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Dental Fragment Collage and Corono-Radicular Reconstitution: with 11 Years of Follow-Up

Karami Malika[1], Sy Aly[2], El Kharroubi Soukaina[3], Lahlou Khadija[4], El Mrini Hafsa[5]

[1,4,5]University Professor, Department of Conservative Dentistry-Endodontics
[2,3]Resident, Department of Conservative Dentistry-Endodontics

Abstract
Coronary fractures are very frequent in our dental practice. This article discusses teaching the treatment of a complicated coronary fracture that occurred on the 21 and the clinical follow-up on 11 years to ensure the sustainability of this therapy. In effect, when the clinical situation allows, the bonding of the fracture fragment represents a therapeutic option ultraconservative, sleek and durable. The major advantage of this therapeutic lies in the aesthetic behavior and long-term biological which remains identical to a natural tooth adjacent and difficult to reproduce by a prosthetic crown. In addition, it will allow a new intervention in case of take-off and defer further projects conventional prosthetic. So, it is an option of interest in certain conditions and requires a clinical backward movement to show its ability.

Keywords: fiber post, bonding, coronary fracture

Introduction

This article addresses the management of a complicated coronal fracture: firstly, endodontic treatment to address the infection causing the sub-palatal abscess, followed by crown bonding using a corono-radicular restoration to ensure retention of the obturation material on the palatal aspect. The purpose of this article is to describe and justify the step-by-step clinical procedure, from the analysis of the clinical situation to the corono-radicular bonding.

Clinical Case Presentation

The patient in this clinical case was a young male who smoked. He first presented to the emergency dental services in 2003. His reason for consultation was a recurring abscess adjacent to teeth 21 and 22. Upon examination of clinical and radiological data, the diagnosis of subperiosteal abscess adjacent to the two necrotic incisors was established (Fig. 1).

Fig. 1: Subperiosteal abscess adjacent to tooth 21.

Endodontic Phase

Endodontic disinfection, thorough canal irrigation, and calcium hydroxide treatment were performed on teeth 21 and 22. Subsequently, the patient was referred to the conservative-endodontic dentistry department to complete the endodontic and coronal therapy after the subperiosteal abscess regressed on the palatal aspect. However, the patient did not adhere to our recommendations and neglected to continue treatment, especially after the disappearance of the subperiosteal abscess, which was the primary reason for the initial consultation.

It was only in June 2005, approximately a year and a half after the initial therapy, that the patient presented to the service for an aesthetic emergency. Indeed, a complete coronal fracture occurred in the caries-damaged tooth 21, whose fragility had been accentuated by the placement of Ca (OH)2, known for its diffusion capacity into the dentinal tubules, leading to a modification of the tooth's mechanical resistance (Fig. 2 and 3).

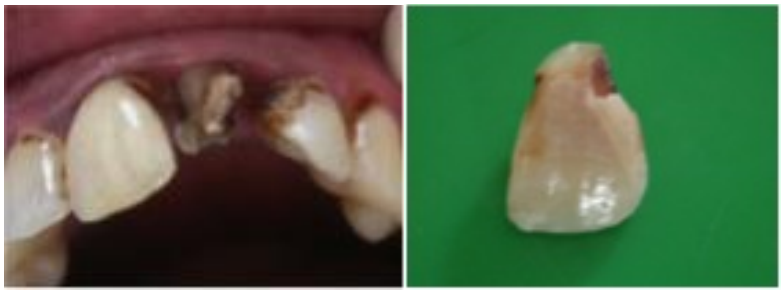

Fig. 2 and 3: Complete coronal fracture of tooth 21.

A retroalveolar X-ray was taken to investigate any associated radicular fracture. The radiograph revealed the beginning of apical regeneration and confirmed the absence of a radicular fracture (Fig. 4).

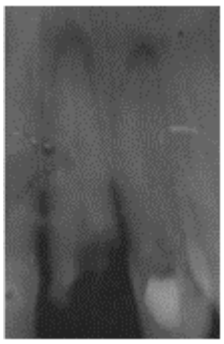

Fig. 4: Retroalveolar radiograph of teeth 21, 22.

Due to canal recontamination by saliva and bacteria, canal preparation followed by an intra-canal medication session using calcium hydroxide (Ca(OH)2) was initiated (Fig. 5).

Fig. 5: Initial preparation and disinfection stage.

In the subsequent session, endodontic obturation through lateral condensation was performed (Fig. 6).

