Internal Bleaching of Discoloured Teeth

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Aesthetic Considerations in Endodontics - Internal Bleaching

Abbott PV.

***Pract Perio & Aesth Dent* 1997; 9: 833-42.**


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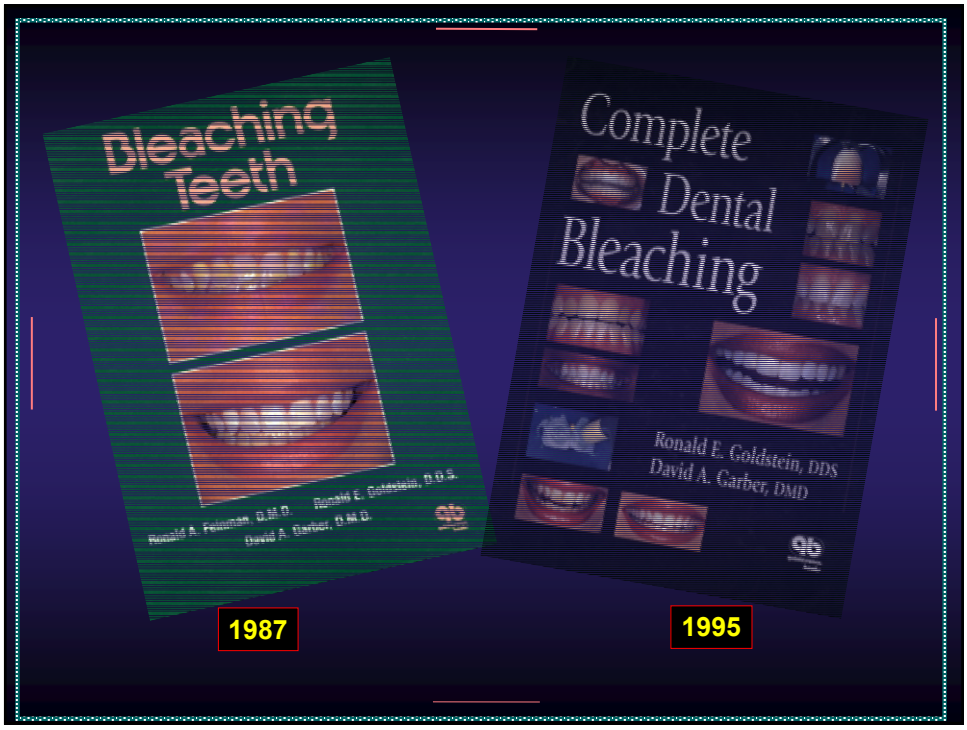
Bleaching Teeth
1987
Complete Dental Bleaching
Ronald E. Goldstein, DDS
David A. Garber, DMD
1995

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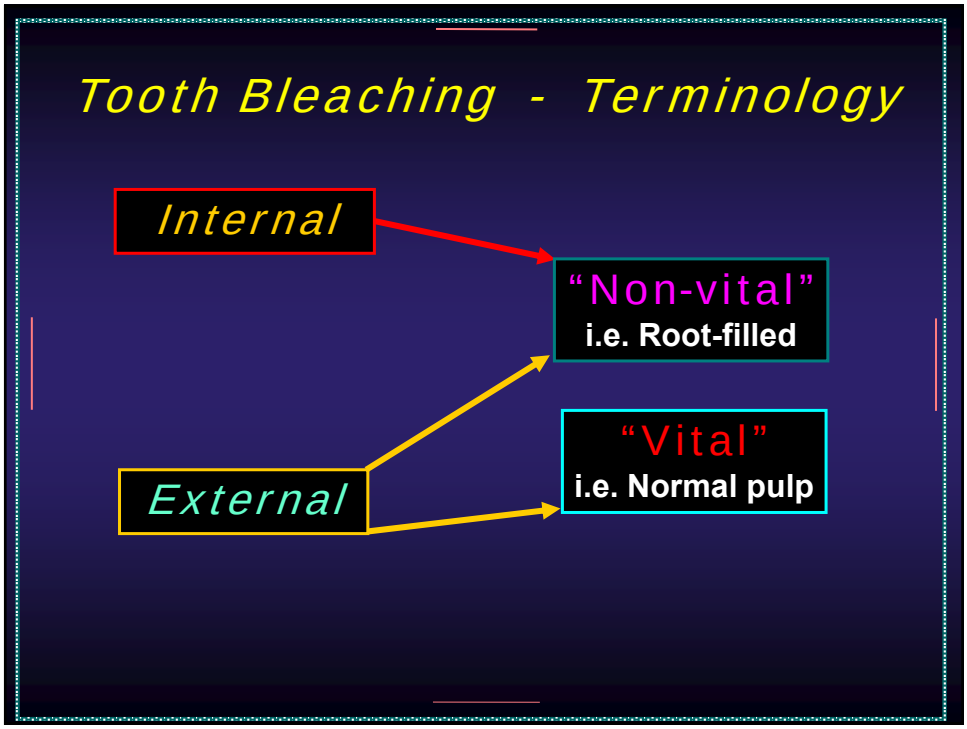
Tooth Bleaching - Terminology
Internal
"Non-vital"
i.e. Root-filled
"Vital"
i.e. Normal pulp
External

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Tooth Stains

- Extrinsic
- Intrinsic

- *Essential to determine the cause of the discolouration prior to treatment*

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Extrinsic Tooth Discolourations

- Cigarettes, pipes, cigars, chewing tobacco - yellowish-brown to black
- Marijuana - dark brown to black rings
- Coffee, tea, foods - brown to black
- Poor oral hygiene - various colours
- Fluorosis - White, yellow, brown, grey, and/or black

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Intrinsic Tooth Discolourations

- Genetic conditions
  - Amelogenesis imperfecta - brown, black
- Systemic Conditions
  - Jaundice - blue-green or brown
  - Porphyria - purplish-brown

- Medications during tooth development
  - Tetracyclines, fluoride - many colours
- Body by-products
  - Bilirubin - blue-green or brown
  - Haemoglobin - grey, black

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Intrinsic Tooth Discolourations

- Pulp changes
  - Pulp canal calcification (PCC)
    - Increased dentine thickness - yellow
  - Pulp necrosis (PN)
    - With haemorrhage - grey, black
      - Release of haemoglobin and iron - e.g. trauma
    - No haemorrhage - grey-brown
      - Protein degradation products

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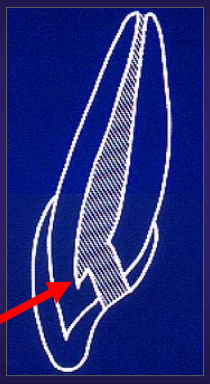
Intrinsic Tooth Discolourations

- Iatrogenic causes
  - Trauma during pulp removal
  - Pulp tissue remnants in pulp chamber



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Intrinsic Tooth Discolourations

- Iatrogenic causes
  - Trauma during pulp removal
  - Pulp tissue remnants in pulp chamber
  - Restorative materials
    - Amalgam, composite, gold, pins, etc
      - If marginal breakdown

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Intrinsic Tooth Discolourations
Iatrogenic causes
Endodontic materials
Medicaments, sealers, temp. fillings, etc.

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Intrinsic Tooth Discolourations
Iatrogenic causes
#5
Endodontic materials
Medicaments, sealers, temp. fillings, etc.

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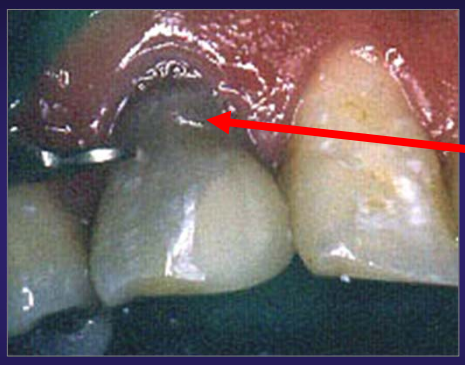
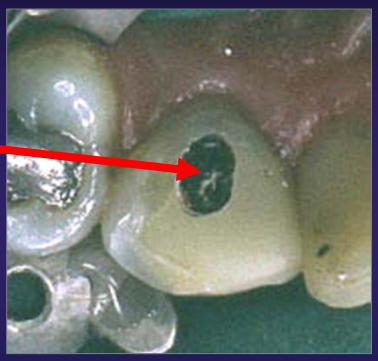
Intrinsic Tooth Discolourations





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Intrinsic Tooth Discolourations

- Iatrogenic causes
  - Trauma during pulp removal
  - Pulp tissue remnants in pulp chamber
  - Restorative materials
    - Amalgam, composite, gold, pins, etc
      - If marginal breakdown
  - Endodontic materials
    - Medicaments, sealers, temp. fillings, etc.
- All usually brown, grey or black

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Extrinsic and Intrinsic Discolouration

- Fluorosis
  - White, yellow, brown, grey, and/or black
    - Often with mottled enamel
- Ageing
  - Yellow
    - Often with added discolouration effects of tooth wear, cracks, restorations, illness, etc

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Management of Discoloured Teeth

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Management of Discoloured Teeth

- Determine the cause of the discolouration
- This will indicate the treatment approach

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Management of Discoloured Teeth

