

Cone-Beam Computed Tomography in Endodontics

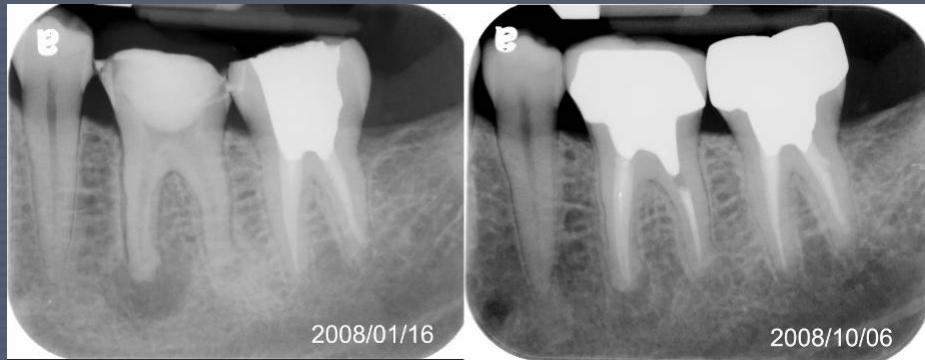
Presenter:林秋君

Date: 2010/05/02

Apical periodontitis (AP)



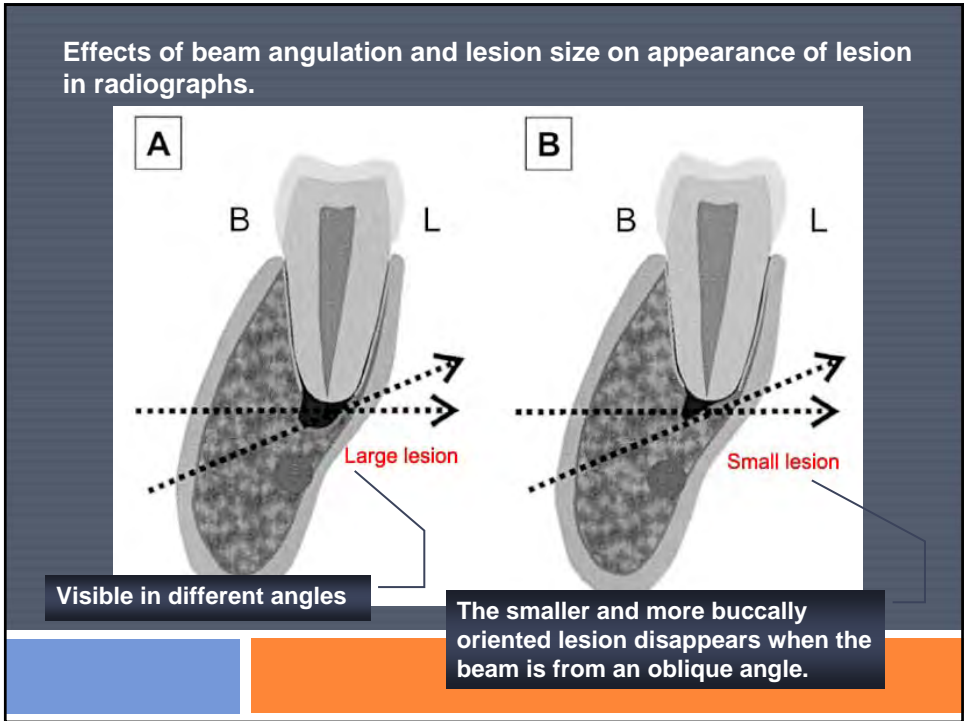
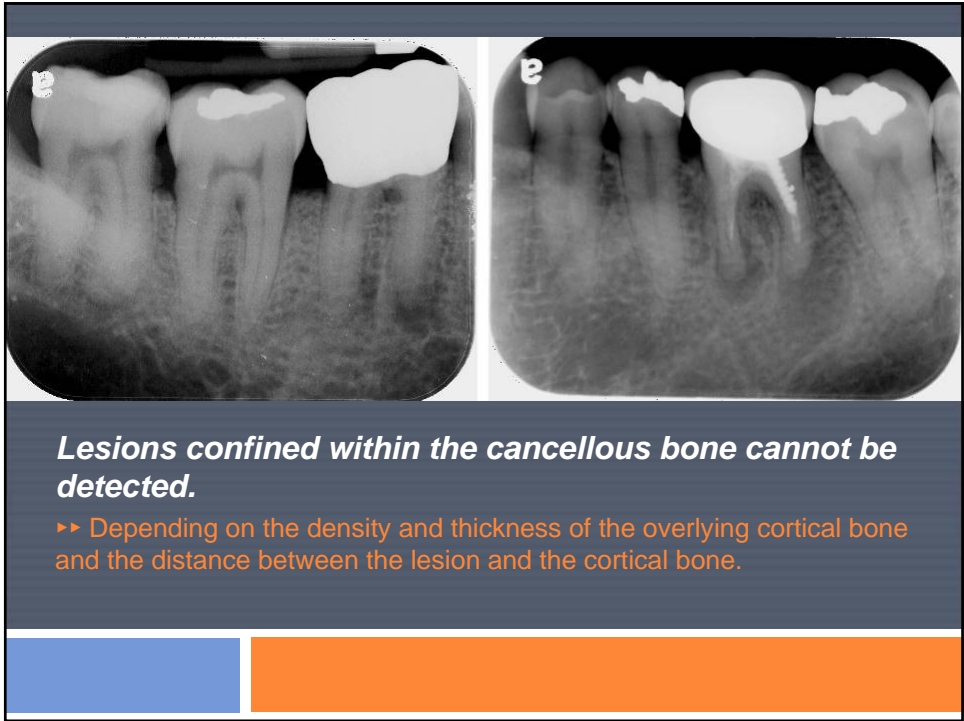
- AP is an inflammatory process in the periradicular tissues caused by microorganisms in the necrotic root canal.
- The aim of root canal treatment is to reduce root infection to a minimal level and eliminate AP.



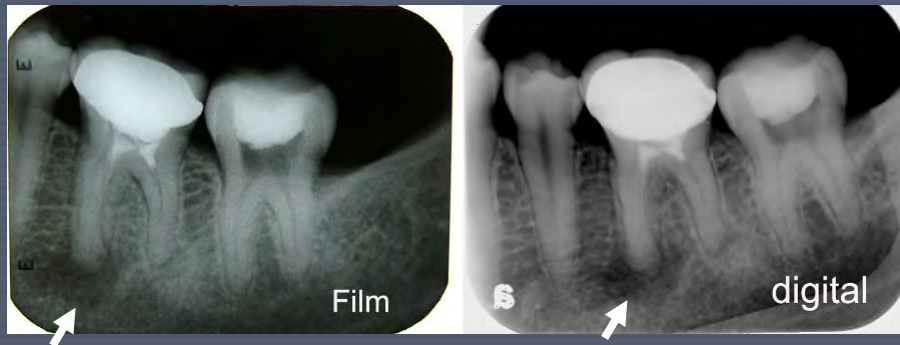
Periapical radiography is an essential resource in endodontic diagnosis, because it offers important evidence on the progression, regression, and persistence of apical periodontitis (AP).



