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Rehabilitation of severely injured anterior teeth in a young patient using ceramic and FRC: a clinical report

CASE REPORT

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Abstract – This clinical report describes the indirect restoration of anterior teeth in a young patient after a severe dental trauma using all-ceramic coronal posts. Step-by-step clinical procedures and their rationale are described. The learning objective of this case report is to outline the principles for the management of traumatic injuries of permanent anterior teeth in young patients to re-establish function and provide good esthetic results.

Trauma to the anterior teeth is relatively common among children and teenagers. Severely fractured anterior teeth always require immediate treatment. Interim solutions are required to restore the function of the dental/alveolar complex. In addition, it is essential to satisfy esthetic requirements, which, when anterior teeth are involved, play a fundamental psychosocial role in children and teenagers' life and relationships (1–4).

Long-term treatment planning should be delayed until the healing period is completed and the patient's maturity allows a long-term restoration.

The treatment of choice for traumatic fractures depends on several factors such as the extent of the injury, the age of the patient and the presence of dental fragments. If the entire tooth fragment is available, and if it is well preserved, immediate reattachment may be possible (5). In case of complicated tooth fractures with pulp exposure or traumatic avulsion and when the fragment is not available, it is possible to carry out either a direct or an indirect restoration. The choice mainly depends on the operator's experience and skill. Special care is needed to preserve the remaining tooth structure and choose the less invasive treatment.

The treatment options to restore such injured teeth are a removable partial denture, or a fixed prosthesis (6). Metal-ceramic crowns have been widely used for restoring anterior teeth and they have demonstrated excellent clinical results over time (7). However, the metal framework may become visible with time and therefore produce un-esthetic results, above all in young patients whose parodontal maturity has not yet been achieved (8). Moreover, additional tooth reduction is necessary to provide crown retention and stability (9, 10).

The development of esthetic materials such as all-ceramic systems and composite resins, and the use of adhesive techniques have led to more conservative approaches to restoration of fractured anterior teeth. Metal-free prosthetic materials are considered an alternative solution to the esthetic problems that may arise with metal-ceramic restorations. All-ceramic veneers guarantee color and translucency close to those of the natural tooth as well as fulfilling the need for adequate retention, while preserving maximum remaining tooth structure (11–15).

Further problems arise when growing patients lose anterior teeth.

When more than one tooth must be restored in growing patients, it is not advisable to link the two hemiarches by means of a fixed prosthesis to ensure the harmonic development of maxilla along the palatal sutura. A removable partial denture could be used although it is uncomfortable, has a negative psychological impact and must be periodically readjusted to follow the patient's growth.

The aim of this report is to present a case of orofacial traumatic injury in a young patient involving fractured teeth and traumatic avulsion, and its rehabilitation with a fixed metal-free structure.

Clinical report

A 10-year-old male child presented to a private dental practice in September 2002 with fractures of the coronal middle third of the maxillary right central (1.1) and lateral (1.2) incisors and with a traumatic avulsion of the maxillary left central incisor (2.1) (Fig. 1). The fractures, which led to esthetic functional and phonetic problems,

Fig. 1. (a) Pre-operative state after the endodontic treatment: the vestibular view shows the coronal residuals of 1.1 and 1.2 after the fractures and the lack of 2.1 after the traumatic avulsion; (b) Occlusal view.

