Root resorption: aetiology, pathology, diagnosis and management

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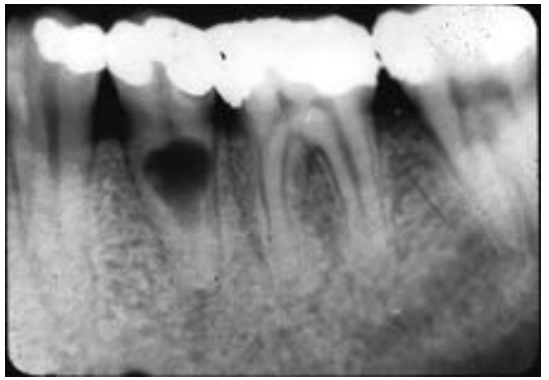
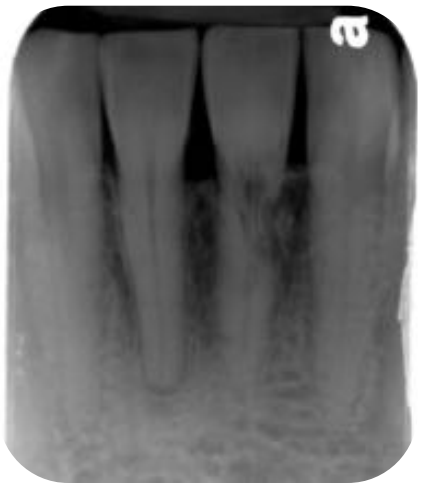
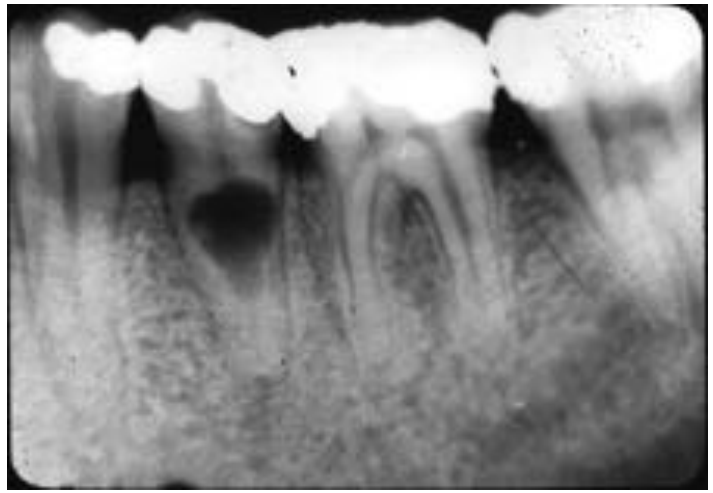
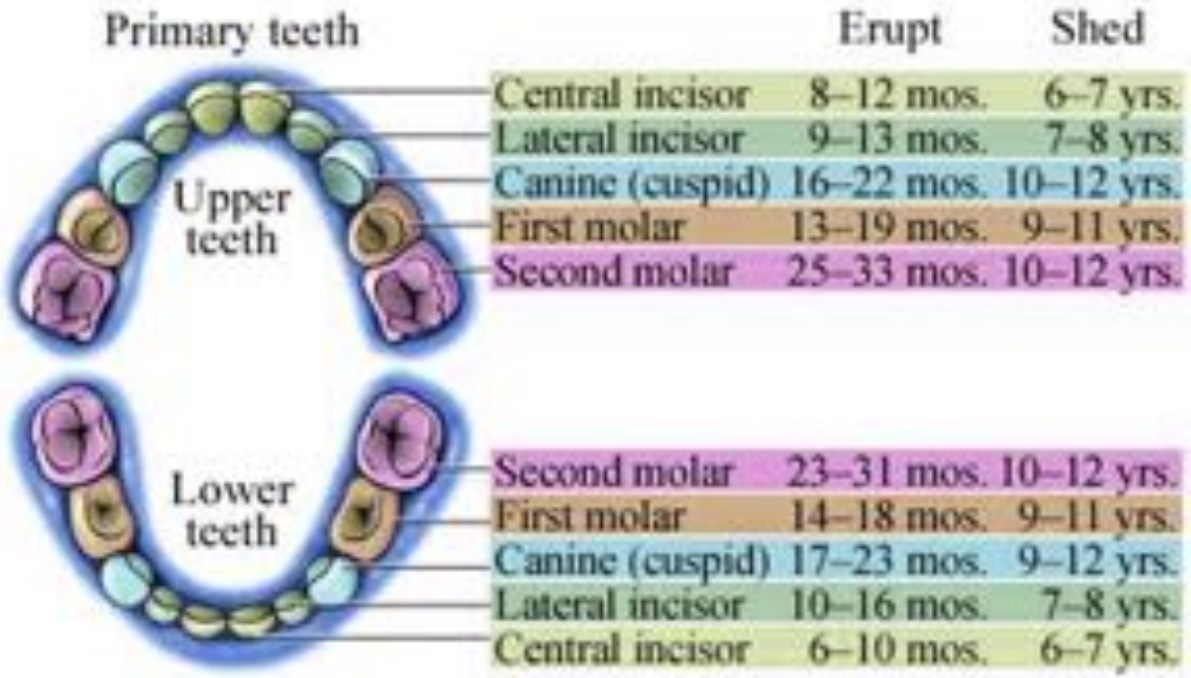




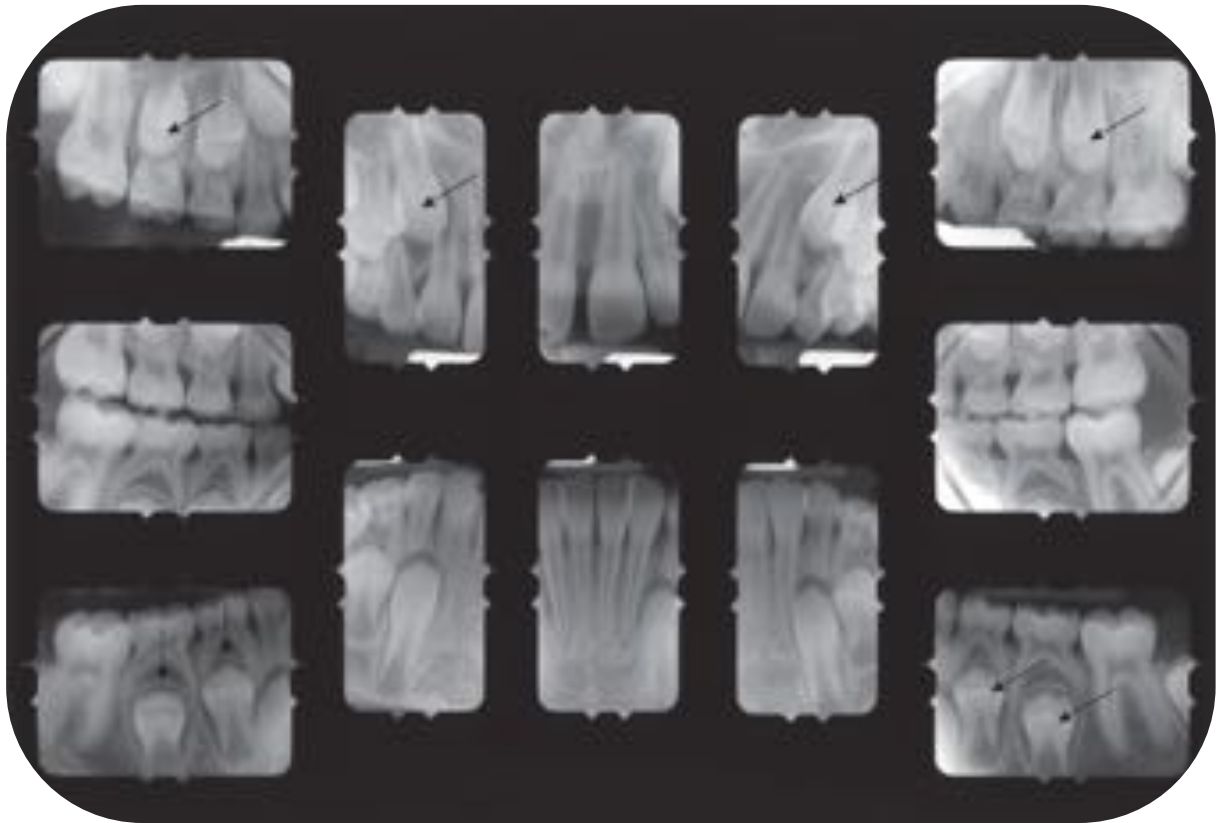
Definition

- Dental resorption is the progressive loss of dental hard tissues as a result of clastic activities
- It may occur as a physiologic (primary dentition) or pathologic phenomenon.





