

Endodontics

Endodontics - terms

- Endodont (dentin + pulp)
- Pulp chamber
- Root canal
- Apical constriction
- Apical foramen
- Ramifications
- Radiographic apex
- Periodontal space

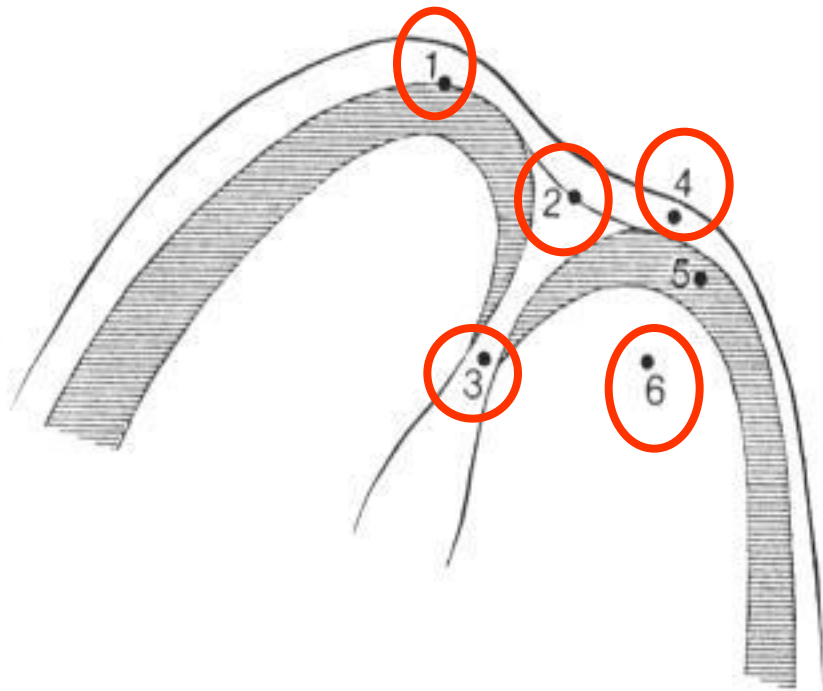
Morphology

- The root canal is not round it is usually oval (long axis mesiodistal direction)
- The root canal is not straight - it deflects distal
- Apical foramen is not on the top of the root but under it (distal or distooral side)

Morphology

- Between apical constriction and apical foramen the wall of root canal are divergent towards periodontal space
- The root canal system has usually more foramina (ramifications)
- The ramifications are situated mostly in apical area (first apical mm)
- All apical foramina are situated in cementum

Apical morphology



1. Rtg apex
2. Foramen apicale
3. Apikální konstriktce
4. Periodoncium
5. Cement
6. Dentin

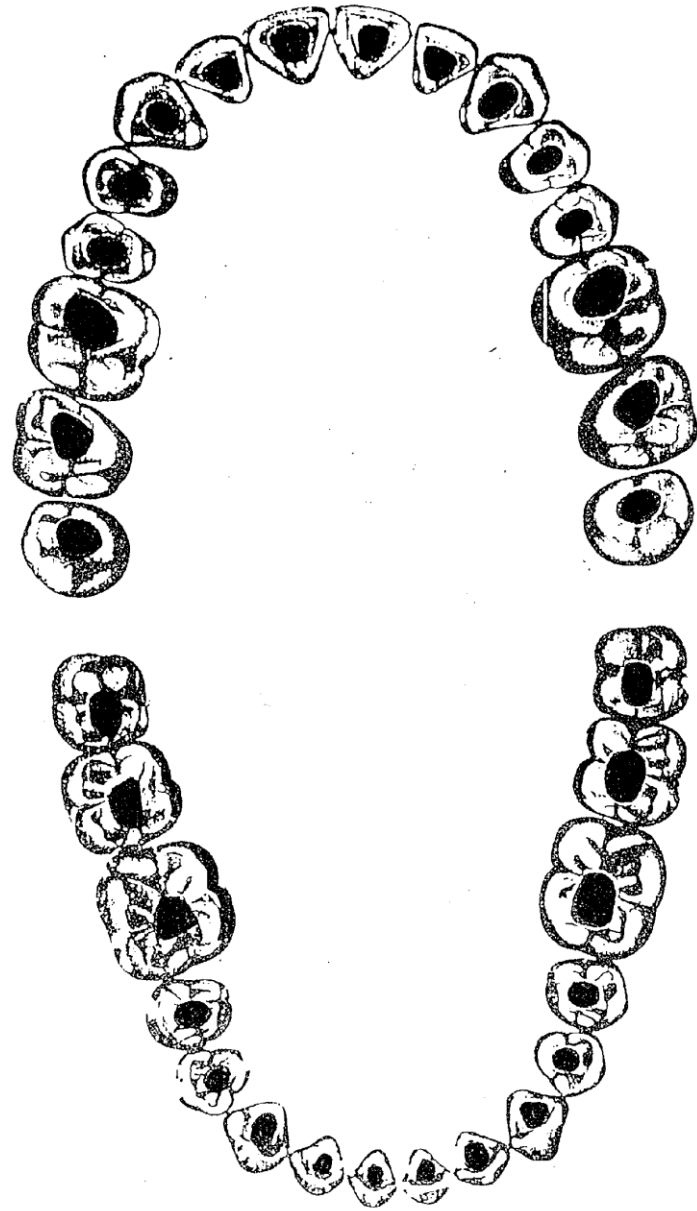
Phases of the endodontic treatment

- **Investigation, diagnostic radiogram, consideration (local, regional, systemic factors)**
- **Removal of old fillings, carious dentin, temporary restoration – rubber dam.**
- **Dry operating field**
- **Preparation of the access (endodontic cavity)**

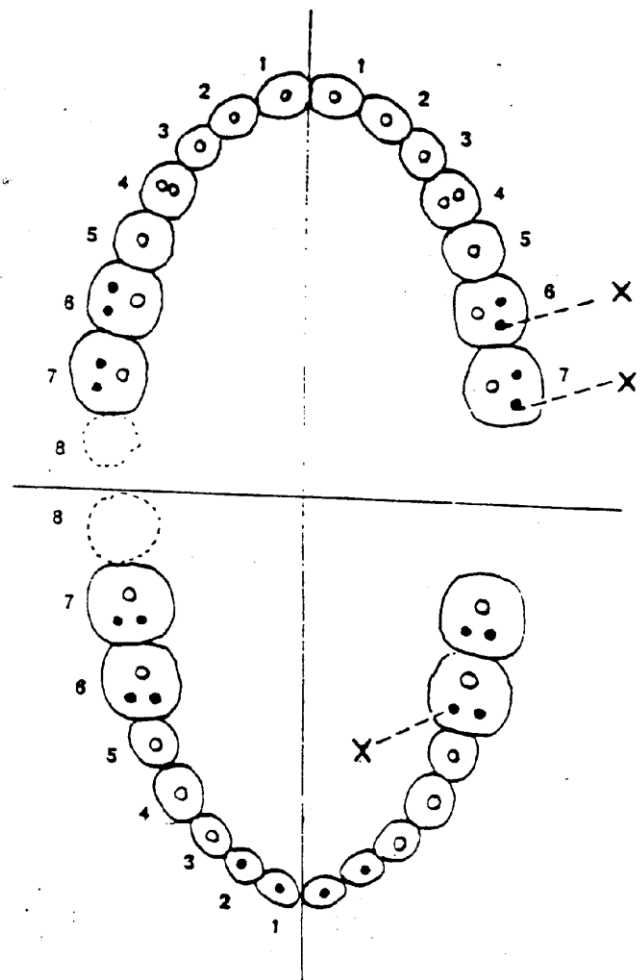
Phases of the endodontic treatment

- **Opening of root canals**
- **Initial flaring and removal of content of root canal**
- **WL (working length)**
- **Root canal shaping and cleaning (irrigation)**
- **Recapitulation, final irrigation**
- **Drying**
- **Filling**
- **Radiogram**
- **Postendodontic treatment**

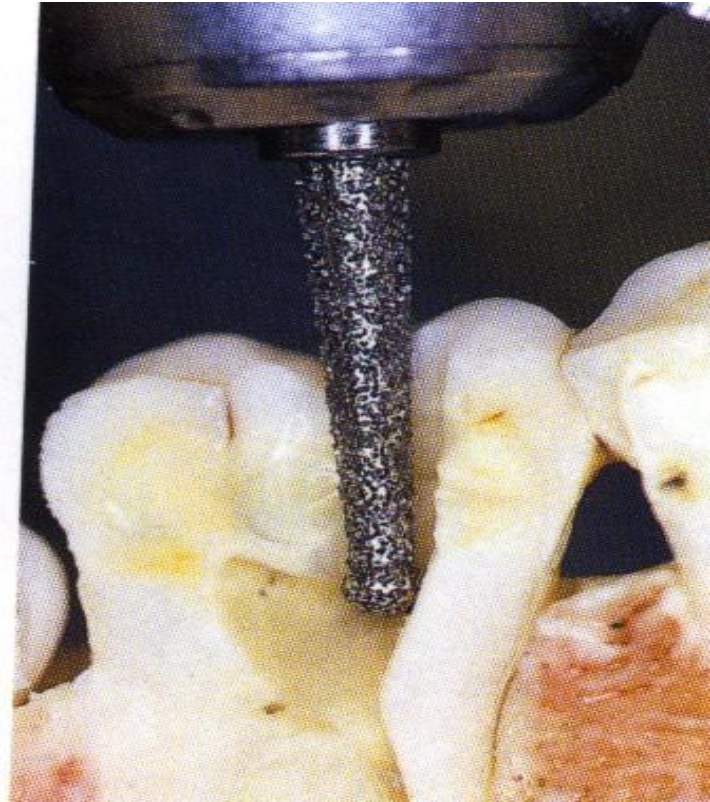
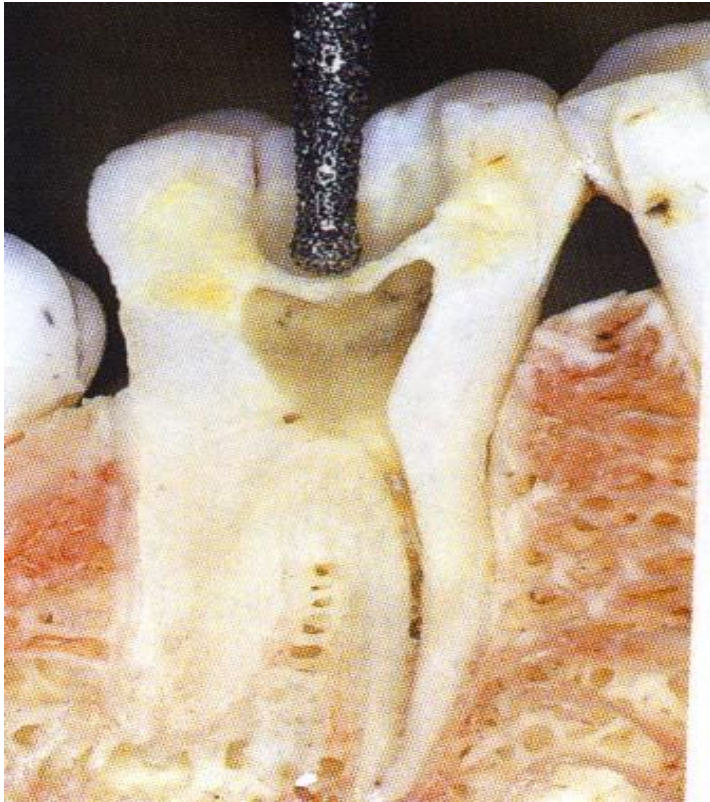
Shapes of endo cavities



