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Case Report

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Management of a Complicated Crown-Root Fracture in a Maxillary Lateral Incisor by Fiber Post and Fragment Reattachment: A Case Report

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Abstract

Background: Complicated crown–root fractures present a clinical challenge due to fracture depth, biological width involvement, and the condition of the coronal fragment. Fragment reattachment is a conservative, biologically driven option that preserves natural esthetics and tooth structure while minimizing biological width violation. When the fractured segment is intact and retrievable, reattachment offers rapid functional and esthetic restoration with reduced procedural complexity. Successful outcomes depend on careful case selection, patient compliance, and a clear understanding of treatment limitations.

Case Report: A 25-year-old male presented with a complicated crown–root fracture of the maxillary left lateral incisor following trauma. The oblique fracture extended 2 mm apical to the palatal gingival margin with pulpal exposure, while the coronal fragment remained intact. Gingivectomy using a diode laser exposed the fracture margin for proper adaptation. Due to prolonged pulpal exposure, root canal treatment was performed. A fiber-reinforced post was placed as an intra-radicular splint to support the weakened structure and facilitate fragment stabilization. The corresponding space within the fragment allowed the post to be fully seated. Both the tooth and fragment were etched, bonded, and reattached using flowable resin cement, followed by composite restoration of the buccal margin.

Conclusion: Fiber-post-supported fragment reattachment provides a conservative and esthetic management option for complicated crown–root fractures while preserving periodontal health and tooth integrity. The 5-year follow-up demonstrated maintained function, stability, and esthetics, supporting fragment reattachment as a predictable first-line treatment when the fractured segment is intact and suitable for reattachment.

Keywords: Gingivectomy, Splints, Patient compliance, Tooth fractures

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Introduction

Crown root fracture (CRF) is said to occur when the fracture line extends beyond the clinical crown and ends on the root surface. The incidence of CRF is about 7% of traumatic dental injuries in permanent teeth. Such injuries can be categorized as complicated or uncomplicated depending on the status of pulpal involvement (1). CRF occurs due to a horizontal or oblique impact on the tooth, leading to the formation of zones of compression located more cervical on the palatal aspect than on the labial, progressing to the development of shearing stresses between these zones (2). CRF patients clinically present with pain, mobile coronal segment, tenderness while palpating, and crevicular bleeding. On radiographic examination, the fracture line is oblique and extends subgingivally (3). When fracture fragments are not displaced or when the fracture line is at 90° to the X-ray beam, it is challenging to accurately assess the full extent of the fracture on a conventional periapical radiograph (4). A delay in reporting to the clinic can cause movement of the coronal fragment, which remains attached to the periodontal apparatus (5). For uncomplicated and complicated crown-root fractures, the International Association of Dental Traumatology (IADT) (2020) guidelines approve fragment reattachment and temporary stabilization of the loose fragment as an interim regimen until a final treatment protocol, such as orthodontic extrusion, auto-transplantation, surgical extrusion, or intentional re-implantation to obtain adequate coronal tooth structure has been determined (3). In a recent systematic review, fragment reattachment was found to be a viable interim option, even for complicated crown-root fractures, with reasonable short-term success (5). A longitudinal observational study revealed that fragment reattachment of teeth had a high functional survival rate, suggesting it may be a good alternative for temporary or long-term therapy. Fragment reattachment

can help delay more invasive procedures, especially in younger children, when other options such as fixed partial dentures or dental implants are not feasible or appropriate (6). There are several benefits to fragment reattachment: it instantly restores the tooth's morphological, functional, and aesthetic aspects, achieves naturalistic translucency, opalescence, and attrition rate comparable to neighboring teeth, preserves the same contacts and contours, reduces chair-side time, and has a beneficial psychological effect on the patient. It is also a minimally invasive, cost-effective procedure that promptly restores function, aesthetics, and phonetics (7).

