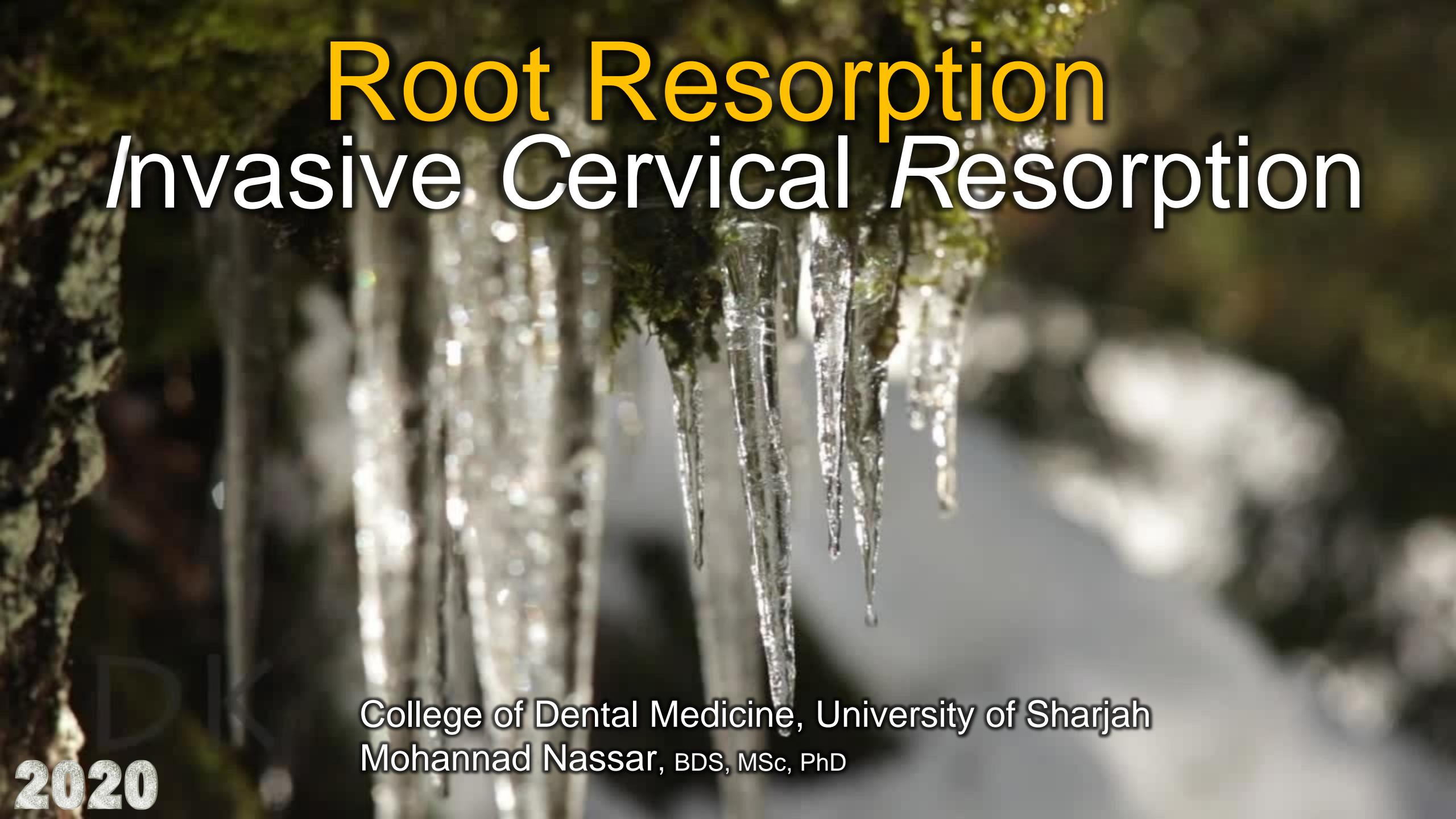


Root Resorption Invasive Cervical Resorption

A close-up photograph of several clear, icicle-like structures hanging from a dark, textured surface, likely a tree trunk or branch. The icicles are elongated and have a slightly irregular shape, with some showing internal crystalline structures. They are illuminated from behind, creating a bright, glowing effect against the darker background.

College of Dental Medicine, University of Sharjah
Mohannad Nassar, BDS, MSc, PhD

2020

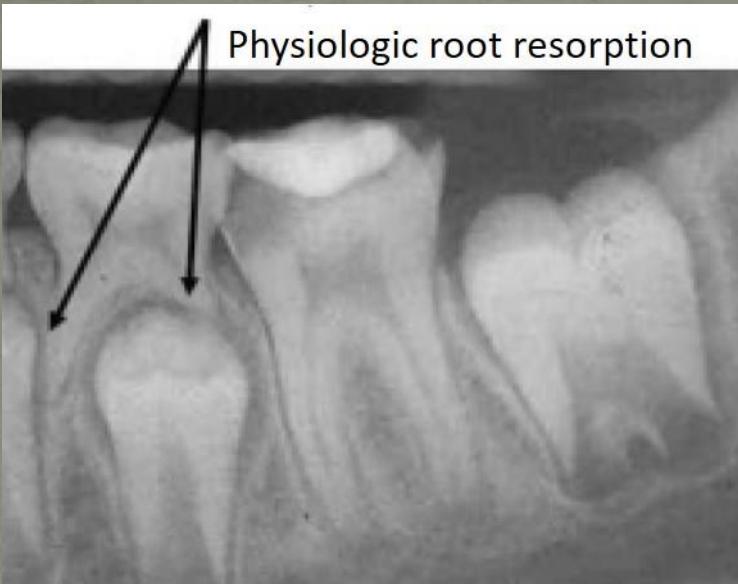
LEARNING OBJECTIVES

1. Describe the clinical and radiographic features of invasive root resorption and compare it to various types of root resorption
2. Understand the etiology, pathogenesis and histologic appearance of invasive root resorption
3. List pertinent information needed when examining patients with invasive root resorption: health history and history of dental trauma, intracoronal bleaching, and orthodontic treatment, etc.
4. Describe the predisposing factors associated with invasive root resorption
5. List, describe and interpret the findings of the diagnostic tests and procedures used in examining patients with invasive root resorption
6. Describe the treatment strategies for invasive root resorption

Root Resorption

Loss of dental hard tissues as a result of clastic activities

Physiologic



Pathologic

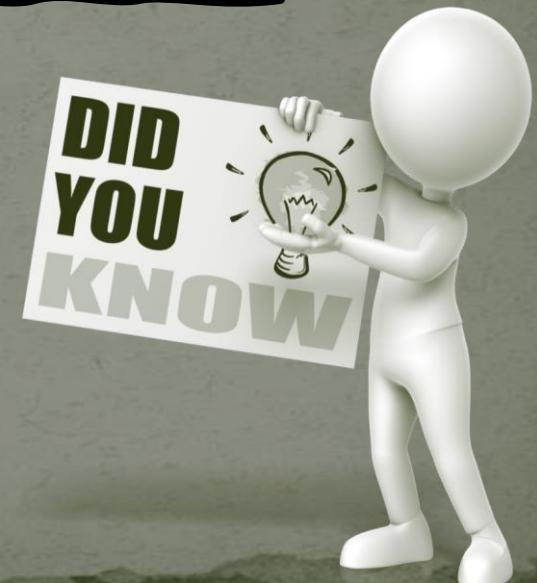


BEWARE

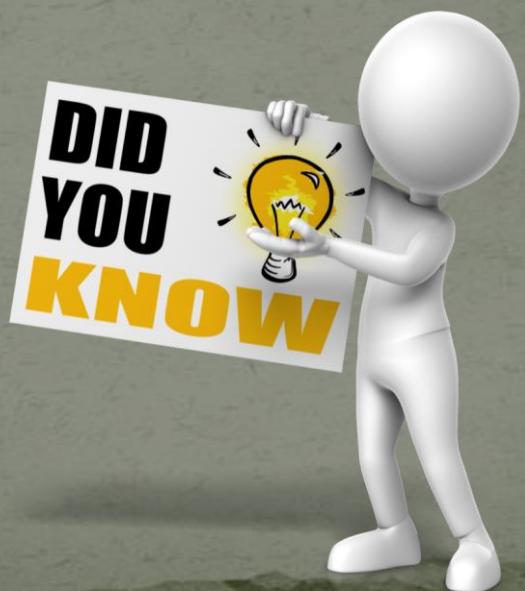


Open apices: immature root! Do not confuse it with root resorption

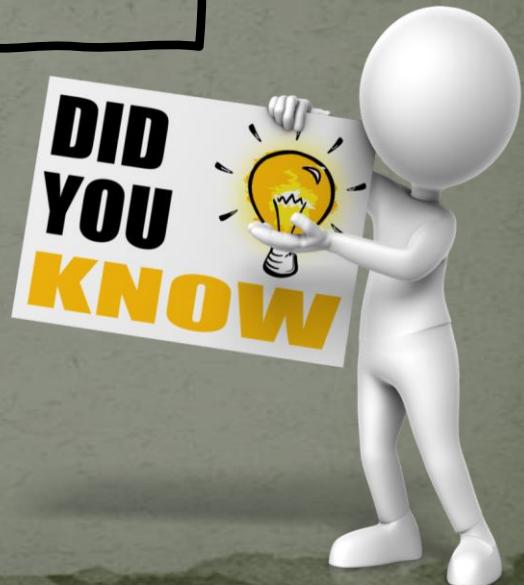
Under normal conditions, permanent teeth are resistant to resorption. Odontoclasts do not adhere to the non-mineralized layers covering the **external root surface** and the **root canal wall** (precementum and **predentin**, respectively).



Damage to the pre cementum, with a resultant breach in its integrity, is the precipitating factor in all types of external resorption



Pressure on the root surface during orthodontic treatment and from impacted teeth, cysts, and tumors may also denude the protective precementum from the root surface and therefore initiate external root resorption.





A



B

- A. Orthodontic treatment-related root resorption
- B. Root resorption on a maxillary lateral incisor from the ectopic eruption of the adjacent canine.

Root Resorption: Permanent Teeth

Root resorption of permanent teeth does not occur naturally and is inflammatory in nature. Thus, root resorption in the permanent dentition is a pathologic event; if left untreated, it may result in loss of the affected teeth.



