

Fragment Reattachment Associated with Pulpotomy in a Posterior Tooth with Incomplete Root Formation

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Abstract - This article reports a case of preserving pulp vitality combined with aesthetics and functional reconstruction of an immature permanent molar extensively destroyed because of a carious lesion. After a pulpotomy using calcium hydroxide, the tooth crown was restored by bonding a dental fragment obtained from an extracted tooth from another individual. Aspects of diagnosis and treatment that directly affect the prognosis of the techniques are discussed. Radiographic and clinical follow-up for two years showed complete root development and a very satisfactory restoration with regard to aesthetics and function.

KEY WORDS: pulpotomy, calcium hydroxide, apexogenesis, dental bonding, molar.

INTRODUCTION

The choice of treatment to be instituted for extensive carious lesions is determined, among other factors, by the maturity level of the permanent tooth¹. In teeth with incomplete root formation, and that will not require intraradicular retention, the vitality of the remaining pulp tissue should be preserved whenever possible, allowing further root development with complete apical closure². One of the conservative therapies of choice is pulpotomy, which involves removal of the coronal pulp tissue and applying a protective and bioactive material directly over the dental pulp. This procedure induces the formation of a dentin barrier that when protected by a final restoration might prevent any subsequent penetration of bacteria and their by-products which could lead to irreversible damage to the pulp^{1,3}.

The restoration of the tooth after pulp therapy can be performed with aesthetic materials, such as composite resin and porcelain. Another option is the fragment reattachment obtained from extracted natural teeth, described sometimes as “biological restoration” or “homogeneous bonding”. This represents an alternative technique that uses adhesive capabilities of materials in combination with strategic placement of parts of duly donated and sterile extracted human permanent teeth^{4,6}. In 1991, Santos and Bianchi⁴ were the first to describe the bonding of tooth fragments in posterior teeth as an adequate alternative technique to conventional methods of restorative dentistry.

The technique has been used primarily in anterior fractured teeth showing good clinical performance and an excellent success rate^{7,8}. It is a low-cost procedure that allows preservation of the inherent properties of the tooth such as

surface smoothness and brightness, anatomic contouring, colour match, and physiologic wear^{9,10}. The aim of this report is to describe a case of pulpotomy and biological restoration in posterior permanent teeth with incomplete root formation.

CLINICAL CASE

Diagnosis and pulp therapy

A 14 year-old patient appeared at the Dentistry Clinic at Federal University of Vales do Jequitinhonha e Mucuri (UFVJM) – Diamantina/Brazil, complaining of pain induced by thermal stimuli on the lower right second molar - 47. Clinical examination revealed an extensive carious lesion involving the occlusal, lingual, and mesial dental surfaces (Figure 1A). Involvement of the coronal pulp, mild thickening of the lamina dura, and incomplete apex formation was observed radiographically (Figure 1B).

Considering the clinical and radiographic findings, the treatment recommended was pulpotomy and a coronal restoration made from a fragment obtained from an extracted tooth and bonded to the existing coronal tooth structure.

The carious tissue and the roof of the pulp chamber were completely removed under rubber dam. The coronal pulp, was removed with sharp curettes and after haemostasis, the pulp chamber floor was capped with calcium hydroxide/saline paste and the cavity was sealed with zinc oxide/eugenol cement (IRM).

After 45 days, the patient did not report any pain symptoms and the tooth responded positively to thermal pulp sensitivity testing. After anaesthesia and rubber dam placement, the temporary sealing was removed, and, with the help of a clinical probe, the formation of a hard tissue barrier was verified blocking the entrance of the root canals (Figure 2 A and B). Radiographic examination revealed restoration of the lamina dura (Figure 2 C). The barrier was protected with a thin layer of calcium hydroxide cement (Hydro-C)

