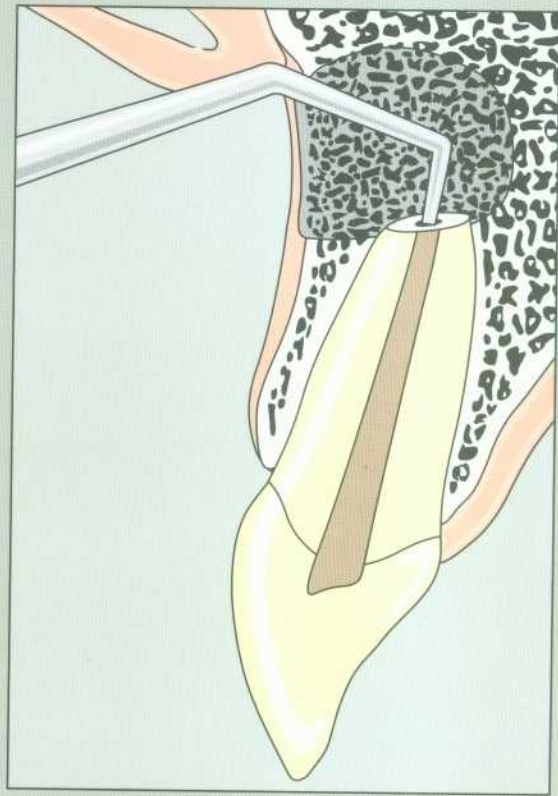
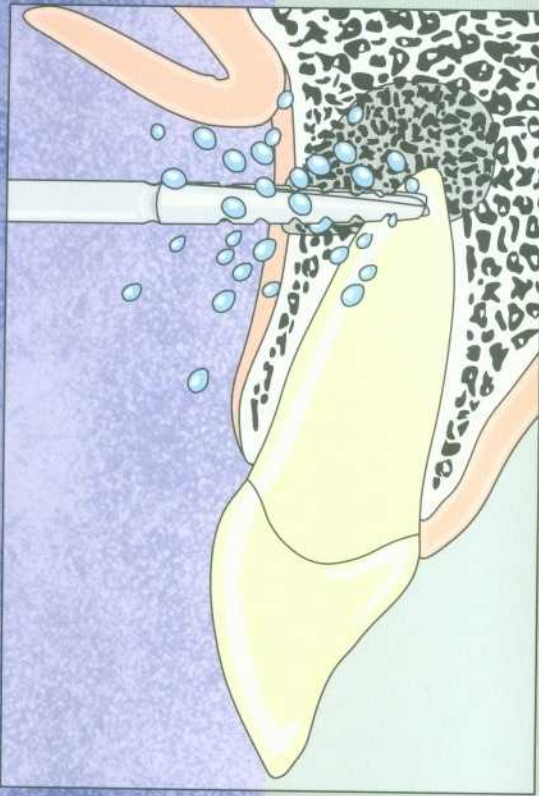


Practical Lessons in Endodontic Surgery



Donald E. Arens, DDS, MSD

In collaboration with

Mahmoud Torabinejad, DMD, MSD, PhD

Noah Chivian, DDS

Richard Rubinstein, DDS, MS

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*To Drs Gutmann, Harrison, Carr Kim, Pecora, Barnes, Bellizzi, Cummings, and all
others who have contributed to the recognition of endodontic surgery as a skill and
an extension of conventional therapy*

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Introduction

Since its inception, root canal therapy has been based on the principle of cause and effect. Once the irritant is eradicated, the body should be able to reverse the inflammatory response and allow for uneventful healing. For this reason, we should anticipate a high degree of success when we cleanse the canal of all debris and obliterate and seal the disinfected space with an inert, nonsoluble material. Three major studies spanning 40 years support this hypothesis and indicate an 87% to 92% success rate when the basic principles of instrumentation, disinfection, and obturation are carefully executed. But what about the other 8% to 13%? Why do cases fail even when we conform to these basic principles?

Although the patient's health condition plays a significant role, most of our failures can be attributed to our inability to remove the irritant completely. The conventional endodontic techniques of today are often inadequate in the face of tortuously curved roots, accessory canals, fractures, resorptive destruction, perforations, and certain defiant and intolerable anaerobes. To manage such problems, we must often rely on a more invasive approach to eliminate the primary etiology and repair the defect. The authors consider the surgical regimen to be an extension of conventional endodontic therapy and an alternative means of creating or improving the necessary canal seal.

This approach differs greatly from the early literature in which root exposure was considered radical and unconventional. In light of the types of arthroscopic and orthognathic surgery now performed daily by dental surgeons, exposure of the apical segment of a root can hardly be considered radical. The authors emphasize this point to persuade the reader that apical surgery is a viable alternative to extraction and to establish the fact that surgical root canal therapy at the apex (or root body) of a tooth offers a high degree of predictability.

We hope this manual will improve the reader's basic surgical knowledge and understanding of what is needed to accomplish the goals and objectives of a surgical intervention. A video, produced in conjunction with the School of Dentistry at Loma Linda University in California, is designed to illustrate the mechanics described herein and integrate the surgical procedures with the concepts.

The authors recognize that although knowledge and mechanics are essential, certain intangibles-surgical skill and confidence level-must be addressed. One should never proceed with a surgical treatment plan without developing the necessary skill to perform the objective, nor should one attempt a procedure that provokes apprehension and anxiety. For that reason, we suggest the novice begin with sites that are easily approached and where the anatomy is most familiar. As skills improve and confidence builds, the surgeon should be able to offer predictable service regard-

less of the location of the surgery or the hazards of the procedure.

We hope readers will find that this combination of workbook and video instruction strengthens their knowledge base and leads to more productive and rewarding practices.

A project of this magnitude requires the advice, counsel, and assistance of so many that there is a risk of not acknowledging someone. However, it would be unconscionable not to make the attempt. For motivation, inspiration, and perception, we are grateful to a pioneer and icon in endodontic surgery, Dr Al Frank. For photographic material that has been graciously loaned, we thank Drs Steve Buchanan, Gay Derderian, Gary Carr, Mu Mu Min, Don Newell, and Cliff Ruddle. For his computer art skills, Mark Dirlam is the best. For taking on the endless word processing drafts, we will be forever indebted to Kristi Arens Dobson.

PART I

Examination and Diagnosis

When Endodontic Surgery Should Be Considered

Endodontic surgery is the answer when a condition can be corrected, repaired, or remedied only by gaining access to the problem surgically. Few circumstances can be called outright endodontic surgical indications. However, many conservative treatment plans meet with difficulties and frustrations that defy conventional methods of therapy. Endodontic surgery is the logical alternative for such cases. For that reason, it should be viewed as an extension of endodontic treatment and not as a separate entity. The only difference between surgery and conventional therapy is the approach; the principles of cleaning, shaping, sterilizing, filling, and sealing the canal are the same. In endodontic surgery, these procedures are simply conducted at the end of the root instead of through the crown.

Surgical Considerations

The following conditions present problems that most often require surgical intervention:

Anatomy. Calcific metamorphosis, canal aberrations, impassable denticles, bifurcations, secondary roots, lateral canals, delta apexes, and internal and external resorption often resist conventional techniques.

Procedure. Irretrievable, separated instruments; perforations; ledges; zips; strips; inadequate and nonretrievable filling material; and irremovable posts, silver points, or gutta-percha filling cores may only be resolved with retrorepair techniques.

Trauma. Class III and IV crown fractures, root fractures, subluxated or luxated teeth, and alveolar fractures and/or displacements often demand the removal of both soft and hard tissue before they can be repaired or replaced.

Biopsy. Suspicious and/or nonhealing lesions, uncharacteristic signs and symptoms, and responses peculiar to treatment require exploratory examination and laboratory evaluation.

Failing endodontics. When regaining access to the canal or removing posts would risk a perforation or root fracture and/or create a restorative problem, a surgical approach may be more appropriate.

Expediency and convenience. In lieu of multiple visits and an extended treatment plan for patients who travel long distances, have major time limitations, require special medical adjunctive therapy, or need treatment of multiple diseased teeth in the

same arch, endodontic surgery may be combined with conventional methods to accelerate the treatment process.

Emergency treatment. Surgery is indicated when patients experiencing a superficial or deep cellulitis and/or severe and uncontrollable pain require an incision and bone trephination to relieve the trapped pressure and/or fluids.

Culture. In cases where conventional and adjunctive antibiotic therapy for odoriferous, painful, and repeatedly problematic teeth have been ineffective, the periradicular area must be accessed to obtain a sample of the exudate and lesion soft tissue (when present). Once obtained, this biopsy specimen can be forwarded to a qualified pathology laboratory for identification of the microorganisms, a histologic evaluation of the lesion, and a definitive diagnosis for an appropriate treatment plan.

Preclinical Evaluation of the Patient

Objective

To determine the patient's medical and dental condition.

Note

If the patient is a minor or is incapable of responding to questions, a parent, guardian, or responsible relative must provide the information as completely as possible. When the responder is other than a parent, the surgeon should personally interview him or her to ascertain relationship and authority for the patient's health care decisions. The history should comprise the patient's past and present physical condition with regard to the following areas:

- Central nervous system
- Respiratory system
- Cardiovascular system
- Hematologic dyscrasias
- Gastrointestinal system
- Urogenital system
- Endocrine system
- Immunologic disorders
- Metabolic disturbances
- Medications
- Addictions (drug/alcohol)

A completed, dated, and signed form, such as the one in Figure 2-1, should become a permanent record in the patient's chart. The ultimate responsibility for the accuracy of the history lies with the dentist and not with the auxiliary personnel.

Problems

1. Except in cases of emergency care, which can be resolved with minimal procedures, treatment for minors or patients incapable of properly responding to medical history questions must be delayed until a parent or guardian has completed and signed the required form. Negative or suspicious responses must be investigated further and may require written advice from the patient's personal physician(s). Figure 2-2 shows an example physician's consultation request form that may be used for this purpose. This sample letter, a copy of the patient's medical history, and the dentist's personal treatment concerns can be duplicated on office stationery and faxed or mailed to the physician of record prior to scheduling further appointments. The physician's response to this letter should become a permanent part of the patient's record.
2. In addition to the physical condition of the patient, emphasis must be placed on evaluating his or her psychological and emotional status. A severely apprehensive patient could present management problems that might interfere with the dentist's ability to achieve the desired result or cause the treatment to be given up entirely. Patients who make sudden and unexpected movements may cause inadvertent injury to themselves, the assistant, or the dentist.
3. Exploring the patient's past dental history and experiences will not only uncover the reason for the visit, but will also indicate how well he or she may react to and cooperate with future treatment.
4. An awareness and assessment of a patient's appearance, facial blemishes, and other physical characteristics, such as sores or needle marks, may indicate the presence of disease and/or drug use that may alter the approach or contraindicate treatment.

Fig 2-1 Sample Patient History Form

Dentist / Surgeon:				
Address				
Phone				
		Today's Date		
Patient's Name	Sex	Age	Weight	
Address		Phone		

Please answer each question.

1. Who is your primary physician? Name
Address
Phone
2. When was the last time you saw a physician, and why?
3. Would you describe your health as: Excellent Good Fair Poor
4. Have you ever been hospitalized? Yes No
5. Have you ever fainted in a dental office? Yes No
6. Do you have severe, frequent, or migraine headaches? Yes No
7. Are you nervous about dental treatment? Yes No
8. Have you ever been unconscious? Yes No
9. Have you ever had a convulsion or seizure? Yes No
10. Have you had any of the following lung problems:

coughing up blood?		Yes	No
coughing or wheezing?		Yes	No
asthma?		Yes	No
bronchitis?		Yes	No
emphysema?		Yes	No
11. Do you ever experience shortness of breath? Yes No
Difficulty in breathing? Yes No
12. Have you had any of the following heart problems:

heart attack?	Yes	No	chest pains?	Yes	No
angina?	Yes	No	high blood pressure?	Yes	No
swollen ankles?	Yes	No	heart palpitations?	Yes	No
stroke?	Yes	No	murmur?	Yes	No
13. Have you had rheumatic fever? Yes No
If yes, did your physician inform you of heart damage? Yes No
14. Have you had heart or vascular surgery? Yes No
15. Have you had prolonged bleeding from a cut, tooth extraction, nosebleed, menstrual period, or other injury? Yes No
16. Do you have frequent nosebleeds? Yes No
17. Have you had an ulcer? Yes No
18. Have you ever had any venereal diseases? Yes No
19. Have you ever been diagnosed with herpes? Yes No
20. Are you HIV positive? Yes No
21. Do you have AIDS? Yes No
22. Are you diabetic? Yes No

(Continued)

I: Examination and Diagnosis

Fig 2-1 Sample Patient History Form (Continued)

23. Have you had any thyroid problems?	Yes	No
24. Have you had hepatitis, yellow jaundice, or liver problems?	Yes	No
25. Have you had any of the following kidney problems:		
frequent infections?	Yes	No
blood in urine?	Yes	No
chronic renal failure?	Yes	No
dialysis?	Yes	No
26. Are you allergic or have you had adverse reactions to		
anesthetics, antibiotics, or other drugs?	Yes	No
If yes, list and describe all medicines.		
27. Are you on any special diet?	Yes	No
28. If female, is there a possibility that you are pregnant?	Yes	No
29. Please list all medications (and doses) you take including aspirin, birth control pills, etc.		

30. Describe any other medical conditions that have not been mentioned above.

31. Nearest relative

Address

Phone

I have answered these questions honestly and to the best of my knowledge.

Signature

(patient)

Parent, Guardian, Other

(relationship, be specific)

Dentist/Surgeon Signature

Date

Fig 2-2 Sample Consultation Request Form

Physician's Consultation Request

Date

Dear Dr.

Mr/Ms [patient] of [address and phone number] has recently been examined in our office, and the results indicate a need for dental treatment that will require one or all of the following procedures: administration of a local anesthetic; raising an oral surgical flap; removing bone; repairing the tooth/root; curetting existing apical pathosis for biopsy; and suturing.

The patient's health history (see enclosed copy) indicates medical problems that may influence the management of this case.

You have been identified as the attending physician. Would you please contact our office by phone, fax, or mail with recommendations regarding the nature of this patient's medical problems relative to their dental needs? We are specifically interested in your advice on the following:

- a) Proceeding, delaying, or canceling the surgery
- b) Altering a medication regimen currently being followed (see medical history)
- c) Prophylactic measures with regard to administering

J local anesthetics; we normally use lidocaine with 1:100,000 epinephrine or 1:50,000 epinephrine.

J sedatives; we normally offer the patient 5 to 10 mg Valium, or in combination with 60 to 80 mg Nembutal at the time of surgery.

J antibiotics; we normally prescribe V Cillin K or Erythromycin, 1000 mg stat and 500 mg every 6 hours for 3 to 10 days.

J analgesics; we normally prescribe ibuprofen 400 to 800 mg every 4 to 6 hours for a period of 3 days.
other

Your comments and suggestions would be greatly valued. Due to the patient's immediate need for the procedure, we would appreciate your response as soon as possible. Thank you for your cooperation.

Sincerely,

Medical Considerations

Objective

To recognize, compensate for, or avoid prohibitive medical conditions.

Note

The medical condition and history of every candidate for endodontic surgery must be thoroughly investigated and evaluated. Although many conditions require caution, the gravity of some may totally eliminate dental surgery from a treatment plan.

Major Risk Conditions

Patients presenting with the following medical problems should have treatment postponed until the condition has been compensated for, has improved, is under control, or has been corrected, *and* until the dentist has been given a *written release* by the patient's attending physician (see Lesson 2).

Severe hypertension. The danger of this condition lies in the possibility of sudden stroke, cardiovascular crisis, or uncontrollable hemorrhage during treatment.

Myocardial infarct. Here, there is a danger of stress-related relapse, coagulant antagonisms, or hemorrhage during the procedure.

Cardiac insufficiencies. A statement prepared by an ad hoc writing group appointed by the American Heart Association (AHA) with liaison members states: "To reduce the risk of bacterial endocarditis the guidelines, summarized by the ADA Division of Science, call for the dentist/attending physician to administer antibiotics to heart patients before they undergo endodontic instrumentation or surgery beyond the apex. Bacterial endocarditis, a rare but potentially fatal infection, causes inflammation of the heart's valves or inner lining, and can lead to irreversible damage" (JAMA 1997). These guidelines are meant to aid practitioners, but are not intended as standards of care or as a substitute for clinical judgment.

The AHA recommends endocarditis prophylaxis for patients with the following conditions (high-risk category):

- Prosthetic cardiac valves, including bioprosthetic and homograft valves
- A history of bacterial endocarditis
- Complex cyanotic congenital heart disease (eg, single ventricle states, transposition of the great arteries, tetralogy of Fallot)
- Surgically constructed systemic pulmonary shunts or conduits

Endocarditis prophylaxis is also recommended for moderate-risk patients with the following conditions:

- Most congenital cardiac malformations other than those listed for high- and negligible-risk patients
- Acquired valvar dysfunction (eg, rheumatic heart disease)
- Mitral valve prolapse with valvar regurgitation and/or thickened leaflets

The AHA does not recommend endocarditis prophylaxis for patients in the negligible-risk category (those who present no greater risk than the general population). The following conditions are included in this category:

- Isolated secundum atrial septal defect
- Surgical repair of an atrial septal defect, a ventricular septal defect, or a patent ductus arteriosus (without residua beyond 6 months)
- Previous coronary artery bypass graft surgery
- Mitral valve prolapse without valvar regurgitation

- Physiologic, functional, or innocent heart murmurs
- Previous Kawasaki syndrome without valvar dysfunction
- Previous rheumatic fever without valvar dysfunction
- A cardiac pacemaker (intravascular or epicardial) or an implanted defibrillator

Bleeding disorders. Leukemia, neutropenia, and leukopenia may require hospitalization of the patient. Anticoagulants should be discontinued only by the patient's attending physician.

Osteoradionecrosis. The loss of vascularity inhibits a normal inflammatory response, which in turn impairs healing.

Uncontrolled diabetes. This condition increases susceptibility to infection and delays healing.

Prosthetic. An expert panel convened by the American Dental Association (ADA) and the American Academy of Orthopedic Surgeons (AAOS) performed a thorough review to determine the need for antibiotic prophylaxis to prevent hematogenous prosthetic joint infections in dental patients who have undergone total joint arthroplasties. The panel's conclusion was that antibiotic prophylaxis is not indicated for dental patients with pins, plates, and screws, nor is it routinely indicated for most dental patients with total joint replacements. However, it is advisable to consider premedication in a small number of patients who may be at increased risk of hematogenous total joint infection (JADA 1997). Such patients include those with the following conditions:

- Inflammatory arthropathies (eg, rheumatoid arthritis, systemic lupus erythematosus)
- Disease-, drug-, or radiation-induced immunosuppression
- Insulin-dependent (Type I) diabetes
- A history of prior prosthetic joint infections
- Malnourishment
- Hemophilia

Practitioners must exercise their own clinical judgment in determining whether or not antibiotic prophylaxis is appropriate. Suggested antibiotic prophylaxis regimens are the same as for bacterial endocarditis prevention (Table 3-1).

Table 3-1 Suggested Antibiotic Prophylaxis Regimens

Situation	Agent	Regimen
Standard general prophylaxis	Amoxicillin	Adults: 2.0 g Children: 50 mg/kg PO 1 hour before procedure
Unable to take medications orally	Ampicillin ^t	Adults: 2.0 g Children: 50 mg/kg IM or IV within 30 minutes before procedure
Allergic to penicillin	Clindamycin	Adults: 600 mg Children: 20 mg/kg PO 1 hour before procedure
	or	
	Cephalexin ^t cefadroxil ^t	Adults: 2.0 g Children: 50 mg/kg PO 1 hour before procedure
	or	
	Azithromycin or clarithromycin	Adults: 500 mg Children: 15 mg/kg PO 1 hour before procedure
Allergic to penicillin and unable to take medications orally	Clindamycin	Adults: 600 mg Children: 20 mg/kg IV within 30 minutes before procedure
	or	
	Cefazolin	Adults: 1.0 g Children: 25 mg/kg IM or IV within 30 minutes before procedure

PO = orally; IM = intramuscularly; IV = intravenously

* Total children's dose should not exceed adult dose.

^t Prophylactic regimens for dental, oral, respiratory tract, or esophageal procedures (no follow-up dose recommended).

^t Cephalosporins should not be used in individuals with immediate-type hypersensitivity reaction (urticaria, angioedema, or anaphylaxis) to penicillin.

Minor Risk Conditions

Caution should be used when treating patients presenting with the following medical conditions. Although treatment does not need to be postponed for any of these conditions, it is wise for the dentist to advise the attending physician of the treatment regimen.

Neurologic conditions. Convulsive or emotionally disturbed patients are best served by preoperatively prescribing appropriate hypnotics, sedatives, or analgesics (see Lesson 11).

Respiratory conditions. Procedures can sometimes induce anoxia in patients with respiratory problems. Patients with asthma or emphysema should be sedated and their airways kept open at all times. For patients who have lost a lung or have severe emphysema, oxygen should be administered throughout the procedure.

Cardiovascular conditions. Caution must be exercised in treating patients with mitral valve damage, prolapse, stenosis, pulmonary heart disease, and bypass experience. Appropriate prophylactic antibiotics and sedatives should be administered preoperatively, and the patient's blood pressure and pulse rate should be monitored throughout the procedure.

Endocrine imbalances. The attending physician should be consulted and appropriate sedatives administered preoperatively (see Lesson 11).

Pregnancy. When treating a pregnant patient, the attending physician should be consulted, operations performed only during midtrimester, sedatives avoided, and the quantity of anesthetic vasoconstrictor minimized.

Hemophilia. Treatment of a patient with this condition requires a physician consultation and a physician's release, a factor replacement, and possible hospitalization.

Immunologic disorders. These disorders require consultation with the attending physician and an appropriate antibiotic regimen (see Lessons 11 and 31).

Infectious diseases. Treatment of patients with infectious diseases requires a physician consultation, barrier control, and appropriate prophylactic antibiotics. All office personnel should be inoculated with the hepatitis B vaccine (see Lesson 10).

Situations Requiring Professional Judgment

Unnecessary teeth. No tooth should be treated when treatment offers no benefit to the patient.

Nonrestorable teeth. Although surgery may improve the pulpal and periradicular condition, treatment is unwarranted if the tooth cannot be appropriately restored to function.

Periodontal conditions. The level of bone support must be determined and evaluated for adequacy. The prognosis and risk factors must be thoroughly explained to the patient, and a consent form should be signed and witnessed (see Fig 7-1, Lesson 7).

Uncooperative or unwilling patient. If dental personnel are unable to deal with the patient physically and emotionally throughout the treatment procedure, or if a patient questions the dentist's judgment and refuses to accept reasonable explanations that support the treatment decisions, the quality of care is at risk; therefore, it is best to suggest a second opinion. Unless the situation at hand demands emergency care, one always has the right to refuse to treat. However, to avoid litigation for abandonment, it is best to refer the patient and have an assistant witness the discussion and the referral process. A detailed recording of the conversation, explanation, and transaction must be entered in the patient's chart.

Inadequate surgical skill and/or experience. When a lack of knowledge, skill, and/or confidence to manage the presenting condition, neurovascular emergencies, and postoperative sequelae invites unnecessary risk, the patient must be offered all reasonable treatment options as well as a referral.

A Legal Perspective on Antibiotic Prophylaxis

Question. The patient brings a recommendation for premedication from his or her physician with which the dentist disagrees. Should the dentist ignore the recommendation or simply defer to the physician's judgment?

Answer. "Neither approach is prudent," says Kathleen M. Todd, JD, Associate General Counsel, Division of Legal Affairs, American Dental Association. The courts recognize that each professional is entitled to and responsible for his or her own treatment decisions. Assuming that both recommendations for treatment are based on sound principles, the answer lies with patients and

their right to make decisions regarding their own welfare.

The answer for the dentist lies with the concept of informed consent. However, for informed consent to be legally binding it is incumbent on the practitioner to inform the patient of all reasonable treatment options and the risks and benefits of each. Of particular importance would be an explanation of how and why the recommendations differ. All discussions with the patient and the patient's physician should be well documented. If the dentist is uncomfortable with the situation, or the patient requests that he or she follow the physician's advice, the dentist is under no obligation to render a treatment that is not deemed to be in the patient's best interest. In such circumstances, Todd states that referral to another practitioner may be the only solution.

Clinical Considerations

Objective

To minimize procedural and healing complications by evaluating the soft tissues, bone topography, periodontium, and teeth involved in and adjacent to the surgical area.

Instruments and Materials

#5 Mouth mirror and #1 mirror handle

#DG16 Endodontic Explorer (EIE Analytic Technology)

#23/UNC15 Expro periodontal probe

Pulp tester: models 2008 or 8003 (EIE Analytic Technology)

Ice pencil (frozen H₂O capsule)

Fiber-optic instrument cable system

Tooth Slooth fracture detector

Examination

Dentition

The tooth or teeth involved and those adjacent are explored for caries and restorative deficiencies. The pulp is tested for vitality, percussed, and subjected to a fiber-optic light source to detect obscure cracks.

Periodontium

All teeth within the involved area are probed for pockets, and the depths are recorded. Based on the findings, a treatment plan combining a periodontal curettage with the endodontic surgery may need to be discussed.

Soft tissues

Gingiva. The *marginal gingiva* is evaluated and its tissue integrity recorded, that is, soft, firm, color (pink, red, blue, black, or white), receded, swelled, clefted, inflamed (bleeds readily to touch). Because the level of the marginal gingiva will be in peril once the sulcular incisions are made, the patient should be informed of this risk during the presentation. When the gingiva is obviously unhealthy, surgery should be postponed until the patient has undergone a prophylactic scaling. The patient must be informed of the importance of good oral hygiene during the postsurgical period.

The *attached gingiva* is evaluated for color, texture, and vertical dimension.

Muscles and frenums. The size, location, texture, and extent of attachments are noted. Particular attention is given to their vertical dimensions. The nasal spine is palpated to determine its contour and sharpness. A delicate elevation will be required to avoid tearing the thin tissue covering a razor edge spine (see Lesson 15).

Mucosal tissue. The tissue covering bone prominences (eminences) and protuberances (exostoses) is extremely thin and often void of underlying connective tissue. Tissue that easily blanches when finger compressed tears readily, is virtually impossible to suture, and heals by scarring. All effort should be made to avoid incising these fragile tissues. Placing the terminating incision(s) in thickened mucosal areas between roots usually solves the problem (see Lesson 14).

Fistulas or sinus tracts. Long-term drains epithelialize and scar, and the mucosal tissue integrity changes dramatically as it becomes a continuation of the underlying granulation tissue of the lesion. Because this epithelialized tissue, when forcibly elevated, will tear, cause an unwarranted perforation that is difficult to close, threaten healing, and leave an unesthetic scar, it must be carefully man-

aged. Such lesion-mucosa communications are restrictive, but flap elevation can continue without further interruption or injury once they are dissected from each other (see Lesson 15).

Structure

The vestibule. The height and depth of the vestibule are noted. *Shallow vestibules* can be problematic because they offer little attached gingiva, create greater involvement with the highly vascular-free mucosa, restrict access to the apical depths, are difficult to elevate and fatiguing to retract, cause swelling, stimulate heavier bleeding during surgery, and increase the potential for an ecchymosis. In contrast, a *deep vestibule* improves flap choice; involves less connective tissue; is easier to incise, reflect, and manage; and offers greater visibility and operating comfort once the flap is raised. (See Lessons 15 and 20.)

The palate. The height and depth of the palate also are examined. A *deep palate* offers long vertical lateral walls and improved root access. A *shallow palate* not only presents visibility, incision, and elevation difficulties, but palatal root access is further complicated by the proximity of the apices to the greater palatine vessels. A major concern with any palatal flap is its reapproximation and reattachment following surgery. The pooling of blood between the flap tissue and the bone may cause a gravitational sag with ischemia and slough the sequela. Although it is more necessary when dealing with a shallow palate, the need for a stent should always be considered, regardless of the palate architecture.

Size of the oral cavity. The size, shape, and ability of the patient to open his or her mouth will influence not only the operator's view of the surgical site, but also the selection and use of surgical instruments.

Skeletal structures. The prominence of the chin and mandibular buccal plate may present density, depth, and angulation difficulties. An extended width of the external oblique ridge, when combined with lingual molar apices, will further complicate visibility and instrument access. Such problems can be solved only by altering bone and root structure. Alternatives such as referral or extract/replant should be taken into consideration.

Radiographic Considerations

Objective

To determine the length, position, and location of a tooth, the dimensions of an existing pathosis, the location of a foreign body, and the proximity of the root apex(es) to major anatomical structures by taking at least two periapical radiographs, from different horizontal angles, and/or a Panorex.

Instruments and Equipment

- Standard linear radiographic unit
- Panorex, or its equivalent
- Radiovisiography (Trophy)
- Digital radiography (Schick Technology)

Interpretation of Radiographic Information

Short roots

Short roots afford easy access, require intrasulcular flap design, and will probably not involve major structures. To preserve an appropriate crown-root ratio, root reduction must be conservative.

Long roots

Long roots offer a choice of flap designs and require extensive tissue elevation. Maxillary teeth may demand the areas of infiltration (Division II and/or infraorbital blocks) be expanded. During surgery, the maxillary sinus, nasal cavity, mental bundle, mandibular canal, and anterior and posterior palatine vessels may be encountered, presenting the possibility of heavy hemorrhaging and poor visibility. Postsurgical sequelae may include extensive swelling, ecchymosis, paresthesia, and anesthesia.

Presence and size of lesions

The absence of a lesion offers a greater choice of flap design. Because the point of entry in bone to gain access to the apex is not obvious, it must be approximated using a previous endodontically measured canal length, the radiograph, or the average standard anatomic length for the particular tooth. When the surgeon is unable to locate an apex, a small piece of sterilized lead foil from a radiographic package or a small segment of a sterile gutta-percha point may be placed in a sample superficial hole cut in the bone where access is estimated (see Lesson 17).

When a lesion does exist, it is important to recognize its size is always greater than its radiographic image. Digital enhancement (zooming) greatly improves the chances of determining the true limits of the pathologic destruction. Periodontal sulcus-lesion communication, although often radiographically apparent, is better determined by probing. Extensive lesions may require intraosseous, Division II, or infraorbital injections to reach a workable level of anesthesia. Hemorrhage may be heavy, granulation tissue may be difficult to curette, and a biopsy is mandatory (see Lesson 19). Caution: Any tissue that warrants removal also warrants diagnosis.

Maxillary sinus

When performing surgery on posterior maxillary roots, perforation of the sinus membrane must always be considered a potential risk. The perforation in and of itself is not a problem; the danger lies with gutta-percha, root segments, tissue remnants, reverse fill materials, and so on, being

pushed into the sinus cavity and causing a foreign body reaction. To prevent such an incident, high-speed evacuation must accompany the root resection and the curettage at all times, but direct aspiration of the sinus should be avoided. If an object does enter the sinus cavity, it should be retrieved through the perforation with tissue forceps. Whenever an aspirator is used to clear the depths of the sinus, pain can be expected and the patient should be forewarned prior to entry. If the particle cannot be retrieved, the patient is informed of the problem and a Caldwell-Luc procedure is initiated, or the site is closed and the patient is referred to an oral surgeon or otolaryngologist.

If no complications other than a perforation are faced, the root(s) approximating the mucus membrane lining is reduced in length and, under normal conditions, a new tissue lining should form against the established periradicular clot. The patient should be instructed to avoid all activities that might cause sinus pressure changes (eg, blowing of the nose, sneezing with the mouth closed, changes in airplane cabin pressure).

Mandibular canal

The mandibular vessels enter the mandible lingual to the ramus. Once in bone, they travel anteriorly and buccally to eventually exit at the mental foramen. To best follow the course of the canal, a Panorex radiograph or multiple periapical radiographs should be taken prior to the surgery. The bone entombing the canal, though dense, can be penetrated easily and unknowingly with high-speed burs. Slowly rotating a surgical round bur in a slow-speed handpiece provides a safety factor and lets the operator develop a feel for the difference in bur resistance when cutting cancellous bone from that of cutting compact bone. Magnification loupes and a surgical microscope enhance visibility, making this distinction even more likely.

Although a nicked or severed nerve may reapproximate and reinnervate, temporary to permanent paresthesia or anesthesia is most probable when a gross separation has occurred. Severance of the artery presents immediate and extensive bleeding, and the subsequent visibility impairment makes localizing and controlling the vessel even more difficult. When confronted with arterial

bleeding, the surgeon should instantaneously apply and maintain direct pressure to the hemorrhaging vessel (see Lesson 23).

Note: It is better to locate these nerves and vessels intentionally *before* surgery and be constantly aware of where they are during the procedure than to find or injure them inadvertently.

Mental bundle

Multiple radiographs and/or a panorex will orient the operator to the mental canal. Its location dictates how and where to incise and reflect the flap. Once the bundle is exposed, it should be kept visible throughout the surgery. Bundle manipulation may leave the patient with minor tingling, but it is extremely rare for this sensation to be long lasting. Complete separation causes extensive bleeding, and the elasticity of the nerve may prevent its reapproximation, leaving the chin and/or lip permanently anesthetized. This injury demands immediate attention. The patient must be referred to an oral surgeon for neural-fiber reattachment.

Exostosis

Bony tori affect the location of flap incisions and, because they tear easily, they tend to complicate elevation, retraction, and suturing (see Lessons 14 and 15). To facilitate treatment and flap closure, these labial or lingual prominences should be ground smooth with round or fissure burs.

Buccal oblique ridge

The width and density of the bone buccal to the mandibular molars makes trephination laborious, requires extensive bone removal to gain access to root apices, and hampers visibility. Lip and cheek retraction is traumatic and uncomfortable for the patient, and postsurgical swelling and pain is often extensive. The alternative treatment of extraction and replantation should be considered for extreme cases (see Lesson 42).

Case Presentation

Objective

To provide the patient with all necessary information regarding his or her specific dental needs in clear, precise, and understandable language.

Background Information

The American Association of Endodontists has published brochures and posters that are designed to assist patients in understanding conventional and surgical endodontic therapy. The pamphlets answer the most frequently asked questions about treatment procedures, problems, and prognosis (800-USA-ENDO). Additional aids such as models, drawings, slides, and instructional tapes are also commercially available.

Technique

Although most consultations are made at chair-side, a case presentation in a well-lit, comfortable office atmosphere may encourage the patient to focus attention on the discussion and not be distracted or intimidated by "clinical" surroundings.

Sufficient diagnostic information should have been gathered during the examination to answer all questions and respond to any objections.

Although the presentation should explain the scientific aspects of the surgery, it is better to focus the conversation on the reasons, features, and benefits of the proposed treatment.

Personalizing the treatment plan by sketching the patient's tooth on paper and diagrammatically tracing his or her individual problems, risks, and solutions gives the patient a visual reference to privately refer to while pondering a decision. Figure 6-1 shows a sample follow-up letter and cost estimate sheet that can be given to patients after the consultation to reinforce the information they have been given.

Problems

1. Presenting too much material
2. Using language that is too scientific
- g. Speaking too quickly
4. Exhibiting a lack of empathy toward the patient's problem, apprehension, fear, or economic situation
5. Intimidating the patient

Fig 6-1 Sample Follow-up Letter and Cost Estimate for Treatment

Concerning Your Treatment

M

Thank you for your kind attention during the consultation. The staff and I hope you enjoy our office. We have prepared this material so that you may have a tangible reference when you return home. It may help you explain our services to someone else. I think you will find your visits with us pleasant. You have made a wise decision to save your tooth.

Root canal therapy is a specialized dental procedure designed to retain a tooth safely and comfortably. **There is no doubt that a functioning, endodontically treated, and well-restored tooth is vastly superior to the best replacement available.** It is financially more advantageous to retain the tooth than to have it extracted and a replacement made. *If extracted and not replaced, there is the disadvantage of reduced chewing ability and loss of cosmetic appearance. Also, due to the increased load bridged teeth must support, the health of other teeth is in jeopardy. Left untreated, the damaged pulp becomes a breeding ground for bacteria, ultimately leading to abscess formation.*

When is a root canal needed? *Removal of the pulp is necessary when tissues inside the tooth become diseased.* This occurs from fracture, decay, faulty bite, or just because a tooth has had a number of fillings. When the infected pulp tissue is removed and the root canals are sterilized, healing may take place.

In order to sterilize the inside of the tooth, conventionally we will make a small opening in the top of the tooth. This will enable us to clean and shape the inside. A rubber dam is used to keep the area clean, dry, and sterile. The length of treatment will depend on the amount of pulpal damage, and the difficulty encountered in eliminating the bacteria. However, work can usually be completed in one to four appointments.

Discomfort in our office is rare. The staff and I do not believe in pain; in fact, we are allergic to it! We will do everything possible to return your tooth to a comfortable state. Because of the condition of the tooth involved and the fact that we are dealing with bacteria most of the time, it may/will be necessary at times to call on additional anesthetics, medications, and antibiotics to bring the tooth and the infection under control.

This is not a "dead tooth." As long as the root is embedded in healthy surrounding tissue that gives it a blood and nerve supply and the crown is properly restored to function, the tooth can be retained as long as any other.

How successful is endodontic therapy? A study was undertaken at the University of Washington School of Dentistry to evaluate treated endodontic cases and to determine their rate of success. Nearly 95% of all treated teeth were treated successfully.

However, the success of any endodontic treatment depends on the health of the patient and the ability of the body to repair the damage. In a small percentage of cases, endodontic surgery is necessary to rid the body of infection and create an environment that will help the healing process.

By electing to have root canal therapy as opposed to an extraction, you have made a wise and valuable lifetime dental health decision. *Upon completion of the treatment, we strongly recommend a permanent restoration (generally a crown) be made to protect the tooth from further damage. We will continue to examine the tooth and follow healing after the restoration has been completed.*

If you have any questions regarding the treatment, please call us anytime. We enjoy our patients and believe in a mutual understanding.

(Continued)

Fig 6-1 Sample Follow-up Letter and Cost Estimate for Treatment /Continued/

CONSULTATION:

Diagnosis:

Exam:

Medical and Dental History:

X-Rays:

EMERGENCY SERVICE:

CONVENTIONAL ENDODONTIC TREATMENT:

OBSERVATIONS:

SURGICAL PROCEDURE (when necessary):

MEDICATION (when necessary):

OCCLUSAL ADJUSTMENT.

ANESTHETIC:

TEMPORARY RESTORATION:

BIOPSY (when necessary):

TOTAL FEE:

(Patient's Signature)

(Date)

Repeated cancellations of assigned appointments or failure to keep confirmed appointments may entail additional charges.

Dentist / Surgeon:

Street Address:

City, State, and Zip Code:

Phone:

Practice Limited to Endodontics

Patient Consent

Objective

To document the understanding and acceptance or rejection of the treatment recommendations, nature of the treatment, and reasonable alternatives, by using a form signed by the patient or guardian and witnessed. This form becomes part of the patient's permanent record.

Note

A dentist is required to inform a patient of the difficulties that may be encountered during or after treatment. The patient must also be advised of the consequences of foregoing treatment. A signed consent form (Fig 7-1) should indicate that the dentist and the patient have agreed to a specific treatment plan. If any later changes in the treatment are suggested or proposed, they also must be discussed and added to the document, along with the date and the patient's and dentist's signatures. This is the law.

Responsibilities

- The dentist is responsible to know the dentist's personal experience with a particular technique and/or instrument.
- Failure to get the patient's written approval for treatment is inexcusable.
- Permission must be received from the patient before any records, radiographs, or photos can be used in publications or presentations.
- Regardless of the existence of a well-conceived and signed surgery consent form, the patient is protected by law when the dentist fails to follow sound dental practice dictates and causes the patient to experience avoidable and unreasonable risks associated with the treatment.

Fig 7-1 Sample Patient Consent Form

Informed Consent for Surgical Procedures

Name:

Date:

Time:

- 1) I hereby request and authorize Dr. _____, aided by any assistants he/she may designate, to perform/assist surgery on tooth # _____ or about the _____ day of _____ 19____ for the purpose of attempting to improve the following conditions: _____

- 2) I also authorize the operating surgeon to perform any other procedure(s) deemed necessary or desirable in attempting to improve the condition(s) stated in paragraph 1, or to improve on any unhealthy or unforeseen condition that may be encountered during the operation.

- 3) I consent to the administration of anesthetics as applied by or under the direction of Dr. _____ and to the use of such anesthetics and medications as deemed advisable in my case.

- 4) I have been advised that part of this surgery is (may be) performed through external incisions in the mucosa (gum), which could leave permanent scars the extent and location of which have been described and demonstrated to me. I have been advised that scars could take one year or more to mature, the changes ordinarily occurring in their appearance having already been described to me.

- 5) I have been told that a medical grade implant will (may) be used in the above-mentioned operation and have been advised of the possible risks as well as alternative methods of treatment.

- 6) I have been informed that the operation described may require implantation (transplantation, replantation) of _____ from other areas of my body or from other persons.

- 7) I understand that if Dr. _____ judges that my surgery should be postponed or canceled at any time or for any reason he/she may do so.

- 8) I hereby state that the information furnished to Dr. _____ during my comprehensive preoperative evaluation is correct.

- 9) I agree to follow the instructions given to me by Dr. _____ to the best of my ability before, during, and after the above-named surgical procedure and notify the surgeon as soon as possible of any questionable conditions that may arise.

(Continued)

Fig 7-1 Sample Patient Consent Form /Continued/

10) Dr. _____ has fully explained all of the pertinent information regarding my proposed treatment, and I understand. Dr. _____ has fully explained, in terms clear to me, the effect and nature of the operation(s) to be performed, foreseeable risks involved, and alternative methods of treatment.

11) I know that the practice of dentistry is not an exact science and therefore reputable dentists cannot guarantee results. I acknowledge that no guarantee or assurance has been made by anyone regarding the operation I have herein authorized. In this connection, I have been advised that the goal of the operation is improvement in appearance and/or function, that there is a possibility that imperfections might ensue, and that the results might not live up to my expectations or the goals that have been established.

12) I hereby give permission to Dr. _____, or any assistant he may designate, to take photographs for diagnostic purposes and to enhance the dental record. I agree that these photographs will remain his/her property. I further authorize him/her to use such photographs for teaching purposes or to illustrate scientific papers, books, or lectures if, in his/her judgment, dental research, education, or science will benefit by their use.

13) I have been given an opportunity to ask any questions I desire regarding the matters covered in the preceding paragraphs, and these questions have been answered to my satisfaction.

14) I assume all financial responsibilities for the proposed treatment.

Date:

Signature:

Patient, or person authorized to give consent for the patient.

If other than the patient, please state relationship:

Witness:

Not a member of the patient's family.

PART II

Preparation for Surgery

Operatory and Surgical Equipment Preparation

Objective

To produce an aseptic environment for surgery in which the operating room facilities and instruments meet highly demanding universal infection control criteria as established by state and federal regulations.

Note

Through the years, there has been considerable controversy regarding the readiness of an operatory prior to dental surgery. Some maintain the preparatory conditions for nonsurgical and surgical procedures should be the same. Others maintain that surgery is invasive; therefore, the operatory and everything connected with surgery should be governed by more stringent disinfecting and sterilizing criteria.

In recent years, this point has become moot. As the fear of AIDS, hepatitis B, and other bloodborne diseases has increased, so has recognition and awareness of the need for protection. Physicians, dentists, and other health care workers alike realize the risk of exposure. In response to this reality and to the Occupational Safety and Health Administration's (OSHA's) enforcement of infection control rules and regulations, there is an intense interest in meeting protective standards.

Patients also have become more cognizant of the problem and their susceptibility to the cross spread of AIDS, hepatitis, and other infectious diseases. The more meticulous a dentist is perceived to be about infection control and the more assurance he or she offers

patients about their welfare, the more confidence they will have in that dentist's ability. To ease patients' fears, it is suggested that the dentist discuss these issues with them during the case presentation.

Instruments and Materials

- Antimicrobial soaps
- Nitrile rubber gloves
- Scrub brushes
- Protective eyewear
- Disinfectant, bleach, etc
- Ultrasonic cleansing units
- Surface barriers
- Plastic identification wrapping or bags
- Clear plastic sleeves, bags
- Moist-heat sterilizer
- Dry-heat sterilizer
- Vapor sterilizer
- Sharps container

Sterilization Techniques

Operatory and equipment

It is virtually impossible to sterilize all operatory surfaces, equipment, and materials. Therefore, dentists must rely on a two-step process of cleaning and surface disinfecting as the first level of microbial defense. The ideal agent should be fast acting, broad spectrum, nontoxic, noncorrosive, easy to use, nondisintegrating, odorless, and cost effective, and have no residual effect. Because few products meet these criteria, a critical selective process must be used to assess the merits and practicality of a product with regard to its use (ie, manufacturer's recommendations, and whether it is an approved EPA-registered hospital-level tuberculocidal disinfectant agent).

Disinfectants. *Alcohols* are protein denaturants and lipid solvents that exhibit bactericidal effectiveness, but their rapid evaporation limits their action. Contrary to belief, alcohols are not regarded by the ADA as acceptable surface or instrument decontamination agents.

Anionic soaps and detergents contain alkyl and/or aryl sulfates or sulfonates, which are responsible for their side effects. They are really only effective when accompanied by vigorous scrubbing.

Quaternary ammonium preparations affect microbial cell membranes and can be highly effective germicides even in low concentrations.

Iodine is a highly effective halogen germicide but is caustic and stains clothing and equipment. The newest generation of iodophors is far less irritating or damaging to skin and clothing.

Chlorine has always been recognized as a potent germicide and still remains the most efficient agent when in its hypochlorite state (bleach). It is EPA registered, ADA approved, and strongly recommended for general use despite its destructive effects on cloth and plastic.

Glutaraldehydes, although more effective as immersion agents, currently enjoy EPA approval as hospital-surface disinfectants, when used in 0.25% to 0.50% concentrations. Glutaraldehydes have a wide antimicrobial range, are easy to use, and are relatively inexpensive. Although not damaging to rubber or plastic, they are extremely deleterious to metal.

Regardless of the agent chosen, all are caustic. Nitrile rubber gloves and protective eyewear *must* be worn when instruments and apparatus are scrubbed.

Barriers. A fast, efficient, safe, though more expensive method of maintaining a scrupulously clean and disinfected operatory is to cover in plastic all surfaces, items, and equipment that may come in contact with blood, saliva, or hands. Plastic disposable sleeves, bags, and wrappings can be discarded and quickly replaced between patients. As a result, the time-consuming scrubbing and chemical decontamination demands are met before or after working hours and not between patients at the expense of productive time.

Instruments

"Although there are agents that are effective as sterilants/disinfectants, they are not acceptable substitutes for heat sterilization," according to Cottone et al (1995). They further state that "sterilization of instruments by immersion in glutaraldehyde solutions can be useful in certain conditions, but its effectiveness is relative to its shelf life, use life, and reuse life. Its simplicity invites abuse."

Sterilizer. To truly and effectively remove all forms of microorganisms, regardless of their status, moist heat (250°F under 15 pounds of pressure for 15 to 20 minutes) or dry heat (350°F for 1 to 2 hours) are the two most practical methods. Technology is improving rapidly and some manufacturers (eg, STAT IM and COX Rapid Heat Transfer) offer sterilizing units with 6-minute, "between-patient" cycles.