It is known that periapical radiolucencies might not be visible radiographically, although they exist clinically.



Difference in the detection of AP using the film and digital radiography



No difference between digital and film radiography to detect periapical lesions.

~ Özen et al. 2009

Smallest lesions → Digital radiography using variable contrast was more accurate than film

Large lesions → No difference

~ Tirrell et al. 1996

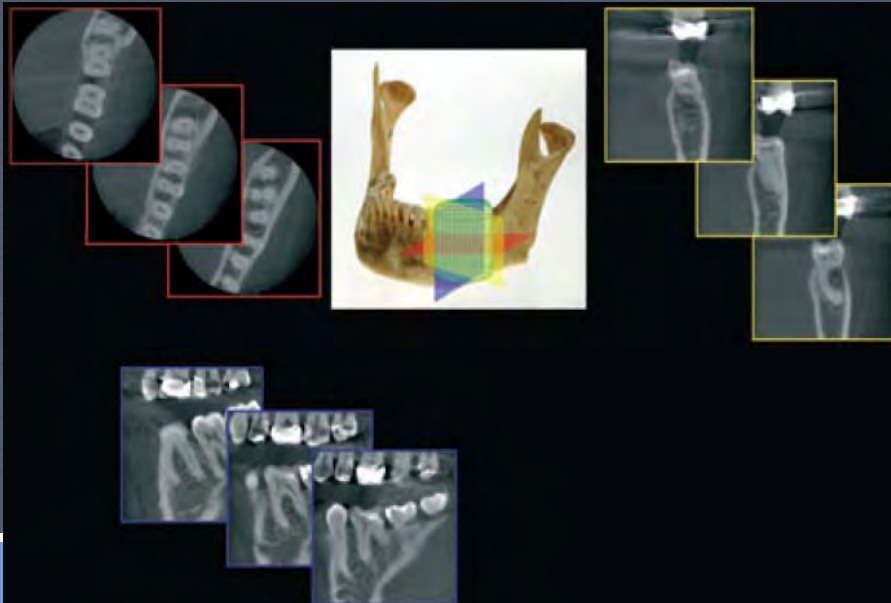
When the lesion **involved the cortical bone** → No difference

~ Yokota et al. 1994

The management of endodontic problems is reliant on radiographs to assess the anatomy of the tooth and its surrounding anatomy.

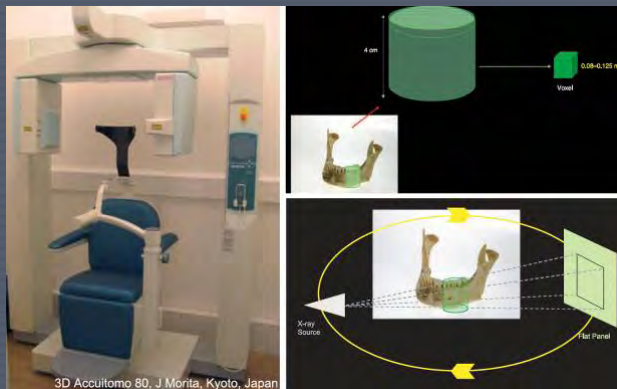
Until recently, most of this core information would be obtained from conventional radiographs. However, such images have inherent limitations.

Three-dimensional imaging is becoming an important and available tool in dentistry.



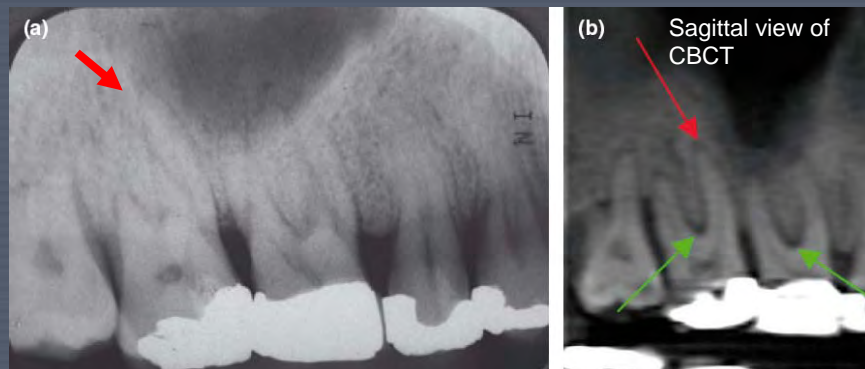
Cone-Beam Computerized Tomography (CBCT)

Cone-Beam Computerized Tomography (CBCT)



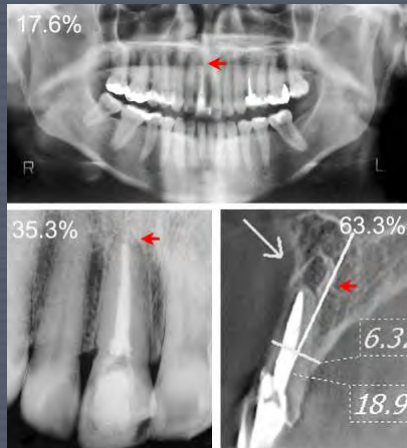
- uniquely designed for dentomaxillofacial imaging and enabled 3-dimensional (3D) visualization of teeth
- used in endodontics, periodontics, orthodontics and dentomaxillofacial surgery.

Advantages of CBCT



Eliminate the superimposition of anatomical structures, such as overlying zygomatic buttress, alveolar bone and adjacent roots.

Estrela et al (2008) analyzed the accuracy of 1508 CBCT images, periapical and panoramic radiographs for AP detection.



	AP prevalence in endodontically treated teeth
Panoramic radiographs	17.6%
Periapical radiographs	35.3%
CBCT	63.3%

They suggested that CBCT was an accurate diagnostic method to detect AP.