Pathologic root resorption

Root Resorption: Classification

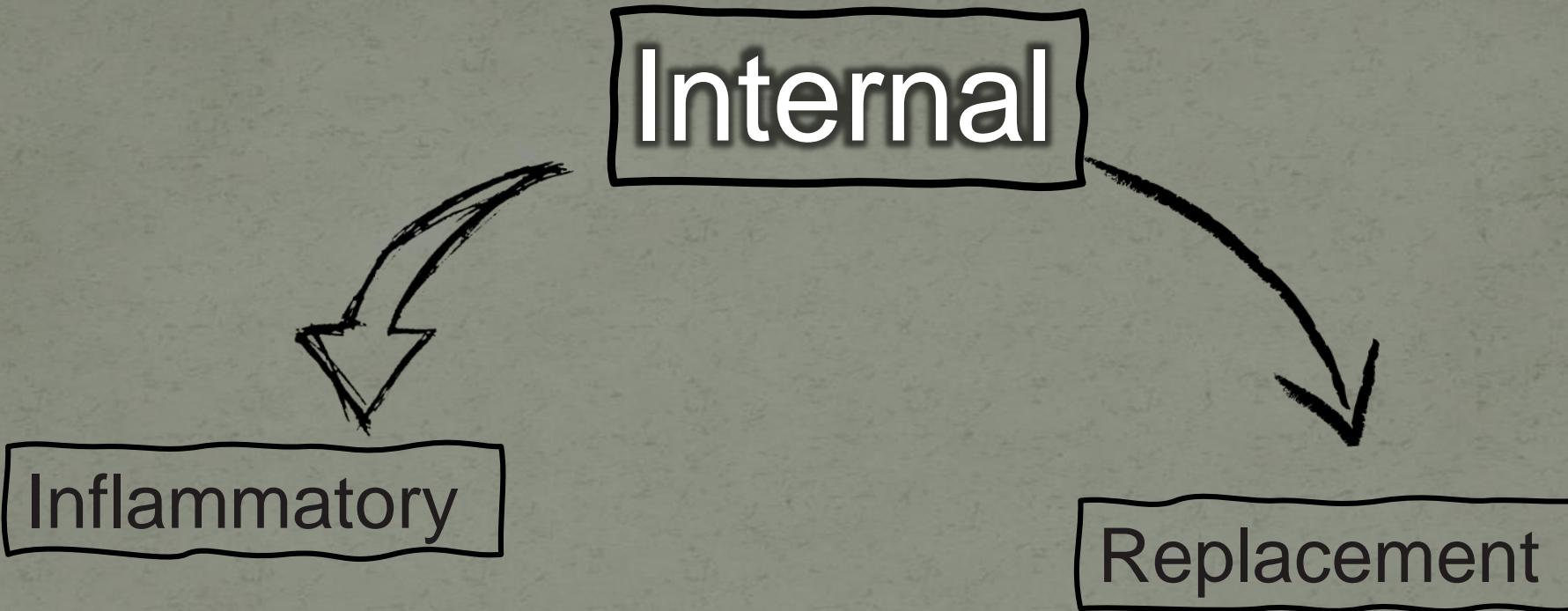
Internal



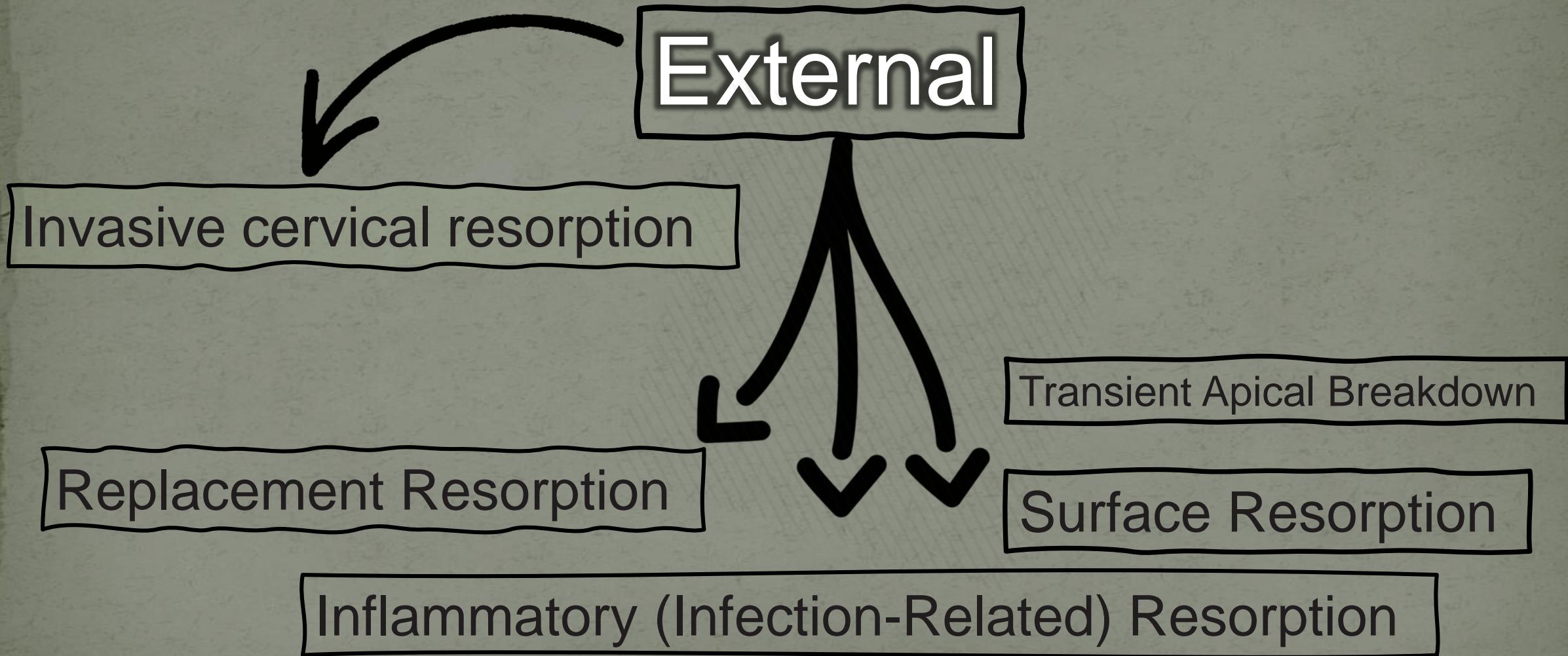
External



Root Resorption: Classification



Root Resorption: Classification



Invasive cervical resorption



External cervical resorption

Supraosseous extracanal invasive resorption

Subepithelial external root resorption

Peripheral inflammatory root resorption



External Inflammatory Resorption



Surface Resorption

EIR differs from surface resorption in that it is a progressive event that relies on microbial stimulation from the infected necrotic pulp of the affected tooth for its progression.



Endodontics

PRINCIPLE

If a patient refuses ~~a~~ necessary diagnostic radiographs, would you treat this patient?

Yes

No

May be



Endodontics

PRINCIPLES AND PRACTICE

If a patient refuses ~~or~~ necessary diagnostic radiographs, would you treat this patient?

Yes

No

May be



Diagnostic Features of External Versus Internal Root Resorption

Difficult to distinguish external from internal root resorption, so misdiagnosis and incorrect treatment may occur.

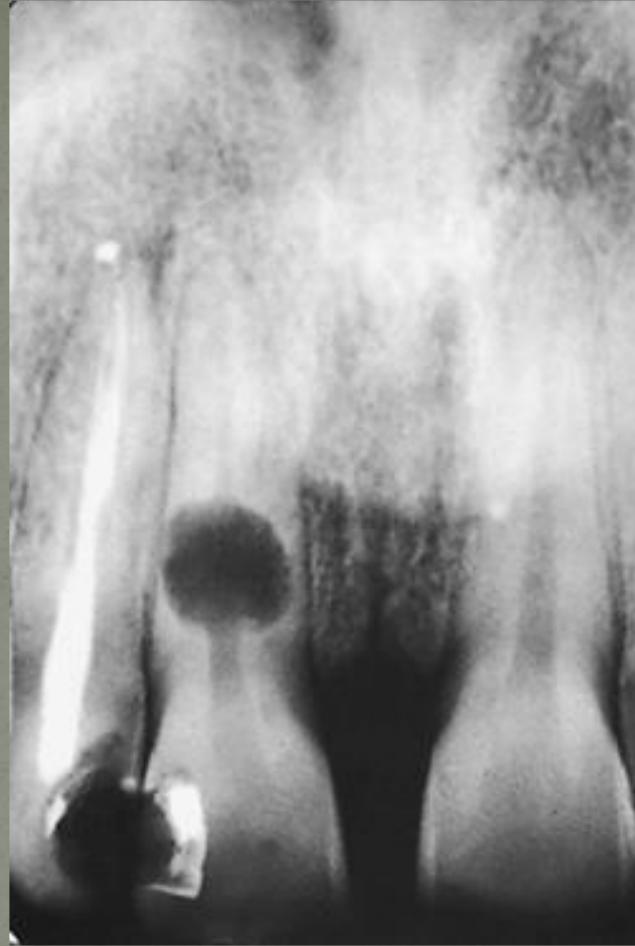
Most misdiagnoses of resorptive defects are made between subepithelial external and internal root resorptions



Radiographic Features

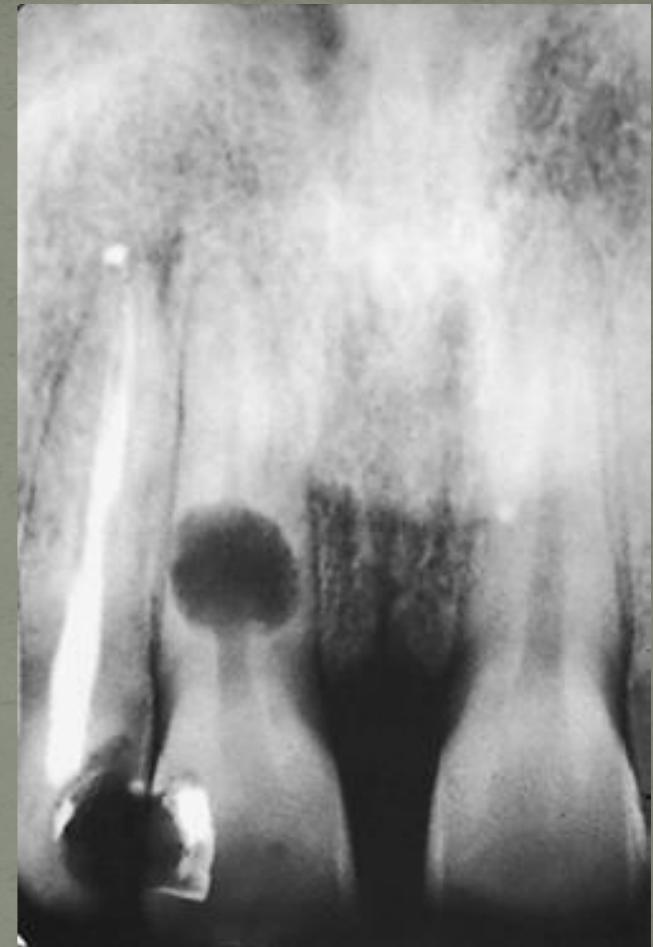
A change of angulation of x-rays gives an indication of whether a defect is internal or external

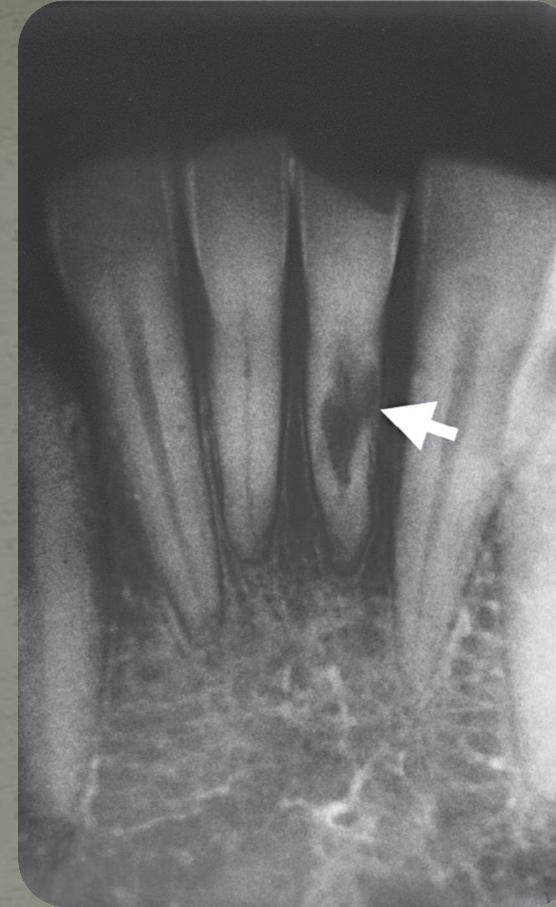
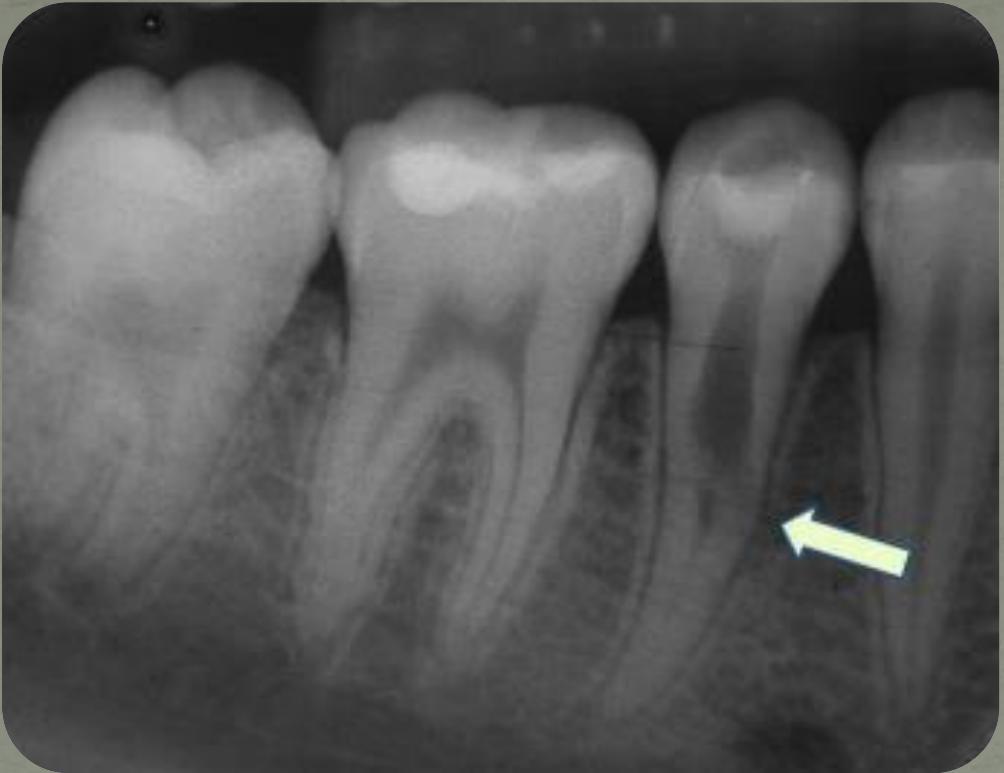
A lesion of internal origin appears close to the canal, whatever the angle of the x-ray. Uniform enlargement of the pulp space is apparent. **Outline of the canal cannot be seen in the resorptive defect.**



The outline of the root canal is usually distorted, and the root canal and radiolucent resorptive defect appear contiguous

Internal root resorption does not involve the bone, and as a rule the radiolucency is confined to the root





On rare occasions, if the internal defect perforates the root, the bone adjacent to it is resorbed and appears radiolucent on the radiograph

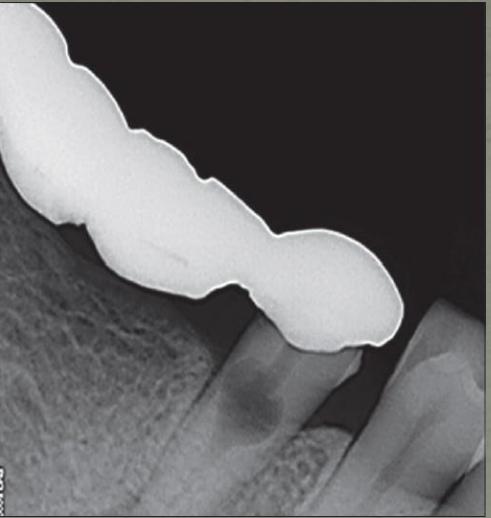
Internal (Intracanal) Resorption

-Oval radiolucency continuous
with the canal wall



Angled radiographs to show internal resorption. Radiographs from two different horizontal projections depict the lesion within the confines of the root canal on both views. The original outline of the canal is distorted. Unlike external root resorption, the adjacent bone is not affected with internal root resorption.

Internal (Intracanal) Resorption



Etiology: Inflammation and secondary infection: Caries, attrition, abrasion, erosion, cracked tooth, trauma, Ca(OH)_2 pulpotomy, crown preparation, extreme heat, chronic pulpitis, idiopathic.

Treatment: Immediate removal of the inflamed tissue and completion of RCT

Sensibility Testing

Teeth with internal resorption usually respond within normal limits to pulpal testing as they contain both vital and necrotic pulpal tissues. However, it is common to have -ve to sensitivity testing because often the coronal pulp has been removed or is necrotic, and the active resorbing cells are more apical in the canal.