Before they are placed in the unit, all instruments should be scrubbed, rinsed, ultrasonically treated, placed in indicator wrapping or plastic bags, and arranged evenly on the sterilizing tray to avoid overloading. The sterilizing unit itself should be monitored periodically with spore strips to determine its efficiency.

The weakest link in the asepsis chain is the dental handpiece. Presently, the external surfaces of high- and low-speed handpieces are sterilizable, but the internal components remain questionable. Major manufacturers are aware of this deficiency and are developing handpieces that are totally sterilizable by autoclave or dry heat without causing damage or decreasing their use life (see Lesson 12). Because no sterilization assurance can be given with the currently available handpieces, the available choices are to phase out nonautoclavable handpieces and use disposable ones (considering the expense a cost of doing business without risk) or to admit to awareness of the situation and use every available means of eliminating the presence of microbes.

Ethylene oxide. This is presently the surest and most effective alternative sterilizing method for all instruments, including handpieces, but it is also the most impractical for a dental office practice. Pure ethylene oxide is toxic and allergenic and forms explosive mixtures with air. Although stabilized in some units with carbon dioxide, the materials must be sterilized in special containers. The equipment

is large and expensive; sterilization takes as long as 24 hours and residual gas can cause burns.

Waste management policies

Regulated waste. Sharps are classified as regulated waste and can be defined as anything that can puncture the skin. Therefore, this category includes needles, scalpel blades, pointed or sharp instruments, burs, files, anesthetic carpules, and wire.

1. Sharps should be disposed of in designated sharps containers located at each dental unit, central service area, and all other areas of the office where they may be used or found. Needles or files should not be bent or broken before disposal.
2. Broken glass is picked up with forceps or tongs and placed in a sharps container.
3. Sharps containers should be filled to the three-quarters mark, and delivered or mailed to an authorized sharps disposal company or service.

Nonsharp regulated waste. Nonsharp waste is that which is dripping wet and/or caked with blood or saliva.

1. Nonsharp waste is placed in an autoclavable biohazard bag. A second biohazard bag is used if the outside of the primary bag has been punctured or contaminated.
2. Biohazard bags are processed through a steam sterilizer, labeled, and disposed of in the same manner as sharps.
3. An extracted tooth, although a nonsharp waste, can be placed in a sharps container for disposal.

Human liquid, blood, or saliva. All protective barriers (gloves, mask, gown, and eyewear) are worn when handling or disposing of liquid body fluids.

1. Liquid body fluids are disposed of by pouring them down the drain with running water. Care must be taken to avoid splashing.
2. Linens and other laundry contaminated with blood or saliva are handled as little as possible and disposed of in an appropriately marked biohazard bag. The laundry can be washed at the facility or through a cleaning service that processes biohazardous materials. Gowns and hats should be used and thrown away with other disposable items, such as gloves.

■ Training

Hepatitis B vaccination. Within 10 days of employment, employees should be given training about the hepatitis B vaccine, given an opportunity to ask questions, and offered the vaccination series free of charge. The training should include information on the vaccine's efficiency, safety, method of administration, and benefits.

Bloodborne pathogens. New employees should also be provided with specific written information including, but not limited to, the OSHA Bloodborne Pathogens Standards.

Note: For specific regulations pertaining to individual practice, readers should contact the department of health's dental division in the state(s) in which they are licensed.

Preparation of the Patient

Objective

To increase the patient's comfort during surgery and to control the introduction of contaminants to the operating room by including the patient in the aseptic process.

Materials and Equipment

Surgical gowns (drapes)
Surgical head dress
Surgical toweling
Towelettes (gauze)
Mouth rinse (Peridex, Listerine)
Protective eyewear

Technique

1. Prior to the surgical appointment, the patient should be instructed to wear loose-fitting, nonbulky clothing to the office the day of the surgery.
2. All tight-fitting clothing, particularly on the wrist or neck, should be loosened or removed.

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3. A sterile, nonabsorbent surgical gown should be offered to the patient. If refused, the patient is seated and a three-quarter to full-length, sterile, nonabsorbent drape is loosely placed over his or her chest, legs, arms, and hands. Although the drape should be secured in place with snaps or pins, the patient's movements, particularly around the neck, should remain unrestricted.
4. The patient's head is covered with a surgical cap. If his or her hairstyle prevents the use of a cap, a sterile towel is wrapped around the head and securely pinned in place.
5. Prior to the appointment, the patient should be instructed not to wear makeup on the day of the surgery. Regardless of conformity to this instruction, the patient's face is scrubbed with 4 x 4-inch gauze squares, presoaked with a nonallergenic disinfecting solution or soap.

Towelettes are excellent substitutions. A special effort is made to cleanse the area around the mouth and lips. Mustaches and beards are cleansed with alcohol-soaked gauze squares. The face is dried with soft sterile towels.
6. The patient's eyes should be protected from spray by specially designed eyewear. These gogglelike glasses block access on the sides. Polaroid or plain dark-colored lenses mask out the brilliance of overhead lights and headlamps. Moistened 2 x 2-inch squares placed on the eyes beneath the glasses eliminate all light source and the temporary blindness tends to reduce the apprehension patients may feel at watching operating room proceedings. In addition to their use as infection control barriers, drapes, gowns, and eyeglasses prevent liabilities such as blood-stained clothing, saline spray in the eyes, and so on.
7. As a final precaution, a sterile towel is placed across the patient's chest to catch gauze and any instruments and materials that may be inadvertently dropped during the procedure.
8. Tooth Preparation: Due to the presence of accessory canals, the surgical prognosis can be improved dramatically by thoroughly instrumenting and thermoplastically obturating unfilled canals to whatever level possible. Canals already endodontically treated should, whenever possible, be reinstrumented and refilled prior to surgery.

Preparation of Surgeon and Surgical Assistant

Objective

To evaluate task and type of exposure expected. Once determined, the dentist selects and provides (at no cost to the employee) hepatitis B immunization and appropriate personal protective equipment, such as gloves, gowns, scrubs, laboratory coats, face shields, eye protection, mouthpieces, resuscitation bags, pocket masks, and ventilation devices.

Note

Even though preparations for private-office surgical procedures cannot be expected to achieve the level of sterility of those performed in hospital operating rooms, certain hospital methods and aids can be efficiently incorporated into a private-office regimen.

Materials and Techniques

■ Presurgical scrubbing

Because bacteria tend to flourish under rubber gloves, the hands should be scrubbed diligently prior to putting on surgical gloves. If a glove were to puncture or tear inadvertently during the surgery, the bacteria from unscrubbed hands would leach out and contaminate the instruments and/or the surgical site. Short-sleeved scrubs are

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worn to provide the freedom needed for the surgeon and assistants to scrub arms and hands effectively and efficiently.

The classic scrubbing and brushing ritual should routinely include the use of disposable sterile orangewood sticks or nail files, autoclaved hand brushes, disposable sterile scrub sponges, and foot-fed antimicrobial soap dispensers and tap water pedals.

The surgeon and operating assistant should be helped into long-sleeve gowns whose cuffs, as required by the Occupational Safety and Health Administration (OSHA), are covered by gloves.

After donning surgically sterile gloves, the auxiliary operatory assistant should position or load sterile handpieces, air/water syringe tips, and anesthetic syringes and unwrap or unbag the surgical instruments. These instruments should be covered with a sterile towel until the operation begins.

Protective equipment

Appropriate equipment does not permit blood or other potentially infectious materials to pass through to the employee's clothing, skin, eyes, or mouth during normal use and for the duration of the time of exposure.

Personal protective equipment. The selection of equipment is based on the frequency and type of exposure expected. Conventional gowns, lab coats, smocks, and so on, are acceptable except in instances where exposure to blood and other body fluids is anticipated. As there is a potential for sprays and splatters to the arms during endodontic surgery, long-sleeve, fluid-resistant gowns are required. Particular attention must be given when procedures require the use of rotary equipment, ultrasonic scalers, and air/water syringes, which by their nature have the greatest potential for spray problems. It is the employer's responsibility to justify selection of attire.

Masks. Sterile filtration masks or mouth cups reduce the potential for aeration transmission from breathing.

Caps. Sterile disposable plastic or paper caps that cover the head must be large enough to eliminate hair exposure.

Eyewear. Protective and/or magnification lenses should prevent access from the sides.

Gloves. At no time should an unprotected hand come in contact with the outer surface of a heavy, well-fitting surgical glove. The glove should be stretched over the gown sleeve to prevent skin exposure.

Problems

1. Ancillary material and equipment should be handled by the sterile auxiliary operatory assistant. The surgeon or surgical assistant should not touch any instrument, material, or equipment that is not sterile.
2. If a glove puncture occurs, the procedure must stop. The surgeon should discard the instrument, remove the gloves, repeat the scrub, don fresh sterile gloves, record the puncture in a personal record and in the patient's chart, and proceed with the surgery.
3. All charts, radiographs, and so on, should be kept out of the operatory. If needed during surgery, they should be placed in a clear plastic sleeve and held by a nonsterile operatory assistant while being reviewed.
4. The employer is entirely responsible for laundry. At least three options are currently acceptable:
 - a. Disposable gowns can be used and discarded in a specially marked waste receptacle.
 - b. Surgical gowns and protective outerwear can be sent to a commercial cleaner that specializes in processing contaminated laundry.
 - c. A specially marked on-site washer and dryer can be used.

Whichever option is selected, handling of the contaminated articles should be kept to a minimum. It is clear that under the present standard, protective clothing cannot be taken home by the dentist or employees.

Patient Care Management

Objective

To address and allay the patients' fears and anxieties to gain their confidence and cooperation and to keep the surgery as free of pain and stress as possible.

Note

It is extremely important to recognize the extent of the patient's apprehension and not underestimate the degree of his or her anxiety. There can be no worse situation than to have a surgical procedure interrupted by an emotional episode, syncope, or spontaneous convulsion.

Conscious Sedation Techniques

The first step to allaying patient fears and anxieties is for the dentist to tell the patient that those fears are recognized and that he or she is sensitive to the patient's apprehension. The examination and consultation appointment should already have conveyed this attitude and reduced the psychophysiologic basis for stress. There is no better placebo than compassion.

■ Pharmacosedation analgesics

Oral ingestion of 800 mg of ibuprofen (4 Advil or 2 Motrin), 5 mg hydrocodone bitartrate and 500 mg acetaminophen (Vicodin) or 50 mg meperidine hydrochloride (Demerol) 30 to 60 minutes prior to the procedure has been shown to significantly raise the pain threshold.

■ Sedatives

Although they have a slow onset and their effectiveness is unpredictable, oral sedatives, such as the following, can be highly effective when administered the night before and/or at the time of surgery:

- Alprazolam (Xanax), 0.25 to 0.50 mg
- Lorazepam (Ativan), 2 to 4 mg
- Diazepam (Valium), 5 to 10 mg
- Oxazepam (Serax), 15 to 30 mg
- Hydroxyzine pamoate (Vistaril), 50 to 100 mg
- Triazolam (Halcion), 0.125 to 0.25 mg

If the sedative is ingested just prior to the operation, a 30- to 60-minute wait is recommended before proceeding.

■ Hypnotics

Because these drugs have no analgesic effect and are better known as sleep inducers, they may be more useful in helping patients rest after the surgery.

Barbiturates (such as Nembutal Sodium) depress the sensory cortex; decrease motor activity; and produce drowsiness, sedation, and hypnosis. In capsule form, they can be very effective as relaxants when administered in doses of 50 to 100 Mg.

Halcion (triazolam) doses of 0.125 to 0.25 mg, individualized to the patient's body weight, produce varied levels of drowsiness.

The degree of sedation with any hypnotic or sedative is unpredictable, and the recovery period may be long. Patients should be forewarned that dizziness, light-headedness, and sleepiness accompany the use of these drugs. Therefore, the patient must be escorted by an adult driver whenever hypnotics or sedatives are administered.

■ Inhalation

Nitrous oxide is rapid, effectively raises the pain threshold, produces a comfortable euphoria, and is controllable and safe for all ages. However, local anesthetics must still accompany its use.

■ Intravenous administration

Depending on the drug chosen, rapid and titratable levels of sedation are attainable with this method. In most states, administering IV sedation requires approval certification by the state examiner, and it involves the purchase and incorporation of additional technical monitoring equipment. The increased risk in the use of such equipment is reflected in elevated malpractice insurance rates. Diazepam and benzodiazepines are more effective as amnesiacs than analgesics; therefore, local anesthetic administration must still accompany their use.

■ General anesthesia

Use of general anesthesia has decreased dramatically as the concepts and agents for conscious techniques have become safer, more reliable, more effective, and less expensive.

■ Local anesthetics

When choosing an anesthetic solution for endodontic surgery, the concentration of a vasoconstrictor is most important. Particularly effective is an initial infiltration or block with 2% lidocaine (Xylocaine) with 1:100,000 epinephrine, followed by a secondary infiltration of the surgical site with 2% lidocaine (Xylocaine) with 1:50,000 epinephrine. This significantly enhances the depth and effectiveness of the anesthesia and greatly reduces local blood flow during surgery.

1. For procedures anticipated to be lengthy, the adjunctive use of 0.5% bupivacaine (Marcaine) with 1:200,000 epinephrine is recommended. Although slightly less effective than lidocaine in controlling hemorrhage, bupivacaine's long action tends to ward off the concurrent pain rebound effect. It can be delivered at any time during surgery, but because it generally provides

3 to 5 hours of controlled anesthesia and pain relief, it is very beneficial when administered just prior to releasing the patient.

2. Perhaps more important than anesthetic selection is execution. A slowly and gently administered anesthetic dramatically allays a patient's fear and apprehension, and this has a marked placebo effect.
3. Initially the injection site is heavily coated with a topical anesthetic, such as 20% benzocaine, Cetacaine, or Hurracaine. The solution or gel should remain in tissue contact for 3 to 5 minutes to produce an effective anesthesia and break the tissue surface tension. The injection target tissue is then stretched, and the needle tip is inserted gently. After penetration, a few drops of solution are deposited slowly. The stretching pressure should be released slowly during the infiltration, and the tissue allowed to relax as the needle exits.
4. After a short waiting period of 3 to 5 minutes, the series of injections are similarly repeated. Needle penetration at this time advances deeper into the tissues. Having patients open and close their mouths while the balance of the cartridge is injected slowly not only distracts them, but allows the functioning masticatory muscles to act like a bellows and force the anesthetic solution deeper into the tissues.
5. Once a working level of anesthesia has been realized, the more concentrated epinephrine solution is injected directly into the surgical site, the interdental papilla, and the tissues adjacent to the proposed incision lines.

Problems

1. If continued and nonrelievable pain occurs during the surgery, the normal infiltration or block regimen is repeated, and the target anesthesia area is expanded laterally to include the adjacent branches of the major vessels on both the labial and lingual aspects.

For maximum anesthesia in the maxilla, Division II blocks should be considered. For both the maxilla and the mandible, intraosseous cancellous injections with the Stabident System (Fairfield Dental) are often quite effective.

If all attempts to offer some degree of comfort fail, the dentist should abort the surgery, close the flap, and reappoint the patient for intravenous or general anesthesia administration. Continuing the procedure while the patient endures excessive pain is unjustifiable. A decrease in treatment quality is directly proportional to the elevation of stress for the surgeon and the decrease in cooperation by the patient.

2. Syncope is a loss of consciousness and postural tone resulting from a dramatic change in the amount of oxygen and glucose that is being delivered to the brain. Fainting is most common in males between the ages of 18 and 35 and occurs more often in the morning than in the afternoon. If fainting occurs, the patient should be positioned so the abdomen and legs are raised to a level above that of the heart and brain. Gravity quickly forces the blood to return to the heart, and oxygen to the brain is ensured. All tight clothing must be loosened, and ice packs should be applied to the neck and brow. Once the patient is conscious, a lemon-flavored glucose drink (Glutol, Paddock Laboratories, Inc) has been found to be very effective in preventing further episodes of syncope.

Surgical Instrument Selection

Objective

To choose instruments and equipment that efficiently satisfy the demands of each surgical movement and that are easy to use and cost effective.

Surgical Hand Instruments

The Chivian/Arens Endodontic Surgery Kit (Hu-Friedy*) includes the following 14 basic instruments that fulfill the needs of most endodontic surgical procedures:

XP23/UNC15 (#23/UNC15 Expro): A universal, general-purpose Shepherd hook explorer combined with a round periodontal probe with easy-to-read markings.

EXD1 (#1 DE Explorer): A sturdy microexplorer for locating and penetrating the apical foramen when minimal access is available.

10-130-05 (#5 Scalpel handle): A finely balanced pen-like scalpel handle that maneuvers easily around tight corners; the round handle enhances dexterity.

P149 (#149 Periosteal elevator): A small, delicate, sharp paddle elevator combined with the wide end of a #9 Molt periosteal elevator.

*Other companies such as Amadent, EIE Analytic Technology, and JEDMED produce equivalent instrument designs. Hu-Friedy instrument identification numbers are included here but these numbers may vary from company to company.

CM2/4 (#2/4 Molt DE curette): A small, straight curette combined with a periosteal elevator.

PHI (#1 Hourigan retractor-23 serrated): A modified Seldin #23 that has serrations on one end for retraction stability and that is particularly effective on irregular bone surfaces.

TRARENS1 (#1 Tissue retractor-Arens [anterior]): A wide, straight anterior retractor provides concurrent flap and lip retraction.

TRARENS2 (#2 Tissue retractor-Arens [posterior]): A wide, angled posterior retractor provides concurrent flap and cheek retraction.

CL85 (#85 Lucas DE surgical curette): A double-ended angular curette for surgical excavation of small to medium lesions.

CL87 (#87 Lucas DE surgical curette): A double-ended angular curette for surgical excavation of medium to large lesions.

SIU17/18 (#17/18 IU DE curette): Ideal for scaling tissue from difficult-to-reach root surfaces.

SC13/14 (#13/14 Columbia DE curette): Ideal for finite removal of tissue attached to root surfaces.

S18 (#18 Iris scissors, curved): Curved, delicate tissue and suture scissors of universal length.

NH5074 (Mathieu-Kocher Perma-Sharp needle holder): Provides excellent control and features Perma-Sharp tungsten carbide inserts to grasp the needle solidly and prevent movement.

Selected Adjunctive Instruments

The following adjunctive instruments are also available from Hu-Friedy:

MH1 (#1 SE Cone socket CS mirror handle)

MIR5 (#5 Front surface CS mouth mirror)

KK15/16 (#15/16 Kirkland DE knife)

SGF3 (#GF3 Goldman-Fox DE curette)

TFB (Allison baby tissue forceps, 4 x 5)

TPKN (Kramer-Nevins tissue pliers, 1 x 2)

Handpieces

Slow-speed handpieces offer the advantage of control. Most high-quality straight, regular, or contra-angled variable-speed conventional handpieces are acceptable. However, they must be true running, balanced, and sterilizable. The long extended shank of a carbide surgical bur in a straight handpiece rarely impedes visibility, is easily cooled, and is generally capable of reaching difficult-to-access areas and the depths of most bone crypts.

High-speed cutting is time efficient. However, frictional heat is quick to build and bone is quick to burn. Substituting control to save time is not valid, nor is it necessary in performing apical surgery.

High-speed cutting with a conventional handpiece is normally accompanied by an unsterile tap water spray and pressurized air. Because the water and the air both exit from the head of the unit, the contaminants are forced into the surgical site, inviting a subsequent pyemic episode. In addition, as the pressurized air is forced into bone and tissue, the patient is placed at risk for an air embolus.

Dental manufacturers have responded to these problems by offering sealed-air, nitrogen, and electrically driven sterilizable handpieces that direct neither air nor lubricants to the surgical site during their use. In addition, disposable handpieces are available (at considerable expense). The purchase and/or installation of such specialized equipment should be considered based on a cost-effective need.

Conventional high-speed, contra-angle-directed burs enter bone at a 90-degree angle, which also happens to be the operator's line of sight. Two problems arise as the bur penetrates the bone: visibility for both the surgeon and the assistant is compromised, and the irrigants are unable to reach and cool the cutting tip.

Manufacturers have responded to this problem by introducing the Air King America (Medidenta) and the Impact Air 45° (EIE Analytic Technology). These 45-degree-angled surgical handpieces are fully autoclavable and facilitate access to the most difficult-to-reach posterior regions of the mouth. Because the bur enters the surgical field at an angle, visibility is unobstructed. Air is directed out the back of the handpiece, away from the site, and the nonatomized water

spray is directed along the surface of the bur for cooling. These safety features virtually eliminate the possibility of causing an embolism or pyemia. These handpieces are well constructed and well balanced, enabling the dentist to maximize penetration depth with long-shanked surgical burs without the fear of bur tip vibration and/or inadequate cooling.

Root End Instruments

Rotary standard

Microhead handpiece (Union Broach)

1, 2 Microhead burs, round

3, 4 Microhead burs, inverted cone

Piezoelectric Ultrasonic

MiniEndo Piezoelectric unit (EIE Analytic Technology)

Piezo ultrasonic systems (Spartan)

Neosonic (P-5) SPM (Amadent)

CT Retrotips (EIE Analytic Technology, Spartan, Amadent)

Minicarriers, pluggers, and mirrors

KG carriers (Union Broach)

PLGRF1 condensers (EIE Analytic Technology)

Carr microcondensers: B-2R, B-2L, JS-1, B-3, P-1, P-2, F-1 (EIE Analytic Technology)

Apical retrograde mirrors, high polish: CM1-6 (EIE Analytic Technology)

Apical retrograde mirrors, Sapphire Plus (EIE Analytic Technology)

27/29 Burnisher (Hu-Friedy)

PF1 WDS1 Woodson plastic carrier (Hu-Friedy)

PF1 G 4/5 Gregg plastic carrier (Hu-Friedy)

#12 Spoon excavator (Hu-Friedy)

Microsurgical Instruments

Microsurgical instruments that respond to unusual access angles and depth conditions and specially designed instruments and equipment are available to enhance visibility (EIE Analytic Technology, Hu-Friedy) (see Lesson 28).

Magnification

Although dentists have used low levels of magnification for some time, the advancements in optic technology lets them view dentistry in a new and exciting way. There is no question that as the level of magnification improves, so does the ability to inspect, evaluate, and perform dental procedures with precision and exactness. Such an equation quickly, easily, and beneficially translates into quality.

1. Loupes offer wide field magnification, good depth of field, and a range of x 2.25 to x 6.
 - Panoramic loupes, x 3, x 4, and x 6 (Keeler Instrument Company)
 - Clip-on-loupe, x 2.25 (Almore International, Inc)
 - Prism loupes, x 4 (Carl Zeiss, Inc)
2. Glasses offer the opportunity to combine safety or prescription lenses with telescopic lenses of various power and field range.
 - Dimension-3 telescopes, x 2.6 and x 3.25 (Orasoptic Research, Inc)
 - Surgi-Spec telescopes, x 2.5 (Piano); x .5 (Piano); Expanded Field
 - High-vision telescopes, x 2.5, x 3.5, x 4.5, and x 6 (Designs for Vision)
3. Microscopes offer the highest standard of enhanced vision. With their magnificent state-of-the-art optics, microscopes are not only capable of providing an excellent depth of field and a power range of x 3 to x 30, but can also furnish an outstanding source of high-intensity light that eliminates shadows from the surgical field.

II: Preparation for Surgery

Entree Protege (Global Surgical Corporation)
OPMI 99, OPMI, and OPMI I (Carl Zeiss, Inc)
V-series microscopes (JEDMED/KAPS)

Instruments used under magnification

Freer periosteal elevator (EIE Analytic Technology)
H161 Tapered fissure Lindemann bone cutting bur; H162 X-Cut tapered Lindemann bone cutting bur; both 9 mm long and 1/10 mm at tip (Brassler)
30° Ruddle curettes, right and left, 3 mm wide and 7 mm wide (EIE Analytic Technology)
#33L Surgical curette, 2 mm wide, Sci-Dent (Endoco)
#34/35 Jaquette scaler, 1 mm wide (Hu-Friedy)
TRArens retractors, anterior and posterior
Carr #1 and #2 serrated retractor (EIE Analytic Technology)
#1 Hourigan retractor (Hu-Friedy)
Rubinstein retractors (1-4), serrated tips, standard/wide, flat/notched (JEDMED)
89/92 Cleoid-discoid, 2 mm wide (Endoco)
#13/14 Columbia DE curette (Hu-Friedy)

Illumination

The normal overhead dental light is inadequate for dental surgery. It must be moved frequently to focus and remove shadows, which not only is inconvenient and time consuming but also threatens aseptic control. Although the microscope provides the most effective, direct, and shadow-proof illumination, the following adjunctive lighting systems can be beneficial alternatives:

Zeon illuminator, fiber-optic frame, and headlamps (Orasoptic Research, Inc)
Headlight DM100 (Sylvan Fiber-Optics)
Fiber-optic illuminated instruments (Quality Aspirators)
Uniglow headlight, power pack, battery pack (Aseptico)
Fiber-optic frame and headlight system, Duralite 3000, Quadrilite 6000 (Designs for Vision)
Halogen 560 (Light-Tech)

PART III

Surgical Techniques

Flap Design

Objective

The full mucoperiosteal tissue flap raised to perform endodontic surgery should offer access and proximity to the underlying bone and offending root(s) without jeopardizing circulation to the flap or the health of the approximating nonelevated tissues, and without limiting the surgeon's approach if an unforeseen problem should arise.

Note

Endodontic surgery requires unimpeded access to bone and root. Therefore the surgeon must elevate a full mucoperiosteal flap, which includes the mucosal tissue, the connective tissue, and the periosteum (Figs 13-1a and 13-1 b). This differs from the split or partial thickness flap more commonly used in periodontal surgery. It is customary for a periodontist to separate the superficial mucosal tissue from the underlying connective tissue and thereby leave the periosteal attachment undisturbed (Figs 13-1 c to 13-1 e). Except for a suspected dehiscence, the need to do a free gingival graft, or the performance of a crown-lengthening procedure, a split thickness flap is rarely indicated in endodontic surgery.

Figs 13-1 a and 13-1 b The full mucoperiosteal flap includes the mucosa (AI, connective tissue |BI|, and periosteum (CI). To elevate the full mucoperiosteal flap, the incision must be made to the bone.

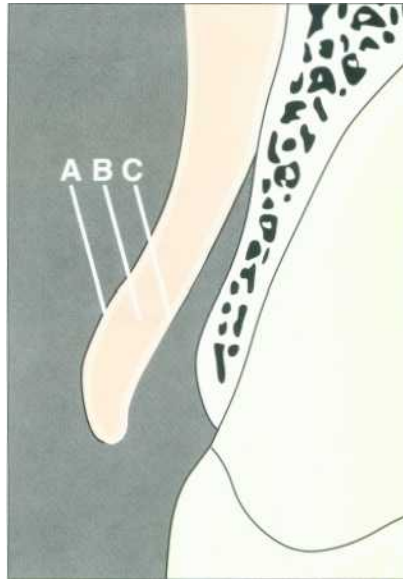


Fig 13-1 a

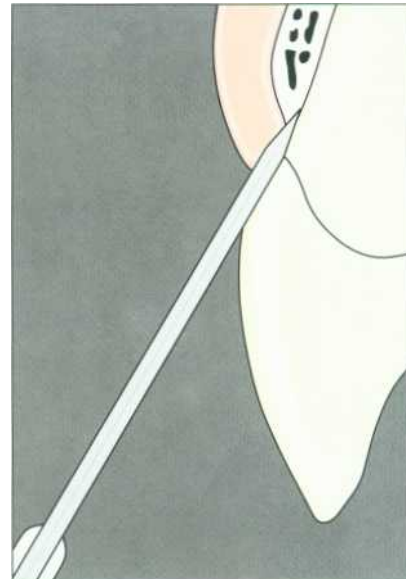


Fig 13-1 b

Figs 13-1c to 13-1e The incision for a split thickness or partial thickness flap must separate the mucosa and a segment of the connective tissue (A and BI from an underlying layer of connective tissue and periosteum IB and Q.

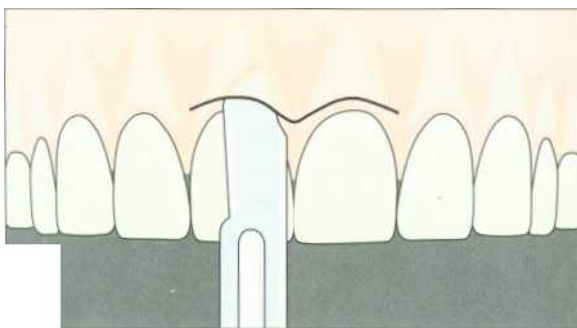


Fig 13-1 c

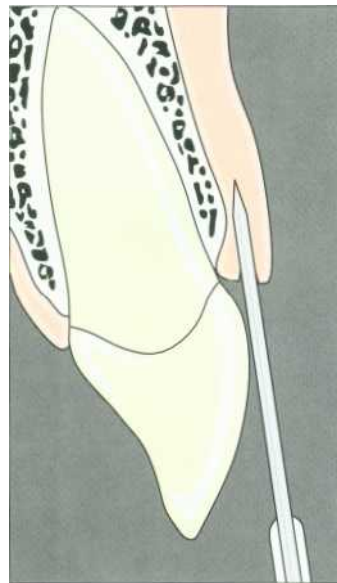


Fig 13-1 d

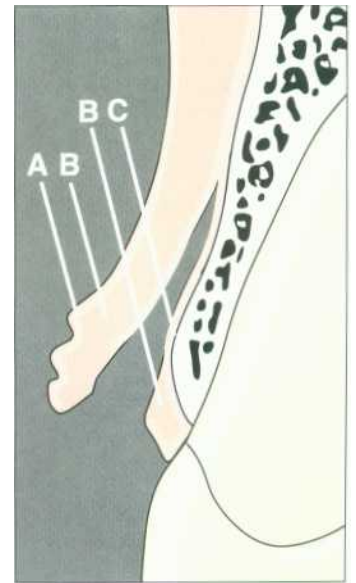


Fig 13-1 e

Considerations

- The number of teeth involved in the surgery
- The length and shape of the roots involved
- The presence or absence of pathosis
- The dimensions of the pathosis
- The amount of attached gingiva
- The existence and depth of periodontal pockets
- The location of muscle attachments and frenums
- The height or depth of the vestibule
- The location of approximating anatomic structures, such as the neurovascular bundles and the maxillary sinus
- The amount of bone covering the site
- The access required to accomplish the objectives
- The presence of veneered crowns on the involved or adjacent teeth

Techniques

Ochsenbein-Luebke

This technique involves making a scalloped horizontal incision in the attached gingiva that joins two vertical incisions made on each side of the surgical site.

Surgical technique. A vertical incision is made on each side of the proposed surgical site in the trough between the root eminences. These vertical incisions extend from a point 1 to 2 mm short of entering the mucobuccal fold to a point on the attached gingiva approximately 3 to 5 mm above or below the marginal gingiva and the sulcus depth. A scalloped horizontal incision following the contour of the gingival margin is made to connect the cervical ends of these vertical incisions (Figs 13-2a and 13-2b).

Figs 13-2a and 13-2b The Ochsenbein-Luebke design connects a scalloped horizontal incision in the attached gingiva with two apically directed vertical incisions. The incisions extend from a point 1 to 2 mm short of entering the mucobuccal fold, to a point on the attached gingiva 3 to 5 mm above or below the marginal gingiva and sulcus depth.

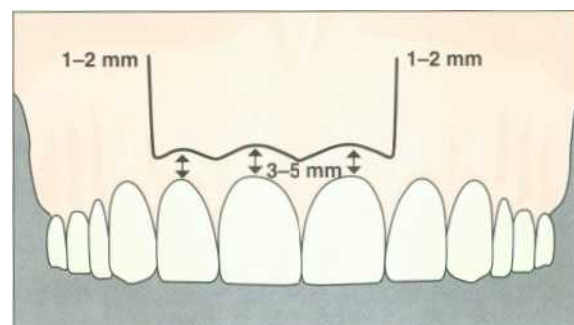


Fig 13-2a

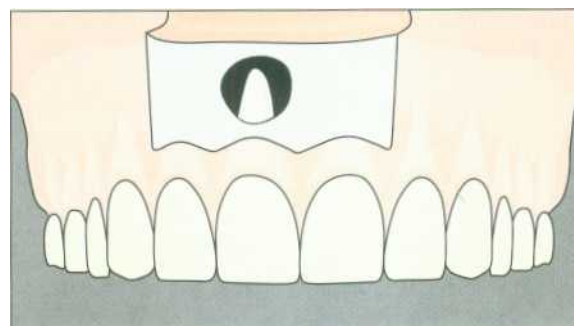


Fig 13-2b

Advantages

1. The flap is simple to incise and reflect.
2. The surgical site is readily visualized.
3. Access to the apex of the involved tooth is good.
4. The marginal gingiva is not disturbed, which greatly reduces the potential for gingival recession. This is particularly advantageous in the presence of prosthetic crowns.
5. Existing nonpathologic dehiscences are avoided because the gingival attachment is not disturbed.
6. Minimal effort is required to retract the flap.
7. Because the incision has good reference points, the flap is easily repositioned.
8. The patient is able to maintain good oral hygiene during the healing period.

Disadvantages

1. Misjudging the size of the lesion may result in the incision(s) crossing the osseous defect.
2. Muscle attachments and frenums present anatomic obstructions that may require modification of the horizontal component.
3. If the horizontal incision is made too close to the free marginal gingiva, clefting may occur.
4. An unesthetic scar may form.

Intrasulcular flap

A horizontal gingival sulcus incision joined by a single vertical incision.

Surgical technique. A vertical incision, one to two teeth mesial or distal to the proposed surgical site, is made in the trough between the root eminences (Figs 13-3a and 13-3b). This incision extends from a point 1 to 2 mm short of entering the mucobuccal fold to a point at the distal or mesial labial line angle of the selected tooth. From this point, a horizontal incision in the gingival sulcus continues to a point two to three teeth to the opposite side of the surgical site. This creates the horizontal component of a triangle. The sulcular incision must be firm to bone and free the gingival tissues, including the involved papillae.

Figs 13-3a and 13-3b The intrasulcular design connects a single vertical fold-to-crest incision (AFB) with a horizontally directed sulcular to-bone incision IB C/ along the gingival crest, two to three teeth on the opposite side of the target.

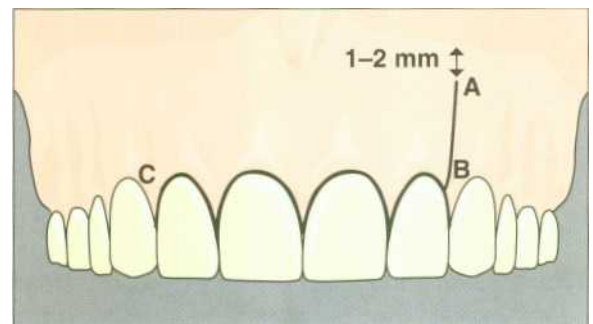


Fig 13-3a

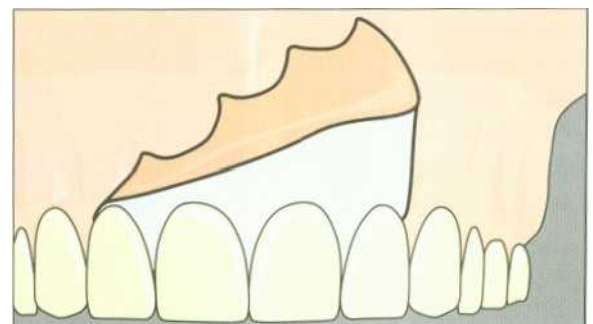


Fig 13-3b

Advantages

1. The possibility of the horizontal incision crossing the osseous defect is eliminated.
2. The crestal exposure facilitates simultaneous periodontal curettage and alveoloplasty.
3. Greater access is afforded for lateral root repair.
4. Flap design is advantageous when treating short roots and/or defects in the coronal third of the root.
5. The flap is easy to reposition because the gingiva has basic reference points.
6. The blood supply to the flap is maximal.

Disadvantages

1. Elevation may be more difficult to initiate.
2. Soft tissue clefting or irreversible pocket formation may result when a dehiscence is uncov-

ered. This may require using guided tissue regeneration techniques prior to closure or referral for postoperative periodontal care.

3. Vertical and horizontal incisions must be long to gain access to the apex of long roots.
4. As the tension of the flap increases, greater retractive forces are required. This can be damaging to the tissues and fatiguing to the operator.
5. Extension of the vertical incision to ease tension may involve the mucobuccal fold. This often leads to soreness and delayed healing.
6. Gingival tissue detachment may lead to changes in the level of the marginal gingiva (recession), particularly when prosthetic crowns are involved.
7. Suturing is more difficult.
8. Oral hygiene may be difficult to maintain during the early stages of recovery.

Modified intrasulcular

When a second, tissue-relaxing vertical incision is made at the terminal end of the horizontal leg of the intrasulcular flap design, a rectangular or trapezoidal flap design is created.

Surgical technique. At the terminal point of the horizontal incision of a triangular flap, a vertical incision is made extending from the crestal tissue at the mesial or distal line angle of the last tooth to the mucobuccal fold. This second vertical incision relaxes the tension on the flap and, when elevated, increases visibility and access to the apex. The length of this second vertical incision is dependent on the amount of relaxation needed (Figs 13-4a and 13-4b).

Advantages

1. Visibility is increased.
2. Access to the surgical site is improved.
3. Tension on the flap is decreased.
4. Repositioning is simplified because the sulcular incisions offer excellent reference points.
5. The crestal exposure facilitates simultaneous periodontal curettage and alveoplasty.
6. There is greater access for lateral root repairs.
7. Flap design is excellent for treating long roots.

Disadvantages

1. Elevation is more difficult to initiate.
2. Blood supply to the flap could be at risk, and ischemia and slough are possible sequelae.
3. Soft tissue clefting or periodontal pocket defects could result when a dehiscence is uncovered. This may require the use of tissue regeneration techniques prior to closure.
4. Gingival tissue detachments could lead to changes in the level of the marginal gingiva (recession), particularly when prosthetic crowns are involved.
5. Suturing is more difficult.
6. Maintaining good oral hygiene is difficult during the early recovery stage.

Figs 13-4a and 13-4b By adding a second vertical incision of any length at the terminus of the crestal intrasulcular design, greater access and less tension can be realized.

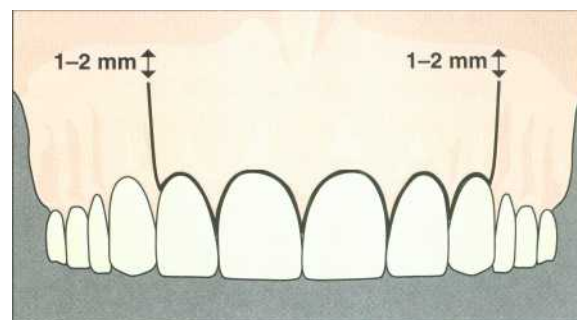


Fig 13-4a

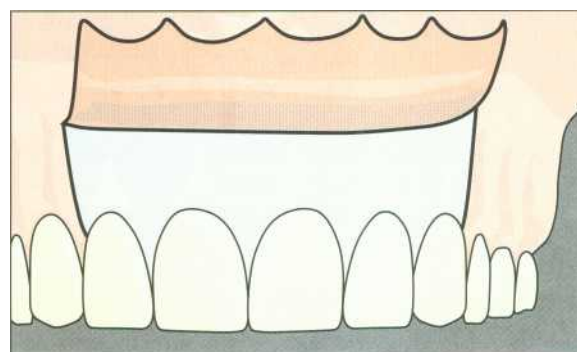


Fig 13-4b

Incision

Objective

To provide a clearly defined opening to bone for maximum tissue thickness reflection, and to establish an easily identifiable and accessible border for reapproximation and reattachment.

Note

Although new technology has made endodontic surgery easier and more predictable, the concepts and principles of modern surgery are still based on the following "tenets of Halsted":

- Tissue should be handled gently.
- Sharp anatomical dissection should be used.
- Aseptic techniques should prevail.
- Careful hemostasis should be attained.
- Suturing material should be fine and nonirritating, and only a minimal amount of suturing should be done.
- All dead spaces should be obliterated.
- Tension should be avoided.
- A period of rest should follow surgery.

Instruments

- #5 Scalpel handle (Hu-Friedy)
- #11 Scalpel blade for puncturing (Bard-Parker)
- #15C Scalpel blade, universal (Bard-Parker)
- #12B Scalpel blade for difficult angles (Bard-Parker)
- CK1-5 Microsurgical scalpel blades (EIE Analytic Technology)

The selection of a scalpel blade should be determined by how appropriate its size and design is to the situation. The sharp point of the #11 triangular blade is capable of puncturing and penetrating soft tissue swellings without transferring pressure to an underlying abscess base (Fig 14-1 a). For this reason, the blade is highly effective when stabbing a fluctuant area, but inefficient when incising flaps (see Lesson 37).

Unless the size, shape, and condition of the cervical tissues are unusual, the #15C blade meets most endodontic flap needs. The right-angle cut employed in the vertical and horizontal incisions of the Ochsenbein-Luebke requires that the blade be perpendicular to the bone as it enters the tissue. For maximum efficiency, this blade was designed to have the 2 mm segment of its semicurved tip in contact with bone at all times (Fig 14-1 b). The apically directed incision used to release the crevicular tissue and the papilla is dictated by the contour of the crown. The blade enters the sulcus at an angle almost parallel with the long axis of the root and, as it hugs the neck of the tooth, it penetrates and frees the epithelial attachment (see Figs 13-1a and 13-1b). This is a critical step. Improper release of the crestal tissues complicates elevation and delays healing.

The seldom-used #12 blade is helpful in reaching difficult-to-incise areas, such as the distal cervical walls of the maxillary and mandibular molars. It is curved to conform to cervical convexities, yet the tip is small enough to release even the most delicate interdental papilla (Fig 14-1c).

The double-edged, disposable CK1-5 microsurgical scalpel blades are incredibly sharp, atraumatic, and easy to use. These delicate blades are a must when operating under high levels of magnification.

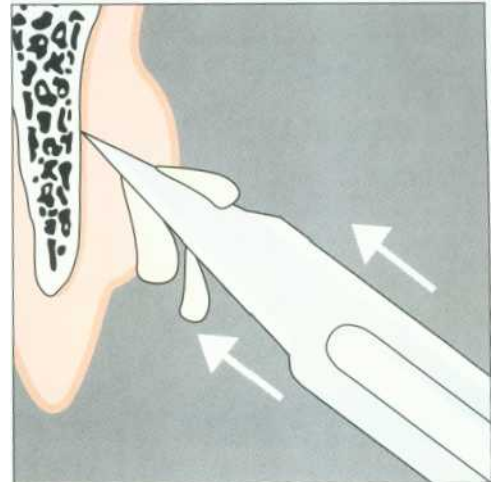


Fig 14-1 a The #11 scalpel blade is most efficient for piercing tissue.

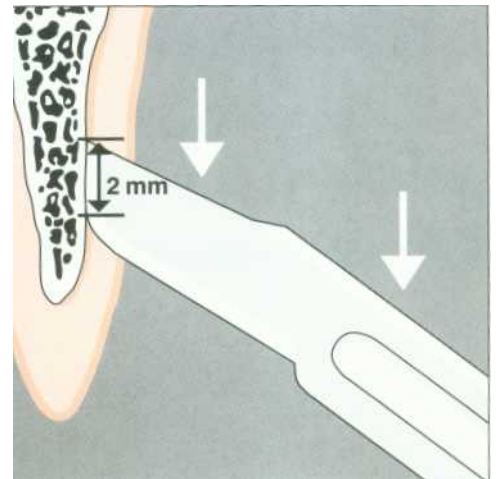


Fig 14-1b The uncurved 2-mm edge of the #15C blade is most effective when cutting to bone.

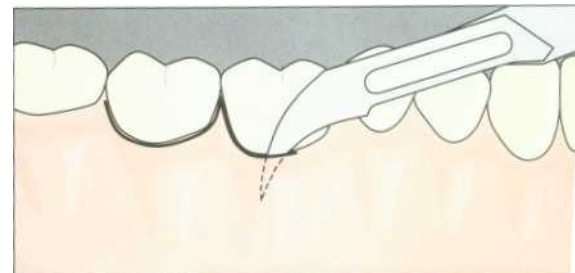


Fig 14-1c The #12 blade is helpful in freeing the gingiv, fibers in difficult-to-access areas.

Techniques

Most endodontic surgery problems can be avoided by adhering to the following incision rules:

1. The incision for a full mucoperiosteal flap

(mucosa, connective tissue, periosteum) must be made with a firm continuous stroke. Once the location and direction of an incision is determined, a single perpendicular blade entry to bone is made at the starting point. The blade then proceeds to its vertical terminus at a slow and deliberate pace. Although an incision may be stopped anywhere along its course, irregularities that may interfere with reapproximation and reapposition can be avoided if the scalpel blade is never lifted from bone until the cut has reached its ultimate terminus (Figs 14-2a and 14-2b).

2. An incision should not cross an existing underlying bony defect.

The true extent of a periradicular lesion is often incalculable from radiographs: Based on the four zones (necrosis, contamination, irritation, and stimulation) reported by Fish (Fish 1951), only a small percentage of a pathosis may be radiographically apparent. Therefore, it is best to overestimate the dimensions and design a flap that offers freedom to extend the access bone window in any direction without involving the incision. This rule applies to both the vertical and horizontal components. Such forethought preserves a solid bone base for periosteal reattachment, prevents bacteria and debris from having direct access to the bone defect, and increases the overall potential for healing (Figs 14-3a to 14-3d).

3. The vertical incision(s) should be made in the concavities between bone eminences.

Whenever the bone topography is convex, the mucoperiosteal tissue is thin. This delicate tissue should be avoided, and the thicker tissues between the eminences, osseous protuberances, and exostoses should be selected for the incision and suture placement (Fig 14-4).

Figs 14-2a and 14-2b Interrupting an incision by lifting the scalpel blade from bone during the cut tends to leave rough, ragged edges that are difficult to reapproximate and often will scar. The smooth edges of a continuous cut [A----B----]Cj will ease suture placement and removal and shorten the healing time.

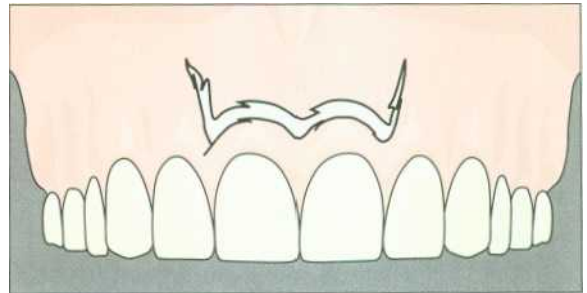


Fig 14-2a

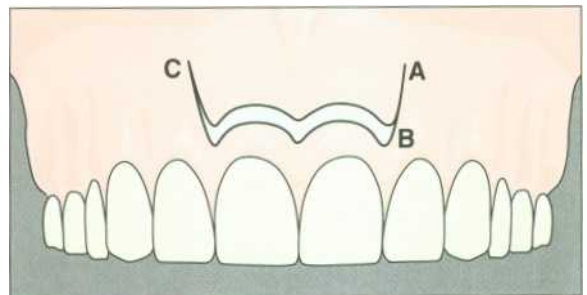


Fig 14-2b

III: Surgical Techniques

Figs 14-3a to 14-3d Based on the four zones of Fish, only the central target of the infected lesion may be obvious radiographically. To prevent an incision from horizontally or vertically crossing the bone crypt caused by the surgery, the extent of the pathosis should be overestimated. Either extensively widen the Ochsenbein-luebke design or overextend the intrasulcular flap lateral to the lesion.

