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CASE REPORT

Direct pulp capping with an adhesive system in management of a complicated incisor fracture: a three-year follow-up case report

Incappucciamento diretto effettuato con un sistema adesivo come soluzione di una frattura complicata in un incisivo: caso clinico con follow-up a tre anni

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Materiali compositi;
Traumi dentali;
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Incappucciamento
pulpare.

Summary

Objectives: This article describes a direct pulp capping with an adhesive system and an immediate reattachment of the intact fractured tooth fragment after an impact trauma to the maxillary lateral incisor that caused a complicated crown fracture and pulpal exposure.

Materials and methods: In this case, a simple reattachment technique was performed without additional preparation. A hybridization of the exposed dentin with an adhesive system was chosen to protect the pulp-dentin interface and bonding the tooth fragment as precisely as possible. A resin composite was used to fill the discontinuity between the fragment and the tooth. The clinical procedure can be considered safe and simple.

Results and conclusions: After three years, the tooth had satisfying esthetics and excellent function and pulp was still vital with no signs or symptoms of inflammation. Clinician should be updated with the current methods and techniques for the management of complicated tooth fracture.

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Riassunto

Obiettivi: Questo articolo descrive un incappucciamento diretto con un sistema adesivo, eseguito successivamente a un impatto traumatico che ha coinvolto l'incisivo laterale, causando la frattura coronale complicata e l'esposizione pulpare. L'integrità del frammento di dente ne ha reso possibile l'immediato reincollaggio.

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Materiali e metodi: In questo caso, si è adottata una semplice tecnica di reinnestamento del frammento, non preceduta da alcun tipo di preparazione. L'interfaccia tra polpa e dentina è stata protetta grazie all'ibridizzazione della dentina esposta con un sistema adesivo, impiegato anche per far aderire il frammento dentale il più precisamente possibile. Le discontinuità presenti tra frammento ed elemento dentale sono state attenuate dall'impiego di materiale composito. La procedura clinica può essere considerata sicura e semplice.

Risultati e conclusioni: A tre anni di distanza, il dente ha mantenuto un'estetica soddisfacente, un'eccellente funzione e la polpa è rimasta vitale, senza alcun segno o sintomo di infiammazione. © 2011 Società Italiana di Endodonzia. Pubblicato da Elsevier Srl. Tutti i diritti riservati.

Introduction

Coronal fractures of anterior teeth are the most frequent form of acute dental injury that mainly affect children and adolescents [1]. The incidence of complicated crown fractures (involving enamel and dentin, and exposing the pulp) ranges from 2% to 13% of all dental injuries and the most commonly involved tooth is the maxillary central incisor [2]. Aesthetic rehabilitation of such traumatized incisors by reattachment of the original tooth fragment appears to be the most conservative treatment approach, even when a coronal fragment is not completely recovered intact [3,4]. Chosack and Eildeman published the first case report on reattachment of a fractured incisor fragment in 1964 [5]. They suggested the fixation of post in the root canal after endodontic treatment and reattaching the coronary fragment to it. After this report, many articles have been published regarding a variety of preparation design and materials for reattachment. Reattachment techniques have been described in demanding clinical situations, as in a case report by Simonsen [6], where incisor fragment was reattached and tooth subsequently subjected to orthodontic treatment without difficulty. Compared with other restorative techniques (composite restorations, laminate veneers, post and core), reattachment of fractured fragments offers several advantages comprising improved esthetics and function [7,8]. As such, this technique should especially be considered in children, as it helps to preserve dental tissues during tooth development [9]. The clinical procedure is safe and simple; therefore, less chair side time is required, which reduces the cost of the treatment.

Treatment of complicated crown fracture, in which direct pulp exposure occurs, implies to protect the exposed pulp with calcium hydroxide (CH) or mineral trioxide aggregate [7]. However, the biocompatibility of current advanced adhesive technology allows the application of solutions in direct contact with the pulpal tissue [10,11], especially when minimal pulpal exposure and absence of bleeding are evident [12].

