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Customized Dowel with a Porcelain-Fused-to-Metal Crown on a Central Incisor Following Root Canal Treatment

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A R T I C L E I N F O

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A B S T R A C T

This case report describes the outcome of restoring the upper right central incisor after completion of root canal treatment, with emphasis on the use of a post-supported crown to rehabilitate the tooth's appearance and function. A 31-year-old male patient presented to the UNEJ Dental Hospital with extensive caries affecting the upper right anterior tooth. The diagnosis was Previously Treated (Post PSA). Treatment consisted of placement of a metal post core followed by fabrication and cementation of a porcelain-fused-to-metal crown restoration (Post PSA). The results of this case indicate that crown restoration can effectively rehabilitate the aesthetic function of a severely damaged tooth after root canal treatment.

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INTRODUCTION

Post-and-core crown treatment is a commonly performed restorative procedure in daily dental practice, particularly for teeth that have sustained extensive structural loss. This treatment is generally indicated when severe damage requires root canal therapy and the remaining tooth structure is insufficient to support a conventional filling. In such cases, a filling alone may not provide adequate strength, retention, or resistance to functional forces. Root canal treatment can further compromise the structure of an anterior tooth because tissue removal disrupts the continuity of the dentin. This loss of dentin is often associated with extensive caries and may leave the remaining tooth structure more brittle and susceptible to fracture (Sidiartha et al., 2020).

The appropriate selection and design of the post and core are essential for achieving adequate retention and stability of the definitive crown restoration. Following root canal treatment, the post is placed within the prepared root canal to connect the remaining tooth structure with the core. The core then provides a foundation for the final crown and helps restore the tooth's external form. In addition to supporting the crown, the post-and-core assembly is intended to distribute functional occlusal loads and stresses more evenly along the root, thereby reducing the concentration of forces that could contribute to root fracture (Ariyanti et al., 2018). The amount of remaining coronal tooth structure, root anatomy, canal configuration, and anticipated functional demands should be considered when selecting the restorative design.

For anterior teeth with extensive structural damage, porcelain-fused-to-metal crowns are often selected to provide an acceptable aesthetic result while maintaining adequate mechanical strength. These crowns may be combined with metal post-and-core restorations to improve retention and resistance, particularly when limited coronal tooth structure remains (Himawan et al. 2025). Custom metal dowels are typically indicated for single-rooted teeth in which the remaining tooth structure is insufficient to support a prefabricated post or a conventional core. Their principal advantages include close adaptation to the individual root canal walls, high mechanical strength, and reliable retention of the core material. Consequently, custom metal post-and-core restorations can provide a stable foundation for the crown in severely compromised anterior teeth, provided that sufficient root structure and an appropriate ferrule are preserved. Placement of a custom dowel may subsequently be followed by fabrication of a porcelain-fused-to-metal crown, a restorative option that combines the structural support of a metal substructure with a tooth-colored porcelain veneer. This approach can provide improved aesthetic outcomes, particularly for anterior teeth, where the visibility of the restoration and the need to reproduce natural tooth appearance are important considerations (Nabila et al. 2025).

THEORETICAL REVIEW

Dowel post and cores are often needed in endodontically treated tooth to provide retention and resistance form for final crown, and finally to restore the form and function of the tooth (S.Grandini, 2005). The coronal restorations are done to replace structure loss, to restore coronal morphology and functions, to

provide the strength for the restoration/tooth complex to with stand functional stress (C. Vârlan, 2009). There are 2 types of dowels according to the materials made from; metallic and non-metallic dowels used in clinical dentistry. Other types of dowel systems are available to restore the tooth structures, such as prefabricated or custom cast, parallel or tapered, and active or passive (R.S. Schwartz,2006). The custom cast dowel has the advantage of good fit and retention, precise marginal integrity, ideal contacts, and reproduction of anatomic morphology (B. Touati,2007).

