



american association of
endodontists

Guide to Clinical Endodontics

Sixth Edition

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Introduction

Welcome to the 2013 edition of the American Association of Endodontists' Guide to Clinical Endodontics. This represents the fifth major revision of the Guide since it was originally developed in 1987. The AAE is dedicated to excellence in the art and science of endodontics and to the highest standards of patient care. This Guide is part of that commitment to excellence.

Endodontics is a dental specialty that has been recognized by the American Dental Association since 1964. The AAE represents the specialty of endodontics and sponsors the American Board of Endodontics, the national certifying board for endodontists.

The definition of the specialty is as follows:

Endodontics is the branch of dentistry which is concerned with the morphology, physiology and pathology of the human dental pulp and periradicular tissues. Its study and practice encompass the basic clinical sciences including biology of the normal pulp, the etiology, diagnosis, prevention and treatment of diseases and injuries of the pulp and associated periradicular conditions.

The AAE developed the Guide to Clinical Endodontics for use by endodontists, and it reflects current clinical considerations in the specialty. AAE members can also share the Guide with general dentists to highlight the importance of appropriately referring cases to an endodontist for treatment.

The guidelines are not fixed protocols. Variations in an individual patient's health, teeth, physical condition and personal preferences are important factors in an endodontist's treatment recommendation. Practitioners cannot guarantee treatment outcomes.

The Guide includes selected references that represent some of the best clinical and scientific evidence available at the time of publication. It does not represent a complete bibliography. For the most current and comprehensive references, visit the Journal of Endodontics Topic Collections at www.jendodon.com/content/topiccollections, which provides up-to-date bibliographies for 41 topic areas. Links to relevant JOE Topic Collections are included in the Guide.

The AAE has made every effort to assure that the nomenclature and definitions used in the *Guide* correspond to those in the 2012 edition of the [AAE's Glossary of Endodontic Terms](#) and reporting codes in the American Dental Association's *Current Dental Terminology 2011-2012*.

The AAE has additional information on treatment planning and other aspects of patient care available online at no cost for AAE members at www.aae.org/treatmentoptions.

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A. Endodontic Examination and Diagnosis

Many features of evaluation in endodontics are common to all dental practice. Diagnostic evaluation of pulpal and periradicular status must be performed for every tooth to be treated. Inclusion of control or reference teeth in examination is essential. Differential diagnosis should be considered when indicated.

An adequate medical and dental history, the patient's description of the chief complaint(s) and visual and radiographic examination provide basic information. Some indicated tests, such as thermal, electrical, cavity, anesthesia, percussion, palpation and mobility, should be accomplished. Additional periodontal examination/evaluation, transillumination and observation of occlusal discrepancies may be indicated.

Reproducing the patient's symptoms is desirable if not mandatory. In some situations, it may be advisable to take radiographic images from more than one angle. It may also be necessary to make/take panoramic radiographs, bitewing radiographs, occlusal plane films and radiographs of the contralateral and opposing teeth. The use of enhanced magnification, illumination or intraoral photography are common adjuncts. The use of small volume cone beam-computed tomography is sometimes indicated. For guidance on the use of CBCT, see the joint *AAE/AAOMR Position Statement on the Use of CBCT in Endodontics*, found at www.aae.org/guidelines.

The diagnostic categories used should be those specified in the AAE's *Glossary of Endodontic Terms* for both pulpal and periradicular diagnoses. It may be necessary to recommend follow-up visits for some patients at periodic intervals to compare specific data from the various examinations to facilitate an accurate pulpal and periradicular diagnosis. Waiting for symptoms to exacerbate might be indicated in some situations before treatment is initiated. At times, it may be necessary to attempt to secure radiographic images from previous practitioners to assist with the evaluation process.

Objectives:

- a. To determine diagnosis and the need for any treatment.
- b. To determine those cases deemed to be too complex for the level of training, experience and expertise of the practitioner. (See the *AAE Endodontic Case Difficulty Assessment Form and Guidelines*.)
- c. To determine if it is advisable to consult with, or refer to, other health professionals.

Selected References:

JOE Topic Collections: Diagnosis www.jendodon.com/content/diagnosis

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B. Endodontic Treatment Planning, Records and Follow-up Visits

Endodontic treatment is based on an analysis of all diagnostic information. Treatment planning should include a determination of the strategic importance of the tooth or teeth considered for treatment, the prognosis and the urgency of treatment. It is incumbent upon all providers of endodontic care to address endodontically-related emergencies in a timely manner. Other factors, such as excessively curved canals, periodontal disease, occlusion, tooth fractures, calcified or occluded canals, restorability and teeth with complex root canal morphology, should be considered. (See the *AAE Endodontic Case Difficulty Assessment Form and Guidelines*.)

Treatment records should include the chief complaint(s) in the patient's own words; a current medical and dental history; the results of diagnostic tests and clinical examination; clinical impressions based on subjective and objective evaluations; the pulpal and periradicular diagnoses and treatment recommendations; a description of treatment rendered, including pulpal status upon entry; the prognosis as reported to the patient; recommendations for tooth restoration; and the preoperative, appropriate working, postoperative and follow-up radiographic examination. Informed consent is required. It may be helpful to record patient commentaries before, during and after treatment. Prescriptions must be recorded, and consultations should be made part of the patient record.

Endodontic care includes evaluation of the patient's postoperative response to the clinical procedures. Providers of endodontic services should encourage patients to return at appropriate follow-up intervals for evaluation.

Selected References:

- Allen RK, Newton CW, Brown CE. A statistical analysis of surgical and non-surgical endodontic retreatment cases. *J Endod* 1989;15:261.
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C. Vital Pulp Therapy

1. Apexogenesis

Indications for Treatment

Apexogenesis is indicated on permanent teeth with immature apices if *all* the following conditions exist:

- a. Tooth has a deep carious lesion that is considered likely to result in pulp exposure during excavation.
- b. No history of subjective pretreatment symptoms.
- c. Pretreatment radiographs should exclude periradicular pathosis.
- d. Mechanical exposure of a clinically vital and asymptomatic pulp occurs.
- e. Bleeding is controlled at the exposure site.
- f. Exposure occurs when the tooth is under dental dam isolation.
- g. Adequate seal of the coronal restoration can be maintained.
- h. Exposure permits the capping material to make direct contact with the vital pulp tissue.
- i. Patient has been fully informed that endodontic treatment may be indicated in the future.

