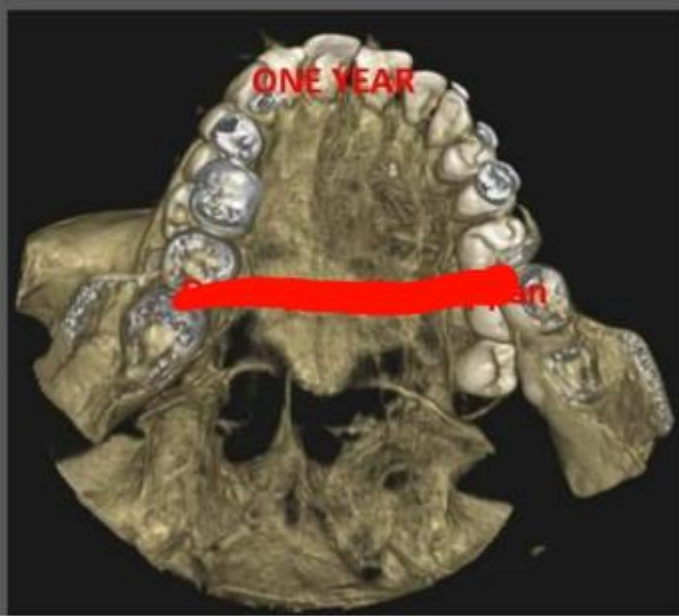
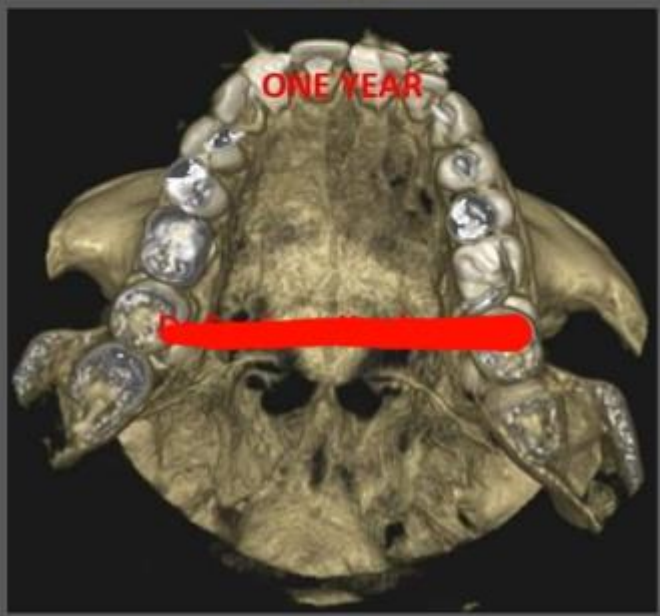
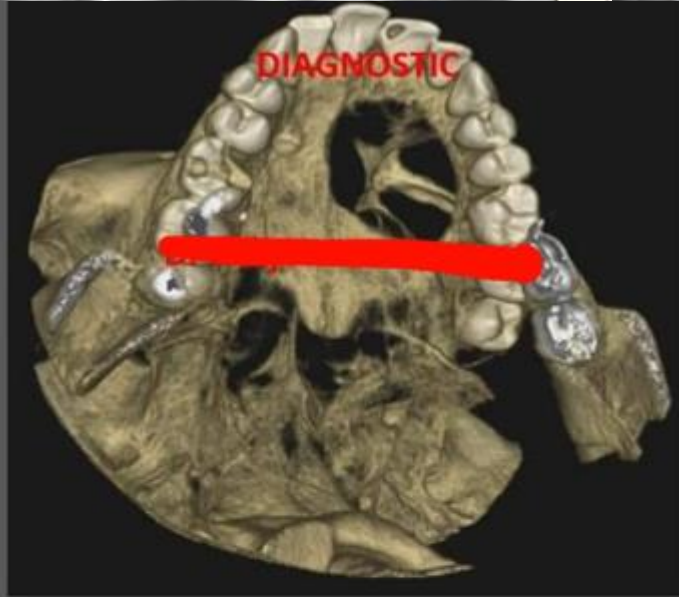


# PERI-RADICULAR SURGERY

PRESENTED BY : DR. GEETA ASTHANA

# CONTENTS

- Introduction
- Rationale of endodontics
- Systemic considerations
- Anatomic considerations
- Materials used in surgery
- Flap design in surgery
- Apicectomy and retrograde filling
- References



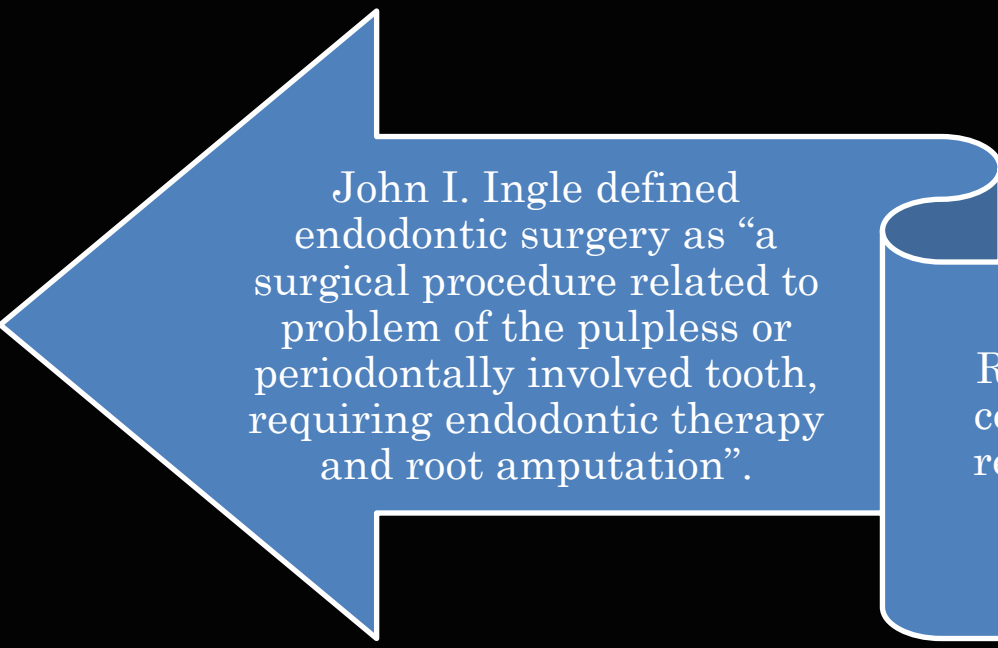
- When and why to do surgery?
- Is surgery a conservative treatment?
- Why not all periapical radiolucencies can be treated by non surgical treatment?
- Prognosis of surgery as compared to non surgical treatment?
- True cyst and pocket cyst treatment?
- Can radicular cyst heal?

# INTRODUCTION

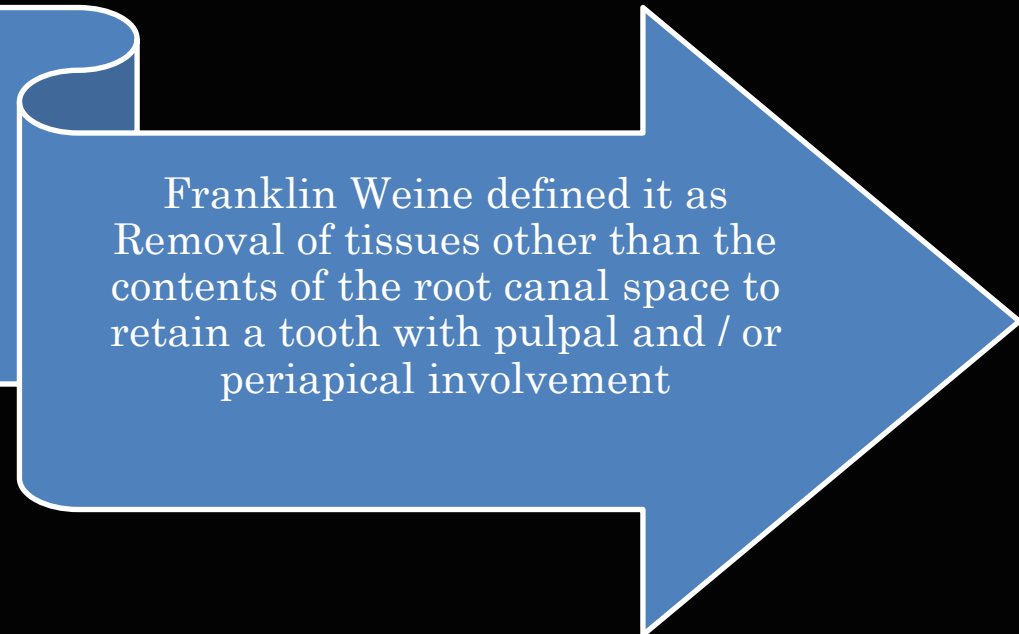
Research studies indicate that the outcome of non-surgical endodontic therapy is highly favourable.

However, despite these impressive statistics, occasionally, surgery may be indicated in order to achieve what was not possible with root canal treatment alone

The most common endodontic surgical procedure is periradicular surgery consisting of periradicular curettage, root-end resection, root-end preparation and root-end filling.

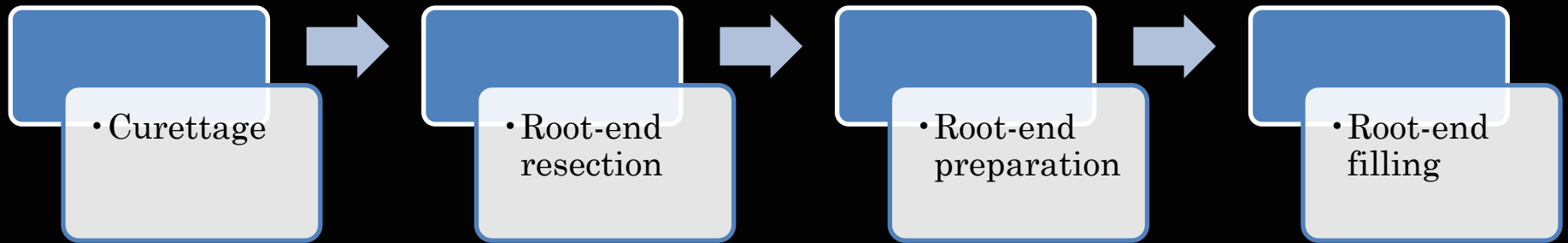


John I. Ingle defined endodontic surgery as “a surgical procedure related to problem of the pulpless or periodontally involved tooth, requiring endodontic therapy and root amputation”.



Franklin Weine defined it as Removal of tissues other than the contents of the root canal space to retain a tooth with pulpal and / or periapical involvement

# PERIRADICULAR SURGERY



# INDICATIONS

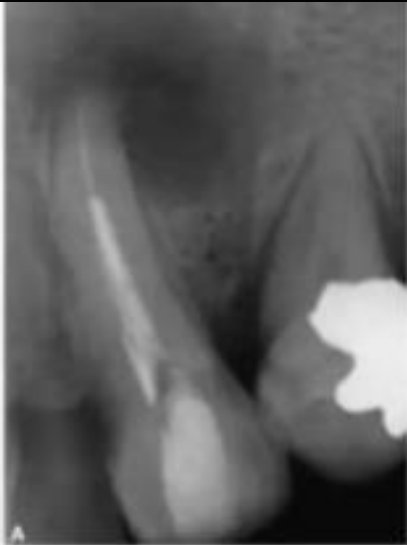
**1. Need for surgical drainage**

**2. Failed nonsurgical endodontic treatment**  
Persistent disease after retreatment

**3. Procedural errors**

- Instrument fracture
- Non-negotiable ledge
- Symptomatic overfilling





Post-treatment disease in maxillary lateral incisor



Complete healing at 6 months after apical surgery.



Disease persists at 1 year; because healing is unlikely following another retreatment, apical surgery is indicated.

#### **4. Anatomical variations**

- Root dilaceration
- Apical root fenestration

#### **5. Biopsy**



# CONTRAINDICATIONS

## **(1) The patient's medical status**

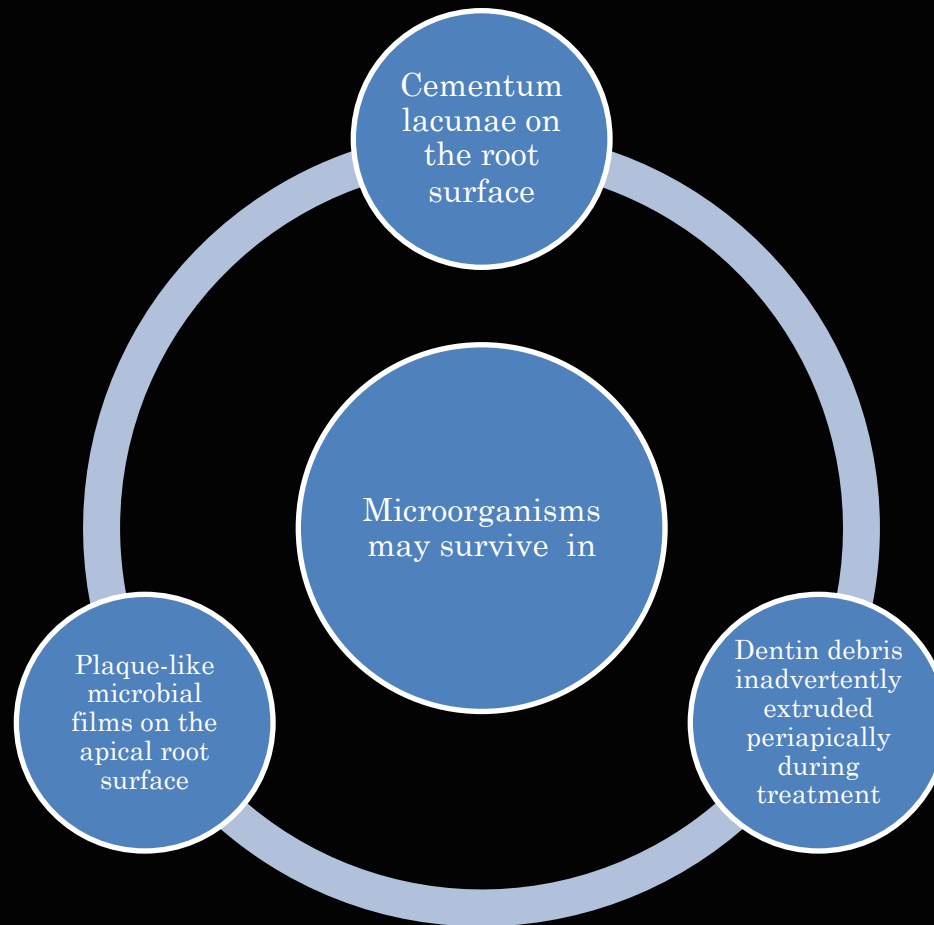
- Psychological considerations
- Presence of severe systemic disease

## **(2) Anatomic considerations**

- Poor Surgical access, possible involvement of neurovascular tissue or poor supporting tissues.

## **(3) The dentist's skills and experience.**

# MAIN REASON FOR ENDODONTIC FAILURE



Persistent periradicular infection

Endodontic  
retreatment

Endodontic  
surgery

Differ significantly in their ability to address the site where  
microorganisms are harbored

Retreatment excludes the  
microorganisms Where as Apical  
surgery confines the  
microorganisms

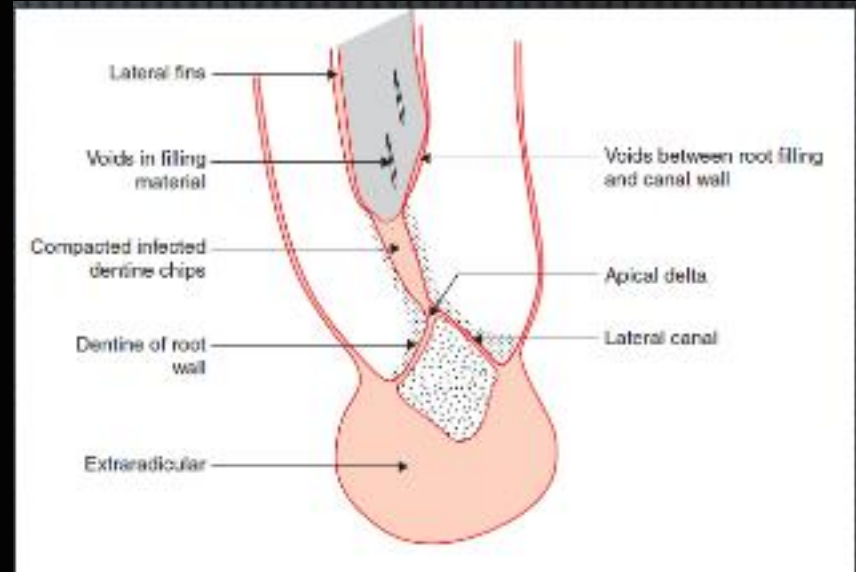
Periradicular surgery, when indicated should be considered an extension of non surgical treatment, because the underlying etiology of the disease process and the objectives of treatment are the same : **PREVENTION OR ELIMINATION OF APICAL PERIODONTITIS**

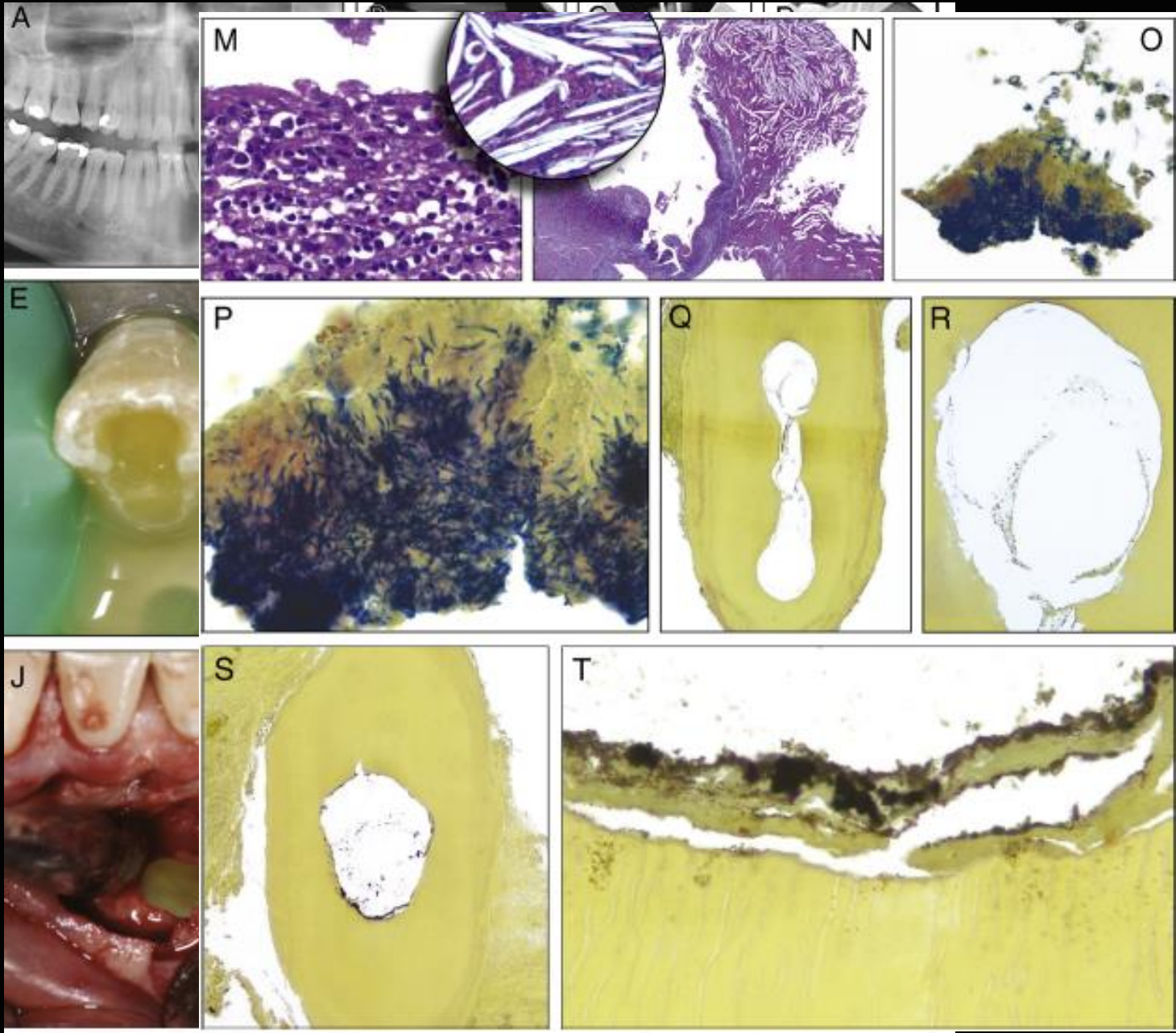
Surgical root canal treatment should not be considered as somehow separate from **NON-SURGICAL TREATMENT** although the instruments and techniques are obviously quite different

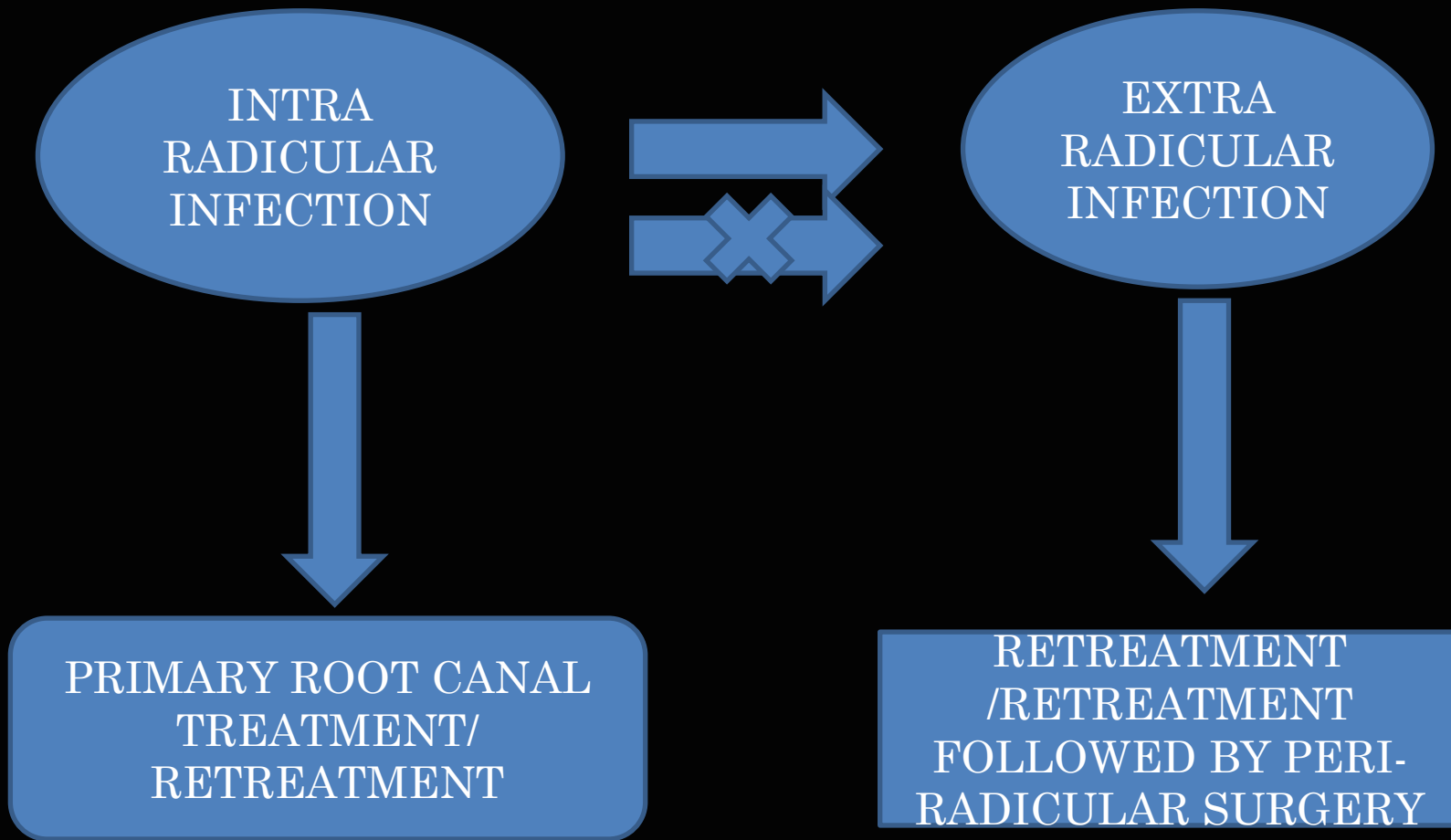
# EXTRARADICULAR INFECTION AS THE CAUSE OF PERSISTENT SYMPTOMS

- A recent concept regarding the issue of extraradicular infections as the cause of treatment failure refers to the infection being dependent on or independent of the intraradicular infection.

