Rehabilitation of periodontally compromised teeth with fiber-reinforced composite resin: A case report

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The rehabilitation of prosthetic spaces resulting from severe periodontitis represents a challenge in terms of functional and esthetic aspects. Generally, tooth extraction is followed by alveolar ridge volume reduction, which increases the esthetic problem. The aim of this article is to report the integration of esthetics and functional parameters in the oral rehabilitation of extracted periodontally compromised mandibular central incisors through the construction of a direct glass fiber–reinforced composite fixed partial denture (DFPD). After periodontal therapy, the patient received a periodontal subepithelial graft, enabling an increase in the thickness and height of the alveolar ridge. The DFPD was fabricated with the use of extracted teeth. Mandibular canines and lateral incisors received cavities 2 mm deep and wide. After fiber insertion, tooth adaptation, and composite resin coverage, the teeth were finished and polished. Results showed an excellent esthetic result with stabilization and function of the remaining periodontally affected teeth. *(Quintessence Int 2011;42:113–120)*

Key words: adhesion, fiber-reinforced composite fixed partial dentures, rehabilitation, subepithelial tissue graft, tooth splinting

The esthetic, anatomical, and functional reestablishment of missing teeth associated with the promotion of support and protection for periodontal structures has always been a challenge. For years, construction of conventional partial prostheses was the only treatment option for prosthetic spaces. In the 1970s, a new type of fixed partial prosthesis based on enamel adhesion principles and the evolution of composite resin was developed to replace a single missing tooth. Initially, the inclusion of steel wires, metal pins, or bars was recommended for retention and strength. However, these materials had no chemical interaction with composite resin, resulting in stress concentrations[1] and a tendency to fail when subjected to masticatory forces.[2]

Composite combined with fiber-reinforced materials seems to better comply with tension stress supporting requirements and adhesion principles.[1] Glass fibers have been extensively studied in terms of flexural properties, surface treatments, fiber volume, and position inside prosthesis structure.[3,4] Effectiveness of glass fiber reinforcement of dental composites is related to knowledge

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Fig 1 Initial clinical aspect of the patient showing an aggressive periodontal disease.

of adhesion and mechanical principles. The use of the greatest quantity of fibers at tension stress regions in a direction perpendicular to the applied forces results in the highest reinforcing effect.[3,5–7] Besides the clinical indications for the infrastructure of fixed partial prostheses, glass fibers are often recommended for periodontal splinting.[8] Glass fiber–reinforced composite fixed partial dentures can be manufactured by direct, semidirect, or indirect techniques.[8] Direct techniques eliminate laboratory procedures, so the prosthesis can be placed in a single session by the use of acrylic teeth,[9] composite resin teeth,[8] or natural teeth extracted from the patient.[10]

The aim of this article is to report the integration of esthetics and functional parameters in an oral rehabilitation of periodontally compromised mandibular left and right central incisors through the construction of a direct glass fiber–reinforced composite fixed partial denture (DFPD).

CASE REPORT

A 34-year-old woman came to the dental school of Paranaense University. Clinical, radiographic, and periodontal examinations diagnosed generalized aggressive periodontitis (Figs 1 and 2). Both mandibular central incisors were extracted due to a lack of bone support (Fig 2) and were refrigerated in saline. The patient's oral hygiene was checked, and periodontal therapy was initiated. Forty-five days later (Figs 3a and 3b), the teeth adjacent to the prosthetic space were diagnosed with level II mobility (according to the Miller index for tooth mobility). To rehabilitate the space and create a periodontal splint for the remaining teeth, the clinicians proposed that the patient's extracted teeth be used in a direct fixed partial adhesive prosthesis, reinforced with resin-impregnated glass fibers (Interlig). However, because bone support and the soft tissue around the surgery area reduced in volume after healing (Figs 3a and 3b), periodontal surgery was necessary to increase the thickness and height of the alveolar ridge (Figs 3c and 3d).

