ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2024; 10(3): 258-262

www.oraljournal.com
Received: 02-06-2024
Accepted: 06-07-2024

Dr. Mayank Sachdeva
Junior Resident, MDS, Department of Conservative Dentistry and Endodontics, ESI Medical College and Hospital, ESI PGIMSR, Joka, Kolkata, West Bengal, India

Dr. Aishwarya Arya
Senior Lecturer, Department of Conservative Dentistry and Endodontics, Awadh Dental College and Hospital, Jamshedpur Jharkhand, India

Dr. Sanchita Khandelwal
Post Graduate Student, Department of Conservative Dentistry and Endodontics, MM College of Dental Sciences and Research, Mullana, Haryana, India

Dr. Yashas DM
Senior Lecturer, Department of Conservative Dentistry and Endodontics, Bapuji Dental College & Hospital, Davangere-Karnataka, India

Dr. Satvika Prasad
PG Student, MDS, Department of Prosthodontics & Crown and Bridge, MM College of Dental Sciences and Research, Mullana, Haryana, India

Dr. Krishna Maity
Private Practitioner, PG-MDS, Department of Conservative Dentistry and Endodontics, MM College of Dental Sciences and Research, Mullana, Haryana, India

Corresponding Author:
Dr. Aishwarya Arya
Senior Lecturer, Department of Conservative Dentistry and Endodontics, Awadh Dental College and Hospital, Jamshedpur Jharkhand, India

Considerations before placement of post: A literature review

Dr. Mayank Sachdeva, Dr. Aishwarya Arya, Dr. Sanchita Khandelwal, Dr. Yashas DM, Dr. Satvika Prasad and Dr. Krishna Maity

DOI: https://doi.org/10.22271/oral.2024.v10.i3d.2011

Abstract
Problem Statement: There has been a significant debate and inconsistency across various studies regarding the optimal selection of post systems for endodontically treated teeth. This inconsistency has led to confusion among clinicians, who often find themselves unsure about which factors to prioritize when selecting a post system that not only provides effective retention but also minimizes the risk of root fractures. As the literature presents varying perspectives, a consolidated understanding of these factors is needed to guide clinicians in making better decisions during treatment planning.
Purpose: The purpose of this review is to critically analyze and synthesize findings from a range of research studies to identify the most important considerations when selecting an endodontic post system. The aim is to develop a framework that helps enhance retention while reducing the risk of root fractures by integrating evidence-based insights and practical clinical guidelines.
Results: The review summarizes key factors that are crucial for the selection of an appropriate post system. By offering a comprehensive evaluation, it provides dentists and clinicians with the necessary tools to assess and choose the right post system for each unique clinical scenario. Through this approach, the review ultimately contributes to improved clinical outcomes and patient satisfaction in the restoration of endodontically treated teeth.

Keywords: Endodontically treated teeth, post systems, retention, root fractures, clinical decision-making, treatment planning

Introduction
"Our objective should be the preservation of what remains, rather than merely focusing on the meticulous restoration of what has been lost." - M.M. De Van
In earlier days, extraction was widely recommended as the treatment of choice for teeth that were extensively decayed or damaged. However, advancements in dental therapy have shifted the focus toward more conservative approaches aimed at preserving natural tooth structures. Today, both endodontic and restorative dentistry place a strong emphasis on retaining natural teeth while ensuring maximum functionality and aesthetic appeal.
The success of endodontic treatment depends not only on the quality of the root canal procedure but also on the subsequent restoration. Endodontically treated teeth must be restored in a manner that allows them to function effectively as part of the oral masticatory system. Research has shown that teeth that have undergone endodontic treatment tend to undergo changes in their physical properties, primarily due to the loss of collagen crosslinking in the dentin and decreased moisture levels. These changes contribute to an increased likelihood of brittleness and fractures compared to teeth that have not been treated endodontically.
One of the critical challenges in managing endodontically treated teeth is the loss of structural integrity, which is often compounded by the loss of moisture and reduced dentin toughness. These compromised teeth require careful consideration during the restoration process. Additionally, it is important to note that teeth naturally have a proprioceptive feedback mechanism, which is lost once the pulp is removed. This loss of feedback increases the risk of overloading endodontically treated teeth during mastication, potentially leading to mechanical failure and eventual tooth loss.

