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A Clinical Review of Endodontic Posts

A Peer-Reviewed Publication
Written by Ian Shuman, DDS, MAGD, AFAAID

Abstract

A post is a rigid restorative device placed in the radicular portion of non-vital teeth. During the restoration of an endodontically treated tooth, a post may be required. Its success depends on the quality of endodontic treatment, shape of the canals, status of the remaining tooth structure, and the periodontal support available. This course will review current research regarding the use of posts, and demonstrate various clinical scenarios and steps needed to provide this restorative treatment.

Educational Objectives

The focus of this clinical study will provide the dental professional with the steps needed to place an endodontic post. After reading this article, the reader should be able to:

1. Understand the concept of an endodontic post
2. Identify the clinical situations where a post is needed
3. Know the latest materials needed for this treatment
4. Follow the steps required to clinically place a post

Author Profile

Ian Shuman DDS, MAGD, AFAAID maintains a full-time general, reconstructive, and aesthetic dental practice in Pasadena, Maryland. Since 1995 Dr. Shuman has lectured and published on advanced, minimally invasive techniques. He has taught these procedures to thousands of dentists and developed many of the methods. Dr. Shuman has published numerous articles on topics including adhesive resin dentistry, minimally invasive restorative, cosmetic and implant dentistry. He is a Master of the Academy of General Dentistry, an Associate Fellow of the American Academy of Implant Dentistry, a Fellow of the Pierre Fauchard Academy. Dr. Shuman was named one of the Top Clinicians in Continuing Education since 2005, by Dentistry Today.

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Educational Objectives

This clinical self-study course teaches a dental professional how to place an endodontic post.

After studying this course, the dental professional should be able to:

1. Understand the concept of an endodontic post
2. Identify the clinical situations where a post is needed
3. Know the latest materials needed for this treatment
4. Follow the steps required to clinically place a post

Abstract

A post is a rigid restorative device placed in the radicular portion of non-vital teeth. During the restoration of an endodontically treated tooth, a post may be required. Its success depends on the quality of endodontic treatment, shape of the canals, status of the remaining tooth structure, and the periodontal support available. This course will review current research regarding the use of posts, and demonstrate various clinical scenarios and steps needed to provide this restorative treatment.

Introduction

After endodontic therapy, a tooth will require a restoration. These clinical situations include the restoration of root canal access openings, the buildup of lost tooth structure in direct restorations with deep preparations, and the replacement of insufficient tooth structure to support a fixed restoration, among others. In some of these instances, if a tooth lacks the structure to support a core, a post may be required.

Therefore, the primary purpose of a post is to retain a core that in turn will support a final restoration. Contrary to some beliefs, posts do not reinforce endodontically treated teeth, and a post is not necessary when there is enough tooth structure present to support the final restoration.

According to Stockton, as a rule, there are two indications for post placement and both must be present to justify its use: the remaining coronal tooth structure is inadequate for retention of the restoration and there is sufficient root length to accommodate the post while maintaining an adequate apical seal.

Discussion

Changes following root canal therapy include loss of tooth structure, absence of pulp, a decrease in moisture content, strength, and dentin toughness, as well as altered collagen fiber alignment. Therefore, prior to post placement, it is critical to perform a pretreatment evaluation to determine the health of the tooth. Provided the endodontic/periodontal condition is healthy and the tooth is restorable, the restoration may proceed.

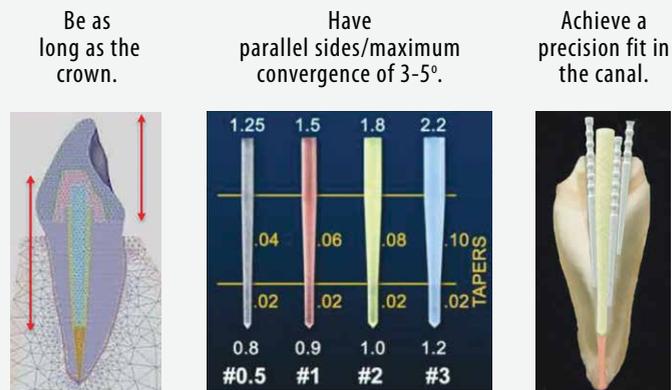
Characteristics of an Ideal Post

A post must be as long as the crown (post/crown ratio),³ have parallel sides with a maximum convergence of 3-5°⁴, and achieve a precision fit in the canal. (Figure 01) A post should require minimal preparation, have resistance to fatigue, an elas-

tic modulus that equals dentin and be non-corrosive. The post should also be easy to fit and adjust, radiopaque, allow easy removal and the post body and head should be highly retentive.⁵

Figure 1:

Post: Fundamental rules A post must ...



