Aurobindo College of Dentistry

Indore, Madhya Pradesh

INDIA

Module plan

- Topic : **Endodontic Surgery**
- Subject: Endodontics
- Target Group: Undergraduate Dentistry
- Mode: Powerpoint – Webinar
- Platform: Institutional LMS
- Presenter: **DR.PRADEEP JAIN**

Contents

- Introduction
- History
- Indications
- Contraindications
- Classification of surgical procedures

a. Conventional

b. Microsurgical

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- Corrective surgery
- Replacement Surgery
- Post surgical complications
- References

Introduction

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PERIRADICULAR SURGERY

when non-surgical treatment had failed.

- Surgical treatment accounts for about 3-10% of the typical endodontic specialty practice.

JOE 20;253;1994,JOE 28;699;2002, JOE 29;806;2003

- A recent study found that endodontists perform almost 78% of surgical root canal treatments;
- General dentists & other specialities → 15.5% & 6.6% respectively.

JOE 2003,29;553

- Another recent study has found that 91.2% performed root end surgery & 89.6% used microscopes & ultrasonics during the procedure.

JOE 35;2009

History

- Surgical approaches to the apical areas of teeth have been known since antiquity.
- A mandible found in Egypt from the 4th dynasty(2900-2750 BC) contained holes that experts consider could have been made for pain relief.

- 1st recorded endo surgery → I & D by Aetius, a Greek physician dentist, over 1500 years ago.
- 1st comprehensive report → 1897 by Partsch.
- Apical resection of the molar was 1st reported by Faulhaber & Neumann in 1912.

INDICATIONS

- Given by Luebke, Glick, and Ingle.
- 1. Need for surgical drainage
- 2. Failed nonsurgical endodontic treatment
  - a. Irretrievable root canal filling material
  - b. Irretrievable intraradicular post
- 3. Calcific metamorphosis of the pulp space

- 4. Procedural errors
    - a. Instrument fragmentation
    - b. Non-negotiable ledging
    - c. Root perforation
    - d. Symptomatic overfilling

- 5. Anatomic variations
    - a. Root dilaceration
    - b. Apical root fenestration

- 6. Biopsy

- 7. Corrective surgery
    a. Root resorptive defects
    b. Root caries
    c. Root resection
    d. Hemisection
    e. Bicuspidization

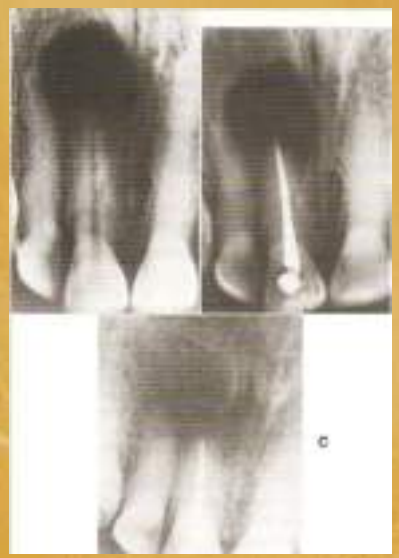
- 8. Replacement surgery
    - A. Replacement surgery
        1. Intentional replantation (extraction/replantation)
        2. Post-traumatic
    - B. Implant surgery
        1. Endodontic
        2. Osseointegrated

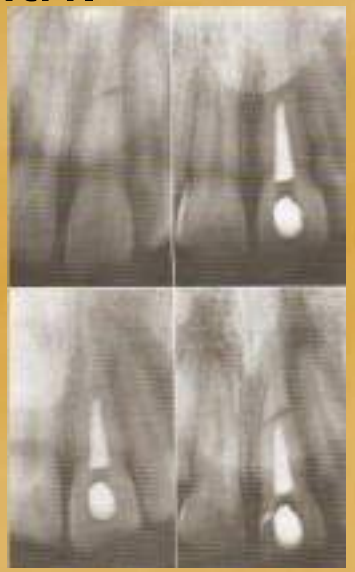
False indications

-- Weine

1. Presence of an incompletely formed apex, making hermetic sealing of the apex impossible.
2. Marked overextension of the overfilling.
3. Persistent pain.
4. Failure of previous treatment.
5. Extensive destruction of periapical tissue and bone involving one third or more of the root apex.

6. Root apex that appears to be involved in cystic condition.
7. Presence of crater shaped erosion of the root apex indicating destruction of apical cementum & dentin.
8. Internal resorption.
9. Extreme apical curvature.
10. Fracture of root with pulpal death.





CONTRAINDICATIONS

- Few absolute contraindications to endodontic surgery exist.

- Most contraindications are relative, and they are usually limited to three areas:
- (1) the patient's medical status,
- (2) anatomic considerations, and
- (3) the dentist's skills and experience.

- Anatomic considerations

(1) the nasal floor,

(2) the maxillary sinus,

(3) the mandibular canal and its neurovascular bundle,

(4) the mental foramen and its neurovascular bundle, and

(5) anatomic limitations to adequate visual and mechanical access to the surgical site.

CLASSIFICATION OF SURGICAL PROCEDURES

- 1. Surgical drainage
  - a. Incision and drainage (I & D)
  - b. Cortical trephination (fistulative surgery)

- 2. Periradicular surgery
  1. Curettage
  2. Biopsy
  3. Root-end resection
  4. Root-end preparation and filling

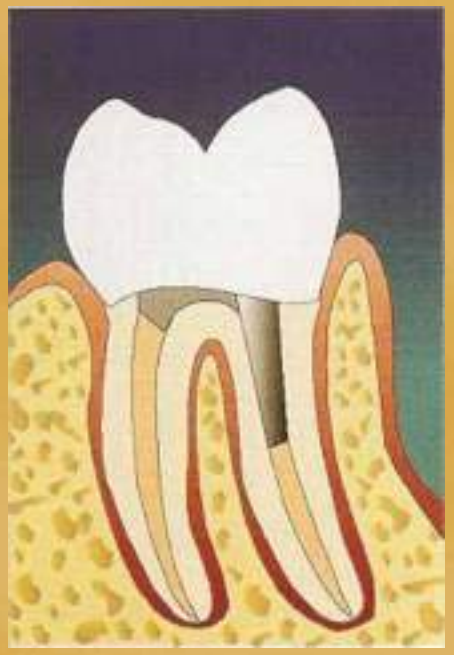
5. Corrective surgery
    1. Perforation repair
        a. Mechanical (iatrogenic)
        b. Resorptive (internal and external)
    2. Root resection
    3. Hemisection

- 3. Replacement surgery (extraction/replantation)

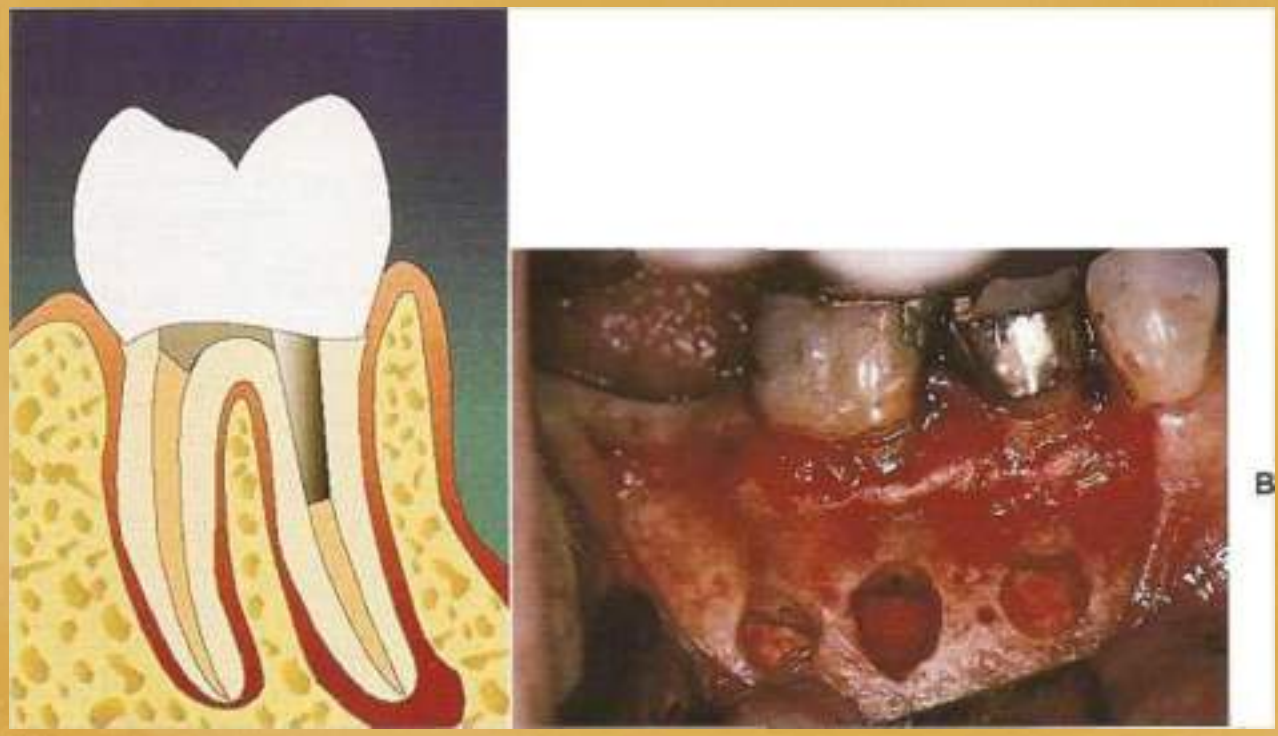
- 4. Implant surgery
    1. Endodontic implants
    2. Root-form osseointegrated implants

CLASSIFICATION OF ENDODONTIC MICROSURGICAL CASES

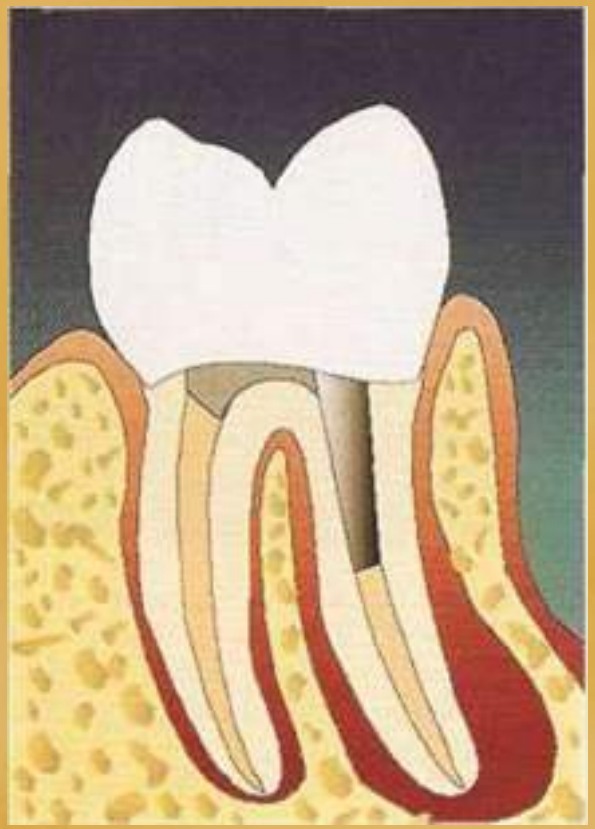
- Class A represents the absence of a periapi-cal lesion but unresolved symptoms after non-surgical approaches have been exhausted.



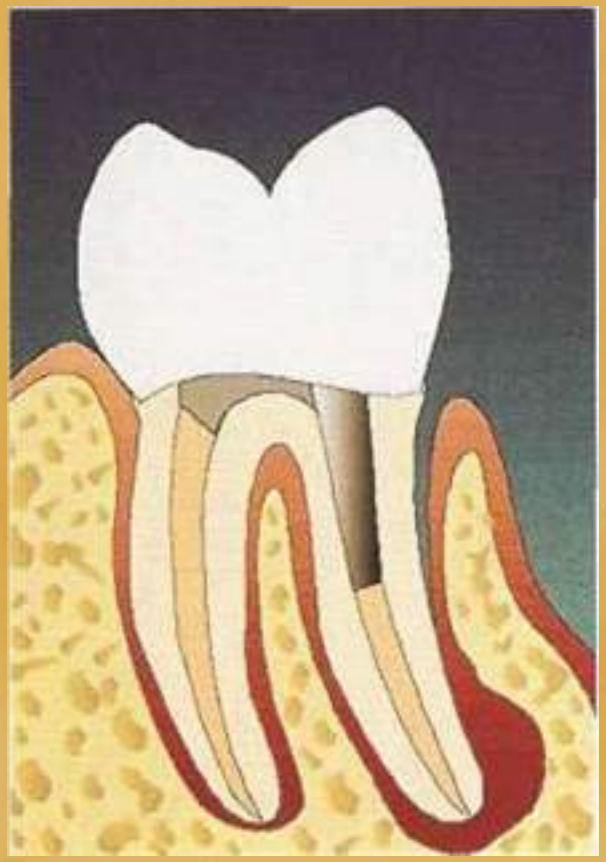
- Class B represents the presence of a small periapical lesion and no periodontal probing depth



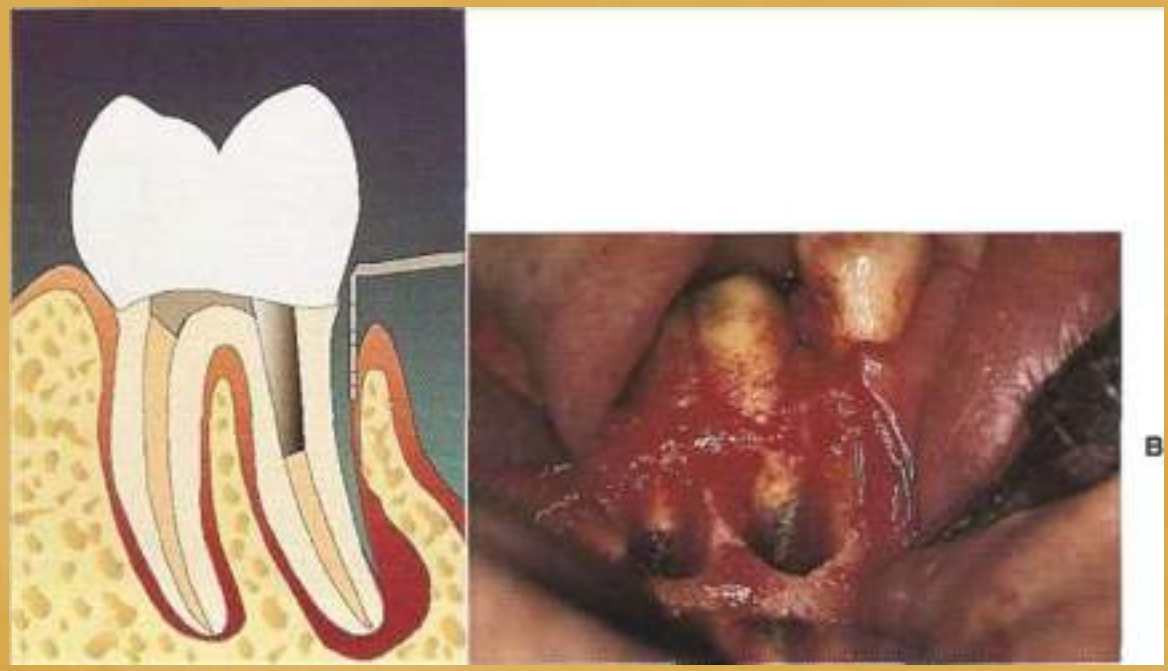
- Class C represents the presence of a large periapical lesion progressing coronally but without a periodontal pocket