Porcelain-fused-to-metal (PFM) restorations, also referred to as metal-ceramic restorations**,** have been widely used in fixed prosthodontics for the restoration of damaged or missing teeth. PFM restorations combine a strong metal substructure with an esthetic ceramic veneer. This combination was developed to overcome the limitations of both metal restorations, which have limited esthetic properties, and conventional porcelain restorations, which are relatively brittle. The development of metal-ceramic systems represented a major advancement in restorative dentistry because it allowed clinicians to achieve an appropriate balance between mechanical strength, marginal adaptation, durability, and esthetics (Zhang, 2017).

The development of PFM restorations was based on the concept of combining the strength and durability of dental alloys with the optical properties of dental porcelain. A major challenge during the early development of these restorations was the difference in thermal expansion between metal and porcelain. The development of compatible metal-ceramic systems, particularly through controlling the coefficient of thermal expansion (CTE), allowed porcelain to be successfully bonded to metal frameworks (Zhang, 2017).

One of the major advantages of PFM restorations is their well-established clinical longevity. A systematic review comparing tooth-supported PFM and all-ceramic fixed dental prostheses reported an approximately 99.5% five-year survival rate for PFM prostheses**,** compared with approximately 92% for all-ceramic prostheses in the included evidence. However, differences in study design and restoration types should be considered when interpreting these results. A clinical study involving 997 PFM single crowns reported five-year survival rates of 96.4% for anterior crowns and 97.5% for posterior crowns. At 10 years, survival rates were 92.3% and 95.9%, respectively. These findings demonstrate the potential for long-term clinical service of PFM crowns (Zhang, 2017).

The principal advantages of PFM restorations include: high mechanical strength due to the metal framework, **g**ood long-term clinical survival, acceptable esthetics when properly fabricated, **e**stablished clinical history supported by decades of research**, v**ersatility for anterior and posterior restorations, **p**redictable laboratory procedures, good resistance to functional loading. The combination of metal strength and ceramic esthetics remains the fundamental reason for the continued clinical relevance of PFM restorations (Zhang, 2017).

METHODOLOGY

A 31-year-old male patient presented to the UNEJ Dental Hospital seeking treatment for a severely carious upper right anterior tooth. The lesion had resulted in extensive loss of the clinical crown, leaving only a minimal amount of sound crown structure. The patient reported diminished self-confidence because of the tooth's appearance and the visible extent of the decay. According to his history, the cavity had been present for approximately five years. It initially appeared as a small defect but progressively enlarged, with substantial deterioration occurring during the preceding three years and ultimately leaving the crown nearly completely destroyed. The patient also reported a previous episode of spontaneous pain associated with the tooth.

Root canal treatment had been completed one month before presentation, and the tooth was asymptomatic at the time of examination. Nevertheless, the patient remained concerned about the extensive structural damage and the limited amount of remaining crown tissue and therefore requested definitive restorative treatment. A comprehensive clinical examination, evaluation of diagnostic models, and radiographic assessment were performed to determine the feasibility of restoration. The findings indicated that the tooth had sufficient conditions for rehabilitation with a custom dowel to provide internal support, followed by placement of a porcelain-fused-to-metal (PFM) crown to restore its form, function, and appearance.



Figure. 1 Postoperative clinical status of the central incisor after root canal treatment



Figure. 2 Radiographic findings for a central incisor following root canal treatment

RESULTS

At the initial appointment, a comprehensive medical and dental history was obtained. The proposed treatment procedure, including the anticipated sequence of clinical steps and treatment timeline, was explained to the patient. After receiving the relevant information, the patient agreed to proceed and signed the informed consent form. Because the tooth had previously undergone root canal treatment, the working length required for post-space preparation was determined. Ideally, the post should extend to approximately two-thirds of the root canal length or, at minimum, correspond to the clinical crown length, representing a 1:1 crown-to-post ratio. In this case, a post-preparation working length of 15 mm was established.

The gutta-percha was subsequently removed to the planned depth using a Gates-Glidden drill that had been marked in advance to indicate the established working length. This marking helped control the depth of post-space preparation and preserve an adequate apical seal. The root canal was then irrigated with saline to flush out residual debris and loose material. Canal enlargement was performed with Peeso reamers, using a sequential technique that progressed from the smallest to the largest instrument size. A periapical radiograph was then obtained to assess the extent of gutta-percha removal and verify the adequacy of the prepared post space. After radiographic evaluation, the access cavity was sealed with a cotton pellet, and a temporary restoration was placed to protect the tooth until the next appointment.



