External Invasive Resorption
- Dilemmas in Diagnosis, Treatment and Prognosis

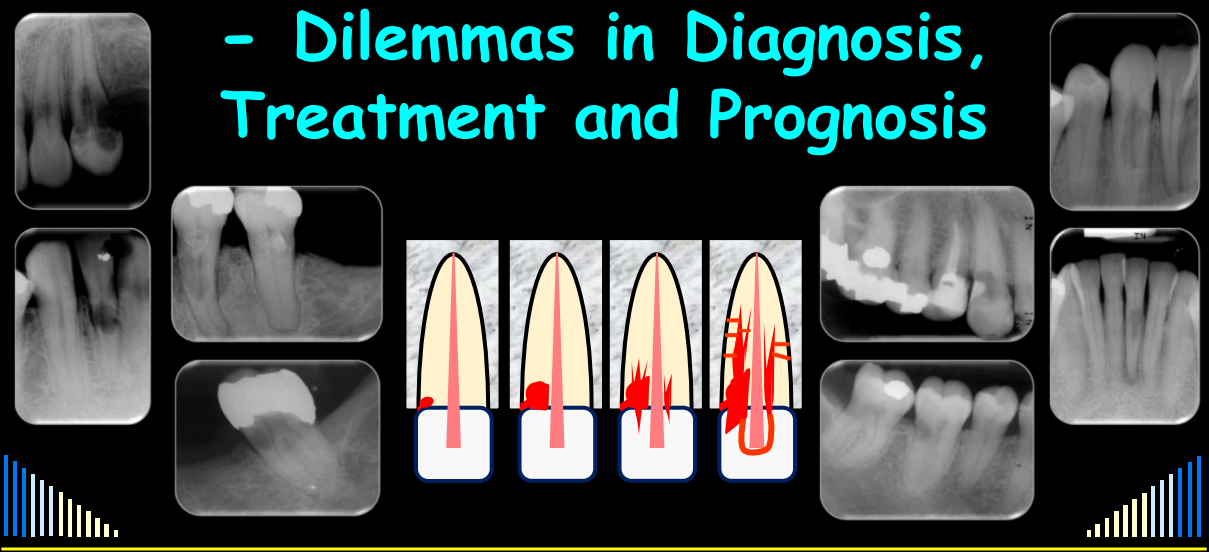
Prof. Paul V. Abbott AO
BDSc, MDS, FRACDS(Endo), FPFA, FADI, FICD, FACD, FIADT

Specialist Endodontist
Winthrop Professor of Clinical Dentistry
School of Dentistry
The University of Western Australia

ORAL HEALTH CENTRE OF WESTERN AUSTRALIA

1

External Invasive Resorption
- Dilemmas in Diagnosis, Treatment and Prognosis



2

Outline

- Definition and Terminology
- Histopathogenesis
  - + Potential Predisposing Factors
- Features / Classification
  - + Differential Diagnosis
- Management Strategies
- Outcomes

3

Classification of Tooth Resorption

Internal

1. Surface
2. Inflammatory
3. Replacement

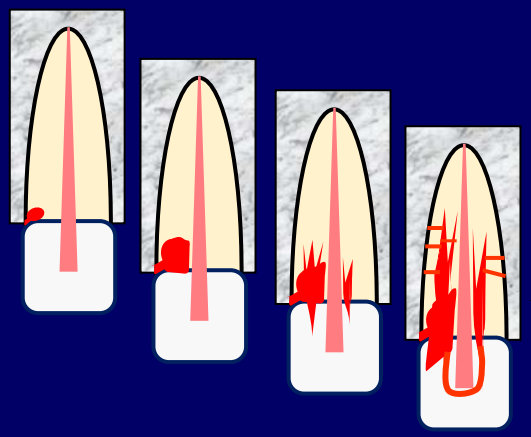
11!

External

1. Surface
2. Inflammatory
3. Replacement
4. Invasive
5. Orthodontic
6. Pressure
7. Physiological
8. Idiopathic

4

Classification of Tooth Resorption



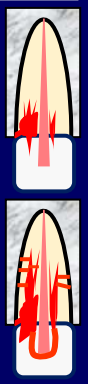
External

1. Surface
2. Inflammatory
3. Replacement
4. **Invasive**
5. Orthodontic
6. Pressure
7. Physiological
8. Idiopathic

5

External Invasive Resorption





- Other terminology that has been used
  - Idiopathic external resorption – descriptive indicative of nature of process
  - Late cervical resorption
  - Cervical resorption
  - External cervical invasive resorption
  - External cervical inflammatory resorption
  - Peripheral inflammatory resorption
  - Extra-canal invasive resorption
  - Fibrous dysplasia of teeth

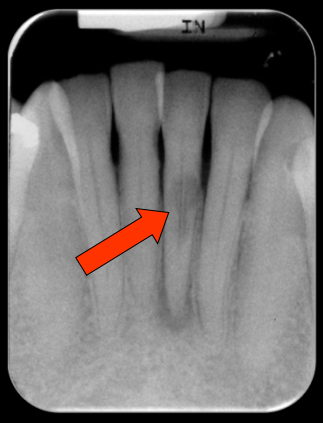
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External Invasive Resorption

- Other terminology that has been used
  - Idiopathic external resorption
  - Late cervical resorption
  - Cervical resorption
  - External cervical invasive resorption
  - External cervical inflammatory resorption
  - Peripheral inflammatory resorption
  - Extra-canal invasive resorption
  - Fibrous dysplasia of teeth

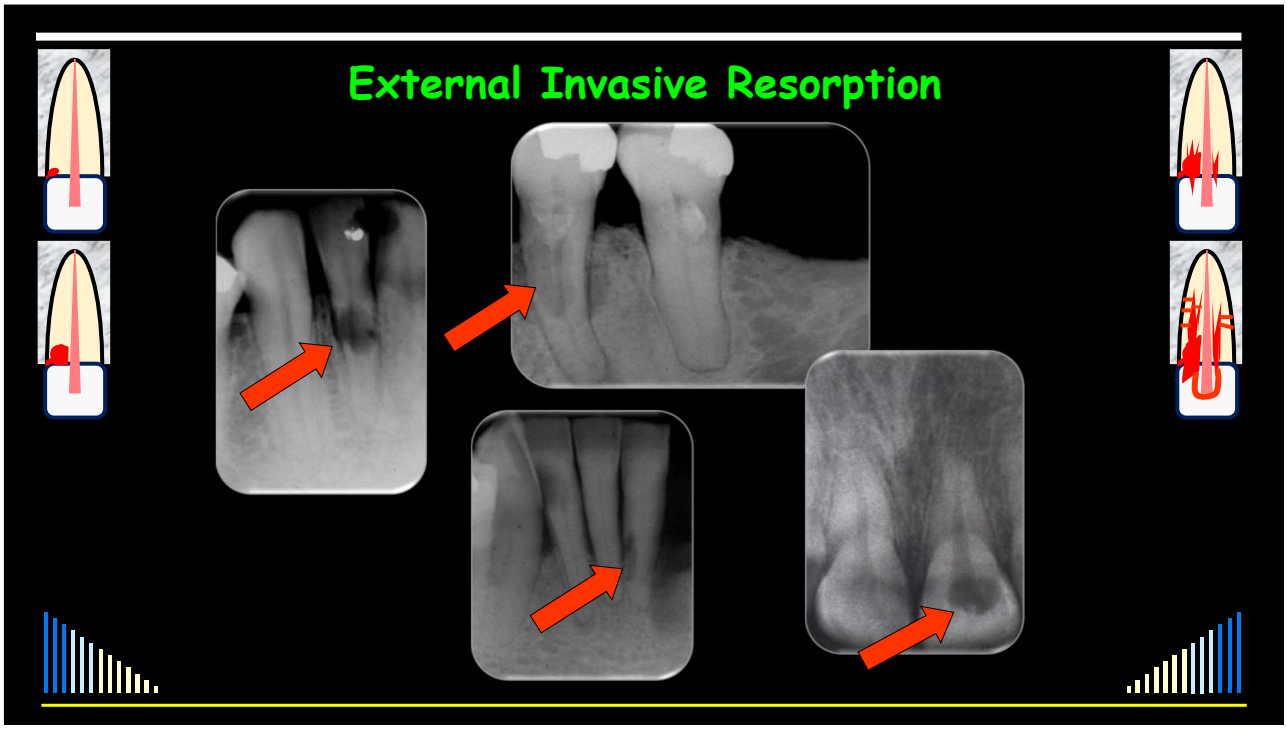
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External Invasive Resorption

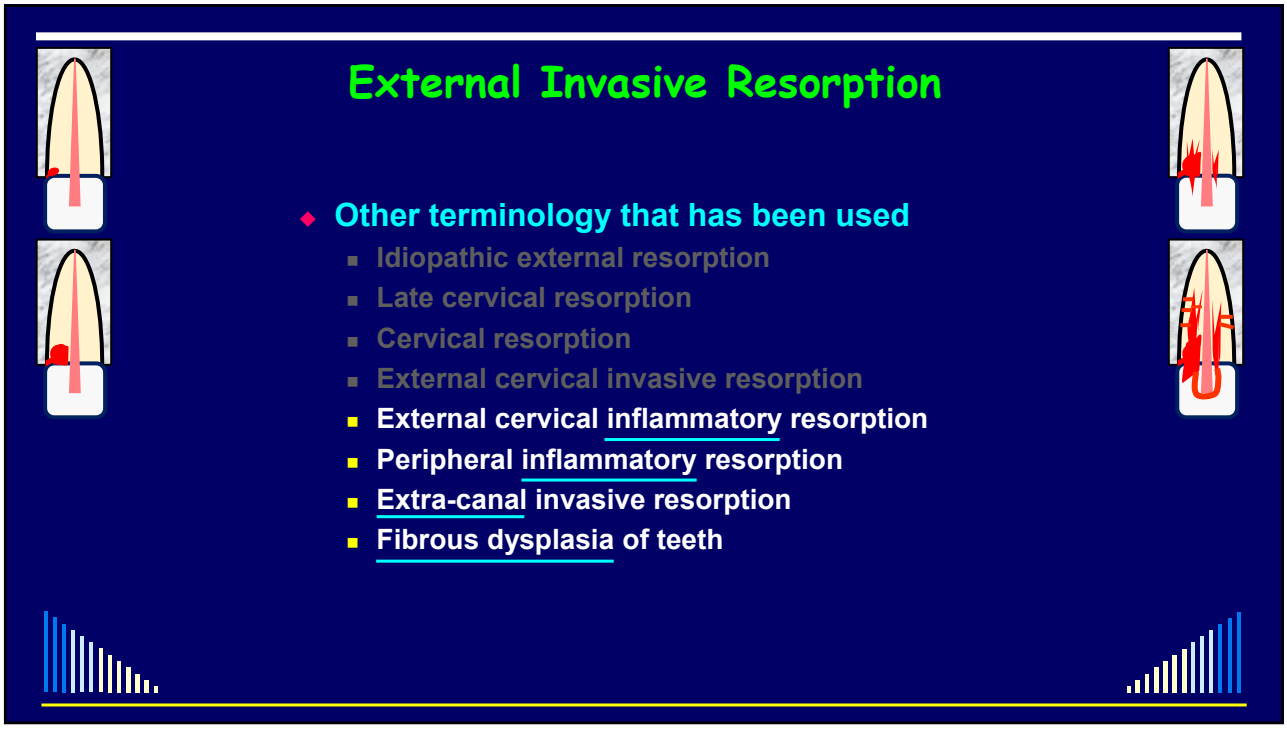




8


External Invasive Resorption

9


External Invasive Resorption
Other terminology that has been used
Idiopathic external resorption
Late cervical resorption
Cervical resorption
External cervical invasive resorption
External cervical inflammatory resorption
Peripheral inflammatory resorption
Extra-canal invasive resorption
Fibrous dysplasia of teeth

10

Outline

- ✓ Definition and Terminology
- Histopathogenesis
  - + Potential Predisposing Factors
- Features / Classification
  - + Differential Diagnosis
- Management Strategies
- Outcomes

11

External Invasive Resorption

Heithersay, G.S.

Quintessence International 1999; 30
Pages: A. 27-37 B. 83-95 C. 96-110

A. Clinical, radiologic and histopathologic features
B. Potential predisposing factors
C. Treatment with TCA, curettage and restoration

ALSO: *Endodontic Topics* 2004; 7: 73-92

12

External Invasive Resorption

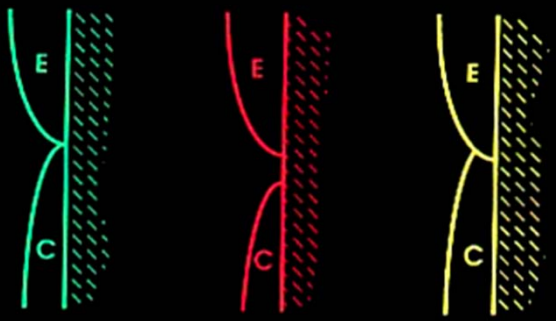
- Rare - approx. 0.02% of population
- Histopathogenesis
  - Obscure
  - Possibly multiple factors - such as:
    - ? Inflammation in the gingival crevice
    - ? Poorly repaired surface resorption
    - ? Accessory canals + toxic/caustic materials
    - ? Anatomical variations in the c-ej^{n}