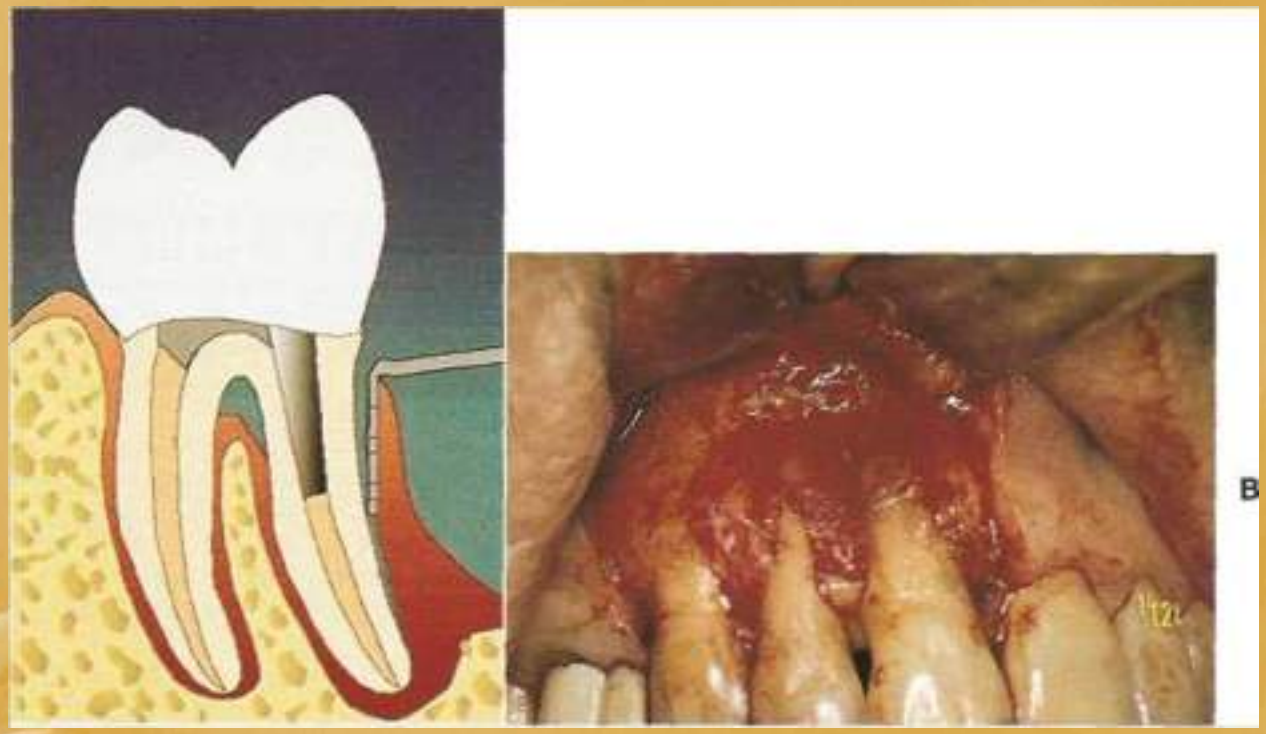
- Class D represents a clinical picture similar to Class C with a periodontal pocket



- Class E classifies a periapical lesion with an endodontic-periodontal communication but no root fracture



- Class F represents a tooth with an apical lesion and complete denudement of the buccal plate.



SURGICAL DRAINAGE

- Accomplished by

(1) Incision and drainage (I &D) of the soft tissue or

(2) Trephination of the alveolar cortical plate.

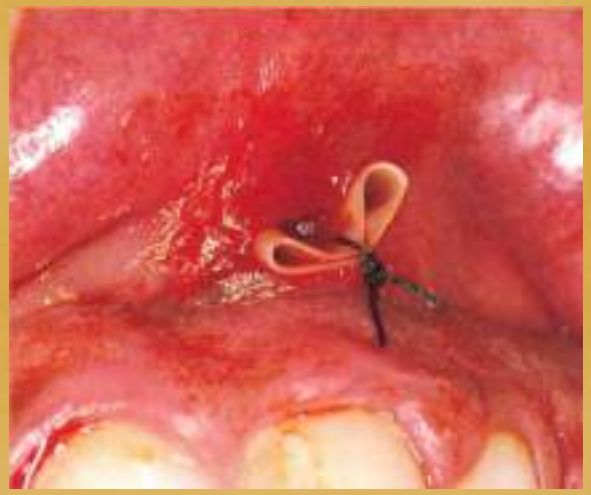
Incision and Drainage

- An incision should be made through the focal point of the localized swelling to relieve pressure, eliminate exudate and toxins, and stimulate healing.

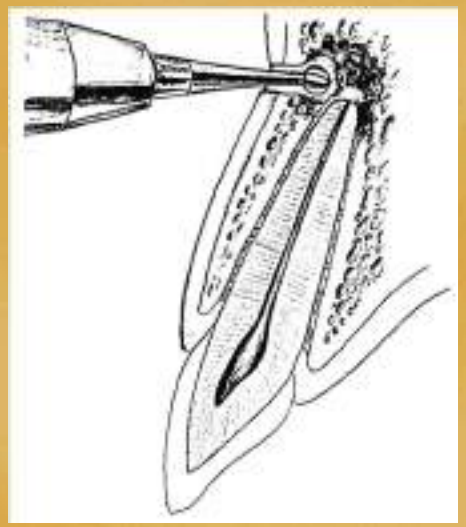
- Incision into a diffuse or indurated swelling before its localization →unsuccessful in affording immediate relief or reduction of the swelling.

Tray Setup

Incision & Drainage



Cortical Trephination



PERIRADICULAR SURGERY

Concepts and Principles

(1) The need for profound local anesthesia&hemostasis,
(2) Management of soft tissues,
(3) Management of hard tissues,
(4) Surgical access, both visual and operative,
(5) Access to root structure,
(6) Periradicular curettage,
(7) Root-end resection,
(8) Root-end preparation,
(9) Root-end filling,
(10) Soft-tissue repositioning and suturing, and
(11) Postsurgical care.

Armamentarium for Periradicular surgery

Anesthesia and Hemostasis

- Failure to obtain profound surgical anesthesia → needless pain and anxiety

- Inadequate hemostasis→ poor visibility of the surgical site → prolonging the procedure → increased patient morbidity.

Selection of Anesthetic Agent

- Based on

→the medical status of the patient and

→the desired duration of anesthesia needed.

- The two major groups of local anesthetic agents are the esters and amides.

- Ester group → Propoxycaine and Procaine

- The Amide group of local anesthetics, which include
- Lidocaine (Xylocaine), mepivacaine (Carbocaine), prilocaine (Citanest), bupivacaine (Marcaine), etidocaine (Duranest), and articaine (Ultracaine)

- **Lidocaine (Xylocaine) the anesthetic agent of choice** for periradicular surgery.

Vasoconstrictor Agent

- These agents include

- **Epinephrine** (Adrenalin),
- **Levonordefrin** (Neo Cobefrin), and
- **Levarterenol** (Levophed)

Injection Sites and Technique

- Nerve block anesthesia
- Infiltration
- The recommended injection rate is 1 mL/minute, with a maximum safe rate of 2 mL/minute.

Monheim's 1984
Malamed 1986

Note

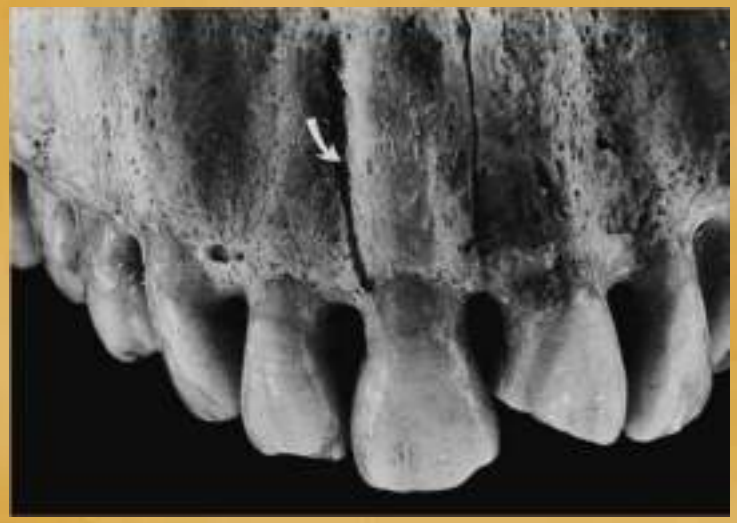
- **Reactive Hyperemia: The Rebound Phenomenon.**

- Delayed beta-adrenergic effect that follows the hemostasis produced by the injection of vasopressor amines.

Soft-Tissue Management

- Flap Designs and Incisions
- Principles and Guidelines for Flap Design

1. Avoid horizontal and severely angled vertical incisions
2. Avoid incisions over radicular eminences.



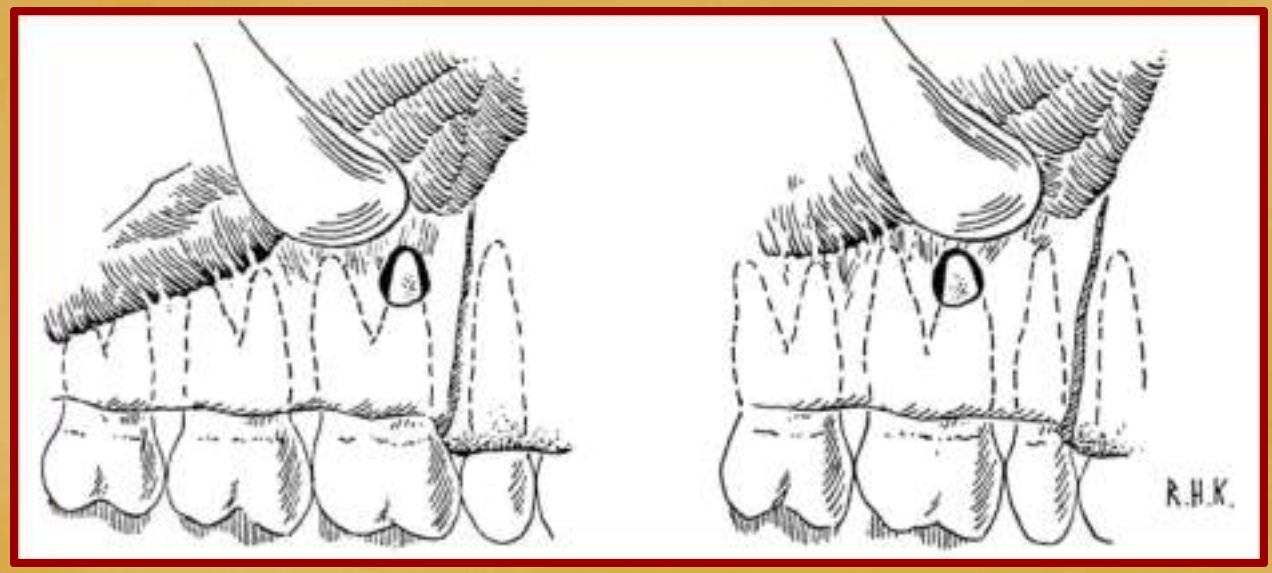
3. Incisions should be placed and flaps repositioned over solid bone.

→ Hooley & Whitcare → mini 5mm bone should exist b/w the edge of the bony defect and the l. line.

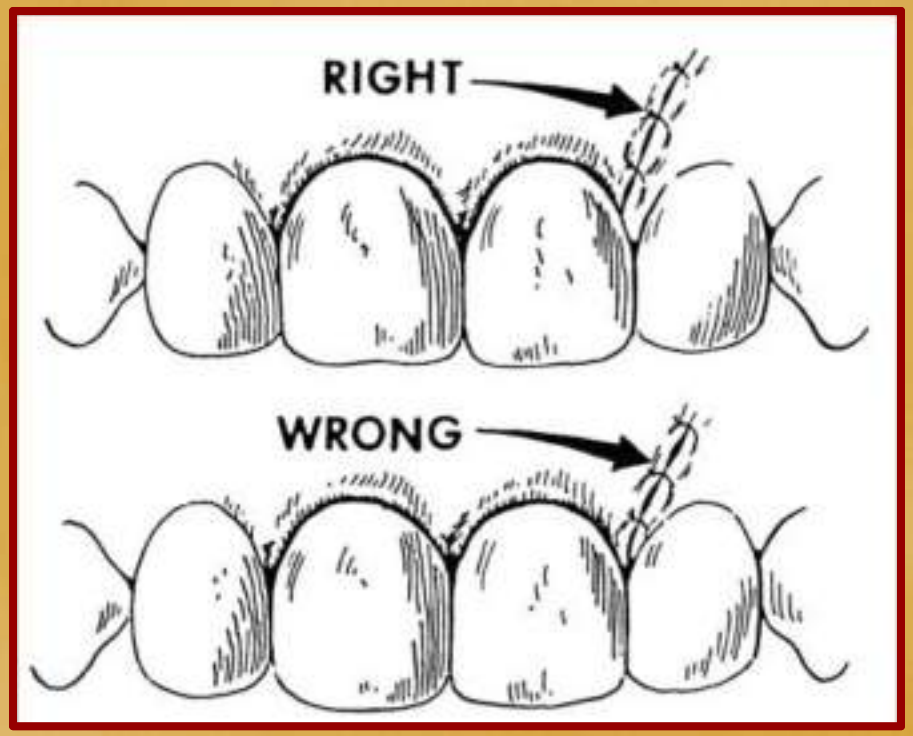
4. Avoid incisions across major muscle attachments.

5. Tissue retractor should rest on solid bone.

6. Extent of the horizontal incision should be adequate to provide visual and operative access with minimal soft-tissue trauma.



7. The junction of the horizontal sulcular and vertical incisions should either include or exclude the involved interdental papilla.



8. The flap should include the complete mucoperiosteum (full thickness).

- According to Gutmann and Harrison, the two major categories of periradicular surgical flaps are the

1.full mucoperiosteal flaps and the

2.limited mucoperiosteal flaps.

Classification of Surgical Flaps

- Luebke & Ingle classification.

- 1. Full mucoperiosteal flaps

  (a) Triangular (one vertical releasing incision)
  (b) Rectangular (two vertical releasing incisions)
  (c) Trapezoidal (broad-based rectangular)
  (d) Horizontal (no vertical releasing incision)
  (e) Papilla based flap

- 2. Limited mucoperiosteal flaps

  (a) Submarginal curved (semilunar)

  (b) Submarginal scalloped rectangular (Luebke-Ochsenbein)

Full Mucoperiosteal Flaps

Triangular Flap

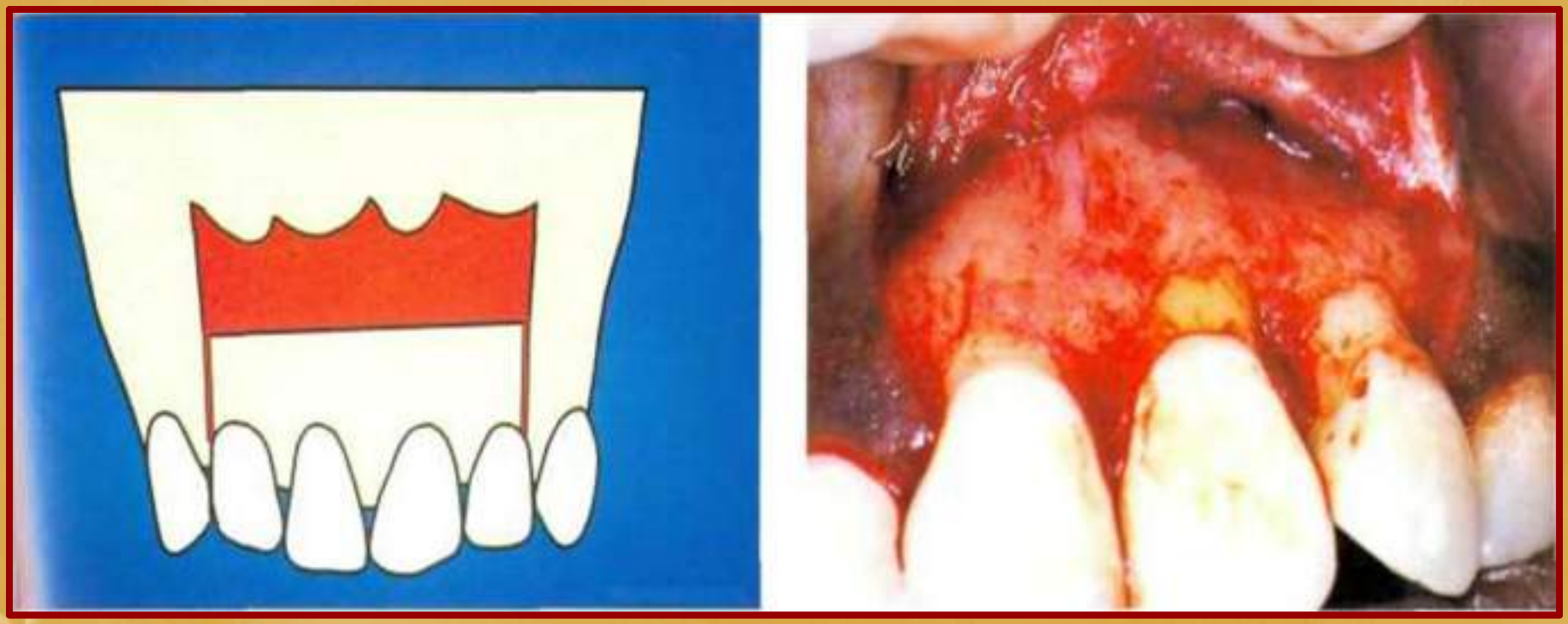
Triangular Flap

- *Adv*

1) Good wound healing
2) Minimal disruption of the vascular supply to the flapped tissue
3) Ease of flap reapproximation.

