Int.J.Curr.Microbiol.App.Sci (2024) *13*(11): 243-252

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 13 Number 11 (2024)**
Journal homepage: http://www.ijcmas.com

Case Study

https://doi.org/10.20546/ijcmas.2024.1311.027

Fragment Reattachment and Intraradicular Splinting for a Complicated Crown-Root Fracture: A Case Report

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Keywords

Complicated crown-root fracture, fragment reattachment

Article Info

Received:
20 September 2024
Accepted:
26 October 2024
Available Online:
10 November 2024

A B S T R A C T

This paper discusses the successful restoration of a challenging crown-root fracture involving an oblique fracture in the middle third of the root and complete fragment detachment. The treatment protocol began with the removal of the fractured crown fragments, followed by pulpectomy and the insertion of resin-cement fiber posts. After reattaching the separated fragments using resin cement, the patient was closely monitored for six months, with regular checkups revealing normal clinical and radiographic outcomes. This diligent follow-up continued for 24 months, resulting in a remarkable recovery.

Introduction

Dental trauma is a commonly occurring condition that presents a unique set of restorative challenges. Statistically, it is observed to be more prevalent in males, with permanent maxillary central incisors being the most frequently affected teeth (Bate *et al.,* 2010; Oliveira *et al.,* 2010; Sibel *et al.,* 2008; Turgut *et al.,* 2004; Dhingra *et al.,* 2009). Correlation between trauma on maxillary central incisors and factors such as gender, race, ethnicity, and age has been established, with increased overjet and maxillary protrusion being commonly associated conditions (Lehl *et al.,* 2004).

Although the uncomplicated crown fracture is a frequently encountered dental trauma, the presence of a complicated crown or crown-root fracture can create a challenging situation for the restorative dentist. A perplexing crown-root fracture is an infrequent injury that begins with a fracture in the crown area and extends diagonally into the root (Kim *et al.,* 2013).

Leading causes of dental injuries are typically attributed to falls, collisions involving bicycles or automobiles, and objects colliding with the teeth (Andreason *et al.,* 2013).

The effectiveness of the treatment can be influenced by various factors including the degree of fracture complexity and direction, the size and movement of the broken tooth fragment, the extent of the fracture line under the gum, the stage of root development, any alveolar fracture, soft tissue injuries, and the condition of the affected tooth's pulp at the time of diagnosis (Kulkarni *et al.,* 2013). In instances where the crown and root segments of anterior teeth are both present and minimally damaged, the tooth fragment reattachment

method utilizing intra-canal anchorage is a highly effective and conservative treatment option for intricate crown-root fractures. Even though the extraction of a tooth and placement of a single implant may offer more predictable results, reattaching a large coronal fragment can still be a beneficial option in various scenarios (Lehl *et al.,* 2004; Andreasen *et al.,* 1994). The restoration of crown and crown-root fractures using the original fragment offers numerous benefits compared to composite restorations. These advantages include the fact that the technique is typically quicker, more cost-effective, and less complex. Additionally, conserving the original translucency and contours of the tooth results in a more aesthetically pleasing restoration. Moreover, the restored tooth is more durable against staining and abrasion in comparison to a resin-based restoration (Andreasen *et al.,* 1994; Onetto *et al.,* 1994). Studies have shown that successful reattachment and long-term survival can be achieved through this treatment method when a single, large enough fragment can be manipulated and precise adaptation between the fragment and tooth has been achieved (Dhingra *et al.,* 2009).

A newer approach for the treatment of transverse root fractures involves performing endodontic treatment on both root fragments, followed by stabilizing the tooth internally with an intra-radicular splint as an alternative fixation method (Onetto *et al.,* 1994; Liew *et al.,* 1986). In cases like this, where the splint used can either be a ready-made one or a personalized post or even an endodontic file, the hard tissue repair of the fracture line is enhanced due to the efficient immobilization of the root fragments (Altay *et al.,* 2001). By utilizing this technique, patients with a root-fractured tooth can experience a faster recovery time and can avoid making multiple visits to the dental clinic, which can save them both time and money. Additionally, it's important to note that multiple fractures are not typically seen with a crown-root fractured tooth, making this technique all the more effective (Andreasen *et al.,* 1994). However, one of the following cases had complicated crown–root fractures along with an oblique root fracture in the maxillary permanent central incisor. With the end goal of presenting a safer option for managing recurrent crown-root fractures in the maxillary central incisor, these case reports focus on a conservative treatment approach.