Figure. 3 Radiographic image of the central incisor following the reduction of gutta-percha

At the subsequent visit, treatment continued with the fabrication of a custom dowel. The procedure began with preparation of the remaining sound hard tissue of tooth 11 to provide an appropriate foundation for the definitive restoration. Buccal tooth preparation was carried out with a round-end tapered bur. The resulting shoulder finish line was positioned subgingivally, providing the required restorative margin while maintaining the planned preparation design. Palatal preparation in the cingulum region was performed with a round-end tapered diamond bur, positioning the shoulder at the gingival margin to establish a defined finish line. Proximal reduction was subsequently completed

with a round-end tapered diamond bur oriented at a 60-degree angle. Finally, a bevel was created circumferentially around the occlusal cavosurface using a flame-shaped diamond bur, thereby refining the preparation margins.



Figure. 4 Clinical appearance of the prepared central incisor.

After completion of the tooth preparation, the post pattern was fabricated using an elastomeric material. A plastic pin or paper clip was first selected and prepared to approximate the diameter of the prepared root canal, thereby providing support for the pattern material. The elastomer was mixed until a uniform consistency was achieved, applied evenly along the paper clip, and inserted into the prepared root canal space, which had previously been lubricated with Vaseline. After the material had set, the paper clip and the polymerized elastomeric pattern were carefully removed from the canal. The resulting impression was then examined for voids, distortions, or areas of the canal wall that had not been reproduced accurately.



Figure. 5 Impression outcome for a central incisor post-and-core restoration

Once the post pattern impression was determined to be satisfactory, the pattern was repositioned in the root canal at its original depth and orientation. An impression was then made with an elastomeric impression material. During this procedure, care was taken to prevent excess material from entering the undercuts of the adjacent teeth. This precaution ensured that the post pattern could be removed and reinserted along a single, clearly defined path of insertion. After the elastomeric material has fully set, the excess paper clip wire is carefully trimmed, and the coronal resin is adjusted so that its height approximates the level of the occlusal plane. This adjustment helps establish an appropriate reference for subsequent laboratory procedures and occlusal evaluation. The

interocclusal relationship is then recorded to facilitate accurate mounting of the working model on an articulator. In addition, a shade guide is used to select a color that closely corresponds to the porcelain-fused-to-metal crown, thereby supporting an appropriate match between the custom post restoration and the planned definitive crown.



Figure. 6 An impression of the dowel pattern was obtained using an elastomeric impression material.

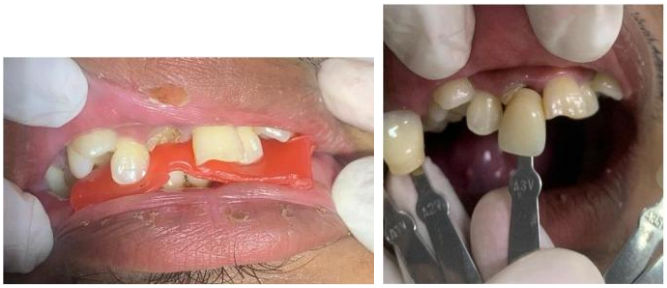


Figure. 7 Occlusal registration performed with red waxand shade guide for the central incisors

The working model is subsequently transferred to the dental laboratory, where it is used to fabricate a cast post, also referred to as a custom-cast post. After fabrication, the cast post is placed intraorally for clinical evaluation. The clinician assesses whether the metal post seats completely within the prepared root canal, provides adequate retention, and maintains an appropriate relationship between the post-core margin and the remaining coronal tooth structure. If these criteria are satisfied, the restoration can proceed to permanent cementation.