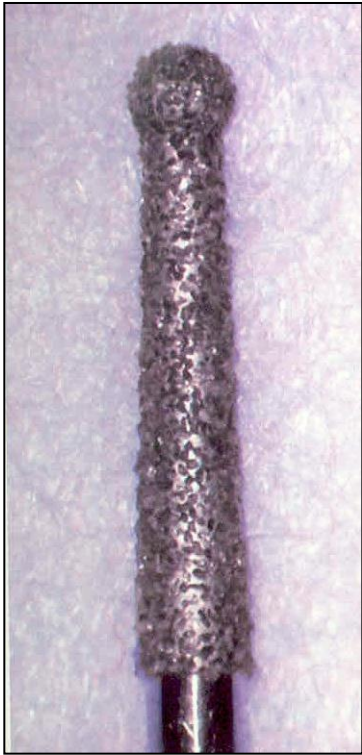
Number of root canals



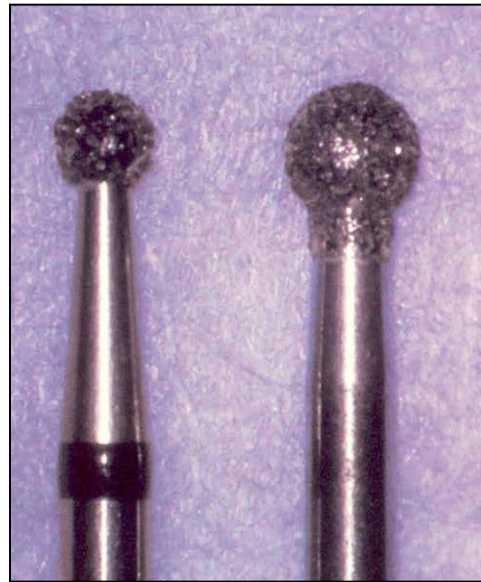
Access



Instruments



Dia trepan

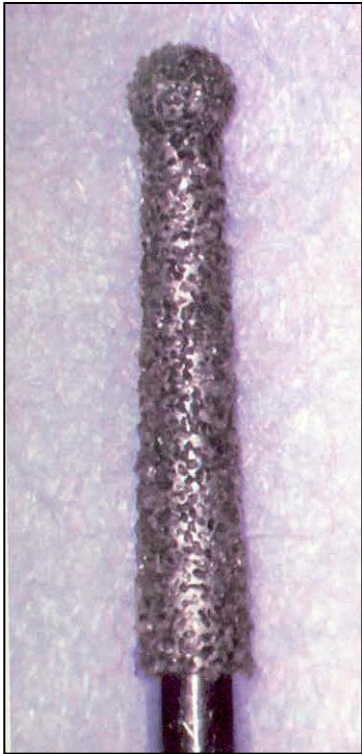


Dia balls



Ball burs

Preparation of the endodontic cavity



Dia trepan

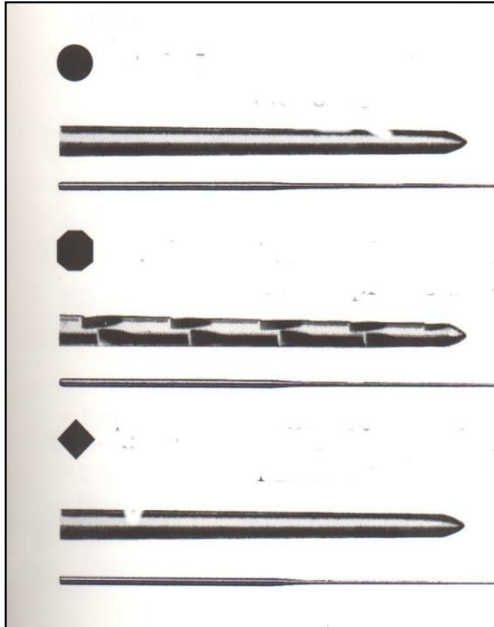


Safe ended tips
Batt's instruments

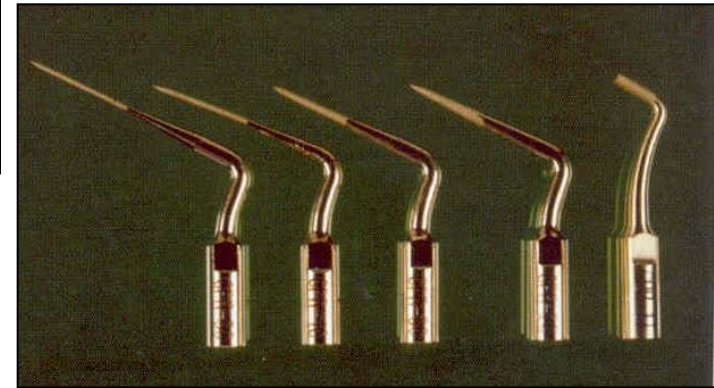


Fissur bur

Endodontic probes



↑
← Endodontic probes,
microopeners



Ultrasound tips

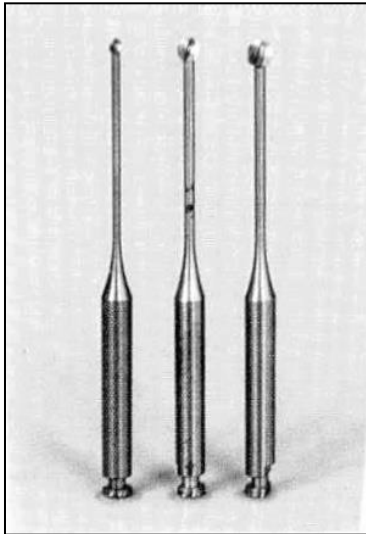


Dye

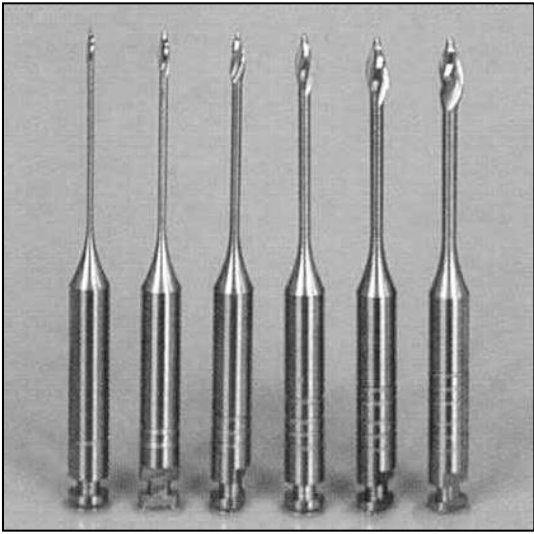
Opening of root canals



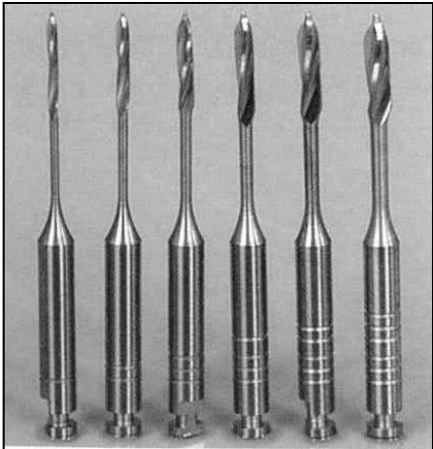
Ball burs



Miller's burs

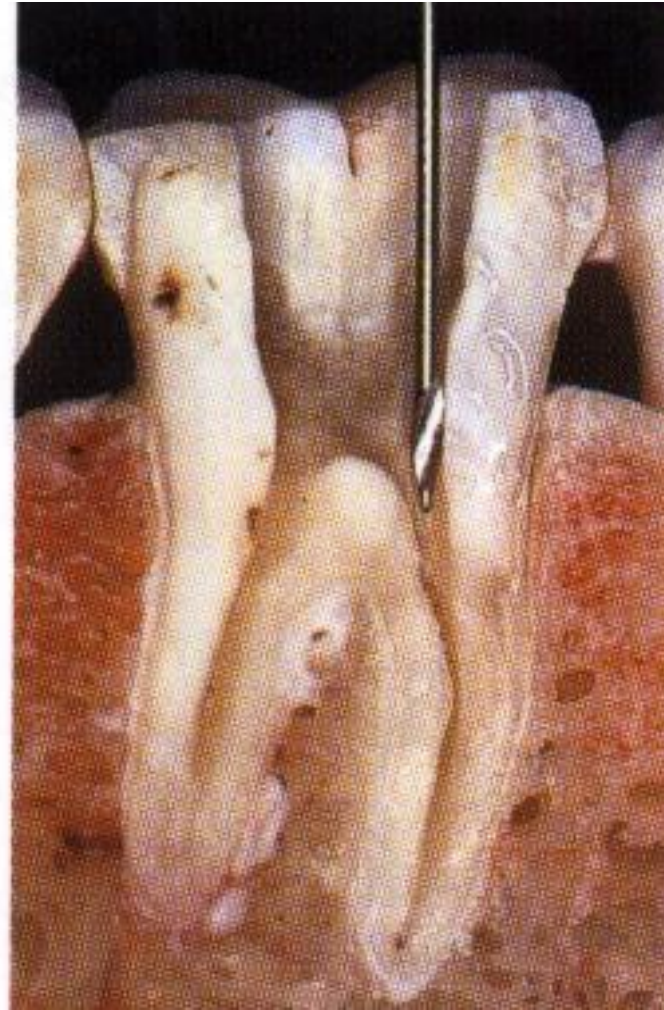
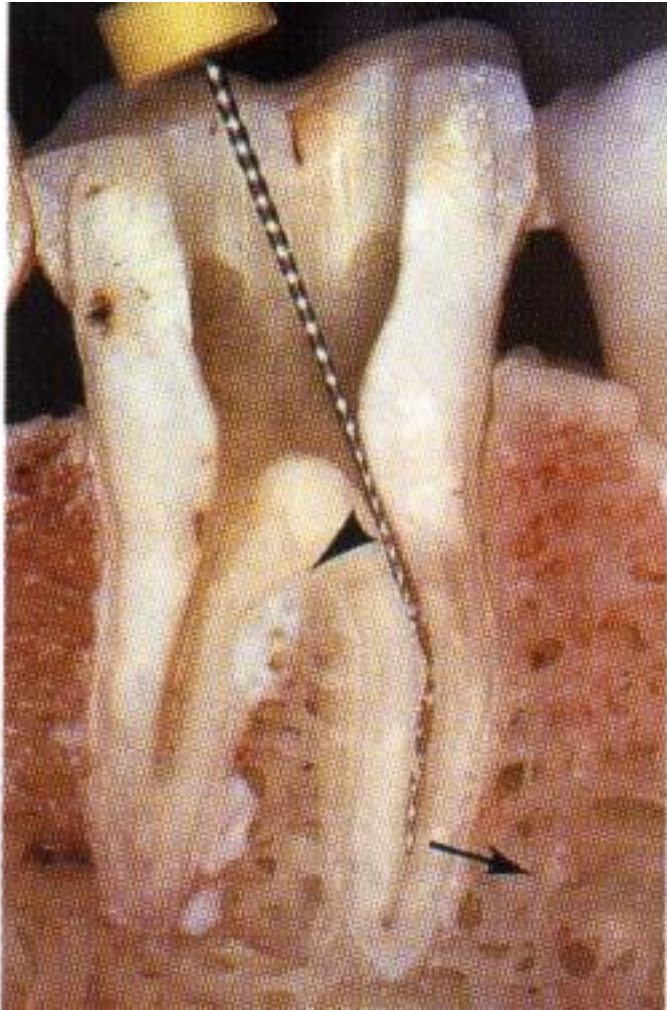


Gates Glidden's burs

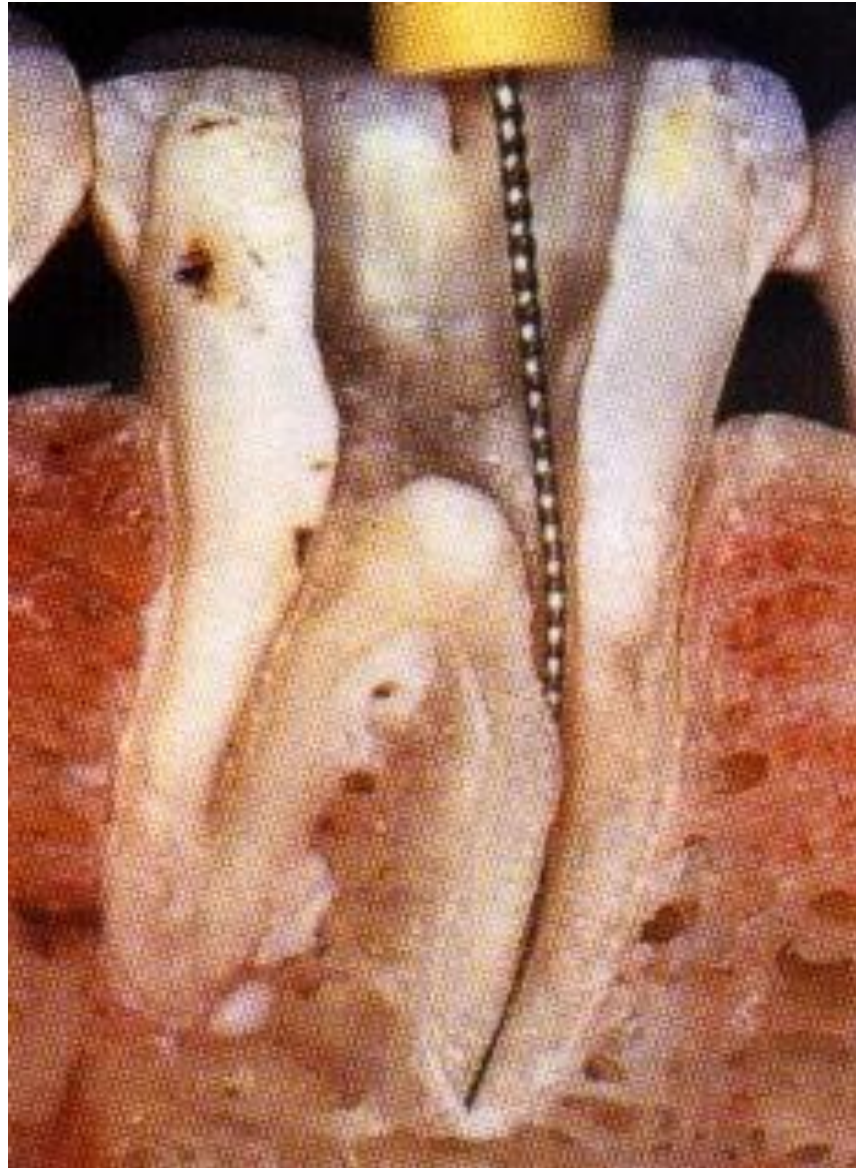


Peeso – Largo burs

Opening of the root canal



Insertion of root canal instrument after opening the pulp chamber and root canal orifice



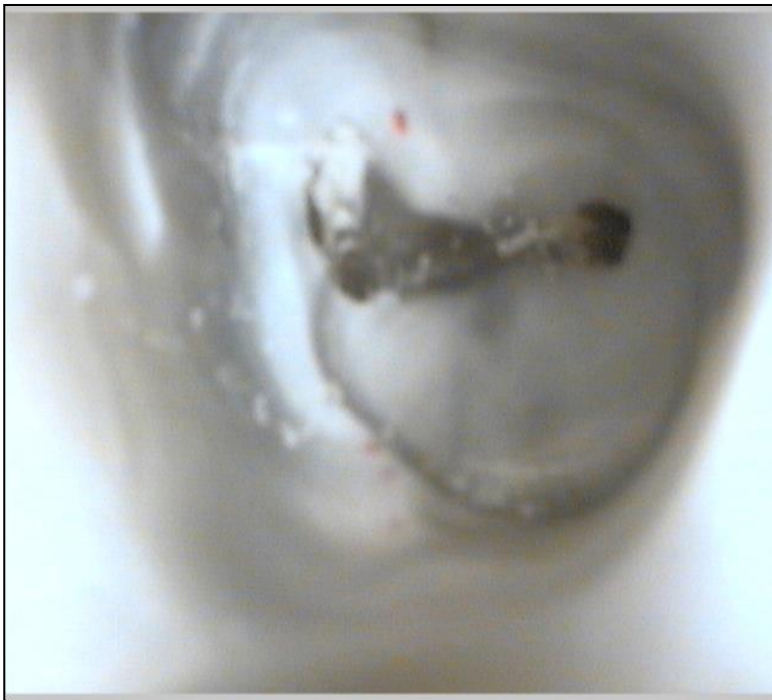


Access kits

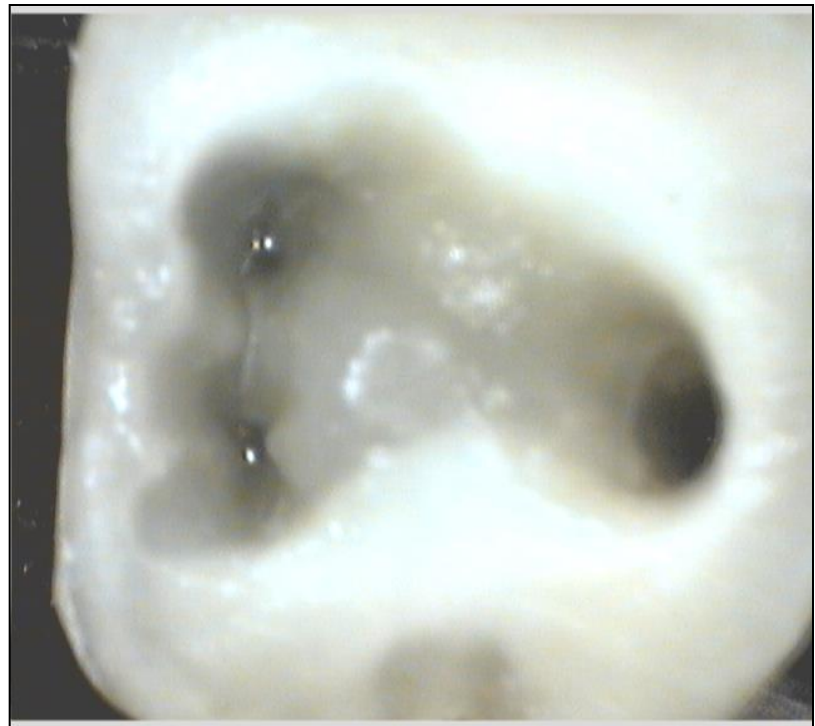


Access cavity

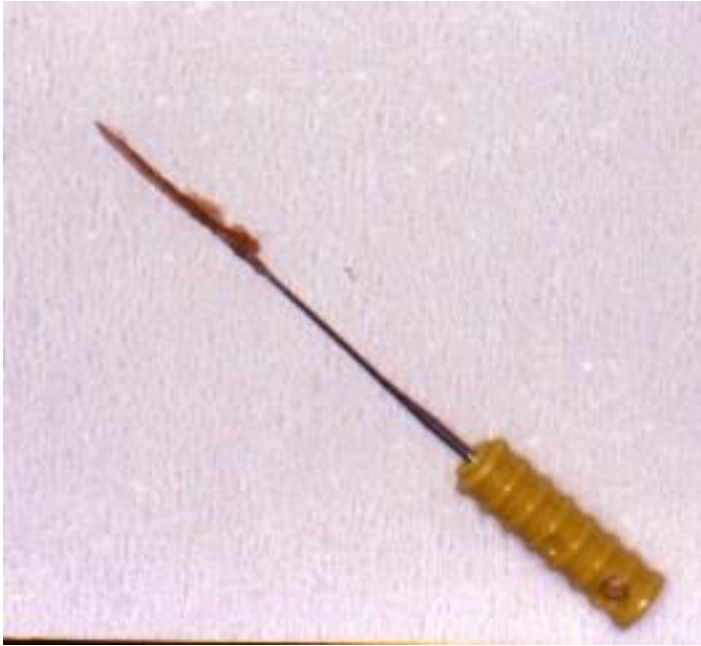
Incorrect



Correct



Pulpextractor



Soft wire
Prickles like harpune
Insertion
Contact with root canal wall – pull 1 mm
Rotation
Exstirpation during pull motion



Canal shaping

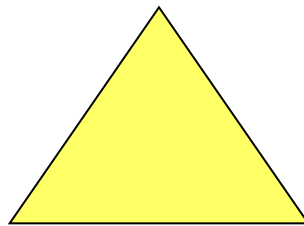
- Reamers (penetration)
- Files (shaping)

Reamer

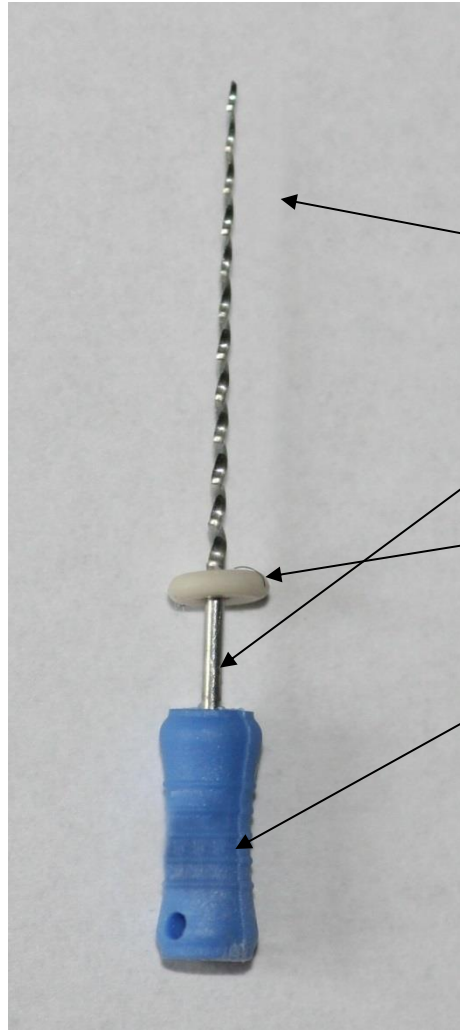
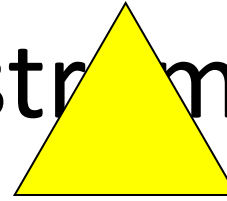
K -reamer

