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Rehabilitation of Fractured Tooth with Post Endodontic Monoblock Restoration – Richmond Crown: A Series of Two Cases

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Abstract

Restoring severely compromised endodontically treated teeth presents a significant challenge in restorative dentistry, particularly when minimal coronal tooth structure remains. In such situations, additional support from the root canal is often required to achieve adequate retention and resistance for the final restoration. Although post and core systems are commonly used, they are associated with several drawbacks, including the risk of root or post fracture, post dislodgement, loss of the restorative seal, and possible damage to the surrounding periodontal tissues. These complications are further intensified in patients with deep bite and reduced overjet, where teeth are subjected to increased oblique forces. In such complex clinical conditions, the Richmond crown serves as an effective alternative. This one-piece cast dowel–core–crown restoration eliminates the need for additional space required for a separate crown. It is a customized, castable system that provides improved retention, durability, and functional stability. With the option of porcelain facing for aesthetic enhancement, the Richmond crown offers a reliable and long-term solution. This case series highlights the successful management of fractured teeth with limited inter-occlusal space using Richmond crowns.

Keywords: Richmond crown, overjet, post core, root canal treatment, fracture.

Introduction

Restoring badly damaged endodontically treated teeth poses a common challenge for many restorative dentists. Often, these teeth are significantly compromised and require additional support from the root canal space to

ensure the stability and retention of the restoration. In cases where the remaining natural crown structure is insufficient to support a full-coverage crown, the post and core procedure becomes a viable treatment option to enhance retention and resistance.

However, the post and core procedure comes with its own set of concerns, including the risk of post or root fracture, dislodgement of the post-core assembly, loss of the restorative seal, and potential injury to the surrounding periodontium.[1] These concerns are further exacerbated in patients with a deep bite and markedly reduced overjet, which subjects the tooth to maximum oblique forces. In such challenging situations, the Richmond crown emerges as a valuable solution. This one-piece cast dowel-core-crown restoration eliminates the need for additional space typically required for a separate crown. The Richmond crown not only addresses the structural and functional aspects of the tooth but also provides an efficient means of preserving dental health and stability in these complex scenarios.

The Glossary of Prosthodontic Terms defines the Richmond Crown as an eponymous term for a specific type of crown designed for endodontically treated teeth. This crown is distinctive because it incorporates a porcelain facing and is named after C.M. Richmond, an American Dentist. The Richmond Crown was initially introduced in 1878 and featured a threaded tube within the root canal, accompanied by a screw- retained crown. Over time, it underwent modifications, ultimately eliminating the threaded tube and transforming into a one-piece dowel and crown unit.

It's important to note that the Richmond Crown is not a post and core system in the traditional sense. Instead, it is a customized, castable post and crown system where both components are cast together as a single unit. This design simplifies the process of creating cast metal restorations, providing improved retention and durability for long-lasting dental service. It's often desirable to camouflage the metal components with tooth-colored restorations. This approach not only enhances the aesthetics of the restoration but also ensures a functionally acceptable outcome.[2]

This case series describes management of fractured teeth with limited inter-occlusal space with Richmond crown.

Case 1

A 28 years old male patient reported with the chief complaints of broken tooth in his upper front teeth region. The patient gave history of trauma due to sports injury 2 years back. Clinical examination revealed broken incisal edge on mesial aspect of maxillary right central incisor. (Fig.1) No tenderness elicited on vertical percussion in respect to the tooth. Clinically no mobility, pus draining sinus or swelling was evident.

Figure 1: Pre-operative clinical photograph showing broken incisal edge in maxillary right central incisor

Pulp vitality was tested using cold test and electric pulp tester and was found to be non-responsive. Endodontic treatment was planned accordingly. It was observed that there was a decreased overjet (<1mm) due to malalignment of lower right central incisor. Therefore, it was planned to provide the patient with Richmond crown after the completion of the endodontic treatment.

In the first appointment, patient was informed of the treatment plan and written consent was taken.

Access cavity was made under rubber dam isolation (Hygenic, Coltene Whaledent). The initial apical file size was No. 20 hand K File (Mani, Japan), and the working length was established using an apex locator (Canal pro, Coltene, Switzerland) and confirmed through radiography. (Fig.2a) The master apical preparation was performed up to a size 50 K File (Mani, Japan), followed by the remaining portion of the root canal, which was enlarged up to a size 70 K hand files using the step-back technique. Finally, a size 40 H file was utilized in a circumferential motion to smoothen the canal. During the shaping process, 17% EDTA gel served as a lubricant, while 5.25% sodium hypochlorite and finally the canal was rinsed with 17% EDTA liquid for one minute.