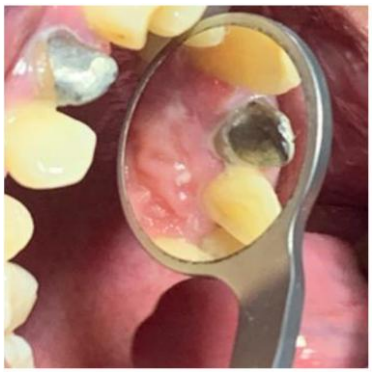


Figure. 8 Post cementation in a central incisor

When the post demonstrates proper adaptation within the root canal and the coronal portion provides sufficient space for placement of an aesthetic porcelain veneer, the cast post is returned to the dental laboratory for porcelain application in the selected shade. Following completion of this laboratory phase, the custom post and porcelain-fused-to-metal (PFM) crown are examined for anatomical form, dimensional accuracy, and consistency of shade. If the restorations are judged satisfactory, a clinical try-in is performed. This appointment includes verification of the occlusal contacts with articulating paper to identify and correct any premature contacts or excessive occlusal interference before final cementation. After confirming that the patient is comfortable and that the occlusion is accurate, the post-and-crown assembly is permanently cemented. Glass ionomer cement is applied evenly to the fitting surface to facilitate secure seating and establish an appropriate seal between the restoration and the prepared tooth structure.



Figure. 9 Placement of a custom dowel-and-core restoration followed by the cementation of a porcelain-fused-to-metal crown.

DISCUSSION

Post-and-core crown restorations are generally indicated for teeth with substantial loss of coronal structure or for teeth that have been treated endodontically. The restoration comprises two separate components: a post-retained core that reinforces and replaces the missing coronal portion, and a definitive crown cemented over the prepared core. This two-unit configuration provides several clinical advantages compared with a single-unit post-and-crown design. If the definitive crown subsequently requires replacement because of fracture, wear, esthetic concerns, or marginal failure, the post can remain in the root canal, thereby reducing the risk of unnecessary disruption to the endodontic treatment. In addition, the adaptation of the crown margin to the remaining root surface and the crown's spatial relationship with adjacent and opposing teeth can be established independently of the exact fit between the post and the root canal. Consequently, crown fabrication and placement can be guided primarily by periodontal, occlusal, and esthetic requirements rather than by post-canal adaptation alone.

The present case involved the need for an esthetic restoration of a maxillary right anterior tooth with extensive structural damage and fracture, specifically tooth 11. The compromised appearance of the tooth had adversely

affected the patient's confidence when smiling, making restoration of both function and appearance essential. Selection of the post design for this root-canal-treated tooth was based on several clinical considerations, including the amount and distribution of the remaining tooth structure, the cervical diameter of the root canal, the length of the root supported by alveolar bone, and the functional and esthetic demands of the planned definitive restoration. After assessment of these factors, a custom-cast post was selected to provide an individualized fit within the prepared canal and to support the coronal core. The post-and-core assembly was restored with a porcelain-fused-to-metal crown, which was chosen to provide the required structural support while also improving the tooth's appearance and its integration with the surrounding dentition.

In this case, the selection of a custom dowel was justified by several clinical considerations. The residual coronal tooth structure measured less than one-third of the crown's cervico-incisal height, limiting the amount of tooth available to support a conventional restoration. In addition, the root canal was relatively wide, with a diameter measuring at least one-third of the root diameter, and the post-endodontic crown had sustained damage so extensive that restoration with either a standard jacket crown or an inlay was not feasible. Retention is influenced in part by the cervico-incisal length of the preparation: an increased core length generally provides greater retention, whereas a shorter core provides less mechanical resistance to displacement. The porcelain-fused-to-metal jacket crown, used in combination with a custom metal dowel to form a monoblock-like restorative unit, was selected to resist lateral loading and promote more uniform distribution of functional stresses across the tooth and its supporting structures. A porcelain coping was also necessary to satisfy aesthetic requirements because the tooth involved was located in the anterior region, where the restoration had to achieve a high degree of visual integration with the adjacent dentition.

CONCLUSIONS AND RECOMMENDATIONS

Rehabilitation of the maxillary right central incisor with a custom dowel and a porcelain-fused-to-metal crown can reestablish tooth function while enhancing the patient's aesthetic appearance.

FURTHER STUDY

Further studies are recommended to evaluate the long-term clinical outcomes of customized dowels combined with porcelain-fused-to-metal crowns in restoring endodontically treated central incisors.

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