J Endod 2008; 34:273-279

Radiation dose and damage from CBCT

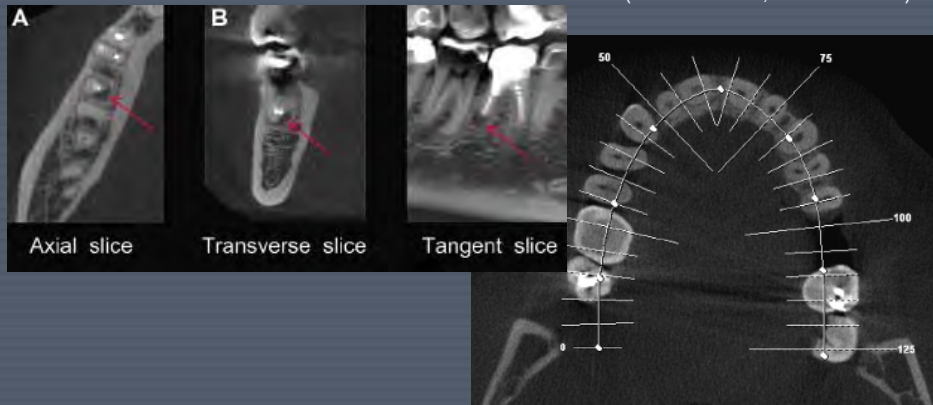
Effective dose of different radiographic sources

Radiographic source		Effective doses (μ Sv)	Compare to pano dose
CBCT	NewTom 3G 12" FOV	58.9	4.4
	i-CAT 12" FOV	193.4	14.5
	i-CAT 9" FOV	104.5	8.6
Conventional CT		1400 (max.) 1320 (mand.) 2100 (max.+mand.)	105.3 (max.) 99.2(mand) 157.9 (max.+mand.)
Pano		13.3	

(International Commission on Radiological Protection guidelines, ICRP 2005, 1990)

CBCT dose varies depending on the device, field of view, and selected technique factors.

(J Endod 2009;35:1491–1497)



The maximum resolution mode impart significantly more radiation dose and requires more reconstruction time than the standard mode.

A radiation dose of CBCT is equivalent to that needed for 4 –15 panoramic radiographs.

- Because effective radiation doses of CBCT are still higher than with conventional panoramic radiography,
- **DO NOT suggest that CBCT is used as the method of choice for screening and detecting periapical lesions in routine clinical practice.**
- **Currently, CBCT must only be considered when conventional radiographic techniques are insufficient to provide enough information for the diagnosis of periapical pathology.**

Clinical cases

1. Abnormal tooth morphology
2. External root resorption
3. Large periapical radiolucency

Abnormal tooth morphology ~

Case 1

Double Dens Invaginatus

Oehlers type III with concomitant type I DI in maxillary left lateral incisor



15 y/o male

Swelling and palpation pain over the palatal gingiva area for about 3 days.

I/D wound over the anterior palate.

Abnormal crown morphology

Two deep palatal pits



Tooth 22

1. percussion(+)
2. palpation pain over the buccal mucosa close to the apical area of 22 and 23
3. fluctuation swelling over the palate near 23 and 24
4. mobility(-)
5. probing depth: WNL
6. EPT(-)

X-ray finding:

1. A large periapical lesion
2. Double dens invagination
3. Open apex



Clinical Diagnosis

Pulp necrosis with chronic apical abscess

Double dens invagination with open apex

Treatment plan

Non-surgical root canal treatment first, including one-visit apexification with MTA

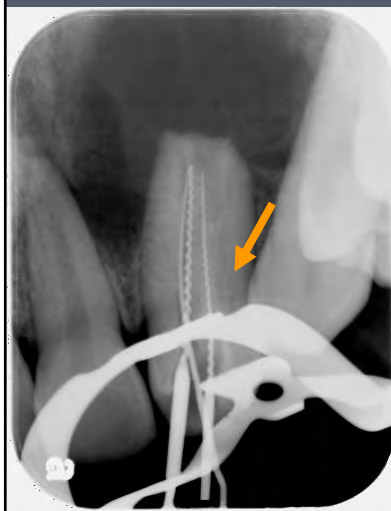
If the non-surgical RCT failed, consider the apical surgery or extraction



TREATMENT COURSE

2009/07/02

Rubber dam application, open chamber, canal debridement and enlargement, irrigation with NaOCl, pus and blood discharge from M canal, M (21mm,#45), D(20mm,#25) ; Ca(OH)₂ dressing, IRM filling.



TREATMENT COURSE

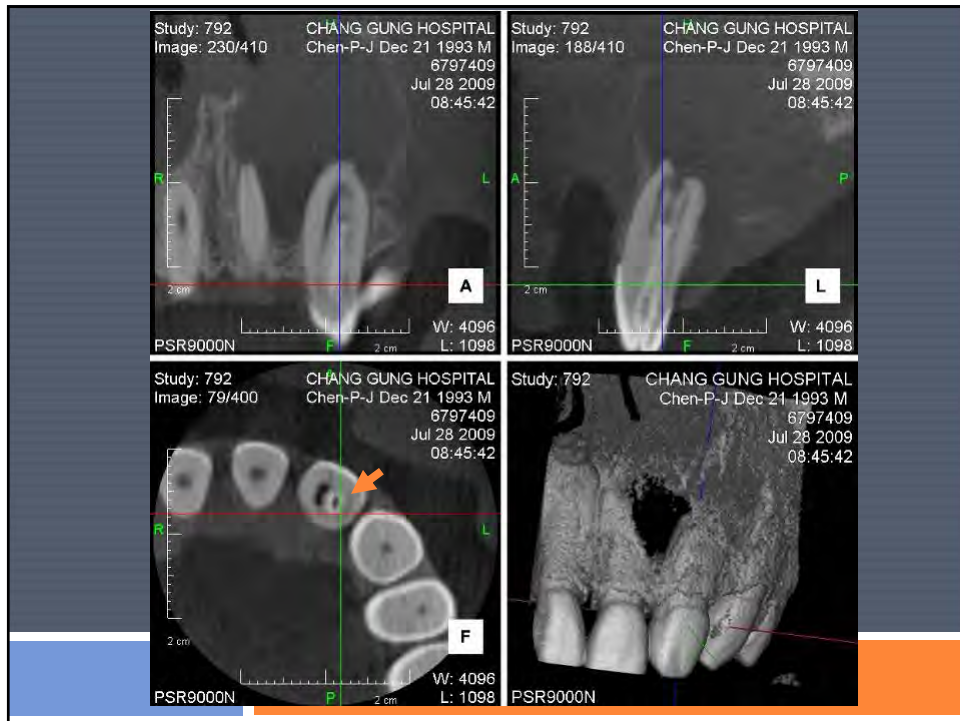
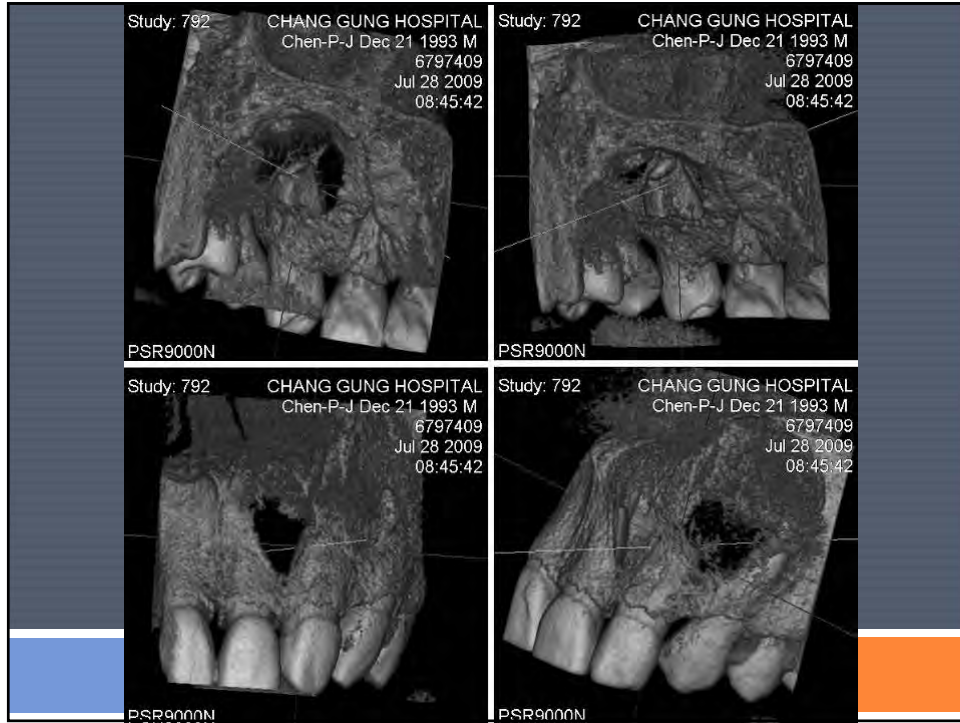
2009/07/24