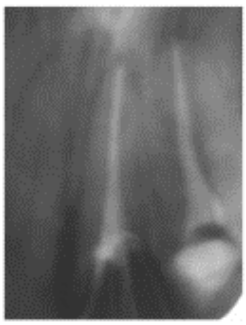

Fig. 6: Endodontic obturation of teeth 21, 22.

Having declined the creation of a temporary prosthesis, the root was temporarily protected by a tight interim coronal restoration between sessions before initiating the preparation of the radicular post space and the bonding of the dental crown.

Therapeutic Decision Whenever the fractured fragment is brought in by the patient and fits perfectly with the residual tooth structure, adhesive techniques are recommended for bonding. (18) Our therapeutic choice of bonded corono-radicular restoration (BCRR) through crown bonding was made for three reasons:

Perfect adaptation of the fractured fragment to the residual root portion.

Favorable occlusal relationships for bonding: no over-occlusion with the presence of posterior support.

Supragingival position of the cervical limit of the residual root.

Thus, before obtaining the patient's consent, they were informed about the limitations of the restoration, its reserved prognosis, and the possibility of making a crown in case of failure of this therapeutic choice.

The treatment objective was to achieve crown bonding using a fiberglass post to stabilize the extensively damaged palatal aspect and ensure retention of the composite that would substitute for the loss of substance caused by caries and the creation of the access cavity. Indeed, in the case of significant coronal damage, retaining the restorative material involves the addition of a radicular post. (8, 15)

The treatment consisted of two phases: the first involved endodontic canal system obturation, while the second focused on radicular housing preparation and the placement of a composite-coated post before proceeding with the restoration through stratification of the coronal substance loss.

The advantages of this original dental crown bonding restoration are as follows:

Perfect reproduction of external anatomy and, notably, the shade, which cannot be replicated identically with ceramics or composite.

Similar biological and mechanical behavior to adjacent teeth regarding food coloring and occlusal constraints, in contrast to ceramics which remain colorless and are more mechanically resistant.

Cost-effectiveness in the absence of a laboratory phase.

Tissue preservation and better absorption and dissipation of stresses while respecting the initial direction of the coronoradicular axis, as the original crown has been retained.

The option for conventional prosthetic intervention in case of failure.

Superior aesthetic and biomechanical qualities for the restoration. (2, 3, 7, 19, 21)

Corono-radicular Reconstruction Phase

An initial periodontal therapy was deemed essential before proceeding with crown bonding. The longevity

of this restoration depends on the patient's oral environment and, most importantly, the operator's skill. Thus, each step remains highly "operator dependent." (7)

This corono-radicular reconstruction phase was carried out in a moisture- and saliva-free environment using a sectorial rubber dam. The patient's brought-in coronal fragment, in a dry state, was decontaminated and preserved in physiological saline. Its perfect adaptation and integrity were confirmed before removing the proximal caries from this crown.

Initially, a partial removal of gutta-percha was performed, leaving an apical plug exceeding 5mm. This residual obturation was vertically recondensed using a Machtou plugger to achieve a flat bottom and improve sealing. (7)

The creation of the canal space for the post was done with a post finishing drill without any excessive parietal preparation. The endocanal space is prepared respecting the residual structures and following the "passive post" concept. (5)

The choice of the post is made based on:

The canal diameter, avoiding any friction with the root's wall.

The root length. Unlike metal posts, most authors recommend a fiber post length less than two-thirds of the root. However, the intracanal length should be greater than the coronal height. The coronal limit of the post should not interfere with crown bonding, while the apical limit should be in intimate contact with the gutta-percha. At this stage, a control radiograph verifies the perfect adaptation of the post. (Fig. 7 and 8)

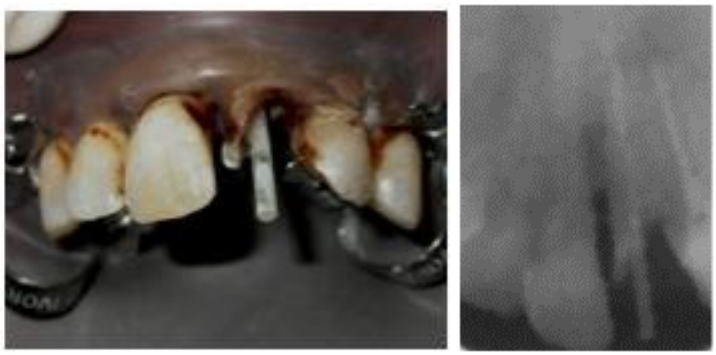

Fig. 7 and 8: Selection and fitting of the post, followed by radiographic control.