In the primary/mixed dentition this is a normal physiologic process resulting in exfoliation of deciduous teeth but in the adult dentition is largely pathological



Pathways for **bacteria** into the **root canal** system

Normal pulp

Insult ↓ Treated ↑

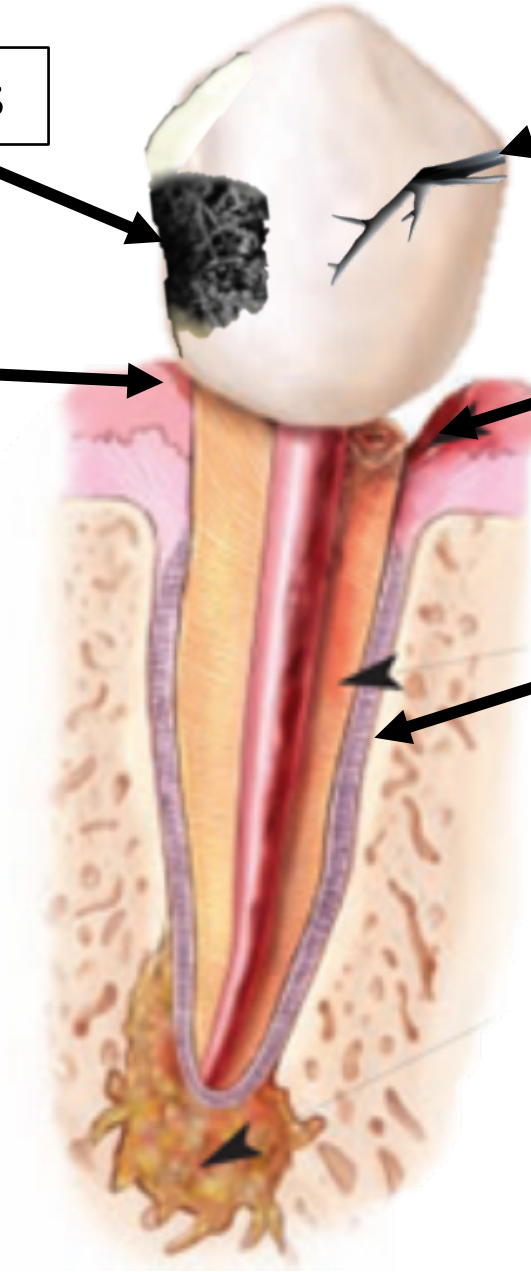
Reversible pulpitis

Untreated ↓

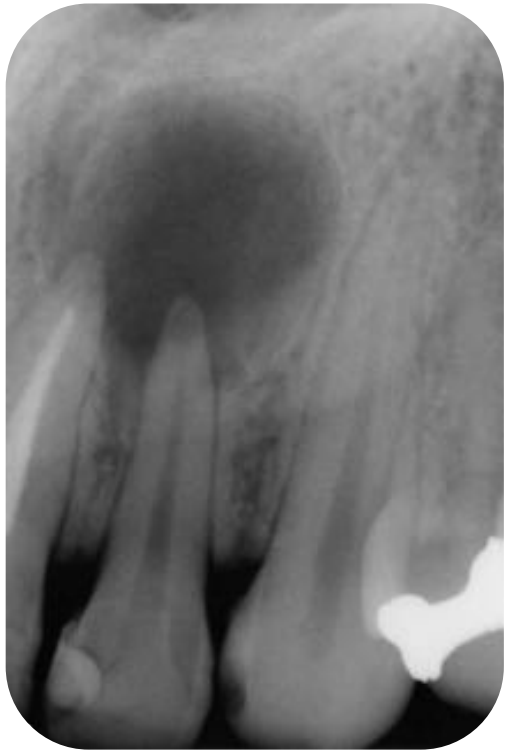
Irreversible pulpitis

Untreated ↓

Pulp necrosis → **Apical periodontitis**



Apical periodontitis



Widened PDL space → untreated → Loss of lamina dura → Untreated → Periapical radiolucency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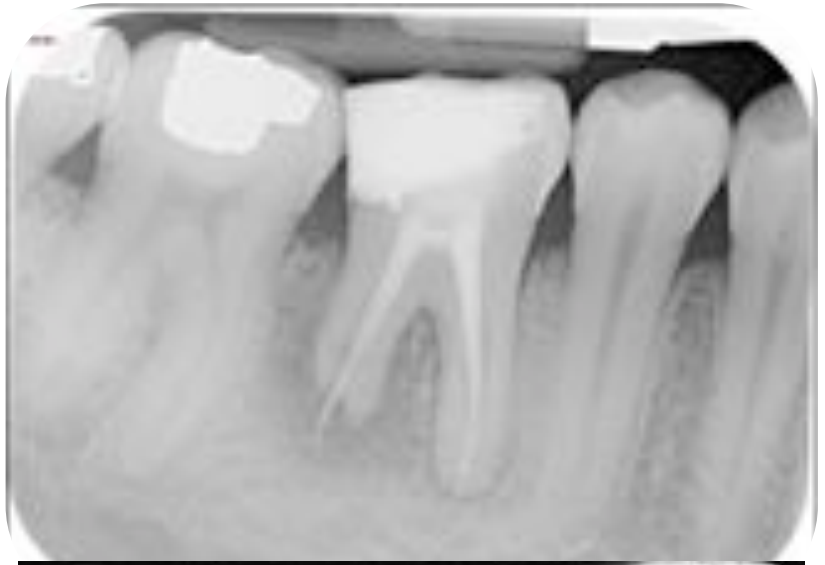
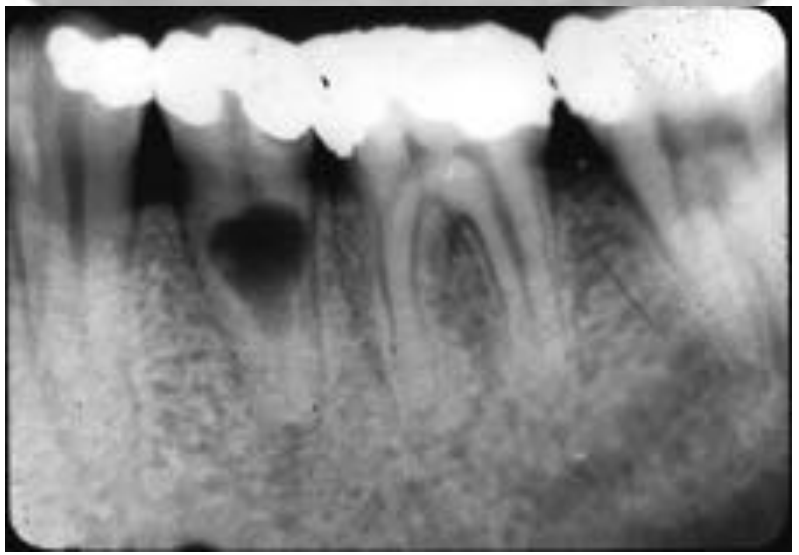
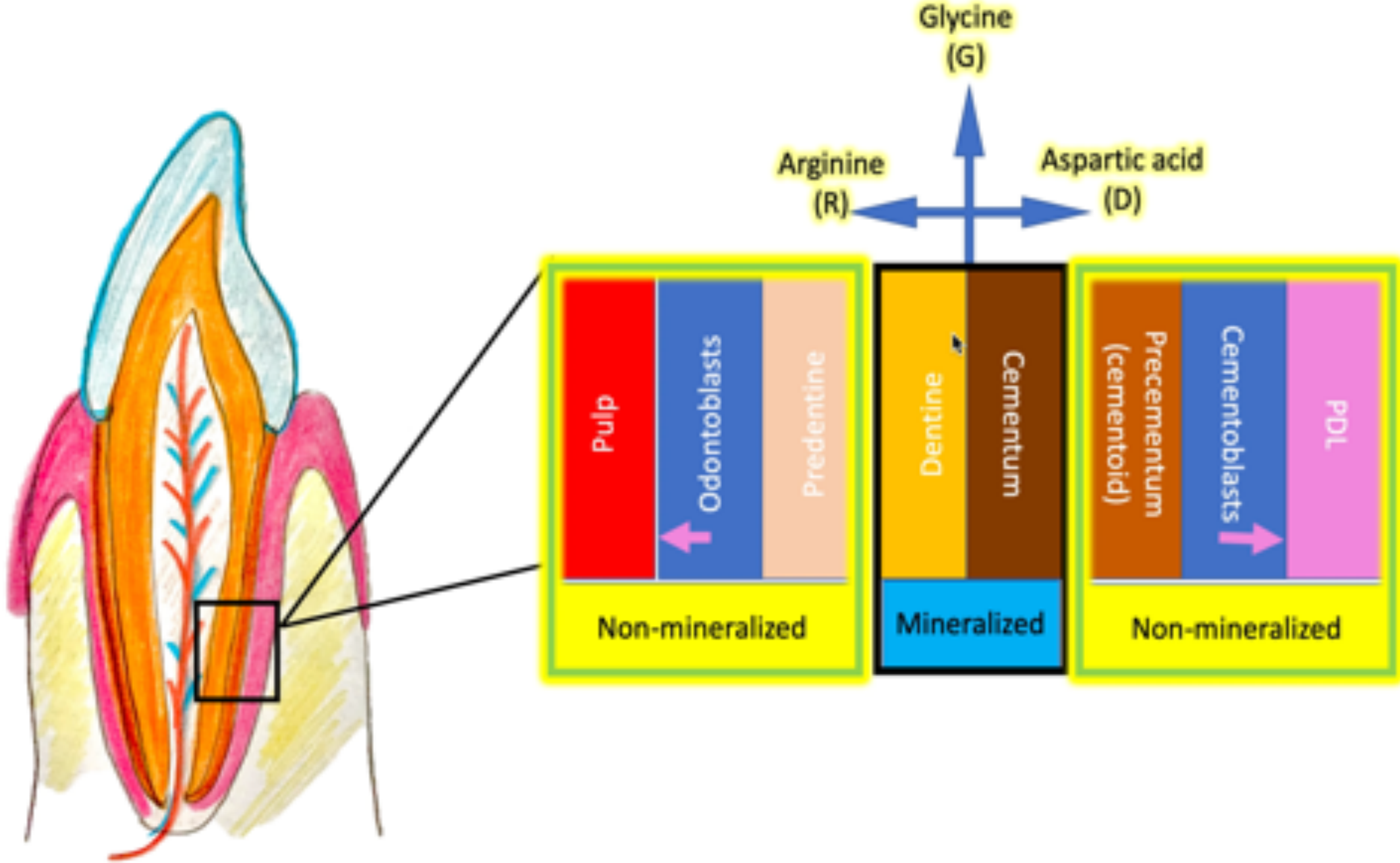





Glycine
(G)
Arginine
(R)
Aspartic acid
(D)
Pulp
Odontoblasts
Predentine
Non-mineralized
Dentine
Cementum
Mineralized
Precementum
(cementoid)
Cementoblasts
PDL
Non-mineralized

Osteoclast/odontoclast

- Motile
- Multi-nucleated giant cell
- Fusion of monocytes/macrophages
- Contact with mineralised tissues (RGD-containing proteins)