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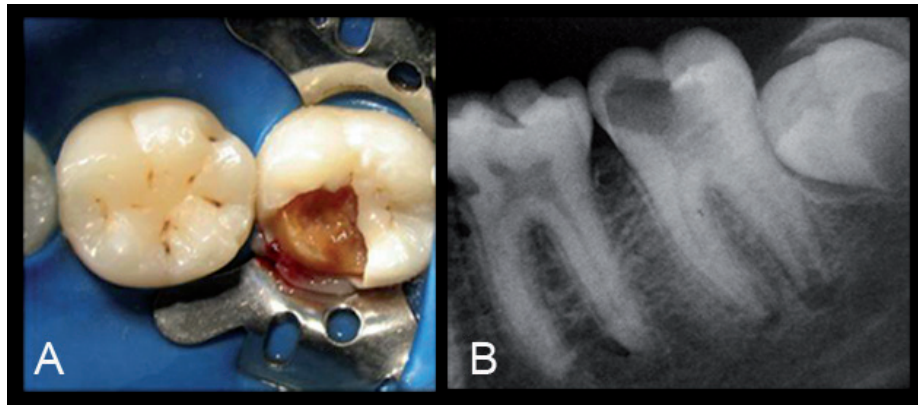


Figure 1. Initial clinical (A) and radiographic (B) presentation.

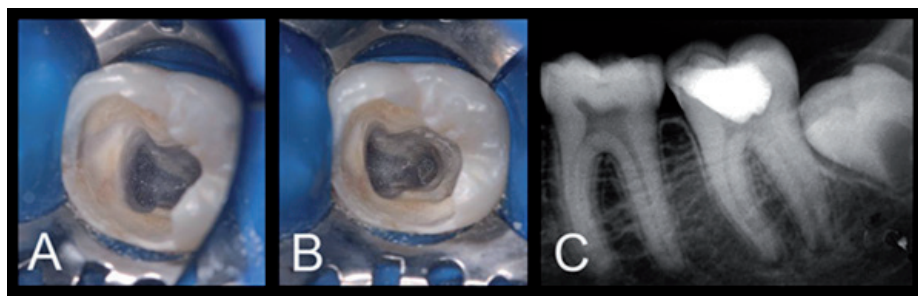


Figure 2. Pulp therapy follow-up. A and B – Dentin barrier blocking entrance of root canals; C- Radiographic aspect after 45 days.

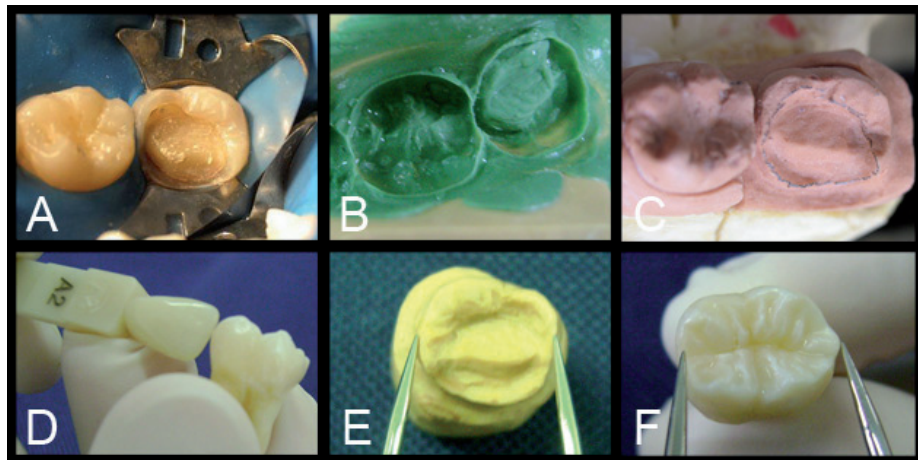


Figure 3. Cavity preparation, molding and obtaining the fragment. A-Tooth prepared; B- Posterior region mold with addition-type silicone; C- Plaster model; D, E and F- Selection of tooth with ideal characteristics.



Figure 4. Laboratory phase of fragment adaptation. A- Fragment suitable adapted; B- Occlusal adjustments of the re-adapted fragment; C- Fragment ready for cementation.

and the crown tooth was morphologically reconstructed with resin-reinforced glass ionomer (Vitremer).