Procedure

Apexogenesis is vital pulp therapy performed to allow continued physiological development and formation of the root. It involves the removal of a portion of pulp and application of a medicament with the aim of maintaining the vitality of the remaining pulp and to encourage continued physiological development and formation of the root.

Objectives

- a. To prevent adverse clinical signs or symptoms.
- b. To develop contact of a radiopaque capping material with the pulpal tissue.
- c. To prevent breakdown of the periradicular supporting tissue.
- d. To obtain radiographic evidence of root development.

2. Pulpotomy

Indications for Treatment

A pulpotomy may be indicated if any of the following clinical conditions exist:

- a. Exposed vital pulps or irreversible pulpitis of primary teeth. Primary teeth with insufficient root structure, internal resorption, furcal perforation or periradicular pathosis that may jeopardize the permanent successor are not indicated for pulpotomy procedures.
- b. As an emergency procedure in permanent teeth until root canal treatment can be accomplished. Pulpal debridement should be encouraged (*see section C3*).
- c. As an interim procedure for permanent teeth with immature root formation to allow continued root development (apexogenesis). (*see section D4*).

Procedure

Pulpotomy is the surgical removal of the coronal portion of vital pulp tissue. A biologically acceptable material is placed in the pulp chamber, and the tooth is restored.

Objectives

- a. To prevent adverse clinical signs or symptoms.
- b. To obtain radiographic evidence of sufficient root development for endodontic treatment. An increase in root length may be evident.
- c. To prevent breakdown of the periradicular supporting tissues.
- d. To prevent resorptive defects or accelerated canal calcification as determined by periodic radiographic evaluation.

3. Pulpal Debridement

Indications for Treatment

Pulpal debridement (pulpectomy) is indicated for the relief of acute pain prior to conventional root canal treatment when complete root canal treatment cannot be accomplished at this appointment. This procedure cannot be submitted for reimbursement when endodontic treatment is completed on the same day.

Procedure

Surgical removal of the entire pulp tissue.

Objectives

Relief of acute pain until complete treatment can be accomplished.

4. Indirect Pulp Capping

Indications for Treatment

Indirect pulp capping is indicated on permanent teeth with immature apices if *all* the following conditions exist:

- a. Tooth has a deep carious lesion that is considered likely to result in pulp exposure during excavation.
- b. No history of subjective pretreatment symptoms.
- c. Pretreatment radiographs should exclude periradicular pathosis.
- d. Patient has been fully informed that endodontic treatment may be indicated in the future.

Procedure

Treatment consists of two visits approximately six to eight months apart. At the first visit, caries biomass is excavated, leaving affected dentin adjacent to the pulp. Calcium hydroxide or other biologically compatible material is placed over the dentin followed by a base, and the tooth is soundly restored. At the second visit, the restorative material and residual caries mass is removed, and the tooth is restored.

Objectives

- a. To prevent adverse clinical signs and symptoms.
- b. To obtain radiographic evidence of root development.
- c. To prevent breakdown of the periradicular supporting tissues.
- d. To prevent resorptive defects or accelerated canal calcification as determined by periodic radiographic evaluation.

5. Direct Pulp Capping

Indications for Treatment

Direct pulp capping is indicated when *all* of the following clinical conditions exist:

- a. Mechanical exposure of a clinically vital and asymptomatic pulp occurs.
- b. Bleeding is controlled at the exposure site.
- c. Exposure permits the capping material to make direct contact with the vital pulp tissue.
- d. Exposure occurs when the tooth is under dental dam isolation.
- e. Adequate seal of the coronal restoration can be maintained.
- f. Patient has been fully informed that endodontic treatment may be indicated in the future.

Procedure

A radiopaque capping material is placed directly onto the surface of vital pulp tissue at the exposure site. The final restoration is placed over the base. The status of the pulp and periradicular tissues should be assessed through periodic recall examinations.

Objectives

- a. To prevent adverse clinical signs or symptoms.
- b. To develop contact of a biocompatible radiopaque capping material with the pulpal tissue.
- c. To maintain normal responsiveness to electrical and thermal pulp tests.
- d. To prevent breakdown of the periradicular supporting tissue.

Selected References:

JOE Topic Collections: Apexification, Pulp Therapy and Apexogenesis.

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D. Nonsurgical Endodontics

1. Dental Dams

Indications for Treatment

Tooth isolation using the dental dam is the standard of care; it is integral and essential for any nonsurgical endodontic treatment. One of the primary objectives of endodontic treatment is disinfection of the root canal system. Only dental dam isolation minimizes the risk of contamination of the root canal system by indigenous oral bacteria. The dental dam also offers other benefits, such as aiding in visualization by providing a clean operating field and preventing ingestion or aspiration of dental materials, irrigants and instruments.

2. Primary Teeth

Indications for Treatment

Nonsurgical root canal treatment for primary teeth is indicated if *any* of the following clinical conditions exist:

- a. Irreversible pulpitis or pulpal necrosis with no evidence of a permanent successor tooth.
- b. Pulpal necrosis with or without evidence of periradicular disease.
- c. Treatment will not jeopardize the permanent successor.

Procedure

Root canal treatment involves the use of biologically acceptable chemical and mechanical treatment of the root canal system to promote healing and repair of the periradicular tissues.

Debridement, enlargement, disinfection and obturation of all canals are accomplished using an aseptic technique with dental dam isolation. Biologically acceptable material is used to obturate the root canal(s).

- a. When a permanent successor tooth is evident, the debridement and shaping of the canal system are followed by obturation with an obturating material that will resorb at a rate similar to the primary root.
- b. When no permanent successor tooth is present, the canals of the primary tooth are obturated with a biologically acceptable nonabsorbable endodontic material. Root canal sealers are used in conjunction with the obturating material to establish an adequate seal.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To create the radiographic appearance of a well-obturated root canal system where the root canal filling extends as close as possible to the apical constriction of each canal. Gross overextension, underfilling in the presence of patent canals, ledges and perforations should be avoided.
- c. To prevent further breakdown of periradicular tissues.
- d. To allow resorption of root structures and absorption of obturating material to occur when a permanent successor tooth emerges.