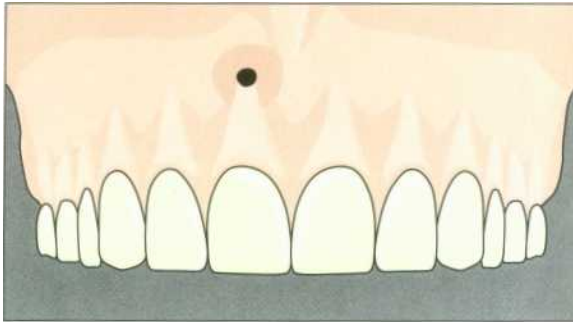


Fig 14-3a

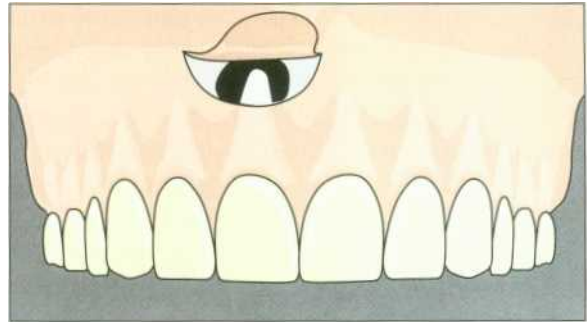


Fig 14-3b

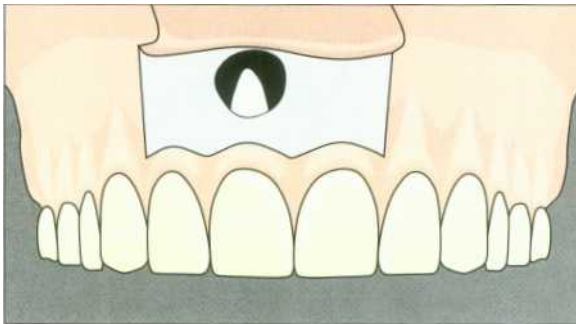


Fig 14-3c

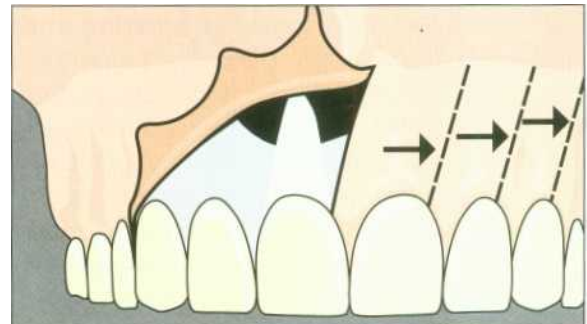
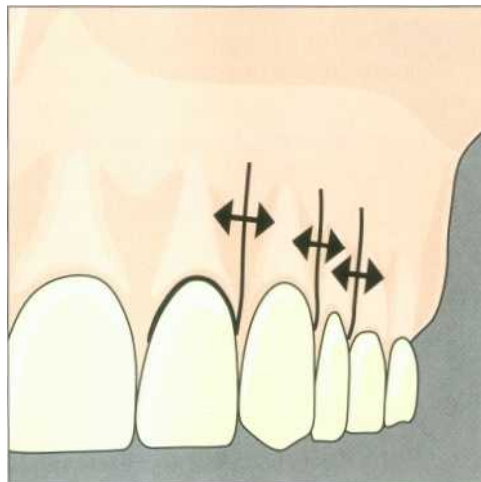


Fig 14-3d

Fig 14-4 To avoid the thin, easily damaged tissues covering root eminences and bone protuberances, incisions should be made in the concavities between the roots, where the tissues are the thickest.



4. The vertical incision should not extend into the mucobuccal fold. The tissues at and above the mucobuccal fold contain muscle fibers and connective tissue. As such, they are highly vascular and have a tendency to bleed extensively when severed. Visibility is hampered throughout the surgical procedure, and healing is often delayed. When faced with shallow vestibules, the surgeon should avoid involving the fold by increasing the obtuseness (greater than 90 degrees) of the vertical incision. Although widening the base of the flap reduces the blood flow to the remaining attached gingiva, sufficient nutrients remain to sustain its health (Figs 14-5a and 14-5b).
5. The termination of the vertical incision at the gingival crest must be at the mesial or distal line angle of the tooth. By excluding the thin, delicate, and poorly nourished gingival crest tissue from the vertical incision, the potential for sloughing and clefting is minimized. In addition, the incision will ease suturing when kept at the line angle of the tooth (Fig 14-6).

Figs 14-5a and 14-5b Incisions that extend into the mucobuccal fold tear and bleed extensively. To avoid incising the fold, increase (obtusely) the angle of the horizontal and vertical junction.

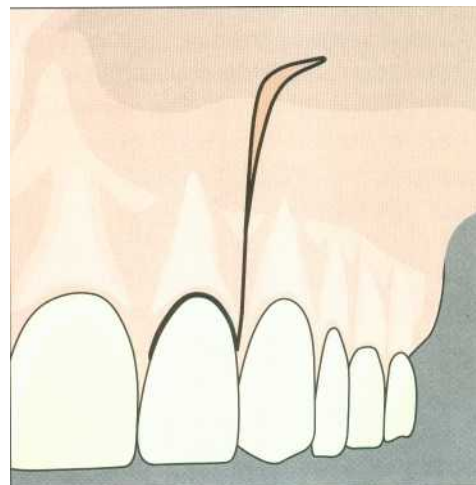


Fig 14-5a

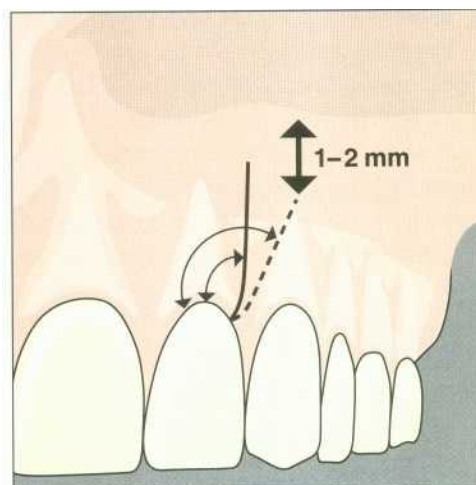
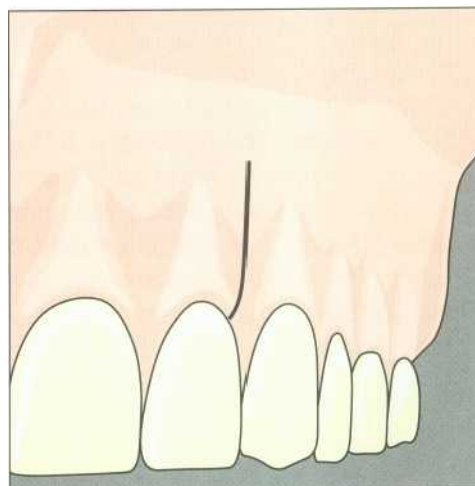


Fig 14-5b

Fig 14-6 By placing the junction of the vertical and horizontal incisions at the line angle of the tooth, the thin, delicate radicular tissue covering the most convex portion of the crown, as well as the thicker interproximal papillae, will be preserved.



6. **The base of the flap must be at least equal to the width of its free end.** The blood supply to the attached and unattached tissues must be maintained and protected throughout the surgical procedure. Because there is evidence that the major blood vessels are arranged vertically (Fig 14-7a) and the role of the collateral circulation of blood to the flap is uncertain, the vertical incisions must never be less than 90 degrees. However, when conditions call for the vertical incisions to exceed 90 degrees, the risk for minor scarring may be increased but the problem of sloughing in even the widest based flap is rare. It is imperative all flaps be kept moist and are not physically abused during the surgical procedure (Fig 14-7b).

Problems

1. **Frenum.** A horizontal incision across a gingivally attached frenum is easily avoided by using an intrasulcular flap design. However, when an Ochsenbein-Luebke flap is indicated, the horizontal incision may cross the frenum at any level without fear of sloughing. For cosmetic reasons, this is an opportune time to remove the segment of the frenum between the incision and the gingival attachment (partial frenectomy). The patient should have been informed of this possibility at the consultation appointment. If this decision is being made at the time of surgery, the patient must be informed of the change and be offered an opportunity to discuss the situation. The patient's approval of the procedure must be witnessed.
2. **Flap tension.** To reduce the tension on a triangular flap, the horizontal intrasulcular incision is extended or a second vertical incision is made at the mesial/distal line angle of the last tooth involved in the original flap design (Fig 14-8). This allows the flap to be raised to a higher/lower level and decreases the possibility of the tissues tearing during retraction. This is particularly advantageous when performing maxillary posterior surgery where access and visibility must be at a maximum. The reduced flap resistance is gentler to the tissues and makes the rest of the procedure far less fatiguing for the surgeon.

Figs 14-7a and 14-7b Because a flap receives its major blood supply from the superiorly or inferiorly attached tissues, it is essential that the horizontal dimensions of the flap attachment (A---)B) never be less than the attached width (C---)D).

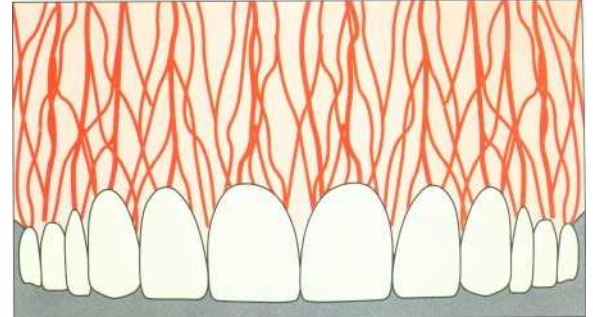


Fig 14-7a

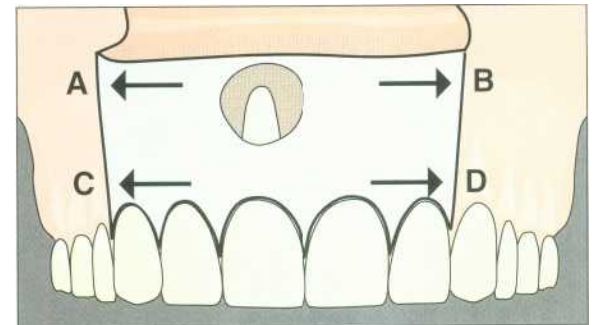


Fig 14-7b

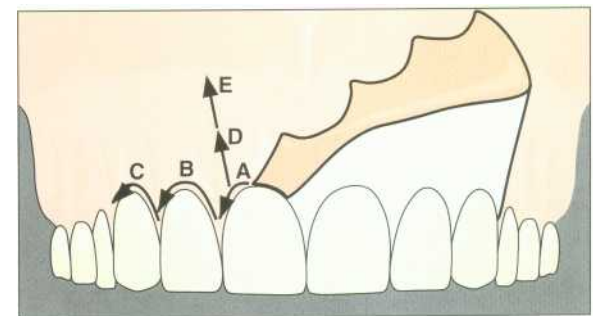


Fig 14-8 Elevating and retracting flaps produced by long vertical incisions put tension on the flap and fatigue the operator. By increasing the length of the horizontal incision (A---)B), or adding a secondary vertical relaxing incision (C---)D), resistance can be reduced or eliminated.

3. Pontic involvement. By extending an initial vertical, obtuse relieving incision off the line angle of the tooth adjacent to the target tooth on the side furthest from the pontic and a second relieving obtuse incision off the distal line angle of the primary target tooth, the surgeon is able to gain sufficient access and avoid the difficulty of suturing beneath the pontic. The obtuseness of each angle is determined by the anticipated size of the lesion (Fig 14-9a).

Alternatively, when greater access is desired, the initial vertical incision can be extended off the line angle of the tooth adjacent to the target tooth on the side furthest from the pontic, as is customary. The incision then changes direction and moves intrasulcularly until the pontic is approached. When the incision reaches the mesiodistal aspect of the pontic, it again changes direction and moves vertically to a level 2 to 4 mm above or below the pontic(s). At this level, it again moves horizontally in a scalloped fashion on firmly attached gingiva until it approaches the line angle of the nearest natural tooth abutment. The incision returns vertically to the line angle of this abutment at the gingival crest where it resumes its posterior horizontal direction intrasulcularly. Placing the incision at this level on the buccal/lingual wall provides a firm base for reapproximation and simplifies the suture technique (Fig 14-9b).

4. Posterior mandible. The distobuccal area (mucobuccal fold) of the posterior second or third molar may provide little room for a vertical relaxing incision. In such cases, a short vertical incision extended off the horizontal intrasulcular incision toward the fold, or extended horizontally up the buccal surface or ridge of the ramus or maxillary tuberosity, simplifies elevation and retraction, reduces the tension on the flap, and provides greater access and visibility to the operator (Fig 14-10).

Figs 14-9a and 14-9b Pontics often present incision elevation, retraction, and suturing problems. Avoid pontics entirely by placing the primary vertical incision anterior to the pontic and add a secondary vertical relaxing incision anterior to the target (A, B, or C). Another alternative is to bypass the pontic by raising the horizontal component of the intrasulcular incision to the attached gingiva and return to the crest posterior to the pontic before continuing intrasulcularly (A--B--C--D--->E--->F-->G~).

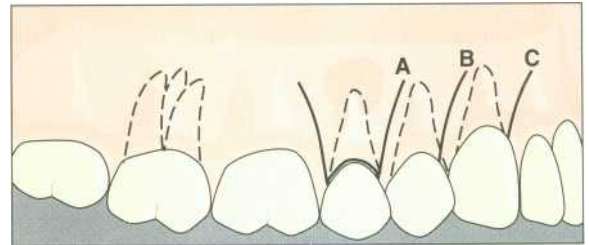


Fig 14-9a

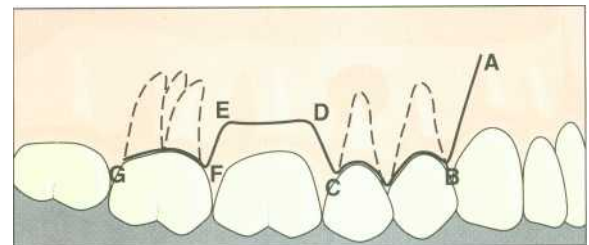


Fig 14-9b

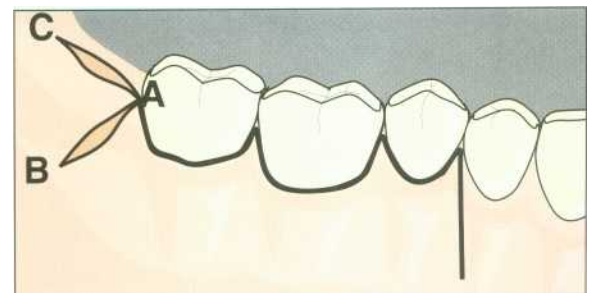


Fig 14-10 To gain greater access in the second and third molar region, it is often necessary to place the relieving incision in the buccal fold or up the ramus.

5. **Palate.** The tissues of the palate are often thick, rubbery, and difficult to manage. The best site for any vertical incision in the palate is off either the mesial or distal line angle of the first premolar. To avoid the greater palatine vessels, this incision should terminate before it reaches the junction of the vertical palate wall and the depth of the vault. When treating anterior teeth of equal length, double vertical incisions are generally required. To relieve tension when treating posterior teeth, a short vertical relaxing incision should be made from the distal line angle of the second molar (Figs 14-11 a and 14-11 b). As an alternative, when there is considerable vault height, a modified Ochsenbein-Luebke incision can be made in the lingual vertical wall (Fig 14-11 c).
6. **Instrument access.** The height of contour of the labial/lingual surfaces of teeth, the height and depth of the palatal vault, an anatomically restricted occlusal opening, inadequate intraocclusal space, trismus, thick cheek pouches, trauma, overextruded teeth, the natural limitations of maxillary molars, and assuredly the heightened anxiety of a patient often prevent the surgeon from accomplishing desired goals with routine surgical techniques. In such cases, one must consider improvised but controlled alternatives of approach to gain access, such as conscious sedation or general anesthesia, or resort to repair and retrofill procedures after extraction (see Lesson 42).

Figs 14-11 a to 14-11 c To avoid the greater palatine vessels, the anterior vertical incision in the palate should extend from the mesial line angle of the first bicuspid (A~B), and a short posterior relaxing incision IC~D~ is added to further reduce tension. When faced with deep palatal vaults, it is possible to gain adequate access with an Ochsenbein-Luebke flap.



Fig 14-11 a

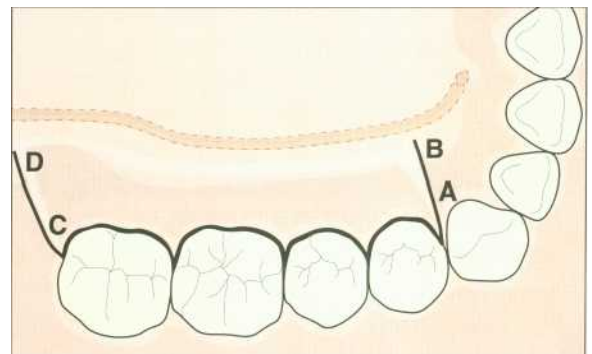


Fig 14-11 b

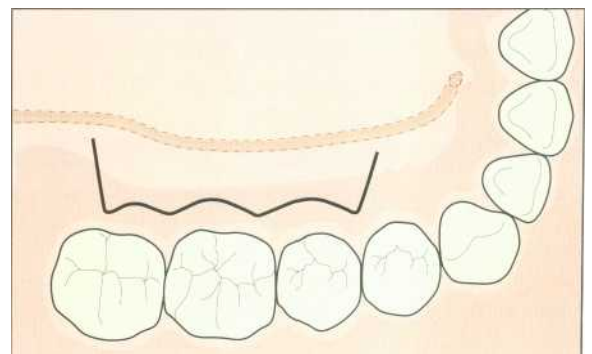


Fig 14-11 c

Elevation

Objective

To gain access to bone by separating a full mucoperiosteal flap of tissue (mucosa, connective tissue, periosteum) and raising it from its underlying hard tissue attachment. The periosteum must be reflected as an integral part of the flap.

Instruments

- #149 Periosteal elevator (Hu-Friedy)
- #GF3 Goldman-Fox DE curette (Hu-Friedy)
- #9 Molt DE curette (Hu-Friedy)
- #2/4 Molt DE curette (Hu-Friedy)
- Allison baby tissue forceps (Hu-Friedy)
- Kramer-Nevins tissue pliers (Hu-Friedy)
- #15C Scalpel blade and handle (Bard-Parker)
- 30° Ruddle curette, right/left (EIE Analytic Technology)

Techniques

Ochsenbein-Luebke

The surface of an efficient elevator has a slight concavity or convexity at its working end. When the concavity is face down, the sharp edge is perfectly designed to cleave or strip the periosteal fibers from bone. A clear, well-defined full thickness incision is a prerequisite for the proper seating of any elevator. The size of the elevator tip and the angle of approach are dictated by the location, dimension, and design of the proposed flap (Figs 15-1 a to 15-1 c).

The working edge of an appropriately sized elevator is placed in the horizontal incision at the vertical/horizontal incision junction. The instrument is teased between the bone and soft tissue, and a firm apically directed force is applied.

It is imperative that the edge of the elevator maintain constant contact with bone. As the tissue (including the periosteum) is raised from bone, the elevator is moved laterally and apically without losing contact with the bone. The flap should be raised sufficiently to expose the bone above/below the lesion (Figs 15-1 d to 15-1 f).

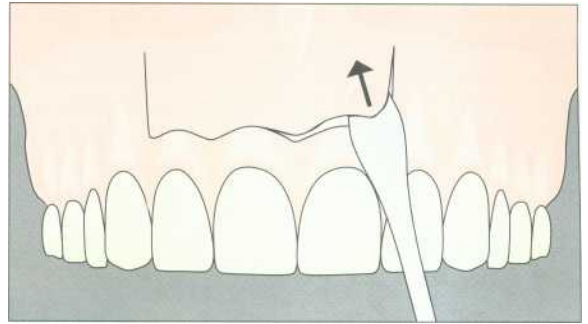


Fig 15-1 a

Figs 15-1 a to 15-1 f To raise an Ochsenbein-Luebke flap, the elevator edge, with its concave surface facing the bone, cleaves the periosteum from bone apically and laterally until the bone above the lesion is exposed.

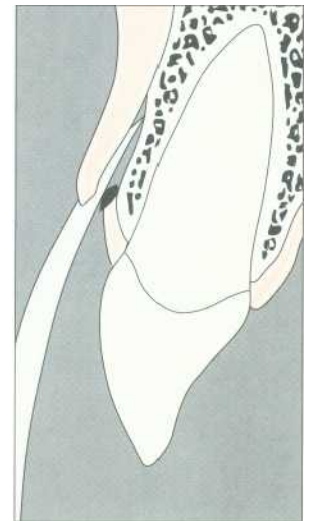


Fig 15-1 b

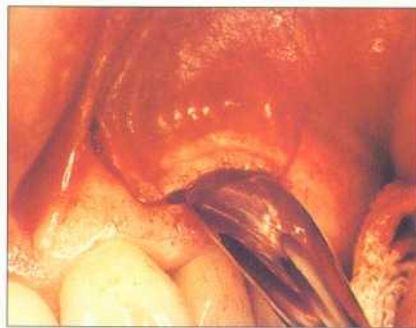


Fig 15-1 c

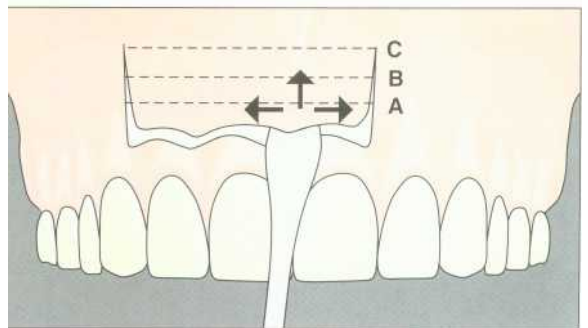


Fig 15-1 d

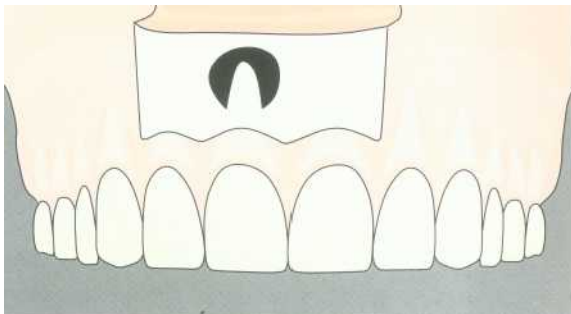


Fig 15-1 e

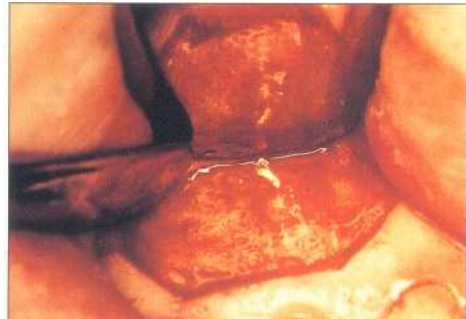


Fig 15-1 f

Intrasulcular

When the periodontal tissues are healthy, the working tip of the elevator (with the convexity facing bone) may be inserted into the junction of the vertical and horizontal incisions at a mesial/sulcular angle.

While maintaining constant contact with bone, a firm but controlled force easily lifts the corner edge of the flap. Once the tissue is undermined, the elevator is moved laterally and apically. The papilla should release easily if the sulcular incision has properly severed the gingival fibers and the lingual communication (Figs 15-2a to 15-2e).

If a periodontal condition exists or is suspected, the crest of bone may be blunt, and the elevator will meet major resistance to the apically directed elevator force. This resistance may be misinterpreted to be

Figs 15-2a to 15-2e Elevation of healthy crestal tissue begins by inserting the elevator edge (concave surface facing the bone) at the junction of the vertical and horizontal incisions, and applying apical and vertical force until the gingival tissues including the flap are freed and the entire flap is lifted to a level superior or inferior to the lesion.

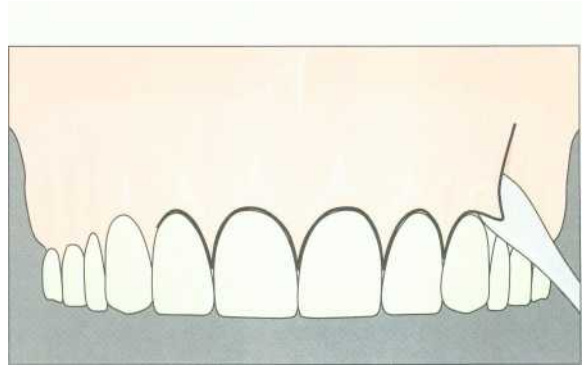


Fig 15-2a



Fig 15-2b

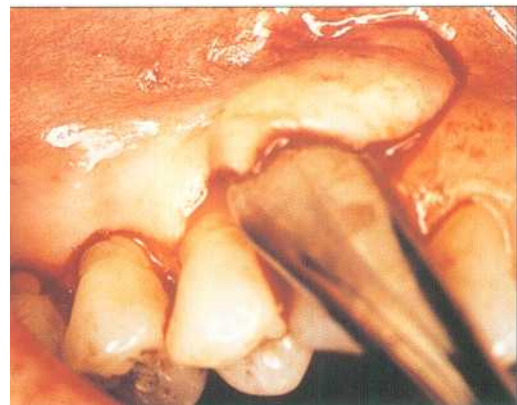


Fig 15-2c

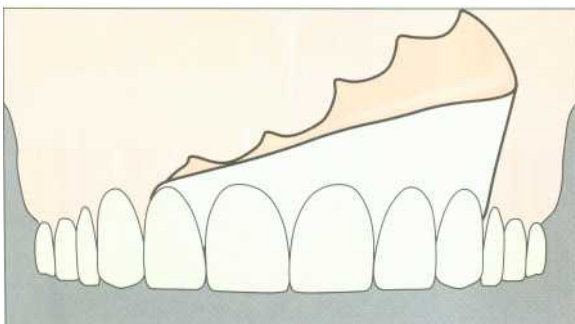


Fig 15-2d



Fig 15-2e

III: Surgical Techniques

the sharp tip meeting a tenacious fibrous and/or periosteal attachment, an overexaggerated cemento-enamel junction, or an erosive ledge. If excessive forces are applied, the operator risks tears and perforations that not only will be difficult to repair, but also will delay healing (Figs 15-3a and 15-3b).

In such cases, it is advisable to use a small curette or a small-tip elevator (#2/4, 30° Ruddle curette) and shift the angle and approach of entry to the vertical incision. The instrument, with its concave surface facing bone, is carefully directed into the vertical incision parallel to the horizontal

incision at a point 2 to 4 mm above/below the measured sulcular depth at the junction of the horizontal and vertical cut. With the elevator edge on bone, the instrument is guided laterally (Fig 15-3c). As the tissue is undermined, the periosteum lifts easily from the bone surface. After sufficient lateral penetration has been made, the minimal-width instrument is directed coronally, freeing the crestal tissue attachments (Fig 15-3d). Once these gingival tissues are freed, the instrument can proceed apically, avoiding the blunt crest, until the reflected flap clears the periradicular lesion (Fig 15-3e).



Fig 15-3a



Fig 15-3b

Figs 15-3a to 15-3e When attempting to raise an intra-sulcular flap and a periodontal pocket exists, initial resistance to normal elevating forces may be met and the gingival tissues are in danger of tearing. It is best to change to a smaller tipped elevator I#2/41 and release the gingival tissues 3 to 5 mm above/below the sulcus by entering the vertical incision laterally before proceeding with the normal apically directed forces.

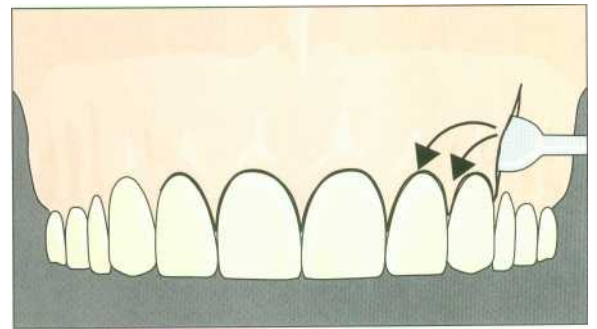


Fig 15-3c

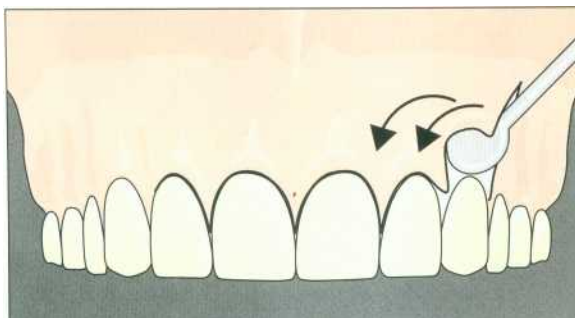


Fig 15-3d



Fig 15-3e

When a known or suspected dehiscence exists, the sulcus should be avoided entirely and an Ochsenbein-Luebke design chosen, or a split thickness flap for the gingival half and a full thickness flap for the apical half should be incised and

reflected. This leaves the existing attached fibers at the coronogingival aspect intact, while offering the advantages of the full thickness reflection and bone and/or lesion exposure in the apical zone.

Figs 15-4a to 15-4f By combining a full thickness flap with a partial thickness flap over a suspected dehiscence, the root apex can be exposed without disturbing the attached coronogingival fibers from the bone-denuded root surface.

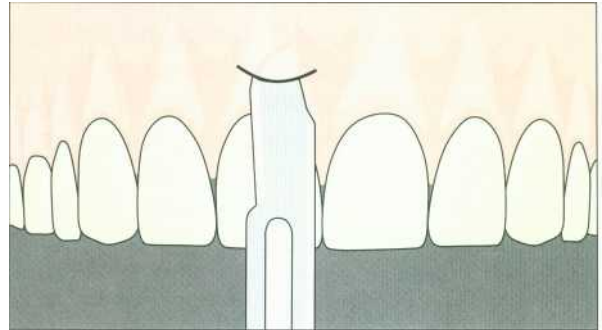


Fig 15-4a



ig 15-4b

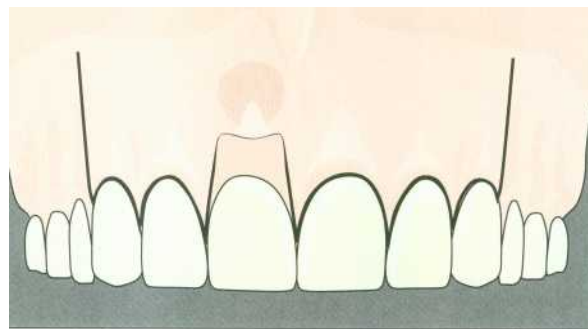


Fig 15-4c



Fig 15-4d

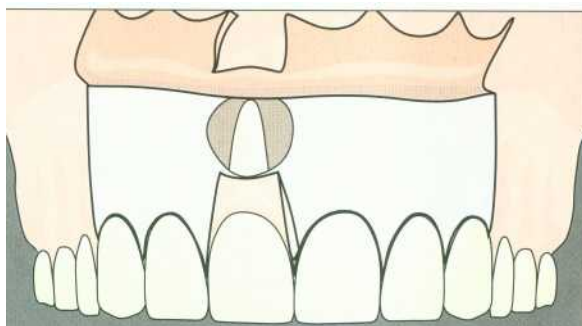


Fig 15-4e



Fig 15-4f

Problems

1. **The tissue covering a bone exostosis** or a root eminence is extremely thin and is therefore easily torn or perforated (Figs 15-5a and 15-5b). Regardless of the instrument chosen, it is imperative the working edge be sharp and kept in constant contact with the bone (Fig 15-5c). A #2/4 curette is extremely efficient in raising these delicate flaps.
2. Bleeding may be encountered and hinder visibility. A slowly readministered infiltration of a local anesthetic containing 1:50,000 epinephrine constricts most of the vessels and allows the operator to continue without major interruptions (see Lesson 23). The operator should also examine the elevator for the sharpness of its edge and concentrate on the angle of the instrument during elevation to ensure the periosteum is being lifted and not torn from its bone attachment.

Figs 15-5a to 15-5c Dull and misdirected elevators will tear tissue, lead to extensive and continuous bleeding throughout the procedure, and delay healing. The elevator edge must remain in constant contact with bone throughout the elevating procedure.



Fig 15-5a



Fig 15-5b

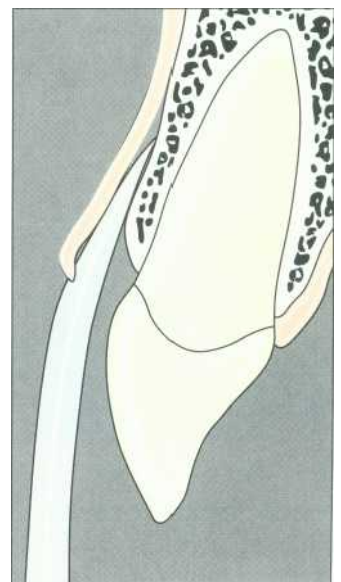


Fig 15-5c

3. **When there is a long-term, well-established epithelialized or fibrous sinus tract**, the pathologic tissue (the lesion) may have become an integral part of the submucosa and mucosa, and elevation must first be restricted to the uninvolved tissues surrounding the lesion. While an elevator, retractor, or tissue forceps are used to maintain reflection, tension is applied to the flap and a #15C scalpel blade is laid flat on the bone, inferior and/or lateral to the communicating tissues (Figs 15-6a and 15-6b). With short up-and-down cutting strokes, the blade is advanced laterally, severing the epithelialized tract. As tension to the flap is maintained, the blade is advanced parallel to the bone surface throughout the cut, and separation takes place without perforating the mucosa (Figs 15-6c and

15-6d). Once dissected, vertical elevation is continued until the flap is raised to a level that exposes the bone above and peripheral to the bone-encased lesion tissue (Figs 15-6e to 15-6f).

4. **Muscle attachments and frenum** present more psychological problems than surgical difficulties. Muscle attachments are usually high or low and easily undermined. However, the frenum is a firmly attached fibrous growth and presents unique problems when the underlying nasal spine is prominent. A small elevator (#2/4, #149) should be used to undermine the tissue on one side of the spine before the tissue is approached and freed on the opposite side. An elevator should never be applied perpendicular to the spine itself (Fig 15-7).

Figs 15-6a to 15-6f An epithelialized sinus tract lepusl will resist normal elevation forces and will require a clean dissection of the mucosd tissue from the lesion tissue before elevation can continue and the bone above the lesion can be exposed.



Fig 15-6a

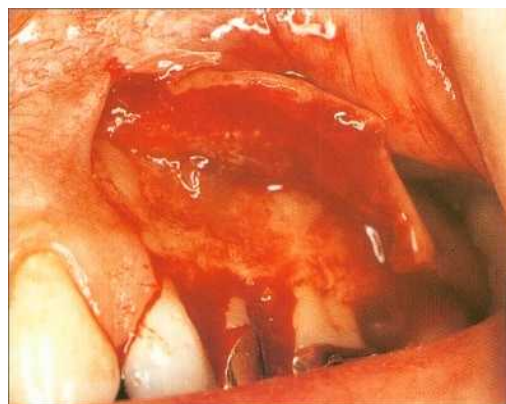


Fig 15-6b

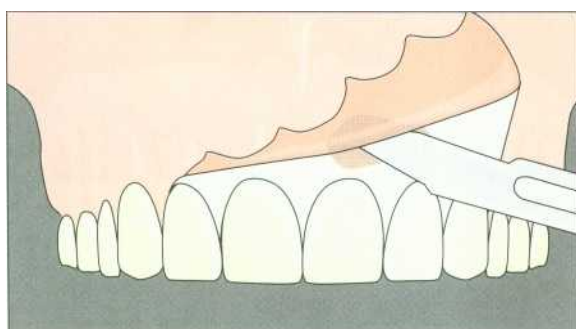


Fig 15-6c

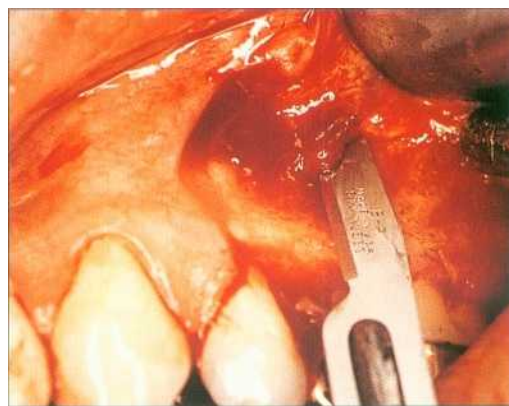


Fig 15-6d

5. Of major concern is **damage to the neurovascular bundle of vessels** that exit from either the mental foramen or the greater and lesser palatine foramina. These areas should be avoided whenever possible, but when they are involved, the surgeon's judgment takes precedence over patient apprehension and speed of treatment. Visibility must be maximized and all forces reduced to a minimum. Terminal branches of the palatine vessels are occasionally severed, but the sequela is usually uneventful. This may not be the case when the mental

bundle is injured. Therefore, it is better to locate the mental vessels intentionally rather than injure them inadvertently. The flap tissue is slowly and carefully reflected until the bundle is exposed (Fig 15-8). Once oriented, the bundle is kept in sight throughout the surgery and all instruments, retractors, and aspirators are diligently kept out of contact. During the consultation, the patient should be informed of the surgical proximity to these neurovascular bundles. The potential risk of paresthesia or anesthesia should be included in the explanation.



Fig 15-6e



Fig 15-6f

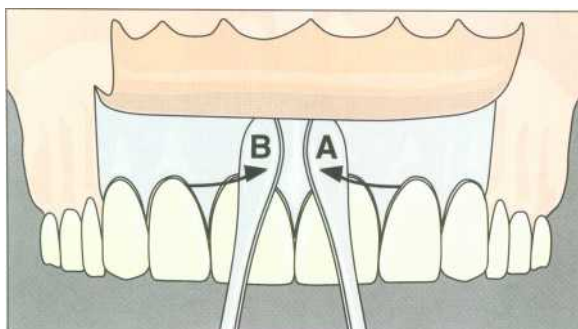


Fig 15-7 A firmly attached fibrous frenum over a prominent nasal spine is subject to tearing when elevation forces are applied. Such tissue should be elevated from each side of the spine with small elevators, and at no time should the spine be approached perpendicularly.



Fig 15-8 It is better to intentionally uncover the mandibular bundle at the mental foramen than to injure the vessels inadvertently.

6. If major resistance is met during elevation and the papillae and/or periosteum appear to **be tearing** from the bone, it usually means the angle of approach is too shallow, the incision is not sharp to the bone, the elevator edge is dull, or the surgeon has selected the wrong size or shape elevator (Fig 15-9a and 15-9b). If such resistance is encountered, the surgeon should

stop immediately. These problems are easily corrected. With minor directional adjustments and possibly a change in instrument, the balance of flap elevation can proceed uneventfully. Although residual tissue tags are a nuisance and may bleed throughout the surgery, they assist in flap readaptation and therefore should not be scraped from the bone surface.

Figs 15-9a and 15-9b If the incision is not sharp to the bone, tearing can be expected. If tearing occurs, elevation should be discontinued, the scalpel blade reinserted into the sulcus, and the crestal tissue reincised to bone.

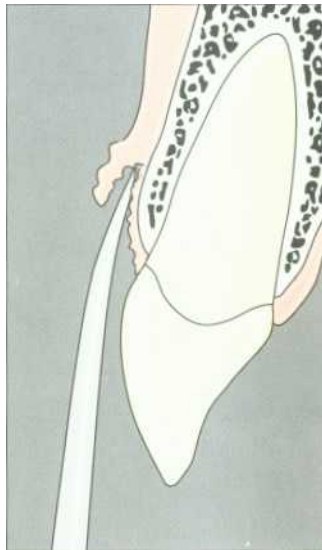


Fig 15-9a



Fig 15-9b

Retraction

Objective

To hold the flap away from the surgical site, providing maximum access and visibility, without causing harm to the flap or the surrounding tissues.

Retractors

#1 Hourigan (Hu-Friedy)

TRArens1, anterior (Hu-Friedy)

TRArens2, posterior (Hu-Friedy)

University of Minnesota CRM (Hu-Friedy)

Rubinstein selection (JEDMED)

Technique

The edge of any tissue retractor must rest on bone and not impinge the tissue of the flap or the lesion. To place a retractor properly, the flap must be elevated sufficiently to expose the bone above/below the root end and the lesion. Once the retractor is fixed firmly, the body of it should be stiff enough to hold the tissues gently out of the way (Fig 16-1).

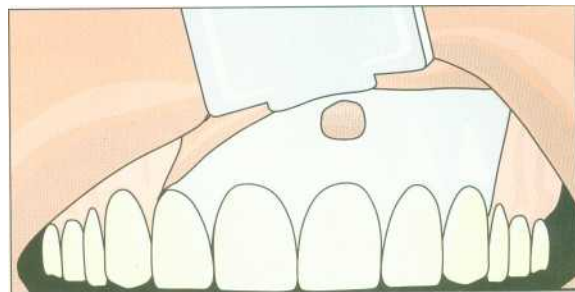


Fig 16-1 The edge of the retractor must rest on bone and not impinge on tissue.

Problems

- 1. Slippage.** At times when the bone topography (anatomic convexities and concavities) interferes with retractor stability, a shallow horizontal slot the width of the leading edge of the retractor is cut into bone above/below the lesion with a small (#1 or #2) round bur. This ridge provides a secure, positive seat to position and maintain the retractor throughout the surgery (Fig 16-2).
- 2. Lip and cheek.** Most retractors adequately reflect the flap, but are incapable of preventing the lip or cheek from encroaching on the site. These strong facial muscles restrict the view, tiring the operator. The instrument designed by Arens offers a small retracting tip for the flap and a wide body that is capable of restraining the facial tissues, muscles, and lips, while reflecting light and preventing operator fatigue (Figs 16-3a and 16-3b).



Fig 16-2 A horizontally prepared slot in the bone above the lesion will secure a retractor in place.

Figs 16-3a and 16-3b The TRArens retracts the flap, lip, and cheek simultaneously.



Fig 16-3a



Fig 16-3b

3. Impingement. At times, either the operator or the patient may intentionally or unintentionally make a move that causes the retractor to shift and impinge the flap fold. If this injury restricts the blood flow to the elevated tissue for any length of time, ischemia, slough, and scar result. The operating site and the position of the retractor must be monitored constantly by the surgeon and the assistant to avoid this controllable mishap (Fig 16-4).

4. Tension. The size and location of the flap depth of the vestibule, thickness and musculature of the lips and cheeks, length of roots, and size of the lesion can individually and collectively offer resistant forces significant enough to cause stress to the reflected tissues and fatigue the operator. To relieve this tension, it is important to recognize the importance of a secondary relaxing incision (Figs 16-5a to 16-5c; see Lesson 13).

5. Dryness. There is a strong tendency for the soft tissue to lose moisture when reflected over long periods of time. Periodically, the flap should be loosely repositioned and bathed and/or blotted with heavily moistened gauze squares.



Fig 16-4 The clinician and the assistants must constantly monitor the position of the retractors at all times to avoid injuring the flap during the surgery.

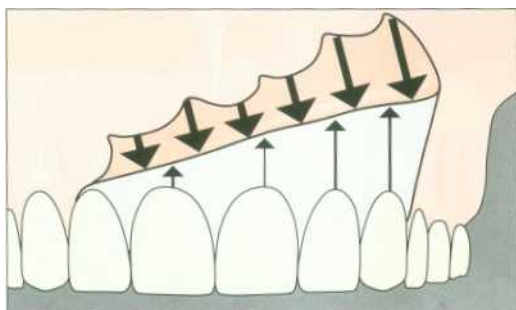


Fig 16-5a

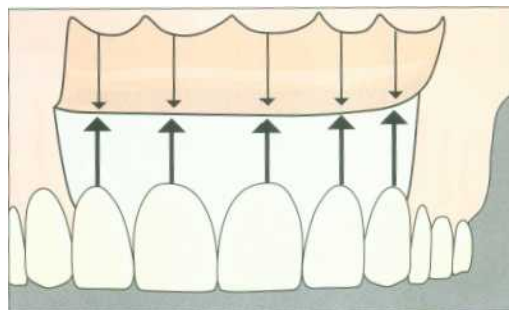


Fig 16-5b

Figs 16-5a to 16-5c
All retracting resistant forces are virtually eliminated by modifying the intrasulcular flap with a relaxing vertical incision.



Fig 16-5c

Osteotomy

Objective

To remove sufficient bone to positively identify the target root and expose the root tip or a root surface defect and create adequate access to the lesion for its removal.

Instruments

Air King America surgical 45° handpiece (Medidenta), or Impact Air 45° (EIE Analytic Technology)

Surgical carbide burs for straight or high speed (Brassler, SS White)

#6, #8 round and long shank

#402 rounded taper

#408 rounded taper

#2/4 Molt DE curette (Hu-Friedy)

H161 Tapered fissure Lindemann bone cutting bur (Brassler)

H162 X-Cut tapered Lindemann bone cutting bur (Brassler)

Stropko irrigator/drier and 27- or 30-gauge needle (EIE Analytic Technology)

Fiber-optic system (Quality Aspirators)

Technique

More often than not, the bone covering a lesion is partially or totally eroded (decalcified). This offers an opportunity to positively identify the root by simply removing the overlying soft bone with the #2 end of the #2/4, an H161 Lindemann bone cutter, and/or a #6, #8 bur gently rotating at slow speed. The window in bone should be sufficiently enlarged to offer full access to the target area and peripheral walls of the defect (Figs 17-1 a to 17-1e). Under normal circumstances, a slow-speed approach with a large round bur and an accompanying water spray is a consistently safe, efficient, and controlled method of removing bone.

When confronted with thick, dense bone commonly found in the mandibular posterior molar region, light brush strokes with long-shanked round burs rotating at high speed are less traumatic, reduce vibration, decrease penetration time, and lend themselves to overall patient comfort. However, high-speed cutting should be done judiciously, and only with an Impact Air 45° or Air King America surgical handpiece with an ample water or saline spray. As the bur approaches the depth of the bone cavity, visibility will be compromised; therefore, surgical progress should be frequently inspected.



Fig 17-1 a



Fig 17-1 b



Fig 17-1 c



Fig 17-1 d

Figs 17-1a to 17-1 e The bone covering a lesion is often thin and requires only a curette to expose the lesion (a and b). Once penetration has occurred, the window can be widened to expose the target root (c and d). This is particularly important when dealing with small molar lesions where the buccal bone is dense and the target apex more difficult to identify (e).



