

TREATMENT SELECTION FOR ANTERIOR ENDODONTICALLY INVOLVED TEETH

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Innovations in material science and clinical techniques have expanded the number of treatment options available for nonvital anterior teeth. These options include the use of composite to fill the access opening with no additional treatment, crown placement, orthodontic extrusion, crown lengthening with or without orthodontic extrusion, dowel restorations with crown placement, and fixed bridge or implant therapy when extraction is necessary. Clinicians need to understand the benefits and limitations of each option in order to provide their patients with optimum function and aesthetics. Using case presentations, this article describes predictable approaches for the diagnosis, treatment planning, and restoration or replacement of endodontically treated teeth in the anterior region.

Learning Objectives:

This article discusses options for treating endodontically treated anterior teeth. Upon reading this article, the reader should have:

- An expanded awareness of available treatment options.
- A greater understanding of the clinical indications for each treatment.

Key words: Nonvital, vital, post, endodontically

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The successful restoration of endodontically treated teeth relates directly to the amount of remaining tooth structure.^{1,3} Ideally, the endodontic procedure should be accomplished with the least amount of dentin removal possible to obtain a clinically stable result. For years, it is believed that placing a post and core in an endodontically treated tooth strengthens the tooth, but recent research has demonstrated that this is not the case.^{4,6} Rather, the removal of dentin for the post space actually weakens the tooth.^{7,9} Saving tooth structure is paramount for the long-term prognosis of the tooth.¹⁰ Posts and cores should only be placed if there is a need to retain a crown, not for tooth reinforcement. Placing a post in an unrestored tooth without removing any more dentin than was necessary for the endodontic procedure is biomechanically advantageous. Thus, the authors may place either gold, glass fiber, or zirconia posts in anterior teeth if gutta-percha can be removed without sacrificing tooth structure in teeth that are otherwise intact. In these clinical situations, a composite material can be used to seal the access opening as the final restoration. Endodontically treated teeth that are structurally intact other than the access opening are not, therefore, strengthened by crowning.

Expanded Treatment Options

Sufficient tooth structure is not always available for a straightforward post-and-core restoration; fortunately, the armamentarium for functional and aesthetic treatment and/or replacement of nonvital anterior teeth has never offered more alternatives for these clinical



Figure 2. The root taper was uniform in diameter and sufficiently wide for the tooth to be extruded orthodontically without compromise to aesthetics.



Figure 3. A gold post with a hook on the coronal surface was cast for attachment to the tooth during extrusion.



Figure 4. The gold post was then cemented and the elastic was attached.



Figure 1. Case 1. Preoperative appearance upon presentation. Note the absence of tooth structure to permit a ferrule effect on tooth #4(15).

situations. Orthodontic extrusion, crown lengthening with or without orthodontic extrusion, and fixed bridge or implant therapy if extraction is necessary, have all demonstrated predictable clinical results with patient satisfaction.¹¹⁻²⁰ The prerequisite for successful treatment with any of these options is a thorough understanding of the benefits and limitations of each modality and treatment planning consistent with the clinical conditions at hand. The following case examples are presented to illustrate the clinical considerations in treatment selection.



Figure 5. An orthodontic elastic was used to attach the orthodontic wire to the gold post hook.



Figure 6. Orthodontic procedures and crown lengthening were completed, and adequate structure had been exposed to restore the tooth.



Figure 7. The highly aesthetic final restoration was completed with a full porcelain crown as well as Class II ceramic inlays on teeth #3(16) and #5(14).

Orthodontic Extrusion With and Without Crown Lengthening

Placement of an endodontic dowel is indicated in clinical situations in which there is no less than 1 mm (ideally, at least 1.5 mm) of healthy tooth structure supragingivally. In those situations in which inadequate tooth structure remains supragingivally, orthodontic extrusion with or without crown lengthening is indicated.

When existing gingival levels are ideal, rapid orthodontic extrusion without crown lengthening

may be utilized to improve crown-root ratios, maintain gingival levels, and allow for a ferrule effect.^{17,21-23} Once the nonvital tooth is rapidly extruded without bone and tissue movement, a dowel is placed and the tooth is restored with a crown. Surgical requirements are limited to a fibrotomy for the purpose of separating connective tissues circumferentially from the root to allow rapid extrusion. Election of this procedure is influenced by the root taper of the subject tooth. Extrusion may be contraindicated when a tooth is characterized by a narrow taper, which will produce an increased distance between the root and adjacent teeth as the tooth is extruded and result in a loss of papilla and diminution of aesthetics. Only when the nonvital tooth is characterized by a wide tapered root that does not enlarge the space between the nonvital tooth and adjacent teeth will the papilla be preserved at the gingival level and aesthetics be maintained.

