Periradicular surgery

Why does root canal treatment fail?

- anatomical considerations
  - uncleansed root canal system
  - missed root canals
- coronal & apical leakage
- periodontal problems
- resistant micro-organisms
- periradicular tissue considerations
  - infection
  - cystic change
  - foreign body
extra-radicular infection
- Tronstad et al. 1990
- Nair et al. 1990
- Abou Rass & Bogon 1998
- Su et al. 2010
- Wang et al. 2012

indications for periradicular surgery
indications

if failure is likely following conventional root canal re-treatment

failure after nonsurgical treatment where re-treatment would be impossible or would not achieve a better result

biopsy of periradicular tissues is required

contraindications for periradicular surgery

contraindications

patient factors - psychological and systemic

practitioner - experience and expertise

anatomical - unusual bony / root configurations
lack of surgical access
pre operative assessment

is non-surgical retreatment possible?

is there a cyst or extra radicular infection / foreign body

are there any major structures that could cause difficulties?

pre operative assessment

cone beam CT

extent and position of lesion
structures that may affect treatment
Surgical versus non-surgical endodontic re-treatment for periradicular lesions

M Del Fabbro¹, S Taschieri², T Testori², L Francetti², R L Weinstein²

¹Department of Odontology, IRCCS Galeazzi Institute, University of Milan, Milan, Italy.
²Department of Odontology, University of Milan, Milan, Italy
Kvist T, Reit C.

Kvist T, Reit C.

Danin et al.

<table>
<thead>
<tr>
<th>What do we need for good surgery?</th>
</tr>
</thead>
<tbody>
<tr>
<td>compliant patient</td>
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<tr>
<td>good anaesthesia</td>
</tr>
<tr>
<td>good access</td>
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<tr>
<td>haemostasis</td>
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<tr>
<td>skilled operator</td>
</tr>
</tbody>
</table>
and the right tools!

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**Periradicular surgery with the microscope**

- Identification of apex: difficult, precise
- Osteotomy: large (10mm), small (5mm)
- Root surface inspection: difficult, easy
- Bevel angle: acute (45°), shallow (<10°)
- Isthmus identification: impossible, easy
- Root-end preparation: approximate, coaxial to root
- Root-end filling: imprecise, precise

---

6 step best optics affordable
compliant and comfortable patient

a full explanation

analgesics

pre-operative

ibuprofen

400-600mg 30min preop

Ong et al Anesth Analg 2005;100:757-73
The efficacy of preemptive analgesia for acute postoperative pain management: a meta-analysis

Also
The efficacy of preoperative versus postoperative Rofecoxib for preventing acute postoperative dental pain: a prospective randomised crossover study using bilateral symmetrical oral surgery

rofecoxib

50mg 2hrs preop

reducing infection

pre-operative

chlorhexidine

rinse X3-5 the day before

Use of chlorhexidine gluconate for pre-operative disinfection of apicectomy sites.
anaesthetic considerations

anaesthesia

haemostasis

impact on $\alpha$ & $\beta$ tissue receptors

impact on tissue metabolism

1:80000

1:50000 epinephrine

1:100000

The efficacy and safety of articaine versus lignocaine in dental treatments: A meta-analysis

Vandana Khatu

School of Public Health, University of Sydney, Sydney, NSW, Australia

Results: Articaine is more likely than lignocaine to achieve an anaesthetic success in the posterior first molar area with a relative risk for success at 1.31 (95% CI 1.12-1.54, $P = 0.0009$). There is no difference in post-injection adverse events between articaine and lignocaine with a relative risk of 1.05 (95% CI 0.66-1.65, $P = 0.85$). However, articaine injection results in a higher pain score as measured by Visual Analogue Scale, than lignocaine at the injection site after anaesthetic reversal with a weighted mean difference of 6.49 (95% CI 0.02-12.96, $P = 0.05$) decreasing to 1.10 (95% CI 0.38-2.02, $P = 0.02$) on the third day after injection.

failure of local anaesthesia

injection site

pooling

inflammation

barrier for normal electrolyte exchange

pH = or > 6.0

reduced excitability threshold
it is necessary to provide haemostasis when using local anaesthesia with nerve block techniques. Additional injections at the surgical site are required.

Reactive hyperaemia results from local tissue hypoxia and acidosis caused by prolonged vasoconstriction.

