"Biological Restoration": Root Canal and Coronal Reconstruction

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ABSTRACT

Anterior tooth fracture, as a result of traumatic injuries, frequently occurs in dentistry. Proper reconstruction of extensively damaged teeth can be achieved through the fragment reattachment procedure known as "Biological Restoration." This case report refers to the esthetics and functional recovery of extensively damaged central maxillary incisors through the preparation and adhesive cementation of "Biological Posts and Crowns" in a young patient. Both biological posts and crowns—post and dental fragment obtained through natural, extracted teeth from another individual—represent a low-cost option and alternative technique for the morphofunctional recovery of extensively damaged anterior teeth.

CLINICAL SIGNIFICANCE

The biological restorations are an alternative technique for reconstruction of extensively damaged teeth that provides highly functional and esthetic outcomes.

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INTRODUCTION

Anterior tooth fracture, as a result of traumatic injuries, frequently occurs in dental clinics, with prevalence of 8.1 in 1,000 children examined.[1] This fact is commonly related to sports, leisure activities, and caries lesions, thus causing functional, esthetic, and psychosocial problems[2–4] in addition to reducing the patient's quality of life.[5]

A satisfactory smile can be achieved by using several techniques and esthetic materials, such as resin and porcelain. Over the past decades, dentistry has achieved great scientific and technological advances regarding restorative and adhesive materials. Nevertheless, to date, no restorative material has been more effective than the properties of the natural dental structures themselves.[6–8] Several authors have suggested the use of natural teeth fragments as an efficient method for restoring fractured anterior teeth.[4,6,9–21] When the patient

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presents the fragment in good condition, this procedure presents optimal results in the restoration of fractured teeth (autogenous bonding).[6,11,12] However, when the patient does not present the fragment, or its use is not recommended, donated extracted teeth (homogeneous bonding) can be used. Fragment reattachment using natural teeth is a technique known as "Biological Restoration" and provides excellent results regarding surface smoothness, esthetics, and the maintenance of the incisal guide in dental structures that cause physiological wear.[4,7,9,12–17] The combination of dental fragments, adhesives, and restorative materials that are commercially available today provides a good functional and esthetic result, connecting these properties within an alternative treatment in the restoration of extensively damaged fractured teeth.[4,17,18]

A proper coronary reconstruction that produces satisfactory esthetic and functional conditions for endodontically treated and extensively damaged teeth is still a challenge for restorative dentistry, considering that, to achieve these conditions, the making of an intracanal retention, aimed at a better retention and stability of the dental fragments, becomes imperative. This retention can be performed by using posts made from several materials,[7,8,22,23] such as fiberglass, carbon fiber, metal, and ceramic. However, no commercially available premanufactured post meets all ideal biological and mechanical properties.[8] The use of biological posts made from natural, extracted teeth represents a feasible option for the strengthening of the root canal, thus presenting the potential advantages: (1) does not promote dentin stress, (2) preserves the internal dentin walls of the root canal, (3) presents total biocompatibility and adapts to conduct configuration, favoring greater tooth strength and greater retention of these posts as compared to premanufactured posts, (4) presents resilience comparable to the original tooth, and (5) offers excellent adhesion to the tooth structure and composite resin and at a low cost.[7,8,21,23]

The use of natural, extracted teeth (homogeneous bonding) for restorations does, however, present limitations, such as the difficulty of finding teeth with a similar color and shape as that of the destroyed element, or the patient may refuse to accept a tooth fragment obtained from another patient, which prevents the execution of the restoration.[6,10,14]

The following study describes a clinical case performed by means of "Biological Restoration" using homogeneous fragment bonding associated with biological posts, both obtained from natural, extracted teeth, aimed at the esthetic and functional reconstruction of extensively damaged and/or fractured central maxillary incisors.

CASE REPORT

A 23-year-old man was referred to the Dentistry Clinic at Federal University of the Valleys of Jequitinhonha and Mucuri—Diamantina, Brazil, presenting crown fractures in right and left maxillary central incisors due to a fall. The clinical and radiographic examinations revealed that both fractured teeth had suffered a loss of tooth structure extending to the cervical third as well as an exposure of the root canals and pulp necrosis (Figure 1).