Technique and restorative material choice and ethical aspects

The patient and legal guardian were informed about the need to restore the tooth permanently and about the techniques and materials available, among them the use of a dental fragment obtained from properly donated extracted teeth (Biological Restoration). When restoration is made with a porcelain prosthesis, the patient need to pay for the cost of laboratory, once it is outsourced and not at the university. Considering good aesthetic and functional outcome obtained with natural fragment reattachment and that there is no cost to the patient, we opted for this technique. Both the patient and his legal guardian were also informed about the ethical principles and tooth sterilization and a written consent was obtained.

Cavity preparation, moulding and obtaining the fragment

The cavity preparation was performed using diamond burs on the occlusal and buccal surfaces restricted to the region affected by caries (Figure 3A). At the same appointment, impressions of upper and lower dental arches were taken for study casts which were mounted (Figure 3 B and C) on a semi-adjustable articulator. An acrylic resin provisional restoration was made. An extracted third molar with suitable colour and size compatible with the tooth to be restored was selected (Figure 3 D, E and F) and autoclaved at 121° C for 15 minutes. Using a diamond disk, the root was separated from the coronal fragment, which was adjusted with diamond drills at high speed under water coolant until a suitable cavity adaptation was achieved (Figure 4A). Subsequently, the fragment was re-adapted with composite resin in the model to achieve better clinical adaptation and, occlusal adjustments were made to facilitate fitting clinically (Figure 4 B and C).

Cementation and follow-up

At the subsequent appointment, following rubber dam placement, the tooth was cleaned and dried to facilitate the cementing procedure. Both tooth and fragment were etched with 37% phosphoric acid for 30 seconds, then washed and dried (Figure 5 A, B and C), and an adhesive system (Adper Single BOND2) was applied to the cavity and the fragment and polymerized for 20s (Figure 5 D and E). The fragment was coated with an autopolymerising resin cement (C&B Cement) and placed in position until the cement was set. The excess cement was trimmed and the rubber dam removed. The occlusion was evaluated and adjusted with burs to avoid excessive occlusal force on the restoration (Figure 5 F, G and H). A periapical radiographic was taken immediately after completion of the procedure.

The patient received instructions regarding oral hygiene and the need for periodic evaluation. Follow-up was accomplished with pulp sensitivity testing and both clinical and radiological examinations. After one year, periapical radiological examination revealed complete root formation and there was a positive response to a sensitivity test by

cold (Endo-Ice; The Hygienic Corporation, Akron, OH, USA). Two years after fragment placement the colour and adaptation had been retained but a carious lesion was observed in the occlusal fissure. The carious tissue was removed and the cavity was restored with composite resin. The remaining pits and fissures were sealed (Figure 6 A-D).

DISCUSSION

This case report describes the pulpotomy and biological restoration as techniques for maintaining the pulp vitality and appearance and function recovery of a molar extensively destroyed by caries. One year after conservative pulp therapy with calcium hydroxide, complete root development was observed. The rich blood supply and immune defence capacity increase resistance to bacterial infection coming from decay progression or pulp exposure of teeth with open apex, allowing root development to be continued^{11,12}. Calcium hydroxide, in addition of having a low cost, has a long history as an effective pulp capping agent in pulpotomized teeth by reason of its ability to induce mineralized barrier formation^{13,14} detected in this case through visual inspection and probing. More recently, Mineral Trioxide Aggregate (MTA) has become an alternative material currently used in vital pulp procedures. MTA has demonstrated superior long-term sealing ability and stimulates a higher quality and greater amount of reparative dentin¹⁴. Despite the high success rate in comparison to traditional material of calcium hydroxide, using MTA as pulpotomy agent is expensive, and may represent a limitation for its routine use.