3. Permanent Teeth

Indications for Treatment

Nonsurgical root canal treatment for permanent teeth is indicated if *any* of the following clinical conditions exist:

- a. Symptomatic or asymptomatic irreversible pulpitis, with or without evidence of periapical disease
- b. Necrotic pulp with or without evidence of periradicular disease.
- c. Teeth with a pulp that would be compromised during dental procedures, including but not limited to caries removal, overdenture abutments, malposed teeth and root resection.
- d. Restorative reason when a placement of a core and possibly a post is necessary for retention of a fixed restoration.
- e. Cracked or fractured teeth with pulpal involvement (with or without clinical symptoms) that can reasonably be expected to maintain satisfactory periodontal health.
- f. Teeth with thermal hypersensitivity that significantly interferes with normal function, when alternative methods have failed to reduce the hypersensitivity.

Procedure

Root canal treatment for permanent teeth involves the use of biologically acceptable chemical and mechanical treatment of the root canal system to promote healing and repair of the periradicular tissues.

Proper access is dictated by the size and shape of the pulp chamber and its canal orifices, as well as by the tooth's position in the arch. Enough roof of the pulp chamber is removed to visualize the entire pulpal floor

Cleaning, shaping, disinfection and obturation of all canals is accomplished using an aseptic technique with dental dam isolation. Root canal sealers are used in conjunction with a biologically acceptable semi-solid or solid obturating material to establish an adequate seal of the root canal system.

It is recognized that intracanal instruments will occasionally separate due to situations that are beyond the practitioner's control. Recognizing this possibility, the practitioner must use sterilized intracanal instruments made of biocompatible materials, such as stainless steel and/or nickel-titanium.

In the event that the fragment cannot be removed or bypassed without compromising tooth structure, the remainder of the accessible root canal space should be obturated with a biologically acceptable semi-solid or solid material. The patient should be informed of any incidence of instrument separation, and the patient should be recalled for monitoring. This discussion should be noted in the patient record.

Paraformaldehyde-containing pastes or obturating materials have been shown to be unsafe. Root canal obturation with paraformaldehyde-containing materials is below the standard of care for endodontic treatment. The American Association of Endodontists and the American Dental Association do not recommend their use.

Silver points were historically indicated and well-accepted as a root canal obturation material; however, modern techniques and improved materials provide the clinician with much better options. The American Association of Endodontists does not recommend their use. The AAE does not recommend replacement of points (i.e. retreatment of the case) unless the case is failing by typical definitions.

Following nonsurgical root canal treatment, the tooth must be restored as soon as possible in order to prevent coronal leakage into the root canal system and prevent fracture of the remaining tooth structure.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To debride and shape the root canal system.
- c. To create the radiographic appearance of a well-obtured root canal system where the root canal filling extends as close as possible to the apical constriction of each canal. Gross overextension, underfilling in the presence of patent canals, ledges and perforations should be avoided.
- d. To maintain health and/or promote healing and repair of periradicular tissues:
 - i. If a tooth had a normal periodontal ligament space and an intact lamina dura surrounding the root(s) at the time of obturation, the subsequent postoperative radiographic appearance should remain unchanged after a suitable period of time for resolution of any transitory radiographic changes.
 - ii. If a tooth had a preoperative periradicular radiolucency, the follow-up radiographic examination should optimally demonstrate an intact lamina dura and a normal periodontal ligament space around the root(s) under observation.
 - iii. If the radiolucent area is decreasing in size or is not enlarging and the tooth is asymptomatic additional follow-up visits with radiographic examination are indicated.
 - iv. There may be periradicular bone healing without reformation of a normal periodontal ligament space.

4. Pulpal regeneration (regenerative endodontics), apexification and recalcification

I. Pulpal regeneration (regenerative endodontics)

Indications for Treatment

- a. The primary indication at this time is incomplete root development (length) as well as incomplete apical closure
- b. Treatment options other than extraction are limited to apexification or pulpal regeneration. An apexification may provide an apical barrier; however this would result in less than ideal root length and dentinal wall thickness, making the root more prone to fracture.
- c. Apexogenesis is not a choice because the pulp is necrotic.

Procedure

This is a biologically-based procedure designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex. Treatment is initiated by isolating the tooth with a rubber dam and gaining access to the root canal system followed by copious, gentle irrigation. Necrotic tissue is extirpated, and the canal is irrigated and dried. Antibacterial medication is placed in the canal to the apex and access is closed with temporary filling material. The patient is recalled in three to four weeks, and this step is repeated until there are no clinical signs or symptoms of infection. The final phase of treatment is initiated by anesthetizing without vasoconstrictor followed by rubber dam isolation. Access is gained followed by copious gentle irrigation. After the canal is dried, apical bleeding is induced by overinstrumentation to create a clot in the canal. Three to four millimeters of mineral trioxide aggregate or similar material is placed in contact with the clot, ending apical to the CEJ. The access is closed with a permanent filling material. Patient is recalled to assess continued development of the root.

Objectives

- a. To treat apical periodontitis
- b. To induce radiographic evidence of apical closure without breakdown of supporting tissues.
- c. To retain dentition, especially during craniofacial development
- d. To promote root development

II. Apexification

Indications for Treatment

This procedure can be done if pulpal generation has failed or there are other reasons not to attempt to regenerate the pulp.

Procedure

Treatment is initiated by cleaning and shaping the canal and packing the area with biologically appropriate material to create an apical barrier. The patient is reappointed, and the root canal treatment is completed.

If there are concerns about patient compliance or long term follow-up, a second method is to use Ca(OH)_2 to induce hard tissue formation as an apical stop. It may be necessary to change the intra-canal medication several times during a six- to 18-month period before root canal treatment can be completed.

III. Recalcification

Indications for Treatment

Treatment or prevention of external and internal resorptive defects perforating to external tooth surface.

Procedure

Treatment may be done either before or after completed root canal treatment, depending on size and location of resorptive defect. If defect is coronal, root canal treatment can be completed before addressing resorptive defect. If resorptive defect is in roots, root canal treatment is not completed until resorptive healing is complete.

