

# Osteomyelitis

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# Osteomyelitis

# Osteomyelitis

- **Definition:** inflammatory condition of the bone, which begins as an infection of the medullary cavity, rapidly involves the haversian systems, and extends to involve the periosteum of the affected area
- Only 2 out of every 10,000 people get osteomyelitis.

# Predisposing factors

- Diabetes (most cases of osteomyelitis stem from diabetes)
- Sickle cell disease
- HIV or AIDS
- Rheumatoid arthritis
- Intravenous drug use
- Alcoholism
- Long-term use of steroids
- Hemodialysis
- Poor blood supply
- Recent injury

# Osteomyelitis of the Jaws

- The potential source of infection is
  1. Periapical infection
  2. Periodontal pocket's
  3. Acute gingivitis
  4. Penetrating and contaminated injuries
  5. Tooth extraction

# Signs and symptoms

- Fever, irritability, fatigue
- Nausea
- Tenderness, redness, and warmth in the area of the infection
- Swelling around the affected bone
- Lost range of motion

# Classification

- Acute osteomyelitis is mainly in children (acute process occurs up to one month after the onset of symptoms)
- Chronic osteomyelitis (mainly adults)
  - primary chronic osteomyelitis (PCO) is defined as chronic non-suppurative osteomyelitis; when PCO occurs in children and adolescents it is termed 'Garré's osteomyelitis'.
  - secondary chronic osteomyelitis (SCO), which is chronic osteomyelitis with suppuration, abscess/fistula formation, and sequestration at some stage of the disease due to a defined, infectious aetiology.

Reference	Classification	Classification criteria
Hjorting-Hansen E Decortication in treatment of osteomyelitis of the mandible. <i>Oral Surg Oral Med Oral Pathol</i> 1970 May;29(5):641-55	I. Acute/subacute osteomyelitis II. Secondary chronic osteomyelitis III. Primary chronic osteomyelitis	Classification based on clinical picture and radiology
Marx RE Chronic Osteomyelitis of the Jaws <i>Oral and Maxillofacial Surgery Clinics of North America, Vol 3, No 2, May 91,</i> 367-81 Mercuri LG Acute Osteomyelitis of the Jaws <i>Oral and Maxillofacial Surgery Clinics of North America, Vol 3, No 2, May 91,</i> 355-65	I. Acute osteomyelitis 1. Associated with Hematogenous spread* 2. Associated with intrinsic bone pathology or peripheral vascular disease* 3. Associated with odontogenic and nonodontogenic local processes* II. Chronic osteomyelitis 1. Chronic recurrent multifocal osteomyelitis of children 2. Garrè's osteomyelitis 3. Chronic suppurative osteomyelitis – Foreign body related – Systemic disease related – Related to persistent or resistant organisms 4. True chronic diffuse sclerosing osteomyelitis	Classification based on clinical picture and radiology, etiology, and pathophysiology Classification of acute osteomyelitis by Mercuri, classification of chronic osteomyelitis by Marx. The arbitrary time limit of one month is used to differ acute from chronic osteomyelitis * From Waldvogel and Medoff 1970
Panders AK, Hadders HN Chronic sclerosing inflammations of the jaw. Osteomyelitis sicca (Garre), chronic sclerosing osteomyelitis with fine-meshed trabecular structure, and very dense sclerosing osteomyelitis. <i>Oral Surg Oral Med Oral Pathol</i> 1970 Sep;30(3):396-412	I. Primarily chronic jaw inflammation 1. Osteomyelitis sicca (synonymous osteomyelitis of Garrè, chronic sclerosing nonsuppurative osteomyelitis of Garrè, periostitis ossificans) 2. Chronic sclerosing osteomyelitis with fine-meshed trabecular structure 3. Local and more extensive very dense sclerosing osteomyelitis II. Secondary chronic jaw inflammation III. Chronic specific jaw inflammations – Tuberculosis – Syphilis – Lepa – Actinomycosis	Classification based on clinical picture and radiology Classification of chronic osteomyelitis forms only