- Independent extraradicular
- infections are those no longer fostered by the intraradicular
- infection and can persist even after successful eradication of the latter.







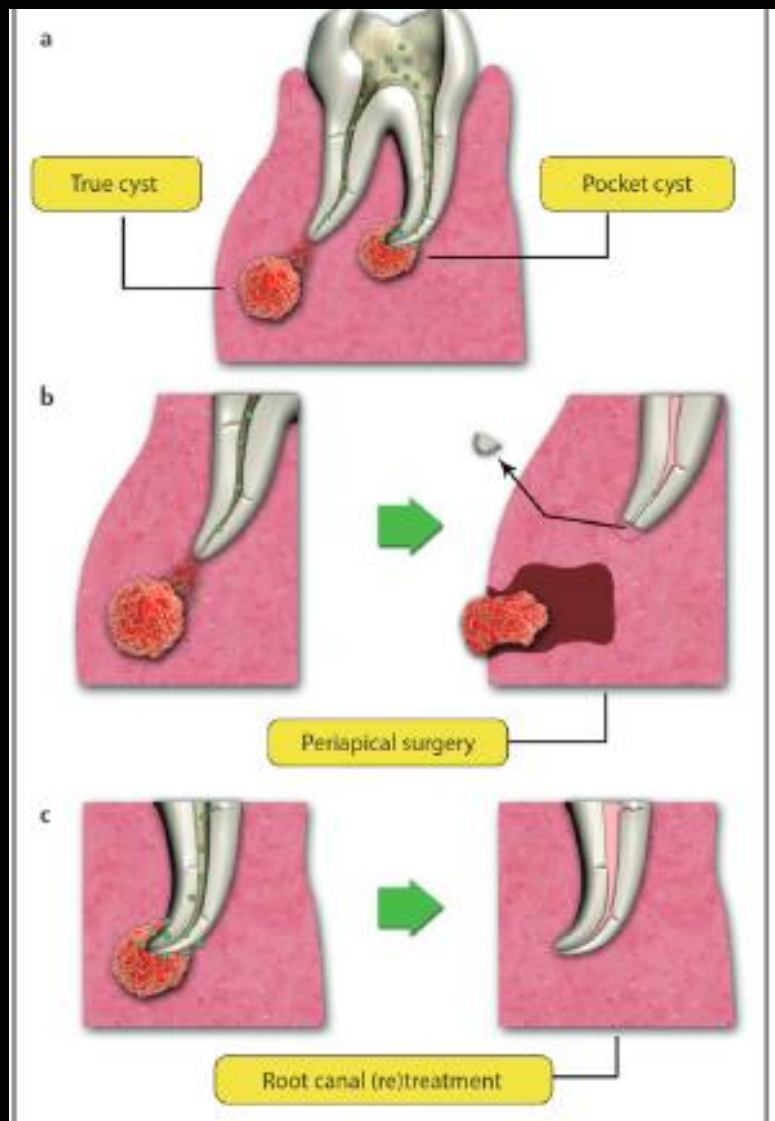


Figure 1. Periapical cysts are caused by the presence of infection in the root canal space and can be categorized as true or pocket cysts (a). Periradicular surgery might be needed for resolving the true cysts (b) while most of the pocket cysts are resolved after root canal (re)treatment without the need for surgical intervention (c)

- Nair surmised based on morphological observations that so called true cysts are resistant to conventional, orthograde endodontics. That may be a reasonable assumption given the lack of direct communication of the cyst lumen with the root canal space.
- Treatment resistance suggests that the process is self-sustaining and thus able to continue and expand regardless of influences of inflammatory mediators released in its vicinity by microbial elements in the root canal space

## WHY MOST OF THE PERI-APICAL RADIOLUCENCIES HEALS NON-SURGICALLY WITHOUT THE NEED TO DIFFERENTIATE BETWEEN P/A CYST OR GRANULOMA?

- Drainage of cystic fluid can help in the conservative management of large p/a lesions.
- The over instrumentation technique is claimed to have clinical success in providing drainage through the canal.
- This technique is based on the assumption that the p/a lesion can be a cyst. It has been suggested that over-instrumentation to 1 mm beyond the apical foramen develops an inflammatory reaction that can destroy the epithelial lining of the cyst as well as degeneration by strangulation and convert it to a granuloma.

- Complete healing of the periapical lesions occurred in near 75% of the cases. It needs to be pointed out that the cases observed may not necessarily represent cystic lesions as no histology was possible in order to confirm the diagnosis.
- The pocket cyst could also be a challenging treatment problem. As the cyst fluid may be under pressure and continuously wet the canal upon instrumentation ,conventional endodontic treatment may be precarious. Yet, calcium hydroxide dressing may offer remedy of the problem

- Apical surgery is a potentially more rational approach to manage teeth with continuous release of fluid from the root canal space.
- Although, for long, such signs have been thought to be diagnostic for cysts, no clinical data exist, thus far, in support of the view that they are relevant to clinical therapy in more than those exceptional cases, where the lesion has consumed a huge portion of the alveolar bone.

Recommendation for apical surgery based upon a 'cystic' appearance in the radiograph must Ricucci & Bergenholtz be regarded a treatment planning error.

Paper by Abbott in this issue of Endodontic Topics. It deserves to be reiterated that clinical follow-up studies of endodontically treated teeth have confirmed that conventional root canal treatment in the presence of a periapical lesion has a very high success rate, if properly conducted.

Hence, current understanding suggests that most lesions of apical periodontitis are treatable by a conventional orthograde approach provided the microbial irritants in the root canal system can be controlled.

In the case lesions do not resolve after periodic radiographic recall, or if the exudative process along the root canal space is abundant, a surgical treatment may be an excellent adjunct, provided the root tips are resected and the apical portion of the root canal retro-filled to eliminate potential bacterial condensations inside or outside the root canal space.



Retreatment

Peri-radicular  
surgery

# HEALING OF PERIAPICAL LESION

SURGICAL

NON  
SURGICAL

50 %  
HEALING

AT 6 MONTH  
FOLLOW UP

88 %  
HEALING

AT 12 MONTH  
FOLLOW UP

FOR COMPLETE HEALING ATLEAST 4 YEAR  
FOLLOWUP NEEDED

# Healing of Periapical Lesions After Surgical Endodontic Retreatment: A Systematic Review

Faisal Alghamdi <sup>1</sup>, Abdulrahman J. Alhaddad <sup>2</sup>, Samar Abuzinadah <sup>3</sup>

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## Abstract

Background: Surgical root canal retreatment is required when peri-radicular pathosis associated with endodontically treated teeth cannot be treated by non-surgical root canal therapy (retreatment), or when retreatment was ineffective, not feasible or contraindicated.

Endodon  
or when :  
Following  
canal reti

Objective  
root cana

Materials  
this review  
2019 and  
criteria a

## Conclusions

Surgical root canal (retrograde) retreatment is defined as an important invasive procedure that permits fast treatment options minus the necessity of the extensive traditional method. Surgical retrograde retreatment demonstrates its efficiency in reducing the period needed for healing of the periapical lesions and suggests benefits that will result in better recognition among patients seeking faster results in short-term follow-up, but on the long-term follow-up showed not significant difference for healing of periapical lesions compared to conventional orthograde retreatment. However, more clinical trials are encouraged to inspect the results of surgical retrograde retreatment on the healing of periapical lesions.

Results: Five to studies showed the importance of surgical root canal retreatment as a treatment option in removing infections within the root canal system and its efficiency in periapical tissue healing. These studies investigated different aspects of healing of periapical lesion after surgical (retrograde) retreatment including success rates, follow-up duration, and

Curettage- Effective curettage of the pathologically effected periradicular tissue which cannot be assesed in an orthograde approach. This includes;

- Therapy resistant granuloma
- True cysts
- Foreign body reactions

Resection: Surgical resection of root apex in cases where the apical ramifications cannot be eliminated in a nonsurgical endodontic treatment or surgical resection in cases of poor periodontal support.

Inspection: Inspection of periapical area to ascertain the causes of <sup>29</sup> failure, inspection of isthmus, and trace accessory canals in nonsurgical endodontic cases that are clinically failing.

Surgery therefore offers a better chance to curtail extraradicular infection, and this is its main benefit.

Traditional surgical endodontic treatment had a moderate success rate of approx 60% (Brown et al JOE 1989)

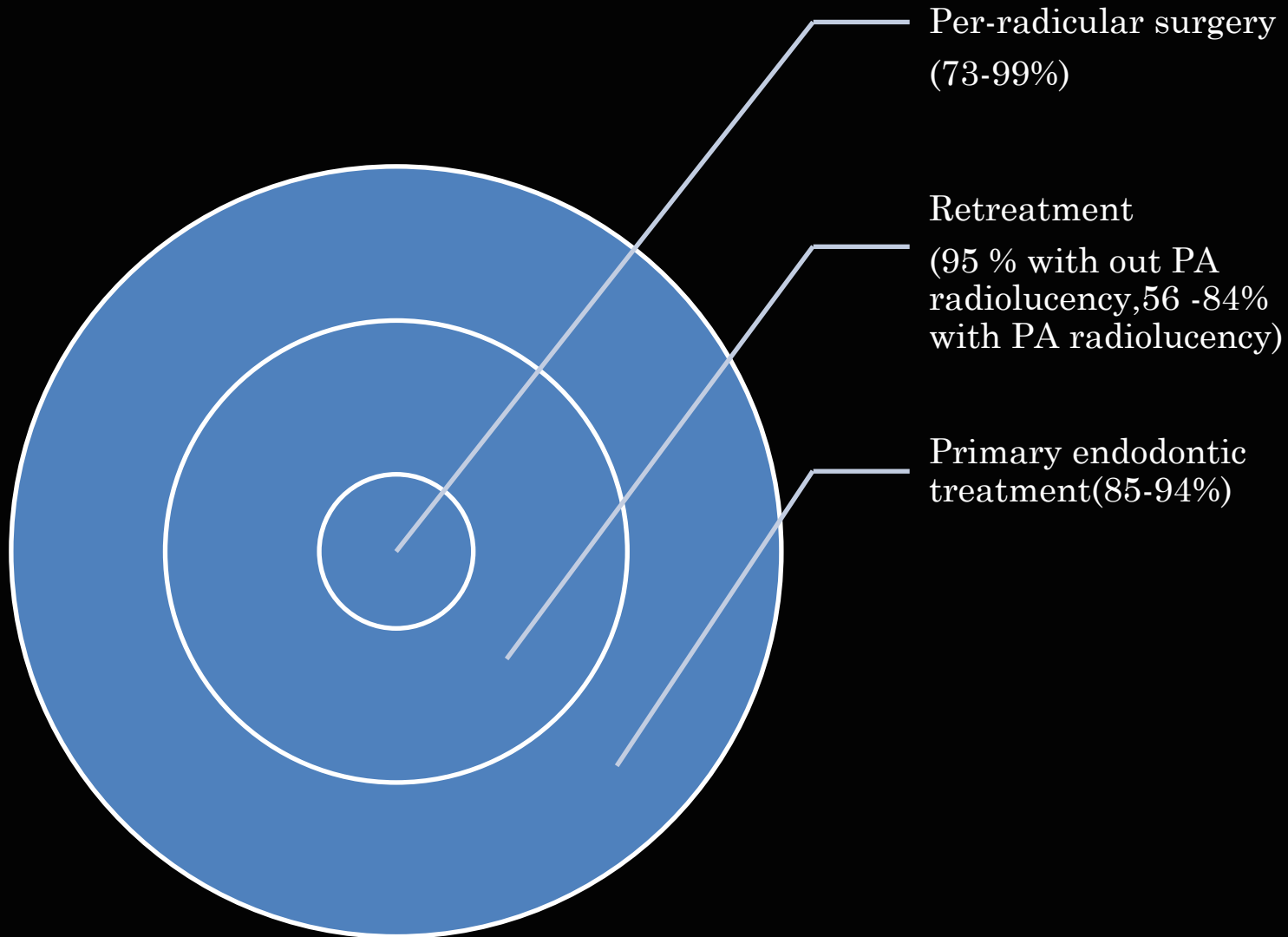
With the advancement of Ultra sonic tips Micro burnishers Micro pluggers Micro needle holders Micro Curettes

Success rate of over 73-99% has been reported

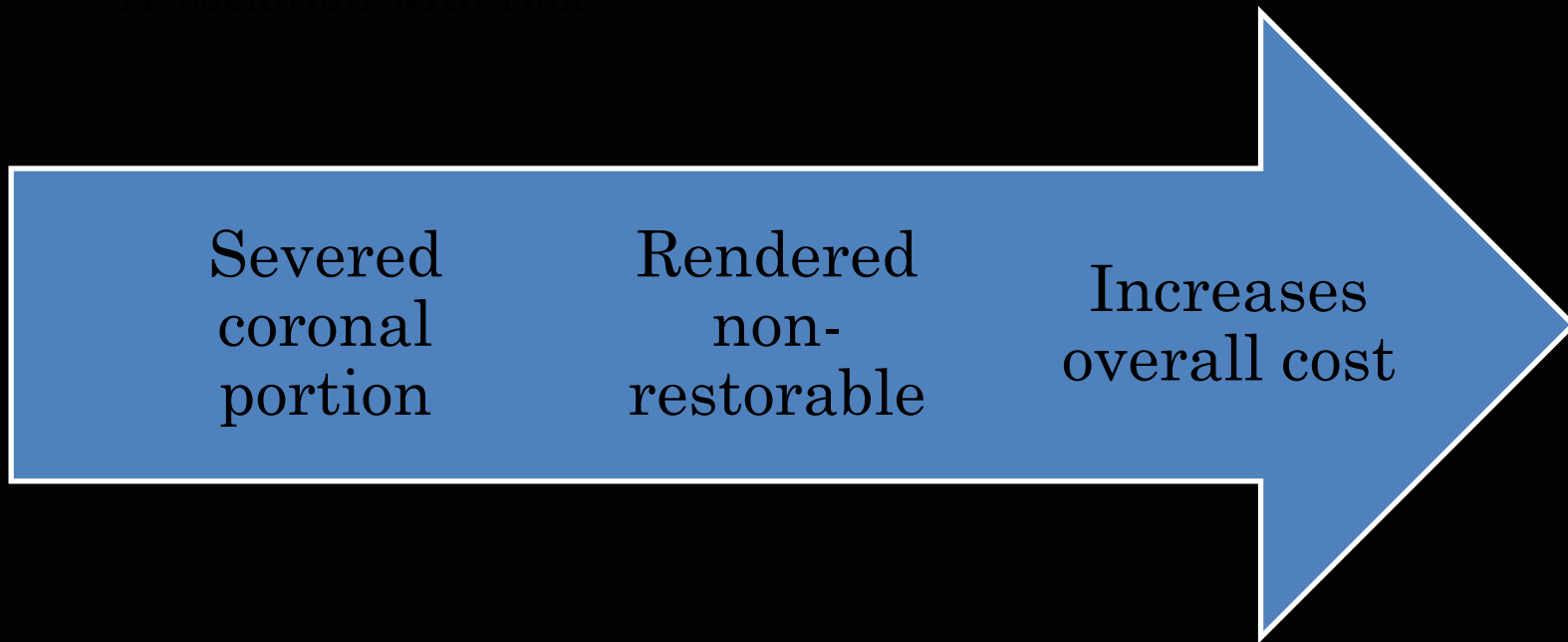
Conventional root canal failure rate is 10% to 15%

The prognosis for retreatment is much poorer than that for routine conventional endodontics. (WONG ET AL)

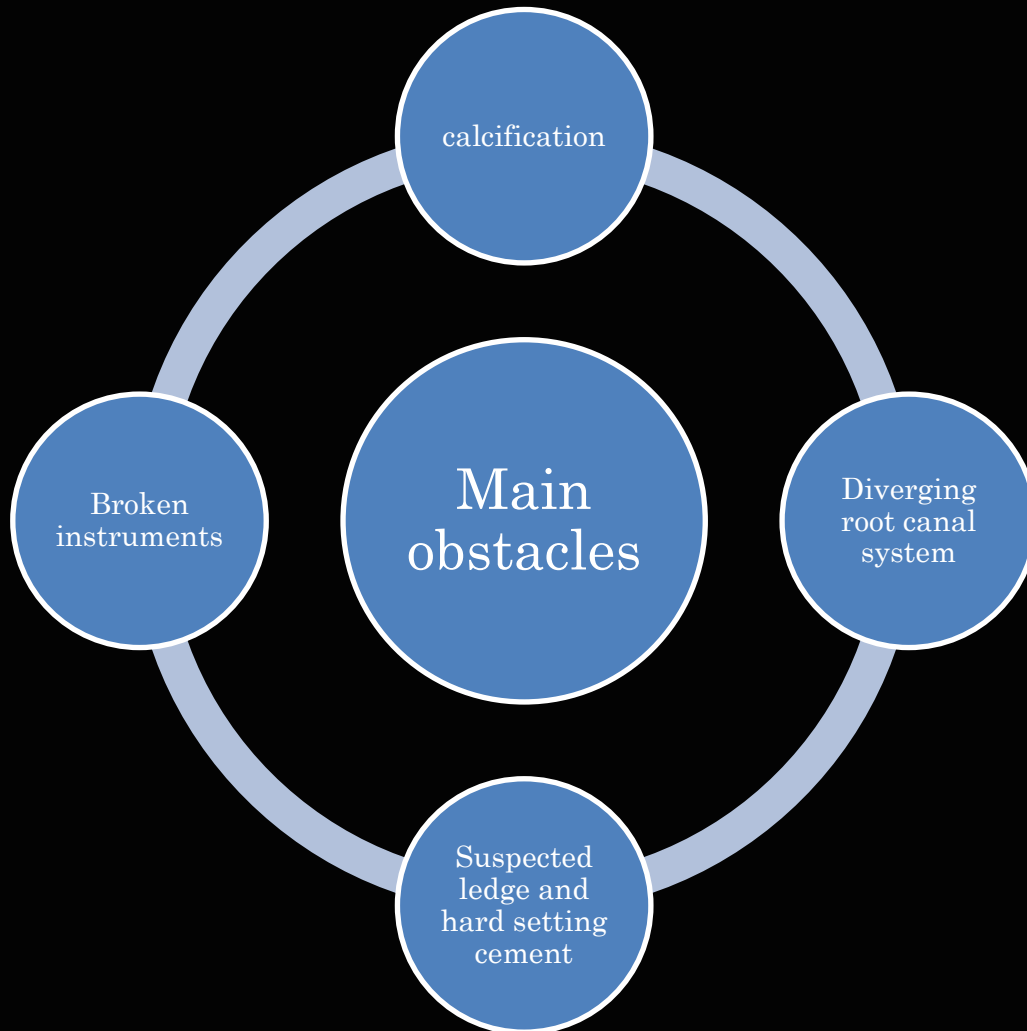
# PROGNOSIS



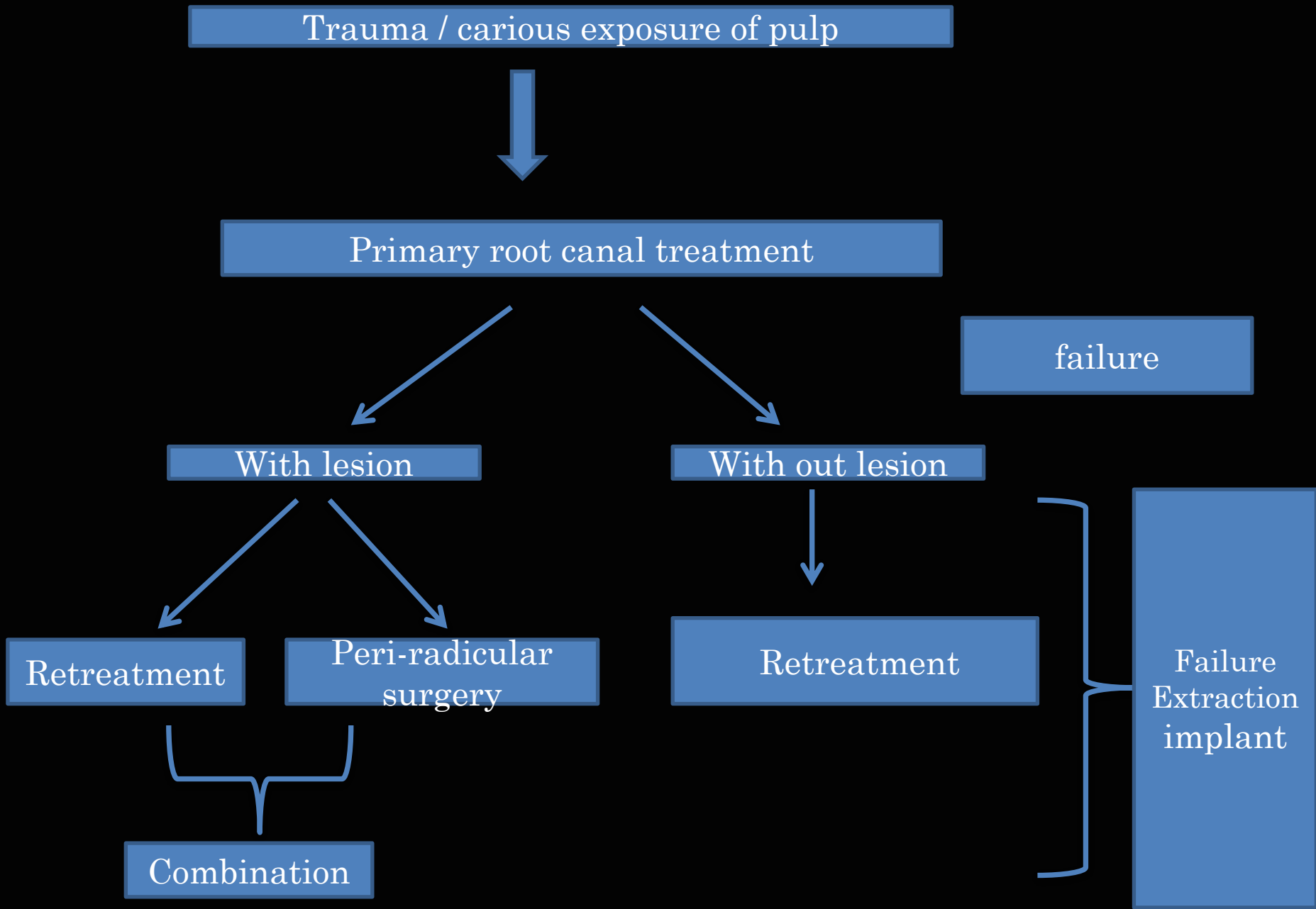
# CORONAL RESTORATION



# FULL BENEFIT OF ROOT CANAL TREATMENT: CANAL MUST BE NEGOTIATED THROUGH OUT



- Feasibility of overcoming these obstacles must be assessed
- Benefit-risk balance may change in favor of the surgical alternative retrieval
- Critical financial concerns  
Apical surgery is recommended when the combined cost of retreatment and restoration is considered prohibitive.



## CLINICAL ARTICLES

# Results of Endodontic Retreatment: A Randomized Clinical Study Comparing Surgical and Nonsurgical Procedures

Thomas Kvist, DDS, and Claes Reit, DDS, PhD

Information on "success" rates after surgical or nonsurgical endodontic retreatment is abundant but inconclusive. Reported healing frequencies vary between 45% and 95%. This study was designed to compare the results of surgical and nonsurgical retreatment procedures. A total of 100 teeth were included in the study. At 12-month recall, a statistically significant difference in healing rates was observed. In conclusion, no such differences may be expected in the

the large pool of potential retreatment cases. The management of such cases has been found to vary substantially among practitioners both in experimental (2), as well as clinical, situations (3). To

In conclusion, this study has failed to show any systematic difference in the outcome of surgical and nonsurgical endodontic retreatment. However, the healing pattern seems to differ between the two groups. Surgical retreatment seems to result in a more rapid periapical bone fill. Findings suggest a higher risk of "late failures" on the other hand. Thus, from a scientific point of view, the length of follow-up period is imperative and may strongly influence the conclusions made.

# Clinical management of nonhealing periradicular pathosis

## Surgery versus endodontic retreatment

John Danin, DDS,<sup>a</sup> Torsten Strömberg, DDS, PhD,<sup>b</sup> Hanz Forsgren, DDS,<sup>c</sup>  
Lars E. Linder, DDS, PhD,<sup>d</sup> and Lars O. Ramsköld, DDS,<sup>a</sup> Huddinge, Sweden  
KAROLINSKA INSTITUTET, HUDDINGE UNIVERSITY HOSPITAL

Nonhealing periradicular pathosis associated with endodontically treated teeth is customarily managed by revision (retreatment). Root-end resection is less often the first choice of treatment.

**Objectives.** This prospective randomized study compared the outcome of retreatment and surgical intervention in root canal treated teeth with nonhealing periradicular pathosis.