Restoring endodontically treated teeth, particularly those that are severely decayed, is a complex task that requires meticulous planning and clinical expertise. In cases where a significant portion of the crown structure has been lost, a post and core build-up is often required to ensure that the tooth can be effectively restored. When no cavity walls remain, the insertion of a post becomes necessary to retain the core material. The combination of a post and core serves as the foundation for the final restoration, allowing the tooth to regain both its function and appearance.

A post and core system involves the placement of a post within the root canal of a structurally compromised tooth, where it provides additional retention and support for the core and coronal restoration. The core replaces the lost coronal structure and serves as a foundation for the final restoration, which could be a crown or other prosthesis. Given the complexity of post-and-core restorations, the selection of the appropriate post system is crucial for the long-term success of the treatment.

The primary objective of this literature review is to analyze the various factors that influence the selection of post-and-core systems. By reviewing past literature and considering biological, mechanical, and aesthetic factors, this review aims to offer clinicians a comprehensive guide that aids in selecting the most suitable post system for each individual case. The insights provided in this review will assist clinicians in making informed decisions that ultimately lead to successful treatment outcomes.

Factors Affecting Post Selection

1. **Root Length:** The length and configuration of the remaining root play a critical role in determining the appropriate post length. Research indicates that longer posts tend to provide better retention and more uniform stress distribution along the root canal. However, it is not always feasible to use a long post, especially when the root is short, curved, or otherwise compromised. In such cases, the clinician must consider whether to opt for a parallel-sided threaded post or a different design that offers the best balance between retention and preservation of the apical seal. It is important to consider both the length of the root and the clinical crown-to-root ratio when selecting a post, as these factors greatly influence the overall stability of the restoration.
2. **Tooth Anatomy:** Each tooth has unique anatomical features that must be taken into account during the selection of a post. Factors such as root curvature, mesio-distal width, and labio-lingual dimension are all significant considerations in determining the suitability of a particular post system. A thorough understanding of root anatomy, combined with accurate radiographic evaluation, helps the clinician avoid complications such as root perforation or excessive dentin removal. Radiographs play a key role in assessing the length, width, and anatomical variations of the root, as well as evaluating the surrounding hard tissue structures. For example, studies have shown that the roots of maxillary central incisors, lateral incisors, and mandibular premolars are typically able to accommodate post-core systems due to their adequate bulk and favorable anatomy.
3. **Post Length:** The length of the post is directly related to its ability to provide adequate retention. Research consistently shows that longer posts offer better retention and lower failure rates compared to shorter posts. Inadequate post length is often cited as one of the leading causes of restoration failure in endodontically treated teeth. Ideally, the post should be as long as possible without compromising the apical seal or causing damage to the remaining root structure. To ensure proper sealing, it is recommended that at least 4mm of gutta-percha be maintained at the apex to prevent leakage and dislodgment. The success rate of dowel-treated teeth increases significantly when the post length matches or exceeds the length of the clinical crown, with studies showing success rates as high as 97.5%.
4. **Post Diameter:** While it may seem logical to assume that increasing the diameter of the post would enhance retention, studies have shown that this is not necessarily the case. Variations in canal morphology mean that increasing the post diameter does not proportionally increase surface contact between the post and canal walls. It is important to avoid increasing the post diameter at the expense of dentin, as the dentin provides the structural support necessary for long-term tooth stability. The overall strength of the tooth is largely dependent on the amount of remaining dentin, which serves as the foundation for the restoration. Therefore, the post's diameter should be carefully selected to strike a balance between maximizing retention and preserving as much dentin as possible.
5. **Post Design:** The design of the post, including its shape and surface characteristics, is a key factor in determining retention and stress distribution. Posts are generally classified based on their shape—whether parallel-sided, tapered, or a combination of both—and their surface characteristics, such as smooth, serrated, or threaded surfaces. Tapered posts conform more naturally to the root's shape and canal configuration, allowing for greater preservation of tooth structure, particularly at the post apex. Parallel-sided posts are associated with improved retention and more uniform stress distribution along the length of the post. However, stress concentration tends to increase at the apex in narrow, tapering roots, which can lead to complications such as fractures. A hybrid design that combines parallel and tapered features is often preferred as it allows for dentin preservation while still providing adequate retention.
6. **Post Width:** The width of the post is an important factor in preserving tooth structure, preventing root perforation, and ensuring adequate fracture resistance. Research suggests that the post width should not exceed one-third of the root's narrowest dimension to minimize the risk of root fracture. While increasing post width may enhance retention to some extent, doing so can compromise the tooth's structural integrity by reducing the amount of remaining dentin. This reduction in dentin thickness can lead to a decreased resistance to fracture, ultimately affecting the longevity of the restoration. Clinicians must carefully evaluate the root's anatomy and select a post width that balances retention with the preservation of tooth structure.
7. **Canal Configuration and Post Adaptability:** The configuration of the canal plays a crucial role in determining whether a custom-designed or prefabricated post is the best choice. A post that closely conforms to the canal's shape is generally more conservative, as it requires less dentin removal and provides better retention and fracture resistance. In cases with funnel-shaped canals, clinicians often face a dilemma: whether to use a