Proposed treatment to restore both maxillary central incisors included intraradicular biological posts made from the roots cutting of extracted and properly sterilized canines as well as the subsequent crown adaptation of central maxillary incisors that had been previously extracted and donated. The patient received instructions regarding the advantages and disadvantages of biological restoration as well as information on other treatment options. After agreeing upon the proposed treatment, a consent form was duly signed. In addition, it was made clear to the patient that the post and the crown would be obtained

from natural, extracted teeth that had been previously sterilized by autoclaving in accordance with biosecurity standards.

First, all carious tissues were removed, followed by endodontic treatment. The restoration technique initially consisted of the preparation of the root canals and their direct molding using addition silicone (ADSIL, Vigodent SA, Rio de Janeiro, Brazil) (Figure 2).

The Making of Dentin Posts

After having established the plaster model, the extracted, donated canines, after having been autoclaved at 121°C for 15 minutes,[25] were selected to construct the posts. Using a diamond disk, the crown portion was separated from a portion of the root, and the root was sectioned mesiodistally along the long axis of the tooth. The cement was removed by abrasion, using diamond drills, and each part of the root was cut in such a way as to form "Biological Posts." Previously acrylic resin molds (Duralay, Reliance Dental Mfg. Co., Worth, IL, USA) for each canal involved were obtained molding the plaster model and used as references orienting shape, thickness, and length of the dentin post (Figure 3A–C).

Adaptation and Cementing of Posts to Root Canals

After the intraradicular posts had been cut and suitably adapted to the plaster model; they were then conditioned with 37% phosphoric acid for 30 seconds, followed by the washing, drying, and application of the adhesive system (ADPER SINGLE BOND 2, 3M ESPE, CA, USA). The posts were taken to the plaster model, which had been previously isolated, along with self-cured resin cement (C & B Cement, Bisco, Schaumburg, IL, USA), so as to facilitate the angle of insertion as well as the adaptation of these posts within the canal during the cementing stage

Figure 1. Initial clinical presentation of both maxillary anterior fractured teeth.

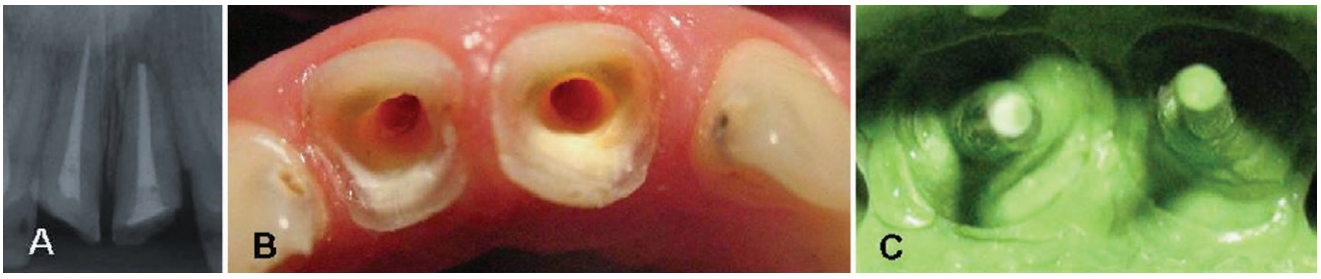

Figure 2. A, *Radiographic aspect of endodontic treatment.* B, *Preparation of canals.* C, *Anterior region mold with addition-type silicone.*

