

Artigo Original de Pesquisa

Evaluation of the marginal adaptation of a fibreglass reinforced resin crown using a scanning electronic microscope

Avaliação da adaptação marginal de coroa de resina reforçada com fibra de vidro em microscópio eletrônico de varredura

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Abstract

Introduction and objective: Dental prostheses manufactured using reinforced resins are an alternative to the rehabilitative treatment of one or more dental elements. With the aim of forecasting the longevity of these prosthetic pieces, this study evaluated the marginal adaptation of a complete crown made from fibreglass reinforced resin.

Material and methods: A tooth having orthodontic indication for extraction was prepared and a prosthetic piece was cemented over it so that, 48 hours later, the extraction could take place. The ensemble was taken in a laboratory and was examined using a scanning electron microscope (SEM). There were made 30 readings in a 8mm tooth-cement-restoration interface and revealed various gaps throughout the sample. **Results:** The lowest value found was 15,82 μm and the highest was 72,81 μm showing an average value of 40,82 μm . **Conclusion:** The gaps were within the limits of clinical tolerance and considering the clinical difficulty in making the prosthetic piece, the treatment was shown to be satisfactory with regard to marginal adaptation.

Palavras-chave:

adaptação marginal;
prótese livre de metal;
microscopia eletrônica de
varredura.

Resumo

Introdução e objetivo: As próteses fabricadas com resinas reforçadas são alternativas para o tratamento reabilitador de um ou mais elementos dentários. Objetivando prever a longevidade dessas peças, este trabalho avaliou a adaptação marginal de uma coroa total confeccionada com resina reforçada com fibra de vidro. **Material e métodos:** Um dente com indicação ortodôntica de exodontia foi preparado e sobre ele uma peça protética foi cimentada para que, 48 horas depois, a extração fosse executada. O conjunto foi levado ao laboratório para leitura em microscópio eletrônico de varredura (MEV). Foram feitas 30 leituras em uma interface de dente-cimento-restauração de 8 mm e reveladas diferentes *gaps* em toda a amostra. **Resultados:** O menor valor achado foi de 15,82 μm , e o maior de 72,81 μm , resultando em uma média de 40,82 μm . **Conclusão:** As *gaps* estavam dentro dos limites de tolerância clínica e, considerando a dificuldade clínica de produção da peça protética, o tratamento mostrou-se satisfatório no que concerne à adaptação marginal.

Introduction

The success of fixed unitary prostheses is related to factors such as longevity, the health of the dental pulp, periodontal stability and patient satisfaction [8]. With regard to the latter issue, the presence of any quantity of metal whatsoever may motivate conflict on the part of the patient, since there is an increasing demand for metal-free solutions [3]. One of the main factors responsible for treatment failure is marginal adaptation, a critical point for these materials, since faults in this region enable the accumulation of bacterial plaque which is harmful both to the dental roots and to gum and bone health [11], whereby interfaces greater than 100 μm are considered to be unacceptable in clinical practice [4].

Among the materials most used in “metal-free” prosthesis are laboratory made fibreglass reinforced resins (e.g.: the Adoro-Vectris system / Ivoclar-Vivadent, Principality of Liechtenstein) or polyethylene (BelleGlass-Connect system / Kerr, CA – USA).

Behr *et al.* [1] compared tooth fracture resistance and the marginal adaptation of resins reinforced with polyethylene and fibreglass and concluded that there was no significant statistical difference between the two materials and that, with regard to marginal adaptation, the result further depends on factors such as the bonding system and the cement used. Kolbeck *et al.* [5] state that, despite having a little difference, fibreglass presented better characteristics than polyethylene fibre in relation to the two properties and emphasizes that better sealing of the edges occurs, regardless of the type of fibre, when the restoration is finished using enamel, and not dentine, due to better cohesion between the bonding system and the cementing agent.

Cho *et al.* [4] assessed the marginal adaptation of this material according to the preparation design, varying the convergence of the axial walls by six, ten and fifteen degrees, and found that marginal adaptation improved, equivalent to 47 μm , the smaller the inclination of the angles. In a similar

study [6] the authors made this comparison by varying between chamfer, chamfer bevel, shoulder and shoulder bevel cervical finish lines and observed larger gaps in prosthetic pieces using chamfered preparations, although they were within clinical tolerance limits.