This case report describes the long term follow-up of the treatment of a complicated crown fracture involving enamel, dentin and pulpal exposure by the reattachment of the fractured fragment using an adhesive technique.

Case report

A 20-year-old boy was reported to the Department of Restorative Dentistry, University of Chieti, Italy following

complicated fracture of the crown in the right maxillary lateral incisor (*figg. 1 and 2*). The trauma had occurred due to a fall about two hours before. The fractured crown fragment was recovered by the patient at the site of the injury and maintained in milk. The patient's medical history was unremarkable. The extra-oral examination revealed no significant abnormality. Clinical and radiographic examinations revealed that there was a horizontal fracture in the middle third region of the tooth involving enamel and dentin with a minimal exposure of the pulp. The pulp seemed in a normal status, with intact vascular supply and absence of bleeding. The fractured tooth presented no mobility, no percussion sensitivity, and no alteration in position. A positive response was observed in the sensibility test. There was no bleeding on probing and no soft tissue injury. X-ray examination revealed no evidence of root or alveolar fracture. Following a detailed examination, the adaptation of the fragment was found to be satisfactory. The tooth fragment was maintained in a 0.9% saline solution during examination period prior to restoration.

After administration of local anesthesia with articaine and 1/100.000 adrenaline (ubistesin; 3 M ESPE, Cergy Pontoise, France), a rubber dam was placed to isolate the fractured tooth (*fig. 3*). No additional preparation was performed on tooth structure or fragment. The remaining tooth surface and the fragment were treated with a 0.2% chlorexidine solution, acid etched for 15 seconds using 36% phosphoric acid (Conditioner 36; Dentsply DeTrey GmbH, Konstanz Germany) and then rinsed thoroughly with water. Excess water was blot dried from the dentin surfaces leaving the surfaces visibly moist. Then, an adhesive (Prime & Bond NT; Dentsply DeTrey GmbH) was applied on the etched surfaces, which were not light-cured. Then, a small increment of resin composite



Figure 1 Preoperative – smile view.



Figure 2 Preoperative – occlusal view.



Figure 4 Immediate postoperative – smile view.

(Enamel Plus HRI, UD3 shade; Micerium, Avegno, Genova, Italy) was applied to the tooth fragment, which was then reattached to its proper position (*fig. 3*). The excess of resin composite was immediately removed under operative microscopy (Kaps SOM32; Karl Kaps GmbH & Co. KG, Aslar/Wetzlar, Germany). Visible light polymerization was done for 80 seconds each on labial and palatal sides using a light-curing unit (L.E. Demetron I, Sybron/Kerr; Orange, CA, USA; output: 1200 mW/cm²) while fragment was kept in position under pressure. Margins were properly finished and polished without diamond burs, but only with a series of Enhance and Pogo points (Dentsply DeTrey GmbH) and Prisma Gloss and Prisma Gloss Extra Fine (Dentsply DeTrey GmbH) polishing pastes. Occlusion was checked and post-operative instructions to the patient were given to discourage from loading the anterior teeth. Clinical and radiographic examinations were

carried out immediately (*figg. 4–6*) and after 1, 3, 6, 12, 24 and 36 months (*figg. 7–9*). In every follow-up visits a stable reattachment of the fragment, good esthetics, and periodontal health were evident. Tooth responded positively to the electric pulp tester and the radiographs showed no periapical changes.

The authors state that the study was conducted according to the ethical principles of the Declaration of Helsinki and that the informed consent was collected by all participants before their enrollment in the study.

Discussion

Functional, aesthetic, and biologic restoration of a fractured incisor often represents a daunting clinical challenge.