Triangl or square wire spun

Symbol



Parts of root canal instruments

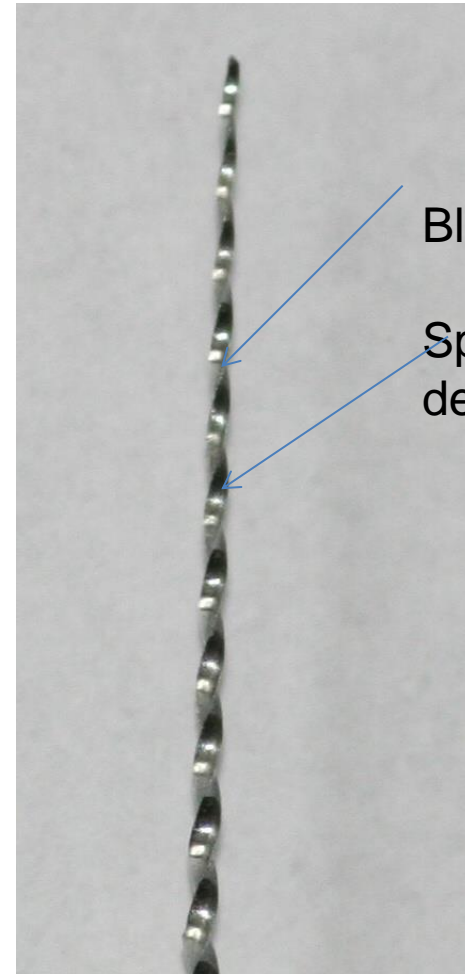


Bladed part

Shank

Stopper

Grip



Blades

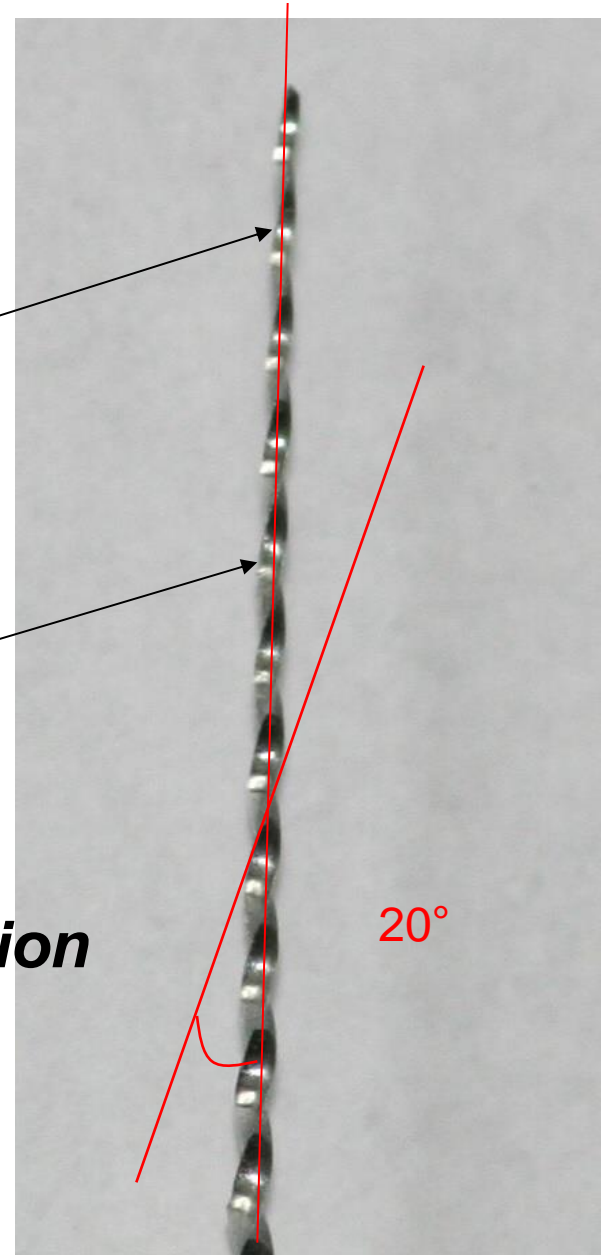
Space for dentin chips

Reamer

Blades

Space for dentin chips

Rotation – reaming action - penetration



Reamer

Rotation (clockwise) – penetration

**Application of plastic material
(counterclockwise)**

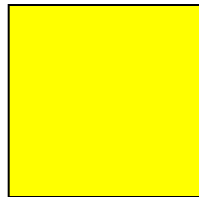
Files

- 1. K-file**
- 2. K-flexofile, flexicut, flex-R file**
- 3. K-flex**
- 4. H-file, S-file**

K file

Wire triangle or square

Symbol is always square

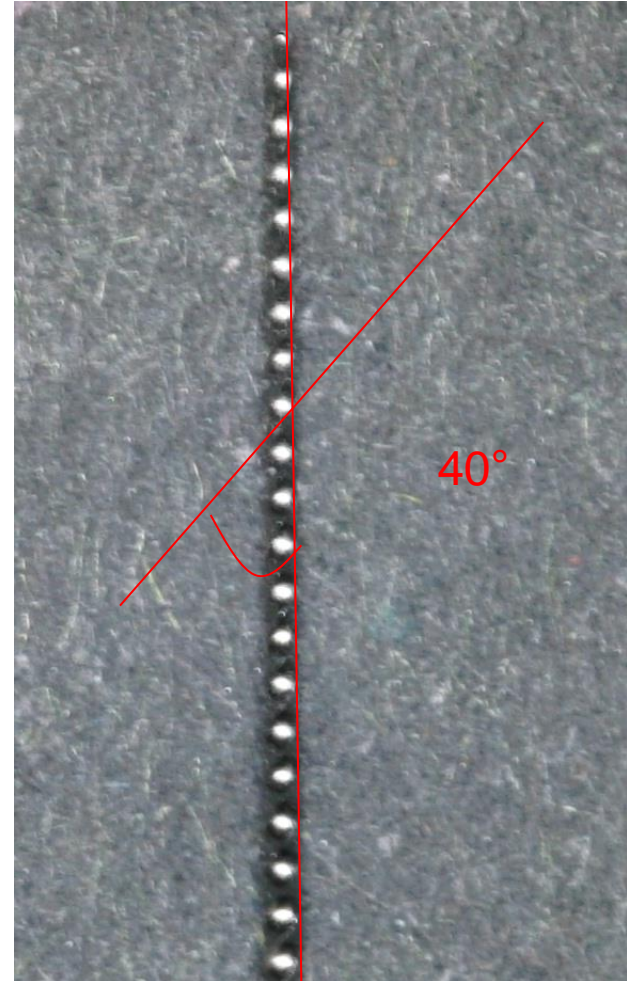


K-file

Filing

Also rotation

45° – 90°

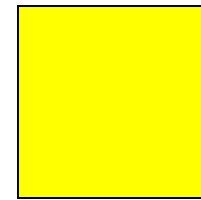


K-flexofile, flexicut, flex-R

- Triangle wire always



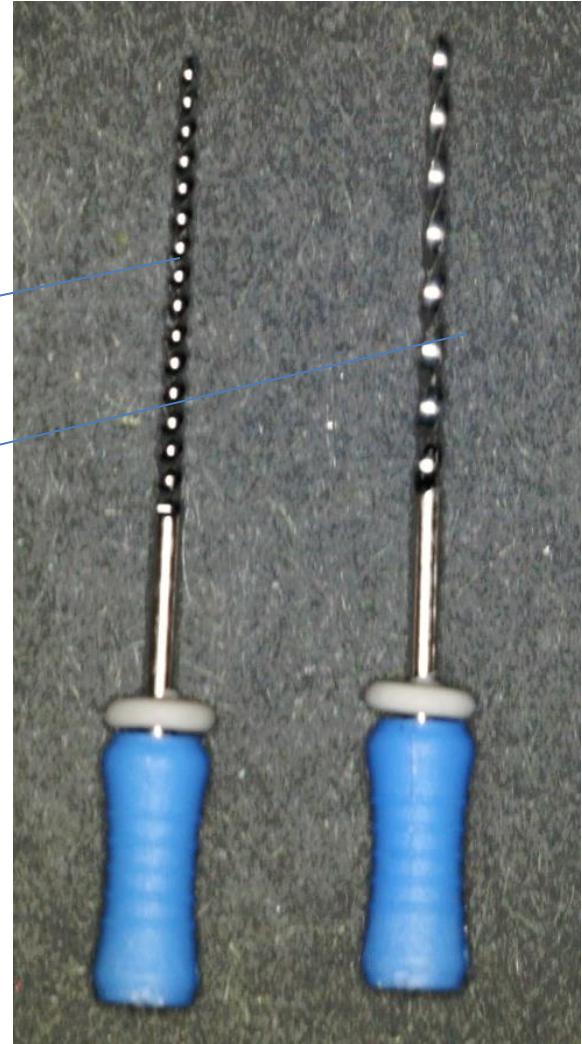
Flexibility



K- flexofile a flex – R file: non cutting tip and first blades are blunt

Like K-file

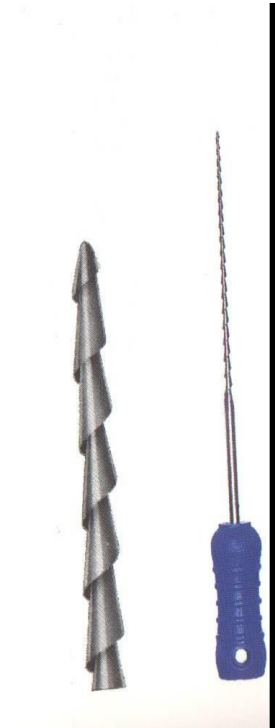
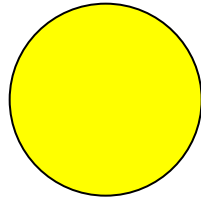
K-file and reamer



H-file

= Hedstroem file

Ring

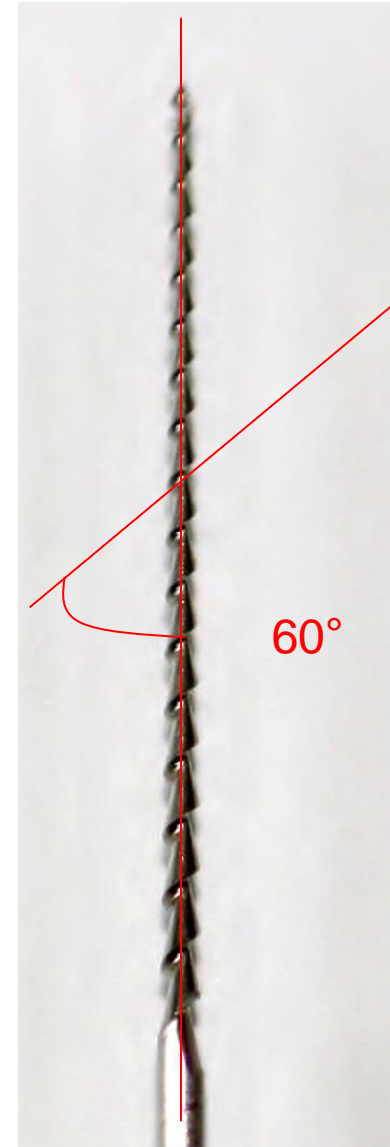
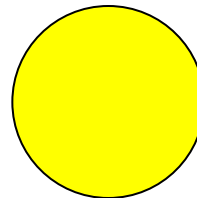


H- file

No rotation!!

Pull motion only!!

Risk of breakage in small sizes



ISO

- Diameter of the tip
- Length of the cutting part
- Taper



ISO standard

06

08

10

15

20

25

30

35

40

45

50

55

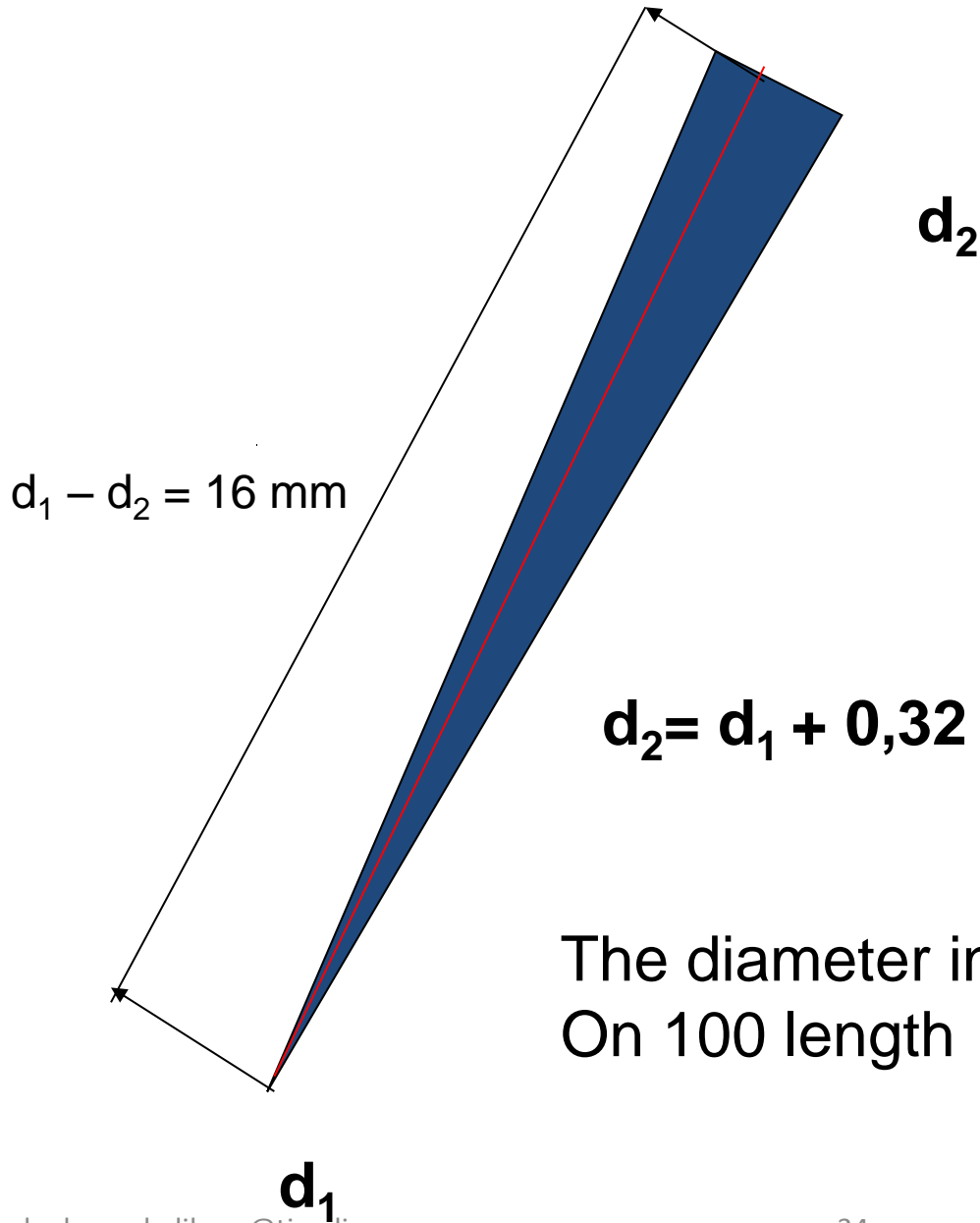
60

70

80

Size – diameter at the tip in mm/100

Taper 2%

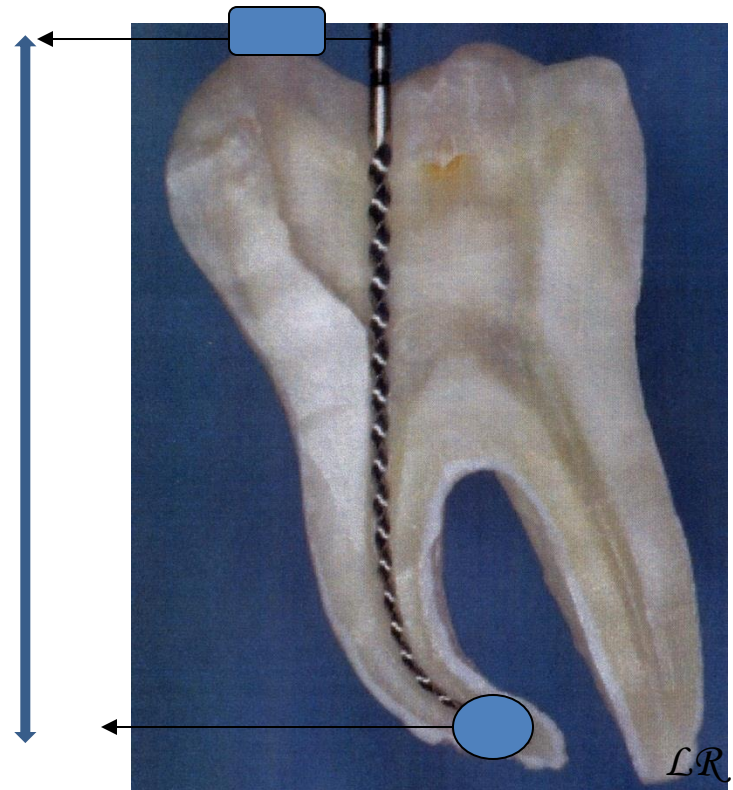


$$d_2 = d_1 + 0,32$$

The diameter increases for 0,02 mm
On 100 length

Working length

- Distance between the referential point and apical constriction
- Radiographically
- Apexlocators
- Combination



Why apical constriction

- Small apical communication
- Minimal risk of damage of periodontium
- Prevention of overfilling (extrusion of filling material)
- Prevention of extrusion of infection
- Good decontamination
- Good condition for root canal filling

Radiogram

X-ray with inserted root canal instrument

Safe length: average length of teeth reduced for
2 – 3mm

Tooth with clinical crown

Procedure

- Instrument ISO 15 introduced into the root canal, stop at the referential point
- Estimation of location of apical constriction (1 – 1,5 mm distance from x-ray apex.