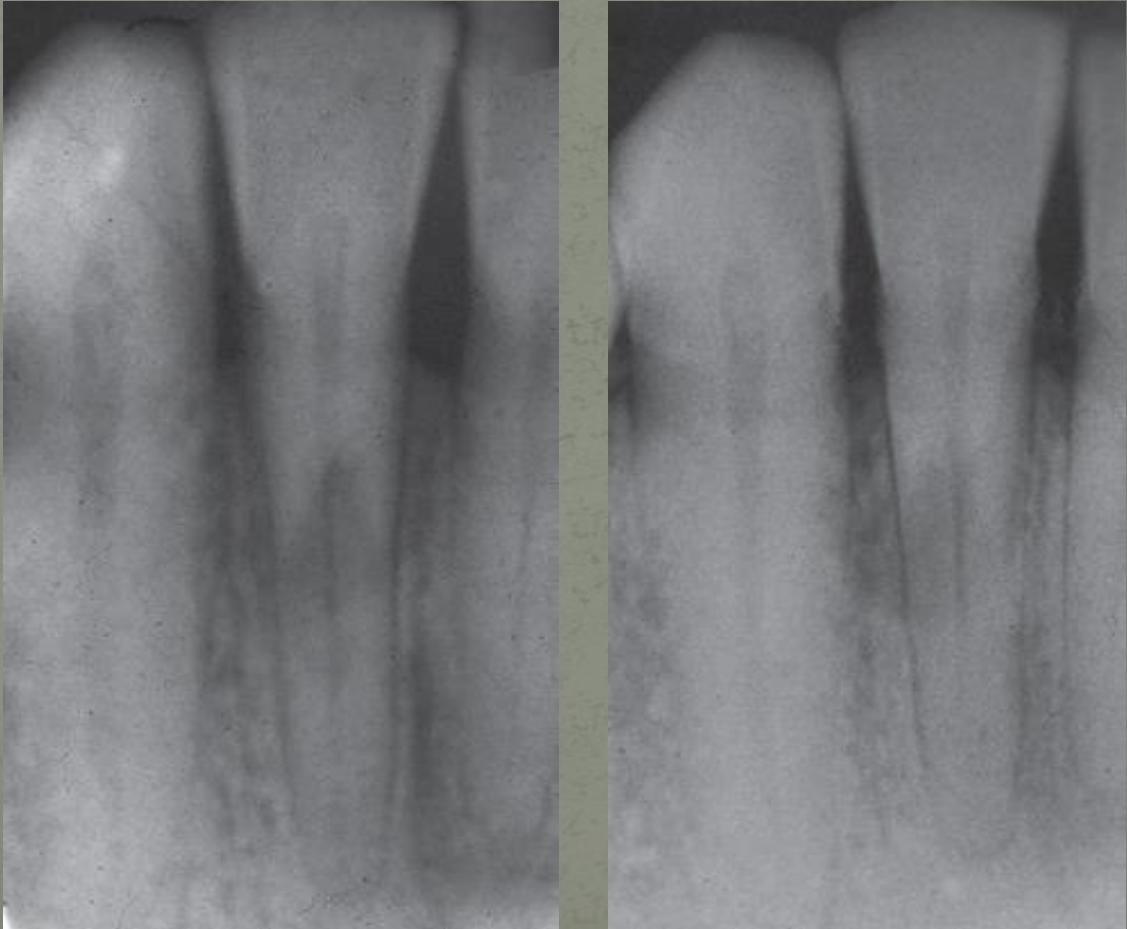




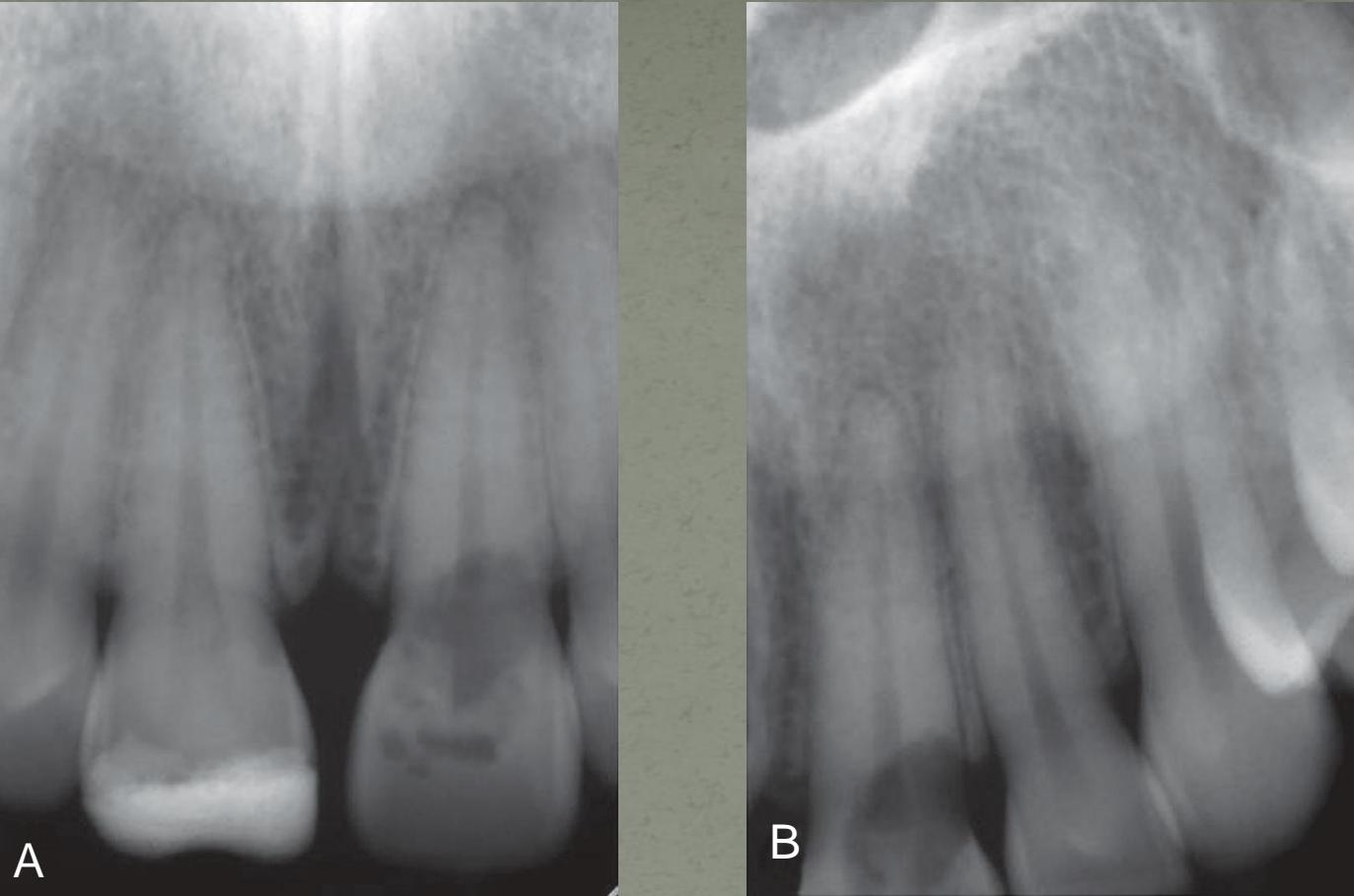
Advanced internal resorption involving the pulp chamber
is often associated with pink spots in the crown.

External Resorption

A defect on the external aspect of the root moves away from the canal as the angulation changes. By using the buccal object rule, it is usually possible to distinguish whether the external root defect is buccal or lingual-palatal.



External Resorption



A) Resorptive lesion is superimposed on the canal and appears to be external because the outline of the canal is still visible through a portion of it. B) Distal shift reveals a palatal extension of the resorptive defect because it has moved in the direction of the shift.



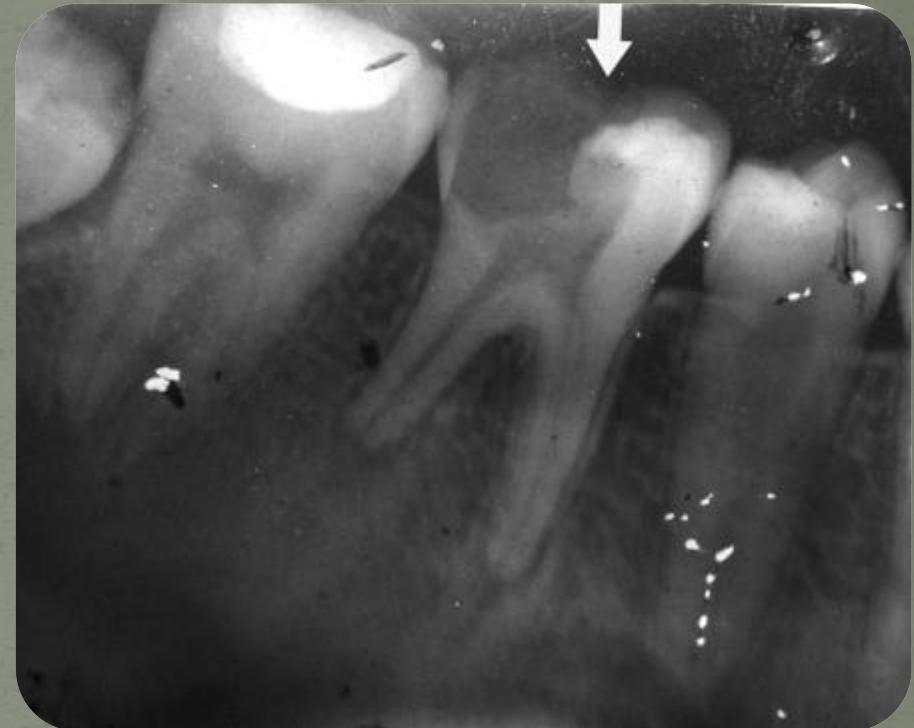
When the defect is external, the root canal outline appears normal and can usually be seen “running through” the radiolucent defect



External inflammatory root resorption is always accompanied by resorption of the bone in addition to the root radiolucencies will be apparent in the root and the adjacent bone.

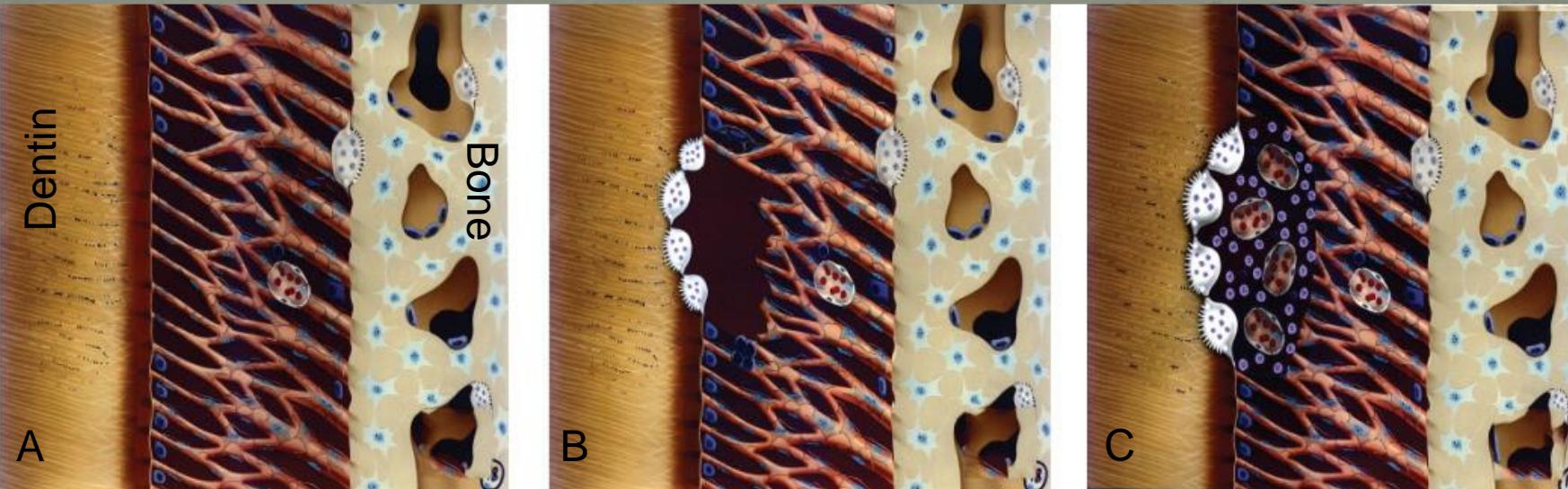
Sensibility Testing

External inflammatory resorption in the apical and lateral aspects of the root involves an infected pulp space, so no response to sensitivity tests supports the diagnosis

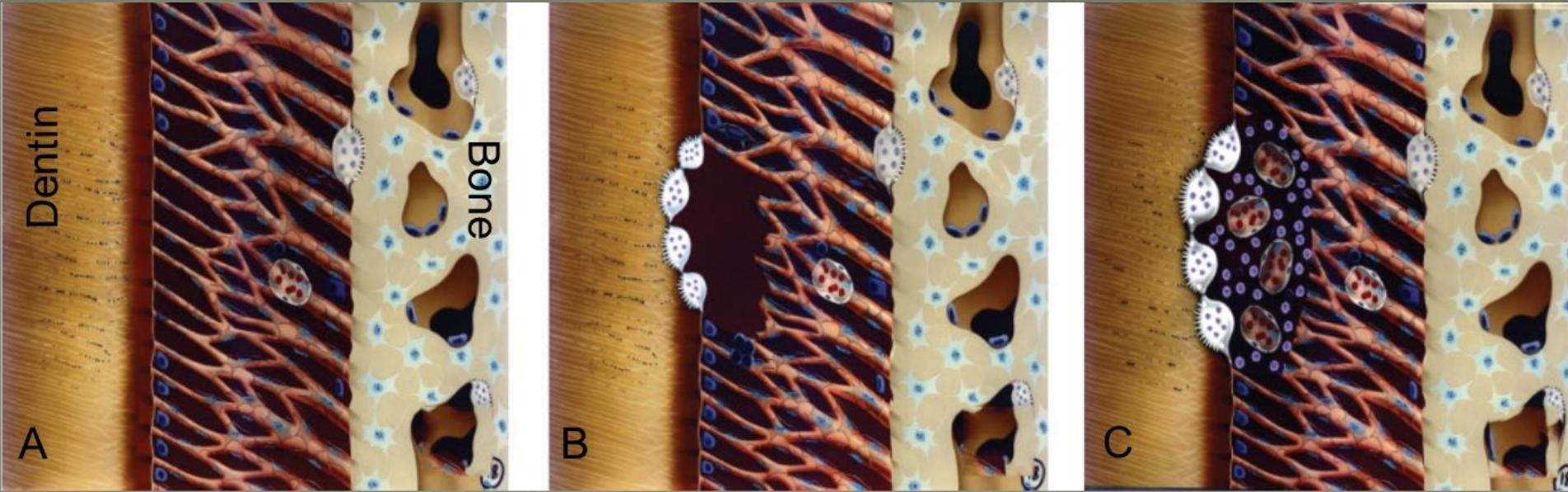


EXTERNAL INFLAMMATORY RESORPTION

EIR is the most common form of external resorption root resorption after luxation (5-18%) and avulsion injuries (30%).



Treatment: removal of the causal agent; namely, infected necrotic pulpal tissue in the root canal space.