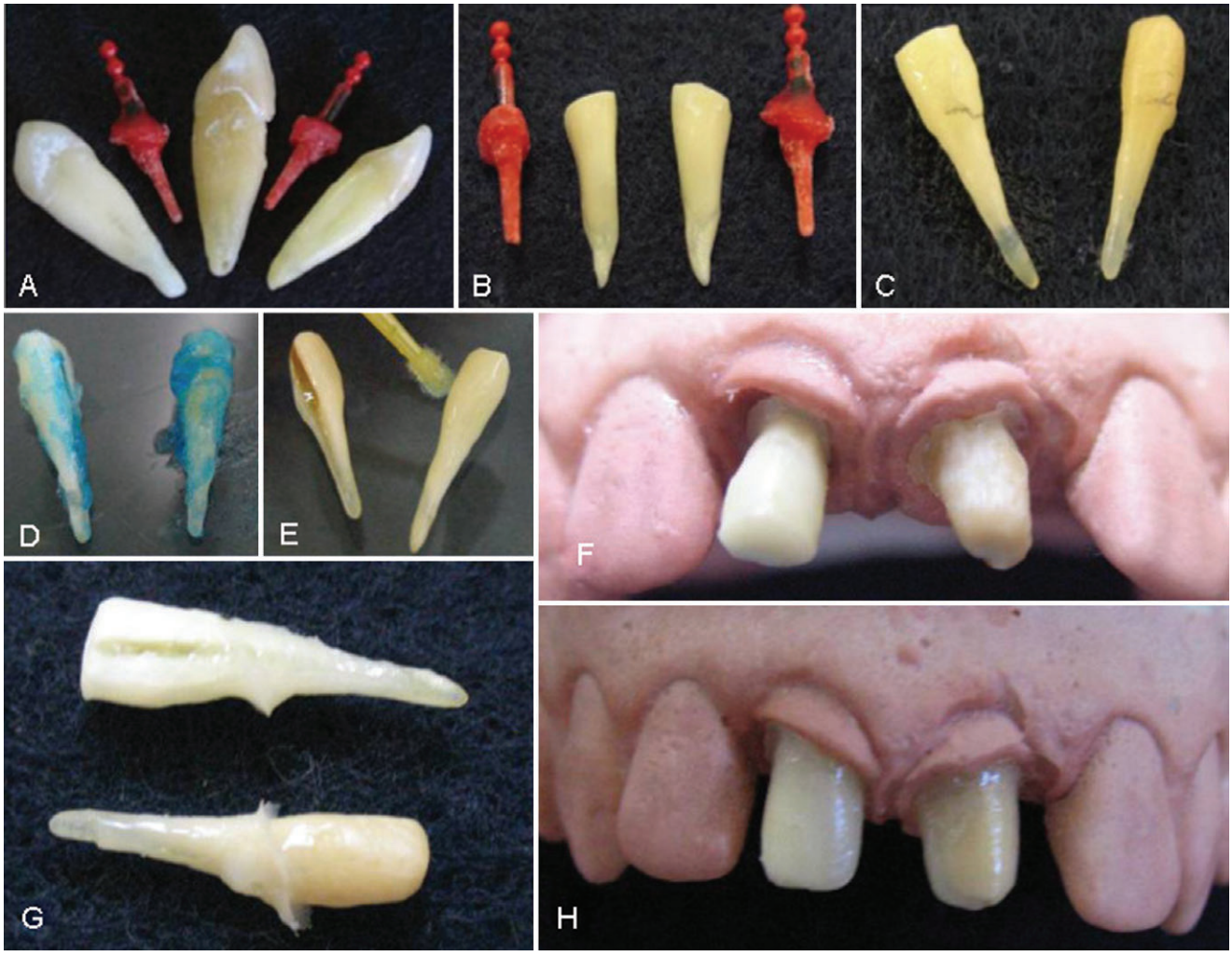

Figure 3. A, *Selected canine teeth.* B, *Radicular sections after cement removal and acrylic resin molds (Duralay) from each canal involved.* C, *"Biological Posts" ready after cutting.* D, *Application of 37% phosphoric acid.* E, *Application of adhesive system.* F, *Post taken to the plaster model with resin cement.* G, *Readapted post.* H, *Filling nucleus made up of photopolymerizable composite resin.*

(Figure 3D–G). A filling nucleus was built on the portion of the post located on the external portion of the canal using a photopolymerizable composite resin (Z250, 3M ESPE, USA) (Figure 3H). After confirming the satisfactory adaptation of the posts to the canals, through clinical and radiographic analyses, the cementing stage was begun. The posts and the inner portion of the canals were conditioned with 37% phosphoric acid for 15 seconds. Next, the adhesive system (ADPER SINGLE BOND 2, 3M ESPE) was applied and the post was polymerized. The self-cured resin cement (C & B Cement, Bisco) was applied to the inner portion of the canals with the help of a lentulo spiral and lightly applied to the surface of the posts, which were then inserted

into the canals under constant digital pressure until the end of the cement polymerization.

Preparation and Molding of the Crown Portions and Model Construction

The crown portions were prepared presenting a chamfered cervical end (Figure 4A,B), mainly in enamel, and molded with addition silicone (ADSIL, Vigodent). Later, provisionary restorations were made using denture teeth and autopolymerizable acrylic resin (Figure 4C,D). The special plaster model with removable die and the antagonist region model were set up in a semi-adjustable articulator serving as a guide to select and adjust the "Biological Crowns" obtained from extracted teeth.