If there is difference in the radiogram more than 2 mm - repeat

If 2 mm or less – add to the safe length

= **working length**

Safe length

- Maxilla:

I1 20

I2 18

C22-24

P20

M 18 mkk, 20 P

Safe length

- Mandible

I 18

C20 -22

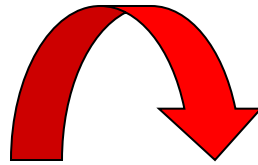
P18

M18

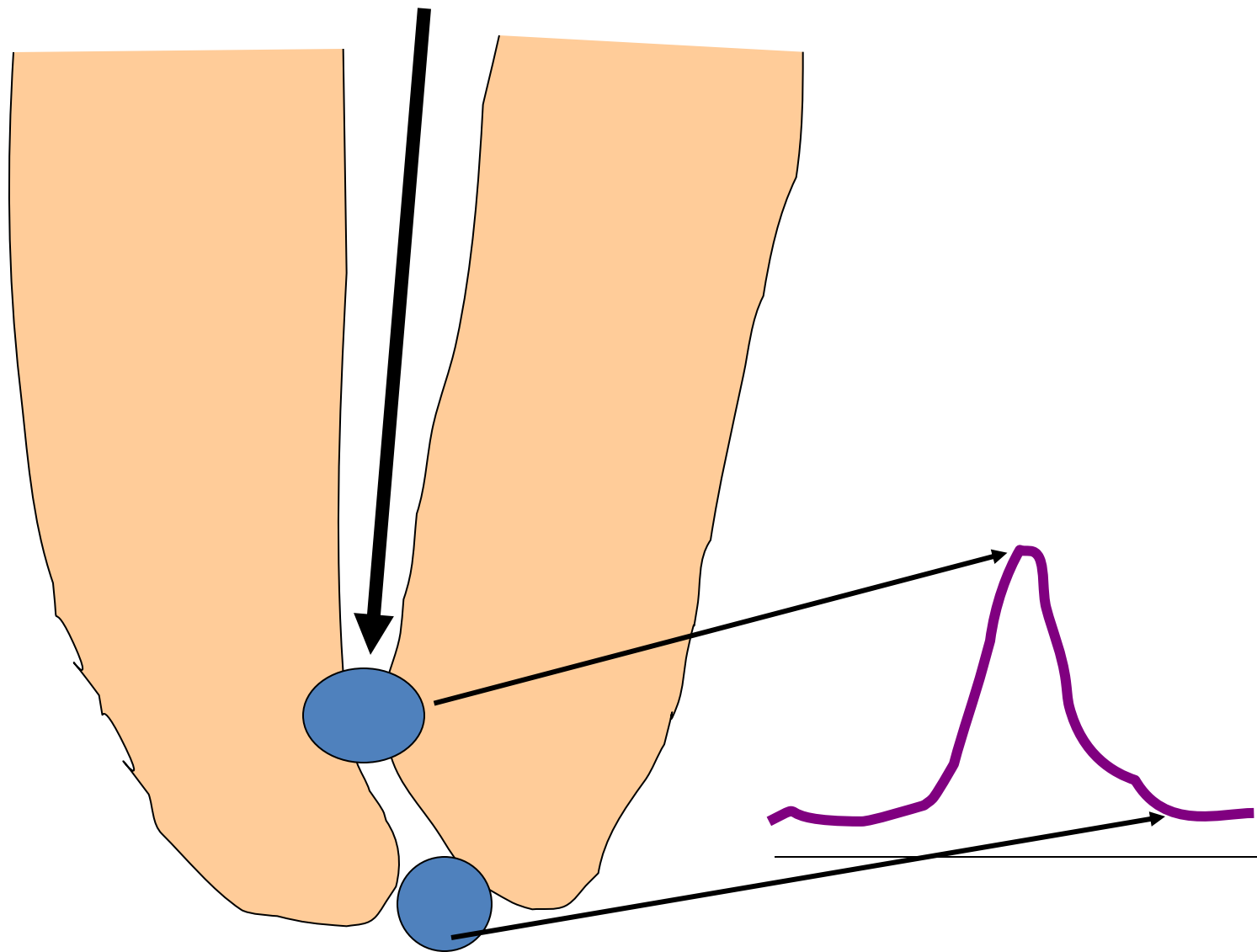
Remember- the length is for teeth with complete crown !!!

Endometry, odontometry

- Endometry



**devices based on measurement
of electrical resistance**

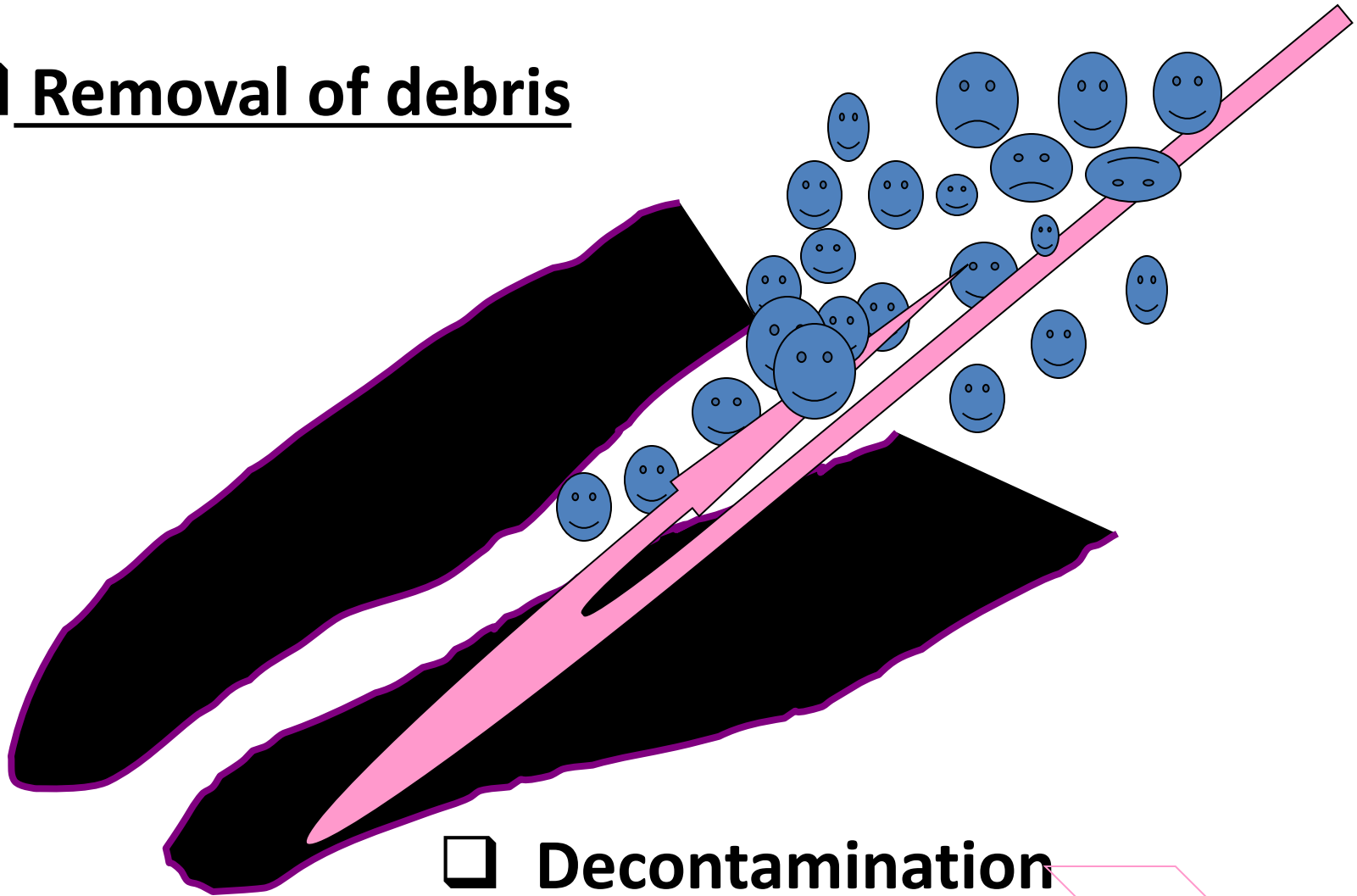


Apexlocator:



Irrigation

Removal of debris



Decontamination



Irrigants

- **Sodium hypochlorite (1,5 – 6%)**
- **Chlorhexidin (0,12% - 0,2%)**
- **EDTA – etyléndiaminotetraacetic acid 17%**



Irrigants

- Sodiumhypochlorite

2 – 6%

- Oxidation a chloration
- Dissolving efect (dissolvs organic material biofilm, rests of dental pulp)
- Bad smell, irritation of soft tissues.

Irrigants

Chlorhexidine

0,12 % - 0,2%

- Antimicrobial effect – long term
- Do not dissolve smear layer
- Improves stability of biofilm

Irrigants

- EDTA

17%

Dissolves inorganic material (chelator)

Important part of irrigation protocols

Irrigation protocols

- Combination of irrigants and their activation

Syringe and cannula

- Blunt, side apertures, smallest ISO 35
- No pressure



Activation of irrigation

- Increased effectivity

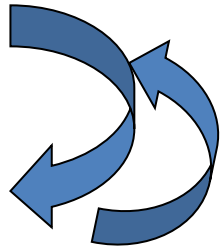
Vibration – movement of liquid

Increasing of temperature of irrigants

Decomposition of irrigants – dissociation (due to heating)

Shaping techniques

- Rotation – 45° clockwise and contraclockwise

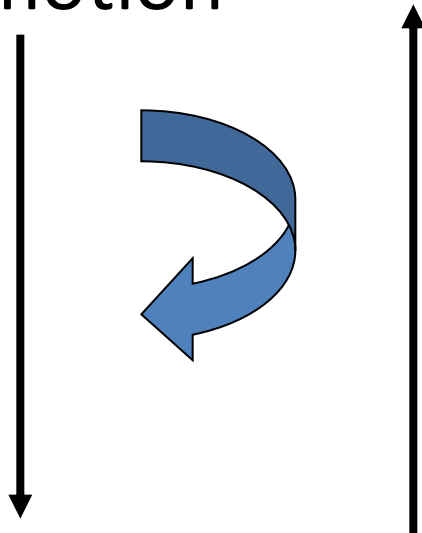


K – reamer

K- file

Shaping techniques

- Rotation clockwise 45° pressure and pull motion



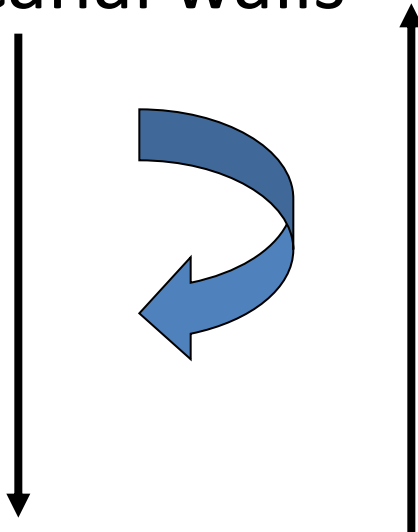
K – reamer

K- file

*Risk of ledging
Zip, elbow effect
Via falsa*

Shaping techniques

- Filing – circumferential filing (filing along root canal walls – circumferentially)



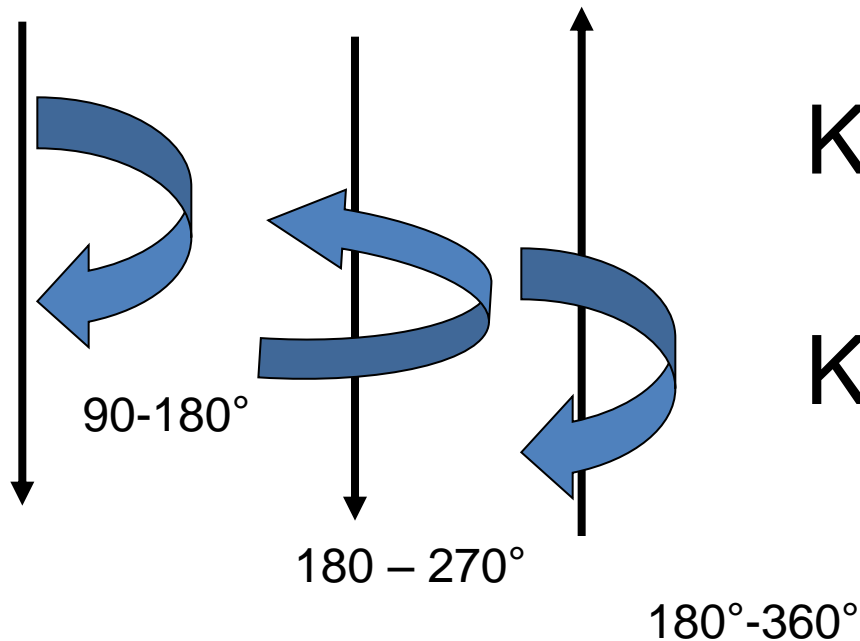
H- file

K – file

Risk of periapical infection infection
Risk of plug

Shaping techniques

- Balanced force



K- flexofile

K – file (?)

Balanced force

- Insert instrument one size bigger than apical size rotating 90° - 180° clockwise
- With slight pressure forward rotate 180°- 270° counterclockwise – dentin chips are cut
- Pull the instrument out (dentin chips are being transported out) – rotate 108°-360° clockwise

Methods of shaping

- Combination of rotation and filing

K - reamer

H- file

Or K-file

Start with rotation

Finishing with filing

Suitable for straight root canals

Methods of shaping

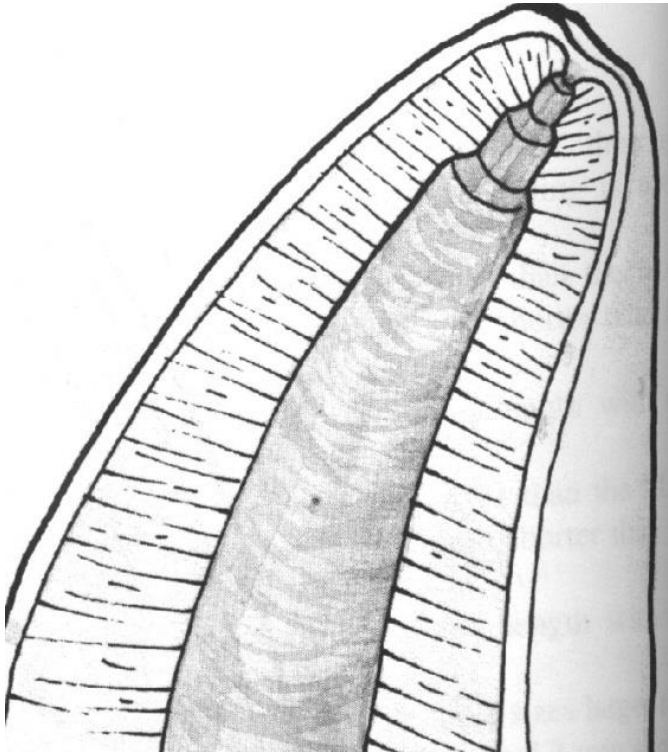
- Step back method

Increasing size with decreasing length.

Insertion of root canal instrument – WL

Next – 1 mm shorter

...



Taper
Final flaring with
the smallest instrument

H- File nebo K - Flexofile.