**Study design.** One such tooth from each of 38 patients was randomly allotted to retreatment or root-end resection and root-end filling. Treatment outcome after 1 year was evaluated and compared clinically and radiographically.

**Results.** The success rate for surgery was higher than for conventional retreatment, but the difference was not statistically significant.

**Conclusions.** For management of nonhealing periradicular pathosis associated with root canal treated teeth, surgical intervention should be considered as an alternative to retreatment. In cases with a similar prognosis for both modes of treatment, the choice should be governed by consideration of intrinsic and extrinsic factors.

(Oral Surg Oral Maxillofac Surg 1998;85:100-105)

## CONCLUSIONS

Although not statistically significant, on the basis of a limited number of patients and a relatively short observation period, the results of the present study show a tendency toward a higher success rate for teeth treated by surgery over retreatment.

Bacterial infect periradicular p conventional en debridement an canal followed t to vary between is attributable t rience of the sur

the diagnosis and status of the individual tooth. In one recent study,<sup>4</sup> a success rate of up to 96% was reported

ular pathosis.<sup>4</sup>



## **Malignant Transformation of Radicular Cyst/Residual Cyst: A Review of Literature**

**Bassel Tarakji<sup>1\*</sup>, Ayesha Shireen<sup>1</sup>, Ayesha Umair<sup>1</sup>,  
Saleh Nasser Azzeghaiby<sup>1</sup>, Ibrahim Alzoghaibi<sup>1</sup> and Salah Hanouneh<sup>1</sup>**

<sup>1</sup>*Department of Oral Maxillofacial Sciences, Al-farabi College of Dentistry and Nursing,  
Riyadh, Saudi Arabia.*

### **Authors' contributions**

*Author BT designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors AS and AU managed the analyses of the study. Authors SNA, BA, and SH managed the literature searches. All authors read and approved the final manuscript.*

**Review Article**

**Received 16<sup>th</sup> February 2014**

**Accepted 26<sup>th</sup> April 2014**

**Published 5<sup>th</sup> June 2014**

### **ABSTRACT**

**Aim:** The aim of this study is to review the literature concerning malignant transformation of radicular cyst.

**Material and Method:** A literature search using MEDLINE, accessed via the National Library of Medicine PubMed interface (<http://www.ncbi.nlm.nih.gov/pubmed>), searching for articles relating to the malignant transformation of radicular/residual cyst written in English from 1960-2013.

**Results:** Our search identified only fourteen studies available to date in English written literature. No randomized controlled trials to assess the possibility of malignant

**Table 1. Shows all the publications from 1960-2013 for malignant transformation of Radicular cysts**

Sl.No.	Authors Name	Type of study	Type of cyst	No. of cases	Malignancy
1.	Serge Sala-Perez et al. [6]	Case report	Radicular cyst	1 case	Squamous odontogenic tumor-like proliferation
2.	Parmar RM et al. [7]	Case series	Radicular cyst	42 out of 1241 radicular cysts	42 out of 1241 radicular cyst with squamous odontogenic tumor like proliferation
3.	Bodner et al. [8]	Case series	Residual cyst	70 out of 116 cases	70 cases associated with primary intraosseous squamous cell carcinoma
4.	Muglali M et al. [4]	Case report	Residual cyst	1 case	Squamous cell carcinoma
5.	Chaisuparat R et al. [9]	Case series	2 Odontogenic kercyst 2 Radicular cyst 2 De novo	2 out of 6 cases	2 cases Primary intraosseous carcinoma
6.	Swinson BD et al. [10]	Case report	Residual cyst	1 case	Squamous cell carcinoma
7.	Oliver JA et al. [11]	Case report	Residual cyst	1case	Squamous odontogenic tumor-like proliferation
8.	Vander Wal KG et al. [12]	Case report	Residual cyst	1case	Squamous cell carcinoma
9.	Schwimmer AM et al. [13]	Case report	Residual cyst	1case	Squamous cell carcinoma
10.	Unal T et al. [14]	Case report	Radicular cyst	1case	Squamous odontogenic tumor-like proliferation
11.	Simon JH [15]	Case report	Radicular cyst	1 case	Squamous odontogenic tumor-like proliferation
12.	Doyle et al. [16]	Case report	Radicular cyst	1 case	Squamous odontogenic tumor-like proliferation
13.	Martinelli C [17]	Case report	Residual cyst	1 case	Squamous cell carcinoma
14.	Wright [18]	Case series	5 cases (4 dentigerous cyst; 1 lateral radicular cyst)	1 case	Squamous odontogenic tumor-like proliferation
Total			76 Residual cyst 49 Radicular cyst	125	48 cases of Squamous odontogenic tumor-like proliferation 77 cases of Squamous cell carcinoma

NON-  
CONSERVATIVE  
TREATMENT

CONSERVATIVE  
TREATMENT

IMPLANT

FPD

EXTRACTION

PERIRADICULAR  
SURGERY

RETREATMENT

- "***A good surgeon knows how to cut, but an excellent surgeon knows when to cut***" is an excellent guiding principle. Thus when presented with endodontic failure, the causes of the failure should be determined carefully, and nonsurgical retreatment should be considered first.

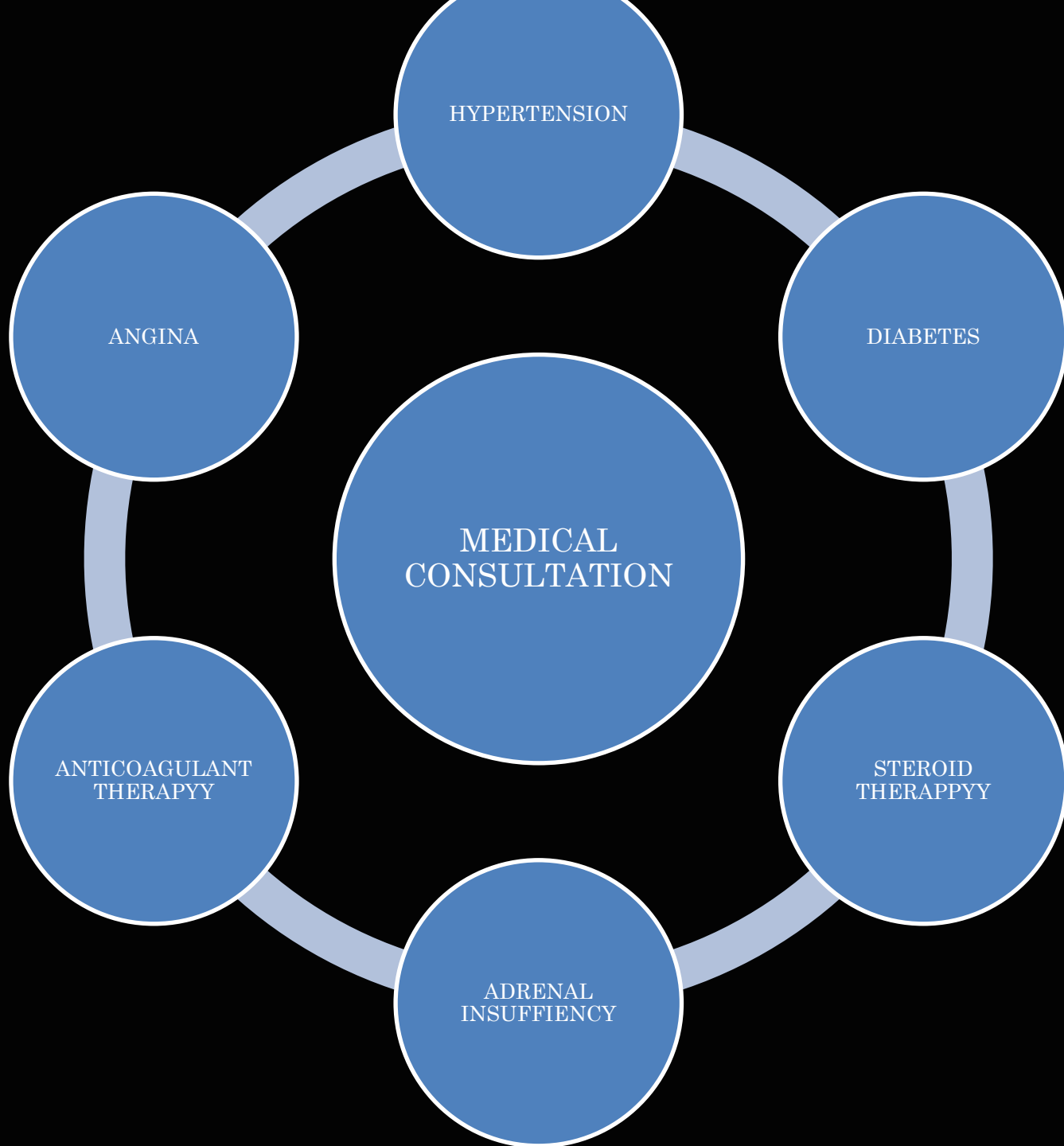
SYSTEMIC

CONSIDERATIONS



Surgical

Nonsurgical



# ANATOMICAL FACTORS



MAXILLARY SINUS

MANDIBULAR CANAL

SURGICAL  
COMPLICATIONS

MENTAL FORAMEN

CORTICAL PLATES

# MAXILLARY SINUS

- Exposure of the maxillary sinus may occur when apical surgical procedures are performed on the roots of any of the teeth located in the maxillary posterior quadrants.
- It has been reported by Eberhardt et al that the apex of the mesiobuccal root of the maxillary second molar is closest to the floor of the maxillary sinus (mean = 0.83 mm) and that the apex of the buccal root of the maxillary first premolar is furthest away (mean = 7.05 mm).

- If it is likely that the *root apex is close* or within the sinus, a more radical root resection may be required to prevent perforation of the antrum.
- Occasionally, perforation *cannot be avoided*. In this case it is important to avoid displacing infected debris or the resected root tip into the maxillary sinus, as this can lead to the development of sinusitis.

WHETHER AN OAC MUST BE CONSIDERED A  
“SURGICAL ACCIDENT” OR WHETHER IT SHOULD  
BE ACCEPTED AS AN INCIDENT MORE OR LESS  
LIKELY TO OCCUR IN PERIAPICAL SURGERY OF  
MAXILLARY POSTERIOR TEETH?

## Periapical surgery and the maxillary sinus: radiographic parameters for clinical outcome

Kaspar Oberli, DDS,<sup>a</sup> Michael M. Bornstein, DDS,<sup>a</sup> and Thomas von Arx, DDS,<sup>b</sup> Bern, Switzerland

DEPARTMENT OF ORAL SURGERY AND STOMATOLOGY, SCHOOL OF DENTAL MEDICINE, UNIVERSITY OF BERN

**Objective.** To find out whether conventional periapical radiographs can be used to determine the risk of creating an oroantral communication (OAC) while performing periapical surgery on maxillary premolars and molars.

**Study design.** One hundred thirteen periapical radiographs of maxillary premolars and molars with periapical radiolucencies indicating chronic apical periodontitis were retrospectively analyzed and classified. The surgery reports were evaluated for occurrence of perforation of the maxillary sinus and postoperative complications.

**Results.** Perforation of the sinus membrane (also referred to as the Schneiderian membrane) occurred in 12 cases (9.6%). Exposure of the membrane without rupture occurred in 15 cases (12%). It was found that the distance between the apex or the periapical lesion and the sinus floor did not serve as a predictor of a possible sinus membrane rupture. On the other hand, if the radiograph showed a distinct distance between the lesion and the sinus floor, there was an 82.5% probability that OAC would not occur. Additionally, a blurred radiographic outline of the periapical lesion did not indicate an increased risk of sinus membrane rupture.

**Conclusion.** Conventional periapical radiographs cannot be used as predictors for perforation of the maxillary sinus during periapical surgery. However, radiographs with a specific distance between the periapical lesion and the sinus floor point toward a very low risk of accidental sinus perforation during periapical surgery. (*Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;103:848-53)

When endodontically treated teeth fail to show periapical healing and the substance of the tooth is worth preserving, periapical surgery should be considered as a therapeutic option. The aim of this surgical procedure is to eliminate the infected periapical tissues by resecting the diseased root apex and sealing the root tip with a retrograde filling, thus allowing the tissues to heal. When planning periapical surgery in maxillary premolars and molars, the proximity of the maxillary sinus has to be considered. The maxillary sinus is an osseous cavity with the shape of a pyramid, the base being the nasal antral wall and the rounded tip lying in the zygomatic bone. Its volume is estimated to be about an average of 15 cc.<sup>1</sup> The maxillary sinus is lined by a ciliary epithelium containing beaker cells. This lining transports bacteria and other possible foreign material

h  
tl  
o  
n  
c  
tl  
h  
b  
n  
fl  
n  
si  
is  
n

## CONCLUSIONS

Although standard periapical radiographs cannot be used as predictors for an OAC in periapical surgery, if the radiograph shows a distinct distance between the periapical lesion and the sinus floor, there is an 85.2% probability that an OAC will not occur. Furthermore, it is concluded that an intraoperative OAC cannot be considered a severe surgical accident if certain precautions are taken. Last, the further improvement of surgical instruments and the introduction of magnifying aids such as loupes, endoscopes, or microscopes may lead to a decrease of intraoperative OAC in the future.



# Microsurgical endodontic treatment of the upper molar teeth and their relationship with the maxillary sinus: a retrospective multicentric clinical study

S. Taschieri<sup>1,2,4</sup>, B. Morandi<sup>1,4</sup>, M. Giovannuscio<sup>2,3</sup>, L. Francetti<sup>1,4</sup>, A. Russillo<sup>1,5</sup> and S. Corbella<sup>1,2,4\*</sup>

## Abstract

**Purpose:** To assess the clinical and radiographic success rate of microsurgical endodontic treatment of upper molar teeth in relationship with the maxillary sinus, with 12 months follow-up.

**Methods:** Patients treated with microsurgical endodontic treatment of upper molar teeth in the period between 2017 and 2019 were recruited from two dental clinics according to specific selection criteria. The outcomes were determined based on clinical and radiographic results taken three, six and 12 months post-operatively, compared with those taken immediately before and after surgery. Clinical and radiographic outcomes were recorded. The distance between the most apical part of the root and of the lesion to the maxillary sinus was measured on CBCT images before the surgery. Patient-related outcomes were recorded.

**Results:** Out of 35 patients evaluated, 21 were selected according to the inclusion criteria and 29 canals treated. After 12 months, 18 patients showed a complete healing. Consequently, the success rate in this study was 85%. The perforation of the Schneiderian membrane that didn't seem to affect the success rate. The pain level decreased significantly over the time during the follow-up.

**Conclusion:** Microsurgical Endodontic treatment of the upper molar teeth is a predictable treatment option even in case of Schneiderian membrane perforation. Larger sample size are needed to compare the results obtained.

**Keywords:** Microsurgical endodontics, Endodontic surgery, Apical pathology, Postoperative pain and swelling

## Conclusion

In conclusion, despite the limitations presented, the success of the endodontic surgery of the upper molar teeth can be considered a valid treatment option and we can therefore draw some considerations: it is a predictable technique that has a good success rate if it is performed by experienced operators with the use of appropriate tools. The perforation of the Schneiderian membrane does not seem to be a factor that influence the success of the surgery and/or the quality of life of the patient. Preoperative CBCT Scan provides significant information about the location of the roots and of the lesions and their relationship to the maxillary sinus.

## Background

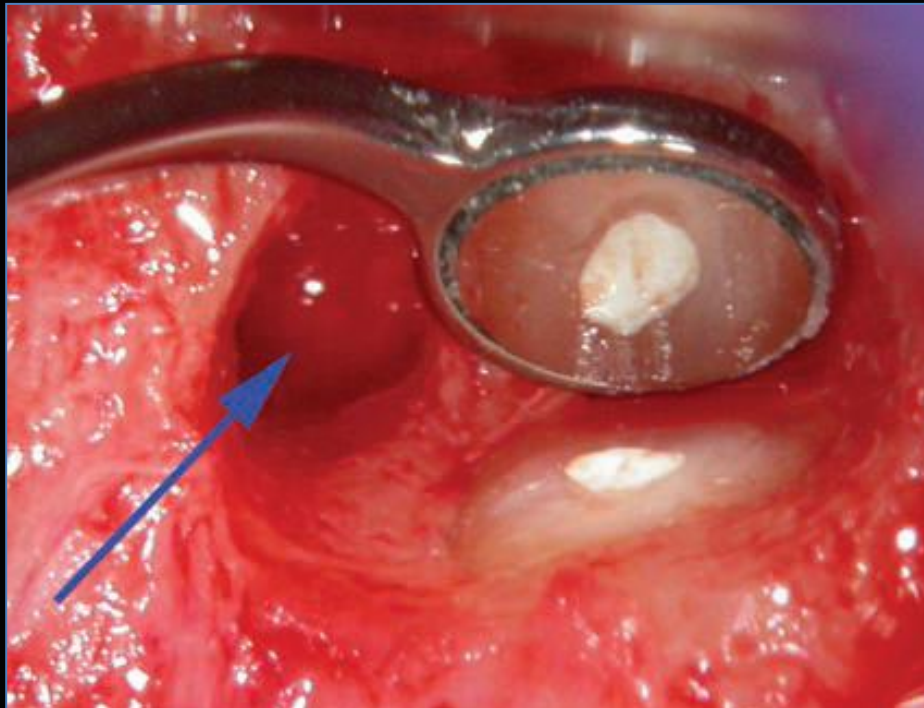
Endodontic surgery is a surgical technique for the maintenance of devitalized teeth with apical pathology after failed endodontic therapy or when nonsurgical treatment is not possible or not recommended [1, 2].

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Full list of author information is available at the end of the article

- The perforation is *normally closed when the flap* is replaced and there should be no risk of oroantral fistula formation and healing should be uneventful.
- Prescription consisting of antibiotics and antihistamines may be required.



# ROOT APEX AND THE CORTICAL PLATES

- When performing surgical procedures on teeth in situations where the apical lesion has not penetrated the cortical plate, the surgeon should be aware of the mean thickness of bone that must be penetrated to reach the root apices.
- The greatest mean distance between a root apex and the buccal cortical plate reported in the two studies was for the distal root of the mandibular second molar with a mean distance of 8.51 mm.

- The tooth with the root apex closest to the buccal cortical plate was the maxillary canine (mean = 1.64 mm) in one study and the buccal root of the maxillary first premolar (mean = 1.63mm) in the second study.
- The distal root of the mandibular second molar is located furthest from the buccal cortical plate, and as one progresses forward in the arch, the root apices of each succeeding tooth become progressively closer to the buccal cortical plate.

# MANDIBULAR CANAL

- The mandibular canal follows an "S-shaped" pathway as it moves from a position inferior and buccal to the distal root apex of the mandibular second molar to a more lingual position inferior to the mesial root apex of the mandibular second molar and the apices of both roots of the mandibular first molar.
- The canal then crosses back to a more buccal position beneath the apex of the mandibular second premolar.

- Denio et al. found that the root apices of the mandibular second molar (mean = 3.7 mm) and the mandibular second premolar (mean = 4.7 mm) were closest to the mandibular canal.
- The mesial root apex of the mandibular first molar was found to be furthest from the canal (mean = 6.9 mm).


# MENTAL FORAMEN


- It is located between and apical to the mandibular first and second premolars.
- One investigator found that the average location was 16 mm inferior to the cemento-enamel junction (CEJ) of the second premolar, although the range was 8 to 21 mm, which would place approximately 20% of the foramina at or coronal to the root apex.



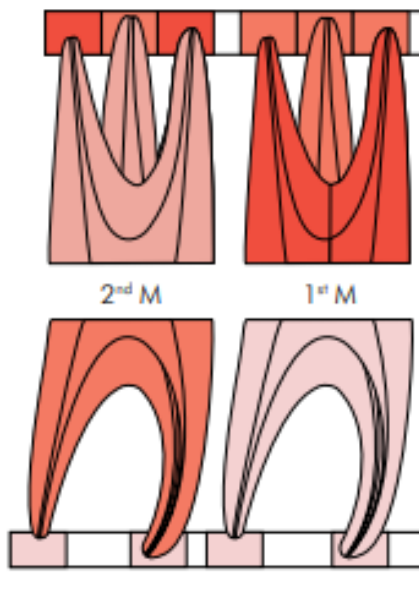
- When a vertical releasing incision is indicated, it typically is made at the mesial line angle of the mandibular canine.
- This location is always mesial to the **mental foramen**, because the foramen is located in the area ranging from the apex of the mandibular first premolar to slightly distal to the second premolar.

## Three Dimensional mapping of the root apex: distances between apices and anatomical structures and external cortical plates

Carlos Henrique FERRARI<sup>(a)</sup> 

Amjad ABU HASNA<sup>(a)</sup> 

**Abstract:** This study aimed to determine the mean distances between



## Conclusion

Most maxillary molars, mandibular molars and second premolars have a high-risk proximity to the near anatomical structures. Most maxillary and mandibular first premolars have a high-risk proximity to adjacent cortical plates. CBCT images are recommended for endodontic diagnosis and treatment when high-risk teeth are involved.

Teeth	Complexities
<b>Maxillary Incisors and Canine</b>	<p>The root apex is normally <i>situated labially</i> directly behind the cortical plate. The root tip of the <i>maxillary lateral incisor</i> tends to be slender, deflecting both distally and in a palatal direction. When positioned distally, surgical access can be difficult.</p> <p><i>Developmental grooves</i> on the palatal surface are sometimes present and can be associated with loss of cortical plate.</p>
<b>Maxillary Premolars and Molars</b>	<p><i>Buccal plate is generally thin (PM)</i> the first and second molar region the cortical plate can be thicker.</p> <p>mesiobuccal root of the maxillary first molar commonly contains an isthmus</p>
<b>Mandibular Incisors</b>	<p>Tooth angulation can result in the apex being <i>positioned lingually</i> and the cortical plate is often <i>thick</i>. The root <i>tips are thin</i> and close together.</p>

Teeth	Complexities
Mandibular Canine and Premolars	<p>The <i>mental foramen</i> should be identified  There are sometimes <i>frenal and muscle attachments</i> that may make reflection of the flap more difficult.  <i>Multiple canals</i> are found in mandibular first premolars in approximately 33% of cases</p>
Mandibular Molars	<p>Access to the mandibular root apices is more complex when  The sulcus is shallow,  The patient has a limited mouth opening,  The cortical plate is thick or  The root apices are inclined lingually.</p> <p>The inferior dental canal must be identified on a radiograph.</p> <p>The canals in the mesial roots are very commonly connected by an <i>isthmus</i>, which can often only be visualized using an operating microscope.</p>



**ENDODONTIC MICROSURGERY, AS IT IS NOW CALLED, COMBINES THE MAGNIFICATION AND ILLUMINATION PROVIDED BY THE MICROSCOPE AND CAN BE PERFORMED WITH PRECISION AND PREDICTABILITY AND ELIMINATES THE ASSUMPTIONS INHERENT IN TRADITIONAL SURGICAL APPROACHES**

(70.9%;  $P < .05$ ). At four to six years, however, this relationship was reversed, with nonsurgical retreatment showing a higher success rate (83.0%) compared with surgical endodontics (71.8%;  $P < .05$ ).

In a meta-analysis of the literature, Seltzer et al.<sup>177</sup> compared the outcomes of traditional surgical endodontics to current endodontic microsurgery techniques and materials and reported a 94% success rate with endodontic microsurgery compared to a 59% success rate when using older techniques and materials. In a recent systematic review, Torabinejad et al. compared the outcomes of tooth retention

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- **Torabinejad et al.** compared the outcomes of tooth retention through endodontic microsurgery to tooth replacement using a single implant. - Their findings show that teeth treated by microsurgical technique had survival rates of 94% at two to four years and 88% at four to six years, indicating that microsurgically-treated teeth tend to be lost at low rates over time

**TABLE 24-2 Survival Rates of Microsurgery Between Two to Four and Four to Six Years<sup>178</sup>**

Author (Year)	Survival rate (%)
Chong et al. (2003)	95
Taschieri et al. (2008)	94
Taschieri et al. (2008)	93
Taschieri et al. (2011)	91
<i>Overall % (2-4 years)</i>	94
Von Arex et al. (2012)	87
<i>Overall % (4-6 years)</i>	88

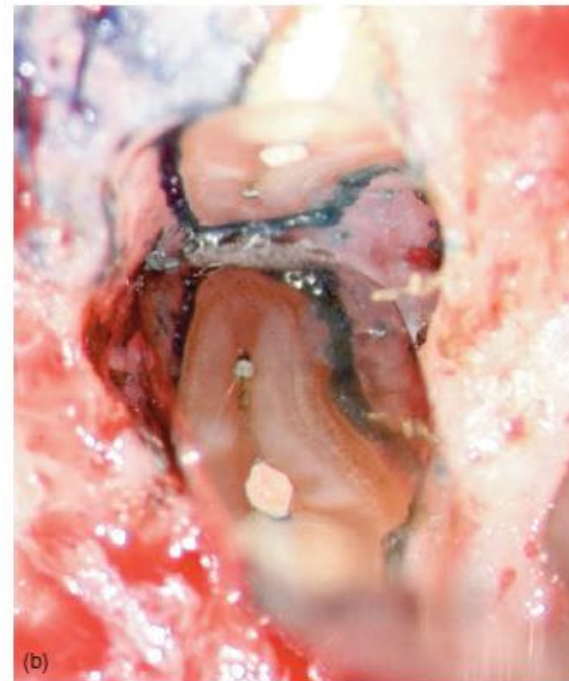
**Table 1: Differences between traditional and microsurgical approaches**

	<b>Traditional</b>	<b>Microsurgery</b>
Identification of the apex	Difficult	Precise
Osteotomy size	Approx. 8-10 mm	3-4 mm
Inspection of resected root surface	None	Always
Bevel angle	Large (45 degree)	Small (<10 degree)
Isthmus identification and treatment	Impossible	Always
Root-end preparation	Approximate (seldom inside Canal)	Precise (always within Canal)
Root-end preparation Instrument	Bur	ultrasonic tips
Root-end filling material	Imprecise	Precise
Sutures	4 X 0 Silk	5 X 0, 6 X 0 monofilament
Suture removal	7 days post-op	2-3 days post-op
Healing success (over 1 year)	40-90%	85-96.8%

# MICROSURGICAL INSTRUMENTS

- Examination Instruments
- dental mirror, periodontal probe, endodontic explorer, and microexplorer

**Figure 2.2** The tip of the microexplorer examination instruments, which can be used to search for a leak in a root end filling or to distinguish a canal or craze line from a microfracture line, and to point to the origin of a leak for explanation and documentation purposes (x16).