The post sectioning is done outside the oral cavity using a diamond disc held perpendicularly to the longitudinal axis of the post. (7, 12, 14)

After post space preparation, thorough cleaning of the post and cervical edges is essential to remove any traces of eugenol, sodium hypochlorite, and remnants of obturation cement that may interfere with adhesion. Some authors, such as D'auberge et al. (2010), recommend rinsing with EDTA, accompanied by the action of a microbrush at the radicular post space to eliminate dentinal mud caused by previous maneuvers. This optimizes the preparation of radicular wall surfaces and better controls intracanal bonding, which is more challenging than bonding to coronal dentin. (7)

Subsequently, acid etching was performed at the post space and the residual crown fragment, followed by thorough rinsing and delicate drying. Using paper points is recommended for perfecting the drying of the radicular post space. (7)

The adhesive system was applied by rubbing with a microbrush on the post (previously degreased with alcohol), the post space, and the crown. Excess adhesive was removed by gentle drying with an air jet and paper points. (6, 7)

After the adhesive system polymerization, the bonding resin was injected into the canal. The post was coated with the same resin and immediately inserted into the canal using a pumping motion to prevent the formation of bubbles and voids within the restoration.

The removal of excess resin is crucial before polymerization to allow the necessary space for crown bonding. It is necessary to verify the perfect adaptation of the fractured crown before encasing it in composite. (5, 7)

Additionally, the palatal aspect, damaged during the access cavity preparation, and the proximal aspect, deteriorated by carious processes, are reconstructed using a stratification composite while filling any persistent gaps between the post and the coronal fragment. (Fig. 9)

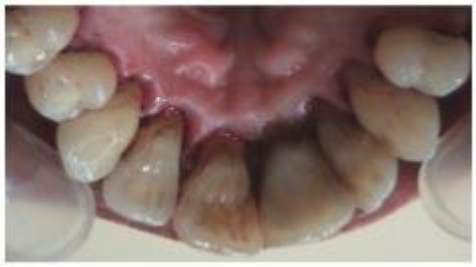

Fig. 9: Reconstruction of the palatal aspect using a stratification composite.

Finally, a retroalveolar radiograph was taken to verify the perfect adaptation of the bonded fragments and check for the absence of gaps. (Fig. 10)

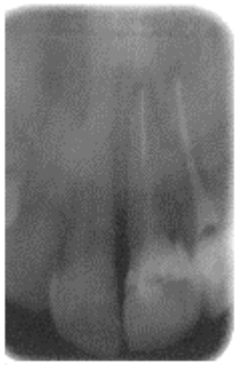

Fig. 10: Radiographic control of the adaptation of the post and crown.

A occlusal control is also performed by instructing the patient to make lateral and protrusive movements to eliminate premature contacts and occlusal overloads. (Fig. 11)

Fig. 11: Clinical control of the adaptation of the post and crown after the bonding protocol.

Furthermore, we instructed the patient to maintain good oral hygiene, continue with periodontal reevaluation sessions, and avoid excessive stress on the crown during occlusion and chewing. The success

of adhesive RCRs relies on the performance of current materials, combined with a thorough analysis of the clinical situation and precision in the operative protocol. (7)

Clinical Follow-up and Postoperative Controls

The first follow-up occurred after 6 months of the corono-radicular reconstruction. The tooth showed no clinical signs, and the patient reported no pain or occlusal discomfort during chewing or speaking. An improvement in gingival health, following initial periodontal therapy (scaling and root planning), was noted. Radiographically, perfect adaptation between the crown and the root was observed. (Fig. 12)

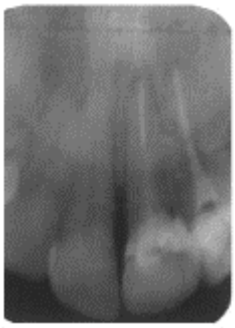

Fig.12 : Radiographic Control at 6 months

The second control took place at 9 months, and the patient reported no issues with the tooth. We decided, in consultation with the patient, to maintain regular checks once a year, unless there is an incident or emergency. (fig. 13)

Fig.13 : Clinical Control of RCRC after 9 months : Note the discoloration of the tooth surface on tooth 21 due to tobacco use.