- Intrinsic stains
- Extrinsic stains

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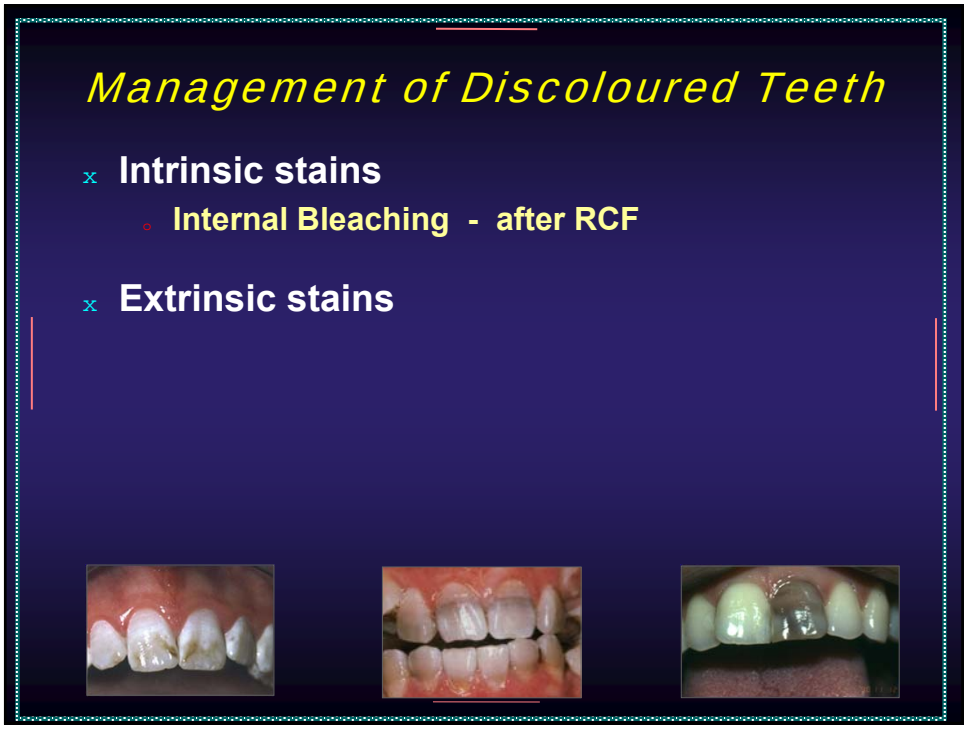
Management of Discoloured Teeth
Intrinsic stains
Internal Bleaching - after RCF
Extrinsic stains

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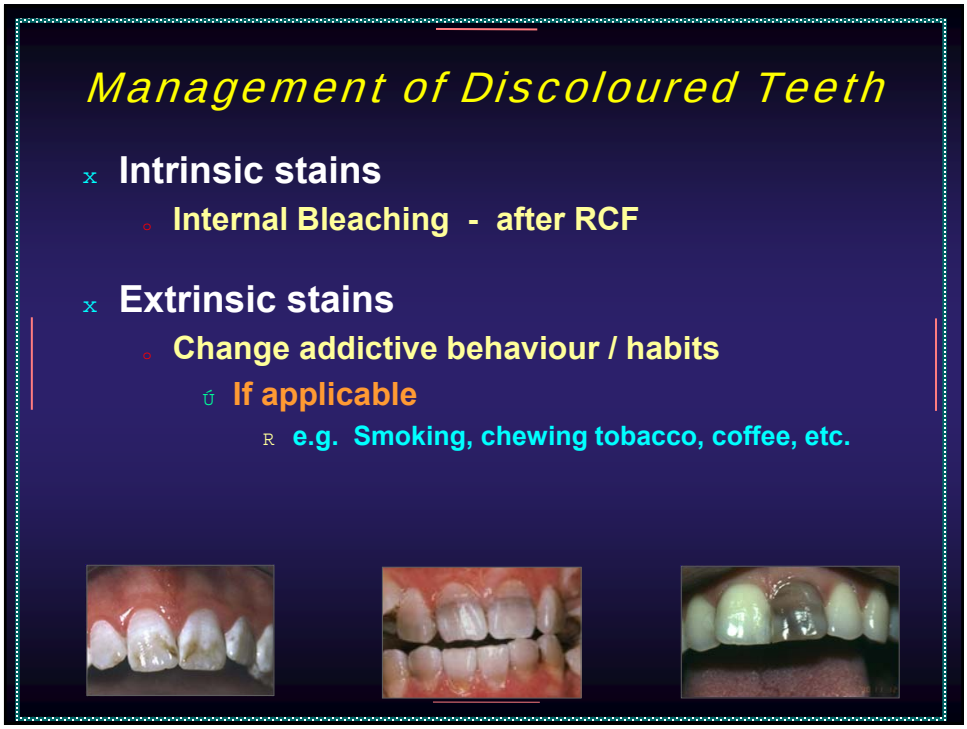
Management of Discoloured Teeth
Intrinsic stains
Internal Bleaching - after RCF
Extrinsic stains
Change addictive behaviour / habits
If applicable
e.g. Smoking, chewing tobacco, coffee, etc.

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Management of Discoloured Teeth

- Intrinsic stains
  - Internal Bleaching - after RCF
- Extrinsic stains
  - Change addictive behaviour / habits
  - Prophylaxis
  - Abrasion - air, ultrasonics, sonics
  - Enamel microabrasion
  - External whitening

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Management of Discoloured Teeth

- Alternatives to bleaching and whitening
  - Labial veneer restorations
    - Porcelain, composite resin

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Management of Discoloured Teeth
Alternatives to bleaching and whitening
Labial veneer restorations
Porcelain, composite resin
Crowns
Porcelain, composite resin, acrylic
BUT: these do not remove the underlying discolouration
∴ The aesthetic result may be compromised

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Management of Discoloured Teeth

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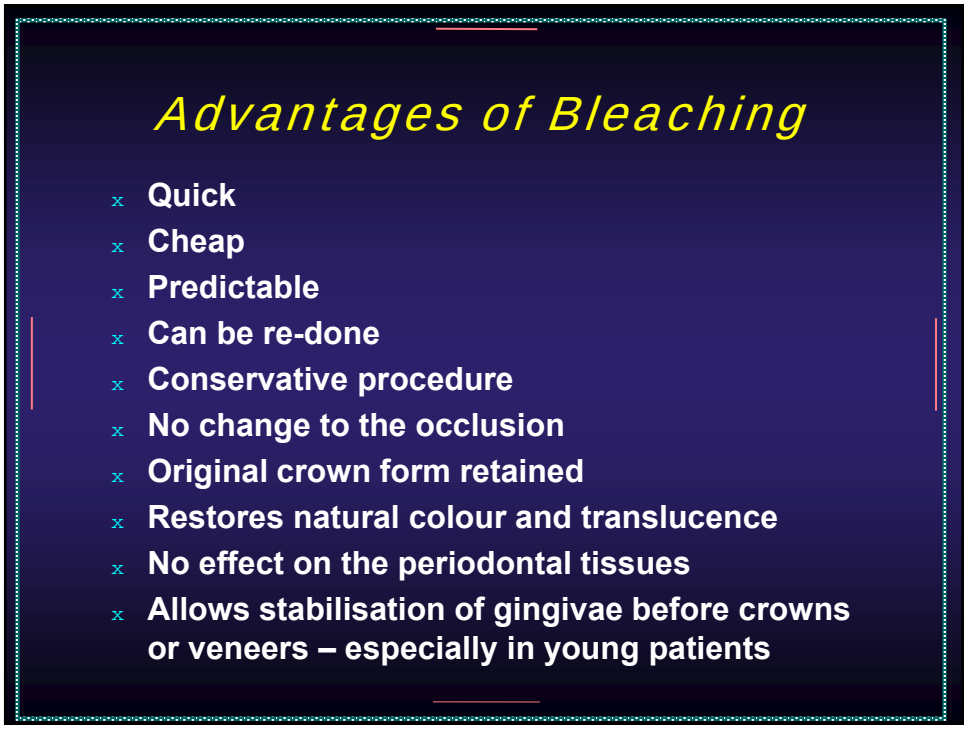
Advantages of Bleaching
Quick
Cheap
Predictable
Can be re-done
Conservative procedure
No change to the occlusion
Original crown form retained
Restores natural colour and translucence
No effect on the periodontal tissues
Allows stabilisation of gingivae before crowns or veneers – especially in young patients

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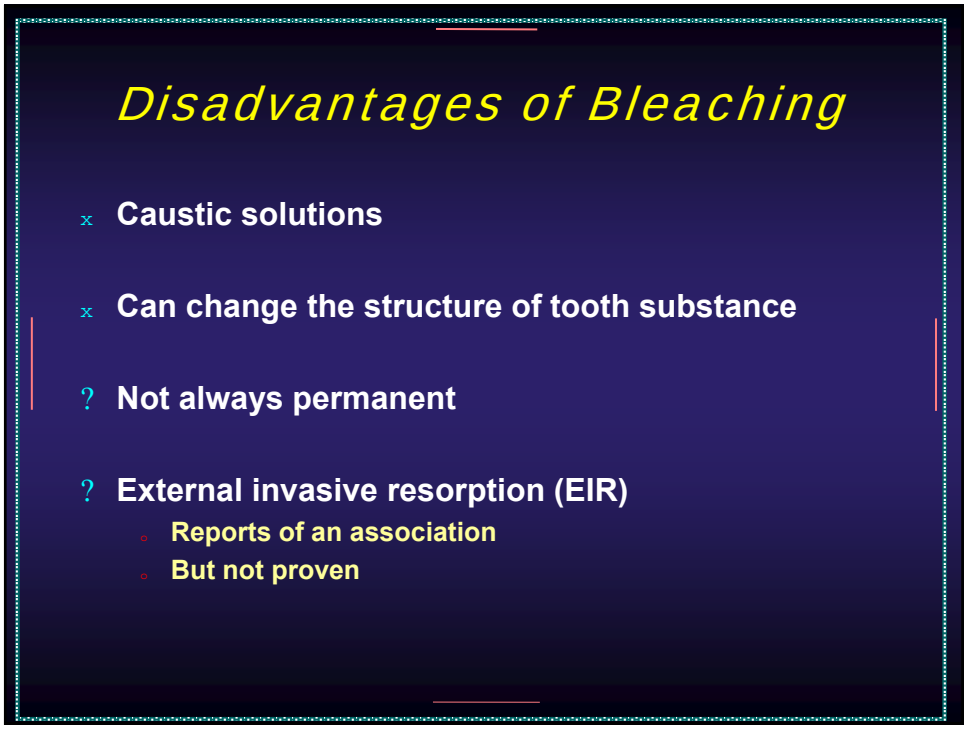
Disadvantages of Bleaching
Caustic solutions
Can change the structure of tooth substance
Not always permanent
External invasive resorption (EIR)
Reports of an association
But not proven