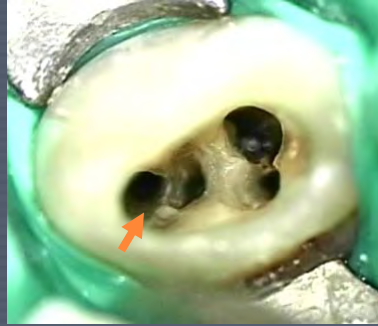
find the P canal under the microscope, MB (21.5mm,#45),P(21.5mm,#20)--> C-shaped canal system, dens invaginatus(21.5mm,#20),

But...another canal can't be found.

***Combine dental CT and microscope to
locate the undisclosed canals***

Dental CT





TREATMENT COURSE

2009/07/28

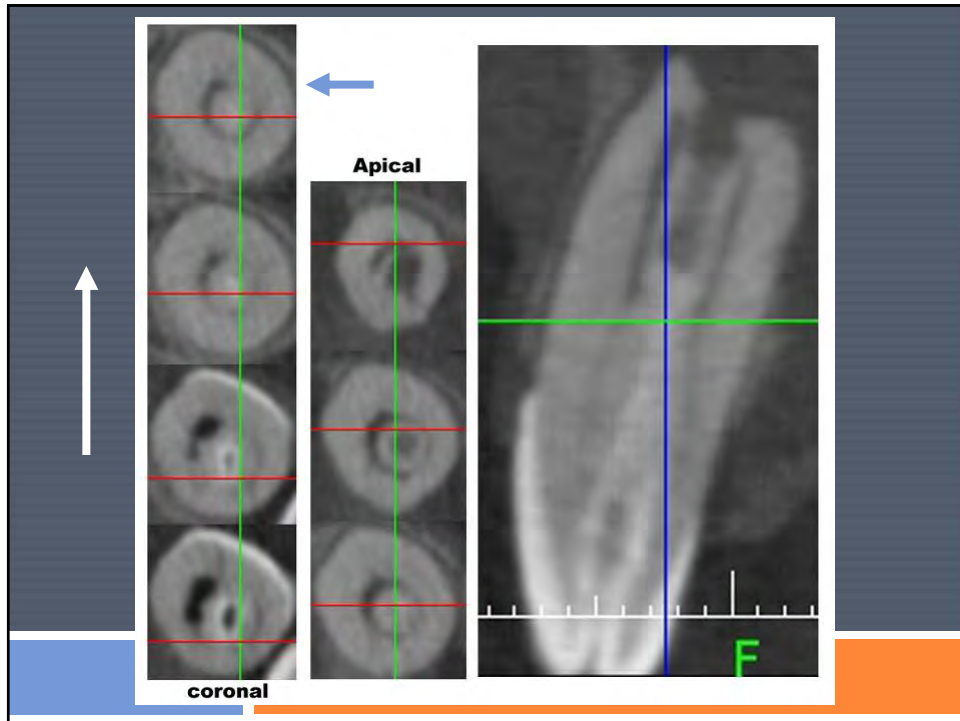
find the DB canal under the microscope

MB and P(21.5mm,#45-->C-shaped canal system)

Dens invaginatus (17mm,#30)

DB (22mm,#25)

*Whether to remove the central dentinal core
(invaginatus) under the microscope or not*



TREATMENT COURSE

2010/02/22

Create MTA barrier

2wks later, back-filling with composite resin under the microscope



Root resorption ~

Case 2

External root resorption

External Root Resorption

sagittal



coronal



axial



an asymptomatic lesion

Diagnosis in the routine radiographic examination

Etiology is still unclear.



67 y/o female

Referred from perio dept for the endodontictx of tooth 33

PDH: receiving the regular perio tx

Local examination for tooth 33:

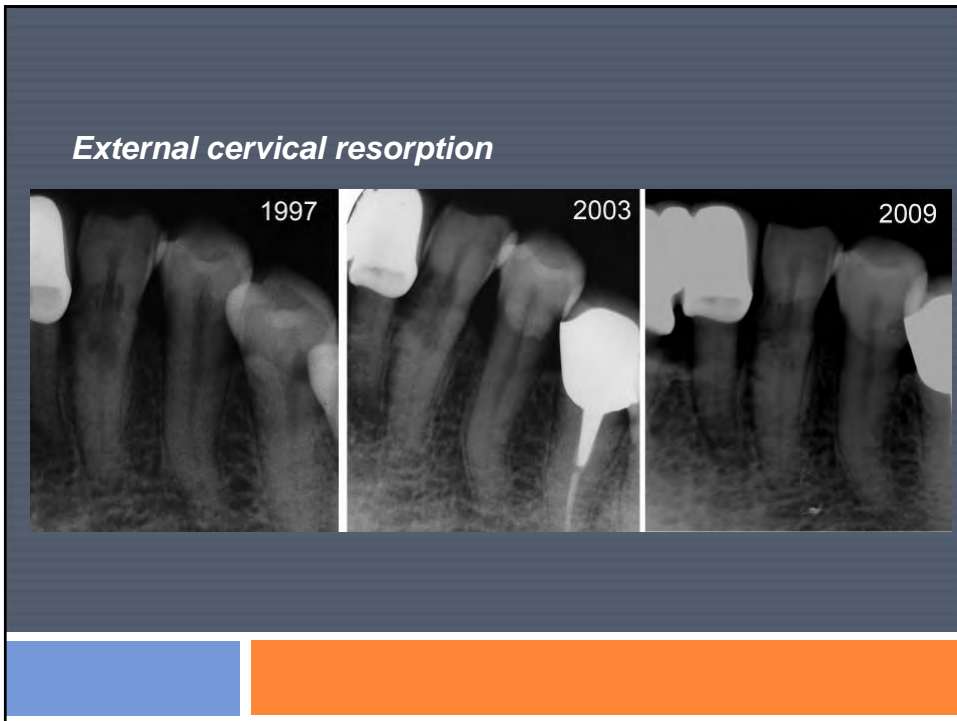
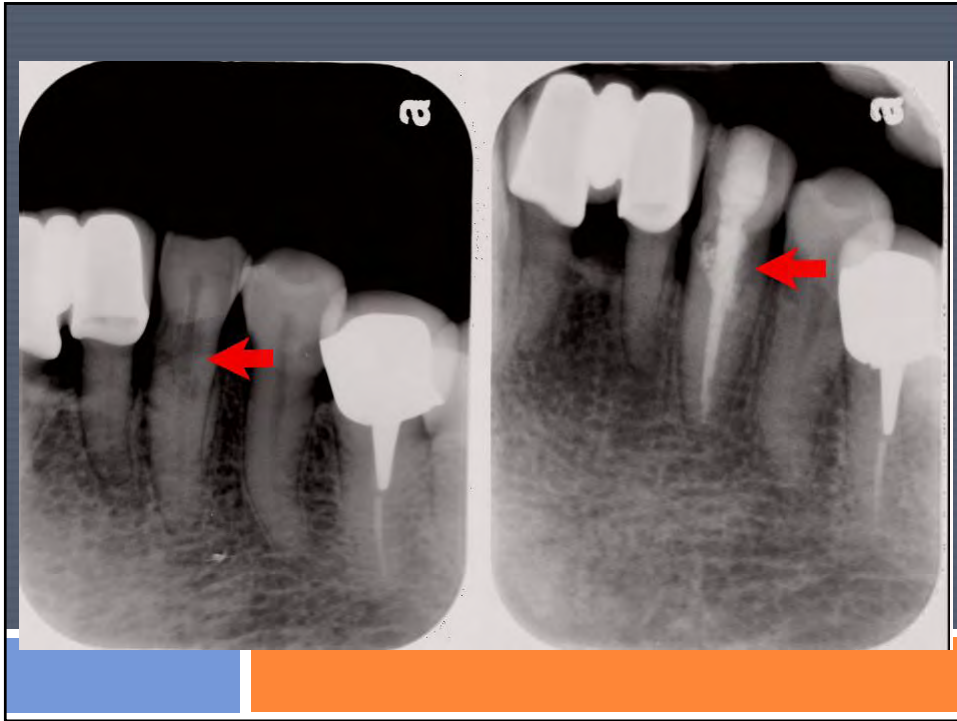
percussion (+), palpation (-), mobility(-), PD: WNL

Tooth discoloration over the coronal part

X-ray finding:

Obscure image around the cervical area
Endo emergency tx was done in perio dept



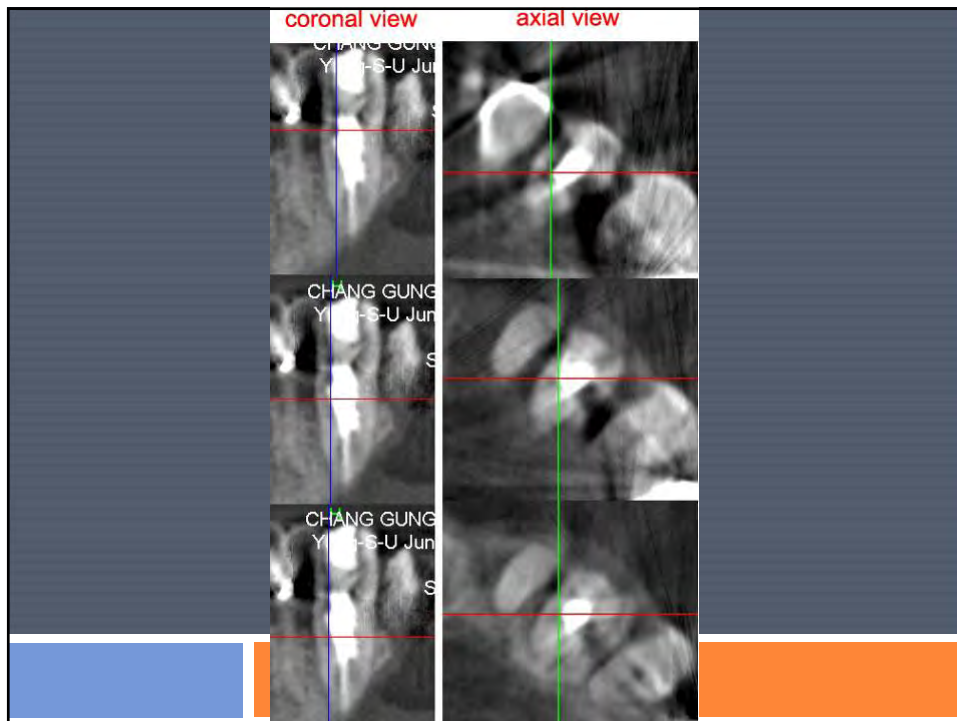


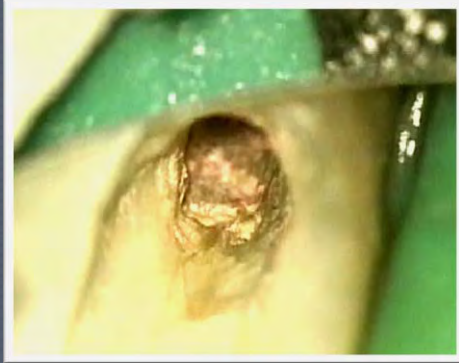
Because the root resorption defect may spread within the root **in all directions**, two-dimensional radiographs is unable to reveal the size, position and extent of the root resorption.