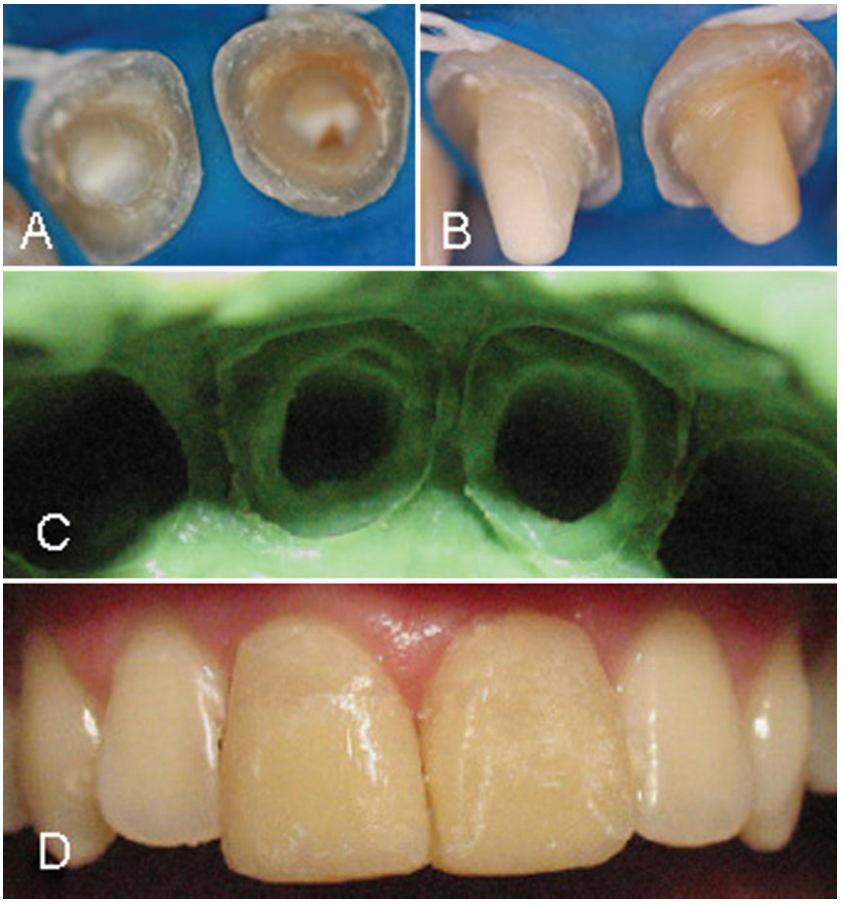

Figure 4. A and B, *Crown portions prepared presenting a chamfered cervical end;* C, *Mold of crown portions prepared with addition-type silicone.* D, *Provisionary restoration with autopolymerizable acrylic resin.*

The Making of "Biological Crowns"

After having created the model, the teeth that were preselected to make "Biological Crowns" were autoclaved at 121°C for 15 minutes and worn, both internally as well as on the cervical portion, using a diamond tip under intense cooling until adapting to the model (Figure 5A,B). To ensure a good adaptation, the cut crowns underwent cervical re-adaptation using a light-cured hybrid composite resin (Z250, 3M ESPE) in the models after applying the adhesive system ADPER SINGLE BOND 2, 3M ESPE) (Figure 5C–F).

Cementation of "Biological Crowns"

In the final clinical session, the correct adaptation of the biological crowns on the remaining teeth was checked and the necessary adjustments were performed (Figure 6A,B). After the coronary portion of the remaining tooth and the inner part of the crown had been conditioned with 37% phosphoric acid for 30 seconds, washed, and dried, and the adhesive system (ADPER SINGLE BOND 2, 3M ESPE) had been applied, the crowns were filled with the self-cured resin cement (C & B Cement, Bisco), brought into position, and maintained under digital pressure until the polymerization of the cement had been completed (Figure 6C–G). Finally, occlusion interference

