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Case Report

Custom Cast Post and Core: The Key to Successful Endodontic Restoration of Anterior Teeth — Case Report

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Abstract

Selecting the right post system and material to repair fractured teeth that have undergone endodontic treatment is a significant challenge for dental surgeons. Typically, cast metal posts and cores are used when there's extensive loss of tooth structure, especially if the plan involves metal-ceramic crowns. It's crucial to restore teeth effectively after endodontic treatment, with the post helping to retain the core needed to support the final prosthesis. When there's considerable loss of tooth structure or not enough ferrule left, it's recommended to use custom cast post and core systems. These systems not only help retain the core but also improve fracture resistance after root canal therapy. Often, an interdisciplinary approach is needed, considering both prosthetic and endodontic treatments, while meeting the patient's expectations and clinical needs. Using custom cast posts along with full veneer crowns has been successful in repairing severely damaged teeth, both functionally and aesthetically. These treatments strengthen weakened, endodontically treated teeth against the forces in the mouth, channeling torquing forces through the root dentin to supportive tissue along the roots. This approach ensures positive outcomes and patient satisfaction, especially in cases involving injured upper front (anterior) teeth. When anterior teeth are weakened or lost due to factors like decay, endodontic treatment, or trauma, extracoronal restoration becomes necessary. Custom cast post and core systems offer retention for core restorations, replacing lost coronal structure. This method has proven effective in restoring badly damaged anterior teeth, followed by porcelain-fused-to-metal restorations. Trauma-induced fractures in permanent anterior teeth are common, causing discomfort and aesthetic concerns for patients. Managing such cases endodontically may require post and core systems to reinforce coronal restorations. Despite the availability of various post systems, custom cast post and core remains a popular choice. The current case report discusses how dealing with severely damaged maxillary anterior teeth often requires using custom cast post and core systems followed by full coverage crowns. This approach effectively addresses both functional and aesthetic concerns.

***Keywords:** Aesthetics, Anterior teeth, Cast metal post and core, Cast post and core, Custom cast post, Custom cast post and core, Endodontic, Esthetic restoration, Esthetics, Ferrule, Fiber post and core, Fractured tooth, Metal ceramic crowns, Porcelain fused to metal crowns, Post endodontic restoration, Prosthetic rehabilitation.*

Introduction

In instances where dental caries affect the pulp, fractures occur, or previous restorations fail, endodontic treatment becomes essential, often leading to significant loss of the tooth's coronal structure.[1,2] Different techniques and materials for post and core build-up are used to restore the compromised tooth structure, with careful selection being vital to maintain the remaining tooth structure's ability to retain the restoration.[3,4,5]

When anterior teeth experience more than 50% loss of tooth structure, they typically necessitate post and core procedures followed by full coverage restorations.[6,7] Franklin Weine emphasizes that failures in teeth treated endodontically often result from insufficient post-endodontic restoration rather than the initial endodontic issue.[8] Factors influencing the choice of post-endodontic materials include the extent of remaining tooth structure, aesthetic concerns, and the condition of the surrounding periodontal tissues. [9,10,11,12]

Fiber posts are favored for their ease of use and time-saving benefits.[13] However, custom-made cast posts remain a conventional option, particularly when accommodating the canal's shape or adjusting the core's angle is required.[14,15,16] Composite resin is another option, suitable for cases with minimal tooth structure loss, providing both aesthetic appeal and functional advantages.[17,18]

When the remaining tooth structure doesn't provide enough retention and resistance for the restoration, reconstructive steps are needed before the final restoration can proceed.[19,20] Cast metal posts are frequently employed to stabilize the core, with custom-made options preferred for their capacity to conform to the canal's shape and endure torsional forces.[21,22]

Custom-made posts and cores are often recommended for the treatment of severely damaged teeth caused by either trauma or cavities.[23,24] They are particularly useful for teeth with curved or elliptical canals as they provide a precise fit in the prepared post space.[25,26] In contrast, prefabricated posts are not suitable for these situations as they cannot adequately adapt to the canal shape.[27,28] The enhanced flexibility of custom-cast post and core systems helps them better withstand torsional stress.[29,30] Moreover, in the case of single-rooted and premolar teeth, which tend to weaken due to the cumulative loss of dental structure during preparation, these specialized posts and cores serve as stabilizers for both the crown and root portions of the tooth.[31,32,33,34]