**Access to the surgical site**

- Flap design and incisions
- Full mucoperiosteal flaps
- Limited mucoperiosteal flaps
sulcular incision
full mucoperiosteal flaps

advantages

good surgical access and orientation of apex
rapid wound healing potential
minimal disruption of blood supply
primary intention healing

full mucoperiosteal flaps

disadvantages

loss of soft tissue attachment level
loss of crestal bone height
postsurgical flap dislodgement
limited mucoperiosteal flaps
advantages

gingival margin not involved
unaltered soft tissue attachment level
crestal bone not exposed

limited mucoperiosteal flaps
disadvantages

disruption of blood supply
flap shrinkage
difficult flap reapproximation
delayed secondary healing
limited view of apical tissues and surgical access impossible to predict bone loss apically
scarring especially semilunar

Luebke Oschenbein

incision should be at 45° to mucosal surface
Chindia ML, Valderhaug J. East Af Med J 1995

Periodontal status following trapezoidal and semilunar flaps in apicectomy

20 patients assigned to one type closed with BSS, removed after 1wk
No difference in pocket depth or attachment level
trapezoidal produced less scarring

Complex regional pain syndrome
Type 2
Specialised flap designs

Velvart P. Papilla base incision: a new approach to recession-free healing of the interdental papilla after endodontic surgery.
Int Endod J 2002;35:453-60

Papilla healing following sulcular full thickness flap in endodontic surgery
**An excellent review!**

### Soft Tissue Management in Endodontic Surgery

Peter Velmart, DMD, and Christine I. Peters, DMD

*J Endod 2005; 31: 4-16*

### Quality of life after microscopic periradicular surgery using two different incision techniques: a randomized clinical study

M. Del Fabbro, S. Taschieri & R. Weinstein

Department of Health Technologies, ICOT Institute Dentopolis Galbani, University of Milan, Milan, Italy

- **Abstract**
  

- **Aim**
  
  To monitor the quality of life of patients after periradicular surgery when two different flap designs were used.

- **Methodology**
  
  Forty patients with teeth having a periradicular lesion of endodontic origin were included according to specific inclusion criteria. Patients were randomly assigned to two groups. In one group, a scalpel incision (SI) with complete papilla mobilization was used, and in the other group a papilla-base incision (PBS) was used. Periradicular surgery was performed using a surgical microscope. Parameters related to the health of the patients were recorded daily in the first week post-surgery using a questionnaire. Pain was evaluated with a 0-100 visual analog scale (VAS).

- **Conclusions**
  
  The papilla-base incision technique may be preferred as a reduction of pain levels, swelling, and drug intake were more rapid in the first week postoperatively compared with cases in which a scalpel incision was used.

### Apical & marginal healing after perirad surgery


59 patients

- Radiographic exam, pocket depth and perio attachment
- 85% successful or uncertain after 1 year

- Loss of attachment
  
  Heal 0.15mm
  
  Non-heal 0.85mm
flap retraction

groove bone to allow seating of retractor

avoid pinching of flap

serrated surface to retractor avoids slip

The Saunders retractor!

flap retraction

time of retraction important

keep irrigated with sterile saline
osteotomy

management of the hard tissues

bone removal

start with a curette to peel away the bone
use a round steel / diamond bur
copious water coolant
shaving technique without pressure

Root-end management
in surgical endodontics

Retain or ?

Remove
root-end resection

indications

removal of pathological material
removal of anatomic variations
removal of iatrogenic errors in apical region
access to periradicular soft tissue lesion

if possible remove 3mm of root-end

root-end resection

use high-speed handpiece (Impact air)
with diamond or tungsten carbide bur
or
straight handpiece with tapered fissure tungsten carbide surgical bur
root-end resection

bevel depends on:
  root inclination and curvature
  number of roots
  thickness of bone
  position of root in bone
  technique for root-end preparation

leakage through the resected tooth

Gilheany PA et al. JOE 20 1994
Apical dentin permeability and microleakage associated with root-end resection and retrograde filling

in vitro study using hydraulic conductance
apical resection - 0, 30, 45 deg
depth of root-end filling increased

leakage with ↑ bevel

leakage with ↑ depth of root-end filling

isthmuses
accessory canals
cracks
root filling
c- shaped canals
misplaced root-end fillings
periradicular curettage

indications

removal of infected and reactive tissue
removal of necrotic cementum
gain access to the root
remove overextended root fillings
obtain a biopsy

Lin L, Gaengler P Langeland K
Periradicular curettage
Int Endod J 1996 29 220-7

root-end preparation and filling

probably always necessary

3mm deep if possible

smooth root surface
  - fine diamond / tungsten carbide bur

consider 10:3 citric acid: ferric chloride

root-end identification

micro-mirrors
mesial root of mand first molars
mesio-buccal root of max first molars
3mm deep
use ultrasonics inc back-action tip
plug softened gutta-percha into root canal