***ONSET OF  
DISEASE***

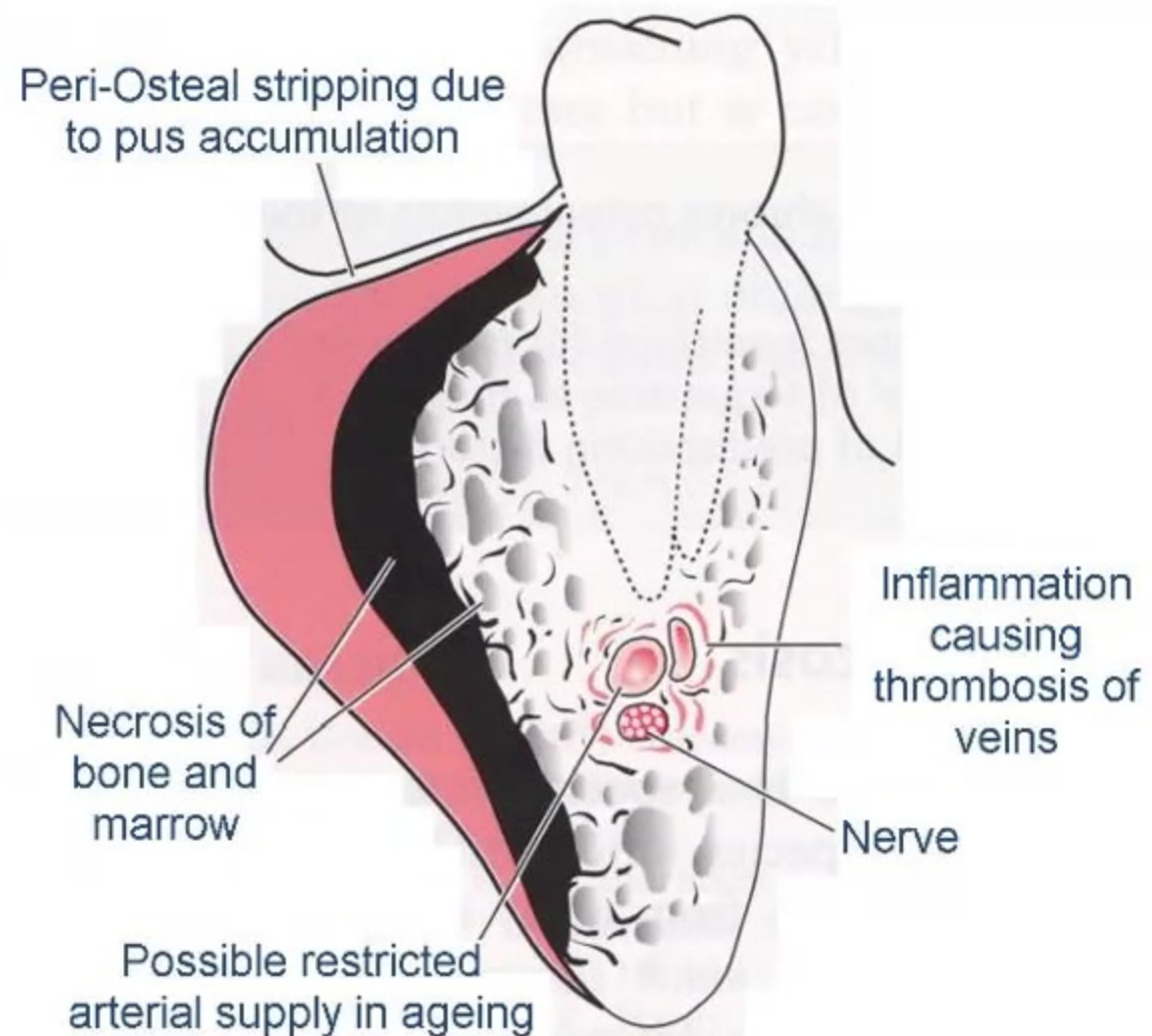
*Acute osteomyelitis*



*t*

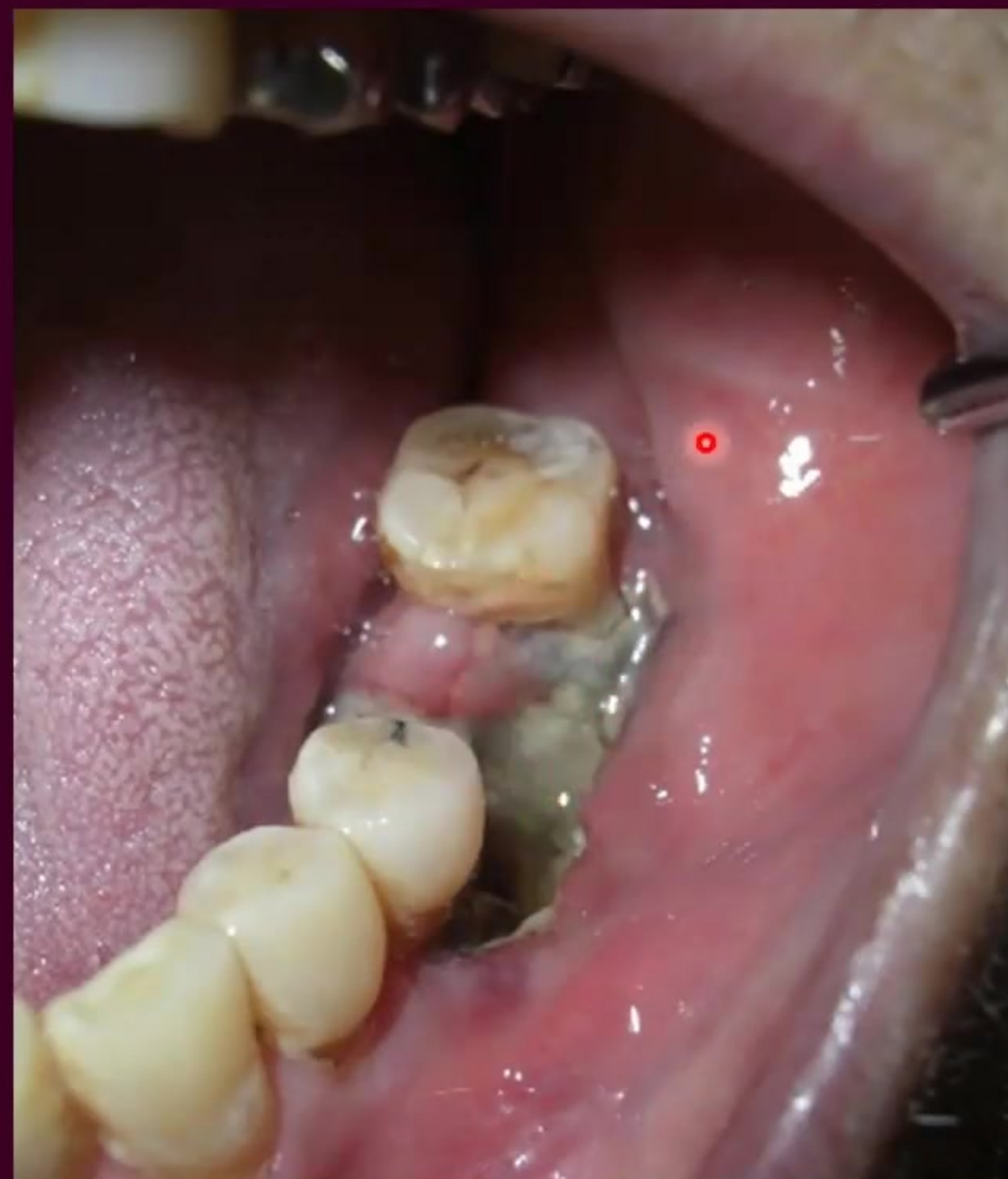
*Onset of disease*  
*Deep bacterial invasion into  
medullary & cortical bone*