Fig 17-1 e

Problems

1. Locating the target root and lesion may pose a problem when the overlying bone is dense and intact. Prior to penetrating the overlying bone to a depth that places the target or adjacent roots in peril (Fig 17-2a), it is best to approach the entry level by one of the following methods:

- Approximating the root length from a high-quality parallel radiograph.
- Interpolating root length and angle distortion from a predetermined endodontic file measurement (Fig 17-2b).
- Computing the length from a digitally produced image (Fig 17-2c).
- Comparing a radiograph taken of a small piece of sterilized gutta-percha or lead foil (from a radiograph packet) that has been placed in a small hole drilled at the approximate root tip location (Fig 17-2d).



Fig 17-2a

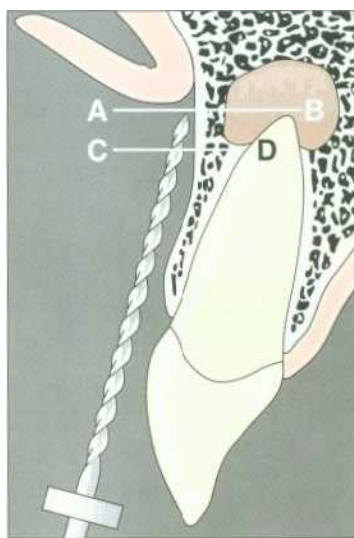


Fig 17-2b



Fig 17-2c



Fig 17-2d

Figs 17-2a to 17-2d When the bone exposing a lesion is dense, misdirected penetration may lead to root damage ~a~. Root length may be approximated from a prior radiograph or an intracanal file measurement |b|; digitized from a radiograph (c~; or guided by a radiograph of a surgically placed lead foil indicator |d|.

Once entry orientation is ascertained, the surgeon can proceed toward the target root with confidence.

2. **Obstructions** often hamper visibility. To maintain a clear view, the flap, lip, cheek, and tongue are elevated, reflected, or retracted, and blood, water, and debris are curetted and/or aspirated from the surgical field.

Conventional high-speed handpieces also may obscure visibility. Their right-angle (90-degree) entry can be a major liability in the molar region, particularly when the bur reaches its maximum penetration depth. This problem can be resolved by fully extending a surgical-length carbide bur from a conventional slow-speed straight handpiece. This extra length will take the body of the handpiece out of the line of sight (Fig 17-3).

For areas of dense bone, manufacturers offer the surgical 45-degree high-speed handpiece. This autoclavable, fiber-optic surgical handpiece not only offers a unique 45-degree head to shank angle, but forces the air out the back of the handpiece, minimizing the potential for an air embolus. This angle of entry is particularly advantageous for posterior surgical sites and when using a microscope.

3. **An inadequate cooling system** can impair healing. A rotating bur must be accompanied by a constant water or saline flow to prevent frictional heat buildup and subsequent osseous necrosis. The Stropko irrigator with an attached 27- or 30-gauge needle provides a fine stream that can be directed into small compromised spaces (Fig 17-4). This is particularly important as penetration deepens and water access to the bur and bone decreases. Although high-speed evacuation systems are essential in clearing the field, care must be used to avoid aspirating the coolant before it reaches its objective.
4. Any time a conventional air-driven handpiece is used, the risk of **emboli and pyemia exists**. These dangers can be avoided by using the previously mentioned sealed-air or electrically and nitrogen-driven handpieces that direct neither air nor lubricants to the surgical site during use.

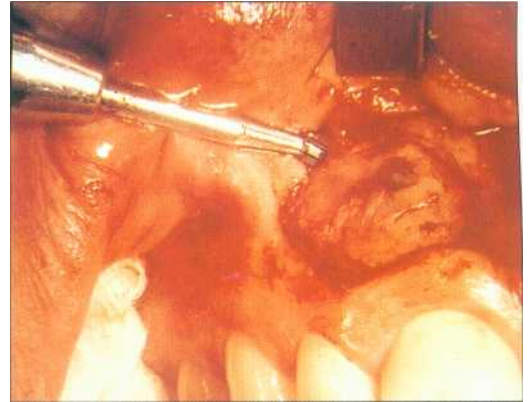


Fig 17-3 A straight surgical length bur and/or a 45-degree contra-angle is less likely to obstruct visibility during the bone removal process.

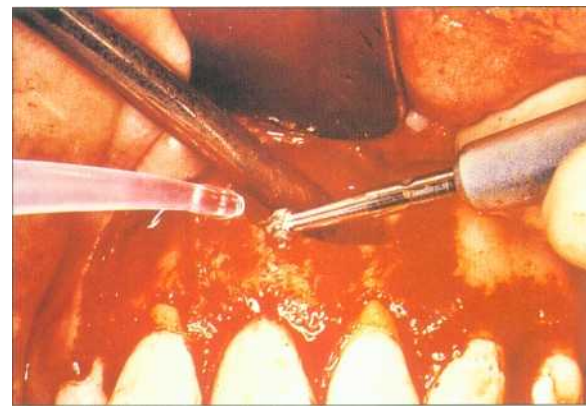


Fig 17-4 All bone removal procedures should be accompanied by a continuous water spray and adequate aspiration.

Curettage

Objective

To remove all pathologic tissue, foreign bodies, and root and bone particles from the periradicular area.

Instruments*

Curettes

#17/18 IU DE curette

#13/14 Columbia DE curette

#2/4 Molt DE curette

#85, #87 Lucas DE surgical curette

Allison baby tissue forceps

Kramer-Nevins tissue pliers

Kelly-Rankin hemostat

#31/32, #34/35 Jaquette scaler

*All from Hu-Friedy.

Technique

Although the typical curette is shaped like a spoon and there is a tendency to use it as such, the sharp edge created when its concave surface faces bone makes it an extremely efficient cleaver.

With the *concave* surface facing bone, the appropriate sized curette is wedged between the soft tissue of the lesion and the border of the window entry. The sharp edge of the instrument is kept in constant contact with the bone as it penetrates the bone crypt (Fig 18-1 a and 18-1 b). This cleaving motion easily strips the tissue from

its bone attachment. Under normal conditions, little or no resistance will be met and the relatively soft tissue will easily disengage from the bone.

Once the lesion is freed from the bone the curette can, with its *convex* surface facing bone, be used as a spoon to easily lift and remove the specimen from the crypt (Figs 18-1 c to 18-1 e). The walls of the bone cavity should appear smooth and free of all tissue tags. The specimen is immediately placed into a properly labeled biopsy bottle (see Lesson 19).



Fig 18-1 a



Fig 18-1 b



Fig 18-1 c

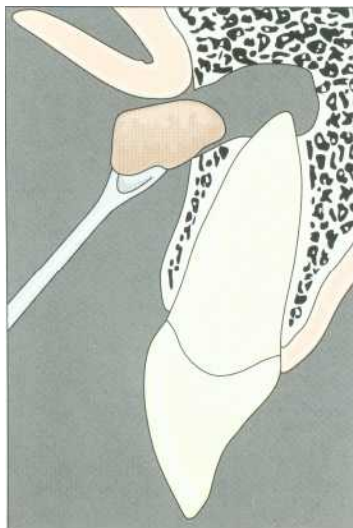


Fig 18-1d

Figs 18-1a to 18-1 e With the concave surface of the curette facing bone, the lesion is stripped from the crypt wall la and bl, spoon freed with the convex side to the bone, and removed from its site (c to e~). The specimen is immediately placed in a biopsy bottle for histologic evaluation.



Fig 18-1 e

Problems

1. When there is resistance to lesion tissue removal, it usually means the **granulation tissue is firmly attached** to the lingual aspect of the root surface (Fig 18-2a). In this case, it is better to gain unconfined access to the condition by widening the osseous window than to continue with a restricted, laborious, inefficient, and time-consuming segmental curettage.

With greater access, a curette is better able to approach the depth of the lesion and free the lingual attachments. Such access also affords an opportunity to reach the lingual root surfaces using periodontal scalers and curettes of various sizes and angles. The lesion tissue and any surviving periodontal membrane can be scraped free of the root with a normal planing motion, lifted from the crypt with a curette, and included in the biopsy (Figs 18-2b to 18-2d).

Figs 18-2a to 18-2d When lingual root adherence resists being removed from the buccal aspect, appropriately sized and angled periodontal curettes can be inserted lingual to the root and used in a planing motion to strip the tenuously attached tissues from the root wall and crypt depth. Lucas curettes can then be used to easily lift the specimen from its bed.

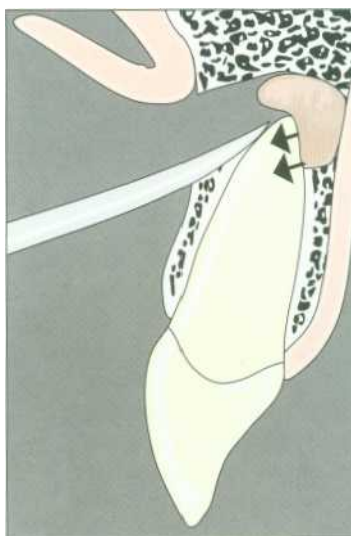


Fig 18-2a



Fig 18-2b



Fig 18-2c



Fig 18-2d

2. When further resistance is met in the depth of the crypt, it generally indicates **the lesion tissue has perforated the lingual plate of bone** and has communicated with the palatal mucosa through the opening in the bone wall. This integration can be verified by placing a finger against the lingual mucosa that approximates the lesion location and physically feeling the curetting action within the depth of the crypt. To avoid perforating the mucosa, the innermost segment of the lesion requires delicate dissection.

Allison forceps or Kramer-Nevins pliers are used to firmly grasp the lesion tissue. The under-surface attachment becomes more visible and accessible as a gentle but firm extracting force is applied. The communication then can be separated easily with a scalpel blade and removed from its bed (Figs 18-3a to 18-3c).

Figs 18-3a to 18-3c A lingually attached lesion that continues to resist removal may be communicating with the lingual mucosal tissues. To avoid perforation, it will be necessary to separate these tissues by firmly grasping the lesion with tissue forceps and carefully dissecting the tissues apart. Once freed, the tissue can be removed from its bed.

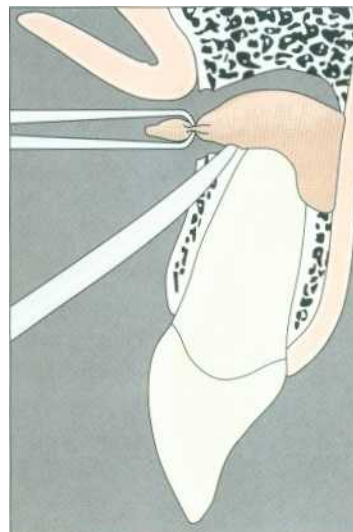


Fig 18-3a

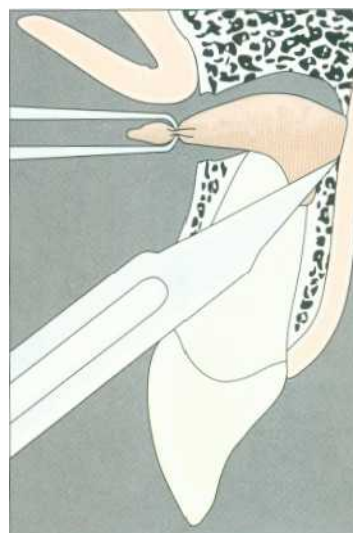


Fig 18-3b



Fig 18-3c

3. When resistance continues and **periodontal planing and scalpel dissection has been unsuccessful in freeing the lesion**, a 2- to 3-mm segment of the apex should be resected, and the tip and any adhering tissue removed and included in the biopsy. This technique is efficient and, because this root segment would normally be removed during the apicoectomy procedure, its loss is of no consequence (Figs 18-4a and 18-4b).

4. **Curetting large lesions** often presents anesthesia problems. When a patient complains of pain during curetting of extensive lesions, the procedure is stopped and the patient is reanesthetized. The area to be anesthetized in such cases must be extended beyond what would be considered the normal range. For example, the usual geographic area infiltrated to anesthetize a maxillary lateral incisor comprises those soft and hard tissues innervated by the anterior superior branches of the maxillary division of the 5th cranial nerve, along with the corresponding branches of the nasopalatine nerve. Unfortunately, this often proves to be inadequate in providing anesthesia to the depth of large bone cavities.

Although intralesion and intraosseous injections would appear to be the easiest solution, they are often painful and ineffective. Greater success can be achieved by reanesthetizing the area innervated by the anterior superior nerves and including both the middle and posterior branches of the maxillary division and the greater palatine nerve in the regimen.

If the pain is not relieved, the patient may be experiencing an epinephrine rebound effect, in which case reanesthetizing with local anesthetic may be ineffective. Continuing the surgery under these stressful conditions can lead to a loss of quality, an incomplete objective, and an unhappy patient. It is best to abort the procedure, reposition the flap, and suture. The reasons for discontinuing the surgery should be explained to the patient in detail, alternative treatments should be offered, and the records should contain comprehensive information regarding the complications leading to the discontinuance and how the problem was resolved.

Regardless of the reasons, the inability to provide adequate anesthesia creates anxiety and apprehension for both the patient and the dentist. Conscious or unconscious sedation techniques should be considered when the patient returns to complete the treatment plan (see Lesson 11).

Figs 18-4a and 18-4b Resecting the root and removing both the apical tip and the attached lesion tissue simultaneously is most efficient.



Fig 18-4a



Fig 18-4b

Biopsy

Objective

To establish a definitive diagnosis by removing a tissue specimen from its bed and submitting it to an oral pathologist for a histologic evaluation.

Note

If tissue warrants removal, it warrants diagnosis. At no time should a surgeon remove tissue and accept the responsibility of its diagnosis based on its appearance, color, or consistency.

Instruments and Materials*

#85 and #87 Lucas DE surgical curettes

#2/4 Molt DE curette

#9 Miller curette

#17/18 IU DE curette

#13/14 Columbia DE curette

Allison baby tissue forceps

Kramer-Nevins tissue pliers

*From Hu-Friedy, except as noted.

III: Surgical Techniques

- #15C Scalpel blade (Bard-Parker) and handle
- #18 Iris scissors, curved
- Specimen bottle with 10% formalin (mailing case available from most pathology laboratories)

Technique

Once the specimen has been freed and removed from its site (see Lesson 18), it is immediately placed in a properly labeled bottle of 10% neutral buffered formalin. Such specimen bottles are available on request from most oral pathology diagnostic centers. If a bottle of formalin is unavailable, alcohol may serve as a substitute. Water is unacceptable. The label should include the following information:

- Both the doctor's and the patient's names
- The date of the sample
- A brief description of the contents (eg, tissue, bone, tooth, root)

The specimen should be accompanied by a detailed report of the case (Fig 19-1) and delivered to the pathology laboratory without delay.

Once the pathologist's report is received, the patient should be informed of the results. This relieves his or her apprehension, and the dentist/patient relationship is enhanced by the prompt attention and a compassionate attitude.

Problems

1. **A too-small, torn, or mutilated specimen** may lead to a false diagnosis. It is the dentist's responsibility to provide a tissue sample that gives the pathologist the greatest opportunity to arrive at an accurate diagnosis. For this reason, every effort should be made to remove the lesion in its entirety.
2. If, during the surgery, the lesion's size, color, texture, or other **characteristics seem suspicious**, the pathologist should be notified and a request made to expedite the diagnosis.
3. **If the biopsy indicates a malignancy**, further examinations, tests, and surgery may be indicated. The patient should be referred to a qualified oral and maxillofacial surgeon or oncologist for more comprehensive follow-up treatment.
4. **The dentist should not hesitate to refer** if he or she becomes concerned, confused, or suspicious of patient reactions or responses that might indicate systemic complications.
5. Patients can be billed for the entire biopsy service (surgical excision and pathology expense) on a fee-for-service basis, or the services can be separate, in which case the pathology laboratory assumes the collection responsibility with the patient. This must be clearly explained to the patient. **Because both offices may file insurance claims**, explanations of their individual roles must be clear when filed, or the claim may be delayed or denied.

For those patients who have multiple dental and medical insurance coverage, claims can be made and collected from more than one carrier. However, total reimbursement cannot legally exceed the fee filed. Accepting full payment from two or more carriers for the same service is fraud and punishable by fines, prison, or both.

Fig 19-1 Sample Biopsy Report Form

Dental Office Name:			
Dentist / Surgeon:			
Address:			
City, State, and Zip Code:			
Phone:			
Fax:			
LAB USE ONLY			
Path #:		Date Received:	
BIOPSY INFORMATION			
Date of Biopsy:			
History of Lesion:			
Duration of Lesion:			
Biopsy Site:			
Clinical Description:			
Radiographic Description:			
Surgical Procedure:			
Provisional Diagnosis:			
PATIENT INFORMATION			
Patient Name:			
(last)		(First)	
(Middle)			
Address:			
(Street)		(City)	
(State)		(Zip)	
Home Phone:		Social Security #:	
Date of Birth:		Sex: F M	
Bill to: 0 Patient 0 Doctor		J Insurance	
Insured:		Relationship: D Self 0 Spouse 0 Other	
Insurance Company Name:			
Address:		ID/Policy #:	
(Street)		(City)	
(State)		(Zip)	
Patient Signature:		Date:	
SURGEON INFORMATION			
Submitting Surgeon:			
Address:			
(Street)		(City)	
(State)		(Zip)	
Phone:		Fax:	

Apicoectomy

Objective

To expose the foramen/canal for inspection by sectioning the apical segment of the root and/or beveling it to the line of sight.

Instruments

Handpieces

Straight (for slow speed; Medidenta)

Air King America (for high speed; **Medidenta**)

Carbide surgical burs, extended length (SS White, Brassler)

#557 and #558 fissure

#701 tapered fissure

#402 rounded taper

#408 rounded taper

Hand instruments (EIE Analytic Technology)

CM1-3 retromirrors

EXD1 microexplorer

CX-1 microexplorer

Technique

The window in bone should be adequate to offer a direct line-of-sight view of the apex (Figs 20-1 a and 20-1 b). Although the root apex can be removed with a round bur, a noncutting-tip fissure bur is far more efficient (Fig 20-1c). The amount of root to be removed is relative to the degree needed to clearly identify and examine root exits, zips, perforations, and isthmi, and at the same time to offer a surface wide enough to support a Class I cavity preparation (Fig 20-1 d).

Figs 20-1a to 20-1 e The extent and direction of bone removal and root resection is relative to the line-of-sight access needed to visually examine, explore, and identify root exits, isthmi, perforations, and endodontic obturations. The more posterior the target is, the more mesial the approach bevel must be.

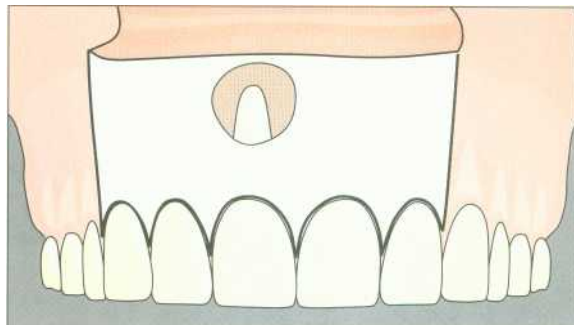


Fig 20-1 a



Fig 20-1 b



Fig 20-1 c



Fig 20-1 d

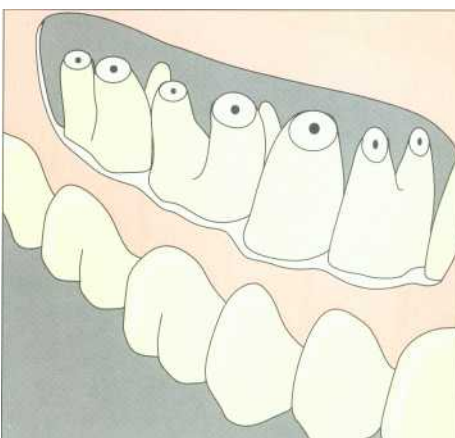


Fig 20-1 e

Problems

1. **Predetermining access needs** is an essential dictate of flap design. Poorly placed vertical and horizontal incisions can not only be confining, but also offer few alternatives to improving the dimensions of the surgical field during the procedure. When designing the flap, the size of the lesion or the location and angulation of the root should never be underestimated (see Lesson 13).

Once the flap is retracted, the first approach is to gain access to the root by increasing the size of the bone window. This is not a problem unless the flap design was inadequate and extending the window would encroach on the vertical or horizontal incisions.

2. **Additional visibility and access may** also be gained by increasing the lingual-to-labial angle of the apical resection. Because the operator must maintain a direct line of sight to the beveled surface throughout the surgery, the more posterior the surgical approach is, the more mesial the bevel must be (Fig 20-1 e). However, it must be understood that as the severity of the angle changes, the shape of the apical exit also changes from round to oval (Fig 20-2a). This critically exposes a greater number of dentinal tubules (Fig 20-2b). According to Gilheaney et al (1994), "the more severe the bevel angle (0 to 45 degrees), the deeper the retropreparation must be to consistently produce a quality retroseal" (see Lesson 25).

The best, albeit most costly, way to enhance visibility is to incorporate high levels of magnification into the armamentaria. Although no studies have been published to prove use of the surgical microscope improves quality, it is generally accepted that the better the visibility, the better the performance (see Lesson 28).

Figs 20-2a and 20-2b The severity of the cutting angle changes the exit shape from round to oval, exposes the dentinal tubules to leakage (b, A_4131, and adversely affects the consistency of the retropreparation depth and the efficiency of the retrofill.

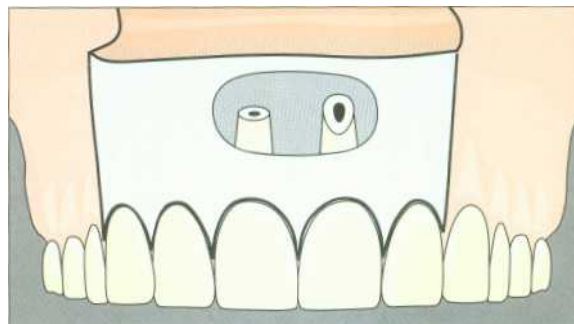


Fig 20-2a

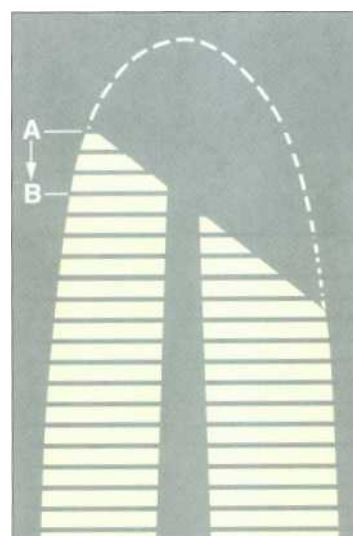


Fig 20-2b

3. **When dealing with roots that have a high incidence of second canals and isthmi**—such as mandibular incisors (41 %), mandibular premolars (29%), mesiobuccal root of maxillary first molars (65%)—a more severe angled cut may be necessary to maximize root exposure. Magnification and retromirrors are of immense help in diagnosing these root end variables and reduce the need to sacrifice root length. As a general rule, roots known to have such anatomic inconsistencies should be considered multiple canal candidates for retrofill (Figs 20-3a to 20-3c).
4. **When confronted with unusually short or apically resorbed roots**, reduction should be kept to a minimum and every effort should be made to preserve the already threatened crown-root ratio.
5. **It is not necessary to reduce root length to the level of an incomplete fill**, perforation, or lateral wall resorption. Root resection should be as conservative as possible. The unfilled pulp space should be managed by re-treating the root canal conventionally and/or managing the remaining deficiencies with efficient retrorepair ultrasonic techniques.
6. **It is not unusual to be challenged by root end curvatures that exceed 45 degrees** and canals that have major deviations in their anatomical exits. These roots may require more than normal root reduction before a positive foramen identification can be made (Fig 20-4).

Figs 20-3a to 20-3c As the level of root resection changes, a corresponding change in the internal canal anatomy can be expected. This is particularly crucial in teeth suspected to have multiple canals.



Fig 20-3a

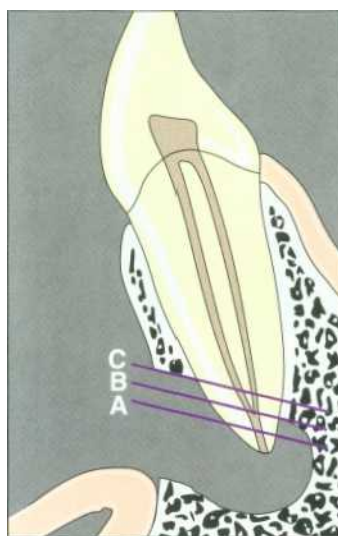


Fig 20-3b

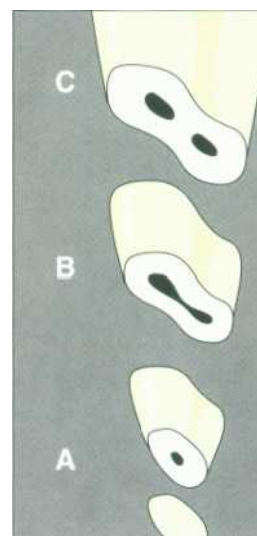
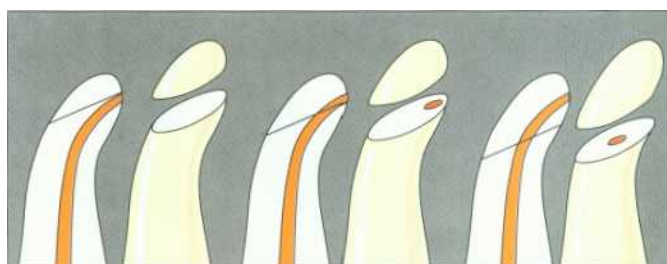


Fig 20-3c

Fig 20-4 Due to common apical, anatomical, and canal deviations, root resection must be continued until a positive apical exit identification is made. Most canals exit lateral to and short of the anatomic root length.



7. Residual root extensions or fragments invite foreign body reactions and failure.

A flap should never be sutured in place until a radiograph confirms root tip removal, as well as soft tissue and crypt cleanliness (Fig 20-5). When a foreign body cannot be located in the surgical field but continues to show on radiographs, it may be embedded in the lip or cheek pouch. A radiograph taken with the film placed between the lip and the bone may solve the mystery (see Lesson 41).

8. Root resection poses a problem when roots approximate major anatomic structures such as the nasal passage, maxillary sinus, anterior or posterior palatine canal, mandibular canal, and mental bundle.

9. Critical mandibular areas and vessels can be avoided by selective bone removal, exposing greater root length, and sectioning the target root 3 to 4 mm above the apex. This same approach is equally advantageous when confronted with long, lingually diverged mandibular incisors, canines in patients with prominent chins, and the palatal roots of patients with shallow palatal vaults (Figs 20-6a to 20-6d).



Fig 20-5 A flap should never be sutured in place after an apicoectomy until a postsurgical radiograph confirms the absence of foreign bodies from bone and/or soft tissue.

Figs 20-6a to 20-6d The neurovascular bundle is first located and isolated. Facial bone is carefully removed until the offending root is exposed superiorly to the vessels. The bone window can then be safely enlarged, and to positively identify the target root, a small indicator cut is made in the root and confirmed with a radiograph. Once oriented, root separation is completed and the tip is elevated and removed without injury to the vessels.

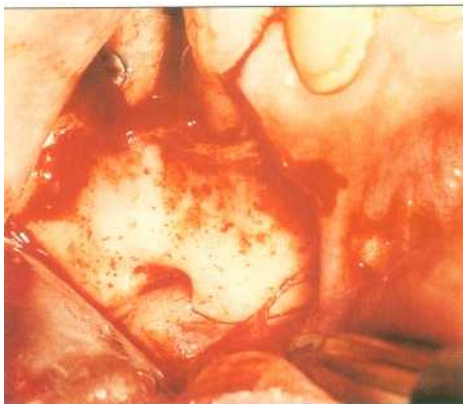


Fig 20-6a



Fig 20-6b



Fig 20-6c

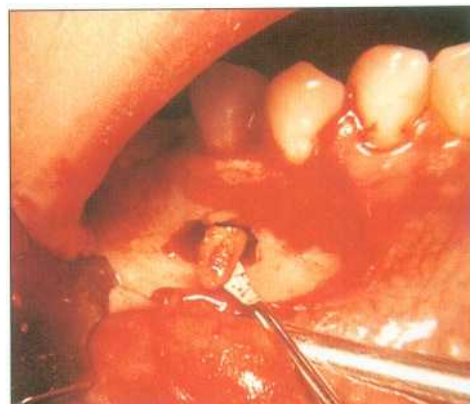


Fig 20-6d

10. Because the sinus varies in size and location, the possibility of **exposure or perforation of the schneiderian membrane** should be an anticipated risk of maxillary surgery. Under normal conditions and circumstances, this situation poses a problem only when the flap design allows an oral communication to exist postclosure, when foreign bodies such as bone, root, filling material, bone wax, cotton pellets, or gauze are inadvertently pushed or washed into the depths of the sinus and are irretrievable; or when surgical asepsis has been violated during the procedure.
11. **Particulate that has entered the sinus** may be retrieved by enlarging the sinus opening and extracting the object with Kramer-Nevins pliers, cotton pliers, or a small-tipped rubber-protected aspirator (Figs 20-7a and 20-7b). Magnification enhancement (eg, x 4.5 to x 30) is invaluable, as is the use of ancillary lighting such as a headlamp (Orascopic Research, Inc) and fiber-optic instrument attachments (Quality Aspirators). If removal is not confirmed radiographically (Fig 20-7c), and the object is considered irretrievable, the operator should cleanse the surgical site, complete the endodontic treatment, reposition and suture the flap, explain the situation to the patient, and refer the patient to an otorhinolaryngologist for a Caldwell-Luc procedure.
12. **Antibiotic therapy** should be considered on a case-by-case basis when there is a sinus communication. Although there is no evidence to indicate antihistamines are helpful, anti-inflammatories have been found to be especially beneficial when given pre- and postsurgically (see Lesson 31). The patient should be instructed to avoid activities that could cause any sinus pressure buildup during the recovery period, such as blowing up balloons, sneezing with the mouth closed, and so on.
13. **Long palatal roots** require greater access and visibility, but the surgical principles remain the same as for any other area of the mouth.
14. **A shallow palate** is difficult to retract, places the palatal vessels in peril, requires extensive bone removal, restricts visibility, elevates stress for the operator, and increases the possibility of palatal detachment and slough. In such cases, a transantral approach to the palatal root is recommended. An extraction and replantation procedure should be considered as a last resort (see Lesson 42).

Figs 20-7a to 20-7c Foreign bodies in the sinus may be retrieved by enlarging the bone entry and carefully vacuuming the particles) with an appropriately sized fiber-optic aspirator tip. To prevent further injury to the sinus floor, the tip of the aspirating instrument should be covered with a soft rubber sleeve.



Fig 20-7a

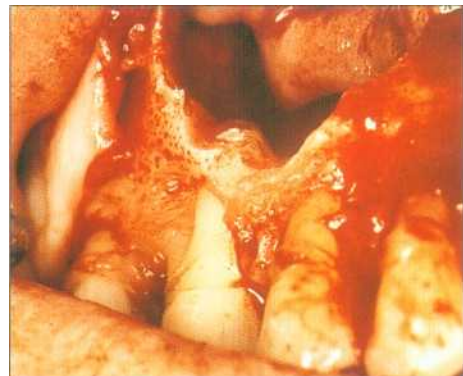


Fig 20-7b



Fig 20-7c

Apical Approach to the Palatal Root

Objective

To meet the access and anatomic challenges of palatal surgery by altering and/or compromising many of the surgical movements during the procedure.

Technique Adjustments

Anesthesia

Appropriate labial or buccal infiltration of anesthetic should be administered for the facial operative site. Greater and lesser palatine injections of a few drops of anesthetic provide ample anesthesia for the entire palate. Overzealous or injudicious administration of local anesthetics, particularly those with high levels of epinephrine, in the palate can cause ischemia and slough.

Flap design

Because access is of prime importance, the best approach is the lingual intrasulcular flap with one or two vertical relaxing incisions in areas where palatal vessel size is smallest. The anterior incision should begin at the mesiolingual line angle of the premolar, or the distolingual line angle of the canine, follow a straight apical course on the palatal wall, and end just before the vault-wall junction. The posterior vertical incision may begin from the distal line angle of the last existing molar, travel posteriorly along the pad, and be as long as

necessary. Alternatively, but with risk, it may proceed apically along the lingual wall, carefully approaching the vault junction and the greater palatine vessels (Fig 21-1; see Figs 14-11 a and 14-11 b).

Elevation and reflection

The palatal tissue and periosteum are far more difficult to release than the labial or buccal mucosa and periosteum. It is essential the operator guide the concave tip of the elevator against bone. Any misdirection of the force could prompt the instrument to slip off the bone and cause serious injury. Careful dissection of the periosteum with a scalpel to free the tissue from the rough, irregularly surfaced bone of the palate is not an uncommon procedure. However, this may cause tissue cuts, tears, and perforations, which may further complicate reflection and make replacement an even greater challenge. Fortunately, the extraordinary vascularity of the palatal tissue provides an excellent environment for healing, and post-operative complications are rare. Once the tissue has been reflected, it is essential to maintain constant visual contact with the surgical site (see Lesson 15).

Retraction

All commercially available retractors are poorly designed for use on the palate and, as a result, retraction of this tough, leathery tissue with small elevators or curettes tends to cause the operator fatigue and frustration. Retraction can be accomplished easily by sling suturing the flap to the opposite arch. This not only provides an uninhibited view, but, by eliminating the retractor, leaves the operator's hands free to manipulate instruments and a hand-piece simultaneously (Figs 21-2a).

Osteotomy

The initial approach to the root through bone should be well above the root apex (Fig 21-2b). This point of entry can be determined by estimating the root length from a preoperative radiograph and allowing a variance for angulation. Periodic orientation may be necessary (see Lesson 17). As soon as the root surface is contacted, the root is slowly denuded of bone until the apex is exposed. At this point, routine apicoectomy and root tip removal procedures may proceed as usual (Figs 21-2c and 21-2d).



Fig 21-1 Sufficient access to the palatal apex can be gained by joining a horizontal intrasulcular incision with a primary vertical incision that extends from the mesial angle of the first premolar, and by adding a secondary relaxing posterior vertical incision that terminates short of the palatine vessels.

Figs 21-2a to 21-2d Once the flap is elevated, retraction is easily accomplished by sling suturing the reflected tissue to the opposite arch, removing bone, and locating the lingual root. After the root has been positively identified, the lingual surface is denuded of bone, the apex is exposed, and normal root resection and removal procedures are followed. The flap is repositioned and sutured in place, and to prevent tissue-bone interface and fluid accumulation, finger pressure is applied and maintained for a minimum of 5 to 10 minutes.

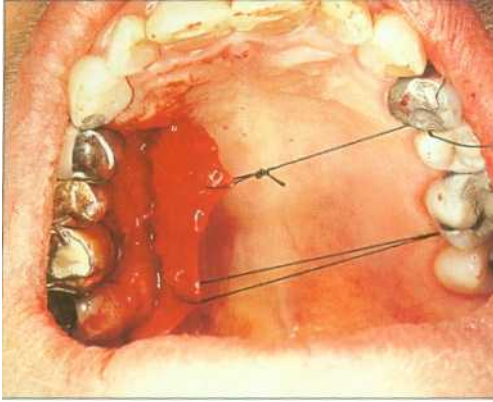


Fig 21-2a

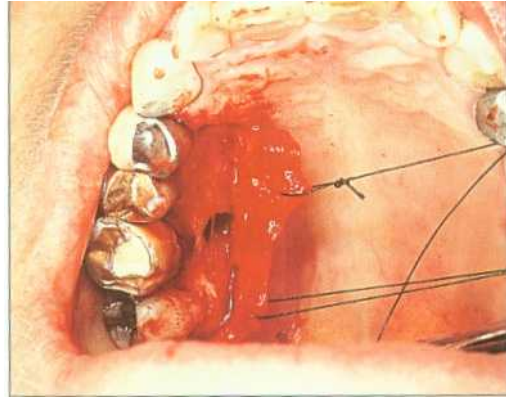


Fig 21-2b

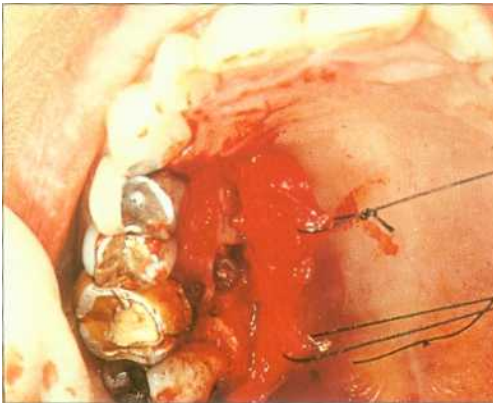


Fig 21-2c

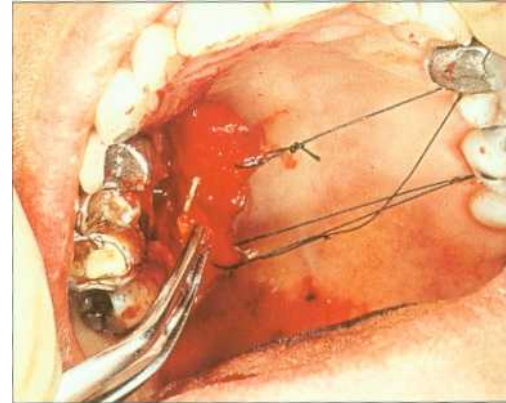


Fig 21-2d

Closure

Once the apicoectomy and any necessary retroprocedures are completed, the flap is repositioned and secured with a continuous sling technique. After the sutures have been placed, constant finger pressure should be applied to the replaced palatal flap for 5 to 10 minutes. This helps prevent a buildup of blood between the bone and the tissue, which could cause the palate to sag or droop. The accumulation of fluid would interfere with the normal reattachment process and the palatal tissue involved would subsequently slough. If the surgeon suspects such an outcome might occur, a stent should be made ahead so it is available, if needed, at the time of surgery.

Transantral Surgical Technique

Initial approach

The procedures for a buccal approach to the maxillary molars—that is, incision elevation and so on—are initiated and the buccal roots are resected, repaired, and retrofilled as usual (Figs 21-3a and 21-3b).

Osteotomy

Bone is slowly removed between and/or above the buccal roots until the palatal root can be clearly identified. When operating in the crypt depth, visibility, magnification (preferably at levels at or above $\times 8$), and enhanced lighting (headlamps by Orascope and/or fiber-optic instrument attachments) are essential.

Figs 21-3a and 21-3b In the buccal approach to the palatal root, the facial flap is reflected and the buccal roots are exposed and resected. The bone above the buccal roots is removed until the palatal root is exposed and positively identified, and the buccal surface of the lingual root is denuded of bone until the apex is exposed. Routine apicoectomy and root end preparation and filling procedures can then follow.

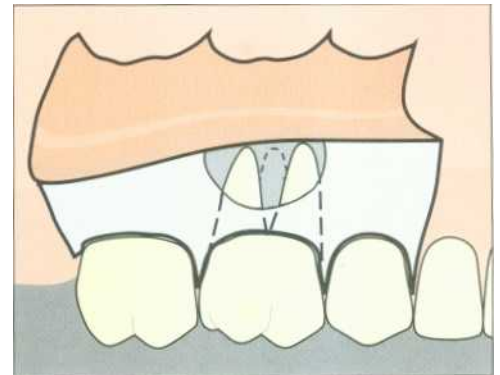


Fig 21-3a

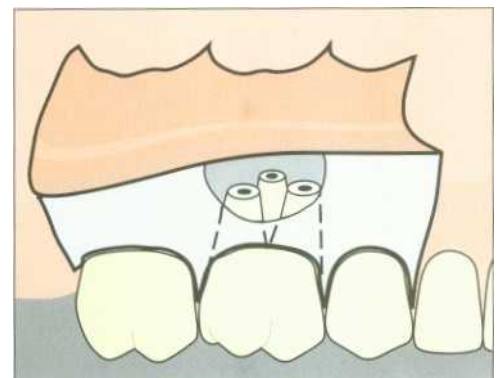


Fig 21-3b

Apicoectomy

Once the root is located, the bone interface is denuded apically until the root tip is located. During this phase, the sinus floor may or may not be perforated. This does not preclude success unless root, bone, or debris enters the depths of the sinus and becomes irretrievable. In an effort to prevent such an occurrence, the apicoectomy should be accomplished by reducing the root tip rather than separating it and risking its dislodgment. With a #6 round bur mounted in a slow-speed straight or a surgical 45-degree handpiece, and controlled irrigation from a 30-gauge needle attached to a Stropko irrigator (EIE Analytic Technology), the apical 3 mm of the root is slowly ground (apically/coronally) away. The bone window may need to be enlarged beyond the normal dimension to accommodate the instruments, the bur, and the aspirator tip. To keep the site clear of fluids and to prevent debris from inadvertently entering the sinus, the transantral approach demands a four-handed, cooperative team effort between the surgeon and the assistant.

On completion of the apicoectomy and all retro-procedures, the surgical area is thoroughly cleansed and a radiograph taken to confirm cleanliness and the absence of foreign objects from the surgical site and the sinus (Figs 21-4a to 21-4c).

Figs 21-4a to 21-4c Microscopic Ia and bI and radiographic (cI views of apexes.



Fig 21-4a



Fig 21-4b



Fig 21-4c

Retrograde Instrumentation: Root End Preparation

Objective

To provide a clean, well-shaped Class I cavity in an apically resected root that is parallel to the long axis of the root, sufficiently centered to offer adequate root wall thickness, and deep enough to receive and retain a nontoxic, biocompatible filling material.

Note

Success can be achieved by thoroughly curetting the periradicular pathosis and merely resecting the apical segment of a well-cleansed, well-shaped, densely obturated root canal (Figs 22-1a to 22-1 d). However, this decision is accompanied by a certain degree of risk. Recent anatomic scanning electron microscope (SEM) studies have clearly demonstrated the existence of a large number of microscopic irregularities in apical morphology, which severely questions the wisdom of curetting a lesion and cutting a root without retrofilling the resected apex. Therefore, it must be concluded that because fins, troughs, multiple portals of exit, and so on may not always be visible to the naked eye, critical assessments of root end anatomy and more accurate decisions regarding the need for retropreparation and retrofilling either must be made at magnification levels of x 8 or higher or must be universally retrofilled without question.

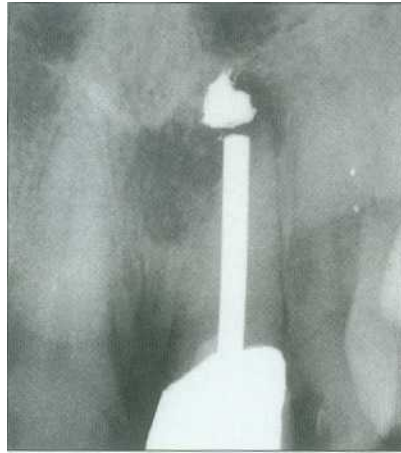


Fig 22-1 a



Fig 22-1 b

Figs 22-1 a to 22-1d If an apical seal can be produced with a well-condensed canal obturation, as shown here, healing can be expected.

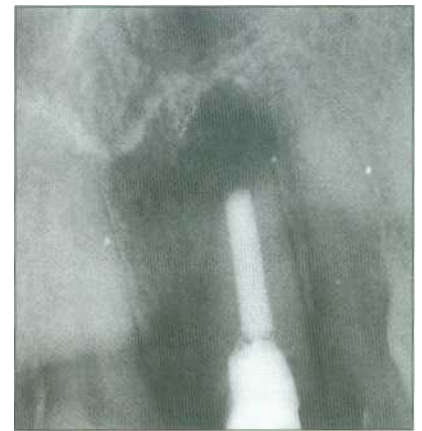


Fig 22-1 c

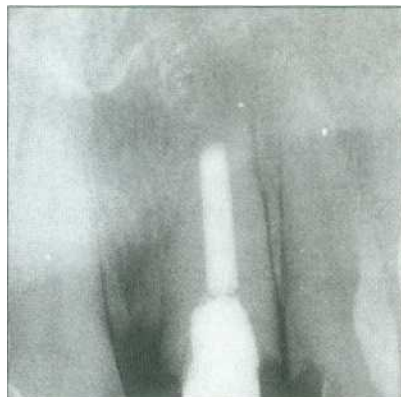


Fig 22-1 d

Ultrasonic Root End Preparation

With the advent of the Carr CT retrotips, the conventional bur root end preparation technique with either a straight or mini contra-angled handpiece has lost favor and given way to the ultrasonic root end technique for the following reasons:

1. The amount of access needed to use the oversized conventional instruments necessitated loss of bone and/or root length (Fig 22-2a).
2. The angle severity of the root bevel needed to gain long axis parallelism with the bur changed the apical exit from round to oval, unnecessarily increasing the dimensions of the retrocanal material-bone interface (see Fig 20-2a, Lesson 20).
3. The angle severity of the root bevel exposed an excessive number of open dentinal tubules to leakage (see Fig 20-2b, Lesson 20).
4. In attempting to gain parallelism to the long axis, the entry was generally gouged (Figs 22-2b to 22-2d) and the angle of penetration invited perforation (Figs 22-2e and 22-2f).
5. Because true parallelism could not be achieved, the buccal wall of the preparation generally was inadequately cleansed and the depth of the preparation was rarely uniform. Both of these deficiencies created leakage and retentive problems (Fig 22-2g).

The minimal length of the Carr tips utilized in the ultrasonic root end preparation system allows the operator to approach the canal perpendicularly, without removing excessive amounts of bone or severely beveling the root. By reducing the bevel angle from the previously suggested 45 to 30 degrees or less, fewer dentinal tubules are exposed and the potential for success is proportionally increased.

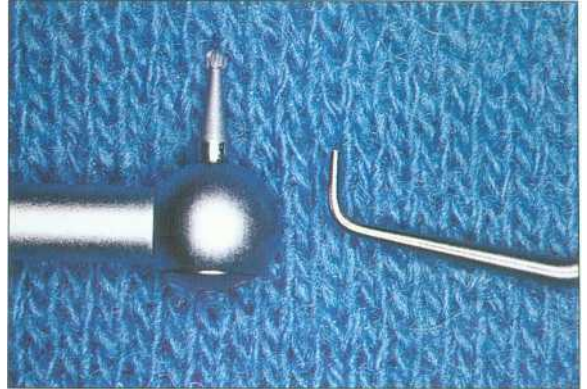


Fig 22-2a When compared to the Carr tips, the mini contra-angle and bur requires an additional 5 to 8 mm of bone and root removal to gain enough vertical dimension to parallel the long axis of the roots.

Figs 22-2b to 22-2g Due to the inability to perpendicularly enter the canal, the bur gouges the resected root surface, and the offset penetration angle leaves the buccal wall uncleansed and invites perforation.



