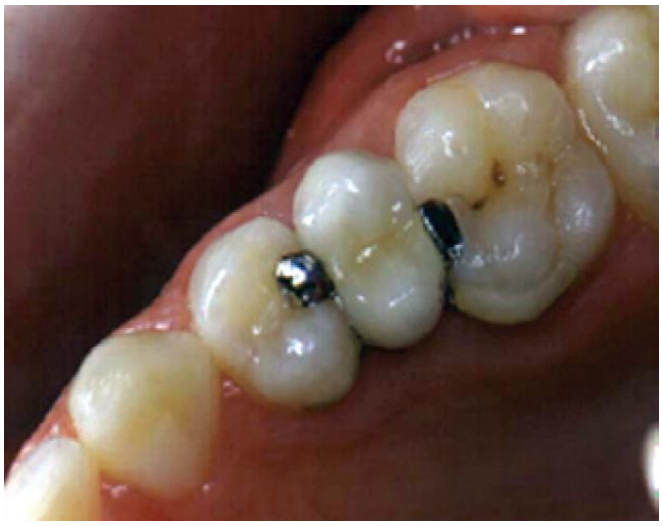

Figure 6. Final aspect (occlusal view).

Figure 7. Final aspect (lingual view).

the total contact area is very small. Retainers of RBFPDs with 10 degrees of convergence have enough clinical retention[35]. This tooth preparation can be performed in different ways, but tooth preparations that hold greater retention have proximal grooves that are 1.0 mm deep, 2.0 mm high and 1.0 mm wide[35]. The proximal grooves are prepared either in the mesial or distal surface (the latter groove is more buccally to enable the grooves to reach 180 degrees to the perimeter of the crown of the tooth). There is also a lingual and an occlusal tooth preparation of 0.5 mm[35].

The preservation of dental structure is essential to improve aesthetics (with minimal metal re-covering in the palatine and the occlusal seats on the occlusal surfaces) and retention (mechanical and adhesive). A new architecture of metal-ceramic adhesive FPDs was introduced and consisted in mechanically retentive structures with perpendicular insertion.

Figure 8. Final aspect (vestibular view).

The innovative prosthetic technique presents some difficulties, both clinical and mechanical, that need to be understood for future investigation. Some of them can be related to the instruments required for tooth preparation: grooves in parallel forms, in areas where the access is hindered and the visibility is limited, and also the impression technique (without rupture or permanent deformation).

This technique has been recommended only in posterior teeth (second premolars or molars) with edentulous spaces that do not exceed one tooth because of technical and biomechanical factors.

After the improvements introduced by investigators, mechanical and clinical experiences show that this prosthesis will be less aggressive than conventional treatments, proving that RBFPDs may be an efficient prosthetic option. This will provide greater selection and a more effective method of treating patients.

CONCLUSION

The replacement of a missing tooth can be performed with several treatments. The new two-component resin-bonded fixed partial denture described overcomes the main drawbacks of the classic ones, providing better retention and aesthetics, which is well pointed out by the stability of the treatment after ten years follow-up.

ACKNOWLEDGMENTS

The authors thank Mr. Mário Dupond and Mr. Fernando Faria, dental technicians, for the assistance in the manufacture of the mechanical devices and the dental prosthesis.