### Pathogenesis of Mandibular **Osteomyelitis**

Inflammation causes thrombosis of vessels in the marrow, '*peri-osteal stripping*' by pus (or surgery) causes loss of peri-osteal blood supply, with consequent bone necrosis. This encourages continuance of infection as well as bone resorption.



Suei Y, Taguchi A, Tanimoto K. Diagnosis and classification of mandibular osteomyelitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2005;100(2):207-14. PubMed PMID: 16037779.

# Alveolar osteitis ( Dry socket)

- **Localized inflammation of bone following either failure of blood clot to form in socket, or premature loss or disintegration of clot.**

**Unpredictable complication of tooth extraction (~1-3%).**



# Alveolar osteitis ( Dry socket)

- **Etiology:**

1. **Failure of blood clot formation due to Poor blood supply as in:**
  - . Paget's disease.
  - . Osteopetrosis.
  - . Following radiotherapy.
  - . Excessive use of vasoconstrictor in local anesthesia.

2. **Premature loss of blood clot may be due to:**
  - . Excessive mouth rinsing.
  - . Fibrinolysis by proteolytic bacteria.



# Alveolar osteitis ( Dry socket)

## Clinical picture :

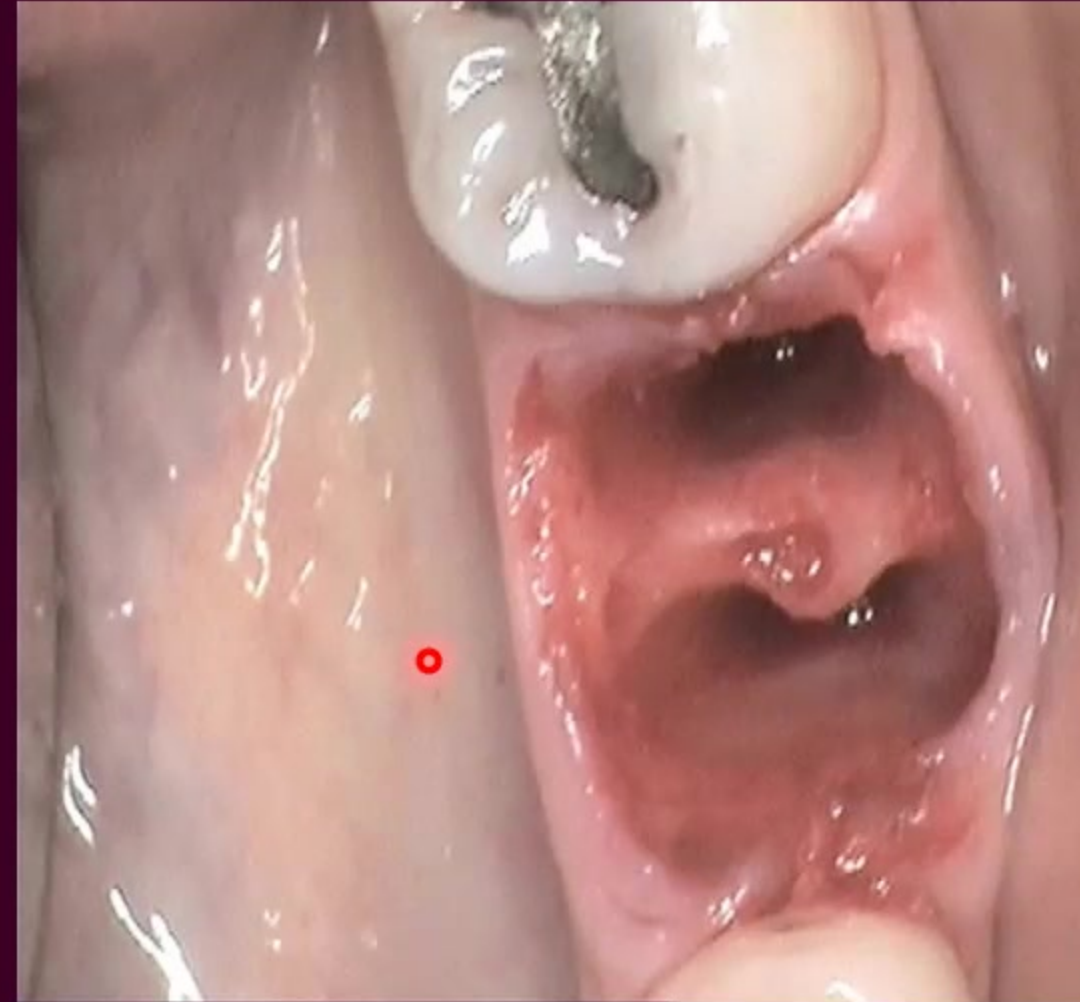
1. Intense pain .
2. Most frequently seen in :
  - . 3<sup>rd</sup> molar extraction
  - . Difficult extraction with trauma
  - . Smoker .
3. tooth socket appears empty and dry
4. jaw bone is visible in the tooth socket
5. Bad breath and Unpleasant taste .
6. Swollen of regional lymph node .