Biological restoration was the restorative technique chosen for this clinical case as it presents excellent aesthetic and functional outcomes^{7,15}. An advantage of using tooth fragments is the enamel's natural surface translucency and smoothness in addition to physiological wear. Moreover, a smaller amount of sound tooth structure is needed for cavity preparation and fragment reattachment and the biological restoration gives the patient the feeling of having a sound tooth¹⁶. In this case, the patient reported being very satisfied with the restorative treatment performed. However, the technique has limitations, such as difficulty related to the selection of teeth with colour and coronal dimensions similar to the tooth to be restored. In most cases, molar teeth present extensive carious lesion, thus preventing its use in obtaining fragments for restorative purpose. In such circumstances, an extracted third molar with required characteristics or teeth extracted due to periodontal disease can be used. In this case, the extracted teeth used in restorative techniques were obtained from the UFVJM surgery clinic, where patients donate their teeth and sign consent for their use. The ideal situation that could minimize these limitations would be to acquire human extracted teeth from Teeth Banks, which are non-profit institutions that store and provide teeth for didactic, clinical, and scientific use¹⁷.

As in any indirect restoration, the laboratory phase of obtaining and adapting the fragment is laborious and a critical step for successful treatment. The tooth used in this restoration was hydrated to minimise the possibility of fracture during fragment cutting is large. Clinically, there may be differences in colour and even a risk of impairing the adhesion of the cement agent since the dehydrated

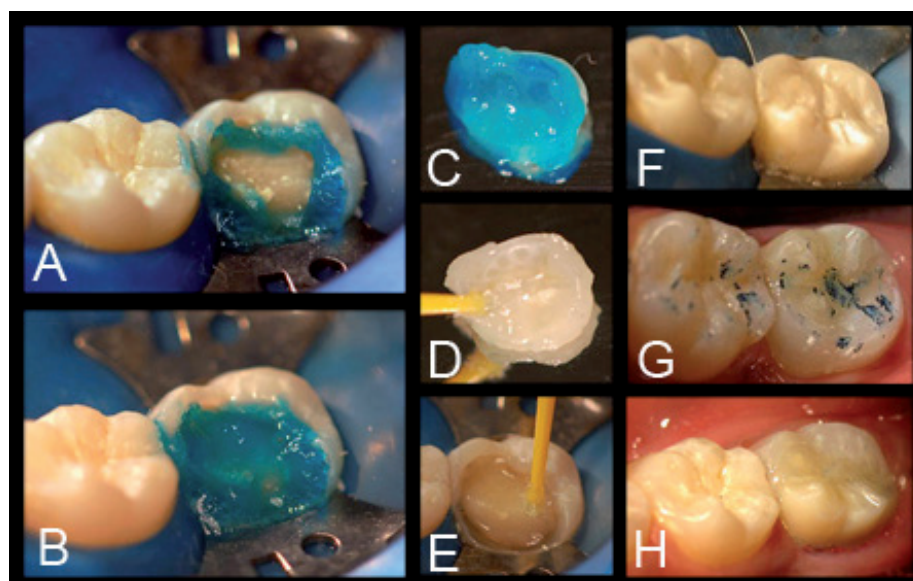


Figure 5. Phases of fragment cementation. A, B and C- Acid conditioning of tooth and fragment; D and E- Adhesive system application F- Fragment cementation with self-cured resin cement; G- Occlusal adjustment; H- Aspect immediately after fragment cementation.