When teeth that have undergone endodontic treatment exhibit a considerable loss of natural tooth structure, using a post becomes essential (8). Research suggests that a post should be employed only when there is inadequate tooth structure to support the final restoration (9). With an emphasis on aesthetics and metal-free restorations, a fiber post is the popular choice among practitioners for such cases. Also, studies indicate that fiber posts result in fewer tooth fractures, likely because their elastic modulus is close to that of dentin, thereby mimicking its biomechanical behavior (10, 11). The presented case report demonstrates the successful management of a complicated crown-root fracture using fiber posts as an intra-radicular retainer and fragment reattachment. The present case report was framed according to the PRICE 2020 guidelines (Figure 1) (12).

Case Report

A 25-year-old male presented at our dental clinic after sustaining orofacial trauma during a bike accident one day prior. Written informed permission for inclusion in this clinical report was acquired from the patient. Initial head and neck examination elicited no discernible lesions or tenderness. Extraoral inspection displayed lacerations and modest edema within the left upper and lower lip vermilion borders. Intraoral evaluation exhibited a fracture line along the buccal aspect within the cervical third of the crown of the left maxillary lateral incisor, propagating towards the mesial, distal, and lingual surfaces (Figure 2). The fractured fragment was maintained in situ by the attached palatal gingiva. Dental radiographs showed an uncomplicated crown fracture without exposure or damage to the pulp tissue. Complete root maturation, with no abnormalities of the alveolar bone or periapex, was also noted (Figure 3).

Additional assessment of the adjacent dentition revealed the left maxillary central incisor to be non-vital, requiring root canal therapy. Contralaterally, the right maxillary central incisor presented as intact, with no evidence of pulpal or apical pathosis (Table 1).

After the cautious removal of the mobile coronal fragment, periodontal probing demonstrated the palatal extension of the fracture ending approximately 2 mm apical to the gingival margin, with concomitant exposure of vital pulp tissue responding positively to thermal sensitivity testing (Figure 4). However, owing to the duration of pulpal exposure, a diagnosis of symptomatic irreversible pulpitis was surmised. The final diagnosis for the left maxillary lateral incisor consisted of a concussion injury and complicated crown-root fracture involving enamel, dentin, and cementum, symptomatic irreversible pulpitis, and normal periapical tissues.

The patient was presented with various treatment options. Considering that the fractured segment was retrievable and intact, fragment reattachment was selected as the therapy of choice. After meticulous debridement and removal of the damaged gingival tissues by gingivectomy using a diode laser (Epic X, BIOLASE, Inc., Irvine, CA, USA), the fragment was irrigated with sterile saline and properly stored for later re-approximation. Verification of accurate adaptation of the fragment onto the original fracture site was later confirmed. Additionally, owing to the duration of pulpal exposure exceeding several hours and the need to reinforce the compromised coronal tooth structure, root canal treatment was also indicated and planned. As the most occlusal aspect of the oblique fracture plane terminated approximately 2 mm apical to the palatal gingival margin, rubber dam isolation was not attainable. Hence, a local anesthetic solution (lignocaine 2% with 1:80000 adrenaline) was infiltrated within the buccal alveolar sulcus and palatal soft tissues. Access into the pulp chamber was established, and the extirpation of the pulp tissue was

completed. Working length determination using an electronic apex locator (Root ZX mini, J Morita) concluded a working length of 21.5 mm, utilizing the buccal cavosurface margin of the fractured fragment as a coronal reference point. Biomechanical preparation and disinfection of the root canal system were accomplished using rotary Nickel–Titanium instrumentation using (MTwo and K3) and 2.5% sodium hypochlorite irrigant to a master apical file of 30/06.

Table 1. Results of the diagnostic test

Tooth number	Cold	Electric pulp tester	Percussion	Mobility
21	No response	No response	Normal	Within physiologic limit
22	Normal	Response	Tenderness	Fracture fragment mobile
11	Normal	Response	Normal	Within physiologic limit
12	Normal	Response	Normal	Within physiologic limit