Classification of Posts

The selection of a post is multifaceted and is based on a variety of classifications including mode of fabrication, surface type and material composition.

1. Posts can be custom-made or prefabricated.
2. Prefabricated posts can be further grouped based on shape:
 - a. Tapered or parallel.
 - b. Smooth, serrated, or threaded.

A post bearing a smooth surface offers the least retention, while a serrated surface is preferable as it provides mechanical undercuts for cement. A threaded surface, while being the most retentive, creates the most significant stress of the three.

3. Posts are also classified based on material type as metallic and non-metal. Metallic posts can be made from a wide variety of materials including precious, semi-precious and base metals. In the presence of microleakage, corrosion can be a negative factor with base metals, often due to the presence of zinc and copper, whereas titanium posts show the greatest corrosion resistance.⁶

Non-metallic posts can be manufactured from zirconium oxide, ceramic, and fibers containing carbon, glass and quartz.

Post Space Preparation: When and How

When preparing a post space, there are physical materials that require removal including gutta percha, canal sealer, dentin as well as chemicals including eugenol and calcium hydroxide among others. One concern among practitioners is how soon gutta percha can be removed after obturation. Based on the premise that the canals have been adequately obturated, gutta percha can be safely removed immediately after condensation.

According to Bourgeois and Lemon, there is no difference between immediate removal or removal after one week.⁷ In a dye ink penetration study by Zmener, there was no difference found between removing gutta percha 5 minutes after obturation or 48 hours after obturation.⁸ Dickey, et al. determined that there was no significant difference between immediate gutta percha removal or removal after waiting 24 hours.⁹

In addition, according to studies, there is a general consensus that 4-5mm of gutta percha must remain for a proper apical seal. A study by Portell and Bernier tested leakage around 3, 5, and 7mm of remaining apical gutta percha.¹⁰ Leakage was found when only 3mm of gutta percha remained.¹⁰ Nixon et al compared leakage around 3, 4, 5, 6, and 7mm of remaining apical gutta percha by “dye ink penetration test and found the greatest leakage at 3mm and the least at 6mm or greater”.¹¹ Kist and Reit found a “higher percentage of periapical radiolucencies when 3mm (or less) of gutta percha remained”.¹²

There are several methods for removing gutta percha including chemical solvents such as xylol, chloroform, and eucalyptol, mechanical removal with rotary instruments such as Gates Glidden and Peeso reamers, and thermal removal using hot pluggers or a combination of these. However, the goal of any removal technique is thorough gutta percha removal without disturbing the apical seal. Since only the upper and middle third of obturation material occupying the canal space need be removed, mechanical removal is recommended and has been proven in multiple studies. A study by Mounce suggests that “gutta percha be removed without solvents in the coronal two-thirds of canals as much as possible and with solvents in the apical third”.¹³ Mattison et al. “recommended that the mechanical method is the most desirable for gutta percha removal during post space preparation.”¹⁴

Another issue is the poor resin bonds caused by eugenol. Eugenol affects bonding of resinous material to tooth structure by inhibiting the free radicals necessary in linking monomer molecules to form resin polymers.^{15,16,17} With eugenol-based root canal sealers significantly reducing the bond strength of posts luted with resin cement, several methods have been suggested that remove eugenol in a safe, efficacious manner. These include the use of EDTA, sodium hypochlorite, and alcohol, with alcohol being perhaps the most effective.¹⁹

One additional issue is the decreasing ability to achieve high bond strengths as the canal space deepens. This is because the nature of the dentin’s collagen structure changes in size, quality and configuration.²⁰ (figure 02)

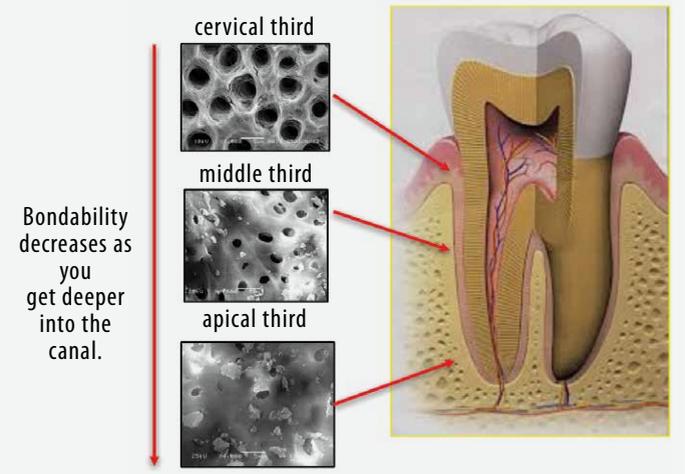
Contraindications for Post Placement

There are several unfavorable conditions that may preclude post placement. These include severe root curvature, perforated roots, and poor crown-root ratio. In addition, signs and symptoms that prohibit post placement in endodontically treated teeth are sensitivity, inflammation, exudate, and a poor apical seal among others. By placing a post under any of these conditions, there is an increased likelihood that an operative case will fail and that the long-term health of the tooth will be poor.