Case report

A 40-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of a broken and mobile upper right front tooth. She had a history of accidental falls one week back. The individual experienced a sense of unease while consuming food and had the impression of something being unsteady behind their anterior tooth. After a thorough medical check-up, doctors found an oblique fracture of 21, which involved the pulp (Figure 1). The visible fracture line on tooth number 21 was apparent on the labial side, however, it was located subgingivally on the palatal side (Figure 2). The crown fragment on the palatal side of 21 was excessively mobile. Due to the strong attachment of the periodontal ligament, this fragment was only partially dislodged from the tooth. The patient experienced persistent and intense pain in their upper front teeth as a result.

On Radiographic examination with intraoral periapical (IOPA) radiograph (Figure 3) revealed the Complicated crown fracture in 21, Complicated crown-root fracture in 21, and Oblique fracture of the middle third of the root in 21. There was an absence of periapical pathology and/or dental caries. No bone fracture was observed. The adjacent teeth responded within normal limits to testing. Based on the clinical and radiographic findings, a diagnosis of complicated crown-root fracture along with oblique root fracture with irreversible pulpitis was achieved, and a treatment plan was proposed.

Treatment plan

The goal of this treatment was to provide immediate relief from the pain for the patient, and to reassure comfort and confidence. Anesthesia was established by local infiltration of lidocaine with 1:80,000 adrenaline. The extremely mobile fractured coronal fragment of 21 was extracted under local anesthesia by periosteal elevation palatally without any incisions (figure 4). The tiny fragment was cautiously wiped down using a sterile, dampened piece of gauze, and subsequently placed in an airtight container filled with saline solution for safekeeping.

After removal of the loose fragment, the tooth margin was clinically visible on the labial side but the tooth margin on the palatal side was located at the subgingival level (figure 5a, 5b).

Root canal treatment was initiated with 21. Following the preparation of the endodontic access cavity, a periapical radiograph was taken to determine the root canal's working length, which was found to be 20 mm. The canal

was prepared using ProTaper® rotary instruments (Dentsply-Maillefer, Switzerland) till F2. Copious irrigation with saline was carried out throughout the procedure. Obturation of the canals was done by F2 size gutta-percha cone with an epoxy resin-based sealer (AH Plus, DentsplyDeTrey, Konstanz, Germany) in combination with lateral and vertical condensation. The root canal treatment was completed [Figure 6]. Gingivectomy was done for 21 to bring the fracture line to the supragingival level. The patient was instructed to avoid any activities that could lead to further trauma to the teeth.

The patient came back to the clinic one day later for the reattachment procedure. Post space was created leaving 5 mm apical gutta-percha, carefully including both the root fragments of 21 with peaso reamer no. size 3 (Mani, INC, Japan) such that their position was not altered (Figure 7).

Any traces of obturation material were removed with paper points and saline. The fit and the length of the Size 2 glass fiber post (Reforpost, Angelus® Ind. e Com Ltda. Londrina, PR, Brazil) were checked and corrected (Figure 8). The dentin was etched with phosphoric acid gel (DeTrey conditioner 36, Dentsply) for 10 sec, rinsed thoroughly with water, and dried as before, before applying the bonding agent (XP Bond, Dentsply) and its self-cure activator into the post space(Figure 9). The fiber post was cemented into the canal with dual cure resin cement (Core-X flow, Dentsply) and it was light cured for 40 sec. The excess cement was removed to accommodate the crown fragment.

Gentle finger pressure was applied to approximate the extracted crown fragment and create a retention box, ensuring proper fit and positioning intra-orally with its corresponding fragment. When correct alignment was achieved, the retention box in the fragment and the root were etched and coated with a bonding agent and activator as per usage protocol. This fragment was luted onto the tooth with the help of the resin cement which was inserted into the retention box in the fragment (Figure 10) and on the cervical portion of the remaining tooth in the mouth. The crown fragment was immediately repositioned firmly in correct alignment with the root (Figure 11). The resin cement was light cured for 40 sec. The excess cement was removed from the tooth surface with a hand instrument passively. A bevel was prepared on the margins of the approximating surfaces of 21 on the labial side and the margins were sealed with nano-composite (Brilliant NG- Coltene Whaledent). Polishing of the surface was done with polishing disks which ensured an aesthetic blending of the margins. The occlusion was carefully checked and adjusted. The patient was provided with additional post-operative guidelines to aid in their recovery, beyond the standard routine instructions.