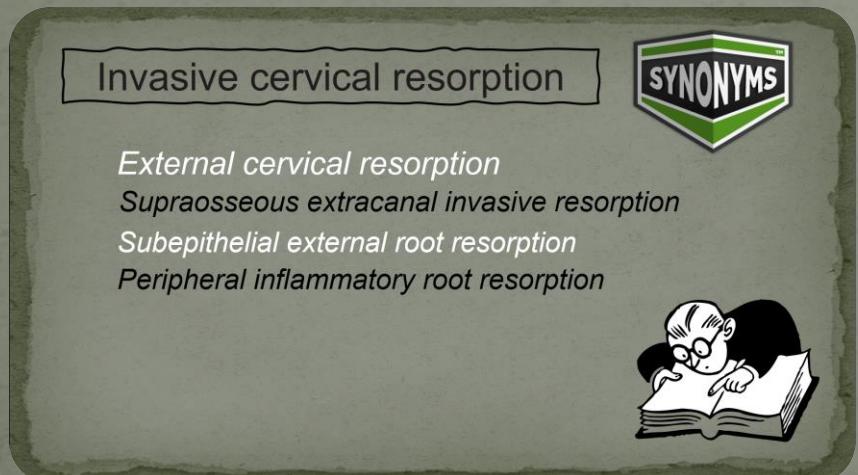


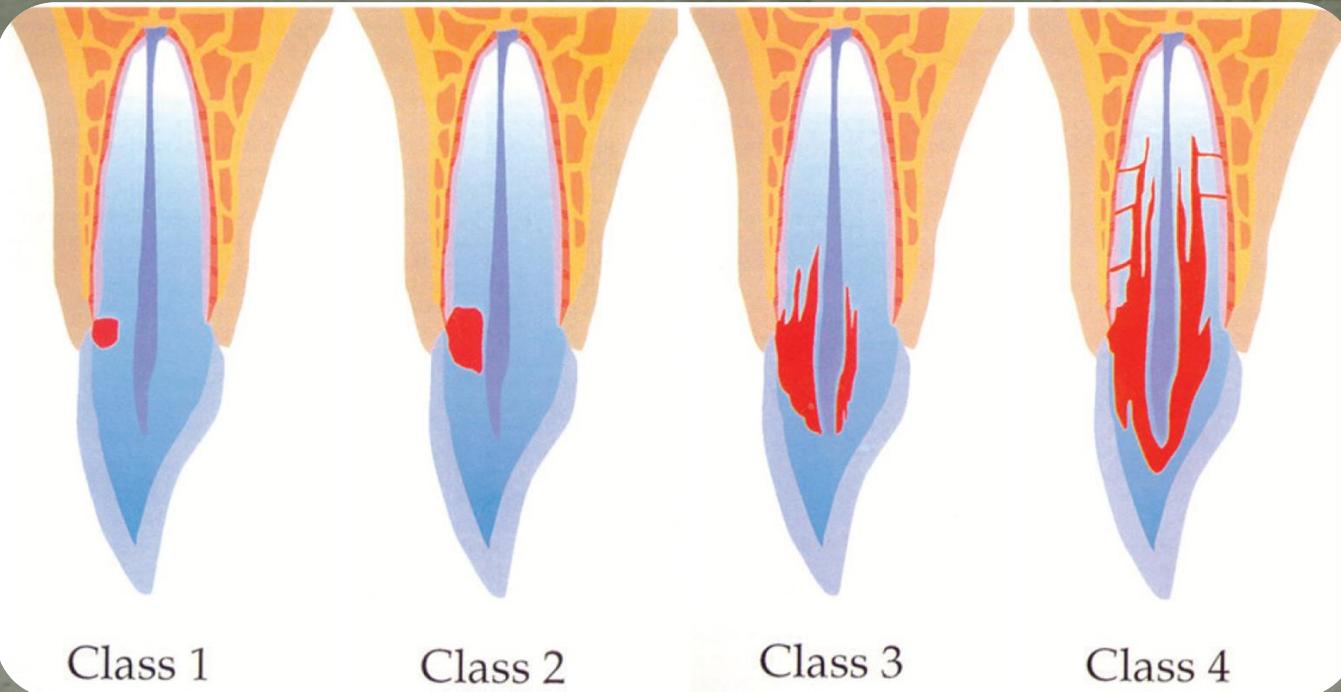
Pathogenesis of infection-related resorption (inflammatory resorption): Response to moderate or extensive injury to the periodontal ligament and associated infection in the pulp. The initial injury to the root surface triggers a macrophage and osteoclast attack on the root surface. Osteoclasts are exposed to toxins from microorganisms located in the root canal and dentinal tubules. These toxins serve as direct activators of osteoclastic activity.

Invasive Cervical Resorption

EXTERNAL CERVICAL RESORPTION (ECR)

Develops on the external root surface immediately **apical** to the epithelial attachment of the tooth.





Class 1: Small lesion with shallow penetration into dentin

Class 2: Well-defined lesion that penetrates close to the coronal pulp chamber
little extension into the radicular dentin

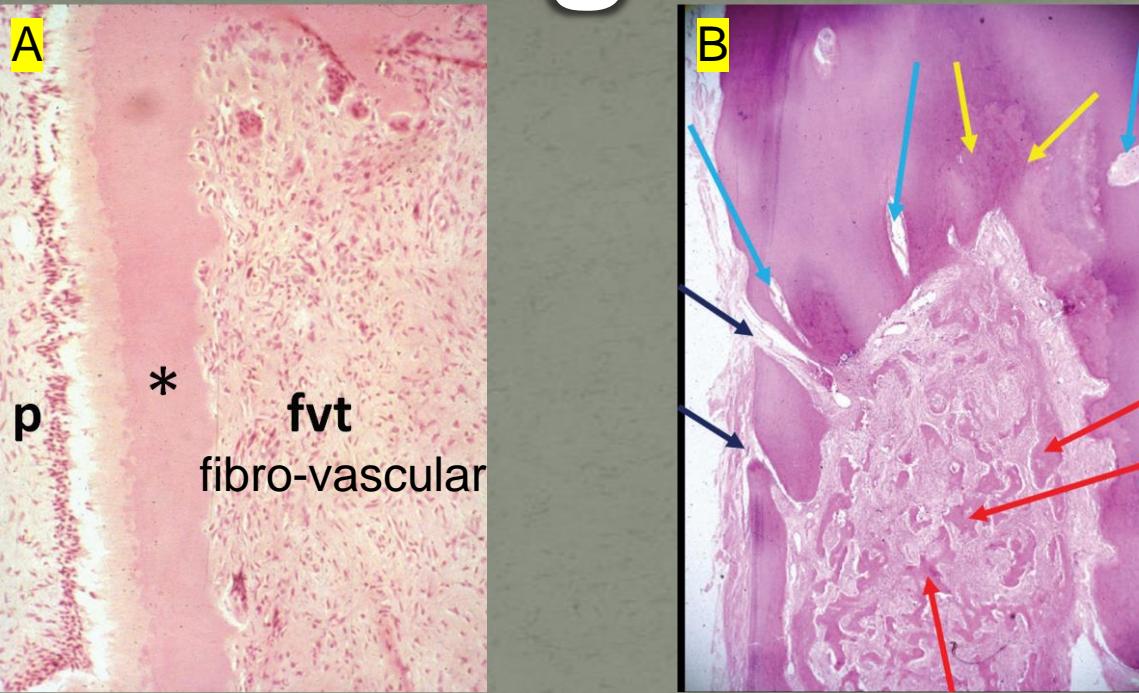
Class 3: Deeper invasion, not only involving the coronal dentin but also
extending into the coronal 1/3 of the root

Class 4: Large invasive process that extends beyond the coronal 1/3 of the root

Etiology and Pathogenesis

Orthodontic treatment, dental trauma, oral surgery, periodontal therapy, bruxism, intracoronal restorations, delayed eruption, enamel stripping, dental developmental defects, internal bleaching were all identified as potential predisposing factors, either alone or in combination.

Pathogenesis



Hyperplastic resorptive tissue, apparently derived from precursor PDL cells, invade the hard tissues of the tooth in a destructive and invasive fashion. Initially, the resorptive tissue is fibrovascular in nature (image A) but as the resorptive process extends more deeply into radicular root structure, it becomes fibro-osseous in character (image B, red arrow).

A combination of Predisposing Factors

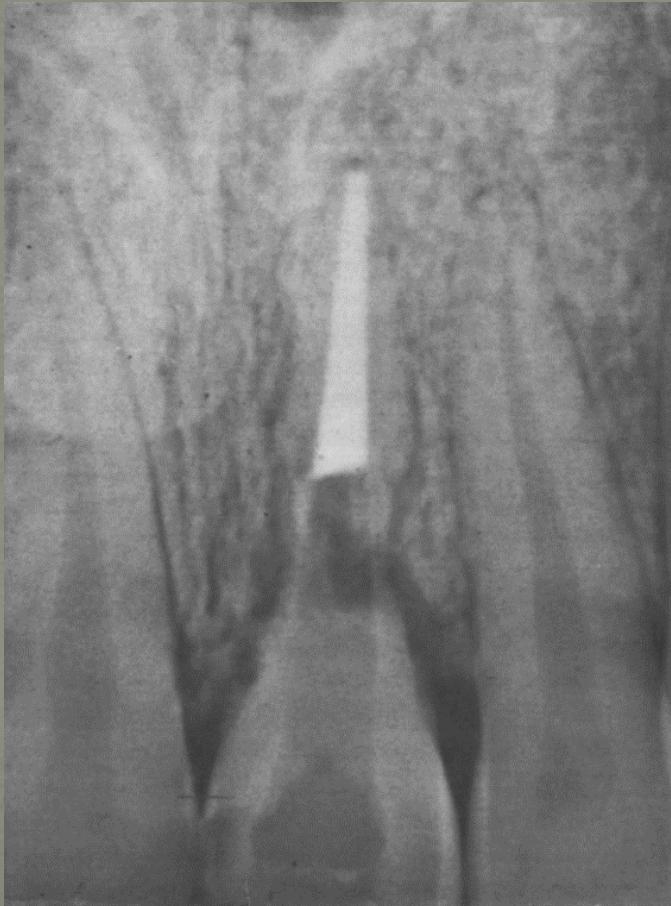
Orthodontic treatment and dental *trauma*

Orthodontic treatment and *intracoronal bleaching*

Trauma and *intracoronal bleaching*

No definitive cause-and-effect relationship has been
established

External Cervical Resorption Following Internal Bleaching in a Traumatized Tooth



26-month post-bleaching

Bleaching: External Cervical Root Resorption

Risk Factors

Deficiency of cementum in the cervical area (5%-10% of the population)

Injury to the PDL (trauma)

