Prosthodontic Management of endodontically treated teeth: A Review.

Sandipan Dutta[1], Shafath Ahmed A[2], Vidyashree Nandini V[3].

[1]Intern, SRM Kattaankulathur Dental College and Hospital, SRMIST.
[2]Professor, SRM Kattaankulathur Dental College and Hospital, SRMIST.
[3]Professor & HOD, SRM Kattaankulathur Dental College and Hospital, SRMIST.

Abstract

Background -Dental professionals face a challenge in determining a tooth having endodontic treatment which is fitted with a post and crown. The author explored contemporary materials such fiber-reinforced posts and ceramic, as well as the concepts regarding the usage of post and core.

Study setting and design- The author selected publications from previous reviews and original research on teeth with endodontic treatment and post and core using MEDLINE and cross-references.

Aim- The article discusses the essential decision-making aspects and associated factors like selection of a post, planning the treatment and rehabilitation of teeth after an endodontic procedure.

Methodology- Advancements in endodontic and prosthodontic restorative methods, along with a wide range of treatment options of differing complexity, have influences and increased the longevity of restorations. Teeth after endodontic treatment are restored to their previous form and function with use of either prefabricated or custom post systems.

Conclusion- for the success of a post and core treatment the selection of a suitable post and core build up material is crucial to address interrelated aesthetic, biological, and mechanical factors.

Keywords: Cement, core, endodontic treatment, grossly decayed teeth, post, restoration.

Address of correspondence: Dr.Vidyashree Nandini.V, SRM Kattaankulathur Dental College and Hospital, SRMIST.
Email address: - vidyashv@srmist.edu.in **Phone no:** 9444901719. **DOI:** 10.5281/zenodo.11044884
Submitted: 08-Feb-2024 **Revised**: 01-Mar-2024 **Accepted:** 22-Mar-2024 **Published:** 26-Apr-2024
Bibliographic details: Journal of Orofacial Rehabilitation Vol. 4(1), Apr 2024, pp. 3-9.

Introduction

When a tooth is structurally compromised due to caries, fractures, failed restorations, or even a mistake made during endodontic treatment, it is said to have had extensive loss of structure. As dental structure is lost, prosthesis rehabilitation provides a challenge for physicians. As a result, dental professionals need to evaluate the possibility of a successful tooth repair.[1-3]

When teeth receive endodontic treatment, the dentin changes due to altered collagen cross-linking, causing the teeth to eventually dry out. Therefore, teeth that have had endodontic treatment tend to be more brittle than teeth that have not, making them more susceptible to fracture. Caries-related and trauma-related tooth structure loss also plays a role in endodontically treated teeth breaking and the subsequent failure of restorations like crowns or fixed partial denture.[4-6]

A 1-2 mm-long ferrule prepared coronally to the finish line significantly reinforces the tooth fracture resistance and is more crucial than the choice of material for the post and core. By inspecting radiographs of teeth receiving endodontic therapy, Ray and Trope explored the correlation between the quality of coronal restoration with that of the root canal filling (Figure 1).[7]

The researchers observed that in cases where both high-quality dental restorations and well-executed endodontic treatments were employed, 91.4% of the teeth exhibited no periapical inflammation. On the other hand, when substandard restorations and inadequate endodontic procedures were applied, only 18.1% of the teeth under

examination were free from peri-radicular inflammation.[8]

Endodontically treated teeth differ in appearance and characteristics from vital teeth due to various factors, including a history of minor or extensive carious lesions, prior restorative treatments, potential fractures, injuries, and the endodontic therapy administered. It is important to realise that a tooth receiving endodontic therapy requires careful execution of the restorative treatment plan.[9]

Types of post:

1. **Active and passive post**: Passive posts need bonding using a luting agent, whereas active posts thread to make contact with the canal wall (Figure 2).[10]
2. **Parallel and tapered posts**: Posts with parallel design are superior to tapered ones because they minimize the wedging effect and lower the risk of causing root fractures. Use of tapered posts is appropriate in thin root structures.[11]
3. **Custom cast post and cores**: These are considered the best option for reconstructing profoundly damaged teeth and should be used when more than one tooth has to have a post placed, they are also recommended for malaligned teeth and smaller teeth, like mandibular incisors, with less limited crown structure.[10]
4. **Prefabricated posts and cores**: These are stainless steel, nickel, chromium alloy, and titanium alloy made posts. In response to concerns about corrosion, titanium objects were added and they are inappropriate for use in small post channels because they have insufficient fracture resistance.[10]
5. **Ceramic and zirconium posts**: For esthetic purposes, zirconium and ceramic posts were established but they have some disadvantages esthetic posts are weaker than metal posts, and thicker posts are required which result in sacrificing healthy radicular tooth structure. zirconium cannot be etched so retention is reduced with zirconium crowns because composite core material cannot be bonded to the post.[12]
6. **Fiber posts**: Fiber posts are made up of carbon fibers, quartz fibers, glass fibers, and silicon fiber posts. They have a good modulus of elasticity than metal posts. Original carbon fibers are black in color which had potential problems of esthetics. More recent versions of Posts with quartz, glass, and silicon fibers are white. In the presence of contemporary adhesively luted fiber-reinforced composite (FRC), fiber posts are becoming less rigid, Root fractures are extremely rare and frequently reversible.[10]

Indications of Post:

A dental post's main function is to maintain a tooth's core when the coronal tooth structure is either damaged or significantly compromised.[13]

Anterior Teeth

A bonding restoration in the access space can be used to gently repair anterior teeth with minimal tooth structural loss. A post increases the possibility of a non-restorable failure in an anterior tooth that is structurally good and provides minimal or no benefit.[14]

A post is usually advised when a mandibular anterior tooth that has received endodontic treatment needs a crown. The small pulp chambers of lower anterior teeth require the use of a post for appropriate retention and resistance against lateral and shearing stresses. Selection of the post for the anterior tooth mostly depends on remaining tooth structure and function of the tooth.[9]

Molar

The cusps of molars that have undergone root canal therapy should normally be protected, although most of the time they do not require the use of a post. The pulp chamber and canals can support a core buildup in the absence of extensive damage to the coronal tooth structure.[15] Molars' primary purpose is to withstand vertical force. If a post is necessary for a molar, it is advised to put it in the canal that is the larger in size. The area of interest is the distal canal in mandibular molars and the palatal canal in maxillary molars.[9]

Premolar

premolars are typically greater than anterior teeth, these teeth often have compact pulp chambers and single roots due to this reason posts are more frequently used. However premolars are frequently subjected to lateral pressure while chewing so the existing tooth structure and functional needs remain the deciding factors.[9]

Selecting factors in a post selection[16]

1. ***Root length***: The selection of post length depends on the size and shape of the surviving root. It is highly advisable to maintain 3 - 5 mm of apical gutta-percha for the preservation of the apical seal.
2. ***Tooth anatomy***: Post selection is improved by factors including root curvature, mesiodistal width, and labiolingual dimensions.
3. ***Post width***: The reasons to select the proper post width include maintaining tooth structure, reducing perforation risk, and increasing fracture resistance. Width of post should not be more than one third of the smallest dimension of the root and is enclosed by at least 1 mm of sound dentine to be able to select an appropriate post width.
4. ***Design of Canal and post flexibility***: The tooth's resistance to fractures is improved by a correctly placed post.
5. ***Coronal structure:*** More important than the post's composition is the quantity of remaining dental structure. To produce the resistant form, the mass of the tooth should be 1.5 to 2 mm above the restorative border.
6. ***Stress:*** Shear force, which is important to post durability, is one of the stresses that are exerted on the post by a variety of forces, including compression, tensile, and shear forces. Increasing the post's length and keeping its diameter at a minimum are thought to be ways to reduce stress.
7. ***Torsional force***: The post could become loose and move out of the canal if a post-core-crown assembly is used. To be safe, a little groove can be put into the root's largest area to stop rotating movement.
8. ***Role of hydrostatic pressure:*** The onset of hydrostatic pressure has been shown to elevate tension within the root canal, decreasing the post's secure placement and increasing the chance of root fracture. Hydrostatic pressure can be reduced by using appropriate post placement with correct post design, and a cement vent to permit for gradual removal of the luting agent.
9. ***Materials compatibility***: It is advised that the post and core be composed of the same alloy. However, using different metals can result in galvanism and may lead to the less noble alloy to corrode.
10. ***Ability to form bonding***: the post adherence to the tooth structure improved retention.
11. ***Designing of post and material***: The designs of post may be categorized based on their forms and external qualities which engages the dentin walls and increase retention. Also, post material must function as a shock absorber which