parallel-sided post and fill the remaining space with cement or opt for a tapered post that better adapts to the canal walls. Extensive canal preparation may necessitate the use of a cast post and core restoration, which offers superior retention compared to a prefabricated post that does not fully match the canal's shape.

8. **Coronal Structure:** The amount of remaining coronal tooth structure significantly influences the selection of the post system. To achieve optimal resistance form, the bulk of the tooth structure above the restorative margin should be at least 1.5 to 2mm. The presence of adequate coronal structure provides better support for the restoration and reduces the risk of failure. Studies have demonstrated that teeth restored with carbon fiber posts show lower resistance to fracture compared to those restored with metal posts, particularly under occlusal forces. This finding highlights the importance of considering the remaining coronal structure when selecting a post.
9. **Stress Management:** Endodontically treated teeth restored with post and core systems are subjected to various types of stress, including compressive, tensile, and shear forces. These forces can significantly affect the stability of the restoration and the overall success of the treatment. Longer posts with smaller diameters have been found to help distribute stress more evenly along the length of the post, thereby preserving tooth structure and reducing the risk of fracture. Effective stress management is critical for ensuring the long-term success of the restoration.
10. **Torsional Force:** Torsional forces act on the post-core-crown unit and can cause the post to become loose or dislodged, leading to failure of the entire restoration. The ability of the post to resist these forces is crucial for the stability and retention of the post-core system. Clinicians must consider the design and material of the post to ensure it can withstand the rotational forces generated during function. The integration of features that resist torsional stress, such as serrations or threading on the post, can enhance the overall stability and prevent complications.
11. **Hydrostatic Pressure:** During post cementation, hydrostatic pressure can develop within the root canal, leading to incomplete seating of the post and potential root fractures. The buildup of pressure can result from the inability of the luting agent to fully escape during placement, causing stress on the surrounding root structure. Selecting a post design that accommodates proper venting is essential for reducing hydrostatic pressure and ensuring a complete and secure fit. Tapered posts are often preferred for this reason, as they are considered self-venting and facilitate the even flow of cement along the entire surface of the post. Additionally, adjusting the viscosity of the luting cement can further aid in minimizing pressure-related issues.
12. **Post Material:** The choice of post material is another critical factor that influences the long-term success of the restoration. An ideal post material should closely mimic the mechanical properties of dentin, including similar modulus of elasticity, compressive strength, and flexural strength. It should also be biocompatible and able to bond effectively with the tooth structure. The use of carbon fiber posts has gained popularity due to their flexibility and ability to absorb and dissipate stress, thereby reducing the risk of root fracture. In contrast, materials like zirconium ceramic, though strong, have a high modulus of elasticity that can transmit excessive forces to the tooth-post interface, potentially leading to fractures. Selecting a material that complements the tooth's natural properties while providing sufficient strength and stability is key to achieving a favorable outcome.