Infection

Lack of seal over the GP

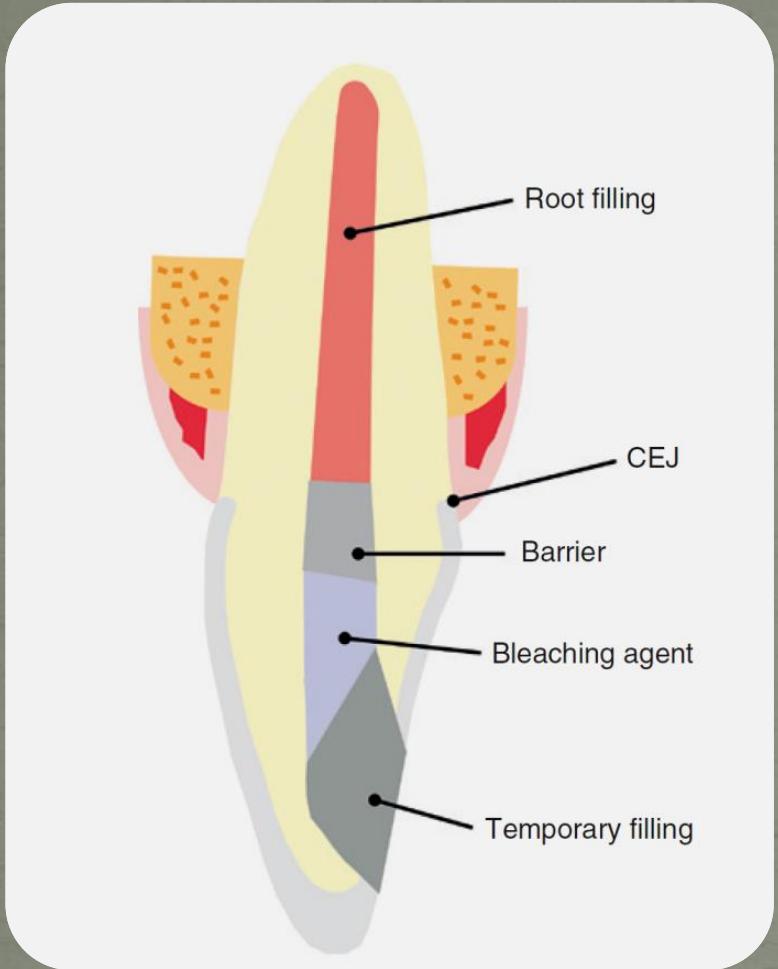
High heat

High concentration of H₂O₂

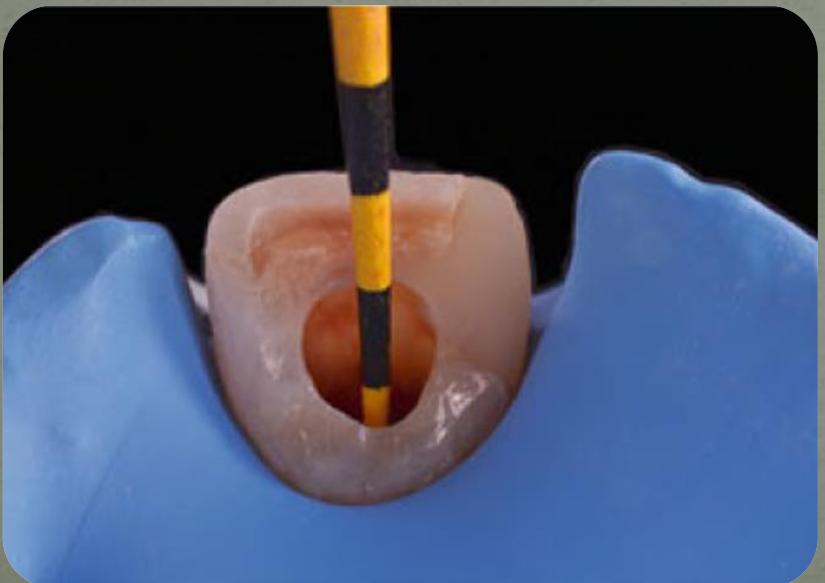
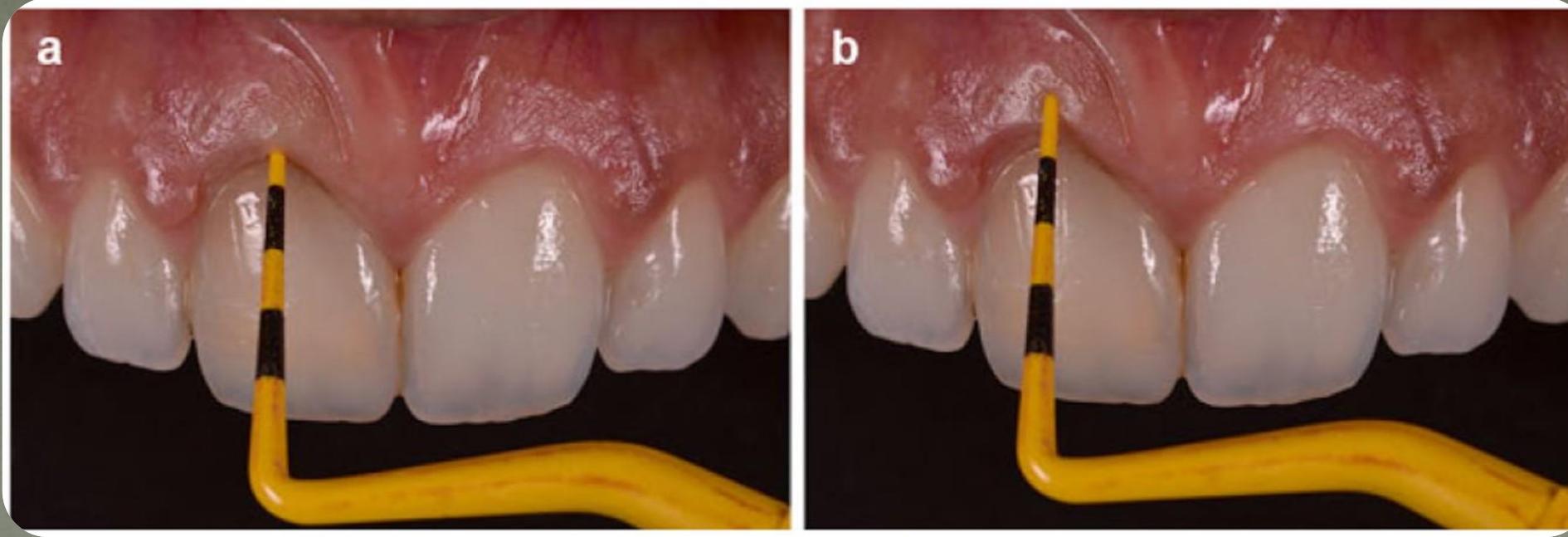
Patient younger than 25 years

**RISK
FACTOR**

Internal bleaching with 30% H₂O₂ is not safe



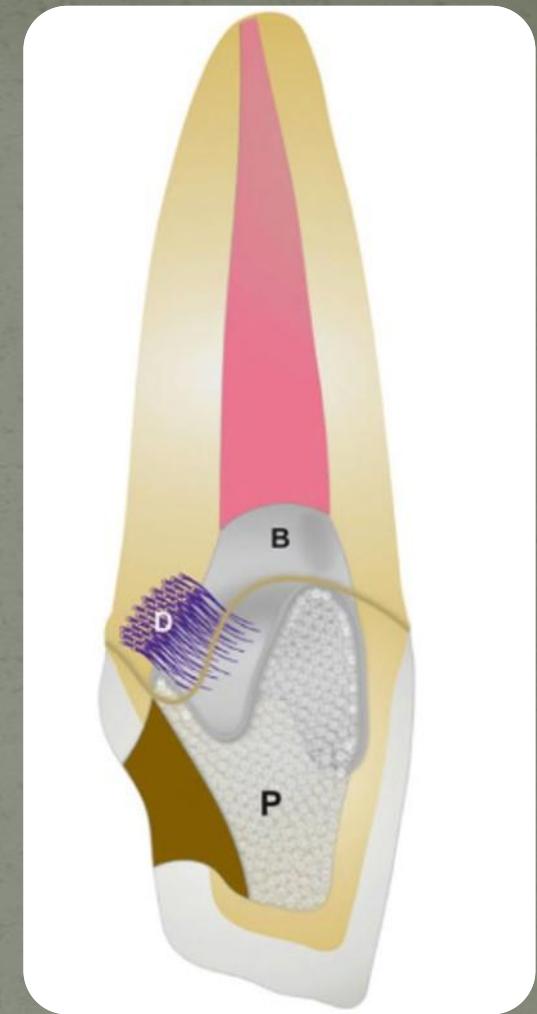
A protective layer of at least a 2-mm thickness should be placed over the root-filling material. Ideally, the vertical outline of the protective barrier should be 1 mm coronally to the CEJ to cover lingual, labial, and proximal CEJ areas.



Periodontal probing determines the level of the epithelial attachment from the incisal edge of the tooth. This will serve as guide for placement of the root canal barrier

PREVENTION

Diagram depicting a coronal extension of the barrier that matches the contour of the epithelial attachment and increases the safety of the bleaching procedure by sealing a wider area against the leakage of peroxide to the periodontal tissue.



PREVENTION

Clinical Features



In the **earlier stages**, it is asymptomatic, with no clinical signs and symptoms. The diagnosis is commonly made as a result of a chance radiographic finding or a pink discoloration. Pulp necrosis and periapical periodontitis develop as the process progresses

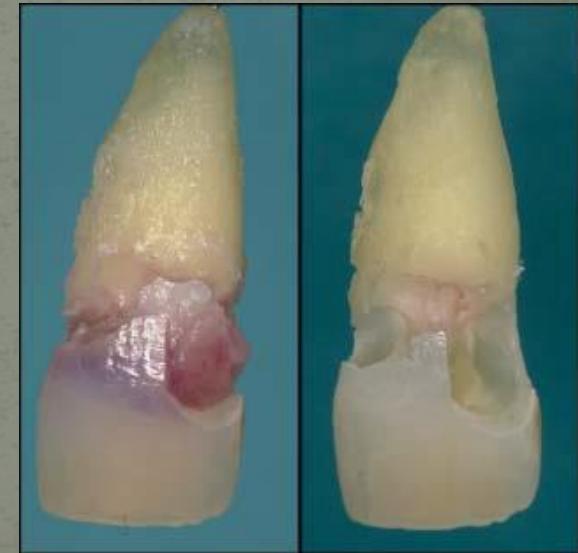


A. Crown of a mandibular first molar with no external signs of resorption. **B.** Radiograph of the tooth pictured in **A** showing an irregular radiolucency extending from the distal cervical region into the crown and adjacent to the pulp space but separated by a radiopaque line

Pink Spot



A pink spot might be noticed due to the granulation tissue undermining the enamel.



BEWARE...



Pulpal injury may cause discoloration, even after only a few days. Initial changes tend to be pink. Subsequently, if the pulp does not recover and becomes necrotic, there may be a grayish darkening of the crown, often accompanied by a loss in translucency.



With apical and lateral external root resorption, the pulp is nonvital, and the granulation tissue is deep in the apical part of the root canal thus the pinkish discolouration can not be seen clinically.

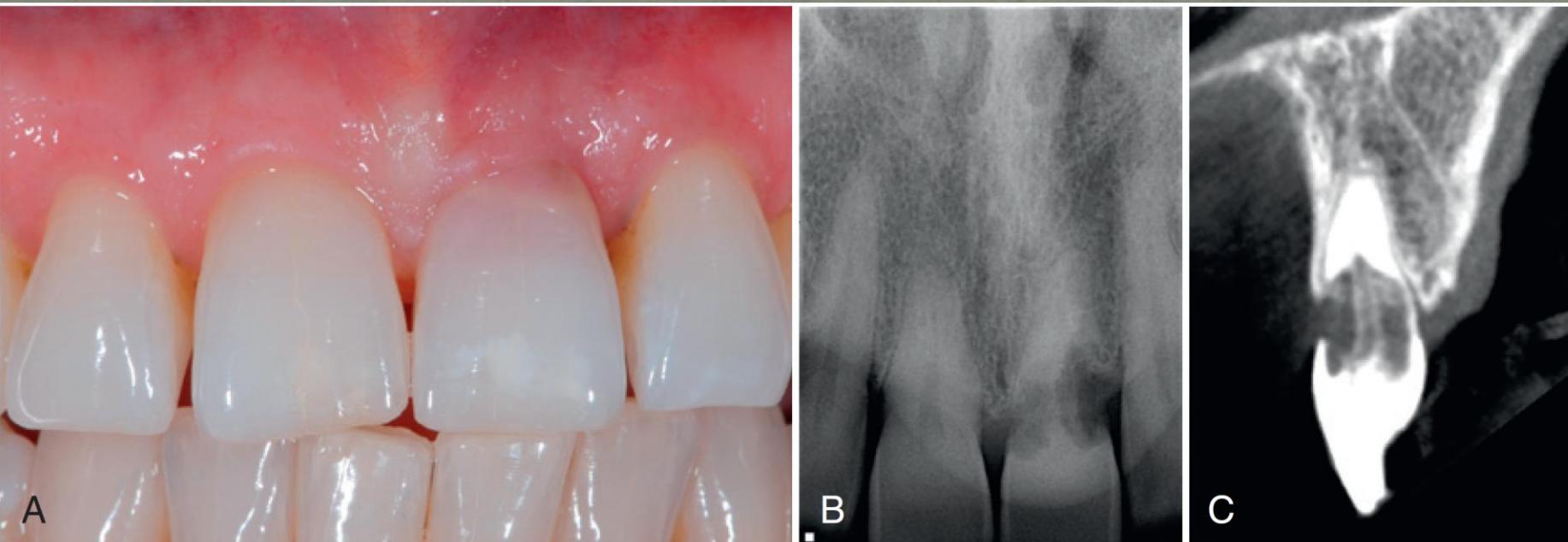
Sensibility Testing

Subepithelial external root resorption does not involve the pulp (the bacteria are thought to originate in the sulcus of the tooth), a normal response to sensitivity testing is usually associated with this type of resorption.

In advanced cases, it extends into the pulp causing irreversible pulpal changes followed by necrosis



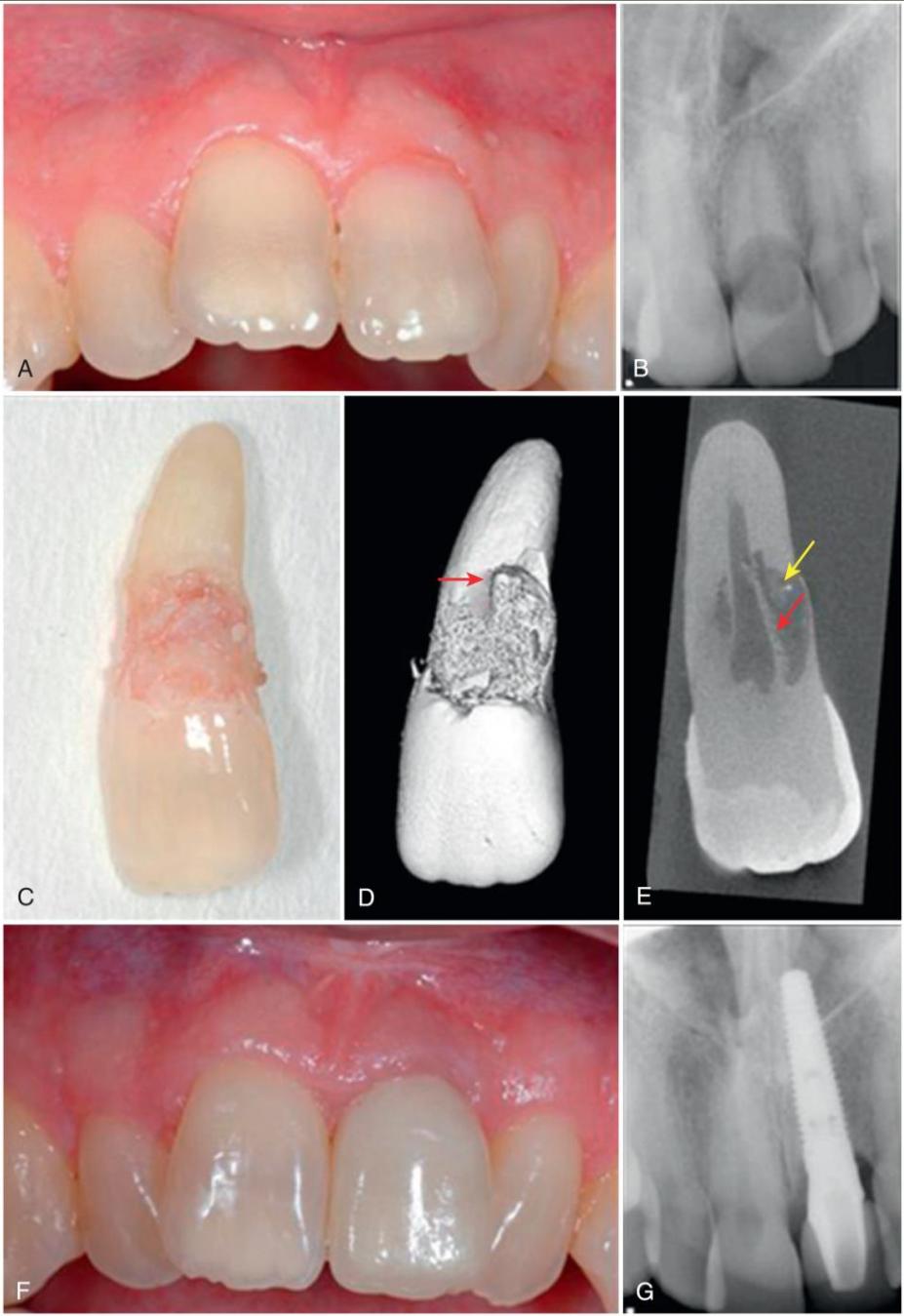
Radiographic Features



Adult patient presented with an asymptomatic pink spot. No history of any predisposing factors. Radiograph revealed radiolucent defects on the proximal aspects; note the “ragged borders”. CBCT slice reveals the true extent of the ECR lesion. Note that the root canal wall appears to be intact.