Repairing severely damaged front (anterior) teeth, like fractured upper incisors, typically entails custom cast posts followed by porcelain-fused-to-metal restorations.[35,36] This method ensures both functional and aesthetic restoration, effectively tackling issues arising from dental trauma, decay, and prior restorations.[37,38]

Post-endodontic restoration significantly influences the long-term outlook of treated teeth, with custom-made cast post and core systems serving as a fundamental element in effectively restoring compromised tooth structures.[39,40] When paired with full coverage crowns, this method is successful in addressing moderate to severe tooth structure loss, guaranteeing both functional stability and aesthetic enhancement.[41,42]

Case Report

A 28-year-old male bank employee residing in Pinjore visited the Department of Prosthodontics, Crown & Bridge, and Oral Implantology and presented with a chief complaint of broken upper front teeth persisting for one month. He reported a history of a road accident occurring one month prior. His medical history was unremarkable. In terms of dental history, he had undergone periodontal splinting for mobile teeth (11 and 21) one month ago and Root Canal Treatment (RCT) for the same teeth two weeks ago. He identified as a vegetarian and denied any history of smoking, alcoholism, tobacco chewing, bruxism, or clenching, expressing a desire for aesthetic improvement.

Clinical examination revealed Elli's class III fractures, exposing pulp, which had been treated with endodontic therapy.

Extraoral examination showed a square-tapering facial form with a straight profile and symmetrical asymmetry (Figures 1 & 2). Facial height appeared normal, and the temporomandibular joint examination revealed no abnormalities. Intraoral examination revealed normal mucosa and gingiva with firm and resilient consistency, absent tooth mobility, and no pain on percussion (Figures 3 & 4).

Radiographic examination showed cone-shaped roots with rounded apices for teeth 11 and 21, with a crown-root ratio of 1:3 for 11 and 1:4 for 21 (Figures 5, 6, & 7). Periapical radiolucency, absence of lamina dura continuity, and horizontal bone loss were noted. Occlusal examination indicated a class I molar relation and a group function occlusal scheme bilaterally (Figures 8, 9, & 10).

Treatment options included post and core followed by porcelain-fused-to-metal (PFM) crowns or extraction followed by implant-supported fixed dental prosthesis. The chosen treatment plan involved fabricating cast post and core for tooth 21 followed by PFM crowns for teeth 11 and 21. Retainers would consist of post and core for tooth 21, with materials including nickel-chromium alloy for the metal post and PFM crowns. Permanent cementation with glass ionomer cement was planned, along with patient education on oral hygiene, specifically dental flossing.

The treatment plan involved preparing post space using Gates drills and hand instruments, leaving 4-5mm of gutta-percha to maintain the apical seal. Custom cast post and core were fabricated and cemented with glass ionomer cement, followed by crown lengthening and placement of metal-ceramic crowns to restore both teeth. For tooth #21, the plan included endodontic therapy followed by cast post and core placement and eventually restoration with a porcelain-bonded-to-metal crown for aesthetic and functional restoration.

The treatment process involved meticulous steps such as post space preparation, core build-up, crown preparation, impression making, and crown placement using suitable materials and techniques tailored to each patient's requirements. The final restorations aimed to restore form, function, and aesthetics, ensuring patient satisfaction and long-term success.