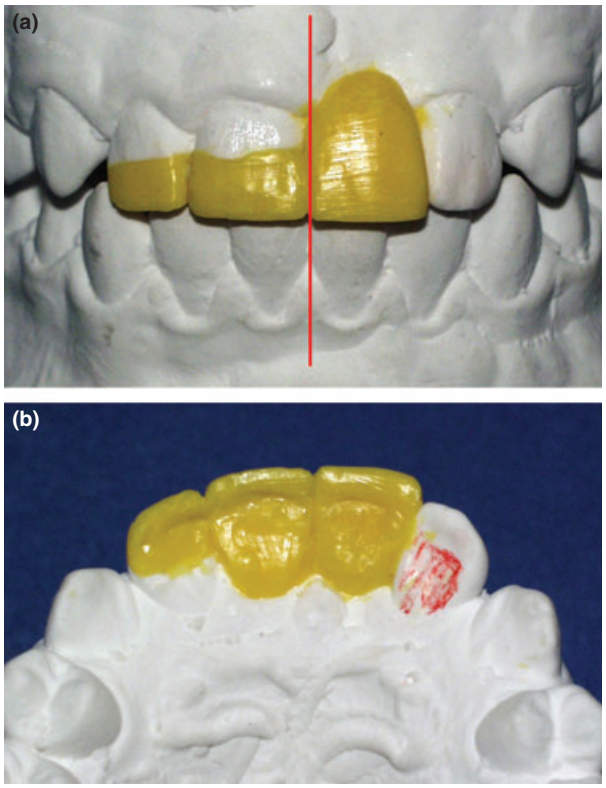

Fig. 2. (a) The gypsum model was constructed with an alginate mold. The model was waxed to rebuild the size and shape of the fractured and lost teeth; (b) Occlusal view: the red area indicates the portion of 2.2 that had to be prepared to provide a bond surface for the cantilevered 2.1.

resulted from a car accident that had occurred the previous month and had required the patient's hospitalization. The parents asked for an interim solution to return the patient to a normal function and appearance as their child was about to begin middle school. Intraorally, the coronal fractures in the right maxillary central teeth involved the enamel–dentin junction and extended from the buccal to the palatal aspect intrasulcularly. The teeth were only treated endodontically as they were diagnosed as non-vital. A gypsum model was fabricated with an alginate impression during the first consultation. The model was waxed to rebuild the size and shape of the fractured teeth (Fig. 2).

Fixed post-like crowns with a coronal pin called coronal posts were created for the rehabilitation of this clinical case.

Coronal posts consist of a single unit porcelain laminate veneer and a short ceramic post, which extends into the root canal orifice to provide additional retention (16).

As for the substitution of the 2.1, fiber reinforced composite (Vectris; Ivoclar Schaan, Liechtenstein) was used to create a special crown with a distal extension to be bonded to the mesio-palatal portion of the 2.2. Compared with a removable partial denture, this fixed prosthetic work allowed to achieve better esthetic results for the patient as well as a more comfortable rehabilitation.

The gutta-percha and the excess endodontic cement were removed using a round bur to a depth of 2 mm down into the canal (CA long ISO 001 016; Komet/Brasseler, Lemgo, Germany) to prevent discoloration of the teeth over time in the cervical area. A 2 mm-thick layer of glass-ionomer cement was placed into the root canals using the capsule delivery system. (Ketac Fil; 3M ESPE, St Paul, MN, USA). After the cement set, the excess was removed from the walls using a diamond rotary cutting instrument (Composhape US no. 390 15 μm; Intensiv SA, Grancia, Switzerland). The preliminary shades and superficial characterizations were selected and recorded by color notations and photographs made prior to the tooth preparation. The remaining tooth structures were then prepared for single all-ceramic coronal post and porcelain crown restorations (Fig 3a). A short coronal post was fabricated and its use was limited to the pulp chamber (Fig 3b,c). This limited extension of the post was used to avoid the root stress that could have occurred with a longer post.

A retraction cord (Ultrapak 0; Ultradent Products Inc, South Jordan, UT, USA) was positioned to improve access to the preparation area and thus facilitate the tooth preparation. The coronal tooth structures of 1.2 and 1.1 were prepared and a 0.4–0.7 mm thick layer of dental tissue was removed using a high-speed, water cooled hand-piece with calibrated burs (FG EU no. 801 ISO 001 014; FG EU 881 ISO 141 014; Komet/Brasseler) and all sharp angles were slightly rounded.

