Case
Mr Thompson

A radiolucency at the root tip, Treat or not?

Mr Thompson

- 51 years; moved recently and presents himself as a new patient in your practice
- He has been regularly seen and treated for 25 years by his previous dentist
- This dentist has extensively restored his dentition 20 years ago; that time a lot of fixed prosthetics was made.
- ‘It has cost me a fortune’, but otherwise I would– he thinks - have lost all my teeth

REQUEST: he has no specific complaints; he wants to keep his teeth still for a long period of time and expects that you will do everything to make that happen.
- Medical history gives nothing special
- He is a university teacher
Clinical examination

• Periodontal
  – Local plaque
  – Dorsal gum is bleeding on probing
  – DPSI-scores: front 2, sextant LL 4, others 3-
  – Between 36 and 37 ‘suspicous’

• Cariologic
  – Large fillings
  – No lesions

• Functional
  – Crown 17 and 25, bridges lower left and right, porcelain at surfaces had disappeared

Radiologic examination
Radiolucency at root tip
Unfilled root canal
Good post and crown

Amalgam remnant

Radiolucency at apex
White line in canal
Under crown
Radiolucency in the pulp space?

Additional examination

Apical periodontitis at 25 with an unfilled root canal

Treat or not

Possible solutions

Treatment options

• Extraction
• Removal post and core and crown and root canal treatment
• Surgical root resection with retrograde filling
• Wishful waiting (monitoring)

Possible solutions

• Reasons to do nothing
  – It is there already 20 years!
  – Crown and post are good
• Reasons to do something.
  – You do not leave radiolucencies untreated, since
    • they may flare up and cause pain
    • they are damaging for the host system
      – eg. atherosclerosis and endocarditis (C-reactive proteins)
On which ground should a certain strategy be chosen:

- Prognosis of treatment
- Consequences of untreated disease
- Position of the tooth
- Risk of complications of therapy
- Access to the root canal
- Quality of original treatment
- Economic costs
- Personal values

“Since prevention and elimination of disease is the benchmark of health professions and since apical periodontitis is the disease unique to endodontics, it is logical to define clinical endodontics as the prevention and/or elimination of apical periodontitis.”

Trope M: Endodontic Topics 2003;5:1-11

Clinical endodontics is defined as the prevention and/or elimination of apical periodontitis.

World health organisation

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity

Do we accept persistence of asymptomatic apical periodontitis as the consequence of successful endodontic treatment?
RCT > 8 y no symptoms

Retreat or monitor?

Treat or monitor

No symptoms

Acute apical abscess treated in 1972
Here the situation in 2004

1. Asymptomatic
2. Infection eliminated
3. Bone defects repaired
4. Safe for general health

Desirable outcomes

Healing! or ?
Desirable outcomes

1. Asymptomatic
2. Infection eliminated
3. Bone defects repaired
4. Safe for general health

Symptoms and function

97% of 1.4 million teeth were functional in the oral cavity 8 years following non-surgical root canal treatment (Salehrabi & Rotstein JOE 90:846-50, 2004)

If asymptomatic inflammation remaining after endodontic treatment is considered as acceptable then what is the logic of treating asymptomatic lesions associated with teeth that have not received endodontic treatment?

So why bother with this?
Desirable outcomes

1. Asymptomatic
2. Infection eliminated
3. Bone defects repaired
4. Safe for general health

Elimination of canal infection

- Ca(OH)$_2$ 1 mon (Byström et al. 1985) sampling (-) 100%
- RF teeth with lesions (Molander et al. 1998) sampling (+) 73%
- RF teeth without lesions (Molander et al. 1998) sampling (+) 45%
- RF teeth with lesions (Nair et al. 2005) histology (+) 88%

Current procedures are not effective to reduce root infection to that level.

Restrained root infection

Microbiological status of 120 root filled teeth (Molander et al. Int Endod J 1998)

Bacteria were found in 77 (64%) main canals.