Prevention of extrusion of filling

Good for curved root canals

- rigidity of instruments
- is increasing with increasing size

Method modified double flared

- I. Opening of root canal

- Coronal third

- II. Apical preparation

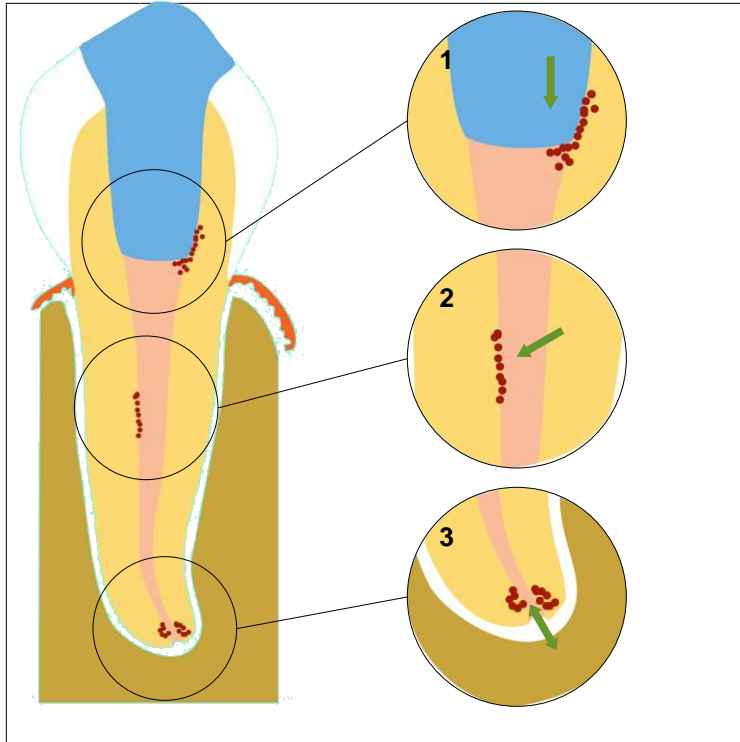
Catheterization, measurement, shaping till ISO 30 – 35 using balanced force. Master file – MAF (last instrument inserted to WL)

- III. Step back

- 3 -4times

- Final flaring (MAF)

Root canal filling



**Good coronal,
Middle
Apical seal.**

Quality guidelines for endodontic treatment,
European Society of Endodontology (ESE), 1994

Ideal root canal filling (Grossman 1988)

- 1. Easy mixing**
- 2. Sufficient working time**
- 3. Good seal**
- 4. X- ray contrast**
- 5. Easy removal**
- 6. No shrinkage**
- 7. Long term volume stability**
- 8. No bacterial growing**
- 9. No permeability for fluids**
- 10. Biocompatibility**
- 11. No staining**

Classification of root canal fillings

➤ Solid

➤ Semisolid

➤ Pastes

Guttapercha

Dried juice of the Taban tree (*Isonandra percha*)
(gutta)

1,4 - polyisoprene

Crystallin structure (60%)

Brittle

Guttapercha

- **Beta phase**
- **Alpha phase 42 – 49 °C**
 - plastic
 - **Gamma phase 56 – 62° (amorfní)**

Cooling process

very slowly (less than 0,5°C) – alpha phase

normal cooling – beta phase

Composition of guttapercha materials in endodontic

Guttapercha 19% – 22%

Zinc oxide 59 - 79%

Heavy metal salts 1% - 7%

Wax or resin 1% - 4%

Resilon (Pentron)

- **Thermoplastic synthetic polymer**
- **Points or material for injection**

Composition:

Polyester polymers

Bioactive glass

Radioopaque fillers (bismuthum oxichlorid a and baryum sulphate)

Silver or titanium cones

- No good seal
- Silver cones - corrosion

Sealers

Chemically curing materials

(their consistency is paste, cements)

Good adhesion to root canal walls as well as solid cones

X- ray contrast

Biocompatibility

Sealers

Importance

Filling of the spaces between the solid cones



Seal of the root canal filling

Sealers

Zinc Oxide-Eugenol

Chloropercha

Calciumhydroxide

Resins

Glasionomer

Silicone

Zinc - Oxid Eugenol

Powder:

Zinc oxide

Liquid:

Eugenol

Acidic resins

Good adhesivity, antimicrobial effect, cytotoxicity?

Resorbable, no compatible with adhesive materials)

Zink Oxid Eugenol sealers

Pulp Canal Sealer (Kerr, USA))

Tubuli- Seal (Kerr, USA)

Caryosan (Spofa Dental, ČR)

Calciumhydroxide sealers

Base (powder)

Calcium hydroxide

Zinc oxide

Other components and vehicula

Calcium hydroxide sealers

Catalyst (paste)

Zinc stearat

Titanium dioxide

Baryum sulphate

or

Eugenol,. Eukalypt

Other components...

Kalciumhydroxide sealers

- Increase of the healig potential of periapical tissues
- Antibacterial effect
- Easy manipulation

But!

Resorbable if not homogeneous

Not suitable for the single cone technique

Resins

- Rezorcin formaldehyd (toxic, obsolete)
- Epoxide
- Polyketone
- Metacrylate

Epoxide resin

➤ Base (powder, paste)

Bismuth oxid

Titanium dioxide

Hexametylentetramine

(Silver)

➤ Catalyst (liquide, paste)

Bisphenoldiglycidylether

Epoxid resin (*advantages*)

- Long working time
- Hydrophilic (good penetration)
- Good adhesion to the root canal walls
- Volume stability
- No dissolution
- Antibacterial

Epoxid resins (*disadvantages*)

- Difficult removal
- Staining
- Initiatory toxicity

AH 26, AH Plus, 2 Seal



Polyketone

➤ Base

Zinc oxide

Bismuth phosphate

Hexametylentetramine

➤ Liquid

Bisphenolglycidylether and other components

Polyketon resins

Advantages

Good adhesion

No contraction

No dissolution

Disadvantages

High stickness

Not removable

Products: Diaket, Diaket A (3M ESPE)

Methacrylate resins

Endo ReZ (Ultradent) – UDMA

For injection – single cone technique

Epiphany (Pentron)

Bis- GMA, etoxy bif- GMA, hydrophilic bifunctional methacrylates

Calcium hydroxide, baryum sulphate, baryum glass silica.

Sealer in combination with Resilon



Glasionomer sealers

- Base (powder)

Aluminium silicate glass

- Liquid

Polyacrylic acid, polymaleic acid, tartaric acid

Glasionomer sealers

(Advantages and disadvantages)

Advantages:

Curing under wet conditions, chemical bonding to hard dental tissues, no staining

Disadvantages

Short working time, difficult removal,
porous

Products

Ketac Endo (3M ESPE), Endion (VOCO)

Silicon based sealers

Polyvinylsiloxane (ev. in mixture with powdered guttapercha)

Biocompatibility

Hydrophilic

Instruments

- Paste carries - lentulo
- Compactors
- Compactors - carriers
- Others

Lentulo



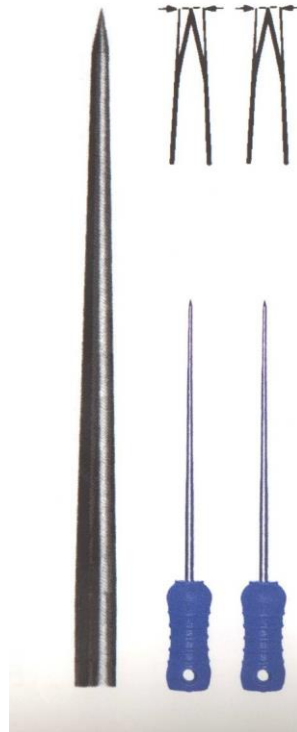
➤ delivers pastes

➤ 1,5 – 2 mm ahead

➤ for sealers

Compactors

Spreader



Pointed

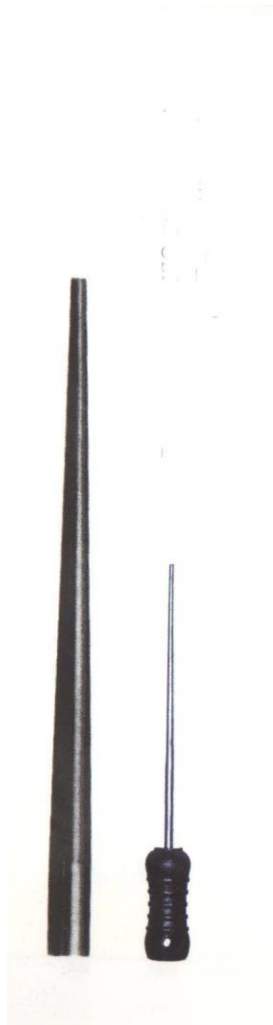
Vertical introduction

Lateral compaction technique

(cold, warm)

Compactors

Plugger

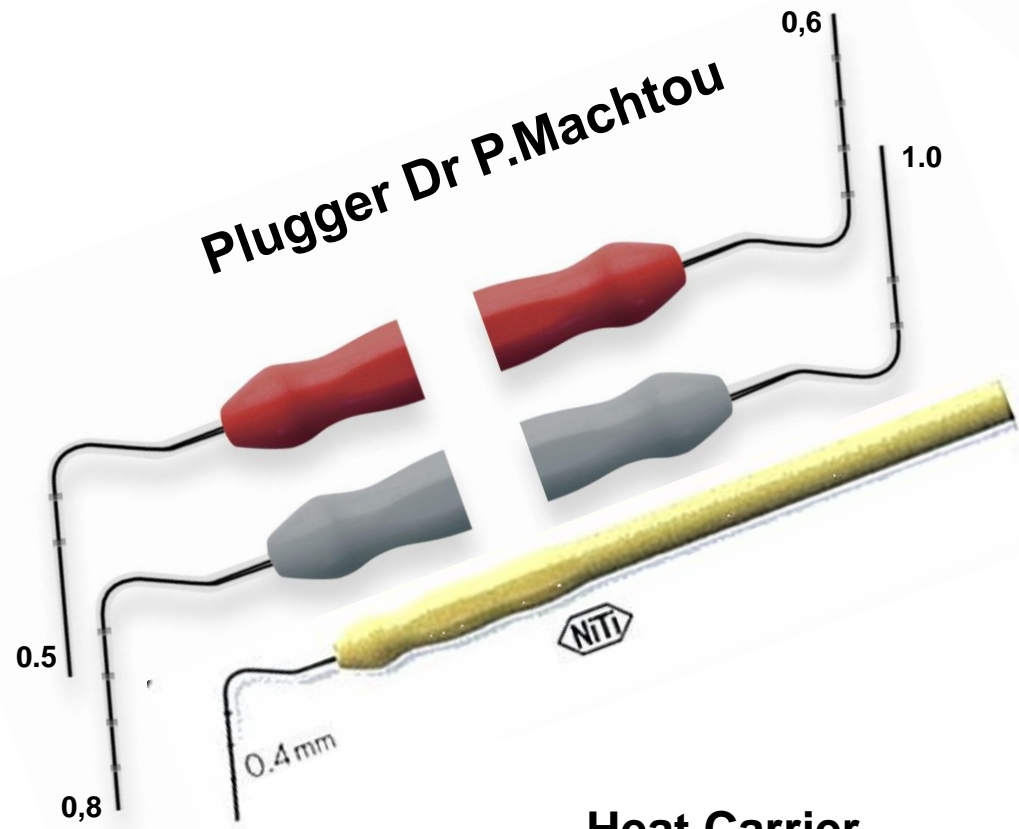


Not pointed

Vertical introduction

Vertical - compaction

Use of a selected Plugger to ensure homogeneity of the filling.

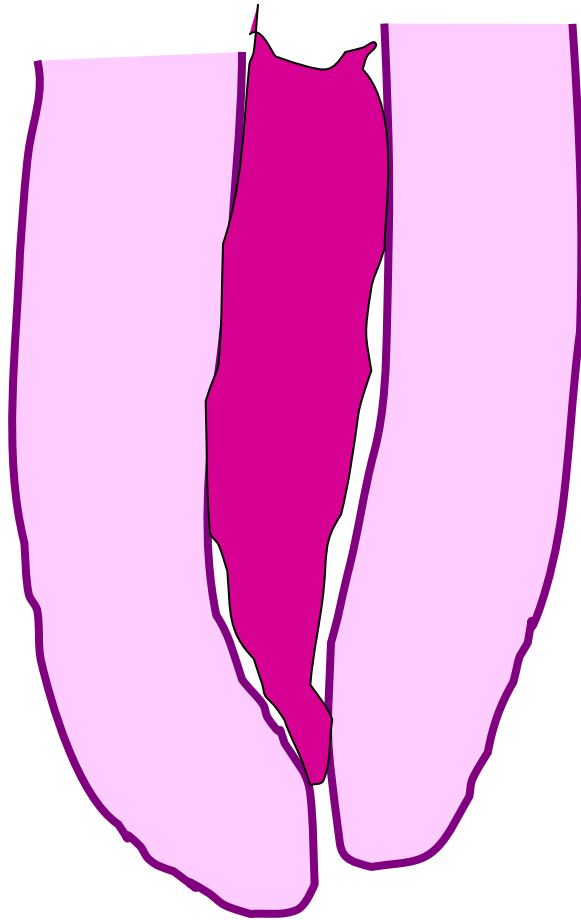


Filling techniques

Cold

Warm

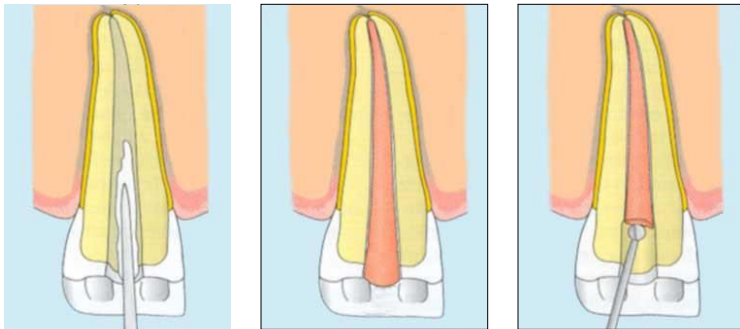
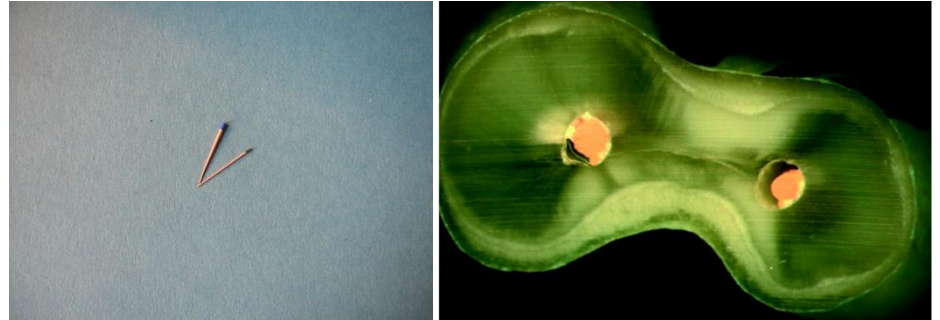
Paste only



**Shrinkage, difficult
removal**

Single cone technique

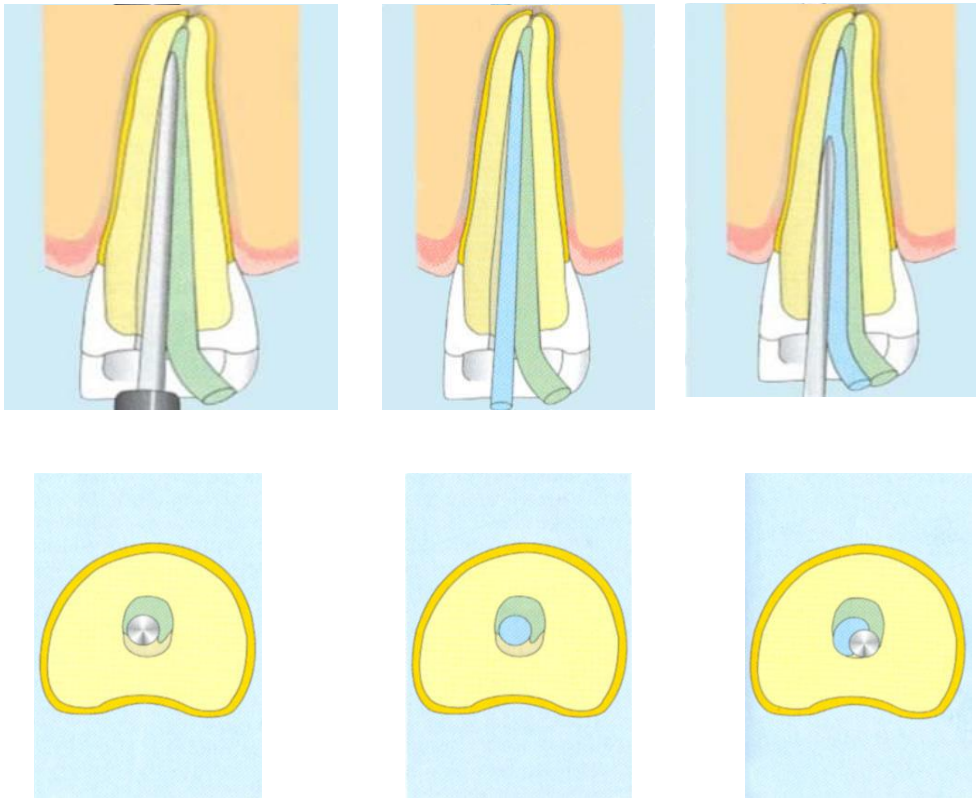
- Easy
- Fast
- Good control of WL
- Standard round preparation – risk of leakage



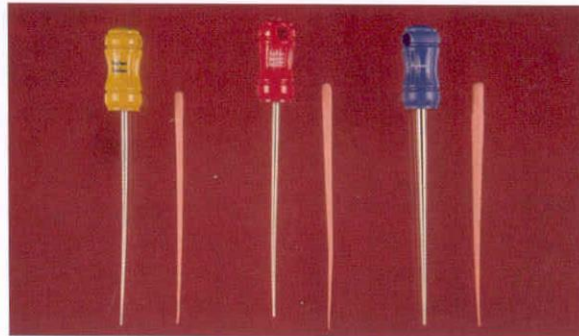
Wesselink, P.: Root filling techniques, Textbook of Endodontology; p. 286-299, Blackwell Munksgaard 2003, Oxford