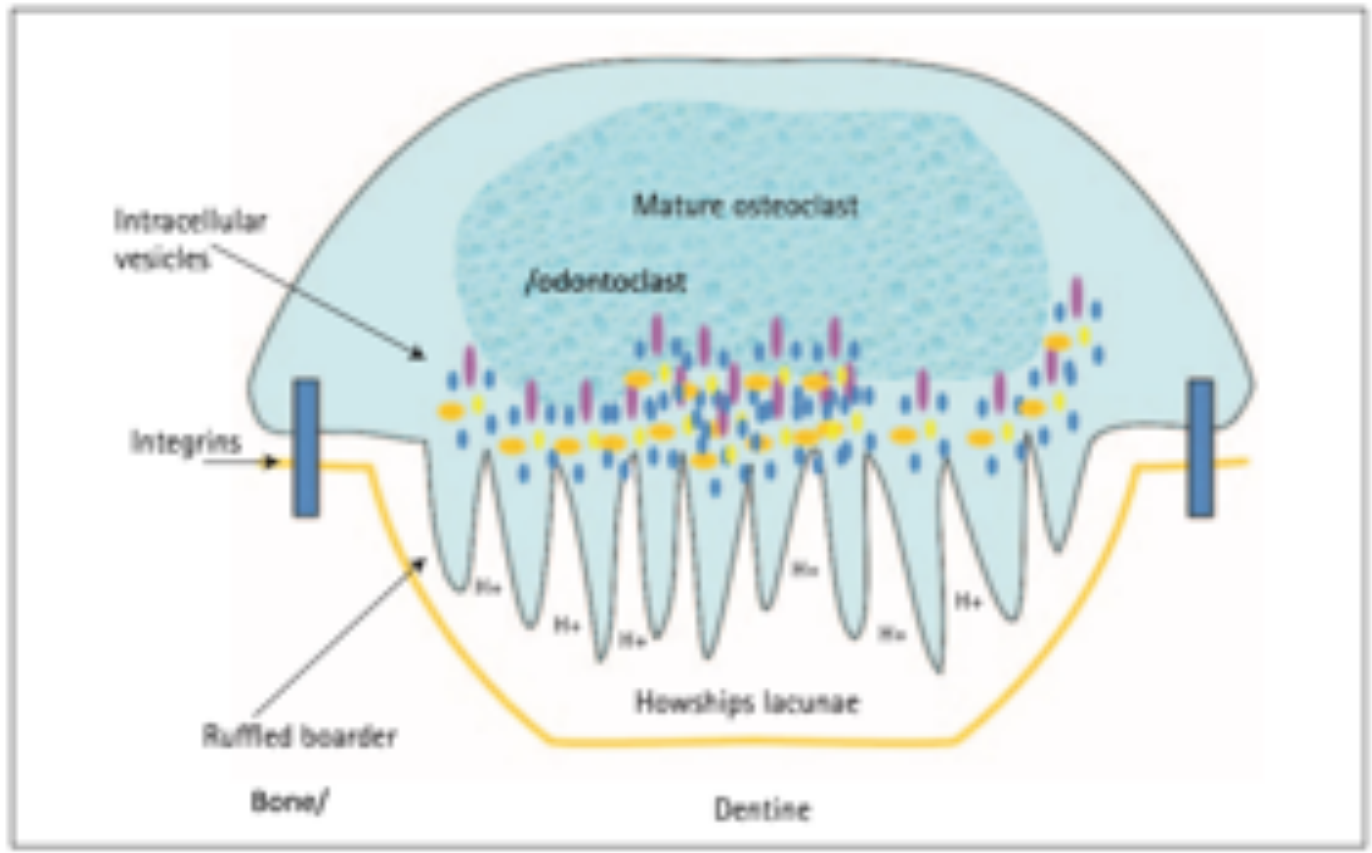
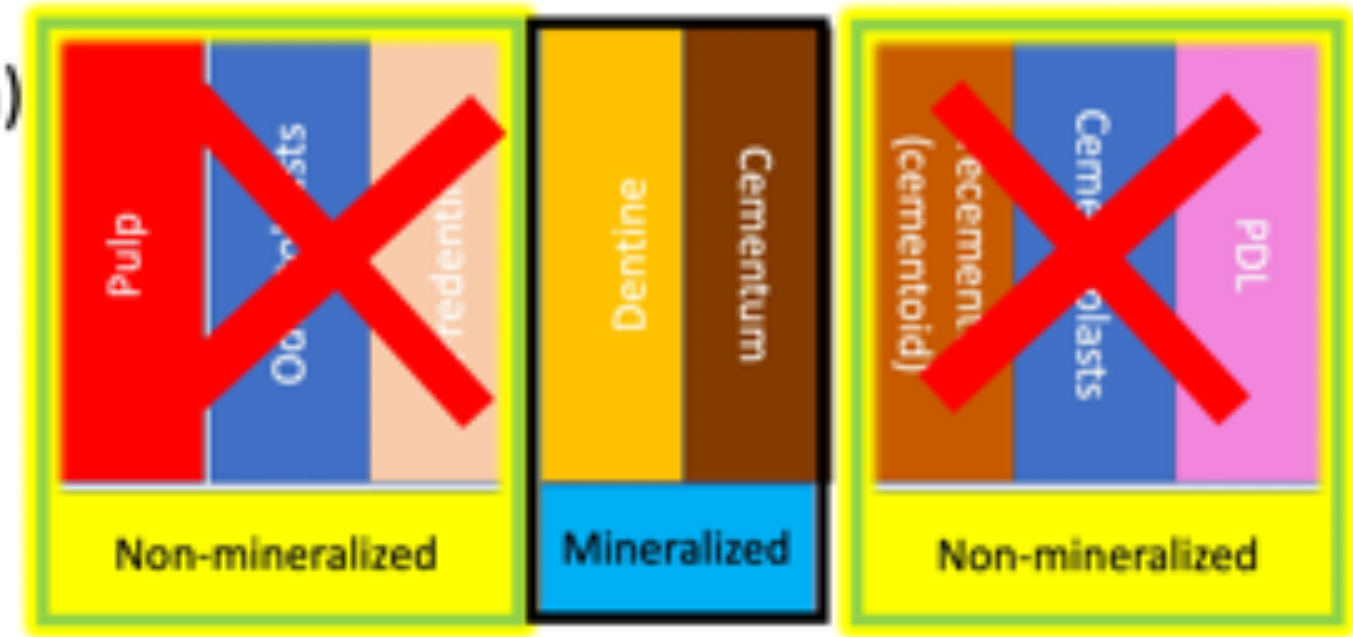


Fig. 1 A mature osteoclast; courtesy of Alan Jack, University of Manchester

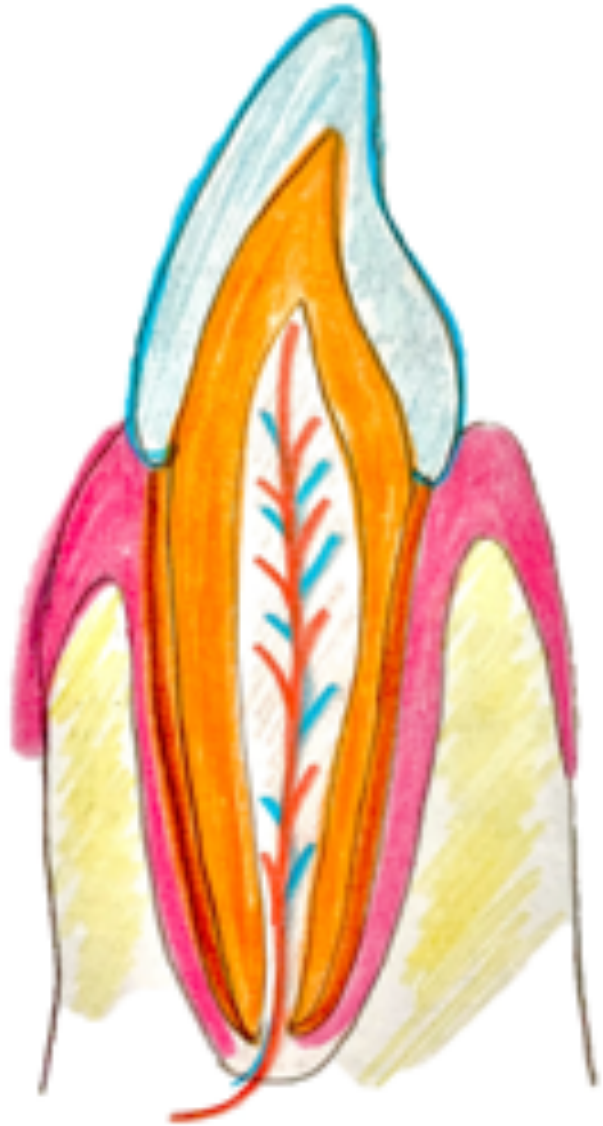
In order for root resorption to occur, two things must happen:

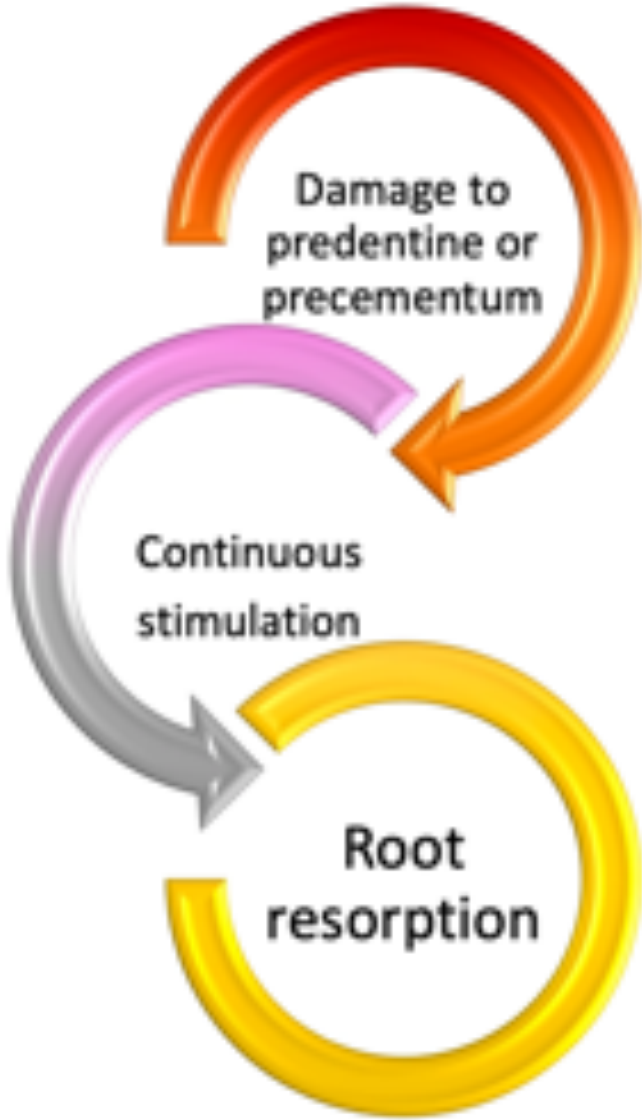
1. Damage to the the non-mineralized tissues covering the external surface of the root, the precementum, or internal surface of the root canal, the predentin.
2. Continuous stimulation