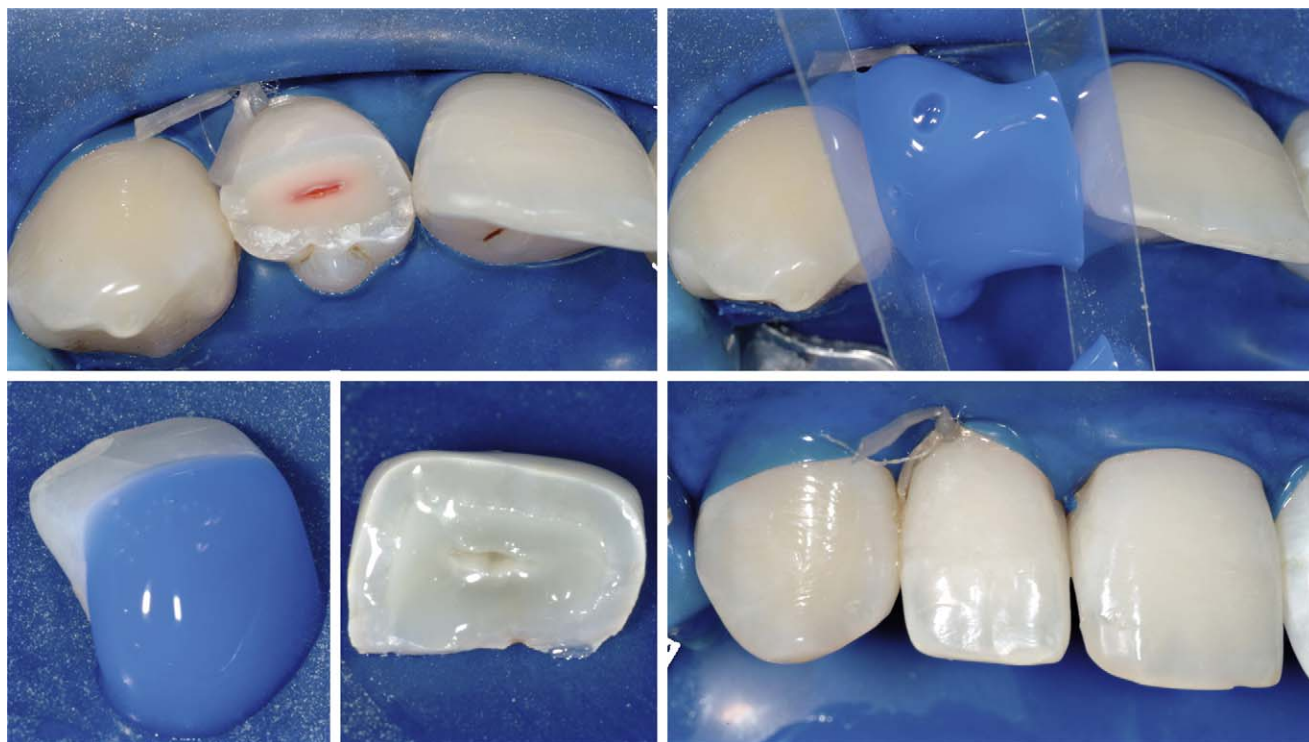


Figure 3 Adhesive procedures.



Figure 5 Immediate postoperative – frontal view.

Conventional composite resin restoration may result in less than ideal contours, colour match, and incisal translucency. Prosthodontic restoration in cases involving younger patients is questionable as confounding variables such as a large pulpal sizes, progressive eruption, and gingival margin instability take this predictable treatment modality for adults and turn the treatment outcome into one of uncertain duration. When an intact fragment is available, fragment reattachment may offer a more functional and aesthetic treatment option [7–9].

The fractured tooth presented in this report practically was set in one fragment. The reattachment technique is indicated when the fracture results in only one fragment,



Figure 7 36-month follow-up – smile view.



Figure 8 36-month follow-up – frontal view.



Figure 6 Immediate postoperative – radiographic image.



Figure 9 36-month radiographic follow-up.

and an evaluation of this adaptation should be done. For favorable aesthetics and better bonding between the remaining crown and the fragment, it was promptly hydrated in a 0.9% saline solution and maintained until the restoration time.