13. **Surface Configuration and Treatment:** The surface characteristics of the post can significantly impact its retention and overall performance. Posts with roughened or textured surfaces provide greater surface area for bonding and have been shown to produce higher retention values compared to smooth posts. Various surface treatments, such as sandblasting, silanization, and acid etching, can be employed to enhance the bond strength between the post and the cement. These treatments create micro-retentive features that improve the adhesive interface, leading to better retention and reduced risk of post dislodgment. Ensuring that the surface configuration is optimized for maximum retention without compromising the post's mechanical properties is an important consideration.
14. **Material Compatibility:** The compatibility of the materials used in the post-core system is essential for preventing adverse reactions and ensuring long-term stability. Corrosion is a major concern when dissimilar metals are used, as it can lead to galvanic action and compromise the integrity of the post. Titanium alloys are often preferred for their high resistance to corrosion, making them an ideal choice for posts. Additionally, the use of posts and cores made from the same material can prevent issues related to differential expansion or corrosion, thereby enhancing the longevity of the restoration.
15. **Bonding Capability:** The bond between the post, core, and tooth structure is crucial for the overall success of the restoration. Resin-based luting agents are widely used for their superior bonding capabilities, particularly when used with fiber-reinforced posts like carbon fiber or glass fiber. These agents not only improve retention but also help in reinforcing the tooth structure by distributing stress more evenly. The adhesive properties of the bonding agent play a significant role in ensuring that the entire post-core-crown unit functions as a cohesive and stable system, minimizing the risk of failure.
16. **Core Retention:** The primary purpose of the post is to provide retention for the core, which replaces the lost coronal structure and supports the final restoration. The design and surface characteristics of the post head greatly influence core retention. Studies have shown that posts with deeper serrations or rougher surfaces provide better mechanical interlocking with the core material, leading to enhanced retention. The shape of the post head, whether it is rounded, flattened, or serrated, also plays a significant role in how well the core material adheres. Ensuring adequate retention of the core is essential for maintaining the integrity of the final restoration and preventing dislodgment during function.
17. **Retrievability:** In cases where the endodontic treatment fails or the post-core system fractures, the ability to retrieve the post without causing excessive damage to the tooth is important. Retrievability is a particularly challenging aspect when dealing with metal or ceramic posts, which may require extensive removal of tooth structure to be dislodged. Carbon fiber posts, however, offer the advantage of easier removal using conventional

rotary instruments and solvents. Some post systems are designed with features that facilitate easier retrieval, such as pre-formed notches or grooves that allow for the application of specialized tools. The ability to safely and efficiently remove a post in the event of failure is an important factor to consider, especially when planning for future retreatment.

18. **Esthetics:** Esthetics is a major concern in modern restorative dentistry, especially in cases involving all-ceramic crowns or restorations in the anterior region. The use of metallic posts can lead to unwanted discoloration of the surrounding gingival tissues, especially if the root walls are thin. This discoloration manifests as a grayish tint that can compromise the overall esthetic outcome. To address this issue, non-metallic posts made from materials like reinforced resins, glass fiber, or ceramics are preferred in situations where esthetics are critical. Prefabricated metal posts can be masked using composite core materials, although the effectiveness of this approach depends on the thickness and translucency of the overlying materials. Clinicians must carefully consider the esthetic requirements of each case when selecting the post system, particularly in highly visible areas.