Orthodontic extrusion with crown lengthening is indicated when sufficient surgingingival tooth structure is *not* present for a post-and-core restoration, *and* gingival and/or bone levels are not ideal (eg, an infra-bony pocket exists or the tissue surrounding the nonvital tooth is more apical). Although surgery is required and treatment time is increased as opposed to rapid orthodontic extrusion with fibrotomy, crown lengthening can produce an aesthetic result by creating a more ideal gingival level or bone contour while preserving the crown-root ratio for subsequent post-and-core restoration.



Figure 8. Case 2. Preoperative evaluation demonstrated the presence of a fistula on tooth #10(22).

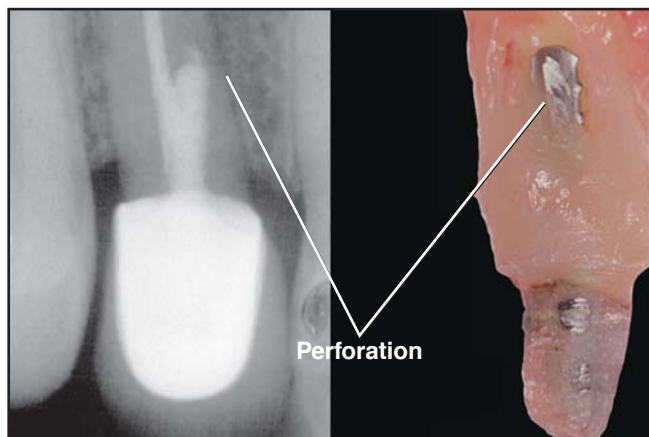


Figure 9. A radiograph confirmed the perforation of tooth #10. The tooth was deemed unsalvageable and was extracted.

Case Presentations

Case 1

A 35-year-old male patient presented with a failing restoration on tooth #4(15) (Figure 1). Upon examination of the tooth, it was discovered that the existing endodontic treatment was incomplete. Retreatment was advised prior to post placement. Radiographic evaluation determined that the root taper was uniform in diameter and provided adequate width to extrude the tooth orthodontically without compromising aesthetics (ideally, 1 mm to 1.5 mm of ferrule effect with maintenance of biologic width) (Figure 2). The patient was referred to an endodontist for completion of the root canal. A gold post was cast with a hook on the coronal surface for attachment of the elastic utilized during extrusion of the root (Figure 3). The post was cemented, and an orthodontic elastic band was attached to the gold post hook and the orthodontic wire (Figure 4). The post was then cemented with a resin cement material (eg, Panavia, Kuraray America Inc, Osaka, Japan; Fuji Bond, GC America, Alsip, IL).

The tooth was extruded for approximately six weeks until adequate tooth structure was exposed for the restoration (Figure 5). The tooth was then stabilized for an additional two months to allow sufficient bone remodeling to occur at the apex. At the completion of the two-month period, the hook was cut from the post, and the crown lengthening surgery was performed by a periodontist (Figure 6). An additional four months were allowed to facilitate tissue maturation prior to delivery of the definitive restoration, during



Figure 10. On the day of extraction, an ovate pontic was seated into the extraction site for restoration with an acrylic bridge.



Figure 11. The acrylic bridge was viewed in place with the ovate pontic seated into the site approximately 3 mm.



Figure 12. A provisional acrylic FPD was worn while bone growth and tissue maturation took place and the pontic site developed.

which period a provisional acrylic crown was utilized. At the conclusion of the maturation period, the root structure was re-prepared for a full-coverage porcelain crown (eg, IPS Empress, Ivoclar Vivadent, Amherst, NY; Authentic, Microstar Corporation, Augusta, GA), and the adjacent teeth #3(16) and #5(14) were prepared and etched to receive ceramic inlays (eg, IPS Empress, Ivoclar Vivadent, Amherst, NY; Avante, Pentron Laboratory Technologies, Wallingford, CT). The case was then finished to ensure optimal aesthetic and functional results (Figure 7).