Lateral compaction

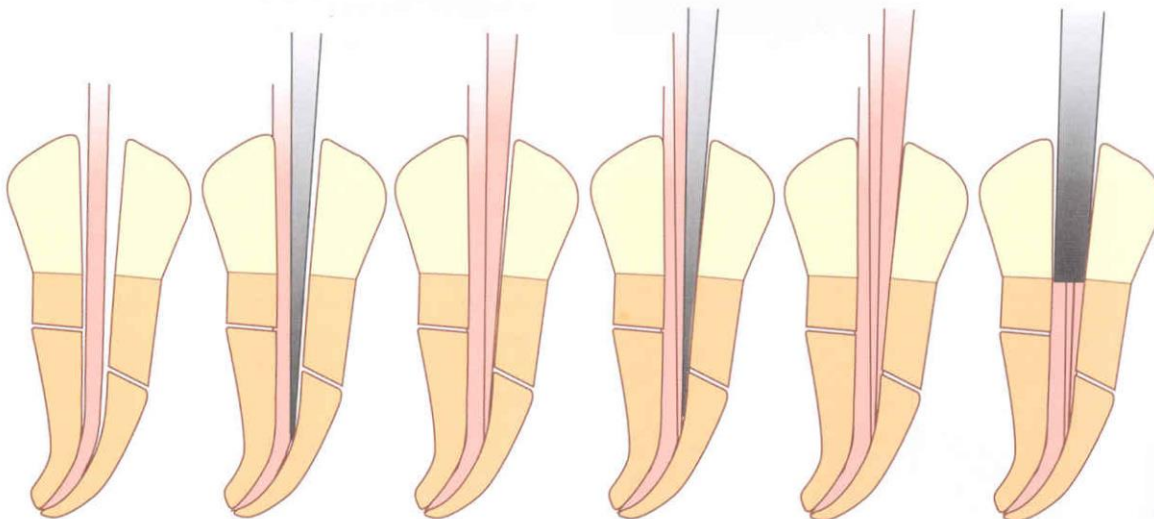
- Standard cold technique



Good control of WL
Risk of the root fracture



A

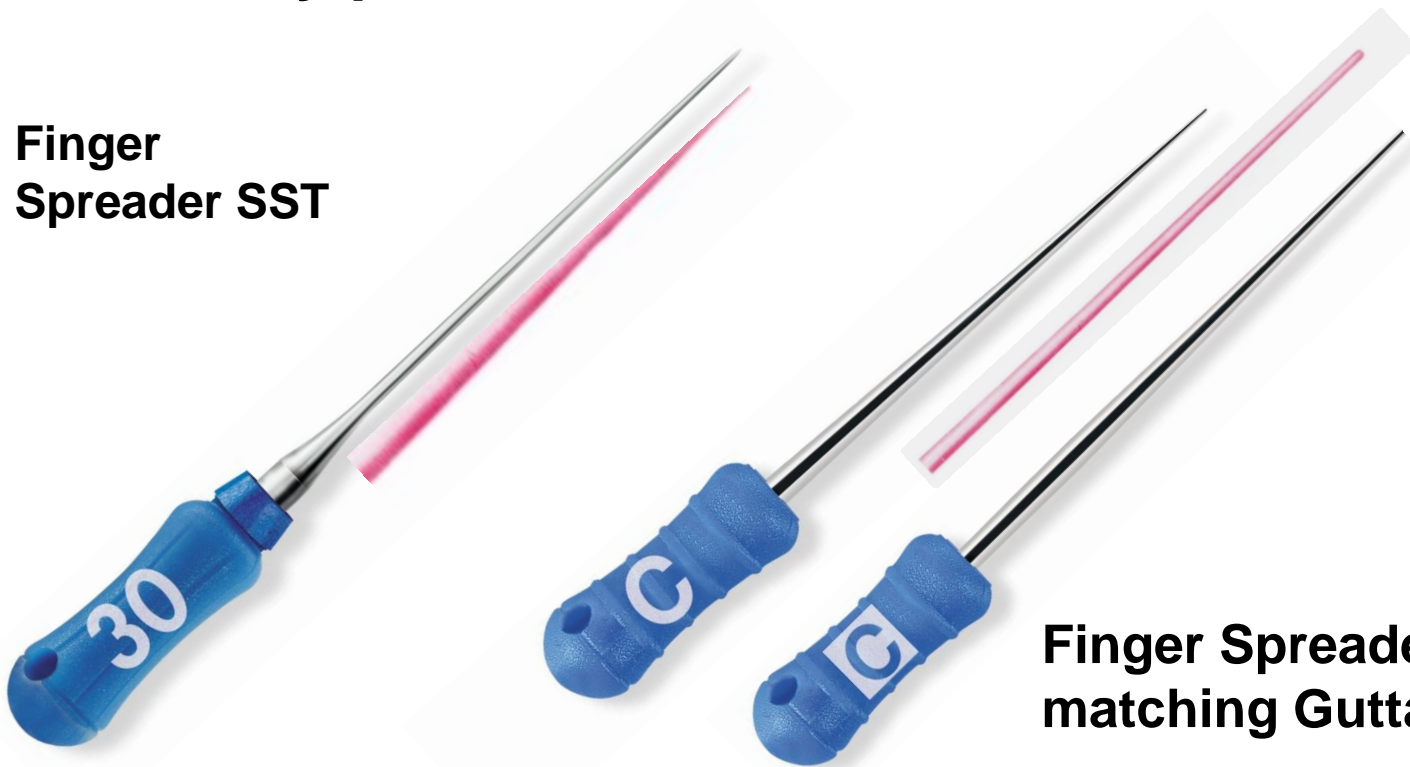


**LATERAL
CONDENSATION
(compaction)**

Lateral Condensation

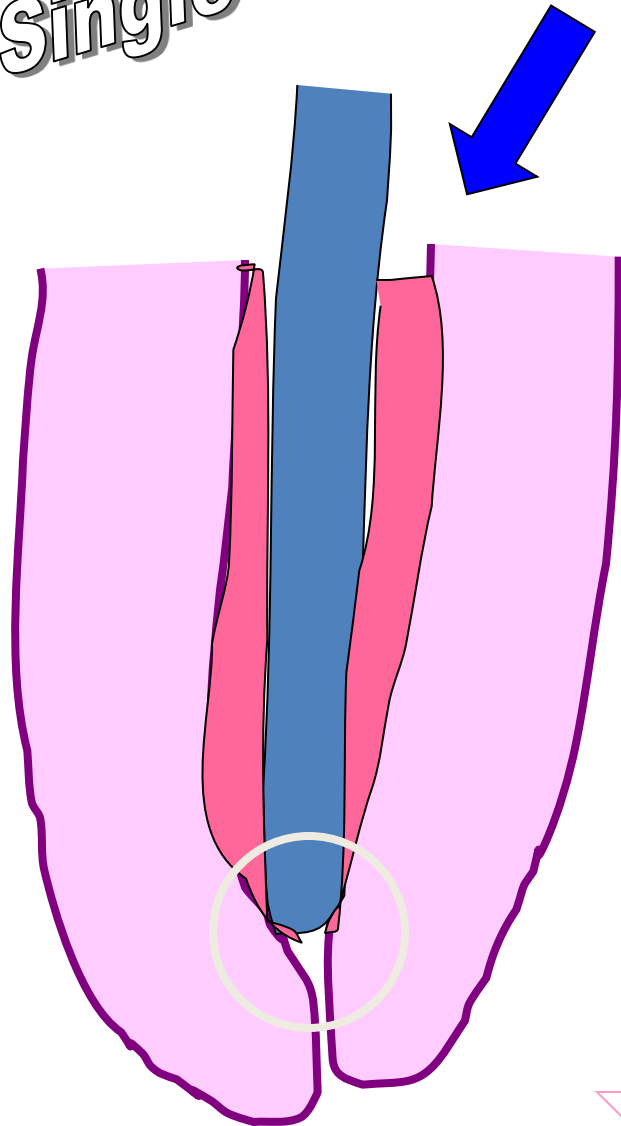
A sealer is placed in the canal followed by a fitted gutta percha Master Point compacted laterally by a tapering Spreader to make room for additional accessory points

Finger
Spreader SST

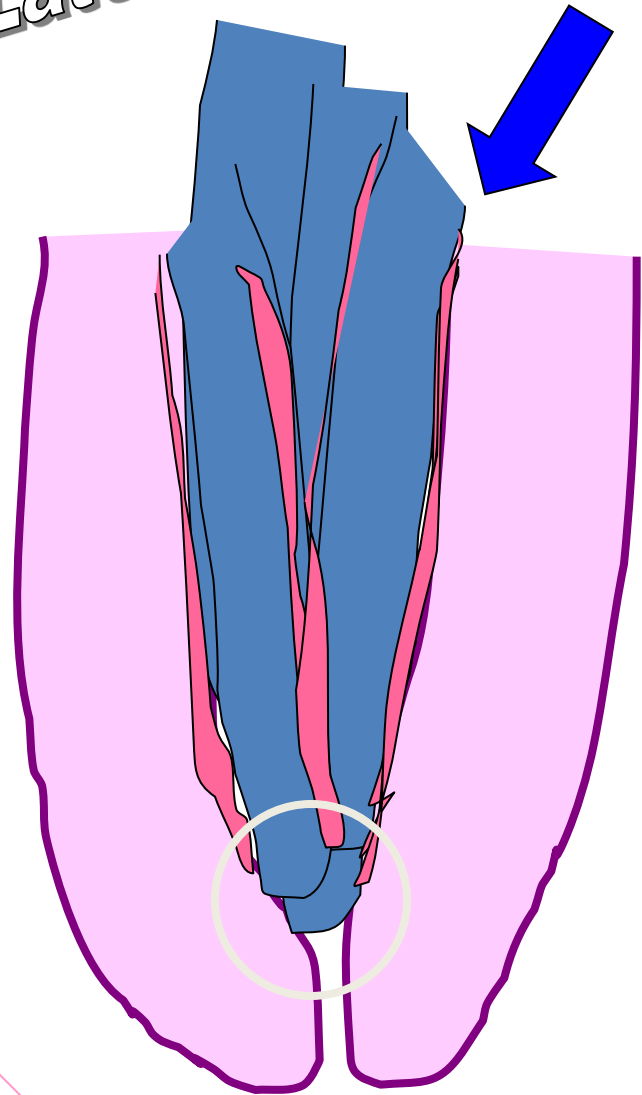


Finger Spreader SST and NiTi
matching Gutta-Percha A-D

Single cone



Lateral compaction

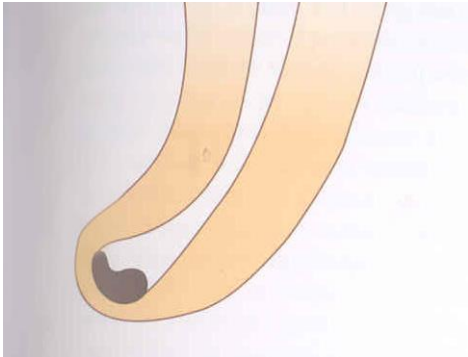
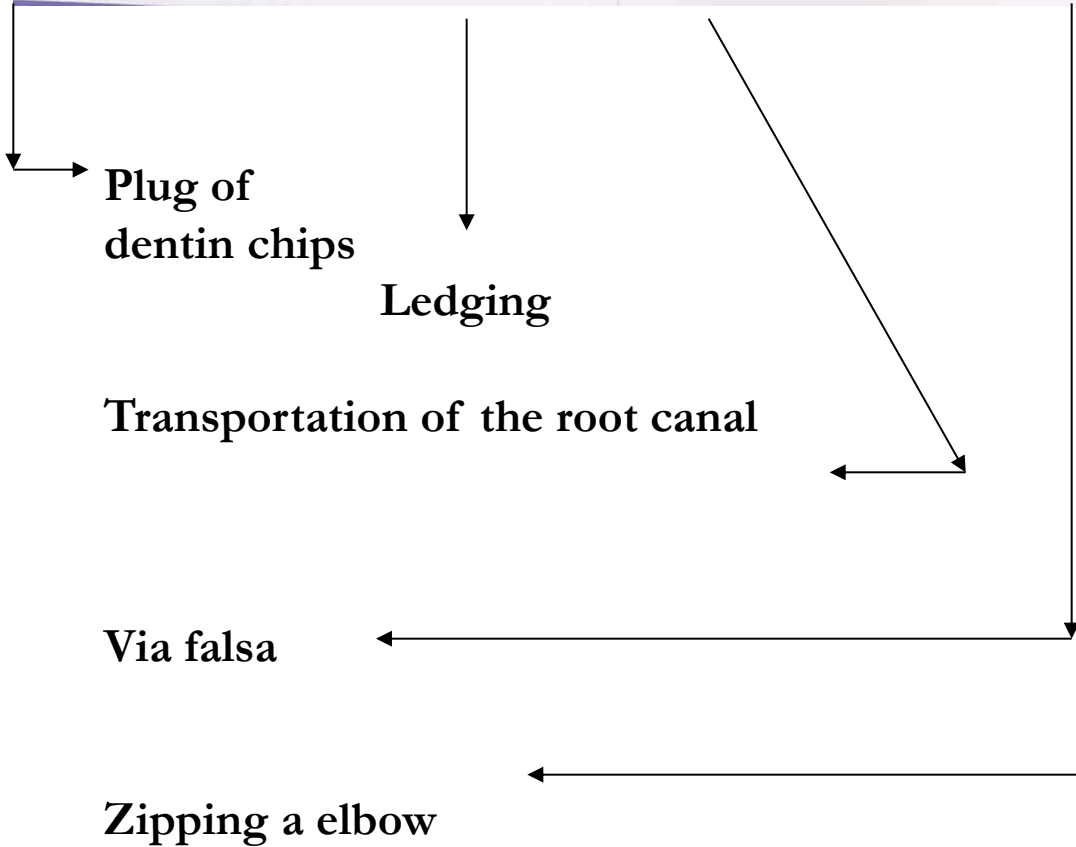
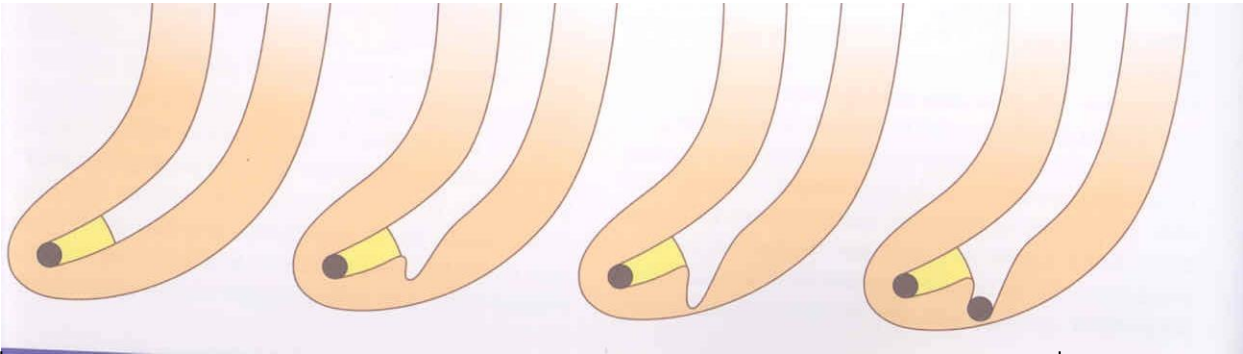