Confronting materials used, Monaco *et al.* [7] compared the marginal adaptation of ceramic and resin reinforced adhesive prostheses with inlay type preparations. When assessing the percentage of the continual margin of the prosthetic piece the authors observed that reinforced resin presented 92.9% margin continuity on the restoration piece-cement interface and 93.3% on the cement-tooth interface and concluded that the more rigid the restoration material used, the greater the tension generated on the edges and, consequently, the better the marginal adaptation and sealing.

This study analysed the marginal adaptation of a fixed unitary prosthesis made using the Ivoclar-Vivadent system.

Material and methods

The prosthetic piece was placed over an upper left first premolar tooth recommended for extraction for orthodontic reasons, number of the process committee of ethics 088/2006. The crown preparation was done using a 1mm supragingival chamfer bevel cervical finish line, in order to avoid interferences during the extraction, with 2 mm abrasion on the occlusal face and 1.2 mm abrasion on the proximal, vestibular and palatine faces.

Condensation silicone (Speedex / Vigodent, RJ – Brazil) was selected as the moulding material, and the procedure was performed using the two-step moulding technique. Once the prosthetic piece had been made by the laboratory the cementation procedure was then undertaken using adhesive cement (Rely-X / 3M-ESPE), with prior preparation of the tooth using 37% phosphoric acid and the application of the dual polymerization bonding system (Prime-Bond 2.1 and Self Cure Activator / Dentsply – RJ – Brazil), and preparation of the prosthetic piece using silane (Dentsply).

Following cementation of the prosthetic piece for 48 hours, the dental element was extracted and preserved in a 0.9% sterile saline solution and was then taken to the Fine Films and Surfaces Micromechanics Laboratory at the Department of Physics of the Federal University of Paraná. The sample was held in a support, metallized with gold and analysed using a JEOL JSM-6360LV sweeping electron microscope (SEM), using readings at increments of 30, 100 and 500 times the tooth-crown interface, on the lingual face, observing 30 points at a distance of 8 mm in length.

The lingual face was chosen due to the greater clinical difficulty in preparing and moulding in this region.

Results

The standard used to evaluate the marginal adaptation of resin reinforced crowns was the measurement of the distance, in micrometers, between the tooth and the restoration by means of S.E.M. observation at increments of 50 and 500 times the original size (figures 1 and 2).

The analysis was based on the readings from 30 specific points on the tooth-cement-restoration interface along 8 millimetres of the lingual face of the first premolar. The results of the readings at each point are shown in table 1. The evaluation demonstrated variations between 15.82 μm and 72.81 μm with an average distance of 40.82 μm between the tooth and the prosthetic crown, that is to say, in the 8mm tooth-restoration interface observed there are differences in the thicknesses of the cement to compensate the distances between the tooth and the prosthetic crown.

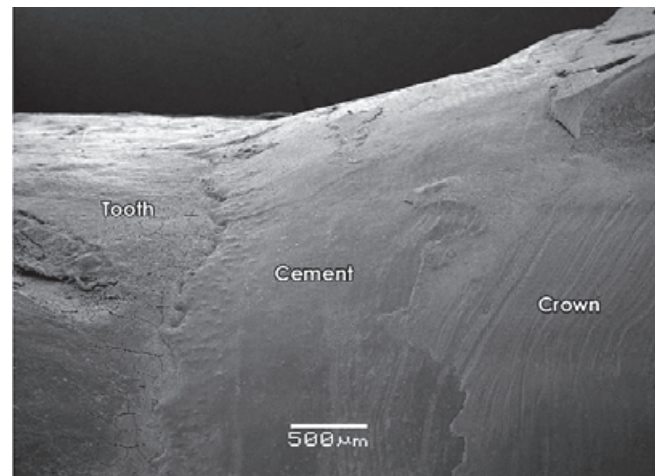


Figure 1 - Tooth-cement-crown interfaces magnified 500 times

Table 1 - Readings at the points along the tooth-cement-crown interfaces

Reading	Gaps	Reading	Gaps	Reading	Gaps
1	62.6	11	23.54	21	20.1
2	61.21	12	35.2	22	29.71
3	59.41	13	44.06	23	22.45
4	27.63	14	53.22	24	41.62
5	31.53	15	36.16	25	45.08
6	42.77	16	28.64	26	51.39
7	44.8	17	42.86	27	72.81
8	42.15	18	40.87	28	45.11
9	44.8	19	45.31	29	15.82
10	39.27	20	37.46	30	37.12

Discussion

Good marginal adaptation is undoubtedly an indispensable factor for the successful longevity of any prosthetic piece. Flaws in relation to this point can be observed principally in the inadequate thickness of the cement film, incorrect cementing techniques and the lack of prior preparation of the piece [9].