# Alveolar osteitis ( Dry socket)

- **Histopathology:**

Histological section of socket wall reveal formation of necrotic bone containing empty lacunae



# Osteonecrosis

- Osteoradionecrosis
- Osteochemonecrosis (corticosteroids and other cancer and antineoplastic drugs)
  - MRONJ (medication-induced osteonecrosis)
    - BRONJ (bisphosphonate-induced osteonecrosis)
  - Phosphorous necrosis of the jaw (exposure to white phosphorous)

# Osteoradionecrosis and Radioosteomyelitis

- Radiotherapy in HNSCC
- Osteoradionecrosis was once considered an infection initiated by bacteria, which invaded the radiationdamaged bone
- The term “radiation-induced osteomyelitis” or radioosteomyelitis was commonly used.  
Marx (1983)

HNSCC

- Radiation

Bone

- Hypoxia
- Hypocellular
- hypovascula

Trauma

- Chronic nonhealing wound
- Susceptible to superinfection



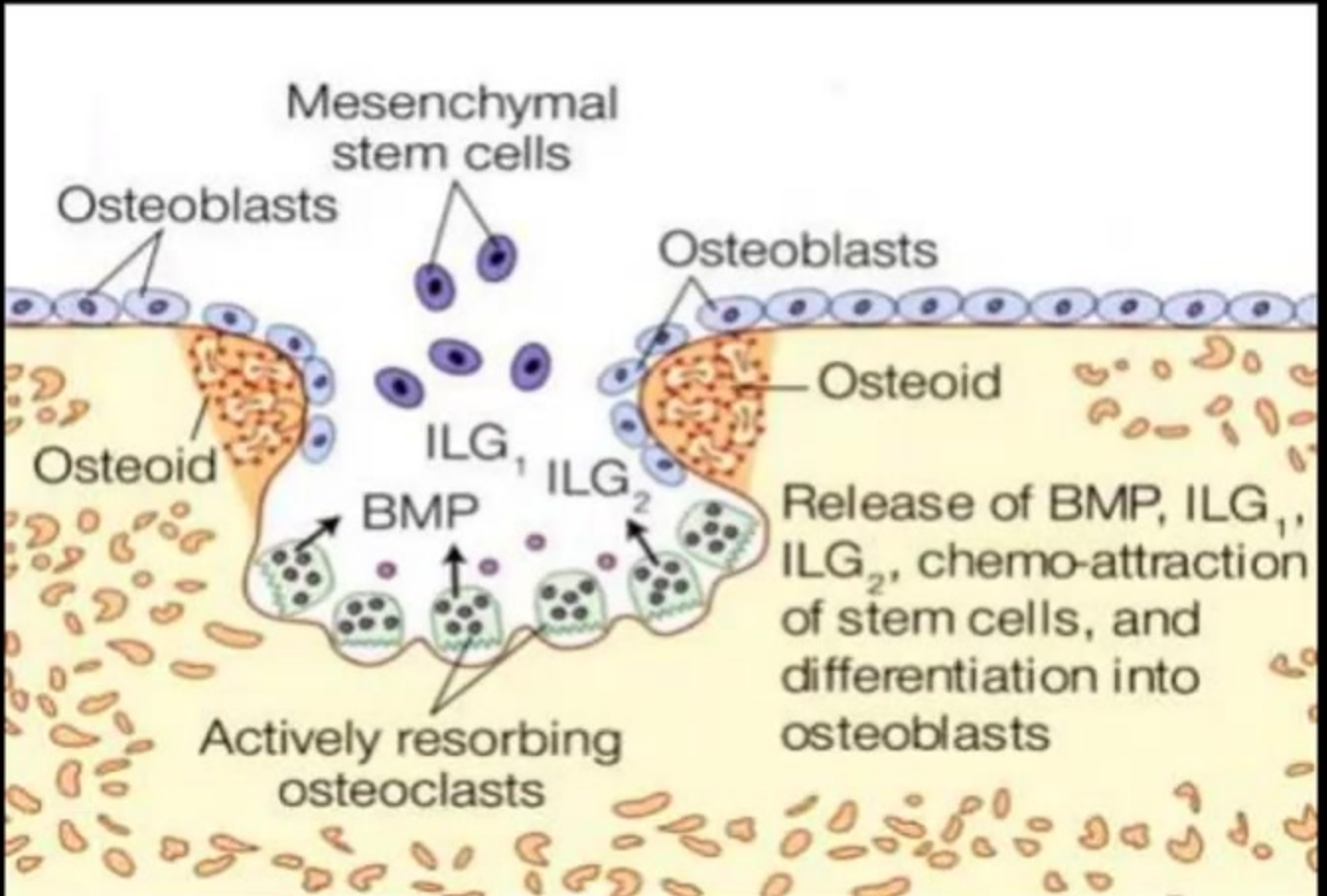
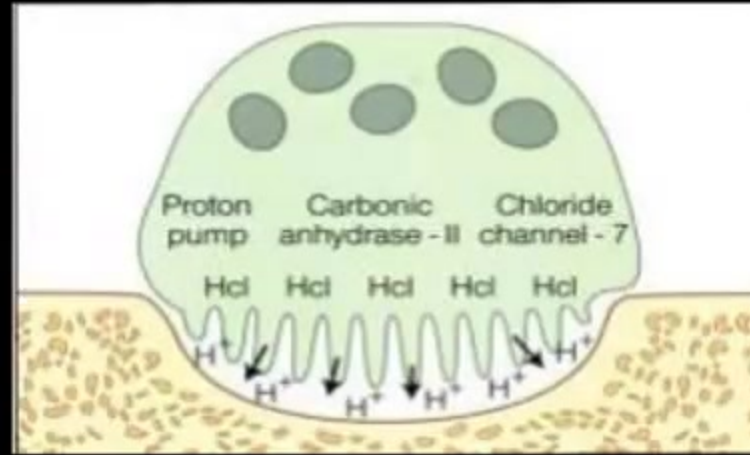
# BRONJ