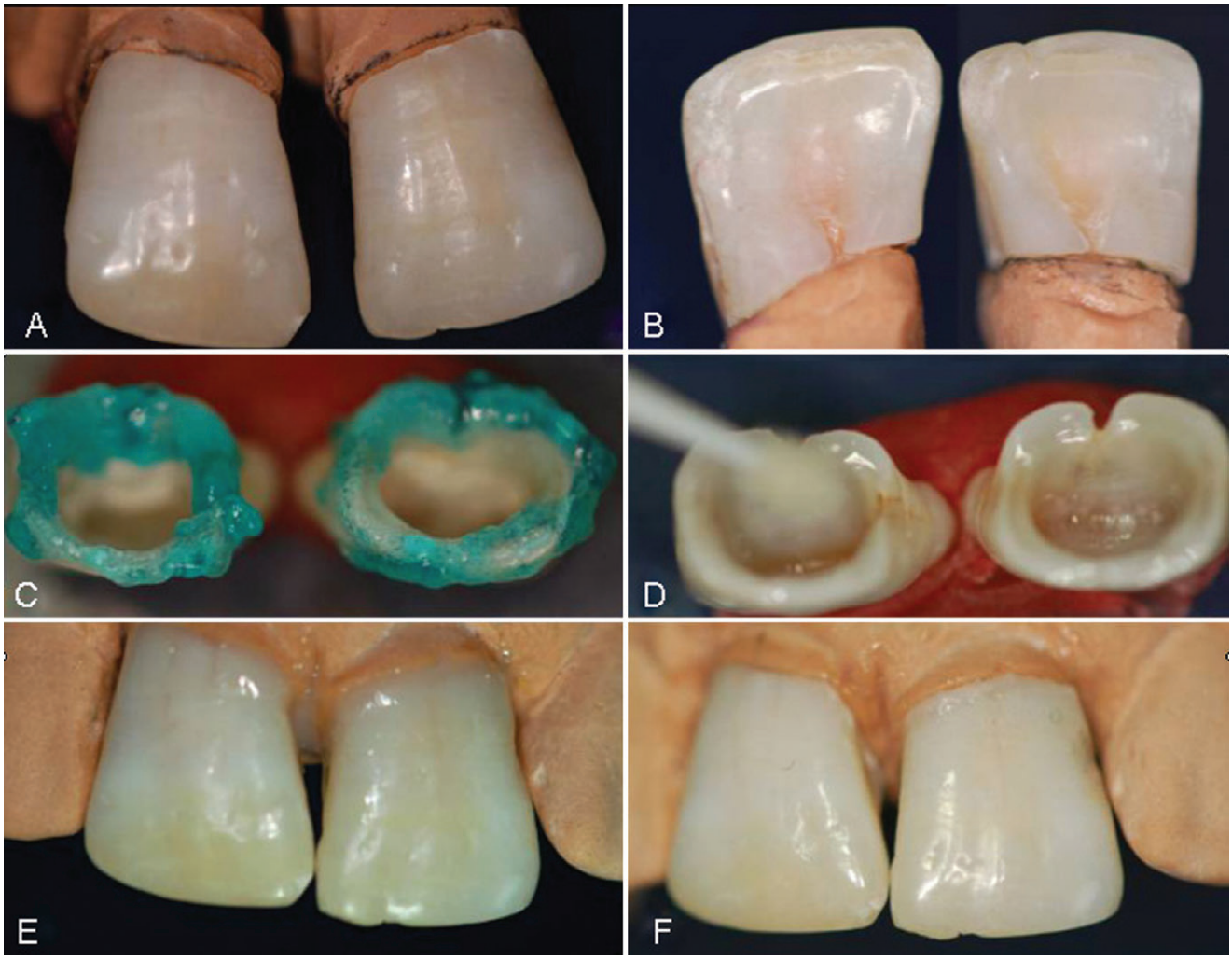

*Figure 5. Vestibular (*A*) and palatine (*B*) adaptation aspect of Biological Crowns to the model.* C,D,E and F, *Re-adaptation of Biological Crown on plaster model:* C, *Application of 37% phosphoric acid;* D, *Application of adhesive system;* E, *Re-adaptation of resin cement;* F, *Cervical re-adaptation to model.*

checks, necessary adjustments, and instructions to the patient regarding hygiene and diet were carried out (Figures 7 and 8). After 1 year follow-up, the clinical and radiographic findings showed that the adaptation of crowns and posts, the esthetics, and the tooth function have remained preserved (Figure 9).