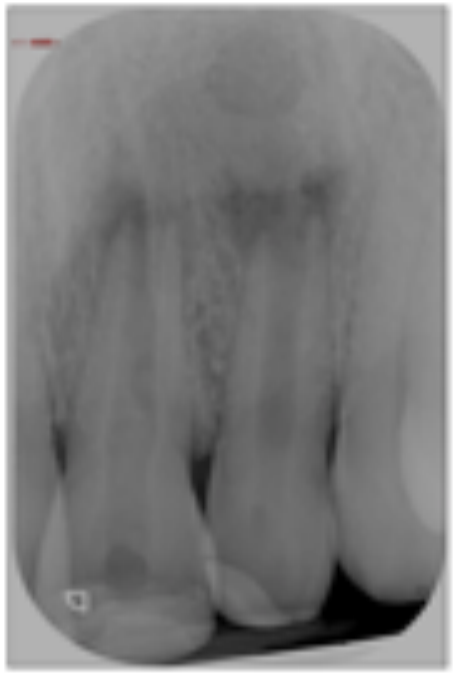
(pressure, infection, inflammation)

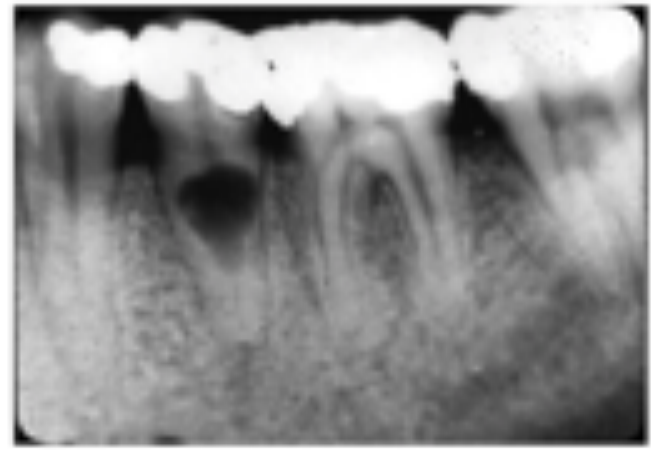


The 2 perquisites for root resorption:









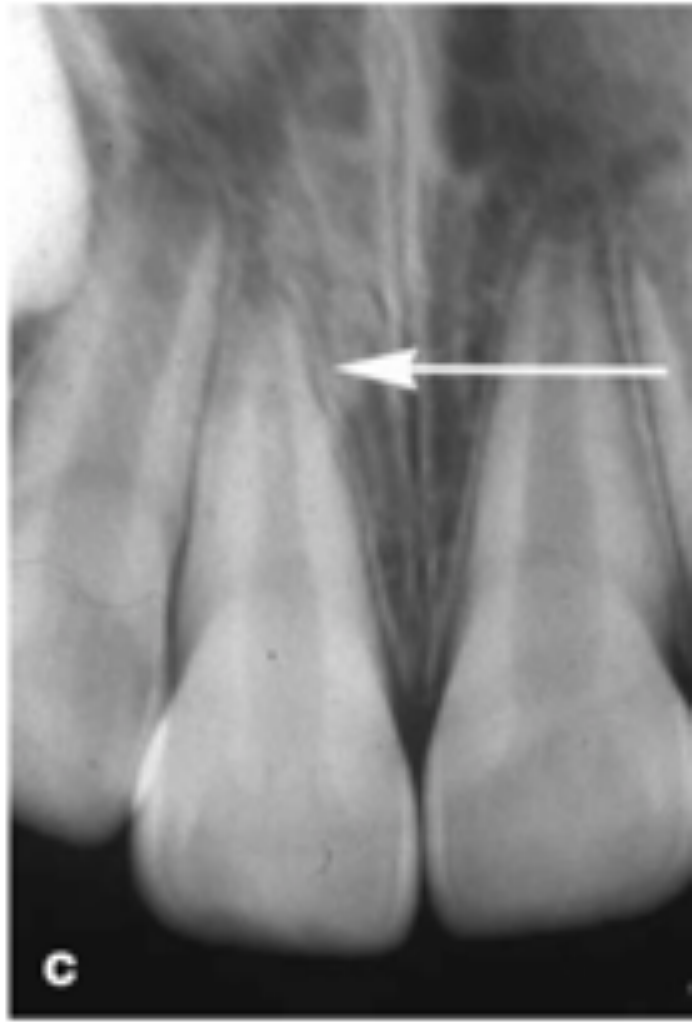
- Resorption
  - External
    - Surface
    - Inflammatory
      - Sterile
      - Infective
    - Replacement
    - Cervical
  - Combined
  - Internal
    - Surface
    - Inflammatory
    - Replacement

Additional Information:

- Site
- Extent
- Periapical disease

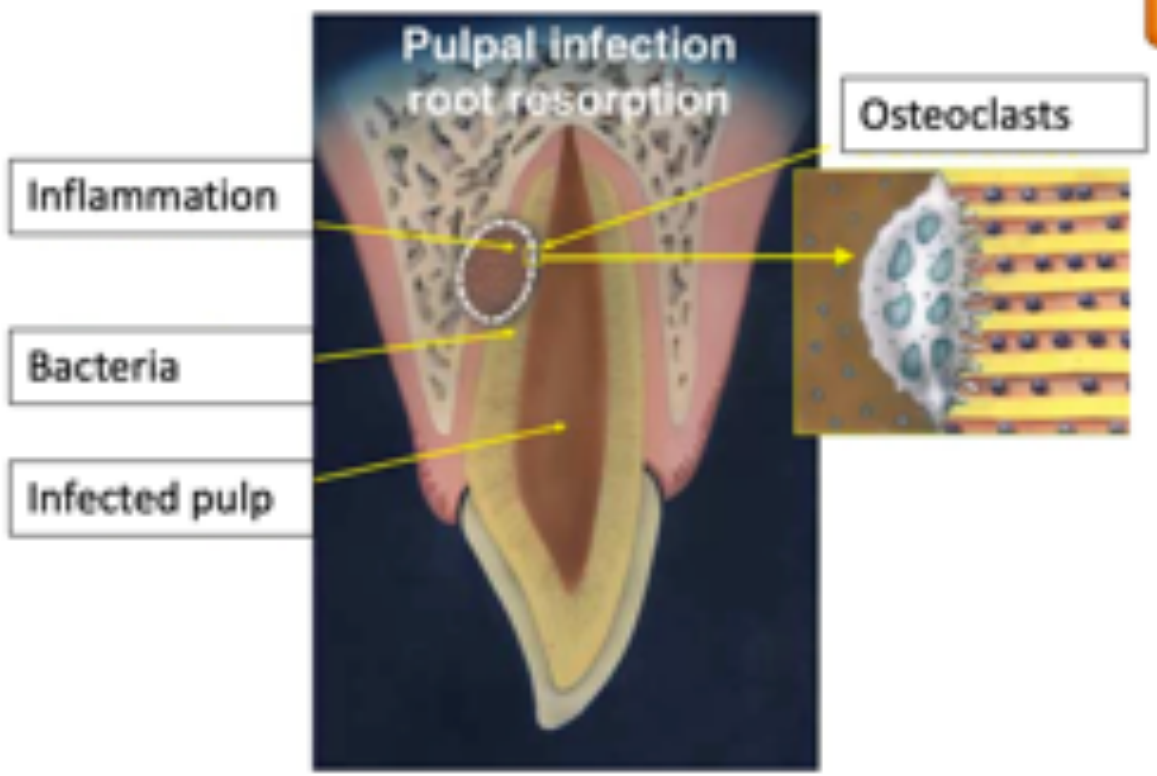
1. External surface resorption

- Defined as 'small superficial resorption cavities in the cementum and outermost layers of the dentine as a result of localised and limited injury to the root surface or surrounding periodontium'
- Self-limiting, heals uneventfully with new cementum
- Sub-clinical
- Unlikely to be seen on radiographs. May be seen as cavitation in the cementum and dentine, or an alteration of the root contour.
- If diagnosed: monitor, no further treatment is necessary



2. External inflammatory resorption

- Damage to root surface + Prolonged stimulus (infection (AP), pressure)



Trauma to root surface
(luxation, avulsion)

Exposed dentinal tubules

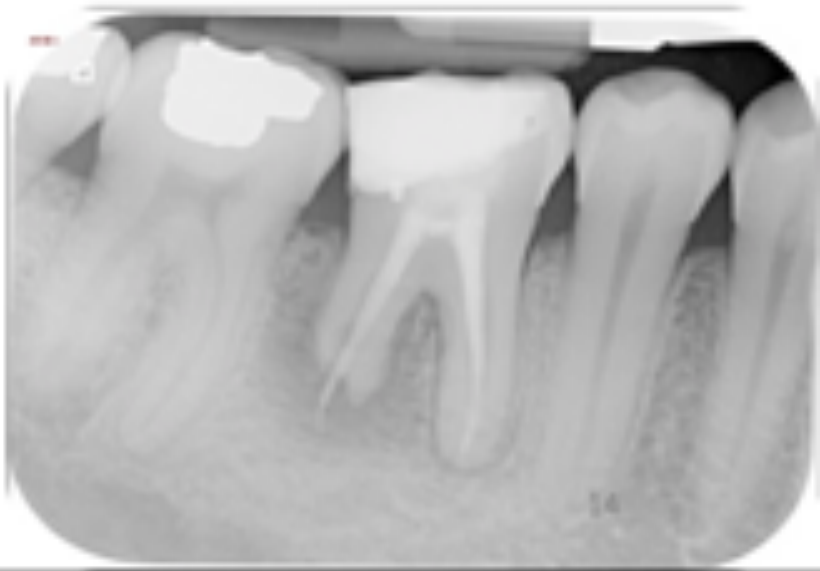
Infected necrotic pulp (stimulus)