- *Disadv*
- Limited surgical access.

Rectangular Flap



Rectangular Flap

- ***Indications***

Periapical surgery:

- multiple teeth
- large lesions
- long or short roots

Lateral root repairs:

— full-length root visualized

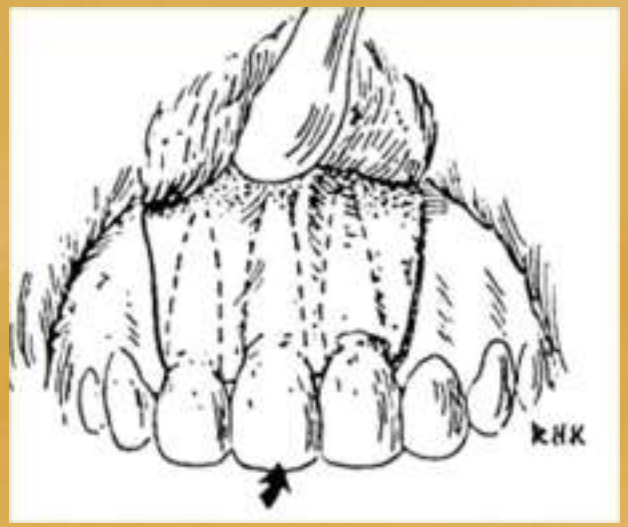
- Especially useful for **mandibular anterior teeth**, multiple teeth, and teeth with long roots, such as **maxillary canines**.
- Not recommended for posterior teeth.

- *Advantages*
- Provides maximum access and visibility.
- Reduces retraction tension.
- Facilitates repositioning.

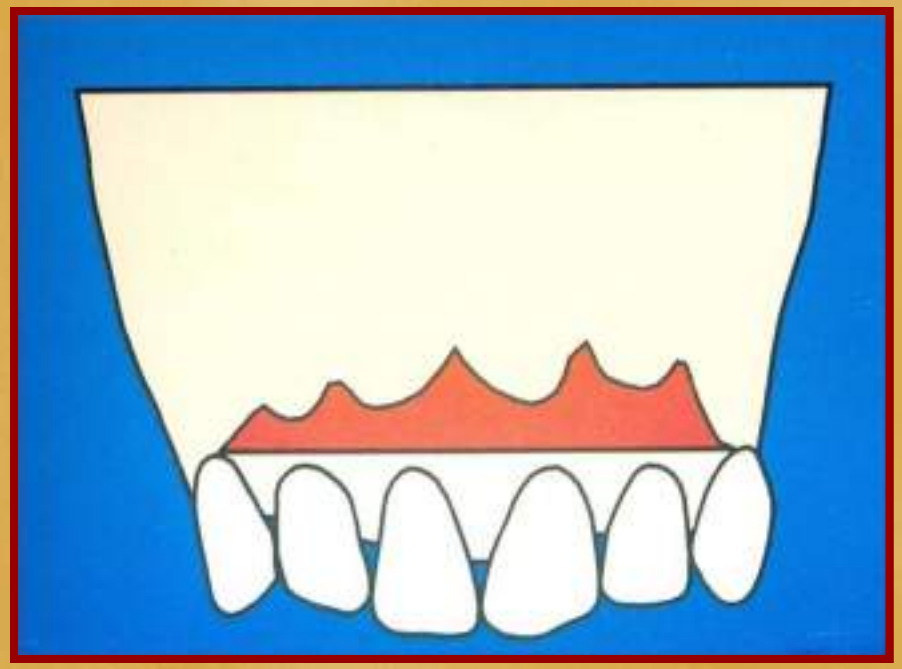
- *Disadvantages*
- Reduced blood supply to flap.
- Increased incision and reflection time.
- Gingival attachment violated:
  - gingival recession
  - crestal bone loss
  - may uncover dehiscence
- Suturing is more difficult.

Trapezoidal Flap

- **contraindicated in periradicular surgery**



Horizontal Flap



Horizontal Flap

- *Indications*

- Cervical resorptive defects.
- Cervical area perforations.
- Periodontal procedures.

- *Advantages*
- No vertical incision.
- Ease of repositioning.

Disadvantages

- Limited access and visibility.
- Difficult to reflect and retract.
- Predisposed to stretching and tearing.
- Gingival attachment violated

Papilla based flap

- To prevent recession of the papilla following endo surgery.

- Excludes papilla.

- 2 diff. incisions at papillary base.
- 1. A shallow incision at the base.
- 2. Incision directed towards the crestal bone.

Limited Mucoperiosteal Flaps

- ***Submarginal Curved (Semilunar) Flap***
- No advantages
- Disadvantages are many, including
- poor surgical access
- poor wound healing,
- Scarring.
- **Not recommended for periradicular surgery.**

Submarginal Scalloped Rectangular (Luebke-Ochsenbein) Flap

Submarginal Scalloped Rectangular (Luebke-Ochsenbein) Flap

Indications

- Prosthetic crowns present.
- Periapical surgery:

→anterior region

→ longer roots

- Wide band of attached gingiva.

- *Advantages*

- Ease in incision and reflection.
- Enhanced visibility and access.
- Ease in repositioning.
- Maintains integrity of gingival attachment:

-- prevents gingival recession

-- avoids dehiscence

-- prevents crestal bone loss

- *Disadvantages*

- Horizontal component disrupts blood supply.
- Vertical component crosses mucogingival junction and may enter muscle tissue.
- Difficult to alter if size of lesion misjudged.

Flap Design for Palatal Surgery

Incisions

- Accomplished by using one or more of four scalpel blades: No. 11, No. 12, No. 15, and No. 15C

- ***Flap Reflection***

- ***Flap Retraction***

- Arnes tissue retractor
- Seldin retractor
- Minnesota retractor

Hard-Tissue Management

- Barnes identified four ways in which the root surface can be distinguished from the surrounding osseous tissue:

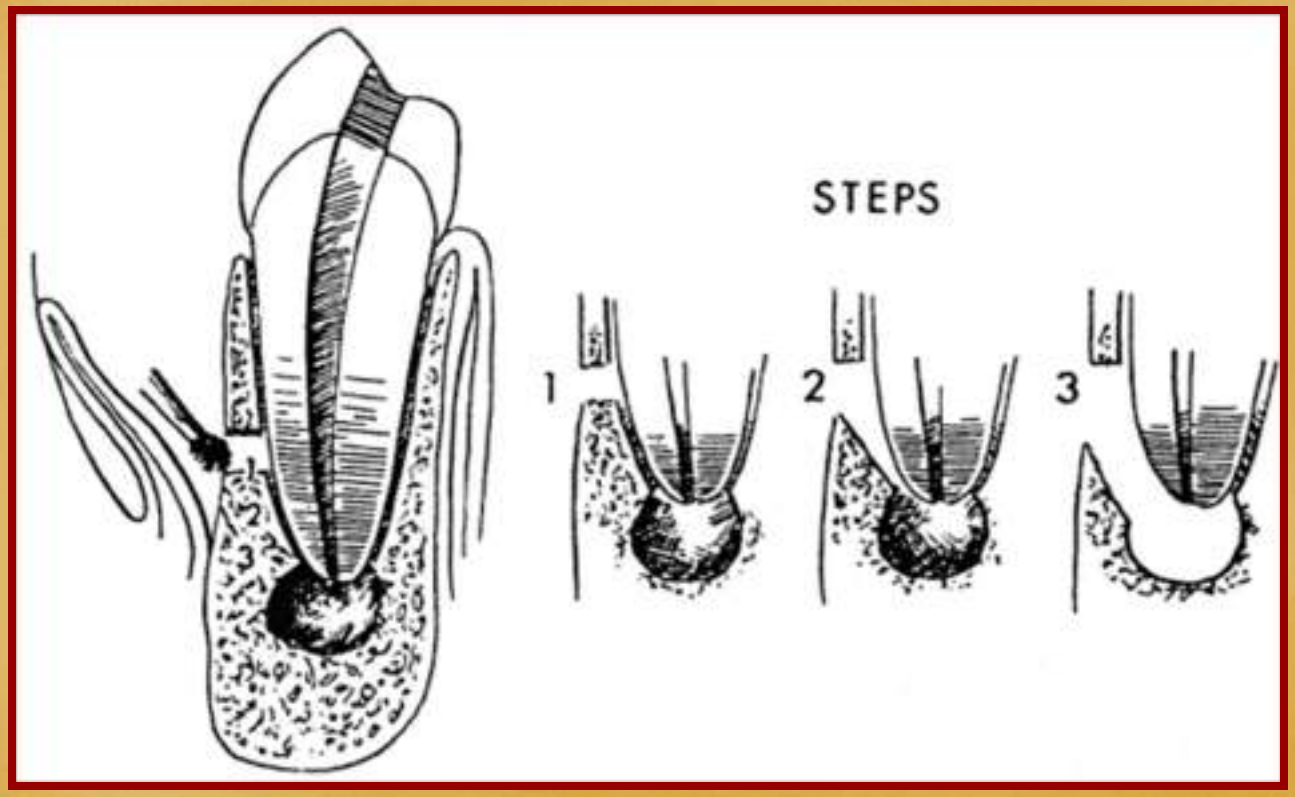
(1) root structure generally has a yellowish color,

(2) do not bleed when probed,

(3) is smooth and hard as opposed to the granular and porous nature of bone, and

(4) is surrounded by the periodontal ligament.

Hard-Tissue Management



- Stepwise removal of bone to the apex, after the root has been identified, prevents gouging adjacent roots or structures

- Cutting of osseous tissue with **a No. 6 or No. 8 round bur** produces less inflammation and results in a smoother cut surface and a shorter healing time than when a fissure or diamond bur is used.

- Light "brush strokes" with short, multiple periods of osseous cutting will maximize cutting efficiency and minimize the generation of frictional heat.

- A low-speed surgical handpiece should be used for osseous removal rather than a high-speed handpiece.
- Impact Air 45 degree high speed hand piece.

- In areas of restricted visibility, the use of a high-speed handpiece with a 45-degree angled head significantly increases visibility.

- Several case reports have been published of surgical emphysema resulting in

- subcutaneous emphysema of the face,
- intrathoracic complications including pneumomediastinum, fatal descending necrotizing mediastinitis, and Lemierre syndrome from the use of a high-speed dental handpiece.

Periradicular Curettage

- Various sizes and shapes of sharp surgical bone curettes and angled periodontal curettes

Root-End Resection

- ***Indications***
- Either biologic or technical.
- El-Swiah and Walker reported on a retrospective study that evaluated the clinical factors involved in deciding to perform root-end resections on 517 teeth from 392 patients.
- They reported that biologic factors constituted 60% of the total, whereas technical factors constituted 40%.

- The most common biologic factors

-- Persistent symptoms and
-- Continued presence of a periradicular lesion.

- The most common technical factors

-- Interradicular posts,
-- Crowned teeth without posts,
-- Irretrievable root canal filling materials, and
-- Procedural accidents.

- There are three important factors for the endodontic surgeon to consider before performing a root-end resection:

(1) Instrumentation,

(2) Extent of the root-end resection, and

(3) Angle of the resection.

Instrumentation

- Ingle et al. recommended that root-end resection is best accomplished by use of a No. 702 tapered fissure bur
- or a No. 6 or No. 8 round bur in a low-speed straight handpiece.
- They stated that a large round bur was excellent for this procedure because → easily controlled and prevented gouging and the formation of sharp line angles.

- Gutmann and Harrison, have suggested the use of a high-speed handpiece and a surgical length plain fissure bur.

IEJ 1985;18:8

- Nedderman et al. used the SEM to evaluate the resected root face and Gp fillings following root-end resection with various types of burs using both high- and low-speed handpieces.

JOE 1988;14:423

- Round burs at both speeds → scooping or ditching of the root surface.
- Cross-cut fissure burs → the roughest resected root surfaces with the gutta-percha being smeared across the root face.
- **Plain fissure burs** → **smoothest** resected root surface, with plain fissure burs and a low-speed handpiece resulting in the **least guttapercha distortion**.

- Morgan and Marshall reported in a study that compared the topography of resected root surfaces using No.57, Lindeman, or Multi-purpose burs.

- The **Multi-purpose bur** produced a smoother and more uniplanar surface than did the No. 57 bur.

- Recently, many investigators have studied and reported on the in vitro and in vivo effects of the application of laser energy for root-end resections.

- A team of investigators from the Tokyo Medical and Dental University in Japan reported on an in vitro study using the Er:YAG laser for root-end resections.
- No smear layer or debris left on the resected root surfaces prepared by the use of the Er:YAG laser.

J Clin Laser Med Surg 1997;15:9

- Komori and associates→ Er:YAG laser and the Ho:YAG laser for root-end resections

- Er:YAG laser produced smooth, clean, resected root surfaces free of any signs of thermal damage.

- The Ho:YAG laser, however, produced signs of thermal damage and large voids between the gutta-percha root canal fillings and the root canal walls.

- Moritz and associates→ carbon-dioxide (CO_2) laser as an aid in performing root-end resections.

- The use of the CO_2 laser as an adjunct following root-end resection with a fissure bur

  →decreased dentin permeability, as measured by dye penetration and sealing of dentinal tubules determined by SEM examination.

- Maillet and associates→ connective-tissue response to healing adjacent to the surface of dentin cut by a Nd:YAG laser Vs dentin cut by a fissure bur.

- Increase in inflammation and fibrous capsule thickness adjacent to the dentin surfaces cut with the Nd:YAG laser compared with the bur-cut surfaces.