Figure 1 - *Extraoral Examination – Frontal View.*

Figure 2 - *Extraoral Examination – Lateral View.*

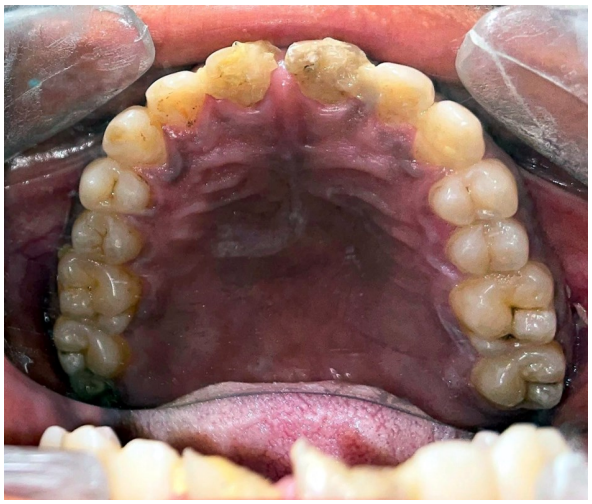

Figure 3 - *Intraoral Examination – Maxillary Arch.*

Figure 4 - *Intraoral Examination – Mandibular Arch*

Figure 5 – *Radiographic Investigation – Endodontic Intervention for Tooth 21.*

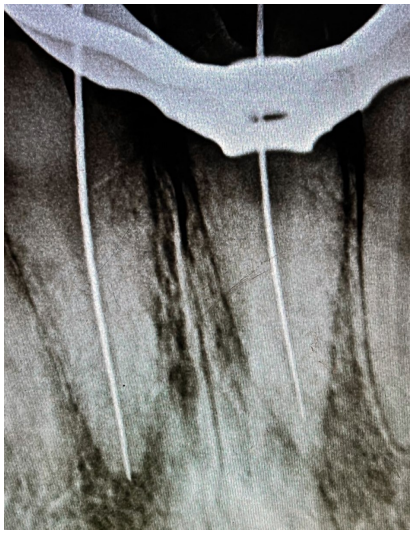

Figure 6 – *Radiographic Investigation – Endodontic Intervention for Tooth 11.*

Figure 7 – *Radiographic Examination – Root Morphology & Crown-to-Root Ratio.*

Figure 8 – *Fractured Teeth 11 & 21*

Figure 9 - *Examination of Occlusion (Molar Relation) – Left Lateral View.*

Figure 10 - *Examination of Occlusion (Molar Relation) – Right Lateral View.*

Clinical steps for post space preparation and tooth preparation were conducted as follows:

1. Post Space Preparation for Tooth 2

Post space preparation with respect to tooth 21 involved ensuring the preservation of 4-5 mm of apical seal, constituting at least half of the root length and extending beyond the crown (Figure 11).

2. Space Creation and Cleaning

Space creation was achieved using Peeso Reamers (Largo peeso reamers, Dentsply, India) (Figure 12), followed by cleaning with saline and drying with paper points (6% Tapered Paper Points, Meta Biomed Co. Ltd., Korea) (Figure 13).

3. Confirmation of Post Space Preparation

Confirmation of post space preparation was done using a radiograph (Figure 14).

4. Custom Cast Post Fabrication

For custom cast post fabrication, the lubricated canal was impressed with a K-file (Stainless Steel K Files - 21mm, Mani, Inc., Japan) (Figure 15), and a castable post and core pattern was directly fabricated in the mouth using low fusing green stick compound (Pinnacle Tracing Sticks, Dental Products of India, Mumbai, India) on the prepared tooth (Figure 16).