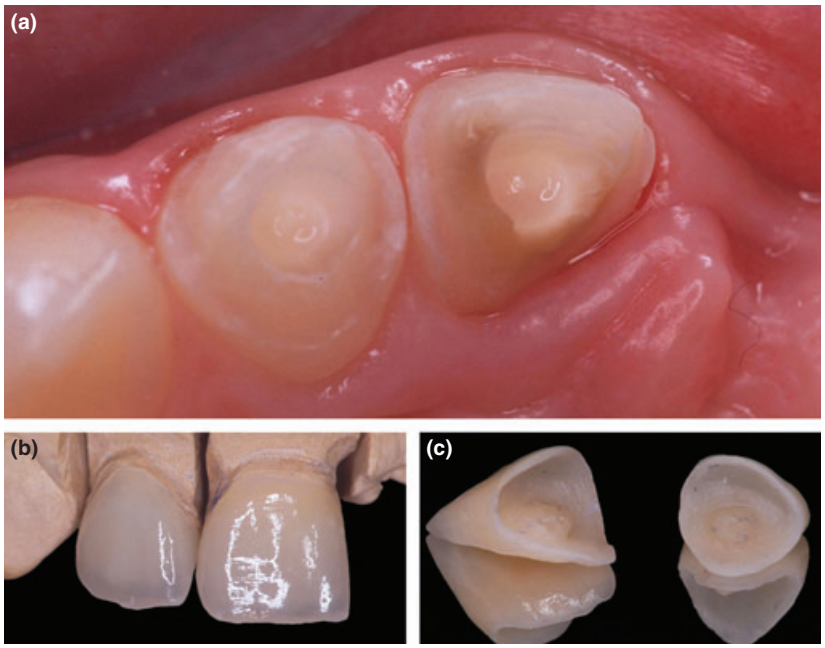

Fig. 3. (a) Occlusal view of the teeth structures prepared for porcelain coronal post restorations; (b) Vestibular view of the single all-ceramic crowns on the gypsum model; (c) Short ceramic posts were fabricated to fill the canal orifice and provide additional retention.

With the goal of maximum conservation, the preparation margin was located at the fracture level on the palatal surface. On the buccal surface, a chamfer margin was apically prepared 1 mm to the fracture line. This allowed for primary stabilization of the crowns during luting procedures and produced acceptable esthetic results.

The definitive impression was made with a vinyl polysiloxane material (President Jet; Coltene Whaledent, Altstatten, Switzerland) and the impression of the opposing arch was made with an irreversible hydrocolloid material (Xantalgin; Heraeus Kulzer, Hanau, Germany). There was no need for an interim prosthesis because of minimal tooth reduction and short waiting time prior to restoration placement. Feldspathic porcelain (Noritake Dental Supply Co, Aichi, Japan) was used to fabricate the restoration, which was cemented a week after the tooth preparation, using an adhesive bonding technique.

A retraction cord (Ultrapak 0; Ultradent Products Inc) was positioned. In addition, a transparent matrix strip (Striproll; Kerr/Hawe, West Collins, Orange, Caif) was inserted into interproximal areas to prevent adjacent teeth from being damaged by etching procedures as well as controlling the overflow of material. The intaglio surface of the ceramic restorations was airborne-particle abraded, etched with hydrofluoric acid for 60 s (Porcelain etch; Ultradent products Inc), then rinsed with an air-water spray for 60 s and subsequently air dried for 15 s. A layer of silane (Silane; Ultradent products Inc), used as a coupling agent on the porcelain restoration, was applied for 60 s and then air-dried. Unfilled resin (Heliobond; Ivoclar Vivadent, Schaan, Liechtenstein) was then applied with a brush and subsequently thinned with air.

The prepared tooth surfaces were cleaned with pumice and the adhesive system (Excite DSC; Ivoclar Vivadent) was applied according to the manufacturer's guidelines. A dual-polymerizing composite resin luting agent (Variolink; Ivoclar Vivadent) was mixed and applied to the restorations. The restorations were then placed and the excess cement was removed. Polymerization of the luting agent was achieved by polymerizing each surface

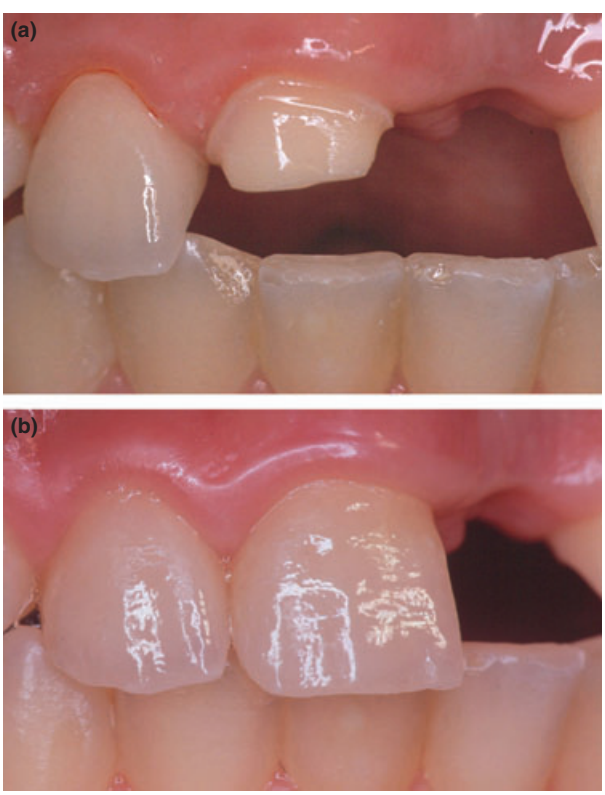

Fig. 4. (a) Vestibular view of the 1.2 all-ceramic coronal post after cementation; (b) Vestibular view after cementation of both 1.2 and 1.1.

of the restoration for 120 s at 580 mW cm^{-2} power (Demetron Optilux 500; Kerr GmbH, Karlsruhe, Germany).