DISCUSSION

Fragment reattachment, as compared to conventional adhesive restorations, is the technique preferred by clinicians when an anterior tooth fracture has occurred, as it presents several advantages when assessing the recovery of tooth function and esthetics.[3,4,6,16,17] This report presents the restorations of the teeth 11 and 21 using biological posts and crowns made from natural, extracted teeth because the patient had not found the original tooth fragments. The teeth were obtained from the Surgery Clinic of Federal University of the Valleys of Jequitinhonha and Mucuri

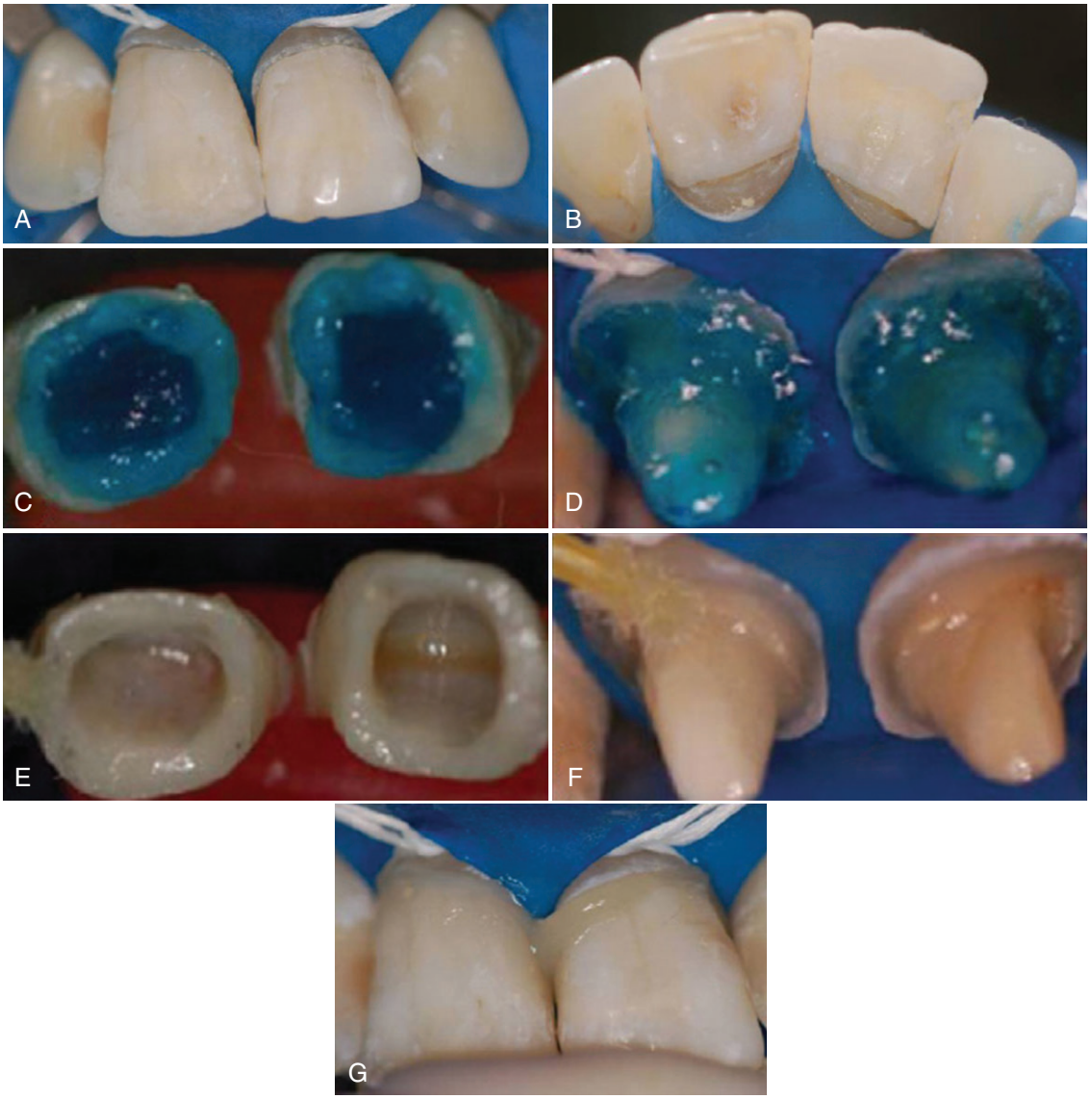

*Figure 6. Vestibular (*A*) and palatine (*B*) aspect of the adaptation of biological crowns. Acid conditioning (*C *and* D*) and adhesive system application (*E *and* F*) of biological crowns and crown portions prepared in both central incisors, respectively;* G, *Cementing.*

(UFVJM) where patients donate teeth by signing a consent form and a term of donation. It is important to note that, before the manipulation of any of these extracted dental elements, the teeth were properly cleaned, stored, and sterilized by autoclaving at 121°C for 15 minutes, ensuring all biosecurity standards.[25]