- Miserendino → Co2 laser
- The rationale for laser use in endodontic periradicular surgery includes

(1) Improved hemostasis and concurrent visualization of the operative field,

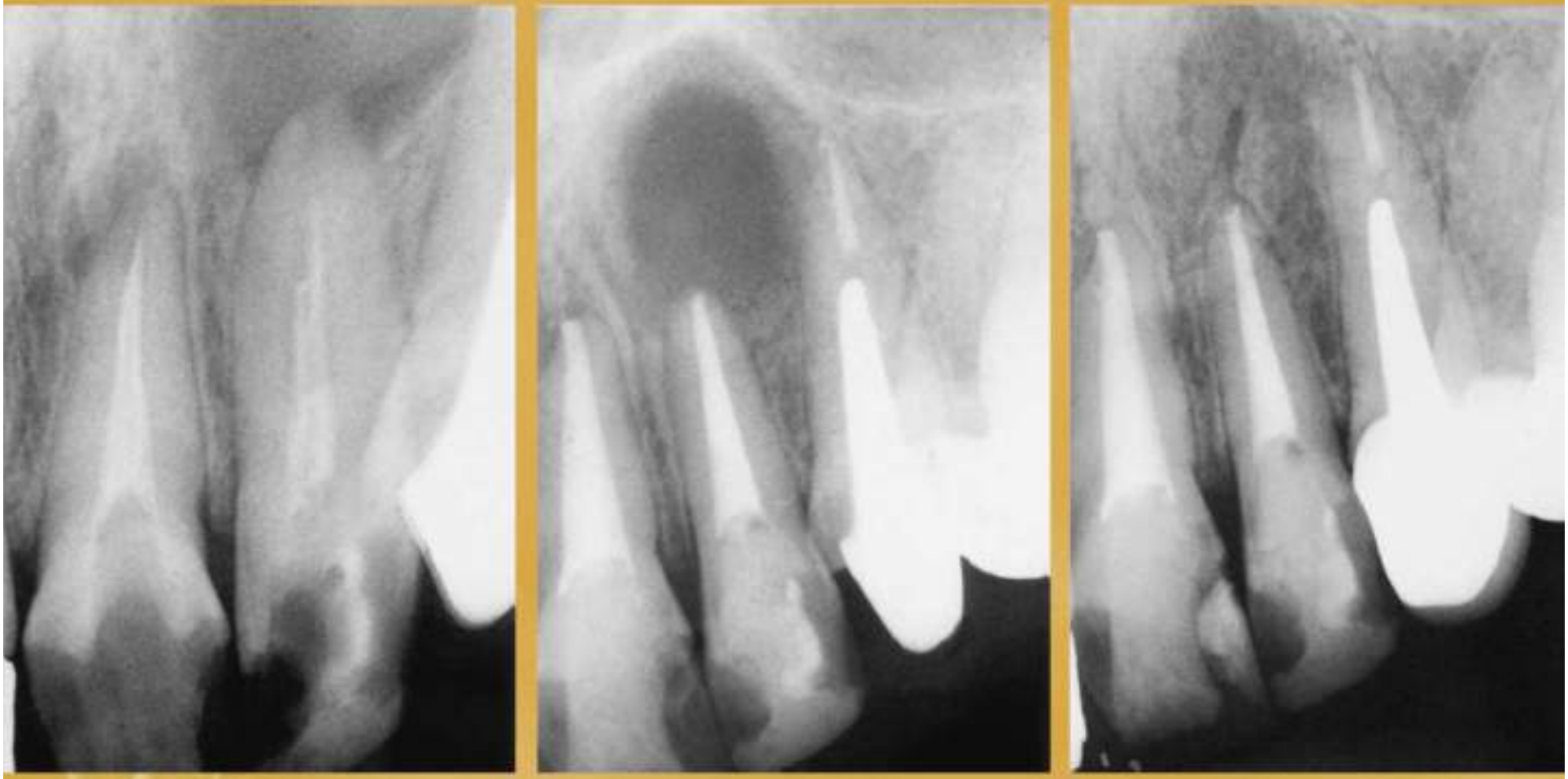
(2) Potential sterilization of the contaminated root apex,

(3) Potential reduction in permeability of root-surface dentin,

(4) Reduction of postoperative pain, and

(5) Reduced risk of contamination of the surgical site through elimination of the use of aerosol-producing air turbine handpieces.

Oral Surg 1988;66:615



Extent of the Root-End Resection

- 2 main principles dictate the extent

1. The cause of the ongoing disease process must be removed.
2. Adequate room must be provided for inspection & management of the root end.

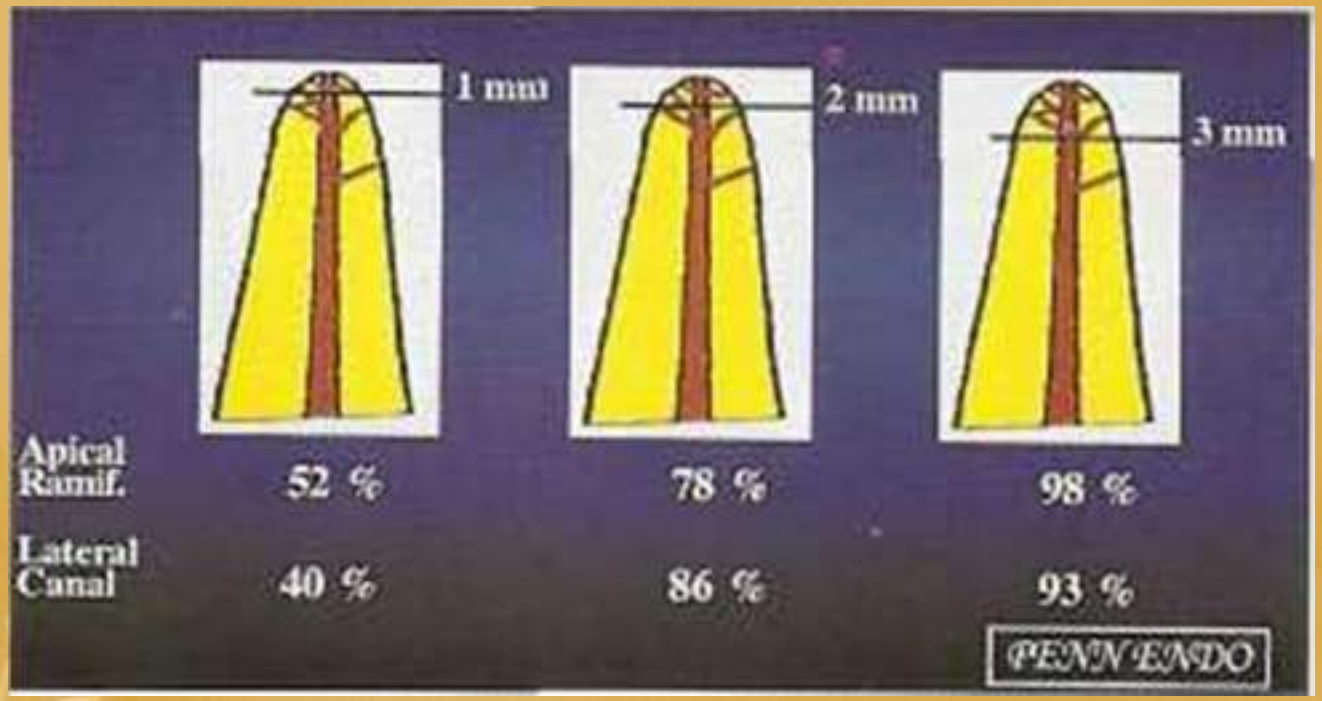
- Factors to be considered

1. Visual and operative access to the surgical site
2. Anatomy of the root (shape, length, curvature).
3. Number of canals and their position in the root
4. Need to place a root-end filling surrounded by solid dentin
5. Presence and location of procedural error
6. Presence and extent of periodontal defects.

7. Level of remaining crestal bone.

8. Canal aberrations

- 75% of teeth → canal aberrations in apical 3mm.



Angle of Root-End Resection

- Enhanced magnification & illumination techniques → eliminated the need to create beveled root surface in most cases.
- From biologic perspective → perpendicular to the long axis of the tooth.
- Steep bevel angle 45-60 degree.

JOE 2006;32,601

- Historically→ should be 30 degrees to 45 degrees from the long axis of the root facing toward the buccal or facial aspect of the root.
- Mehlhaff et al → avg root end bevel required using rotary burs was → 35.1 degree

JOE 1997;23:448

- In two other studies →

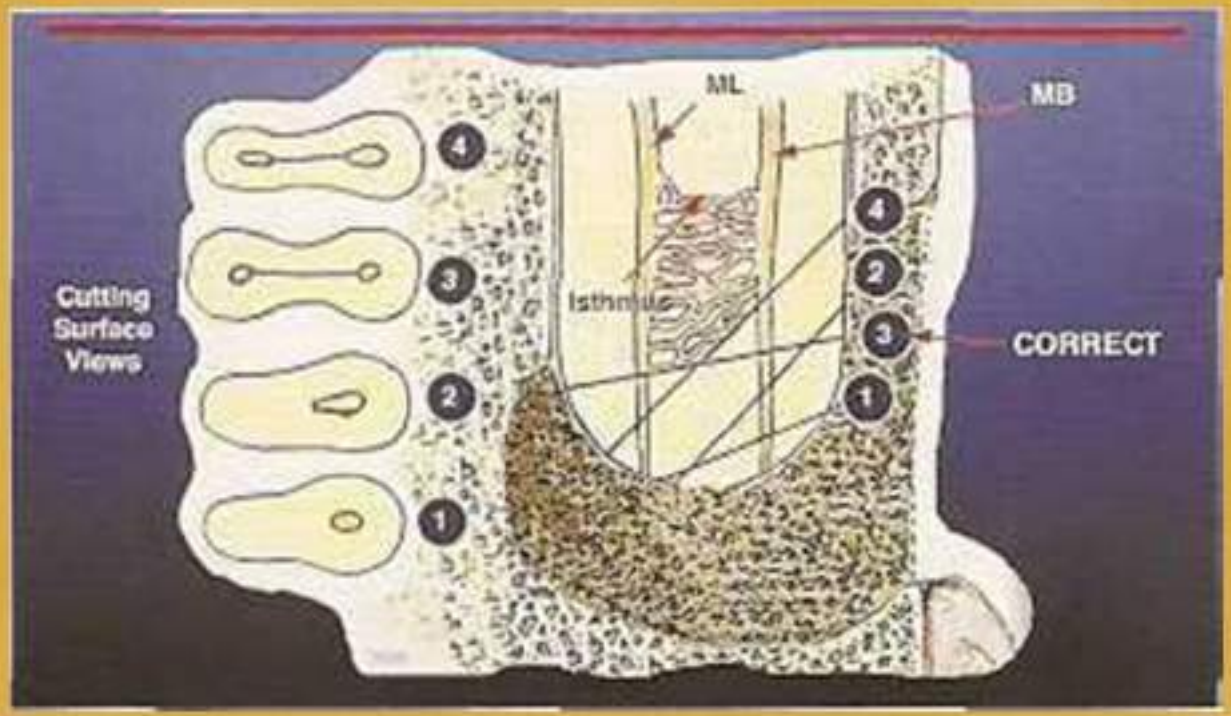
  as the root end bevel ↑ → depth of leakage around root end filling ↑

JOE 1994;20;22,
JOE 1998;24;726

- Tidmarsh and Arrowsmith examined the cut root surface following root-end resections at angles between 45 degrees and 60 degrees approximately 3 mm from the root apex using SEM,
- They reported the presence of an average of 27,000 DT/mm^2 on the face of the root-end resection midway between the root canal and the DCJ.


0°
10°


0°
45°


ML
MB
Cutting Surface Views
Isthmus
CORRECT
4
3
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2
3
1

Rationale for perpendicular resection

1. Includes all the apical ramifications.
2. As the angle of resection ↑

   → no of DT exposed ↑
3. Extending the root end cavity prep beyond the coronal extent of the root surface is simpler.
4. Stress forces → evenly distributed.

- Carr and Bentkover stated that failure to cut completely through the root in a buccal–lingual direction is one of the most common errors in periradicular surgery.

Importance of Surgical Hemostasis

- Good visualization of the surgical field and of the resected root surface is essential.

- Ideally, these hemostatic agents should be placed subsequent to the root-end resection and before the rootend preparation and filling.

- These topical and local hemostatic agents have been broadly classified by their mechanism of action as -- DCNA 1997
- 1. Mechanical agents (Nonresorbable)
  a. Bone wax (Ethicon, Somerville, NJ)
- 2. Chemical agents
  a. Vasoconstrictors: epinephrine (Racellets, Epidri, Radri) (Pascal Co, Bellevue,WA)
  b. Ferric sulfate: Stasis (Cut-Trol, Mobile, AL); Viscostat; Astringedent U ltradent Products, Inc, U T)
- 3. Biologic agents
  a. Thrombin U SP: Thrombostat (Parke-Davis,Morris Plains, NJ); Thrombogen (Johnson & Johnson

- 4. Absorbable hemostatic agents
    - a. Mechanical agents
        - i. Calcium sulfate USP
    - b. Intrinsic action agents
        - i. Gelatin: Gelfoam (U pjohn Co, Kalamazoo, MI); Spongostan (Ferrostan, Copenhagen, Denmark)
        - ii. Absorbable collagen: Collatape (Colla-tec Inc, Plainsboro, NJ); Actifoam (Med-Chem Products Inc, Boston,MA)
        - iii.Microfibrillar collagen hemostats: Avitene (Johnson & Johnson, New Brunswick, NJ)
    - c. Extrinsic action agents
        - i. Surgicel (Johnson & Johnson, New Brunswick, NJ)

Bone Wax

- In 1972, Selden reported bone wax to be an effective hemostatic agent in periradicular surgery.
- Highly purified beeswax.
- When placed under moderate pressure, plugs the vascular openings.
- No effect on the blood-clotting mechanism.
- All remaining bone wax should be thoroughly removed before surgical closure.
- Reported the presence of persistent inflammation, foreign-body giant cell reactions, and delayed healing.

JOE 1985 ;11:75

- No longer be recommended for use in periradicular surgery

Vasoconstrictors

- Epinephrine, phenylephrine, and nordefrin
- Epinephrine has been shown to be the most effective and the most often recommended.
- Cotton pellets containing racemic epinephrine in varying amounts (Epidri, Racellete, Radri) are available.

Tefla Pads

- Gutmann and Harrison stated that cotton fibers that are left at the surgical site may impair the actual root-end seal.
- Telfa pads contain no cotton fibers.
- Weine and Gerstein and Selden have cautioned against the use of vasoconstrictors as topical agents

  → systemic vascular change
- In patients with more severe heart disease, epinephrine-impregnated cotton pellets or gauze, or gingival retraction cord, should be used with caution or avoided.

Ferric Sulfate

- First introduced as Monsel's solution (20%ferric sulfate) in 1857.
- MOA results from the agglutination of blood proteins and the acidic pH (0.21) of the solution.
- Chemical reaction with the blood rather than an alpha-adrenergic effect.
- Cytotoxic and may cause tissue necrosis and tattooing.
- Care is taken to thoroughly curette and irrigate the agglutinated protein material before surgical closure.

Thrombin

- Acts to initiate the extrinsic and intrinsic clotting pathways.
- It is designed for topical application only and may be life threatening if injected.
- Has been used successfully in neurosurgery, cardiovascular surgery, and burn surgery.
- The main disadvantages →its difficulty of handling and high cost.

Calcium Sulfate

- Calcium sulfate (plaster of Paris) is a resorbable material used in surgery for over 100yrs
- Has gained popularity, in recent years, as a barrier material in GTR procedures.
- Powder and liquid component that can be mixed into a thick putty-like consistency and placed in the bony crypt using wet cotton pellets to press it against the walls.
- Biocompatible, resorbs completely in 2 to 4 weeks, and does not cause an increase in inflammation.
- Advantage of being relatively inexpensive.

Gelfoam and Spongostan

- Hard, gelatin-based sponges that are water insoluble and resorbable
- Made of animal-skin gelatin and become soft on contact with blood.
- Act intrinsically by promoting the disintegration of platelets, causing a subsequent release of thromboplastin.
- The major use → in periradicular surgery is placement in the bony crypt, after rootend resection and root-end filling have been completed just before wound closure.
- Reduction in the rate of osseous healing

Collagen

- 4principal MOA are involved in hemostasis enhanced by collagen-based products:

(1) stimulation of platelet adhesion, aggregation, and release reaction;

(2) activation of Factor VII (Hageman Factor);

(3) mechanical tamponade action; and

(4) the release of serotonin.