# INCISION



**Figure 10.10** Intrasulcular incision with a no. 15 scalpel blade. Note the vertical position of the scalpel as it cuts through and releases the crestal fibres.

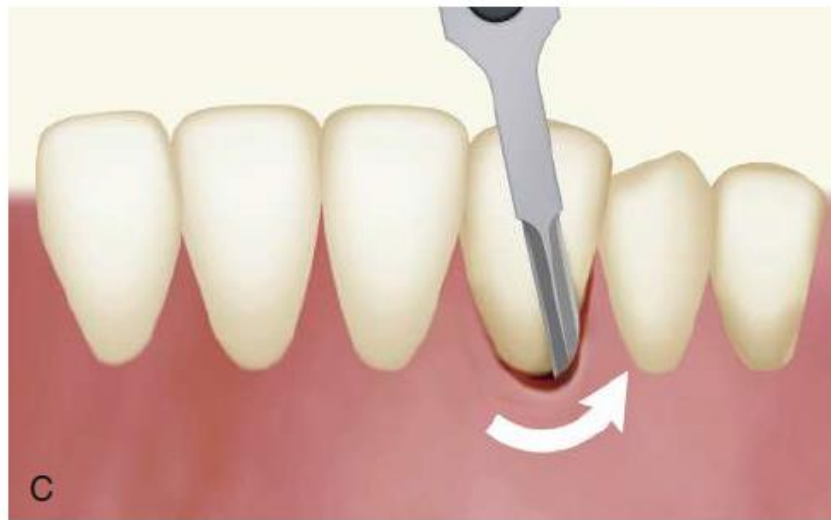


**Figure 10.11** Use of a no. 12 scalpel blade to release the fibres of the interdental papilla. Note the depth and angulation of the blade.

- Microscalpels size 1 to 5



15 C Blade  
Micro-Blade



• **Fig. 20.7** (A) Feather microsurgical blades. (Courtesy of J. Morita.) (B–D) Application of Feather microsurgical blades. (Courtesy of J. Morita.)

# FLAP REFLECTION



**SELDIN**

**HOWARTH'S**

**MOLT'S NO.9**

# FLAP RETRACTION



Farabeuf retractors  
for retraction  
of the cheek and  
mucoperiosteal flap

Kocher-Langenbeck  
retractors,





Weider retractor  
for retraction  
of tongue



**Figure 2.5** Tissue retraction instruments (KimTrac) with various mouth widths and shapes from 8 to 14 mm. These retractors have the thinnest serrated blade available.

ic protector.

# PENETRATION OF BONE



Low- or High-speed  
handpiece



ROUND BUR NO. 6 & 8

# LINDEMANN BUR

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(a)



(b)

**Figure 2.10** A 45 degree surgical handpiece (a) is designed to irrigate the surgical site while ejecting air from the back of the handpiece, eliminating water splatter and air emphysema (b).

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# MATERIALS FOR EXCAVATION

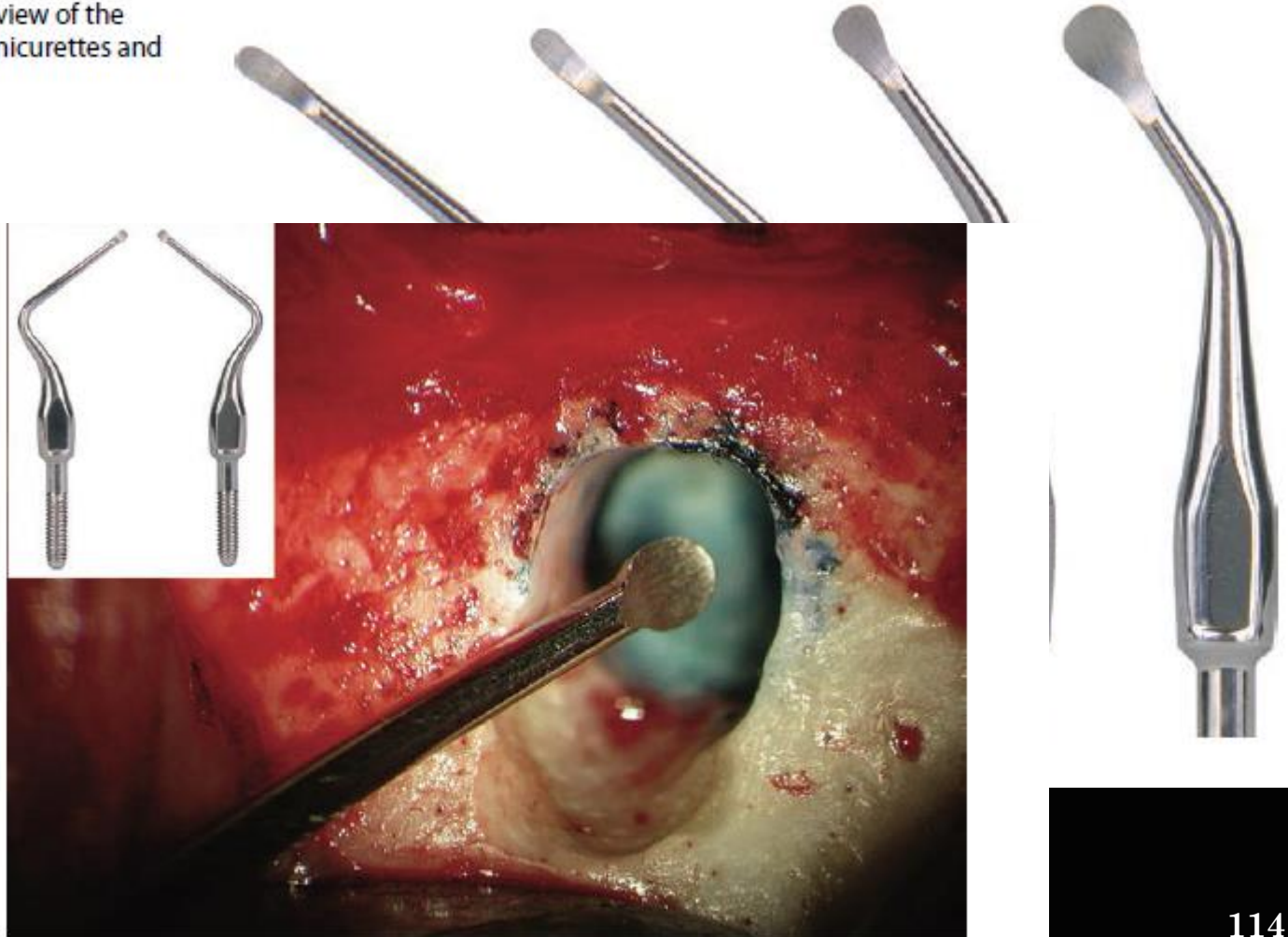


curettes for removing periradicular  
inflammatory soft tissue



Columbia 13-14 curette

**Figure 2.12** Enlarged view of the specially designed minicurettes and mini-molt curettes.



**Figure 2.13** Small round curette in action.

# MATERIALS FOR ROOT END RESCETION

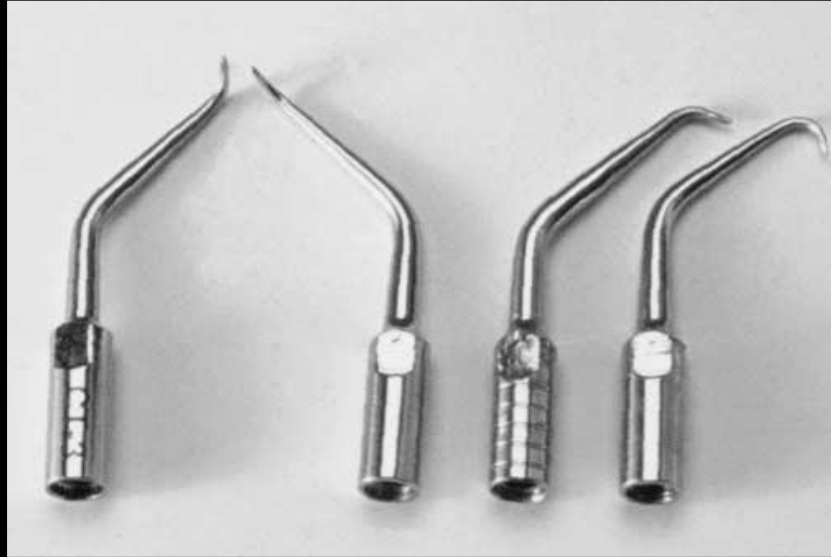


ROUND BUR NO. 6 & 8  
TAPER FISSURE NO. 207



**Figure 2.16** Size comparison of the modified rectangular micromirrors with a regular dental mirror.

# MATERIALS FOR ROOT END PREPARATION



KiS TIPS

## KiS 1D2 Tip

- The KiS-1D2 is a general purpose tip designed for the anterior and posterior areas of the mouth.
- It offers a less intrusive cutting surface of 2.0 mm.



## KiS 1D4 Tip

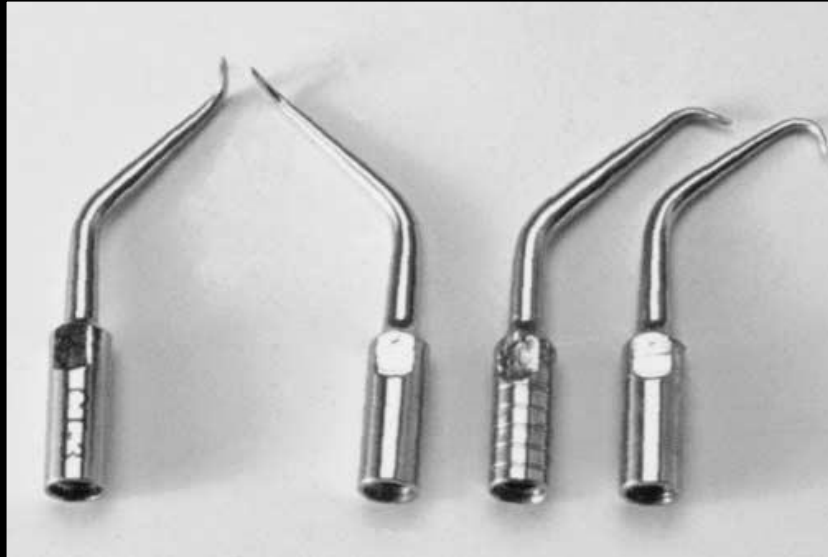
- The KiS-1D4 is a general purpose tip designed for the anterior and posterior areas of the mouth.
- It offers a longer cutting surface of 4.0 mm.



# CT TIPS

- Surgery is initiated with the “1” tip and followed by the “2” or “3,” depending on tooth position.
- **CT-1 Initiating Tip** – a straight-line tip with 90° angle used to initiate the preparation.
- **CT-2 Main Right Tip** – an angled tip for use on upper right and lower left to complete the preparation.

- **CT-3 Main Left Tip** – an angled tip for use on upper left and lower right to complete preparation.



# UT TIPS

- **UT-1 Initiating Tip** – a straight-line tip with 90° angle used to initiate the preparation.
- **UT-2 Universal Right Tip** – an angled tip for use on upper right and lower left to complete the preparation.

- **UT-3 Universal Left Tip** – an angled tip for use on upper left and lower right to complete the preparation

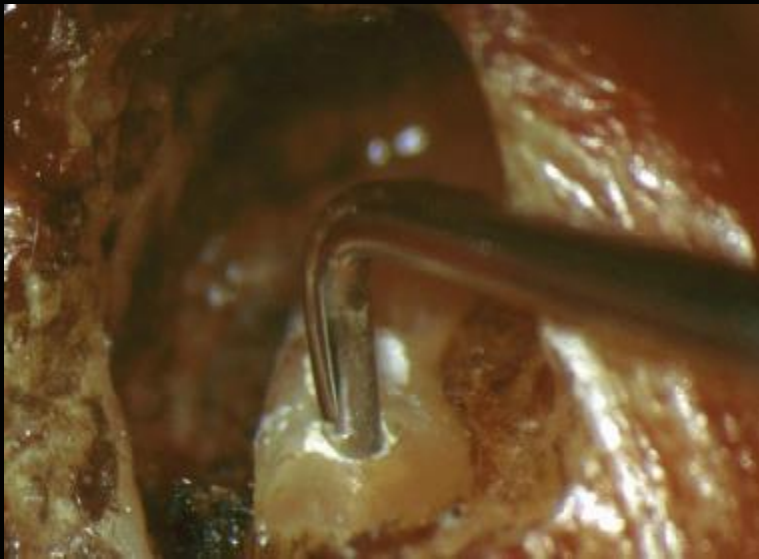


# MICROPLUGGERS

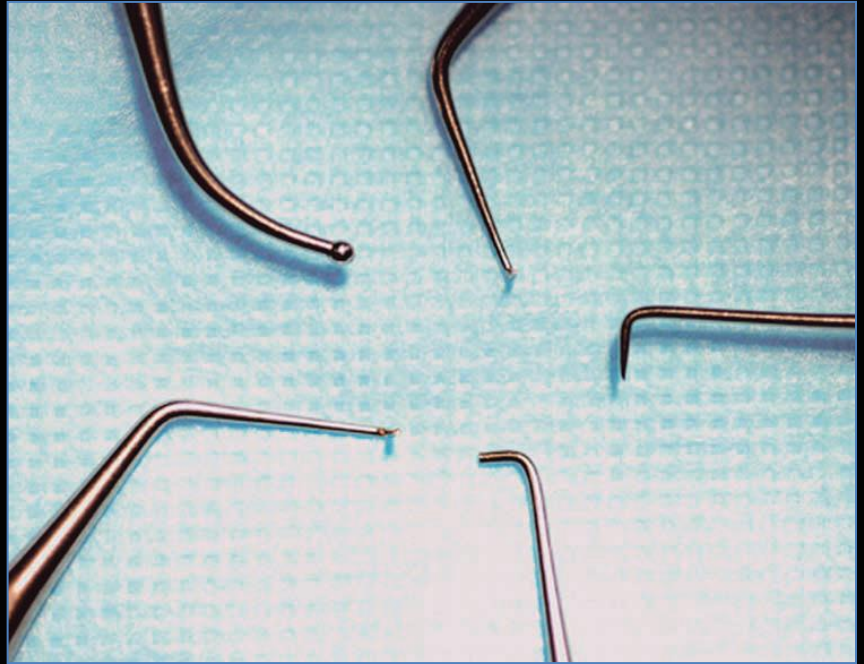
- **Micropluggers** come in ball ends ranging from 0.25 to 0.75 mm.
- They can be either **straight-handled** or **double-angled**.
- **The straight-handled** micro pluggers come in two different angles:
  - a 90-degree tip for universal use and
  - a 65-degree tip helpful for the lingual apex

- **The double-angled microplugger tips are offset by 65 degrees—one left and one right for left and right molar surgeries.**





**Plugging** into the apical preparation with a small **plugger** at 16 X.



Comparison between micro and macro pluggers



# NEEDLE HOLDER



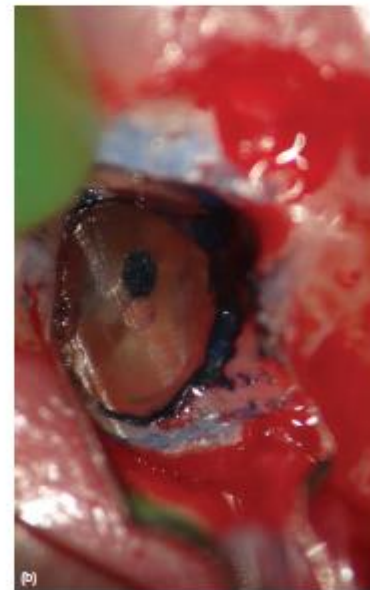
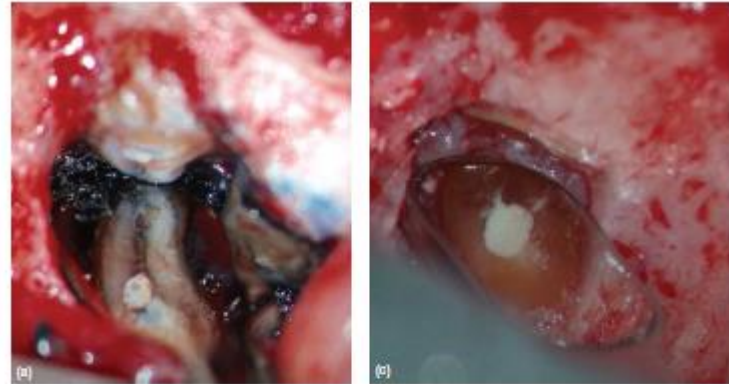
**Mayo-Hegar needle holder.**



# INSPECTION OF ROOT END



**Figure 2.16** Size comparison of the modified rectangular micromirrors with a regular dental mirror.



**Figure 2.17** Micromirror reflecting the entire surface of the resected root of tooth. (Courtesy of Dr. Kanayo Kon.)

# MATERIALS FOR COVERING OR FILLING A SURGICAL WOUND

## **Petrolatum Gauze.**

- Petrolatum (VaselineR) gauze is available in sterilized packages and is used mainly for covering exposed wounds, for tamponade of bone cavities.

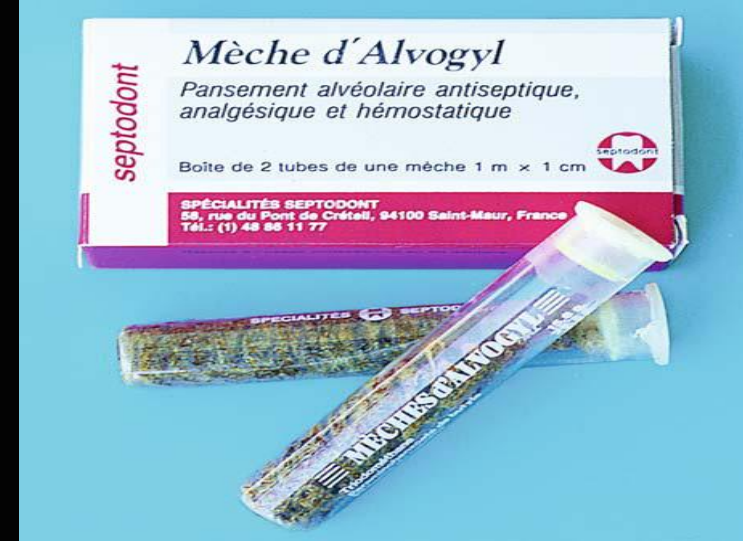


## Iodoform Gauze.

- This gauze has antiseptic, analgesic and hemostatic properties.
- Its indications for use are the same as for petrolatum gauze, although it may remain in place for longer.

## Surgical Dressing.

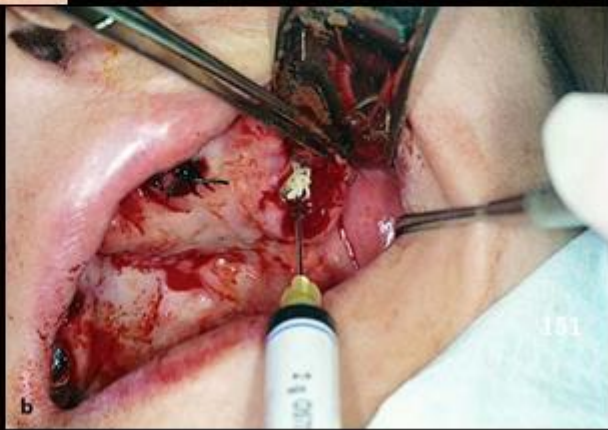
- This is an autopolymerized puttylike paste, available in sterilized packaging.
- It is used as a *temporary protective* covering of intraoral wounds after surgical procedures.



# MATERIALS FOR TISSUE REGENERATION

- Sometimes during surgical procedures (removal of cysts) **large bony defects** are created, which cause problems associated with esthetics, function, and the healing process, or they may even affect the stability of the jaw bone.
- **Tissue regenerative materials** may prove useful in the regeneration of periodontal tissues, for the filling of bone defects or for augmentation of a deficient alveolar ridge, etc.
- The most commonly used such materials are **membranes and bone grafts**.

ML



stabilization of the membrane in an area of bone deficit after surgical extraction



# Effect of Guided Tissue Regeneration on the Outcome of Surgical Endodontic Treatment: A Systematic Review and Meta-analysis

Igor Tsesis, DMD,\* Eyal Rosen, DMD,\* Aviad Tamse, DMD,\* Silvio Taschieri, MD, DDS,<sup>†</sup> and Massimo Del Fabbro, PhD<sup>‡</sup>

## Abstract

**Introduction:** The use of guided tissue regeneration (GTR) techniques has been proposed as an adjunct to endodontic surgery in order to promote bone healing. Studies assessing the added benefits of GTR for the outcome of endodontic surgery are significantly variable in their treatment protocols, follow-up periods, and inclusion criteria, thus generating inconsistent and confusing results. The aim of this study was to evaluate the influence of GTR on the outcome of surgical endodontic treatment by means of a systematic review of the literature and meta-analysis. **Methods:** An exhaustive literature search combined with strict inclusion and exclusion criteria was undertaken to identify clinical studies that assessed the added benefit of GTR in endodontic surgery. **Results:** A trend of better outcome was found when GTR was used compared to control cases, but the results were not statistically significant. Lesion size, lesion type, and membrane type were identified as factors significantly affecting the outcome of GTR versus control cases. GTR techniques favorably affected the outcome of surgical endodontic treatments in cases of large periapical lesions and through-and-through lesions. A favorable outcome was found when using a resorbable membrane over using a nonresorbable membrane or graft alone. **Conclusions:** GTR tech-

Surgical endodontic treatment is an option for teeth with apical periodontitis and may be indicated for teeth with periapical pathology when nonsurgical retreatment is impractical or unlikely to improve the previous results or when a biopsy is needed (1, 2). Modern endodontic surgical technique uses enhanced magnification, minimal root resection bevel, ultrasonic root-end preparation to a depth of 3 to 4 mm, and newer biocompatible root-end filling materials (3). A success rate of over 90% has been reported with this technique (2–4).

The final histologic results of the wound healing in endodontic surgery may be repair or regeneration depending on the nature of the wound; the availability of progenitor/stem cells; growth/differentiation factors; and microenvironmental cues such as adhesion molecules, extracellular matrix, and associated noncollagenous protein molecules (5, 6).

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## Conclusions

Based on the currently available data, GTR techniques may improve the outcome of bone regeneration after surgical endodontic treatment performed in cases with certain periapical lesions, such as large periapical lesions, and through-and-through lesions. A favorable outcome is expected for using a resorbable membrane over a nonresorbable membrane or a graft alone. Large-scale prospective clinical studies are needed to further evaluate possible benefits of GTR techniques in endodontic surgery.