Silicone-based polishing points (Composite Polishing Kit; Shofu Dental GmbH, Ratingen, Germany), and polishing disks (Soflex Pop-On 1981M-1981F; 3M ESPE)

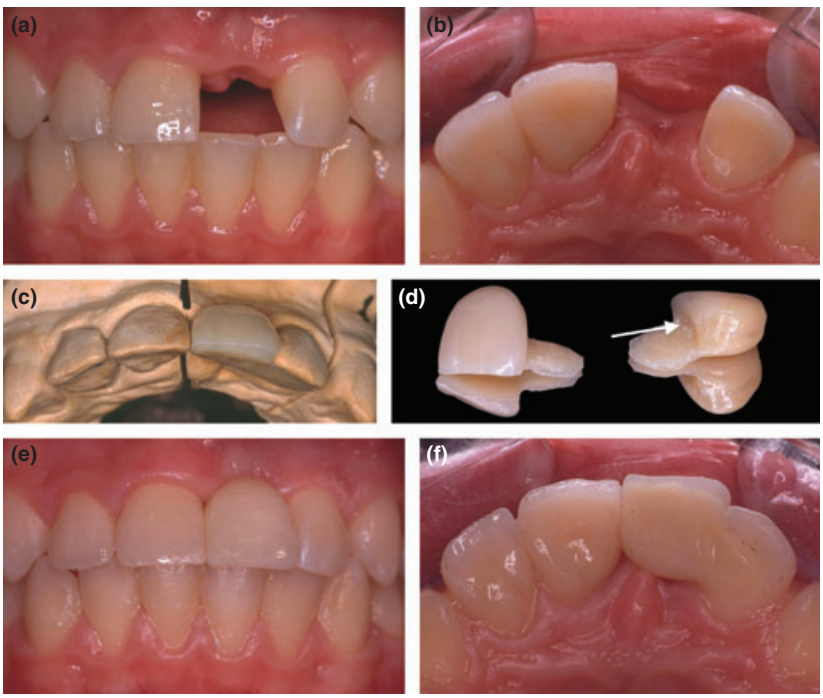

Fig. 5. (a) Vestibular view of the anterior teeth after the rehabilitation of the I° quadrant; (b) Palatal view after the preparation of 2.2; (c) The special crown created with fiber reinforced composite on the gypsum model; (d) The special crown with a distal extension to be bonded to the mesio-palatal portion of the prepared 2.2 (arrow); (e) Vestibular view a week after the restoration placement; (f) Occlusal view a week after the cementation.

Fig. 6. (a) Pre-operative state; (b) Post-operative state of the patient (detail); (c) Post-operative state 3 years later; (d) Post-operative state 3 years later (detail).

of decreasing coarseness were used to polish marginal areas, while finishing strips (Soflex 1954N-1956; 3M ESPE) were used in interproximal areas (Fig 4).

During the same appointment of the cementation, the palatal portion of 2.2 was prepared and a 0.5 mm thick layer of dental tissue was removed using a high-speed, water-cooled hand-piece with calibrated burs (FG EU no. 801 ISO 001 014; FG EU 881 ISO 141 014; Komet/Brasseler) with a chamfer at the cingulum. Then the mesio-palatal portion of 2.2 was prepared removing the aprismathic enamel layer so as to provide a bond surface for the cantilevered 2.1 (Fig. 5a,b). The impression was made with a vinyl polysiloxane material (President Jet; Coltene Whaledent, Altstatten, Switzerland).

FRC (Vectris; Ivoclar) was then used to construct a special crown with a distal extension to be bonded to the mesio-palatal portion of the suitably prepared surface of 2.2 (Fig. 5c,d).

After a week, this prosthetic restoration was cemented using the above described adhesive bonding technique (Fig 5e,f).

The patient was scheduled for maintenance every 6 months, and the restoration has been in place for 3 years (Fig. 6).

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