Radiographic Features

A pink spot was noticed. A radiograph revealed an unusual presentation; the lesion is circular and has well-defined margins. Note that the outline of the root canal is visible and intact through the radiolucent lesion. The tooth was unrestorable and was extracted; Note the intact root canal wall (*red arrow*). Posttreatment view (F) and radiograph (G) after replacement of the upper left central incisor with an implant retained crown.

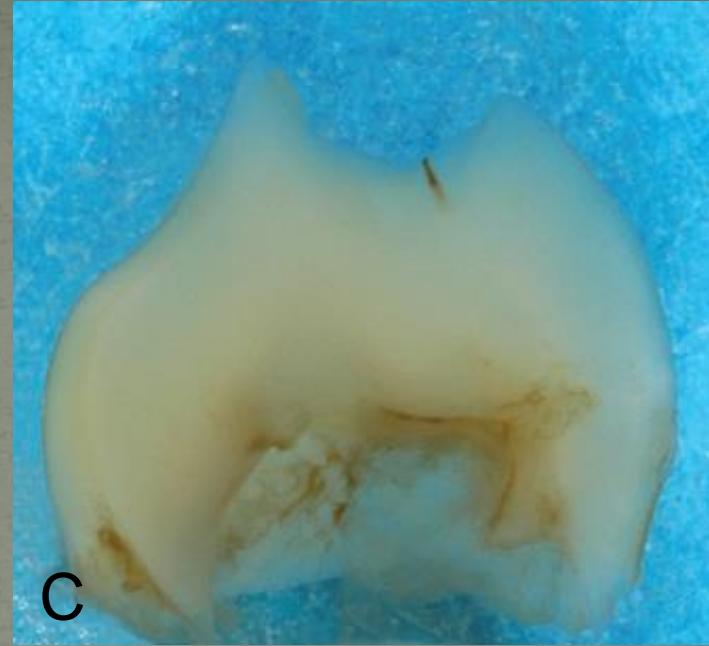
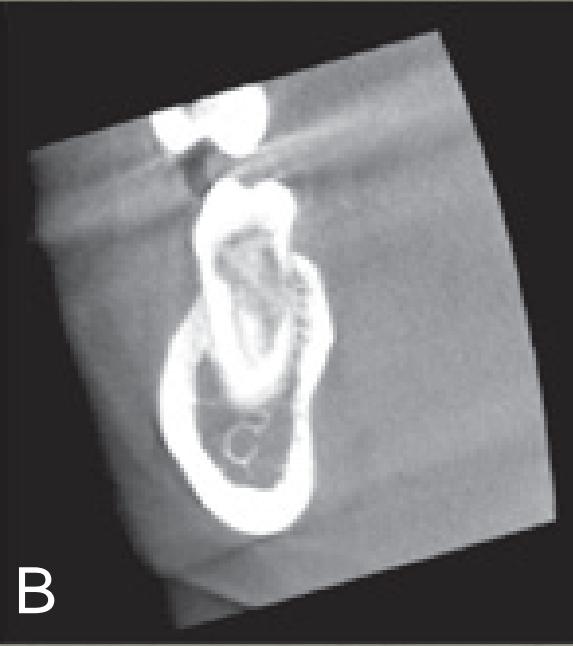


Radiographic Features

- ECR defects present as a radiolucency, often in but not confined to the cervical region of the affected teeth.
- Irregular margins are more common. ECR defects may have smooth and/or well-defined margins.

Radiographic Features

- The radiographic features of ECR are very similar to those of Internal Root Resorption (IRR)
- ECR: the outline of the canal wall should be visible and intact and should maintain its course as it passes through the defect (not true in advanced cases)



ECR: A. Teeth #36 and 37 in a 27-year-old patient. The patient had symptoms of irreversible pulpitis associated with 37. 36 was asymptomatic. B. CBCT scan (37) at the level of the area indicated by the arrow in A. Note massive resorption involving the crown and root. C. Mesial portion of the crown of 37 after clearing

The detection and management of root resorption lesions using intraoral radiography and cone beam computed tomography - an in vivo investigation.

Patel S¹, Dawood A, Wilson R, Horner K, Mannocci E.

Author information

Abstract

AIM: To compare the accuracy of intraoral periapical radiography with cone beam computed tomography (CBCT) for the detection and management of resorption lesions.

METHODOLOGY: Digital intraoral radiographs and CBCT scans were taken of patients with internal resorption ($n = 5$), external cervical resorption ($n = 5$) and no resorption (controls) ($n = 5$). A 'reference standard' diagnosis and treatment plan was devised for each tooth. Sensitivity, specificity, positive predictive values, negative predictive values and receiver operator characteristic (ROC) curves, as well as the reproducibility of each technique were determined for diagnostic accuracy and treatment option chosen.

RESULTS: The intraoral radiography ROC Az values were 0.780 and 0.830 for diagnostic accuracy of internal and external cervical resorption respectively. The CBCT ROC Az values were 1.000 for both internal and external cervical resorption. There was a significantly higher prevalence ($P = 0.028$) for the correct treatment option being chosen with CBCT (%) compared with intraoral radiographs (%).

CONCLUSION: CBCT was effective and reliable in detecting the presence of resorption lesions. Although digital intraoral radiography resulted in an acceptable level of accuracy, the superior accuracy of CBCT may result in a review of the radiographic techniques used for assessing the type of resorption lesion present. CBCT's superior diagnostic accuracy also resulted in an increased likelihood of correct management of resorption lesions.

CBCT was significantly more accurate than periapical radiographs at diagnosing the presence and nature of the root resorption

CBCT

- Eliminates the need for exploratory treatment.
- Allows 3D assessment of the nature, position, and extent of the resorptive defect
- Useful to determine whether the ECR has perforated the root canal wall



Management: Objectives

Excavate the resorptive defect

Halt the resorptive process

Restore the hard tissue defect with an aesthetic filling
material Prevent and monitor the tooth for recurrence



Management

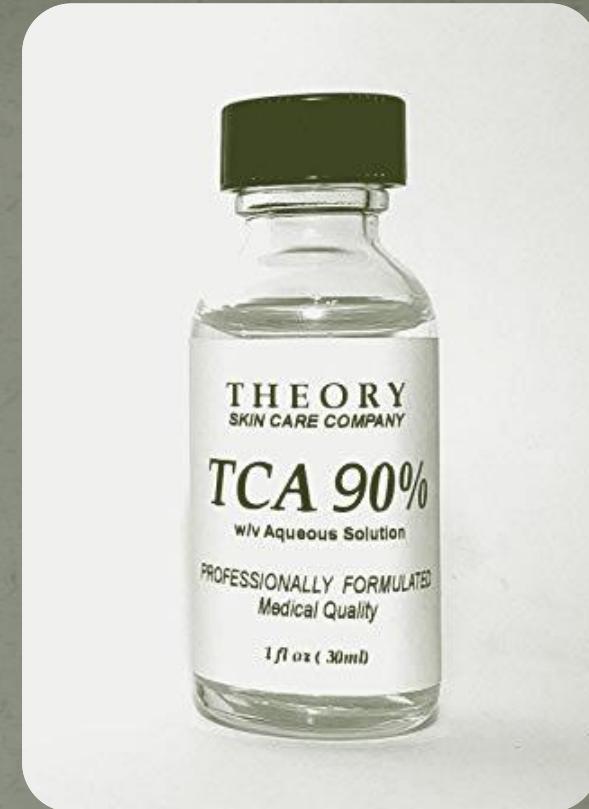


Before & After

The topical application of a 90% aqueous solution of trichloracetic acid (TCA) causes a coagulation necrosis of the highly active and invasive resorptive tissue

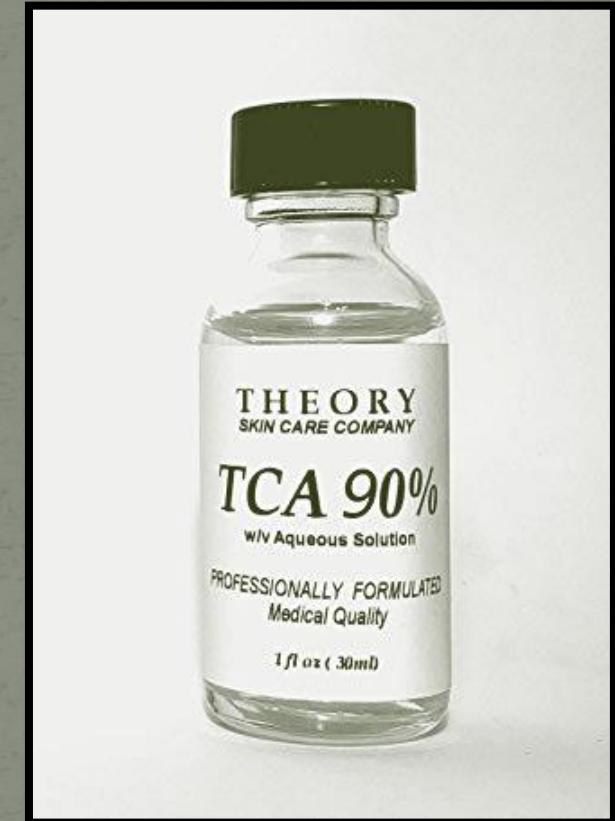


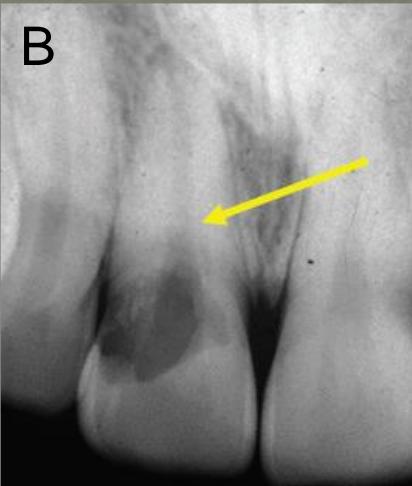
A. After a protective application of glycerol to adjacent soft tissue, a dental dam “cuff” is placed for protection and isolation. TCA, on a small cotton pellet, is applied so that the resorptive tissue within the cavity undergoes coagulation necrosis. **B.** Following curettage of the avascular tissue. The incisal margin is smoothed with high-speed bur under water spray and GIC is placed in the cavity



Precautions:

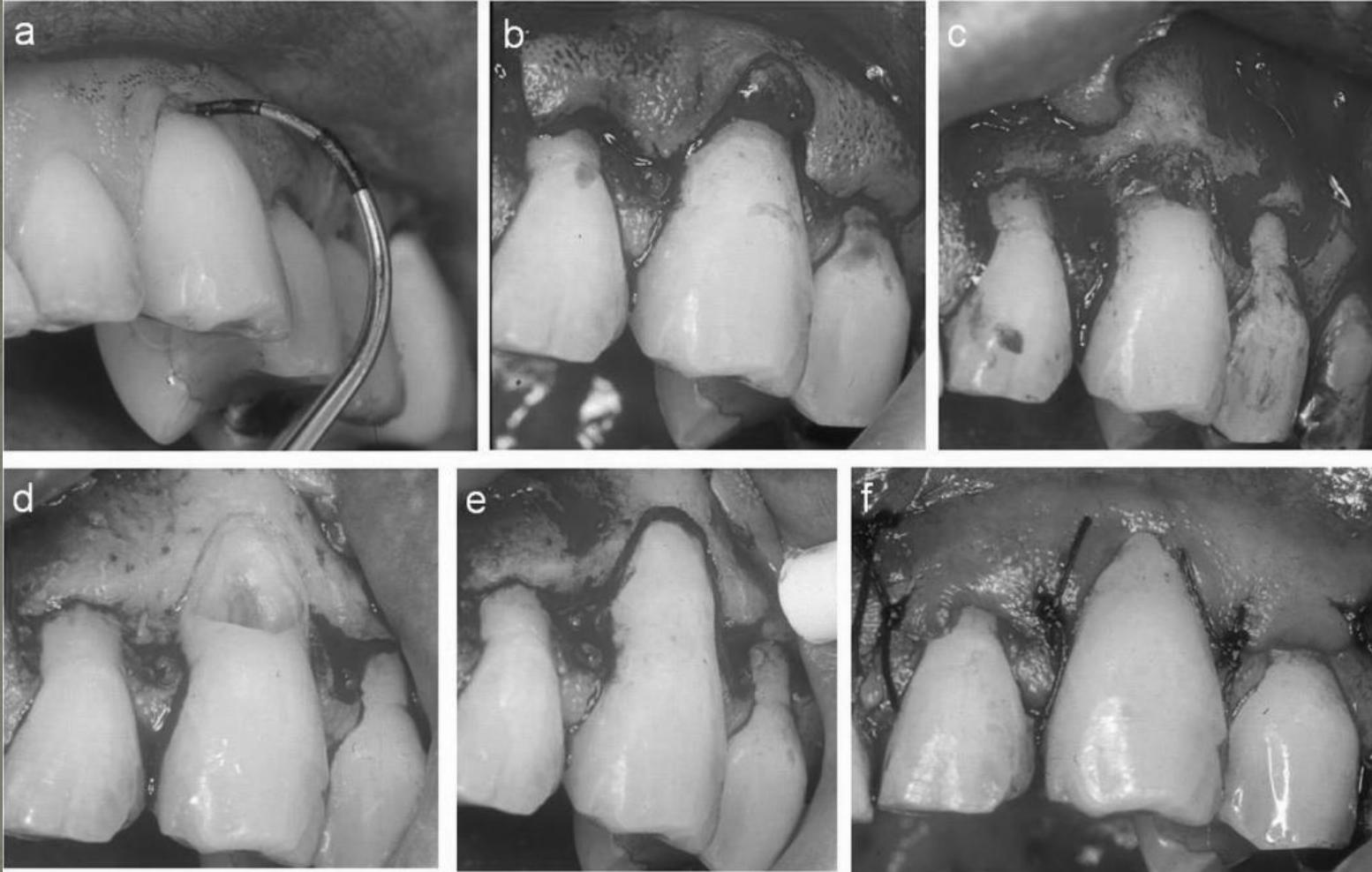
1. Apply glycerol to adjacent soft tissues and insert a glycerol-impregnated cotton roll into the labial and buccal sulcus
2. Apply RD using a cuff technique
3. TCA is absorbed into a small cotton pellet, then dampened on a gauze to remove excess.