Figure 2:

Regardless of the Methods Used for Contaminant Removal, Dentin Changes Along the Length of the Root Canal...

... the nature of the collagen changes in size, quality and configuration.



A Newly Prepared Solution for the Removal of the Smear Layer Nawfal A. A. Zakarea NAA et al. International Journal of Dental Sciences and Research, 2014, Vol. 2, No. 1, 19-26

Root Fracture and Post Fracture

Root fracture may be due to post placement under the above-mentioned contraindications or because of incorrect post selection, improper post space preparation, and/or poor cementation techniques. When a post is not properly cemented, occlusal forces can cause micro-movements of the post that lead to disintegration of cement, a concentration of stresses at the root apex and root fracture. Another cause of post stress leading to root fracture is a shorter than required post length. Sugaya et al. found that the number of cases of root fracture “originating in the apical region decreased with an increase in post length”.²¹

Post diameter is also responsible for root fractures. Post diameter is dictated by root canal anatomy and a minimal dentin thickness of 1mm around the post should be provided,²² with post diameters being no greater than one-third of the root diameter. Studies of post diameters have found that as the post diameter increases, retention does not increase significantly.^{23,24} In another study, Standlee and Kurer reported “there were no significant retention changes with variations in diameter”.²⁵ However, they did find that as the diameter of the post increases, there is an increase in stresses on the tooth and a decrease in the tooth’s resistance to fracture. In these studies, large diameter posts showed the highest rate of root fracture. Yet, it is possible that post design, shape and surface types have the greatest influence over this problem.

Post Design:

In regard to design, “threaded posts have been found to cause the highest strain and incidence of root fracture”.²⁶ In fact, this and other studies have shown that threaded posts with a taper

increase root fracture by 20 times that of parallel threaded posts. Tapered cemented posts and parallel non-threaded posts are responsible for the least number of root fractures.²⁷

Post Shape:

While a tapered post requires less removal of tooth structure, it behaves like a wedge. Exertion of lateral forces can result in vertical root fracture. And while a parallel shaped post requires removal of more tooth structure (than a tapered post), it is more retentive and decreases force distribution. According to Yamamoto et al, tapered posts produced the greatest stress at the coronal shoulder and parallel posts generate their greatest stress at the apex of the canal preparation.²⁸ In a study by Johnson and Sakamura, “parallel posts resisted tensile, shear and torquing forces better than tapered posts and distributed stress more uniformly along their length during function”.²⁹

Post Material:

For today’s practitioner, the ability to replace a fractured post is an easy choice when faced with the alternative of a non-restorable root fracture. According to Kivanç et al. “endodontically treated anterior teeth restored with glass fiber posts exhibited higher failure loads than teeth restored with zirconia and titanium posts.²⁷ Self-etching adhesives are better alternatives to etch-and-rinse adhesive systems for luting post systems”.

This idea that fiber posts are a reliable fail-safe method has been substantiated in the literature. Garbin et al. found that in regard to root stress distribution, metal posts were less favorable than glass fiber posts.³⁰ Silva found that “fiber posts show more homogeneous stress distribution than metallic posts. The post material seemed to be more relevant for the stress distribution in endodontically treated teeth than the posts’ external configuration”.³¹ Based on research by Akayyan and Gülmez “significantly higher failure loads were recorded for root canal treated teeth restored with quartz fiber posts. Fractures that would allow repeated repair were observed in teeth restored with quartz fiber and glass fiber posts”.³²

The ideal post

As mentioned, an ideal post is comprised of many components in the form of materials and engineering features. While there is no absolute agreement in the world’s dental community on the ideal, there are certain rules that may be followed to provide a best-case scenario. The design should be one that is of the parallel non-threaded nature. It should also be both tapered and parallel at strategic points along its body. (figure 03) Finally, glass fiber offers a material that is both strong and kind to the root. This is all true in a concentric canal space where volumetric shrinkage is kept to a minimum. (figure 04) However, there are many canal space configurations that do not conform to the perfect round shape. Studies such as those by Martelli et al. have shown that a single post in a non-concentric canal will have a larger amount of cement/core material.³³ Once set, this large amount of cement undergoes volumetric shrinkage and microleakage, which is one of the main causes of endodontic failure.