helps to minimize the effect of stress on the tooth structure. The post material should bond to the tooth structure, have physical characteristics similar to dentin, biocompatible in the oral environment.

12. ***Accessibility***: the clinician's ability to safely remove the post with minimal damage to the tooth in the case of post-fracture or lack of endodontic therapy should be taken into consideration while selecting the post. carbon fiber posts are better than metallic and ceramic posts because they are easily and comfortably replaceable.
13. ***Esthetics:*** Aesthetics are especially important when it comes to anterior teeth since the post and core material must match the tissues that surround it with respect to appearance

The Ferrule Effect:

This is very crucial for the long-term success of any post and core treatment. A ferrule is described as a vertical portion of tooth structure cervical to the post preparation. Its primary purpose is to improve resistance against cervical fracture.[17] Compared to teeth that lack a ferrule, those with a 1 mm vertical ferrule height have shown increased resistance to damage.[18] If maintain the ferrule height of 1.5-2mm significantly increases the strength and prevent fracture of endodontically treated teeth.[19]

Luting Cement:

Zinc phosphate, resin, glass ionomer, resin cement, and resin-modified glass-ionomer cement are the most commonly used luting cements. Recently Resin cements have been more popular compare to other cements because they tend to reduced leakage and provide at least short-term strengthening of the root.[17] In contrast to zinc phosphate or glass-ionomer cement, resin cement when combined with stainless steel and carbon fiber results in less microleakage.[20] When compared to resin cement, the majority of other luting cement frequently are less technically demanding. Be careful to mix and position the auto-cure or dual-cure resin cement in harmony with the post before using it to secure the post. To ensure the full insertion of the post, these processes must be completed rapidly and accurately.

Core Materials:

The post is used to protect the core, which is essential for protecting crown. Cast posts and cores can be direct or indirect according to their mode of fabrication. Intraorally, the core may be formed directly on the tooth or extarorally, using indirect technique on a cast. During fabrication the core is developed with general shape and orientation. Prefabricated posts are employed in a combination with another restorative build-up material like glass-ionomer, composite resin, or amalgam are available as options.[21] Amalgam is a restorative material with well-known advantages as well as disadvantages. It has great physical and mechanical qualities that make it particularly useful in situations that are stressful.[22] However, amalgam might cause aesthetic issues when used in combination with ceramic crowns, possibly resulting in gingival region darkening. Composite resin is currently the most widely used core material. It has various properties that make it an excellent building material to improve retention, including the ability to be attached to many existing posts and the surviving tooth structure. After the polymerization process, The tooth's exceptional tensile strength allows for quick crown preparation. On the negative side, Shrinkage occurs in the composite during polymerization. absorbs water thereafter, swelling, and suffers plastic deformation when placed under repeated stresses.[23]

Discussion

An ideal post system should have the following feature (a) physical properties comparable to dentin (b) Minimal dentin reduction and excellent retention (c) distribute functional stresses uniformly along the surface of the root (d) compatibility with respect to esthetics (e) passivity after cementation, (f) resist movement; (g) excellent core stability; (h) easily restore (i) compatibility with core material; (j) ease of application; safety and dependability and (k) a low price.

This study determined the most appropriate choice for the post-and-core system and offers the resulting beneficial advice: (1) preservation of healthy tooth structure during the post-space preparation; (2) in noncircular root canals and significant loss of coronal tooth structure, custom-cast post is advised. (3) for small circular canals, parallel-sided, passive, serrated, self-adjusting prefabricated posts are the choice. (4) In circular canal, posts are used which have anti-rotational features. (5) Ensuring a sufficient apical seal while maintaining the post's length is important; and (6) For multirooted small teeth, more than one post may be inserted. (7) For accurate fitting, passive parallel posts work best. If apical dentin width is limited, a combination of parallel and tapered posts may be chosen. (8) The adhesive characteristics of the post head can assist in the stable retention of the core material. (9) The post must give enough stiffness, material adaptability, bonding prowess, and aesthetic harmony with the final repair. (10) Retrievability should be taken seriously in case of failure (11) The system should be simple to operate and low in cost.