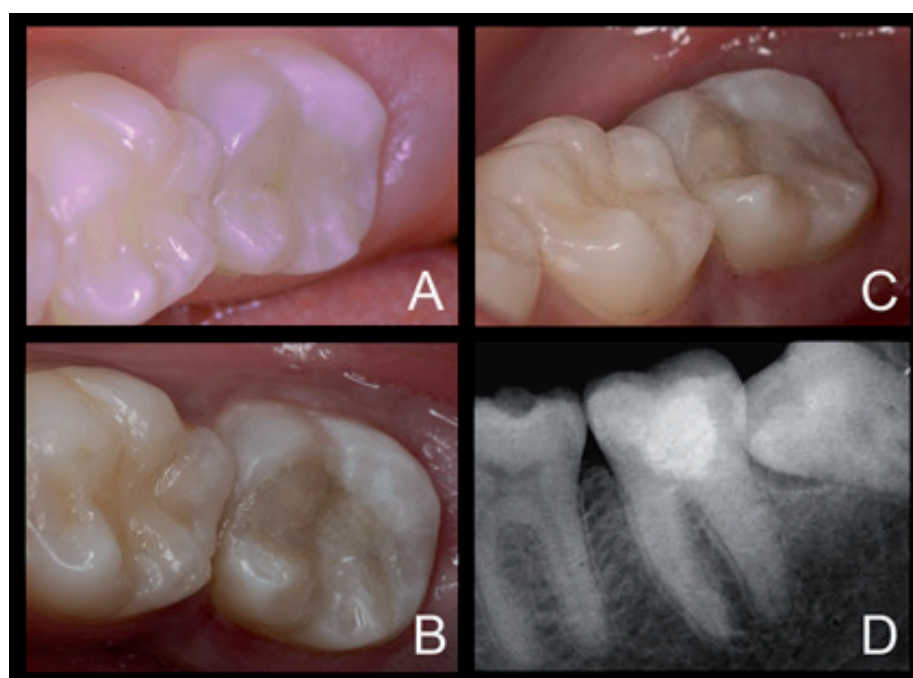


Figure 6. Clinic and radiographic follow-up. A- Carious lesion in occlusal groove; B- Occlusal aspect after restoration and sealing; C- Lingual view of cervical adaptation; D- Periapical radiographic after 2 years follow-up.

dentin does not provide a hybrid layer in an appropriate manner¹⁸. The use of rubber dam to protect the operative field should also be noted as it is a factor directly related to the success of the cementing procedure¹⁹.

Compared to other materials used in indirect restorations such as porcelain, biological restoration may represent an important alternative within low-income groups⁸. The cost of dental materials in many cases exceeds the ability of the dentist to charge or the patient to pay, once indirect restorations are outsourced from a teaching environment²⁰. There may be resistance by some patients in accepting a tooth of another person in their mouth⁵. Therefore, it is important to clarify for patient that tooth

fragments used in biological restoration are cleaned and subjected to a rigorous process of autoclaving and therefore offer no risk of contamination²¹. In this case report, after presenting the treatment option, at no time did the patient or legal guardian show resistance to the technique.

For a predictable treatment prognosis, biological restoration requires the cooperation and special care of the patient. Oral hygiene should be reinforced, since the restoration is subject to the development of the carious process. In this case report, the patient received guidance in oral hygiene and a follow-up appointment is made every six months. After two years of follow-up, it was observed that the restoration was performing well, but a carious le-

sion had developed in the occlusal fissure. We believe that sealing the pits and fissures immediately after cementation of the fragment should be considered to reduce the risk of caries development.

Despite the satisfactory results obtained in this case study and other studies^{6-8,10} experimental and longitudinal studies are needed to verify long-term behaviour and the physical and mechanical properties of biological restoration.

The reported observations demonstrated that the recovery of pulp tissue and function were achieved from the combination of pulpotomy and biological restoration. This case supports the hypothesis that biological restoration is an alternative technique for restoring severely damaged teeth, taking into account its limitations.

MANUFACTURERS' DETAILS

- Otosporin Farmacoquímica, Rio de Janeiro, RJ, Brazil
- IRM Caulk Dentsply, Milford, DE, USA
- Hydro C Dentsply, York Division Co, USA
- Vitremer 3M ESPE St Paul MN, USA
- Adper Single BOND 2, 3M ESPE, Irvine, CA, USA
- C&B Cement, Bisco, Schaumburg, IL, USA