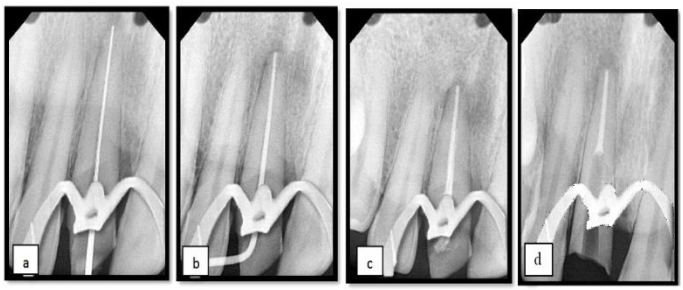

Figure 2: (a) Determination of working length; (b) Master cone selection; (c) Obturation of the root canal (d) Post space preparation

On the second appointment, obturation of the root canal was performed following cold lateral compaction technique, with gutta percha and Sealapex sealer (Kerr, USA) (Figure 2c). The patient remained clinically asymptomatic throughout the entire root canal treatment procedure.

Post space preparation (Fig. 3) – A post space was prepared using a Peeso-reamer size 1, 2 and 3 at a speed of 12,000 RPM (Mani Inc., Tochigi, Japan) to remove the coronal obturating material. Care was taken to ensure that the apical seal remained undisturbed. The preparation process was completed with the use of an H-file (Mani Inc., Tochigi, Japan) in a circumferential motion to smoothen the walls. This approach maintained divergence towards the coronal root canal and eliminated any undercuts within the post space. A direct pattern of prepared post space was made by using type I inlay wax. (Fig.3)

Figure 3: Direct impression for cast metal post and core

Direct pattern was invested and metal post core was fabricated. (Fig. 4a, 4b, 4c, 4d)The patient was recalled after 3 days for trial fitting of the cast metal post and core. (Fig. 4e, 4f, 4g) Shade selection for the final prosthesis was done using Vita classical shade guide (Fig. 4h).

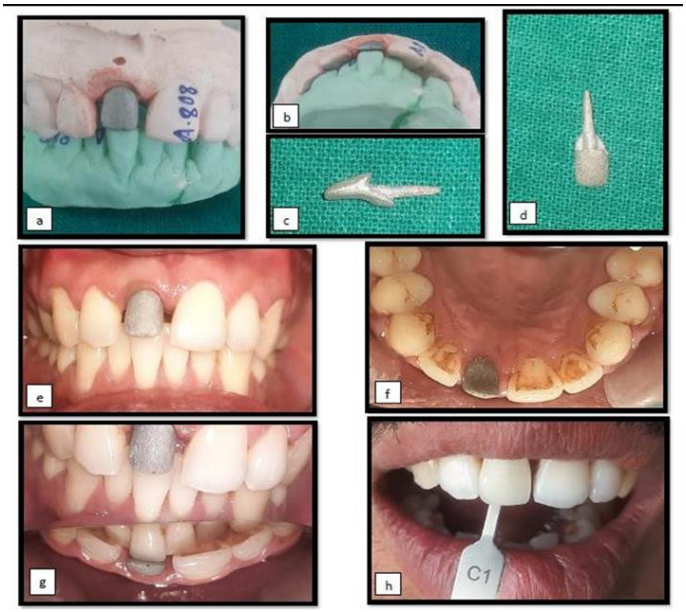

Figure 4: Cast metal post and core fabricated and trial fitting in patient's mouth

After confirming the fit, the post-core was send back to the laboratory for ceramization. The patient was recalled after 7 days. Following a thorough check for proper margin adaptation and aesthetics, the Richmond crown

was cemented in place using type I Glass Ionomer Cement (Fuji, GC) (Fig. 5).

Figure 5: Cementation of Richmond crown in patient's mouth

Case 2

A 62-year-old female patient presented with a 2-day history of a fractured upper anterior tooth following mastication of hard food. The tooth had undergone root canal treatment one year earlier. Clinical examination revealed a fractured crown of the maxillary left lateral incisor (Fig. 6), which was non-tender to vertical percussion, with no mobility, sinus tract, or swelling. Radiographic evaluation showed a well- obturated canal with no periapical pathology, PDL widening, or loss of lamina dura. However, clinical evaluation revealed a significantly reduced coronal tooth structure (approximately 2 mm) due to fracture, along with a reduced overjet (<1 mm) (Fig. 6). In view of the limited remaining crown height and occlusal considerations, rehabilitation with a Richmond crown was planned.

After detailed explanation of the treatment plan, informed written consent was obtained. Post space preparation was carried out using Peeso reamers sizes 1, 2, and 3 at 12,000 RPM (Mani Inc., Tochigi, Japan) to remove the coronal obturating material, while maintaining approximately 4 mm of the apical seal. Final refinement of the post space was done with an H-file (Mani Inc., Tochigi, Japan) using circumferential filing to smoothen the canal walls, as described earlier.

A direct pattern of prepared post space was made by using type I inlay wax. Impression taken along with wax pattern with putty. (Fig.7) Shade selection for the final prosthesis was done using Vita classical shade guide The patient was recalled after 3 days for trial fitting of the cast metal post and core.

After confirming the fit, the post-core was send back to the laboratory for ceramization. The patient was recalled after 7 days. Following a thorough check for proper margin adaptation and aesthetics, the Richmond crown was cemented in place using type I Glass Ionomer Cement (Fuji, GC) (Fig.8).