The patient was recalled regularly for clinical as well as radiographic follow-ups. Follow-up sessions were scheduled for 1 week, 2 weeks, 1 month, 6 months, 1 year, and 2 years after treatment. On Examination 21 were found to be asymptomatic with satisfactory aesthetics. Periodontal status was good with a 1mm pocket. Gingival tissues had a normal texture with normal contouring. An intra-oral periapical radiograph showed intact tooth structure with intact lamina dura. The patient when observed after 2 years, presented with an asymptomatic tooth and no complaints of discomfort. Upon performing the intra-oral examination, it was discovered that the soft tissue had healed exceptionally well and there was a secure reattachment (Figure 12, 13). The periapical radiographs taken at each visit were non-contributory.

Results and Discussion

Research has uncovered that suffering from trauma-induced fractures in the front teeth can have a profound and lasting effect on an individual's emotional and social welfare, as well as causing significant discomfort and pain. The complexity and extent of the fracture, as well as any accompanying tooth injury, can heavily influence the design of any subsequent restorative procedures.

Managing teeth that have complicated crown-root fractures can be challenging as there are only limited treatment options available (Brown *et al.,* 2000; Fariniuk *et al.,* 2003):

(i) The tooth can be saved by removing the fractured coronal fragment and restoring it as long as the fracture line hasn't invaded the biologic width..
(ii) The optimal solution to restoring a fractured tooth involves utilizing a combination of techniques, including the removal of the coronal fragment and employing gingivectomy or osteotomy to expose the fracture line and establish the biologic width.
(iii) Removal of the coronal fragment and initiation of endodontic treatment and restoration of the tooth with a post crown.

(iv) Before restoration with a post crown, it is recommended to remove the coronal fragment and start endodontic treatment, then consider either orthodontic or surgical extrusion of the apical fragment.
(v) If a crown-root fracture is severe, the tooth may need to be extracted and substituted with a removable or fixed prosthesis.

Several case reports have been documented, detailing follow-up periods ranging from one month to six years, regarding the successful reattachment of subgingivally fractured teeth. Fragment reattachment is increasingly being recognized as a conservative alternative to traditional methods such as composite build-up or full crown coverage, as evidenced by these reports. If the broken fragment of the tooth is still in one piece, reattaching it is a great option with numerous benefits. Not only does the reattached tooth maintain its natural translucency and resistance to abrasion, but it also saves time and money when compared to other restoration methods. Also, the reattached tooth will wear down at a similar rate as adjacent teeth, unlike composite restorations which are prone to faster wear and tear. According to a multitude of research, it has been proven that the resilience of a reattached tooth matches that of an undamaged natural tooth (Farik *et al.,* 2000; Farik *et al.,* 1999). By preserving the moisture content of the fragments, it was ensured that the collagen fibers in the dentin did not collapse or suffer minimal damage, thus contributing towards a stronger bonding effect while also enhancing the appearance of the fragment by preventing any undesired whitening effects (Sharmin *et al.,* 2013). So, in this particular case study, the broken pieces of the tooth were stored in a saline solution until they could be reattached. The patient had a fracture below the gum line, which required a gingivectomy to bring it above the gum line. The pulp space left after a root canal was used to attach a post to help hold the tooth in place.