# Guided Tissue Regeneration in Periapical Surgery

Louis Lin, BDS, DMD, PhD,\* Melody Y-H. Chen, DDS, MS,<sup>†</sup> Domenico Ricucci, DDS, MD,<sup>‡</sup> and Paul A. Rosenberg, DDS\*

## Abstract

Tissue regeneration by using membrane barriers and bone grafting materials in periapical surgery is an example of tissue engineering technology. Membrane barriers and/or bone grafts are often used to enhance periapical new bone formation. However, the periapical tissues also consist of the periodontal ligament (PDL) and cementum. For regeneration of the periapical tissues after periapical surgery, one of the important requirements is recruitment and differentiation of progenitor/stem cells into committed pre-osteoblasts, pre-PDL cells, and pre-cementoblasts. Homing of progenitor/stem cells into the wounded periapical tissues is regulated by factors such as stromal cell-derived factor 1, growth factors/cytokines, and by microenvironment such as adhesion molecules and associated noncollagenous matrix. Bone formation after injury appears to recapitulate normal embryonic tissue development. Regeneration involves a complex interaction of different cells, extracellular matrix, signaling factors, and microenvironment. More research is known concerning the biologic mechanism of late temporal and spatial relationships between bone, PDL, and cementum regeneration and wound healing. Simply applying membrane barriers and/or bone graft during periapical surgery result in complete regeneration of the tissues. It has not been clearly demonstrated that membrane barriers are capable of recruiting progenitor/stem cells and inducing these undifferentiated cells to differentiate into PDL cells and cementum cells after periapical surgery. (*J Endod* 2010;36:103–107)

## Key Words

Bone grafting materials, guided tissue regeneration, membrane barriers, periapical surgery

Systematic review of the literature concerning guided tissue regeneration in periapical surgery is not possible because of wide variations in research methodology. Tissue engineering involves the use of biologic and engineering sciences to develop biologic substitutes that restore, maintain, or enhance tissue function (1). In general, there are 3 main approaches to tissue engineering: (1) to use isolated cells or cell substitutes as cellular replacement parts, (2) to use acellular biomaterials (scaffolds) capable of inducing tissue regeneration, and (3) to use a combination of cells and biomaterials (1, 2). These approaches are suitable for single tissue regeneration such as new bone formation. For example, in terms of multiple tissue regeneration, new periodontal or periapical tissue formation, the involvement of tissue engineering technology might be even more complex (2). The process of introducing biomaterials into the host to enhance or modify natural wound healing can be considered as tissue engineering (1, 2). Tissue regeneration by using membrane barriers and/or

## Conclusion

Except in apicomarginal bony defects caused by combined periodontal-endodontic or endodontic-periodontal lesions (67, 70) or in large periapical lesions communicating with the alveolar crest (68, 69), the use of membrane barriers in periapical surgery has not been shown to have a clear benefit in regenerating periapical tissues. The ability of bone grafts to induce new bone formation has been well-documented (17, 18, 20–22, 78–83). However, new PDL and cementum regeneration in periapical surgery has not been shown to benefit from the use of bone grafts.

\*support periodontal repair rather than regeneration (10). Guided tissue regeneration by using membrane barriers and/or bone grafting materials has also been used in periapical surgery to enhance new bone formation (17–22). Those studies were mostly focused on new bone formation, and did not address formation of



# HEMOSTATIC AGENTS

**Table 5.2** Topical hemostatic agents.

## Mechanical Agents

Bone Wax™ (Ethicon, Somerville, NJ)

Calcium sulfate

## Chemical Agents

Epinephrine

Ferric sulfate

## Biological Agents

Thrombin USP™ (Thrombostat, Thrombogen)

## Absorbable Hemostatic Agents

### *Intrinsic action*

Gelfoam™ (Upjohn Co., Kalamazoo, MI)

Absorbable collagen

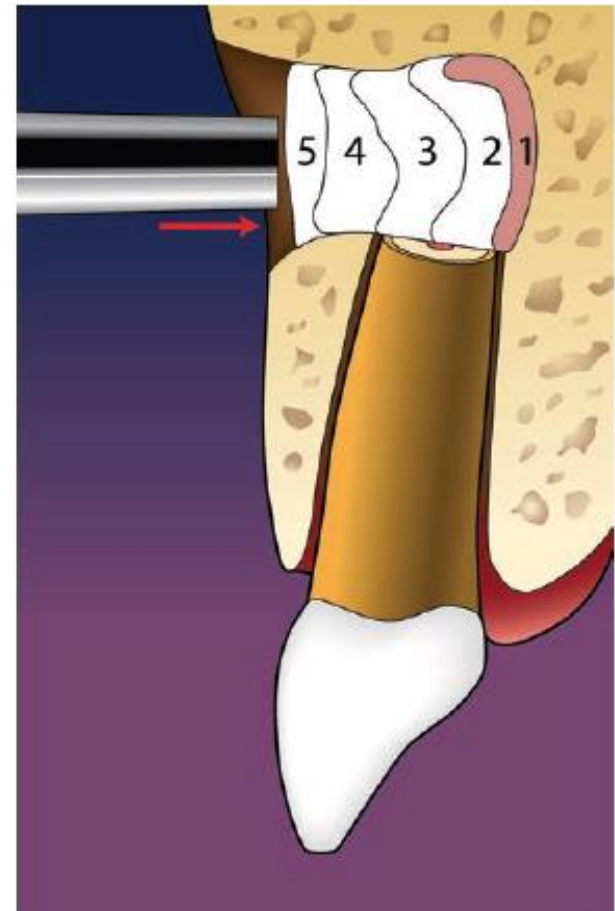
Microfibrillar Collagen Hemostats

### *Extrinsic action*

Surgicel™ (Johnson & Johnson, New Brunswick, NJ)

### *Mechanical action*

Calcium Sulfate Surgiplast™ (ClassImplant, Rome, Italy)



**Figure 5.9** Several hemostatic Racellets packed in the osteotomy site and pressure applied for about 2–3 min.



**FIGURE 24-17** *A.* Gingival tissues before injection of a local anesthetic. *B.* Gingival tissues after injection of a local anesthetic containing 1:50,000 epinephrine.

FLAP

the hand



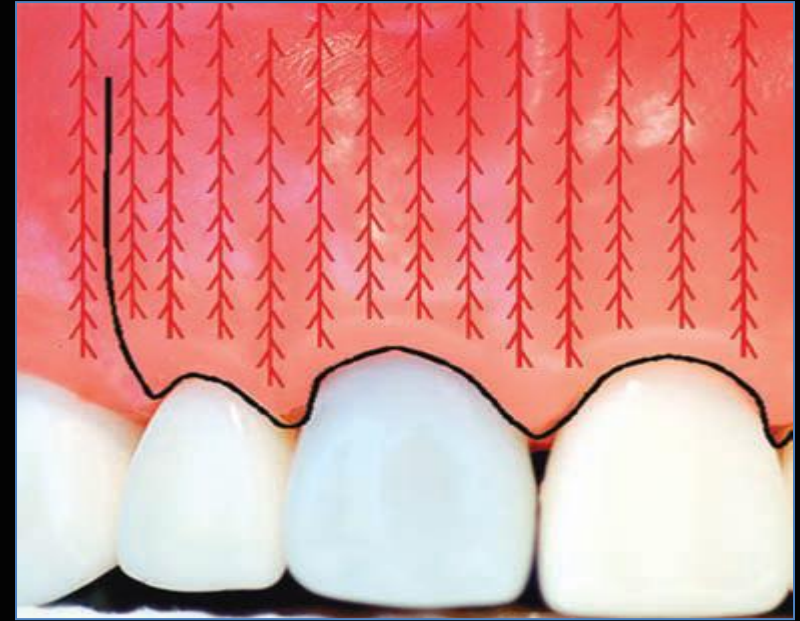
sheep

al Surgeon

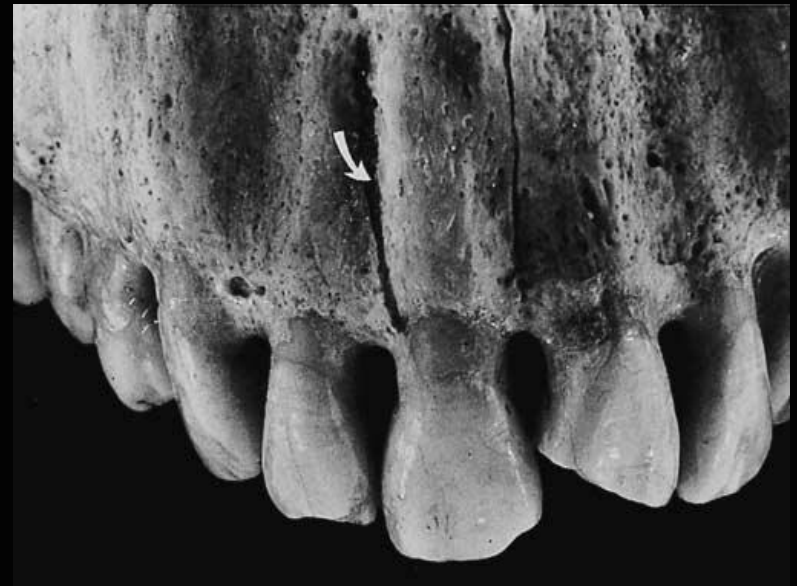
**FIGURE 24-18** Severe crestal bone loss and gingival recession after a periapical surgery.

# PRINCIPLES AND GUIDELINES FOR FLAP DESIGN.

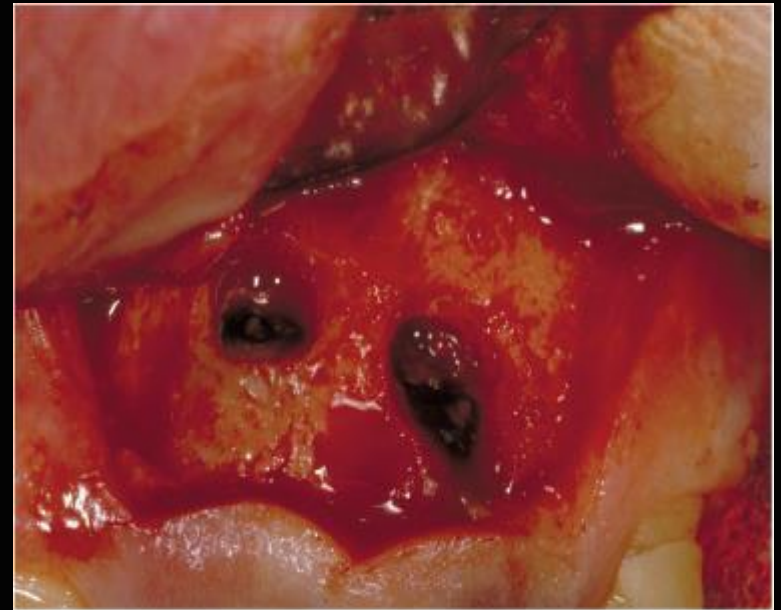
1. Avoid **horizontal** and **severely angled vertical** incisions.



2. Avoid incisions over **radicular eminences**.



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

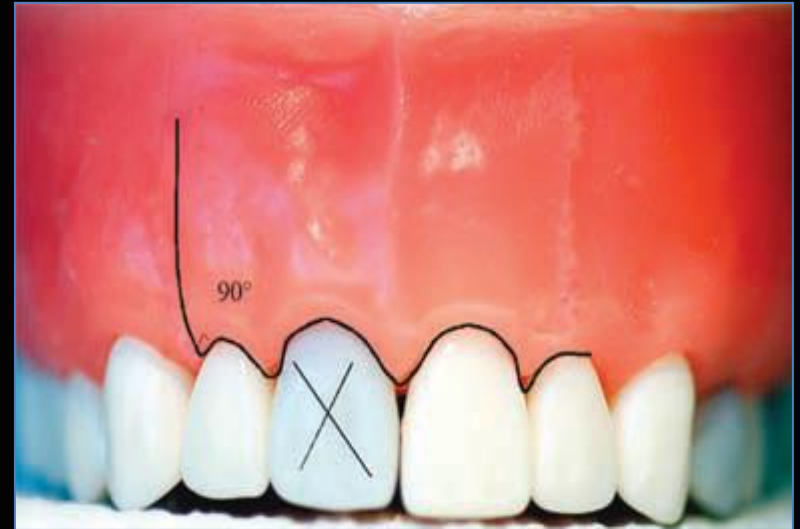


4. Avoid incisions across major **muscle attachments.**

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 muco-periosteum** (full thickness).





**NEVER PERFORM ANY VERTICAL INCISION(S) ON  
THE MANDIBULAR LINGUAL AREA**

# CLASSIFICATION OF SURGICAL FLAPS

According to **Gutmann and Harrison,**

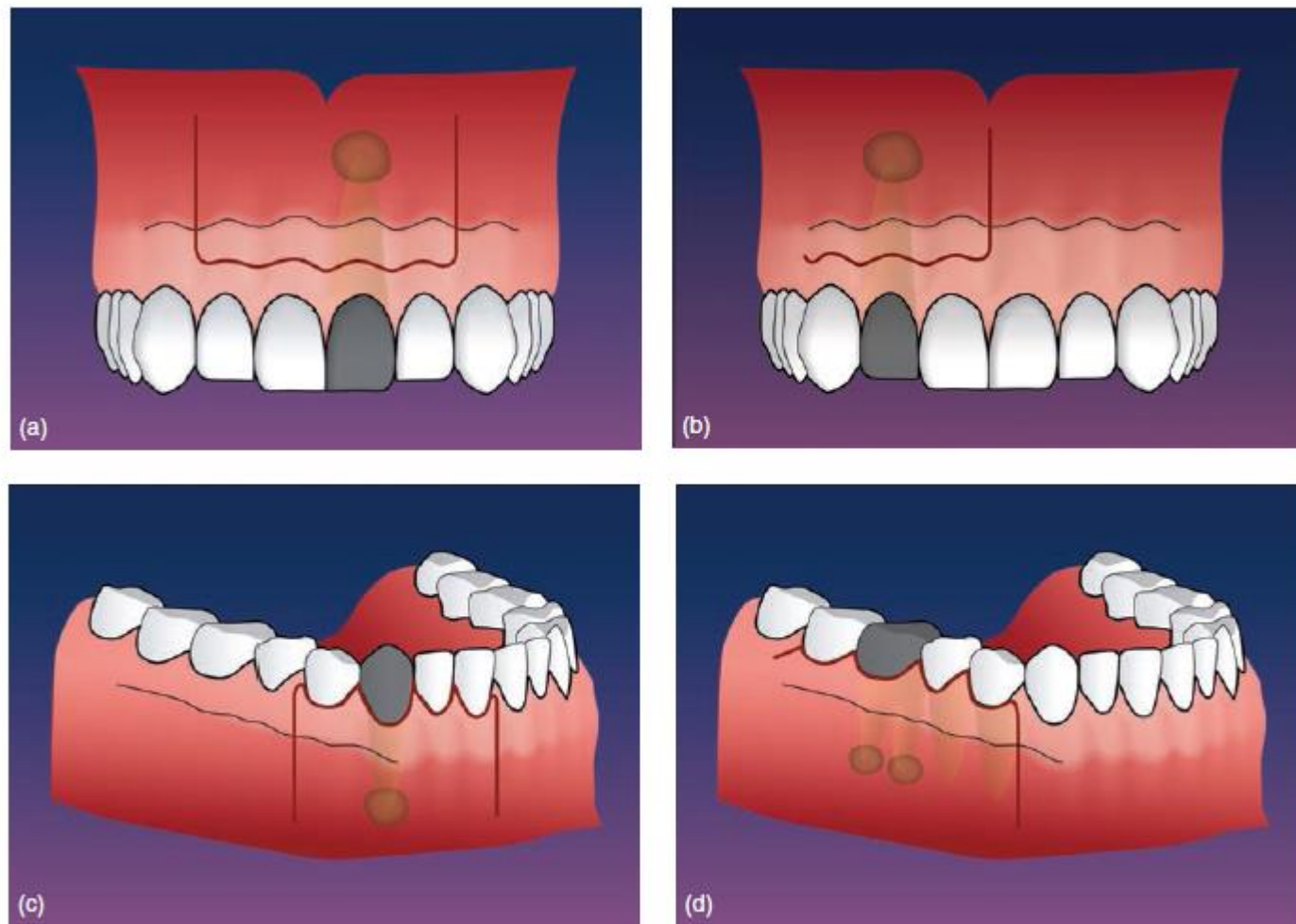
## **Full mucoperiosteal flaps**

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

## **Limited mucoperiosteal flaps**

- (a) Submarginal curved (semilunar)
- (b) Submarginal scalloped rectangular (Luebke-Ochsenbein)

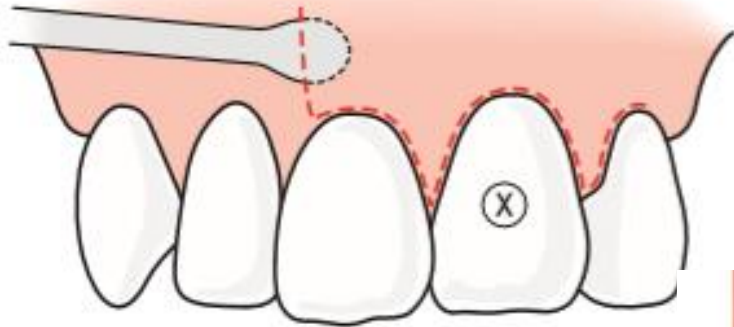
# THERE ARE FOUR MAJOR FLAP DESIGNS IN ENDODONTIC MICROSURGERY



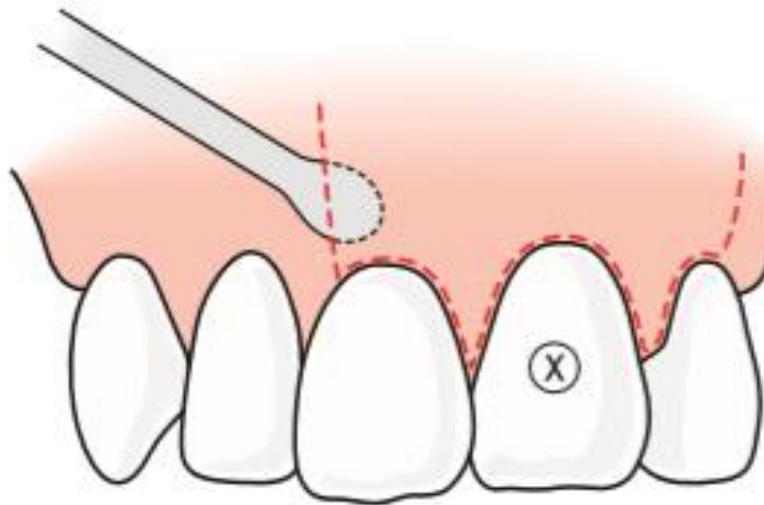
**Figure 6.1** Current flap designs in endodontic microsurgery: (a) submarginal rectangular flap; (b) submarginal triangular flap; (c) sulcular rectangular flap; (d) sulcular triangular flap.

# FLAP REFLECTION

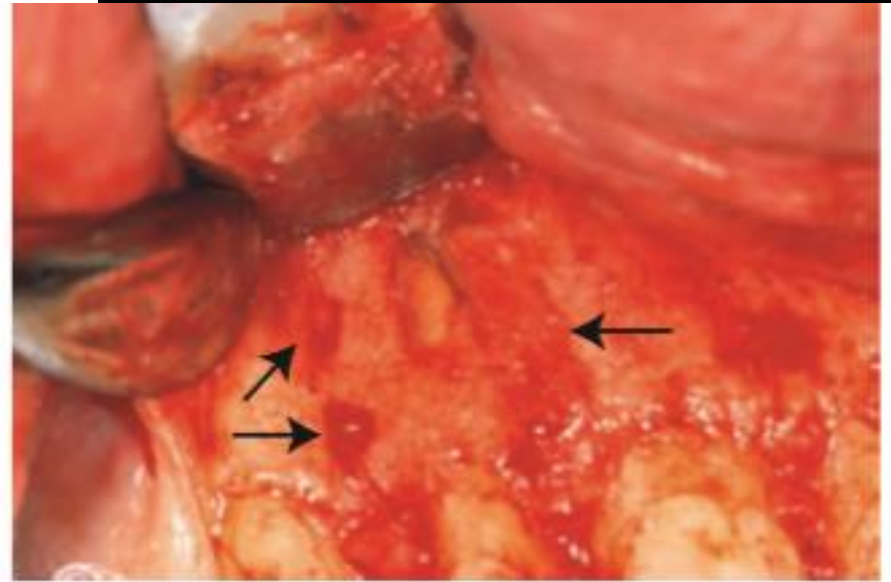
- Flap reflection is the process of separating the soft tissues (gingiva, mucosa, and periosteum) from the surface of the alveolar bone.
- Marginal gingiva is very delicate and easily injured.
- It is, therefore, not appropriate to begin the reflective process in the horizontal incision for full mucoperiosteal flaps.



**Figure 10.12** The periosteum is initially elevated by a force against the cortical bone in the region of the alveolar tissues.



**Figure 10.13** The periosteal elevator is subsequently moved coronally to elevate the marginal tissues.

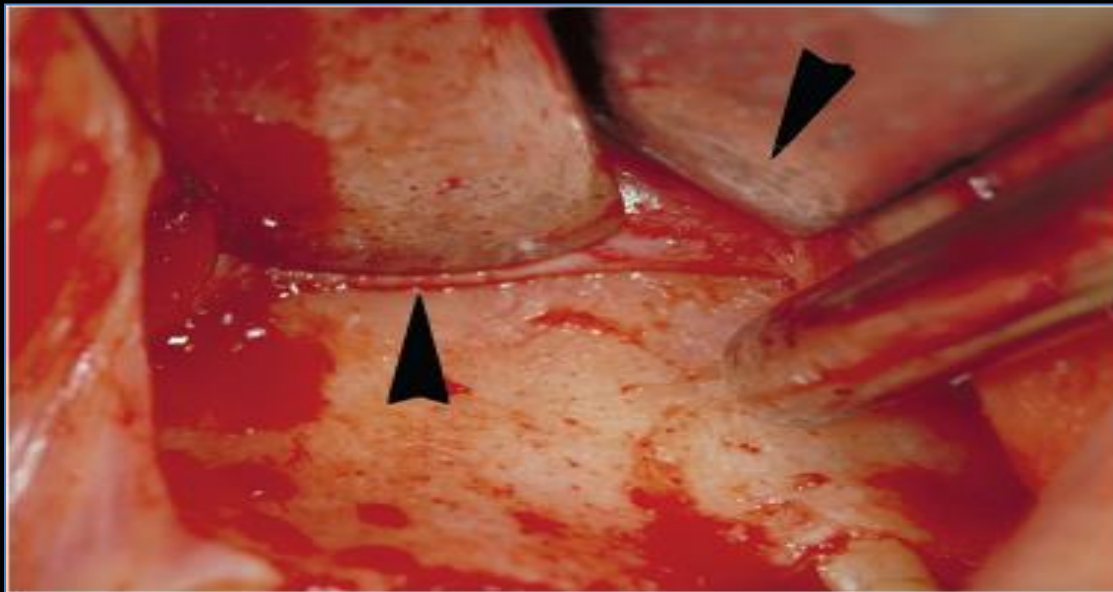


**Figure 10.15** Tissue tags remain on the cortical bone after flap elevation (arrowed).

## FLAP RETRACTION

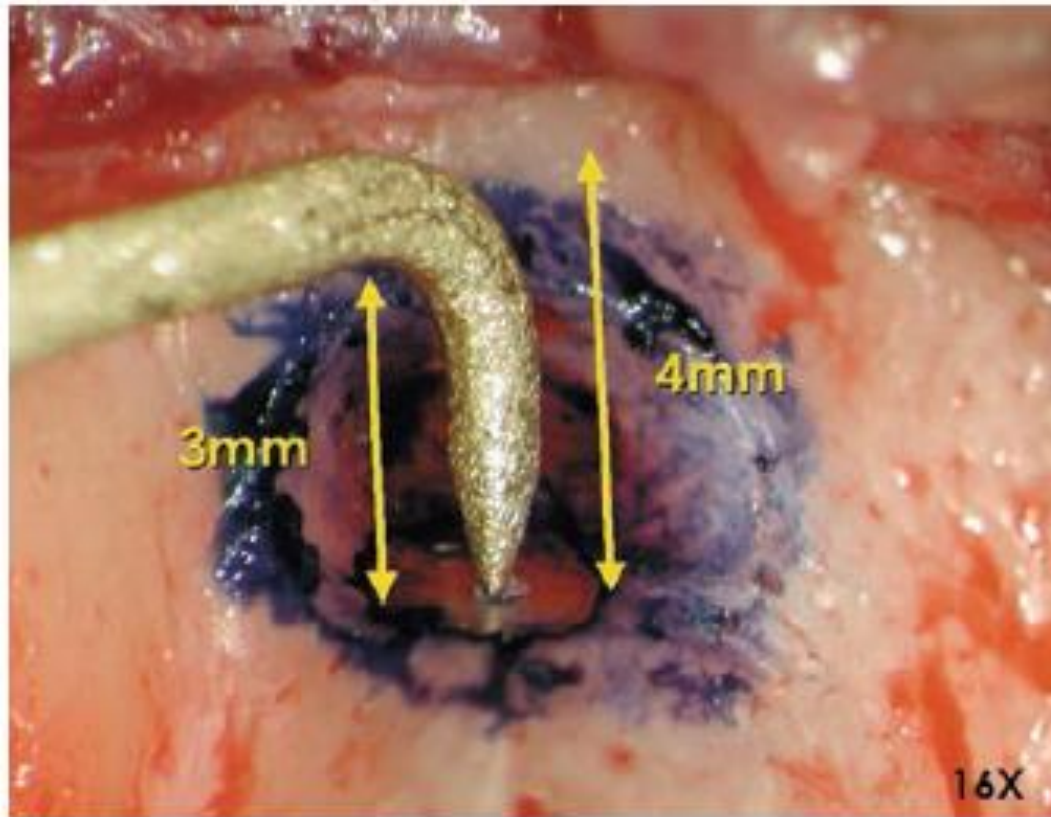
- **Flap retraction is the process of holding in position the reflected soft tissues.**
- Proper retraction depends on **adequate extension** of the flap incisions and **proper reflection** of the mucoperiosteum.
- The tissue retractor must always rest on **solid cortical bone** with light but firm pressure.