Heithersay 1999

13

Carranza FA, IN: Glickman's *Clinical Periodontology* 7th Ed. 1990; 52-3

The Cemento-Enamel Junction

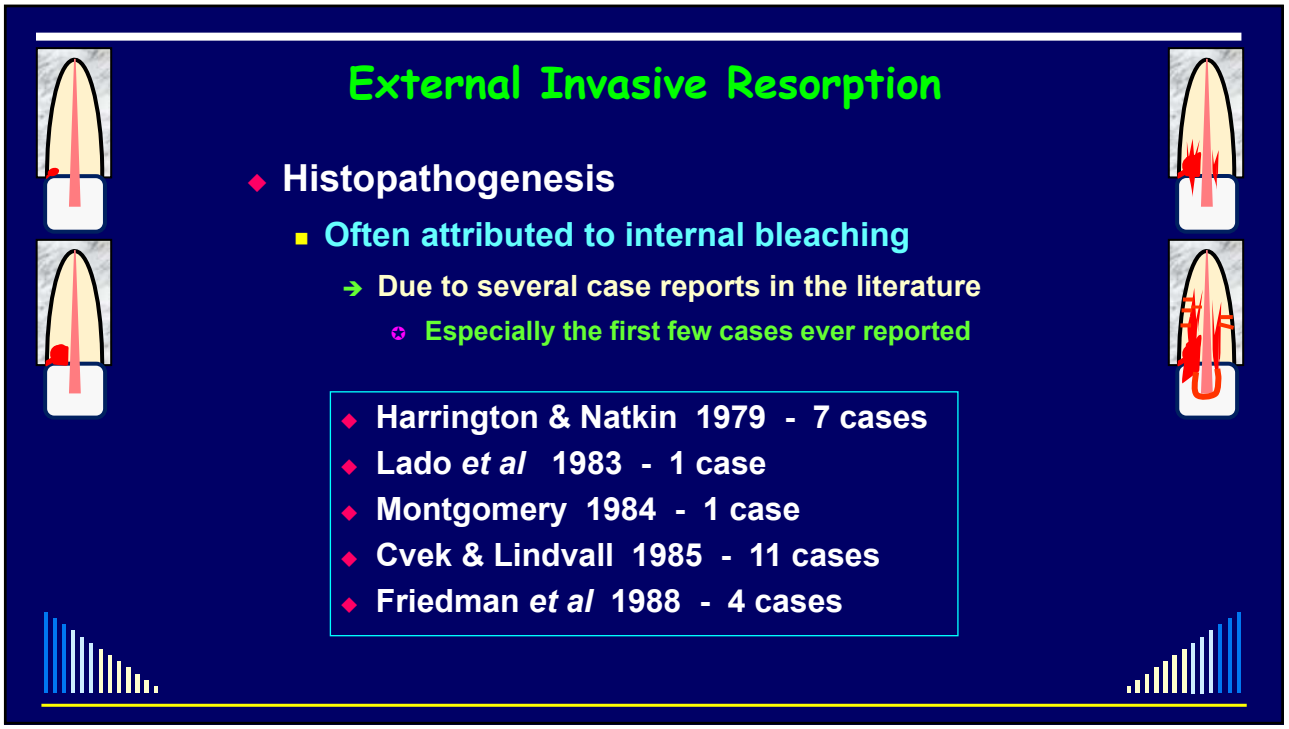


30% of teeth

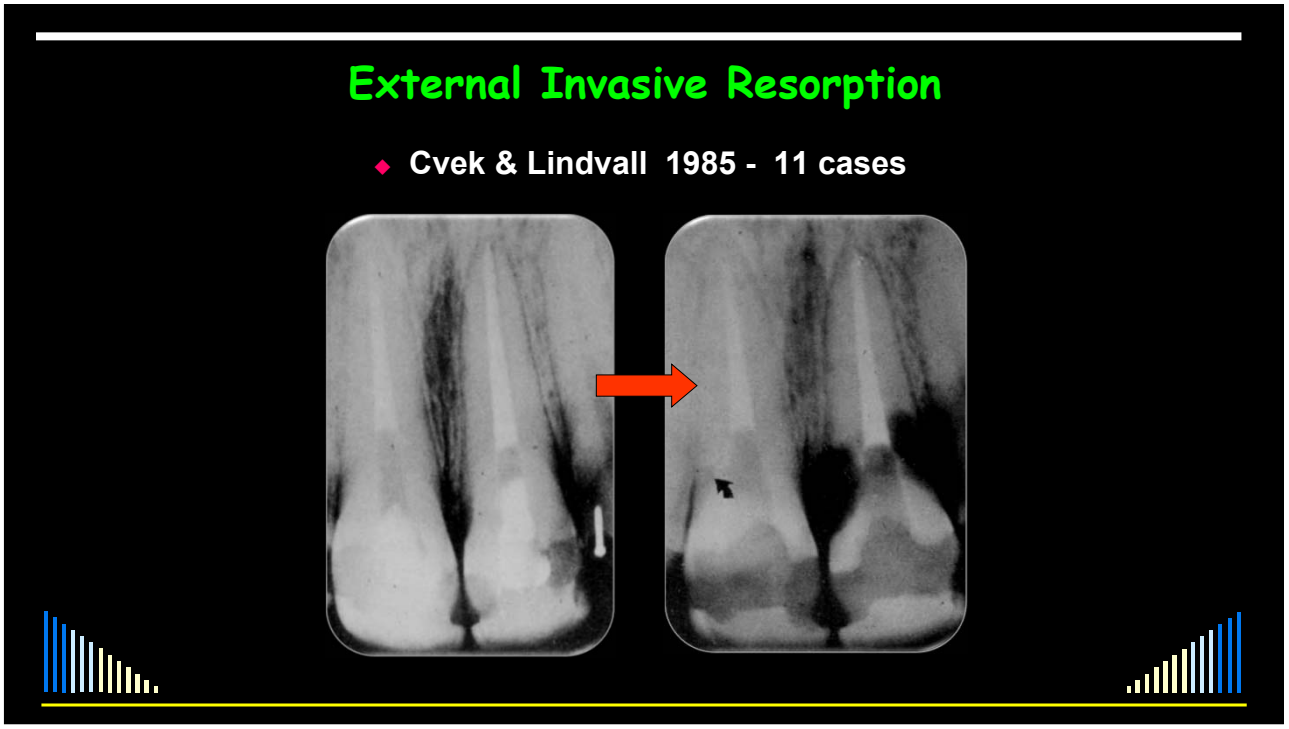
60 - 65% of teeth

★ 5 - 10% of all teeth
★ 30% of upper incisors

14


External Invasive Resorption
Histopathogenesis
Often attributed to internal bleaching
Due to several case reports in the literature
Especially the first few cases ever reported
Harrington & Natkin 1979 - 7 cases
Lado et al 1983 - 1 case
Montgomery 1984 - 1 case
Cvek & Lindvall 1985 - 11 cases
Friedman et al 1988 - 4 cases

15


External Invasive Resorption
Cvek & Lindvall 1985 - 11 cases

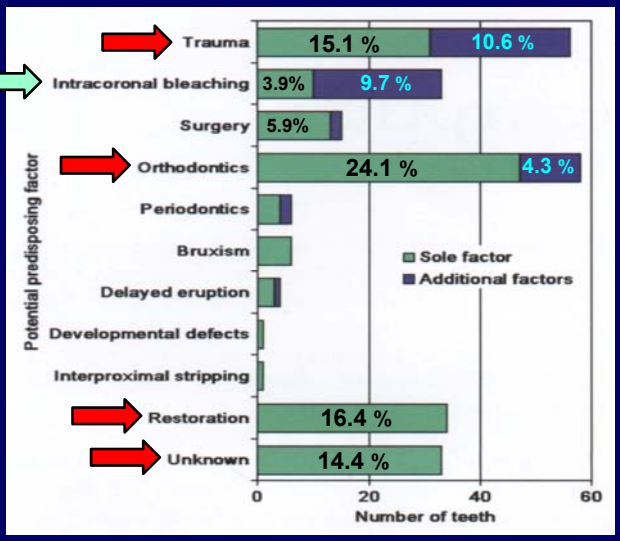
16

External Invasive Resorption

- Histopathogenesis
  - Often attributed to internal bleaching
    - → Due to several case reports in the literature
      - Especially the first few cases ever reported
    - → But not supported with later studies - e.g.
      - Heithersay *et al* - *Aust Dent J* 1994
        - Only 4 of 196 bleached teeth reviewed for up to 19 years
      - Abbott - *Pract Perio & Aesth Dent* 1997
        - None of 254 bleached teeth reviewed for up to 5 years

17

Potential Predisposing Factors



Heithersay 1999

18

Analysis of a Referral-based Endodontic Practice. Part 1. Demographic Data and Reasons for Referral

Abbott PV. *J Endod* 1994; 20: 93-96.

TABLE 5. Types and incidence of root resorption among the 2000 patients referred for treatment

Type of Resorption	No. of Patients
Internal inflammatory	10 (0.5)*
Internal replacement	1 (0.05)
External inflammatory	86 (4.3)
External replacement	13 (0.6)
External cervical invasive	57 (2.8)
External idiopathic	7 (0.4)
Totals	174 (8.65)

* Numbers in parentheses, percentage.


CLINICAL ARTICLE

Analysis of a Referral-Based Endodontic Practice: Part 1. Demographic Data and Reasons for Referral



19

An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

Potential Predisposing Factor	% Patients	%Teeth
Unknown	23.0	33.5
Trauma	15.2	12.8
Orthodontics	11.5	10.8
Restoration	11.8	10.5
Periodontal Disease / Treatment	9.6	8.3
Previous Root Canal Filling	10.2	8.3
Surgery	3.4	2.8
Bleaching	3.1	2.5
Bruxism	2.8	2.5
Transplanted Tooth	2.2	2.3
Post/Crown	2.2	2.0
Cracked Cusp	1.9	1.5
Bridge Abutment	1.2	1.0
Other	1.2	1.0
Submergence	0.6	0.5

2021 - Abbott & Sunthoramoorthy (unpublished data)

20

An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

Gender	% Patients	% Teeth
Male	55.7%	47.4%
Female	44.3%	52.6%

Summary	Age (Yrs)
Youngest	11
Oldest	84
Mean	43.9
Median	43
Mode	40

Age (Yrs)	% Patients
10-19	9.1
20-29	11.9
30-39	19.6
40-49	20.1
50-59	22.4
60-69	8.7
70-79	5.9
> 80	2.3

2021 - Abbott & Sunthoramoorthy (unpublished data)

21

Outline

- ✓ Definition and Terminology
- ✓ Histopathogenesis
  - + Potential Predisposing Factors
- ◆ Features / Classification
  - + Differential Diagnosis
- ◆ Management Strategies
- ◆ Outcomes

22

External Invasive Resorption

Features

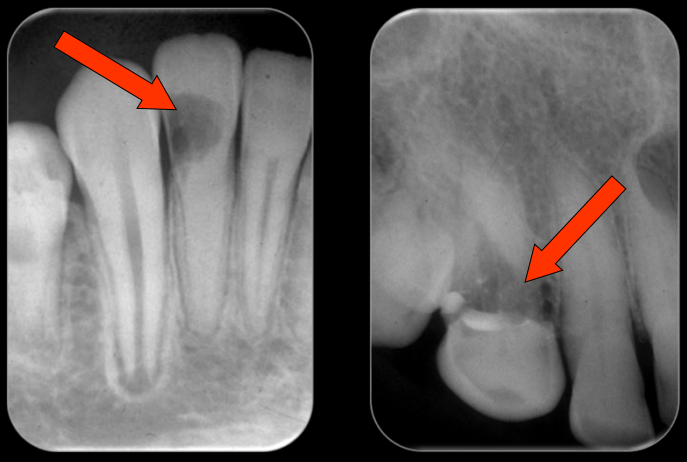
- Sub-gingival - external origin
- Radiolucent area - poorly defined margins
- Very vascular tissue - bleeds readily
- Can resemble caries or internal resorption

Heithersay 1999

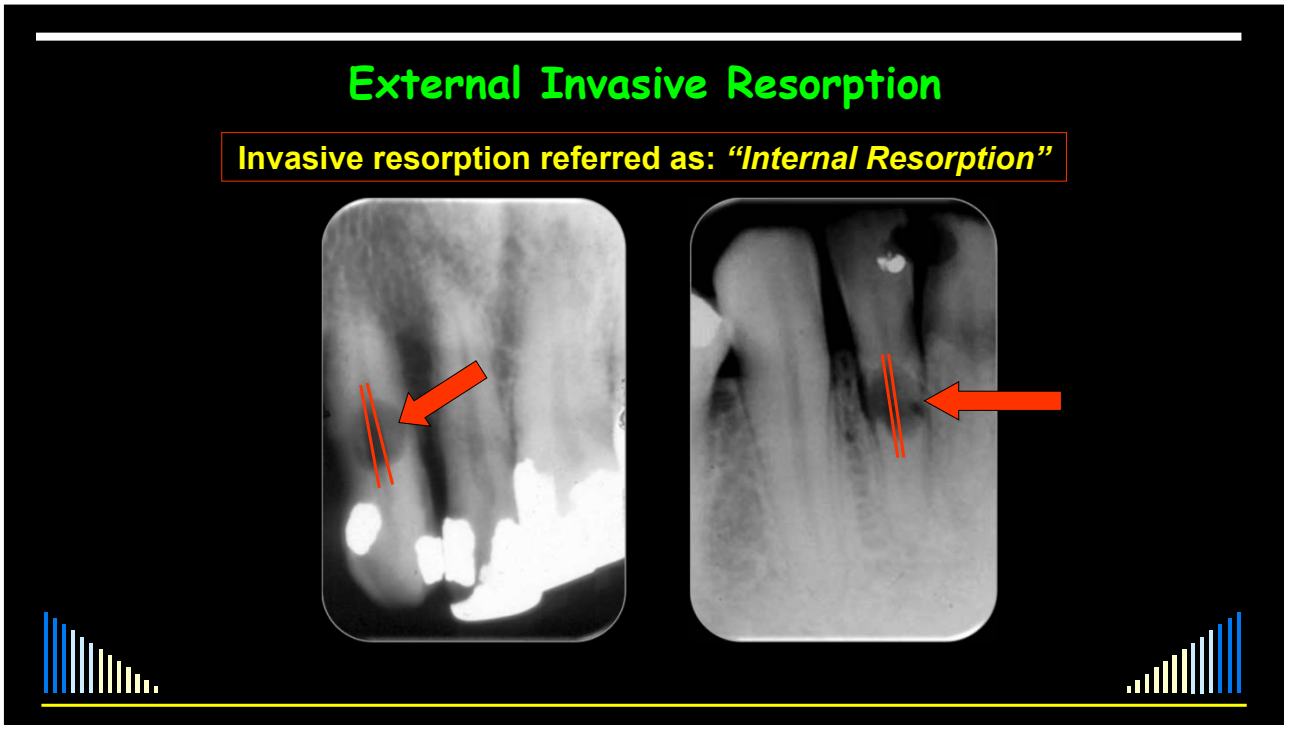
23

External Invasive Resorption

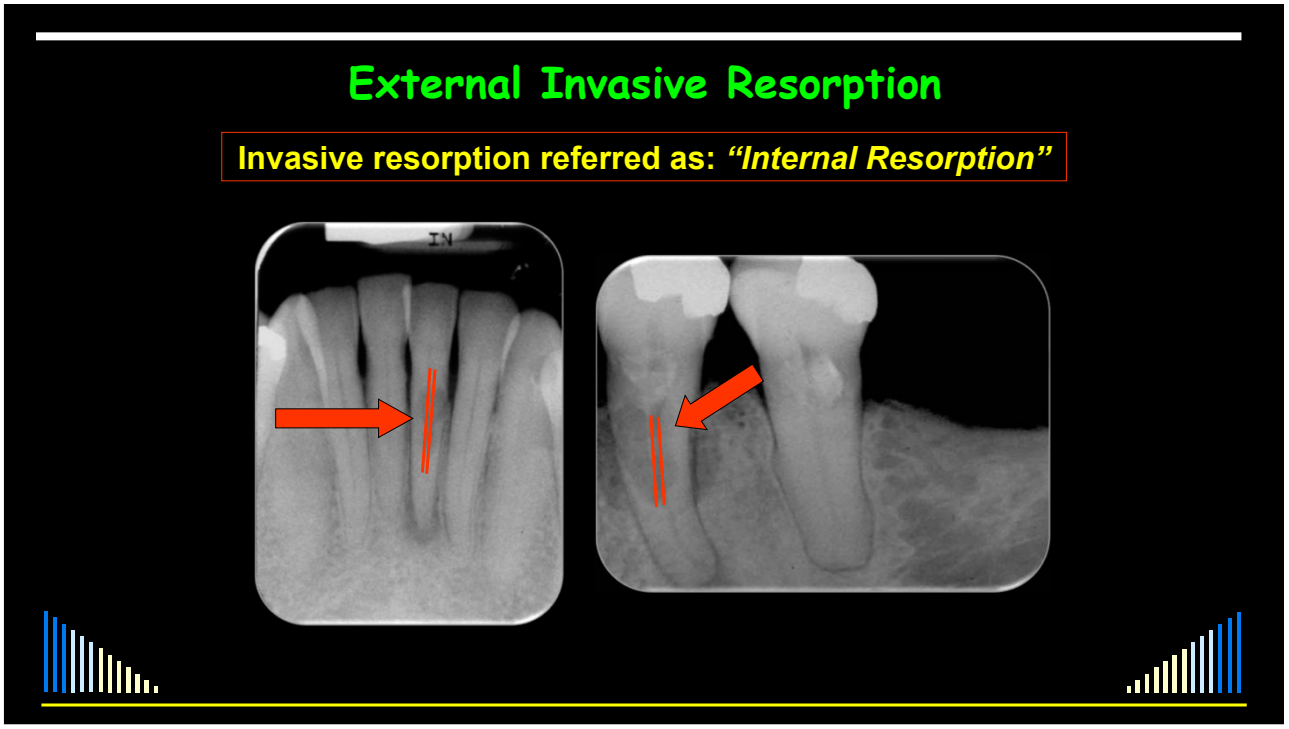
Invasive resorption cases referred as: *"Caries"*



24


External Invasive Resorption
Invasive resorption referred as: "Internal Resorption"

25


External Invasive Resorption
Invasive resorption referred as: "Internal Resorption"

26

External Invasive Resorption

"PINK TEETH" - are most likely due to external invasive resorption

- *i.e. NOT internal inflammatory resorption*
- Since internal inflammatory resorption needs necrotic & infected pulp tissue coronal to the resorbing area to stimulate the resorption
- But there is insufficient space for this in the crown of the tooth



27

Analysis of a Referral-based Endodontic Practice. Part 1. Demographic Data and Reasons for Referral

Abbott PV. *J Endod* 1994; 20: 93-96.