Apical periodontitis

External inflammatory root resorption

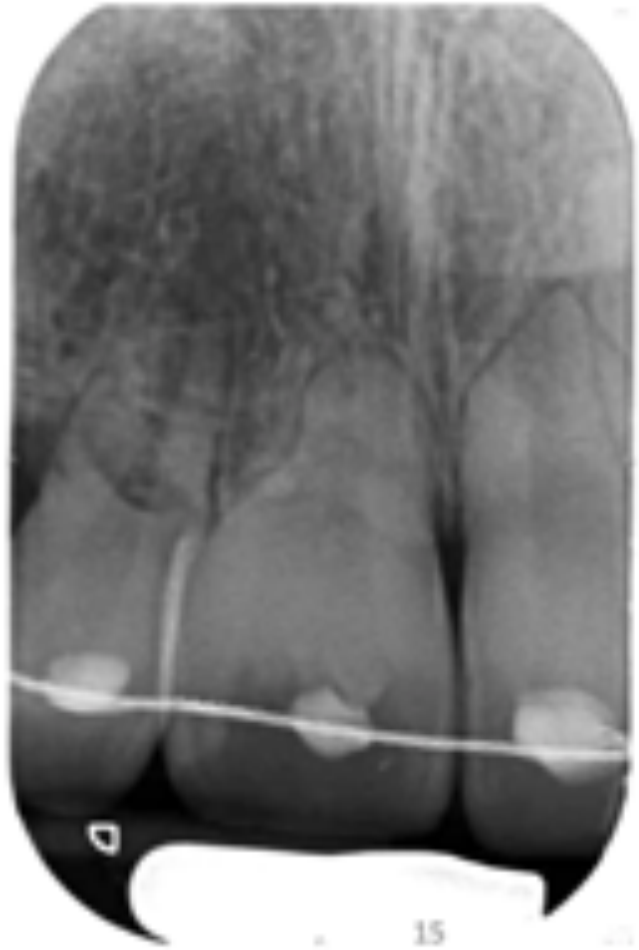
External inflammatory resorption

- The most common form of root resorption after luxation (5-18%) and avulsion (30%) injuries
- Often sub-clinical unless there is an acute inflammatory process (swelling, TTP, mobility, abscess)
- Unchecked this process can completely resorb roots in months.
- Radiographically, incidental radiographic finding. Presentation will vary depending upon whether the process is infective or sterile.



A. Sterile inflammatory external root resorption (pressure resorption)

- Associated with **pressure** (orthodontics, impacted teeth, cyst, tumor)
- Radiographic shortening and blunting of the root apices. The apices are classically rounded.
- Radiographic evidence of causative pathology such as ectopic tooth, tumor…
- Teeth are asymptomatic and the pulp is usually vital unless the pressure of the operative procedure is high, which disturbs the apical blood supply.



Example

- Extensive trauma induced pressure resorption is evident in the radiograph of the maxillary right central and lateral incisors due to an unerupted canine and its crypt.

Management

- Management of sterile inflammatory external root resorption: remove the source of stimulation
- For example extraction of the impacted canine or to halt active orthodontic treatment

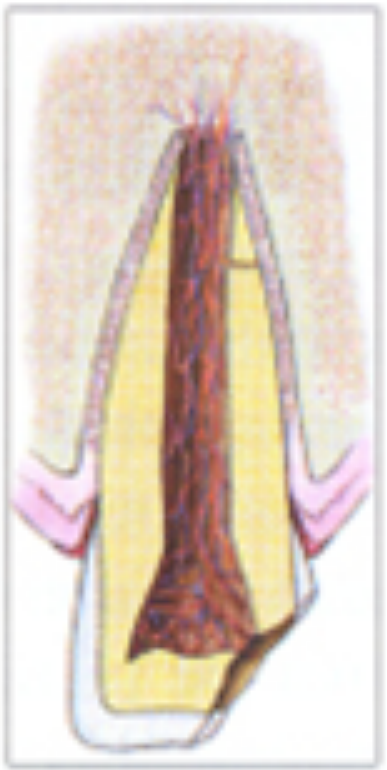
B. Infective inflammatory external root resorption

- Associated with trauma and/or pulpal necrosis
- Radiographic irregular concavity/concavities: bowl shaped resorption of the **root** and a corresponding radiolucency in the **bone**.
- The resorptive area is associated primarily with the apex or a lateral canal or both.
- The tooth will **NOT** be **responsive** to EPT or thermal pulp tests
- Management: **prevent** external inflammatory resorption from occurring following trauma or **arrest** this type of resorption if it is already present.

Lateral luxation:
-Damage to protective cementum layer
-Exposed dentinal tubules

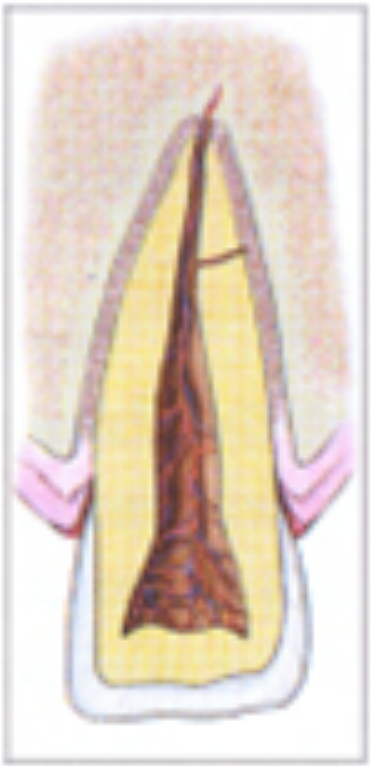
Crown fracture:
- Exposed dentinal tubules
- Bacteria in the root canal

Injuries that are likely to result in pulp necrosis and infection of the root canal system, according to the stage of root development at the time of injury



Incompletely developed teeth	Fully developed teeth
• Avulsion WITH crown fracture • Intrusion WITH crown fracture	• Avulsion • Intrusion • Lateral luxation WITH crown fracture • Extrusion WITH crown fracture

Immediate root canal treatment following repositioning/replantation and splinting should be considered for teeth with these injuries in order to **prevent** the development of external inflammatory root resorption

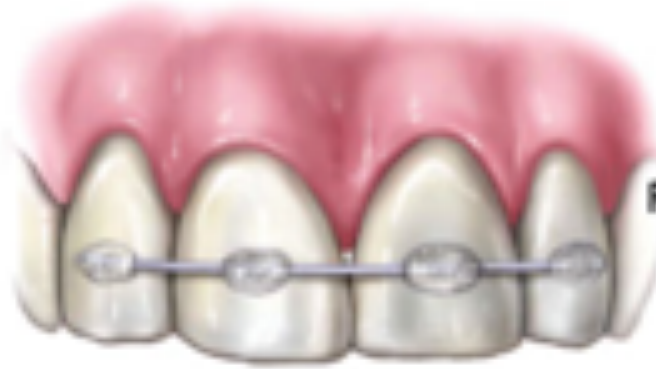


Recommended preventive treatment protocol to prevent external infective inflammatory root resorption

- Systemic AB: doxycycline 100 mg – 2 tablets on the 1st day, and then 1 tablet daily for 1 week (unless there is a contraindication, amoxicillin can be used instead)
- IMMEDIATELY after replantation/repositioning and stabilization with a splint
  - Start RCT for the mature tooth (chemomechanical preparation)
  - Place a CS-AB paste intracanal dressing (Ledermix paste)
- Then non-setting Ca(OH) 2 intracanal dressing to induce formation of an apical hard tissue barrier (if hard tissue barrier formation is required)
- Complete root canal treatment
- Arrange to review after 6 months and then annually for at least 5 years.

Example

Avulsion



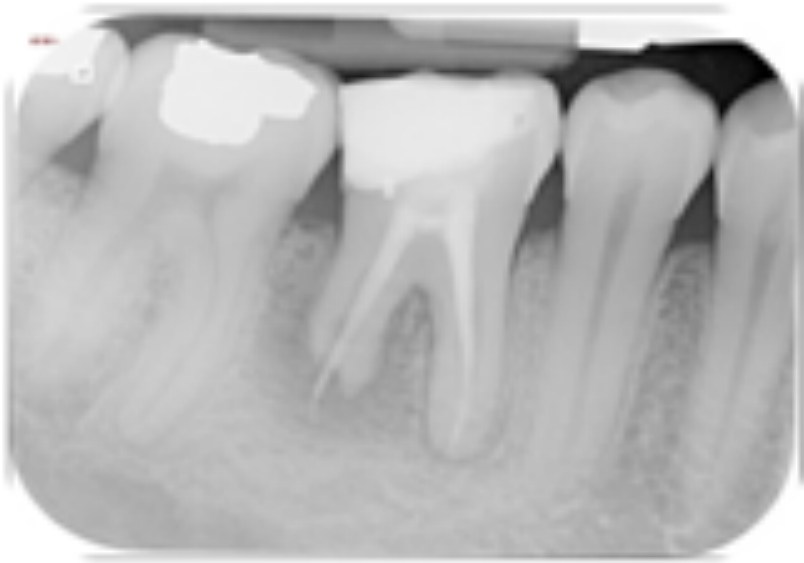
Replant and splint

Systemic AB
1 week

RCT + Ledermix

Recommended interceptive treatment protocol for teeth where external inflammatory root resorption is already established

- Assess restorability (tooth investigation)
- Start RCT (chemomechanical preparation)
- CS-SB paste intracanal dressing
- Then Ca(OH)2 intracanal dressing to induce hard tissue repair
- Once hard tissue repair is evident, place the root canal filling
- Arrange to review after 6 months and then annually for at least 5 years.
- **Systemic antibiotics are NOT indicated (unless cellulitis)**



Ledermix
(Corticosteroid+Antibiotic)
(Anti-inflammatory+Anti-bacterial)

- The active ingredients are the potent anti-inflammatory corticoid **triamcinolone acetonide (1%)** in combination with the broad-spectrum antibiotic **demeclocycline (3%).**
- Steroids have been used locally, within the root canal system, to reduce pain and inflammation.