- If the retractor inadvertently **rests on the soft tissue** at the base of the flap, mechanical trauma to the alveolar mucosa may result in *delayed healing and increased postsurgical morbidity*.
- Selection of the *proper size and shape of the retractor* is important in minimizing soft-tissue trauma.



- An axiomatic principle of endodontic surgery is that the longer the flap is retracted, the greater the postsurgical morbidity.
- Regardless of whether the retraction time is short or long, the periosteal surface of the flap should be irrigated frequently with physiologic saline (**0.9% sodium chloride**) solution.

# HARD TISSUE MANAGEMENT



**Figure 7.6** The ideal osteotomy is no larger than 4 mm in diameter to accommodate the 3-mm long ultrasonic tip in the bone crypt. The osteotomy is small but large enough to accommodate the ultrasonic tip.

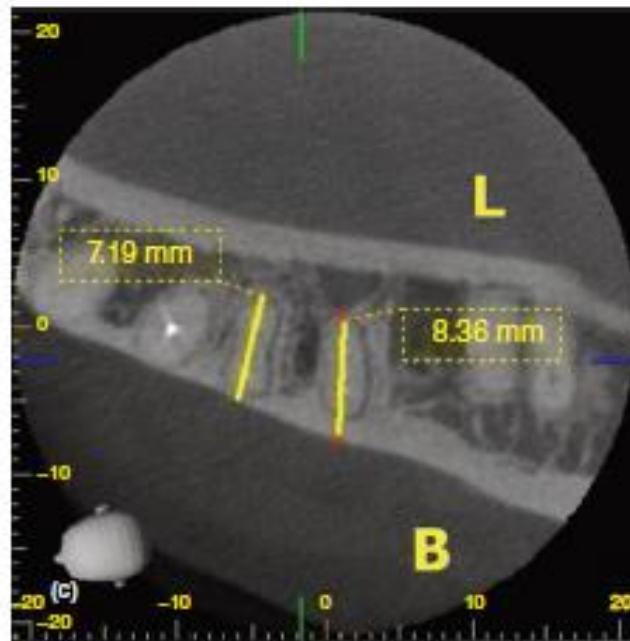
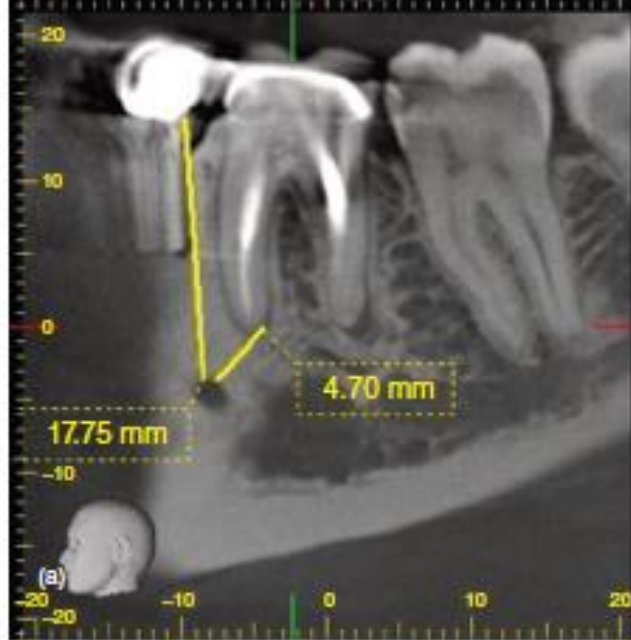
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Comparison of  
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truments (left,  $\times 1$ ) and  
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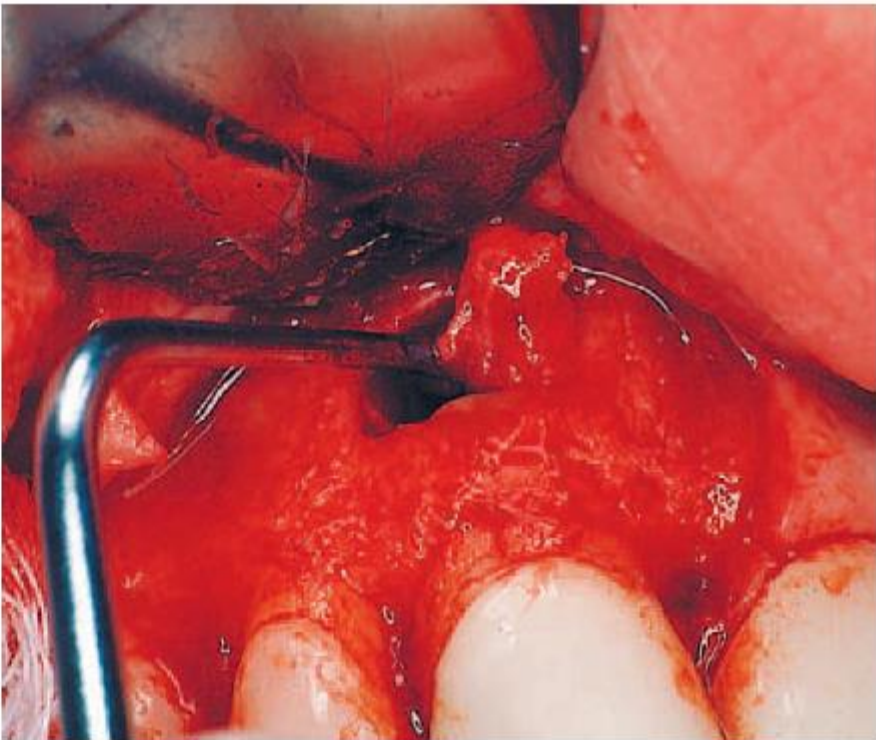
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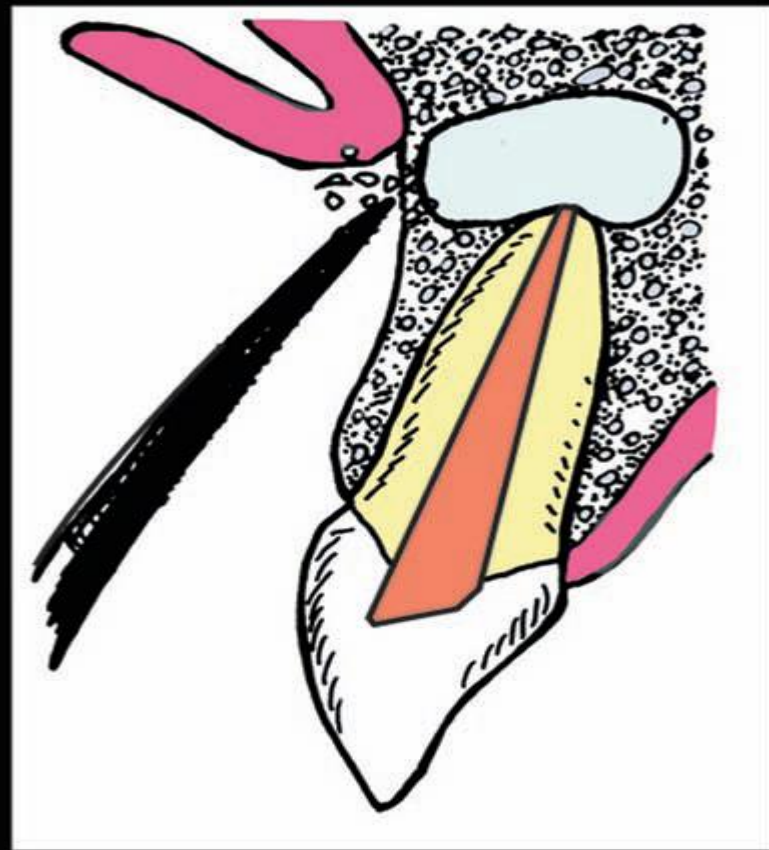
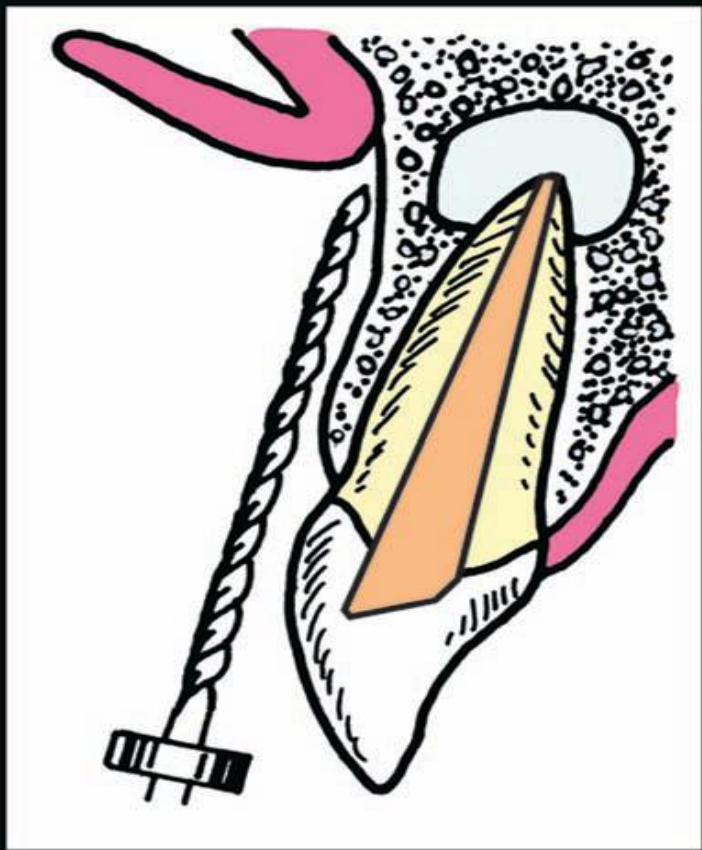
**Figure 7.1** Use of CBCT: (a) a sagittal view from a CBCT image of tooth #19 measuring the distance from the mental foramen; (b) a coronal view from a CBCT image of tooth #19 measuring the distance from buccal plate to the lingual surface of the root; (c) an axial view from a CBCT image of tooth #19 measuring the distance from the buccal plate to the lingual surface of both mesial and distal roots.

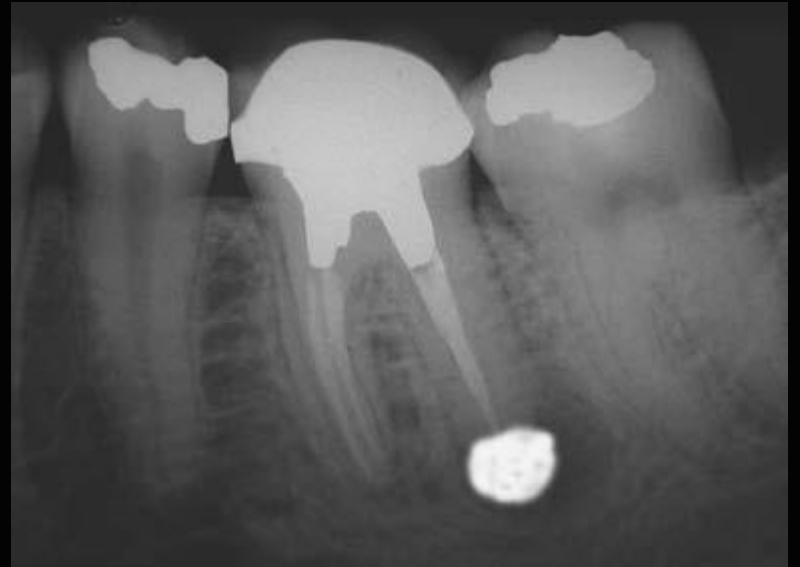
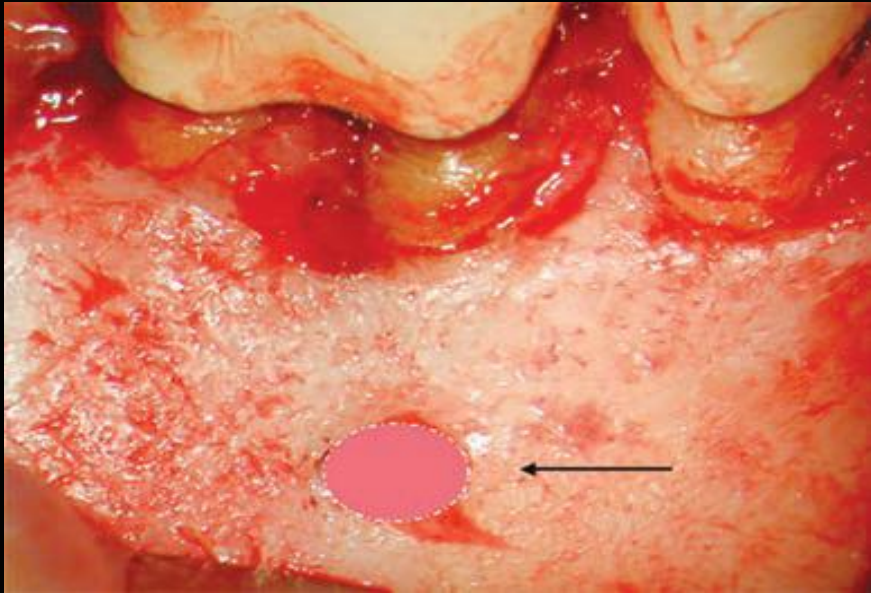


**Figure 10.19** Straight and angled bone curettes are useful to manage the wide variety of challenges encountered in bone and soft tissue removal.

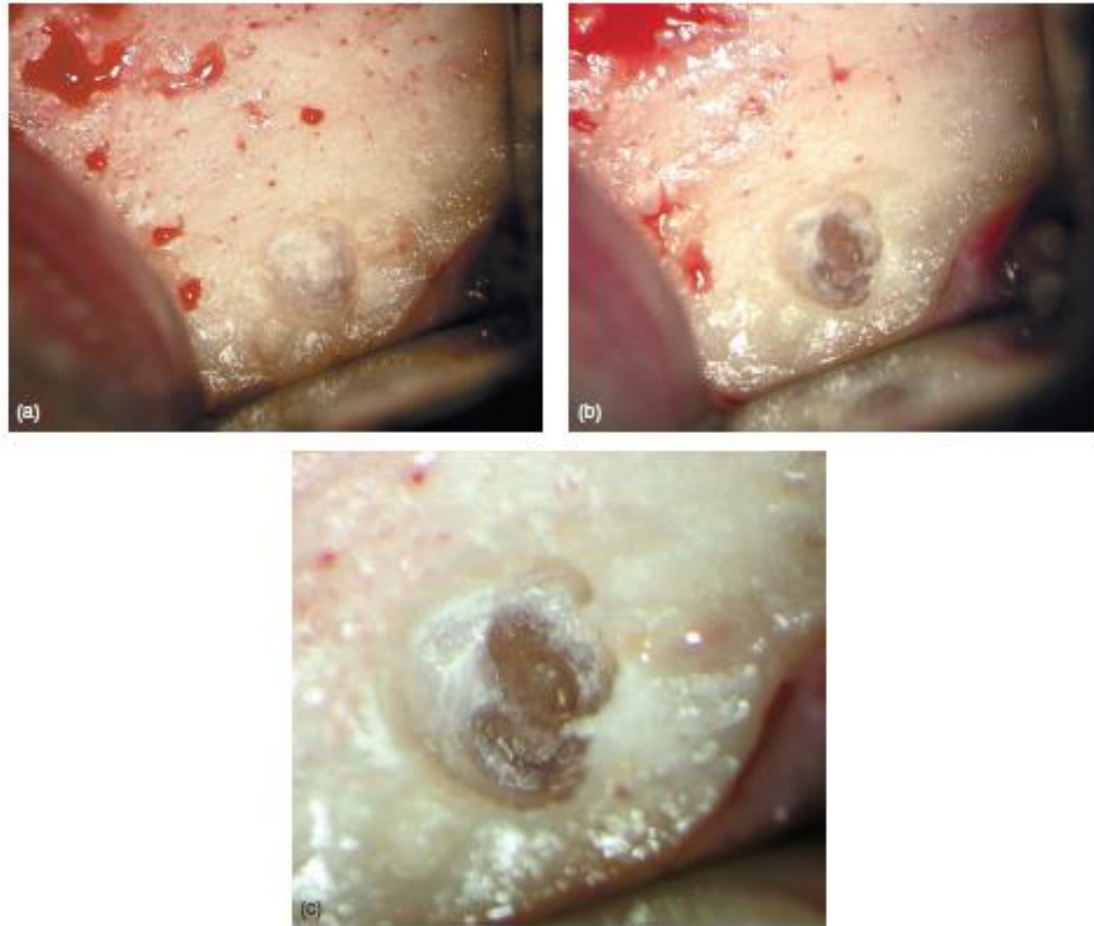


**Figure 10.20** Use of the bone curette to peel the soft tissue lesion from the bone cavity.





# HOW TO IDENTIFY ROOT ?



**Figure 7.3** Osteotomy: (a) a small initial osteotomy and root tip are hardly visible at  $\times 2$ ; (b) the root has a darker, yellowish color, and is hard, whereas the bone is white; (c) root tip is clearly visible.

# KEY HOLE OST

- In some cases, a re

Figure 7.7 Ultrasonic tips of varying lengths: 3 mm, 6 mm, and 9 mm.

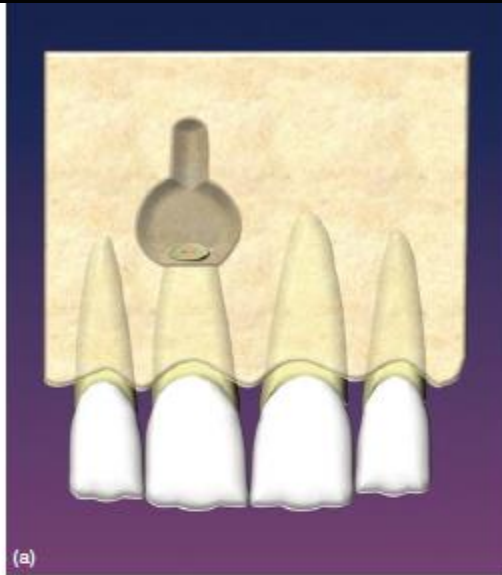


Figure 7.8 (a) Schematic drawing that illustrates the key hole osteotomy modification to accommodate the longer tip without enlarging osteotomy size. (b) Key hole modification on an osteotomy for the mesial root tooth #30. The key hole modification will allow the ultrasonic tip to approach the roots without excessively sacrificing any extra bone structure. (Figure 7.8b and c are courtesy of Dr Kaname Yokota.)

by creating a narrow  
in an apical direction  
tip with minimum

# BONEWINDOW TECHNIQUE

Figure 7.9 W&J  
fine cuts w  
when harv

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# EFFECT OF HEAT AND ADVANTAGES OF COOLANT

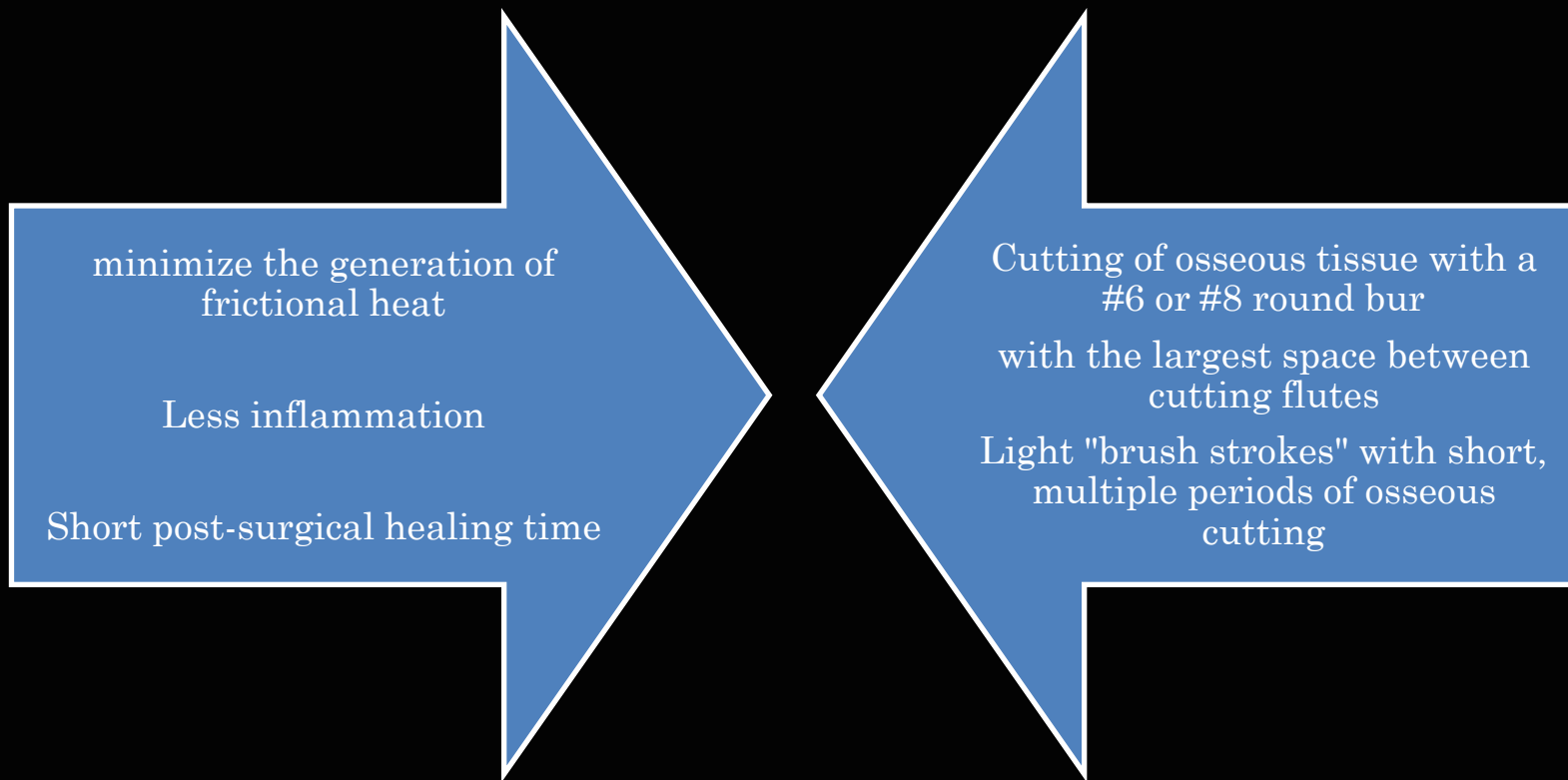
irreversible damage to bone occurred when it was **heated to above 56°C**

The coolant stream(**sterile water or saline**) must be directed accurately to the cutting surface of the bur.

Reduces the temperature rise,assists in removing bone chippings and coagulated blood and debris from the flutes of the bur,.

- The shape of the bur used for bone removal and the design of its flutes play a significant role in postsurgical healing.
- Cutting of osseous tissue with a #6 or #8 round bur produces less inflammation, results in a smoother cut surface, and a shorter healing time than when a fissure bur or diamond bur is used.
- Burs with the ability to cut sharply and cleanly, with the largest space between cutting flutes, regardless of the speed of rotation, leave defects that heal in the shortest postsurgical time.

# EFFECT OF SIZE SHAPE AND PRESSURE OF BUR



- In most areas of the mouth, visual access is adequate while using a high speed handpiece and surgical length burs.
- In areas of restricted visibility the use of a high speed handpiece with a 45° angled head significantly increases visibility.
- The Impact Air 45° high speed handpiece offers the added advantage that the air is exhausted to the rear of the turbine rather than toward the bur and the surgical site.



- Case reports of surgical emphysema resulting in subcutaneous emphysema of the face including fatal descending necrotizing mediastinitis from the use of a high speed dental handpiece have been published.
- Clinicians should be aware of the spectrum of this potential problem and specifically of the potential hazards of pressurized nonsterile air blown into open surgical sites by the dental drill.