Fig 22-2b

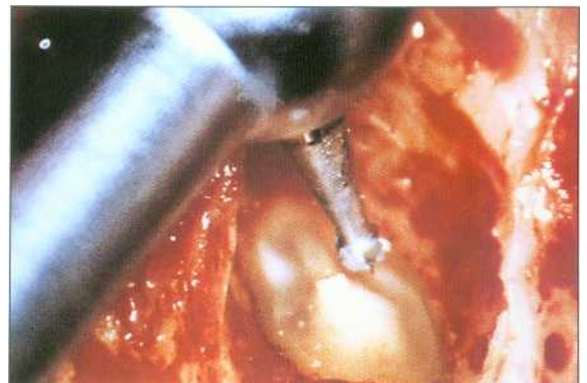


Fig 22-2c

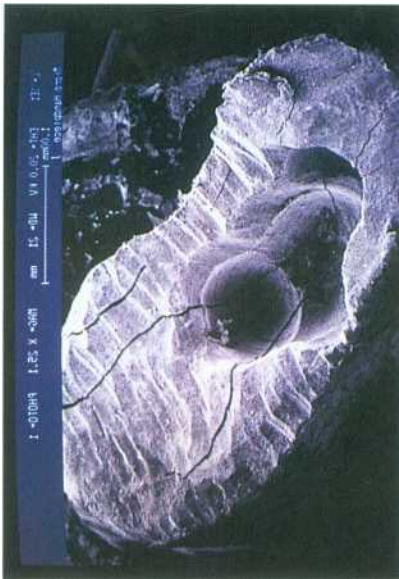


Fig 22-2d

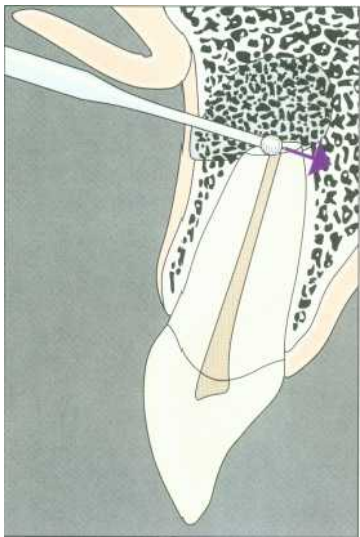


Fig 22-2e

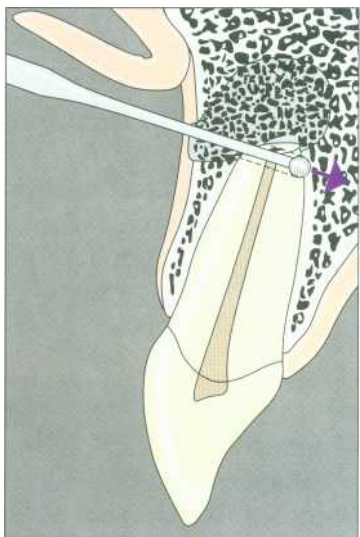


Fig 22-2f



Fig 22-2g

Instruments

Ultrasonic units

Piezoelectric (EIE Analytic Technology)

Spartan (Obtura)

Neosonic (P-5) SPM (Amadent)

CT Retrotips (EIE Analytic Technology, Spartan, Amadent)

CM1-6 Retromirrors (EIE Analytic Technology, Hu-Friedy)

SM1-4 Sapphire retromirrors (EIE Analytic Technology)

CT Retromicroexplorers (EIE Analytic Technology, Hu-Friedy)

CM Microexplorer (EIE Analytic Technology)

Stropko irrigator/drier (EIE Analytic Technology)

Technique

In addition to the great advantage of being able to cavitationally enlarge and shape the canal with ease and safety, ultrasonics uphold the ultimate principle of conventional endodontic therapy—power cleansing both the canal and the tubules within the canal while maintaining parallelism and consistency throughout the depth and width of the preparation (Figs 22-3a to 22-3c).

Figs 22-3a to 22-3c The miniature EIE Piezoelectric (a~, the Spartan (b~, and the regular-sized Cori tips ici.



Fig 22-3a



Fig 22-3b



Fig 22-3c

Most retropreparation problems can be avoided by adhering to the following:

1. The CT tips should be sharp and, for safety, the power of the ultrasonic units should be adjusted according to the dimensions (thickness) of the root tip (Figs 22-4a to 22-4d). Initially, it is advantageous to prepare a small pilot hole and/or score the isthmus outline without water.

However, a continuous flow of an appropriate irrigator should quickly accompany the balance of the cutting procedure. The irrigator is needed both to cleanse the area of debris and to cool the instrument tip and reduce root-surface frictional heat buildup. Numerous studies have recently been published regarding the damaging effect of excessive heat and vibration.



Fig 22-4a

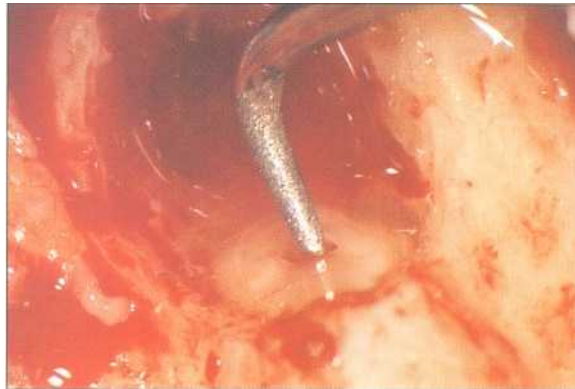


Fig 22-4b



Fig 22-4c



Fig 22-4d

Figs 22-4a to 22-4d Based on access and root angulation, a carefully selected CT tip is positioned over the canal parallel to the long axis and powered to prepare a pilot hole or score an isthmus.

2. The cut surface, as well as the depth of the preparation should be dried periodically with appropriately sized paper points or pressurized air syringed through a 27- or 30-gauge needle attached to a Stropko irrigator/drier. The repeated drying process enables the operator to better view and monitor preparation progress. The Stropko offers the distinct advantage of alternating water and air without having to switch instruments.
 3. Once the appropriate angled tip has made penetration, the canal is cleansed and shaped until the desired depth and width have been realized (Figs 22-5a to 22-5c). To avoid perforation, the CT tip must remain parallel to the line axis of the root as it advances up/down the canal.
 4. According to Gilheaney and associates (1994), when a root is resected at a 90-degree angle it produces a 0-degree bevel, and the apical cavity preparation requires a depth of only 1 mm to provide sufficient room for a quality retroseal. However, as the bevel of the resection is increased, so must the depth of the preparation to compensate for the buccolingual variance in angulation. As a consequence, the study indicates a 30-degree beveled root requires a minimal depth of 2.1 mm, and a 45-degree beveled root demands at least 2.5 mm of filling material to produce the same seal quality. In conclusion, the study suggests that an increase in the depth of the retrograde filling significantly decreased apical leakage. This agrees with earlier studies (Mattison et al 1985) that recommended the preparation be at least 3.0 mm at its shallowest measurement (Figs 22-6a and 22-6b).
- As a guide, the authors recommend the preparation never be less than the full length of the CT working tip, which on average measures 3.4 mm from its preparation point to the shank curve (Figs 22-6c and 22-6d).
5. On reaching the desired depth, the apical canal preparation should be dried with the Stropko irrigator/drier and the walls inspected for cleanliness with varied angled and micro-sized retromirrors (Figs 22-7a and 22-7b).

Figs 22-5a to 22-5c Penetration of the canal continues in a direction parallel with the long axis of the root until a consistent width and depth are realized.



Fig 22-5a



Fig 22-5b



rig zz

III: Surgical Techniques

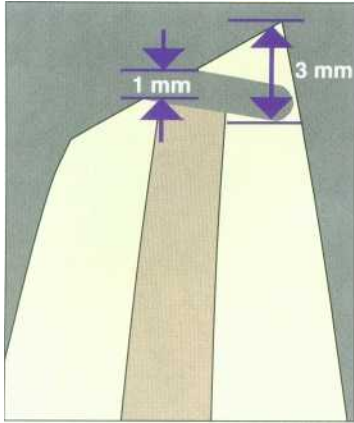


Fig 22-6a

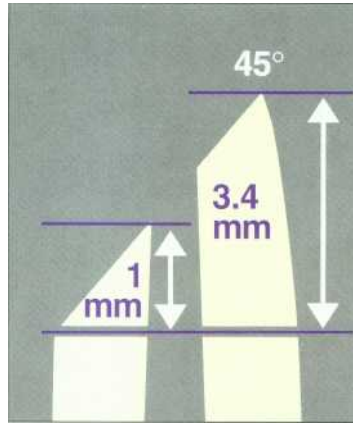


Fig 22-6b

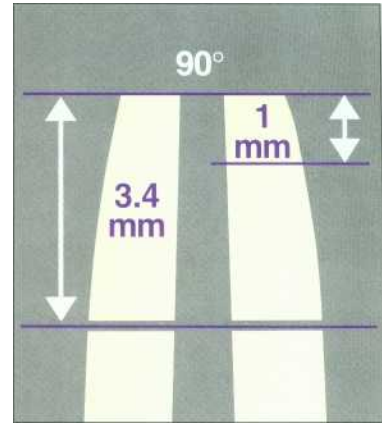


Fig 22-6c

Figs 22-6a to 22-6d When the bevel of the resection and/or the angle of penetration exceeds 90 degrees, maintaining consistency in wall depth becomes more difficult. If the angle of the floor of a preparation is not equal to the angle of the root resection, it is possible to have a lingual depth of 3.4 mm and be only 1 mm deep at the buccal wall. Studies indicate that a minimum parallel wall depth of 1 to 3 mm is needed to produce a quality seal (Gilheaney 1994). Seating a CT tip to the shank will guarantee a 3.4-mm depth.

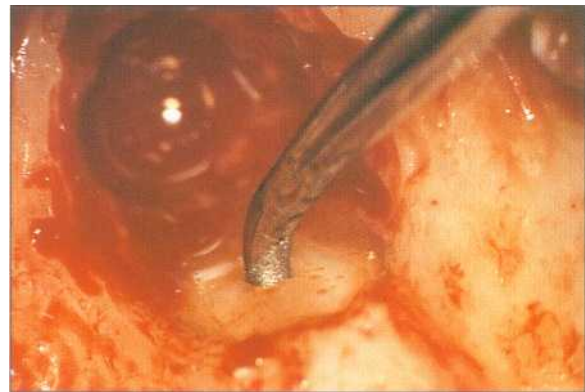


Fig 22-6d

Figs 22-7a and 22-7b To detect the true depth and degree of cleanliness of the buccal wall, the preparation must be dried with a Stropko drier and viewed with microslized autoclavable stainless or Sapphire retromirrors.

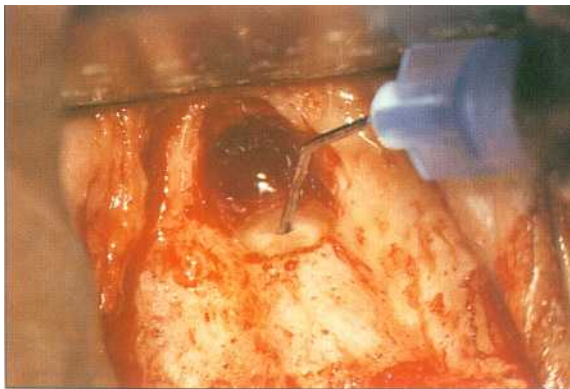


Fig 22-7a



Fig 22-7b

Problems

1. **Calcified canals.** The preparation of a calcified root requires patience. When the initial penetration appears stymied, the operator should check the source and intensity of the power and then examine the CT tips for sharpness. The rule: Double the time, not the power or the force.
2. **Vertical entry.** Excessive root length, lingual root angulation, and the approximation of anatomic landmarks may restrict access to the root canal system and make vertical entry into the canal difficult. One or more of the following procedures may help:
 - a. Gradually increasing the dimension of the window by removing more bone superior/inferior to the root tip.
 - b. Gradually reducing the root length.
 - c. Beveling the mesial or distal aspect of the root and allowing the ultrasonic file to enter lateral to the anatomic structure.
 - d. Offering the patient an alternative treatment—extract/replant or a referral.
3. **Thin root tips.** Although the ultrasonic root preparation technique is advantageous because it is capable of producing a minimal width preparation, a 2-mm border of peripheral root structure must exist around the final preparation. To achieve this dimension, further root length reduction may be required to reach a broader aspect of the root (Figs 22-8a and 22-8b).

Figs 22-8a and 22-8b To provide adequate wall strength, the cavity preparation should be centered in the root, and the peripheral walls should provide a 2-mm width of tooth structure throughout the depth of the preparation. To offer this dimension, additional root length may need to be sacrificed.

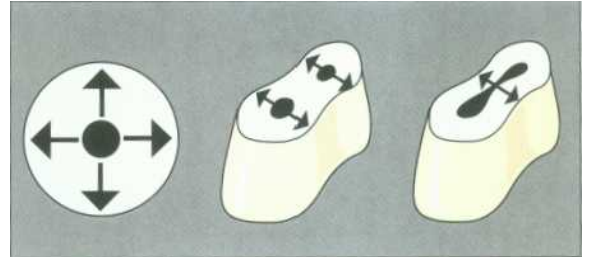


Fig 22-8a

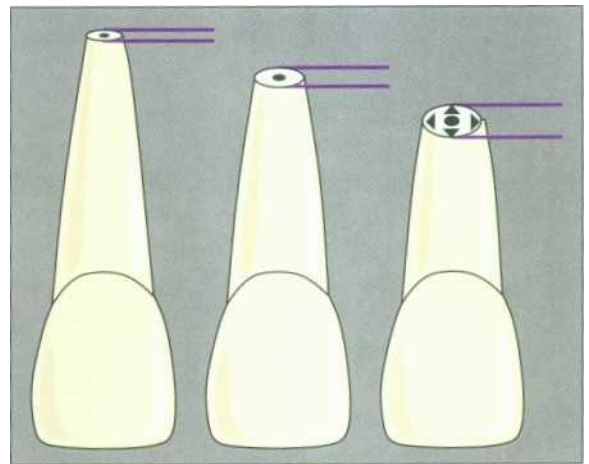


Fig 22-8b

BE Analytic Technology markets a second generation of CT tips that are half the size of the regular tips. These Slim Jim CT tips have been specially designed for the thin, challenging root (Figs 22-9a and 22-9b).

The smaller preparation and/or heavier root body helps reduce the potential for stress cracks from the vibration of the energized tips. It has been shown that a direct relationship exists between the power setting and the incidence and extent of cracks (Min et al 1997; Figs 22-10a and 22-10b).

4. Perforation. A risk with any instrumentation technique is perforation. With ultrasonics, it is most important to select a CT tip with an angle that most appropriately follows the long axis of the root. However, due to the fact that the CT tips are designed with multiple-angled shanks, the tip may appear to be parallel to the axis when in fact it is not (Figs 22-11 a and 22-11 b). Magnifying glasses, microscopes, and retromirrors not only minimize the likelihood of perforation during the procedure, but also increase the possibility of locating one if it occurs inadvertently. When a continuous flow of blood exits from the canal, or when paper points unceasingly stain with blood during the canal drying procedure, a perforation somewhere along the internal wall must be suspected. The opening must be located and sealed or the root reduced to the level of the perforation, and the canal preparation technique repeated.

5. Isthmus. Although Hess' study (1925) decades ago alerted dentists to the fact that the root canal system is complex, there still exists the paradigm that each root has one canal and one exit. Recent scanning electron microscope (SEM) studies presented by Carr (1997) and others have certainly disproved that perception.

In reality, a study by Weller et al (1995) demonstrates that over 90% of the mesiobuccal roots of 50 maxillary first molars had isthmi 3 mm from the apical foramen; numerous stereomicroscopic examinations report the presence of an exhausting number of canaliculi exiting within the last 3 mm of the apex; and 70% of the cases evaluated by

Figs 22-9a and 22-9b Slim Jim CT Tips are specially designed to minimize the width of the preparation in thin, challenging roots. CT Tips are used in the buccal canal, and a smaller preparation is made with a Slim dim in the thinner lingual segment of the root.



Fig 22-9a



Fig 22-9b

Figs 22-10a and 22-10b There is a direct and proportional relationship between the thickness of a root; the power, heat, and vibration produced by an ultrasonic unit; and root cracking.



Fig 22-10a

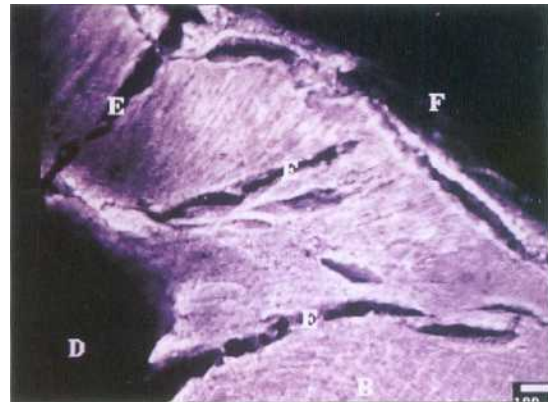


Fig 22-10b

Figs 22-11 a and 22-11 b Because CT tips are designed with multiple shank-to-tip angles, orientation is sometimes a problem. Though the angles may appear to be parallel to the axis of the root, the second angle can easily be misdirected.



Fig 22-11 a



Fig 22-11 b

Burch and Hulen (1972), Vertucci (1979), and Green (1960) show the major canal exiting laterally. Additional reports emphasize the fact that not all canals are round, and roots having two canals may have a single exit, two individual exits, or two exits with a communicating ribbon isthmus throughout the full length of the root (Fig 22-12a).

If the shape of a root suggests the presence of multiple exits and anastomosing junctions, swabbing the root end with methyl blue dye may help delineate the presence of these aberrations. Without magnification of x 8 to x 12 or higher, the operator is at a decided disadvantage

for finding and tracing their path. For all intents and purposes, teeth reported to have a high percentage of multiple canals should always be considered as having multiple exits and a connecting isthmus. With that in mind, the last 2 to 3 mm of the root should be resected, and the apical canal preparation should take on the form of an extended oval or groove (Figs 22-12b and 22-12c).

6. Facial burns. When ultrasonically preparing teeth in difficult-to-reach areas, the surgeon must be particularly careful that the energized CT tip shaft does not come in contact with the lip, cheek, or facial tissues.

Figs 22-12a to 22-12c Without magnification, isthmi may go unnoticed and lead to failure. The apical canal preparation in teeth known or suspected to have multiple canals should take the form of an oval or groove.

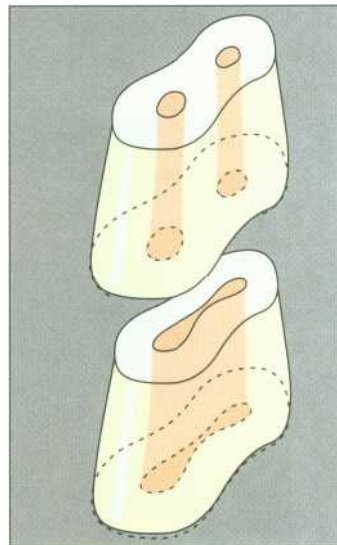


Fig 22-12a



Fig 22-12b



Fig 22-12c

Hemorrhage Control

Objective

To maintain a clean, dry, and highly visible surgical site, and spontaneously manage and control any abnormal bleeding.

Note: Anyone who performs an invasive procedure must respect the seriousness of the responsibility and not only be knowledgeable about the vascular anatomy of the surgical site, but also be prepared to manage any and all neurovascular complications that may inadvertently occur.

Materials and Techniques

High-volume aspiration

Although aspirators are readily available, Quality Aspirators offer fiber-optic light attachments and high-power vacuum systems that are reliable and affordable.

Local vasoconstriction

Local anesthetics. In addition to the initial and normal block and infiltration regimen indicated with anesthetic solutions having a vasoconstrictor value of 1:100,000 or its equivalent, the local and superficial tissues overlying the surgical site should be injected with an anesthetic solution that has a higher concentration, such as lidocaine with 1:50,000 epinephrine. This first level of control should prove adequate for the duration of most endodontic surgeries. Repetition of the infiltration and blocks may be required for extended cases. When

III: Surgical Techniques

conditions indicate the procedure will be lengthy, it is best to reinject a long-acting anesthetic, such as 0.5% bupivacaine (Marcaine) with 1:200,000 epinephrine, sometime during the procedure.

Epinephrine-saturated gauze. Small strips of pure noncotton fiber gauze such as Nu-Gauze (Johnson & Johnson) can be saturated with concentrated solutions of 1:1000 or 1:10,000 epinephrine or adrenaline chloride and packed into the bleeding bone crypt. This packing is not absorbable and must be removed once the hemorrhage has been curtailed.

Racemic epinephrine. Small cotton pellets saturated with an average of 1.9 mg of racemic epinephrine hydrochloride (content range 1.6 to 2.2 mg) are available under the brand name EPIDRI (Pascal). The pellets are available in various sizes and dispenser boxes, and the total package content of the racemic epinephrine hydrochloride ranges from 720 to 990 mg. These pellets are not absorbable and all residual fibers must be removed once hemorrhage is curtailed.

Adjunctive coagulants

Gelfoam (Upjohn). Small-cut pieces of this gelatinous, water-soluble, sterile, porous sponge will expand on contact with blood when packed into the bone cavity. Although biologically absorbed within 4 to 6 weeks, its removal is recommended once hemorrhage is controlled. If this material is left in place, a postoperative prophylactic antibiotic regimen should be prescribed.

Surgicel (Johnson & Johnson). This modified carboxymethylcellulose is primarily oxidized regenerated cellulose. On contact with blood, the cellulose develops acid products that cause an artificial clot to form. This material is not absorbable. Once the clot has formed, it is recommended the site be flushed clean and, because of this agent's inflammatory nature, an antibiotic regimen should be prescribed.

Avitene (Avicon). This purified bovine collagen derivative attracts platelets which initiate thrombi aggregation and clot formation. It is absorbable and highly biocompatible.

Bone wax (Ethicon). By the manufacturer of the same name, this combination of pure beeswax and a softening agent (isopropyl palmitate) is placed in the bone cavity with the #4 end of the #2/4 curette. The wax is then compacted with the curette, a wet gloved finger, or compressed wet Nu-Gauze strips. The material merely creates a physical barrier and does not stimulate any chemical clotting reaction. Because the surgeon can never be sure all of the compacted wax has been removed from the depths of the porous cancellous bone and the root end preparation, and because this residual material has been known to stimulate a latent inflammatory reaction and delay or prevent periradicular healing, controversy exists regarding its use. However, when properly used, it is very effective. It should never be used when there is a possibility of it being inadvertently pushed into the sinus.

Agglutinates. Concentrated solutions of ferric sulfate ($\text{Fe}_2[\text{SO}_4]_3$ with 15.5% astringent and 21 stasis) and ferric subsulfate ($\text{Fe}_4[\text{OH}]_2[\text{SO}_4]_5$ with 53% Cut-trol and 72% Monsels solution) are known to stop bleeding on contact. When a small piece of cotton-free gauze or a Telfa strip is dampened with ferric sulfate and placed in contact with the bleeding area, a chemical reaction with blood and blood products takes place instantly. The area contacted immediately blackens, verifying the ferric reaction, and the bleeding stops abruptly. Although some researchers have noted a migration of macrophages to sites following its use, very little is known about the reaction or the inflammatory effects of this agent. It is thought that agglutination of blood proteins occurs when blood comes in contact with ferric sulfate and the agglutination plugs capillary orifices. Since numerous studies indicate postsurgical difficulties are directly related to the amount of ferric sulfate used, the solution should be used sparingly. To prevent any potential bone slough, all discolored bone should be removed and fresh bleeding reconstituted in the crypt prior to closure.

Collaplug and Collacote. Although known to be effective, further investigation of their long-term effects is necessary before these products can be recommended for routine use.

Problems

1. **Severed artery.** To locate the exact source of the bleeding, the pulsating area must be evacuated as well and as quickly as possible. Gauze is packed directly on the severed vessel and firm finger pressure is applied and maintained for 5 to 10 minutes. If finger access is limited, an instrument such as a ball burnisher or a curette can be inserted into the opening and pressed firmly against the gauze and the vessel. The pressure must be firm and constant to collapse the vessel and achieve coagulation. If this proves unsuccessful, it may be necessary to gain greater access by further uncovering the injured vessel and cauterizing it with an electrocautery tip.

If an artery within soft tissues is severed, placing multiple mattress sutures in the soft tissues surrounding the area often indirectly chokes off the vessel. If heavy bleeding continues, attention must be given to the volume of blood lost and the eminent danger of shock. Auxiliary personnel should be trained to assist with these procedures and should monitor the patient's vital signs while the dentist continues to compress the vessel. When it becomes apparent the vessel cannot be occluded, the situation should be considered critical and an emergency service (911 or an alternative) should be called immediately. All supportive procedures should be followed until help arrives.

2. **Systemic factors.** When abnormally severe and prolonged bleeding has been experienced throughout a surgical procedure, a physical deficiency should be suspected. A number of stages and factors are involved in the clotting mechanism, and a weakness or absence of any one of these components could be the reason for the abnormal bleeding and the inability to coagulate. The patient (or parent or guardian) and the patient's physician should be notified of the dentist's suspicions, and the volume of blood lost during the procedure should be mentioned.

Problems of this nature can often be avoided by taking the time to discuss applicable areas of the comprehensive medical history. "Do you bruise easily?" "When you cut yourself, do you bleed excessively?" "Are your menstrual cycles lengthy and heavy?" "Are you a smoker?" If the answers are yes, proper precautions can be implemented prior to the surgery.

3. **Documentation.** The patient's record should describe any adverse event and the management details. The patient should be followed throughout the recovery period, and the records should indicate all postincident responses, additional referrals, test results, and treatments that the patient experiences as a result of the episode.

The dentist and all staff members must be certified in CPR (in most states), and the telephone numbers of all locally available emergency services should be posted by each office telephone.

Root End Filling Materials

Objective

To select a biocompatible material capable of producing a hermetic seal that prevents residual irritants and oral contaminants from exiting the root canal system and entering the periradicular tissues.

Note

An *ideal* root filling material would have the following characteristics:

- Adhere and adapt to the walls of the root preparation
- Prevent leakage of microorganisms and their by-products into the periradicular tissues
- Be biocompatible
- Be insoluble in tissue fluids
- Be dimensionally stable
- Be unaffected by the presence of moisture

No currently recommended material complies with all of these requirements.

Materials

Numerous root end filling materials have been suggested. The most widely advocated are discussed here.

Gutta-percha. Although this semisolid, nonresorbable, biocompatible material has good handling characteristics, it has the following disadvantages:

1. It is moisture sensitive.
2. The apical seal depends on the structure of the gutta-percha, its degree of condensation, and the nature and amount of root canal sealer used.
3. There is a tendency for its margins to open when the canal root interface is cut, heated, or burnished.

Amalgam. This has been the most widely used material and has the longest history, but its problems are:

1. As a result of the metal's primary shrinkage, it initially leaks.
2. It produces corrosive by-products.
3. There is a possibility of mercury and tin contamination.
4. It is moisture sensitive.
5. A retentively designed cavity preparation is required for retention.
6. It may cause tissue tattooing.
7. Scattered particles are not resorbable and may be difficult to retrieve.

Zinc oxide. Although zinc oxide-eugenol cements such as Super EBA, IRM, and Cavit have recently gained popularity because they do not stain soft or hard tissue and are nongalvanic when placed in contact with posts and cores, zinc oxide materials have the following disadvantages:

1. They are moisture sensitive.
2. They cause initial tissue irritation.
3. Resorbability is questionable.
4. There is leakage.

Dentin bonding agents. Although they adapt better and leak less than amalgam, these agents also can be problematic:

1. They form an ineffective bond against moist dentin.
2. All composites are known to leak immediately after insertion.

Glass ionomers. The combination of silicate and polycarboxylate cements are advantageous because of their chemical bond to the dentin, but there are disadvantages:

1. The root preparation must be absolutely dry.
2. The seal is adversely affected by moisture and low pH.

Mineral trioxide aggregate. Recently, mineral trioxide aggregate (MTA) has been suggested as a root end filling material. The principle compounds present in VITA are tricalcium silicate, tricalcium aluminate, tricalcium oxide, and silicate oxide. The powder consists of fine hydrophilic particles that set in the presence of moisture or blood, and in time solidify to a hard structure.

In vitro leakage studies have shown that MTA leaks significantly less than amalgam and zinc oxide-eugenol cements (Super EBA and IRM). In addition, in vitro cell culture studies have shown MTA to be biocompatible when placed in contact with cells. Furthermore, an in vitro experiment using VITA as a root end filling material showed the material to be less inflammatory than amalgam and that fibrous connective tissue and/or cementum formed over the cut root surface and the MTA. The problems with MTA, which are mostly associated with handling characteristics, are:

1. Managing the amount of moisture while mixing and placing
2. A lack of resistance for dense compaction
3. The inability to flush the crypt clean without washing out the filling
4. A 2- to 4-hour setting time

Conclusion

Currently, no material has been found that meets all of the requirements of an ideal root filling material. The authors have successfully used Super EBA and IRM for over 20 years. However, the results of the recent in vitro and in vivo studies, as well as the incredibly positive clinical experiences with MTA, make it difficult to endorse the use of any other material for root end filling or perforation repair. (Although VITA was FDA approved at the time this lesson was written, its availability was quite limited. Until it is universally marketed, the authors recommend the use of Super EBA and/or IRM.)

Root End Filling Procedure

Objective

To place and compact a selected filling material into a root end Class I cavity preparation.

Instruments and Materials

Paper points

Stropko irrigator/drier (EIE Analytic Technology)

Iodoform packing strips

Cotton-free gauze

EPIDRI racemic epinephrine pellets (Pascal)

Bone wax (Ethicon)

Cavity varnish (Copalite)

Mixing slab (Medidenta)

Cement spatula (Hu-Friedy)

Minicarriers

K-G amalgam carrier (Union Broach)

Messing gun (Union Broach)

IPC carver (Premier, Hu-Friedy)

West (EIE Analytic Technology)

Pluggers and condensers

PGF1, PLGF2 Minipluggers (Hu-Friedy)

P-1, P-2 Microsurgery condensers (EIE Analytic Technology)

Buchanan 90° (EIE Analytic Technology)

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CM Retromirrors (EIE Analytic Technology)

PFIWDS1 Woodson plastic filling composite instrument (Hu-Friedy)

#27/29 Ball burnisher (Hu-Friedy)

#83, #85, and #87 Lucas DE surgical curettes (Hu-Friedy)

#2/4 Molt DE curette (Hu-Friedy)

CVTH2 Tharp carver (Hu-Friedy)

High-volume aspiration

Several manufacturers market instruments equivalent to those listed. Identification numbers vary from company to company.

Technique

Most apical filling materials require a dry cavity and a dry field. To ensure success, the surgical site should be aspirated of all fluids and bleeding controlled. Although a totally dry environment is unnecessary with MTA because it is hydrophilic and requires moisture to set, it is still preferable to work in a dry, unobscured chamber. The depth of the bony crypt behind/around the root end can be packed with bone wax, epinephrine-dampened iodoform gauze, or EPIDRI pellets, or minimally blotted with ferric sulfate- or ferric subsulfate-dampened strips (Figs 25-1 a to 25-1 b; see also Lesson 23).

Figs 25-1 a and 25-1 b To maintain a clear, dry, unobstructed view of the prepared apexes, the depth of the bone crypt is packed with epinephrine-saturated gauze or pellets.



Fig 25-1 a

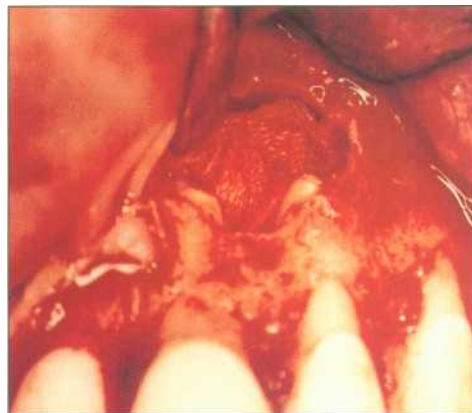


Fig 25-1 b

Once the root has been isolated, the cavity preparation is flushed clean and thoroughly dried with air blown through a 30-gauge short needle attached to a Stropko irrigator/drier. Short-cut segments of sterile paper points are inserted into the apical preparation to test dryness and detect any blood staining that might indicate a perforation (Figs 25-2a to 25-2e).

If amalgam has been selected as the filling material, two thin layers of cavity varnish (Copalite) may be painted in the preparation and

on the cut root surface prior to its placement. Although amalgam is still the material most often used, it is not the authors' choice and is quickly losing popularity.

If the canal preparation is to be filled with thermoplasticized gutta-percha, it is best to dress the preparation walls with sealer. Minicondensers are used to vertically condense the material to minimize voids and maximize compaction. The borders should be examined under high magnification to evaluate the interface seal.

Figs 25-2a to 25-2e The apical cavity preparation is flushed clean and dried with the Stropko irrigator/drier 1a and 1b. Cut segments of paper points are used to detect the presence of blood, which could indicate a perforation 1c and 1d.



Fig 25-2a

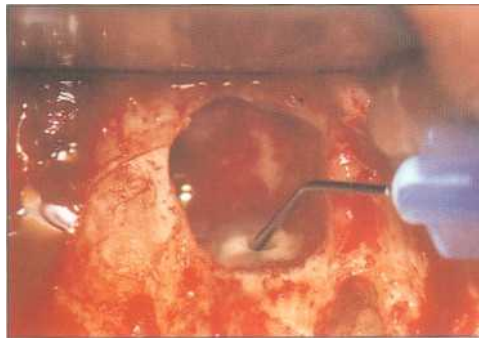


Fig 25-2b



Fig 25-2c

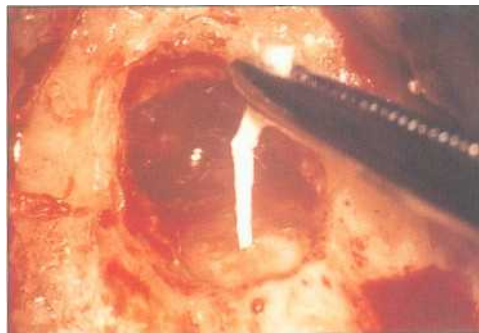


Fig 25-2d



Fig 25-2e

All other filling materials, including pastes, must be mixed according to the manufacturer's standards and carried to the preparation by mini carriers or messing guns or in small semisolid increments with plastic instruments (1 PF1 WDSI) or carvers (CVTH2) (Figs 25-3a and 25-3b).

Pluggers of various sizes and angles (P-1 or

B-3) are used to effectively condense the material to the depth of the preparation (Figs 25-3c to 25-3g). This is particularly important when condensing pastes that are prone to trapping air. All excess and flash should be curetted and/or aspirated from the site with Lucas curettes (#83, #85, or #87) or carvers (Figs 25-3h and 25-3i).

Figs 25-3a to 25-3g Material may be placed with amalgam carriers (a) or messing guns, or carried to place on small PF 1 plastic instruments (b). To eliminate voids, small amounts of filling material should be alternately placed (c) and compacted to depth with appropriately sized condensers (d to g).



Fig 25-3a

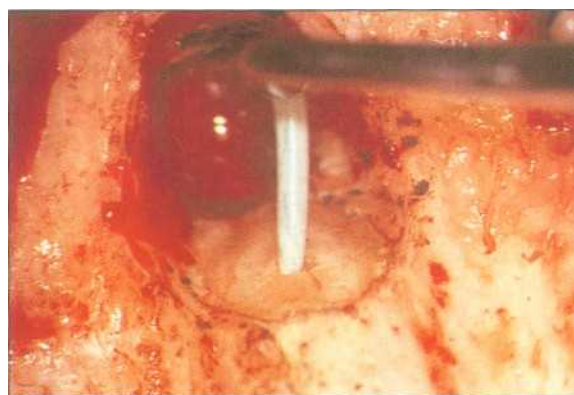


Fig 25-3b



Fig 25-3c



Fig 25-3d

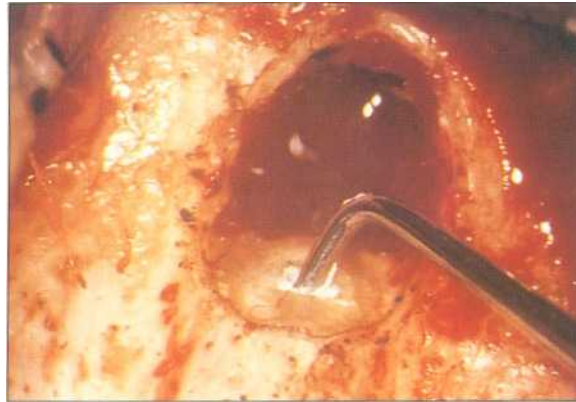


Fig 25-3e



Fig 25-3f

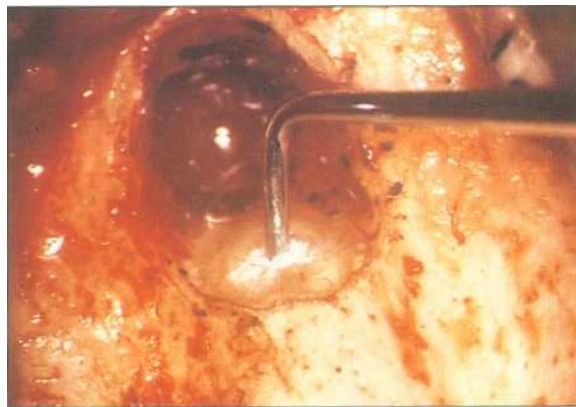


Fig 25-3g

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Figs 25-3h to 25-3k Excess and flash is removed from the site with a large curette lh and ij, and the filling material is burnished with a flat or balled instrument lj and kj.



Fig 25-3h

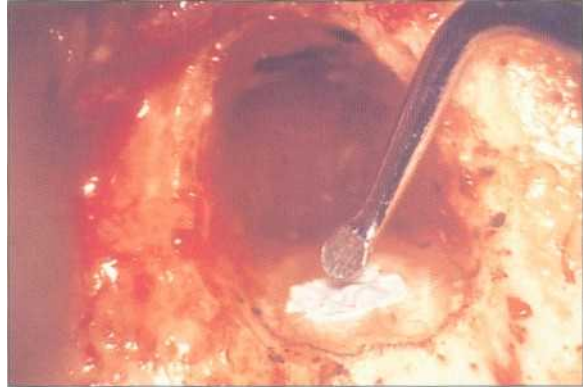


Fig 25-3i



Fig 25-3j



Fig 25-3k

After satisfactorily condensing the material, the surface is burnished (Figs 25-3j and 25-3k). Based on recently published data, passing a finishing bur (fluted Brassler ETUF9) over condensed and set zinc oxide-eugenol cement (IBM and Super EBA; Figs 25-3l and 25-3m) produces excellent marginal adaptation along the retrofilling/canal wall interface, whereas retrofillings finished with only a ball burnisher or a moistened cotton pellet consistently display poor adaptation and flash.

With the aid of fiber-optic lighting, magnification, and retromirrors, the filling is carefully inspected for flaws or loss of marginal integrity. This evaluation is best done under the highest magnification available (Fig 25-3n). Any gauze, pellets, and/or bone wax is removed, and the surgical site and crypt are flushed and aspirated clean. A radiograph is taken to evaluate the filling and to appraise the periradicular area for the direction and density of the filling and for the presence of any overlooked filling material (Fig 25-3o).

Figs 25-3l to 25-3o A Lindemann finishing bur is passed over the set filling material II and ml. The final assessment of the root filling should be determined clinically by probing, and visually inspected under the highest degree of magnification (n~. A final radiograph is taken to evaluate the direction and density of the filling and cleanliness of the crypt (ol.



Fig 25-3l

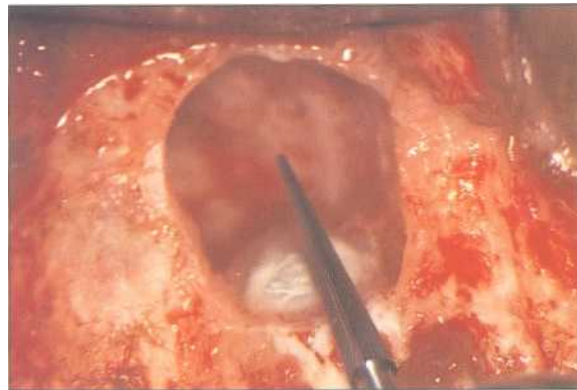


Fig 25-3m



Fig 25-3n



Fig 25-3o

Problems

1. When a remnant piece of filling material appears radiographically, yet the bone surface and crypt appear clean, the undersurface of the flap should be examined (see Lesson 41).
2. If the filling material, particularly pastes (Super EBA, IRM, etc), sets prior to compaction and/or completion, it is best to remove the partial filling and repack.
3. When the cavity preparation is kept small, less filling material is in contact with the apical tissues. With a reduced interface, there should be a correspondingly smaller inflammatory reaction, promoting a more complete heal.
4. To prevent the potential for tissue tattooing, particularly in the anterior region, nonmetallic and nonstaining filling materials should be used.
5. To eliminate galvanic potential, nonmetallic root end filling materials should be used when contact with a metallic post or crown margin is anticipated.

Suture Materials

Objective

To maintain the position of the flap reattachment by using a suture material that is strong, atraumatic, nonallergenic, and easy to use.

Instruments

Surgical needles

Thread-to-needle attachment. The most important factor to be considered in the selection of a needle is the ease with which it enters and exits the tissue. Atraumatic eyeless needles offer the advantage of having the thread swaged or compressed in the needle as opposed to being knotted.

Size of needle. The thickness of the tissue and the location of the incision dictate the ideal length, size, and design of the suture needle. A variety of shapes are available including quarter circle, three-eighths circle, and one-half circle, and the cross section of the needle can be round or triangular. The newly designed K-Needle (EIE Analytic Technology) makes a tapered-point, atraumatic hole. Quite often, final needle selection is based on the personal preference and experience of the operator. Although the three-eighths half circle seems to be universal, the posterior palatal molar region may demand the one-half circle.

Sutures

Black silk. The most widely used of the five major suture materials is braided black silk. It consists of two protein fibers glued together with sericin (a fiber). Because it is braided, it encourages debris and bacteria to accumulate between the filaments along the suture line. To reduce the potential for infection, the patient should be given a prescription for a 1-week regimen of chlorhexidine rinse (Peridex) and instructed on the benefits of good oral hygiene.

Prior to the removal of silk sutures, the surgical site and the suture line should be thoroughly cleansed with a disinfectant such as 3% hydrogen peroxide or Peridex. In spite of its inherent disadvantage, silk sutures are strong, available in a variety of lengths, easy to use, easily identified even when partially buried in swollen tissues, cost effective, rarely allergenic, and available in sizes ranging from 0-0 to 6-0.

Polyester. The Ethibond and Ethibond Extra (Ethicon) suture is a nonabsorbable, braided polyester fiber that is uniformly coated with polybutylate. This highly adherent coating is a biologically inert nonabsorbable compound which acts as a lubricant to mechanically refine its physical properties and improve ease of passage through tissues. Contrasted to the braided, uncoated silk fiber, the handling characteristics of polyester are a great improvement.

Ethibond Extra sutures are sterile, inert, and elicit minimal tissue reaction. They are braided for optimal handling properties, and the dyed sutures are colored with D and C Green No. 6 for good visibility in the surgical field.

Tecdek (EIE Analytic Technology) is a newly introduced Teflon-coated polyester that glides easily through tissue, is profoundly strong, minimizes bacterial colonization, and comes in sizes 4-0, 5-0, and 6-0.

Polyamide-nylon monofilament. Some monofilaments are difficult to tie when wet and have a tendency to cut through tissue when pulled during placement or mouth movement or when tension increases as the tissues swell. This problem, along with the hard, sharp, irritating, and uncomfortable cut ends, can be decided disadvantages. Monofilament is available for a variety of needle sizes and shapes.

Supramid and Supramid Extra are solid strands of plastic, nonabsorbable, sterile surgical sutures composed of the long-chain aliphatic polymers Nylon 6. They are indicated for use in general soft tissue approximation and/or ligation. Supramid and Supramid Extra sutures elicit a minimal acute inflammatory reaction in tissues. These suture materials are inert, strong, virtually unbreakable, and have a smooth nonporous surface that makes them impenetrable to bacteria.

GORE-TEX (Gore nonabsorbable monofilament). GORE-TEX is manufactured entirely from expanded polytetrafluoroethylene (PTFE), commonly known as Teflon. The carbon fluorine bond is one of the strongest bonds of all organic compounds. Except for temperatures exceeding 300° C, nothing can swell or dissolve this polymer. Its unique combination of chemical, thermal, and mechanical properties make GORE-TEX one of the most inert substances known. In its solid suture state, it is strong and easy to manage. Because of its smooth nonporous surface, debris and bacteria are unable to accumulate on its surface. Being white, it is easily identifiable for suture removal. This suture material is presently available in sizes 4-0, 6-0, and 9-0, as well as in CV 4, CV 5, and CV 6 needle shapes.

GORE-TEX sutures are appreciably more expensive than the other types of sutures. However, its antibacterial advantages merit its consideration, especially when closing an Ochsenbein-Luebke flap, the vertical relaxing incisions of an intrasulcular design, or tears or punctures that might have occurred inadvertently during the surgical procedure.

Catgut. Catgut is a collagen and therefore absorbable in tissue. When used as a suture material, it eliminates the need for suture removal. This is particularly advantageous for patients who are handicapped, pressed for time, or inconvenienced by the distance they would need to travel for the removal visit. However, because of differences in manufacturing and origin, its absorption ratio varies considerably. It is difficult to work with when used directly out of the package, but once the isopropyl alcohol has been diluted or displaced by hydrating the gut in a water dish for 5 to 10 minutes, it loses its tendency to curl and becomes easy to manipulate. Catgut is available in all sizes and needle shapes.

Suturing

Objective

To join and maintain in position the edges of incised, torn, or perforated tissues during the initial healing phase.

Note

To evaluate the quality of the root resection and to verify the absence of foreign bodies (gutta-percha, root end filling material, root fragments, etc) in the soft tissues and bone crypt, all endodontic surgery sites must be radiographed prior to suturing.

Techniques

The easiest and most adaptable suture is the interrupted suture. It requires a single entry and exit, and each suture terminates in a surgical knot (Figs 27-1a to 27-1c). It can be used with all flap designs and offers the advantage of functioning independently. If one suture breaks or is pulled free, the remaining sutures are not disturbed.

Disadvantage. Because most flap closures require a series of interrupted sutures, placing them is time consuming and the increased number of knots collects food and debris.

Continuous sutures

This suture style is used to join the edges of an incision from one end of the wound to the other with a single stitch. It is particularly advantageous when closing long horizontal incisions. A continuous suture is easy to place and, because there are fewer knots, it is easy to keep clean.

Disadvantage. The major concern with any continuous suture is when one suture loosens or pulls free, the entire incision line is placed in jeopardy. The patient should be forewarned of this possibility and urged to call the office if it occurs.

Figs 27-1a to 27-1c The interrupted suture is a series of disconnected ties that terminate in either a double loop square knot or a triple loop surgical knot.

