

# Tooth Fragment Re-Attachment in an Incompletely Formed Root: A Case Report with Literature Review

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## Abstract

Coronal fractures of anterior teeth are the most common form of dental trauma that occur in children and adolescence. They cause functional, aesthetics and psychological problems for both their children and parents. Intact tooth fragment provides a very conservative approach for reattachment of dental fragment. Owing to its good long lasting aesthetics (as tooth's original anatomic form, color and surface texture are maintained) and functional restorability it provides a better alternative as compared to the resin based composite or crown restoration. It overcomes the problem of repeated reconstruction of composite with age and provides a positive psychological response. The article reports a case of a child with anterior tooth fracture that was successfully treated using tooth fragment reattachment. It aims to review and discuss the methodology along with different preparation techniques and adhesives used by various authors and analyze the advancement and most accepted procedure for of the treatment. It also highlights the shortcomings of the technique as patient cooperation determines the prognosis of the procedure and a long term follow up determines the success of the procedure.

**Keywords:** Adhesives, fragment reattachment, maxillary central incisor, preparation technique, simple crown fracture

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## INTRODUCTION

Tooth trauma has always been a common challenge for dental professionals because of different protocols for treatment. Dental trauma often has a severe impact on the social and psychological well-being of a patient and his/her parents.<sup>[1]</sup>

Crown fractures in permanent teeth constitute 26%–76% of all traumatic dental injuries.<sup>[2]</sup> Coronal fractures are a common occurrence, particularly in children between 8 and 11 years old.<sup>[3]</sup> Maxillary incisors are the most susceptible of the dentition (80% central incisors and 16% lateral incisors)<sup>[4]</sup> owing to their labial proclination and position in the arch.<sup>[5]</sup>

Coronal anterior tooth fractures are broadly divided into complicated fracture (11%–15% involving the enamel, dentin, and pulp) and simple fractures being 28%–44% (enamel and dentin).<sup>[6]</sup> The primary goal of the treatment of traumatically injured teeth remains esthetic and functional rehabilitation.<sup>[7]</sup> Advancement in adhesive dentistry has enabled an excellent biological and most conservative approach of fragment reattachment if fragment is available.<sup>[3,7]</sup>

Chosack and Eildeman for the first time in 1964 reported reattachment of tooth fragment after trauma of a 12-year-old child. The amputated anterior crown was cemented to a cast post.<sup>[8]</sup> Tennery was the first to report the reattachment of a fractured fragment using the acid-etch technique.<sup>[7]</sup>

The repositioning of a fractured crown fragment using a bonding fragment technique offers advantages such as reestablishment of function, esthetics, shape, shine and surface texture, absence of differential wear in addition to the original contour, and alignment.<sup>[3]</sup> This procedure has been accepted as the most esthetic and cost-effective restorative option alternative to the restoration of the fractured tooth with resin-based composite or full-coverage crown.<sup>[7]</sup>

The study aims to report a follow-up case and evaluation of clinical success of a simple anterior crown fracture with

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fracture reattachment as a first line of treatment with literature review of various developed techniques for the procedure.

## CASE PRESENTATION

An 8-year-old child accompanied by his parents visited the Dental Outpatient Department of All India Institute of Medical Sciences, Raebareli, Uttar Pradesh, with a fractured upper right central incisor (11) being hit by a water bottle while playing at school the previous day. The intact crown fragment was recovered at the site of injury and was carried by a tissue paper by the patient's mother.

On clinical examination, intraoral findings revealed Ellis and Davey Class II fracture [Figure 1], with mild tenderness on percussion. There was no other soft and hard tissue injury associated with the trauma. Periapical radiographic examination showed an intact periodontal ligament space, incomplete root formation of tooth 11, and no root fracture [Figure 2]. Tooth was tested for sensibility by electrical pulp tester and tooth showed delayed response. There was no relevant medical history.

Considering the position and pattern of the fracture, the occlusion, and a tooth remnant with an intact edge [Figure 3], reattachment of the fragment to its original position using adhesives was considered a reliable first-line treatment option for the case.

The fractured fragment was immediately stored in saline to rehydrate the fragment as it was dehydrated for 10–15 h from the time of injury.

The affected tooth was isolated. A dentinal groove was created inside the tooth fragment [Figure 4]. Then, the crown fragment and the tooth remnant were acid etched for 30 s with 37% phosphoric acid gel, rinsed for 30 s, and dried with air spray. A conventional two-bottle adhesive system (two-step fifth-generation) was applied on the enamel. The fractured tooth and the fragment was light cured for 20 s independently using argon light-curing equipment of light intensity 1300 Mw/cm<sup>2</sup> [Figure 5]. After juxtaposition of the fragment with the tooth, using hybrid composite resin cement. Excess adhesive was removed, and they were light cured for 40 s both buccally and palatally. As esthetical good interface was achieved, no further polishing, finishing, or beveling was required [Figure 6].