# Size of the resected root

- The 3–4mm of the apical portion of the root should be clearly exposed, at least to the buccal, mesial and distal.
- Most root-end preparation tips, whether ultrasonic or

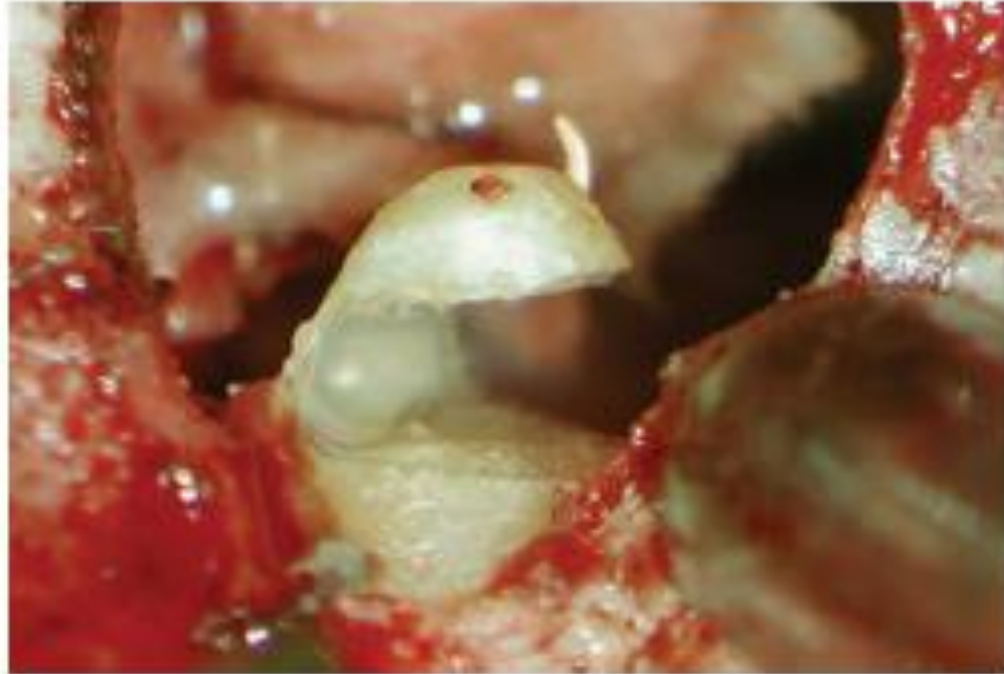
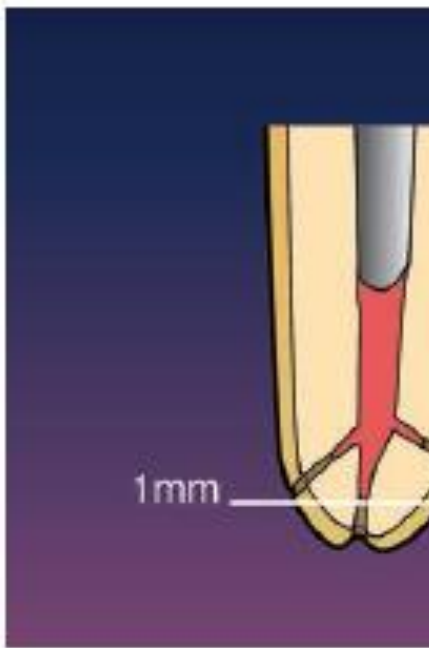
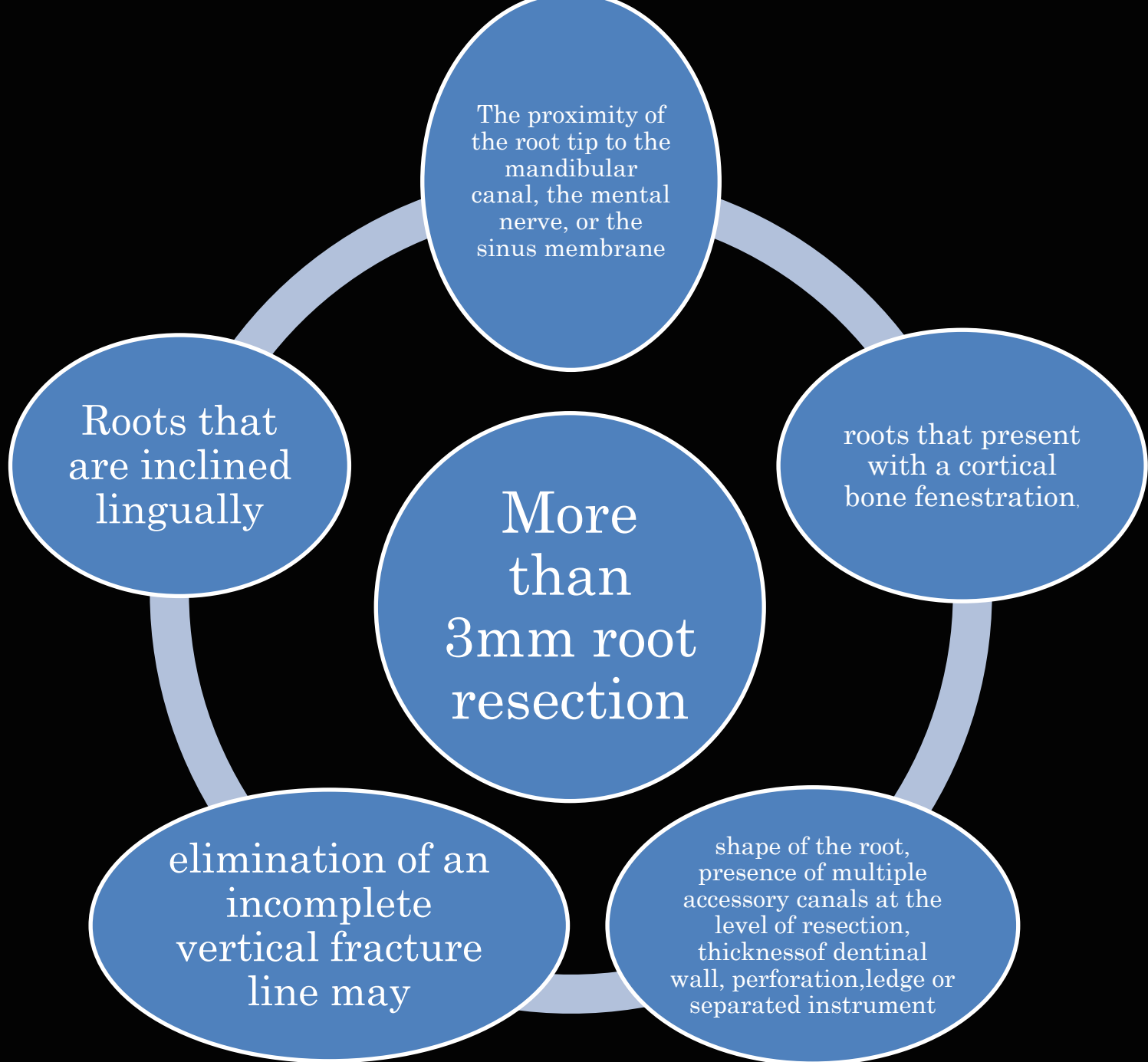


Figure 8.3 Removal of the apical

nals.



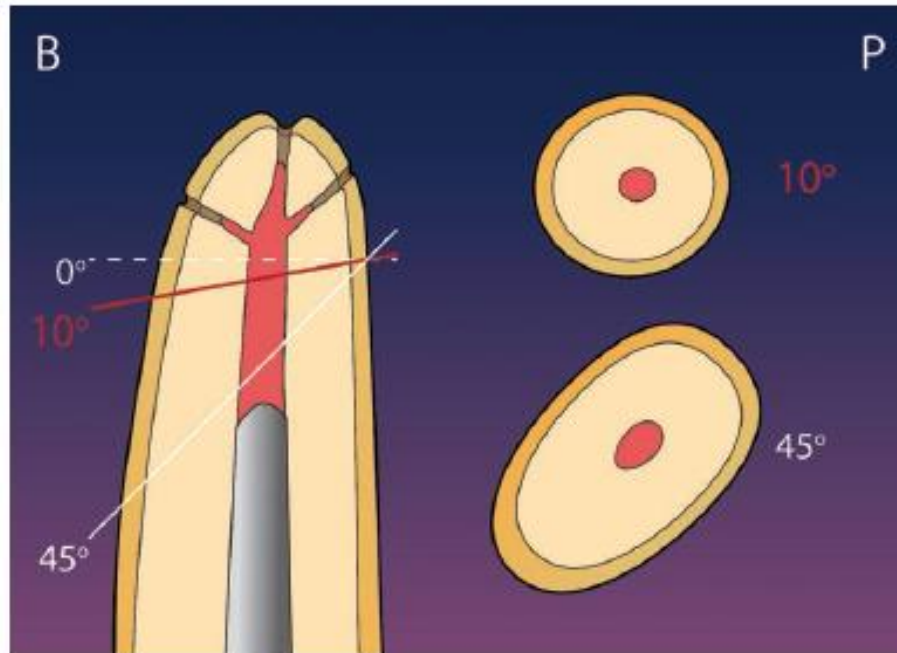
# ROOT END RESECTION: STEEP BEVEL VERSUS SHALLOW BEVEL

Steep

0 degree



**Figure 8.8** angle bevel oval-shape buccal can whereas th accessory (the main c direction n without be color).



**Figure 8.9** A 45 degree angle bevel is associated with more exposed dentinal tubules on the cut root surface, which can be associated with an increased risk of bacterial microleakage postoperatively.

More exposed dentinal tubules on the cut root surface

Complete root end resection

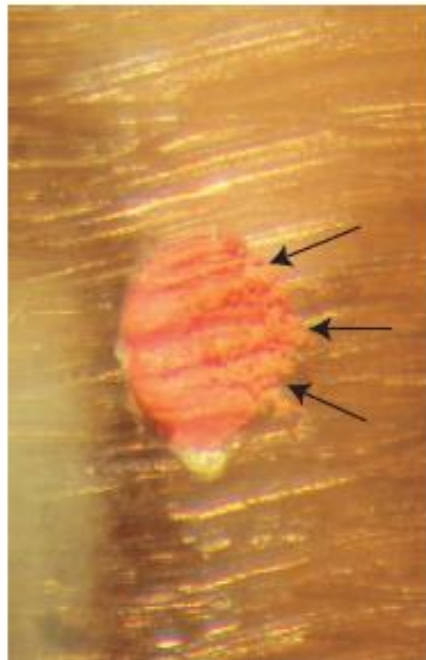
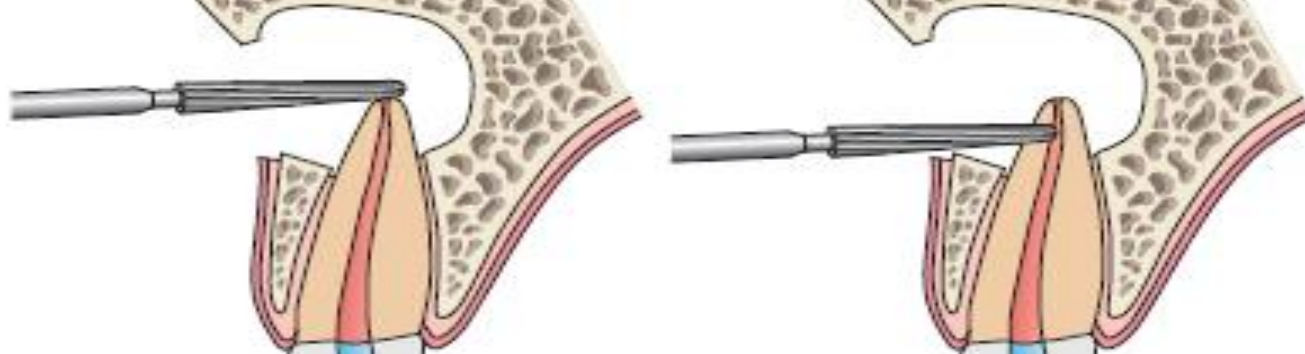


Figure 10.26 Rough surface of resected root after being cut with a coarse diamond. Note the gutta-percha has been dragged across the surface of the root (arrowed).



Figure 10.27 Smooth surface of resected root and root filling created with an ultrafine diamond and waterspray. Note the adaptation of the root filling material to the outline of the canal.



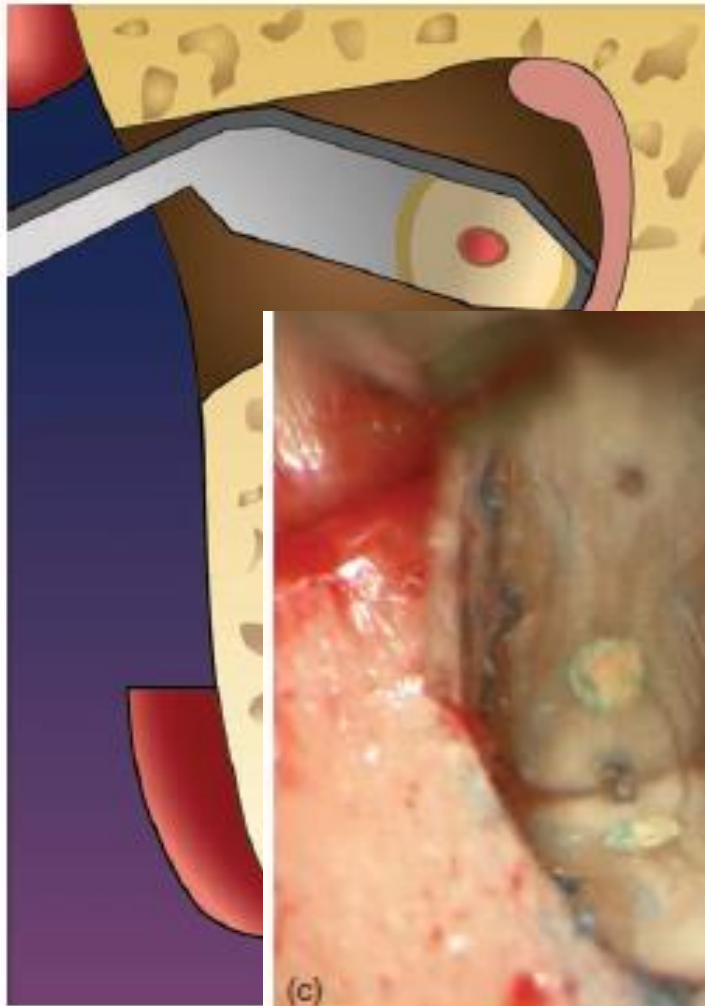
Figure 10.21 Diagrammatic representation of (A) root-end resection from the apex to coronal; (B) root-end resection when the amount of root to be resected has been determined. (C) Clinical case of root-end resection in which the amount of the root to be resected has been predetermined. (D) Resection of the root apex.

# INSPECTION OF THE RESECTED ROOT

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**Figure 9.1** Stropko irrigator with an attached micromirror. (a) Stropko irrigator; (b) schematic drawing of root surface.



**Figure 9.3** During inspection, the micromirror is placed at 45 degrees to the resected surface and the reflected view of the root surface shows every anatomical detail of the canal system. A high magnification of the microscope is used at  $\times 14$  to  $\times 26$ .

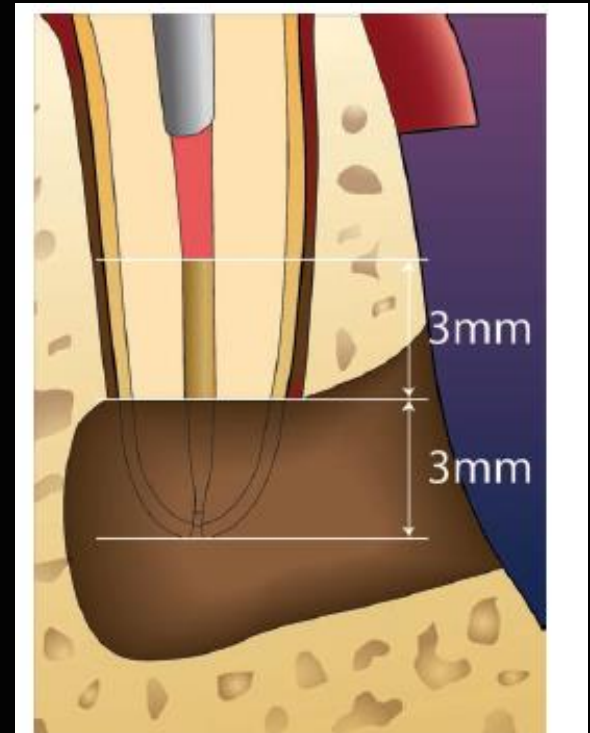


residual root caries



# ULTRASONIC ROOT END PREPARATION

- Root-end preparations should accept filling materials that predictably seal off the root canal system from the periradicular tissues.
- Carr and Bentkover have defined an ideal root-end preparation as a *class I preparation* at least 3.0 mm into root dentin with walls parallel to and coincident with the anatomic outline of the pulp space.



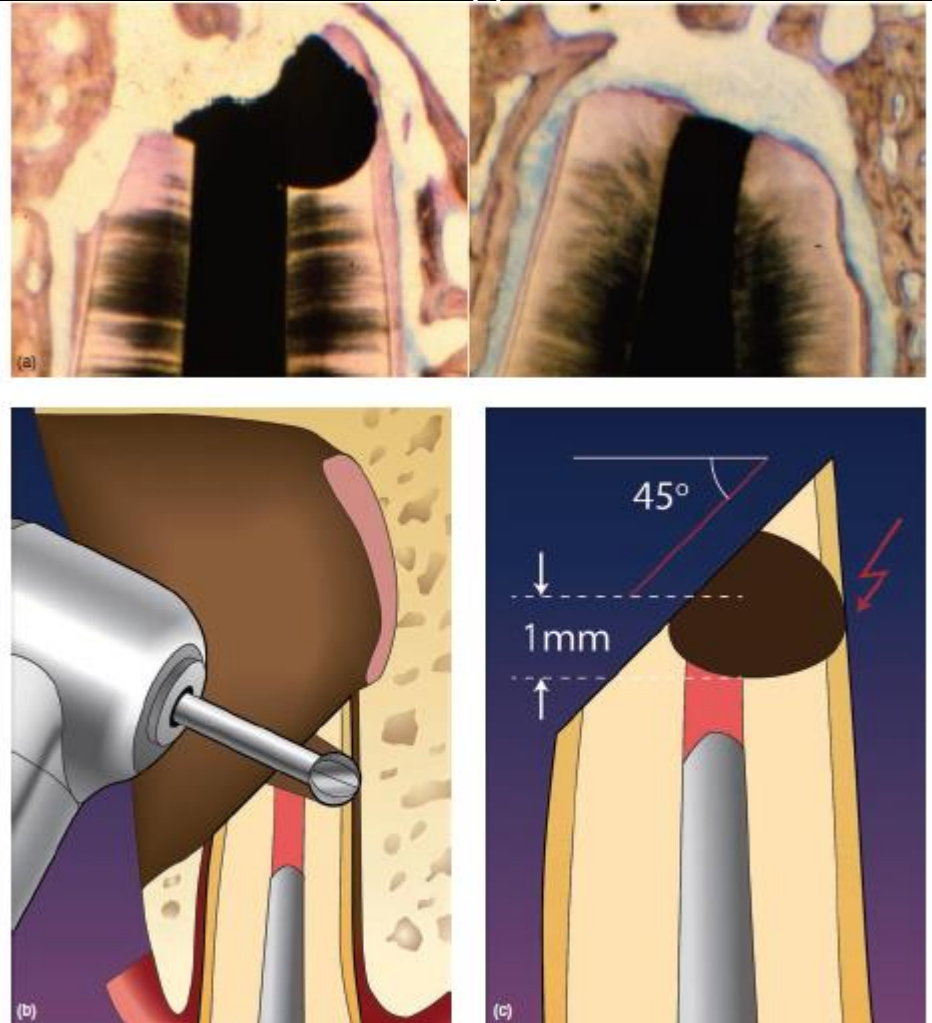
**Figure 10.1** The ideal root end preparation can be defined as a Class I cavity at least 3 mm into root dentine after the apical root tip of 3 mm is resected, with walls parallel to and within the anatomic outline of the root canal space.

○ They also identified **five requirements** that a root-end preparation must fulfill:

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

- The traditional root-end cavity preparation technique involved the use of a contra angle and a small round or inverted con

○



**Figure 10.2** Preparation with an old microhandpiece. (a) Histological images of root end preparations in dog teeth by a bur (left) and ultrasonic tip (right). The bur preparation nearly resulted in a lingual perforation, while the ultrasonic preparation preserved the integrity of the root apex and remained along its long axis. (b) and (c) Preparation with a bur ends up in a dome-shaped preparation rather than a Class I cavity preparation and therefore retention of the root end filling material is compromised.

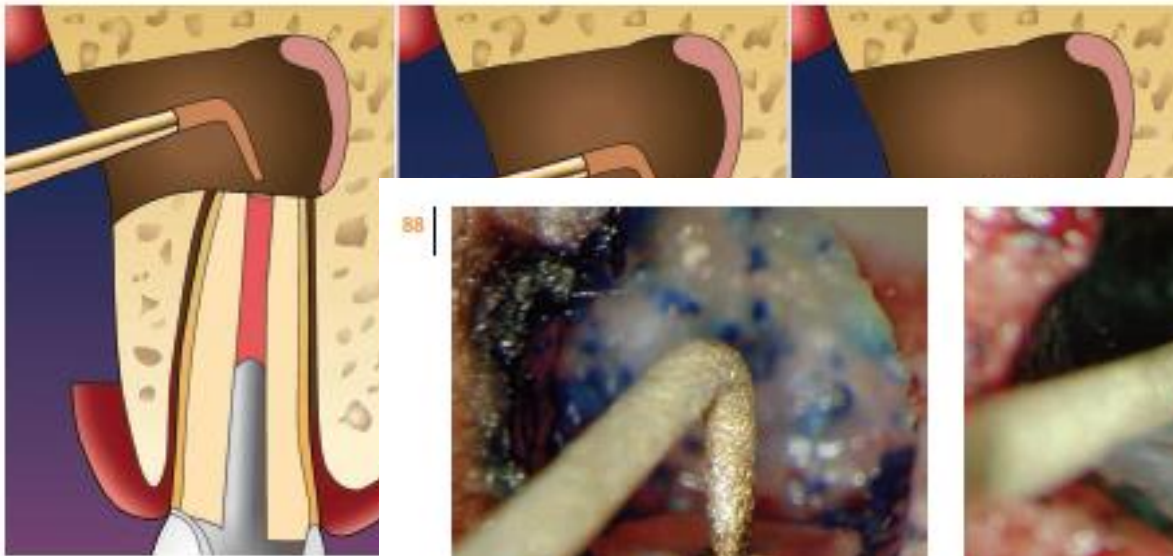


Figure 10.4 Schematic drawing shows alignment. This mistake sometimes res

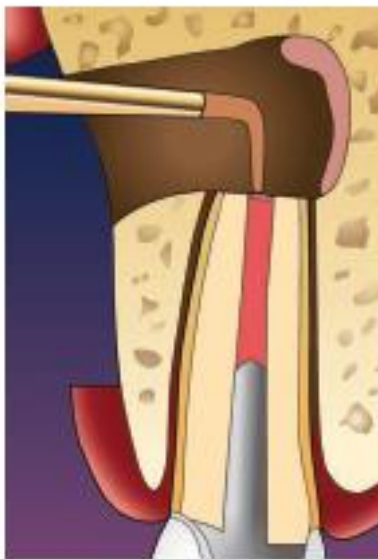


Figure 10.5 Schematic drawing shows root.

88



Figure 10.8 Tooth #7: (a) root end preparation on tooth #7 (magnification  $\times 16$ ); (b) when root end preparation is done in the correct direction, gutta percha is "walking" out of the preparation (magnification  $\times 16$ ).