Complications of endodontic treatment

Local

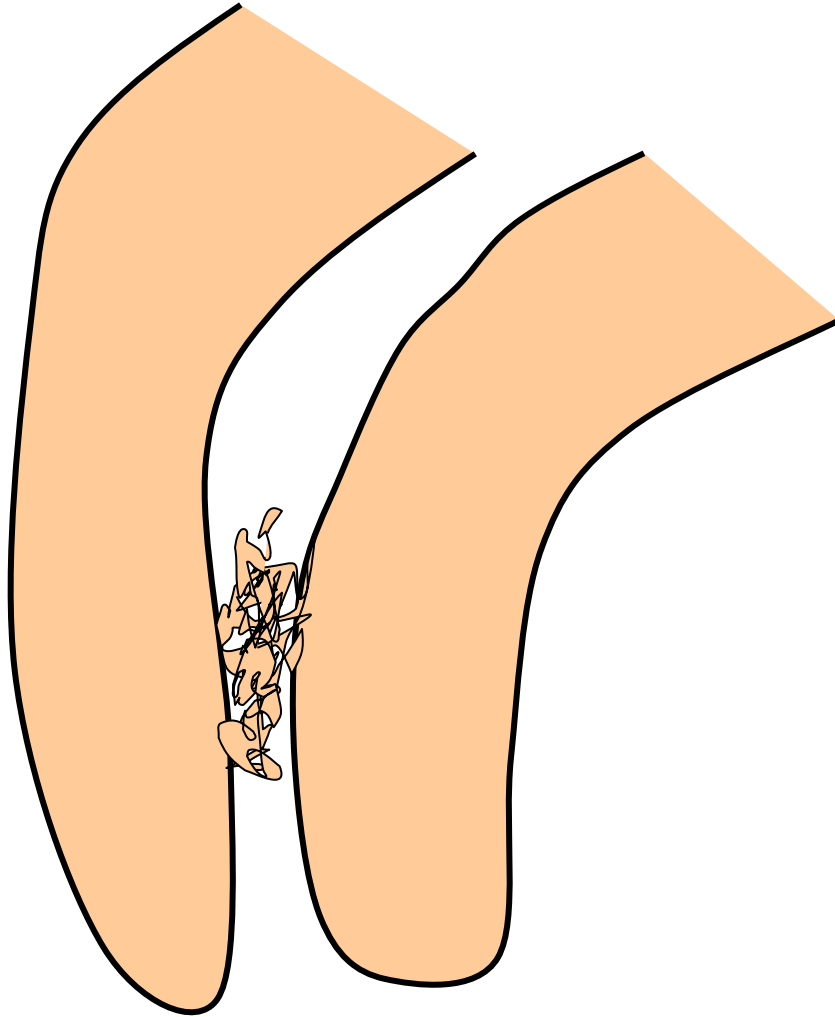
Regional

Systemic



Local complications

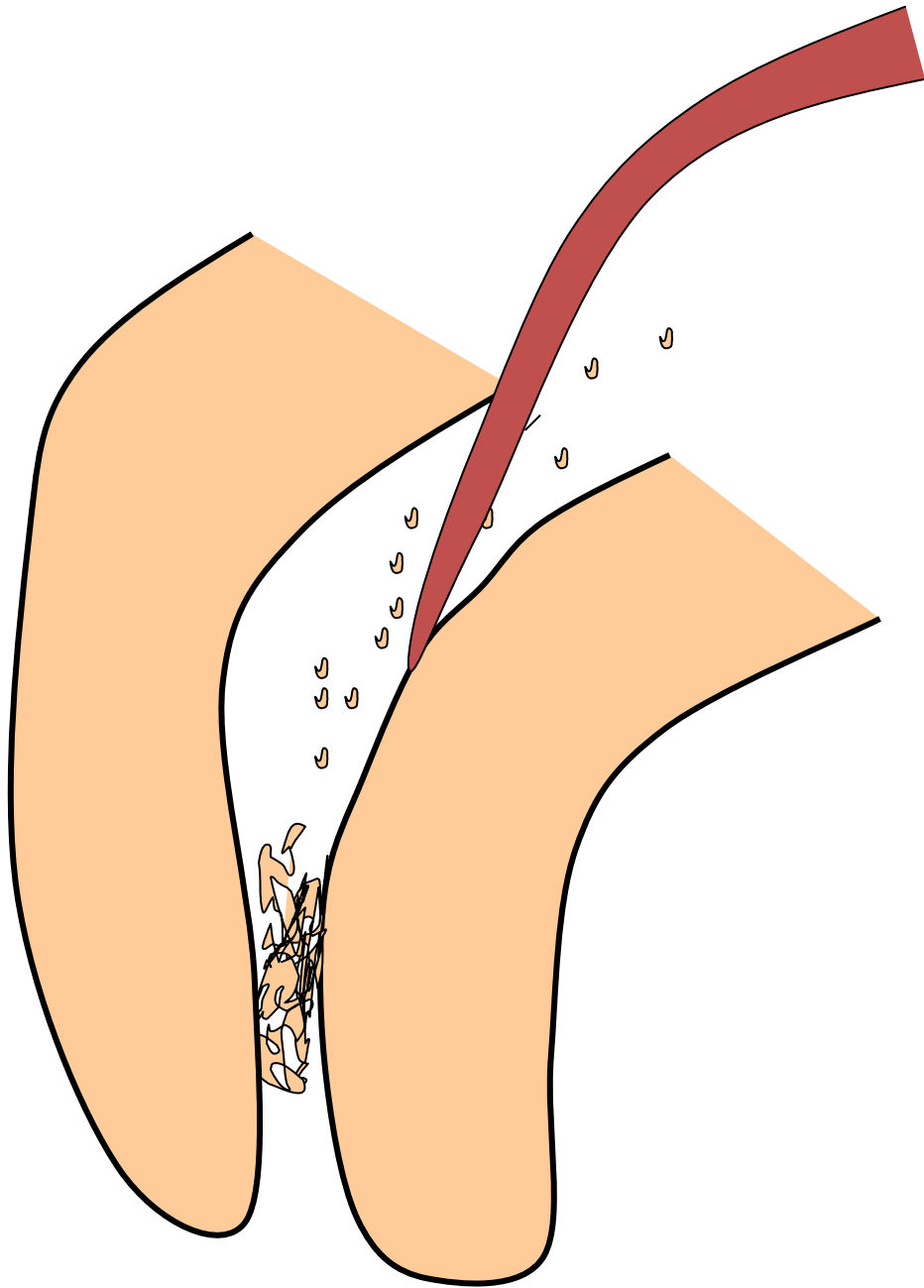
Plug



Reasons

**Insufficient irrigation and
recapitulation**

Loss of the working length

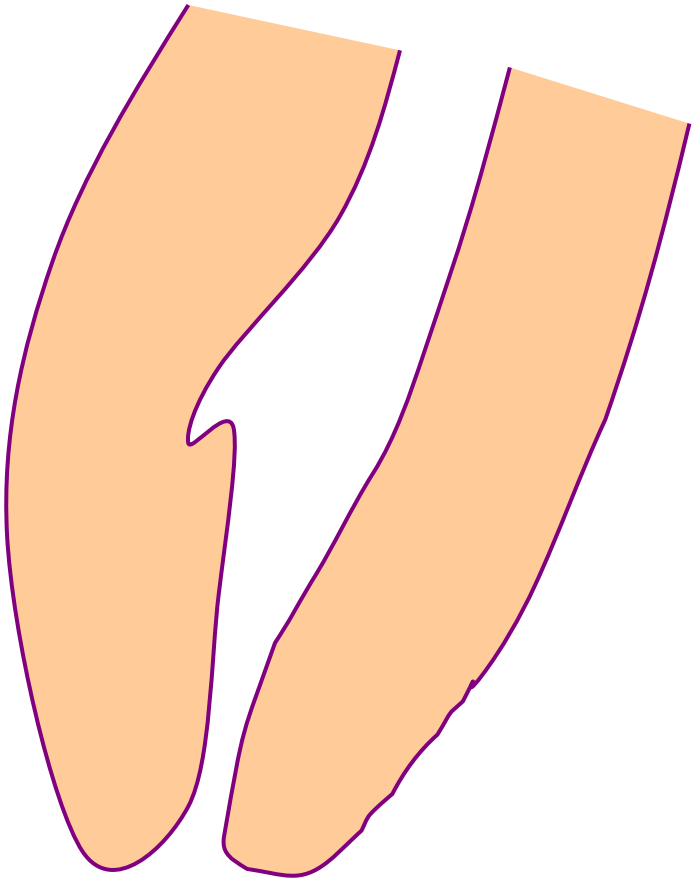


Solution

**Repeated careful
instrumentation
with a thin
instrument**

*Irrigation is not
effective in this
case!!!*

Ledging



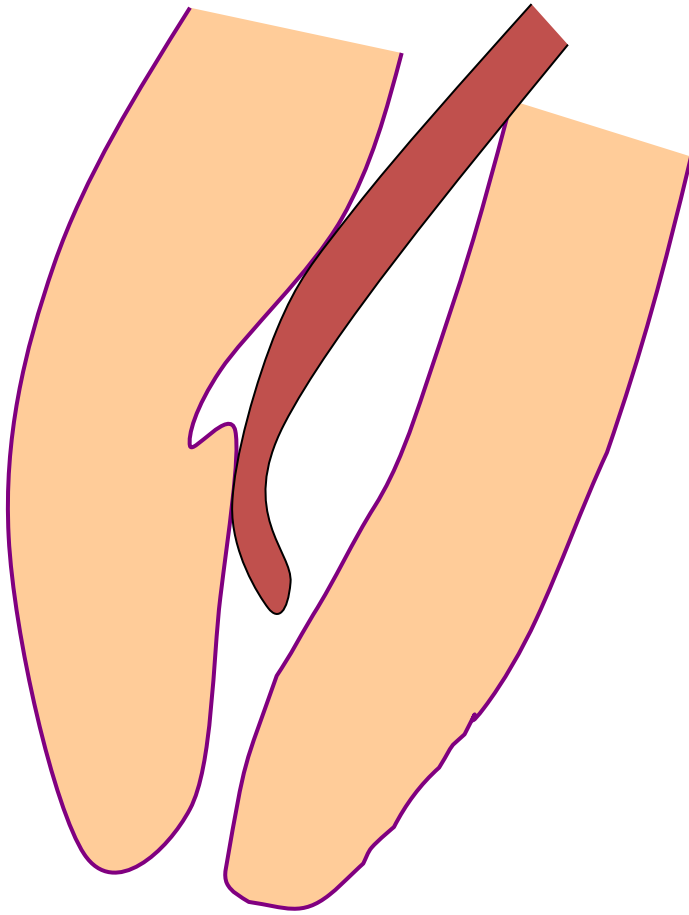
Reasons

The instrument is not bended in advance!

No control of the WL

=

No recapitulation Loss of the WL



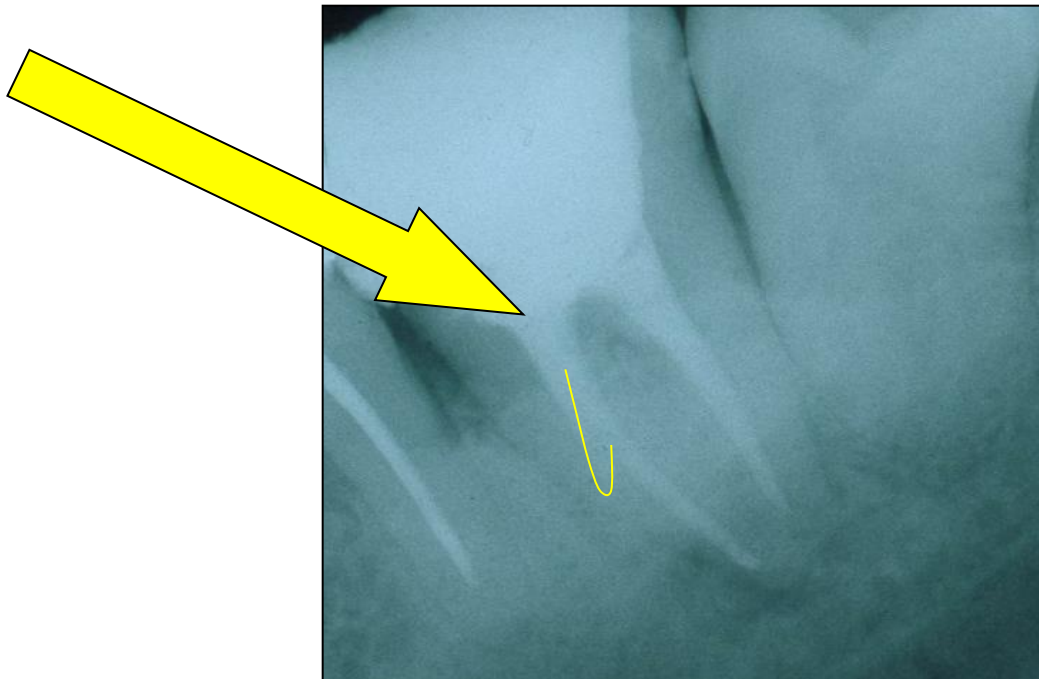
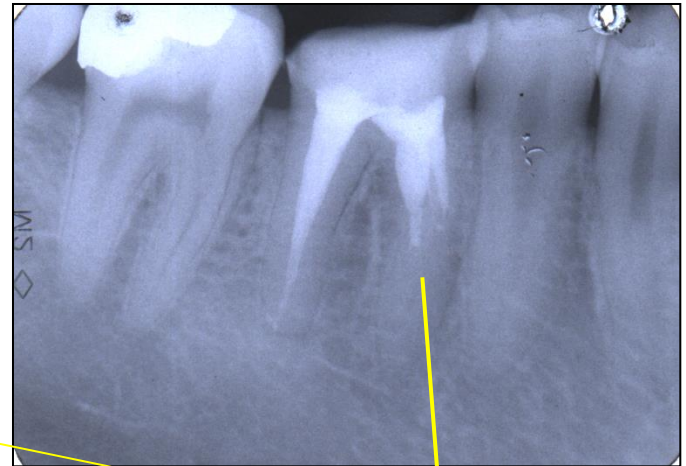
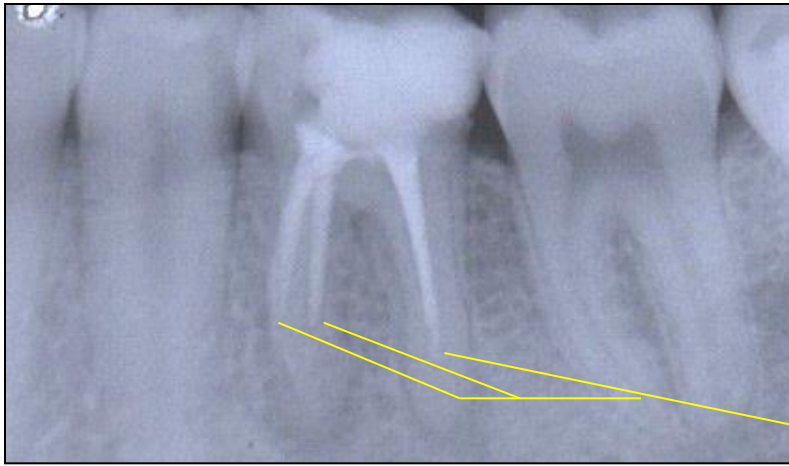
Solution

The instrument must be
bended in advance

Careful but complete rotation

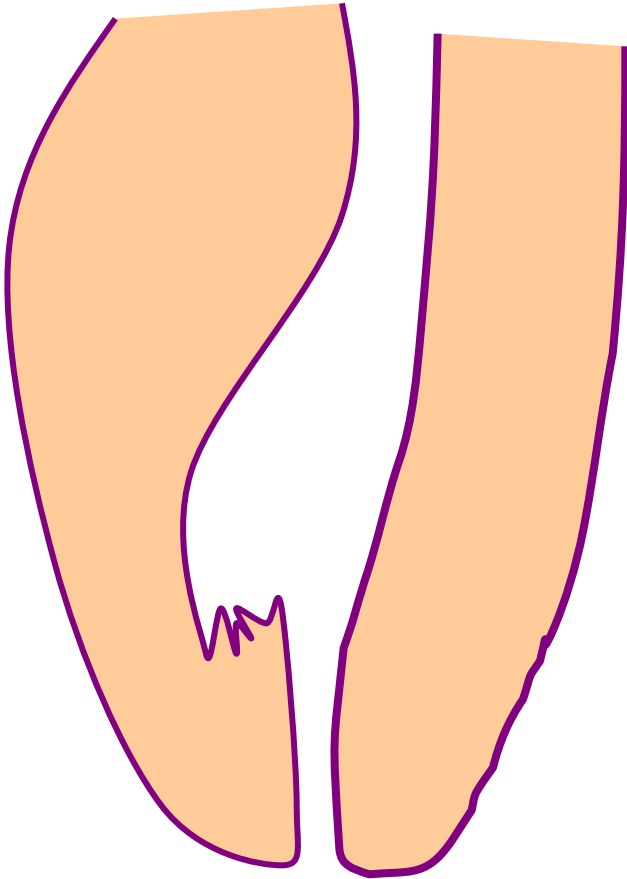
Finishing with the fine filing

No NiTi!!!



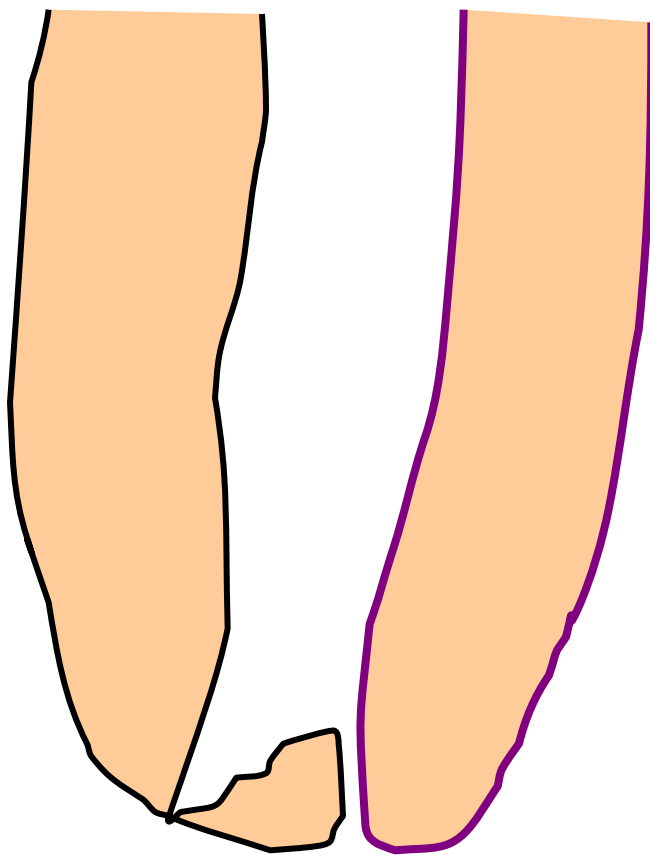
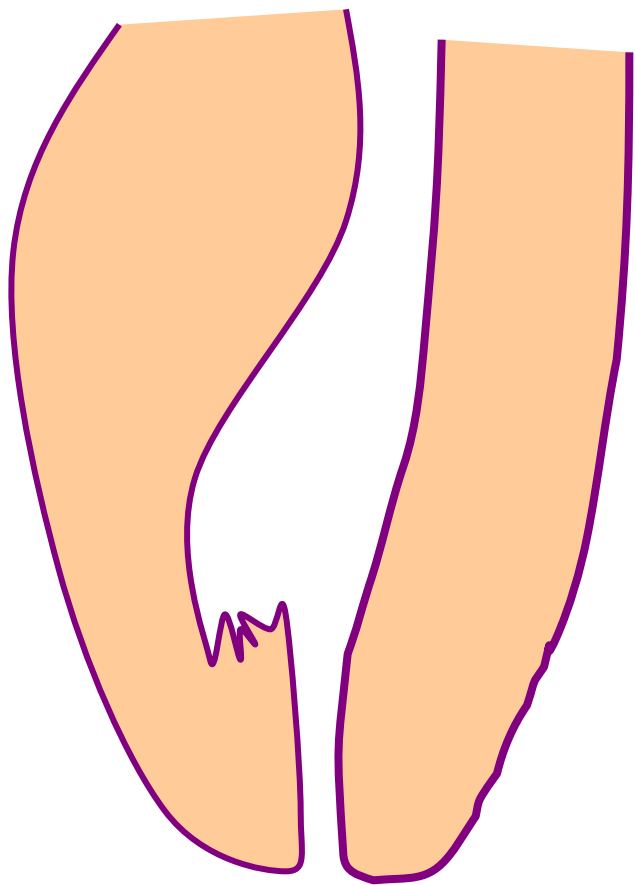
Ledging

Zippering a Elbow



The instrument is not bended in advance!