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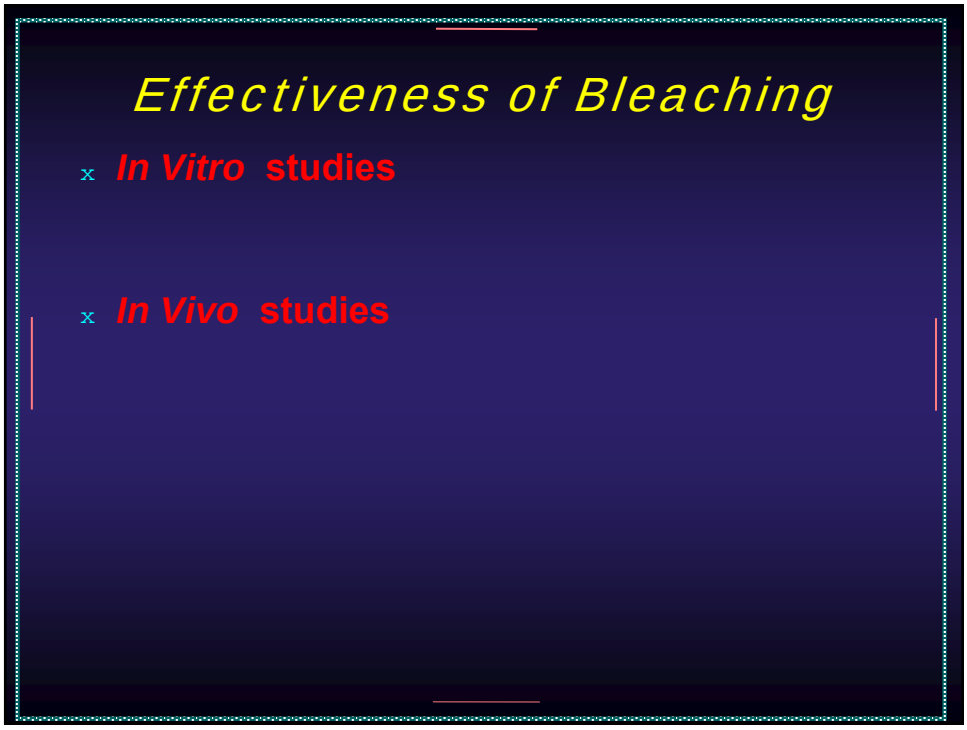
Effectiveness of Bleaching
In Vitro studies
In Vivo studies

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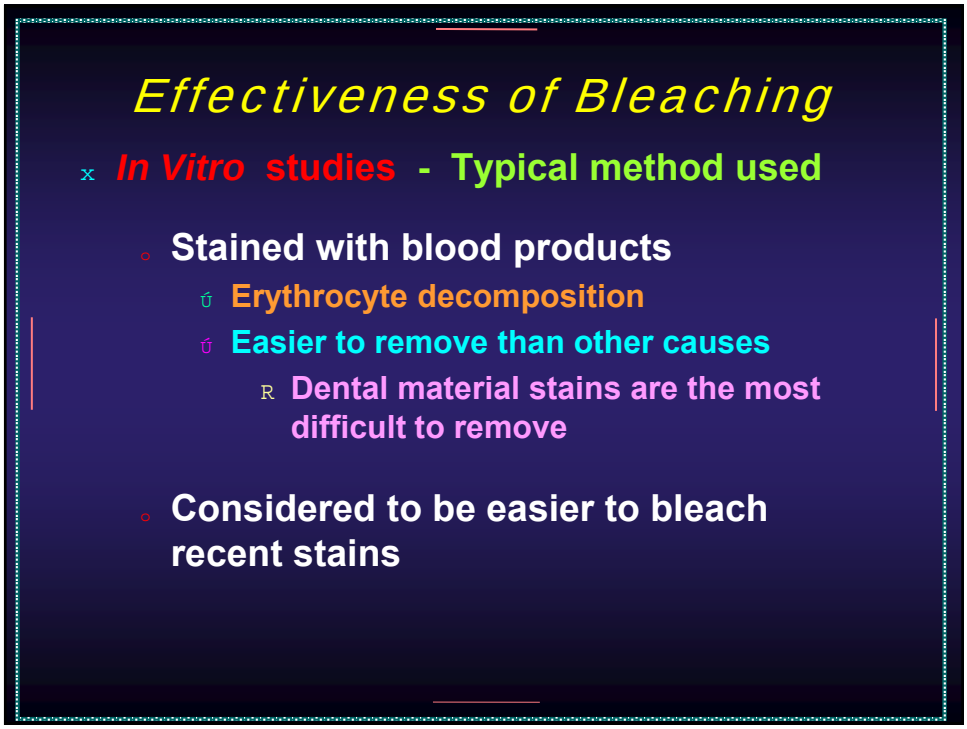
Effectiveness of Bleaching
In Vitro studies - Typical method used
Stained with blood products
Erythrocyte decomposition
Easier to remove than other causes
Dental material stains are the most difficult to remove
Considered to be easier to bleach recent stains

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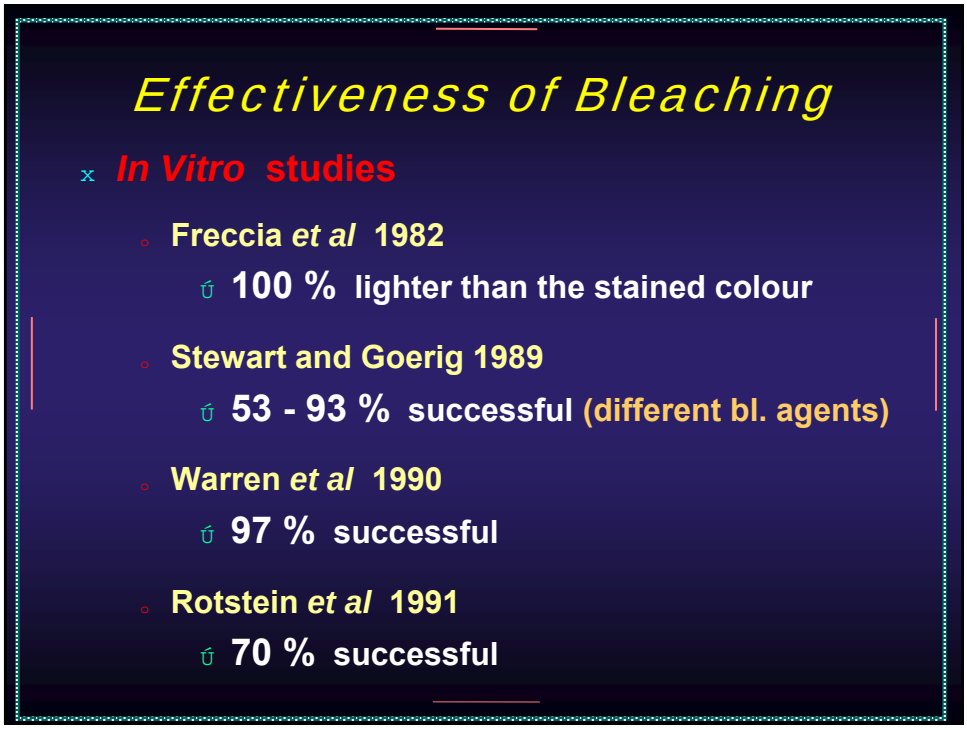
Effectiveness of Bleaching
In Vitro studies
Freccia et al 1982
100 % lighter than the stained colour
Stewart and Goerig 1989
53 - 93 % successful (different bl. agents)
Warren et al 1990
97 % successful
Rotstein et al 1991
70 % successful

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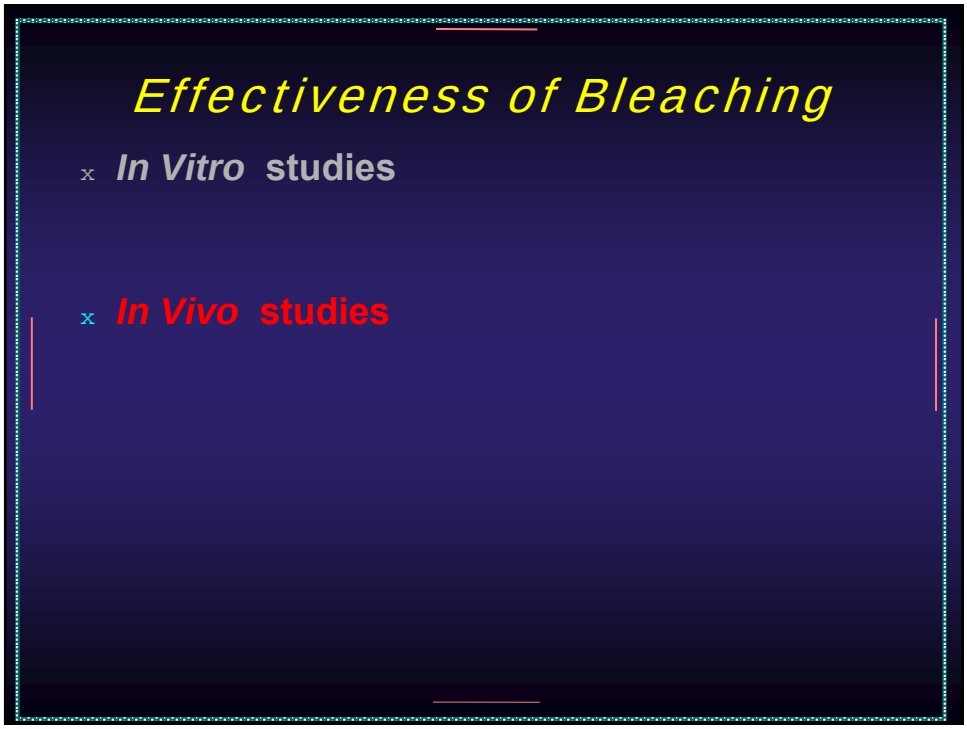
Effectiveness of Bleaching
In Vitro studies
In Vivo studies