TABLE 5. Types and incidence of root resorption among the 2000 patients referred for treatment

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External cervical invasive	57 (2.8)
External idiopathic	7 (0.4)
Totals	174 (8.65)

* Numbers in parentheses, percentage.

36% referred as "internal resorption"


CLINICAL ARTICLE

Analysis of a Referral-Based Endodontic Practice: Part 1. Demographic Data and Reasons for Referral



28

An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

Referred As	No. Teeth	% Teeth
Resorption	53	18.1
Internal Resorption	48	16.4
External Resorption	52	17.7
External Invasive Resorption	93	31.7
Caries	15	5.1
Another Tooth	14	4.8
Other: Pink Tooth, Granulation Tissue, Pain, Inflammation, Radiolucency, Chronic Abscess, Infection + Resorption or Perforation, Root Defect + Perio Pocket + Inflammation, For Endodontics, Dens Invaginatus	18	6.1
Totals:	293	100.0

2021 - Abbott & Sunthoramoorthy (unpublished data)

29

External Invasive Resorption

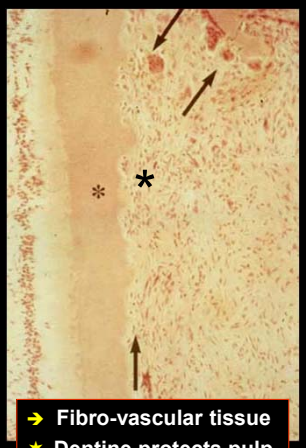
Features

- Resorption is by ***INVASIVE*** tissue
  - NOT by inflammatory tissue
  - But adjacent tissue may become inflamed
    - ➔ *As a secondary response to:*
      - *The defect on the root surface*
      - *Plaque retention in the defect*

Heithersay 1999

30

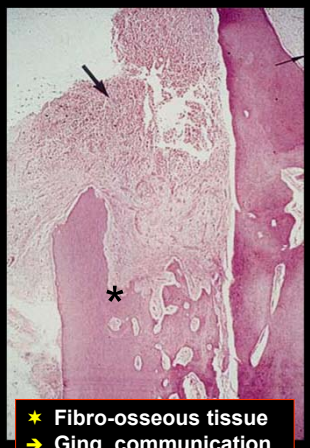
External Invasive Resorption



→ Fibro-vascular tissue
✶ Dentine protects pulp



✶ Fibro-vascular tissue + ectopic calcifications
→ Extensions into PDL & further into root



✶ Fibro-osseous tissue
→ Ging. communication and inflammation

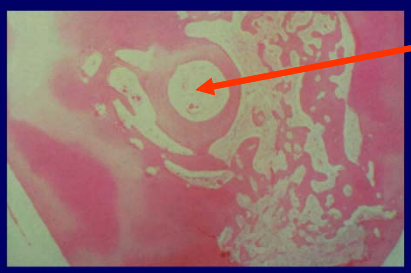
Heithersay 1999

31

External Invasive Resorption

Features

- Pulp is "protected" by a thin layer of dentine
  - *But it may be exposed during treatment*



Pulp Space



Heithersay 1999

32

External Invasive Resorption

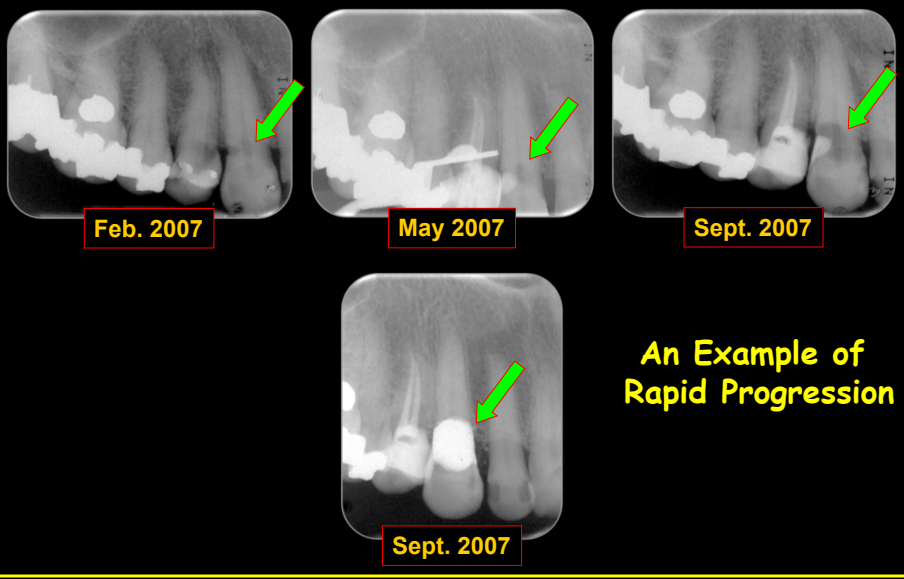
Features

- Speed of progression of invasive resorption
  - *Largely unknown*
    - → *Since time of initiation usually unknown*
  - *Appears to be rapid initially*
  - *Later very slow*
  - *May have "bursts" of activity*

✶ *Not investigated; clinical impression only*

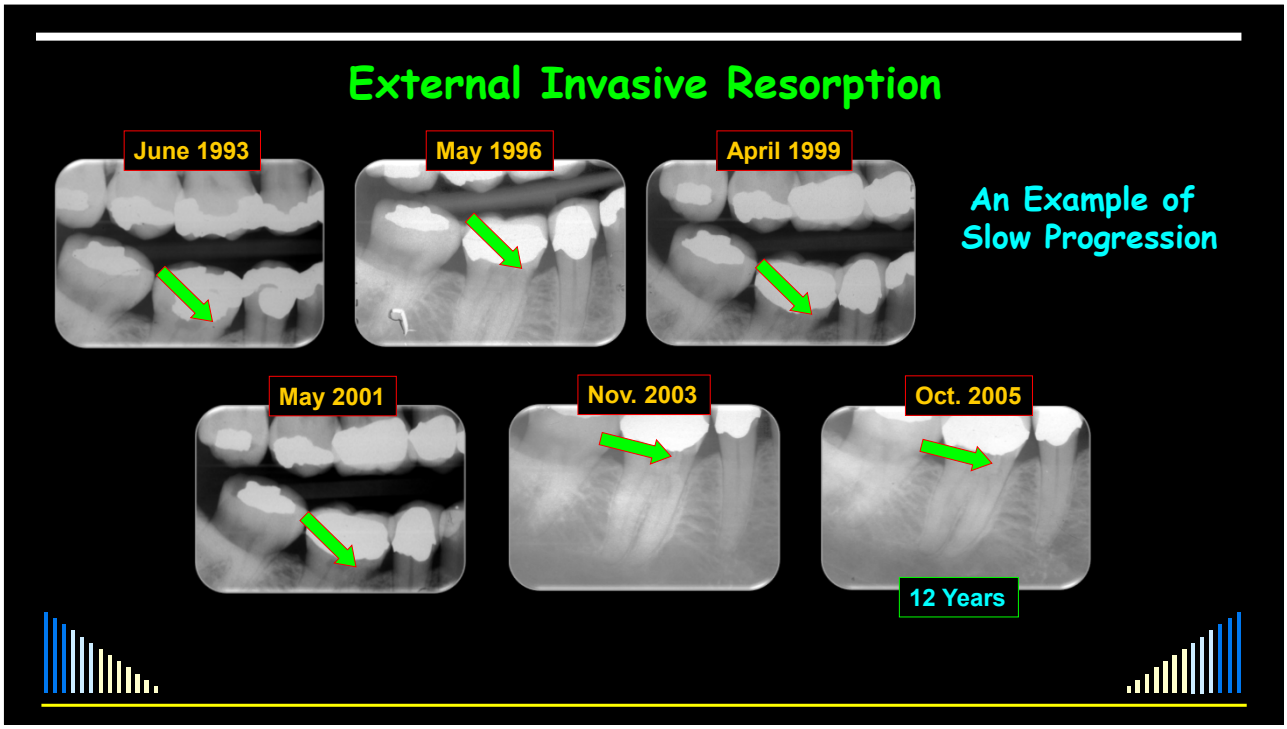
33

External Invasive Resorption



An Example of Rapid Progression

34

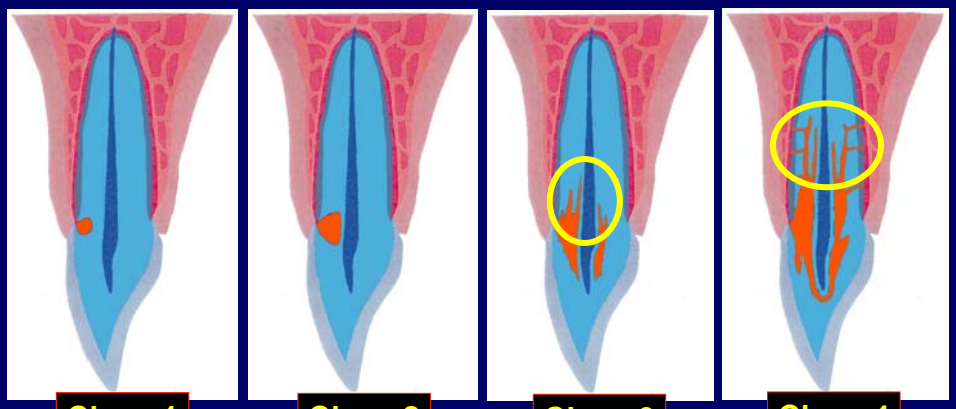

External Invasive Resorption
June 1993
May 1996
April 1999
An Example of
Slow Progression
May 2001
Nov. 2003
Oct. 2005
12 Years

35


External Invasive Resorption
Crown removed
An Example of
Slow Progression
Oct. 2005
12 Years

36

External Invasive Resorption



Heithersay 1999

37

External cervical resorption: a three-dimensional classification

Patel *et al.* - *Int Endod J* 2018;51:206-214

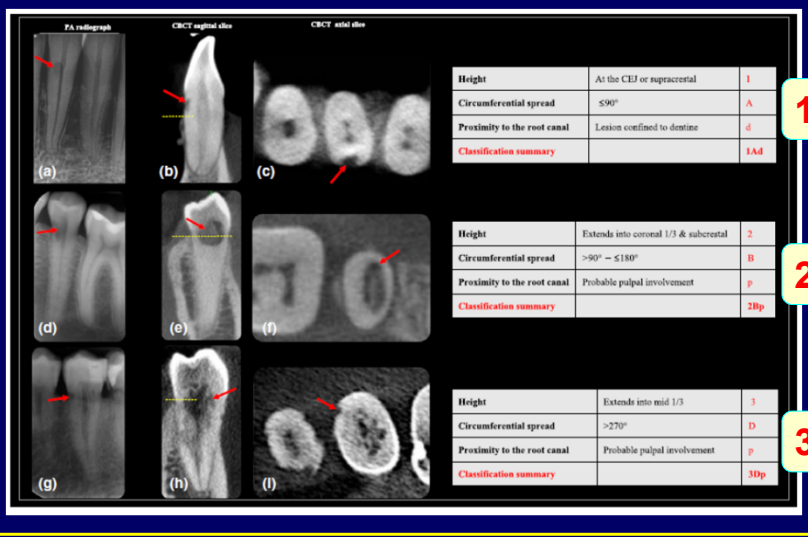
- For use with CBCT scans

Height	Circumferential Spread	Proximity to the Root Canal
1. At the CE-J or coronal to crestal bone (supra-crestal) 2. Extends into the coronal third of the root (sub-crestal) 3. Extends into the middle third of the root 4. Extends into the apical third of the root	A. Less than 90° B. 90° - 180° C. 180° - 270° D. More than 270°	d. Confined to dentine p. Probable pulp involvement

38

External cervical resorption: a three-dimensional classification

Patel *et al.* - *Int Endod J* 2018;51:206-214



39

An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

Heithersay Class	No. of Teeth	% of Teeth
1	12	4.1
2	60	20.5
3	104	35.5
4	117	39.9
Total:	293	100

2021 - Abbott & Sunthoramoorthy (unpublished data)

40

An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

Tooth Types	Maxillary	Mandibular
Central	21.8	6.8
Lateral	5.1	3.1
Canine	8.9	6.5
1st Premolar	1.7	3.1
2nd Premolar	3.8	4.8
1st Molar	10.6	8.5
2nd Molar	4.4	4.4
3rd Molar	2.4	4.1
TOTALS:	58.7	41.3

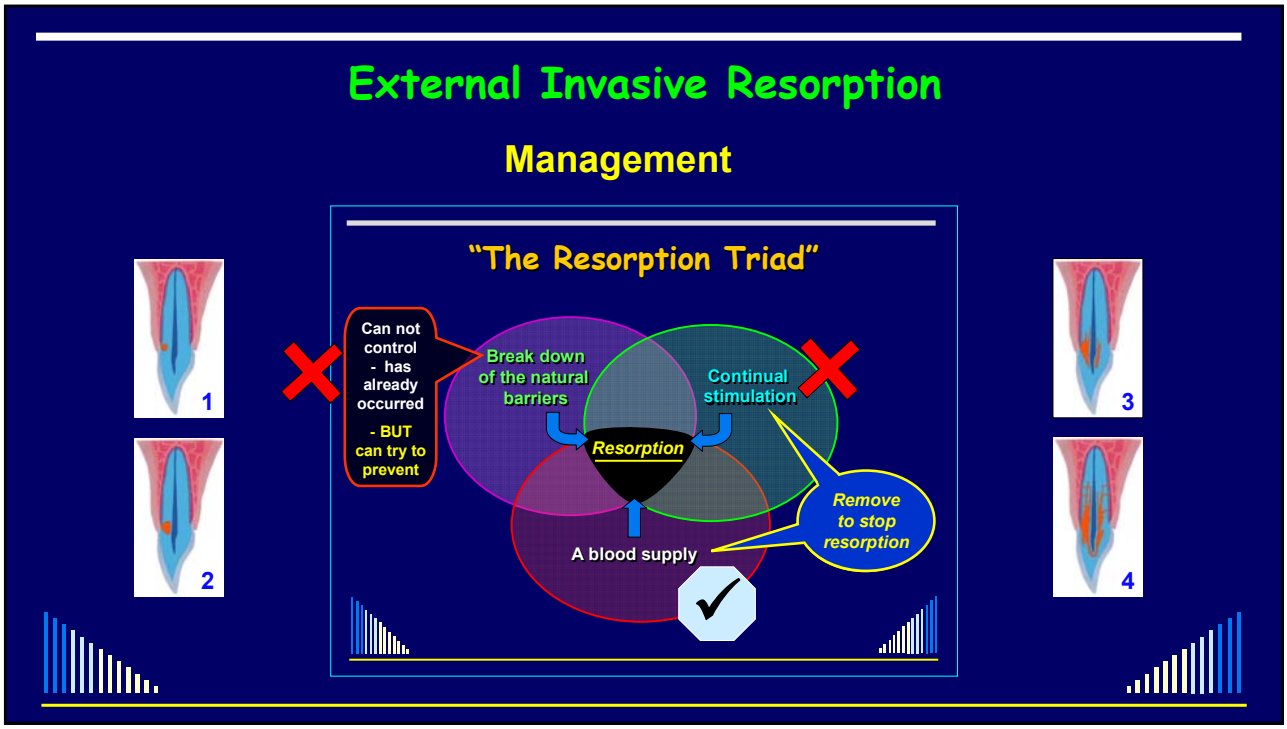
2021 - Abbott & Sunthoramoorthy (unpublished data)