- Bisphosphonate:
  - Osteoporosis
  - Multiple myeloma
  - Metastatic cancer

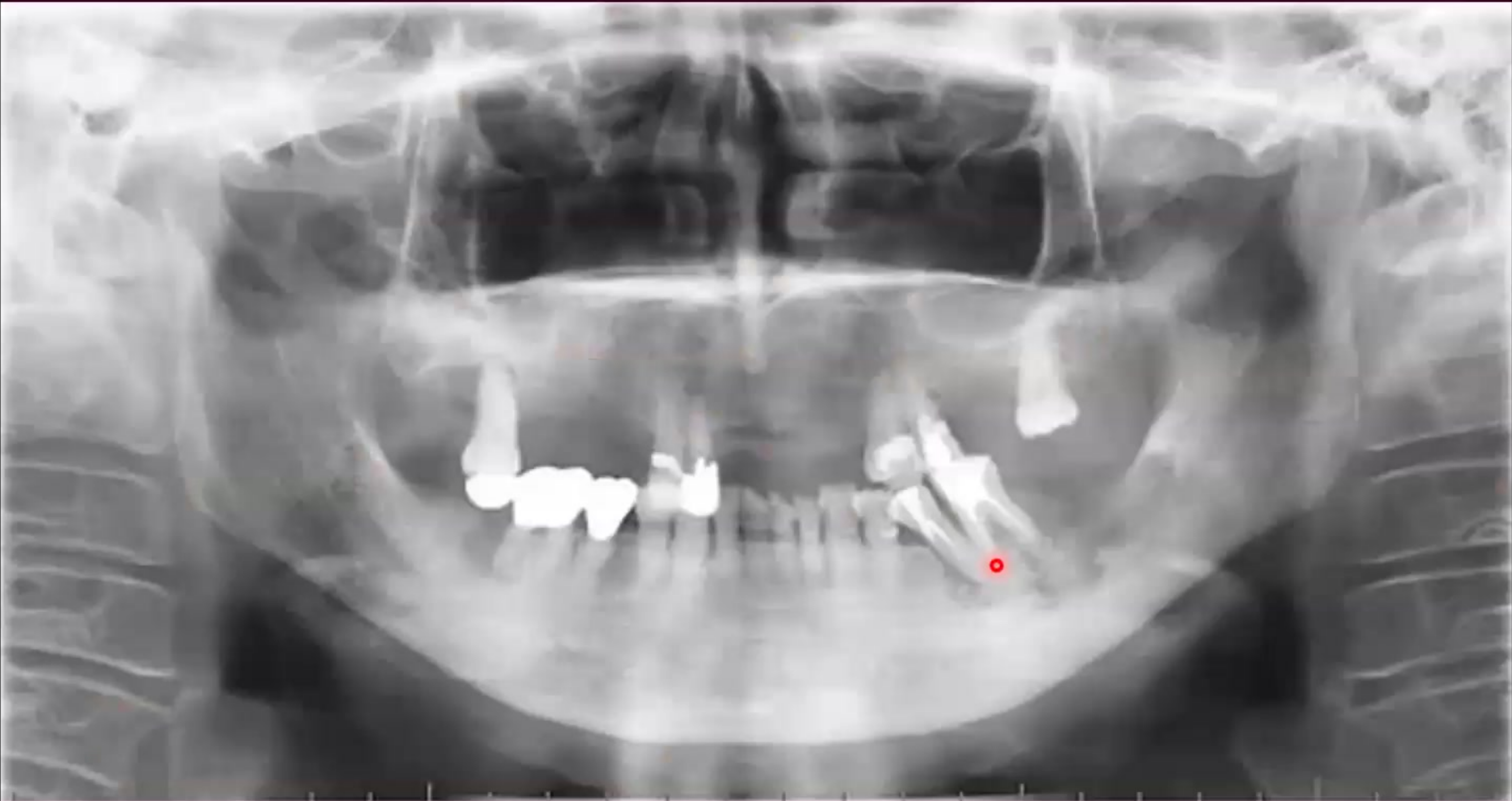


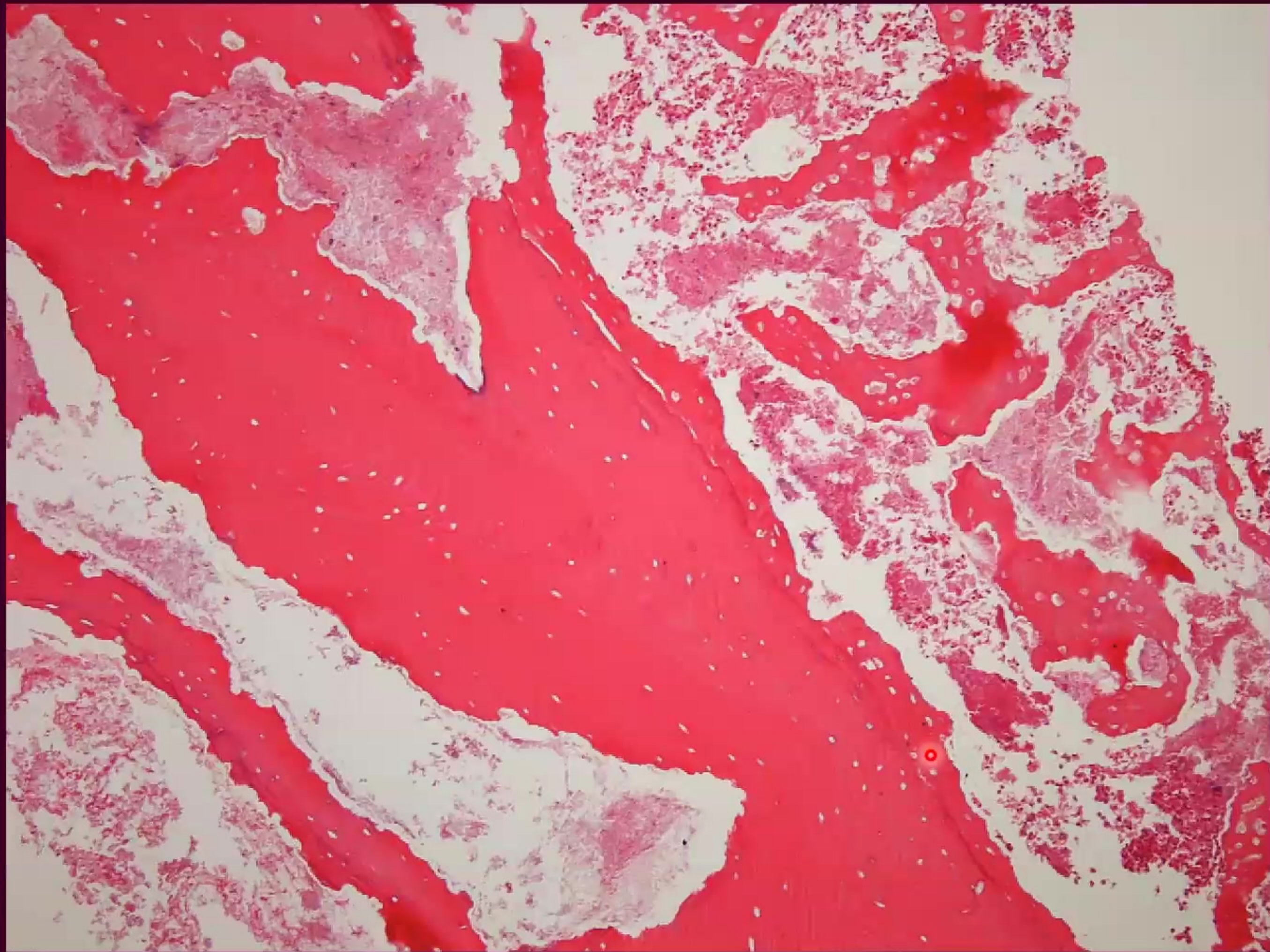
# Biologic Action of Bisphosphonates

- Osteoclastic toxicity
    - Apoptosis
    - Inhibited release of bone induction proteins
      - BMP, ILG1, ILG2
    - Reduced bone turnover, resorption
    - Reduced serum calcium\*
    - Hypermineralization\*
      - “sclerotic” changes in lamina dura of alveolar bone
- \* = *goal of medicinal use*











saving faces | changing lives\*

American Association of Oral and Maxillofacial Surgeons

# Position Paper

## Medication-Related Osteonecrosis<sup>9</sup> of the Jaw—2014 Update

### Special Committee on Medication- Related Osteonecrosis of the Jaws:

Salvatore L. Ruggiero, DMD, MD, Clinical Professor, Division of Oral and Maxillofacial Surgery, Stony Brook School of Dental Medicine, Hofstra North Shore-LIJ School of Medicine, New York Center for Orthognathic and Maxillofacial Surgery, Lake Success, NY

Thomas B. Dodson, DMD, MPH, Professor and Chair, Associate Dean for Hospital Affairs, University of Washington School of Dentistry, Department of Oral and Maxillofacial Surgery, Seattle, WA

John Fantasia, DDS, Chief, Division of Oral Pathology, Hofstra North Shore-LIJ School of Medicine, New Hyde Park, NY

Reginald Goodday, Professor, Department of Oral and Maxillofacial Sciences, Dalhousie University, Halifax, NS

Tara Aghaloo DDS, MD, PhD, Associate Professor, Oral and Maxillofacial Surgery, Assistant Dean for Clinical Research, UCLA School of Dentistry, Los Angeles, CA

### Introduction

The Special Committee recommends changing the nomenclature of bisphosphonate-related osteonecrosis of the jaw (BRONJ). The Special Committee favors the term **medication-related osteonecrosis of the jaw (MRONJ)**. The change is justified to accommodate the growing number of osteonecrosis cases involving the maxilla and mandible associated with other antiresorptive (denosumab) and antiangiogenic therapies.