In many “successful” cases:
Absence of radiolucency and persistence of inflammation.
Bacteria:
- 68% of filled canals associated with radiographic periodontitis.
- 45% of filled canals without radiographic periodontitis.

(Molander et al, Int Endod J, 1998)

Sampling in ramifications, isthmuses not possible. Planktonic bacteria probably easier to detect than bacteria enclosed in biofilms.

The follow-up period for 22 roots:

Average: 5 years 4 months
Minimum: 3 years
Maximum: 10 years 8 months


RCT procedures
Using rubber dam.
Disinfect the field: 30% H₂O₂ and 5% iodine.
Irrigation: copious 1% NaOCl.
Obturation: LC with GP and Pulp Canal Sealer.
In 18 of the 22 roots, the canal was filled to 0-2 mm from the apex.

Treatment result of 22 roots:
Free of apical radiolucency: 18 (82%)
Free of apical periodontitis: 3 (14%)
In the ferret and dog, the most apical portion of the root canal consists of a delta of many small canals that were neither cleaned nor filled by the technique used. Poor healing (6-12 mon)

“One week after tooth extraction, no inflammatory cells were present.”

Seltzer et al. Oral surg 1964
Katebzadeh et al. J Endod 1999

Desirable outcomes
1. Asymptomatic
2. Infection eliminated
3. Bone defects repaired
4. Safe for general health

Apical healing
On radiographs: 90%
On radiographs: 50%
(Caplan DJ. Endod Top 2004)
Histology/cadaver: 7-49%
Histology/biopsy (≥ 3yr): 14%
(Ricucci & Langeland Int Endod J 1998)

<table>
<thead>
<tr>
<th>Percentage of RF teeth with radiolucency</th>
<th>Country</th>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>1991</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>1997</td>
<td>52%</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>1997</td>
<td>61%</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>2000</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>2001</td>
<td>52%</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>2003</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>2004</td>
<td>65%</td>
<td></td>
</tr>
</tbody>
</table>
Apical healing

<table>
<thead>
<tr>
<th>ACTA</th>
<th>2004</th>
<th>1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Endo beh</td>
<td>5.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Endo + AP</td>
<td>48.8</td>
<td>39.2</td>
</tr>
<tr>
<td>AP- Endo</td>
<td>6.6</td>
<td>5.2</td>
</tr>
<tr>
<td>Kroon+ AP</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Kroon+ PDL&gt;</td>
<td>15.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Plast.+ AP</td>
<td>7.2</td>
<td>3.6</td>
</tr>
<tr>
<td>Plast + PDL&gt;</td>
<td>7.1</td>
<td>3.1</td>
</tr>
</tbody>
</table>

On radiographs: 90%  

On radiographs: 50%  
(Caplan DJ. Endod Top 2004)

Histology/cadaver: 7-49%  

Histology/biopsy (≥ 3yr): 14%  
(Ricucci & Langeland Int Endod J 1998)

Radiographs

The absence of apical radiolucency does not guarantee the absence of bone involvement.  
(Bender & Seltzer 1961, van der Stelt 1985)

Cortex must be involved
Location of radiolucency
False-negative diagnosis: ± 40%

Positive predictive value of radiolucency 100%

Negative predictive value of radiolucency

| Brynolf 1967 | 53% |
| Rowe & Binnie 1974 | 55% |
| Barthel et al. 2004 | 67% |

Ricucci
Ørstavik et al. (Eur J Oral Sci 2004)
Success rate: 90%

Negative predictive value of radiolucency:
60%

90% x 60% = 54%

Radiographic assessment (scores 1-5):
no radiolucency to bad radiolucency
(Brynolf 1967, Ørstavik et al. 1987)

Histological inflammatory status from no inflammation to severe inflammation  (r: 0-1.0)

<table>
<thead>
<tr>
<th>Scale for Average Ridit, r</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
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<tbody>
<tr>
<td>0.16</td>
<td>2.10</td>
<td>3.64</td>
<td>4.65</td>
<td>5.39</td>
<td>6.10</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ASSOCIATED PAI SCORES

Fig. 1. Association of PAI score with average ridit. A group of roots with PAI score 1 would have an average ridit of 0.096; PAI score 2 would give r=0.248 and so on. Based on Brynolf’s data (11) as previously compiled (11).


