"Biologic Restoration:" A case report of a novel method for restoration of a fractured anterior tooth

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ABSTRACT

Anterior tooth fracture, as a result of traumatic injuries, is a common occurrence in routine dental practice. Trauma to the anterior teeth affects the physical and psychological well-being of the patient and hence, requires quick functional and esthetic repair. In spite of the advances in material science, none of the materials completely simulate the physical and mechanical properties of natural tooth structure. Henceforth, a biological restoration seems to be a successful biocompatible and cost-effective alternative approach for treating such cases. Here, we report the clinical case of esthetic and functional reconstruction of a fractured maxillary right central incisor by means of "biological restoration" using Homogenous fragment bonding associated with the cementation of biopins produced from human dentin in a 32-year-old male patient.

Keywords: *Biological restoration, Biopins, Coronal tooth fracture, Dental trauma, Homogenous fragment bonding*

The coronal fracture of the anterior teeth is a common occurrence in routine dental practice. In this regard, maxillary central incisors are the most susceptible teeth to fracture due to their vulnerable position in the dental arch [1] and protrusion caused by the eruptive pattern [2]. The coronal fractures, as classified by the World Health Organization, can be uncomplicated crown fractures which involve enamel and dentin fractures or may be complicated crown fractures which are associated with pulp and/or periodontal involvement [3].

Over the past decades, various treatment options using several techniques and esthetic materials such as resin and porcelain have been developed to restore the uncomplicated crown fractures. Despite technological advancements in material science, however, none of the materials completely simulate the physical and mechanical properties of natural tooth structure [4]. Therefore, "biological restoration" is gaining popularity as the most adequate restoration technique for fractured anterior teeth.

The concept of biological restoration was given by Santos and Bianchi in1991 [5]. It involves the procedure of fragment bonding using natural teeth; the fragment being a part of the fractured tooth (autogenous bonding) or that obtained from an extracted tooth (homogenous bonding). Such a restoration is not only cost-effective but also maintains the original characteristics of natural dental elements, meets the functional demands and re-establishes the esthetic hue [6].

When the available tooth structure is not sufficient to retain the fragment for bonding, it is necessary to use additional retention in the form of a post. The use of biopins made from the dentin of natural, extracted teeth represents a feasible option for the strengthening of permanent anterior vital teeth that require additional retention [6]. This article describes a clinical case of esthetic and functional reconstruction of a fractured maxillary right central incisor by means of "Biological Restoration" using Homogenous fragment bonding associated with the cementation of biopins produced from human dentin.

CASE REPORT

A 32-year-old male patient was referred to the department of conservative dentistry and endodontics for the treatment of fractured upper right front tooth (Fig. 1a). He reported a history of trauma 3 years back due to fall from a bicycle. The patient further reported that he had undergone previous unsuccessful treatments in relation to that tooth with tooth-colored filling material which had loosened in due course of time. At present, the patient had no pain or any other symptoms in that region. The patient's medical history was non-contributory.

Intraoral clinical examination revealed uncomplicated oblique crown fracture with respect to tooth number 11 involving enamel and dentin. The periodontal tissues were healthy and oral hygiene was in good condition. The regional lymph nodes were non-palpable. Chairside examination revealed a positive response with respect to tooth number 11 on electric pulp testing.

An intraoral periapical radiograph was advised to evaluate the extent of the fracture and the root status. The fracture line was passing through the coronal dentin and without any root fracture (Fig. 1b). Hence, the diagnosis was established as Ellis Class II fracture with respect to tooth number 11.

Since the original tooth fragment was unavailable and the patient had a history of multiple restorative failures, a Homogenous biological restoration procedure was proposed, associated with the use of dentinal pins (biopins) to enhance the retention of the fragment to the remainder of the tooth. The technique was explained to the patient, and a signed informed consent was obtained.