Figure 13. The preparations were duplicated in a final stone model.



Figure 14. The definitive metal-ceramic restoration demonstrated an aesthetic appearance postoperatively.

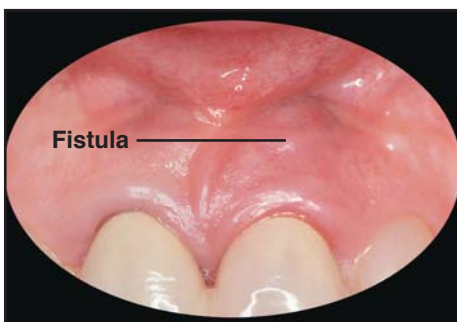


Figure 15. Case 3. Preoperative appearance of failing endodontic therapy and a lesion above the #9(21) incisor. A fistula was also identified.

When gingival levels are ideal at the outset of treatment, crown lengthening without orthodontic extrusion can create a ferrule effect around the restored root but may result in a larger crown and a compromised crown-root ratio. Only if the gingival level of the tooth to be treated is more coronal at the outset is crown lengthening without extrusion advised.

Extraction and Fixed Partial Denture

When a nonvital tooth is not salvageable and must be extracted, treatment options include restoration with a

fixed partial denture (FPD) using an ovate pontic or implant therapy.^{12,16,24} In such cases, orthodontic extrusion is often performed prior to extraction to compensate for the effect of ridge resorption and to maintain gingival harmony with the adjacent teeth. This could result in reducing or eliminating the necessity for grafting of connective tissue and/or bone. Extraction followed by restoration with an FPD is a direct approach that can provide a highly aesthetic and functional result if properly planned. Gingival shrinkage at the extraction site and bone resorption can be expected, however, with the resulting unaesthetic effect of a black triangle between the pontic and the adjacent teeth. A connective tissue graft or a combination bone-connective tissue graft may be required to avoid this effect. Additional conditions that may contraindicate restoration with an FPD include the desire to preserve uncompromised adjacent teeth and/or the presence of excessive space, resulting in disproportionate teeth.

Case 2

A 27-year-old female patient presented with a chief complaint regarding the diastema between teeth #6(13) and #7(12) and pain in the area of tooth #10(22). Upon careful examination, a prior endodontic root canal and post placement in tooth #10 were found, and a fistula was present on the labial tissue (Figure 8). Radiographic review determined that a probable post perforation had occurred, and the endodontist deemed the tooth hopeless (Figure 9). It was confirmed by examination of the extracted root that the post indeed had perforated the lateral surface of the root. On the day of extraction, an acrylic provisional restoration was designed with an



Figure 16. Excessive space between teeth #8(11) and #9 eliminated the option of restoration with an FPD.

ovate pontic placed approximately 2 mm to 3 mm into the extraction site (Figures 10 and 11). The authors determined that the papilla could be more predictably maintained by use of the ovate pontic rather than with implant placement and grafting of connective tissue. The provisional restoration was placed for four months to allow bone growth and tissue maturation to occur and to develop the pontic site (Figure 12). At the end of four months, the provisional was removed, the site was evaluated, and the definitive metal-ceramic FPD was constructed on the final stone cast (Figure 13). The restoration was pleasing to the patient (Figure 14).

Extraction and Implant Placement

Successful implant placement requires careful anatomical analysis and measurements with specific attention to conditions at the implant site. The following case presentation illustrates the aesthetic complications that can arise when such conditions are less than ideal.

Cases 3 and 4

In case 3, a 57-year-old male patient presented with failing endodontic therapy and a lesion above tooth #9(21) (Figure 15). A fistula was present. It was determined that the tooth was hopeless and required extraction. Because of the excessive space between teeth #8(11) and #9, a fixed partial denture was contraindicated (Figure 16). At the time of treatment (1992), a Brånemark threaded titanium implant with an external hex, which was representative of the state-of-the-art at that time, was placed. (Today, the author would place an implant with an internal connection-type implant design for biomechanical reasons). The excessive space that had precluded restoration with an FPD also presented a lack of sufficient papilla that was problematic for the aesthetics of implant therapy. Since the patient was averse to grafting procedures, none were performed, and the definitive restoration resulted in a black triangle due to insufficient tissue (Figure 17). If the void produced by a lack of papilla were filled with porcelain, rectangular teeth would result and be aesthetically unacceptable. Fortunately, the patient's lip line was not high, and the triangle was not visible (Figure 18). Additionally, it was considered probable that grafting would not have assured a predictable aesthetic result due to the excessive space between the adjacent teeth. The case illustrates the reality of



Figure 17. The patient's aversion to grafting procedures in spite of a lack of sufficient tissue for ideal aesthetics produced a black triangle in the final restorative result.