<table>
<thead>
<tr>
<th>Diminished recall rate</th>
<th>PAI=1</th>
<th>PAI=1+2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 year</td>
<td>100%</td>
<td>42%</td>
</tr>
<tr>
<td>1 year</td>
<td>67%</td>
<td>45%</td>
</tr>
<tr>
<td>2 year</td>
<td>61%</td>
<td>56%</td>
</tr>
<tr>
<td>3 year</td>
<td>56%</td>
<td>62%</td>
</tr>
<tr>
<td>4 year</td>
<td>36%</td>
<td>65%</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Diminished recall rate</th>
<th>PAI=1+2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 year</td>
<td>79%</td>
</tr>
<tr>
<td>1 year</td>
<td>83%</td>
</tr>
<tr>
<td>2 year</td>
<td>89%</td>
</tr>
<tr>
<td>3 year</td>
<td>92%</td>
</tr>
<tr>
<td>4 year</td>
<td>94%</td>
</tr>
</tbody>
</table>

Before and after creating a large defect in cancellous bone
(Pathways of the Pulp 1984-1998)

Recall rate: 36%
Success rate in a well-controlled 4-yr longitudinal study using PAI
> 90%

PAI index is based on the study of Ingrid Brynolf Odont Rev 18 suppl 11, 1967
A histological and roentgenographical study of the periapical region of
Human upper incisors

Huumonen and Ørstavik Endod Topics 2002:1; 3-25
m1
Foto links is niet bijgesneden, rechts wel
mvogels; 22-6-2006

m3
Dit zijn bijgesneden gedeeltes uit originele scan van vorige slide.
mvogels; 22-6-2006
Success rate (AH26) at year 4
PAI=1  62%
PAI=2  33%
PAI=1+2  95%

“Following successful root canal treatment clinical symptoms originating from an endodontically induced apical periodontitis should neither persist nor develop and the contours of the periodontal ligament space around the root should radiographically be normal.”
European Society of Endodontology (ESE) 1994

Score 2 ≠ Success!

Recall rate: 36%

Recall rate: 83%
Success rate in a university longitudinal study using PAI 90%


Success rate at year 4 (AH26)
PAI=1  62%
PAI=2  33%
PAI=1 + PAI=2  95%

Recall rate: 36%


79% or 26%?

<table>
<thead>
<tr>
<th>Type of cases</th>
<th>PAI=1 Success</th>
<th>PAI=2 Success or failure?</th>
<th>PAI=3 Failure</th>
<th>Number of roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>58%</td>
<td>32%</td>
<td>10%</td>
<td>675</td>
</tr>
<tr>
<td>Non-AP</td>
<td>70%</td>
<td>24%</td>
<td>6%</td>
<td>483 (72%)</td>
</tr>
<tr>
<td>AP</td>
<td>26%</td>
<td>53%</td>
<td>21%</td>
<td>192 (28%)</td>
</tr>
</tbody>
</table>
Comparison of success rate for AP cases in two longitudinal university studies

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Recall Rate</th>
<th>Treatment Quality</th>
<th>Criteria</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sjögren et al. J Endod 1990;16:498 Sweden</td>
<td>204</td>
<td>46%</td>
<td>0.5% NaOCl, Ca(OH)_2 LC, no sealer, Root filling 0–2 mm to apex 80%</td>
<td>Include teeth with periodontal contours widened around excess of material</td>
<td>86%</td>
</tr>
<tr>
<td>Ørstavik et al. Eur J Oral Sci 2004;112:224 Norway</td>
<td>192</td>
<td>83%</td>
<td>0.5% NaOCl, Ca(OH)_2 LC, with sealer</td>
<td>PAI=1:</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PAI=1+2</td>
<td>79%</td>
</tr>
</tbody>
</table>