Figure 11 - *Preparation of Post Space with Respect to Tooth 21.*

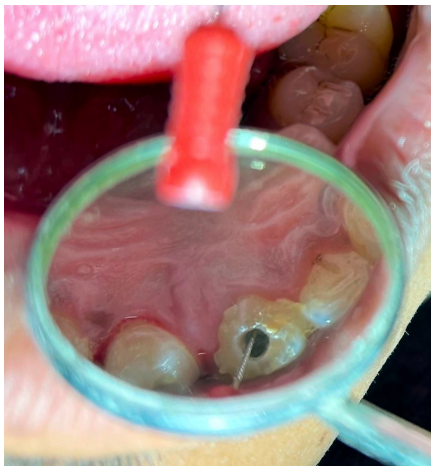

Figure 12 - *Preparation of Post Space with Peeso Reamer.*

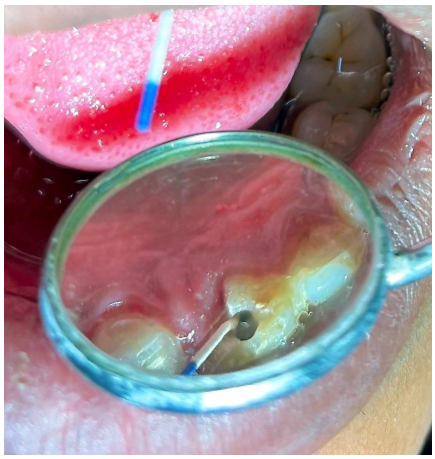

Figure 13 - *Prepared Post Space*

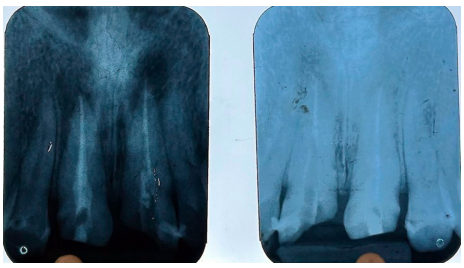

Figure 14 - *Confirmation of Post Space Preparation with Respect to Tooth 21 Using Radiograph.*

Figure 15 - *Impression of the Post Space and the Core with the K-file.*

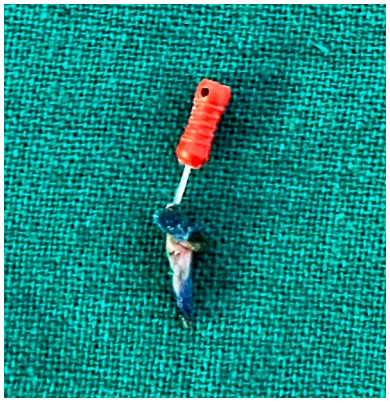

Figure 16 - *Impression of Post Space and the Core with the Greenstick.*

5. Pattern Spruing and Investment

The pattern was sprued on the incisal end and invested (Figures 17, 18, 19, & 20).

6. Evaluation of Cast Post

Evaluation of the cast post was done in the patient's mouth and was further confirmed radiographically (Figures 21, 22, & 23).

7. Pre-Luting Procedures

Before luting the cast post, sandblasting was performed, and then the post was cemented using glass ionomer cement (GIC) (GC Fuji Gold Label Type 1 Luting Cement, GC Corporation, Tokyo, Japan).

8. Tooth Preparation for PFM Crowns

Tooth preparation for PFM crowns was subsequently conducted for teeth 11 and 21 (Figures 24 & 25).

9. Gingival Retraction and Final Impression

Gingival retraction was done using retraction cord (Medi Pak Retraction Cord – 000, Medicept Dental Pvt. Ltd., United Kingdom) & cord packer (Gingival Cord Packer Non-Serrated #4, GDC Fine Crafted Dental Pvt. Ltd., Hoshiarpur, Punjab, India) (Figure 26), and a final impression (Zetaplus C-Silicone, Zhermack, Italy) was made (Figure 27).

10. Fabrication of Temporary Crowns

Temporary crowns (provisional restoration) (Protemp™ 4 Temporisation Material, 3M ESPE, 3M India, Karnataka, India) were subsequently fabricated using an indirect technique.

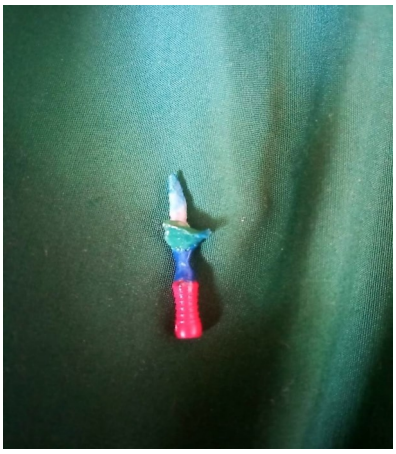

Figure 17 – *Final Pattern before Spruing.*

Figure 18 - *Laboratory Procedure - Sprue Attachment.*

Figure 19 - *Laboratory Procedure - Sprue Attached to the Sprue Former.*

Figure 20 - *Laboratory Procedure – Investing.*

Figure 21 – *Final Post after Casting.*

Figure 22 - *Evaluation of the Post Before Luting (in Patient's Mouth).*

Figure 23 – *Radiographic Evaluation of the Post Before Luting.*

Figure 24 - *Tooth Preparations with Respect to Teeth 11 and 21.*

Figure 25 - *Tooth Preparations - Subgingival Finish Lines Prepared.*

Figure 26 - *Retraction Cord Packed with the Cord Packer Before Making the Final Impression.*