The technique described in the present case report is simple, quick, and economic compared with other more invasive procedures. A number of case reports explain the successful reattachment of uncomplicated tooth fracture cases. The present case report shows that the fragment can be used even if the fracture is complicated, but the margins are accessible. However, professionals must keep in mind that a dry and clean working field and the proper use of bonding protocol and materials are the keys to success in such cases.

Various materials such as flowable composite, dual cure, or resin modified glass ionomers have been suggested to reattach fragments [4]. Similarly, several techniques were described, such as simple reattachment using only adhesive systems without additional preparation [8,14]; simple reattachment using an adhesive system associated with an intermediate material [8,15]; enamel beveling before the reattachment [14,16]; external chamfer (circumferential or partial) in the fracture line after the reattachment [7,15]; V-shaped internal enamel groove [6]; internal dentin groove [15,17]; and, overcontour with a thin composite layer [4,150]. However, there is no consensus regarding the more appropriated technique. The selection of the reattachment technique depends on several aspects, such as clinical situation, type of dental injury, characteristics and feasibility of the fragment, presence or absence of pulpal exposure, violation or not of the biologic width. In this case report, a simple reattachment using adhesive systems associated with resin composite as intermediate material with no additional preparation was chosen since it is the less invasive technique and offers the advantage of better esthetics. However, many studies showed that with this technique the restored tooth does not recover the original mechanical strength [4,14,15]. Considering this, some authors indicate the beveling of the fractured border. The beveling of the enamel margins of tooth and fragment before reattachment the fragment can improve the retention and mask the finishing line with a resin composite [17]. However, this technique requires additional enamel preparation, and in certain cases, the precise fit between the segments is lost, which makes the correct positioning of the fragment more difficult. Moreover, the beveling exposes the composite layer to wear and discolorations, which impairs the aesthetics of the repair and increases the need for additional maintenance.

An important endodontic aspect to be considered is the management of the pulp exposure. Although direct pulp capping with adhesive systems is a controversial technique [18], reports exist of successful clinical cases with direct adhesive restorations on vital teeth where the pulp had been exposed [10]. Such potential for repair appears to be greater in young patients and some studies have demonstrated a good prognosis with dentin protection is carried out with adhesive systems, even in the presence of pulpal exposure [10,13].

Studies have demonstrated that pulp tissues possesses the inherent ability to repair, heal, and form reparative mineralized and recent indications revealed that the failure of composite restorations may be related to the sealing and adaptation of the tooth restorative interface. Bacterial infiltration and microleakage have been attributed as a major

factor in the pulpal inflammation and necrosis of the exposed vital dentin, regardless of the selection of the restorative material applied to the dentin or to the pulp [19]. The use of non-adhesive materials (e.g. CA or MTA) as a protective agent may, however, generate a gap at this interface. Such gap can subsequently result in bacterial colonization and/or a hydraulic pump effect that stimulates the flow of tubular fluid inward, which may cause postoperative sensitivity upon mastication [19,20]. Then, in this report an hybridization of the exposed dentin with an adhesive system was chosen to protect the pulp-dentin interface and bonding as precisely as possible the tooth fragment. The favorable clinical outcome may have been a result of good adaptation of the fragment, associated with the sealing effect of the restorative material used and the proper fit and contour of the margin.

Conclusions

In conclusion, with the materials available today, in conjunction with an appropriate technique, esthetic results can be achieved with predictable outcomes through reattachment of a tooth fragment. This appears a viable technique that restores function and esthetics with a very conservative approach, and it should be considered when treating patients with coronal fractures of the anterior teeth, especially younger subjects.

Clinical relevance: The novel adhesive systems have biocompatibility features that allow their employment in the treatment of traumatized teeth with pulp exposure.

Conflict of interest

The authors have no conflict of interest to disclose.

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