However, the patient only presented to our service 5 years later in 2010, reporting coronal mobility and occlusal discomfort during chewing. Indeed, a vertical force on the crown had led to the dislodgment of the crown along with its post and the composite reconstruction following an apple incision. (fig. 14 and 15)

Fig.14 and 15 : Detachment of RCRC

A clinical examination was conducted by performing axial and horizontal percussion, as well as palpation in the vestibular fornix to identify any pain or swelling. Probe exploration was also carried out in the post space and around the root perimeter to detect any signs of fracture. Subsequently, a K-file number 15 was introduced into the root canal to check the sealing of the endodontic obturation. Radiographic examination revealed the integrity of the root.

Since the detachment occurred without causing a coronal or radicular fracture, the reintervention remained reversible and possible. Therefore, a surgical field was established before starting the bonding protocol. Initially, we verified the perfect adaptation of the two fragments and irrigated and dried the root canal space.

The steps for preparing the root canal space, etching, rinsing, drying, and applying adhesive were identical to the first bonding protocol. Subsequently, a composite was injected into the root canal space and at the coronal level before inserting the post-fragment assembly into the canal. (fig. 16)

Fig.16: Reattachment of RCRC

After the polymerization of the composite, a control radiograph was taken to verify the perfect adaptation between the -parietal? - and cervical walls and the restoration. Subsequently, light-curable composite resin was used to fill the persistent gap at the tooth junction before proceeding to occlusion control and the completion of the restoration. (fig. 17 and 18)

Fig.17 and 18: Vestibular and Palatal Views of RCRC in July 2013.

Note the perfect reproduction of discolorations on both sides of the bonded crown - given that the patient is a smoker. This discoloration is unlikely with a prosthetic crown in the medium or long term.

Finally, we asked the patient to strictly adhere to our postoperative recommendations and advice to ensure the longevity of the restoration.

In July 2013, another check-up was conducted, during which we performed a periodontal reassessment followed by initial therapy, including scaling and root planning. Subsequently, the dental examination revealed recurrent caries on the maxillary incisors, requiring curettage and composite restorations using the layering technique. (Fig. 19, 20)

Fig.19-20: Curettage of proximal caries, composite fillings, and polishing on teeth 21, 22, and 11 after the resumption of periodontal therapy.

The successful functional and aesthetic integration of the restoration has been ensured. (fig. 21)

Discussion

Our therapeutic choice is based on the one hand, on the patient's motivation to retain the crown, and on the other hand, on the patient's rejection of a prosthetic solution due to their moderate socioeconomic status. We also conducted a study of occlusal relationships in static and dynamic conditions, and the conditions were favorable for bonding the coronal fragment, especially since the patient did not exhibit anterior overbite or exclusive incisive guidance. Although this type of clinical case is not common, it is advisable to consider bonding the coronal fragment whenever the clinical situation allows. This bonding technique enables an exact reproduction of very specific anatomical details while preserving the natural crown. Certainly, a prosthetic solution could address the issue, but it could never replicate the macro and micro-geography of the initial crown, especially the original shade of the tooth, which remains challenging to select and reproduce, particularly in the presence of chromogenic dental discolorations, as in our case. Moreover, we observed that the bonded crown and composite behave normally in the oral environment by absorbing exogenous colorants from food or the external environment. This external discoloration is not possible with a ceramic prosthetic crown, whose external surface remains colorless in the oral environment. However, resorting to a ceramic crown is recommended, especially when the cervical limit of the fracture is subgingival. Furthermore, the longevity and aesthetic outcome of such restorations are highly satisfactory.

Additionally, the practitioner faces three major challenges when dealing with prosthetic restoration of a single central incisor, such as tooth 21:

1. How to plan a prosthetic project on a central incisor, reproducing the same anatomy and micro-geography of the adjacent incisor?
2. How to convey the ideal shade to the laboratory while reproducing striations and superficial colorations?
3. What will be the shade of the future crown in the long term? Will this crown exhibit aesthetic and biological behavior similar to natural teeth in the oral environment, especially in a tobacco-using patient?

For all these reasons, it is advisable to manage such fracture cases optimally and prefer adhesive corono-radicular reconstructions whenever possible, allowing for the restoration of the depulped tooth while economically preserving dental structures (7). Therefore, the reasoning of healthcare professionals should be directed towards the solution that requires the least sacrifice of tissue (9). Intra-coronal reinforcement

is essential to prevent any subsequent fractures. However, the mechanical resistance of the restored tooth is not improved. Therefore, the post does not reinforce the remaining dental structure but ensures proper distribution of occlusal forces and retention of the restoration material or the reattached coronal fragment (references 4, 8, 12).