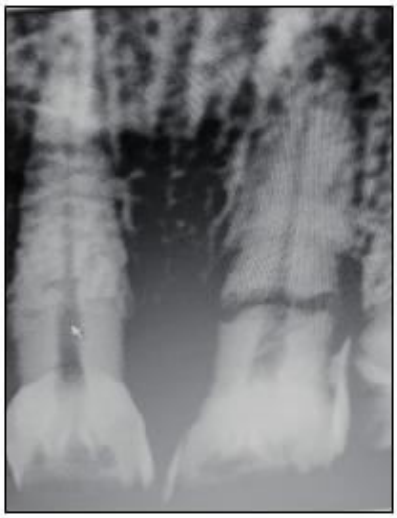
Figure.1

Preoperative clinical picture

Figure.2

Visible fracture line palatally extending subfingivally

Figure.3



Intraoral preoperative radiograph

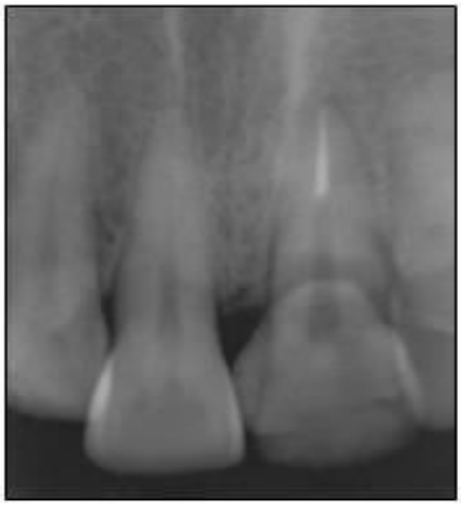
Figure.4

Figure.5a

Figure.5b

Figure.6

Figure.7



Post space preparation

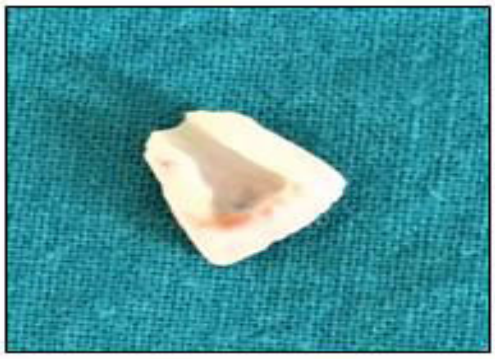
Figure.8

Fit of the post checked

Figure.9

Tooth etched with phosphoric acid gel for 10 sec

Figure.10



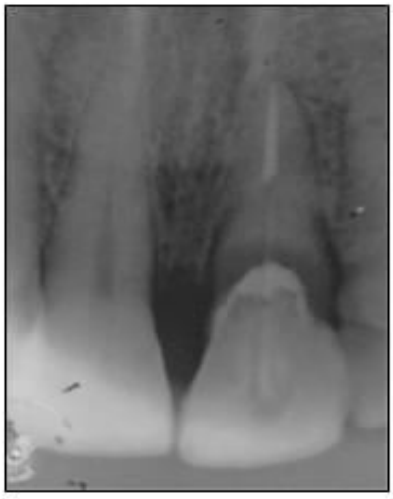
The retention box in the fragment

Figure.11

Caption

Figure.12

Figure.13



Intra-oral peri-apical radiograph after 2 years

It is suggested to utilize an intracanal post to strengthen the reattached tooth's cervical area because it interlocks the root and coronal fragments, reducing stress on the reattached tooth fragment (Kumar *et al.,* 2010; Wang *et al.,* 2010; Tosun *et al.,* 2012).

According to initial studies that looked back in time, the use of fiber posts in dentistry has shown promising results in terms of how well it works clinically. The rate of failures is 3.2% for a period of up to 4 years. One way that fiber post is helpful is when trying to reattach a broken tooth segment. It can act as a stabilizing splint between the broken piece and the rest of the tooth, making it more likely that the reattachment will be successful. Not only does use of fiber post help to save more of the natural tooth structure and improve the appearance of the tooth, but it also distributes stress more effectively because its elasticity is similar to that of natural dentin (Geeta *et al.,* 2014). Thus, we planned to place fiber-reinforced posts before the fragment reattachment technique.

When restoring teeth with a crown-root fracture, different factors such as the size of the fracture, how much tooth structure is available, if there is any tooth fragment present when biting down, the appearance, and the patient's age and willingness to participate can determine what kind of restoration is required. If a large coronal fragment is available, it can be used to restore the tooth, as shown in the current case.

The intricacies of the techniques discussed in this text may not be common knowledge, but they hold immense value in restoring teeth with complex fractures in the crown, crown root, or root. The use of intracanal fiber post systems has yielded remarkable clinical success in such situations. Thanks to innovative bonding agents and restorative resins, dental experts can now confidently achieve dependable results through reattachment and intra-radicular splinting techniques. With this ground-breaking approach, teeth that were once thought to be beyond saving can now be preserved with an impressive and harmonious outcome.

Author Contributions

Dr. Ruchita Kishor Rathod: Affiliation Address: Yogita Dental College And Hospital, Khed, Ratnagiri, City: Khed, Ratnagiri. State: Maharashtra: Conceived the original idea and designed the model and wrote the manuscript.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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How to cite this article:

Ruchita Kishor Rathod. 2024. Fragment Reattachment and Intraradicular Splinting for a Complicated Crown-Root Fracture: A Case Report. *Int.J.Curr.Microbiol.App.Sci.* 13(11): 243-252.
doi: https://doi.org/10.20546/ijcmas.2024.1311.027