REFERENCES

1. Palmer DS, Barco MT, Pelleu GBJr, McKinney JE. Wear of human enamel against a commercial castable ceramic restorative material. J Prosthet Dent. 1991; 65: 192-5.
2. Ratledge DK, Smith BG, Wilson RF. The effect of restorative materials on the wear of human enamel. J Prosthet Dent. 1994; 72: 194-203.
3. Hudson JD, Goldstein GR, Georgescu M. Enamel wear caused by three different restorative materials. J Prosthet Dent. 1995; 74: 647-54.
4. Ramp MH, Suzuki S, Cox CF, Lacerfield WR, Koth DL. Evaluation of wear: enamel opposing three ceramic materials and a gold alloy. J Prosthet Dent. 1997; 77: 523-30.
5. Fayad MA, Al-Rafee MA. Failure of dental bridges. III. Prevalence of failure and its relation to place of construction. J Oral Rehabil. 1996; 23: 675-8.
6. Botelho MG. Improved design of long-span resin-bonded fixed partial dentures: three case reports. Quintessence Int. 2003; 34: 167-71.
7. Boening KW. Clinical performance of resin-bonded fixed partial dentures. J Prosthet Dent. 1996; 76: 39-44.
8. Vallitty PK. Survival rates of resin-bonded, glass-fiber-reinforced composite fixed partial dentures with a mean follow-up of 42 months: a pilot study. J Prosthet Dent. 2004; 91: 241-6.
9. Besimo C, Gachter M, Jahn M, Hassell T. Clinical performance of resin-bonded fixed partial dentures and extracoronal attachments for removable protheses. J Prosthet Dent. 1997; 78: 465-71.
10. Dietschi D. Indications and potential of bonded metal-ceramic fixed partial dentures. Pract Periodontics Aesthet Dent. 2000; 12(1): 51-8.
11. Kihçarslan MA, Kedici PS, Uludag BC. In vitro fracture resistance of posterior metal-ceramic and all-ceramic inlay-retained resin-bonded fixed partial dentures. J Prosthet Dent. 2004; 92: 365-70.
12. Gilmour ASM, Ali A. Clinical performance of resin-retained fixed partial dentures bonded with a chemically active luting cement. J Prosthet Dent. 1995; 73: 569-73
13. Pospiech P, Rammelsberg P, Unsold F. A new design for all-ceramic resin-bonded fixed partial dentures. Quintessence Int. 1996; 27: 753-8.
14. Fayad MA, Al-Rafee MA. Failure of dental bridges. II. Effect of some technical factors. J Oral Rehabil. 1996; 23: 438-40.
15. Hagiware Y, Matsumura H, Tanaka S, Woelfel JB. Single tooth replacement using a modified metal-ceramic resin-bonded partial denture: a clinical report. J Prosthet Dent. 2004; 91: 414-7.
16. Rochette AL. Attachment of a splint to enamel of lower anterior teeth. J Prosthet Dent. 1973; 30: 418-23.
17. Krueger GE, Diaz-Arnold AM, Aquino SA, Scandrett FR. A comparison of electrolytic and chemical etch systems on the resin-to-metal tensil bond strength. J Prosthet Dent. 1990; 64: 610-7.
18. Lawson JR. Alternative alloys for resin-bonded retainers. J Prosthet Dent. 1991; 65: 97-9.
19. Tanaka T, Nagata K, Takeyama M, Atsuta M, Nakabayashi N, Masuhara E. 4-META opaque resin - a new resin strongly adhesive to nickel-chromium alloy. J Dent Res. 1981; 60: 1697-706.
20. Mukai M, Fukui H, Hasegawa J. Relationship between sandblasting and composite resin-alloy bond strength by silica coating. J Prosthet Dent. 1995; 74: 151-5.
21. Watanabe F, Powers JM, Lorey RE. In vitro bonding of prosthodontic adhesives to dental alloys. J Dent Res. 1988; 67: 479-83.
22. Rokni SR. Combination acid-etched and coping-superstructure fixed partial prosthesis. Quintessence Int. 1996; 27: 189-92.
23. Rammelsberg P, Pospiech P, Gernet W. Clinical factors affecting adhesive fixed partial dentures: a 6-year study. J Prosthet Dent. 1993; 70: 300-7.
24. Barrack G, Thompson V, Simonsen R. Etched cast restorations. Quintessence Int. 1985; 1: 27-33.
25. Burgess JO, McCartney JG. Anterior retainer design for resin-bonded acid-etched fixed partial dentures. J Prosthet Dent. 1989; 61: 433-6.
26. Eshleman JR, Janus CE, Jones Cr. Tooth preparation designs for resin-bonded fixed partial dentures related to enamel thickness. J Prosthet Dent. 1988; 60: 18-22.
27. Creugers NH, Snoek PA, Van`t Hof MA, Kayser AF. Clinical performance of resin-bonded bridges: a five-year prospective study. III: failure characteristics and survival after rebonding. J Oral Rehabil. 1990; 17: 179-86.
28. Crispin BJ. A longitudinal clinical study of bonded fixed partial dentures: the first five years. J Prosthet Dent. 1991; 66: 336-42.
29. Marinello CP, Kersbaum T, Heinberg B, Hinz R, et al. First experiences with resin-bonded bridges and splints - a cross sectional retrospective study, II. J Oral Rehabil. 1988; 15: 223-35.
30. Simonsen R, Thompson V, Barrack G. Etched cast restorations: clinical and laboratory techniques. Chicago: Quintessence Publishing; 1983.
31. Verzijden CW, Creugers NH, Van`t Hof MA. A meta-analysis of two different trials on posterior resin-bonded bridges. J Dent. 1994; 22: 29-32.
32. Thompson V, Barrack G, Simonsen R. Posterior design principles in etched cast restorations. Quintessence Int. 1983; 14: 311-8.

33. Simon JF, Gartrell RG, Grogono A. Improved retention of acid-etched fixed partial dentures: a longitudinal study. J Prosthet Dent. 1992; 68: 611-5.

34. Caputo AA, Gonidis D, Matyas J. Analysis of stresses in resin bonded fixed partial dentures. Quintessence Int. 1986; 17: 89-93.

35. Shakal MA, Pfeiffer P, Hilgers R-D. Effect of tooth preparation design on bond strengths of resin-bonded prostheses: A pilot study. J Prosthet Dent. 1997; 77: 243-9.

36. McGivney GP, Castleberry DJ. Rests and rest seats. In: McGivney GP, Castleberry DJ, editors. McCracken`s removable partial dentures. 9th ed. St. Louis: Mosby-Year Book; 1995. p. 62-80.

37. Chow TW, Chung RW, Chu FC, Newsome PR. Tooth preparations designed for posterior resin-bonde fixed partial dentures: a clinical report. J Prosthet Dent. 2002; 88: 561-4.

38. Lin C, Hsu K, Wu C. Multi-factorial retainer design analysis of posterior resin-bonded fixed partial dentures: a finite element study. J Dent. 2005; 33: 711-720.

39. Sarafianou A, Kafandaris NM. Effect of convergence angle on retention of resin-bonded retainers cemented with resinous cements. J Prosthet Dent. 1997; 77: 475-81.

CORRESPONDENCE AUTHOR

João Carlos Antunes Sampaio Fernandes
Professor of Fixed Prosthodontics, Faculty of Dentistry of Porto, Portugal
e-mail: sampaiofernandes@gmail.com

Recebido: 21/09/2010
Aceito: 29/10/2010