Figure 6: (a) Pre-operative profile image; (b) Pre-operative clinical photograph showing broken crown in maxillary left lateral incisor; (c) Preoperative radiographic image

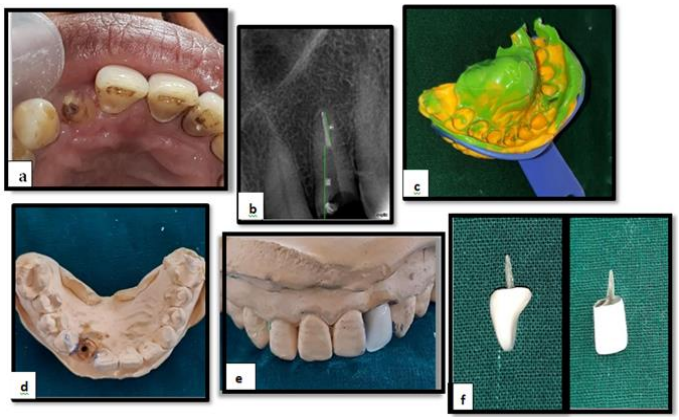

Figure 7: (a) Post space creation done in respect to 22; (b) Radiographic image of post space; (c) maxillary impression taken along with wax pattern with putty; (d)

Master cast with tooth preparation done for Richmond crown;

(e) Master cast with Richmond crown; (f) Richmond crown

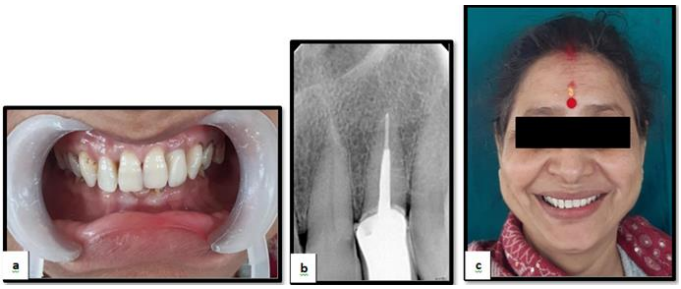

Figure 8: (a) Buccal view of the Richmond crown with respect to 22; (b) Radiograph of cemented Richmond crown; (c) Post-operative profile image

Discussion

Endodontic treatment has indeed been a longstanding practice with a high success rate. When a significant amount of tooth structure is lost due to factors such as fracture, caries, or secondary decay around previous restorations, or during endodontic treatment, the remaining crown structure may not be sufficient to support a large prosthetic crown.[3] In such cases, specialized procedures are required with the objective of increasing the remaining crown length. This extension of the crown length aims to ensure that the tooth can effectively manage the arc of rotation under oblique forces during normal function.[4]

Richmond crown was first introduced in 1878 as a single-piece post-retained crown featuring a porcelain facing.[1] This is typically indicated for cases where a single tooth is grossly decayed or severely broken, resulting in minimal remaining crown height. It is particularly useful when there is a steep incisal guidance, which means there is a deep bite and very little overjet. In such situations, there may be limited cervical tooth structure remaining, and this design offers advantages.[5]

The Richmond crown design is preferred in this case because it provides enhanced cervical stiffening compared to other post systems. It helps maintain the integrity of the restoration by minimizing flexion forces on the remaining tooth structure during normal oral function, thus ensuring the longevity and effectiveness of the restoration.

Also, as in this case there was little or negligible incisal overjet (<1mm) present, space for full coverage crown over the cast core was insufficient. By minimizing the need for extensive tooth reduction and maintaining a thinner profile, the Richmond crown not only conserves tooth structure but also contributes to better esthetic outcomes. This makes it a highly favorable choice in cases where both tooth preservation and esthetics are critical considerations.[6] A single-unit post-core crown restoration indeed offers several advantages over its multiple-unit counterparts. One of the key advantages is related to the integration of the post and core as a single unit. In cases where the post and core are separate entities, there is a potential issue of flexion of the post under functional forces. This flexion can exert stress on the post-core interface, leading to problems such as separation of the core from the post due to permanent deformation of the post material. However, in a single-unit post-core crown, this issue is mitigated because the post and core are fabricated as a cohesive and integrated unit. This design minimizes the risk of stress concentration at the interface, enhancing the overall durability and longevity of the restoration. It also simplifies the restoration process and can lead to better clinical outcomes.[7]

Conclusion

The clinician's judgment plays a crucial role in determining the best course of action, with the primary goals being to meet the specific needs of the case,

maximize retention, and minimize stress on the tooth. While various post designs may be available and suitable for different clinical situations, the ultimate success of the treatment is heavily influenced by the amount of remaining tooth structure following endodontic therapy as well as the alignment and condition of the opposing tooth in occlusion. Preserving as much healthy tooth structure as possible is often a key factor in achieving long- term success and ensuring the patient's oral health and satisfaction.

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