Treatment is initiated by cleaning and shaping the canals (and possibly obturating the canals) and packing the area with appropriate material to create resorptive repair. The patient is reappointed for monitoring. Treatment is completed when resorptive repair is observed.

These procedures may involve several treatments (medication changes) over an extended period of time. Biologically acceptable materials should be used.

Objectives

Encourage biological root repair.

5. Perforation Repair

Indications for Treatment

Nonsurgical repair is indicated if *any* of the following clinical conditions exist:

- a. A perforation of tooth structure has occurred during nonsurgical root canal treatment or post space preparation, and the perforation is within alveolar bone.
- b. A communication between the pulp space and external root surface as a result of root resorption or dental caries.

Procedure

The perforation defect is repaired using a biologically acceptable material to seal the communication between the pulp canal space and external root surface.

Objectives

- a. To seal the root canal space from the external surface of the root.
- b. Minimize extrusion of the repair material.
- c. Promote healing of the periodontal structures at the site of the perforation.

6. Nonsurgical Root Canal Retreatment

Indications for Treatment

Nonsurgical root canal retreatment is indicated if *any* of the following clinical conditions exist:

- a. Continued periradicular pathosis, with symptoms.
- b. Radiographic evidence of a deficiency in the quality of the root canal obturation when periradicular pathosis or symptoms continue after endodontic treatment.
- c. Persistent symptoms.
- d. Anticipated restorative or prosthetic procedures that could compromise any pre-existing root canal obturations.
- e. Anticipated restorative or prosthetic procedures on a tooth where the previous treatment quality is questionable.
- f. Salivary contamination when bacterial leakage into the root canal system is suspected.

Procedure

Nonsurgical root canal retreatment is a procedure to remove the previously placed root canal obturating material and re-obturate the tooth. Cleaning, shaping, disinfection and obturation of all canals are accomplished using an aseptic technique with dental dam isolation. Root canal sealers are used in conjunction with a biologically acceptable semi-solid or solid obturating material to establish an adequate seal of the root canal system.

Additional procedures may be required to remove posts and manage canal obstructions, radicular defects, aberrant canal morphology, ledges or perforations.

Retreatment cases may vary greatly in complexity, requiring greater effort, time and skill, and should be undertaken with due regard to the ability and experience of the practitioner. Retreatment may require augmentation by other treatment modalities, such as apexification, recalcification or surgical intervention to provide optimal treatment.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To create the radiographic appearance of a well-obtured root canal system where the root canal filling extends as close as possible to the apical constriction of each canal. Gross overextension, underfilling in the presence of patent canals, ledges and perforations should be avoided. To maintain health and/or promote healing and repair of periradicular tissues:
 - i. If a tooth had a normal periodontal ligament space and an intact lamina dura surrounding the root(s) at the time of obturation, the subsequent postoperative radiographic appearance should remain unchanged after a suitable period of time for resolution of any transitory radiographic changes.
 - ii. If a tooth had a preoperative periradicular radiolucency, the follow-up radiographic examination should optimally demonstrate an intact lamina dura and a normal periodontal ligament space around the root(s) under observation.
 - iii. If the radiolucent area is decreasing in size or not enlarging and the tooth is asymptomatic, additional follow-up visits with radiographic examination are indicated.
 - iv. There may be periradicular bone healing without reformation of a normal periodontal ligament space.

Selected References:

JOE Topic Collections: Ultrasonics and Sonics www.jendodon.com/content/ultrasonicsandsonics

JOE Topic Collections: Regenerative Endodontics www.jendodon.com/content/regenerativeendodontics

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E. Surgical Endodontics

1. Incision and Drainage/Trephination

Indications for Treatment

Incision and drainage of soft tissues is indicated if *any* of the following clinical conditions exist:

- a. If a pathway is needed in soft tissue with localized fluctuant swelling that can reasonably be expected to provide necessary drainage.
- b. When pain is caused by accumulation of exudate within soft tissues.
- c. When necessary to collect samples for bacteriologic analysis.

Trephination of hard tissues is indicated in any of the following clinical situations:

- a. If a pathway is needed from hard tissue that can reasonably be expected to provide necessary drainage.
- b. When pain is caused by accumulation of exudate within the alveolar bone.
- c. When necessary to collect samples for bacteriologic analysis.
- d. When adequate drainage cannot be established through the tooth.

Procedure

Incision and drainage is a surgical opening created in soft tissue for the purpose of releasing exudate or decompressing the area of swelling.

Trephination is the surgical perforation of the alveolar cortical bone to release accumulated intraosseous exudate.

These procedures may include the placement and subsequent timely removal of a drain.

Antibiotics may be indicated if there is diffuse swelling (cellulitis), systemic symptoms or in patients who are immunocompromised.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To reduce localized soft tissue swellings.
- c. To promote acceptable repair of hard and soft tissues.
- d. To prevent damage to teeth or anatomical structures.

2. Periradicular Curettage

Indications for Treatment

Periradicular curettage is indicated if *any* of the following clinical conditions exist:

- a. Symptomatic periradicular pathosis following endodontic treatment.
- b. A periradicular lesion that enlarges after endodontic treatment, as noted on follow-up radiographic examination.
- c. A periradicular lesion that may involve soft tissue swelling.
- d. A marked overextension of obturating materials interfering with healing.
- e. A biopsy is deemed necessary.
- f. A periradicular lesion associated with intractable discomfort in spite of orthograde endodontic treatment.

Procedure

Periradicular curettage is a surgical procedure to remove diseased or reactive tissue and/or foreign material from the alveolar bone in the apical or lateral region surrounding an endodontically treated tooth. By definition, the root is not resected.

A mucoperiosteal flap is surgically elevated and, when necessary, bone is removed to allow direct visualization of and access to the affected area. Thorough removal of all targeted tissue and/or foreign material is performed. Guided tissue regeneration techniques and/or bone replacement may be used if, at the time of surgery, the clinical condition warrants their use. Primary closure of the surgical site is desired.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To promote repair of hard and soft tissues.
- c. To minimize damage to adjacent teeth or anatomical structures.