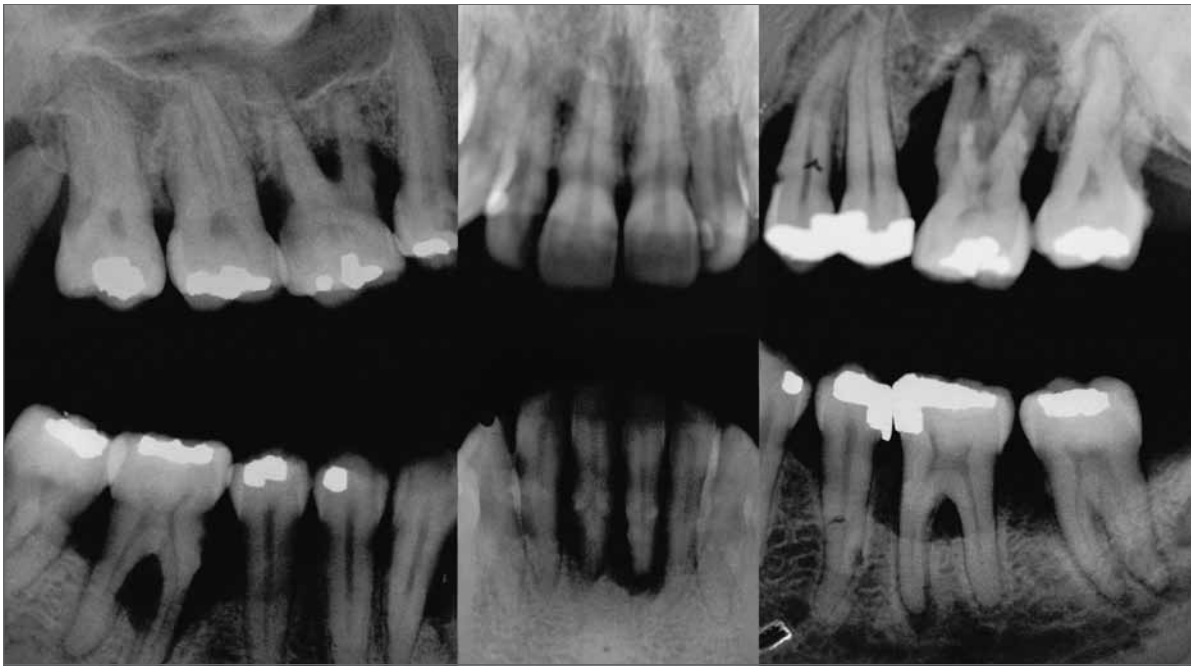

Fig 2 Full-mouth periapical radiograph examination showing generalized loss of bone support and loss of function for the mandibular central incisors and maxillary left first molar.

Fig 3 *(a and b)* Clinical views after extraction of the mandibular central incisors and periodontal treatment showing improvement of periodontal conditions but reduction of height and thickness of marginal ridges. *(c and d)* Healing 90 days after supepithelial tissue graft insertion, showing improvement of marginal ridge.