**Figure 1:** Ellis class II fracture in 11



**Figure 2:** Periapical radiograph showing incompletely formed roots



**Figure 3:** Intact fractured fragment



**Figure 4:** Groove preparation in the fractured fragment



The patient was instructed to prevent biting on hard objects and report in case of any symptom. The patient was kept on a regular monthly follow-up for 6 months. The tooth gradually restored to normal response of pulp sensibility test after 1 month of trauma. The patient visited after 1 year of follow-up. The anterior fragment was perfectly intact without any color change in the marginal interface [Figure 7].

## DISCUSSION

Traumatic fractures of the anterior teeth are the most commonly attended dental injuries in children because of their active lifestyle.<sup>[9]</sup>

Reconstruction of crown fractures has developed through the years. Several techniques have been developed to restore uncomplicated fractured crowns, such as porcelain veneers or jacket crowns; however, such treatments require substantial sacrifice of dental structure and sometimes even endodontic treatment.<sup>[10]</sup>

The development of resin composite materials has made it possible to have a more conservative approach toward the

treatments of these injuries when the fractured fragment is available.<sup>[10,11]</sup>

Proper treatment plan following a traumatic dental injury is crucial for preventing the biological and sociopsychological impacts. The treatment and prognosis for each case may differ according to the patient's age, amount of enamel available for bonding, wideness and wetness of the dentin tubules in young permanent teeth, possibility of bacterial contamination of the dentin and pulp, and availability of the tooth fragment for adhesion.<sup>[9]</sup>

As per study reports, original tooth fragment reattachment offers an excellent treatment option for anterior fractured teeth as their original anatomic form, contour, color, surface texture, translucence, occlusal alignment, and function are maintained.<sup>[10,12]</sup>

Numerous factors play an important role in determining how long the reattached tooth fragment remains functional. Among these factors, the media used to store the tooth fragment after fracture, type of material used for adhesion, use of materials to protect the dentin-pulp complex, flow of composite resins or cement, and technique used for the reattachment procedure are the most prominent.<sup>[9,13]</sup>

The successful reattachment depends on fragment's extend of dehydration. The longer the fragment remains dehydrated, the poor tooth's strength will be. Improvement of tooth's resistance can be achieved by fragment rehydration.<sup>[8]</sup>

Farik *et al.*<sup>[14]</sup> analyzed the strength of reattached fractured teeth dehydrated for a period from 5 s to 24 h. Fragments dehydrated for more than 1 h significantly decrease its fracture resistance. At the same time, teeth reattached with fragments dehydrated for 24 h and rehydrated in water for at least 1 day and night (the same period of time) did not lose its strength. Wet dentin offers greater shear bond strength (SBS) as dehydration of dentin causes collapse of collagen fibers and obstruction of adequate resin monomers' penetration, leading to a poor adhesion between dentin and composite material.<sup>[8]</sup> Dehydrated tooth's fragment can cause disturbance of the esthetics as the probability for mismatching with the original tooth's color will be higher. In most cases, dehydrated fragment is lighter than the remained after the fracture remnant. Study reports have shown return of share bond strength after only 30 min of rehydration before fragment reattachment.<sup>[15]</sup> Therefore, rehydration is a very useful step in this clinical procedure.

As in the case reported, the fragmented was rehydrated in saline for more than an hour.

## Preparation techniques and materials used

Fracture strength of reattached fragment may approximate this of not fractured teeth according to the techniques performed and materials used. Most experimental clinical studies in the field which give the bases for outcome of the results were performed by Farik, Worthington, and Reis.<sup>[8]</sup>

There are several studies published describing successful clinical cases with reattached fractured incisors. The authors have



**Figure 5:** Light curing of fractured tooth and fragment with argon laser



**Figure 6:** Postoperative frontal view of 11



**Figure 7:** Clinical follow-up after 1 year of reattachment

applied different techniques for tooth preparation varying from beveling, preparation of circumferential chamfer, v shape notch preparation,<sup>[10]</sup> groove formation over contouring to resources for pulp protection, and only adhesive reattachment.<sup>[9,11,16]</sup>

Dean *et al.*<sup>[17]</sup> explore the influence of mode of preparation upon fracture resistance of reattached fragments. They concluded that 45° bevel does not increase tooth's strength. Fractured teeth reattached without preliminary preparation have shown resistance as those beveled 45°.

Reis *et al.* have shown that fragment reattachment without any type of wearing of the remaining tooth surfaces restores only 37.1% of the intact tooth's fracture resistance. External chamfering (buccal) recovered 60.6% of that fracture resistance; bonding with an over contour and placement of an internal groove nearly restored the intact tooth fracture strength, recovering 97.2 and 90.5%, respectively.<sup>[11,18]</sup>

In over contouring, good performance could be attributed to enlargement of adhesion area provided by tooth preparation around the fracture site. The greater extension of material on the surface provides better force distribution over a large enamel area, contrary to the simple reattachment, where the stress concentration is in the fracture line.

In the case reported, internal groove was prepared in the tooth fragment surface in accordance with study done by Yilmaz *et al.* and Pavone *et al.*<sup>[16,19]</sup> The technique meets two chief objectives: (1) creating physical space for the material protecting the dentin-pulp complex and composite resin cement and (2) increasing the fracture strength of the reattached tooth fragment.<sup>[9,16,19]</sup>

The direction of the fracture line is an important aspect in re-restorability, and it has a direct bearing on the prognosis of teeth. The fracture line was in a favorable direction in the case reported.<sup>[20]</sup> Consequently, an accurate adaptation of the tooth fragment was achieved, and esthetic, functional, and biological parameters could be successfully maintained.