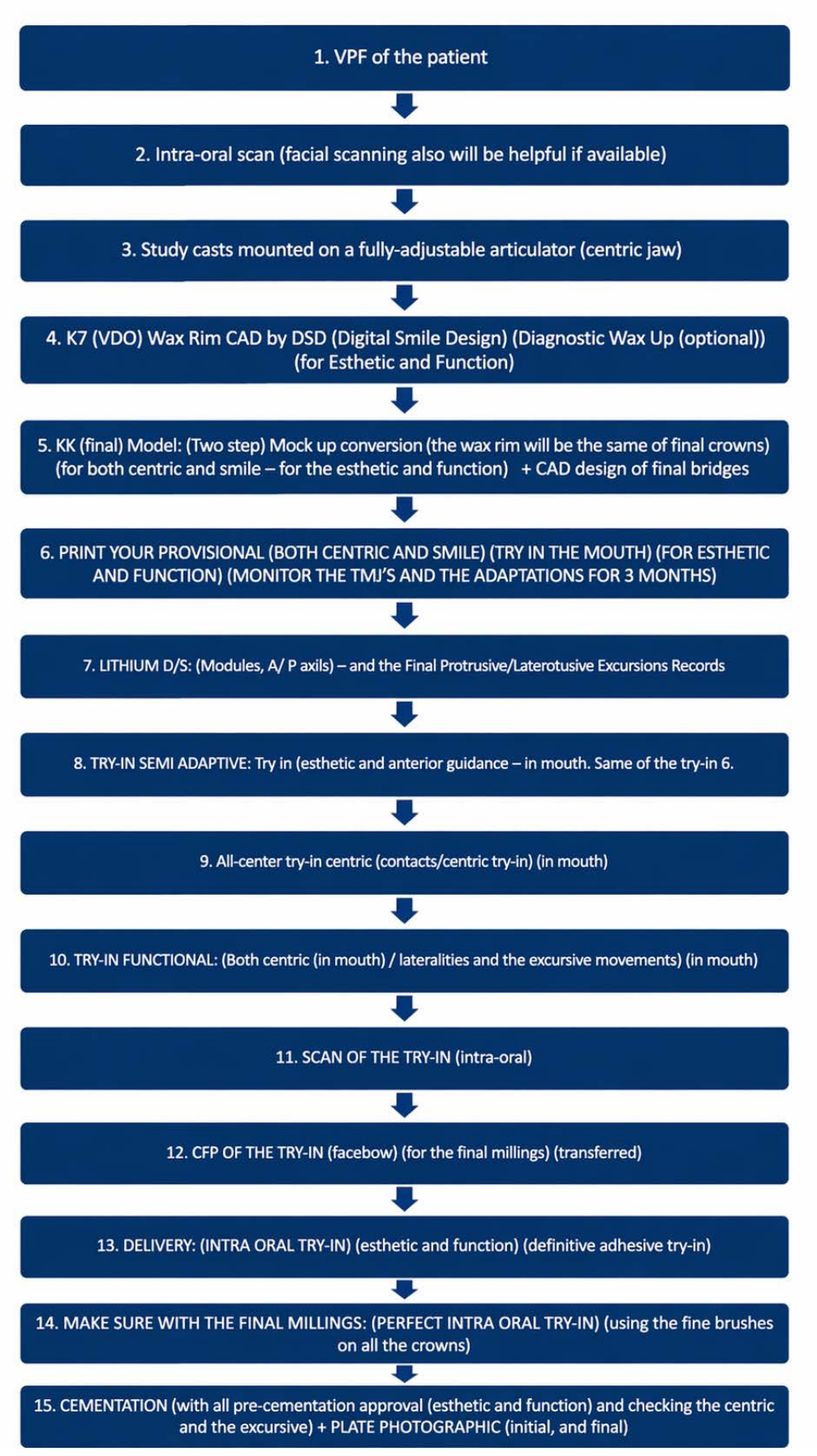

Figure 1. PRICE 2020 Flowchart

Figure 2. Preoperative Clinical Image

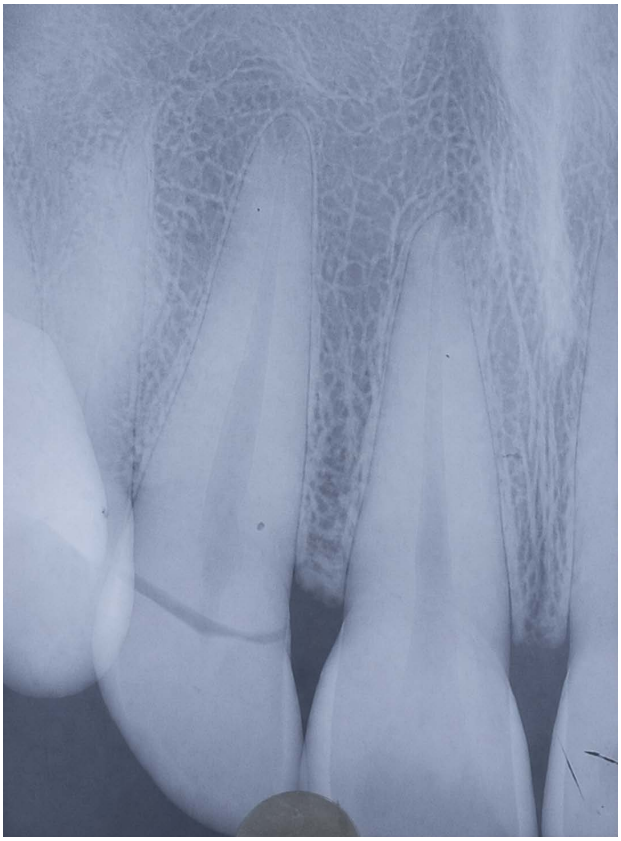

Figure 3. Preoperative Radiograph

Subsequent obturation was performed with a single-cone technique using eugenol-free sealer cement Sealapex (Kerr Corporation, Orange, CA, USA). Similarly, root canal treatment was done for the maxillary left central incisor. The coronal two-thirds of the master cone was sectioned off in the maxillary left lateral incisor, leaving 4–5 mm of obturating material confined to the apical one-third of the canal. Post space for the fiber-reinforced post was then prepared using a peeso reamer size 2 (MANI, Inc., Tochigi, Japan), and a size 1 post (Angelus, Londrina, PR, Brazil) was cemented using dual-cure resin cement (Multilink N Automix, Ivoclar Vivadent) to function as an intracanal retainer (Figure 5).

Space was also prepared within the reapproximated fracture fragment to seat the coronal aspect of the post fully. Both the natural tooth fragment and the intraoral

Figure 4. Removal of the fractured fragment

Figure 5. Placement of fiber post following root canal treatment

fracture site were conditioned with 37% phosphoric acid etchant. After thoroughly rinsing, a bonding agent (3m ESPE Adaper 2) was applied to all prepared tooth surfaces, and a flowable resin cement (Endure Nano flow, Septodont) was placed to fill any gaps and firmly bond the fragment to the original fracture line. Finally, tooth preparation along the