Nevertheless, selecting teeth with a color and shape that is compatible with the dental elements to be restored presented a barrier to performing the biological restoration

Figure 7. A, B, and C, *Final clinical and radiographic presentation of crowns immediately after cementing and adjustment of occlusion.*

technique. This is due to the fact that the extraction of healthy anterior maxillary teeth is quite uncommon. This, however, could be minimized by using Tooth Banks—nonprofit institutions that store and provide teeth for didactic, clinical, and scientific use.[25]

In the present case study, since the coronary destruction extended to the cervical third, intraradicular reinforcement was deemed necessary to provide retention and

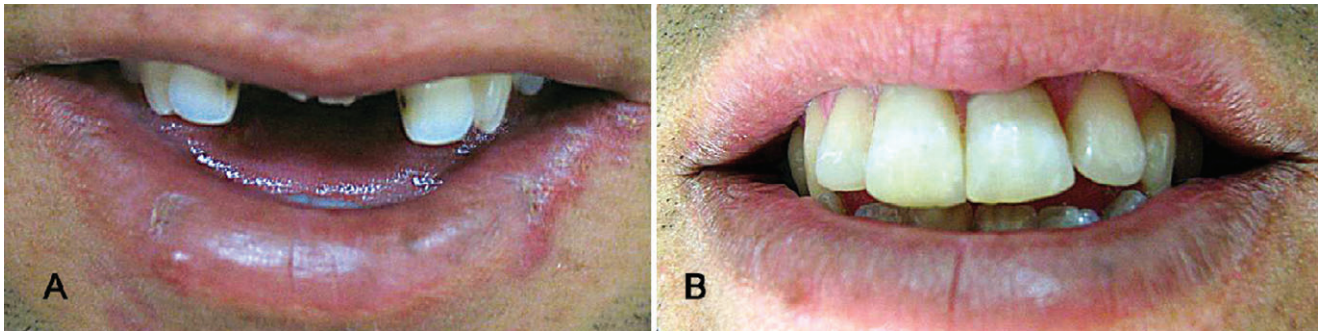

Figure 8. A, *Initial aspect of smile.* B, *Final aspect of smile.*

*Figure 9. Control clinical (*A, B, *and* C*) and radiographic (*D*) aspect after 1 year.*

stability to the crowns. Dentin posts made from roots of extracted and donated canines were used, as they allow for a juxtaposed adaptation to the root canals and do not cause stress to the dentin, since they contain the same biomechanical behavior as the restored teeth.[7,8,22,24] The adhesion provided among the "Biological Post," the cementing agent, and the dental structure allows one to attain a sole biomechanical system (monoblock) with materials that are compatible among themselves.[8,24] The use of posts in teeth with great compromise of the dental structure allows the occlusal forces that will place pressure on the tooth to be better distributed throughout the root.[20] These facts call for a careful assessment of the patient's occlusion in the investigation of interference in protrusion movements and the presence of premature contacts, factors that can lead to the failure of the technique.

Although biological crowns return excellent esthetic and functional results to the fractured teeth (such as the smoothness and shine of the surface, anatomical contour, natural color, hardness, and resistance to wear), both the teeth and the posts require that the patient pay special attention to hygiene and dental care so as to avoid excessive pressure on the teeth, which could in turn cause fractures. Even if a longer period of time is spent by the clinician during the preparation and adaptation of the fragments,[12] these "Biological Restorations" take on special importance in restorative dentistry, especially since they are less expensive, which makes this practice a feasible option within Schools of Dentistry that attend mostly to people of a lower economic level.

The association between "Biological Crowns and Posts" offers excellent esthetic, functional, and psychosocial results, which justifies the use of this technique to achieve the morphofunctional recovery of extensively damaged teeth. However, further studies are called for to assess adhesion, fracture resistance, and the long-term behavior of the posts and crowns so as to better understand the benefits of the technique and make it a more acceptable practice among dentists and patients.

DISCLOSURE

The authors do not have any financial interest in the companies whose materials are included in this article.