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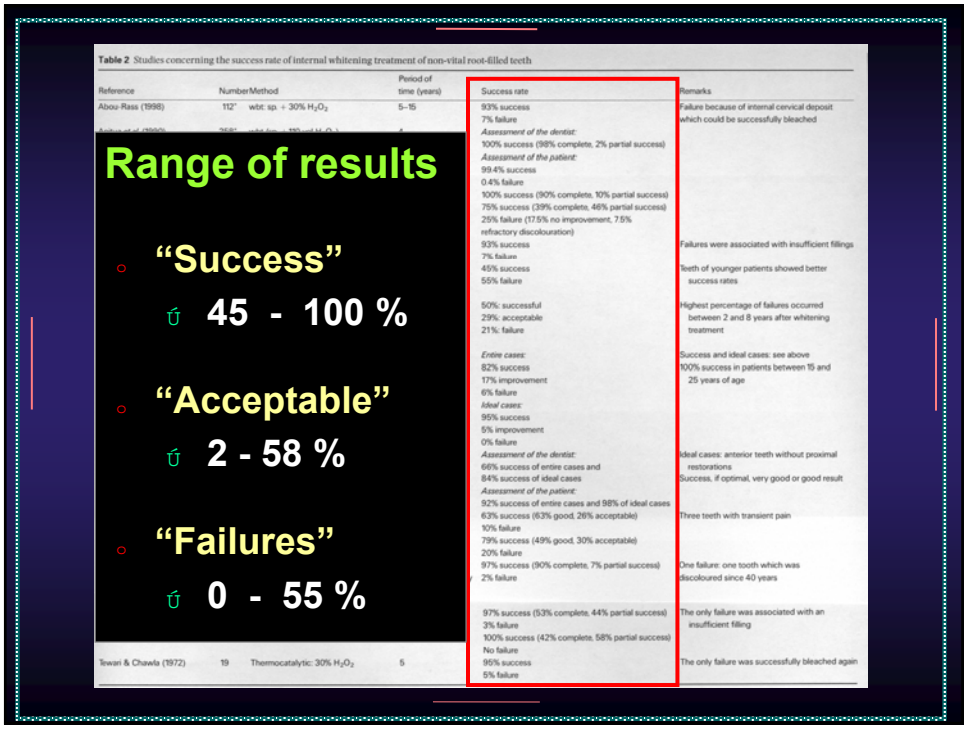

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Effectiveness of Bleaching

- ***In Vivo* studies - Some typical examples**
  - **Brown 1965**
    - **82.5 % “responded”**
  - **Howell 1980**
    - **90.3 % satisfactory**
    - **2.4 % no change**
    - **7.3 % “considerable improvement”**

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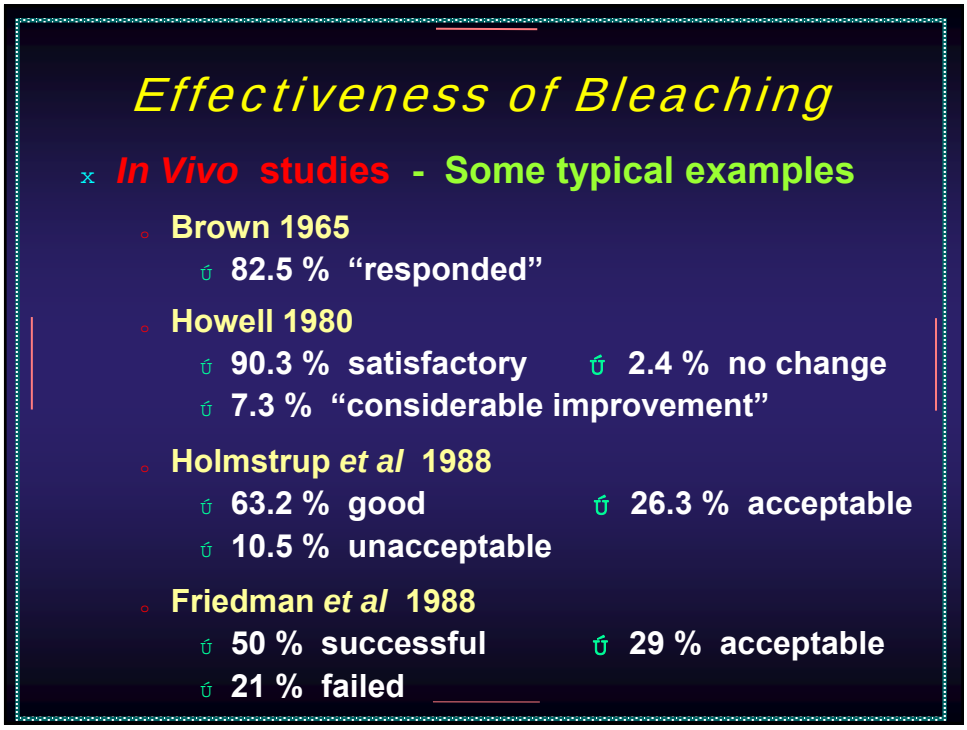
Effectiveness of Bleaching
In Vivo studies - Some typical examples
Brown 1965
82.5 % "responded"
Howell 1980
90.3 % satisfactory
2.4 % no change
7.3 % "considerable improvement"
Holmstrup et al 1988
63.2 % good
26.3 % acceptable
10.5 % unacceptable
Friedman et al 1988
50 % successful
29 % acceptable
21 % failed

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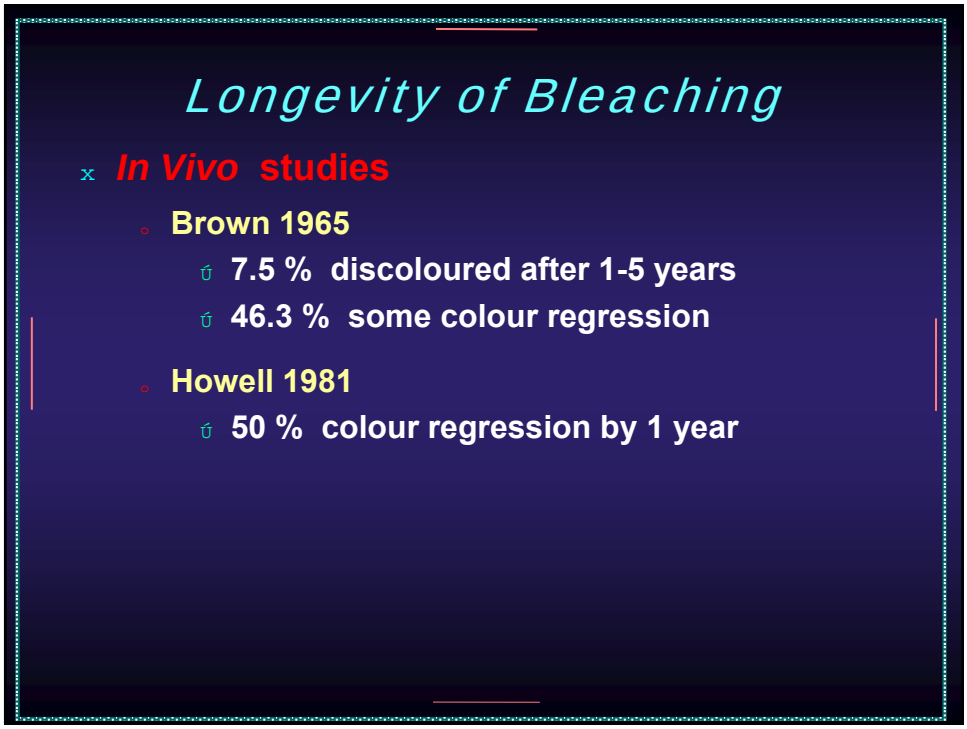
Longevity of Bleaching
In Vivo studies
Brown 1965
7.5 % discoloured after 1-5 years
46.3 % some colour regression
Howell 1981
50 % colour regression by 1 year

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Longevity of Bleaching

- *In Vivo* studies
  - Brown 1965
    - 7.5 % discoloured after 1-5 years
    - 46.3 % some colour regression
  - Howell 1981
    - 50 % colour regression by 1 year
  - Feiglin 1987
    - 55 % discoloured over 6 years
  - Holmstrup *et al* 1988
    - 20 % discoloured by 3 years

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Discolouration after Bleaching

- Possible reasons (Howell 1981)
  - Break down of restorations
    - Bacteria and their by-products
    - Food, drinks
  - Permeability of tooth
    - Saliva or tissue fluid
    - Food, Drinks
  - Chemical reduction of oxidation products from the bleaching agent - H_2O_2
    - Unlikely to occur: since bleaching is a one way chemical reaction

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The Chemistry of Bleaching

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Bleaching Materials and Methods

- Oxalic acid - 1877
- Hydrogen Peroxide (H_20_2) - 1884
- Electric current - 1895
- Ultraviolet light - 1911
- Intracoronal heat - 1913
- Superoxol + electric light rays - 1918
- Superoxol + Sodium Perborate - 1924
- Sodium Perborate and Water - 1959
- "Walking bleach" - 1963

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Internal Bleaching - Chemistry

- "Walking Bleach" Technique
  - Hydrogen peroxide - H_2O_2
    - Superoxol - 35% H_2O_2
  - Sodium Perborate - $2NaBo_2[OH]_2[nH_2O]$

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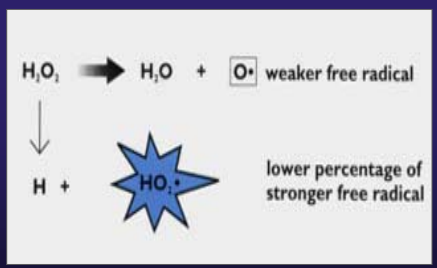
Hydrogen Peroxide - H_2O_2