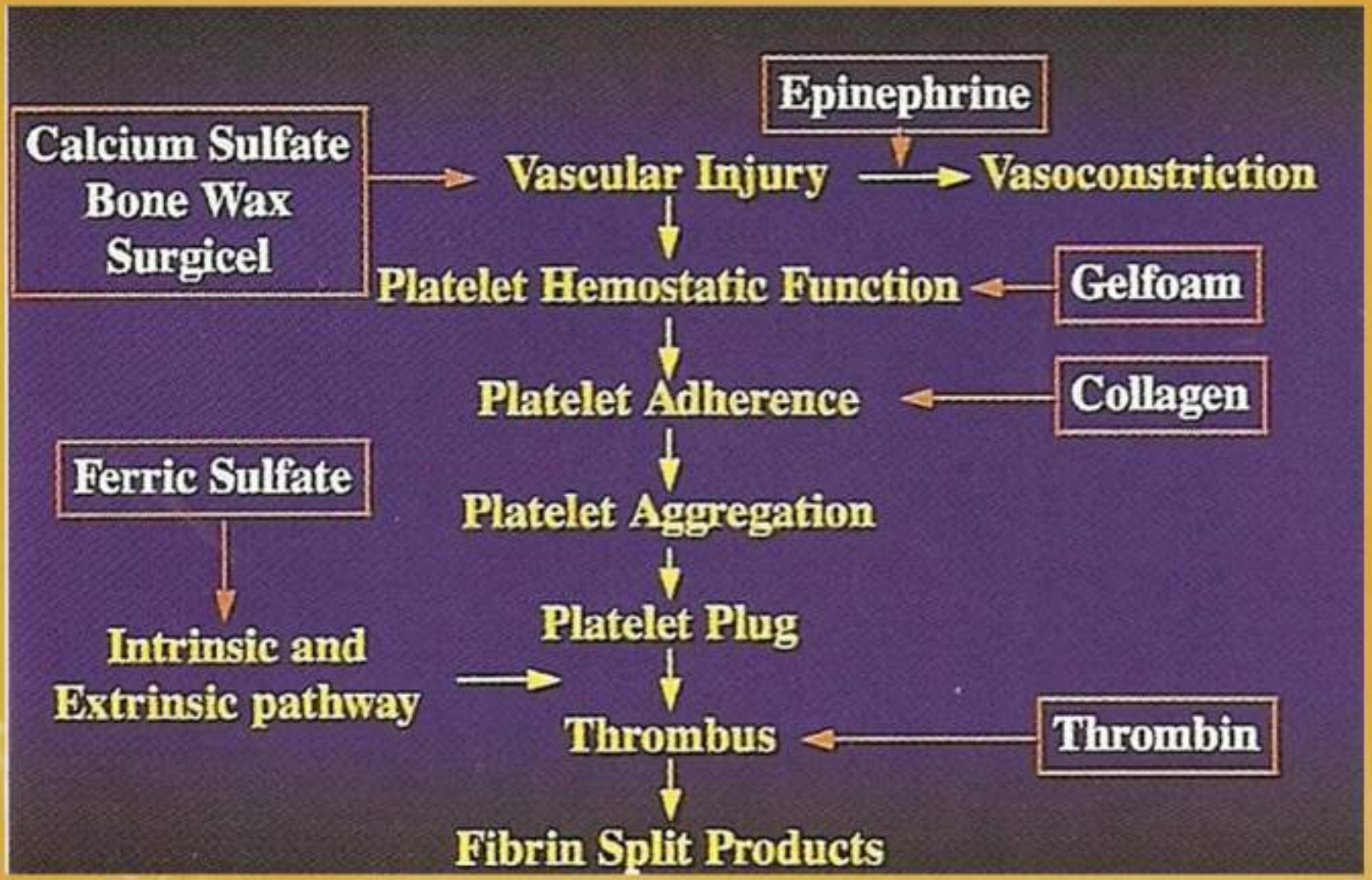
- Obtained from bovine sources and is supplied in sheets (Collatape) and sponge pads (Actifoam)
- Hemostasis is usually achieved in 2 to 5 minutes

Microfibrillar Collagen Hemostat

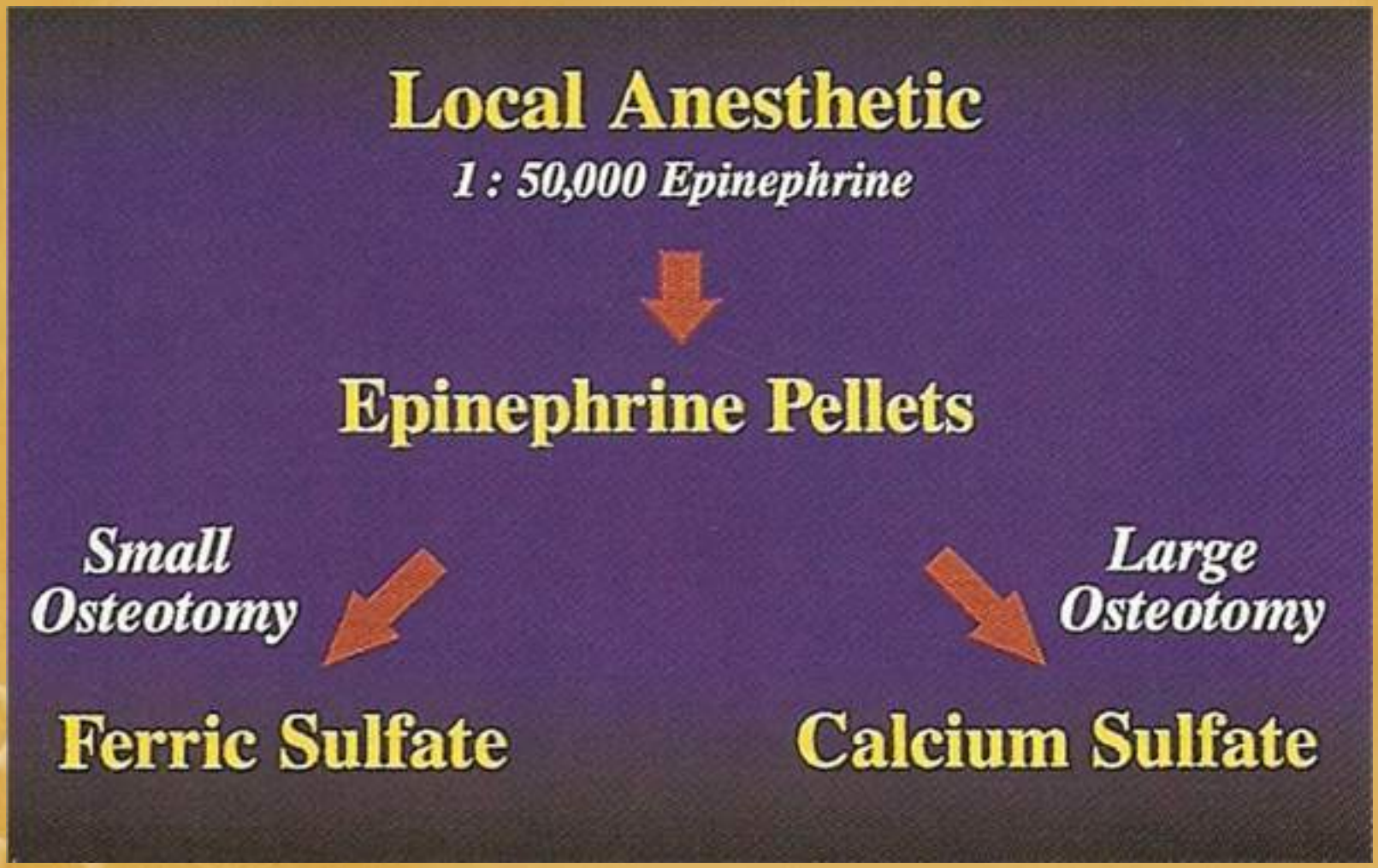
- Avitene and Instat
- Derived from purified bovine dermal collagen, shredded into fibrils, and converted into an insoluble partial hydrochloric acid salt.
- Provides a collagen framework for platelet adhesion.
- Applied to the surgical site by use of a spray technique.
- Disadv→ inactivated by autoclaving, in contaminated wounds may enhance infection, and are expensive

Surgicel

- Is a chemically sterilized substance resembling surgical gauze and is prepared by the oxidation of regenerated cellulose (oxycellulose).
- Which is spun into threads, then woven into a gauze that is sterilized with formaldehyde.
- Mode of action is principally physical.
- Acts as a barrier to blood and then as a sticky mass that acts as an artificial coagulum or plug
- Reduce the rate of repair and increase inflammation


Epinephrine
Calcium Sulfate
Bone Wax
Surgicel
Vascular Injury
Vasoconstriction
Platelet Hemostatic Function
Gelfoam
Platelet Adherence
Collagen
Ferric Sulfate
Platelet Aggregation
Platelet Plug
Intrinsic and
Extrinsic pathway
Thrombus
Thrombin
Fibrin Split Products

Recommended hemostatic procedure for microsurgey

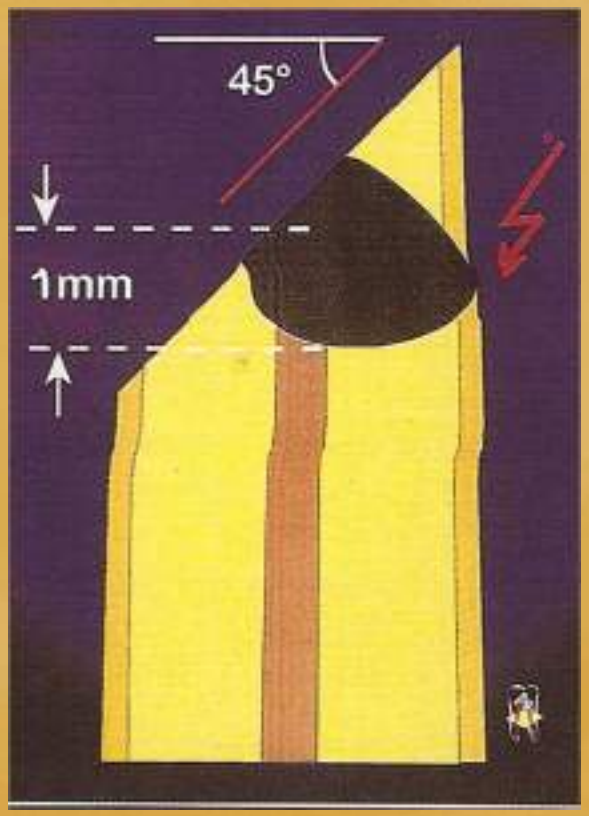


Root-End Preparation

- Crucial step in establishment of an apical seal.
- Goal – dimensionally sufficient for placement of a root-end filling material.
- Ideal prep→ Class I cavity – along the long axis of the tooth – at least 3mm deep

Carr & Bentkover

- Historically→ small round or inverted cone burs in a miniature or straight low-speed handpiece.



- Now with the ultrasonic technique using ultrasonic tips.

- Five requirements

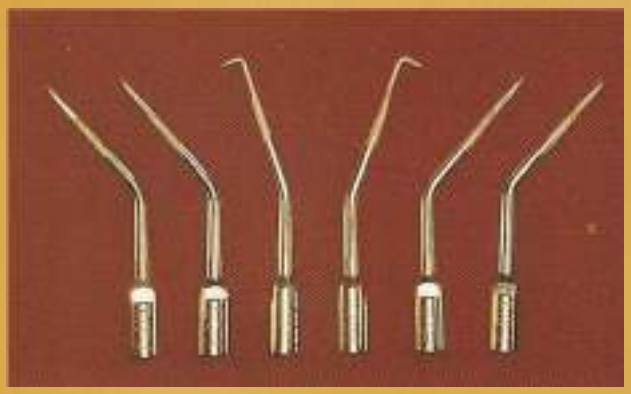
1. The apical 3mm of the root canal must be freshly cleaned & shaped.
2. The prep must be parallel to and coincident with the anatomic outline of the pulp space.
3. Adequate retention form
4. All isthmus tissue when present must be removed.
5. Remaining dentin walls must not be weakened.

Ultrasonic root-end preparation

- First advocated by Richman in 1957
- Conventional root-end cavity prep – problems for the surgeon

1) Access to the root-end– difficult
2) High risk of perforation of lingual root-end.
3) Insufficient depth & retention of root-end filling
4) Exposes more DT
5) Necrotic isthmus tissue cannot be removed.

- Carr introduced retro-tips designed specifically for root-end cavity prep during endo surgery.



- *Adv*

1. Less osseous tissue removed
2. More conservative prep that follows the long axis of the tooth.
3. Risk of root-end perforation is reduced
4. Less beveling of the root
5. Less smear layer when compared to burs.

- *Disadv*
- Potential for creating root fractures.
- Abedi et al → higher incidence of microfractures in the root-end prep with ultrasonics

OOOOE 1993;80:207

- Ultrasonic units create vibrations ranging from 30 to 40 kHz by exciting the quartz or ceramic electric crystals that are located in the handpiece.

- Copious irrigation is essential in ultrasonic root end preparation so that the root tissue does not become heated and result in microfractures.
- The first ultrasonic tips for endodontics and endodontic surgery were the CTs that were first available in early 1990.

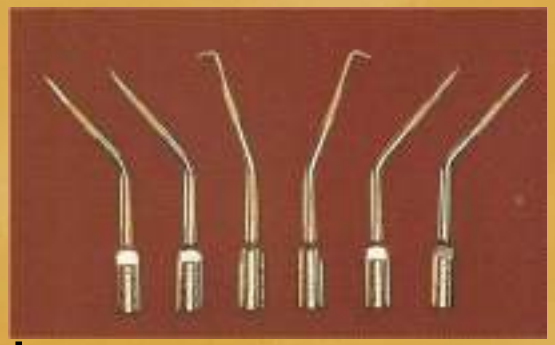
- The new KiS tips, which have been on the market since 1999.
- The KiS tips are coated with zirconium nitride, which provides strength and surface roughness.
- The improved cutting and irrigation characteristics of the KiS tips reduce the risk of microfractures.

- The following is a list of ultrasonic tips and their suggested areas of use:
- Anterior teeth: KiS 1 and 2 tips
- Premolars: KiS 1 and 2 tips or KiS 3, 4, 5, and 6 tips (depending on access space)
- Molars: KiS 3, 4, 5, and 6 tips
- Isthmi(wide):KiS2tip
- Isthmi (narrow): KiS 1, 3, and 6 tips

Tip design

- Varying lengths & diameters.
- Stainless steel → CT-5tips

- May be coated with diamond or Zirconium nitride
  Eg: Kis tips
- Inc cutting efficiency.



- Diamond coating → most aggressive.

Studies

- Wuchenich et al. compared the root-end cavities prepared with conventional handpieces or ultrasonic tips in cadavers in a SEM study.
- Cleaner and deeper root-end cavity preparations, aiding retention of the root-end filling material and disinfection by removing infected dentin.

JOE 1994;20:279-82

- Saunders et al, while experimentally using the ENAC system (smooth stainless steel tips) on extracted teeth reported crack formation in the walls of the cavity, which may increase the chance of apical leakage.

IEJ1994;27:325-9

- Layton, used smooth stainless steel tips also on extracted teeth to evaluate if the cracks were created during the root resection procedure or after the root-end preparation with ultrasonic tips.
- Observed more cracks on the resected surfaces after root-end cavity preparation than after root resection only.

JOE 1996;22:157-60

- Higher prevalence of microfractures when he used the tips at higher power settings.
- Walpington et al. have suggested using low to moderate intensity for 2 min to minimizes the risk of root dentine microfactures.

EDT1995;11:177-80

- Gray et al., on cadavers reported that the ultrasonic tips did not cause a greater than average number of cracks.
- It was suggested that the periodontal ligament might dissipate stresses and thereby prevent cracking.

JOE 2000;26:281-3

Root-End Filling

- To establish a seal between the root canal space and the periapical tissues.
- According to Gartner and Dorn, a suitable root-end filling material should be

(1) able to prevent leakage of bacteria and their by-products into the periradicular tissues,

(2) nontoxic,

(3) noncarcinogenic,

(4) biocompatiblwith the host tissues,

(5) insoluble in tissue fluids,

(6) dimensionally stable,

(7) unaffected by moisture during setting,

(8) easy to use, and

(9) radiopaque.

- One might add, it should not stain tissue (tattoo)

- Metals such as gold-foil, silver posts, titanium screws, tin posts , amalgam (with and without bonding agent) and gallium alloy are some of the solid, commonly used retro-filling materials.