Gutmann JL et al  Int Endod J 1994

ultrasonic root-end prep - SEM

• surface debris assessment
• smear layer
• ultrasonic v bur v bur+acid rinse
Wuchenich G et al  J Endod 1994

Root-end preparation - ultrasonic vs bur

• retention - cleanliness - parallelism
• cadavers/prep/extract/section/photo/SEM
• Ultrasonic- parallel walls/deeper preps/
  follow canal/cleaner surface

Abedi et al Oral Surg  1995

ultrasonic prep and root apex

• bur vs ultrasonic
• 2 machines - ENAC/Neosono
• CT-2 tip/3mm/2 min prep
• SEM of replicas
• Ultrasonic = increase number of cracks

Waplington M, Lumley PJ, Walmsley AD
Oral Surg 1997; 83: 387-92

Incidence of root face alteration after
ultrasonic retrograde cavity preparation

ultrasonic prep of resected root apex:
different power settings

no root cracking but some chipping
Surgical endodontics

Haemostasis in periradicular surgery

Int Endod J 1996 29 135-49

Witherspoon D & Gutmann JL

Haemostasis in surgical endodontics

**Local agents**

- adrenaline coated pledgets
- Ferric sulphate
- bone wax
- gelatin sponge
- tissue adhesives
- Fibrin sealants
- adrenaline coated pledgets

**Haemostatic agents**

- non-collagen based
- Astringedent
- Cut-Trol
- Ferric sulphate
- necrotizing agent of low pH (0.8-1.6)
- coagulates proteinaceous material near normal healing BUT surgical wound must be curetted and irrigated with saline (Jeansomme et al)
- Expasyl
- Aluminium chloride AlCl₃

von Arx
Aluminium chloride and kaolin

Haemostatic agents
non collagen based

Wellisz et al
J Craniofac Surg 2006; 17: 420-5

Momota et al

Hydroxyapatite putty

Water-soluble alkylene oxide copolymers
Haemostatic agents

**collagen based**

- Collacote
- Collaplug
- Collastat
- Instat
- Hemofibrine
- Hemocollagene
- Bioguide


- Collacote +/- epinephrine in bony crypt of humans
- no changes in BP or pulse rate
- provided good haemostasis

Haemostasis in surgical endodontics

epinephrine-impregnated cotton balls
Dorn SO, Gartner AH J Endod 1990

Super EBA v IRM v Zn-free Amalgam

• retrospective study - 488 cases
• recall 6 months to 10 years
• super EBA & IRM > than Amalgam
• Am 75% / IRM 91% / Super EBA 95%
Rud et al J Endod 1997

dentine-bonded composite root-end fillings

• 551 teeth
• sealed with Gluma-Retroplast
• 2-4y recall (92%, 85%, 81%)
• failures: loose root filling, not filled
• 21 roots - resurg - 76% after 1 year

Andreasen JO et al J Endod 1993

2 teeth extracted - histological exam
dentine bonding and resin root-end filling

• pdl formation
• lamina dura
• cementum - intimate contact
• Sharpey’s fibres inserted
• biological closure - cementogenesis

Mineral Trioxide Aggregate
MTA as root end filling
monkeys
histological exam after 5 months
no perirad inflamm in 5/6 MTA
cementum formation in 5/6 MTA
all amalgams had inflamm and no cementum

dry the root-end cavity with Stropko or paper points
great care!!!

Messing gun
Dovgan carrier
MAP system
Dentsply
closure of the surgical site

reapproximation
compression
stabilisation

stabilisation

sutures
non-absorbable
natural absorbable
synthetic absorbable

sutures
non-absorbable: silk, nylon
natural absorbable: gut, collagen
synthetic absorbable: PGA, polyglactin

Tevdek
braided polyester
PTFE

needle
length
arc
Harrison JW Jurosky KA

Wound healing in the tissues of the periodontium following periradicular surgery 1. The incisional wound

J Endod 1991 17, 425-35
vital connective tissue remain attached to root surface on reflection of flap. Preservation prevents apical epithelial down-growth vitality of root attached tissues preserved by: preventing dehydration avoiding curettage of root surfaces flap retraction technique that eliminates force on intrasulcular incisional wound site

Harrison JW Jurosky KA

Wound healing in the tissues of the periodontium following periradicular surgery 2. The dissectional wound

J Endod 1991 17, 544-552
The dissectional wound
Harrison JW Jurosky KA
1991

Healing is rapid although slower than incisional wound
granulation tissue replaces fibrin clot in wound site
as early as 4d after surgery
 replaced by granulation tissue by 14d
periosteum does not survive
cambium layer destroyed
collagen undergoes depolymerization
depolymerized collagen plays a role in rapid
reattachment of flapped tissue to bone