- An oxidising agent:
  - Produces perhydroxyl and oxygen "free radicals"
    - Highly unstable and very reactive
- Weakly acidic in pure aqueous form:
  - Produces more free oxygen radicals
    - Weaker bleaching agent than the perhydroxyl radical



Goldstein & Garber 1995

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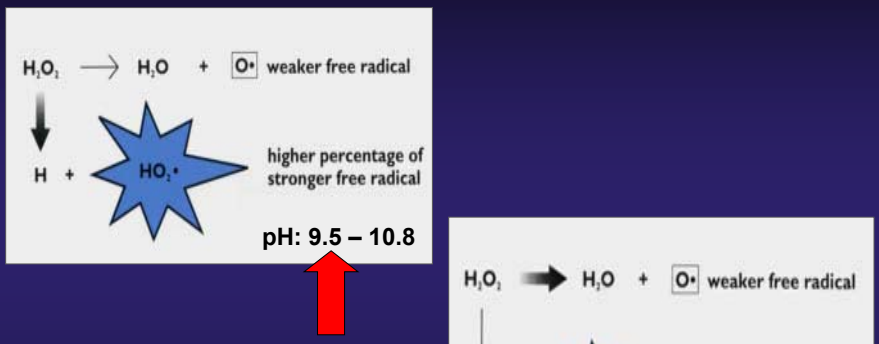
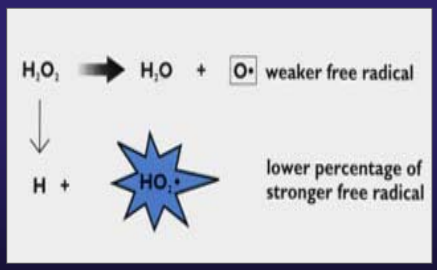
Hydrogen Peroxide - H_2O_2



- BUT at alkaline pH:
  - Greater bleaching effect as more perhydroxyl free radical is released



Goldstein & Garber 1995

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Sodium Perborate - $2NaBo_2[OH]_2[nH_2O]$

- When contact with water:
  - Breaks down to produce H_2O_2 - Approx. 10%

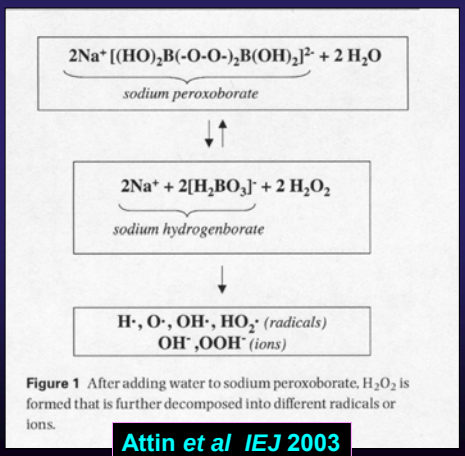

Figure 1 After adding water to sodium peroxoborate, H_2O_2 is formed that is further decomposed into different radicals or ions.

Attin *et al* *IEJ* 2003

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Sodium Perborate - $2NaBo_2[OH]_2[nH_2O]$

- When contact with water:
  - Breaks down to produce H_2O_2 - Approx. 10%
- Has alkaline pH of 10.0
  - ∴ Increases the effectiveness of bleaching if used with H_2O_2

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Internal Bleaching - Chemistry

- Bleaching - an oxidation-reduction reaction
- Agent must diffuse through the dentine
- Free radicals attack organic molecules
  - Break unsaturated bonds to create simpler molecules
    - Š Less absorption energy
      - ∴ Less light reflected
        - å Produces a whitening effect

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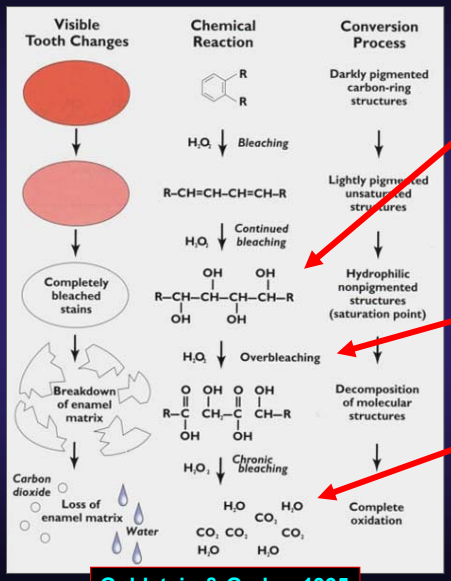
Internal Bleaching - Chemistry



Goldstein & Garber 1995

- Has a "saturation point"
  - Lightening effect slows dramatically
- Breaks down proteins & carbon-containing molecules
  - Increases brittleness and porosity
- If continued - converts dentine & enamel to CO_2 and H_2O
- ***ESSENTIAL to Know When to Stop !!!***

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An *in vitro* comparison of different bleaching agents in the discoloured tooth

Ho S, Goerig AC.

***J Endod* 1989; 15: 106**

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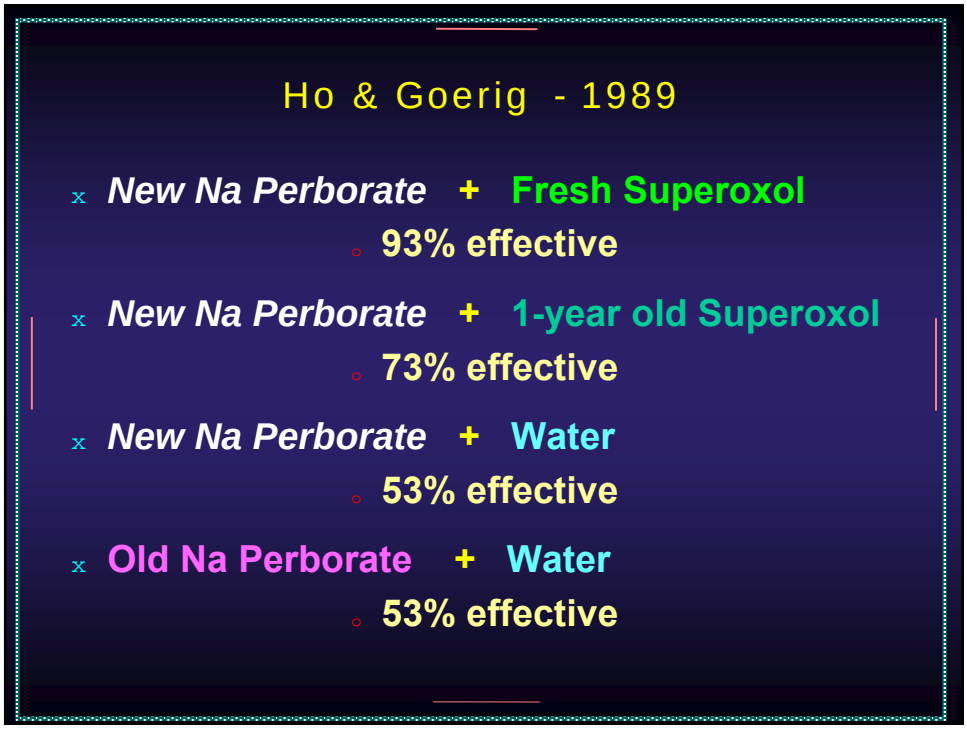
Ho & Goerig - 1989
New Na Perborate + Fresh Superoxol
93% effective
New Na Perborate + 1-year old Superoxol
73% effective
New Na Perborate + Water
53% effective
Old Na Perborate + Water
53% effective

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Ho & Goerig - 1989
New Na Perborate + Fresh Superoxol
93% effective
Recommendations:
Na Perborate - avoid moisture contamination
H_2O_2 - Use a fresh solution
- Replace supply every 6 months: track dates
- Buy a small jar only: 25 mls
- Store in brown glass jar with tight lid/seal
- Store in the fridge: cool and dark

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H_2O_2 - Effects on Tooth Structure

- Titley *et al* - *J Endod* 1988; 14: 69-74
  - H_2O_2 produces a precipitate on the enamel surface
  - Acid etch first + then H_2O_2
    - More precipitate and a more porous enamel surface
- Titley *et al* - *EDT* 1988; 4: 32-6
  - H_2O_2 leaves an amorphous precipitate on dentine
  - Acid etch first + then H_2O_2
    - Less precipitate and more tubules open

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H_2O_2 - Effects on Tooth Structure

- Adibfar *et al* - *J Endod* 1992; 18; 488-91
  - Peroxide is absorbed by both enamel and dentine during bleaching
  - Leaches out if left in water for a long time
  - Can not remove just by rinsing

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H_2O_2 - Effects on Bonding Materials

- Titley *et al* - *EDT* 1989; 5: 132-8
  - Highly significant reduction in bond strength of GIC to dentine after treatment with H_2O_2
- Titley *et al* - *J Dent Res* 1988; 67: 1523-8
  - Highly significant reduction in bond strength of composite to enamel treated with H_2O_2

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H_2O_2 - Effects on Bonding Materials

- Torneck *et al* - *EDT* 1990; 6: 97-103
  - No measurable adhesion of composite to dentine treated with H_2O_2
    - A highly significant difference in bond strength of composite resin to untreated dentine
  - Bond failure was cohesive AND adhesive
    - Suggests H_2O_2 affects setting of bonding resin AND its adhesion to filled resin

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H_2O_2 - Effects on Bonding Materials

- Torneck *et al* - *J Endod* 1991; 17: 156-60
  - Water immersion for 7 days
    - Eliminated the reduction in bond strength for composite to peroxide treated enamel
    - Significantly higher bond strength for peroxide-treated enamel compared to saline-treated enamel
      - Possibly due to improved surface conditioning or cleansing action by the peroxide
  - Saliva may have similar effect to water, but possibly slower