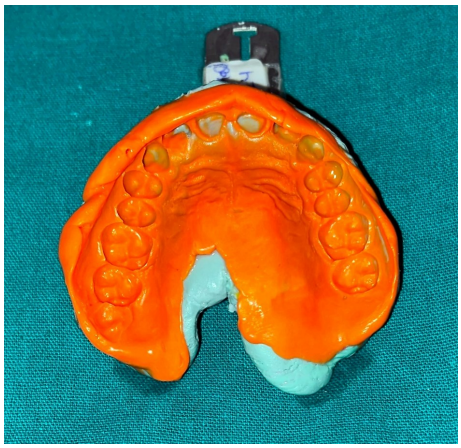

Figure 27 - *Final Impressions.*

11. Metal Try-In and Shade Selection

Metal try-in was done at the next appointment (Figures 28 & 29). This was followed by shade selection using a shade guide (2M2 & 2M3). The trial was sent to the lab followed by ceramic application and final fabrication of the crown.

12. Bisque Try-In Stage

The subsequent appointment, i.e., the bisque try-in stage (Figure 30), was aimed to test the fixed crowns for fit, assess occlusion, articulation, and integration with surrounding tissues.

13. Final Crown Fabrication and Glazing

After the bisque trial, i.e., after necessary occlusal adjustments, the crowns were sent to the lab for glazing.

14. Luting of Final Crowns

The final metal-ceramic crowns (Figures 31 & 32) were luted using glass-ionomer cement (GC Fuji Gold Label Type 1 Luting Cement, GC Corporation, Tokyo, Japan).

15. Post-Treatment Evaluation

A subsequent visit was scheduled for further evaluations. Both subjective and objective assessments were conducted, revealing the patient's satisfaction with the treatment outcomes. No subjective complaints, negative responses to percussion or palpation, unfavorable crown conditions, food retention, or issues with restoration margins were noted. Moreover, the surrounding gingiva exhibited normalcy.

This case showcased the effective and aesthetic restoration of a fractured maxillary anterior tooth using a minimally invasive and cost-effective approach (Figures 33 & 34).

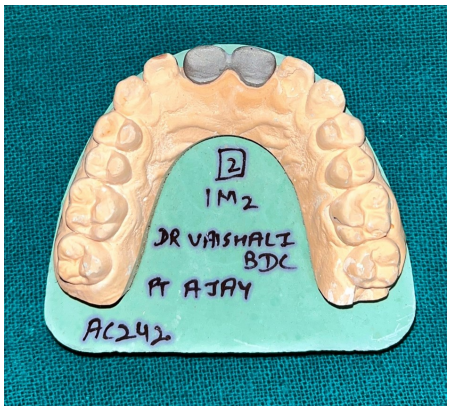

Figure 28 - *Metal Trial (Outside the Patient's Mouth).*

Figure 29 - *Metal Trial (Inside the Patient's Mouth).*

Figure 30 - *Bisque Trial.*

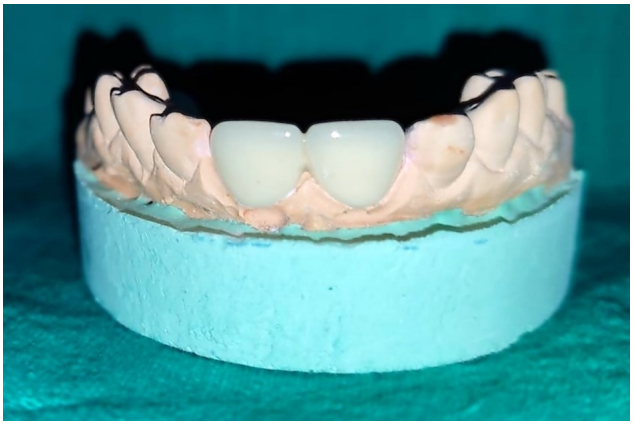

Figure 31 - *Final (Glazed) Porcelain-Fused-to-Metal (PFM) Crowns (Outside the Patient's Mouth).*