3. External invasive cervical resorption

- Invasion of the cervical region of the root by fibrovascular tissue derived from the PDL progressively resorbing cementum, dentine and enamel, eventually involving the pulp.
- Often symptomless though there may be a sensation of mild discomfort or irritation from the surrounding gingival tissues.

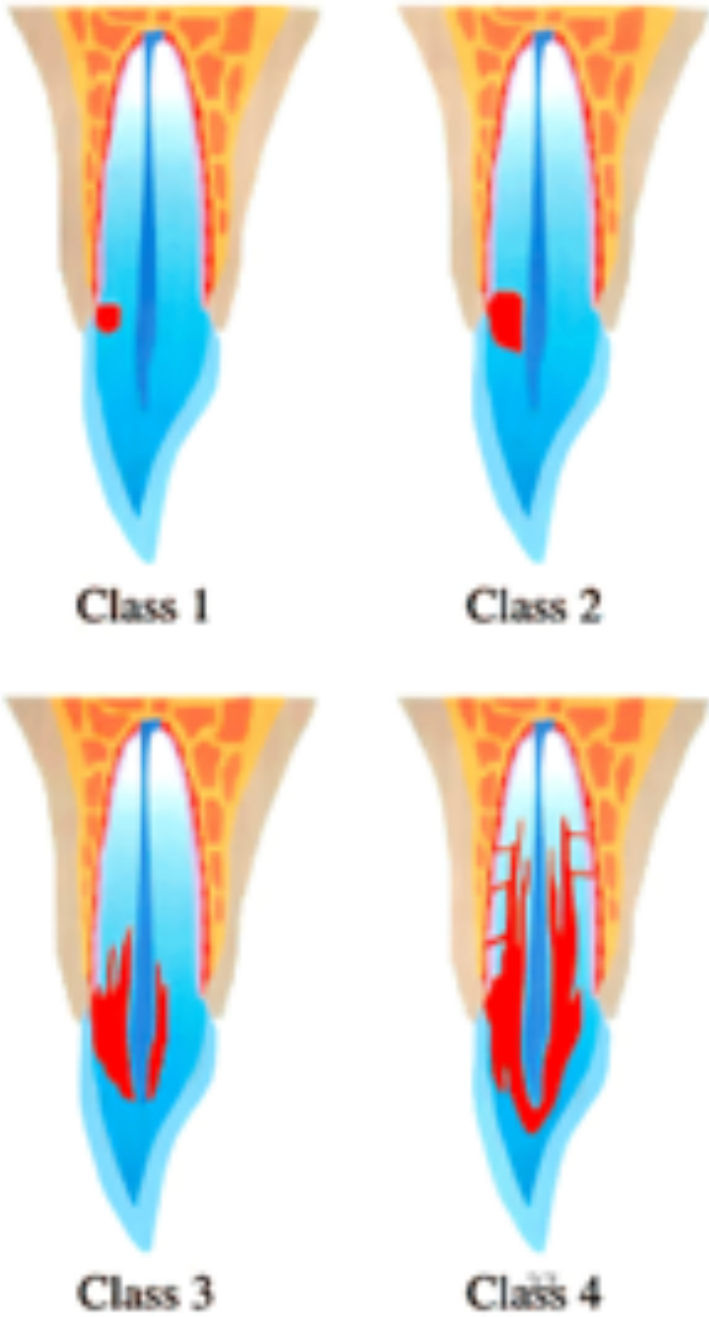
External invasive cervical resorption
Potential predisposing factors:

Clinical presentation

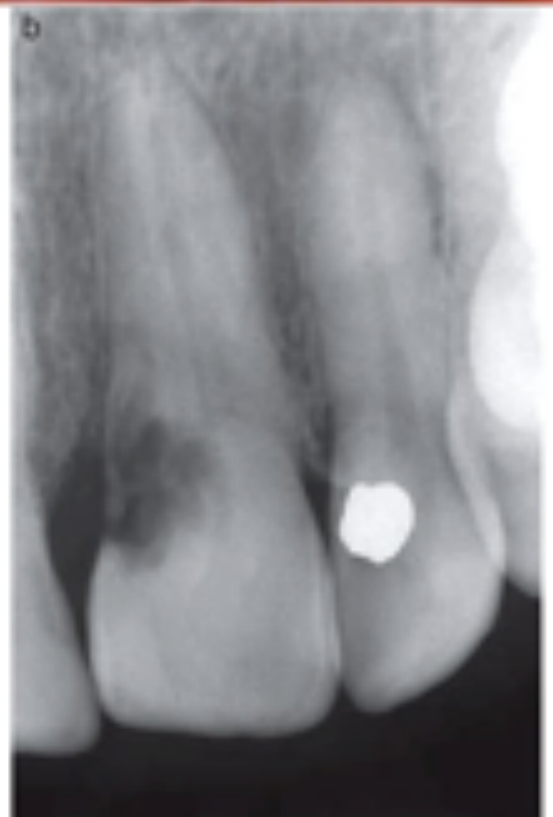
- The cervical enamel and root surface may appear to be pink due to vascular granulation tissue within the resorptive cavity
- Probing may elicit profuse bleeding
- The edges of the cavity may be palpated as being sharp and thinned
- Probing of the cavity reveals a hard, rough surface and distinguishes resorption from caries
- A purulent exudate indicates a superimposed infective process
- Unless the lesion is very extensive, the tooth will be positive to vitality testing as the pulp will not be involved
- Mobility of the coronal portion may be indicative of a pathological fracture.

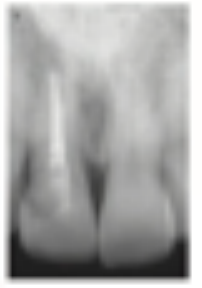
Heithersay's classification

- **Class 1** – Denotes a small invasive resorptive lesion near the cervical area with shallow penetration into dentine.
- **Class 2** – Denotes a well-defined invasive resorptive lesion that has penetrated close to the coronal pulp chamber but shows little or no extension into the radicular dentine.
- **Class 3** – Denotes a deeper invasion of dentine by resorbing tissue, not only involving the coronal dentine but also extending into the coronal third of the root.
- **Class 4** – Denotes a large invasive resorptive process that has extended beyond the coronal third of the root.



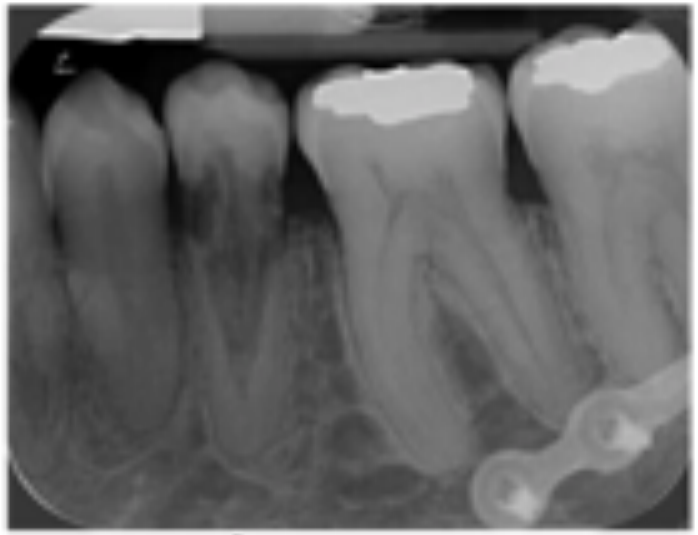
Class III





Management of tooth resorption

GS Heithersay, Australian Dental Journal Supplement 2007;52:(1 Suppl):S105-S121



Class IV

Class II

Success rate:
Class I & II 100%
Class III 78%
Class IV 12.5%

- The treatment may involve a non-surgical/surgical exposure of the resorption or, in severe cases, extraction of the tooth.
- Treatment involves the removal if the granulation tissue, etching with trichloroacetic acid (TCA) to remove tissue remnants, and an adhesive restoration of the defect.

Transient apical breakdown (TAB)

- Trauma induced non-infective root resorption
- Usually follow luxation injuries
- Radiographically: confined periapical radiolucency which resolves within a few months
- Positive sign (increased vascular supply to aid in pulp healing)
- Often there is an associated colour change due to intra-pulpal haemorrhage and this **may** resolve spontaneously (50% of the cases) if revasularization to the coronal pulp chamber occurs (aesthetic problem if tooth colour didn't go back to normal)
- In the longer term the internally resorbed apex will close uneventfully.