The use of CT is very helpful in diagnosing the exact size and location of resorption.

~ Kim et al 2003

Dental CT





Large periapical radiolucency~

Case 3

Traumatic bone cyst



51 y/o female

visiting our OS dept for the evaluation of the large radiolucency over the L't mandibular body referred from LDC

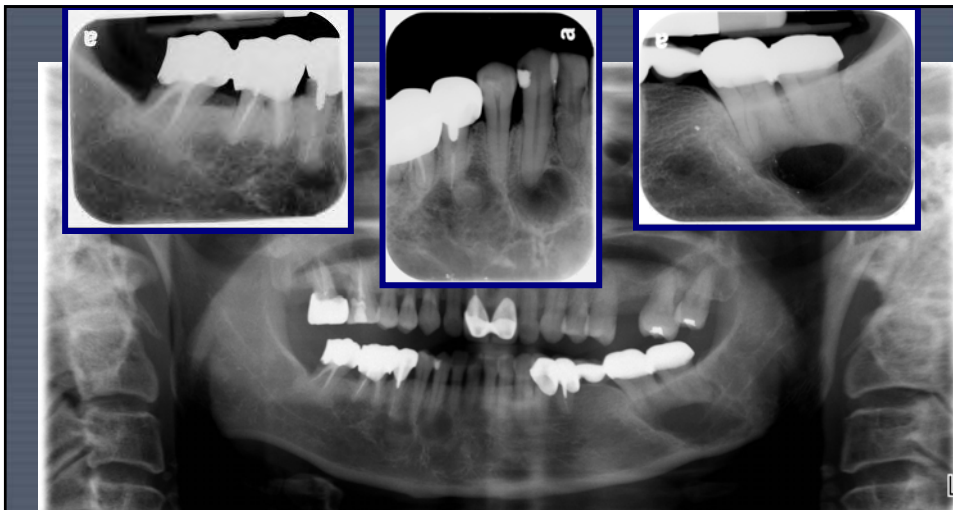


2009/09/14 in OS dept:

R-L lesions over L't mandibular body and tooth 43 apical area

R-O lesion over teeth 44 45 area

Tx: arrange medical CT and endo tx for 37, 38 and 43



Local examination in ENDO dept on 2009/09/21 :

1. multiple mandibular radiolucent lesions over 46,45,44,43,37 and 38
2. No intraoral or extraoral swelling, no obvious s/s
3. 44,43,37,38: EPT(+), no obvious percussion and palpation pain, probing depth: WNL, no obvious root resorption
4. No paresthesia along the course of the L't mandibular nerve.

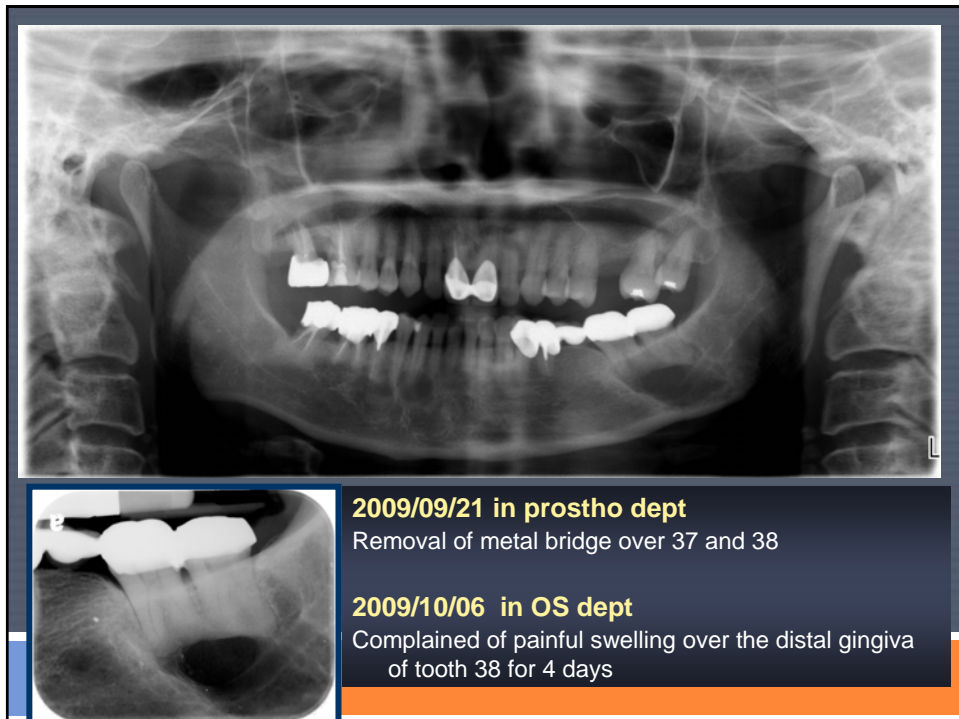
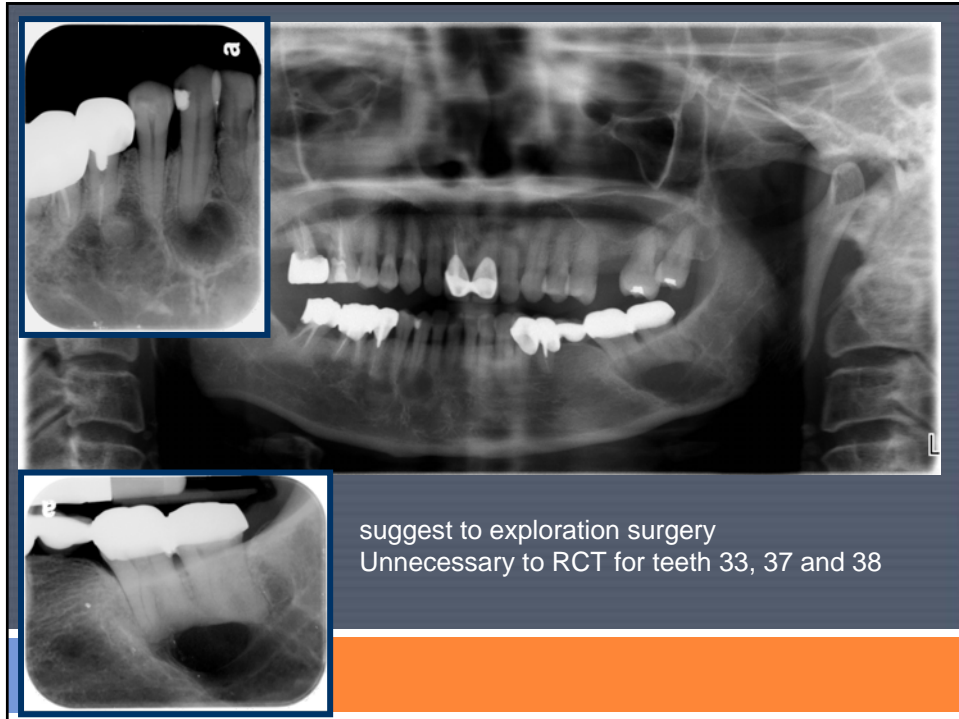