Figure 32 - *Final (Glazed) Porcelain-Fused-to-Metal (PFM) Crowns (Inside the Patient's Mouth)*

Figure 33 – *Pre-operative View of the Patient.*

Figure 34 – *Post-operative View of the Patient.*

Discussion

Restoring teeth that have undergone endodontic treatment and sustained fractures typically involves the use of custom metallic cast posts or prefabricated post and core systems, followed by full coverage crowns, which can be either metal-ceramic or all-ceramic.[43,44] Custom cast post and core restoration offers a precise fit with minimal luting cement interface and features an inherent anti-rotation mechanism, providing high strength and requiring minimal tooth reduction during endodontically treated tooth preparation.[45,46] The success of post and core restoration largely depends on the preservation of tooth structure.[47,48]

In specific cases involving extensive loss of anterior tooth structure, coronal destruction, and functional rehabilitation, custom-made metallic post and core combined with metal-ceramic individual crowns were utilized for various reasons.[49,50] It's essential to note that while the post aids in retaining the core for crown retention, it does not reinforce or strengthen the endodontically treated tooth.[51,52]

Research indicates that having a 2mm crown ferrule surrounding the remaining tooth structure improves the fracture resistance of anterior teeth restored with cast post and core and metal-ceramic crowns.[53,54] Cast posts, known for their ability to adapt to canal contours and provide an anti-rotational mechanism, have shown improved survival rates over time.[55,56]

Nevertheless, prefabricated posts have gained popularity due to their convenience, particularly with the introduction of radiopaque and translucent fiber-reinforced posts.[57,58] These posts enable single-appointment post and core fabrication and the use of aesthetic all-ceramic crowns.[59,60] However, fiber and ceramic posts require adhesive bonding, which is a technique-sensitive procedure.

A successful restoration following endodontic treatment is crucial for healing periapical inflammation, with high success rates of 91.4% associated with good restorations and treatments.[61,62] Conversely, poor restorations and treatments yield much lower success rates of only 18.1%.[63,64] Even when endodontic treatment is subpar, a good permanent restoration can still achieve a success rate of 67.6%.[65,66] This underscores the importance of post-endodontic restoration, which has been emphasized by Trope and Ray.[67]

In a specific case involving teeth fractured due to a road accident, with inadequate coronal retention for crown placement, a custom-made cast post and core was chosen over other types of prefabricated posts due to their superior performance. Custom-made cast posts ensure core stability as the core is integral to the post, reducing the risk of dislodgement.[68] Additionally, they better conform to canal morphology and have shown higher long-term survival rates compared to prefabricated posts.[69,70]

Clinical assessment is vital for determining the appropriate post length, considering the remaining gutta-percha and root length.[71,72] It's recommended to leave three-fourths of the root length with at least 4-5 mm of apical gutta-percha for adequate apical seal.[73] Post diameter should not exceed one-third of the root diameter.[74] Surrounding tooth structure, especially the presence of a 2mm crown ferrule, enhances fracture resistance, particularly in anterior teeth restored with cast post and core and metal ceramic crowns.[75,76]

Given the case's presentation of reduced peri-cervical tooth structure in tooth 21, cast posts were chosen for post-endodontic restoration followed by full coverage restoration. Palatal ferrule integrity is crucial, providing similar reinforcement to a complete 360-degree ferrule in maxillary incisors.[77,78] Decreasing remaining tooth structure highlights the importance of post-core retention.

Various cement types are used for luting endodontic posts, including glass ionomer cements, zinc phosphate cement, and resin-based self-adhesive cements. In this case, glass ionomer cement was used.