Conclusion

The restoration of severely compromised endodontically treated teeth requires careful consideration of the post system chosen. The success of the treatment depends not only on the clinical skills of the practitioner but also on a thorough understanding of the mechanical, biological, and esthetic factors that influence the behavior of different post-core systems. Each tooth presents unique challenges, and the selection of a post system must be tailored to the specific needs of the case, taking into account the anatomical features of the tooth, the desired esthetic outcome, and the mechanical demands of the restoration.

By synthesizing the key factors discussed in this review, clinicians can make informed decisions that lead to more predictable and successful restorations. Whether dealing with straightforward cases or more complex scenarios involving extensive loss of tooth structure, a strategic approach to post selection is critical for achieving long-term clinical success. Advances in materials science and post designs have provided clinicians with a wide range of options, allowing for more customized and effective treatment plans. Ultimately, the goal is to provide restorations that not only meet functional requirements but also satisfy patients' esthetic expectations.

Understanding the nuances of post selection and considering the interplay between retention, stress management, material properties, and esthetics will help clinicians navigate the complexities of restoring endodontically treated teeth. This comprehensive review serves as a valuable resource, guiding practitioners in choosing the most appropriate post system for each clinical situation, ensuring optimal results and patient satisfaction.

References

1. Weine FS. Endodontic therapy. 6th ed. St. Louis: Mosby; c2003. p. 546-584.
2. Hargreaves KM, Cohen S. Cohen's Pathways of the Pulp. 10th ed. St. Louis: Elsevier; c2011. p. 786-821.
3. Gopikrishna V, Chandra BS. Grossman's Endodontic Practice. 13th ed. Delhi: Wolters Kluwer; c2014. p. 398-417.
4. Cheung W. A review of the management of endodontically treated teeth: post, core, and the final restoration. J Am Dent Assoc. 2005;136(5):611-619.
5. Ferrari M, Vichi A, Garcia-Godoy F. Clinical evaluation of fiber-reinforced epoxy resin posts and cast post and cores. Am J Dent. 2000;13(Spec No):15B-8B.
6. Plotino G, Grande NM, Isufi A, Ioppolo P, Pedullà E, Bedini R, *et al*. Fracture strength of endodontically treated teeth with different access cavity designs. J Endod. 2017;43(6):995-1000.
7. Libman WJ, Nicholls JI. Load fatigue of teeth restored with cast posts and cores and complete crowns. Int J Prosthodont. 1995;8(4):155-161.
8. Holmes DC, Diaz-Arnold AM, Leary JM. Influence of post dimension on stress distribution in dentin. J Prosthet Dent. 1996;75(2):140-147.
9. Hirshfeld Z, Stern N. Post and core—the biomechanical aspect. Aust Dent J. 1972;17(6):467-468.
10. Davy DT, Dilley GL, Krejci RF. Determination of stress patterns in root-filled teeth incorporating various dowel designs. J Dent Res. 1981;60(7):1301-1310.
11. Nissan J, Dmitry Y, Assif D. The use of reinforced composite resin cement as compensation for reduced post length. J Prosthet Dent. 2001;86(3):304-308.
12. Stockton LW, Williams PT. Retention and shear bond strength of two post systems. Oper Dent. 1999;24(4):210-216.
13. Kurer HG, Combe EC, Grant AA. Factors influencing the retention of dowels. J Prosthet Dent. 1977;38(5):515-525.
14. Shillingburg HT, Hobo S, Whitsett LD, Jacobi R, Brackett SE. Fundamentals of Fixed Prosthodontics. 4th ed. Hanover Park: Quintessence Publishing Company; c2017. p. 302-350.
15. Standlee JP, Caputo AA, Hanson EC. Retention of endodontic dowels: effect of cement, dowel length, diameter, and design. J Prosthet Dent. 1978;39(4):400-405.
16. Musikant BL, Deutsch AS. A new prefabricated post and core system. J Prosthet Dent. 1984;52(5):631-634.
17. Tilk MA, Lommel TJ, Gerstein H. A study of mandibular and maxillary root widths to determine dowel size. J Endod. 1979;5(3):79-82.
18. Akkayan B, Gulmez T. Resistance to fracture of endodontically treated teeth restored with different post systems. J Prosthet Dent. 2002;87(4):431-437.
19. Creugers NH, Mentink AG, Fokkinga WA, Kreulen CM. Five-year follow-up of a prospective clinical study on various types of core restorations. Int J Prosthodont. 2005;18(1):34-39.
20. Stern N, Hirshfeld Z. Principles of preparing endodontically treated teeth for dowel and core restorations. J Prosthet Dent. 1973;30(2):162-165.
21. Trabert KC, Caputo AA, Abou-Rass M. Tooth fracture: a comparison of endodontic and restorative treatments. J Endod. 1978;4(11):341-345.
22. Smith CT, Schuman N. Restoration of endodontically treated teeth: a guide for the restorative dentist. Quintessence Int. 1997;28(3):457-462.
23. Barkhordar RA, Radke R, Abbasi J. Effect of metal collars on resistance of endodontically treated teeth to root fracture. J Prosthet Dent. 1989;61(6):676-678.
24. Sidoli GE, King PA, Setchell DJ. An in vitro evaluation of a carbon fiber-based post and core system. J Prosthet Dent. 1997;78(1):5-9.
25. Bergman B, Lundquist P, Sjogren U, Sundquist G.