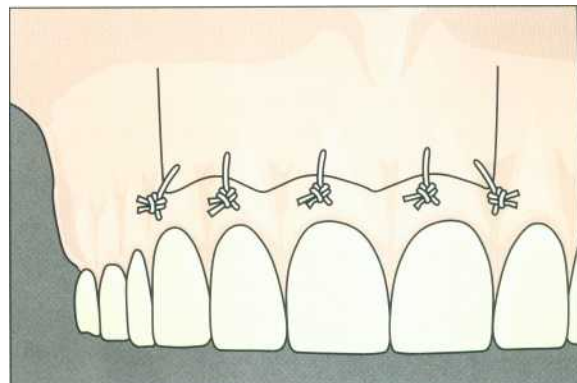


Fig 27-1 a

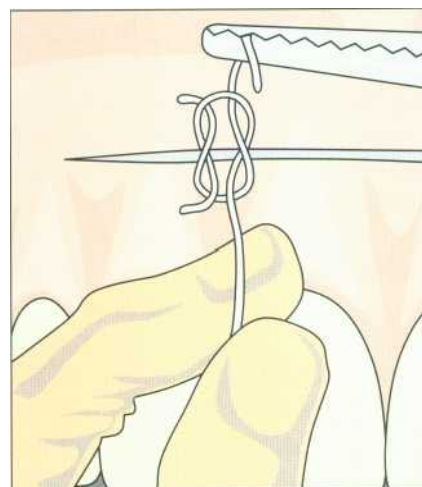


Fig 27-1 b

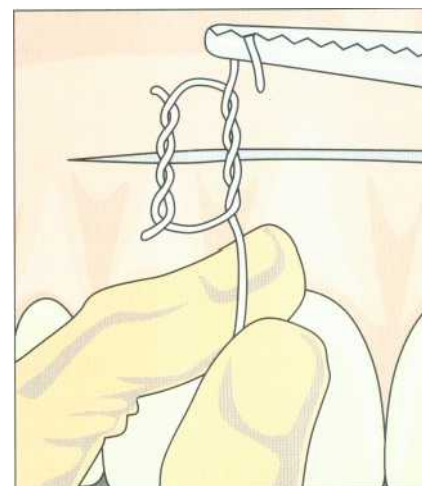


Fig 27-1 c

Mattress sutures

The mattress suture originates as an interrupted suture. However, contrary to the normal procedure of cutting both threads, the needle-attached thread is not cut but continues to enter and exit along the incision line in a series of angled loops until it terminates in a three-threaded surgical knot at the end of the wound. This suture style is

easy to place and, because it only has one knot at the beginning and one knot at the end, it is easy to remove and keep clean (Figs 27-2a to 27-2e).

Disadvantage. The angle of the weave repositions the flap in torque with the attached tissues. This invites gaps and overlaps along the incision line.

Figs 27-2a to 27-2e The mattress suture begins with a two-threaded surgical knot, and after a series of continuously angled loops, ends in a three-threaded knot.

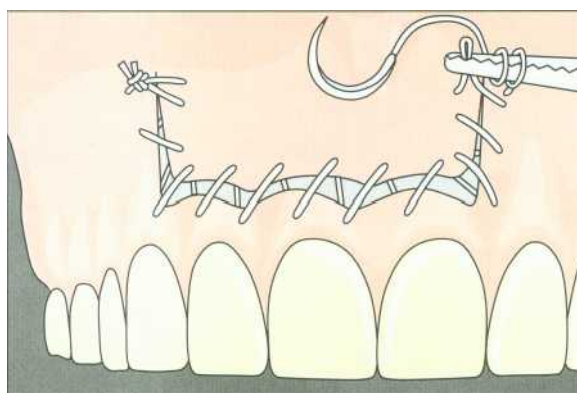


Fig 27-2a

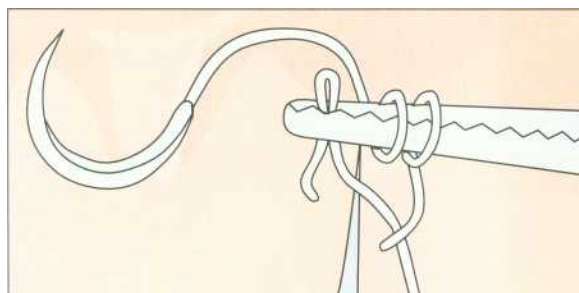


Fig 27-2b

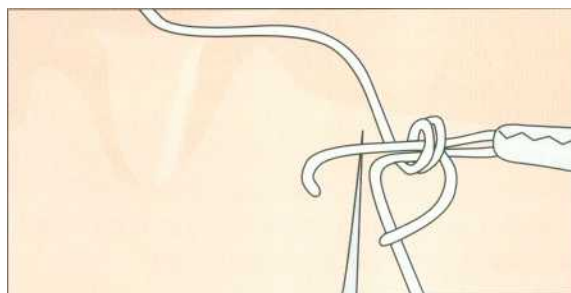


Fig 27-2c

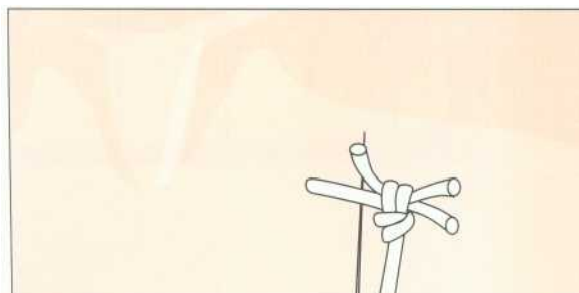


Fig 27-2d

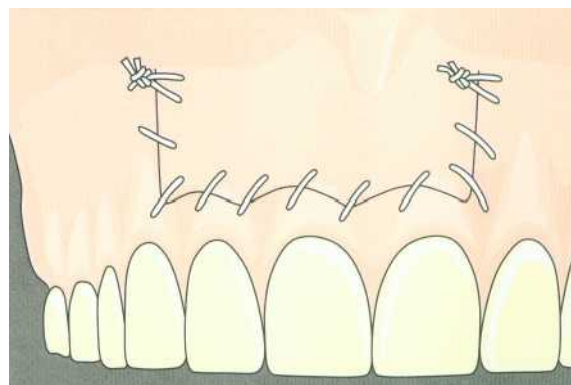


Fig 27-2e

Blanket sutures

A blanket suture is a modified mattress suture. It begins as an interrupted suture, but differs from the mattress as it continues down the incision line. The uncut needle thread is brought through a loop of thread after each tissue entry. As each loop interlocks, it tightens and straightens the previous loop in a preferred untorqued angle until it ends in a three-threaded surgical knot. These perpendicular sutures are better able to hold the edges of the flap in apposition and are easy to place, remove, and keep clean (Figs 27-3a to 27-3c).

Sling sutures

The sling suture is really a modified mattress suture that is extremely versatile and efficient in closing long intrasulcular flaps. It originates at the junction of the vertical and horizontal incisions with an interrupted suture. The uncut thread is then fed to the lingual by passing the needle between the teeth apical to the height of contour. The thread is woven around the lingual neck of the tooth and returned to the facial side of the arch by feeding the needle above/below the contact points of the next nearest embrasure. Unless the cingula of the anterior teeth or the height of contours of the posterior teeth are destroyed or absent, it is generally unnecessary for the needle to pass through the lingual tissues before it is returned to the facial aspect.

The needle next enters and exits the papillae and is fed beneath the contact points to the lingual. This weaving sequence continues along the full length of the flap, where it ultimately ends in a three-threaded surgical knot (Figs 27-4a to 27-4d).

Figs 27-3a to 27-3c The blanket suture is similar to the mattress suture in that it begins with a two-threaded surgical knot, but as it continues down the suture line, the needle loops and locks each entry and exit before ending in a three-threaded knot.

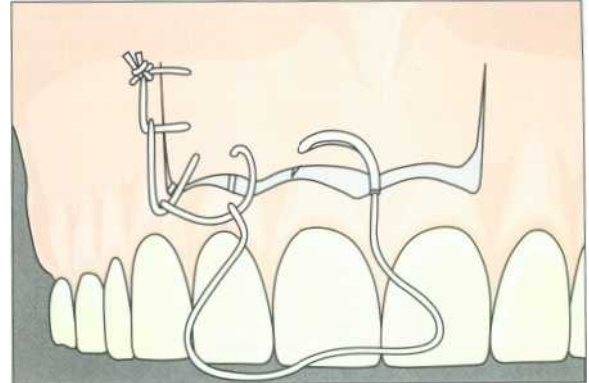


Fig 27-3a

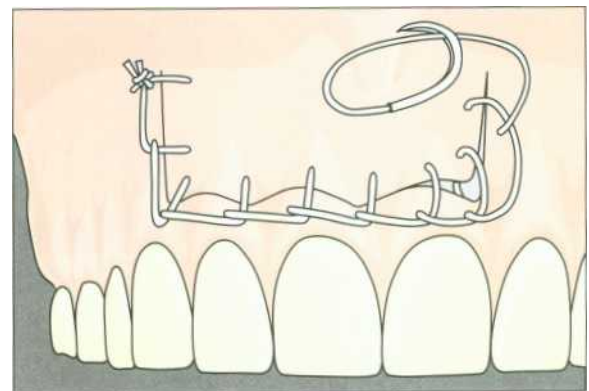


Fig 27-3b

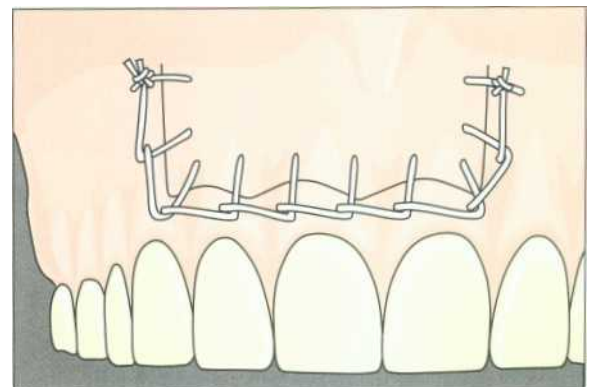


Fig 27-3c

Figs 27-4a to 27-4d The sling suture begins with a single two-threaded surgical knot, and before ending in a three-threaded surgical knot, it weaves down the intrasulcular line, passing from the buccal aspect to the lingual aspect, entering and exiting the facial crestal tissue at each embrasure 1a and b~. The cingula and/or heights of contour are used for lingual retention. The continuous sling technique is particularly useful when closing posterior flaps (c~. To better secure closure in the absence of sufficient crown structure, the lingual tissue may be entered and exited at each embrasure 1d).

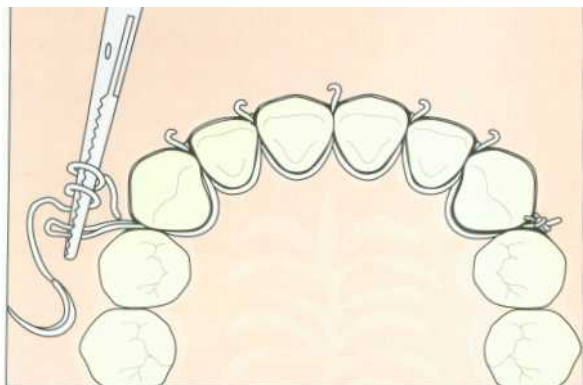


Fig 27-4a

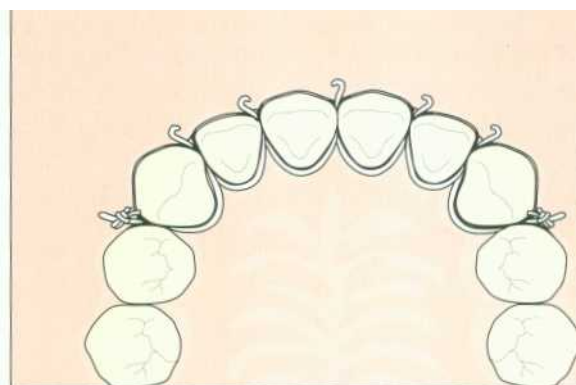


Fig 27-4b

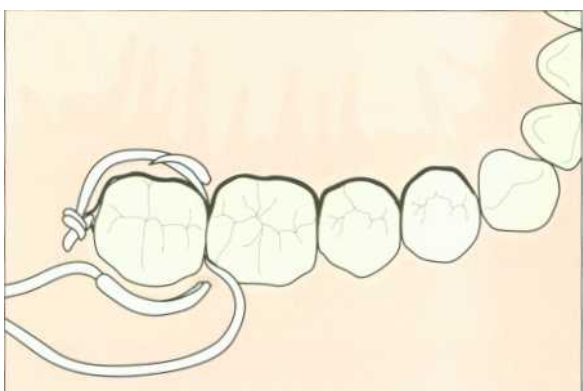


Fig 27-4c

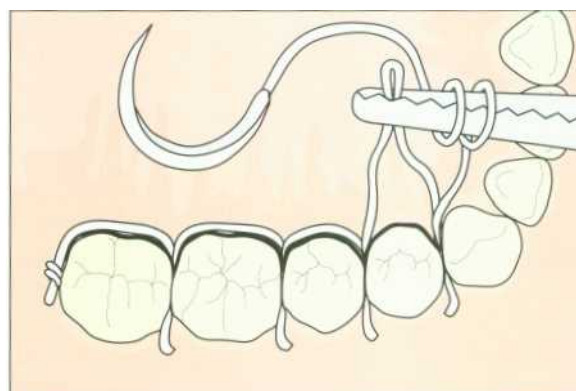


Fig 27-4d

Thread breakage is apt to occur when the operator attempts to feed the needle from the labial to the lingual if the contacts are long and tight, there is extensive caries in the embrasures, crowns are present and splinted, or the operator tries to floss the suture thread between the crowns as opposed to feeding the needle under the contact points.

If the thread breaks during placement, the segment of the sling that has already been placed should not be removed. Instead, it is best to allow a length of the broken thread to extend out of the embrasure where it broke and begin a new sling suture at the opposite incision junction. The new sling advances along the crest as usual, and when the broken thread is reached, the new end is tied to the broken end at that embrasure (Figs 27-5a to 27-5c).

Figs 27-5a to 25-5c If a continuous sling suture breaks during placement, a new sling is started at the opposite end of the incision and both slings are tied together at the breaking point with a surgical knot.

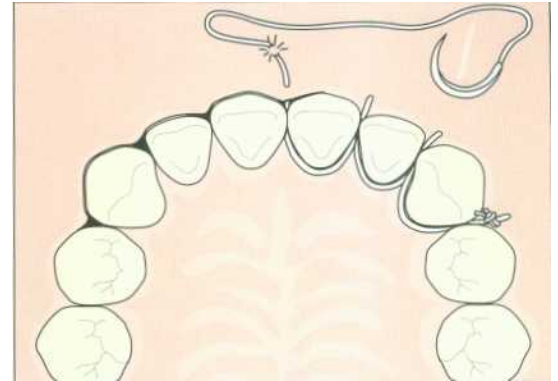


Fig 27-5a

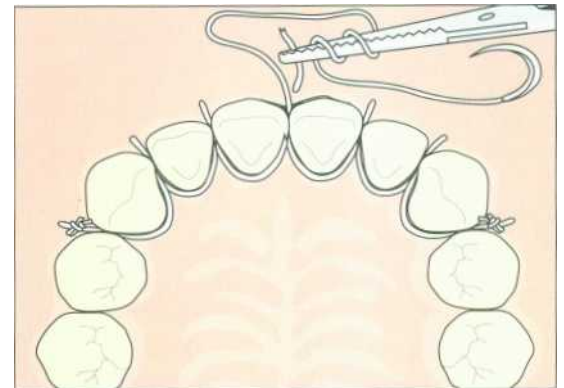


Fig 27-5b

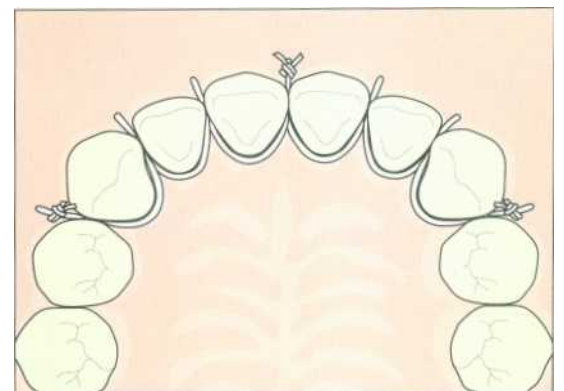


Fig 27-5c

Basket sutures

The basket suture is a variation of the sling where only one tooth is involved. The needle is inserted in the flap as in the sling, but approximately 2 inches of the thread is left unfed. The suture loops around the lingual aspect of the tooth apical to the height of contour and returns to the buccal where the needle reengages the flap. The suture material retraces its original path around the lingual, returning to its origin, where it is knotted with the 2 inches of unfed suture thread (Figs 27-6a and 27-6b).

A modification of the basket suture is an alternative technique whereby the papillae can be sutured in place without the thread exiting in the

incision line at any time. The initial entry is made approximately 6 mm below the mesiolabial papillae, is passed beneath the tissue, and exits 2 mm below the mesiolabial papillae. Approximately 2 inches of thread is left unfed at the entry point. Once it exits the tissue, the thread is passed through the contact to the lingual. Here it is woven around the lingual neck of the tooth to the mesial lingual line angle, where it is passed through the contact to the distolabial aspect. It then penetrates the distolabial papillae at the 6-mm level (where it passes under the flap), exits at the 2-mm level, and is terminated in a knot with the primary thread at the entry point (Figs 27-a and 27-b).

Figs 27-6a and 27-6b The basket suture, which can be used regardless of the number of teeth involved, is basically a sling that weaves between the embrasures, using the lingual aspect of the tooth twice for retention (A→B→A) as it returns to its origin to close with a surgical knot.

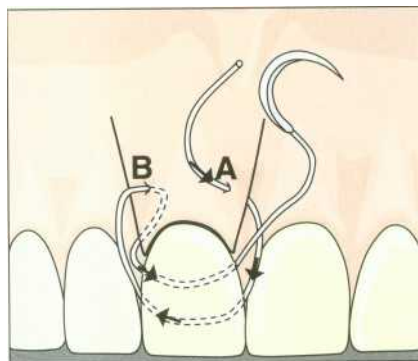


Fig 27-6a

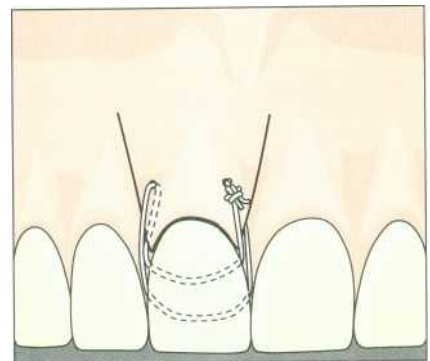


Fig 27-6b

Figs 27-7a and 27-7b A simple modification to the basket is designed to prevent the suture thread from passing through the incision line. Entrances and exits (A→B→C→D→A) all occur in the freed flap and the lingual contours are used for retention.

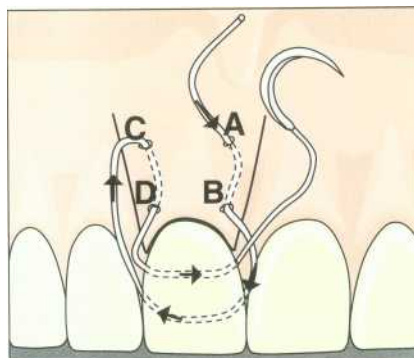


Fig 27-7a

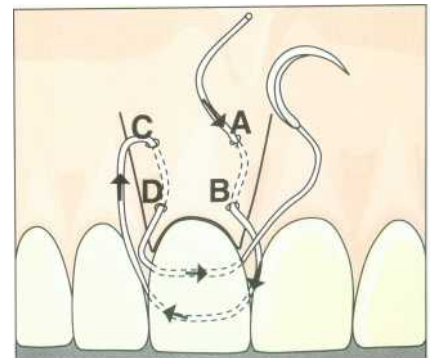


Fig 27-7b

Sutures for vertical incisions

Closing the vertical incision is easily accomplished with one or more interrupted sutures. These are loosely placed and are only intended to maintain the closure. If these sutures are pulled tight, the tissue may overlap and even tear. The patient will be uncomfortable throughout the postsurgical period, and the sutures will be difficult and painful to remove.

For a long vertical cut, a gentle, easy-to-place, easy-to-remove vertical closure alternative to a series of interrupted sutures is a crisscross continuous suture. The needle enters the unattached tissue at a level near the vertical-horizontal junction. It crosses the incision line and reenters from the undersurface of the attached tissue at a level a few millimeters below/above the mucobuccal fold. Here it exits and horizontally crosses the incision line where it reenters the surface of the unattached tissue at the previously selected fold level. From this level, it recrosses the incision line from underneath and enters the undersurface of the attached tissue at a level equal to that selected for the initial entry. It then crosses horizontally to join the primary free end in a surgical knot at the entry point (Fig 27-8a and 27-8b).

Figs 27-8a and 27-8b Vertical incisions should be closed without adding tension to the flap with a simple interrupted suture. When the incision is long, a crisscross technique IA->B>C-4DI that never allows the thread to pass between the incision edges is best.

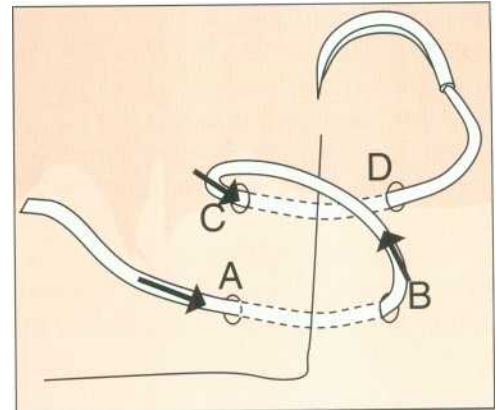


Fig 27-8a

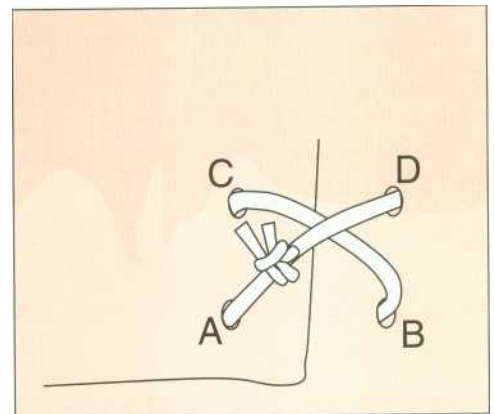


Fig 27-8b

Suggestions

1. The more precise the incision, the better the reapproximation and the better and faster the healing.
2. To avoid needle tears when closing an Ochsenbein-Luebke flap, 3 to 4 mm of the attached gingival tissue should be elevated before attempting to insert the suture needle (Fig 27-9).
3. Suturing begins by inserting the needle through the superficial surface of the unattached tissue before entering the inferior surface of the attached tissue (Fig 27-10).
4. To prevent tearing, the suture needle should enter and exit tissue at least 2 mm from the incision edge and be spaced approximately 2 mm apart (Fig 27-11). The terminating knots should be placed over tissue and not over the incision line.
5. Sutures are only pulled tight enough to bring and keep the incised edges in contact.
6. A sutured flap should be tested by moving the lips and/or cheeks. If gaps become evident, they should be closed by interrupted sutures.
7. A sutured flap should be finger compressed for 3 to 5 minutes. Compressing the tissues for a short period of time after they have been repositioned creates an initial adhesion and prevents blood from pooling between the inner surface of the flap and the bone.
8. A pool of blood may build between palatomucosal tissue and bone, causing the flap to sag. The loss of adhesion results in tissue ischemia and slough. If such a possibility exists, an acrylic stent should be prefabricated as a precaution.
9. To ensure that no sutures are inadvertently missed at the time of removal, the number of sutures originally placed should always be recorded.
10. Reanesthetizing the patient with a long-acting anesthetic, such as bupivacaine hydrochloride (Marcaine) with 1:200,000 epinephrine (5%), at the time of dismissal may be helpful in controlling an initial pain response for 2 to 4 hours.
11. A gentle cleansing of the surgical site with a disinfectant-soaked gauze sponge or cotton swab lets the operator more clearly identify the quality of the sutures.

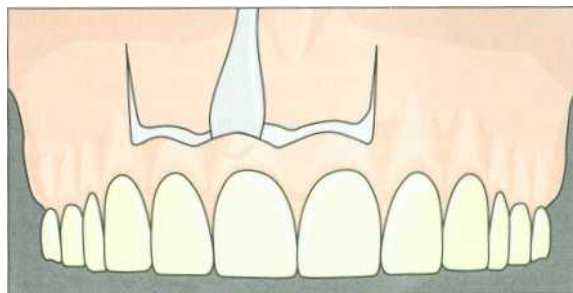


Fig 27-9 To provide needle room and prevent tearing prior to closing an Ochsenbein-Luebke flap, at least 2 mm of the attached gingiva should be elevated from bone.

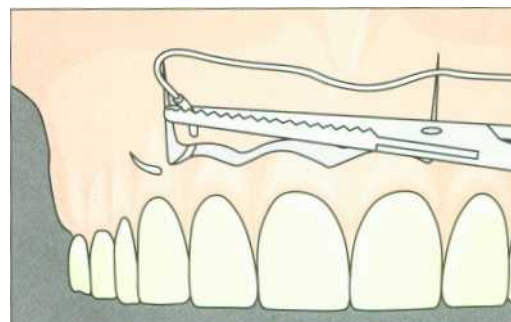


Fig 27-10 All suturing begins by first inserting the needle through the detached tissue before entering the attached tissue.

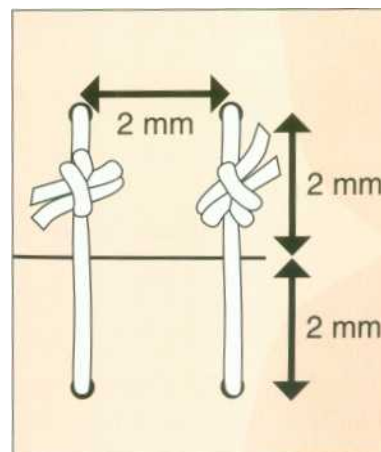


Fig 27-11 To prevent a suture from cutting through the thin gingival tissues while reducing its potential to pull free over time, a 2-mm bite should be taken on either side of the incision and a 2-mm space should exist between each suture placement.

III: Surgical Techniques

12. Prior to releasing the patient, the operator should carefully and softly cleanse the face and lips with a nonallergenic soap.
13. Prior to release, the patient's mouth should be examined carefully after he or she has rinsed gently with a small glass of cooled saline solution.
14. An ice pack should be provided immediately after the surgery and the patient should be instructed on how to position it over the surgical site.
15. The patient should be contacted 6 to 12 hours after surgery to evaluate his or her condition and needs.

Microsurgery

Objective

To magnify and illuminate the surgical field using microscopic equipment.

Note

The advantages of microsurgery include:

- Better assessment of the surgical site
- Better visualization of root anatomy
- Better assessment of surgical technique

There are also a few disadvantages:

- Takes time to learn
- May not be applicable in every surgical case
- Requires adequate operating room size
- Requires a costly initial investment

III: Surgical Techniques

As the power of magnification is increased, there is a corresponding loss in the depth of field. Although all surgical procedures could be performed under high power, the surgeon soon learns which of the following power settings serves individual procedures best (Figs 28-1 a to 28-1 c):

- Low magnification, x 2.5 to x 8.0
- Medium magnification, x 8.0 to x 16.0
- High magnification, **x 16.0 to x 30.0**

Instruments

CK1-5 Microscalpels (EIE Analytic Technology)

#2/4 Molt DE curette (Hu-Friedy)

H161 Tapered fissure Lindemann bone cutting bur (Brassler)

#13/14 Columbia DE curette (Hu-Friedy)

#34/35 Jaquette scaler (Hu-Friedy)

#171 L Tapered tissue surgical bur (Brassler)

Air King America surgical 45° handpiece (Medidenta)

Impact Air 45° handpiece (EIE Analytic Technology)

CX-1 Microexplorer (EIE Analytic Technology)

Piezoelectric ultrasonic unit (EIE Analytic Technology)

Spartan (Obtura)

CT1-5 and CK Ultrasonic tips (EIE Analytic Technology)

Stropko irrigator/drier (EIE Analytic Technology)

CM1-6 Microsurgical mirrors (EIE Analytic Technology)

#12 Spoon excavator (Hu-Friedy)

#12/13 PFIWDSI Plastic instrument (Hu-Friedy)

P-1 and B-3 Pluggers (Hu-Friedy)

#2/29 Ball burnisher (Hu-Friedy)

ETUF930 Fluted finishing bur (Brassler)

Microscopes

V-Series (JEDMED)

OPMI 99 (Carl Zeiss Inc)

Entree Protege (Global Surgical Corporation)

Fig 28-1 a to 28-1 c These views of graduated magnifications 1a: x 5; b: x 12; c: x 16! not only demonstrate the value of enhanced visibility, but also illustrate how the depth of field decreases as the magnification power increases.

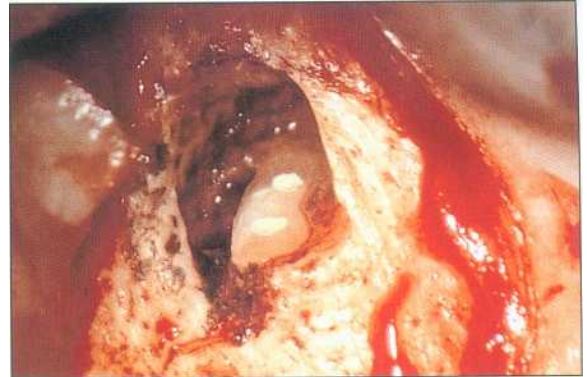


Fig 28-1 a



Fig 28-1 b



Fig 28-1 c

Operating Positions

It would be virtually impossible to establish a list of operating positions that would meet all the conditions faced in performing surgical procedures in the oral cavity. The ultimate goal is to *learn* how to *adjust* the patient, the assistant, and the surgeon into positions that are comfortable and nonfatiguing.

Microscope location

Although most operators would prefer a wall or ceiling mount, the dimensions and decor of existing operating rooms may force the operator to adjust to a cumbersome, rolling floor model. The location of immovable cabinets, mounted radiograph machines, and dental chairs may restrict flexibility and force the patient, the surgeon, and the assistant to be placed in compromised positions so the microscope can be used on both the right and left sides of the oral cavity. To provide versatility, some restrictions may only be accommodated by purchasing additional couplers, binoculars, cameras, and monitors.

Dental chair position

The chair should be raised to a level where the operator's and assistant's backs are vertical and unstrained, and their legs are unrestricted and parallel with the direction of the scope. The headrest should be large enough to position and maintain the patient's head in the proper occlusal plane. Generally it is best to position the chair below the operator's eye level for maxillary surgery, and above the operator's eye level for mandibular surgery.

Binoculars

Although binoculars are available as straight, inclined, and adjustable inclining tubes, most surgeons immediately recognize the advantage of direct vision with the straight tube. However, the inclined tube necessitates the awkwardness of working indirectly through a mirror. The inclinable tube affords the latitude to work directly or indirectly.

Surgeon's position

Unless the surgeon is comfortable, even the shortest and simplest procedures are tiring. Again, it is difficult to set the position parameters because of the differences in hand preferences (right-handed versus left-handed), and chairside approaches (front, side, or back).

Comfort begins with an operating stool that offers arm supports and a seat that can be raised to keep the thighs parallel to the floor. If possible, the operating room should allow the surgeon to position the chair on the operating side of the patient. Again, room conditions may restrict such freedom, forcing the patient to turn to positions that accommodate the surgeon and the scope.

Assistant's position

Depending on the extent of the microscopic equipment used, in particular when a beam splitter is employed, the assistant's duties may range from working in the normal chairside capacity to working directly in the surgical field through the assistant's articulating observation scope. To maintain harmony and efficiency, a second assistant passes instruments and materials as needed. The beam splitter offers the opportunity for the assistants to monitor an image of the oral cavity projected from a video camera to a small LCD (liquid crystal display) screen or to a more affordable, yet practical, well-positioned, high-quality monitor.

Techniques

- 1. Intrасulcular incisions are made** with microscalpels, generally under low magnification. These double-edged scalpels conform to the gingival sulcus and produce atraumatic incisions.
- 2. Flaps are reflected** with a #2/4 curette, generally under low magnification. The small end of the curette is used to reflect the attached gingiva and the larger end to reflect gingival mucosa.

- 3. The osteotomy is performed** with an H161 bur in an Impact Air 45° handpiece. This procedure generally begins under low magnification, and periodic assessments are made with higher levels of magnification as progress ensues. The H161 bur has fewer flutes than conventional burs, causes less clogging, and generates more efficient cutting. The Impact Air 45° handpiece facilitates placement in the posterior regions of the mouth, and its angle of entry is lateral to the line of sight. Water is directed along the surface of the bur while air is ejected from the back of the handpiece. This decreases the chance of embolism and pyemia and creates less splatter than conventional handpieces.
- 4. Curettage is performed** with a #13/14 Columbia curette and a #34/35 Jaquette scaler under medium magnification. The #13/14 Columbia curette allows access to the lingual aspect of the root. The #34/35 Jaquette scaler allows for efficient removal of tissue from the junction of the bony crypt and the root. Both of these scalers allow for more efficient removal of tissue than conventional spoon-shaped curettes.
- 5. Apicoectomy is performed** with a #171 L tapered fissure bur in an Impact Air 45° handpiece under medium magnification. Less splatter is created with a tapered fissure bur than with a crosscut fissure bur.
- 6. The root surface is inspected** with a CM microexplorer under high magnification. Tiny canaliculi and isthmi are readily identified. Tactile sensation is increased when the root surface is explored with high magnification. The root surface should be dried with a Stropko irrigator/drier prior to inspection.
- 7. The apical preparation is created** with a CT ultrasonic tip energized by an ultrasonic unit under medium magnification. The apical preparations are made parallel to the long axis of the root to a depth of 3.4 mm. Periodic orientation of the tip to the long axis of the root is checked at low magnification.
- 8. The apical preparation is rinsed and dried** with a Stropko irrigator/drier under medium magnification. All preparations must be dry to ensure the proper adaptation of the retrofilling material. It is impossible to properly assess the beveled surface of the root or the preparation when it is wet.
- 9. The apical preparation is inspected** with a microsurgical mirror under high magnification. The labial wall is carefully inspected to check for the complete removal of gutta-percha or other filling material. The 3-mm preparation is measured off the labial wall. It is felt that many surgical failures have occurred as a result of poor depth because of the difficulty in seeing the labial wall. If gutta-percha is found on the labial wall, it is removed ultrasonically with a CK back-action tip, or moved away from the labial wall with a P-1 plugger or the plugging end of a P-1 or B-3 plugger. Prior to the introduction of microsurgical mirrors, it was impossible to assess the thoroughness or cleanliness of an apical preparation.
- 10. The retrofill material of choice is placed** with a suitable carrier under medium magnification. A #12 spoon excavator or the flat surface of a plastic #12/13 PFIWDSI instrument is recommended to place either Super EBA or IRM, and a KG carrier or messing gun is used when placing mineral trioxide aggregate (MTA).
- 11. The retrofilling material is condensed** with a P-1 or B-3 plugger under medium magnification. The P-1 plugger or the plugging end of a B-3 plugger should fit inside the normal apical preparation and, with coronally directed pressure, ensure proper condensation against the cavosurface walls.
- 12. The retrofill is burnished**, and the surface and root are finished under medium magnification. A hard cement, such as Super EBA or IRM, can be finished with a ETUF930 fluted finishing bur. If necessary, warm sterile water can be applied to Super EBA to accelerate setting time. A dampened cotton pellet is used to clear the root tip of excess MTA.
- 13. The retrofill is examined** under high magnification. A CM microexplorer is used to check marginal adaptation and integrity.
- 14. The flap is sutured back in place.** Low magnification maybe used for this procedure. The sutured site is examined under high magnification.

PART IV

Postsurgical Care

Immediate Postsurgical Care

Objective

To make the patient as comfortable as possible, both physically and mentally, prior to being released from the office.

Techniques

1. Immediately after the flap is sutured, **minor bleeding** can be controlled by finger pressing a moistened sterile gauze pad or wound dressing, such as Collatape, against the flap for 5 to 10 minutes. Firm finger pressure should be sufficient to collapse the severed vessels under the flap and stimulate clot formation.
2. Seepage is a common sequela for several hours after surgery. This may be due to the hemostatic pressure buildup as the rebound effect increases the blood flow to partially severed and blocked vessels. Seepage requires little attention other than to reassure the patient of its normalcy. Because the surgical site may seep throughout the sleeping hours, the patient should be forewarned.
3. In the operating room, all surgical gauze, toweling, and instruments should be removed from the patient's sight as quickly and quietly as possible.
4. If the patient is heavily sedated, he or she should be awakened slowly.

5. The surgeon should **change the patient's chair position** by slowly elevating him or her to an upright position; ask whether there is a feeling of light-headedness once the patient has risen.
6. The patient may appear well, but it is wise to **check the vital signs** before raising the patient to a seated position.
7. To build the patient's confidence, the surgeon can **thank the patient for cooperating** and acknowledge how well the surgery went.
8. The surgeon should allow time for the patient to relax.
9. A disposable ice pack should be covered with soft toweling, and the patient instructed on where and how to **hold the ice pack firmly in position** against the facial tissues approximating the surgical site. The immediate reduction in temperature and the pressure on the face not only slows the blood flow and stimulates intravascular clotting, but intercepts and counteracts the rebound effect described by Lindorf (1979). The cold also desensitizes the peripheral nerve endings and in so doing becomes an effective analgesic.
10. The surgeon should **explain the postsurgical instructions** slowly to the patient. If the operating facility has been cleared, this may be an appropriate time to bring the person accompanying the patient into the room to reaffirm the comments, instructions, and advice. Both the patient and the companion should be given printed instructions that reiterate the verbal instructions (see Lesson 30).
11. Contrary to what most people believe, postoperative pain is rare. Unfortunately, it is also unpredictable. Severe pain is not inevitable with a long, difficult surgical procedure, nor is comfort guaranteed after a short, simple treatment. Recent studies indicate 400 to 800 mg of ibuprofen administered preoperatively significantly reduces postoperative discomfort and pain (see Lesson 11). Nonnarcotic nonsteroidal anti-inflammatory drugs are suggested as postoperative analgesics. It is recommended that the patient be instructed to take Advil (400 to 800 mg) every 4 to 6 hours for the first 24 to 48 hours postoperatively and to call the office if this proves to be insufficient.
12. **The surgeon should assist the patient to a standing position** and give support at all times. Sweating, clamminess, and any change in facial color should be considered an indication of weakness and an early sign of syncope.
13. A patient who has been premedicated should not be released until able to respond normally when questioned and can walk without difficulty. At that time, responsibility for the patient may be transferred to the accompanying adult. The dentist may continue to offer assistance or provide a recovery area until the patient is ready for release.

Postsurgical Instructions

Objective

To inform the patient of the normal surgical sequela and to instruct on postoperative home care.

Note

Postsurgical instructions and availability of the surgeon are both professional and legal responsibilities.

Suggestions

1. The surgeon or a staff member must **discuss the postsurgical instructions with the patient** and/or a responsible guardian or companion prior to the patient's release from the office. Because the patient may be stressed at that time, oral instructions may be misunderstood or easily forgotten. To avoid confusion, printed instructions (Fig 30-1), including a phone number where the surgeon or an assistant can be reached, should be given to the patient.
2. The surgeon should **telephone the patient on the evening of the procedure** to evaluate his or her condition and to answer any questions. This gesture of care and concern is reassuring to the patient and the family.
3. During office hours the following day, the surgeon or a staff member should contact the patient to check on swelling, bleeding, or any other problem that might require an office visit.

IV: Postsurgical Care

Figure 30-1 Sample Postsurgical Instructions Form

Surgeon's name:

Surgeon's address:

Office phone:

Home phone:

Assistant's name:

Home phone:

1. It is normal for **blood to seep from the site** of a surgical procedure for several hours after the operation. Cleanse the mouth with a mild rinse consisting of Y2 tsp of table salt and Y2 glass of warm water. Talking and strong mouth rinses may stimulate bleeding and should be controlled for the first few days. If bleeding continues or becomes profuse, try to locate the exact spot the blood is coming from by gently flushing the mouth clean and looking in a mirror. Once you determine where it is coming from, hold a piece of gauze, some toweling, or a tea bag against the tissue and bone, and apply firm but gentle pressure for 10 minutes without moving the fingers away from the site. Do this in a sitting position. If heavy bleeding continues, call the surgeon's office or home.
2. It is normal for a surgical area to swell following an operation. Such swelling may last from a few hours to several days. Immediately following surgery, an ice pack was applied to your face directly over the surgical site. An ice pack should remain in place for a period of 15 to 20 minutes, then be removed for 15 to 20 minutes. Keeping an ice pack on the area more than 20 minutes is counterproductive and could actually stimulate bleeding. This alternating sequence should continue throughout the first 6 to 8 postsurgical hours. Heat, preferably moist heat, may be applied as needed after 24 hours.
3. It is normal to experience some pain following surgery. Using the ice pack and taking two 200-mg ibuprofen tablets or capsules every 4 to 6 hours should help reduce the postoperative pain. If the pain persists or worsens, additional medication may be required. Please call the surgeon's office or home.
4. Careful toothbrushing is desirable and promotes healing. The bristles of the brush should not contact the surgical area. Brush only the teeth, and make every effort to avoid the gums. Forty-eight hours after surgery, begin rinsing the mouth with any of the flavored mouthwashes or a mild saltwater solution (Y2 tsp table salt to V2 glass of warm water). Follow directions if Peridex has been prescribed.
5. Postsurgical infection is unusual, but possible. Signs of infection may cause increased pain, increased swelling and tenderness, elevated body temperature, chills, and other flulike symptoms. An objectionable odor and taste may also be experienced. When these conditions exist, begin rinsing the mouth with a very hot saltwater solution, reinstitute the facial ice packs, and call the surgeon's office or home.
6. It is normal to experience a loss of appetite following surgery. The teeth may be tender, and certain foods may be difficult to chew. However, nourishment must be provided to ensure healing. A high-protein diet, as well as 2 multivitamin capsules, taken 3 times a day for the first week, will aid in tissue repair. Energy foods that require little or no chewing include liquid protein supplements, soups, diet concentrates, milkshakes, eggs, cereal, fruits, and ground beef.
7. An appointment has been made for the removal of the stitches. If, for any reason, one or more of these stitches loosens and hangs free, please call the office.
8. Thank you for your cooperation. Please feel free to call the office with any concerns.

General Antibiotic Management

Objective

To prevent, reduce, or eliminate the number and virulence of microbial organisms by prescribing antibiotics in appropriate doses and durations.

Note

When prophylactically indicated for high-risk patients, antibiotics should be administered in accordance with the American Heart Association (AHA) guidelines and the American Dental Association/American Academy for Orthopedic Surgeons (ADA/AAOS) care recommendations for patients with prosthetics who are at increased risk of hematogenous total joint infection (see Lesson 3).

The pharmacodynamics of antibiotic therapy are that it suppresses bacterial protein synthesis or it inhibits cell wall formation and induces autolysis.

Indications

The AHA recommends endocarditis prophylaxis for the following endodontic procedures:

1. Intraligamentary local anesthetic injections
2. Endodontic instrumentation or surgery beyond the apex
3. Intentional reimplantation of extracted or avulsed teeth

Clinical judgment may also indicate antibiotic use in selected circumstances where significant bleeding has been encountered.

Certain indications require judgment on the part of the surgeon:

1. The patient is on antibiotics at the time he or she undergoes surgery.
2. Surgery is performed, and an active infection is evident or suspected (from symptoms such as pus, odor, etc).
3. During surgery, the site or the instruments are inadvertently contaminated.
4. The patient presents with suspicious clinical or medical signs or symptoms (see Lesson 3).

Antibiotic Recommendations

1. Routine dental infections
 - a. Penicillin G, V-Cillin K, Pen-Vee K: 1000 mg initially; 500 mg every 6 hours for 7 to 10 days
 - b. Cephalosporins (Keflex, Anspor, Ceclor) 500 to 1000 mg initially; 500 mg every 6 hours for 7 to 10 days
2. Nonresponsive or anaerobically suspected dental infections
 - a. Clindamycin (Cleocin): 300 mg initially; 150 to 300 mg every 8 hours for 7 to 10 days
 - b. Metronidazole (Flagyl): 250 mg every 6 hours for 7 to 10 days

Because metronidazole is only effective against anaerobic microbes, it should be combined with penicillin when managing major dental infections.

3. Patients with penicillin or cephalosporin sensitivities
 - a. Erythromycin stearate (Erythrocin): 1000 mg initially; 500 mg every 6 hours for 4 to 7 days

- b. Ciprofloxacin (Cipro) for severe infections: 500 mg every 12 hours for 4 to 7 days
- c. Tetracyclines (Acromycin, Terramycin, Aureomycin, Vibramycin, Declomycin): 1000 mg initially; 500 mg every 6 hours for 4 to 7 days
- d. Amoxicillin tablets (Augmentin): 500 mg every 8 hours for 4 to 7 days
- e. Cefaclor Pulvules (Ceclor): 500 mg every 8 hours for 4 to 7 days

Problems

1. **Pseudomembranous colitis.** This condition is induced by the exotoxin derived from *Clostridium*. To correct this problem, the dentist should:
 - a. Discontinue the medication;
 - b. Refer to the patient's physician or internist;
 - c. Administer vancomycin (Vancocin): 500 mg every 6 hours for 4 to 7 days; and
 - d. Recommend an absorbent/protectant preparation (eg, kaolin, pectin).
2. **Gastric distress.** Any drug can cause this problem, but it is more apt to occur when erythromycin and tetracycline are administered orally. Problems may include epigastric pain, nausea, vomiting, diarrhea, and yeast infections. As a precaution, the dentist should:
 - a. Discontinue the medication;
 - b. Prescribe enteric-coated Erythrocin; and
 - c. Prescribe medication to be taken with food.
3. **Pregnancy.** The dentist should always check with the patient's obstetrician.
4. **Drug interactions.** The dentist should:
 - a. Check reference materials on medication interactions; and
 - b. Advise all female patients that certain antibiotics may interfere with the effectiveness of oral contraceptives.
5. **Overuse.** The injudicious use of antibiotics is just as abusive as not prescribing when there is reason. If there is a medical indication, an infection was found prior to or during the surgery, or for some reason it is felt the operating field may have been contaminated, it is reasonable to prescribe an appropriate antibiotic.

6. Underprescribing. The most common errors are prescribing an insufficient dose and discontinuing its use prematurely. If a reason exists to prescribe any drug, an adequate dose should be given, and the patient's reactions monitored in subsequent days. The dosage and duration should be adjusted as needed relative to the patient's response. If, within three days, there appears to be no improvement, the dentist should switch to an alternate drug and consider culturing the site.

7. Anaphylactic reaction. In the case of an anaphylactic reaction, the correct response is as follows:

- a. Call 911 immediately;
- b. Currently certified staff administer supportive CPR; and
- c. Unless the dentist is trained in emergency medicine, he or she should refrain from administering drugs.