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Clinical Recommendations

- After internal bleaching:
  - Delay restoration of the access cavity and replacement of other restorations
    - For a minimum of 14 days
      - Fill the entire access cavity with Cavit (with NO cotton pellet) for this time
- After external bleaching:
  - Delay all restorations for at least 14 days

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Disadvantages of Bleaching

- x Caustic solutions
- x Can change the structure of tooth substance
- ? Not always permanent
- ? External invasive resorption (EIR)
  - Reports of an association
  - But not proven

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External Invasive Resorption

- x Harrington & Natkin 1979
  - Reported 7 cases with EIR

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External Invasive Resorption

- Harrington & Natkin 1979
  - Reported 7 cases with EIR
- Lado *et al* 1983 - 1 case
- Montgomery 1984 - 1 case
- Cvek & Lindvall 1985 - 11 cases
- Friedman *et al* 1988
  - 4 cases out of 58
    - å 7%

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External Invasive Resorption

- Total 36 cases reported 1979 – 2003
  - *But how many teeth have been bleached ??*
    - Probably millions!!
- Clinical studies: Total 701 teeth
  - 8 cases of EIR (1.1%)
  - Slightly higher than the population estimate of 0.02% - Heithersay 1999

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Possible Factors / Mechanisms

- Trauma
- Base over RCF
- Level of RCF removed
- Heat used in bleaching
- Chemical burn from O_2 and H_2O_2
  - Cause coagulation and inflammation
  - May lead to necrosis of p.d.l.
- Cementum defect

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External Invasive Resorption

- Total 36 cases reported
  - 10 teeth
    - No details reported of the bleaching process
  - The other 26:
    - None had cervical seal / base over RCF
    - All had H_2O_2
    - 24 also had Na Perborate

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External Invasive Resorption

- Total 36 cases reported
  - 10 teeth
    - No details reported of the bleaching process
  - The other 26:
    - None had cervical seal / base over RCF
    - All had H_2O_2
    - 24 also had Na Perborate
    - 22 used heat
    - 10 had history of trauma
      - Others - no detail given

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Cervical root resorption following bleaching of endodontically treated teeth

Madison S, Walton R.

J Endod 1990; 16: 570-4

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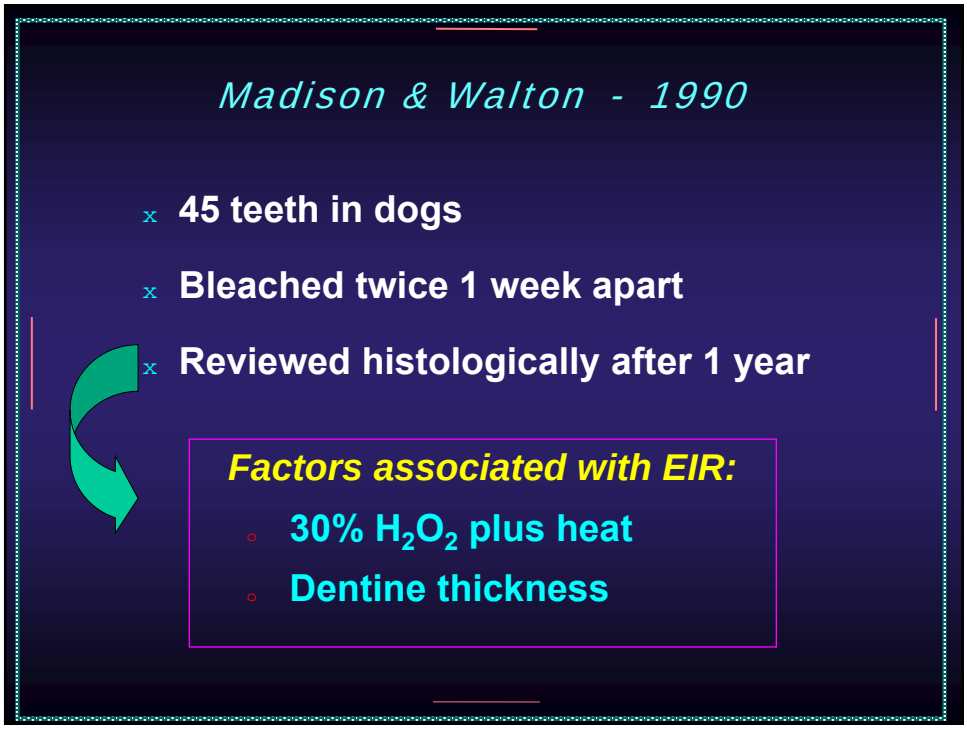
Madison & Walton - 1990
45 teeth in dogs
Bleached twice 1 week apart
Reviewed histologically after 1 year
Factors associated with EIR:
30% H_2O_2 plus heat
Dentine thickness

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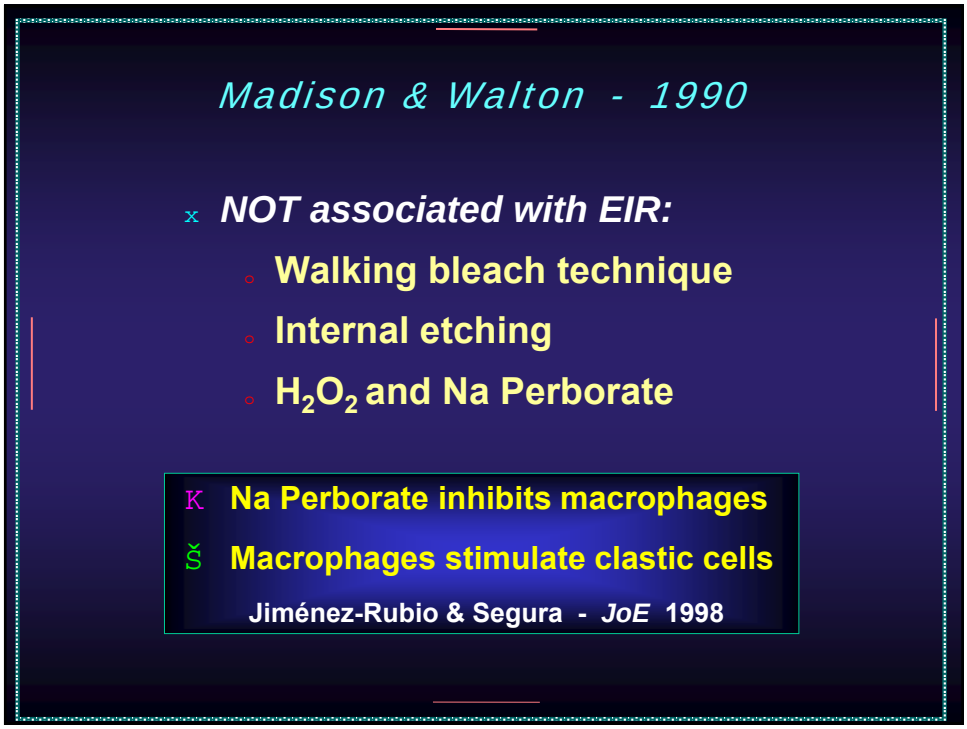
Madison & Walton - 1990
NOT associated with EIR:
Walking bleach technique
Internal etching
H_2O_2 and Na Perborate
Na Perborate inhibits macrophages
Macrophages stimulate clastic cells
Jiménez-Rubio & Segura - JoE 1998

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Possible Factors / Mechanisms

- Trauma
- Base over RCF
- Level of RCF removed
- Heat used in bleaching
- Chemical burn from O_2 and H_2O_2
  - Cause coagulation and inflammation
  - May lead to necrosis of p.d.l.
- **Cementum defect**

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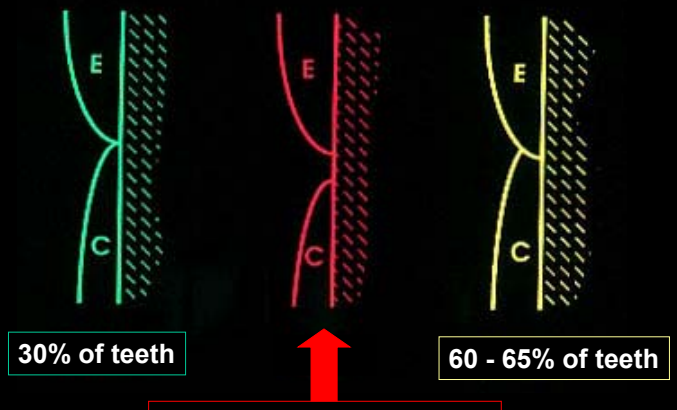
Cemento-Enamel Junction



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Heithersay *et al* - *ADJ* 1994

- 204 teeth reviewed for up to 19 years after internal bleaching
  - 4 teeth (1.9%) had EIR
  - All had luxation injuries
- Concluded:
  - "There is a very low, although positive, risk of EIR after bleaching – *especially if there has been a history of trauma to the tooth*"

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Heithersay - *Quintessence Int* 1999

- 257 teeth with EIR
  - 0.02% of the population
- Assessed for "*potential predisposing factors*"
  - Sole factors
  - Multiple factors