Figure 18. Note the acceptable aesthetics in 1992. A more ideal result can be obtained with today's ceramics.



Figure 19. Case 4. The prognosis of tooth extraction and implant placement is improved when the patient's existing anatomical conditions are favorable.



Figure 20. Preoperative evaluation indicated that the space between adjacent teeth was more ideal for a pleasing papilla result than in the prior case.



Figure 21. The papilla between teeth #9 and #10 was maintained. Note the significant aesthetic improvement following treatment of the nonvital tooth with implant therapy.



Figure 22. The definitive smile was created with a porcelain veneer at tooth #8, an implant-supported full-coverage crown at #9, and a porcelain veneer at #10.

clinical conditions in which no ideal solution exists other than unrealistic orthognathic procedures. When the space between adjacent teeth is ideal, the papilla is more readily maintained and a more optimum aesthetic result can be attained as depicted in case 4 (Figures 19 through 22).

Conclusion

When sufficient tooth structure remains supragingivally and it is necessary to place a core for crown retention, a post-and-core followed by a crown remains the restoration of choice. In the four cases illustrated, remaining tooth structure was inadequate for post-and-core restoration, and necessary adjunctive therapy was utilized in its absence to achieve aesthetic results. Among the decisive factors to be considered in selecting adjunctive therapy are the following:

- 1) Root taper: Orthodontic extrusion is contraindicated in the presence of narrow root taper in order to prevent loss of papilla and diminution of aesthetics.
- 2) Gingival levels: Aesthetic requirements may necessitate the alteration or preservation of gingival levels.
- 3) Crown-root ratio: Crown lengthening without orthodontic extrusion is contraindicated if crown-root ratio is jeopardized.
- 4) Spacing: When excessive space exists between adjacent teeth, fixed partial dentures are contraindicated and implant placement with or without orthodontic extrusion is indicated.
- 5) Patient preference: As Case #3 illustrated, patient preference regarding therapies such as grafting procedures and clinical options may reduce the available options and affect the outcome of the case.

Without question, techniques and materials exist today to facilitate aesthetic restoration of nonvital anterior teeth even when a conventional post-and-core restoration is not feasible. The success of any of these alternative therapies relies on careful evaluation of clinical and other considerations present and the appropriate match of modality and circumstances.