3. Root-End Resection (Apicoectomy)

Indications for Treatment

A root-end resection (apicoectomy) in conjunction with periradicular curettage is indicated if *any* of the following clinical conditions exist:

- a. Symptomatic periradicular pathosis following endodontic treatment.
- b. A periradicular lesion that enlarges after endodontic treatment, as noted on follow-up radiographic examination.
- c. A marked overextension of obturating materials interfering with healing.
- d. Access for periradicular curettage, biopsy or to an additional root is necessary.
- e. Access for root-end preparation and root-end filling is necessary.
- f. When the apical portion of the root canal system of a tooth with periradicular pathosis cannot be cleaned, shaped and obturated.

Procedure

Root-end resection (apicoectomy) is the preparation of a flat surface by the excision of the apical portion of the root and any subsequent removal of attached soft tissues.

A mucoperiosteal flap is surgically elevated and, when necessary, bone is removed to allow direct visualization of and access to the affected area. Thorough removal of all targeted tissue and/or foreign material is performed. Guided tissue regeneration techniques and/or bone replacement may be used if, at the time of surgery, the clinical condition warrants their use. Primary closure of the surgical site is desired.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To promote repair of hard and soft tissues.
- c. To minimize damage to adjacent teeth or anatomical structures.
- d. To preserve as much root length as possible.

4. Root-End Filling (Retrofilling)/Root Repair

Indications for Treatment

Root-end filling (retrofilling) and root repair, when anatomically feasible, are indicated if *any* of the following clinical conditions exist:

- a. Persistent periradicular pathosis resulting from an inadequate apical seal that cannot be corrected nonsurgically.
- b. Periradicular pathosis and a blockage of the root canal system that could not be obturated by nonsurgical root canal treatment.
- c. Root perforations and transported canals.
- d. Resorptive defects.

Procedure

Root-end filling (retrofilling) is an additional procedure following root-end resection (apicoectomy). A biologically acceptable restorative material is placed into a root-end preparation. Root resorptive defects and perforations are repaired with a biologically acceptable filling material.

Following root-end resection, a preparation is made and a biologically acceptable repair material is placed. Guided tissue regeneration techniques and/or bone replacement may be used if, at the time of surgery, the clinical condition warrants their use. Primary closure of the surgical site is desired.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To promote acceptable repair of hard and soft tissues.
- c. To minimize damage to adjacent teeth or anatomical structures.
- d. To preserve maximum root length possible.
- e. To limit root-end filling and root repair materials to the confines of the preparation.
- f. To seal the root canal system or defect.

5. Biopsy

Indications for Treatment

A biopsy is indicated if *any* of the following clinical conditions exist:

- a. When an adequate amount of tissue or foreign material can be removed from the periradicular surgical site for histopathologic examination.
- b. Persistent pathosis or pathosis inconsistent with endodontic disease is noted on clinical or radiographic examination.
- c. Medical history indicates the merits of biopsy.

Procedure

A biopsy is the surgical removal of a soft and/or hard tissue specimen for histopathologic examination.

Objective

To establish a diagnosis by histopathologic examination.

6. Root Resection (Root Amputation)

Indications for Treatment

A root resection procedure is indicated if at least one root of the tooth is structurally sound and *any* of the following conditions exist:

- a. Periodontal furcation defect with a severe infrabony defect .
- b. Vertical root fracture confined to the root to be separated and removed.
- c. Carious, resorptive root or perforation defects that are inoperable or cannot be corrected without root removal.
- d. Persistent periradicular pathosis where nonsurgical root canal treatment or periradicular surgery is not possible.

Procedure

Root resection (root amputation) is a surgical procedure for the removal of a root or roots of a tooth. There are two methods of resection: the vertical cut technique and the horizontal root resection.

In the vertical cut technique, the tooth is sectioned vertically through the furcations, allowing for separation of the affected root and crown from the remaining root structure. This method is referred to as a hemisection when used on mandibular molars.

A horizontal root resection involves surgically amputating the root and preserving the crown portion of the tooth. This technique is often used to preserve an existing prosthesis.

When possible, it is preferable to complete the root canal procedure and place a permanent restoration that extends into the canal orifices prior to the root resection procedure.

Objectives

- a. To alleviate present or prevent future adverse clinical signs or symptoms.
- b. To eliminate or reduce significant periodontal defect(s).
- c. To perform acceptable root canal obturation(s) in the remaining root segment(s).
- d. To perform proper contouring of remaining tooth structure.
- e. To seal all external openings into the pulp chamber.
- f. To provide a portion(s) of the tooth that is/are restorable and that can be maintained by the patient.
- g. To preserve an existing prosthesis where one root of an abutment requires removal (horizontal root resection).

7. Intentional Replantation (Extraction/Replantation)

Indications for Treatment

Intentional replantation is indicated when *all* of the following clinical conditions exist:

- a. Persistent periradicular pathosis following endodontic treatment.
- b. Nonsurgical retreatment is not possible or has an unfavorable prognosis.
- c. Periradicular surgery is not possible or involves a high degree of risk to adjacent anatomical structures.
- d. The tooth presents a reasonable opportunity for removal without fracture.
- e. The tooth has an acceptable periodontal status prior to the replantation procedure.

Procedure

Intentional replantation is the insertion of a tooth into its alveolus after the tooth has been extracted for the purpose of accomplishing a root-end filling or root repair. Stabilization of the replanted tooth may or may not be necessary. When possible, root canal treatment is performed prior to intentional replantation.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To properly orient the tooth in the socket.
- c. To eliminate periradicular pathosis.
- d. To minimize periodontal pathosis.
- e. To preserve the maximum root length possible.
- f. To place root-end filling(s) or root repair material(s).
- g. To maintain the tooth as a functional member of the dentition.

8. Surgical Removal of the Apical Segment of a Fractured Root

Indications for Treatment

When a root fracture occurs in the apical portion and pulpal necrosis results, the fractured segment may be removed surgically following or in conjunction with nonsurgical root canal treatment. Surgical removal of the apical segment of a fractured root is indicated when *all* of the following clinical conditions exist:

- a. Root fracture in the apical portion of the root.
- b. Pulpal necrosis in the apical segment as indicated by a periradicular lesion or clinical signs or symptoms.
- c. Coronal tooth segment is restorable and functional.