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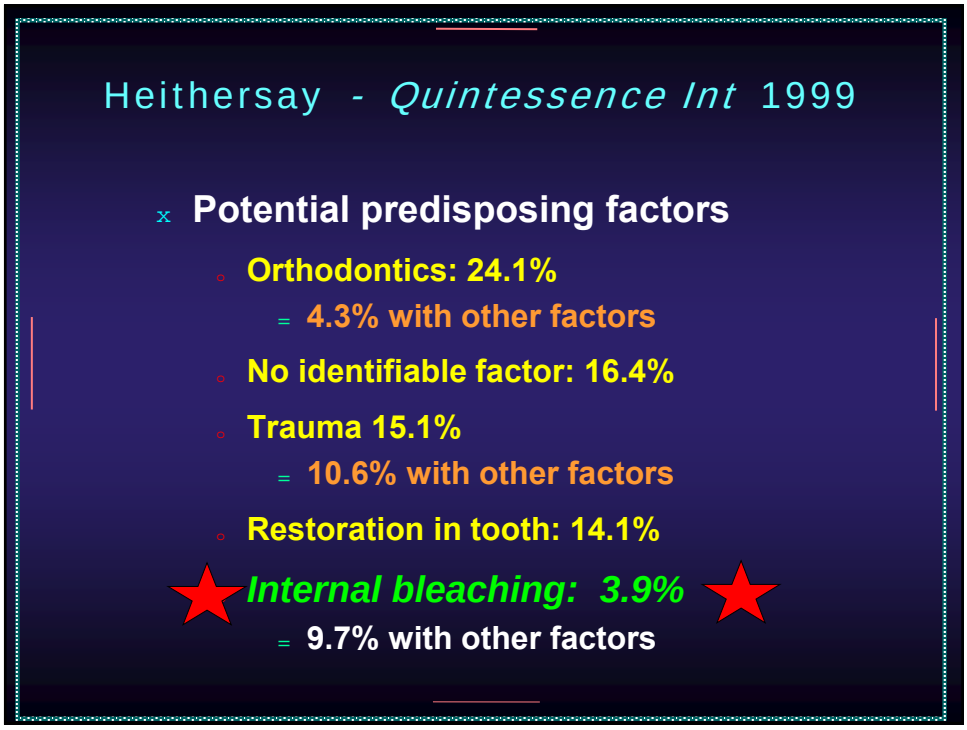
Heithersay - Quintessence Int 1999
Potential predisposing factors
Orthodontics: 24.1%
4.3% with other factors
No identifiable factor: 16.4%
Trauma 15.1%
10.6% with other factors
Restoration in tooth: 14.1%
Internal bleaching: 3.9%
9.7% with other factors

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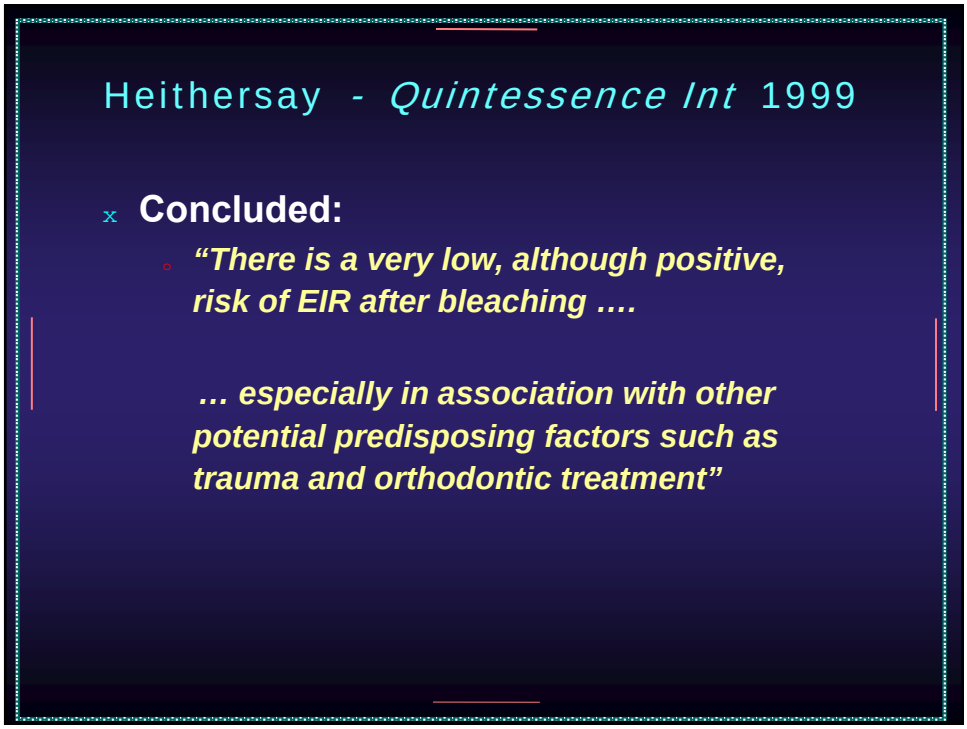
Heithersay - Quintessence Int 1999
Concluded:
"There is a very low, although positive, risk of EIR after bleaching ....
... especially in association with other potential predisposing factors such as trauma and orthodontic treatment"

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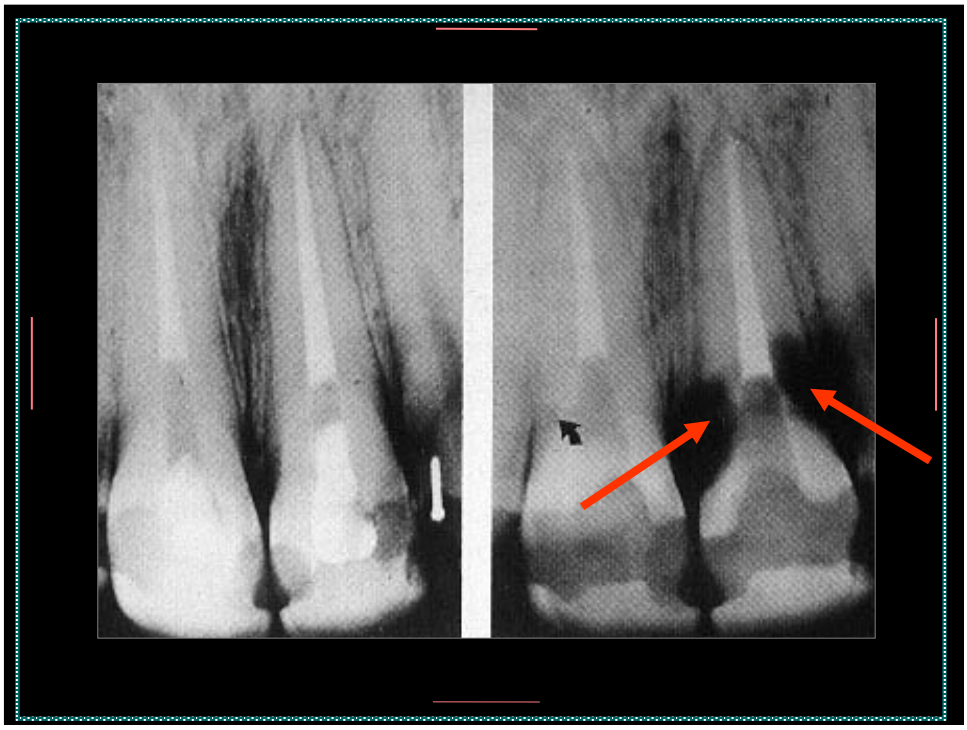

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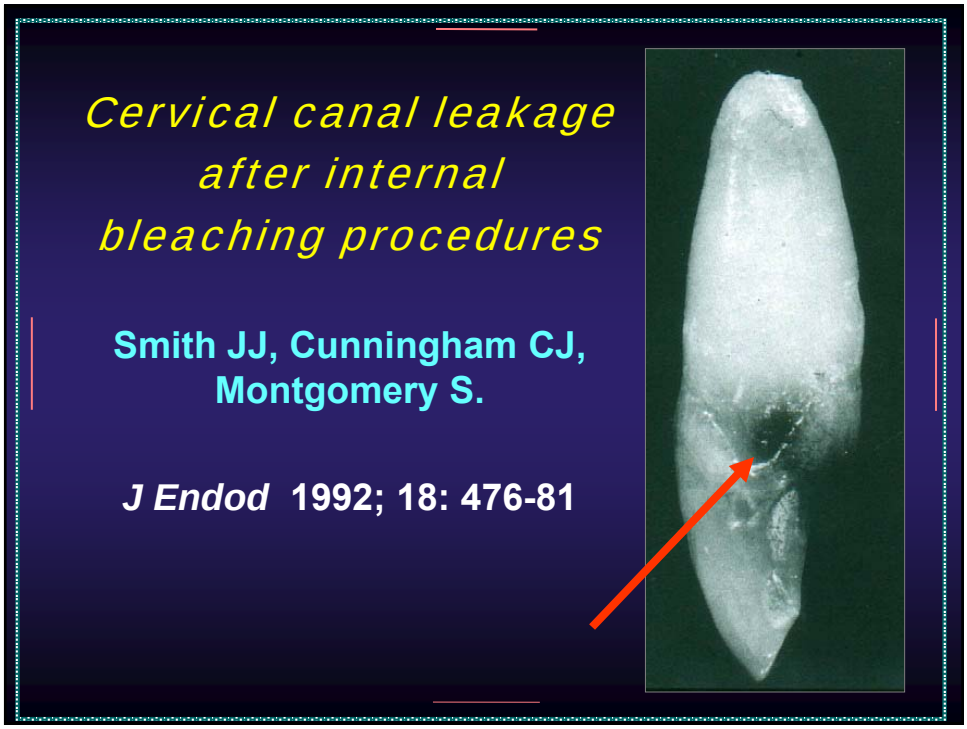
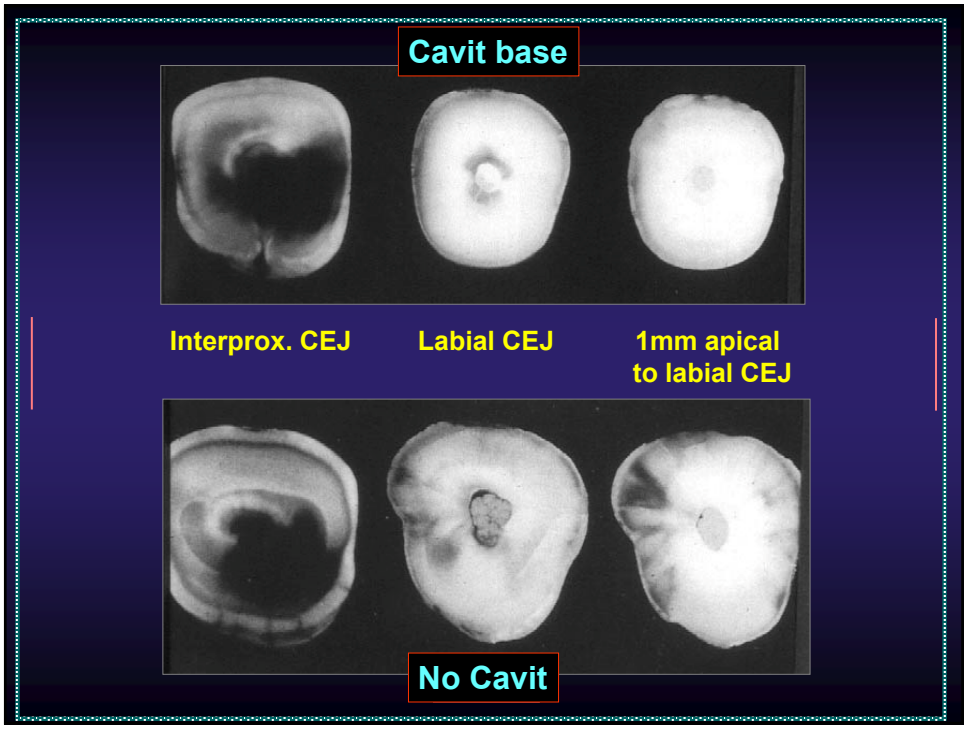