Acknowledgment

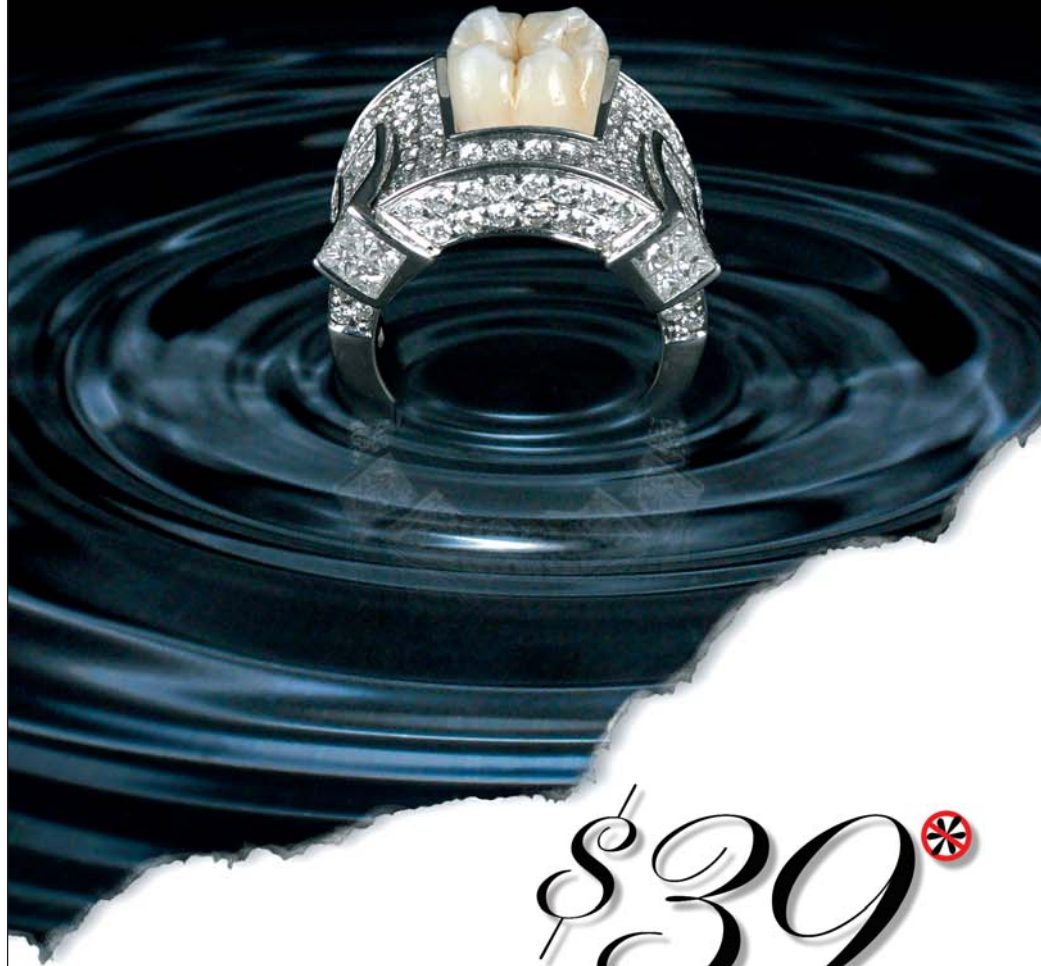
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References

1. 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(4): 243-250.
2. Spear F. When to restore, when to remove: The single debilitated tooth. *Compend Cont Educ Dent* 1999;20(4):316-328.
3. Christensen CJ. When to use fillers, build-ups or posts and cores. *J Am Dent Assoc* 1996;127(9): 1397-1398.
4. Assif D, Gorfil C. Biomechanical considerations in restoring endodontically treated teeth. *J Prosthet Dent* 1994;71(6):565-567.
5. Milot P, Stein RS. Root fracture in endodontically treated teeth related to post selection and crown design. *J Prosthet Dent* 1992;68(8):428-435.
6. Fernandes AS, Dessai GS. Factors affecting the fracture resistance of post-core reconstructed teeth: A review. *Int J Prosthodont* 2001;14(4): 355-363.
7. Goodacre CJ, Spolnik KJ. The prosthodontic management of endodontically treated teeth: A literature review. Part III. Tooth preparation considerations. *J Prosthodont* 1995;4(2):122-128.
8. Pilo R, Tamse A. Residual dentin thickness in mandibular pre-molars prepared with gates glidden and ParaPost drills. *J Prosthet Dent* 2000;83(6): 617-623.
9. Stern N, Hirshfeld Z. Principles of preparing endodontically treated teeth for dowel and core restorations. *J Prosthet Dent* 1973;30(2):162-165.
10. 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.
11. Baraban DJ. The restoration of endodontically treated teeth: An update. *J Prosthet Dent* 1988; 59(5):553-558.
12. Benenati FW, Simon JH. Orthodontic root extrusion: Its rationale and uses. *Gen Dent* 1986;34(4): 285-289.
13. Ivey DW, Calhoun RL, Kemp WB, et al. Orthodontic extrusion: Its use in restorative dentistry. *J Prosthet Dent* 1980;43(4):401-407.
14. Simon JH, Kelly WH, Gordon DG, Ericksen GW. Extrusion of endodontically treated teeth. *J Am Dent Assoc* 1978;97(1):17-23.
15. Ziskind D, Schmidt A, Hirschfeld Z. Forced eruption technique: Rationale and clinical report. *J Prosthet Dent* 1998;79(3):246-248.
16. Salinas TJ. A three unit FPD vs. single tooth implant restoration: What is the standard of care? Presented at: Annual meeting of the Academy of Prosthodontics; May 5, 2003; Boston, MA.
17. Heithersay GS. Combined endodontic-orthodontic treatment of transverse root fractures in region of the alveolar crest. *Oral Surg Oral Med Oral Pathol* 1973;36(3):404-415.
18. Ngan P, Knobloch L. Multidisciplinary and esthetic approach to clinical crown lengthening: Report of a case. *Quintessence Int* 1993;24:835-839.
19. Lemon RR. Simplified esthetic root extrusion techniques. *Oral Surg Oral Med Oral Pathol* 1982; 54(1):93-99.
20. Johnson GK, Sivers JE. Forced eruption in crown-lengthening procedures. *J Prosthet Dent* 1986; 56(4):424-427.
21. Stevens BH, Levine RA. Forced eruption: A multidisciplinary approach for form, function, and biologic predictability. *Compend Cont Educ Dent* 1998;19(10):994-1000.
22. Simon JH, Kelly WH, Gordon DG, Ericksen GW. Extrusion of endodontically treated teeth. *J Am Dent Assoc* 1978;97(1):17-23.
23. Durham TM, Goddard T, Morrison S. Rapid forced eruption: A case report and review of forced eruption techniques. *Gen Dent* 2004;52(2):167-175.
24. Mandel RC, Binzer WC, Withers JA. Forced eruption in restoring severely fractured teeth using removable orthodontic appliances. *J Prosthet Dent* 1982;47(3):269-274.