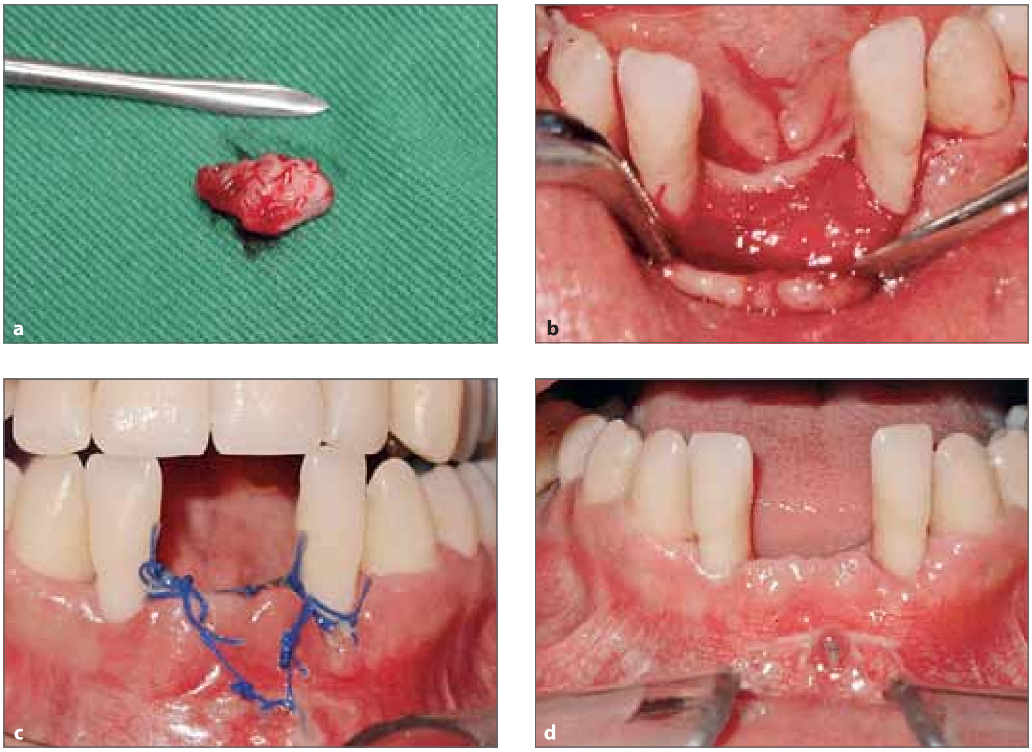

Fig 4 *(a)* Subepithelial tissue graft removed from the area around the maxillary left first molar. *(b)* Preparation of the area to receive tissue graft. *(c)* Immediately after surgery. *(d)* Ninety days after surgery.

Periodontal surgery

A subepithelial tissue graft (Fig 4a) was inserted in the region corresponding to the extracted teeth (Figs 4b and 4c). The donor region was the palatal tissue around the maxillary left first molar. Ninety days after periodontal surgery (Fig 4d), the prosthetic restorative treatment was accomplished.

Direct adhesive restorative procedure for DFPD

The cavity preparations for DFPD were limited to the creation of space for fiber insertion and composite resin coverage (1-mm layer over the fibers). In general, a 2-mm cavity is enough to accommodate fibers and composite resin, but cavity width depends on fiber width. In the present case, a resin-impregnated glass fiber (Interlig) 2 mm wide was employed. Cavity preparations were made at the lingual surfaces of the mandibular right and left canines and lateral incisors at the cervicoincisal height corresponding to the proximal contacts with a spherical diamond bur (#1016, KG Sorensen) (Fig 5a).

The extracted teeth were endodontically prepared and adhesively filled with a microhybrid composite resin (Filtek Z250, 3M ESPE). The teeth were then sectioned to fit the vertical space from marginal ridges to incisal plane (Fig 5b). Cavity preparations were also made to increase the area for adhesion with glass fibers (Fig 5c).

Retainers and extracted teeth were conditioned with 37% phosphoric acid (Denstply) for 15 seconds, washed, and gently dried. An adhesive system (Scotchbond Multi-Purpose, 3M ESPE) was applied according to the manufacturer's instructions and pho-

Fig 5 *(a)* Removal of the excess of crown portion to fit exactly the vertical space from marginal ridge to incisal plane. *(b)* Cavity preparation of extracted teeth to increase the area for adhesion with glass fibers. (c) Cavity preparation 2-mm deep in remaining teeth (mandibular left and right canines and lateral incisors. *(d)* Glass fiber inserted by adhesive technique.

topolymerized with a halogen light source (Optilight II, Gnatus) for 20 seconds at 700 mW/cm². A small portion of a microhybrid composite resin (Filtek Z250) was inserted in all retainers and extracted teeth, and the glass fiber strip was adjusted on it for perfect adaptation and contour (Fig 5d). Only then were the composite resin and fiber strip light cured for 40 seconds on the lingual surfaces of each tooth. For total fulfillment of preparations and fiber coverage, new composite resin increments were inserted and light cured for 40 seconds.