Harrison JW

Healing of surgical wounds in oral mucoperiosteal tissues

J Endod 1991 17, 401-8

removal of sutures

after 48 hrs and no longer than 96 hrs
epithelium, glycosaminoglycans,
glycoproteins, myofibroblast-fibronectin
network provide barrier to dislodgement

Rapid wound healing is common
post-operating treatment

compression of tissues for 3-5min with surgical gauze dampened in sterile saline after suturing

post-operative care

NSAIDS
Outcomes

Long-term evaluation of surgically placed amalgam fillings
amalgam root end-fillings. Long term review >10yrs
60 of 104 teeth (57.7%) successful

Rud J, Rud V, Munksgaard EC. J Endod 1996
Retrograde root fillings with dentine-bonded modified resin composite
351 root-end fillings with Retroplast; examined after 1 year
80% complete healing; 2% scar
12% uncertain; 6% failure

Apicectomy: a comparative clinical study of amalgam and glass ionomer cement as apical sealants
105 root-end fillings with amalgam or glass ionomer examined after 1 year
91% success for amalgam
89% for glass ionomer

Dorn SO. Gartner AH. J Endod. 16, 1990
Retrograde filling materials: a retrospective success-failure study of amalgam, EBA, and IRM.
Retrospective study 488 cases
success rates 75% amalgam 91% IRM 95% Super EBA

Treatment outcome of surgical and non-surgical management of endodontic failures.
Review of literature
success rate of 66% uncertain healing 11% failure 23%

Grung B et al J Endod, 16, 1990
Periapical surgery in a Norwegian county hospital: follow-up findings of 477 teeth
477 teeth treated by one surgeon
78% complete healing 9% incomplete healing 13% failure

Cheung LK, Lam J. Aust Dent J 1993
Apicectomy of posterior teeth - a clinical study
32 teeth success rate 62%
5 (16%) cases failed 3-6 months after surgery. Post surgical review of at least 6m recommended
Apicectomy on molars - a clinical and radiographical study
86 teeth; 70 teeth reviewed
success rate 73% incomplete 21% extracted 6%

Follow up after periapical surgery: the value of one year control
474 teeth reviewed after 1 y complete healing in 250 teeth
214 further follow up, 194 (91%) until stable
of 41 judged healed after 1 y, 2 failed later 1 year review advised

Treatment results of apical surgery in premolar and molar teeth
136 roots followed up for 6m-8y
success 44.1% doubtful 22.8% unsuccessful 33.1%

Treatment outcome of surgical and non-surgical management of endodontic failures.
Review of literature success rate 66% uncertain healing 11% failure 23%

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**Outcome of Endodontic Surgery: A Meta-analysis of the Literature—Part 1: Comparison of Traditional Root-end Surgery and Endodontic Microsurgery**

Frank C, Setter, DMD, PhD, MS, Sreela B. Shabi, BDS, DMD, Meelu R. Kobit, BDS, DMD, Bekir Karabacak, DMD, MS, and Syedek Kin, DDS, PhD

![Relative risk 1.58X](image)

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**A prospective clinical study of Mineral Trioxide Aggregate and IRM when used as root-end filling materials in endodontic surgery**

B. S. Chong, T. R. Pitt Ford & M. B. Hudson

Int Endod J 2003 36 520-526

**Table 4** The number of teeth filled with each material and the different modes of healing observed after 1 and 2 years

<table>
<thead>
<tr>
<th>Year 1 (n = 122)</th>
<th>Year 2 (n = 108)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>RM (n = 58)</td>
</tr>
<tr>
<td>Complete</td>
<td>24</td>
</tr>
<tr>
<td>Incomplete</td>
<td>25</td>
</tr>
<tr>
<td>Uncertain</td>
<td>8</td>
</tr>
<tr>
<td>Unsatisfactory</td>
<td>0</td>
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</tbody>
</table>
A comparative prospective randomized clinical study of MTA and IRM as root-end filling materials in single-rooted teeth in endodontic surgery

Jerome A. H. Lindhe, MD, DDS, Jost W. F. H. Freanken, DDS, Frans H. M. Kroon, DDS, PhD, and Hans P. van den Akker, DDS, PhD
Amsterdam

Results. Complete healing was observed in 64% of the MTA-treated teeth vs 50% of the IRM-treated teeth. Incomplete healing was seen in 21% (MTA) vs 36% (IRM), and unsatisfactory in 6% (MTA) vs 14% (IRM). Only 1 failure was seen (MTA). No statistically significant differences were found between the 2 retrofitting materials.