41

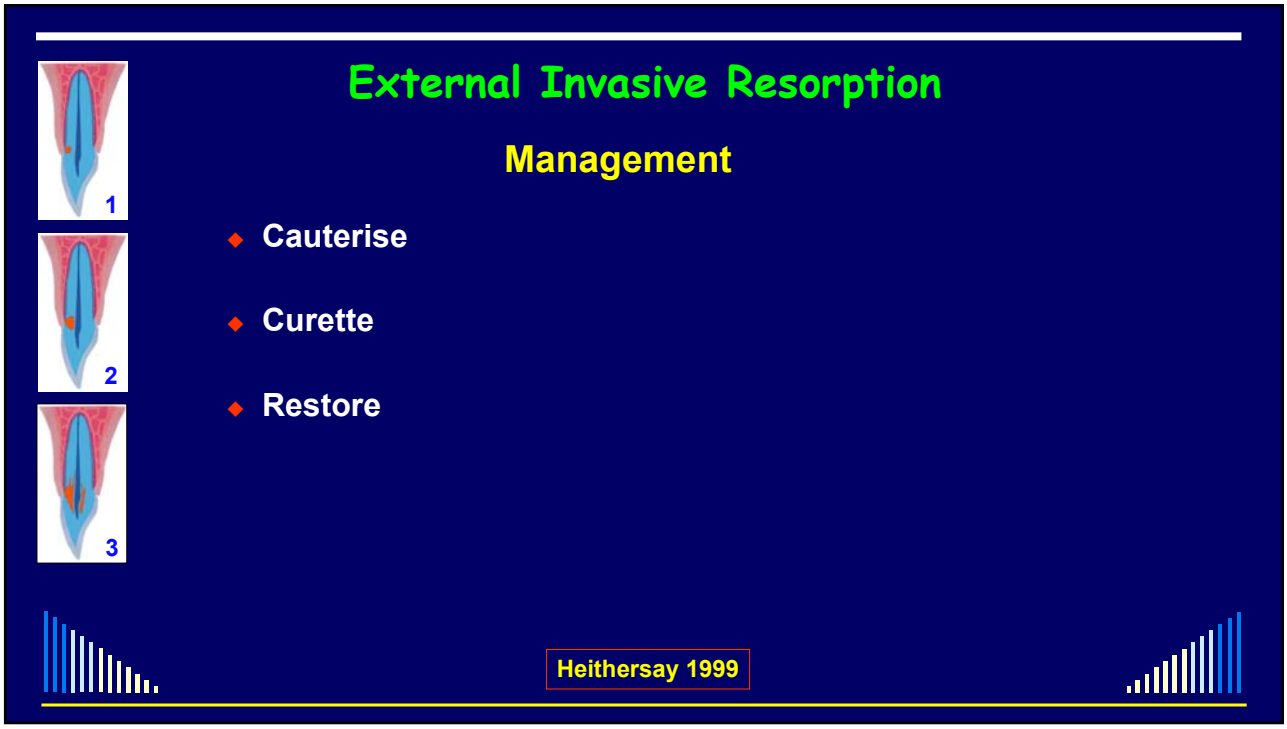
Outline

- ✓ Definition and Terminology
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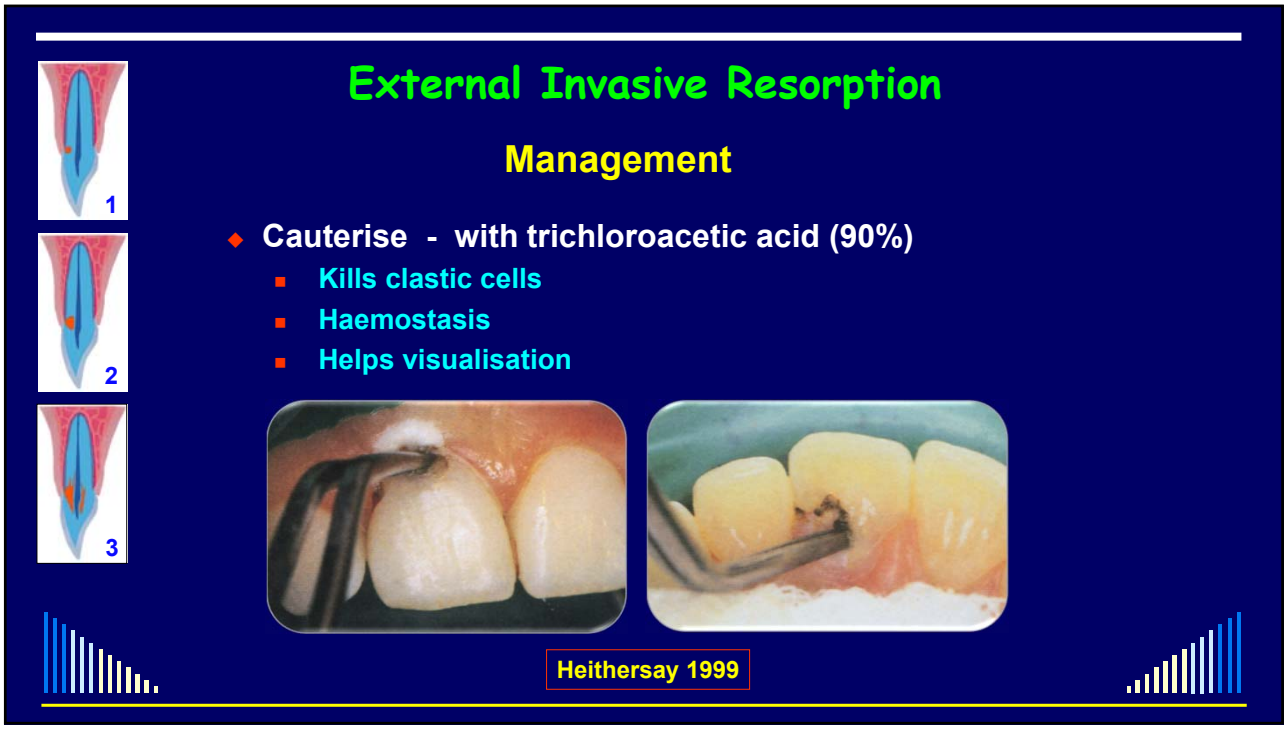
42


External Invasive Resorption
Management
"The Resorption Triad"
Can not control - has already occurred
- BUT can try to prevent
Break down of the natural barriers
Continual stimulation
Resorption
A blood supply
Remove to stop resorption
1
2
3
4

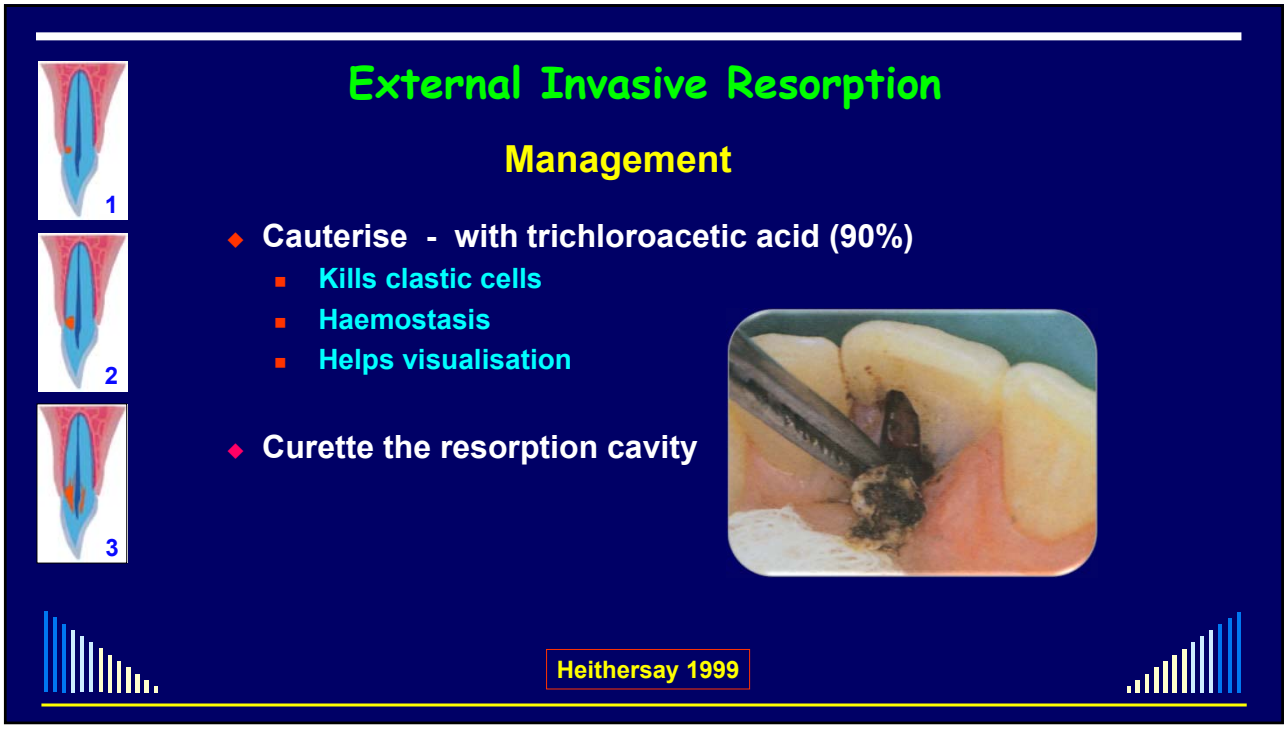
43


External Invasive Resorption
Management
Cauterise
Curette
Restore
Heithersay 1999
1
2
3

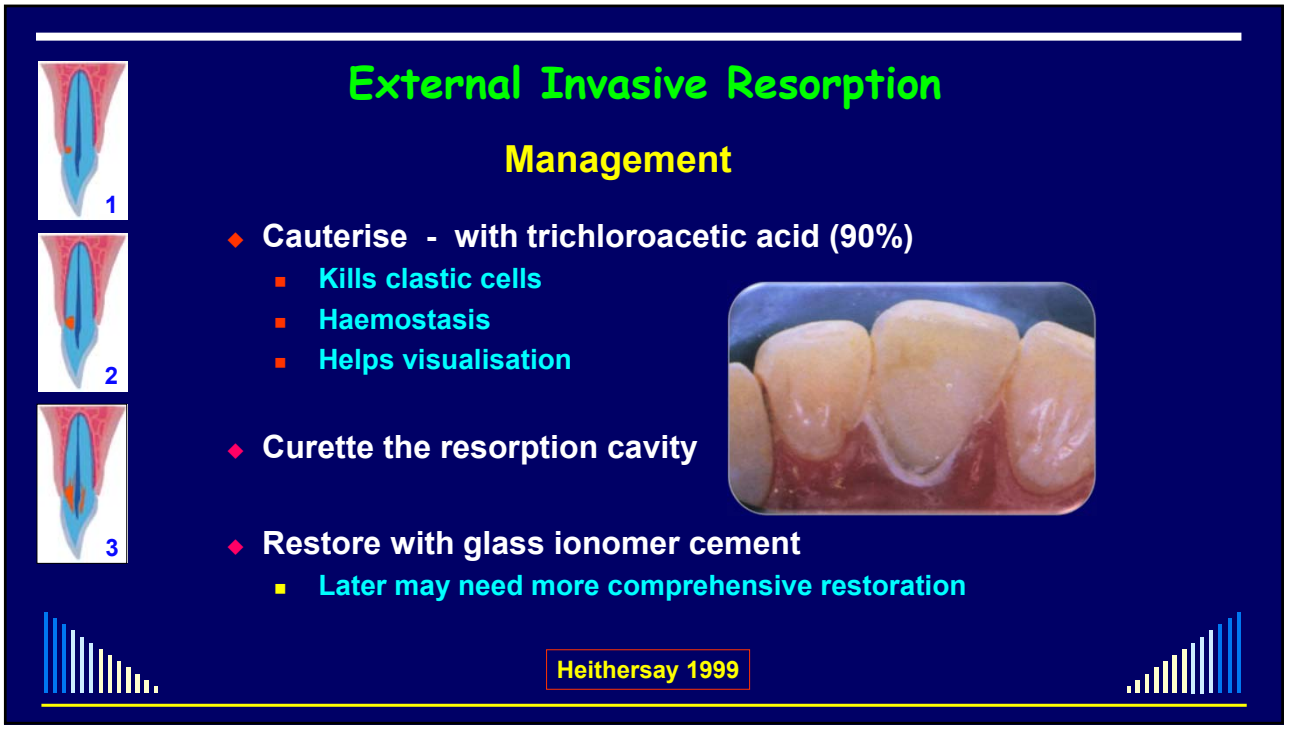
44


External Invasive Resorption
Management
Cauterise - with trichloroacetic acid (90%)
Kills clastic cells
Haemostasis
Helps visualisation
1
2
3
Heithersay 1999

45


External Invasive Resorption
Management
Cauterise - with trichloroacetic acid (90%)
Kills clastic cells
Haemostasis
Helps visualisation
Curette the resorption cavity
1
2
3
Heithersay 1999

46


External Invasive Resorption
Management
1
2
3
Cauterise - with trichloroacetic acid (90%)
Kills clastic cells
Haemostasis
Helps visualisation
Curette the resorption cavity
Restore with glass ionomer cement
Later may need more comprehensive restoration
Heithersay 1999

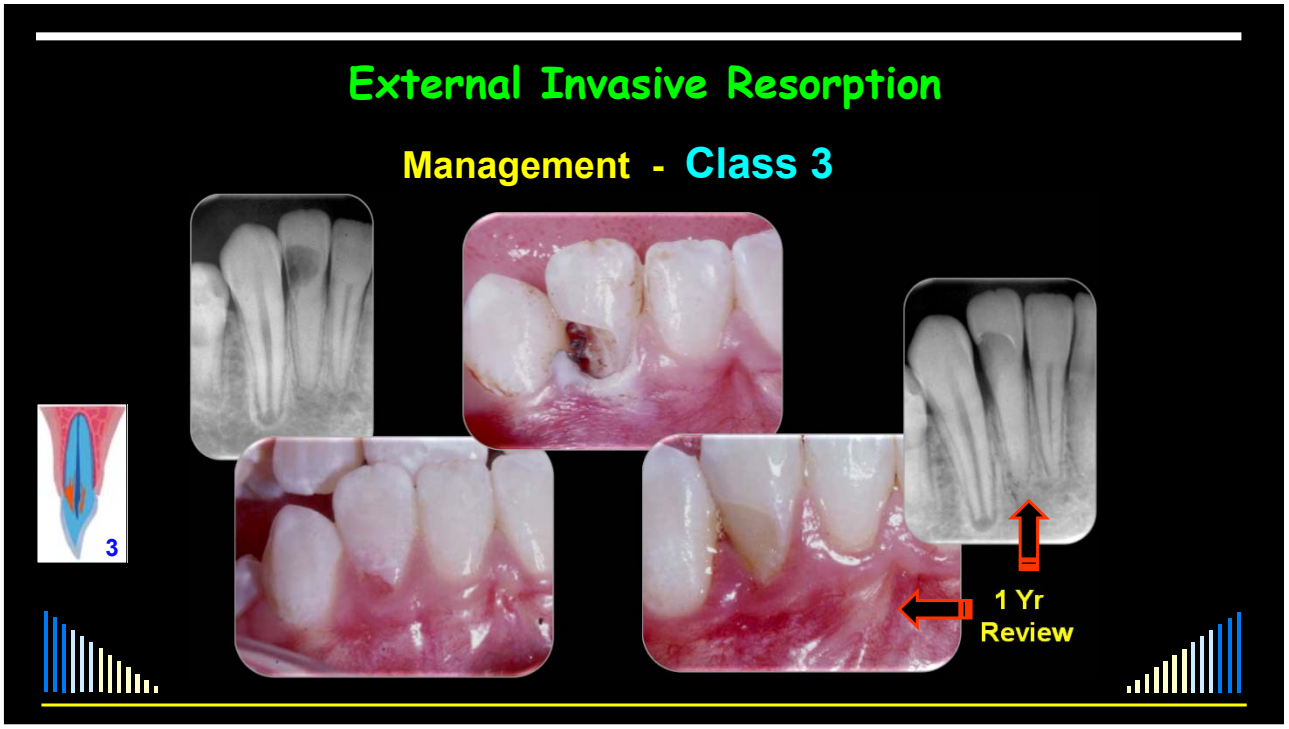
47


External Invasive Resorption
Management - Class 1
1

48


External Invasive Resorption
Management - Class 2
2

49


External Invasive Resorption
Management - Class 3
3
1 Yr
Review

50

External Invasive Resorption

Management - Class 3

Some cases may also require:

- Root canal treatment
  - When pulp exposed during curettage



Heithersay 1999

51

External Invasive Resorption

Pulp exposed during curettage







52

External Invasive Resorption

Management - Class 3

Some cases may also require:

- Root canal treatment
  - When pulp exposed during curettage
  - For an internal approach to the resorptive area
    - May be advantageous and important to preserve the interdental papilla
      - Especially with anterior teeth
    - When external opening can not be detected

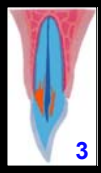


Heithersay 1999

53

External Invasive Resorption

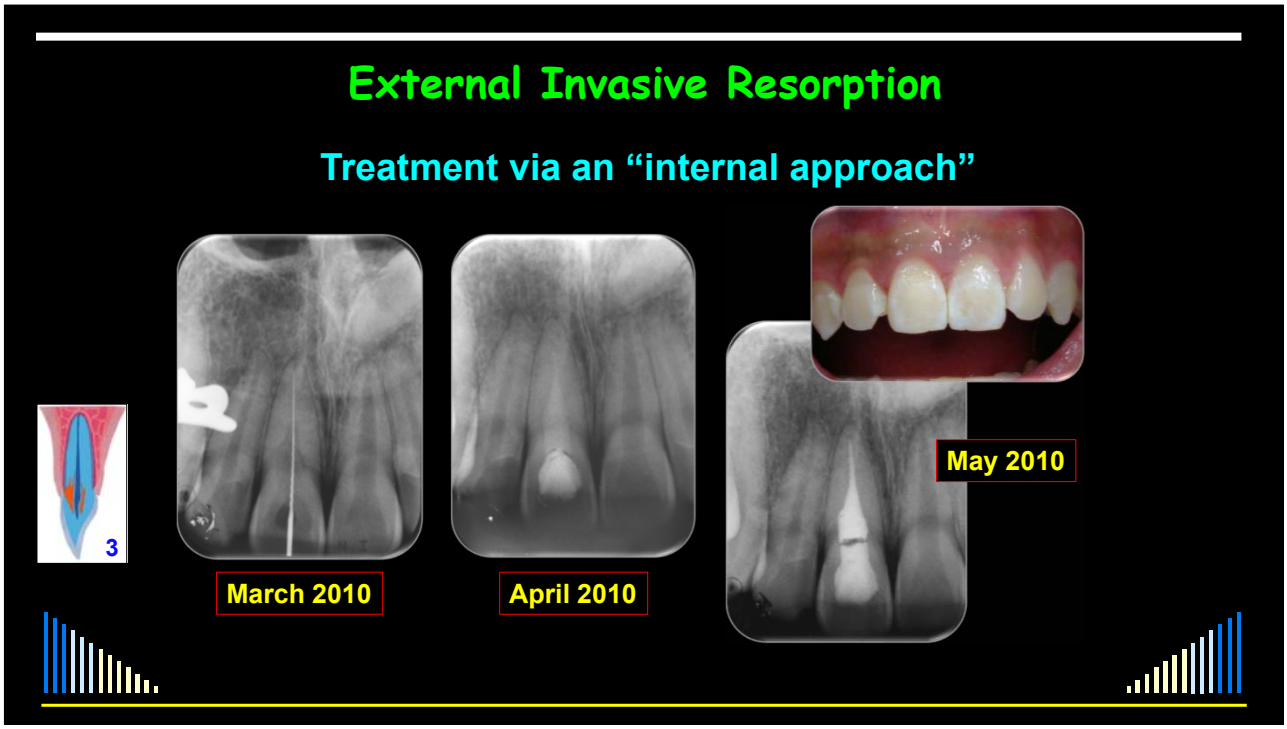
Treatment via an "internal approach"





Pre-op - Feb. 2010

54


External Invasive Resorption
Treatment via an "internal approach"
3
March 2010
April 2010
May 2010

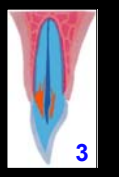
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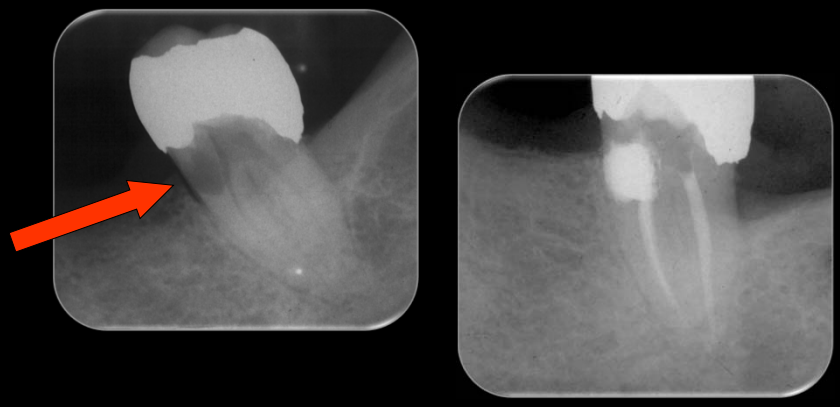

External Invasive Resorption
Treatment via an "internal approach"
3
5½ Year Review – Sept. 2015

56

External Invasive Resorption

Treatment via an "internal approach"





57

External Invasive Resorption

Management - Class 3

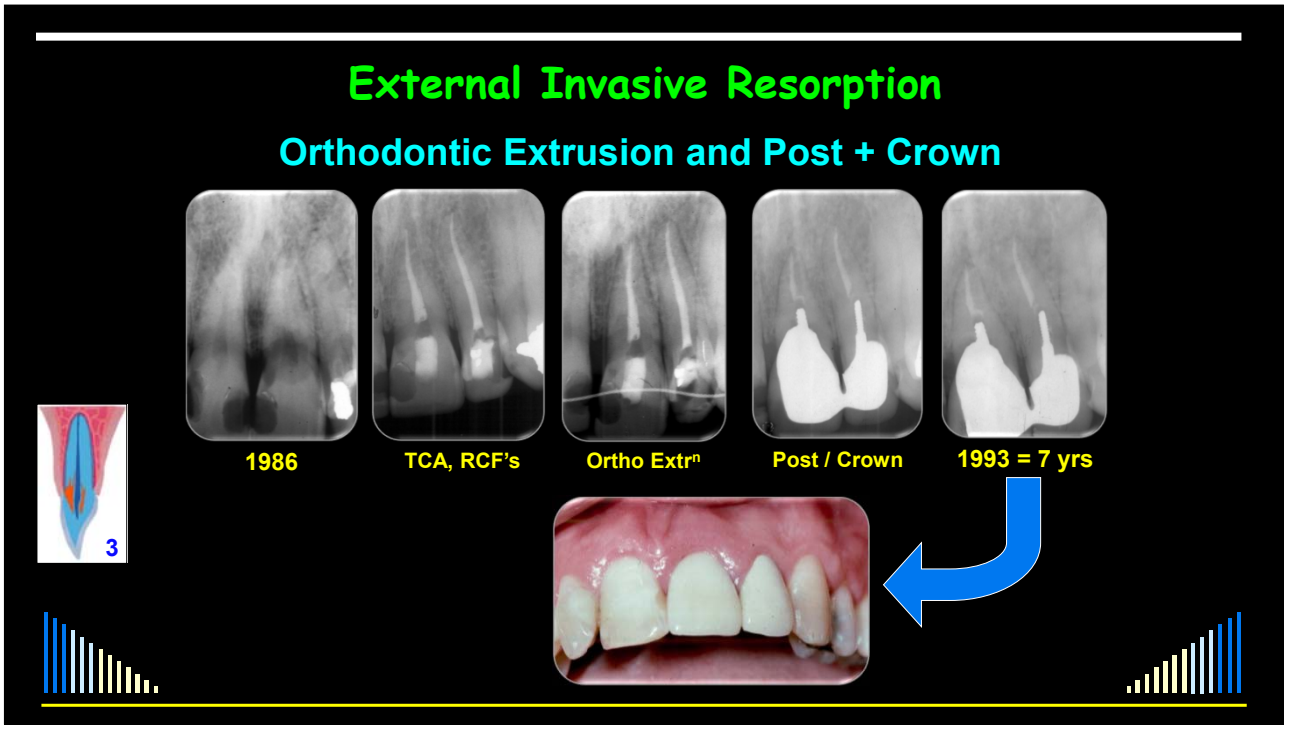
Some cases may also require:

- **Root canal treatment**
  - When pulp exposed during curettage
  - For an internal approach to the resorptive area
    - Advantageous to preserve the interdental papilla
  - When needed to restore the tooth (e.g. with a post)
- **Orthodontic extrusion**
  - When required to expose / restore margins

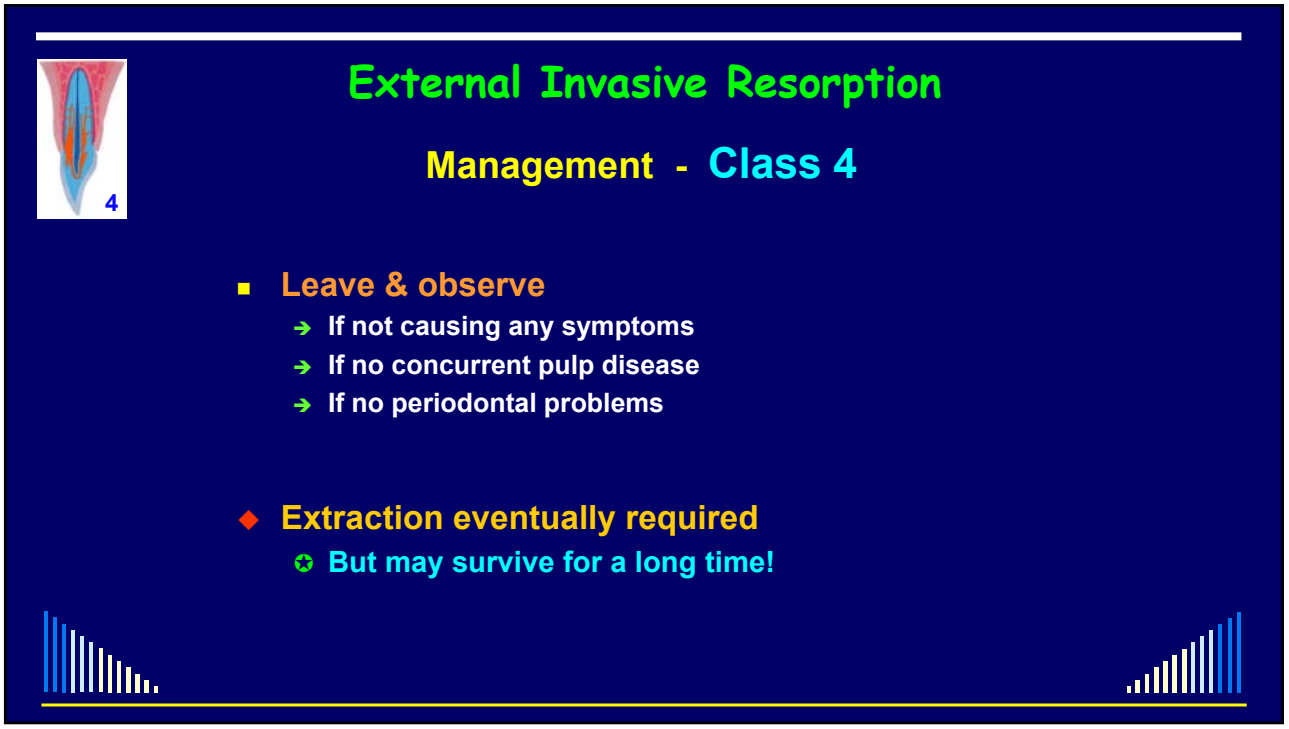


Heithersay 1999

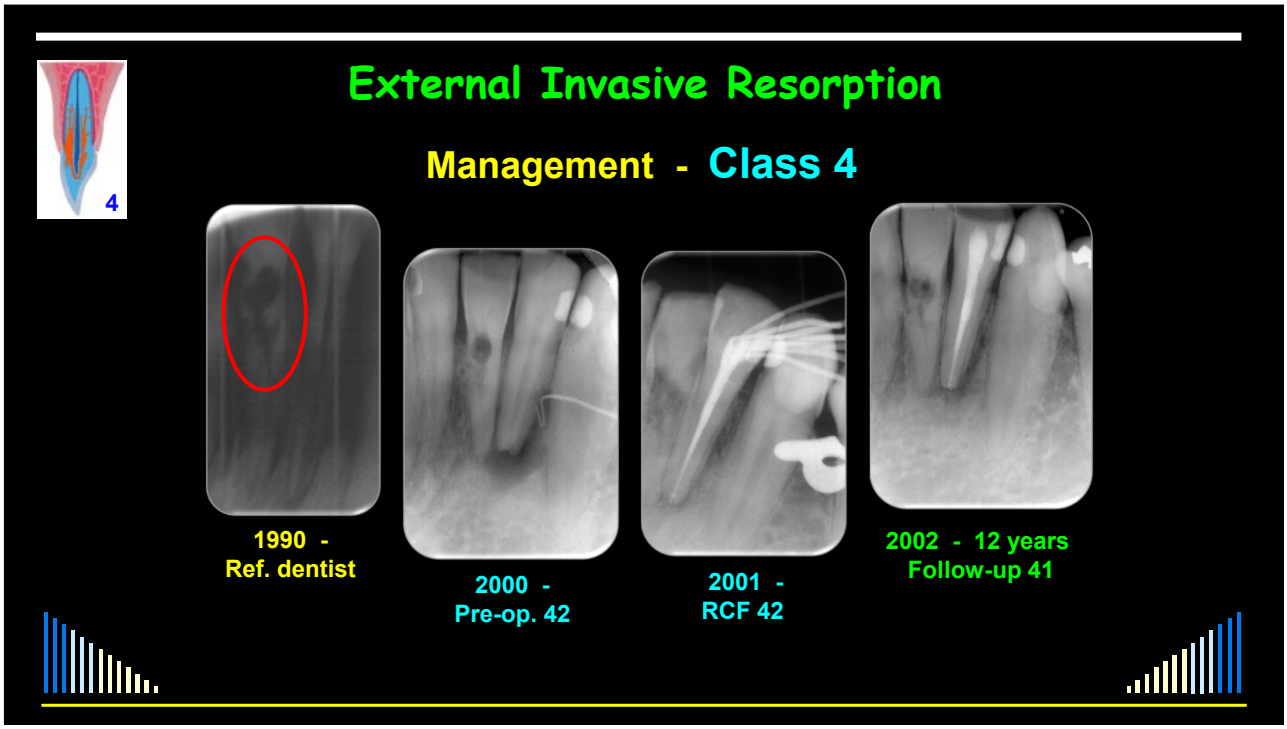
58


External Invasive Resorption
Orthodontic Extrusion and Post + Crown
1986
TCA, RCF's
Ortho Extrn
Post / Crown
1993 = 7 yrs
3

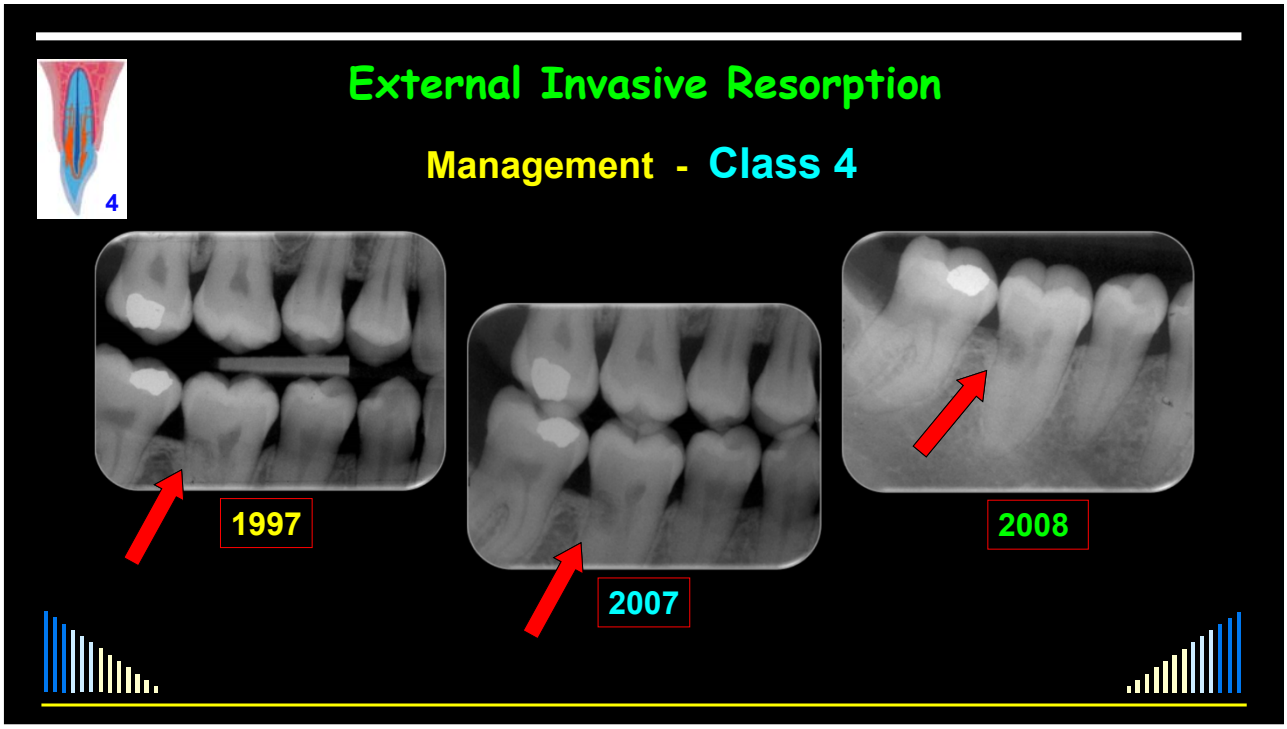
59


External Invasive Resorption
Management - Class 4
4
Leave & observe
If not causing any symptoms
If no concurrent pulp disease
If no periodontal problems
Extraction eventually required
But may survive for a long time!