Conclusion

In clinical practice, one of the most challenging situations is the restoration of damaged teeth that has undergone endodontic treatment because it involves prosthetic and operative dentistry. Using different kinds of materials and designs for posts in restoring endodontically treated teeth, the dentist should be selecting the post system that is ideal for that particular situation. The choice of post design and system has an important effect on how long endodontic therapy will be successful and how stable the tooth will be.

References

1. McLean A. “Criteria for the predictably restorable endodontically treated tooth”. Journal of Canadian Dental Association 64 (1998): 652-656.
2. Whitworth JM., et al. “Crowns and extra-coronal restorations: endodontic considerations: the pulp, the root-treated tooth and the crown”. British Dental Journal 192.6 (2002): 315.
3. Morgano SM and Brackett SE. “Foundation restorations in fixed prosthodontics: current knowledge and future needs”. The Journal of Prosthetic Dentistry 82.6 (1999): 643-657.
4. Helfer AR., et al. “Determination of the moisture content of vital and pulpless teeth”. Oral Surgery, Oral Medicine, Oral Pathology 34.4 (1972): 661-670.
5. Rivera EM and Yamauchi M. “Site comparisons of dentine collagen cross-links from extracted human teeth”. Archives of Oral Biology 38.7 (1993): 541-546.
6. Oliveira FDC., et al. “Fracture resistance of endodontically prepared teeth using various restorative materials”. The Journal of the American Dental Association 115.1 (1987)
7. Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and

the coronal restoration. Int Endod J 1995;28:12-8.
8. Kayahan MB, Malkondu O, Canpolat C, Kaptan F, Bayirli G, Kazazoglu E. Periapical health related to the type of coronal re-storations and quality of root canal fillings in a Turkish subpopulation. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:e58-624. Cecil Williams, Manish Kumar , Manas Bajpai , Deshant Agarwal 2014;10
9. Cecil W, Manish K, Manas B, Deshant A. Prosthodontic management of endodontically treated teeth: A literature review. International Journal of Clinical Preventive Dentistry. 2014;10(1):45-50.
10. Williams C., et al. "Prosthodontic management of endodontically treated teeth: A literature review". International Journal of Clinical Preventive Dentistry 10.1 (2014): 45-50.
11. Qualtrough AJ., et al. "A comparison of the retention of tooth-colored posts". Quintessence International 34.3 (2003)
12. Butz F., et al. "Survival rate and fracture strength of endodontically treated maxillary incisors with moderate defects restored with different post-and-core systems: An in vitro study". International Journal of Prosthodontics 14.1 (2001)
13. Goodacre CJ, Spolnik KJ. The prosthodontic management of endodontically treated teeth: a literature review. Part I. Success and failure data, treatment concepts. J Prosthodont 1994;3:243-50
14. Heydecke G, Butz F, Strub JR. Fracture strength and survival rate of endodontically treated maxillary incisors with approximal
15. Randow K, Glantz PO. On cantilever loading of vital and non-vital teeth. An experimental clinical study. Acta Odontol Scand 1986;44:271-7
16. Morgano SM and Brackett SE. "Foundation restorations in fixed prosthodontics: current knowledge and future needs". The Journal of Prosthetic Dentistry 82.6 (1999): 643-657.
17. Mezzomo E, Massa F, Libera SD. Fracture resistance of teeth restored with two different post-and-core designs cemented with two different cements: an in vitro study. Part I. Quintessence Int 2003;34:301-6.
18. Sorensen JA, Engelman MJ. Ferrule design and fracture resistance of endodontically treated teeth. J Prosthet Dent 1990;63: 529-36.
19. Zhi-Yue L, Yu-Xing Z. Effects of post-core design and ferrule on endodontically treated maxillary central incisors fracture resistance. J Prosthet Dent 2003;89:3
20. Junge T, Nicholls JI, Phillips KM, Libman WJ. Load fatigue of compromised teeth: a comparison of 3 luting cements. Int J Prosthodont 1998;11:558-64
21. Gateau P, Sabek M, Dailey B. In vitro fatigue resistance of glass ionomer cements used in post-and-core applications. J Prosthet Dent 2001;86:149-55.
22. Gateau P, Sabek M, Dailey B. Fatigue testing and microscopic evaluation of post and core restorations under artificial crowns. J Prosthet Dent 1999;82:341-7.
23. Oliva RA, Lowe JA. Dimensional stability of silver amalgam and composite used as core materials. J Prosthet Dent 1987;57: 554-9.