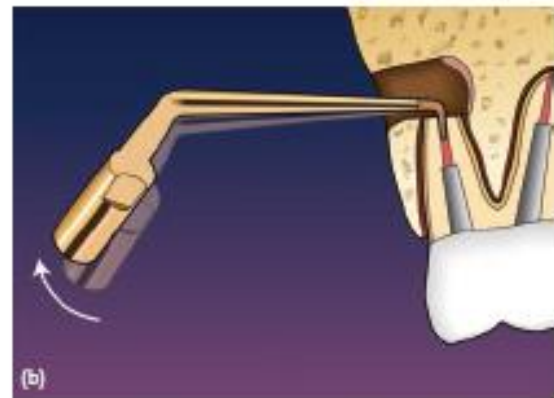
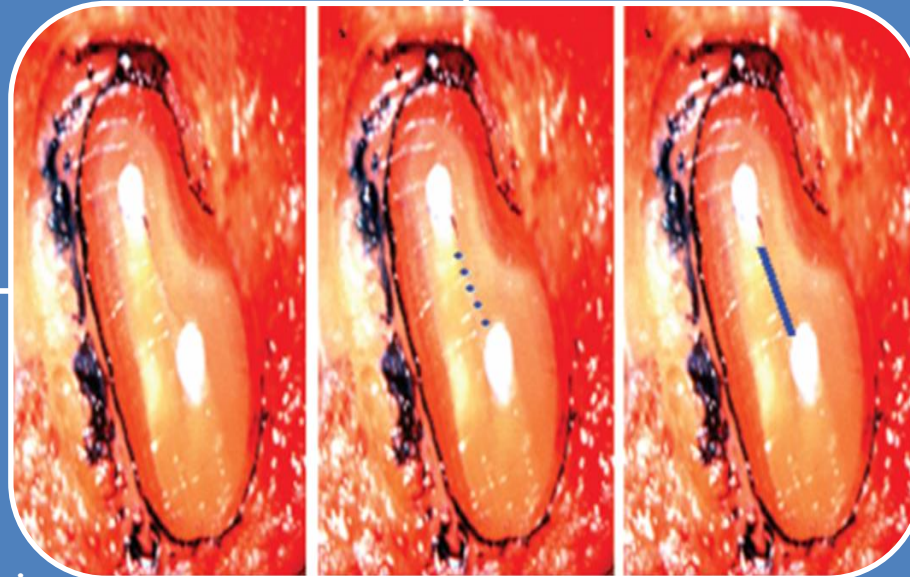


Figure 10.9 Inspection of root end preparation. (a) A small part of gutta percha is left (arrow) on the buccal wall of the prepared root end cavity. (b) In order to remove this excess gutta percha, the ultrasonic tip can be angled buccally so that the end of the tip will vibrate against the facial wall and gradually loosen the remaining filling material.

- The use of ultrasonic instrumentation is especially useful in the preparation of an isthmus.

With the CT-1 tip **inactivated and no water spray**, place the pointed tip exactly where desired and just lightly 'tap' the rheostat for an instant.

The process is repeated, until there are a **series of 'dots'** created on the isthmus



After the groove is deep enough to guide the tip, the **water spray** is turned back on and the preparation is **deepened to 3mm** while using a similar small, pointed tip

Dots are connected then, to create the initial '**tracking groove**'. It eliminates the chances of **slipping off the tip**.

# PLACEMENT AND FINISHING OF ROOT- END FILLINGS

## IDEAL PROPERTIES

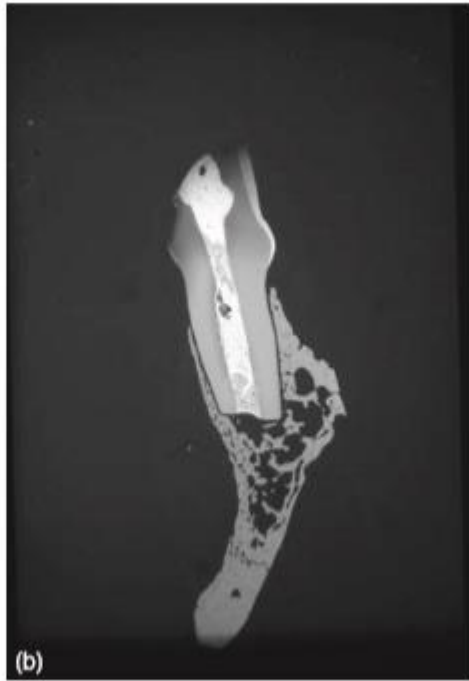
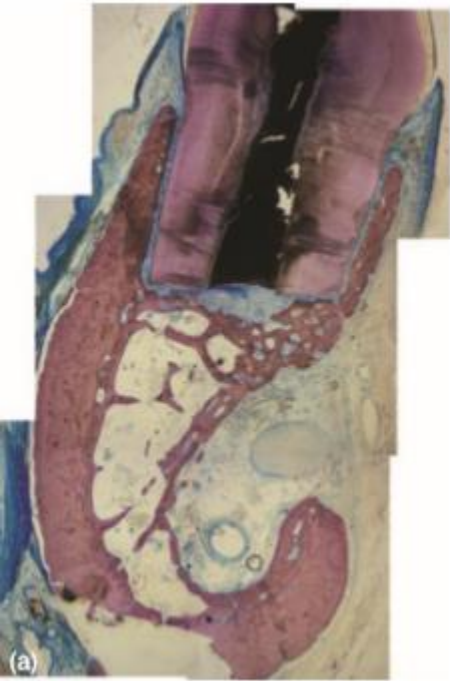
1. Provide for easy manipulation and placement with adequate working time.
2. Maintain dimensional stability after being inserted.
3. Seal the REP completely.
4. Conform and adapt easily to the various shapes and contours of the REP.
5. Be biocompatible and promote cementogenesis.
6. Be non-porous and impervious to all periapical tissues and fluids.
7. Be insoluble in tissue fluids, not corrode or oxidize.

8. Be non-resorbable.
9. Be unaffected by moisture.
10. Be bacteriostatic, or not encourage bacterial growth.
11. Be radiopaque, or easily discernable on radiographs.
12. Not discolor tooth structure of the surrounding tissues.
13. Be sterile, or easily and quickly sterilizable immediately before insertion.
14. Be easily removed if necessary.
15. Be non-carcinogenic, and non-irritating to the periapical tissues.

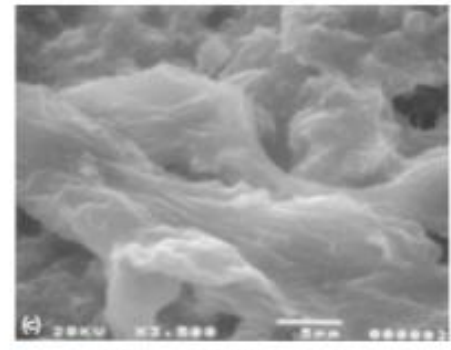
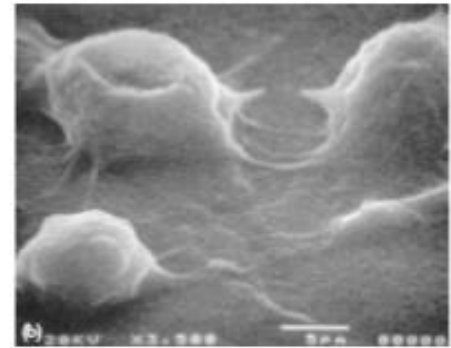
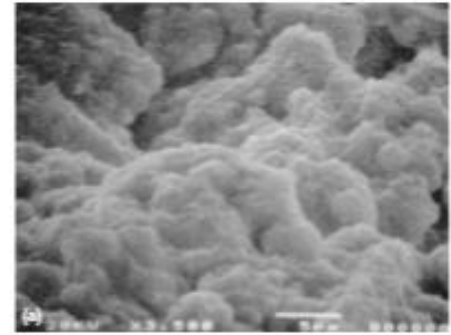


# MTA

- It is mainly composed of tricalcium silicate, tricalcium aluminate, and tetracalcium aluminoferrite in addition to small amounts of other mineral oxides.
- Bismuth oxide is added to render the mix radiopaque.
- MTA is *biocompatible* and hydrophilic and seems to provide *excellent sealing* properties that are not affected by contamination with blood.
- MTA has a high pH, similar to calcium hydroxide.

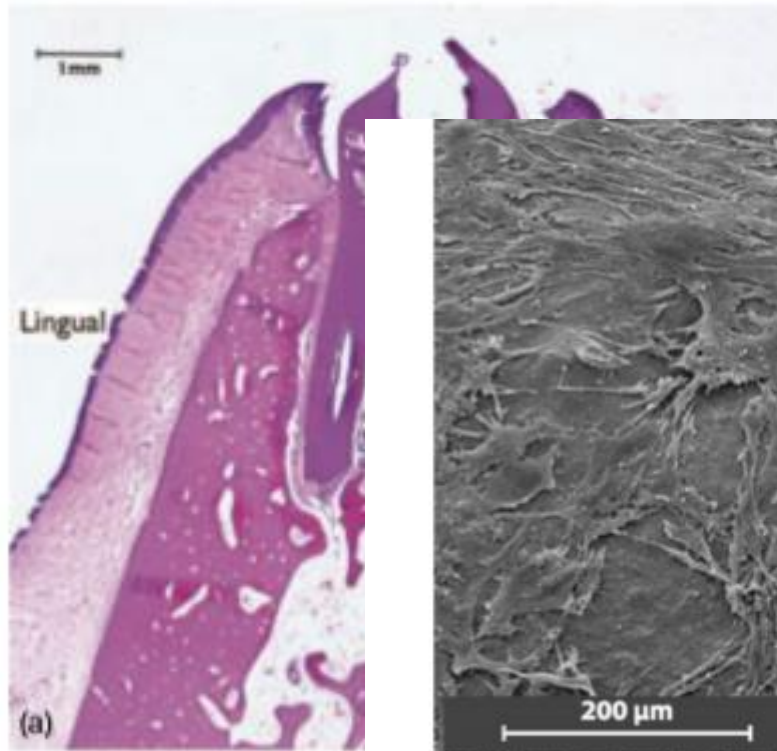


**Figure 11.1** Dog root apex with ProRoot MTA: (a) histology; (b) micro CT.

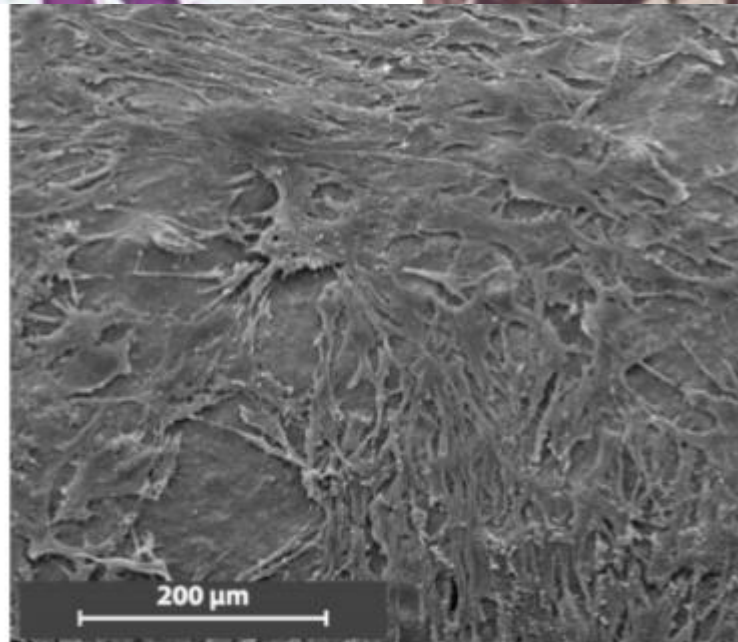


**Figure 11.2** SEM pictures of MDPC-23 cells on (a) plastic plate, (b) and (c) ProRoot MTA; high magnification of cell grown on ProRoot MTA.

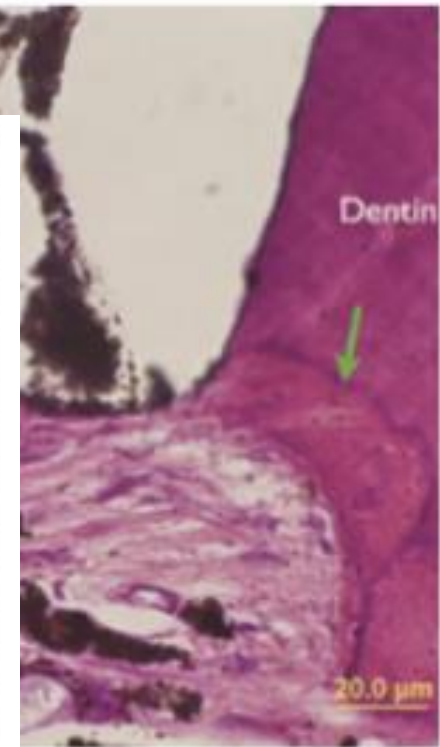
Root end filling material to dye, fluid, and bacterial penetration when compared to other



**Figure 11.4** Periapical tissue re-establishment of buccal c inflammatory cells were found in the periapical area near the exit of the root canal. RRM remnant in periapical tissue did not induce inflammatory reaction (yellow arrow). Cementum-like tissue formed on the resected root end surface and RRM root end filling (green arrow) with fibrous insertion from the adjacent PDL-like tissue.



**Figure 11.5** PDL stem cells attach and spread well on the surface of RRM, suggesting the material is biocompatible.



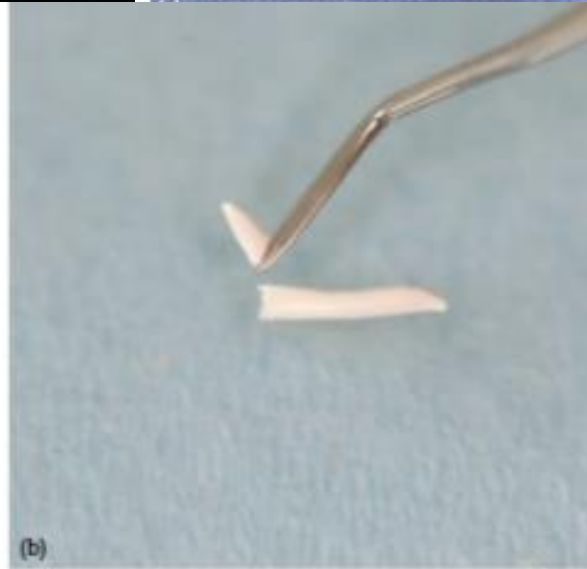
Overview of cross-section: the root end surface. No inflammatory reaction in the periapical area. Cementum-like tissue formed on the resected root end surface and RRM root end filling (green arrow) with fibrous insertion from the adjacent PDL-like tissue.

# MANIPULATION

- The correct powder/water ratio is 1 part powder to one part sterile water.



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**Figure 11.5** Bioceramic putty can be rolled to form a cylinder with the desired diameter. The operator can use MTA carrier to pick up the adequate length of Bioceramic and place it into the root-end cavity.

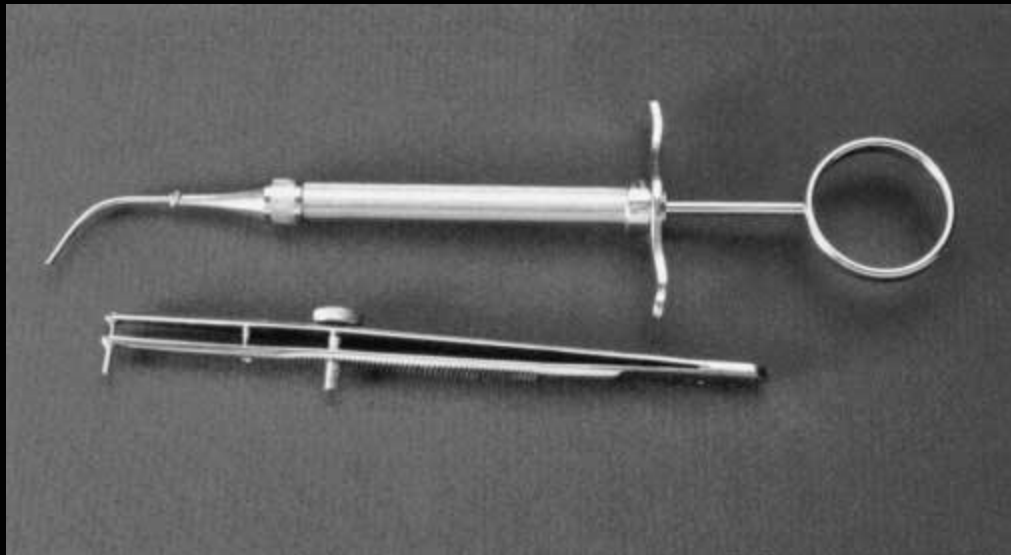
manageable



**Figure 11.6** Use of MTA block. MTA block was designed by cutting grooves into a 0.5 inch x 0.5 inch x 2 inch plastic block. (a) Mixed MTA is filled into a groove of the MTA block. (b) and (c) Small amount of MTA pellet is scooped out of the grooves using a carrier.

## Available carriers

- Retrofill Amalgam Carrier
- KG Carrier
- The Messing Root Canal Gun
- Dovgan MTA Carriers
- The MAP System



# SOFT-TISSUE REPOSITIONING AND SUTURING

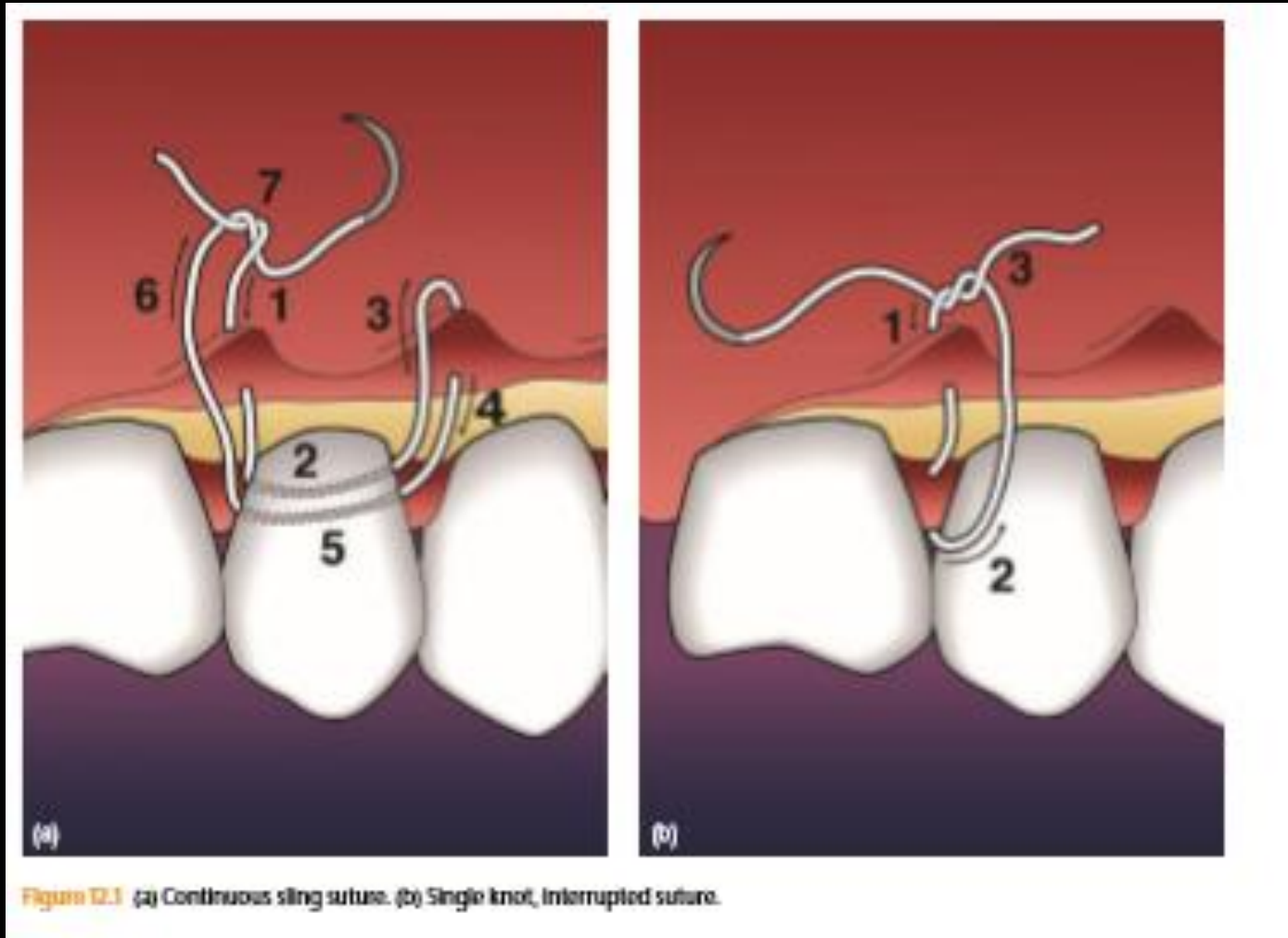
- **Thorough examination** of the underside of the flap, between the mucoperiosteum and the alveolar bone, should be done before repositioning the flap to remove any debris or foreign material that may be present.

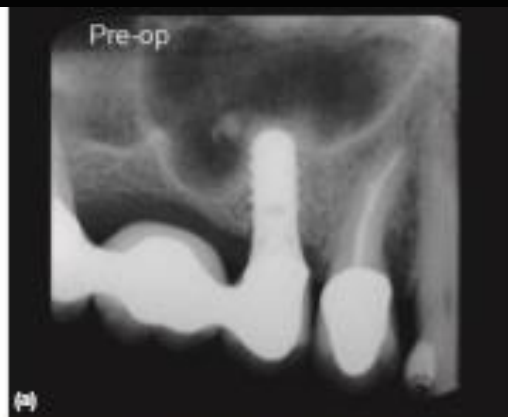
## Repositioning and Compression

- The elevated mucoperiosteal tissue should be gently **replaced to its original position** with the incision lines approximated as closely as possible.

## ○ Suture Techniques

- The continuous sling suture and the single knot interrupted suture are the most commonly used types of suture in endodontic microsurgery





**Figure 12.4** A triangular submarginal flap was raised to reach and curettage the apical third of tooth #5. (a) Preop radiograph; (b) pre-operative presentation of the soft tissue; (c) incision; (d) flap elevation; (e) to (h) synthetic monofilament 6.0 sutures, whose knots are not tied on the incision line; (i) to (j) sutures removed after 72 hours.

**Figure 12.4** (Continued) (m) and (n) 2 month follow-up; (o) and (p) 4 month follow-up. The incision line not visible.

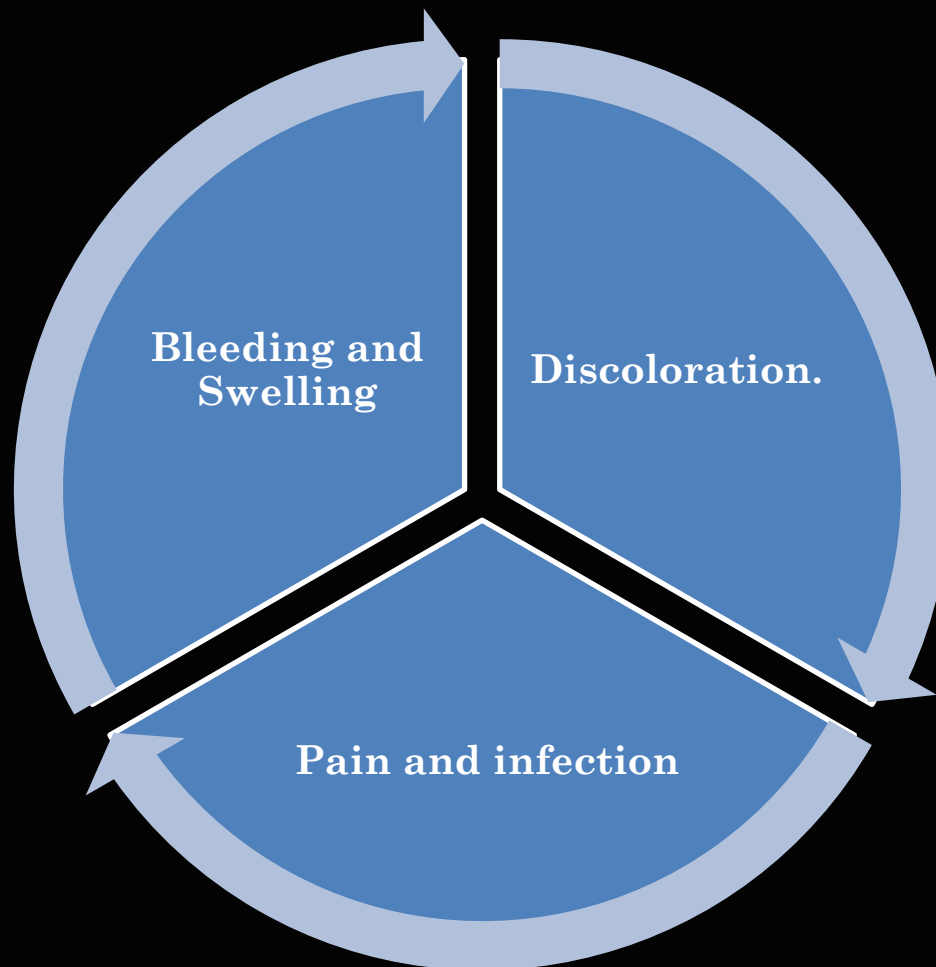
# POSTSURGICAL CARE

application of  
ice pack to the  
surgical site

Strenuous  
activity,  
smoking, and  
alcohol should  
be avoided

Oozing of  
blood from the  
surgical site is  
normal for the  
first 24 hours

# POST OPERATIVE PROBLEMS



## CONCLUSION

- Enhancement in magnification illumination, microsurgical instruments, ultrasonics and root end filling all have contributed to the rapid evolution of periradicular surgery.
- With proper case selection and treatment planning, periradicular surgery can be considered as a predictable, cost effective alternative to extraction and tooth replacement.

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THANK YOU!!