Figure 3:

So where does a parallel/tapered, serrated, quartz fiber, color changing post fit in?

It is in a unique category, satisfying all of the qualities and characteristics needed in a 21st century post.

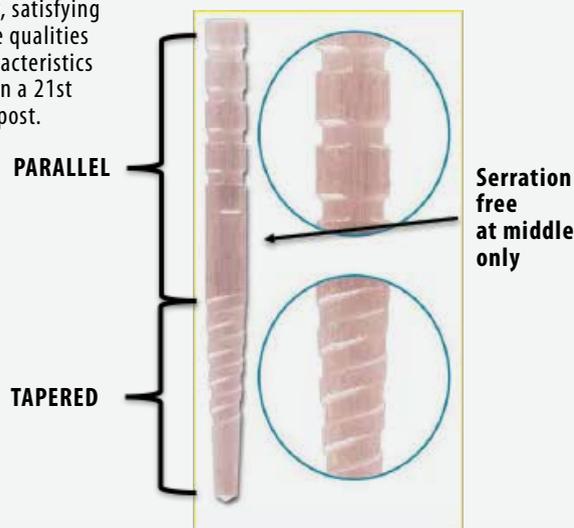
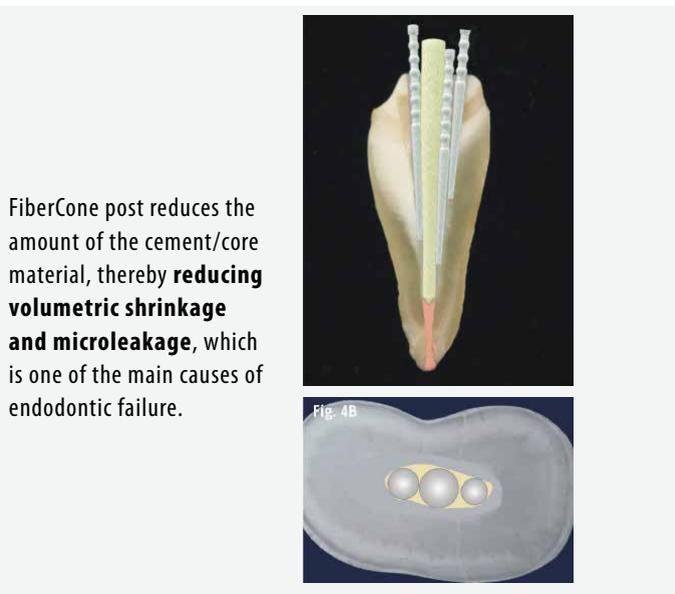


Figure 4: Volumetric Shrinkage



FiberCone post reduces the amount of the cement/core material, thereby **reducing volumetric shrinkage and microleakage**, which is one of the main causes of endodontic failure.

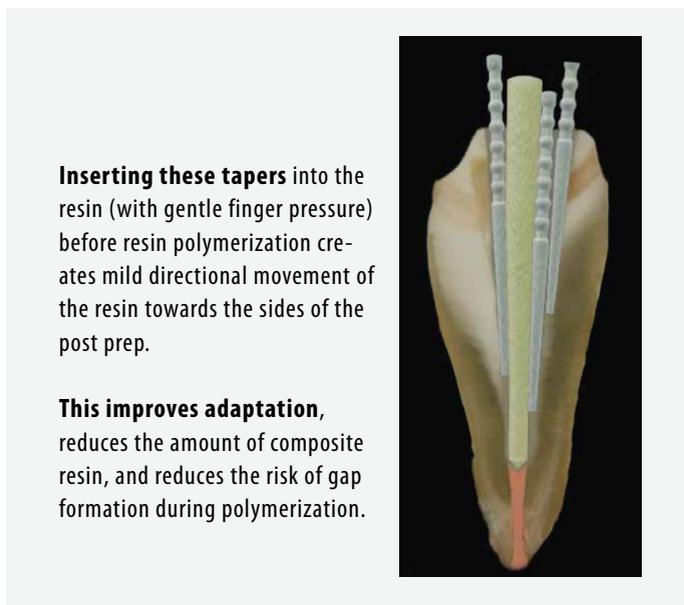
To reduce the incidence of this problem, accessory posts have been developed that reduce volumetric resin shrinkage by reducing the overall volume of composite in both the canal space and the core itself. (figure 05) This reduces the amount of the cement/core material, thereby reducing volumetric shrinkage and microleakage, which is one of the main causes of endodontic failure. Designed for use with a “master” post, these accessory or auxiliary posts are placed like auxiliary gutta percha cones that ride along the master cone. Adding auxiliary posts allows much better adaptation in the case of flared and

oval canals.³⁴ It is important to note that these posts do not require additional drilling. Because of their small size, accessory posts can also be used in auxiliary canals to increase retention and anti-rotational security. Ideally, these posts should be macro-retentive in the coronal half, and tapered in the apical half. Inserting these tapers into the resin (with gentle finger pressure) before resin polymerization creates mild directional movement of the resin towards the sides of the post prep. This improves adaptation, reduces the amount of composite resin, and reduces the risk of gap formation during polymerization. While posts and cores are a vital part of certain restorative cases, core restorations are indicated if either of the following clinical conditions exists:

1. The replacement of missing coronal tooth structure is necessary.
2. The “enhanced retention and resistance to displacement of the final restoration is necessary”.³⁵

Whichever reason is suitable, attention must be paid not only to the type of post, but the direct core material as well.

Figure 5: FIBERCONE accessory posts: physical properties



Mechanical Properties of Direct Core build-Up Materials:

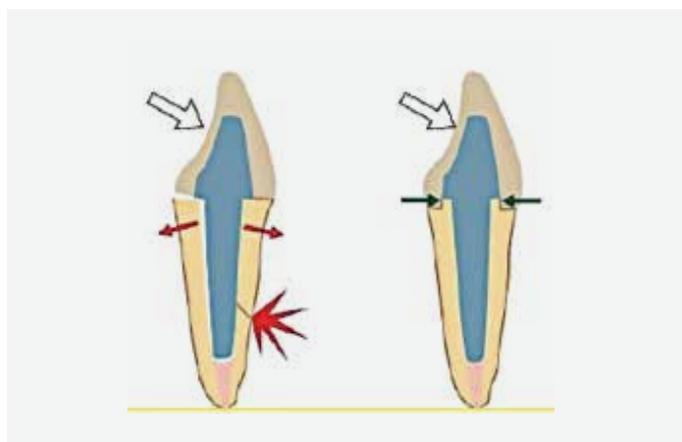
A study by Combe et al. “measured the mechanical properties of materials used for direct core build-ups, including a high copper amalgam, a silver cement, a VLC resin composite and two composites specifically developed for this application. Compressive strength, elastic modulus, diametral tensile strength and flexural strength and modulus were measured for each material as a function of time up to 3 months.

The results showed failure in terms of flexural strength for the amalgam after one hour and the silver cement at all time intervals.”³⁶ Based on the evidence, composite appeared to be

the best choice for core buildup material. The reasons for the advantages of composite are its high compressive strength, ease of manipulation, rapid polymerization, and ability to bond to dentin. There are disadvantages as well including polymerization shrinkage and poor dimensional stability, however these disadvantages have been eliminated with the use of hybrid and universal nano-composite flowables. Hybrid composite appears to be one of the best materials for a core buildup. In a study by Burke, et al. prepared core buildups using a “hybrid composite material provided the highest fracture resistance”.³⁷

In addition to correct material selection, the core preparation has two primary requirements: cuspal coverage and ferrule. Simply stated, cuspal coverage and the ferrule are both required to prevent fracture. Cuspal coverage is achieved by virtue of crown or onlay fabrication and design. At its most basic, a ferrule is a band that prevents the end of an object from splitting. (figure 06)

Figure 6:



Importance of the ferrule:

The ferrule provides bracing or a casing action to protect the integrity of the root. Crowns whose margins encompass a ferrule alter the distribution of forces. These restorations have a subgingival collar, that acts vis-a-vis a ‘hugging’ action and prevents vertical fracture of the tooth. To be effective, the margin must encompass at least 1.5-2.0mm of tooth structure. A study by Sorensen and Engelman “evaluated the fracture resistance of pulpless teeth with various ferrule designs and amounts of coronal tooth structure. The results demonstrated that one millimeter of coronal tooth structure above the crown margin substantially increased the fracture resistance of endodontically treated teeth.”³⁸ Because root fracture is one of the most serious complications following restoration of endodontically treated teeth, it is worth evaluating the effect of a crown ferrule on the fracture resistance of endodontically treated teeth restored with prefabricated posts. In a study by Pereira, a comparison was made “of the fracture strengths using posts and cores and variable quantities of coronal dentin located apical to core foundations with corresponding fer-

rule designs incorporated into cast restorations".³⁹ It was found that "an increased amount of coronal dentin significantly increased the fracture resistance of endodontically treated teeth".³⁹

Post and Core: Case Report

A 72-year-old male patient presented for treatment of an upper right second premolar. The tooth had been restored with a full coverage crown. The patient presented with the crown in hand. Exam revealed that the crown had failed due to primary caries and subsequent, secondary fracture. (figure 07) The tooth was restorable, but due to the invasive nature of the caries, endodontic treatment was performed. This was followed by post and core. Gutta percha, and root canal sealer was removed, leaving 6mm of gutta percha at the most apical aspect of the root. A post space was prepared and eugenol residue removed by scrubbing the post retaining walls with ethyl alcohol. This was then rinsed, dried, and the canal etched with 35% phosphoric acid, and this was rinsed and dried. A dual cure bonding agent was applied to the post retaining walls, and excess wicked with drying points.