TAB

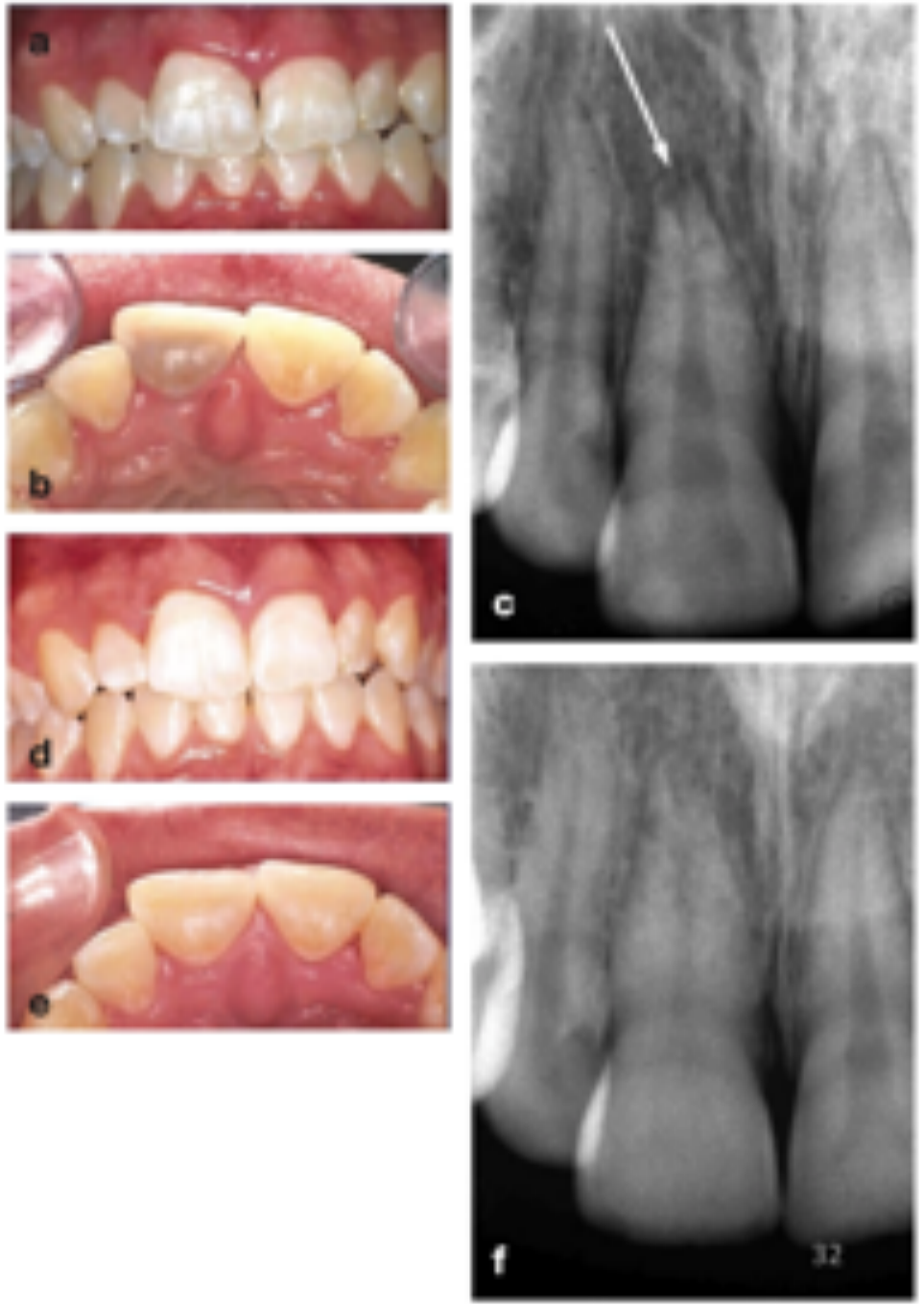
a) 11 was laterally luxated and repositioned

b) One month later, 11 was discoloured

c) One month later, 11 shows signs of TAB

d,e)A year later, discolouration has resolved

f) Radiograph taken 1 year after the original trauma shows resolution of the apical internal resorption and no other signs of periradicular pathosis.



4. External replacement resorption (Ankylosis)

A. Clinically:

- Often no symptoms but there may be clinical signs when 10-20% of the root is affected.
- There are three significant clinical manifestations of ERR:
  1. High pitched or metallic sound to percussion
  2. Lack of mobility
  3. Infra-occlusion (specially of it started before the age of 10)

B. Radiographically:

  1. Loss of the lamina dura
  2. The root dentine will appear either irregular or 'moth-eaten' as bone progressively replaces dentine
  3. There is an absence of radiolucency

- The condition is progressive, eventually resorbing the entire root.
- To date there is no means of arresting or reversing the condition.
- Risk factors: avulsion with extra alveolar dry time >60 minutes, water as a storage medium, early use of ca(OH)2 as intra-canal medicament following trauma, intrusive luxation, prolonged rigid splint

Treatment options

1. Accept position, restore the incisal level with composite and monitor

2. Autotransplantation

3. Surgical repositioning

4. Extraction and prosthetic replacement

5. Decoronation

Decoronation

Decoronation preserves not only the width of the ridge but also the vertical height.

Internal root resorption

- This process takes place within the canal system.
- Association with traumatised/replanted teeth or those teeth that have undergone pulpotomy and crown preparations as all these processes may damage predentine and allow odontoclastic action on the underlying dentine
- There must be **vital pulp tissue apical** to the odontoclasts to provide a blood supply for *nutrients* and **necrotic/infected tissue coronal** to the osteoclasts to maintain *stimulation*

Internal surface resorption (ISR)

- Radiographically: **indistinguishable**
- Osteoclastic activity is initiated but arrests
- It is self-limiting without further stimulation
- The cause is mostly unknown (possible trauma, infection of he coronal pulp)

Internal inflammatory resorption (IIR)

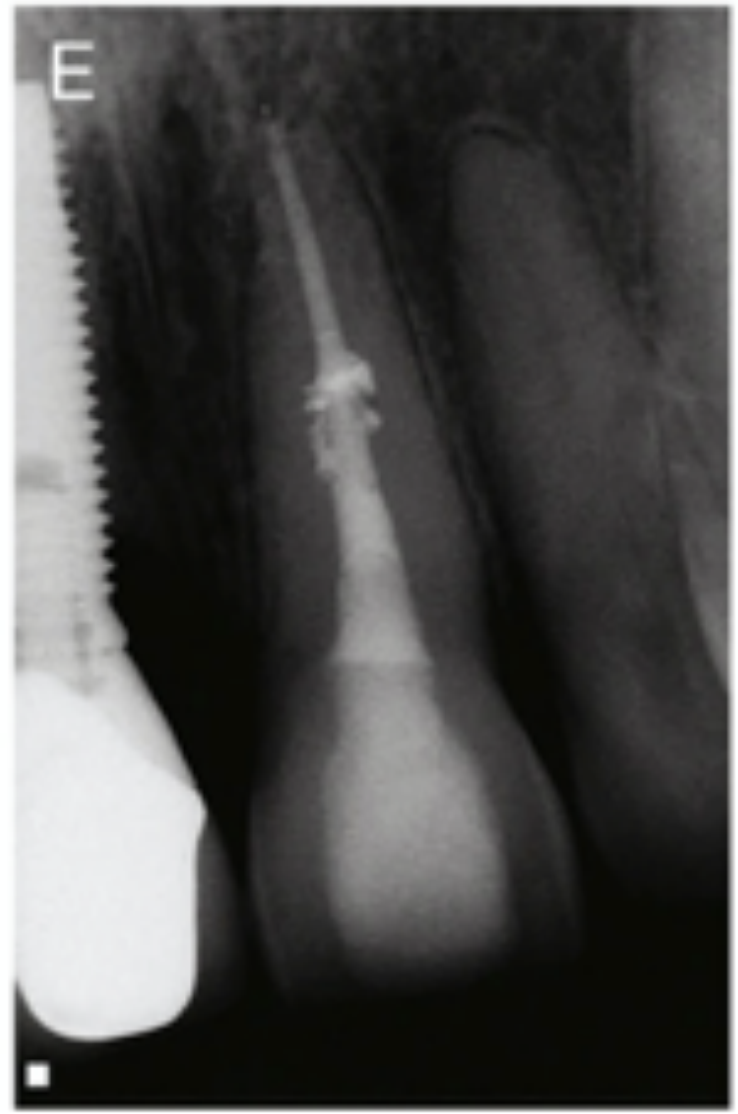
- **Clinically**: the tooth is often partially vital and there may be the symptoms of pulpitis. Vitality testing may be inconclusive.
- Both IIR and EIR may present with a 'pink spot' though the origin and histopathology of these varies.
- **Radiographically**: ovoid or irrigular enlargement of pulp chamber or root canal
- Differentiation between the two is largely based upon radiographic examination using the parallax technique

- The tooth may have a history of trauma, vital pulp therapy or crown preparation.

Internal replacement root resorption (IRR)

- Rare
- Radiographically:
  - Irregular enlargement of the canal space
  - Diffuse areas of mixed radiolucencies and radioopacities reflecting **metaplastic** changes
  - It may lead to obliteration of the canals space with cancellous-like bone
- Replacement resorption may be very difficult to distinguish from ECR. CBCT maybe helpful
- Not fully understood
- Theories??
  - Dental pulp stem cells produce the osteoid material as a reparative response to trauma, inflammation or bacteria.
  - The cells are non-pulpal in origin and have migrated into the pulp from the periapical tissue via capillaries.