- Cements and sealers such as ZnOE Cement IRM, Super EBA, cavit, zincpolycarboxylate, zinc phosphate and glass Ionomer cements, mineral trioxide aggregate, calcium phosphate cement and bone cement have also been employed for retro-fillings.

- Other commonly used materials are composite resin (with and without bonding agent) and gutta-percha.

- The less commonly used materials are laser, citric acid demineralization, ceramic inlay , teflon, mixture of powdered dentin & sulfathiazole and cynoacrylates

Amalgam

- It is the most extensively used retro-filling material from past seven decades.
- The first reports of placing it as a root-end filling subsequent to resection is attributed to Farrar(1884).
- Later Rhein (1897), Faulhaber & Neumann (1912), Hippels (1914) and Garvin (1919) extolled the use of root-end amalgam fillings.
- High copper zinc free amalgam is preferred.
- Use of Amalgambond, a 4-META bonding agent with amalgam significantly reduces the microleakage of amalgam retrofillings.

- Few limitations which include
- Initial marginal leakage,
- Corrosion,
- Tin and mercury contamination of periapical tissues,
- Moisture sensitivity of some alloys,
- Need for retentive undercut preparation,
- Staining of hard and soft tissues and
- Technique sensitivity.

Gutta Percha

- Until the development of thermoplasticized gutta-percha, the placement of GP as a root-end filling material was not advocated.
- Orthograde gutta-percha root canal obturation that is associated with apical surgery is burnished after apicoectomy with either cold or hot burnisher.
- Its adaptation to root dentin walls can also be accomplished with the use of solvents, excavators, scalpels and burs.
- It is reported that a better seal can be obtained with thermoplasticized gutta-percha than amalgam with and without varnish. *IEJ 1990;27;107-12*

- *Disadv*
- Due to it’s porous nature, it absorbs moisture from surrounding periapical tissue and expands initially, which is followed by contraction at a later stage.
- This may result in poor marginal adaptation and increased micro leakage.

Zinc Oxide Eugenol (ZOE) and Reinforced ZOE Cements

- IRM and Super EBA provide a better apical seal.
- IRM is ZOE cement reinforced by addition of 20% polymethacylate by weight to the powder.
- Studies reveal that IRM seals better than non
- zinc amalgam.
- Super EBA is ZOEcement modified with ethoxybenzoic acid to alter the setting time and increase the strength of the mixture.
- Super EBA has much better physical properties than ZOE.

- Super EBA showed
- high compressive strength, high tensile strength, neutral pH, and low solubility.
- Even in moist conditions Super EBA adheres to tooth structure.
- Reports showed a good healing response to super EBA with minimal chronic inflammation at the root apex.

J Endod. 1978 ; 4: 203-6.

- EBA demonstrates virtually no leakage.

Endont Dent Traumatol. 1988; 4: 82-4.

- Super EBA provides a better seal, when compared with amalgam as a root-end filling material.

OOOE 1985; 59: 82-7;J Endod. 1989; 15: 157-60.

Cavit

- It is a Zinc oxide based temporary filling material.
- Cavit is soft when placed in the tooth and subsequently undergoes a hygroscopic set after permeation with water, giving a high linear expansion (18%).
- This rationalizes its use as a root-end filling material.
- Cavit has been shown to exhibit greater leakage than IRM.
- It is found to be soluble and quickly disintegrates in tissue fluids.
- Biocompatibilitystudies with Cavit are in conflict, showing it tobe both toxic and nontoxic.

IEJ. 1981; 14: 121-4. J Endod. 1988; 14: 236-8.

Gold Foil

- First reports of its use as a root-end material is attributed to Schuster in 1913 and Lyons in 1920.
- Exhibits perfect marginal adaptability, surface smoothness and tissue biocompatibility.
- Implants of gold foil produce only mild tissue reaction. When compared to IRM, composite resin, amalgam and glass ionomer, goldfoil was least toxic.
- Leakage studies in rootend preparations have indicated minimal or no leakage.
- The routine use of gold foil as a root-end filling material does not appear practical because of the need to establish a moisture free environment careful placement and finishing.

Polycarboxylate cement

- It was introduced by Smith in 1968.
- Apical leakage studies have indicated that polycarboxylates, when used as root-end fillings, leak at levels significantly greater than amalgam or gutta-percha.
- Based on their poor sealing ability and uncertain periradicular tissue response, the use of polycarboxylate as root-end filling material is highly questionable.

Zinc phosphate cement

- Rhein in 1897 used zinc phosphate cement along with gutta-percha to seal the root canal system prior to root-end resection.
- In 1941 Herbert recommended zinc phosphate mixed with powdered thymol as a root-end filling material following root-end resection.
- Does not fulfill the requirements, it is not indicated as a rootend filling material.

Glass Ionomer Cement (GIC)

- Biocompatibility studies have shown evidence of initial cytotoxicity with freshly prepared samples, with decreasing toxicity as setting occurs.
- It is easy to handle and does not cause any adverse histological reaction in the periapical tissue.

OOO1987; 64: 475-9.

- Sealing ability of GIC was adversely affected when the root end cavities were contaminated with moisture at the time of placement of cement.

Dent Res 1987; 66: 297 Abstr. #1520.

- Light cure, resin reinforced GIC was used as a retrograde filling material by Chong et al.

IEJ 1991; 24: 223-32.

- It showed least microleakage due to less moisture sensitivity, less curing shrinkage and deeper penetration of polymer into dentin surface.
- Newer glass ionomer cements containing glass-metal powder have been reported to have less leakage and showed no pathologic signs.

J Dent Res. 1987; 66: 898. Abstr # 568.

Composite resin

- Composite resins due to their cytotoxic or irritating effects on pulp tissue have received minimal attention as root-end filling materials.
- Light cure composite resin showed significantly lower apical leakage than amalgam and ketac-silver.
- Rud et al applied Gluma *in vivo to cases requiring* periradicular surgery and compared it to cases treated with root-end amalgam fills.
- Gluma exhibited complete healing in 74% of the cases as compared to amalgam which showed in only in 59% of cases.

Mineral Trioxide Aggregate (MTA)

- It was developed at Loma Linda University,CA, U.S.A in 1993 by Torabinejad.
- This cement contains tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and other mineral oxides forming a hydrophilic powder which sets in presence of water.
- The resultant colloidal gel solidifies to a hard structure within 4 hours.
- Initially the pH is 10.2 which rises to12.5 three hours after mixing.
- More opaque than EBA and IRM.

- MTA provides superior seal when compared with Amalgam, IRM and Super EBA.

  J Endod 1995; 21: 109-21.

- MTA, when used as a root-end filling material, showed evidence of healing of the surrounding tissues. *J Endod. 1995; 21: 295-99.*

  EDT 1996; 12:161-178,

- Most characteristic tissue reaction of MTA was the presence of connective tissue after the first postoperative week. *IEJ. 2003; 36: 44-48.*
- Studies have shown that osteoblasts have favorable response to MTA as compared to IRM and amalgam.

- With longer duration, new cementum was found on the surface of the material.

JOE 2000; 27: 404-406.

- In a two year follow-up study with MTA as root-end filling material resulted in a high success rate.

IEJ. 2003; 36: 520-526.

Calcium Phosphate Cement (CPC)

- Developed by ADA-Paffenbarger Dental Research Center at the United States National Institute of Standards & Technology,
- CPC is mixture of two calcium phosphate compounds, one acidic and the other basic.
- Commonly known as hydroxyapatite cement, it is composed of tetracalcium phosphate and dicalcium phosphate reactants.
- These compounds, when mixed with water, react isothermally to form a solid implant composed of carbonated hydroxyapatite.
- It is as radio opaque as bone.

- When combined by dissolution in moisture, even blood, CPC sets into hydroxyapatite. It demonstrates excellent biocompatibility, does not cause a sustained inflammatory response or toxic reaction.
- Its compressive strength is greater than 60 MPa and has shown to maintain its shape and volume over time.
- CPC implants are resorbed slowly and are replaced by natural bone in an approximate 1:1 ratio in an osteoconductive manner.
- CPC seems to be quite promising as a retrograde filling material but it is yet to get approval from the United States FDA.

Microsurgery

Microsurgery

- Def :
- Surgical procedure on exceptionally small & complex structures with an operation microscopes.

- **History :** Microscopes were introduced to medical field 50 years back.
- 1st -- otolaryngology -- 1950s
- Endodontics -- 1990s
- Apotheker – 1981 (Magnification —8X) poorly configured & ergonomically difficult to use.
- Dr. Gary Carr – 1992, introduced an ergonomically configured microscope
- Optimum magnification → x8 to x24

Syngcuk Kim, DCNA, Vol:48, No:1,2004

- Triad of endodontic Micro surgery:

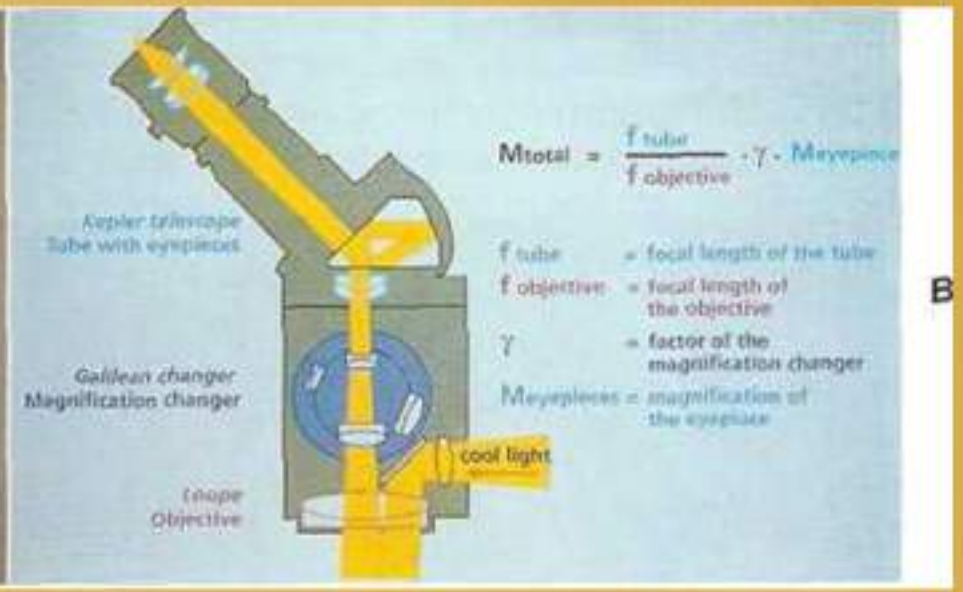
- Results in,

1) Correct apical preparation,
2) Precise retro preparation &
3) Hermetic retro filling.

Magnification & Illumination

- The surgical operating microscope works on these four areas.

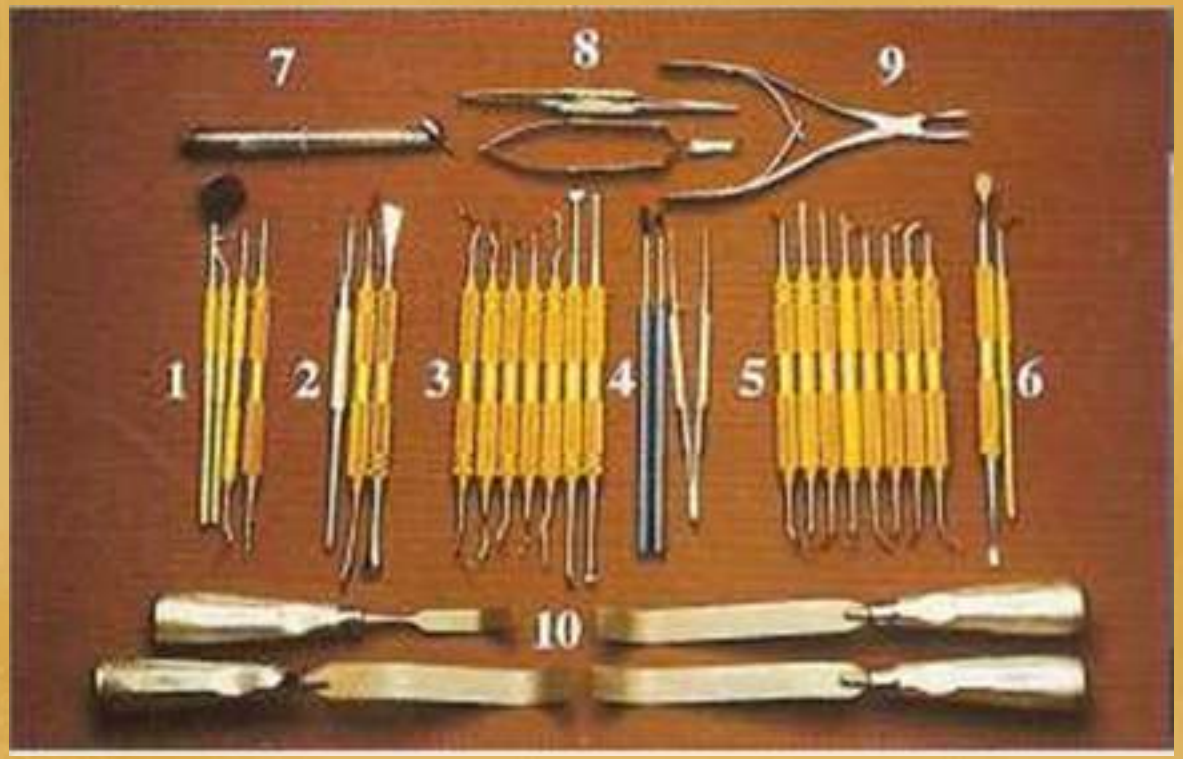
1) Magnification
2) Illumination
3) Documentation
4) Accessories


Kepler trinocular
Tube with eyepieces
Galileo changer
Magnification changer
Eteope
Objective
cool light
Mtotal = f tube / f objective · γ · Meyepiece
f tube = focal length of the tube
f objective = focal length of the objective
γ = factor of the magnification changer
Meyepieces = magnification of the eyepiece

B

MICROSURGICAL INSTRUMENTS

- Microsurgical instruments are miniaturized versions of traditional surgical instruments.



EXAMINATION INSTRUMENTS

- Include the mirror,
  periodontal probe,
  explorer, and microexplorer
- Microexplorer: 2-mm tip bent
  at 90 degrees on one end and 130 degrees on the other.
- The short tip →
- easy to maneuver inside the
  small bone crypt.

- Distinguishing a fracture line from an insignificant craze line.

INCISION AND ELEVATION INSTRUMENT

- A 15C blade and handle and soft tissue or periosteal elevators

- 15C blade→ small enough to manage the interproximal papilla but large enough to make a vertical releasing incision in one stroke.
- Micro-blades are useful when the interproximal spaces are very tight.

- The soft tissue elevators are designed to elevate the gingiva and tissue from the underlying cortical bone with minimum trauma to the tissue.
- One end of the instrument has a thin, sharp, triangular beak and the other end has a sharp, rounded beak that varies in size.

CURETTAGE INSTRUMENTS

- A minijacquette 34/35 scaler,
- A Columbia 13-14, and
- Minimolten and
- Miniendodontic curettes.
- Curettage of the lingual wall or PDL → requires miniaturized curettes.
- Minijacquettes and miniendodontic curettes were designed especially for this purpose.

INSPECTION INSTRUMENTS

- Four micromirrors of two types.
- Two of the mirrors are made of stainless steel. The micromirrors with blue handles have scratch-free sapphire mirror surfaces.
- An important feature of the mirror neck is flexibility.

RETROFILLING CARRIER AND PLUGGING INSTRUMENTS

- Two retrofilling carriers.

- Each has a 0.5-mm diameter ball on one end and a 1-mm wide blade on the other.
- One blade is in line with the handle, and the other is offset at 45 degrees.

- Six micropluggers, all of which have ball ends ranging from 0.2 to 0.5 mm in diameter on one end.