Figure 7:



The intra-radicular site was gently air-dried, and light cured, followed by the cementation of a MACRO-LOCK® ILLUSION™ X-RO® (Clinician's Choice) with two FIBERCONE accessory fiber posts using BISTITE® II DC, a self-etching, dual-cured adhesive resin cement system with excellent handling and adhesive properties. (Tokuyama Dental). (figures 08, 09)

Figure 8 & 9:

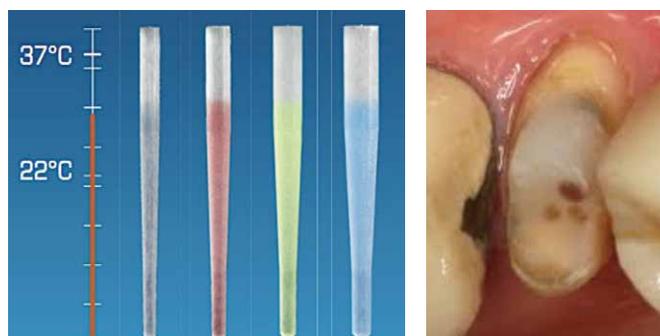


After light curing, a core buildup was made with Core Paste XP (DenMat) in a universal dentin shade. After complete dual curing, a full coverage crown preparation was created with adequate ferrule to prevent future fracture and a provisional placed during lab crown fabrication. (figure 10) In addition, should the need arise for post retrieval and canal re-entry, the post can be located using a spray of cool water. (figure 11)

Figure 10:



Figure 11: Color change technology when the temperature is colder than 22° C / 71.6° F



Conclusion

It has been demonstrated that when there is a need for a post and core, and the correct procedures are followed, a tooth that is compromised from a restorative aspect can expect a good prognosis. In addition, various rules and best practices should be followed as they pertain to current research and clinical findings. This will insure a healthy outcome for teeth needing additional structure.

References

1. W. Cheung. "A review of the management of endodontically treated teeth: post, core and final restoration." JADA, vol. 136, no. 5, pp. 611-619, 2005.
2. Stockton LW. Factors affecting retention of post systems: a literature review. J Prosthet Dent. 1999 Apr;81(4):380-5
3. Rosenstiel SF, Land MF, Fujimoto J, Contemporary Fixed Prosthodontics, Elsevier, 2016
4. Schmagea P, Ozcan M, McMullan-Vogelc C, Nergiza I. The fit of tapered posts in root canals luted with zinc phosphate cement:

- A histological study. *Dental Materials* (2005) 21, 787–793
5. Factors determining post selection: a literature review. Fernandes AS, Shen S, Cou0nho I. *J Prosthet Dent*. 2003 Dec;90(6):556-62
 6. Dérand T. Corrosion of screw posts. *Odontol Revy* 1971;22:371–378.
 7. Bourgeois RS, Lemon RR. Dowel space preparation and apical leakage. *J Endod* 1981; 7: 66–69.
 8. Zmener O. Effect of dowel preparation on the apical seal of endodontically treated teeth. *J Endod* 1980; 6: 687
 9. Dickey DJ, et al. Effect of post space preparation on apical seal using solvent techniques and Peeso reamers. *J Endod* 1982; 8: 351-354
 10. Portell FR, Bernier WE, et al. The effect of immediate vs delayed dowel space preparation on the integrity of the apical seal. *J Endod* 1982;8: 154-60
 11. Nixon C, Vertucci FJ, Swindle R. The effect of post space preparation on the apical seal of root canal obturated teeth. *Today's FDA*. 1991;3:1-6C
 12. Kvist T and Reit C. Results of endodontic retreatment: a randomized clinical study comparing surgical and nonsurgical procedures. *J Endod* 1999;25:814-7.
 13. Mounce R. Current concepts in gutta-percha removal in endodontic retreatment. *NY State Dent J*. 2004 Aug-Sep;70(7):32-5.
 14. Mattison GD, Delivanis PD, Thacker RW Jr, Hassell KJ. Effect of post preparation on the apical seal. *J Prosthet Dent*. 1984 Jun;51(6):785-9.
 15. Reem A, Al-Mutairi S, Ghandoura S. Effect of Eugenol on Bond Strength of Adhesive Resin: A Systematic Review OHDM - Vol. 13 - No. 4 December, 2014
 16. Bowen RL, Argentar H. A stabilizing comonomer. II. Stabilization and polymerization characteristics. *Journal of Dental Research*. 1972; 51: 1614-1618.
 17. Fujisawa S, Kadoma Y. Action of eugenol as a retarder against polymerization of methyl methacrylate by benzoyl peroxide. *Biomaterials*. 1997; 18: 701-703.
 18. Mosharraf, Z. Effect of the type of endodontic sealer on the bond strength between fiber post and root wall. *J Dent*. 2014 Jul;11(4):455-63
 19. *Journal of the American Oil Chemists' Society*. San Myint, et al. October 1995, Volume 72, Issue 10, pp 1231-1233
 20. Nawfal A. A. Zakarea NAA et al. A Newly Prepared Solution for the Removal of the Smear Layer. *International Journal of Dental Sciences and Research*, 2014, Vol. 2, No. 1, 19-26
 21. Sugaya T. et al. Comparison of fracture sites and post lengths in longitudinal root fractures. *Endod*. 2015 Feb;41(2):159-63.
 22. Lloyd PM, Palik JF. The philosophies of dowel diameter preparation: a literature review. *J Prosthet Dent*. 1993
 23. Guzy GE, Nicholls JI. In vitro comparison of intact endodontically treated teeth with and without endo-post reinforcement. *J Prosthet Dent* 1979;42:39-44.
 24. Trabert KC, Caputo AA, Abou-Rass M. Tooth fracture — a comparison of endodontic and restorative treatments. *J Endod* 1978;4:341-5.
 25. Standlee JP, Caputo AA, Collard EW, Pollack MH. Analysis of stress distribution by endodontic posts. *Oral Surg Oral Med Oral Pathol*. 1972;33:952–60.
 26. Khasnis SA, Kidiyoor KH, Patil AB, Kenganal SB. Vertical root fractures and their management. *J Conserv Dent*. 2014 Mar-Apr; 17(2): 103–110.
 27. Fuss Z, Lustig J, Katz A, Tamse A. An evaluation of endodontically treated vertical root fractured teeth: impact of operative procedures. *J Endod*. 2001 Jan; 27(1):46-8.
 28. Yamamoto ET. et al. Finite element analysis and fracture resistance testing of a new intraradicular post. *Journal of Applied Oral Science*. *J. Appl. Oral Sci.* vol. 20 no.4 Bauru July/Aug. 2012.
 29. Johnson JK, Sakamura JS. Dowel form and tensile force. *J Prosthet Dent* 1978;40:645-9.
 30. Fracture resistance of teeth restored with different post systems using new-generation (7th) adhesives. Kivanç BH, Görgül G. *Contemp Dent Pract*. 2008 Nov 1;9(7):33-40 .
 31. Garbin CA, Spazzin AO, Meira-Júnior AD, Loreno SC, Lyra AM, Braz R. Biomechanical behaviour of a fractured maxillary incisor restored with direct composite resin only or with different post systems. *Int Endod J*. 2010;43(12):1098-107.
 32. Silva N, et al. Influence of different post design and composition on stress distribution in maxillary central incisor: Finite element analysis. *Indian J Dent Res*. 2009 Apr-Jun;20(2):153-8
 33. Akkayan B, Gülmez T. Resistance to fracture of endodontically treated teeth restored with different post systems. *J Prosthet Dent*. 2002 Apr;87(4):431-7.
 34. Martelli H Jr, Pellizzer EP, Rosa BT, Lopes MB, Gonini A Jr. Fracture resistance of structurally compromised root filled bovine teeth restored with accessory glass fibre posts. *Int Endod J*. 2008 Aug;41(8):685-92.
 35. Farahnaz S et al. Fracture resistance of structurally compromised premolar roots restored with single and accessory glass or quartz fiber posts. *Dent Res J*. 2014 Mar-Apr; 11(2): 264–271.
 36. *Fundamentals of Fixed Prosthodontics* 3rd edition, Herbert T. Shillenburg, p. 367
 37. Combe EC, Shaglouf AM, Watts DC, Wilson NH. Mechanical properties of direct core build-up materials. *Dent Mater*. 1999 May;15(3):158-65.
 38. Fracture resistance of five pin-retained core build-up materials on teeth with and without extracoronal preparation. Burke FJ, et al. *Oper Dent*. 2000 Sep-Oct;25(5):388-94
 39. Sorensen JA, Engelman MJ. Ferrule design and fracture resistance of endodontically treated teeth. *J Prosthet Dent*. 1990 May;63(5):529-36.
 40. Pereira JR. Effect of a crown ferrule on the fracture resistance of endodontically treated teeth restored with prefabricated posts. *J Prosthet Dent*. 2006 Jan;95(1):50-4.