The technique was executed during two separate sessions. Primary impression of the upper and lower arches was made using fast setting alginate (Algitex; DPI, Mumbai, India), and study models were prepared with Type IV dental stone on the first appointment. For homogenous fragment bonding, an extracted tooth of approximately same size, shape, and color as tooth number 11 (Fig. 2a) was obtained from a separate patient, who was undergoing extraction due to a weak periodontal condition in the department of oral surgery. The tooth was debrided under running tap water and subsequently using ultrasonic scaler unit (Biosonic, Coltene Whaledent, Switzerland) on the same day and was sterilized in vacuum-induced autoclave chamber at 121°C and 15 lb pressure for 15 min. The cutting of the dental fragment and the biopins was performed with diamond burs (Fig. 2b and c).

Two biopins were obtained by cutting the dentin portion of a coronal slice, following the transverse direction of the tooth so that the dentinal tubules were perpendicular along the axis of the pin. The pins were then contoured until a cylindrical shape of approximately 1mm diameter, and 4 mm length was obtained. After the cutting and adaptation of the restorative fragment to the model (Fig. 3a and b), a drilling simulation was performed to place the biopins in the plaster die and the fragment, using a spherical diamond bur (1 mm diameter and a depth of 2 mm) with a low rotation. This was to simulate what would be performed clinically in the patient mouth.

In the second clinical session, the pinholes were prepared with respect to tooth number 11 (Fig. 4a) as was done in the plaster die for the cementation of the biopins, with a spherical bur of 1 mm diameter until a depth of 2 mm for each pinhole. Subsequently, each of the fragment, the remainder of the tooth, and the biopins were etched for 30 s with 37% phosphoric acid gel (Magic ACID, Coltene), rinsed for 30 s, and dried with air spray followed by application of dentin bonding agent (One Coat Bond SL, Coltene) which was light-cured for 40 s using a light emitting diode (LED) light curing equipment (Coltolux LED, Coltene) having an intensity of 1400 watt/cm^2. The biopins were then cemented into the pinholes of the dental fragment using composite resin (SwissTec Composite, Coltene Whaledent) and photopolymerized for 40 s each.

Subsequently, the dental fragment with the embedded dentine pins was adjusted (Fig. 4b) and cemented to the remainder of the tooth 11 in patient's mouth with light-cured composite resin (Fig. 4c). A bevel was constructed at the apparent bond line, and the restoration was done using a selected shade of light-cured composite resin. The newly restored dental surface was then finished and polished using fine grit diamond points and a fine-grained composite polishing disk (Soflex, 3 M, Japan) (Fig. 5a). Post-operative instructions were given to the patient, and a radiograph was taken (Fig. 5b). The patient was recalled after 1 month but did not report back and was lost to follow-up.

DISCUSSION

Traumatic injuries involving maxillary central incisor cause a significant impact on the quality of life in terms of physical and psychological discomfort and have the potential to negatively affect social relationships. Management of the same provides a big challenge to the clinicians both from a functional and an

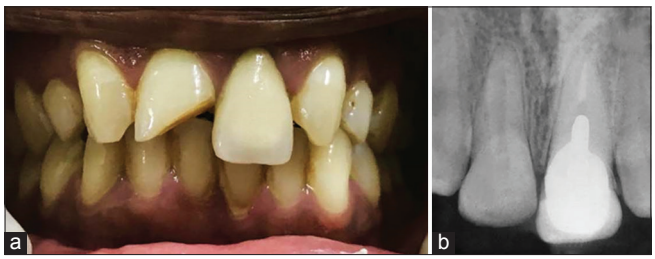

Figure 1: (a) Pre-operative clinical photograph and (b) pre-operative radiograph

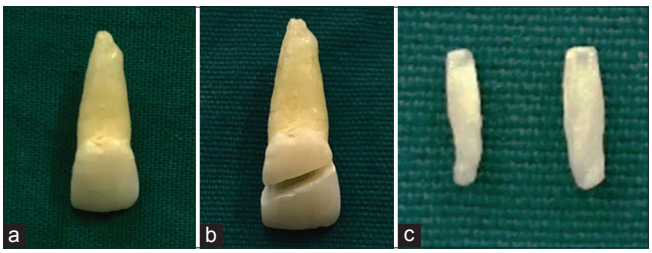

Figure 2: (a) Selected extracted central incisor, (b) cut of the dental element to obtain the restorative fragment, and (c) dentinal biopins