The evaluation of the marginal adaptation of a procedure carried out in the mouth shows the difficulties inherent in the process of preparing, moulding and cementing the prosthesis.

The results (table I) demonstrate that the piece functions well in terms of adaptation, as gaps of between 100 and 200 μm are considered to be acceptable in clinical practice [2]. The analysis of the material showed an average value of 40.82 μm (figure 2), in agreement with other authors, such as Cho [4] who found a value very close to the value presented in this study, thus placing the material within the standards of excellent clinical practice.

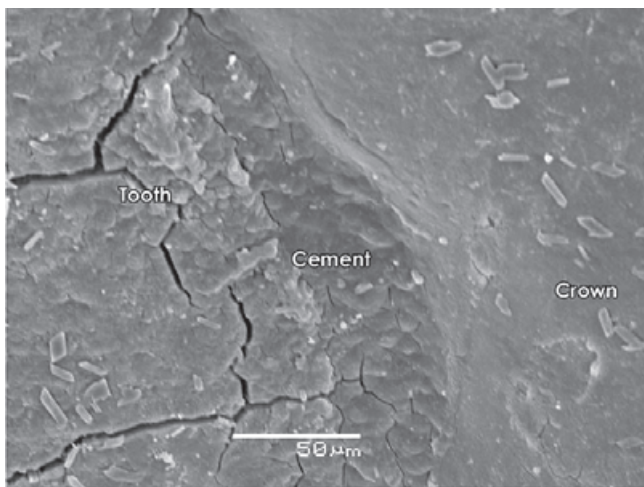


Figure 2 - Interface magnified 50 times. Average interface line of 40.82 μm

Conclusion

The aim of this study was to include the difficulties inherent to the preparation, moulding and cementation of the prosthetic piece in the analysis of the marginal adaptation of fibreglass reinforced resin (Ivoclar-Vivadent system). Considering the results obtained, it can be concluded that the system is a good option for the reestablishment of dental crowns, since it complies with the requirements for good marginal adaptation, diminishing the possibilities of infiltration and recurring caries.

References

- Behr M, Rosentritt M, Sikora MI, Karl P, Handel G. Marginal adaptation and fracture resistance of adhesively luted glass fibre-composite reinforced molar crowns with different inner crown surfaces. *Journal of Dentistry*. 2003;31(7):503-8.
- Boening KW, Wolf BH, Schmidt AE, Kastner K, Walter MH. Clinical fit of Procera AllCeram crowns. *The Journal of Prosthetic Dentistry*. 2000;84(4):419-24.
- Bottino MA. Estética em reabilitação oral metal-free. São Paulo: Artes Médicas; 2000.
- Cho L, Song H, Koak j, Heo S. Marginal accuracy and fracture strength of ceromer/fiber-reinforced composite crowns: effect of variations in preparation design. *The Journal of Prosthetic Dentistry*. 2002;88(4):388-95.
- Kolbeck C, Rosentritt M, Behr M, Lang R, Handel G. In vitro examination of the fracture strength of 3 different fiber-reinforced composite and 1 all-ceramic posterior inlay fixed partial denture systems. *Journal of Prosthodontic*. 2002;11(4):248-53.
- Cho L, Choi JM, Yi YJ, Park CJ. Effect of finish line variants on marginal accuracy and fracture strength of ceramic optimized polymer/fiber-reinforced composite crowns. *The Journal of Prosthetic Dentistry*. 2004;91(6):554-60.
- Monaco C, Krejci I, Bortolotto T, Perakids N, Ferrari M, Scotti R. Marginal adaptation of 1 fiber-reinforced composite and 2 all-ceramic inlay fixed partial denture systems. *International Journal of Prosthodontics*. 2006;19(3):373-82.
- Pegararo LF, Valle AL, Araújo CR, Bonfante G, Conti PCR, Bonschela V. *Prótese fixa*. São Paulo: Artes Médicas; 1998 (EAP APCD).
- Ricci, WA. Adaptação marginal em coroas ceramocerâmicas. *Revista Gaúcha de Odontologia*. 2003;51(3):7-10.
- Shillingburg HT, Hobo S, Fisher DW. Preparation design and margin distortion in porcelain-fused-to-metal restorations. *The Journal of Prosthetic Dentistry*. 2003;89(6):527-32.
- Yeo IS, Yang JH, Lee JB. In vitro marginal fit of three all-ceramic crown systems. *The Journal of Prosthetic Dentistry*. 2003;90(5):459-64.