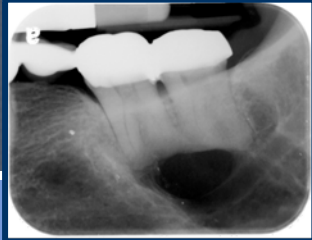
Local examination in ENDO dept on 2009/09/21 :

1. Large radiolucent lesion with a well-defined border in the apical area of teeth 37 and 38.
2. Buccal bony expansion over the teeth 37 and 38 was noted without any swelling and fluctuation.
3. The lesion was superimposed on the inferior alveolar canal and the mandibular inferior border was intact.



Suspect the multiple mandibular radiolucent lesions over 46,45,44,43,37 and 38 were not associated with endodontic origin.





2009/10/06 in OS dept
incisional biopsy over the left mandible
air noted, empty inside the bone
no obvious cyst capsule
suspected traumatic bony cyst
curettage done and specimen for H-P exam

Pathological report

- THE SECTION SHOWS FIBROUS TISSUE WITH CHRONIC INFLAMMATORY CELL INFILTRATION. FRAGMENTS OF BONE TISSUE ARE ALSO NOTED

DIAGNOSIS

MANDIBLE, LEFT, INCISIONAL BIOPSY
----- **CHRONIC INFLAMMATION**
----- COMPATIBLE WITH BENIGN CYST



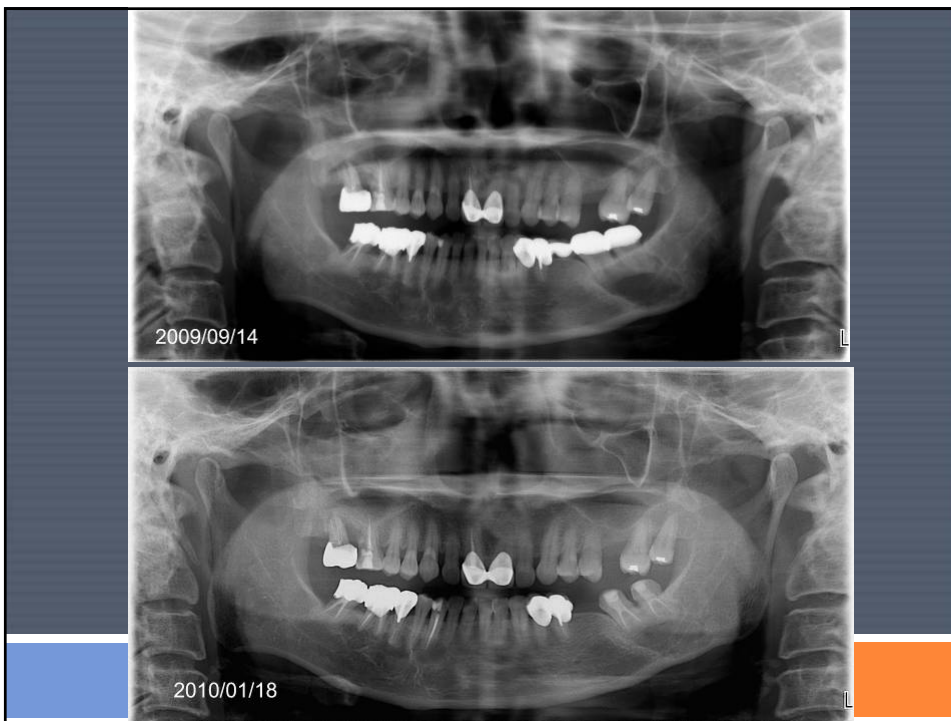
2009/12/01, 2009/12/11: complete RCT for tooth 37

2009/12/15: complete RCT for tooth 38

2010/01/18:

37, 38: percussion(-), palpation(-), mobility(-), probing depth: WNL

X-ray finding: large radiolucent lesion (decreasing)