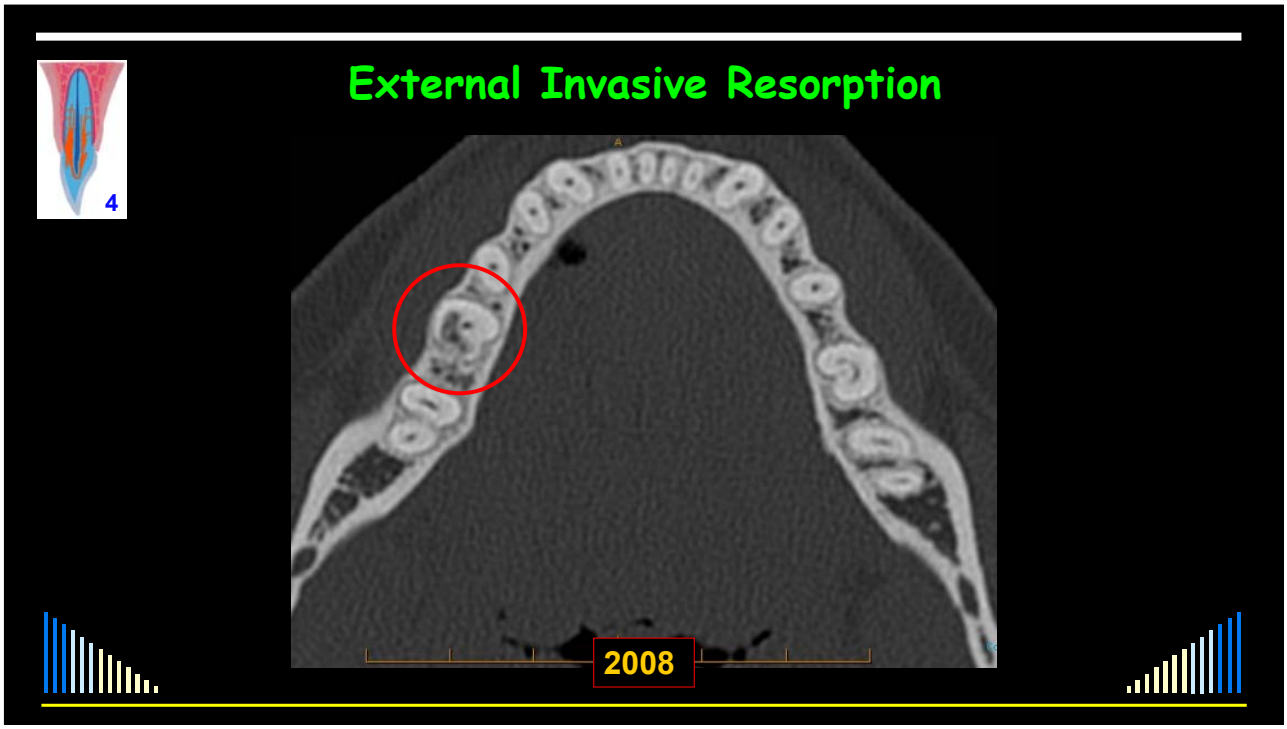
60


External Invasive Resorption
Management - Class 4
4
1990 -
Ref. dentist
2000 -
Pre-op. 42
2001 -
RCF 42
2002 - 12 years
Follow-up 41

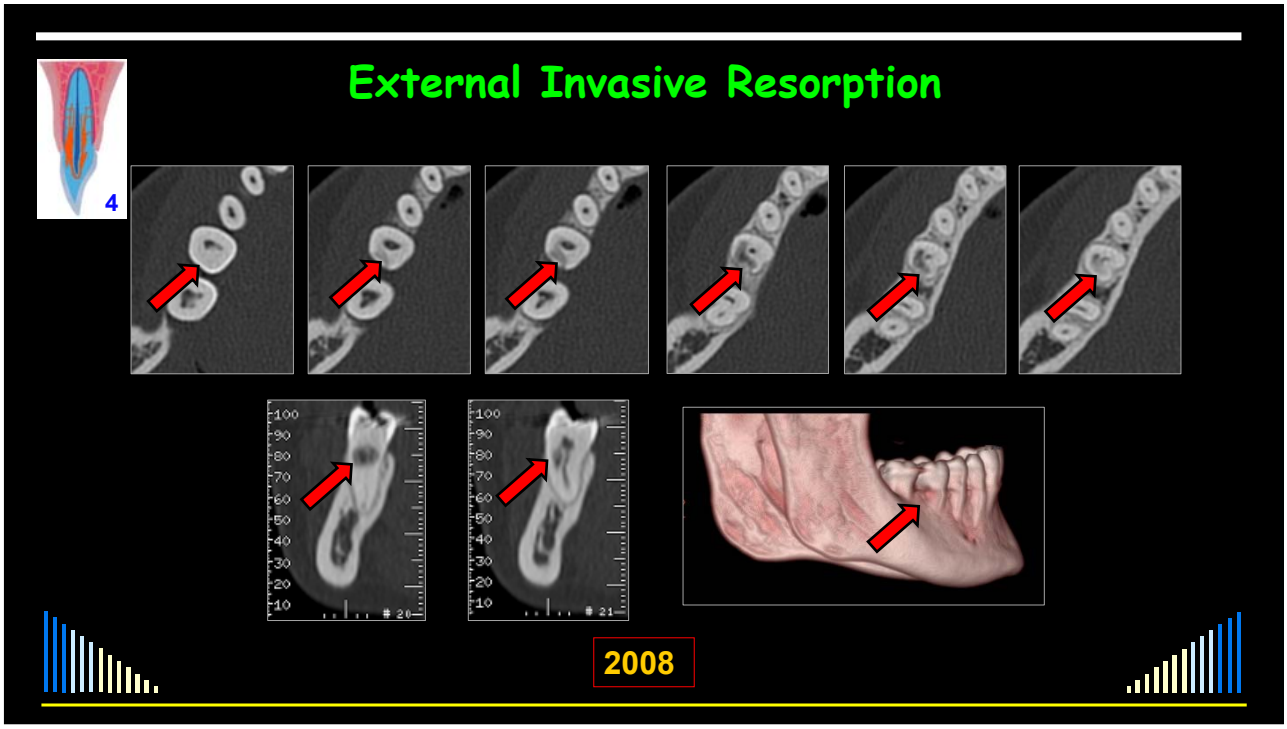
61


External Invasive Resorption
Management - Class 4
4
1997
2007
2008

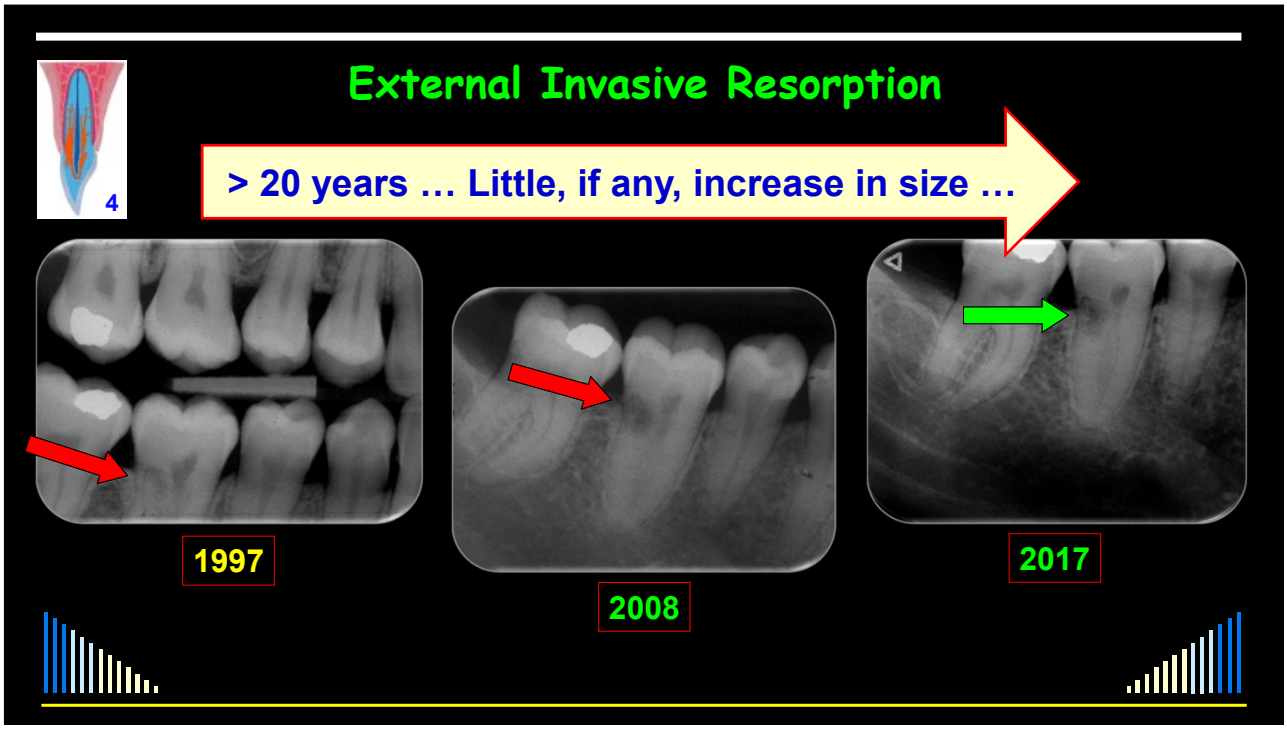
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External Invasive Resorption
4
2008

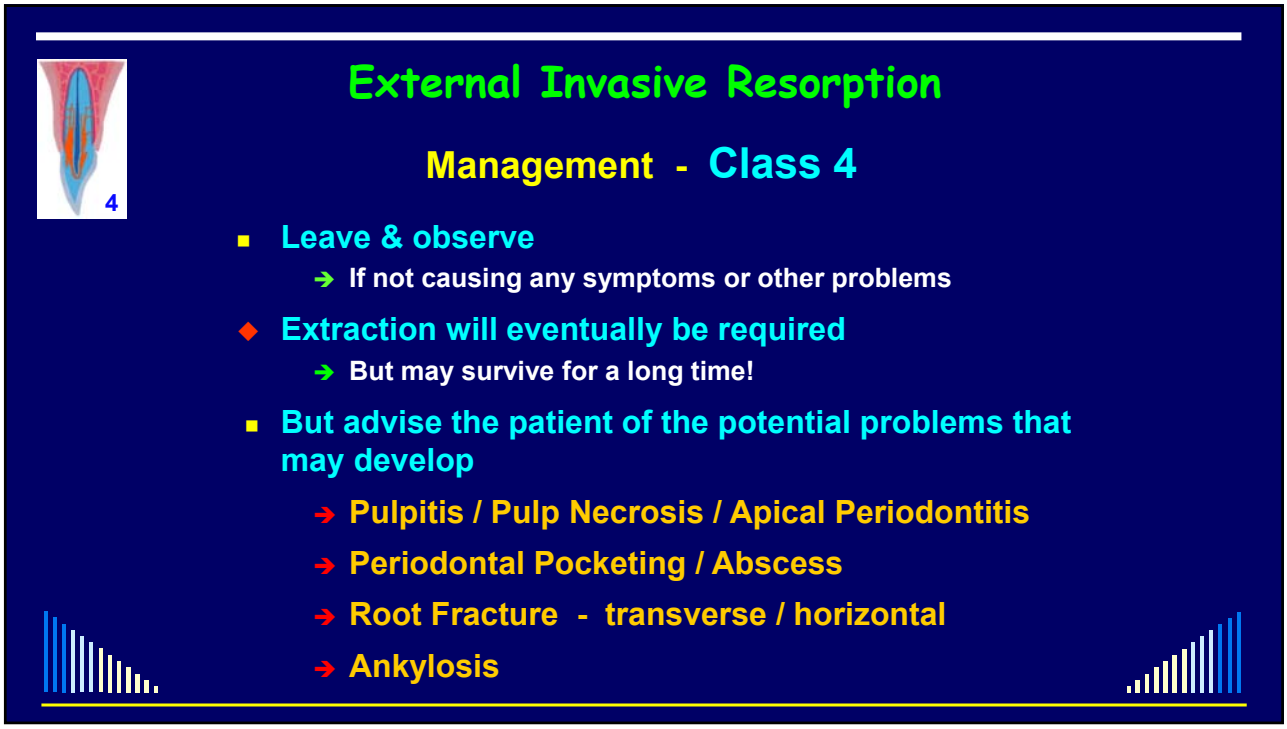
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External Invasive Resorption
4
2008

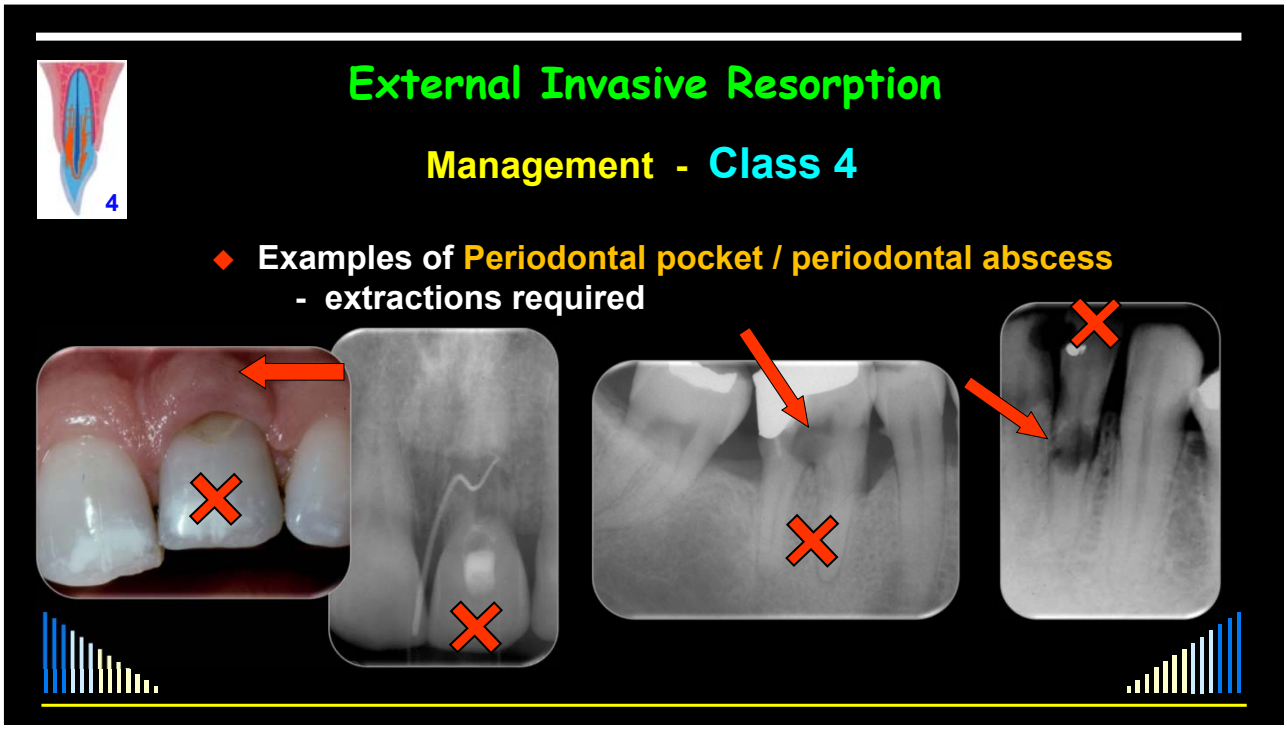
64


External Invasive Resorption
4
> 20 years … Little, if any, increase in size …
1997
2008
2017