Rotation in curved canals



Stripping

Reasons

**Bad orientation in morphology – no diagnostic x-
Instruments are not bended
Rotary NiTi with a big taper**

Dangerous zones

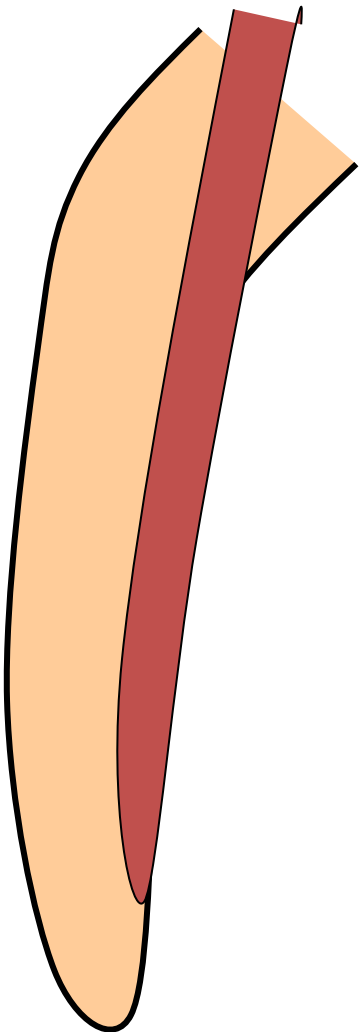
Mandibular molars – mesial roots

Premolars, esp. maxillar

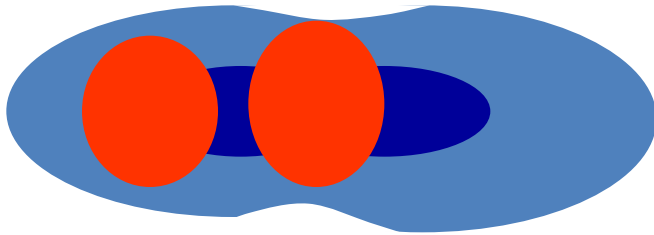
Mandibular incisors



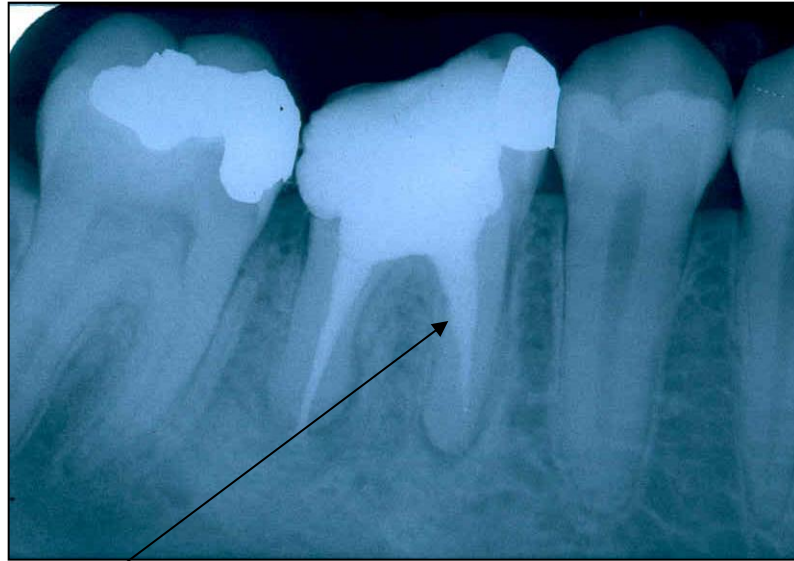
Oblast isthmu



Stripping



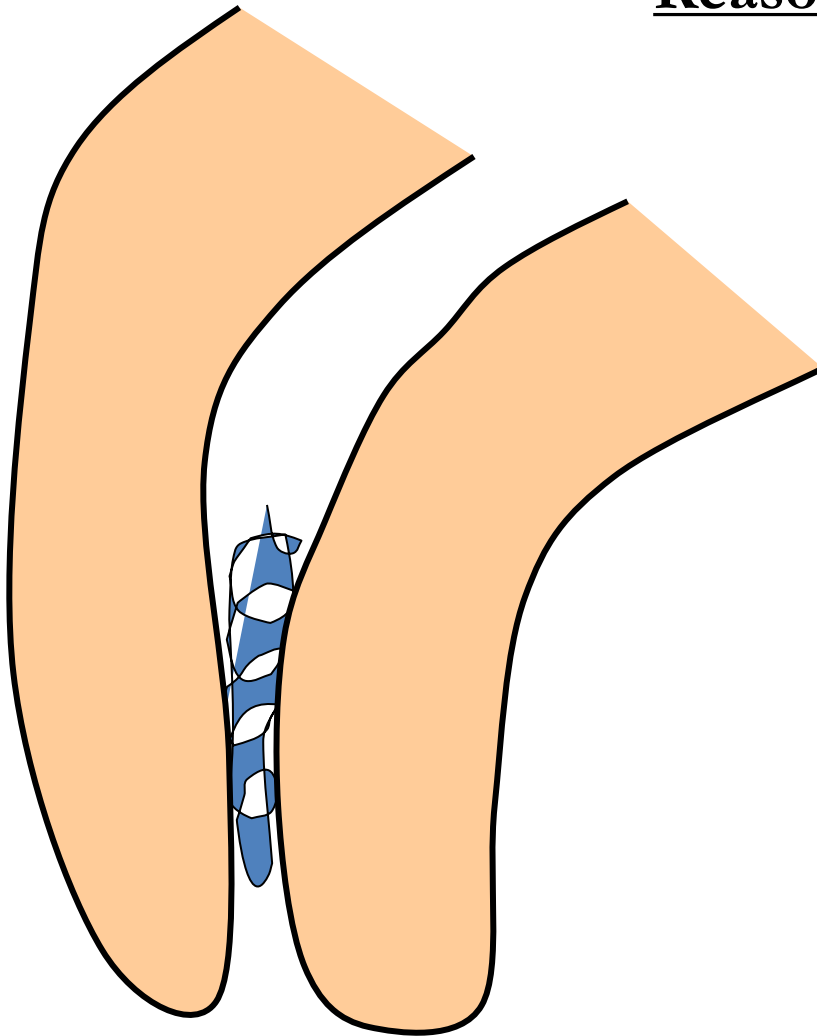
Stripping



Bend the instrument and eventually blunt it !

Fracture of the root canal instrument

Reasons



**Insufficient
coronal flaring**

**Old root canal
instrument**

Aggressive force

**Incorrect
movement of the
root canal
instrument**

Solution

Enlargement of the
root canal till the
instrument

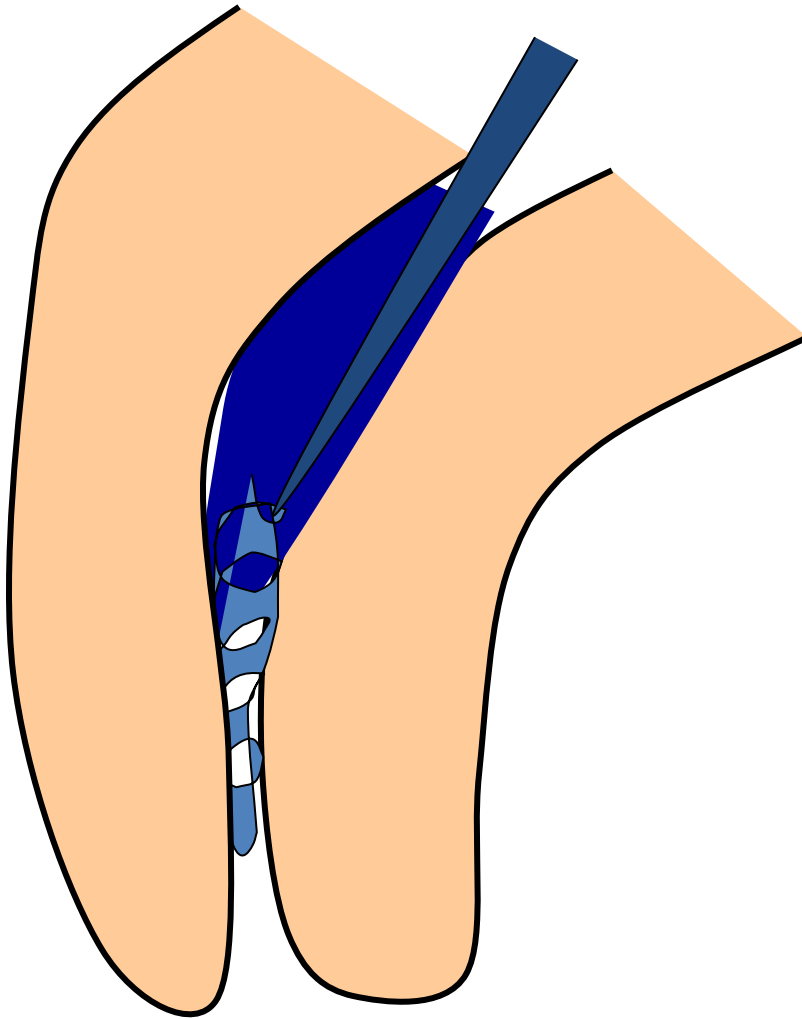
Ultrasound tips

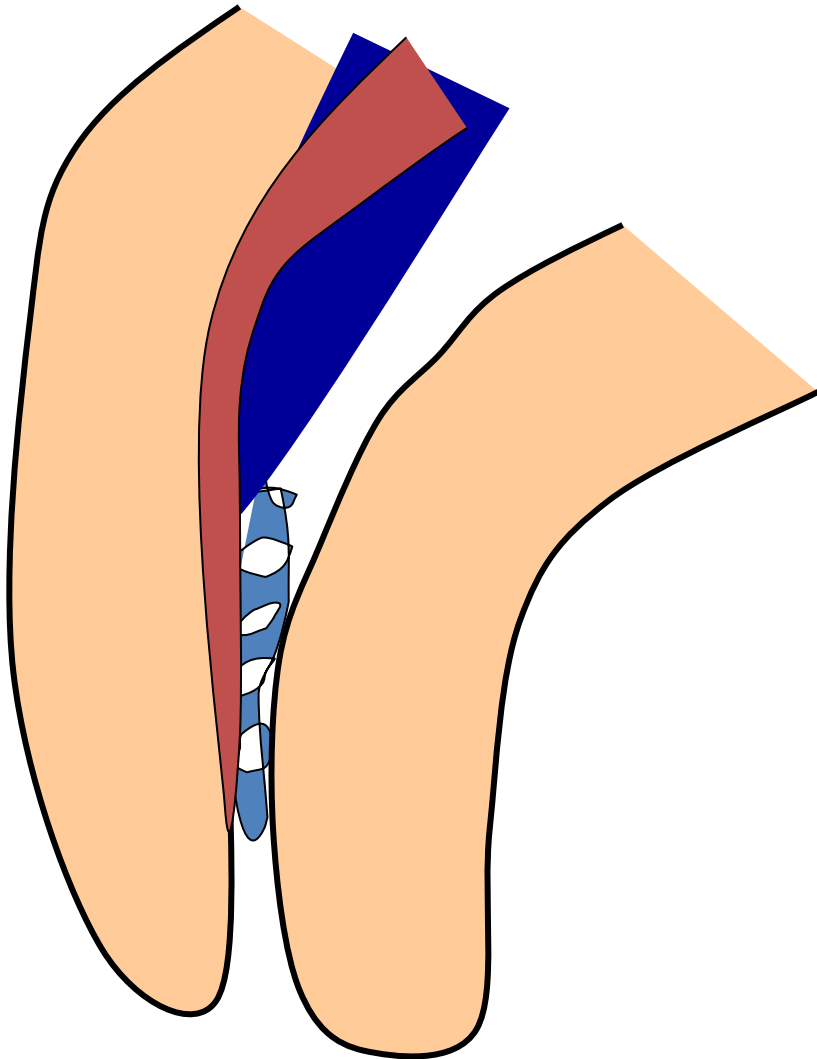
Rotating root canal
instrument – caution!

Bypass

Leaving in

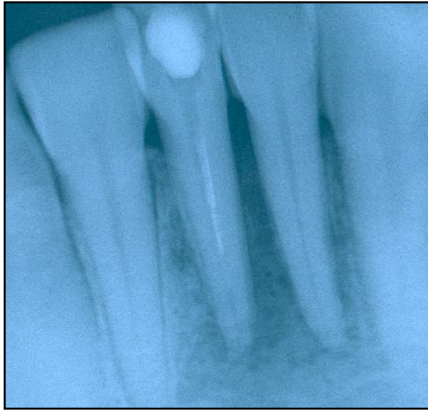
Surgical treatment





Bypass

Fractured instrument

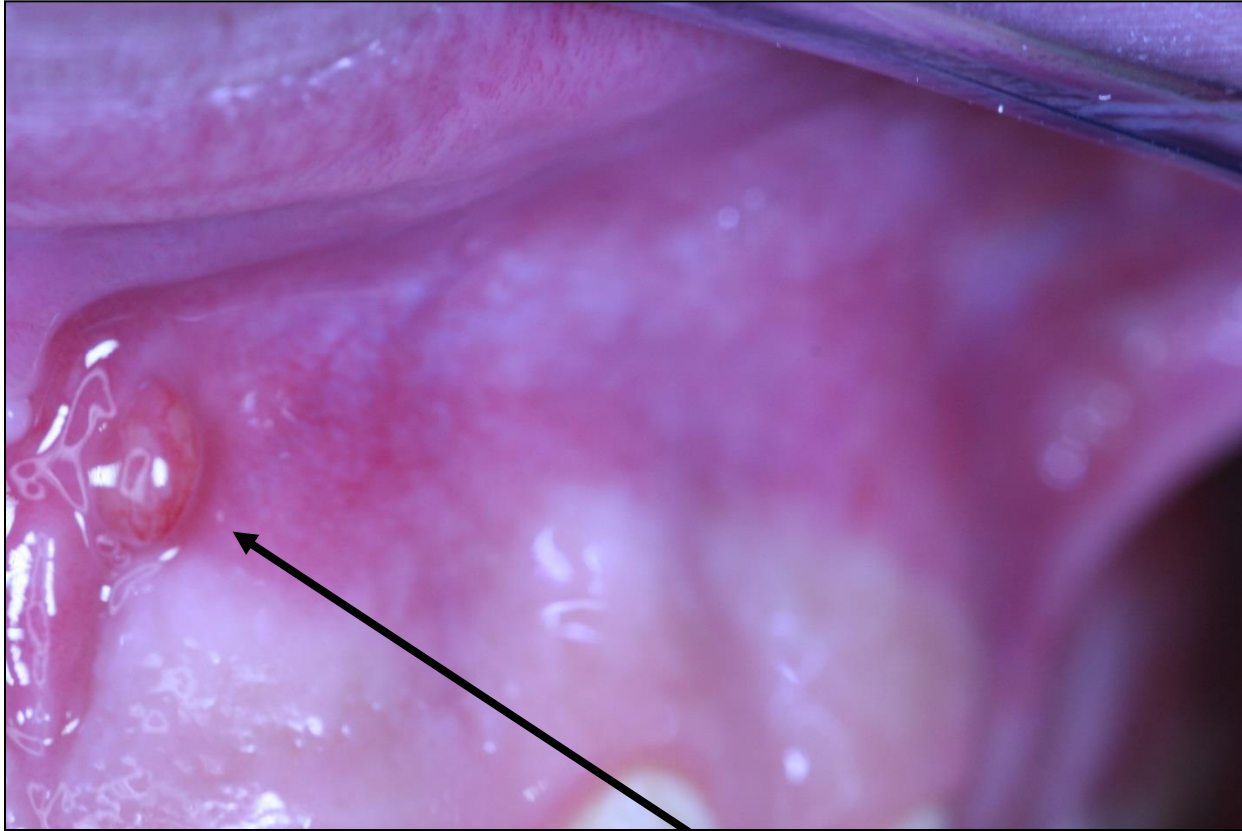


Via falsa

- Perforation of the bottom of the pulp chamber or the coronal part of the root canal
- Perforation in the middle part of the root canal
- Apical perforation

Regional complications

Damage of periodontium or
surrounding tissues



Píštěl

Systemic complications

Systemic complications

- Periostitis
- Inflammation of soft tissues (face, neck)
- Gulp of the instrument (X ray, remnant diet, information)- cough
- Aspiration of the instrument -emesis



Caution!

Always find the loss instrument !!!!!

Safe work in endodontics

- Rubber dam
- Glasses