Procedure

A mucoperiosteal flap is surgically elevated and, when necessary, bone is removed to allow direct visualization of and access to the affected site. The apical portion of the affected root and all of the targeted tissue are removed. A root-end resection and/or root-end filling may be necessary. Guided tissue regeneration techniques and/or bone replacement may be used if, at the time of surgery, the clinical condition warrants their use. Primary closure of the surgical site is desired.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To remove the fractured root segment.
- c. To promote acceptable repair of hard and soft tissues.
- d. To maintain a favorable crown-to-root ratio.
- e. To prevent damage to adjacent teeth or anatomical structures.
- f. To maintain the tooth as a functional member of the dentition.

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F. Management of Traumatic Dental Injuries

1. Enamel Fracture (Uncomplicated Crown Fracture)

Indications for Treatment

Treatment of enamel fracture is indicated if *any* of the following clinical conditions exist:

- a. Enamel fracture.
- b. Chipped enamel not involving underlying dentin.
- c. To permit immature teeth to complete root development (apexogenesis).

Procedure

Enamel fractures usually require minimal treatment; chipped enamel can either be smoothed or repaired with bonded resin or the tooth fragment can be bonded back in place.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To establish an acceptable esthetic and functional tooth.

2. Crown Fracture without Pulp Exposure (Uncomplicated Crown Fracture)

Indications for Treatment

Treatment of crown fracture involving enamel and dentin, with no direct exposure of the pulp, is indicated when *both* of the following clinical conditions exist:

- a. The crown fracture involves enamel and dentin with no pulp exposure.
- b. The pulp tests reveal no indication for endodontic treatment.

Procedure

In addition to restoring the esthetic aspect of the tooth by repairing with bonded resin or bonding the tooth fragment back in place, procedures for treating crown fractures without pulpal exposure are intended to protect the dentin and the underlying vital pulp. In immature teeth, continued root development may take place (apexogenesis).

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To establish an esthetic and functional tooth.
- c. To permit continued/complete root development in immature teeth as demonstrated on periodic radiographic examination.

3. Crown Fracture with Pulp Exposure (Complicated Crown Fracture)

Indications for Treatment

Treatment of crown fracture is indicated when *both* of the following clinical conditions exist:

- a. Crown fracture involves enamel, dentin and exposure of the pulp.
- b. The pulp is vital.

Procedure

For immature teeth with a vital pulp:

Pulp capping or shallow pulpotomy procedures are indicated. A biologically acceptable material is placed directly in contact with the pulp to maintain the vitality and function of the remaining radicular portion of the pulp. A final bonded restoration is placed or the tooth fragment can be bonded back in place. When the root reaches full maturation, nonsurgical root canal treatment and crown placement may be indicated when necrosis occurs.

For permanent (fully formed) teeth:

If a crown is not necessary for restoring the fractured tooth, it is acceptable to use vital pulp therapy followed by bonded composite resin or bonded fractured crown segment restorations, if carried out on teeth without clinical signs or symptoms of irreversible pulpitis and in a manner consistent with minimizing bacterial contamination. If the tooth requires a crown to restore function or esthetics, nonsurgical root canal treatment is indicated.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To place a radiopaque capping material in contact with the pulpal tissue to achieve dentinal repair.
- c. To establish an acceptable esthetic and functional tooth.
- d. To assess pulp vitality.
- e. To maintain health and/or promote healing and repair of the periradicular supporting tissue.
- f. To minimize resorptive defects or accelerated canal calcification, should they occur, as determined by periodic radiographic evaluation.
- g. To promote sufficient root development for endodontic treatment. An increase in root length may be evident.

4. Crown-Root Fracture

Indications for Treatment

Crown fracture involves enamel, dentin and cementum that may or may not involve the pulp.

Procedure

Immature teeth:

For immature teeth, the need for protecting the pulp is most important. Treatment, both emergent and definitive, is more complex and often requires an innovative and multidisciplinary approach.

Emergent care. The purpose of treatment is to protect the pulp so that root development may continue. Pulp capping procedures are indicated. A biologically acceptable material is placed directly in contact with the pulp to maintain the vitality and function of the remaining radicular portion of the pulp. A final restoration is placed. When the root reaches full maturation, nonsurgical root canal treatment and crown placement may be indicated. In addition, crown lengthening or orthodontic extension may be necessary.

Definitive care. The same procedures as for crown fractures with and without pulp exposure are indicated.

Fully formed teeth:

Emergent and definitive care. Nonsurgical root canal treatment is indicated in most cases. Procedures to facilitate restorations may include, but are not limited to, surgical crown lengthening and orthodontic root extrusion.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To place a radiopaque capping material in contact with the pulpal tissue.
- c. To establish an acceptable esthetic and functional tooth.
- d. To maintain normal responsiveness to electrical and thermal pulp tests.
- e. To maintain health and/or promote healing and repair of the periradicular supporting tissue.
- f. To minimize resorptive defects or accelerated canal calcification as determined by periodic radiographic evaluation.
- g. To promote sufficient root development for endodontic treatment. An increase in root length may be evident.

5. Root Fracture

Indications for Treatment

Root fracture involves cementum, dentin and pulp, and may be horizontal or oblique.

Procedure

Emergent care. In most cases, emergent care is directed towards reduction and stabilization of the fracture site.

Definitive care. Definitive care is limited to periodic radiographic and clinical evaluations. If pulpal necrosis develops, root canal treatment is indicated.

If a root fracture occurs in the apical portion and pulpal necrosis results, the fractured segment may be removed surgically following/or in conjunction with nonsurgical root canal treatment. (See Section E-6) If coronal tooth structure is lost apical to crestal bone, root extrusion or surgical crown lengthening may be indicated.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To establish an acceptable esthetic and functional tooth.
- c. To observe radiographic evidence of continued/complete root formation in immature teeth.
- d. To observe radiographic evidence of root fracture repair (calcific, fibrous/fibrotic or bony).
- e. To establish minimal tooth mobility.

6. Luxation

Indications for Treatment

Luxation includes slight to severe injuries to teeth and their supporting structures.

- a. Concussion — Trauma resulting in sensitivity to percussion but no excessive mobility and no displacement.
- b. Subluxation — Trauma resulting in sensitivity to percussion and injury to supporting tissues resulting in abnormal loosening of a tooth or teeth without displacement.
- c. Extrusive luxation — Partial axial displacement of the tooth out of its socket.
- d. Lateral luxation — Displacement of the tooth in a direction other than axially that can be accompanied by fracture of the alveolar socket.
- e. Intrusive luxation — Axial displacement of the tooth into the alveolus and can be accompanied by fracture of the alveolar socket.