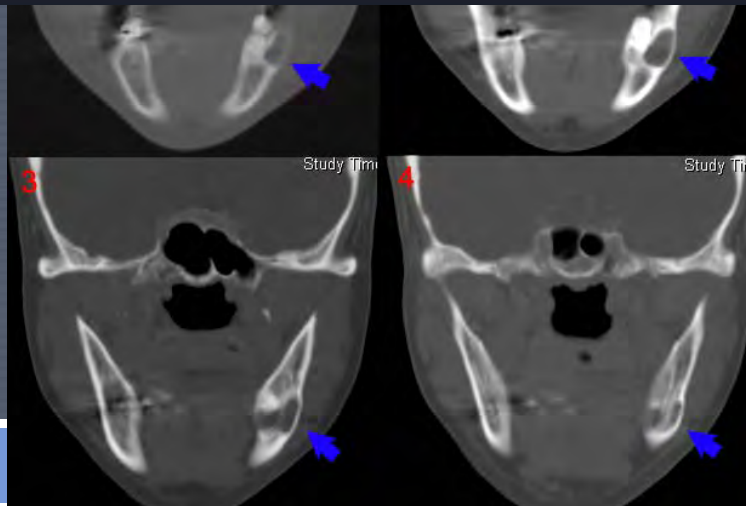


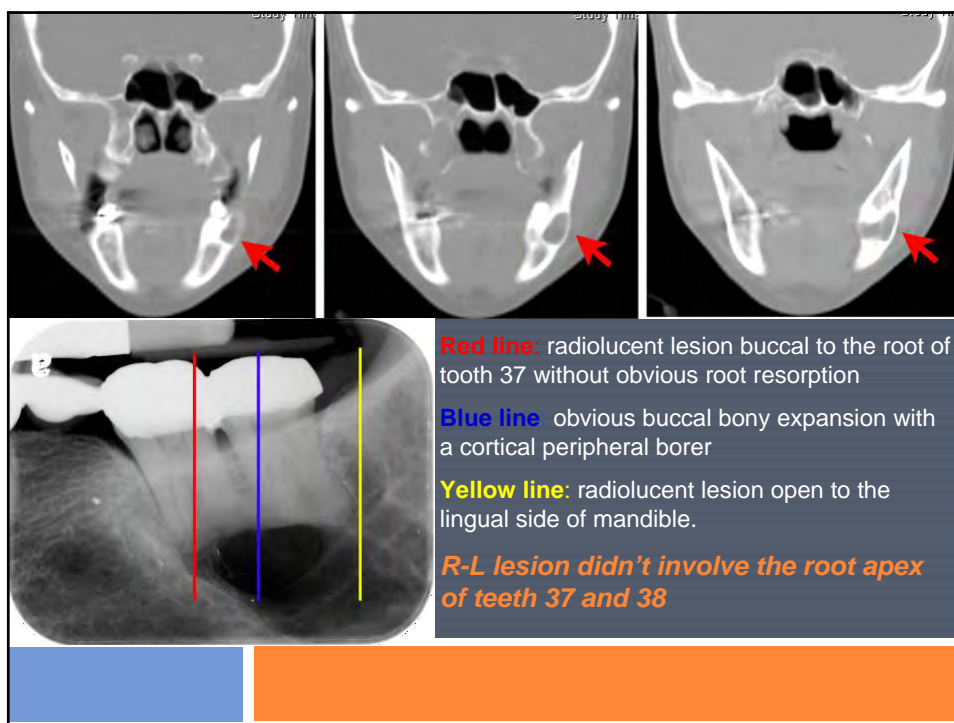
Medical CT

Medical CT of head and neck without and with contrast enhancement reported:

well defined cystic structure in the left posterior mandible, unilocular configuration with involving the tooth root. The wall is intact.

IMP: left mandibular cyst, simple or radicular cyst





- The radiolucent images observed in the mandible or maxilla surrounding the root apex may lead to an **erroneous diagnosis** of apical periodontitis.
- It is essential to consider that periradicular lesions can be of **endodontic or nonendodontic origin**.
- The accurate diagnosis is important to ensure the **maintenance of pulpal vitality**, which contributes to a better prognosis.

Determining whether periapical radiolucency is a cyst or periapical granuloma cannot be done with conventional radiographs.

Until a biopsy is taken, the clinician does not know the histologic diagnosis.

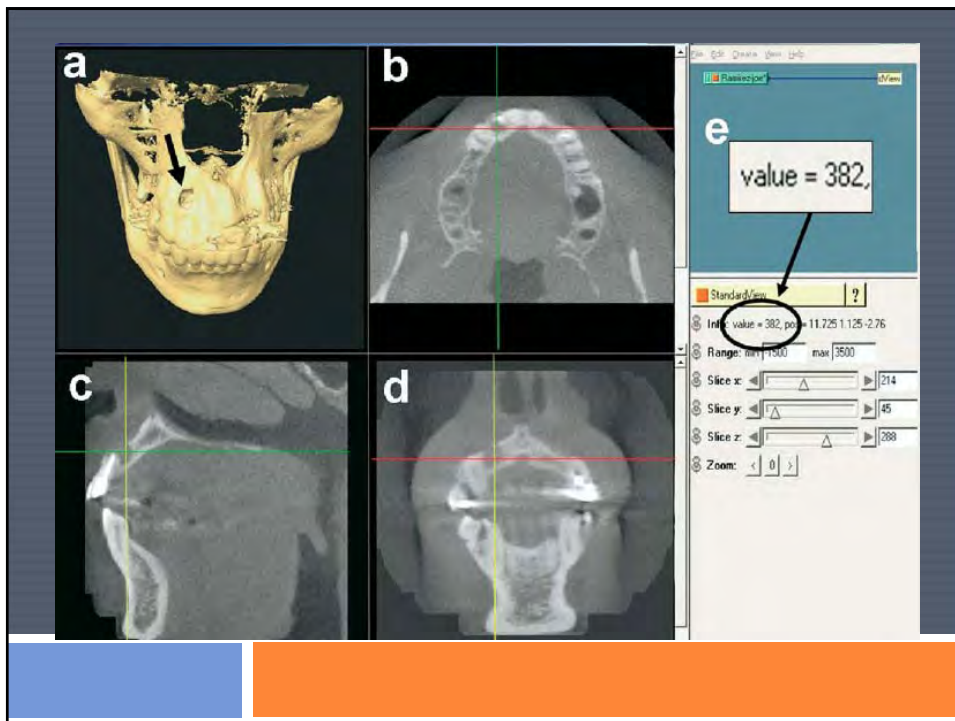
Trope et al. (1989) stated that a cyst could be differentiated from a granuloma by a CT scan depending on different density.



Simon et al (2006)

- compared the differential diagnosis of large periapical lesions using CBCT and biopsy
- 17 large periapical radiolucencies (equal to or greater than 1x1cm measured by CBCT)

J Endod 2006;32:833–837



13 of the 17 lesions had the same diagnosis by the CBCT-scan data and the biopsy report.

TABLE 1. Results of seventeen large periapical lesions scanned by the CBCT-scan and by biopsy report

Case #	Tooth #	Dx NewTom/ biopsy	(a) Center	(b) Min	(c) Max	(d) Lips	(e) Buccal cortical bone	(f) Lingual cortical bone
Caps								
1	9,10	CAP/CAP	301	-49	521	-996	2200	1413
2	10	CAP/CAP	203	-169	246	-842	1507	1254
3	7	CAP/CAP	125	8	438	-537	1436	990
4	10	CAP/CAP	226	233	451	-605	1439	964
5	8	CAP/CAP	564	496	642	-429	1592	1384
6	8-9	CAP/CAP	692	451	717	-426	1974	2120
Cysts								
7	9,11	CYST/CYST	-348	-634	-147	-865	1536	1078
8	12	CYST/CYST	-358	-657	-316	-716	1195	1267
9	8,9	CYST/CYST	-468	-563	-113	-670	993	1605
10	7,8	CYST/CYST	-160	-384	-169	-703	1211	1501
11	7	CYST/CYST	-43	-88	197	-462	1562	928
12	10	CYST/CYST	-127	-316	-43	-449	1829	1231
13	6,7,8,9	CYST/CYST	-462	-546	-166	-813	1549	1029
Differential diagnostic								
14	9,10	CYST/CAP	-358	-563	-17	-436	1423	1114
15	8	CYST/CAP	-139	-675	66	-735	1844	797
16	9	CYST/CAP	-143	-387	54	-660	1536	1455
17	7	CYST/CAP	-306	-514	-98	-472	1442	1387

Positive measurements represented **solid soft tissue** as opposed to negative numbers representing **fluid filled cavities or cavity (air filled) space**.

- **Simon et al** found that the CBCT *may* be clinically more accurate and more useful than the biopsy because of shortcomings in histological technique.

Conclusion

- CBCT may provide a better, more accurate, faster method to differentially diagnosis a solid from a fluid filled lesion or cavity.

Thank you