buccal fracture margin was refined using a fine-grit diamond bur to create a 1.5 mm-wide x 0.7 mm-deep chamfer finish line. The preparation was filled with a nanohybrid composite resin (Beautifil II, Shofu) and contoured utilizing conventional polishing methods. Occlusion was verified, and a concluding radiograph was exposed (Figure 6). A 5 year follow up of the case revealed intact fragment, esthetics, and function and no symptoms. The reattached fragment performed excellently when assessed using the United States Public Health Service (USPHS) criteria (13). All parameters were rated Alpha (Ideal/Clinically excellent), except surface texture, which was rated Bravo (Acceptable/Clinically good) due to slight roughness (Table 2). This minor imperfection was successfully managed with composite polishing, restoring a smooth, clinically acceptable surface. No secondary caries, loss of retention, or postoperative sensitivity were

Figure 6. Postoperative final radiograph

observed, confirming the durability and success of the fragment reattachment procedure.

Discussion

Selecting suitable treatment approaches for patients with complex crown-root fractures stemming from dental traumatic injuries represents an immense clinical challenge. Coordinated interdisciplinary management involving periodontics, endodontics, and restorative dentistry is frequently necessitated in these scenarios. Moreover, adequately choosing amongst the exponential diversity of modern dental materials poses an additional obstacle (14-16).