REFERENCES

1. Andreasen JO, Ravn JJ. Epidemiology of traumatic dental injury to primary and permanent teeth in a Danish population sample. Int J Oral Surg 1972;1:235–9.
2. Petti S, Tarsitani G. Traumatic injuries to anterior teeth in Italian schoolchildren; prevalence and risk factors. Endod Dent Traumatol 1996;12:294–7.
3. Glendor U. Epidemiology of traumatic dental injuries—a 12 year review of the literature. Dent Traumatol 2008;24: 603–11.
4. Aguiar KCFM, Nascimento TN, Corona SAM, Dibb RGP. Homogeneous bonding, alternative technique for anterior teeth fracture. Rev Gaucha Odontol 2000;48:153–4 (in Portuguese).
5. Cortes MIS, Marcenes W, Sheiham A. Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12–14-year-old children. Community Dent Oral Epidemiol 2002;30:193–8.
6. Busato AL, Loguercio AD, Barbosa AN, et al. Biological restorations using tooth fragments. Am J Dent 1998;11:46–9.
7. Galindo VAC, Nogueira JSE, Yamasaki E, Kós Miranda D. Biological posts and natural crowns bonding—alternatives for anterior primary teeth restoration. J Bras Odontoped Odontol Bebe 2000;16:513–20 (in Portuguese).
8. Kaizer OB, Bonfante G, Pereira Filho LD, et al. Utilization of biological posts to reconstruct weakened roots. Rev Gaucha Odontol 2008;56:7–13 (in Portuguese).
9. Tavano KT, Botelho AM, Motta TP, Paes TM. Biological restoration: total crown anterior. Dent Traumatol 2009;25:535–40.
10. Gabrielli F, Dinelli W, Fontana UF, Porto CLA. A presentation and clinical assessment of a restoration technique in anterior teeth, with adaptated extracted teeth fragments. Rev Gaucha Odontol 1981;29:83–7 (in Portuguese).
11. Yilmaz Y, Zehir C, Eyboglu O, Belduz N. Evaluation of success in the reattachment of coronal fractures. Dent Traumatol 2008;24:151–8.
12. Demarco FF, Moura FRR, Tarquinio SBC, Lima FG. Reattachment using a fragment from an extracted tooth to treat complicated coronal fracture—case report. Dent Traumatol 2008;24:257–61.
13. Nogueira Filho GR, Machion L, Teixeira FB, et al. Reattachment of an autogenous tooth fragment in a fracture with biologic width violation: a case report. Quintessence Int 2002;33:181–4.

14. Busato ALS, Antunes M. Heterogeneous bonding in anterior fractured teeth. Rev Gaucha Odontol 1984;32:137–40 (in Portuguese).

15. Oz IA, Haytaç MC, Toroglu MS. Multidisciplinary approach to the rehabilitation of a crown-root fracture with original fragment for immediate esthetics: a case report with 4-year follow-up. Dent Traumatol 2006;22:48–52.

16. Reis A, Loguercio AD, Kraul A, Matson E. Reattachment of fractured teeth: a review of literature regarding techniques and materials. Oper Dent 2004;29: 226–33.

17. Baratieri LN, Ritter AV, Monteiro Junior S, de Mello Filho JC. Tooth fragment reattachment: an alternative for restoration of fractured anterior teeth. Pract Periodontics Aesthet Dent 1998;10: 115–25.

18. Macedo GV, Diaz PID, Fernandes CAO, Ritter AV. Reattachment of anterior teeth fragments: a conservative approach. J Esthet Restor Dent 2008;20:5–20.

19. Baratieri LN, Monteiro S Jr, Caldeira de Andrada MA. Tooth fracture reattachment: case reports. Quintessence Int 1990;21:261–70.

20. Andreasen FM, Noren JG, Andreasen JO, et al. Long-term survival of fragment bonding in the treatment of fractured crowns: a multicenter clinical study. Quintessence Int 1995;26:669–81.

21. Osborne JW, Lambert LR. Reattachment of fractured incisal tooth segment. Gen Dent 1985;33:516–7.

22. Imparato JCP, Bonecker MJS, Duarte DA, Guedes Pinto AC. Restorations in anterior primary teeth: an alternative technique through gluing of natural crowns. J Bras Odontoped Odontol Bebe 1998;1:63–72 (in Portuguese).

23. Cândido MSM, Pozzobon RT, Porto Neto ST. Esthetic resolution through heterogeneous bonding root-coronal, laminate and recontourn. J Bras Odontol Clin 1999;15:29–33 (in Portuguese).

24. Batista A, Lopes CG. Performed dentin post reinforcing teeth with immature apexes. Rev Bras Prot Clin Lab 1999;3:199–21 (in Portuguese).

25. Imparato JCP. Banks of human teeth. Curitiba: Editora Maio; 2003, 190 p. (in Portuguese).

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