The immediate finishing was performed with a #12 scalpel blade; incisal contact adjustment was accomplished with #1190F and #3168F diamond burs (KG Sorensen) following aluminum oxide sandpaper discs (Sof Lex, 3M ESPE). The final polishment was performed with abrasive siliconized rubber for finishing and polishing (KG Sorensen).

Clinical outcome

Periodontal therapy was effective for reestablishing oral health (Figs 3a and 3b), but for the final esthetic results, corrections in height and thickness of marginal ridges were necessary and were accomplished with a subepithelial graft. Ninety days postsurgery, the patient returned with better conditions because of the prosthetic treatment (see Figs 3c and 3d). Excellent esthetics and function were obtained with the use of extracted teeth on a DFPD (Fig 6a). The teeth that had shown periodontal mobility (mandibular left and right canines and lateral incisors) were splinted. The periodontal tissues showed clear signs of health and improved esthetics at the pontic region, as could be seen 60 days after rehabilitation (Fig 6b). In addition, oral hygiene could be easily practiced by the patient (Figs 6c and 6d).

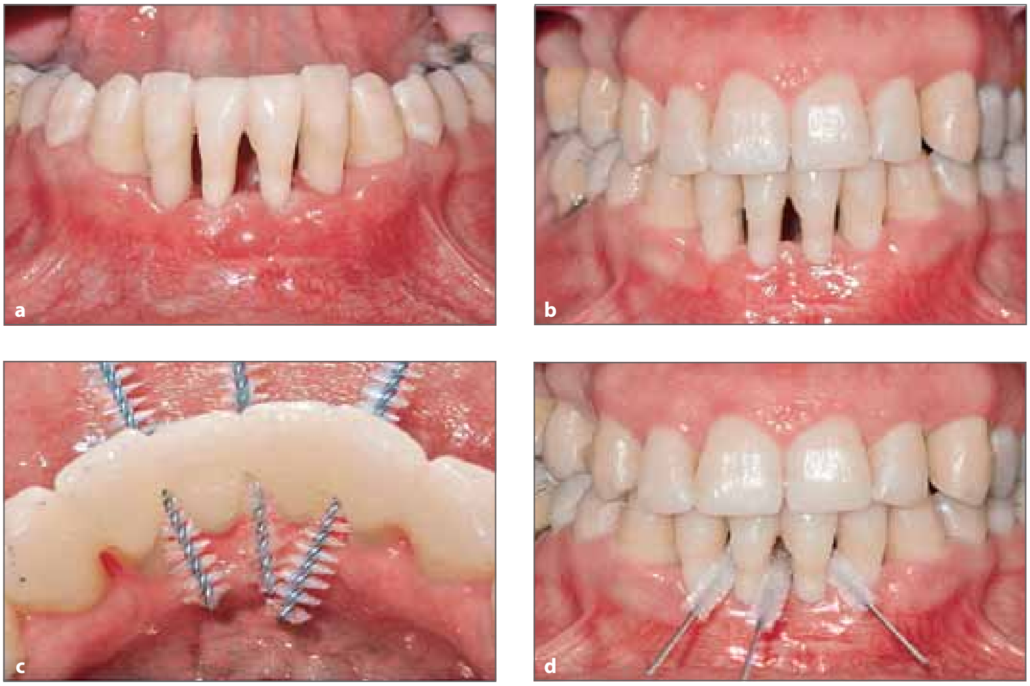

Fig 6 *(a)* Immediate clinical view of completed oral rehabilitation. *(b)* Sixty days after rehabilitation procedures showing accommodation of periodontal tissues and consequent prosthesis esthetics. *(c and d)* Easy hygiene access.

DISCUSSION

Considering the present prosthetic rehabilitation, the use of the patient's extracted teeth in a DFPD structure was considered due to esthetic and functional possibilities, as well as the patient's economic psychologic status. In addition, the need for periodontal splinting of anterior mandibular teeth adjacent to the prosthetic space added to the reasons for this therapy. In spite of the fact that direct prostheses are not always considered full definitive treatment options, the above listed advantages resulted in a reasonable alternative. Conventional fixed prostheses need greater tooth structure removal of crown preparations and are also more expensive, thereby limiting their clinical indication. In the present case, the restorative treatment could be categorized as a periodontal prosthesis[9]; this esthetic solution for missing teeth promotes better support for the remaining periodontally affected teeth.