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CONTINUING EDUCATION (CE) EXERCISE No. 21



To submit your CE Exercise answers, please use the answer sheet found within the CE Editorial Section of this issue and complete as follows: 1) Identify the article; 2) Place an X in the appropriate box for each question of each exercise; 3) Clip answer sheet from the page and mail it to the CE Department at Montage Media Corporation. For further instructions, please refer to the CE Editorial Section.

The 10 multiple-choice questions for this Continuing Education (CE) exercise are based on the article "Treatment selection for anterior endodontically involved teeth," by Robert Rifkin, DDS, and Ed McLaren, DDS. This article is on pages 553-560.

1. The successful restoration of endodontically treated teeth most closely depends on:

- Gingival levels.
- Remaining tooth structure.
- Spacing between adjacent teeth.
- Patient preference.

2. Placement of an endodontic post and core:

- Strengthens the tooth.
- Weakens the tooth.
- Has no effect on the tooth.
- None of the above.

3. The placement of a dowel is indicated for clinical situations in which there is no less than what amount of healthy tooth structure supragingivally?

- 0.5 mm.
- 1.0 mm.
- 2.0 mm.
- 2.5 mm.

4. Orthodontic extrusion with crown lengthening is indicated when sufficient supragingival tooth structure is:

- Not present for a post-and-core restoration.
- Present for a post-and-core restoration but gingival and/or bone levels are not ideal.
- Not present for a post-and-core restoration but gingival and/or bone levels are ideal.
- Not present for a post-and-core restoration and gingival and/or bone levels are not ideal.

5. When a nonvital tooth is unsalvageable and must be extracted, treatment options include:

- Restoration with a fixed partial denture (FPD) using an ovate pontic.
- Restoration with an FPD using implant therapy.
- Both a and b.
- None of the above.

6. The following can be expected after extraction followed by restoration with an FPD:

- Gingival shrinkage at the extraction site.
- Bone resorption.
- A black triangle between the pontic and adjacent teeth.
- All of the above.

7. Nonvital anterior teeth can be replaced using the following techniques:

- Implant therapy.
- Orthodontic extrusion.
- Crown lengthening without orthodontic extrusion.
- All of the above.

8. The armamentarium for functional and aesthetic treatment and/or replacement of nonvital anterior teeth offers many alternatives for clinical situations where sufficient tooth structure is not available. When sufficient tooth structure remains supragingivally and it is necessary to place a core for crown retention, crown lengthening with orthodontic extrusion remains the restoration of choice.

- The first statement is true, the second statement is false.
- The first statement is false, the second statement is true.
- Both statements are true.
- Both statements are false.

9. All of the following are factors to be considered in selecting adjunctive therapy except:

- Gingival levels.
- Caries.
- Crown-root ratio.
- Patient preference.

10. When existing gingival levels are ideal, rapid orthodontic extrusion without crown lengthening:

- Weakens crown-root relationships.
- Increases gingival levels.
- Allows for a ferrule effect.
- Decreases gingival levels.