In general, the use of fiber posts in RCRC is preferred for the following reasons:

- Elastic modulus as close as possible to that of the residual dental substance.
- Adhesion capacity to cementum surfaces (references 4, 12).
- Tissue economy by respecting radicular dentin and the possibility of preserving intra-coronal undercuts (references 5, 9, 16, 17, 18, 22).
- Low failure rate and absence of corrosion phenomena (references 2, 5, 7, 14, 17).
- Significant time savings: the procedure is completed in one or two sessions (references 6, 7).
- Endodontic treatment is ideally performed 24 hours before RCRC. However, D'AUBAREDE Q et al. (2010) recommend performing endodontic treatment and restoration in the same session to reduce the number of operative steps (reference 7).
- Cost-effective for both the patient and the practitioner.
- Improved restoration retention by increasing the bonding surface (reference 7).
- Possibility of reintervention in case of failure as fiber posts have a longitudinal structure allowing for the guidance of drills during a redo (references 7, 18).
- Increased fracture resistance and consolidation of residual structures (references 11, 13).
- Better distribution of occlusal forces is observed in RCRC with fiber posts than in metallic inlay cores, ensuring the longevity of the restoration. Moreover, failures are less frequent in these RCRC compared to entirely composite restorations without radicular reinforcement by a post (references 2, 11, 7).

However, the major drawback of these RCRC lies in the sensitivity of the bonding protocol and the delicacy of application (reference 10). Recent studies show that the failure rate of this type of restoration is very low, primarily linked to detachments and coronal fractures due to significant occlusal stress (reference 7). Factors favoring detachment or influencing bonding include the structure of radicular dentin, which differs from coronal dentin (reference 2). The bonding to radicular dentin is more challenging due to a lower number of tubules compared to coronal dentin, with a high percentage of inter-tubular and sclerotic dentin that is less favorable for bonding (reference 10). Additionally, access to the root canal space is less favorable than in a coronal cavity, and bonding difficulties arise from challenges in cleaning and removing excess endodontic filling materials or dentin shavings produced during post space preparation (references 2, 5). Therefore, meticulous cleaning of canal walls using ultrasonic inserts allows exploration of all non-instrumented diverticula and crevices inaccessible to conventional irrigation. This promotes cohesion between the restoration and residual tissues (references 5, 12). Aboudharam G et al. (2010) demonstrated that the success of the bonding protocol can be increased by optimizing intracanal bonding quality through ultrasonic cleaning, micro-abrasion, or air-abrasion. These tools are helpful in improving surface bonding ability by removing residues of sodium hypochlorite and eugenol, which diminish adhesive system performance (references 2, 7, 14). Furthermore, the establishment of a tight operative field, the selection of an RCRC system with compatible elements, and regular checks are necessary to prevent early detachments that may be partial and invisible, posing a risk of recurrent caries at the dentin-material interface (references 2). A study by B. AYNA et al. on 87 endodontically treated anterior teeth restored with bonded corono-radicular reconstructions concluded that the problem of retention and partial fracture represented 1.1% of the sample after one year of clinical evaluation.

However, after a 3-year follow-up, only one restoration was lost due to trauma (reference 4). Studies by SANTOS CL et al. (2011) and RESTON E et al. (2014) demonstrated successful bonding of coronal fragments on fractured incisors over periods of 7 and 10 years, respectively. In conclusion, composite restorations reinforced by fiber posts have shown clinically acceptable success rates in terms of aesthetics and functionality (references 3, 4, 19, 20, 21). TACIR I.H et al. compared reinforced and non-reinforced composite restorations with glass fibers and concluded that flexural and fracture resistance could be improved with glass fiber reinforcement (references 12, 23). However, our unproven technique remains an interesting alternative to consider in specific clinical situations. Long-term clinical follow-up of treated cases is essential to evaluate the limitations of these corono-radicular bonded restorations (references 1, 5).

Conclusion

Currently, the scope of adhesive conservative restorations is expanding while that of prosthetic restorations is narrowing (references 9, 22). Therefore, it is recommended to consider corono-radicular bonded restorations, as they perfectly align with the principles of tissue conservation and accurate reproduction of both original tooth color and anatomy (references 9, 7, 6, 19, 20, 16, 22).

Finally, several authors have established a set of principles to be followed by practitioners to increase the longevity of these restorations:

- Clearly define clinical indications
- Ensure a tight endodontic obturation
- Strictly adhere to the operative protocol to control the risk of detachment
- Avoid mixing products from different kits (references 7, 19).

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