Cervical canal leakage after internal bleaching procedures
Smith JJ, Cunningham CJ, Montgomery S.
J Endod 1992; 18: 476-81

72



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Conclusions - Smith *et al* 1992

- 2mm Cavit base was sufficient to dentinal penetration of the dye
- Cavit should be placed slightly coronal to labial CEJ
- Cemental defects – greater dye penetration in areas of defects

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An *in vitro* comparison of bleaching agents on the crowns and roots of discoloured teeth

Warren MA, Wong M, Ingram TA.

***J Endod* 1990; 16: 463-7**

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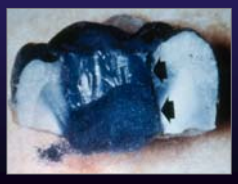
Warren *et al* - 1990

- **IRM base at CEJ or 2mm below CEJ**
  - **No difference in bleaching result**
- **BUT - also bleached some of the tooth root**
  - **Effectiveness of IRM "seal" against liquid penetration is very questionable**



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RECOMMENDED to cover root canal filling with 2mm Cavit before bleaching

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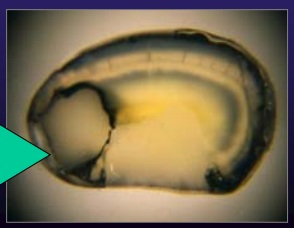
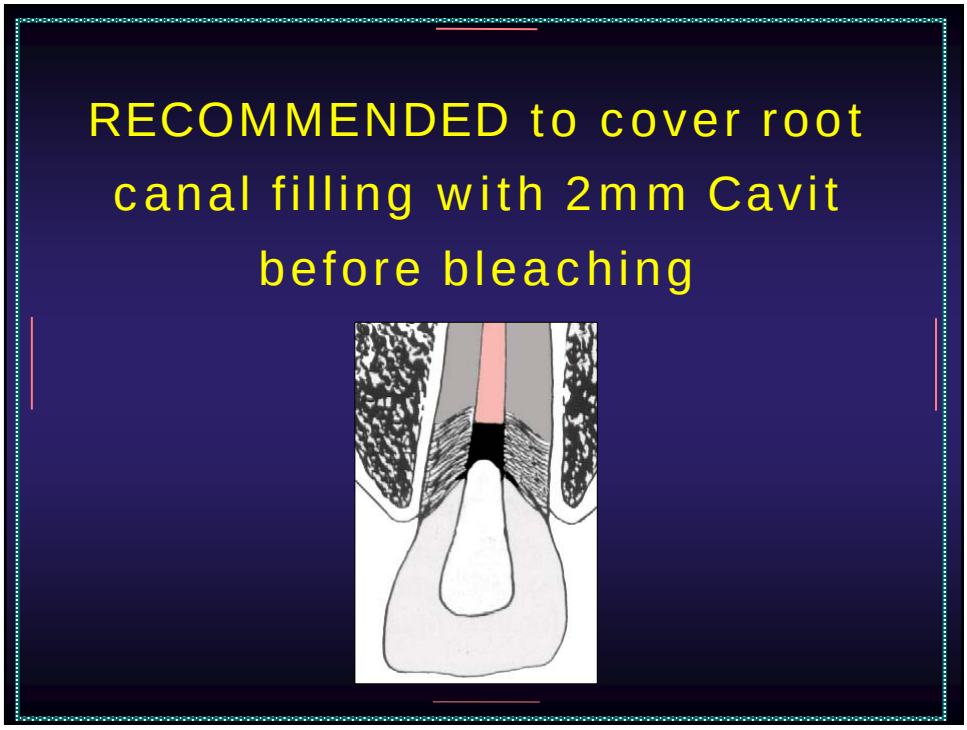
Why not GIC ???

- **Very difficult to place without getting on labial dentine wall of access cavity**
- **Very difficult to remove if on labial wall**
- **GIC's not proven to prevent moisture penetration through dentine**



78


RECOMMENDED to cover root canal filling with 2mm Cavit before bleaching

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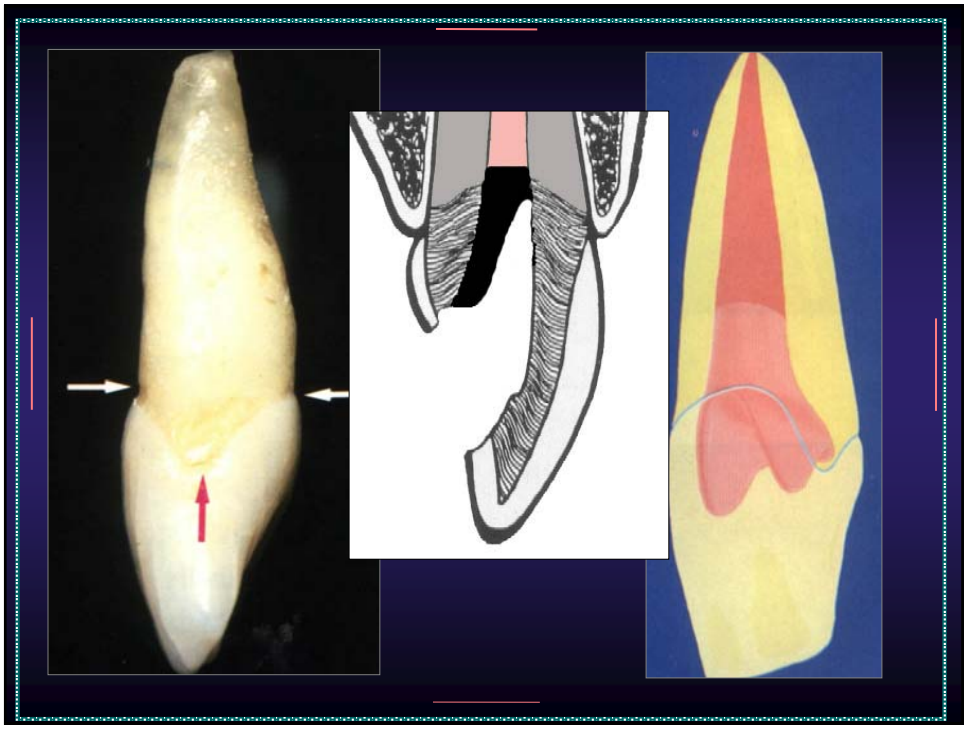

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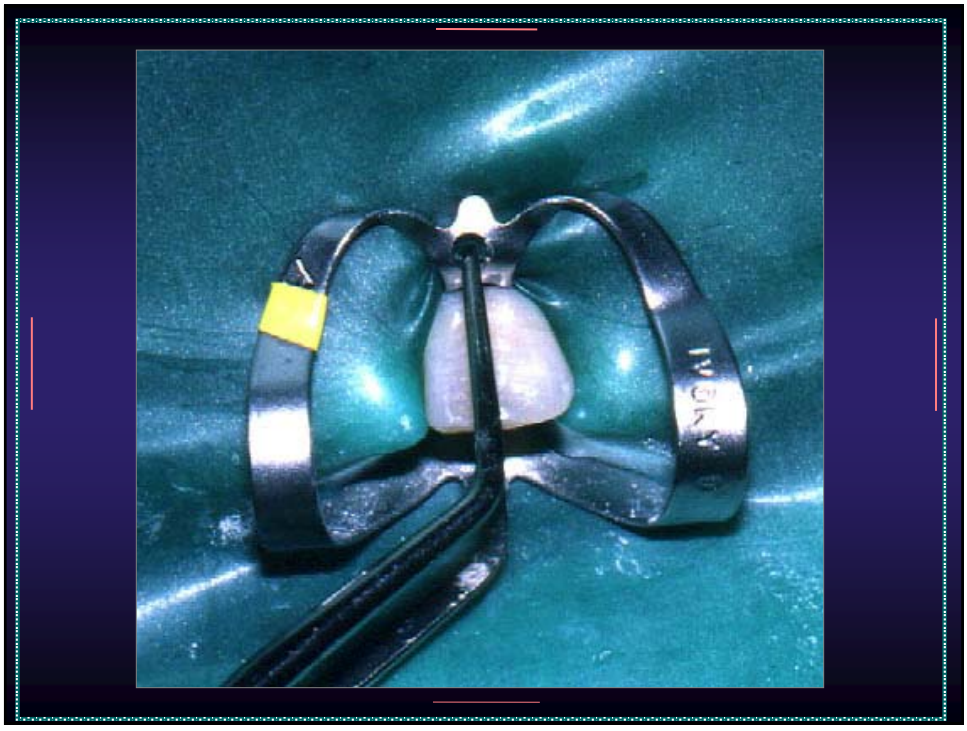

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