ADDRESS FOR CORRESPONDENCE

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REFERENCES

1. Witherspoon, D.E. Vital pulp therapy with new materials: new directions and treatment perspectives-permanent teeth. *Pediatr Dent.*, 2008; **30**:220.224.
2. Camp, J.H. Diagnosis dilemmas in vital pulp therapy: treatment for the toothache is changing, especially in young, immature teeth. *Pediatr Dent.*, 2008; **30**:197.205.
3. Kiatwateeratana, T., Kintarak, S., Piwat, S., Chankanka, O., Kamaolmatyakul, S., Thearmontree, A. Partial pulpotomy on caries-free teeth using enamel matrix derivative or calcium hydroxide: a randomized controlled trial. *Int Endod J.*, 2009; **42**:584.592.
4. Santos, J. and Bianchi, J. Restoration of severely damaged teeth with resin bonding systems: case reports. *Quintessence Int.*, 1991; **22**:611.615.
5. Busato, A.L., Loguercio, A.D., Barbosa, A.N., Sanseverino, M.C., Macedo, R.P., Baldissere, R.A. Biological restorations using tooth fragments. *Am J Dent.*, 1998; **11**:46.49.
6. Barcelos, R., Neves, A.A., Primo, L., de Souza, I.P. Biological restorations as an alternative treatment for primary posterior teeth. *J Clin Pediatr Dent.*, 2003; **27**:305.310.
7. Baratieri, L.N., Ritter, A.V., Monteiro Júnior, S., de Mello Filho, J.C. Tooth fragment reattachment: an alternative for restoration of fractured anterior teeth. *Pract Periodontics Aesthet Dent.*, 1998; **10**:115.125.
8. Nogueira Filho, G. da R., Machion, L., Teixeira, F.B., Pimenta, L.A., Sallum, E.A. Reattachment of an autogenous tooth fragment in a fracture with biologic width violation: a case report. *Quintessence Int.*, 2002; **33**:181.184.
9. Tavano, K.T., Botelho, A.M., Motta, T.P., Paes, T.M. 'Biological restoration': total crown anterior. *Dent Traumatol.*, 2009; **25**:535.540.
10. Corrêa-Faria, P., Pinto de Alcântara, C.E., Caldas-Diniz, M., Botelho, A.M., Tavano, K.T. "Biological restoration": root canal and coronal reconstruction. *J Esthet Restor Dent.*, 2010; **22**:168.177.
11. Souza, R.A., Gomes, S.C., Dantas, J. da C., Silva-Sousa, Y.T., Pécora, J.D. Importance of the diagnosis in the pulpotomy of immature permanent teeth. *Braz Dent J.*, 2007; **18**:244.247.
12. Kontham, U.R., Tikku, A.M., Damle, S.G., Kalaskar, R.R. Apexogenesis of a symptomatic mandibular first permanent molar with calcium hydroxide pulpotomy. *Quintessence Int.*, 2005; **36**:653.657.
13. Trope, M., McDougal, R., Levin, L., May, K.N. Jr., Swift, E.J. Jr. Capping the inflamed pulp under different clinical conditions. *J Esthet Restor Dent.*, 2002; **14**:349.357.
14. El-Meligy, O.A. and Avery, D.R. Comparison of mineral trioxide aggregate and calcium hydroxide as pulpotomy agents in young permanent teeth (apexogenesis). *Pediatr Dent.*, 2006; **28**:399.404.
15. Sanches, K., de Carvalho, F.K., Nelson-Filho, P., Assed, S., Silva, F.W., de Queiroz, A.M. Biological restorations as a treatment option for primary molars with extensive coronal destruction - report of two cases. *Braz Dent J.*, 2007; **18**:248.252.
16. Yilmaz, Y., Zehir, C., Eyuboglu, O., Belduz, N. Evaluation of success in the reattachment of coronal fractures. *Dent Traumatol.*, 2008; **24**:151.158.
17. Imparato, J.C.P. *Banks of human teeth*, 1st edn. Curitiba: Editora Maio, 2003; 190p. (In Portuguese)
18. Pashley, D.H., Tay, F.R., Carvalho, R.M., et al. From dry bonding to water-wet bonding to ethanol-wet bonding. A review of the interactions between dentin matrix and solvated resins using a macromodel of the hybrid layer. *Am J Dent.*, 2007; **20**:7.20.
19. Capp, C.I., Roda, M.I., Tamaki, R., Castanho, G.M., Camargo, M.A., de Cara, A.A. Reattachment of rehydrated dental fragment using two techniques. *Dent Traumatol.*, 2009; **25**:95.99.
20. Trope M. COMMENTARY. "Biological restoration": root canal and coronal reconstruction. *J Esthet Restor Dent.*, 2010; **22**:178.
21. Cru, E. and Carpenter, W.M. Extracted teeth - decontamination, disposal and use. *J Cal Dent Assoc.*, 1997; **25**:801.804.