Postsurgical Pain

Objective

To make the patient as comfortable and as free of pain as possible following surgery.

Note

Although an easy, uncomplicated surgical procedure does not ensure a painless postsurgical experience, precise incisions, smooth periosteal elevation, atraumatic retraction, and a well-repositioned closure enhance the potential for uneventful, painless healing.

Analgesic Techniques

■ Placebo

Studies have shown that a significant analgesic effect can be observed in a patient when postsurgical instructions are given authoritatively, confidently, convincingly, and compassionately. When some form of drug therapy (regardless of the dosage, strength, or duration) accompanies enthusiasm and respect for the dentist, the result is even more positive.

Acetaminophen

In some patients, this nonaspirin alternative has been found to be more effective at the 1000-mg levels than 60 mg codeine. Acetaminophen is an effective antipyretic and produces fewer gastrointestinal problems, but it lacks the needed postsurgical anti-inflammatory properties. Tylenol is an excellent choice for patients sensitive to aspirin and codeine.

Nonsteroidal anti-inflammatory drugs

The propionic acid derivatives, commonly known as NSAIDs, have both analgesic and anti-inflammatory properties. Although salicylates such as aspirin are included in this group, ibuprofen has become the drug of choice for managing dental pain.

The most commonly recommended NSAIDs are:

Advil: 200 mg (2, 3, or 4) every 4 to 6 hours

Motrin: 400 mg (1 or 2) every 6 hours

Naprosyn: 500 mg initially; 250 mg every 8 hours

Toradol: 20 mg initially, then every 4 to 6 hours

Lodine: 400 mg every 8 hours

The effectiveness of ibuprofen.

1. A study published by Dionne et al (1983) showed a 400-mg dose of ibuprofen ingested prior to surgery was highly effective in reducing the incidence of postsurgical pain.
2. A study by Cooper et al (1984) showed NSAIDs prescribed at the 400- to 600-mg level are more effective than narcotics for managing postsurgical pain, and the aspirin or acetaminophen combinations are best at the 60-mg level.
3. Caution: Ibuprofen is irritating to the gastrointestinal tract and should be avoided in patients who have a history of ulcers, other stomach disorders, or a known sensitivity to aspirin.

Narcotics

As opposed to peripherally acting drugs, narcotics affect the central nervous system and, unless they are used in combinations with aspirin or acetaminophen, they lack anti-inflammatory efficacy.

Commonly prescribed narcotics include:

Codeine: 30 to 60 mg every 3 to 4 hours

Codeine compounds or combinations:

30 mg codeine + 500 mg acetaminophen

or

30 mg codeine + 500 mg Tylenol

Every 3 to 4 hours

Synthetic narcotics

This drug group is highly addictive, is unpredictable in effect, and causes many side effects, including gastrointestinal problems and dizziness. Common prescriptions are:

Demerol: 50 mg meperidine (1 or 2) every 6 to 8 hours

Mepergan-Fortis: 50 mg meperidine + 325 mg acetaminophen (1 or 2) every 6 to 8 hours

Semisynthetic narcotics

These medications can be extremely effective but more addictive than codeine. Examples of semisynthetic narcotic derivatives include:

Hydrocodone: 5 mg (1 or 2) every 4 to 6 hours

Vicodin: 5 mg hydrocodone + 500 mg acetaminophen (1 or 2) every 4 to 6 hours

Vicodin ES: 7.5 mg hydrocodone + 750 mg acetaminophen (1 or 2) every 4 to 6 hours

Examples of oxycodone Class II drugs (10 times more potent than codeine):

Oxycodone: 1.5 mg every 6 hours

Percocet: 5 mg oxycodone + 325 mg acetaminophen every 6 hours

Percodan: 4.5 mg oxycodone + 325 mg aspirin every 6 hours

Tylox: 5 mg oxycodone + 500 mg acetaminophen every 6 hours

Sedatives and hypnotics

These medications may be used on a limited basis to help patients rest and sleep more comfortably.

Examples include:

Librium: 50 to 100 mg chlorthalidone 1 hour prior to surgery

Valium: 5 to 10 mg diazepam 1 hour prior to surgery

Xanax: 0.25 mg 1 hour prior to surgery

Problems

1. **Aspirin** (salicylate) interferes with the production of prothrombin by blocking the use of vitamin K, thereby prolonging bleeding time. Utilizing aspirin or aspirin-related drugs is particularly risky with patients being treated with

blood thinners (or other anticoagulants that depress synthesis of factors) such as Coumadin or gout medication (Benemid, Anturane).

2. **All medically compromised patients** must be monitored for synergistic or antagonistic reactions when any medication is prescribed.
3. **Patients should be forewarned of light-headedness** and possible gastrointestinal disturbances when narcotics, sedatives, or hypnotics are prescribed.
4. **Nonsteroidal anti-inflammatory drugs should always be taken with food** and should never be prescribed for patients who are sensitive to aspirin or have a history of ulcers.
5. **All medications present potential risks during the first six months of pregnancy.** During the last trimester, appropriate drugs should be prescribed only with the approval of the patient's physician. Aspirin, NSAIDs, and narcotics should be avoided entirely.

Postsurgical Bleeding

Objective

To arrest the flow of blood and achieve coagulation.

Materials

Local anesthetic ball burnisher (Hu-Friedy)
Ferric sulfate 2/29 agglutinates (Stasis, Cut-trol)
EPIDRI racemic epinephrine pellets (Pascal)
Gelfoam (Upjohn)
Surgicel (Johnson & Johnson)
Avitene (Avicon)
Hemofibrin (Septodont)
Bone wax (Ethicon)
Sutures (Ethicon)
Absorbable collagen wound dressing: Collatape, Collacote,
Collaplug (Colla-Tec)
Ice pack (disposable)

Technique

After 24 uneventful hours, moist heat can be applied to enhance the necessary inflammatory response to increase blood flow and promote healing.

Problems

1. **Bleeding experienced within 12 to 24 hours postsurgically** is often the result of the rebound effect, and is sometimes difficult to control. The patient should be instructed to place a moist sterile gauze pad on the surgical site and apply firm finger pressure for 10 to 20 minutes. If this fails to stop the bleeding, the patient should try to locate the exact spot from which the flow originates, and press a moistened tea bag against the target area for 20 to 30 minutes. If the blood flow continues, it is best to see the patient in the office.

To provide comfort, the surgical area is infiltrated or blocked with a local anesthetic containing 1:100,000 epinephrine. Once the patient is sufficiently anesthetized, the bleeding site itself is injected with a local anesthetic containing 1:50,000 epinephrine. Firm finger pressure is immediately applied to the site for 10 to 20 minutes. If this fails to control the hemorrhage, the flap must be reopened, the offending spurters and vessels located, and coagulant techniques initiated (see Lesson 23).

2. **Interstitial bleeding** that filters to the superficial tissues of the face is commonly referred to as *ecchymosis*. This cosmetic problem merely requires reassurance to the patient that it is a natural harmless sequela and that the discoloration will gradually fade. The patient should be informed that normal tissue color should be expected to return in 10 to 14 days (Fig 33-1).

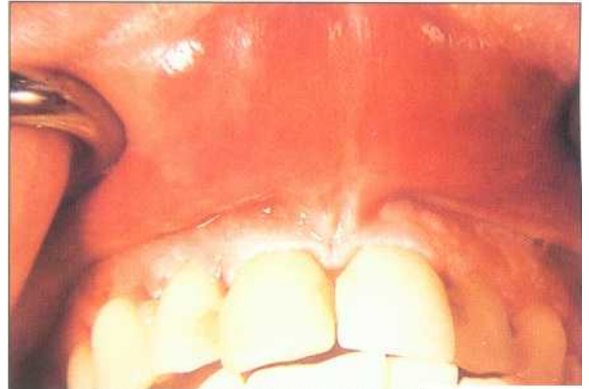


Fig 33-1 Interstitial bleeding that filters to the superficial tissues of the face is commonly referred to as ecchymosis.

Heavy bleeding during surgery does not always forecast an ecchymosis, nor does minimal bleeding portend the absence of postsurgical leakage to the face. However, it is suggested the patient be forewarned of the possibility and be instructed to call the office if any discoloration becomes apparent. This not only allays fears if it does occur, but lessens any thought that the patient was inappropriately treated and/or bruised during the surgical experience. Because blood is a productive culture medium, it is wise to prescribe an antibiotic if the patient does present with this sequela during the early 3 to 5 days of recovery.

3. **Uncontrolled postsurgical hemorrhage after the initial clot has formed** (secondary bleeding) usually indicates an injury has occurred to the area, or an ensuing infection is present. When faced with heavy latent bleeding problems, home remedies are generally futile. The patient must be seen in the office and injected with a local anesthetic with 1:100,000 epinephrine. The immediate surgical site is injected with a local anesthetic with 1:50,000 epinephrine.

The flap must be reelevated, and the bleeder(s) must be identified, pressured, crushed, chemically treated, and/or physically packed off (see Lesson 23).

If the bleeding is emanating from soft tissue, the offending vessels must be located and sutured off. The flap should not be resutured to its position until the hemorrhage has completely stopped, and the surgeon is assured that minor movement of the lip or cheek will not reinstitute the blood flow. The patient is released and instructed to rest and remain quiet, refrain from smoking, lie flat, reinstitute cold (ice-pack) therapy, force fluids, and contact the surgeon or office staff if the hemorrhage reerupts. The surgeon or office staff must be in frequent contact with the patient for the following 48 hours.

4. **When major uncontrollable bleeding continues**, hospital assistance may be necessary to stop the hemorrhage and investigate the underlying cause. Until the patient is under the care of an emergency physician, he or she must be kept warm and constantly monitored for signs of shock.

Postsurgical Swelling

Objective

To determine whether the swelling is an accumulation of blood or edematous fluid due to the normal sequelae of surgery, or is a post-operative infectious exacerbation requiring treatment.

Note

Swelling is basically a predictable and anticipated inflammatory response to surgery and has no clinical significance other than esthetics. However, it can provoke considerable concern and apprehension for patients if they are not properly informed prior to surgery. To avoid unnecessary alarm, the postoperative instructions should underscore the expectancy and normalcy of swelling. The importance of following the recommended regimen of home care procedures that minimize swelling and promote healing should be emphasized in both oral and written instructions (see Lesson 30).

Prevention

Compression of the flap immediately after suturing and the placement of the ice pack against the patient's face approximating the surgical site prior to release substantially influence the amount of swelling a patient experiences. The crushing of the vessels physically causes clotting, and the lowered temperature induces coagulation by slowing the blood flow. The ice pack should remain in place for a period of 15 to 20 minutes and then be removed for 15 to 20 minutes. This alternating sequence should continue throughout the first 6 to 8 postsurgical hours.

Healing

Unless bleeding is or has been a critical factor post-surgically, it is essential that normal, healthy blood flow be restimulated as soon as possible. Therefore continuing with periodic ice therapy after 24 hours is only encouraged if the swelling is severe after the first day.

Heat will encourage revascularization and assist the inflammatory response in its effort to heal the wound. There are a wide variety of methods for applying heat. Intraorally, the patient can hold warm saline (1/2 tsp salt in 1/2 glass warm water) in the mouth over the site for periods of 2 to 5 minutes.

Extraorally, a heating pad or hot wet toweling can be gently placed on the face over the surgical site for short periods of time. Unless circumstances change, swelling should diminish daily and be relatively unnoticeable 72 hours after surgery.

Problems

1. **Hematoma.** Continued swelling over an extended period of time may indicate a postoperative hematoma. If the skin or mucosa is discolored but the swelling has been reducing in size (albeit slowly), it is probably due to entrapped blood, which will be absorbed in time.

The unwanted facial discoloration is caused by a leakage of blood to the superficial tissues of the face, lip, and/or cheek. This ecchymosis, though alarming, is a cosmetic problem. The patient should have been forewarned of this possibility during the consultation. To allay the patient's fears, it is wise to explain how and why swelling occurs, and assure the patient it is a harmless and an unfortunate sequela. Because blood is a productive culture medium, it may be wise to place the patient on an antibiotic regimen for 3 to 5 days.

The discolored "black-blue-green-yellow" area should return to its normal color in 10 to 14 days. It is suggested the patient's condition be monitored during this period (Fig 34-1).

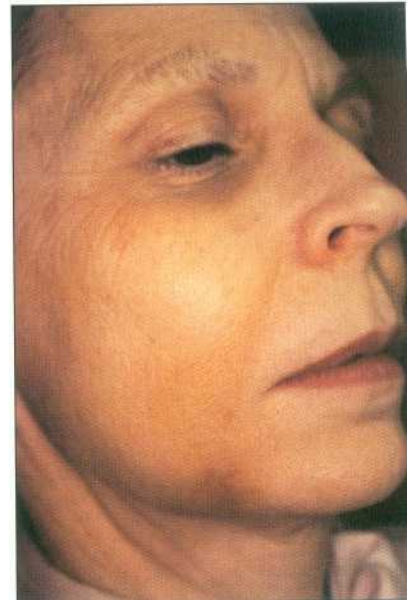


Fig 34-1 Continued swelling over an extended period of time may indicate a postoperative hematoma. Note the extent of the swelling and discoloration around and beneath the patient's eye, and how gravity has carried the fluids to the angle of the jaw.

2. **Relapse.** Reduced swelling over the first 3 to 5 days followed by a sudden increase in size indicates secondary injury to the site has stimulated new bleeding, or the patient has developed a postoperative infection. The patient should be seen promptly and questioned about his or her most recent activities. The flap site is examined, facial color evaluated for pointing, body temperature taken, and any other signs or symptoms noted and recorded in the patient's chart.

If the cause is recognized as renewed bleeding that has already stopped, no treatment may be necessary. If it is active bleeding, the flap may need to be reopened, the blood evacuated, the hemorrhage controlled (see Lesson 23), and the tissues resutured in place (see Lesson 35).

If the temperature is elevated and the swelled flap area is soft and tender to palpate, the cause is probably infection related. In this case, it may be necessary to incise (puncture) the fluctuation and not only aspirate the fluid, but insert a small mucoperiosteal wick drain (see Lesson 37).

The alternative is to remove the sutures if they are still present, reelevator the flap (it may be necessary to reincise), aspirate the fluids, and recurette and recleanse the bone crypt (see Lessons 14, 15, 17, and 35). Such a course of action is determined by the condition of the flap, the patient's temperature, facial redness, and/or infectious facial pointing (pustule). In such cases, the placement of a mucoperiosteal or facial drain may also be warranted (see Lesson 37).

Once the condition has been corrected, an ice pack is placed on the facial tissues and cold therapy (20 minutes on, 20 minutes off) is instituted.

3. **Pain control.** Regardless of how the situation is approached, anesthetizing the patient is a problem. Injecting swollen areas is painful and less effective for the following reasons:

- a. The pH value of the tissue fluids retards hydrolysis of the free alkaloidal base.
- b. The fluids within the swelling dilute the anesthetic solution.
- c. The anesthetic solution is quickly absorbed.
- d. Because the injection is so painful, an insufficient volume of anesthetic is administered.

For maximum patient comfort and cooperation, conscious sedation techniques should be employed (see Lesson 11).

Depending on the patient, the degree of difficulty encountered during this emergency, and the history of the effectiveness of pain medication with this patient, an appropriate analgesic regimen should be prescribed (see Lesson 32).

Guidelines

1. The dentist should be in frequent contact with the patient for the 72 hours following treatment. Conversations with the patient, or with an attending relative or guardian, are imperative.
2. Emergency care must be available at all times. The patient must have all available phone numbers where help can be reached.
3. If after 72 hours of therapy improvement is not apparent, culture techniques should be initiated, and a change in antibiotic selection and dose should be considered.
4. A second opinion should be sought if no progress is seen in 5 to 7 days.
5. An appropriate antibiotic regimen should be initiated for all of the conditions described in this lesson (see Lesson 31).

----- Postsurgical Flap Problems

Objective

To reenter the surgical site to cleanse the wound and determine the cause for retreatment.

Note

The incidental release of the flap may precipitate a visit for reflapping. In such cases, the operator is merely obligated to reposition the flap and retie or replace the loosened or lost sutures. The symptomatic patient who is experiencing moderate to severe pain, associated swelling, and intense anxiety and discomfort requires greater attention. The flap has to be released in its entirety and the surgical site reevaluated before reclosure.

Instruments and Materials

Anesthetic (Astra)

Surgical scissors (Hu-Friedy)

#15C Scalpel blade (Bard-Parker)

#149 Periosteal elevator (Hu-Friedy)

#2/4 Molt DE curette (Hu-Friedy)

#85 and #87 Lucas DE surgical curettes
(Hu-Friedy)

Suture setup

#18 Iris scissors (Hu-Friedy)

#317 Cotton dressing pliers (Hu-Friedy)

Gauze and cotton-tipped swabs (Johnson & Johnson)

#5 Mirror and #1 handle (Hu-Friedy)

TRAreus retractor (Hu-Friedy)

Sutures (Tevdek, EIE Analytic Technology)

Technique

The administration of a local anesthetic may be arduous and severely painful; for this reason Division I and II blocks are preferable to infiltrations. However, if the infiltration technique is chosen because of its simplicity, the injections should be given in a series of small, slowly administered doses. Initial penetration should be peripheral to the site, and subsequent injections should sequentially encroach on the surgical target. The series of injections should be administered minutes apart. To attain the maximum level of anesthesia and reduce the patient's anxiety and apprehension, conscious sedation techniques are advised (see Lesson 11).

Once the patient is comfortably anesthetized, the site should be preoperatively painted with a disinfectant and the mouth rinsed with Peridex (Proctor & Gamble) or 3% peroxide.

Sutures, if present, are severed and removed. The original incision line is reincised, and the tissue is reelevated. Once the bone crypt is exposed, all existing fluids, residual clots, and debris are aspirated. With maximum magnification and illumina-

tion, the root and crypt depth are thoroughly inspected. The offending tooth is examined for defects, and the quality of the seal is evaluated. If the operator is satisfied that no additional root repair is required and the surgical site is clear of all debris, the flap is reapproximated and resutured. A strict antibiotic and analgesic regimen should be instituted and maintained for the next 4 to 7 days. The patient is carefully monitored during the initial postsurgical period, and a suture removal appointment is scheduled.

Considerations

- 1. The length of time since the surgery** has a definite effect on the condition of the flap edges. If there is significant slough, it may be necessary to trim away all white avascular-appearing tissue before resuturing the flap in place. In addition to sutures, it may be necessary to place a suitable periopack around the necks of the involved teeth to protect and secure the flap.
- 2. Intense bleeding** may be faced as the flap is elevated and reflected. Although injecting anesthetic with 1:50,000 epinephrine anesthetic directly into the site may be of some assistance, it is more likely that hemorrhage control agents will be required to stop the flow while the area is being curetted. Once the crypt bleeding has come to a halt, the flap can be repositioned and resutured and pressure and ice can then be applied to the facial tissues approximating the surgical site. The patient should not be released until bleeding is totally abated (see Lesson 33).
- 3. Although postsurgical infections are rare, they do occur.** Precautionary culture techniques should be considered when initial antibiotic therapy appears to be ineffective. An alternative antibiotic regimen should be instituted until the culture results indicate a more specific drug discipline (see Lesson 31).
- 4. For pain,** in addition to prescribing an appropriately selected analgesic regimen, it may be advisable to administer a long-acting anesthetic, such as bupivacaine (Marcaine), prior to releasing the patient (see Lesson 32).

Postsurgical Evaluation and Suture Removal

Objective

To remove sutures and debris from the surgical site.

Note

Periodontists and oral surgeons have long maintained that the optimum postsurgical time for suture removal is 7 days. This time period is not unreasonable, because most of their surgical procedures require healing by secondary intention. However, this is inconsistent with periapical surgery, for which the healing process is much more rapid.

Sutures should be removed as soon as possible following periradicular surgery. Most are ready for removal 2 to 3 days following surgery. Extensive delays encourage debris and bacteria accumulation that invite postoperative infection.

Prior to suture removal, the patient should be questioned about his or her postoperative experiences (eg, pain, swelling, bleeding, ecchymosis, paresthesia, infection). All patient concerns and questions are answered as clearly and precisely as possible. This shows an interest in the patient's welfare and demonstrates a sense of caring for him or her as a person. Answers are summarized and recorded. The surgical site is examined, and any unusual or extraordinary conditions are recorded (eg, flap discoloration, gapping of the incision line, gingival clefting, loosened or missing sutures, cervical recession). Unless something contraindicates their removal, the sutures should be removed carefully and painlessly.

Instruments and Materials

Peridex (Proctor & Gamble) or equivalent

Topical anesthetic

Suture Removal Kit

Cotton-tipped swabs

#18 Iris scissors (Hu-Friedy)

#317 Cotton dressing pliers (Hu-Friedy)

#5 Mirror and #1 handle (Hu-Friedy)

Sterile gauze pads

Magnification instrument (of at least x 2.5 and preferably x 4.5)

Technique

1. The patient is asked to gently swish 60 to 90 mL (2 to 3 oz) Peridex in the mouth for 1 to 2 minutes. A warm water rinse should follow.
2. A topical anesthetic is applied to the surgical site to minimize the discomfort of lip and cheek movement, finger pressure, and instrumentation.
3. A Peridex-saturated cotton swab is used to clean the sutures and surrounding tissues. Disinfecting the exposed threads helps reduce the number and virulence of the bacteria that may inoculate the underlying tissue as the suture is removed.
4. The knot section is grasped, and the suture is gently lifted from its bed.
5. The suture is cut with fine-tipped scissors and quickly removed with cotton forceps.
6. The incision line is recleansed with a Peridex-saturated cotton swab, and the patient is asked to rinse with warm water.
7. After the sutures are removed, postsurgical care is repeated; for example, a soft towel cleansing of the face, clearing the area of instruments, and so on (see Lesson 29).
8. If the biopsy results are available, they should be thoroughly discussed.
9. As the healing process takes place, the patient should gradually reinstitute normal hygiene habits. Powered water spray devices, such as a Water Pik (Teledyne), should not be used for approximately 2 to 3 weeks.
10. The patient is reminded of the need for and importance of follow-up examinations.

Problems

1. **If the area is swollen or excessively tender** at the scheduled suture removal appointment, postpone the removal for 24 to 48 hours, and place the patient on a Peridex cleansing regimen.
2. **When the vertical incision sutures are buried in tissue**, anesthetize the surgical site topically and follow with a normal infiltration of a local anesthetic.
3. Some sutures in the same line may be ready for removal, while others need more time.
4. The surgeon can avoid the embarrassment of **leaving in sutures** by knowing how many were placed and how many were removed. Caution takes precedence over expediency.

PART V

**Surgical Management of Difficult
Endodontic Conditions**

Incision for Drainage

Objective

To establish a communication between an internally pressurized highly inflamed or infected area and the oral cavity.

Note

A swelling of the mucosa or lip may be a minor problem, as is the case with a parulis (gum boil) or edema from trauma. However, when a patient's temperature rises above 100°F (38°C), and infectious fluids invade multiple spaces, elevate the tongue, occlude the airway, and penetrate the cavernous sinus or brain, the condition is life-threatening and demands immediate attention.

Instruments and Materials

MIR5-MH1 Mirror and handle (Hu-Friedy)
#11 Scalpel blade (Bard-Parker)
#5 Scalpel handle (Hu-Friedy)
#15C Scalpel blade (Bard-Parker)
#2/4 Molt DE curette (Hu-Friedy)
#83 or #84 Lucas DE curette (Hu-Friedy)
#4, #6, or #8 Round bur (Brassler)
Double-ended forked drain pusher (Union Broach)

#18 Iris scissors (Hu-Friedy)

Mathieu-Kocher Perma-Sharp needle holder
(Hu-Friedy)

Kramer-Nevins tissue pliers (Hu-Friedy)

Allison baby tissue forceps (Hu-Friedy)

Iodoform gauze strips

Rubber dam, latex free (HCM Hygienic)

4-0 Suture (Tevdek, EIE Analytic Technology)

Aspirator (Quality Aspirators)

Stropko irrigator/drier and 26- to 30-gauge
needle (EIE Analytic Technology)

CO₂ Laser

Evaluation

Information gathering

Historical facts regarding the growth, color, location, and duration of the infection must be gathered from the patient, parent, or guardian and recorded in the chart (see Lesson 2).

Clinical evidence

Radiographs of the suspected tooth (teeth) and adjacent area should be taken. For patients with severe swelling and pain, a Panorex may prove easier, more comfortable, and more informative. Computerized tomography (CT) scans and syntography bone scans are frequently being used to help diagnose difficult cases that have long, involved dental and/or medical histories.

Clinical evaluation

The tissues are visually inspected and finger palpated to determine size, color, hardness, fluctuation, tenderness, extension, and nodular involvement.

Diagnosis

All teeth in the involved arch are electric pulp tested, cold tested, and percussion tested to determine whether the problem is of odontogenic origin. The results of each test should be recorded carefully in the patient's chart.

Biopsy

Although the clinical appearance and condition of a tooth (teeth) in the vicinity of a surface swelling may initially indicate the cause is of pulpal origin, the clinician must trust the results of the diagnostic tests. When pulp and percussive testing prove to be inconclusive, the choices are to wait until the signs and symptoms become more decisive or to remove the lesion and send the specimen to a laboratory for histologic evaluation. Rather than assuming the responsibility of waiting when the condition may prove to be serious, biopsy seems to be the more logical decision.

Treatment

Lesions of nonodontogenic origin

The procedure for benign surface growths (ie, papillomas, fibromas) is as follows:

1. The peripheral area is anesthetized.
2. The growth is grasped with suitably sized tissue forceps.
3. The approximating healthy and uninvolved tissue around the growth is incised using a #15C scalpel.
4. The specimen is lifted and freed from its bed by carefully incising the underlying attachment.
5. The specimen is placed in an appropriate bottle of 10% formalin and sent to a qualified oral pathology laboratory for evaluation (see Lesson 19).
6. The tissue is sutured with 5-0 or 6-0 Tevdek suture material. Laser-treated lesions are usually bloodless and rarely require sutures.

7. Appropriate analgesics are prescribed for moderate pain (see Lesson 32).
8. The patient is given home care instructions (see Lesson 30).
9. The surgeon notifies the patient of the diagnosis as soon as possible and refers the patient if further treatment is needed.

The procedure for suspicious neoplastic tissue (ie, extensive lichen planus, leukoplakia, squamous) is as follows:

1. A tissue specimen or surface scraping is obtained for histologic or cytologic evaluation by a pathology laboratory.
2. The lesion is surgically removed in the same manner as described for the removal of a non-odontogenic lesion.
3. The patient is referred for a second opinion and/or surgery.

Lesions of pulpal origin

Acute apical abscess.

1. The chamber of the offending diseased tooth (teeth) is opened and the canal is negotiated. Once patency length has been reached, the canal is thoroughly instrumented to an established working length. An acute pressurized periradicular abscess should respond to the canal cleansing/shaping procedures and repeated patency recapitulations with a substantial flow of exudate.
2. If drainage subsides and ultimately stops, the canal chamber can be closed and the patient placed on an antibiotic and analgesic regimen (see Lesson 31). Because of the potential for relapse, the patient should be monitored closely over the following 24 to 48 hours.
3. If no drainage is elicited or drainage continues even after the tooth has been substantially instrumented, there are two choices:
 - The tooth may be left open and the patient reappointed to complete the endodontic procedures and concurrently perform a necessary apicoectomy.

- The tooth may be closed and direct access to the source of the pressure (fluid) gained through the soft tissues (artifistulation) and bone (trephination). In this case, an Ochsenbein-Luebke flap is incised, elevated, and retracted (see lesson 17). Depending on the condition of the bone plate, the bone covering the lesion may need to be trephined with a #4, #6, or #8 round bur (Figs 37-1 a and 37-1 b).
4. To maintain communication with the oral cavity, a strip of X-inch-wide Iodoform gauze or a small piece of rubber dam or rubber tubing is inserted into the opening and the crypt. The flap is repositioned and a short length of the drain is allowed to extend out of the incision between the edges of the flap. The flap and the drain are then sutured in place. The patient is placed on an appropriate antibiotic regimen and reappointed for the completion of the endodontic therapy (Fig 37-1 c to 37-1 e).
 5. Depending on the patient's response, the drain may be left in place throughout the root canal therapy and, unless symptoms remain or additional complications are met, a subsequent apicoectomy may be unnecessary. When the patient appears to be free of all symptoms, the drain can be removed.

Mucosal and submucosal swellings.

1. Patients with submucosal swellings present to the office because of discomfort from the bloated and distended tissues and concern about the diagnosis, but they rarely complain of being in extreme pain (Fig 37-2a).
2. The objective with these patients is to establish drainage to deflate the swelling and evacuate the accumulated fluids until the source of the infection can be determined and treated. However, swollen and infected areas are difficult and painful to inject, and the level of anesthesia often proves to be inadequate for the following reasons:
 - The local tissue pH value may be reduced to such a degree that hydrolysis of the anesthetic salt is retarded, thus preventing liberation of the free alkaloidal base.
 - The anesthetic solution may be diluted when added to the existing fluid volume.

V: Surgical Management of Difficult Endodontic Conditions

Figs 37-1 a to 37-1 e To gain access to a pressurized abscess when bone covers the lesion, the buccal plate must be trephined with a round bur. To prevent posttrephination fluid buildup, an avenue of escape should be maintained with a wick drain.



Fig 37-1 a



Fig 37-1 b



Fig 37-1 c

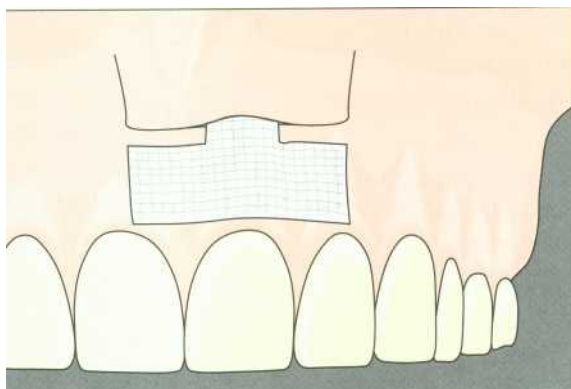


Fig 37-1 d



Fig 37-1 e

- The anesthetic solution may be absorbed quickly because the inflamed area is highly vascular.
 - The injection may be so painful that the operator never reaches the targeted nerve branches or administers the quantity of solution necessary to produce anesthesia.
3. Pricking the locally swollen mucosal abscess center with the point of a #11 scalpel blade is an extremely fast and efficient way to eliminate these localized fluids. This blade is designed to puncture tissue and can pierce mucosal and submucosal swellings without pressuring the base of the abscess. With this advantage it is possible to provide the patient relief without administering an anesthetic. The technique is as follows:
- The patient is forewarned of the reasons for and intent to treat the condition without local anesthesia. Conscious sedation premedication techniques should be considered (see Lesson 11).
 - The point of the #11 blade is used to quickly puncture the center of the swollen area. Without pressurizing the abscess base, the opening is widened by lifting the cutting edge (Figs 37-2b and 37-2c).
 - A small aspirator is inserted into the opening, and the swelling is emptied of blood and exudate using high-powered evacuation.
 - If further access is needed, the incision is reentered with the #11 blade, and the size of the opening is again increased by simply lifting the cutting edge.
 - The aspirator is reinserted into the incision, and the fluids are evacuated until no exudate is evident.
 - With a mucoperiosteal abscess, the fluid accumulates between the bone and the mucosa. Once the fluid pressure has been released, a drain may be placed (Fig 37-2d). However, the placement of a fixed drain will depend on how well the endodontic procedure progresses.
 - If the need for endodontic therapy has been determined and agreed to, it may be initiated at this time, or the patient can be reappointed and treatment pursued when conditions improve. If drainage continues throughout the cleaning and shaping procedure, a wick drain is indicated.

Figs 37-2a to 37-2d A mucoperiosteal abscess is a buildup of fluid between the bone and the mucosa and can easily be drained by pricking the swelled center with a # 11 scalpel. Using a wick drain is also an option.



Fig 37-2a

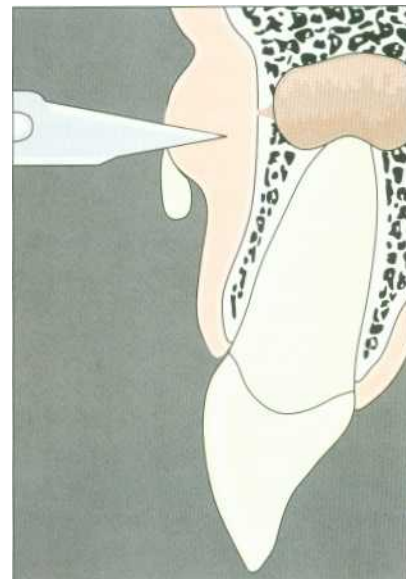


Fig 37-2b

V: Surgical Management of Difficult Endodontic Conditions

- Appropriate antibiotics are prescribed (see Lesson 31).
 - The value of good postsurgical home care during convalescence is discussed with the patient, parent, or guardian. Printed information is provided and explained to reinforce the spoken instructions (see Fig 30-1).
 - The patient is monitored on a daily basis and reappointed in 3 to 4 days for evaluation and for a decision to either continue drainage or initiate conventional endodontic instrumentation and obturation procedures.
 - Depending on the patient's progress, the wick drain may be removed at this visit or a subsequent visit a week later.
4. For patients who present with moderate to severe facial swelling, the surgeon is again faced with atraumatically reaching workable levels of anesthesia. More adequate levels of anesthesia can be realized and the dangers and uncertainties of injecting directly into the infected area can generally be avoided by administering division block injections. Although the Division II block is considered to be more effective in the maxillae than infiltrations, the technique is difficult to teach and perfect, and therefore is rarely used.
5. When the Division II block is not used to anesthetize an infected area in the maxillae, the following effective and compassionate local anesthetic infiltration technique is suggested:
- An adequate layer of topical anesthetic is applied to the swollen tissue and the tissue adjacent to the swelling.
 - Once the superficial tissue is desensitized, anesthetic can be administered by slowly injecting small doses of solution peripheral to the swelling. Subsequent slow and gentle infiltration injections are given and the center of the abscess is approached laterally.
 - When the peripheral area is numb, the anesthetic solution may be injected directly into the center of the abscess.

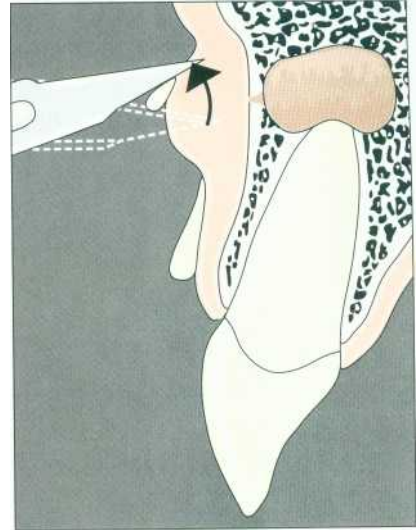


Fig 37-2c



Fig 37-2d

Cellulitis.

The accumulated exudate in the superficial and deep spaces that produces swelling of the lip, cheek, face, and neck is a deeply centered infection and may require lifting a full mucosal flap to gain access to the source. In such cases, the following steps are taken:

1. The area is anesthetized as previously described for moderate to severe swelling.
2. An Ochsenbein-Luebke flap is incised, elevated, and retracted (see Lessons 14, 15, and 16).
3. A #83 or #84 curette is inserted between the edges of the incision and used to probe carefully beneath the raised flap in search of the fluid pocket.
4. If a flow of exudate is initiated, a small-tipped aspirator is inserted under the flap directly on the point of flow and the fluids are evacuated. The facial swelling may noticeably deflate during this process.
If no flow can be stimulated, the bone over the lesion needs to be trephined. The location of the offending root/lesion is confirmed on a radiograph and the bone overlying the lesion is penetrated with a #6 round bur (see Lesson 17). The crypt is aspirated and curetted of all fluids, debris, and soft granulation tissue. Biopsy procedures should be followed as previously described (see Lessons 17, 18, and 19).
5. If the decision has been made to perform an osteotomy to gain access to the lesion and the abscess fluid, there is no reason (other than a lack of time) that the root canal and the entire apicoectomy procedure cannot be performed at this appointment. In this case, the flap is temporarily repositioned but not sutured. Moistened gauze is placed over the flap, and a rubber dam is used to isolate the tooth (teeth). The canal is accessed, well instrumented, dried, and obturated. The chamber is temporarily sealed, the dam and the gauze removed,

the flap reraised, and the remaining apicoectomy steps (including any retroprocedures) resumed.

6. Once the trephination and/or apicoectomy have been completed, the flap edges are reapproximated and the flap sutured in place.
If the surgeon has chosen to perform the trephination and not complete the endodontic therapy and apicoectomy, it is necessary to maintain an oral communication by placing a quarter-inch-wide iodoform gauze or a rubber dam wick drain between the edges of the flap. The patient must return at a later time, when the site is more comfortable, to complete the root canal.
7. Appropriate antibiotics and analgesics are prescribed (see Lessons 31 and 32).
8. The patient, parent, or guardian is given oral and written instructions on postsurgical care (see Lessons 29 and 30).
9. An ice pack is placed on the surgical area, and cold therapy (20 minutes on and 20 minutes off) should be instituted and continued for the following 6 to 8 hours (see Lesson 34).
10. The patient must be monitored on a daily basis.
11. When conditions have returned to normal (generally within 3 to 7 days), the sutures and drainage wick can be removed. If the surgeon chooses to perform the trephination and not complete the endodontic therapy, traditional cleaning, shaping, and obturation procedures can be accomplished as soon as the crisis is over (generally within 72 hours), when the patient is comfortable and without symptoms. Unless fluid is present, an odor is detected within the canal, or the patient continues to have symptoms, apical surgery may not be required.
12. Regardless of the treatment regimen elected, the patient should be clinically and radiographically evaluated at 6 weeks, 3 months, 6 months, and 1 year.

Problems

Because few dentists feel comfortable administering Division II blocks and the use of general anesthesia in an office is not recommended, conscious sedation techniques, such as nitrous oxide inhalation analgesia, sedative/hypnotic oral drug therapy, and intravenous sedation, can be extremely helpful in relieving the apprehensions and anxieties associated with emergency situations (see Lesson 11).

Extraoral point

Because drainage will follow a path where it meets the least resistance, it is not uncommon for the suppurative accumulation to migrate to the subcutaneous area of the face or neck. When this happens, an angry red target zone may appear on the skin. As the condition progresses, the dimensions of the wheal increase, swelling becomes more apparent, and the infection surfaces in the form of a cutaneous boil. This condition is often prompted by patients who have placed hot water bags or heating pads on their faces in an effort to relieve pain. The heat draws the fluid to the face, and the red wheal becomes evident as the face swells (Fig 37-3a).

If allowed to point and drain on its own, a jagged, unesthetic scar results. Although any perforation of the skin is likely to scar, a small facial puncture with a #11 scalpel would be far more desirable and much less noticeable. Therefore, when facial drainage is imminent, the point of the #11 scalpel is inserted into the central zone of the swelling (Fig 37-3b). The puncture hole is kept open by inserting a small rubber dam T-drain or strip of quarter-inch iodoform gauze into the opening. Anesthetic is not usually required for this procedure. The drain can be left in place until the source (tooth and/or lesion) is under control. It is imperative that the patient understand why the surgeon has chosen to incise for drainage extraorally and that he or she has agreed to the procedure.

Figs 37-3a and 37-3b A quick and easy #11 scalpel puncture will establish adequate facial drainage with minimal scarring. A wick drain is optional.

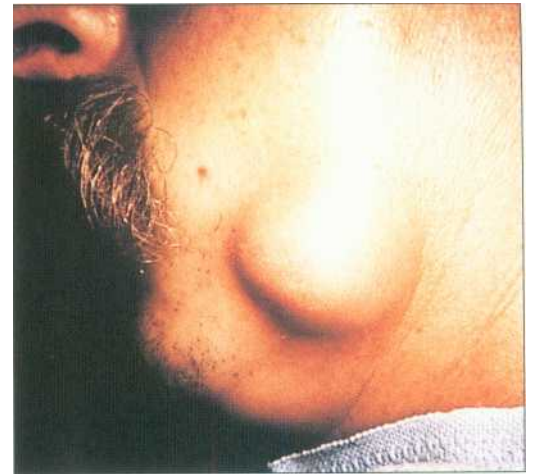


Fig 37-3a



Fig 37-3b

Nonresponding swelling and pain

1. The vitality of the adjacent teeth is reevaluated.
2. The surgeon cultures and covers the abscess with a broad-spectrum antibiotic until the results of the sensitivity tests are returned (see Lesson 31).
3. Exploratory surgery and biopsy should be considered.
4. A wick drain is maintained until the results of the culture and biopsy are received.
5. The patient's temperature, pain, and extent of swelling is monitored and recorded on a daily basis.
6. If the patient has not responded to therapy within 5 to 7 days and/or conditions appear to be worsening each day, the patient is referred for a second opinion. A conference is held with the referred dentist and the details of treatment submitted for his or her review. To avoid patient feelings of abandonment, the surgeon should continue to maintain an open line of communication with him or her throughout treatment and recovery.
7. The referral process and all patient/parent/guardian/referring dentist(s) comments or discussions regarding diagnosis and treatment options (suggested, advised, or implied) are documented in detail in the patient's chart.

Danger zones

1. The accumulation of exudate in deep spaces may produce hard, diffuse, uncomfortable swellings and the pressurized fluid searches for areas to fill. If this highly infectious material is allowed to collect and localize in the vicinity of the angular or pterygoid veins, the microbes have a direct path to the cavernous sinus and/or brain and the patient's life is in danger.
2. When exudate accumulates in the submandibular spaces of the mandible and the drainage crosses the midline, the floor of the mouth and the tongue may be forced upward and back. As the throat swells and the tongue raises, the patient's airway is threatened to a point at which a tracheotomy is needed.
3. The decision to incise and drain is based on timing and experience. Although early lancing may only produce hemorrhage, not lancing, particularly in critical areas, may allow the infection to progress and the inactivity to endanger the patient.

Perforation

Objective

To surgically expose and repair an iatrogenically or idiopathically produced defect in the wall of a root.

Note

The decision to repair these defects surgically can be made only after the following questions have been considered:

- Is the repair site accessible to treatment?
- Will the surgical repair jeopardize the adjacent teeth because there is insufficient room to operate?
- Can the crestal bone be maintained?
- Will the patient be left with an untreatable periodontal pocket?

Techniques

Presurgical

The first mode of treatment to be considered when a perforation has been detected and confirmed at a pretreatment evaluation or during the instrumentation of a canal should be the calcium hydroxide apexification procedure. If, for some reason, this technique is deemed impractical or prior attempts have failed, the canal should be cleansed of all debris and filled to the best of the operator's ability with thermoplasticized gutta-percha.

Surgical

To ensure adequate visibility and accessibility, root wall defect repairs demand an intrasulcular flap incision, elevation, and reflection. Once the root and the defect have been positively identified, sufficient bone is removed to gain complete and unrestricted access to the peripheral borders of the perforation. Once hemorrhage is controlled (see Lesson 23), all granulation tissue and extruding canal debris is removed from the site with appropriately sized curettes and effective aspiration.

A Class I cavity is prepared in the external root wall to the full depth of the now exposed canal (Fig 38-1a). Depending on location and access, the cavity is prepared with a long-shank carbide bur (#4, #6) in a slow-speed handpiece, or an appropriately selected ultrasonic CT tip (see Lesson 22). When a metallic post has been placed in the canal, the preparation may require the use of a tungsten steel (#4) bur rotated at high speed.

Once the preparation and surgical site have been cleared and dried, a suitable root end filling material can be placed in the preparation (Fig 38-1 b). With the amount of literature currently supporting its use, it appears that mineral trioxide aggregate (MTA) is possibly the most suitable reparative material. If MTA is unavailable or esthetics is a major concern, a non-staining material such as IRM or Super EBA would be satisfactory (see Lesson 24).

The transportation and compacting procedures are the same as for a root end filling (see Lesson 25). The margins are burnished smooth, and the flap is reapproximated and sutured in place (Fig 38-1c).

Postoperative instructions are provided and reviewed with the patient, parent, or guardian (see Fig 30-1, Lesson 30).

Figs 38-1 a to 38-1 c A successful root wall perforation repair is based on ability to access the defect and prepare the Class I cavity without extensive coronal bone and/or tooth structure loss.

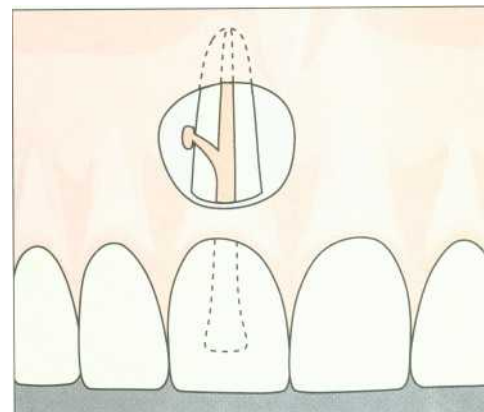


Fig 38-1 a

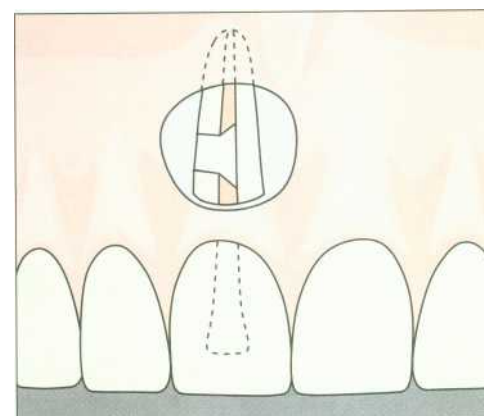


Fig 38-1 b

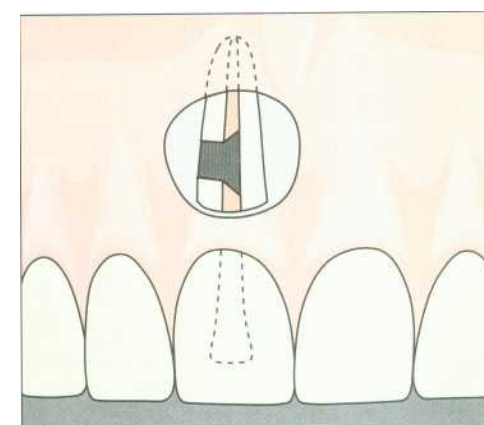


Fig 38-1 c

Problems

1. **Perforation defects** at or slightly below the gingival crest are the most difficult to repair. Repairs at this level are generally at the expense of crestal bone and likely condemn the patient to future periodontal problems. Unless periodontal conditions can be reasonably restored by corrective crown lengthening or other regenerative procedures, intentional replantation with concomitant repair should be considered a more reasonable, less destructive alternative (see Lesson 42).
2. **When teeth have inaccessible defects** (eg, perforations or resorptions that occur on the lingual walls of mandibular teeth) or when the destruction involves two or more surfaces of the same root, extensive bone removal would be required and would leave the patient with an irreparable periodontal problem. The operator should consider elevating and semiextracting the tooth from its socket, and turning it to a position that exposes the defect and accommodates preparatory and filling procedures. This becomes a viable option because the periodontal membrane and root surface, having remained within the socket untouched and continuously bathed in blood throughout the procedure, experience no extraoral exposure. According to Andreason et al (1994), this is recognized as the critical determinant for success.
3. **Tissue tattooing** often follows amalgam root wall repairs. For esthetic reasons, buccal or labial root perforations should be sealed with a nonmetallic, nondiscoloring material such as Super EBA, IRM, or glass ionomers.
4. **When the restorative procedure calls for a dowel**, it is imperative the dowel space and the final dowel be prepared prior to the repair. A petroleum jelly-coated temporary wax or acrylic pin is temporarily placed into the prepared dowel space as an internal guide. The flap is reflected and the preparation cavity is cut into the root. The reparative filling material is condensed against the temporary pin. Once the material has set, the pin is easily removed, the canal space cleaned, and the final post cemented in place. The seal is evaluated, and the flap is sutured in place (Figs 38-2a to 38-2c; see Lesson 24).