Indications for cast posts include lost or extensively damaged natural crowns of root-filled teeth, bridge abutment in root -filled teeth, significant axial position changes, and reinforcement of crowned anterior teeth susceptible to cervical fractures.[79,80]

Contraindications include severe root curvature, persistent periapical lesions, poor periodontal health, inadequate crown-to-root ratio, weak or fragile roots, heavy occlusal contacts, unusual habits, occupational factors, economic constraints, and inadequate skills.[81,82]

Henceforth, when choosing between custom cast posts and prefabricated posts, factors such as the individual tooth condition, degree of discoloration, success of endodontic treatment, root length, and the impact of previous restorations should be considered.[83] Ultimately, the aim is to achieve optimal aesthetics, function, retention, and resistance, tailored to each patient's specific needs and circumstances.[84]

The evolution of post-and-core systems has seen significant advancements with the integration of computer-assisted designing (CAD) and computer-assisted manufacturing (CAM) technologies. These technologies offer precise, custom-fit restorations that enhance the structural integrity and longevity of endodontically treated teeth.[85]

CAD/CAM technology has been increasingly applied to the design and fabrication of post-and-core systems. This integration ensures better adaptation to the root canal, optimal core structure, and improved mechanical properties of the restoration.[86]

Types of CAD/CAM Post-and-Core Systems[87]

1. Custom-Fabricated Posts: Utilizing CAD/CAM technology, posts can be custom-fabricated to fit the specific anatomy of the patient's root canal, providing a superior fit compared to prefabricated posts.

2. Prefabricated CAD/CAM Posts: These posts are designed using CAD technology and manufactured to standardized dimensions, offering a balance between customization and efficiency.

Steps in CAD/CAM Fabrication of Post-and-Core Systems[88]

1. Digital Impression: A digital impression of the tooth and root canal is taken using intraoral scanners, providing a precise model of the patient's dental anatomy.

2. Design Phase: Using CAD software, the post-and-core system is designed to match the digital impression, ensuring a custom fit.

3. Manufacturing Phase: The design is sent to a CAM machine, which fabricates the post-and-core system from materials such as zirconia or other high-strength ceramics.

4. Finishing and Polishing: The fabricated post-and-core system is finished and polished to ensure smooth surfaces and proper fit.

5. Placement: The custom-fabricated post-and-core is placed into the prepared root canal, providing a foundation for the final restoration.

Several studies have demonstrated the effectiveness and benefits of CAD/CAM fabricated post-and-core systems. For instance, a study by Tan et al. (2018) compared the fracture resistance of CAD/CAM-fabricated posts to traditional cast posts and found that CAD/CAM posts provided superior resistance to fracture under load.[89]Additionally, a clinical trial by Schmidt et al. (2019) showed higher patient satisfaction and reduced chair time with CAD/CAM post-and-core systems compared to conventional methods.[90]

Future Directions

The future of post-and-core restorations lies in the continued advancement of CAD/CAM technology. Innovations such as improved scanning accuracy, advanced materials, and automated manufacturing processes will further enhance the precision, efficiency, and outcomes of these restorations.

In conclusion, CAD/CAM technology represents a significant advancement in the design and fabrication of post-and-core systems, offering numerous benefits over traditional methods. Its application in endodontic restorations provides improved fit, function, and longevity, contributing to better overall patient outcomes.

Conclusion

Choosing the right post and core system and material is critical for the long-term success of treatment. Custom cast post and cores are advised for restoring severe loss of coronal tooth structure and for retaining metal-ceramic crowns. This approach to restoration is straightforward, efficient, and contributes significantly to the long-term success of treating fractured teeth.

Several factors must be considered when selecting the optimal post and core system, including the quantity and quality of preserved tooth structure, aesthetic needs, as well as the indications, contraindications, advantages, and disadvantages of each post system. Cast metallic posts and cores are especially recommended for restoring severely lost coronal tooth structure with inadequate ferrule and for retaining metal-ceramic crowns due to their stability and durability.

Given the wide range of post systems available, having a comprehensive understanding of their advantages, disadvantages, indications, and contraindications is crucial for making informed decisions. When the remaining sound tooth structure is less than 50%, a custom cast post is often the preferred choice. In anterior tooth restoration, aesthetics take precedence over function, underscoring the importance of selecting a post system that fulfills both functional and aesthetic requirements.

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Conflict of Interest

The authors declare there is no conflict of interest.

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