A. Soft tissue is evident in a defect on the palatal aspect of the central incisor with a history of orthodontic treatment 6 years earlier. **B.** A radiograph shows a large, irregular radiolucency. This is classified as class 3. **C.** Application of TCA. **D.** Following curettage, root canal filling. **E-F.** The cavity was then restored with glass-ionomer cement protected with an unfilled resin.

Granulation tissue removal and repair with restoration



(a) Clinical examination
(b,c) Flap (d) Ostectomy was performed (e) After cleaning, GIC filling. (f) Sutures were applied.



Management of a class 2 invasive cervical resorption by flap reflection, curettage of resorptive tissue, and restoration. **A.** Following periodontal flap refection and curettage of resorptive tissue, the extent of the resorption cavity is revealed showing no involvement of the dental pulp. **B.** Restoration of the resorptive cavity. **C.** Flap repositioned and sutured. **D.** Excellent soft tissue healing

Endodontic Implications

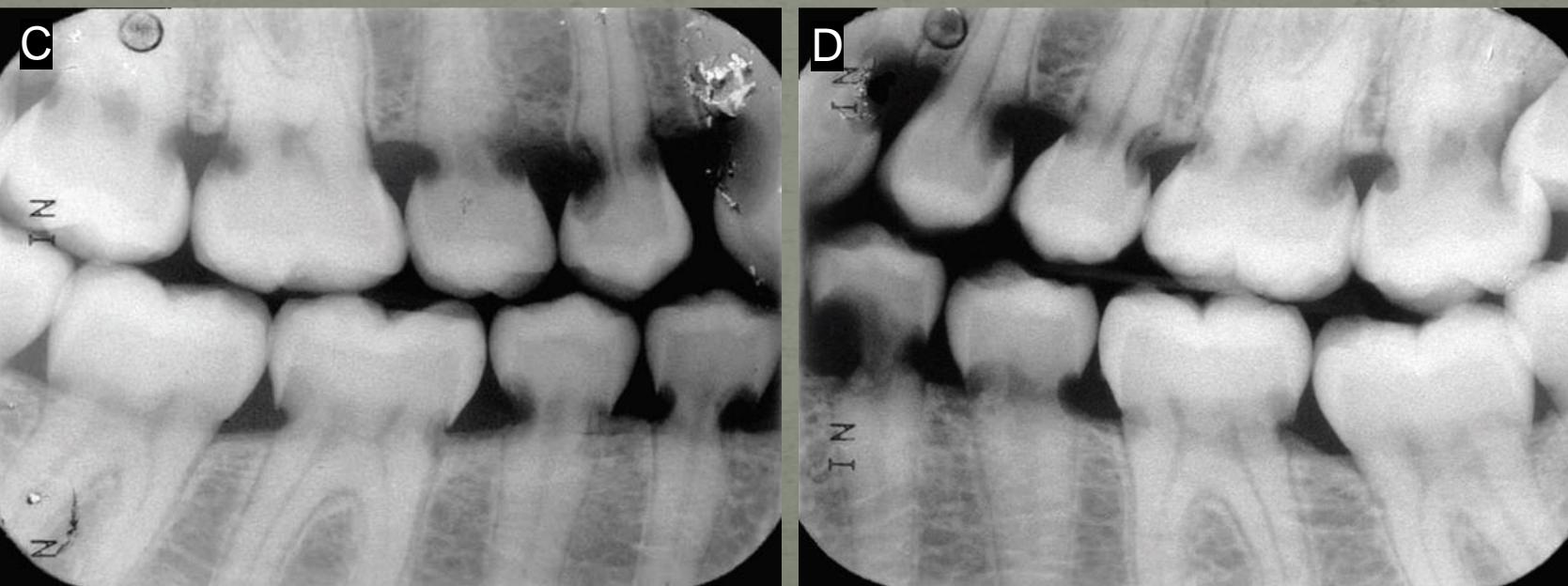
Class 1 and 2: Pulp is generally not involved and no indication for endodontic therapy.

Class 3 and 4: Pulp will ultimately be encroached

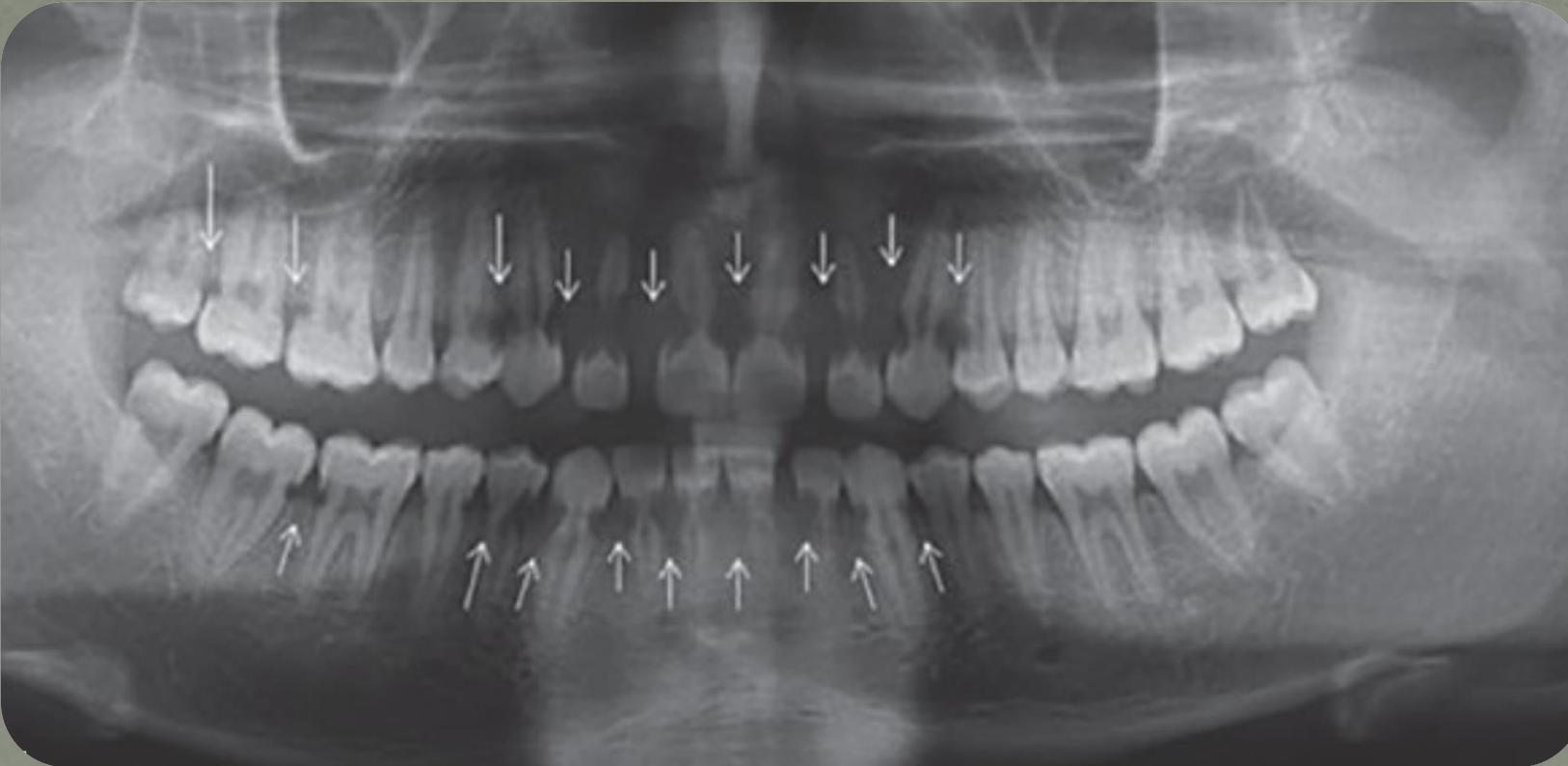
Success rate for treatment

Class 1 and 2: 100%, Class 3: 77.8%, Class 4: 12.5%

Multiple External Invasive Cervical Resorption



Multiple External Invasive Cervical Resorption



J Craniomaxillofac Surg. 2012 Dec;40(8):e301-6. doi: 10.1016/j.jcms.2012.01.009. Epub 2012 Mar 13.

Oral findings associated with primary hyperoxaluria type I.

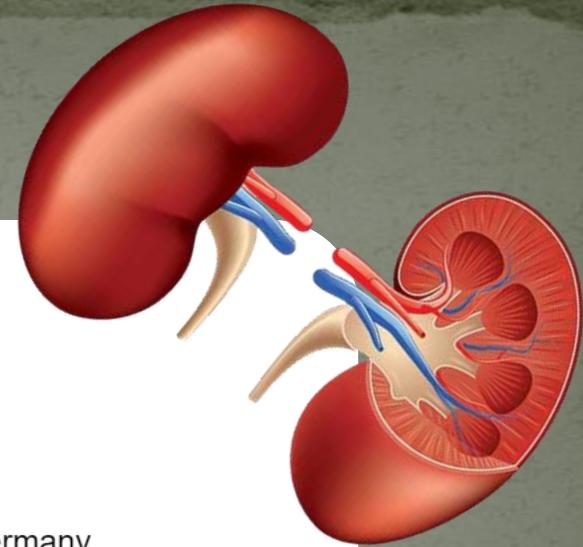
Mitsimponas KT¹, Wehrhan T, Falk S, Wehrhan F, Neukam FW, Schlegel KA.

Author information

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Konstantinos.Mitsimponas@uk-erlangen.de

Abstract

In the present paper we report the oral findings of a patient who was diagnosed with hyperoxaluria. Hyperoxalurias can basically be classified as primary and secondary, with the first being inborn errors of metabolism and the second a result of excessive oxalate intake. Primary hyperoxalurias form a rare group of metabolic diseases that are inherited in the autosomal recessive fashion. The affected genes code for specific hepatic enzymes that are involved in glyoxylate metabolism and their deficiency results in overproduction of oxalate. Two different types are described: Primary hyperoxaluria type I results from a deficiency of peroxisomal enzyme alanine-glyoxylate aminotransferase and the more rare type II from a deficiency of cytosolic enzyme D-glycerate dehydrogenase. Since oxalate is primarily excreted through the kidneys, abnormally high concentration of oxalate in the urine occurs. This can in turn result in recurrent kidney stones and parenchymal renal damage and end-stage renal disease (ESRD). Inability to further excrete oxalate through the kidneys leads to its deposition in various organs (oxalosis). Several oral findings have been described in patients with oxalosis, most important of whom are bone resorption in the jaws, external root resorption and rapidly progressive dental mobility, as well as dental pain associated with deposition of oxalate in the dentine and the pulp.



J Endod. 2009 Jun;35(6):904-13. doi: 10.1016/j.joen.2009.03.044.

Human and feline invasive cervical resorptions: the missing link?--Presentation of four cases.

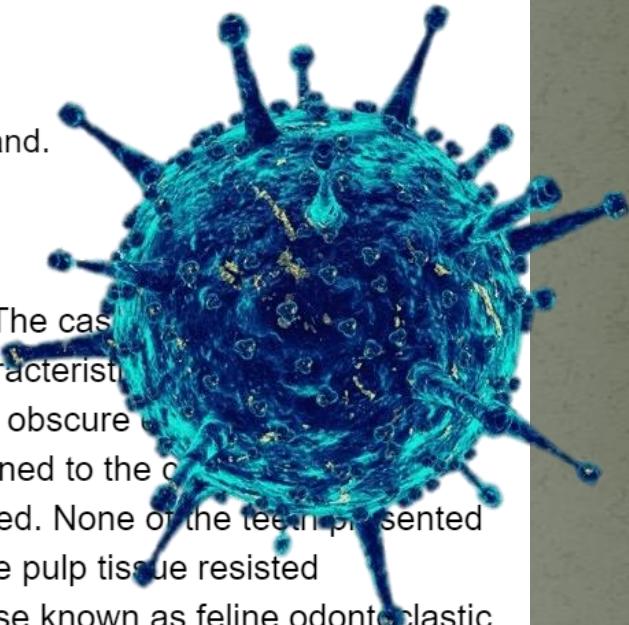
von Arx T¹, Schawalder P, Ackermann M, Bosshardt DD.

Author information

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Abstract

This report describes 4 patients presenting with multiple teeth affected by invasive cervical resorption (ICR). The cases occurred between 2006 and 2008; previously, no cases of multiple ICR (mICR) had been reported in Switzerland. Characteristic features of the cases included progression of disease over time, similar clinical and radiographic appearance of lesions, and obscure etiology. Histologically assessed teeth showed a similar pattern of tooth destruction, with resorptive lesions being confined to the dentin. In Howship's lacunae and multinucleated, tartrate-resistant acid phosphatase-positive odontoclasts were detected. None of the teeth presented with internal resorption. The positive pulp sensitivity corresponded to the histologic findings, indicating that the pulp tissue resisted degradation even in advanced stages of resorptive lesions. Although mICR is rare in humans, a similar disease known as feline odontoclastic resorptive lesions (FORL) is common in domestic, captive, and wild cats. The etiology of FORL, like that of mICR, remains largely unknown. Because FORL has been associated with feline viruses, we asked our mICR patients whether they had had contact with cats, and interestingly, all patients reported having had direct (2 cases) or indirect (2 cases) contact. In addition, blood samples were taken from all patients for neutralization testing of feline herpes virus type 1 (FeHV-1). Indeed, the sera obtained were able to neutralize (2 cases) or partly inhibit (2 cases) replication of FeHV-1, indicating transmission of feline viruses to humans. Future studies on mICR (and FORL) should evaluate the possible role of a (feline) virus as an etiologic (co-)factor in this disease.



Dentomaxillofac Radiol. 2003 May;32(3):150-5.

Multiple idiopathic cervical root resorption: systematic review and report of four cases.

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Author information

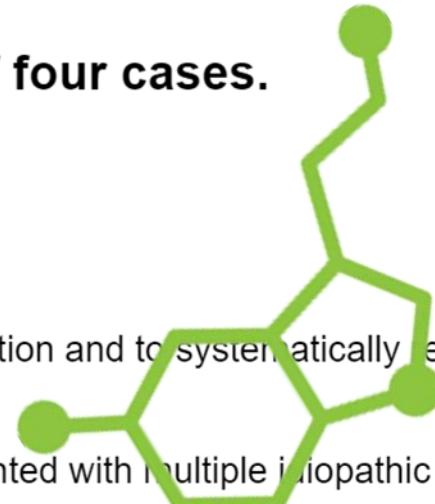
Abstract

OBJECTIVES: The objectives of this study were to report four cases of multiple idiopathic cervical root resorption and to systematically review the literature on this condition.