- Two of the instruments have a 90-degree and a 65-degree tip with a straight handle.
- Two angled microplugger tips are offset by 65 degrees, one left and one right for left and right molar surgeries .
- All microplugger tips are 3 mm long and 0.2 or 0.5 mm in diameter.

MISCELLANEOUS INSTRUMENTS

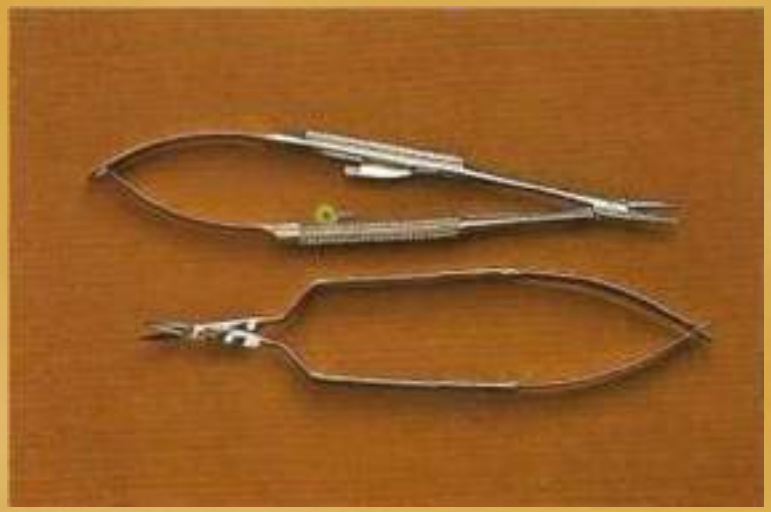
- A large ball burnisher and a bonefile are used to smooth the bone and root surface, to mold bone augmenting material, such as calcium sulfate, to the bone contours.
- A minirongeur is used to remove granulation tissue from a lesion.

OSTEOTOMY INSTRUMENTS

- The Impact Air 45 handpiece
- The H 161 Lindemann bone cutting bur has fewer flutes than conventional burs, resulting in less clogging and frictional heat and more efficient cutting.

SUTURING INSTRUMENTS

- The Laschal microscissors, or any small-beaked scissors,
- The Castroviejo needle holder are used to manage 5-0 or 6-0 synthetic sutures.



- Before the advent of microsurgery, 4-C silk sutures were the standard for endodontic surgery.
- To prevent inflammation and associated delayed healing, 5-0 and 6-0 monofilament sutures of nylon or polypropylene are now used.
- Similarly, suture needles with a triangular cross section for easy penetration of the tissue and ½ and 3/8 curvatures are recommended.

TISSUE RETRACTION INSTRUMENTS

- The Kim/Pecora (KP) 1, 2, and 3 retractors have wider mouths than conventional retractors (15 mm compared with 10 mm) and are 0.5 mm thinner.
- Their serrated ends anchor the retractors securely onto the bone.

- The KP 4 retractor is a small, all-purpose retractor with the same features as the others but has the standard 10-mm width.
- The KP 1 retractor fits the convex contour of the bone.

- The KP 2 retractor is designed for use with the convex bone contours of the mandibular anterior

- *Stropko irrigator/drier:* Fits on a standard air/water syringe and uses blunt 0.5-mm diameter micro tips (Ultradent Co.).
- Highly effective for irrigating and drying retropreparations.

Ultrasonic Units & Tips

- Ultrasonic units create vibrations in the range of 30 to 40 kHz by exciting quartz or ceramic piezoelectric crystals in the handpiece.
- The energy created is carried to the ultrasonic tip, producing forward and backward vibrations in a single plane.
- Continuous irrigation along the cutting tip cools the surface and maximizes debridement and cleaning.
- The three most widely used ultrasonic units are the EMS Miniendo (Analytic Endo), the Spartan (Spartan/Obtura) and the P-5 (Satelec)

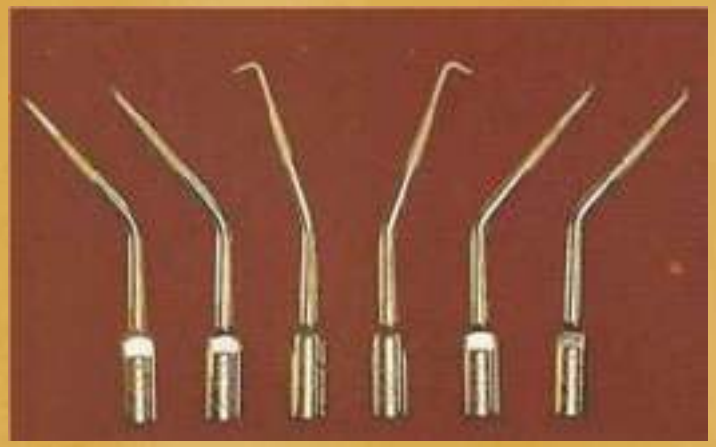
Ultrasonic Tips

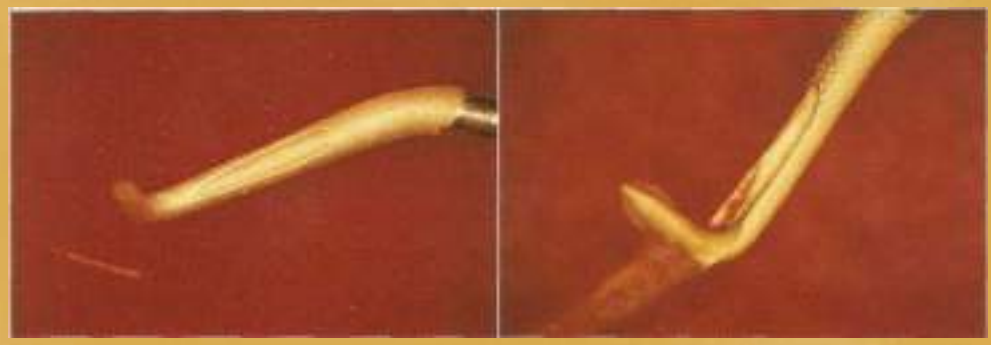
- First designed by Dr. Gary Carr, are known as Carr tips, or CTs.
- They are ¼ mm in diameter and about 1/10 the size of a conventional microhead handpiece.
- CTs (1-5) .
- The CT 1 and CT 5 have the same design except that the CT 5 is more sharply pointed.
- Mainly for maxillary and mandibular anterior teeth.

- The hook-shaped tip, known as a back-action or CK tip, is very effective for cleaning the buccal wall of a canal.

- The CT 2 and CT 3 have a double angle to facilitate work in posterior teeth,
- CTs are made of stainless steel

- In 1999 Spartan/Obtura introduced a new type of ultrasonic tip.
- The Kim Surgical (KiS) ultrasonic tip is the next generation of microsurgical tips.





- It is coated with zirconium nitride and has an irrigation port near the tip rather than in the shaft (as with CTs).
- Has a 3-mm cutting tip.
- These advanced tips cut faster and smoother and cause fewer microfractures because of the improved positioning of the irrigation port

- The KiS 1 tip, → 80-degree angled tip and is 0.24 mm in diameter,

→for the mandibular anterior teeth and premolars.

- The KiS 2 tip → wider diameter tip

→for wider apex teeth

(e.g., maxillary anteriors).

- The KiS 3 tip → for hard to reach posterior teeth.
- It has a double bend and a 75-degree angled tip for use in the maxillary left side or the mandibular right side.

- The KiS 4 tip is similar to the KiS 3 except that the tip angle is 110 degrees, to reach the lingual apex of molar roots.
- The KiS 5 tip is the counterpart of the KiS 3 for the maxillary right side and the mandibular left side.
- The KiS 6 tip is the counterpart of the KiS 4 tip.

- *Difference between traditional & microsurgery:*

Procedure	Traditional	Micro surgery
Identification of the apex	Sometimes difficult	Precise
Osteotomy size	Large (8-10mm)	Small (3-4mm)
Inspection of resected root surface	None, imprecise	Always, precise
Bevel angle	45-65 degrees	0-10 degrees
Isthmus identification & treatment	Impossible	Always

Retro preparation	Bur, approximate	Ultra sonic tip, precise
Root end filling	Amalgam	MTA, super EBA etc.,
Sutures	4x0 silk	5x0, 6x0 monofilament
Suture removal	7 days post-op	2-3days post-op
Healing success (over 1yr)	40-90%	85-96.8%

Soft-Tissue Repositioning and Suturing

- Thorough examination of the underside of the flap, in the depth of the fold between the mucoperiosteum and the alveolar bone, should be done before repositioning the flap.

- Repositioning and Compression

Sutures

- Classification
- Material → Absorbable
  → Non-absorbable
- Size → 3-0, 4-0, 5-0, 6-0….etc.,
- Physical design → Monofilament
  → Multifilament
  → Twisted/Braided

Materials

- Non-absorbable
  - Silk → braided
  - Nylon → monofilament (Ethilon)
  - EPTfe → monofilament (Gore-tex)
  - Polyster → braided (Ethibond)

- Absorbable
  - Surgical gut
  - Plain gut → monofilament (30 days)
  - Chromic gut →monofilament (45-60 days)

- Synthetic

  Polyglycolic →braided (16-20days)

  (Vicryl, Ethicon, Dexon)

  Polyglecaprone → monofilament(90-120days)

  (Monocryl, Ethicon)

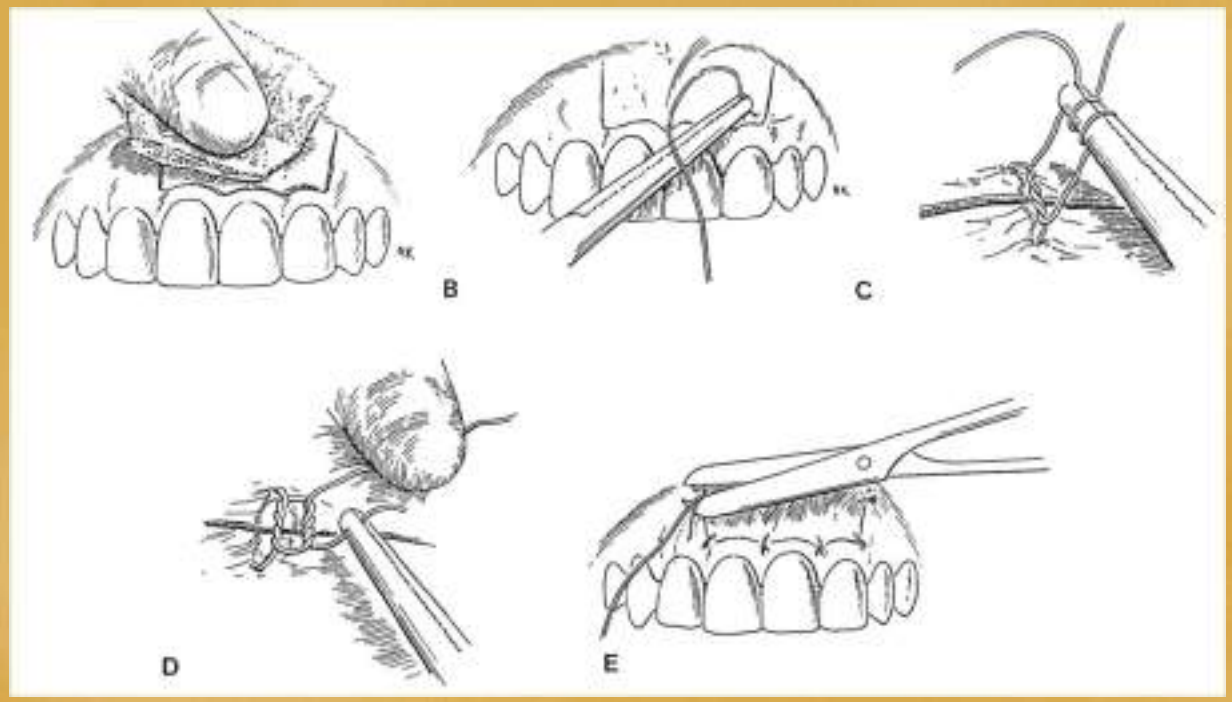
  Polyglyconate → monofilament (Maxon)

Needle Selection

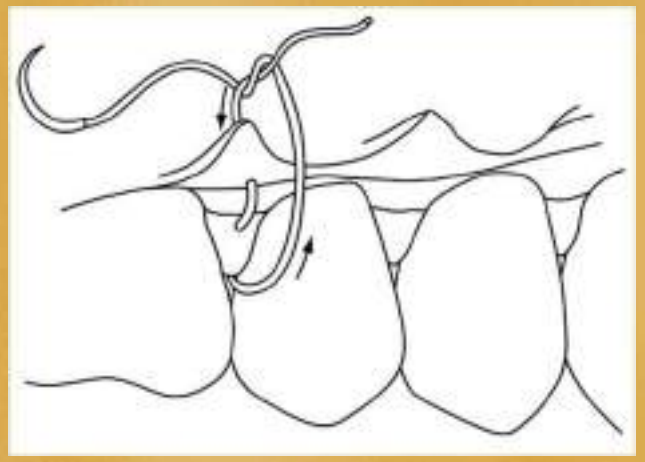
- A needle with a reverse cutting edge (the cutting edge is on the outside of the curve) is preferable.
- Available in arcs of 1/4th, 3/8th, ½ , and 5/8th of a circle, with the most useful being the 3/8th and ½ circle.
- The smaller the radius of the arch, the more conducive the needle is to quick turnout.