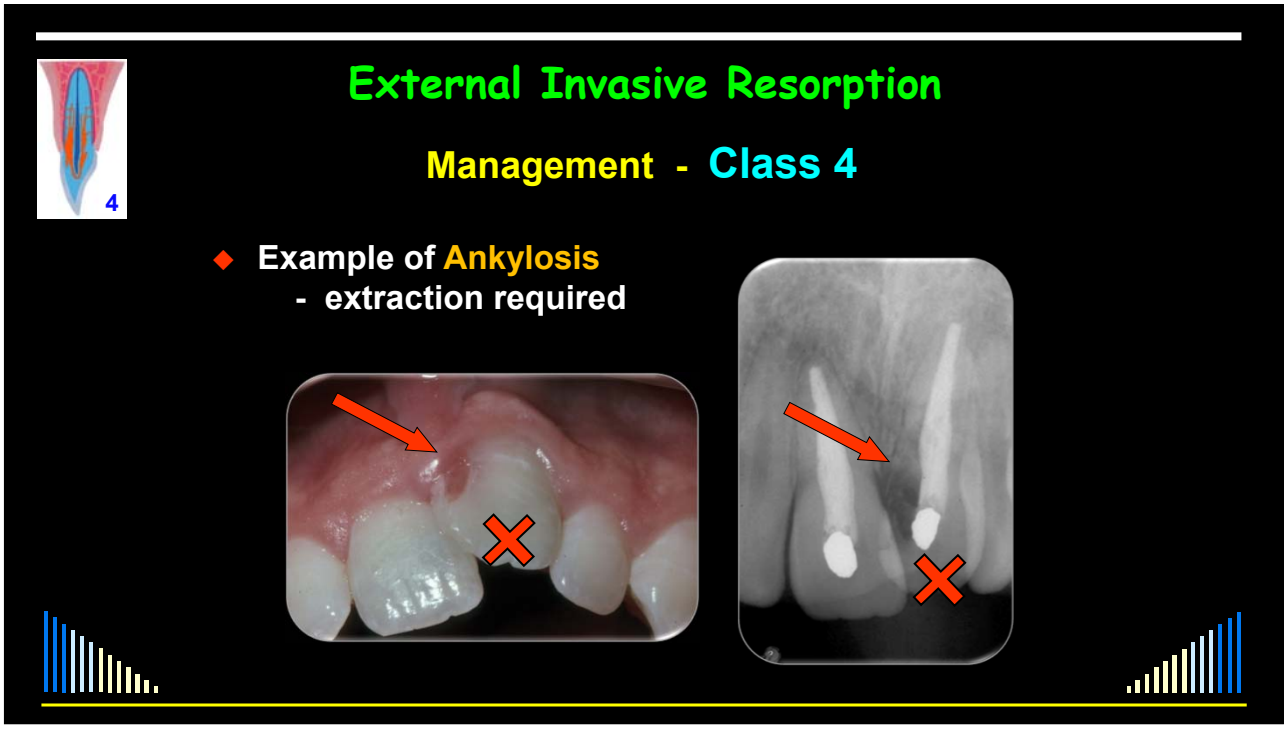
65


External Invasive Resorption
4
Management - Class 4
Leave & observe
If not causing any symptoms or other problems
Extraction will eventually be required
But may survive for a long time!
But advise the patient of the potential problems that may develop
Pulpitis / Pulp Necrosis / Apical Periodontitis
Periodontal Pocketing / Abscess
Root Fracture - transverse / horizontal
Ankylosis

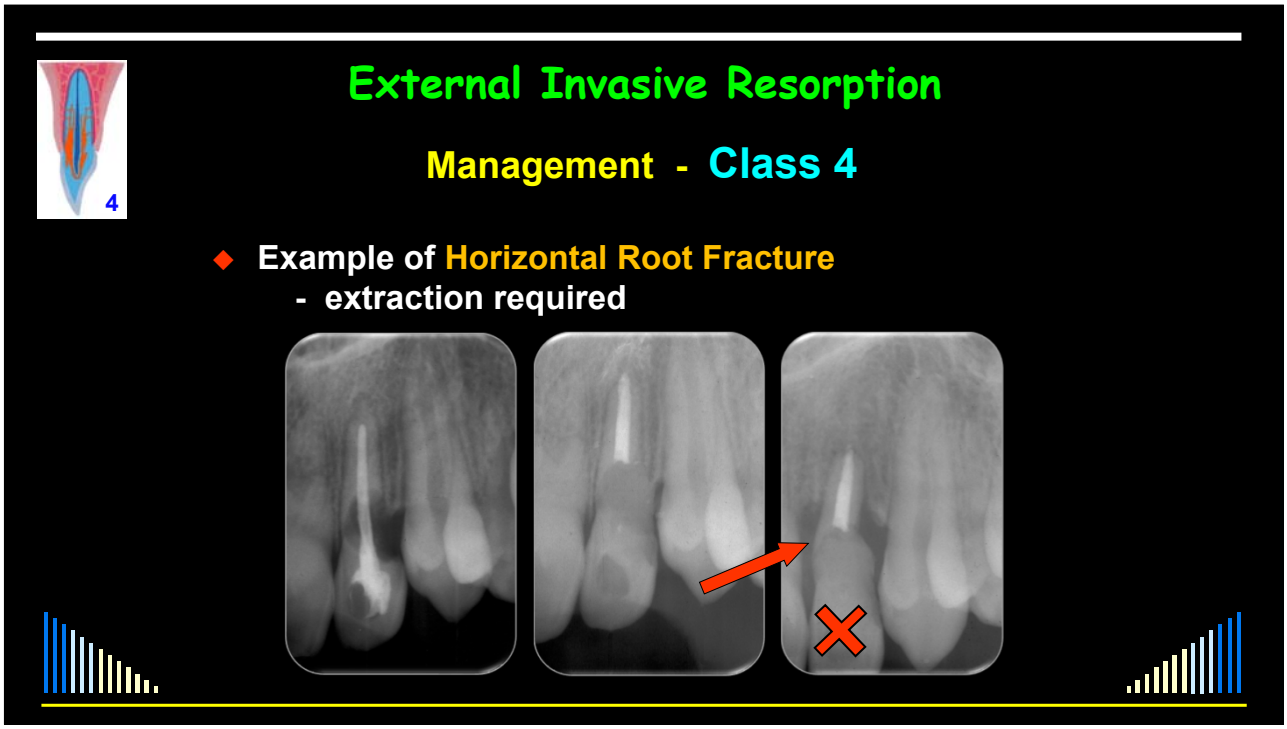
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External Invasive Resorption
Management - Class 4
4
Examples of Periodontal pocket / periodontal abscess
- extractions required

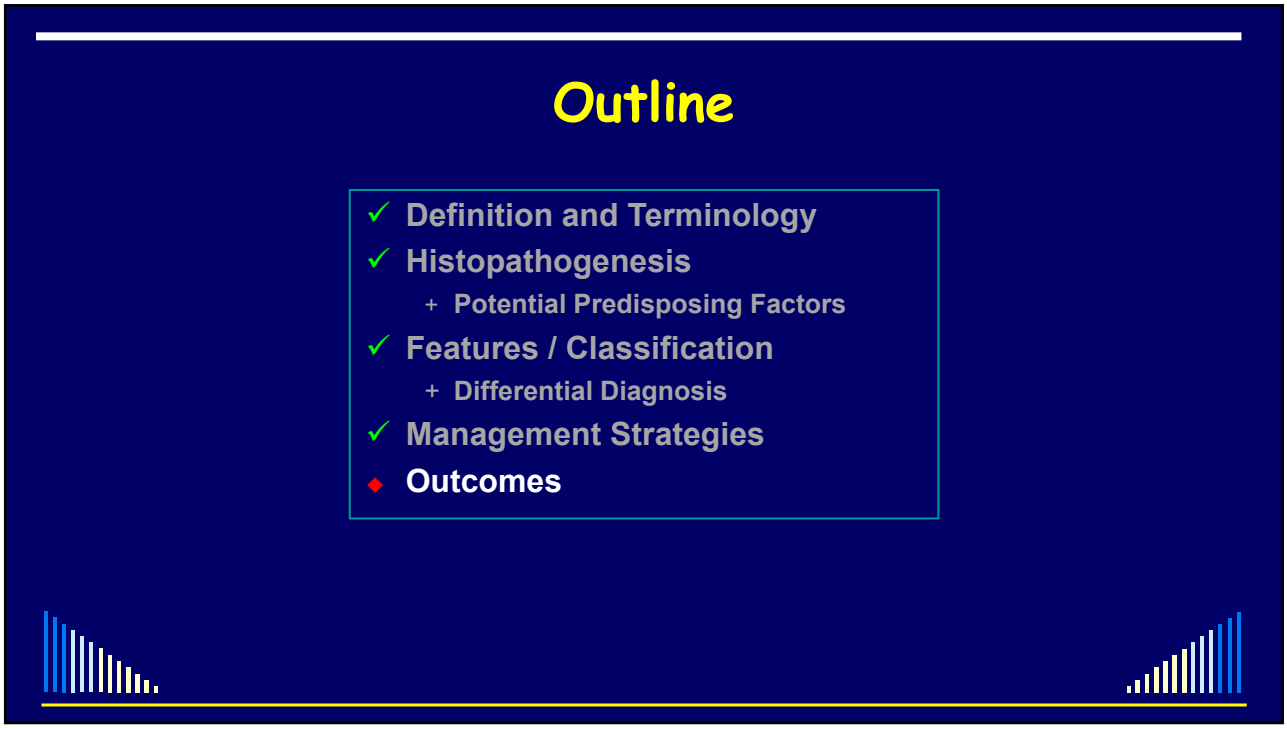
67


External Invasive Resorption
Management - Class 4
4
Example of Ankylosis
- extraction required

68


External Invasive Resorption
Management - Class 4
4
Example of Horizontal Root Fracture
- extraction required

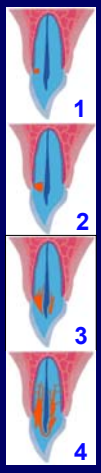
69


Outline
✓ Definition and Terminology
✓ Histopathogenesis
+ Potential Predisposing Factors
✓ Features / Classification
+ Differential Diagnosis
✓ Management Strategies
Outcomes

70

External Invasive Resorption

Treatment Outcome over 5 years

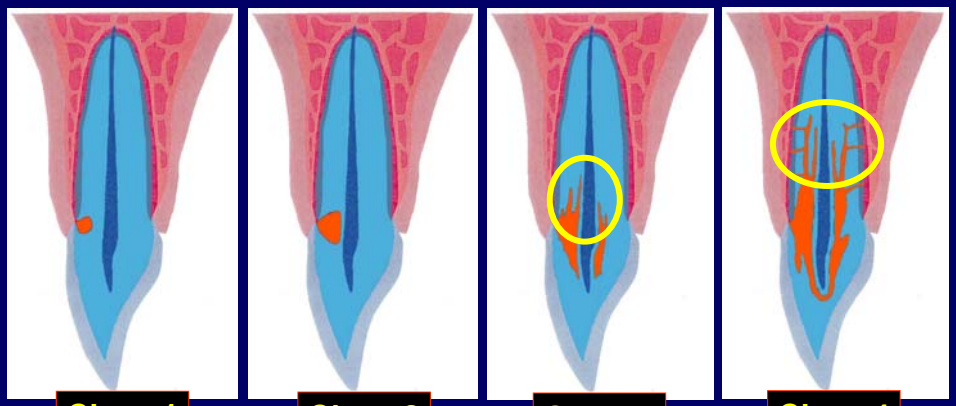


	Resorption Control	Tooth Survival	Overall Success
Class 1	100 %	100 %	100 %
Class 2	100	100	100
Class 3	96.8	92.1	77.8
Class 4	50.0	50.0	12.5