Restorative and endodontic results after treatment with cast posts and cores. J Prosthet Dent. 1989;61(1):10-15.
26. Burgess JO, Summitt JB, Robbins JW. The resistance to tensile, compression, and torsional forces provided by four post systems. J Prosthet Dent. 1992;68(6):899-903.
27. Turner CH. Cement distribution during post cementation. J Dent. 1981;9(3):231-239.
28. Cohen BI, Pagnillo MK, Newman I, Musikant BL, Deutsch AS. Retention of three endodontic posts cemented with five dental cements. J Prosthet Dent. 1998;79(5):520-525.
29. Deutsch AS, Musikant BL, Cavallari J, Ledley JB. Prefabricated dowels: a literature review. J Prosthet Dent. 1983;49(4):498-503.
30. Ichikawa Y, Akagawa Y, Nikai H, Tsuru H. Tissue compatibility and stability of new zirconia ceramic in vivo. J Prosthet Dent. 1992;68(2):322-326.
31. D'Arcangelo C, D'Amario M, Vadini M, De Angelis F, Caputi S. Influence of surface treatments on the flexure properties of fiber posts. J Endod. 2007;33(7):864-867.
32. Petersen KB. Longitudinal root fracture due to corrosion of an endodontic post. J Can Dent Assoc. 1971;37(2):66-68.
33. Angmar-Mansson B, Omnell KA, Rud J. Root fracture due to corrosion. I. Metallurgical aspects. Odontol Revy. 1969;20(3):245-265.
34. Saupe WA, Gluskin AH, Radke RA Jr. A comparative study of fracture resistance between morphologic dowel and cores and a resin-reinforced dowel system in the intraradicular restoration of structurally compromised roots. Quintessence Int. 1996;27(7):483-491.
35. Turner CH. Post-retained crown failure: a survey. Dent Update. 1982;9(4):221-229.
36. Cohen BI, Condos S, Deutsch AS, Musikant BL. Fracture strength of three different core materials in combination with three different endodontic posts. Int J Prosthodont. 1994;7(2):178-182.

How to Cite This Article
Sachdeva M, Arya A, Khandelwal S, Yashas DM, Prasad S, Maity K. Considerations before placement of post: A literature review. International Journal of Applied Dental Sciences. 2024;10(3):258-262.