MRONJ adversely affects the quality of life, producing significant morbidity. Strategies for management of patients with, or at risk for, MRONJ were set forth in the American Association of Oral and Maxillofacial Surgeons (AAOMS) updated *Position Paper on Bisphosphonate-Related Osteonecrosis of the Jaws* and approved by the Board of Trustees in 2009.<sup>1</sup> The *Position Paper* was developed by a Special Committee appointed by the Board and composed of clinicians with extensive experience in caring for these patients and basic science researchers. The knowledge base and experience in addressing MRONJ has expanded, necessitating modifications and refinements to the previous *Position Paper*. This Special Committee met in September 2013 to appraise the current literature and revise the guidelines as indicated to reflect current knowledge in this field. This update contains revisions to

Format: Abstract

Send to

*Oral Surg Oral Med Oral Pathol Oral Radiol.* 2015 Aug;120(2):207-26. doi: 10.1016/j.oooo.2015.03.001. Epub 2015 Mar 11.

## World Workshop on Oral Medicine VI: Controversies regarding dental management of medically complex patients: assessment of current recommendations.

[Napeñas JJ](#)<sup>1</sup>, [Kujan O](#)<sup>2</sup>, [Arduino PG](#)<sup>3</sup>, [Sukumar S](#)<sup>4</sup>, [Galvin S](#)<sup>5</sup>, [Baričević M](#)<sup>6</sup>, [Costella J](#)<sup>7</sup>, [Czerninski R](#)<sup>8</sup>, [Peterson DE](#)<sup>9</sup>, [Lockhart PB](#)<sup>10</sup>.

### Author information

#### Abstract

**OBJECTIVES:** Current recommendations for safe and effective dental management are less than optimal for some medical conditions because of limited evidence, conflicting conclusions, or both. This review (1) compiled and evaluated dental management recommendations for select medical conditions; (2) summarized recommendations and their assigned levels of evidence; (3) identified areas of conflict, ambiguity, or both; and (4) identified issues that warrant future research, enhanced consensus statements, or both.

**STUDY DESIGN:** Systematic literature searches were performed for guideline publications, systematic and narrative reviews, and opinion documents containing recommendations for (1) medication-related osteonecrosis of the jaw (MRONJ); (2) cardiovascular diseases (CVDs); (3) prosthetic joints (PJs); and (4) systemic steroid therapy (SST).

**RESULTS:** The search yielded the following numbers of publications that met the inclusion criteria: MRONJ - 116; CVDs - 54; prosthetic joints - 39; and systemic steroids - 12.

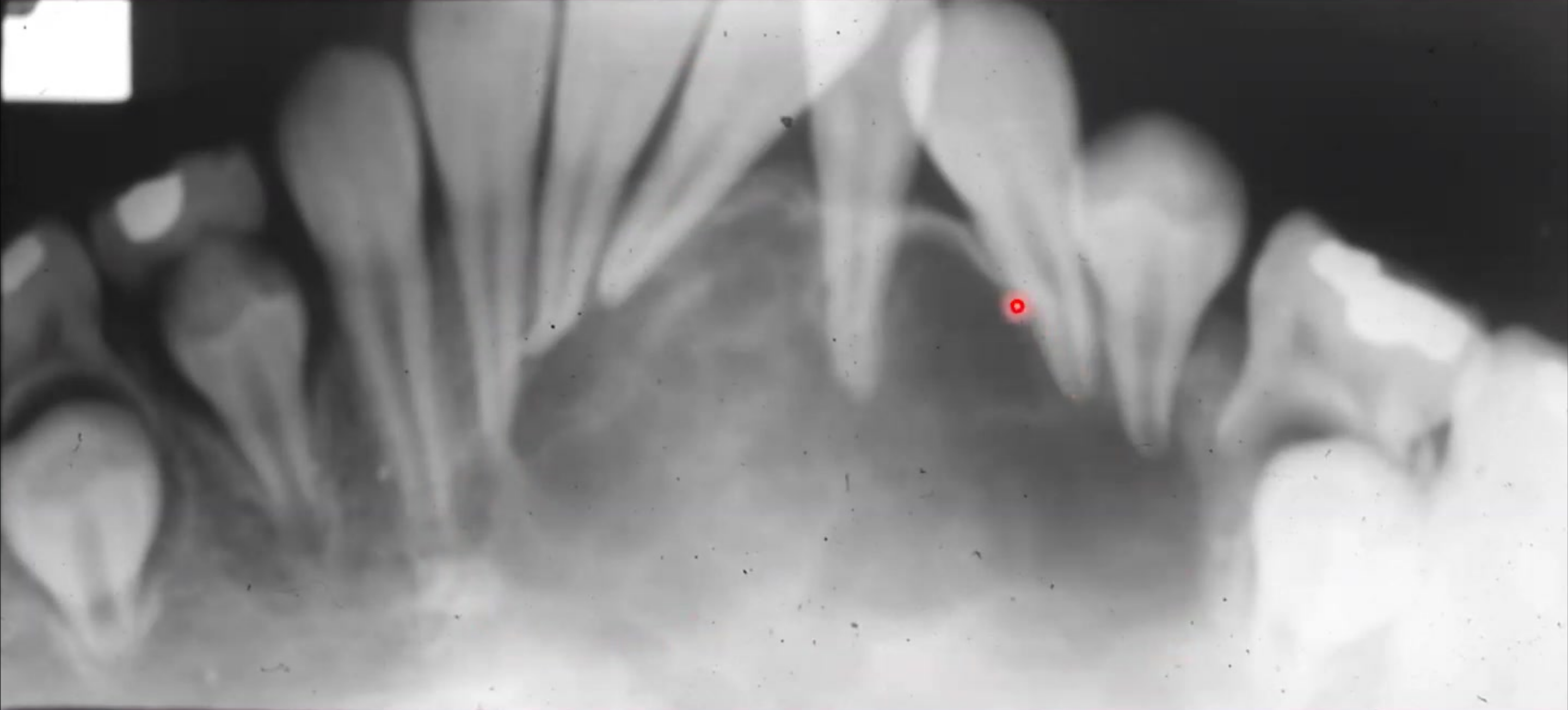
**CONCLUSIONS:** Very few of the compiled recommendations were assigned or linked to levels of evidence by their authors. Key conclusions include the following: MRONJ-expert recommendations trend toward proceeding with dental treatment with little to no modification in osteoporotic patients on bisphosphonates; CVDs-current recommendations are primarily directed to general surgery and applied to dentistry; PJs-routine antibiotic prophylaxis is not indicated for dental treatment; and SST-steroid supplementation is not indicated for most patients undergoing dental procedures under local anesthesia.