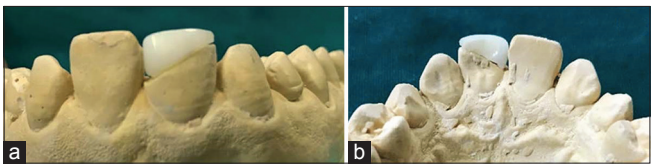

Figure 3: (a) Adaptation of the fragment to the gypsum model, vestibular view, (b) adaptation of the fragment to the gypsum model, palatal view

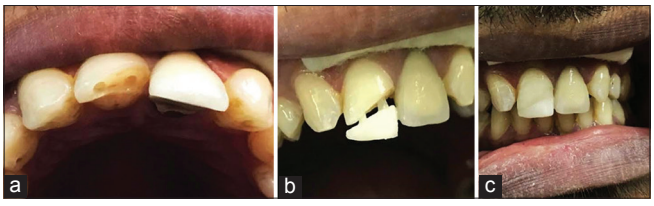

Figure 4: (a) Pinholes made in the fractured incisor for adaptation of the biopins, (b) clinical sample of the dental fragment with the biopins, and (c) dental fragment adapted to the remaining tooth

Figure 5: (a) Post-operative clinical photograph and (b) post-operative radiograph

esthetic perspective [7]. The clinical decision regarding the choice of restorative procedure directly affects the treatment prognosis and requires a careful assessment of extent and pattern of the fracture, the endodontic involvement and the possibility of using the fragment in the bonding process [8]. In the present case, homogenous fragment bonding was preferred as the patient no longer had the original dental fragment and had undergone previous unsuccessful treatments.

The present case study promotes the use of dentin pins or biopins to enhance retention and stability of the fragment. Biopins not only provide enhanced retention and stability but also unlike the other commercially available posts, they have the greatest advantage of biocompatibility - their resiliency and coefficient of thermal expansion being similar to that of a dental element.

An alternative option to biopins includes metallic posts that are threaded into the dentin. However, these being active posts, may propagate cracks in the dentin, pose a greater risk of perforating the pulp chamber and initiate inflammatory responses of the pulp [9]. On the other hand, dentin pins being passively cemented in dentin, form a micromechanical homogenous unit with the dentin, resulting in uniform stress distribution [6]. It further presents total biocompatibility as compared to pre-manufactured posts, presents resilience comparable to the original tooth and offers excellent adhesion to the tooth structure and composite resin which acts as a cementing medium creating a monoblock effect [4]. Laboratory and clinical evaluation of uncomplicated fragment reattachment using pinholes by Beltagy demonstrated placement of pinholes provided high fracture strength than simple reattachment as the fracture strength is directly proportional to the surface area and concluded a restoration success rate of 90% with pinholes [9].

In spite of various advantages of using dentin pins, it is important to address to a number of their limitations such as the patient's refusal to accept a tooth fragment obtained from another patient, difficulty of acquisition of the extracted teeth with a similar color and shape as that of the destroyed element, difficulty of manipulating the fragment due to reduced size, possibility of perforating the pulp chamber during preparation of the pin-hole and color disharmony for a period of time due to incomplete fragment rehydration with collagen breakdown as the extracted tooth sample was kept dry for about 2–3 days before reattachment. Even if the procedure is time-consuming, these biological restorations are less expensive, which makes this practice a feasible option within Dental Teaching Institutes that mostly attend people of a lower economic class [4,6,9].

CONCLUSION

Although this is a little-known technique and very few studies have been reported in the literature, such association between "biological crown and posts" offers excellent functional and esthetic outcome in the morpho-functional recovery of a fractured tooth. However, further studies are necessary to assess adhesion, fracture resistance and the long-term behavior of the biological restorations to better understand the benefits of the technique and make it more acceptable among the dentists and patients.

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