Author Profile

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Author Disclosure

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Questions

- A post is a rigid restorative device placed in what portion of non-vital teeth:
 - coronal
 - cementum
 - radicular
 - a and b
- The success of a post depends on all but which one of the following:
 - shape of the canals
 - number of canals
 - quality of endodontic treatment
 - status of the remaining tooth structure
- The primary purpose of a post is:
 - to retain a core
 - maintain the coronal seal of the root canal treatment
 - protect and preserve remaining tooth structure
 - strengthen the tooth externally
- Changes following root canal therapy include:
 - loss of tooth structure
 - absence of pulp
 - altered collagen fiber alignment
 - all of the above
- Characteristics of an ideal post include all but which one of the following:
 - be wider than 2/3 of the root diameter
 - A post must be as long as the crown
 - parallel sides with a maximum convergence of 3-5°
 - achieve a precision fit in the canal
- In general, non-metallic posts can be manufactured from which of the following:
 - titanium
 - carbon fiber
 - zinc/copper alloys
 - stainless steel
- Chemical solvents used to remove gutta percha include:
 - eucalyptol
 - chloroform
 - xylol
 - all of the above
- Which of the following published data that suggests the mechanical method is the most desirable for gutta percha removal in post preparation:
 - Matthews
 - Matise
 - Mattison
 - Morgan
- Eugenol can be removed in a safe, efficacious manner using:
 - alcohol
 - lye
 - ammonia
 - hydrochloric acid
- The signs and symptoms that are unfavorable for post placement include:
 - a poor apical seal
 - a, c, and d
 - inflammation
 - exudate
- Incorrect post selection, improper post space preparation, and poor cementation techniques can all be causes of:
 - fracture directly at the DEJ
 - enamo-dentin fracture
 - cemental-alveolus fracture
 - root fracture
- Ideally, a minimal dentin thickness around the post should be:
 - 1mm
 - 2mm
 - 3mm
 - 4mm
- Which of the following stated that no significant retention changes would occur with diameter variation.
 - Standlee
 - Stan Lee
 - Stanley
 - Robert E. Lee
- Which of the following is true:
 - For every 2mm of decreasing tooth diameter, there is a fracture rate of 6x.
 - For every 1mm of decreasing tooth diameter, there is a fracture rate of 8x.
 - For every 2mm of decreasing tooth diameter, there is a fracture rate of 8x.
 - For every 1mm of decreasing tooth diameter, there is a fracture rate of 6x
- In a study by Kivanc, endodontically treated anterior teeth restored with glass fiber posts exhibited higher failure loads than teeth restored with posts made from:
 - polonium
 - plutonium
 - titanium
 - nobelium
- Fiber posts show more homogeneous stress distribution than posts made from:
 - zirconium
 - metal
 - acrylic
 - none of the above
- According to Akayyan and Gülmez, significantly higher failure loads were recorded for teeth restored with fiber posts made from:
 - carbon
 - chromium
 - quartz
 - carbon-chromium
- A tapered post requires less removal of tooth structure but it acts like a:
 - wedge
 - lever
 - dodecahedron
 - cornice
- According to Yamamoto, et al. tapered posts produced the greatest stress at the:
 - apical third
 - coronal half
 - mid root
 - coronal shoulder
- Who reported that tapered cemented posts are responsible for the least number of root fractures?
 - Kivanc and Gorgul
 - Tittle and Wilson
 - Bledsoe and Glenn
 - Schaub and Johnson
- In a best-case scenario, a post design should have which of the following aspects:
 - threaded
 - tapered or parallel
 - glass fiber
 - all of the above
- Shillinburg and Turner found that as the post diameter increases, retention:
 - decreases
 - increases
 - remains the same
 - varies
- Eugenol affects bonding of resinous material to tooth structure by inhibiting:
 - ionic variance
 - anionic pathways
 - a and b
 - free radicals

A Clinical Review of Endodontic Posts

Name: _____ Title: _____ Specialty: _____

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Educational Objectives

1. Understand of the concept of an endodontic post;
2. Identify the clinical situations in which posts are needed;
3. Know the latest materials needed for treatment with posts; and
4. Follow the steps required to clinically place a post.

Course Evaluation

1. Were the individual course objectives met?

Objective #1: Yes No Objective #2: Yes No

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5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
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9. Please rate the usefulness of the supplemental bibliography.	5	4	3	2	1	0
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