FIGURES

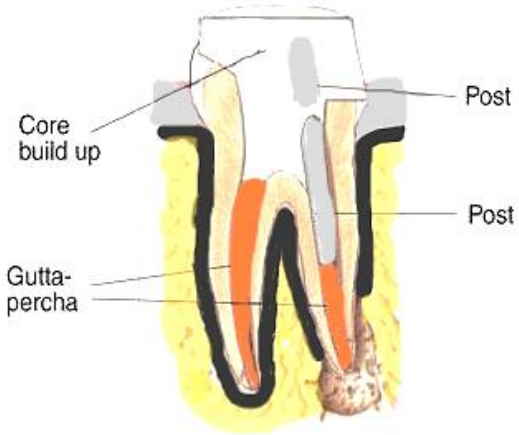

Figure 1

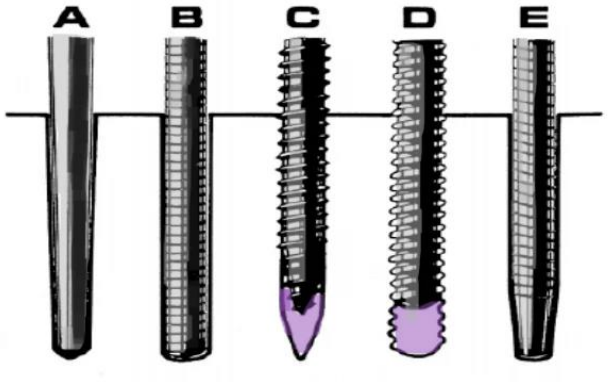

Figure 2

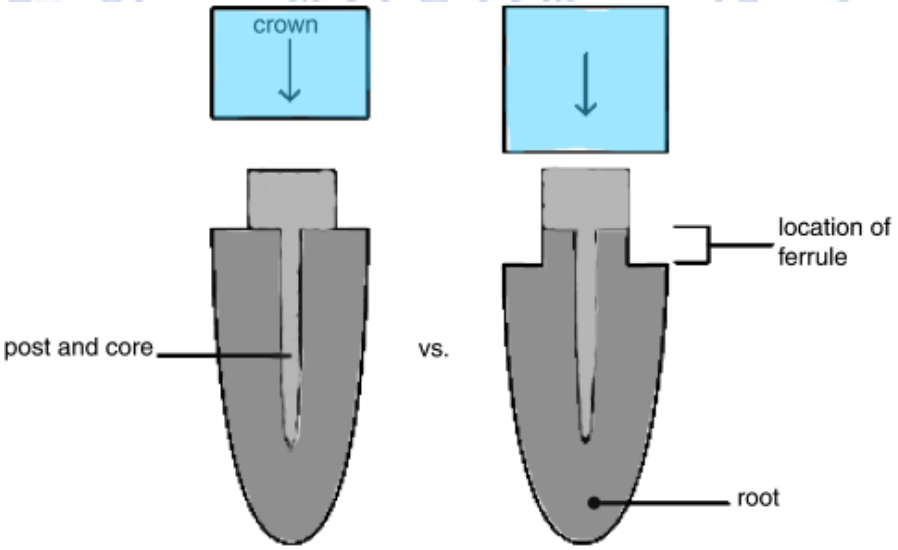

Figure 3