Taken together, both the studies by Lindeboom et al.4 and Chong et al.7 suggest that there may be a clinically relevant difference between MTA and IRM. Therefore, adequately powered randomized clinical trials need to be undertaken to investigate the efficacy of different root-end filling materials (as well as other treatment modalities frequently used in endodontic surgery). The many challenges and complexities of such trials, including the required sample sizes, should not deter investigators to plan and seek funding for well-designed, multicentered clinical trials. The studies by Chong et al.7 and Lindeboom et al.4 provide important and valuable preliminary data necessary for the planning of a definitive study and should be interpreted as such.

Thomas Dietrich, DMD, MD, MPH
Boston University
School of Dental Medicine
Boston, MA

A Prospective Clinical Study of Periradicular Surgery Using Mineral Trioxide Aggregate as a Root-end Filling

William Philip Saunders, BDS, PhD, FDS, RCSEdin, FDS, RCPS, FDS, RCS Eng, MRD, FHEA

Level 2C prospective consecutive outcome study
no comparator
micorsurgical microscope
miniblades bone removal
root-end resection ultrasonic preparation
root-end filling sutures
prospective cohort study

322 teeth

37 patients were not available for regular recall.

6 teeth had vertical root fractures at operation

277 teeth examined,

163 showed complete healing radiographically

82 teeth had progressive healing with no symptoms

33 teeth demonstrated failure.

the overall success rate was 89%.
Periradicular surgery

Outcomes of Nonsurgical Retreatment and Endodontic Surgery: A Systematic Review
Majdrosud, Xorかどう, M.D., MS, Robert Core, DDS, MS, Robert Hardysides, DDS, and Mehdrosh Shoja, DMD, MS, PhD
J Endod 2009 35 930-7

Results
2-4 years
Surgery (77.8%) vs Non Surgical (70.9%)
4-6 years
Surgery (71.8%) vs Non Surgical (83.0%)

cone beam CT

Use of computed tomography for diagnosis and follow-up after endodontic surgery: clinical case report with 8 years of follow-up
Mario Tanomura Filho, DDS, PhD; Regina K. P. Lima, DDS, MS; and Juliane M. G. Tanomura, DDS, PhD
ARAQUARA DENTAL SCHOOL, SÃO PAULO STATE UNIVERSITY

Computed tomography (CT) is a valuable tool for diagnosis and planning in conventional and surgical endodontic therapy. This case report describes the use of CT in the diagnosis of a periapical lesion unmasked by periapical radiography in the mandibular molar area. The CT also showed a possible root perforation associated with the lesion. Following CT, surgical planning, periradicular curettage, and sealing of the root perforation were performed. Eight years after surgery, cone beam CT revealed periapical bone repair. Computed tomography can be an important resource for diagnosis and planning in conventional and surgical endodontic therapy, as well as for evaluation of post-operative bone repair. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;109:629-633)

Periradicular surgery

Periapical radiography and cone beam computed tomography for assessment of the periapical bone defect 1 week and 12 months after root-end resection
B. Christiensen1, L. L. Kirkevang, E. Gofruben, and A. Wenzel

Conclusions: On average, the periapical bone defect measured on periapical radiographs was approximately 10% smaller than on coronally sectioned CBCT images 1 week post-operatively. More remaining defects were detected 1 year after periapical surgery on CBCT images than on periapical radiographs, but it is uncertain how this information is related to success or failure after root-end resection.

Cone beam CT
Resurgery

REVIEW
The outcome of endodontic resurgery: a systematic review

J. Peterson & J. L. Gutmann

Int Endod J 2001 34 169-175

Saunders 2008
Comparison of clinical outcome of periapical surgery in endodontic and oral surgery units of a dental teaching hospital: a retrospective study

strict radiographic criteria used to assess success
Rahbaran S, Gilthorpe MS, Harrison SD, Gulabivala MS 2001

Success rates

<table>
<thead>
<tr>
<th>Clinic</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endodontic clinic</td>
<td>37.4%</td>
</tr>
<tr>
<td>Oral Surgery clinic</td>
<td>19.4%</td>
</tr>
</tbody>
</table>

P=0.009

Treatment outcome affected by:

- technical quality of surgery  P<0.001
- placement of root-end filling  P=0.039
- absence of preop p/a lesion  P=0.042
- absence of post  P=0.047
- presence of adequate coronal rest  P=0.056
  odds ratio 3.71
How much endodontic surgery will there be in the future?

in the age of bonding
there may be more!!!

Thankyou