Figs 38-2a to 38-2c If a dowel is to be fabricated after the perforation repair, while preparing and filling the defect a temporary dowel should be used.

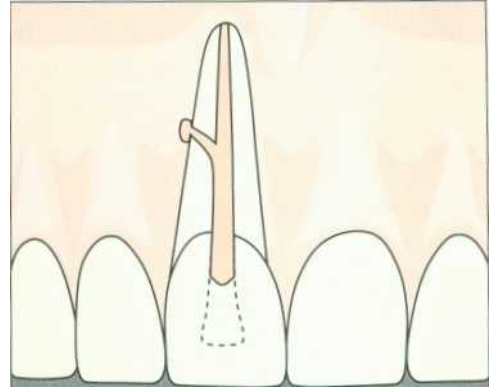


Fig 38-2a

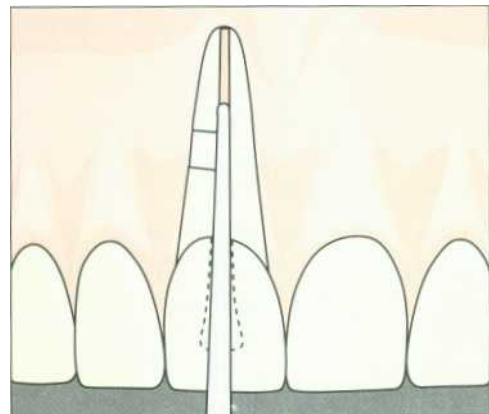


Fig 38-2b

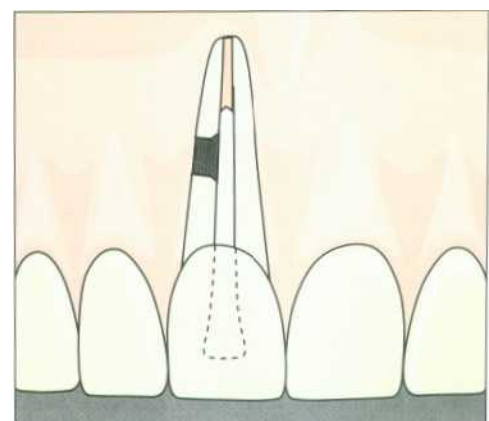


Fig 38-2c

If during pin removal the filling material is loosened and the seal broken, both the new dowel and the root filling material are removed, and the cavity preparation and filling process is repeated. The alternative is to cement a permanent post in place prior to the surgery at a depth short of that desired, and increase the risk of it loosening or fracturing while preparing the root. The risks, rewards, and prognosis must be thoroughly agreed on with the patient prior to the surgery.

- 5. When chrome alloy or stainless steel dowels are already in place,** they are particularly difficult to cut unless high-speed tungsten steel burs are used. For this reason, the patient should be forewarned that the cutting procedure may fracture and/or loosen the dowel or so shorten it that both the restoration and the tooth will be at risk. To avoid leakage and subsequent failure, it is essential the post be completely entombed within the prepared cavity (Figs 38-3a to 38-3c).

Ultrasonics do not offer a dowel cutting alternative because the alloy tips do not generate enough energy to cut into most metallic dowels, and the vibrating action would most likely be sufficient to loosen the restoration.

- 6. Due to the cause-and-effect problems that arise from inadvertent iatrogenic incidents,** the procedure must be thoroughly explained to, understood by, and agreed on with the patient. The patient's written consent is kept in the record (see Lesson 7).

Figs 38-3a to 38-3c If an existing dowel is integral to the perforation, the approach to the defect will remain the same, but the post should be cut short of the preparation and the 3-mm minimal retropreparation depth rule should be observed.

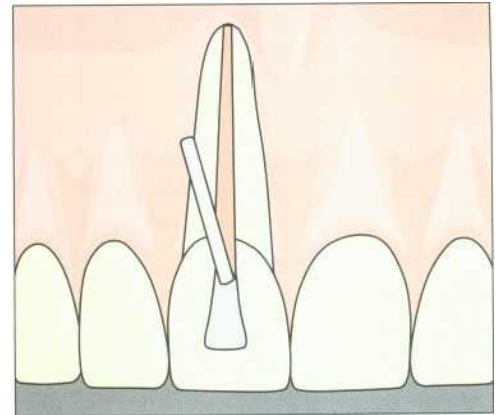


Fig 38-3a

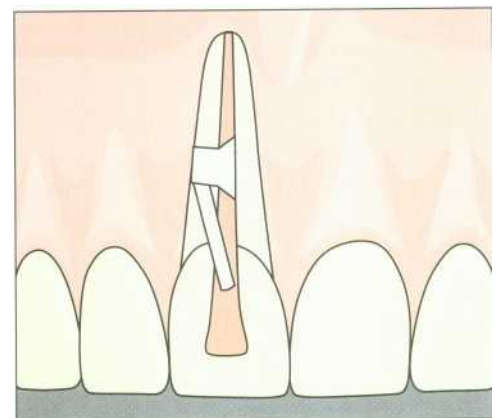


Fig 38-3b

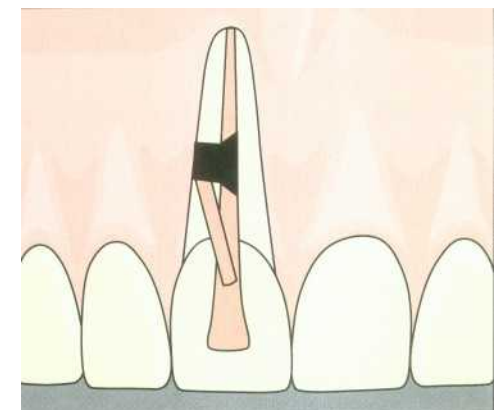


Fig 38-3c

Root Amputation, Hemisection, and Radectomy

Objective

To remove one or more diseased, fractured, or nontreatable roots of an otherwise retainable and restorable multirooted tooth.

Note

Endodontics must first be satisfactorily completed on the retainable root(s) before others are removed. The need to reflect a flap is determined on a case-by-case basis and is predicated on furca anatomy, location, degree of caries, fracture depth, and amount of access needed.

Indications for the need for root amputation include the following:

- Periodontal, through and through, nontreatable furcas
- Severe pocket depth involving only one of the roots
- Extensive root caries, creating a nonrestorable condition
- Irreparable perforation or resorption in one of the roots
- Vertical fracture of one of the roots
- Mesiodistal fracture of maxillary molar
- Buccolingual fracture of a molar
- One root that is not amenable to conventional or surgical endodontic treatment

Contraindications for root amputation include:

- Systemic risks
- Extensive bone loss of all the roots
- Pronounced mobility of the tooth
- A furca that is so far apical, access would leave little bone support
- Inseparable, fused roots
- No roots amenable to conventional or surgical endodontics
- A crown-root ratio of the retained root that offers insufficient bone support
- No benefit to the treatment plan

Instruments*

- #23/UNC15 Expro explorer
- #1 DE Explorer
- #701 Long-shank carbide bur for a high-speed surgical 45° handpiece (Brassler)
- #149 Periosteal elevator
- #2/4 Molt DE curette
- #2, #3 Root elevators or root picks
- FX#74 Forceps, 150, 151
- #83, #84 Lucas DE curettes

Techniques

Root amputation of mandibular molars

1. This compromising technique involves the removal of a root without disturbing the crown (Figs 39-1 a and 39-1 b). An intrasulcular flap is usually necessary and, to provide a path for the extraction, an extensive amount of buccal bone must be removed to uncover the root.
2. Once the flap is elevated and retracted, the coronal half of the buccal aspect of the root to be sacrificed is denuded of bone with a round bur in a high-speed handpiece. A tapered fissure bur rotating at high speed enters the now-exposed root at

Figs 39-1 a and 39-1 b Although removing one root from a multirooted tooth while retaining the crown solves the immediate problem, it condemns the patient to possible periodontal problems in the future.



Fig 39-1 a



Fig 39-1 b

*From Hu-Friedy, except as noted.

or slightly below/above the proximal cementoenamel junction. It continues to cut horizontally and lingually, penetrating the root until separation is complete at the furcal junction. Periodic radiographs should be taken to monitor the level and progress of the cut.

3. Using appropriately sized root picks, hemostats, and small forceps, the disconnected root is elevated and lifted from its socket in a buccal direction. If considerable resistance is met when applying the extracting force, increased extraction space may be developed by removing additional buccal and interseptal bone, and/or shortening the length of the root by reducing the coronally exposed segment with the fissure bur.

Problems. Even when the furca is supracrestal and a minimal amount of bone has been removed, the healing area following root amputation presents an abnormal architecture. Food trapping soon becomes unmanageable, and even patients with superb oral hygiene habits have difficulty keeping a clean mouth. The long-term prognosis of this service should be considered poor, and this fact must be conveyed to the patient.

Hemisection of mandibular molars

1. Because conventional endodontic procedures to gain access to the canal normally precede the election to hemisect a mandibular molar, the internal chamber of the crown has generally been gutted. To minimize the potential for fracturing the weakened crown structure during the extraction process, the overall crown height is reduced 2 to 4 mm, and the segment over the condemned half is further reduced to within 2 mm of the gingival crest (Figs 39-2a and 39-2b). The buccal and lingual grooves, when present, act as guides for this crown division. All crown and root division can be accomplished with a carbide bur in a high-speed handpiece. A copious water spray and high-volume aspiration should accompany all cutting procedures. At this time, a radiograph is taken to orient the vertical step to the furca.
2. Once adjusted to the furca, a single, vertical, buccal-to-lingual cut, no wider than the bur, is made 2 to 4 mm deep or until it reaches the gingival crest. A second radiograph is taken to determine whether

Figs 39-2a to 39-2g This sequence of steps will simplify the removal of a single root from most mandibular and maxillary multiple-rooted teeth:

- If the crown is severely weakened, reduce the occlusion, particularly over the target root.
- 2) Use the buccal grooves to orient the initial cut to the furca.
- 3) Continue the vertical cut to the furca.
- 4) Separate the root from the tooth body.
- 5) Verify the separation radiographically.
- 6) Extract the root.
- Verify the cleanliness of the socket radiographically.



Fig 39-2a

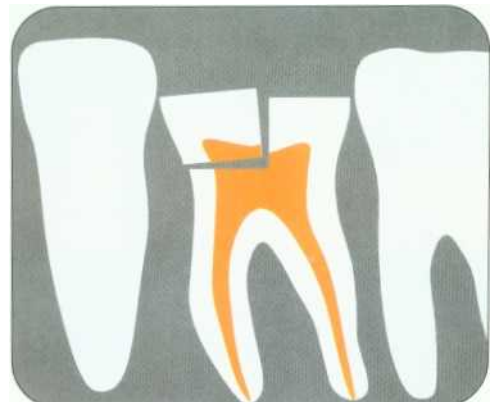


Fig 39-2b

the vertical cut is perpendicular to the furca. Direction adjustments are made if necessary, and the vertical cut is continued until separation is complete. The more apical the furca, the more often radiographs and directional adjustments must be made (Figs 39-2c to 39-2e).

3. Root separation may be determined visually, by feel (bone offers less cutting resistance than root structure), by radiograph, or by test elevating the root for movement (Fig 39-2f). However,

no instrument is ever used to wedge roots apart. When separation is confirmed, the buccal, lingual, and proximal walls of the root are elevated until a Class III mobility is realized, and the root is free in its socket. The beaks of appropriately sized forceps are positioned on the root body and, with minimal compressive forces, the root is lifted from its socket. A final radiograph is taken to confirm the absence of root segments and foreign bodies (Fig 39-2g).



Fig 39-2c

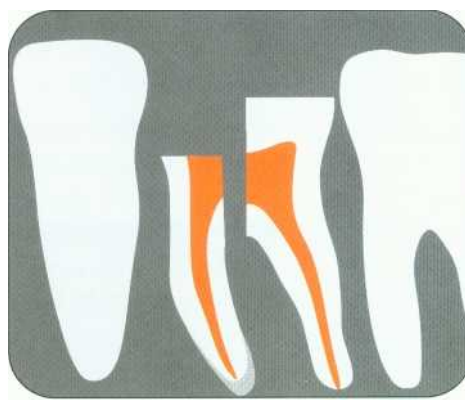


Fig 39-2d



Fig 39-2e



Fig 39-2f

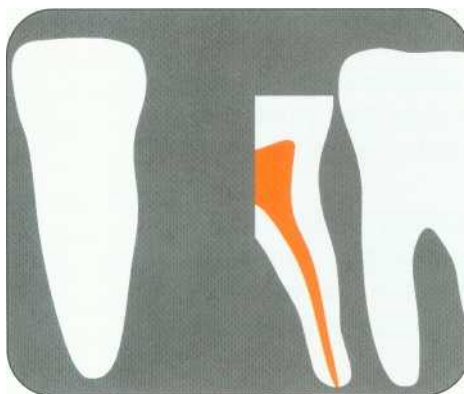


Fig 39-2g

Problems.

1. Unlike in a root amputation, a flap should only be necessary with a mandibular hemisection when the target root has fractured or decayed subcrestally, refuses to lift from the socket, or breaks during the hemisecting procedure. If such a situation should arise, the technique described for root amputation is followed.
2. Deep apical furca junctions demand flap elevation and considerable bone removal to locate the junction and protect the retained root from inadvertent bur damage.
3. Root spurs or ledges left on the retained root create an uncleanable pocket and lead to periodontal breakdown. The furcal junction must be made smooth with a safe end tapered bur or diamond (Figs 39-3a to 39-3d).
4. Excessive mobility of the retained root may require provisional splinting until bone in the extraction site has had an opportunity to regenerate.
5. For its protection and for the health of the surrounding tissues, the crown segment of the retained root(s) should be reduced and a well-fitting, temporary, nonoccluding crown placed.

Figs 39-3a to 39-3d To prevent any future periodontal pocket development, the furcal junction must be smooth and free of ledges, grooves, or inadvertent cuts.



Fig 39-3a



Fig 39-3b



Fig 39-3c



Fig 39-3d

Radectomy

Buccal root(s) of maxillary molars. When considering the removal of one or more of the roots of a maxillary molar, the most desirable technique calls for the removal of the overlying segment of the crown prior to an attempt to remove the root. However, because maxillary teeth have a greater root base, the restorative options are also greater. For this reason, the amputation procedure described in this lesson for mandibular teeth may sometimes be applied to maxillary molars.

To provide sufficient access and increased visibility and to prevent damage to the remaining roots, the ideal resection of the maxillary root(s) requires a full mucoperiosteal flap. The following example describes the procedure for the removal of the mesiobuccal root of the maxillary first molar. The steps should be interpreted and adjusted to meet the demands of other maxillary roots.

1. The occlusion is reduced by 2 to 4 mm, and the section over the offending root is reduced to the gingival crest. The mucosa is incised, elevated, and reflected, and the cortical bone is removed from the coronal aspect of the buccal

surface of the target root with a large round #4 bur in a slow-speed handpiece.

2. A tapered fissure bur in a high-speed, 45-degree surgical handpiece is used to initiate the cut at the mesioproximal cemento-enamel junction. The bur cuts on a horizontal plane, but in a slightly apical direction as it proceeds toward the furca (Fig 39-4a). To prevent nicking the adjacent buccal or lingual roots as the furca is approached, caution becomes most important. Whenever there is doubt regarding location or direction of the furca, a radiograph should be taken.
3. The success of the cut is determined by probing, curetting, or elevating the root to ascertain mobility. At no time is a wedge placed in the separating cut. When the root moves freely, the thin layer of remaining crown structure over the freed root is removed, and the root is lifted from its socket. To enhance the patient's oral hygiene, the sharp edges of bone and remaining roots are filed smooth. The crown is recontoured and a well-fitting temporary crown is fabricated and seated. The flap is repositioned, and a final radiograph is taken to ensure that all root structure and debris have been eliminated. After assessment of the radiograph, the flap is sutured in place (Fig 39-4b).

Figs 39-4a and 39-4b The serial removal of the distal buccal root of a maxillary molar.



Fig 39-4a



Fig 39-4b

Lingual root of maxillary molar. A palatal flap is reflected and bone is removed until the lingual root is exposed and identified. The coronal half of the root is denuded of bone with a round #4 bur. A long-shank carbide fissure bur, at high or slow speed, initiates a horizontal cut a few millimeters apical to the mesio-proximal cemento-enamel junction. The bur is moved inward buccally/distally and slightly apically (to compensate for the root's lingual inclination) until separation is complete. This allows the root to be extracted in accordance with its vertical lingual line axis. Once the root is elevated and lifted from its socket, the bone and crown are recontoured, and the flap is repositioned. A final radiograph is taken to ensure that all root structure and debris has been removed. After assessment of the radiograph, the flap is reapproximated and sutured in place (Figs 39-5a and 39-5b).

Problems.

1. Most often the angle of the palatal root is divergent, and consequently its buccal path of removal is generally obstructed by the crown. To solve this problem, the occlusal/lingual aspect of the crown must be grossly reduced. A less favorable option is to remove additional palatal bone and drastically change the shape of the ridge.
2. To avoid periodontal food packing, the crown should be fabricated with a reduced buccolingual table.

Figs 39-5a and 39-5b The extraction site and early healing of a maxillary molar palatal root.

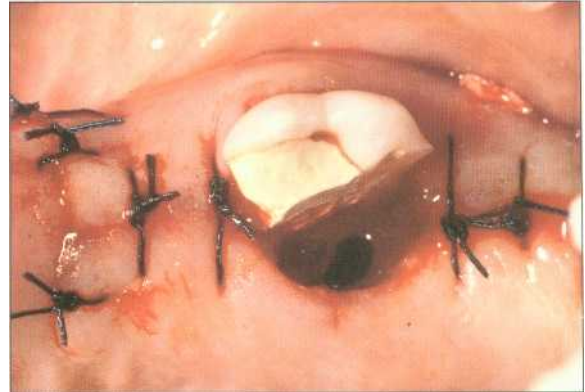


Fig 39-5a



Fig 39-5b

Periodontics and Endodontics

Objective

To take the opportunity to perform concurrent periodontal reparative procedures when raising a full mucoperiosteal flap during the course of an endodontic surgical procedure.

Clinical Considerations

- The extent of periodontal disease
- The depth of periodontal pockets
- The mobility of the involved and adjacent teeth
- The amount of recession and root exposure
- The proximity of adjacent roots
- The thickness of the soft tissues, especially that of the palate
- The width of the attached gingiva
- The presence of veneered crowns on the involved or adjacent teeth
- The thickness or thinness of bone covering the surgical site
- The presence of primary or secondary etiologic factors
- The level of the patient's oral hygiene

Instruments

Scalers/Curettes (Hu-Friedy)

#2R/2L, #4R/4L, #13/14 Columbia
#11/14, #12/13 Gracey, mesiodistal
#3/4, #5/6 Gracey
#85, #87 Lucas DE
#13/14, #17/18 Indiana University
#GF3, #31/32 Goldman-Fox

Burs

#2, #4, #8 Round burs (Brassler)
Medium and large finishing burs, flame and ovoid shapes (Brassler)
Ultrasonic air-polishing prophyl unit (Cavitron)
Prophy-Jet 30 air-polishing unit (Cavitron)
Cavimed Prophy/Perio 200 unit (Dentsply)
Titan SW sonic scaler (Star Dental)

Techniques

Restorative deficiencies

Deficiencies such as overextended crown margins or overfills of amalgam and resin should be corrected with small finishing burs. These irregularities, as well as any noted underfills or underextended open margins of restorations, should be charted and the operator made aware of the condition(s). In root section cases (hemisection, etc), dentinplasty and enamelplasty should be performed on the furcation of the endodontically treated molars to remove any ledges or edges that might inhibit oral hygiene access.

Minor root planing procedures

The removal of local etiologic factors-ie, plaque, calculus, necrotic cementum, and underlying contaminated dentin-should be accomplished with extremely sharp scalers and/or curettes. For best

results, these instruments should be sharpened repeatedly during the procedure. Root planing to the level of existing calculus is acceptable in the presence of acute abscess, because it denotes the chronic disease level.

However, viable root cementum must not be planed above/below that level for fear of losing the potential for repair and reattachment. Proper and efficient debridement of difficult anatomic configurations may require the use of specially designed scalers or curettes and/or ultrasonic scaling devices.

Curettage of the soft granulation tissue pocket lining

This is accomplished with appropriately angled Gracey and Indiana curettes. The selected instrument tip is placed against the tooth at the base of the bone defect. The tooth and bone are denuded with horizontal, circumferential strokes. Only when the periodontal lesion site has been completely debrided, and the tooth is smooth and free of diseased tissue and deposits, can a new attachment apparatus form.

Osseous reshaping

The goal is to achieve a contour that reflects the original crestal/ridge anatomy. To obtain these favorable contours, all nonsupported bone must be removed, and sound supporting structure may also require reshaping. Small bone files can be used to remove difficult-to-reach, rough, irregular, or sharp edges. Proper osseous reshaping of shallow, wide interproximal bone craters facilitates easy flap adaptation, provides oral hygiene access, and promotes healing.

When attempting to regenerate the lost attachment apparatus of a molar furcation, the operator has the following options:

Bone grafting. This procedure, although well documented in the literature, is technique sensitive and based on a choice of the following materials. (The experience of the operator also offers varying degrees of success.)

- Autogenous bone harvested from such sites as the palatal retromolar region or from the iliac crest offers the distinct advantage of being a fresh viable implant.
- Allograftic materials such as freeze-dried bone and marrow are readily available, provide the needed matrix, and do not require surgical opening of a donor site.
- Alloplastic materials, such as the nonresorbable nonporous hydroxyapatites, the resorbable beta tricalcium phosphate, the porous hydroxyapatites, and coral, artificially establish the structural matrix needed to enable the clotting mechanism to complete its cycle. Although these materials are easy to use, they are quite dependent on the host's response, and the operator's ability to prevent the material from communicating with the oral cavity.

Guided tissue regeneration (GTR). This involves the placement of a physical barrier, such as GORE-TEX (Gore), between the flap and the denuded tooth surface. The technique is sensitive to how the material is trimmed to fit the variety of shapes and grooves of the bone and teeth against which it is being placed. The GORE-TEX membrane ostensibly retards the apical migration of the epithelium, excludes the gingival connective tissue from the lesion, and enables selective healing from the periodontal ligament space. A new attachment seems to be achieved as a result of the reunion of new connective tissue with a root surface that was previously deprived of a periodontal ligament (Figs 40-1 a to 40-1 c).

In addition to the technical demands of the GTR procedure, PTFE is nonresorbable and most often must be removed with a second surgical procedure. If, during the 4- to 6-week postsurgical recovery period, it becomes exposed, it can become painful to the patient, and the barrier is subject to infection when it does not have complete soft tissue coverage.

Recently, calcium sulfate has been suggested as a barrier graft when it is used in combination with demineralized freeze-dried bone. Calcium sulfate has a long history regarding efficacy, safety, and biocompatibility in both medicine and dentistry. Combined with allograftic bone, it is reasonable to assume it will retard epithelial and connective tissue invasion

Figs 40-1 a to 40-1 c If after apical surgery a periodontal defect is considered a detriment and a potential cause of failure, the exposed root surfaces are meticulously scaled, planed, and coated with citric acid. The flap is displaced, a membrane is trimmed and fitted over the apical and coronal defect, and sling sutured in place. The flap is reapproximated to the crown and sutured slightly coronal to its position. The flap should cover the membrane completely. The membrane can be removed in 5 to 6 weeks.



Fig 40-1a

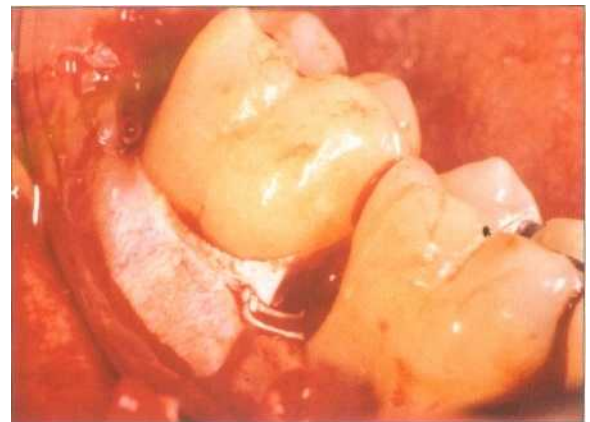


Fig 40-1 b



Fig 40-1 c

into a bone crypt. Although articles and case reports are appearing to attest to the value of this GTR barrier technique, additional studies must be done to determine ratios, long-range success, and so on before it can be prescribed for routine use.

Coronal positioning of the flap to delay apical migration of the epithelium also shows promise in the natural regeneration of furcation defects.

Apical positioning of the buccal flap

This is appropriate for cases deemed unsuitable for regenerative procedures, opening the furcation and providing direct access. However, open furcations create a cleanliness challenge and, if the plaque control techniques are poor, may even portend a worse prognosis for the tooth as a result of the progression of attachment loss and root caries. For this reason, the patient must be instructed on the importance of efficient and consistent periodontal care and monitoring by a periodontist.

Due to the nature of keratinized tissue, palatal flaps cannot be apically positioned as easily as buccal or labial flaps. To apically position palatal tissue, the initial vertical-horizontal incision must be scalloped, and the tissue between the incision and the tooth must be removed. The palatal tissue must be thinned to achieve pocket reduction, but the thinning procedure must leave an intact connective tissue layer subjacent to the epithelial layer to prevent sloughing of the palatal tissue and subsequent bone exposure.

Problems

If the surgeon believes the motivation to maintain a sound and efficient periodontal program is lacking, plaque control inadequacies cannot be rectified, and the dental history indicates a predilection for root caries, the patient may be best served by maintaining coverage of the furcal areas by repositioning the flap to its presurgical level.

Atypical and Exploratory Surgery

Objective

To enter tissue and bone to investigate painful and suspicious areas for signs that may lead to a diagnosis, to retrieve a radiographically observable foreign body, to examine the depth of an injury, or to repair an osseous defect.

Note

The purpose and limitations of these procedures must be clearly communicated to the patient and, because the surgery is often elective, approval to proceed must be received and documented in the patient's chart (see Lesson 7).

Technique

1. An intrasulcular flap must be designed to afford sufficient access and allow for extension if needed (Figs 41-1a to 41-1f).
2. A lesion is followed to its full depth.
3. If suspicious tissue and/or fluid is encountered, the tissue can be biopsied and/or the exudate cultured. A wick technique is used to keep the extraoral communication open, appropriate antibiotic therapy is considered, and contact with the patient is maintained until a diagnosis is made (Figs 41-2a and 41-2b).

Figs 41-1a to 41-1f Access is of prime importance to repair, alter, or correct iatrogenic incidents, such as instruments displaced in bone (a and b), or to surgically retrieve a broken instrument in a root (c, d, e, and f).



Fig 41-1a



Fig 41-1b



Fig 41-1c



Fig 41-1d

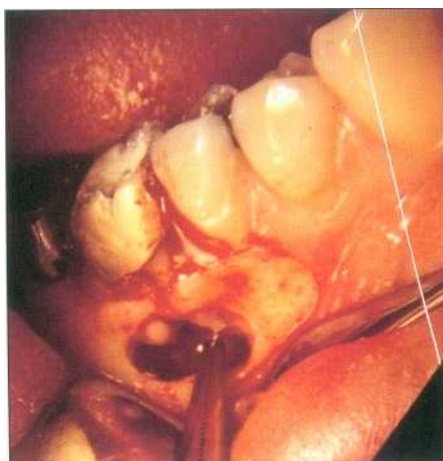


Fig 41-1e



Fig 41-1 f

Problems

1. **Lesions.** All suspicious growths, sores, and/or unusual discolorations and radiolucencies should be brought to the patient's attention and, depending on the surgeon's training and background, be removed and biopsied, or referred for investigation. The records should indicate the size, color, location, and any other characteristics that might be useful to the referee. If the patient refuses to respond to the advice, his or her refusal should be noted and witnessed.
2. **Difficult-to-locate foreign bodies.** Pieces of bone, root, gutta-percha, and alloy that appear radiographically to be in bone are often found embedded in the undersurface of the flap. The surgical site is radiographed with the flap raised, as well as when it is in place, to help orient the surgeon to the object's location (Fig 41-3).
3. **Major dental injuries.** Most often, luxated or subluxated teeth need only be resealed into the socket and splinted in place. More serious injuries often necessitate a flap to expand and repair the alveolus before the teeth can be replanted or repositioned into their original socket. In cases where considerable bone damage has occurred, the entire ridge may need to be repositioned, and the fragmented bone pieces and/or artificial bone may need to be compacted and/or grafted into the voids.
4. **Long-term periapical disease.** As shown by Kakehashi et al (1965) in their classic study, periapical disease is the sequela of pulpal disease. The host responds to the bacterial toxins from the canal with a periradicular inflammation. Unfortunately, there may be no pain associated with this response and consequently no treatment sought. Therefore, the process remains chronic. Microscopically most of the lesion consists of lymphocytes, plasma cells, and macrophages, and at times these cells may even encapsulate. Clinically there may be evidence of a fistula. Radiographically the condition appears as a radiolucency.

The degree of invasiveness of the disease may cause the loss of a considerable amount of cancellous bone, and in an effort to relieve pressure may take its toll by perforating both the labial and lingual plates of bone. When both plates have been penetrated, it may be necessary to build a synthetic bone scaffold within the crypt to prevent a

Figs 41-2a and 41-2b The endodontic procedures in this case might have been avoided had this non-odontogenic myxoma been diagnosed by a preliminary biopsy.



Fig 41-2a

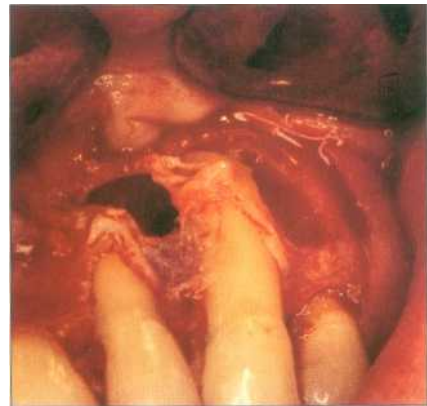


Fig 41-2b

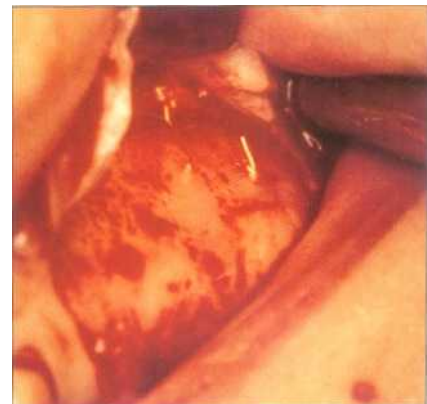


Fig 41-3 Foreign bodies may become embedded in the undersurface of the mucosa and/or facial tissues and can only be located by taking a radiograph of the area between the dentition and the facial tissues (lip, cheek).

fibrous connective tissue growth (scar) from occurring. Although scar is considered harmless, it is difficult to later identify the residual radiolucency as scar or as insufficient healing. For this reason, when both buccal plates have been perforated, it is better to pack the crypt with an allograftic material, such as freeze-dried bone, or an alloplastic hydroxyapatite, such as beta tricalcium phosphate.

Once the crypt is packed, a protective barrier such as a polytetrafluoroethylene membrane (GORE-TEX) or resorbable polyglactin (Vicryl) should be placed over the bone and the bone graft material. This method, known as *guided tissue regeneration*, will prevent tissue migration into the crypt. In time, bone will replace the graft and fill the void. Radiographs will eventually verify osteogenesis (Figs 41-4a to 41-4f).

5. **Ratner bone cyst.** This controversial, painful, and deeply penetrating bone cavity may simultaneously involve an inordinate number of anaerobes. The target area must be exposed, aspirated, and curetted to full depth. In an effort to combat this incredibly invasive microbial infection, ancillary drug therapy may involve the use of oral antibiotic combinations (V-Cillin K and Flagyl), intramuscular administrations, or repeated doses of antibiotics placed or injected into the emptied cavity.
6. **Limitations.** Depending on the severity of tissue damage and the operator's experience, treatment varies from suturing minor mucosal, lip, or cheek lacerations to referral. At times, a patient will need care that is beyond the scope of the surgeon's training. In this case, first-aid procedures to control bleeding and maintain an airway should be instituted until help is available.
7. **Documentation.** Records must be detailed, accurate, and (whenever possible) witnessed (see Lesson 7).

Figs 41-4a to 41-4f When a lesion or surgery causes a breakthrough from the facial aspect to the lingual aspect, scar tissue, and not bone, may fill the void. Unless the original radiographs are available for comparison, when planning future treatment it will be difficult to tell whether the lesion has healed or is an active pathosis. The original radiograph, taken postsurgery 1a and 1b, differs little from the 10-year follow-up. Therefore, when a through-and-through communication is identified, the lesion should be thoroughly curetted, the root problem addressed, an alloplastic bone substitute compacted into the crypt (see Lesson 401), and a guided tissue regenerative barrier placed. This sequence was taken 5 years after the successful use of beta tricalcium phosphate and a GORE-TEX membrane 1c to 1f.



Fig 41-4a



Fig 41-4b



Fig 41-4c

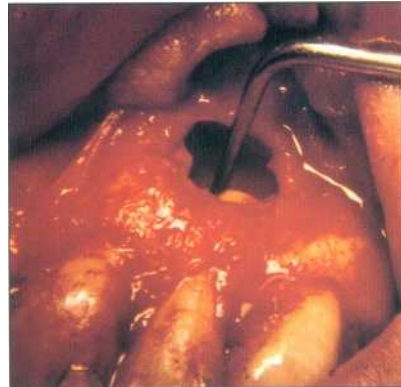


Fig 41-4d



Fig 41-4e



Fig 41-4f

Extraction and Replantation

Objective

To retain a tooth that is considered nontreatable by conventional (nonsurgical) and/or surgical endodontic procedures.

Indications

Conventional treatment problems that often require surgical intervention include the following:

- Inadequate interocclusal space in which to gain access to the canals (eg, microstomia, trismus)
- Canals that are impossible to instrument
- Canals that resist disinfecting regimens
- Repeated exacerbations
- Continued and uncontrollable pain during and/or after treatment
- Asymptomatic lesions that continue to expand in size after retreatment(s)

Problems that often preclude surgical treatment include the following:

- Access to the problem is difficult (eg, perforation or resorption of interproximal root surfaces or lingual aspects of mandibular teeth)
- The bone is high, thick, and/or dense (eg, the external oblique ridge buccal to mandibular second and third molars)
- The risk to strategic anatomical structures (eg, palatal or mandibular vessels or proximity to adjacent roots) is unjustifiable

- A severe periodontal problem exists and/or the removal of bone to gain access would leave the patient with an untreatable periodontal problem.
- Previous apicoectomies have failed.
- The patient's medical condition prohibits a long surgical approach.

Instruments

#15C Scalpel blade (Bard-Parker)
#12D Scalpel blade (Bard-Parker)
#5 Scalpel handle (Hu-Friedy)
E#301, E#302, E#303 Elevators (Hu-Friedy)
FX#13, FX#17, FX#33, FX#73, FMD#4, F#10S
Forceps (Hu-Friedy)
#1, #2 Round burs (Brassier)
#701, #558 Fissure burs (Brassier)
Retrofill instruments (EIE Analytic Technology)
Suture setup
Sutures (Tevdek)
#18 Iris scissors (Hu-Friedy)
Mathieu-Kocher Perma-Sharp needle holder
(Hu-Friedy)

Technique

1. The canals are cleansed, shaped, and filled with gutta-percha as well as possible. Some initial lift can be expected postsurgically, so it is advisable to take the tooth completely out of occlusion prior to extraction.
2. The gingival attachment is incised with a scalpel (Fig 42-1 a).
3. A firm, carefully directed, continuous force is applied to an appropriately placed elevator. Elevation should continue until the tooth reaches a Class II I mobility. *Proper elevation is critical and the most important factor in a successful replantation* (Fig 42-1 b).
4. Appropriately sized forceps are carefully positioned on the neck of the crown, and the tooth is slowly raised from its socket with a *gentle* rotating force via the path of least resistance. Effort should be made to avoid crushing the tooth and the periodontal membrane.
5. If the tooth resists extraction, the elevation process is repeated.
6. Once the tooth has been lifted from its socket, the root(s) is examined for perforations, cracks, or other defects. The tooth should be held in the forceps throughout the balance of the reimplantation procedure. This protects the root-attached periodontal membrane from being injured during manipulation and helps reorient the operator to the path of reinsertion (Fig 42-1 c). This is particularly advantageous when the crown of the tooth is mutilated or absent.
7. A radiograph is taken to inspect the surgical site for residual root, bone, or restorative material. Moistened gauze packing is placed over the alveolus, and the patient is instructed to maintain a gentle but constant biting force.
8. Wet gauze is carefully and gently wrapped around the forceps and the tooth, exposing only the apex and/or root defect to the operator's line of sight.
9. Two to four millimeters of the apex is resected, and a Class I cavity is prepared in the center of the root(s) and/or the defect with a #1 or #2 round bur (see Lesson 22). All cutting procedures should be accompanied by a continuous but indirect flow of room-temperature water or saline.
10. An appropriate root end filling material is placed and compacted in the preparation (Figs 42-1d and 42-1 e; see Lessons 24 and 25).
11. All excess filling material is curetted and/or gently washed away. The gauze is removed carefully, and the forceps tip and tooth are dipped into a cup of warm saline. The periodontal membrane is bathed clean with a gentle agitation.
12. The base of the socket can be curetted of any pathologic tissue, but the walls must be avoided to preserve any injured but still healthy periodontal membrane.

Figs 42-1a to 42-1g The gingival attachment is incised and the tooth is elevated to a Class III mobility Ia and bI. The forceps are used to free the tooth from its socket lcl. The defect is inspected, and a Class I cavity is prepared in the resected root wall in the case of the incisor (dl, or in the apex in the case of the molar lel. Once repaired, the tooth is gently guided into its alveolus, and a resin or suture splint is used to secure the tooth into position lfl. The radiograph was taken at 38 years postsurgery lgl.



Fig 42-1 a

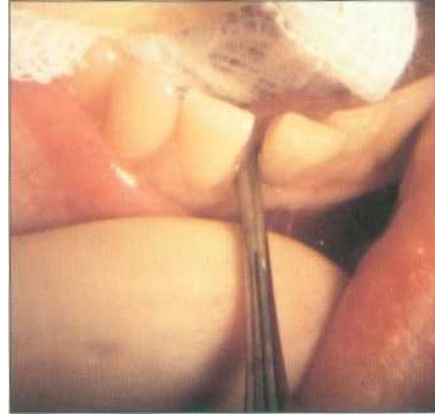


Fig 42-1 b

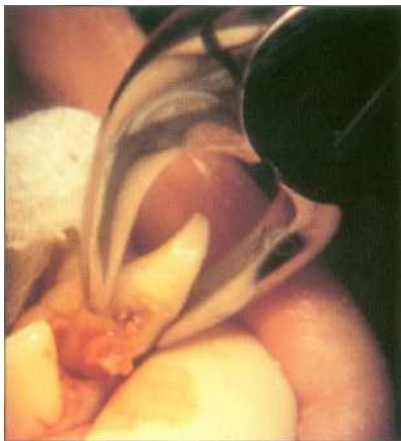


Fig 42-1 c



Fig 42-1 d



Fig 42-1 e

V: Surgical Management of Difficult Endodontic Conditions

13. The tooth is carried to the socket and, with a gentle but firm force, is reinserted and guided into its original position. The insertion process should be slow enough to allow the trapped blood to escape from the alveolus. The reduction in root length allows any residual fluids to pool without creating a latent hydraulic pressure that would not only lift the tooth from its bed, but could become a source for postsurgical pain.
14. Once the tooth is properly seated, it is checked for alignment and occlusion. Because some initial lift occurs postsurgically (regardless of preventive attempts), the tooth must be kept clear of occlusion.
15. For interim stabilization, a series of sutures criss-crossing over the occlusal surfaces (MB-DL, ML-DB) keep the tooth in position and allow for lift. This is a particularly advantageous technique when there are no adjacent teeth. When adjacent teeth are present, a more rigid tooth-to-tooth bonded resin splint can be fabricated. When the procedure is accompanied by a gingivectomy, a periodontal zinc oxide splint can be placed. At no time is any splint left in place more than 10 days (Figs 42-1 f).
16. A postoperative radiograph is taken to verify the replanted position.
17. Appropriate antibiotics and analgesics are prescribed, if they are deemed necessary (see Lessons 31 and 32). The patient is scheduled for evaluation and suture or splint removal in 7 days. Postoperative care is discussed, and the patient is released with a printed set of instructions (see Lesson 30).
18. On the day of the patient's return visit, the splint may be removed, the occlusion checked, and the mobility evaluated.
19. A series of postoperative clinical and radiographic evaluation appointments should follow at 6 weeks, 3 months, 6 months, 1 year, 2 years, and 5 years (Fig 42-1 g).

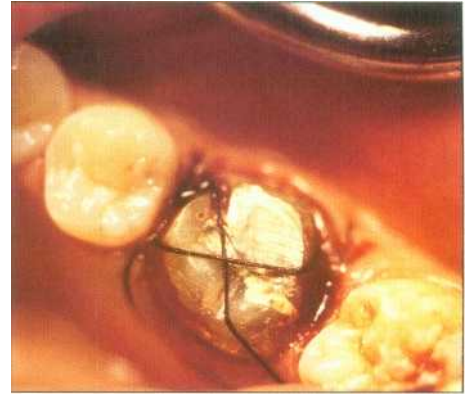


Fig 42-1 f

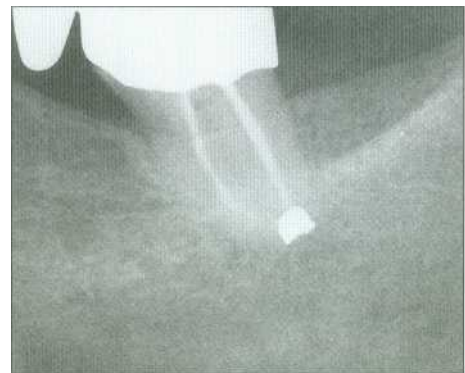


Fig 42-1 g

Problems

1. **Impossibility of tooth extraction without extreme compression pressure to the periodontium and bone.** The success of an extract/replant procedure is directly proportional to the ease of extraction. In cases where the root anatomy or the thickness and density of the plates of bone impede the tooth's removal, a flap is laid and some of the buccal crestal bone is removed. In lieu of fracturing the root or severely injuring the periodontal membrane, it is sometimes better to hemisect or radisect the tooth and replant the roots separately (Figs 42-2a to 42-2c).
2. **The crown fractures during extraction.** All patients entering an extract/replant procedure must be informed that crown or root fracture is always a risk and, depending on the circumstances, the treatment plan may change or be aborted during the procedure. Most often the tooth to be extracted has little or no crown or what does exist is so undermined that the squeezing forces of the forceps crush what remains. Again, a flap must be reflected and sufficient crestal bone removed to gain additional forceps access. Unfortunately, studies show a higher rate of resorption can be expected the further apical the forceps are placed.
3. **Root fracture of multirooted teeth.** The problem clearly depends on the strategic location of the tooth in question and its need for the success of the restorative treatment plan. If the roots are salvageable, they may be sectioned from each other and the replant procedure continued for one or both.
4. **Root defects.** Prior to treatment, the patient should be informed that treating the defect by conventional surgical procedures depends on the degree of predictability of the repair. If access to the problem is compromised during the procedure, the conventional approach may be aborted and extract/replant procedures initiated (Figs 42-3a to 42-3e). If the prognosis for extraction/replantation is poor, the procedure is terminated and the tooth is not replanted.

Figs 42-2a to 42-2c For teeth that are difficult to extract (c), hemisection followed by the separate replantation of available root is an alternative (b). The radiograph was taken 16 years postsurgery (d).



Fig 42-2a



Fig 42-2b

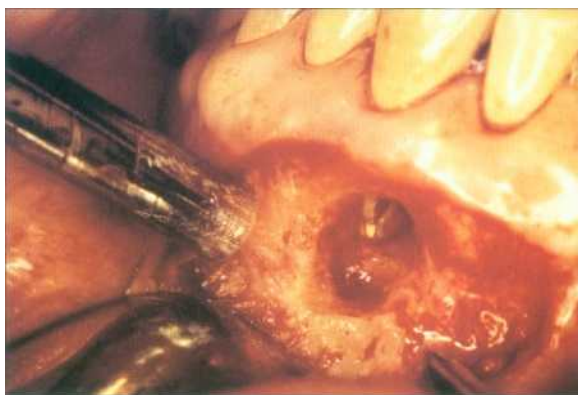


Fig 42-2c

Figs 42-3a to 42-3e When gaining access will sacrifice bone or root length Ia and bl, and the principles of surgery will be so compromised that the success of the procedure is in danger, extracting, repairing, and replanting procedures may be a better approach (c and dl. The radiograph was taken 1 8 years postsurgery lel.



Fig 42-3a



rig 44-Ju



Fig 42-3c



Fig 42-3d



Fig 42-3e

5. **External resorption.** The potential for fracture during removal and further resorption following replantation should be thoroughly explained to the patient and agreed on prior to treatment.
6. **Pain.** Patients may experience pain for the first 7 to 10 days posttreatment and should be advised of and prepared for this possibility. Preoperatively, they should be administered an anti-inflammatory drug (400 to 800 mg of ibuprofen), which is continued during their postoperative recovery at the appropriate dosage (see Lessons 11 and 32). The pain following an extract/replant procedure is apt to be a sequela of the extraction trauma and its occurrence does not indicate imminent failure.
7. **Risk.** When a patient's medical condition does not warrant risk or his or her emotional disposition will not tolerate the procedure, it should not be offered.
Furthermore, although the success of extraction/replantation has been reported to be as high as 86%, it is by no means a guaranteed procedure. The patient must recognize and accept the conditions of treatment and seek other opinions or alternative treatment if undecided (see Lesson 7).
8. **Uncooperative patients.** A patient who is either uncooperative or unwilling to understand the procedure or its benefits is not a candidate for replantation. The risk of a breakdown in communication, and a lack of patient cooperation invites the threat of liability and does not warrant performing the procedure and assuming the responsibility.

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