However, the key to success of the procedure lies in maintaining a dry and clean working field and the proper use of bonding protocol and materials in adhesive dentistry.<sup>[13]</sup>

Materials used for reattachment of fractured teeth are investigated from many clinicians as they influence strength of the connection tooth structure fragment. A huge variation has been found in terms of the material used in combination with the techniques mentioned in treating these cases. These included using bonding agents only (Adper Scotchbond Multi-purpose bonding; 3M-ESPE)<sup>[21,22]</sup> associating bonding agents with flowable resins ((Filtek Supreme Flowable; 3M-ESPE),<sup>[23,24]</sup> hybrid composite<sup>[11]</sup> (Filtek Supreme Resin Composite; 3M-ESPE), dual or self-cured luting cement<sup>[18]</sup> (RelyX ARC; 3M ESPE), or light-cured luting cement.<sup>[25]</sup>

Development of contemporary composite materials and the possibilities of modern adhesive dentistry are reasons for new investigations connected with reattachment technique.<sup>[8]</sup>

Baratieri *et al.* describe usage of glass-ionomer cement and resin "sandwich technique."<sup>[26]</sup> Another alternative is the adhesive system on the basis of 4-metacriloxietil trimetiltanhydride in combination with 3-n-butyl borate (4-META),<sup>[8]</sup> a light-cured opaque resin which shows good bond strength with enamel and dentin and has been used by clinicians for reattachment.

Andreasen *et al.* in 1995 published a clinical study investigating strength of reattached tooth fragments. As per the clinical outcome of the study, the retention level was high at fragments reattached with acid etching and bonding agent.<sup>[27]</sup> In a contemporary study of Farik *et al.*,<sup>[28]</sup> it is confirmed that most bonding systems fifth-generation increase fracture resistance of reattached crown fragments when used in combination with resin. Self-etching adhesives have lower fracture resistance at reattachment compared to the adhesives with components in different bottles (multibottled).<sup>[8]</sup>

Very limited studies have been done for comparing the combination of different materials and different application techniques.

The most recent study published by Chazine *et al.*<sup>[11]</sup> evaluated the SBS at the fragment tooth junction using different materials in combination with different application techniques to reattach a broken incisor fragment.

The study results were in analogy with Farik *et al.*<sup>[28]</sup> that different adhesive materials used do not have much significance in SBS and adhesives in combination with unfilled resins give good results. Whereas, the study clearly highlights a positive correlation between SBS and the technique used, thereby further authenticating the results of success reported by Reis *et al.*<sup>[18]</sup> and Stellini *et al.*<sup>[29]</sup> that an additional prepreparation, such as the chamfer technique or bevel, combined with an over contouring has given values as high as 60% of the intact tooth.

Sometimes, the fracture comprises enormous part of the dentin and full polymerization is difficult to achieve.<sup>[18]</sup> In these cases, chemically polymerized or double-polymerized materials are preferred though a study done by Dean *et al.*<sup>[17]</sup> does not find any much difference in the result. The use of preliminary made silicon matrix is recommended by some authors to maintain the correct position of the fragment. This procedure is simplified by preparing a transparent silicon mask with vinyl polysiloxane based on a wax-up or on previous restorations or intact hard tissues with adequate form.<sup>[9]</sup>

## Prognosis

Limited data are available on the strength of reattached fractured fragments.<sup>[11]</sup> There have been reports of<sup>[11,13]</sup> the absence of clinical discolorations and pathological changes in the anterior teeth with an original fragment reattached with a follow-up of 1–2 years. The present case was reported after 1-year follow-up. Clinical investigation done by Cavallieri è Zerman<sup>[30]</sup> compared two different ways of treatment of crown fractures – direct adhesive buildup and reattachment of tooth fragment. After 5 years of follow-up, more stable esthetic results were achieved at application of fragment reattachment.

In a contemporary clinical study after 2 years of follow-up of reattached fractured incisors of 11 children aged 8–13, the authors receive “satisfying” and “very satisfying” clinical and roentgen results concerning periodontal, pulpal, color harmony, and occlusion.<sup>[11]</sup>

Summarizing it all, original tooth fragment reattachment can be considered the best option to recover fractured anterior teeth in young patients when the fragment is available. The advantages presented by this conservative technique overcome any prosthetic treatment.

## CONCLUSION

Reattaching a tooth fragment with newer adhesive materials may be used successfully to restore fractured teeth with adequate strength, but long-term follow-up is necessary in order to predict the success of the treatment. Patient cooperation and understanding of the limitations of the treatment is of utmost importance for good prognosis.

This method opens different opportunities for esthetic and functional restorations that are economically effective at the same time. Essential advantage of the reattached teeth is the fact that all the alternative methods as direct adhesive resin reconstruction, veneers, and crowns can be performed in case of failure.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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