In the past, the clinical longevity of direct adhesive fixed partial prostheses was poor. Detachment was common under normal occlusal forces due to inefficient interaction between metals and composite resin.[2] In a mechanical analysis of the stress distribution on inlay-anchored adhesive fixed partial dentures, Magne et al[1] showed that metal structures tend to present high levels of interfacial stress at the adhesive interface, which contributes to failure. The unique material that enabled the production of a uniform compression of the adhesive interface under functional loading was unreinforced composite. However, as a brittle material with low fracture strength,[11] composite alone cannot withstand occlusal forces in load-bearing situations, which makes the use of a strengthening mechanism necessary.

The association between glass fibers and composite resins on glass fiber reinforced composite prostheses (FRCPs) can support high load-bearing situations. Behr et al[12] showed control groups of FRCPs supporting loads of 396 to 556 N, and Song et al[13] showed values from 885 to 1779 N with modification of preparation design and pontic distance. These values are well above the maximum chewing force measured in young patients with natural dentitions (~400 N).[14] Recommendations to use these fiber-reinforced composites are based on the facts that they are able to adhere to the mineralized dental substrates, the framework material has a physiologic stiffness, and it also contributes to an improvement of esthetics.[15] These mechanical properties and adhesion capabilities enable better stress distribution.[1,16]

The clinical success of FRCPs can be accessed by overall survival rates (success until first debond) and functional survival rates (success even after rebonding). Studies tend to consider framework fracture as treatment failure. In a clinical study of the first generation of FRCPs, Vallittu and Sevelius[15] showed a 93% survival rate after 24 months of follow-up of one- to three-pontics prostheses; high survival rates have also been reported in short-term studies (100% at 12 months for three-unit FRCPs)[17] or relative long-term ones (95% at 4.3 years;[18] 75% at 5.25 years[19]). In some situations, the framework integrity is minimally affected, enabling rebonding or repairing. In this situation, the success rate increases from 75% to 95% at 5.25 years.[19] Freilich et al[18] reported few changes in any clinical parameters from baseline to 48 months, and Vallittu[19] considered a mean survival time of 55 months. In comparison, metal-framework adhesive fixed prosthesis overall survival rate was 61% and functional survival rate of 76% in long-term follow-up (11 years).[20] Some important parameters can be considered during patient follow-up: surface integrity, anatomical contour, marginal integrity, and structural integrity.[18]

Important factors influencing the mechanical properties of fiber-reinforced composites include inherent material properties of fibers and polymer matrices; fiber surface treatment and impregnation of fibers with resin; adhesion of fibers to the polymer matrix; quantity of fibers; direction of fibers; position of fibers; and water sorption of FRC matrix.[3,4,8] Regardless, data from clinical studies show that survival is associated primarily with substructure design volume.[18,19] The more fibers included in a prosthesis framework, the better it will be. Because most fractures occur at the pontic-retainer union, it is especially desired that fibers be placed in great volume at the tension side and perpendicular to applied forces, becoming most effective on increasing the load to fracture.[3] Box-shaped tooth preparations tend to increase the cervico-occlusal space for fiber accommodation.[13]

The periodontal surgical treatment with subepithelial tissue graft was necessary to promote health and esthetics and increase treatment longevity. Furthermore, it provided the increase in volume of the ridge, addressing vestibular depression areas and promoting the conditioning of regional gingival tissue. Due to their low costs, DFPDs seem better indicated in patients with favorable occlusal conditions. Since occlusal instability can be a great problem for periodontally affected patients, the use of DFPD can stabilize occlusal condition while reducing risks of tooth loss.[21] Sakagami and Kato[22] showed that patients with severe periodontitis have poor occlusal conditions that might have been triggered by the instability of centric occlusion due to attachment loss.[21] The present case supports the possibility of optimal esthetics and function with a low-cost prosthetic treatment alternative, but the correct indication seems mandatory for long-term success in patients with loss of bone support.

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