In this clinical scenario, fragment reattachment constituted the most conservative modality to restore the traumatized tooth. Numerous studies have demonstrated favorable outcomes utilizing this therapeutic approach (17). Adequate hydration of the fractured piece is imperative for success, as preserving the collagen ultrastructure is necessary to maintain bonding capacity and the segment's natural aesthetics. For this patient, the fragment had been retained in the oral cavity and kept moist by salivary contact until initial presentation at our clinic. Investigations comparing storage media for dental fragments concluded that storage in milk or saliva is optimal, as minimal osmotic or dimensional alterations of dentin occur, enabling superior bond strength. Consistent with reports indicating saliva as the ideal hydrating medium for subsequent reattachment procedures, the segment in this case was optimally maintained (18). Throughout the approximately 2-hour reattachment procedure, the crown portion was kept in sterile physiologic saline to prevent desiccation.

Table 2. USPHS criteria applied to the case outcome at 5 years

Parameter	Case outcome (5 years)
Color match	Alpha
Marginal discoloration	Alpha
Marginal integrity	Alpha
Anatomic form	Alpha
Surface texture	Bravo
Secondary caries	Alpha
Retention/fracture	Alpha
Postoperative sensitivity	Alpha

Preserving the integrity of the biologic width is deemed essential in restorative treatments to maintain periodontal health. Crown lengthening is done to restore the biologic width. In the present case, crown lengthening was performed (on the palatal side) by gingivectomy using a diode laser, as the biologic width was found to be sufficient (3 mm) on transgingival probing (19,20).

Concomitant root canal treatment was also completed, given the diagnosis of symptomatic irreversible pulpitis. Due to the substantial tooth structure loss from the oblique fracture pattern and heavy occlusal forces, creating a reinforced monoblock foundation by bonding the natural crown fragment, fiber post, and remaining tooth was essential. The hybrid use of two NiTi rotary systems can improve tactile instrumentation control; hence, initial canal shaping was achieved with the MTwo system, finishing apically with K3 instruments (21,22). The minimum effective concentration of NaOCl (2.5%) was used during chemo-mechanical debridement to limit collagen degradation, which could undermine resin–dentin bonding, a crucial factor for monoblock integrity (23).

Considering tooth vitality and the patient's aesthetic demands, immediate single-sitting obturation was preferred over multiple appointments, despite pulpitis, as current evidence demonstrates similar outcomes regardless of pulpal status (24). Sealapex cement was selected given its eugenol-free formulation, ideal handling properties, excellent apical seal, and stability within the root canal space (25). Despite isolated reports of apical extrusion-related toxicity, this sealer demonstrates good clinical biocompatibility (26,27).

Glass fiber posts offer favorable esthetic qualities and mechanical properties analogous to dentin, permitting reliable bonding with resin cement within prepared root canals. Thus, they are routinely recommended for reinforcing teeth with substantial coronal tooth loss from trauma (28,29). In planning fragment reattachment, managing stresses along the fracture interface during anterior guidance is imperative (30). Hence, the initial

application of a flowable resin lacking filler particles facilitates precise adaptation between the tooth segments prior to light curing. Once aligned, additional mechanical retention was achieved by preparing a V-shaped double chamfer finish line across the fracture boundary in the outer enamel layer. While most published cases report positive outcomes without further fragment preparation, studies have shown a 37–60% increase in fracture resistance when supplementary channels or bevels are incorporated, likely due to an enlarged surface area for bonding (5, 31). However, some in vitro analyses indicate that maximal fracture strength is achieved solely with bonded interfaces, without physical alterations to the fragment (14). Here, the purpose of placing an overlying nanohybrid resin composite within the chamfer was twofold: to mask any residual fracture lines for ideal esthetics and improve resistance to shear forces across the interface (15, 32,33).