Heithersay 1999

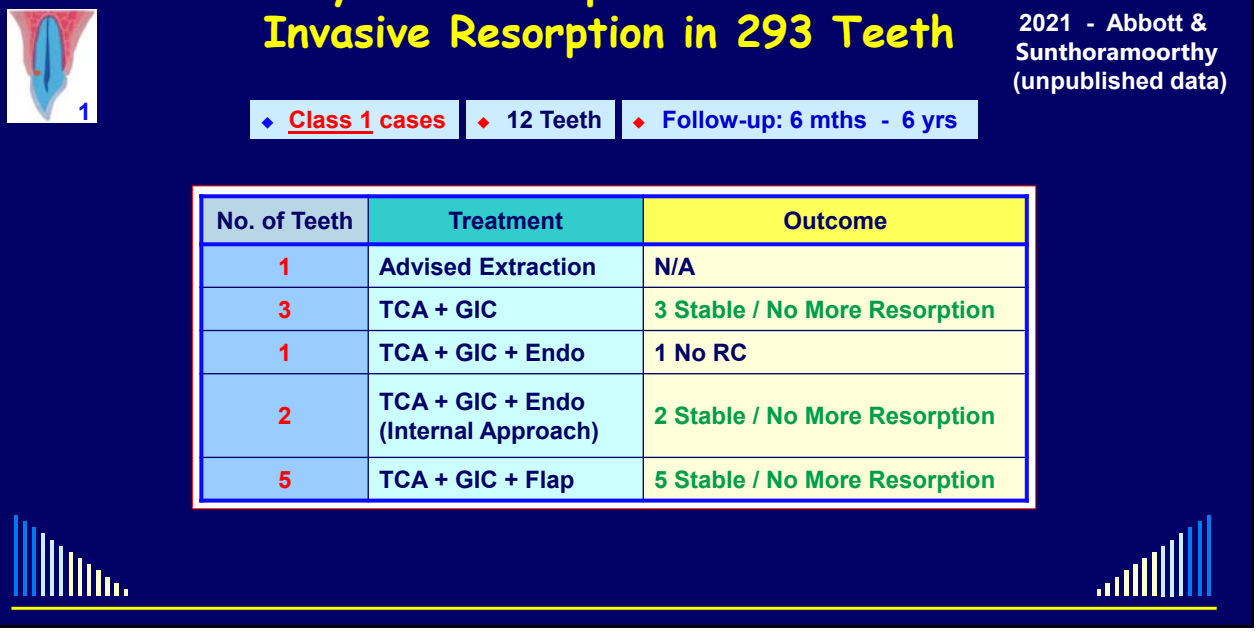
71

External Invasive Resorption

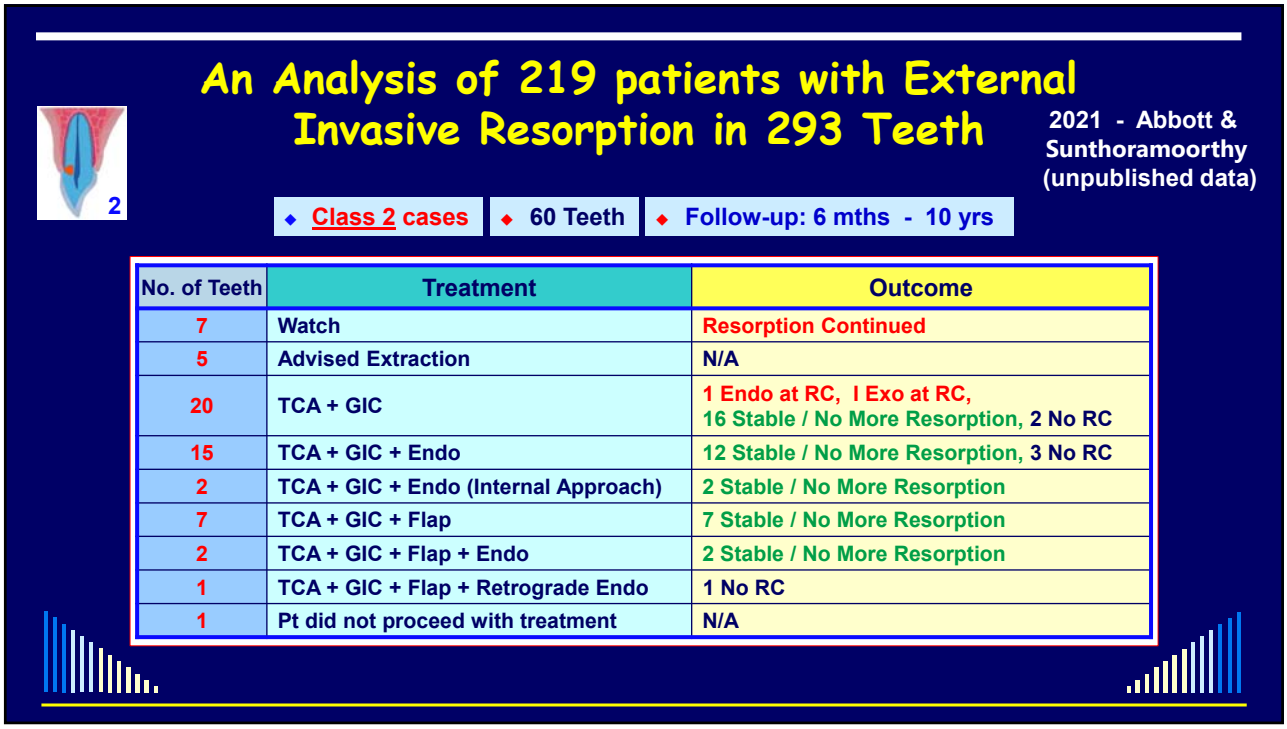


Heithersay 1999

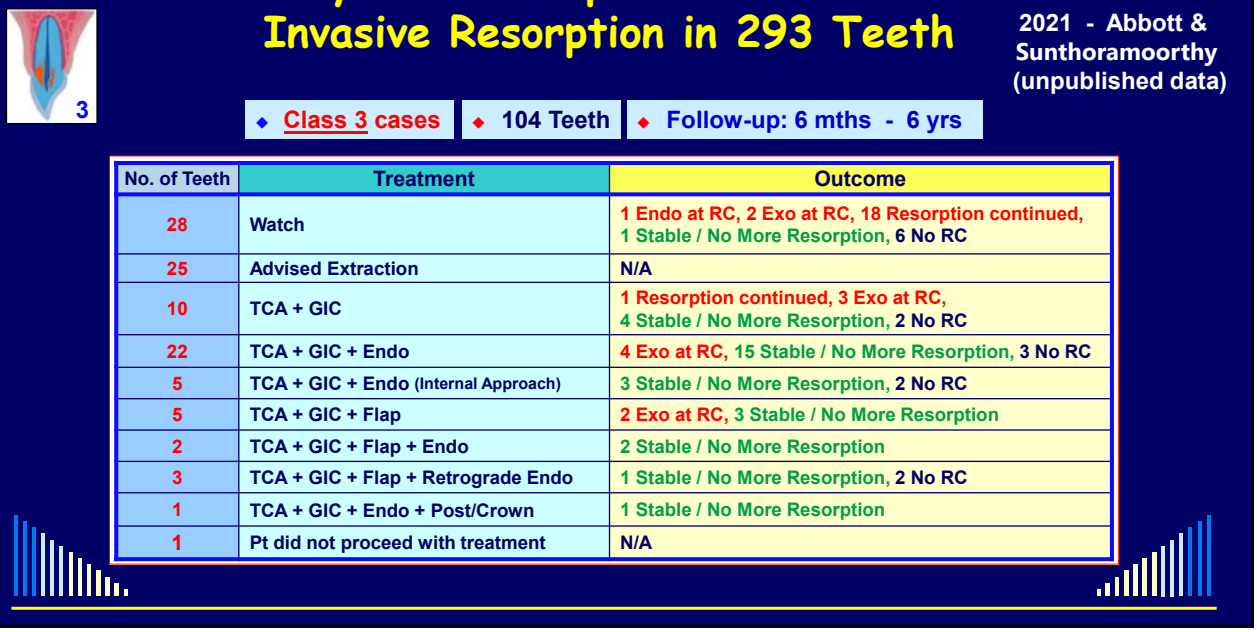
72


An Analysis of 219 patients with External Invasive Resorption in 293 Teeth
2021 - Abbott & Sunthoramoorthy (unpublished data)
1
Class 1 cases
12 Teeth
Follow-up: 6 mths - 6 yrs
No. of Teeth | Treatment | Outcome
1 | Advised Extraction | N/A
3 | TCA + GIC | 3 Stable / No More Resorption
1 | TCA + GIC + Endo | 1 No RC
2 | TCA + GIC + Endo (Internal Approach) | 2 Stable / No More Resorption
5 | TCA + GIC + Flap | 5 Stable / No More Resorption

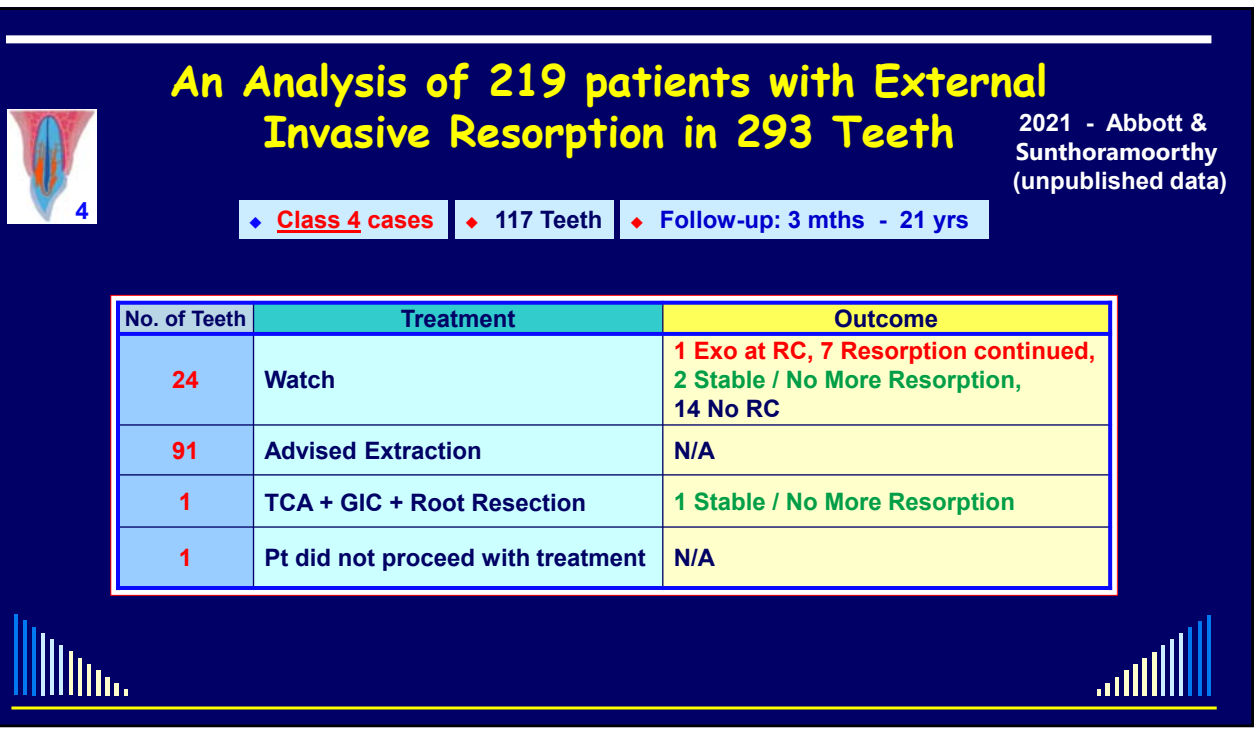
73


An Analysis of 219 patients with External Invasive Resorption in 293 Teeth
2021 - Abbott & Sunthoramoorthy (unpublished data)
2
Class 2 cases
60 Teeth
Follow-up: 6 mths - 10 yrs
No. of Teeth | Treatment | Outcome
7 | Watch | Resorption Continued
5 | Advised Extraction | N/A
20 | TCA + GIC | 1 Endo at RC, I Exo at RC, 16 Stable / No More Resorption, 2 No RC
15 | TCA + GIC + Endo | 12 Stable / No More Resorption, 3 No RC
2 | TCA + GIC + Endo (Internal Approach) | 2 Stable / No More Resorption
7 | TCA + GIC + Flap | 7 Stable / No More Resorption
2 | TCA + GIC + Flap + Endo | 2 Stable / No More Resorption
1 | TCA + GIC + Flap + Retrograde Endo | 1 No RC
1 | Pt did not proceed with treatment | N/A

74


An Analysis of 219 patients with External Invasive Resorption in 293 Teeth
2021 - Abbott & Sunthoramoorthy (unpublished data)
3
Class 3 cases
104 Teeth
Follow-up: 6 mths - 6 yrs
No. of Teeth | Treatment | Outcome
28 | Watch | 1 Endo at RC, 2 Exo at RC, 18 Resorption continued, 1 Stable / No More Resorption, 6 No RC
25 | Advised Extraction | N/A
10 | TCA + GIC | 1 Resorption continued, 3 Exo at RC, 4 Stable / No More Resorption, 2 No RC
22 | TCA + GIC + Endo | 4 Exo at RC, 15 Stable / No More Resorption, 3 No RC
5 | TCA + GIC + Endo (Internal Approach) | 3 Stable / No More Resorption, 2 No RC
5 | TCA + GIC + Flap | 2 Exo at RC, 3 Stable / No More Resorption
2 | TCA + GIC + Flap + Endo | 2 Stable / No More Resorption
3 | TCA + GIC + Flap + Retrograde Endo | 1 Stable / No More Resorption, 2 No RC
1 | TCA + GIC + Endo + Post/Crown | 1 Stable / No More Resorption
1 | Pt did not proceed with treatment | N/A

75


An Analysis of 219 patients with External Invasive Resorption in 293 Teeth
2021 - Abbott & Sunthoramoorthy (unpublished data)
4
Class 4 cases
117 Teeth
Follow-up: 3 mths - 21 yrs
No. of Teeth | Treatment | Outcome
24 | Watch | 1 Exo at RC, 7 Resorption continued, 2 Stable / No More Resorption, 14 No RC
91 | Advised Extraction | N/A
1 | TCA + GIC + Root Resection | 1 Stable / No More Resorption
1 | Pt did not proceed with treatment | N/A

76

An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

2021 - Abbott & Sunthoramoorthy (unpublished data)

◆ ALL cases ◆ 293 Teeth ◆ No. Needing Root Canal Treatment

Class	No. of Teeth	No. Treated for Invasive Resorption	No. that Required Root Canal Treatment	No. Treated via an Internal Approach	% of Teeth that had Root Canal Treatment
1	12	11	1	2	27 %
2	60	47	20	2	47 %
3	104	48	33	5	69 %

77

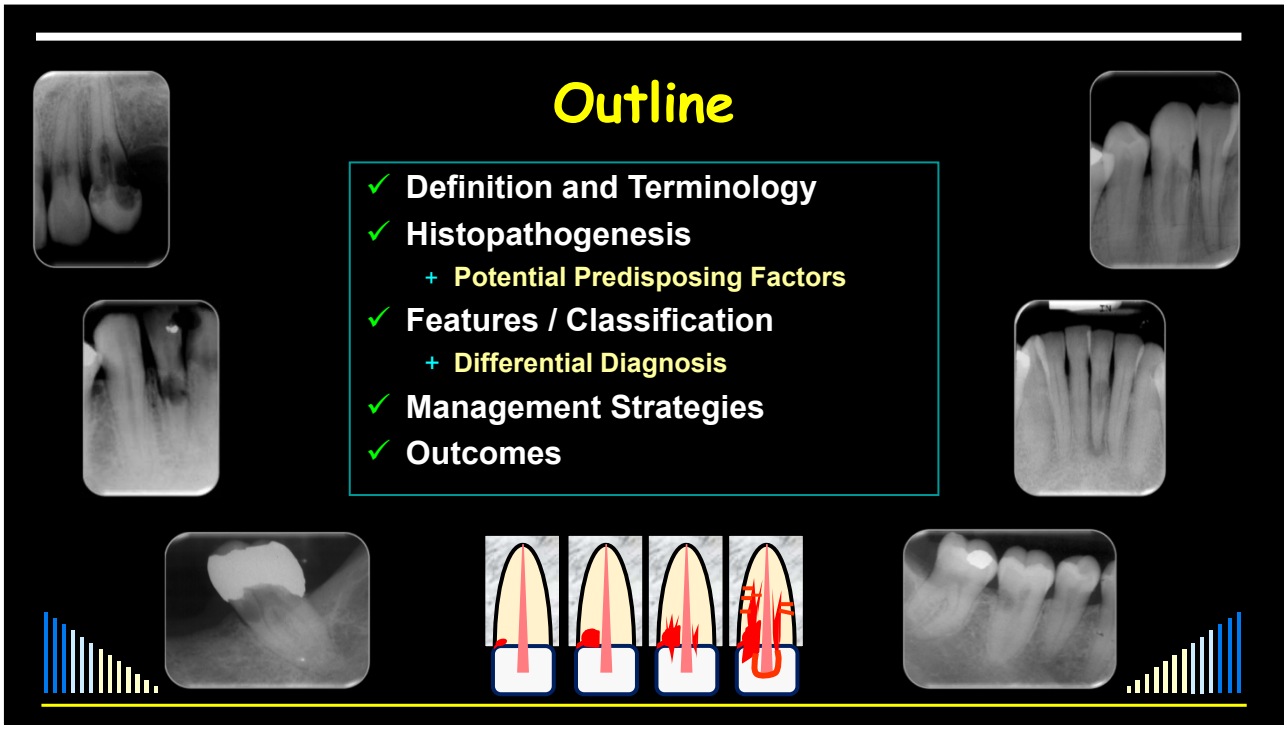
An Analysis of 219 patients with External Invasive Resorption in 293 Teeth

2021 - Abbott & Sunthoramoorthy (unpublished data)

◆ ALL cases ◆ 293 Teeth ◆ Follow-up: 3 mths - 21 yrs

Class	No. of Teeth	Advised Extraction	Advised Watch	Treated Resorption	Resorption Control With TCA Treatment	Resorption Continued After Treatment	No Recall / Unknown Result
1	12	1 (8%)	0	11 (92%)	10 (91%)	0	1 (1%)
2	60	5 (8%)	7 (12%)	47 (78%)	39 (83%)	4 (9%)	7 (15%)
3	104	20 (19%)	28 (27%)	48 (46%)	30 (63%)	10 (21%)	15 (31%)
4	117	91 (78%)	24 (21%)	1 (0.8%)	1 (100%)	0	0

78


Outline
✓ Definition and Terminology
✓ Histopathogenesis
+ Potential Predisposing Factors
✓ Features / Classification
+ Differential Diagnosis
✓ Management Strategies
✓ Outcomes

79