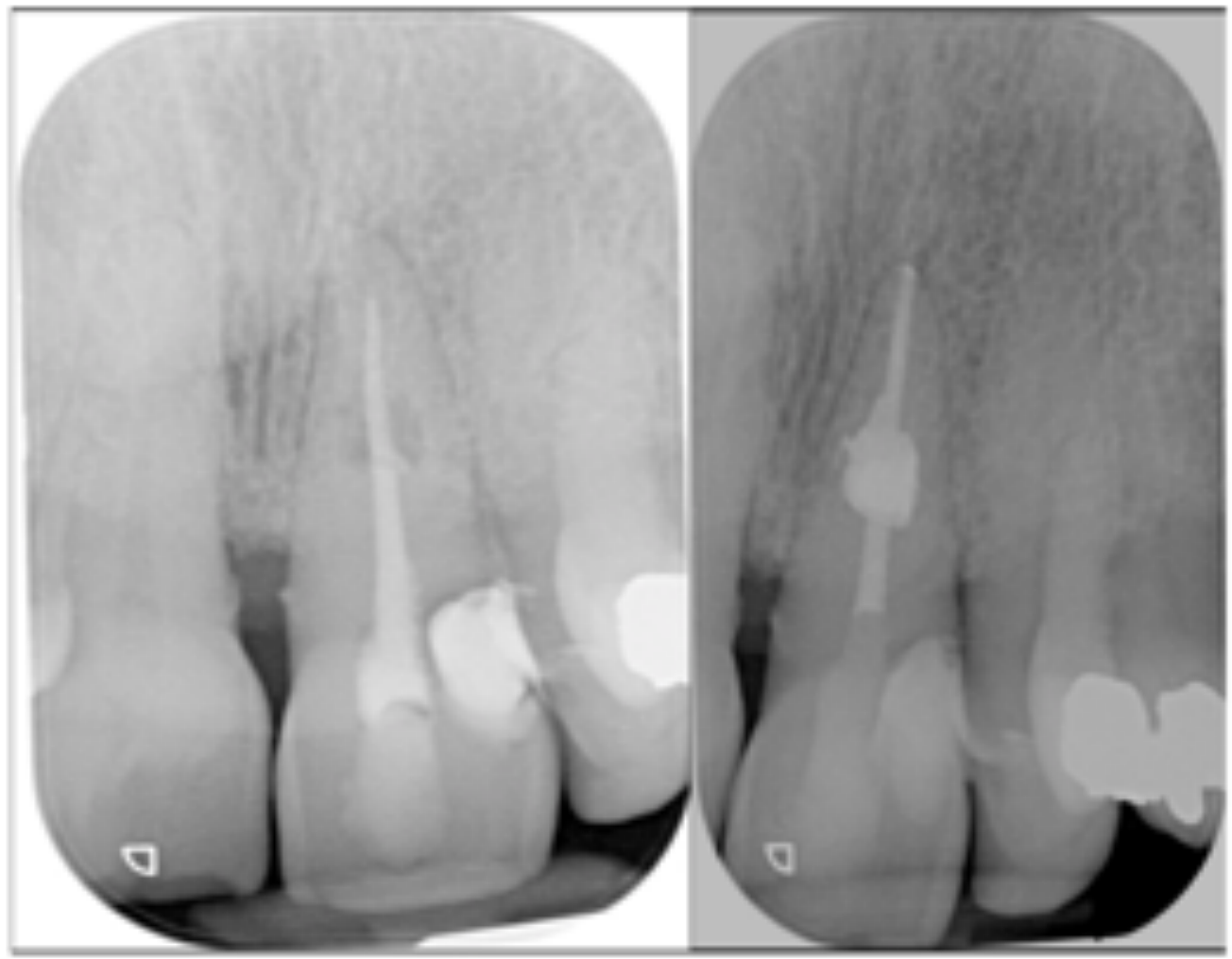
Internal replacement resorption

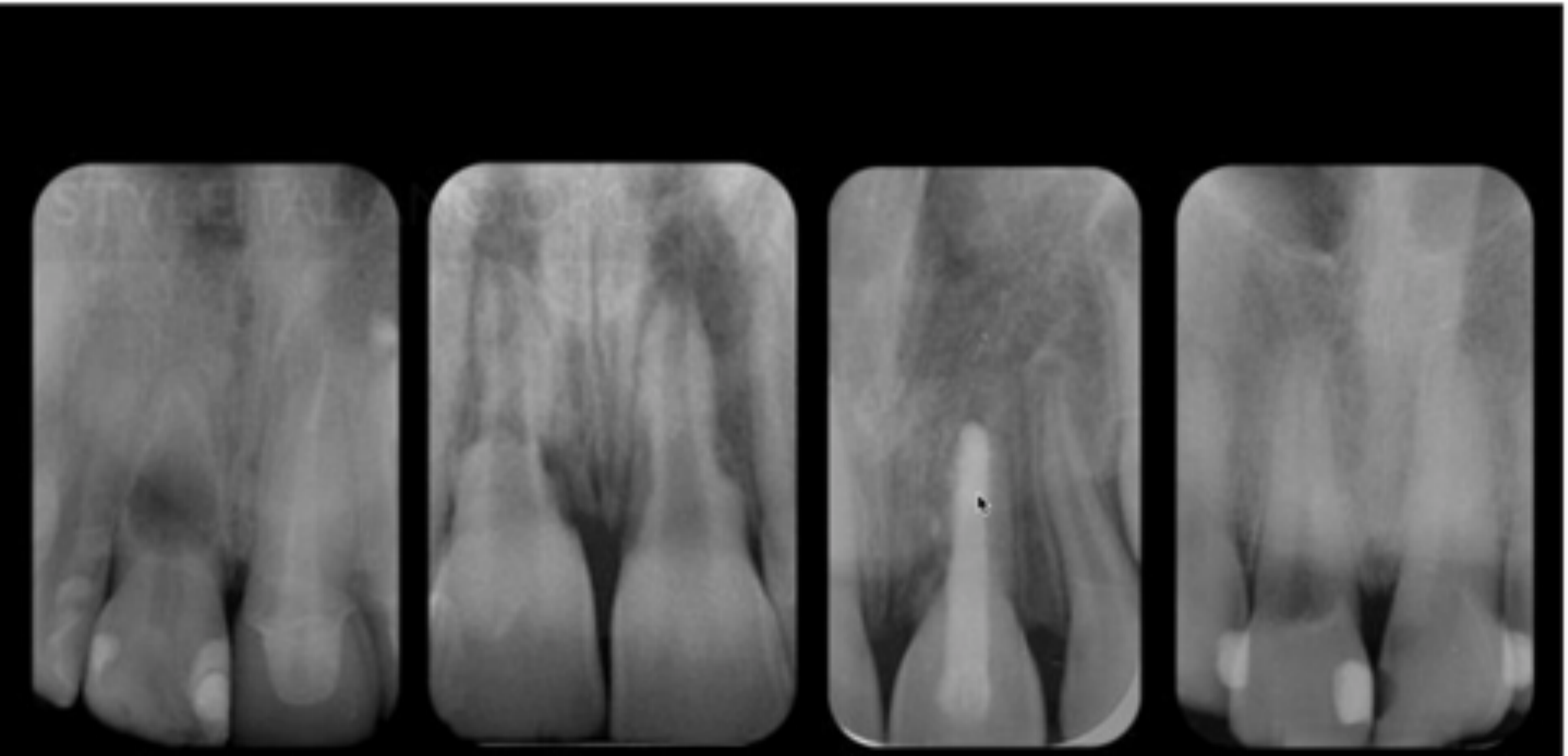


Patel et al - *J Endod* 2010; 36: 1107-21

Management

- Remove any stimulus and vital tissue that may be allowing the resorptive process to perpetuate.
- If the tooth is restorable, root canal treatment is usually the treatment modality of choice. Intracanal medicament Ca(OH)2 is a must
- **Single stage RCT is NOT recommended.**
- Challenges: Hemorrhage from the canal (possible perforation??), Obliteration of the canal (replacement resorption) may need ultrasonic tips, agitation of root canal irrigants, Obturation (Thermoplastic gutta-percha techniques)




1. Internal resorption
2. Inflammatory resorption
3. Replacement resorption
4. Invasive cervical resorption

Incompletely formed tooth VS resorption

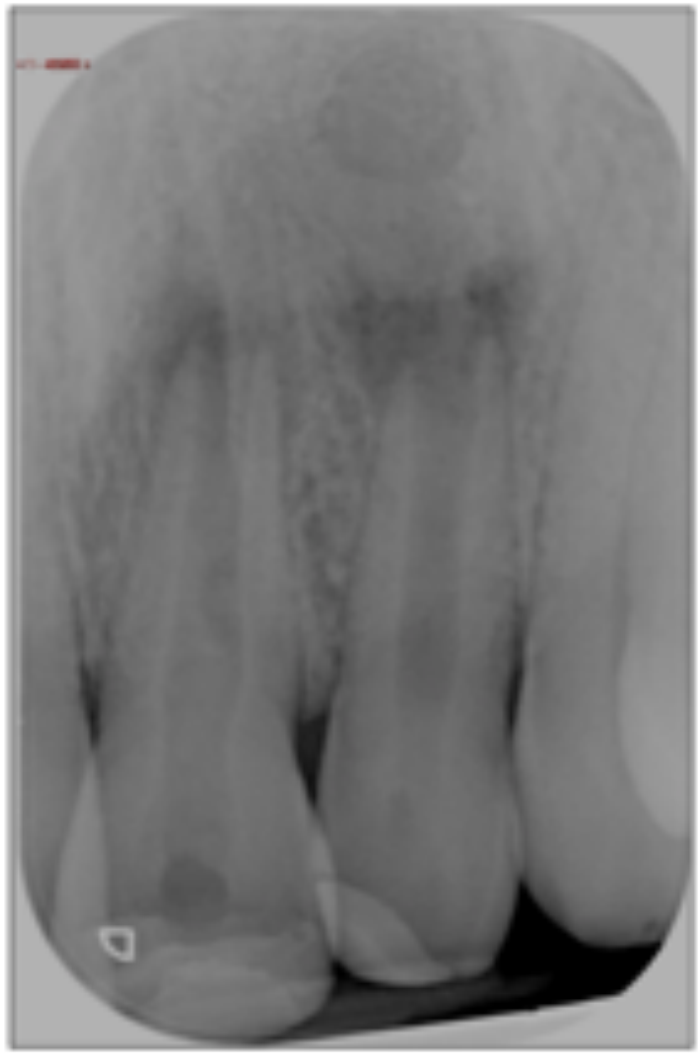


Table 1 Diagnostic features of resorption

Diagnosis	Mobility	Percussion	Colour	Vitality	Radiographic signs
External surface resorption	Normal	Normal	Normal	Normal	Minimal if at all: small cavity in the cementum and superficial dentine
External inflammatory resorption	Maybe increased	Normal	Normal, may change if pulpal involvement	Non-vital unless 'sterile' pressure resorption	Loss of lamina dura, irregular saucer shaped lesions with adjacent peri-radicular radiolucency
External cervical resorption	Maybe increased	Normal	Possible pink discolouration of cervical enamel	Normal, possibly increased response to vitality testing if lesion close to pulp. Absent if pulpal involvement.	Radiolucency of cervical third of root, may resemble class V cavities or internal resorption
External replacement resorption	Absent	Metallic sound	Normal, may change depending upon nature of trauma	Typically absent as sequelae of trauma	Irregular alteration to root form, loss of lamina dura, bony infiltration resorptive cavities with direct apposition of bone onto root surface. Absence of radiolucency of the periodontal ligament.
Internal inflammatory resorption	Normal	Normal	Possible pink discolouration if lesion is coronally situated	Mixed response: positive in active lesions, absent in extensive lesions	Expansion of canal, often symmetrical with sharp, well-defined margins
Internal replacement resorption	Normal	Normal	Possible pink discolouration if lesion is coronally situated	Mixed response: positive in active lesions, absent in extensive lesions	Irregular expansion of canal. Possible pulpal obliteration with mixed radio-opacities in the canal space