Additional recent work has shown fiber posts themself improve fracture resistance enough to make ancillary preparation of the fragment portion unnecessary (34). The elastic modulus of the post system more closely matches that of natural root dentin than that of metals, thereby enhancing monobloc stability (35). Concluding radiographs verified optimal root filling density, proper seating of the fiber post, accurate realignment of the fragment, and uniform adaptation at the bonded interfaces. Patients should be encouraged to attend regular reviews; however, this was limited to two appointments here due to the remote residential location. Nevertheless, the 5-year follow-up showed durable esthetic results, healthy periodontium, and a reservoir of intact natural tooth structure (Figure 7, Table 3). The clinical performance of the reattached fragment was evaluated using the USPHS criteria, a widely accepted method for assessing restorations in long-term follow-up. Evaluation of the reattached fragment at 5-year follow-up, using USPHS criteria, demonstrated favorable outcomes. The restoration was rated Alpha for color match, marginal adaptation, anatomic form, secondary caries, and postoperative sensitivity, confirming excellent functional and esthetic performance. A Bravo rating was recorded for surface texture, attributed to minor roughness likely resulting from long-term wear at the restoration–tooth interface (36) (Table 2). This was corrected by polishing with composite finishing systems, thereby restoring a smooth and clinically acceptable surface. These results emphasize that, while minor changes in surface characteristics may occur over time, they can be easily managed, thereby maintaining fragment reattachment as a durable and reliable treatment option.

Figure 7. 5 Year follow-up postoperative image

While selecting suitable treatment is important in dental trauma cases, preventing injuries by promoting proper orofacial protection during high-risk sports also remains a fundamental responsibility (37). Participation in high-velocity sports is a well-established risk factor for orofacial trauma. The role of dental professionals, therefore, extends beyond the management of injuries to the active promotion of preventive strategies. Among these, custom-fabricated mouthguards remain the gold standard, offering superior fit, comfort, and protection compared to stock or boil-and-bite alternatives. Their effectiveness in reducing the incidence and severity of dental and maxillofacial injuries has been consistently demonstrated, and they are strongly endorsed in the most recent international guidelines (38). Incorporating preventive counseling into routine dental care not only safeguards oral health but also enhances athlete awareness and long-term compliance, thereby reducing the overall burden of sports-related injuries (39). Evidence from medical education similarly emphasizes that supportive learning environments and real-world exposure improve adherence to preventive strategies and clinical competence, lessons equally relevant to dentistry (40). In the present case, adherence to such preventive measures might have reduced the likelihood of trauma and the subsequent need for complex restorative intervention.

Conclusion

Fragment reattachment offers a simple, conservative, and cost-effective option for managing crown–root

Table 3. Timelines

TIME	EVENT	
0	Patient visited the clinic, history, clinical and radiographic examination	Complicated crown-root fracture in relation to the maxillary left lateral incisor
0	Root canal treatment w.r.t 21, 22 followed by fiber post placement and fragment reattachment in 22	
+1 weeks	1st follow-up (clinical and radiographic assessment)	Symptom-free, reattached fragment intact
+5 years	2nd follow-up (clinical and radiographic assessment)	Symptom-free, reattached fragment intact

fractures, providing favorable esthetics and function while preserving natural tooth structure. In the present case, interdisciplinary management—combining surgical crown lengthening, root canal therapy, fiber post reinforcement, and adhesive fragment bonding—resulted in a successful long-term outcome. Regular follow-up remains essential to ensure durability and periodontal health.

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Authors' Contribution
Conceptualization: Preethesh Shetty, Mythri Padaru, Raksha Bhat
Methodology: Preethesh Shetty, Mythri Padaru
Validation: Preethesh Shetty, Raksha Bhat
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Investigation: Preethesh Shetty, Mythri Padaru
Data curation: Mythri Padaru, Raksha Bhat
Writing – original draft: Raksha Bhat, Mythri Padaru
Writing – review & editing: Preethesh Shetty, Raksha Bhat
Visualization: Mythri Padaru
Supervision: Preethesh Shetty, Raksha Bhat
Project administration: Raksha Bhat
Resources: Preethesh Shetty

Competing Interests
The authors declare that they have no conflicts of interest.

Data Availability
Not applicable.

Ethical Approval
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