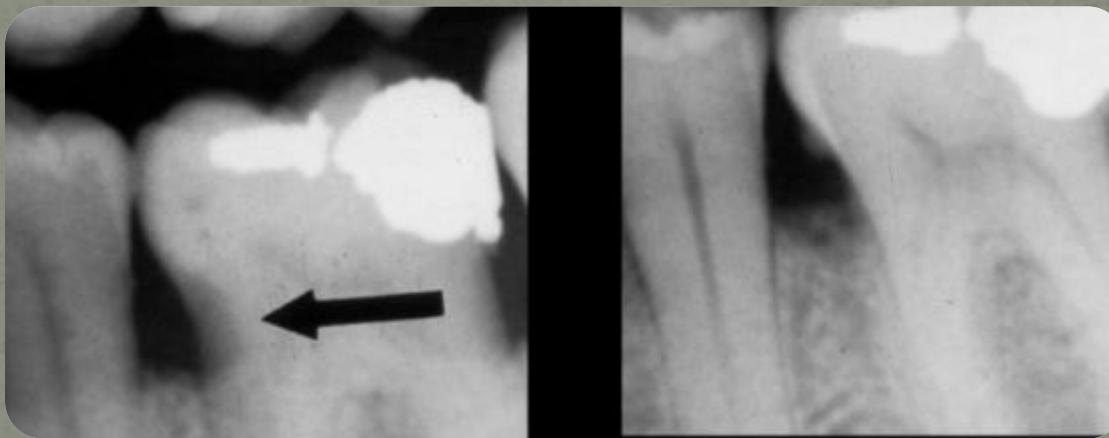
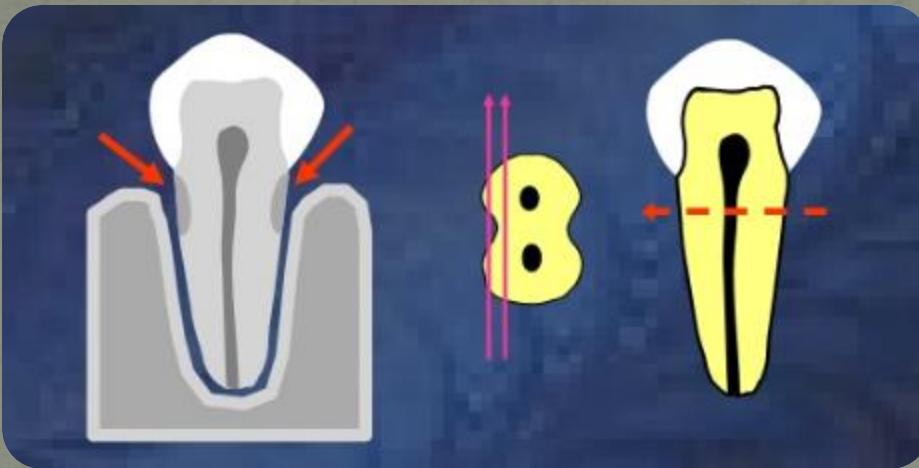
METHODS: The clinical and radiographic findings and the medical/dental histories of four patients who presented with multiple idiopathic cervical root resorption were recorded. Additionally, 10 references from the literature that reported on 14 patients were reviewed.

RESULTS: Multiple idiopathic cervical root resorption was an incidental finding on routine clinical and radiographic examination. There appeared to be no correlation between this type of resorption and any medical/dental finding. Radiographically, multiple idiopathic cervical root resorption was found to begin at the cemento-enamel junction and then either progress to involve the entire cervical region or, at some point, spontaneously arrest. Those cases that progressed to involve the entire cervical region required extraction. The number of teeth that demonstrated this condition ranged from 5 to 24 per patient. More teeth became involved as the condition was followed in time. There was no detectable frequency of occurrence for any particular dental region or tooth among the involved teeth. Of a total of 18 patients, 13 were females whose ages ranged from 7 years to 68 years. Ten of the 18 patients were Caucasian.

CONCLUSIONS: Multiple idiopathic cervical root resorption was found most frequently associated with younger females. This condition appeared to be of unknown aetiology and uncertain natural history.

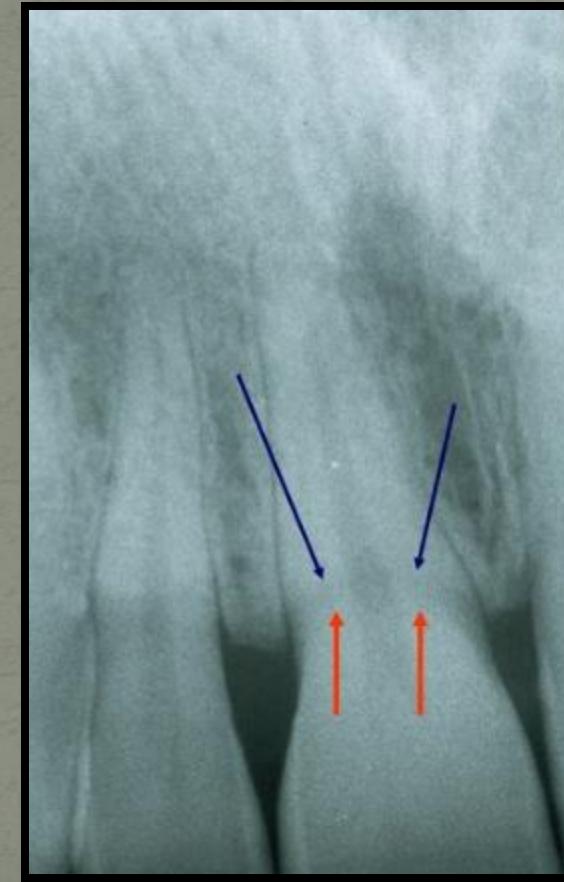


Posterior Cervical Burn-out



Differential Diagnosis

Anterior Cervical Burn-out

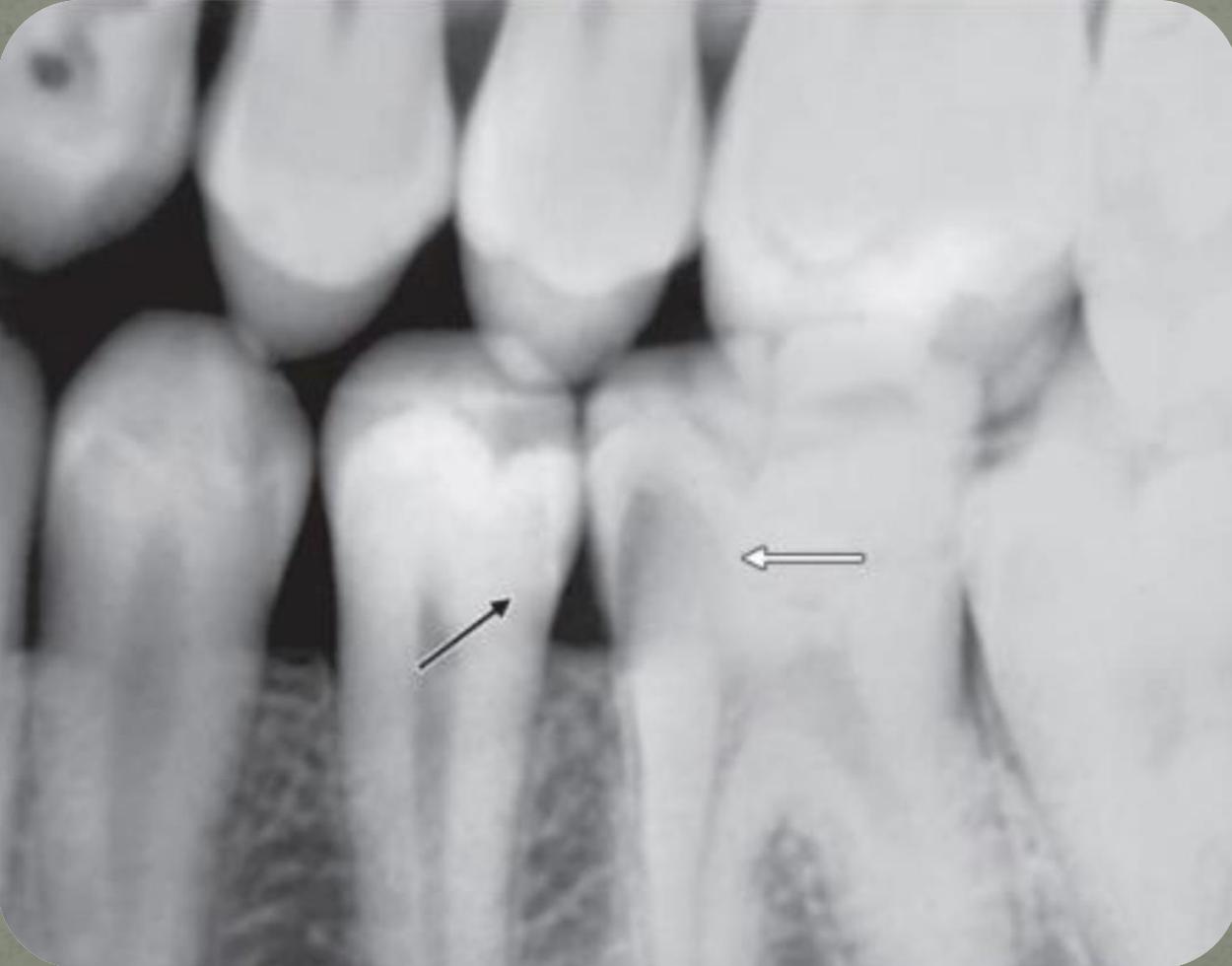


Differential Diagnosis

Root Caries



Proximal Caries



Differential Diagnosis

ECR: Tooth #11 of a patient who recalled being struck with a cricket ball when she was 11 years old. The dentist mistakenly diagnosed the resorptive defect as caries and attempted to manage it accordingly. The tooth was asymptomatic; however, a 4-mm periodontal probing depth was identified on the palatal aspect



Misdiagnosis





Misdiagnosis



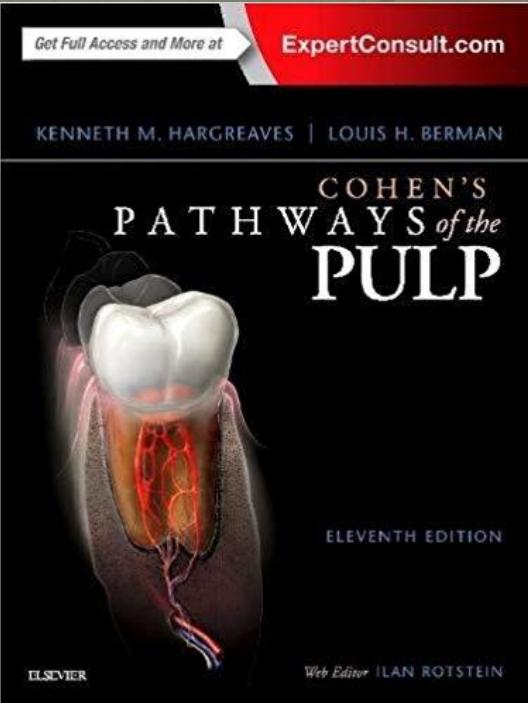
A, Cervical resorption on a premolar that was mistaken for a carious lesion and restored with composite resin. Eventually, the gingival over the defect became chronically inflamed. **B**, Surgical exposure of the defect with the composite removed. Note the extension below crestal bone. **C**, After osseous recontouring and exposure of the gingival margin of the defect. **D-F**, Restoration with composite resin. Root canal treatment was subsequently completed.



Test Your
Knowledge!



References



CHAPTER 16

Root Resorption

SHANON PATEL | CONOR DURACK | DOMENICO RICUCCI

CHAPTER OUTLINE

- | | |
|---|---|
| <p>General Histologic Features</p> <p>External Inflammatory Resorption</p> <ul style="list-style-type: none">IntroductionEtiology and Pathogenesis of External Inflammatory ResorptionHistologic AppearanceClinical FeaturesRadiographic FeaturesManagementFollow-up and Prognosis of External Inflammatory Resorption <p>External Cervical Resorption</p> <ul style="list-style-type: none">IntroductionEtiology and PathogenesisHistologic Appearance | <p>Clinical Features</p> <p>Radiographic Features</p> <p>Management</p> <p>Internal Root Resorption</p> <ul style="list-style-type: none">IntroductionEtiology and Pathogenesis of Internal Root ResorptionHistologic AppearanceClinical FeaturesRadiographic Features and DiagnosisManagementChemomechanical Debridement of the Root CanalObturation <p>Summary</p> |
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Review Article

External Cervical Resorption: A Review

Shanon Patel, BDS, MSc,^{*} Shalini Kanagasingam, BDS, MFDS,^{*†} and Thomas Pitt Ford, BDS, PbD, FDS^{*}

Abstract

External cervical resorption (ECR) is the loss of dental hard tissue as a result of odontoclastic action; it usually begins on the cervical region of the root surface of the teeth. The etiology, predisposing factors, diagnosis, and management of ECR are reviewed. Effective management and appropriate treatment can only be carried out if the true nature and exact location of the ECR lesion are known. The role of cone beam computed tomography as a diagnostic adjunct for the management of ECR is also reviewed. (*J Endod* 2009;35:616–625)

Key Words

Cone beam computed tomography, diagnosis, external cervical resorption

Root resorption is the loss of hard dental tissue (ie, cementum and dentin) as a result of odontoclastic action (1). Physiologic root resorption associated with primary teeth is desirable because it results in exfoliation of the teeth, thereby allowing eruption of the permanent successors. However, root resorption of permanent dentition is usually unfavorable because it might result in irreversible damage and/or eventual tooth loss.

Root resorption might be classified by its location in relation to the root surface, ie, internal or external resorption. External root resorption can be further classified into surface resorption, external inflammatory resorption, external replacement resorption, external cervical resorption, and transient apical breakdown (1).

One of the least understood of the types of external resorption is external cervical resorption (ECR). This form of external resorption has been described at length by Heithersay (2–5), who preferred the term *invasive cervical resorption*, which describes its invasive and aggressive nature. Other terms used to describe ECR include odontoclastoma (6), peripheral cervical resorption (7), extracanal invasive resorption (8), suprasseous extracanal invasive resorption (9), peripheral inflammatory root resorp-



That's all Folks!
Thank you for your attention