Procedure

Emergent care. Includes repositioning the tooth and nonrigid stabilization, when necessary, to allow healing of the periodontal ligament and supporting bone.

Definitive care. Includes nonsurgical root canal treatment in teeth with pulpal necrosis or irreversible pulpitis as determined by appropriate diagnostic procedures and radiographic assessment.

The treatment for immature teeth varies from fully formed teeth in that efforts must be attempted to allow revascularization of the immature pulps and continued development. In the case of intruded immature permanent teeth with open apices, emergent care can consist of monitoring on a regular basis for re-eruption and continued root formation. Fully formed teeth can receive nonsurgical root canal treatment should pulpal necrosis or irreversible pulpitis develop.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To provide a well-obtured root canal system where the root canal filling extends as close as possible to the apical constriction of each canal.
- c. To maintain health and/or promote healing and repair of periapical tissues:
 - i. If a tooth had a normal periodontal ligament space and an intact lamina dura surrounding the root(s) at the time of obturation, the subsequent postoperative radiographic appearance should remain unchanged after a suitable period of time for resolution of any transitory radiographic changes.
 - ii. If the radiolucent area is decreasing in size or not enlarging and the tooth is asymptomatic, healing is considered to be incomplete, and additional follow-up visits with radiographic examination are indicated.
 - iii. If a tooth had a pre-operative periapical radiolucency, the follow-up radiographic examination should optimally demonstrate an intact lamina dura and a normal periodontal ligament space around the root(s) under observation.
 - iv. There may be periapical bone healing without reformation of a normal periodontal ligament space.

7. Avulsion (Exarticulation)

Indications for Treatment

Treatment is indicated when a tooth is completely separated from its alveolus.

Procedure

Emergent care is directed toward timely replantation of the avulsed tooth. The patient should be referred to his or her physician to evaluate the need for a tetanus booster if the avulsed tooth has come into contact with soil or if tetanus coverage is uncertain.

- *The following pertains to teeth with less than one hour of extra-oral dry time or teeth transported in an acceptable transport medium (e.g., saliva, saline, milk, Hank's balanced salt solution).*

Emergent care - Without compromising the root surface, rinse the tooth with sterile saline, or Hank's balanced salt solution. Do not curette or scrape the root surface. Irrigate the tooth socket and gently replace the tooth into its normal position. Stabilize by splinting to adjacent teeth using a nonrigid splint; stabilize for the appropriate time (10 to 14 days) to allow reattachment of periodontal ligament fibers. Systemic antibiotics are advisable. Use a chlorhexidine mouthrinse (0.12%) twice a day for one week.

Definitive care - For immature teeth with wide open apices, place the tooth in doxycycline (~100mg/20ml saline) before replantation. Pulpal revascularization may occur and definitive care consists of monitoring radiographically on a regular basis for evidence of pulpal revascularization and continued root formation. For immature teeth in which revascularization does not take place, apexification procedures are followed by nonsurgical root canal treatment or regenerative endodontics. For mature teeth, timely (within seven to 10 days of replantation) nonsurgical root canal treatment that includes intracanal procedures to minimize resorption (short-term calcium hydroxide seven to 10 days) is indicated following replantation. Primary teeth are not suitable for replantation.

- *The following pertains to teeth with greater than one hour of extra-oral dry time.*

Emergent care. Remove debris and necrotic periodontal ligament from the root surface, immerse the tooth in a sodium fluoride solution for 20 minutes, flush the socket with saline to remove coagulum and gently replace the tooth into its normal position. Stabilize by splinting to adjacent teeth using a nonrigid splint; stabilize for the appropriate time to allow reattachment of periodontal ligament fibers (four to six weeks). Systemic antibiotics are advisable. The patient should be referred to his or her physician to evaluate the need for a tetanus booster if the avulsed tooth has come into contact with soil or if tetanus coverage is uncertain.

Definitive care. For mature teeth, timely nonsurgical root canal treatment that includes intracanal procedures to minimize resorption is indicated within seven to 10 days of replantation.

Permanent teeth with immature apices and an extra-oral dry time of greater than one hour are not suitable for replantation.

Objectives

- a. To establish revascularization in teeth with immature root development.
- b. To achieve re-attachment of periodontal ligament fibers and establish a normal periodontal ligament space.
- c. To re-establish a fully functioning tooth.
- d. To alleviate present and prevent future adverse clinical signs or symptoms.
- e. To provide a well-obtured root canal system where the root canal filling extends as close as possible to the apical constriction of each canal.
- f. To maintain health and/or promote healing and repair of periradicular tissues:
 - i. If a tooth had a normal periodontal ligament space and an intact lamina dura surrounding the root(s) at the time of obturation, the subsequent postoperative radiographic appearance should remain unchanged after a suitable period of time for resolution of any transitory radiographic changes.
 - ii. If the radiolucent area is decreasing in size or not enlarging and the tooth is asymptomatic, healing is considered to be incomplete, and additional follow-up visits with radiographic examination are indicated.
 - iii. If a tooth had a preoperative periradicular radiolucency, the follow-up radiographs or radiographic examination should optimally demonstrate an intact lamina dura and a normal periodontal ligament space around the root(s) under observation.
 - iv. There may be periradicular bone healing without reformation of a normal periodontal ligament space.

If nonsurgical endodontic treatment is required:

- a. To remove root canal contents.
- b. To provide a well-obtured root canal system, as close as possible to the apical constriction of each canal.
- c. To create the radiographic appearance of a well-obtured root canal system, as close as possible to the apical constriction of each canal. Gross overextension or underfilling in the presence of patent canals, ledges and perforations should be avoided.
- d. To promote healing and repair of periradicular tissues.
- e. To prevent further breakdown of periradicular tissues.
 - i. If a tooth had a normal periodontal ligament space and an intact lamina dura surrounding the root(s) at the time of obturation, the subsequent postoperative radiographic appearance should remain unchanged after a suitable period of time for resolution of any transitory radiographic changes.
 - ii. If the radiolucent area is decreasing in size or not enlarging and the tooth is asymptomatic, healing is considered to be incomplete-and additional follow-up visits with radiographic examination are indicated.
 - iii. If a tooth had a pre-operative periradicular radiolucency, the follow-up radiographic examination should optimally demonstrate an intact lamina dura and a normal periodontal ligament space around the root(s) under observation. There may be periradicular bone healing without reformation of a normal periodontal ligament space.
 - iv. Periradicular surgery may become indicated.