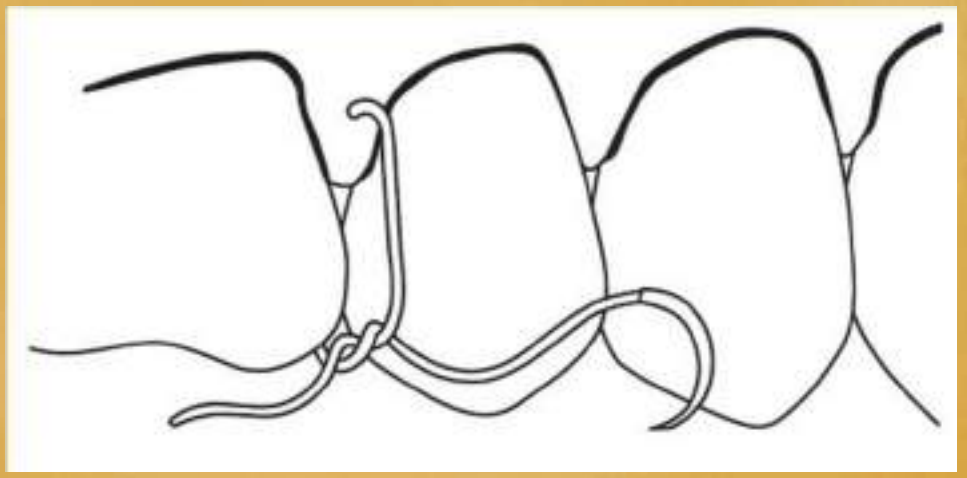
Suture Techniques

- *Single Interrupted Suture*

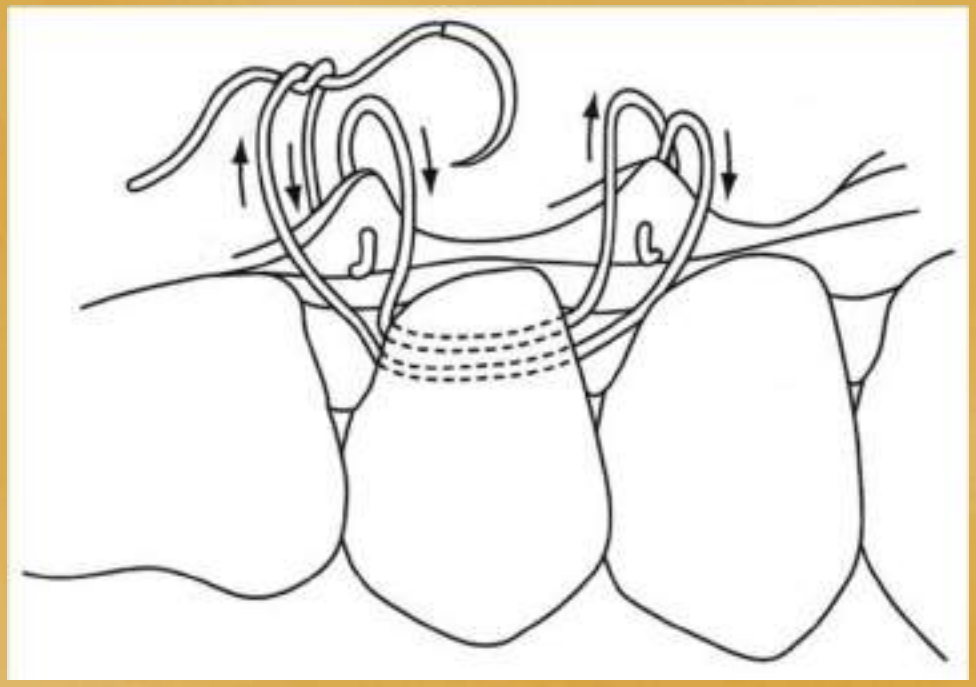


- *Interrupted Loop (Interdental) Suture.*

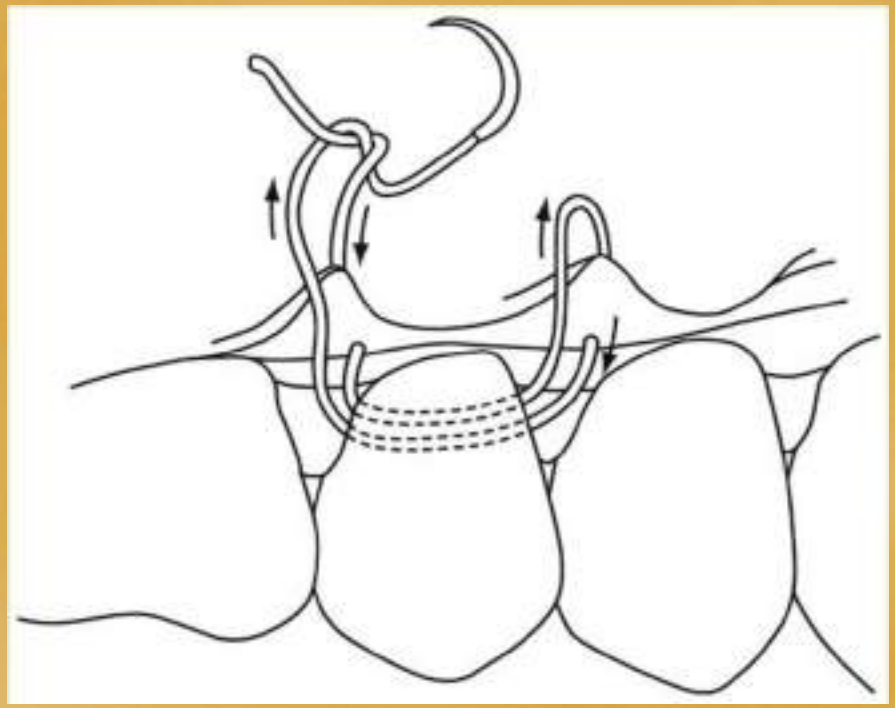




- *Vertical Mattress Suture*



- *Single Sling Suture*



Instructions for Postoperative Care Following Endodontic Surgery

1. Do not do any difficult activity for the rest of the day.
2. Have a good diet and drink lots of liquids for the first few days after surgery.
3. Do not lift up your lip or pull back your cheek to look at where the surgery was done.
4. A little bleeding from where the surgery was done is normal. This should only last for a few hours.
5. You may place an ice bag (cold) on your face where the surgery was done. You should leave it on for 20 minutes and take it off for 20 minutes. You can do this for 6 to 8 hours. After 8 hours, the ice bag (cold) should not be used.
6. Rinse your mouth with 1 tablespoon of the chlorhexidine mouthwash (Peridex). Done twice a day for 5 days.

Post surgical complications

- Bleeding and Swelling

- Discoloration

- Pain & Infection

- Oral Hygiene

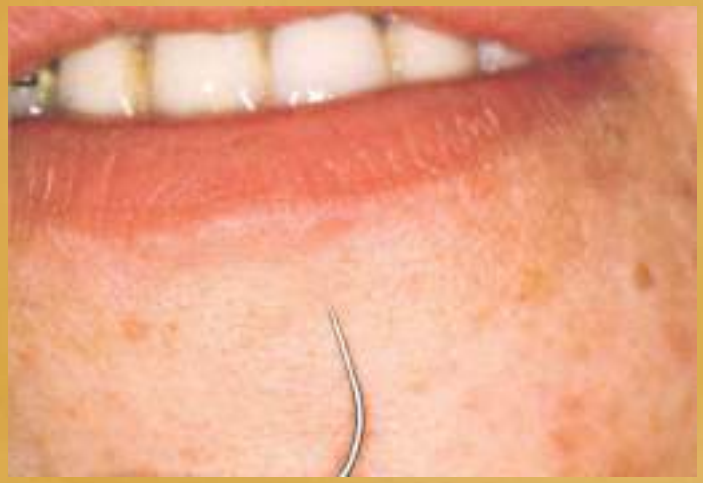
- Tissue trauma






- Procedural defects

- Parasthesia



Suture Removal

- Gutmann and Harrison, the key to preventing sutures from having a negative effect on wound healing following surgery is their early removal.
- It has been recommended that sutures should not be allowed to remain longer than 96 hours.

Corrective Surgery

I. Perforation repair

- A. Mechanical
- B. Resorptive/caries

II. Periodontal repair

- A. Guided tissue regeneration
- B. Root resection/hemisection
- C. Surgical correction of the radicular lingual groove

Perforation Repair

- *Mechanical*
- High potential areas for perforations are the pulp chamber floor of molars and the distal aspect of the mesial root of mandibular molars and the mesial buccal root of maxillary molars (strip perforations).





- *Resorption (External or Internal) and Root Caries*

Root Amputation

- Indications

1. Existence of periodontal bone loss
2. Destruction of a root through resorptive processes, caries, or mechanical perforations.
3. Surgically inoperable roots that are calcified, contain separated instruments, or are grossly curved.
4. The fracture of one root that does not involve the other.
5. Conditions that indicate the surgery will be technically feasible to perform and the prognosis is reasonable.

- Contraindications

1. Lack of necessary osseous support for the remaining root or roots.
2. Fused roots or roots in unfavorable proximity to each other.
3. Remaining root or roots endodontically inoperable.
4. Lack of patient motivation to properly perform home-care procedures.

- Morphologic factors:

- Two different approaches to resection:

1. To amputate horizontally or obliquely the involved root at the point where it joins the crown, a process termed root amputation.
2. To cut vertically the entire tooth in half—from mesial to distal of the crown in the maxillary molars, and from buccal to lingual of the crown in the mandibular molars—removing in either case the pathologic root and its associated portion of the crown. This procedure is termed hemisection.

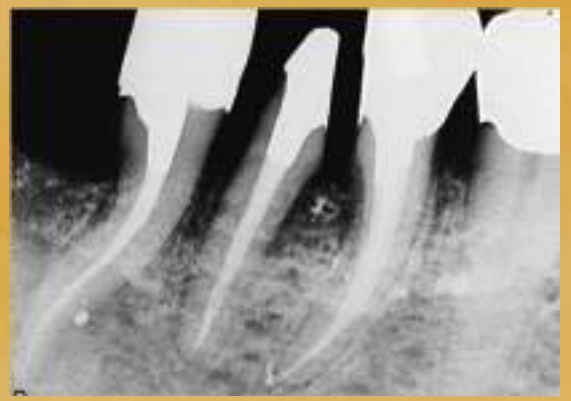
Amputation technique for maxillary molars

- Mesiobuccal roots
- Best performed with a surgical-length smooth fissure bur.

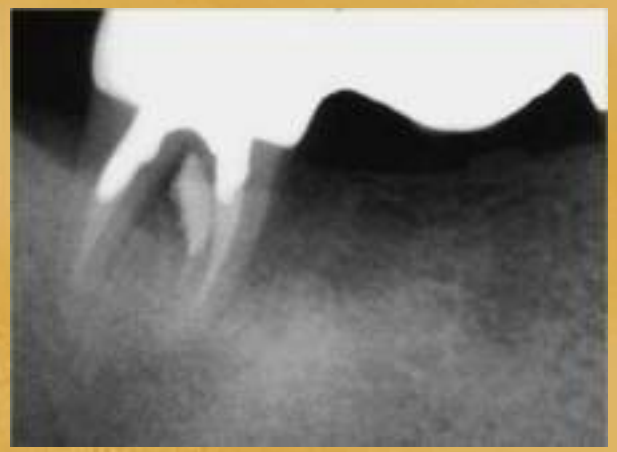
Amputation technique for mandibular molars

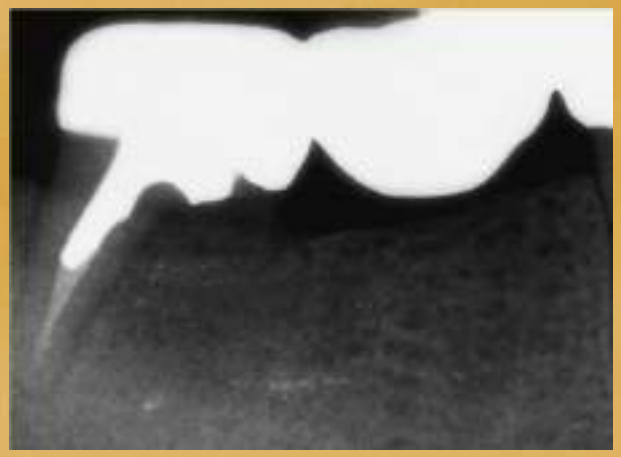
- The most common method of root amputation involving mandibular molar teeth is a **hemisection.**
- A terminal second mandibular molar is ideally suited for hemisection, provided there is opposing occlusion and adequate bone support for the remaining root.





- **Bisection or "bicuspidization"** should be considered in mandibular molars in which periodontal disease has invaded the bifurcation and when repair of internal furcation perforations has been unsuccessful.
- **Single root amputation of mandibular molar teeth** (leaving the crown intact) may, on occasion, be indicated where a splint or fixed partial denture is in place.





- A tooth that is hopelessly involved, yet is a non-terminal member of a fixed partial denture, may be converted into a pontic by total amputation of its root or roots.
- Premolars → the most common.
- **Studies**
- Success rate of 62 to 100% occurring over times ranging from 1 to 23 years.
- Overall success rate of 88%.

J Am Den Assoc 1972;85:870

J Clin Periodontol 1975;2:126

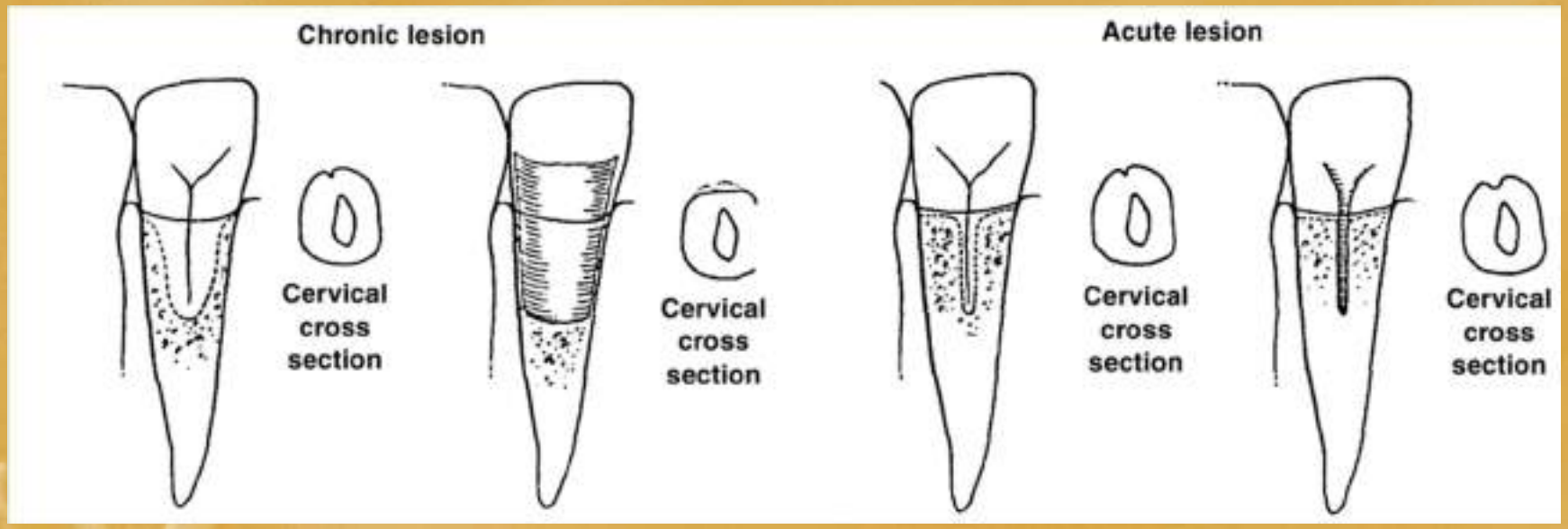
J Periodontol 1988;59:805.

J Clin Periodontol 1998;25:209.

Surgical Correction of the Radicular Lingual Groove

- Exclusively in maxillary lateral and central incisors,
- Precludes the deposition of cementum in the groove; hence it prevents PDL attachment.
- Narrow periodontal pocket, a bacterial pathway, often to the root apex, that can lead to retroinfection of the pulp.
- Pecora and his associates in Sao Paulo reported a 2% incidence in central incisors and a 2.6% incidence in lateral incisors.

- Robinson and Cooley→ surgical intervention
  → correct the defect and allow healing



REPLACEMENT SURGERY (EXTRACTION/REPLANTATION)

- Intentional replantation→ "the act of deliberately removing a tooth and—following examination, diagnosis, endodontic manipulation, and repair—returning the tooth to its original socket."

  Grossman, in 1982

- Abulcasis, an Arabian physician practicing in the eleventh century→ 1st credited with recording the principle of extraction/ replantation.

Indications

1. Inadequate interocclusal space to perform nonsurgical endodontic treatment caused by the patient's limited range of motion.
2. Nonsurgical treatment and/or re-treatment are not feasible because of canal obstructions
3. Surgical approach for periradicular surgery is not practical because of limiting anatomic factors
4. Nonsurgical and surgical treatment have failed and symptoms and/or pathosis persist.

5. Visual access is inadequate to perform root-end resection and root-end filling.
6. Root defects (resorption, perforation) exist in areas that are not accessible through a periradicular surgical approach without excessive alveolar bone loss.
7. To thoroughly examine the root or roots on all surfaces to identify or rule out the presence of a root defect, such as a crack or root perforation.

- Three factors that directly affect the outcome of extraction/replantation procedures;

1. Keeping the out-of-socket time as short as possible.
2. Keeping the PDLcells on the root surface moist with saline or Hanks Balanced Salt Solution
3. Minimizing damage to the cementum and PDLcells by gentle elevation and extraction of the tooth. The forcep beaks should not touch the cementum if at all possible.

Studies

- Kingsbury and Wiesenbaugh reported on 151 mandibular premolar and molar teeth that were extracted, treated, and replanted. They evaluated these teeth over a 3-year period and reported a success rate of 95%.

  J Am Dent Assoc 1971;83:1053.

- Koenig and associates reported on a study involving 192 extracted and replanted teeth. Following an evaluation period of between 6 and 51 months, they reported a success rate of 82%.

  Gen Dent 1988;36:327.

- More recently, Bender and Rossman reported on 31 cases of extraction/replantation. They reported a success rate of 80.6% with an observation period of up to 22 years.

  Oral Surg 1993;76:623.

- Kratchman stated, “With increased understanding of the periodontium and improved techniques, intentional replantation should no longer be viewed as a treatment of last resort, but rather a successful treatment alternative.

Dent Clin North Am 1997;41:603

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Thank
You!