Desirable outcomes

1. Asymptomatic
2. Infection eliminated
3. Bone defects repaired
4. Safe for general health

Risk of untreated disease

The incidence of exacerbations per year is less than 5% (Erikson H., Essential Endodontology, 1998)

Potential systemic effects of endodontic post-treatment disease

Coronal heart disease
Adverse pregnancy outcomes
CRP = C-reactive protein
Inflammation marker in blood

Ridker et al. New Eng J Med 1997;336:973-9
CRP < 0.5 mg/L
No heart attack
CRP 1-3 mg/L: a risk factor for coronal heart disease

Fredriksson et al. J Periodontol 1999;70:1355-60
Periodontitis patients: CRP=2mg/L
Without periodontitis: CRP=0mg/L

Loos et al. J Periodontol 2000;70:1528-34
Periodontitis results in higher CRP (p=0.030) and Interleukin-6 (p=0.015), potentially increase the risk of CHD.

Buttke TM, Shipper G, Delano EO, Trope M. JOE 2005
Chronic apical periodontitis is not associated with elevated CRP in dogs.

Total burden of dental infection (Total Dental Index)

(Oral infection includes diseases of mucous membrane.)

The risk of coronal heart disease increases in individuals with high Total Dental Index.
The severity of dental infections correlates with the severity of coronal heart disease.

Total Dental Index was significantly associated with CHD.
- Mattila et al. *Atherosclerosis* 1993;103:205-11
- Mattila KJ. *Eur Heart J* 1993;14:51-3

Tooth loss was significantly associated with CHD.
- DeStefano et al. *BMJ* 1993;306:688-91

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Important findings during the last 15 years:

- Periodontitis results in higher CRP, potentially increases the risk of CHD.

- Whether the risk of coronal heart disease increases in individuals with apical periodontitis?
- Whether the risk of coronal heart disease decreases after successful root canal treatment?
Caplan et al. IADR Abstract 2004

Links between apical periodontitis and coronal heart disease

During a maximum follow-up or 32 y with 708 males, lesions of endodontic origin among those < 40 y old were statistically significant, associated with CHD after controlling for baseline values of education, income, total cholesterol, triglycerides, diabetes, hypertension and smoking.


Endodontic variables and coronary heart disease

Age, tooth loss and individuals with 2 root-filled teeth were significantly associated with coronal heart disease.

The logistic regression analysis did not support an association between periapical radiolucency and coronal heart disease.

Failing to show the link between AP and CHD does not prove its absence.

Absence of radiolucency ≠ Absence of AP
All individuals

Root canal infection as a systemic health hazard has been debated over the years, however controlled clinical studies are rare and most authors judge the risk for the medical uncompromised individual as low.

(Debelian G.J. et al., 1994; Murray C.A. et al., 2000)

Whether persistence of apical periodontitis will harm the general health?

Still no final conclusion can be made.

Compromised outcomes:

Coexistence of post-treatment root infection, post-treatment periapical inflammation, and life of highest quality.

Possible solutions

Aristotle

Phronesis: practical wisdom

The ability to think about ‘practical matters’
To do the ‘right thing at the right moment’

Practical wisdom: combination of understanding and experience and the ability to read individual situations
On which ground should a certain strategy be chosen:

- Prognosis of treatment
- Consequences of untreated disease
- Position of the tooth
- Risk of complications of therapy
- Access to the root canal
- Quality of original treatment
- Economic costs
- Personal values

Knowledge is power, and it’s time to equip our patients with the information they need to make rational, informed decisions about their dental care.

Patient

- As important professional knowledge and skill might be, it must be emphasized that the final decision is in the hand of the INFORMED patient. (Reit, Textbook of Endodontology, 2004)
- Remember that the patient is the expert on which symptoms are tolerable, which economic costs are acceptable and which risks are worth taking. (Reit, Textbook of Endodontology, 2004)

In fact, I make assumptions while the evidence lacks.

But leaving radiolucencies untreated, I question it!

The End