8. Alveolar Fracture Involving Teeth

Indications for Treatment

Treatment is indicated when there is an alveolar fracture that involves the socket of the tooth or teeth.

Procedure

Emergent care. Requires reduction of the fractured alveolar segment and rigid splinting for an appropriate period of time (4-6 weeks).

Definitive care. Involves the evaluation of the pulpal status of the associated teeth and completing nonsurgical root canal treatment when indicated.

Objectives

- a. To achieve satisfactory healing of the alveolar fracture while maintaining the natural dentition.
- b. To provide nonsurgical root canal treatment when indicated.

Orthodontic Considerations for Traumatized Teeth

Special considerations for recently or previously traumatized teeth are necessary when orthodontic treatment is initiated or continued. The severity of the trauma is indicative for the length of the evaluation and healing period prior to orthodontic forces being applied to the traumatized tooth or teeth.

- A three-month wait and observation period is recommended for minor traumatic injuries such as minor concussions, subluxations and extrusion type injuries.
- Teeth that have sustained moderate to severe damage to the periodontal ligament, such as with avulsion, intrusion, and severe subluxation, 6 months of observation and healing is recommended.
- It is also recommended that teeth that have sustained a root fractures should not have orthodontic forces applied for a minimum of one year. Root fractured teeth should show radiographic healing prior to orthodontic forces being applied.
- In all cases of teeth that have been traumatized, when orthodontic forces are initiated, they should be light and intermittent. The more damage to the periodontal ligament should be inversely proportional to the amount and force of orthodontic movement.
- The clinicians and patient/parents should also be aware that teeth that have a history of trauma, and have not required endodontic treatment, are more susceptible to pulpal necrosis during the application of orthodontic forces.

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G. Intracoronaral Bleaching

Indications for Treatment

An intracoronaral bleaching procedure is indicated for a tooth that has both of the following clinical conditions:

- a. The tooth is discolored from an internal source.
- b. Acceptable root canal treatment has been performed if possible.

Procedure

The intracoronaral bleaching procedure uses oxidizing agents within the coronal portion of an endodontically treated tooth to remove tooth discoloration. Dental dam isolation is essential. The degree of restoration to a normal color and return of the coronal translucency is dependent upon the cause, severity and duration of the discoloration. To reduce the potential for resorption, a cement barrier must be placed to minimize penetration of the oxidizing agent into dentinal tubules in the cervical area. The use of heat in combination with 30% hydrogen peroxide should be avoided.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To reduce or eliminate discoloration.
- c. To improve the degree of translucency.
- d. To minimize potential resorption.

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H. Restoration of Endodontically Treated Teeth

1. Post (Dowel)

Indications for Treatment

Post placement is indicated if *all* of the following clinical conditions exist:

- a. The remaining coronal tooth structure is inadequate for the retention of a restoration.
- b. When there is sufficient root length to accommodate the post while maintaining an adequate apical seal.
- c. There is adequate tooth structure remaining to allow for a ferrule after crown preparation.

Procedure

Following nonsurgical root canal treatment, a post space is created in the root canal by careful removal of the coronal canal obturating material. A sufficient amount of material must be retained in the apical portion of the canal to maintain an adequate apical seal. A custom or proprietary post is fitted and cemented into the root canal for core retention. The post should be passively retained and is cemented and/or bonded into place so that no voids exist between the post and the surrounding tooth structure and root canal filling material. Preparation of the post space and placement of the post should be accomplished using an aseptic technique with dental dam isolation.

Objectives

- a. To retain the core restoration.
- b. To place the post along the long axis of the root.
- c. To avoid perforations or root fractures.
- d. To preserve the apical seal.
- e. To eliminate any space between the post and the surrounding tooth structure or root canal filling material.
- f. To place the post in root structure that is supported by bone.
- g. To minimize contamination of the root canal system during the procedure.

2. Core

Indications for Treatment

Core restorations are indicated if *any* of the following clinical conditions exist:

- a. The replacement of missing coronal tooth structure is necessary.
- b. When the enhanced retention and resistance to displacement of the final restoration is necessary.

Procedure

The core material fills the pulp chamber and the coronal portions of the obturated root canal spaces, enhances the coronal seal and replaces missing coronal tooth structure in an endodontically treated tooth prior to the placement of the final restoration. The core may be constructed with a variety of acceptable materials and may or may not be used in conjunction with posts.

Objectives

- a. To provide retention for the final restoration.
- b. To occupy the entire pulp chamber with the core when possible.
- c. The core does not perforate the pulp chamber floor.
- d. To eliminate space between the core and the root canal filling material.

3. Posterior Teeth

It is recommended that endodontically treated posterior teeth be restored with a full cuspal protective restoration. The restoration should protect the remaining tooth structure and provide a coronal seal.

4. Anterior Teeth

Restoration of an endodontically treated anterior tooth is based on its clinical condition. Choice of the final restoration should be based on esthetic and functional requirements. The restoration should protect the remaining tooth structure and provide a coronal seal.

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I. Post/Post and Core Removal

Indications for Treatment

The removal of a post, post and core, or core restoration is indicated if *any* of the following clinical conditions exist:

- a. Loss of adequate retention.
- b. Recurrent caries associated with the existing post, core or both.
- c. Fracture of the post, core or both.
- d. When access to the root canal system for nonsurgical retreatment is necessary.

Procedure

Posts and cores are removed in a variety of ways. These methods must be applied in a judicious manner to minimize the potential for damage to the root and the adjacent teeth and tissues.

Objectives

- a. To alleviate present and prevent future adverse clinical signs or symptoms.
- b. To remove the entire post.
- c. To avoid root fractures or perforations.
- d. To minimize damage to the tooth, adjacent teeth or tissues.

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