**Table III.** Key recommendations from guideline statements and systematic reviews: dental management of patients receiving bisphosphonates for osteoporosis (none of the publications assigned levels of evidence for any of the recommendations)

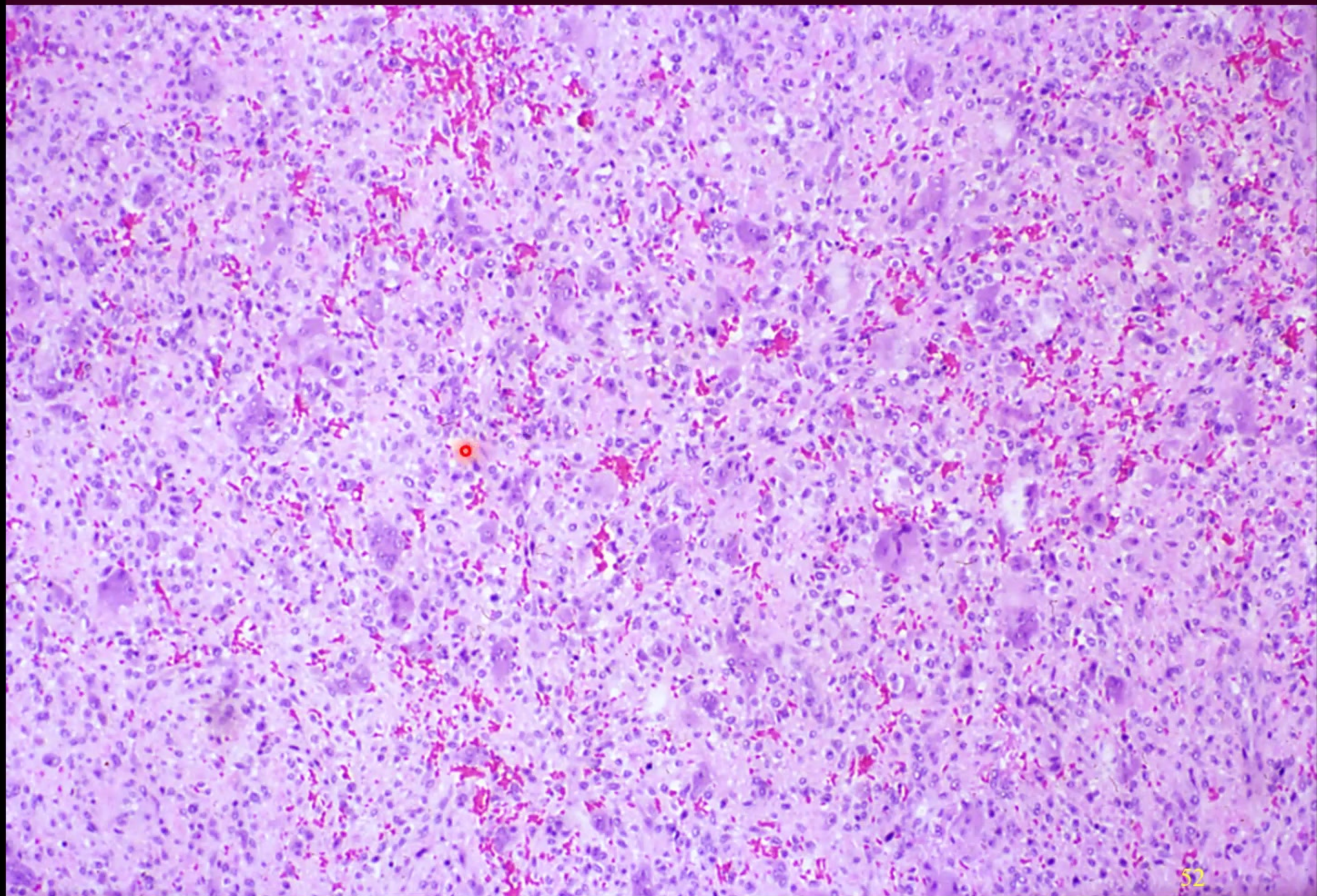
	<i>Level of evidence*</i>
	<i>Class of recommendation†</i>
In all patients, clinicians should discuss:	
• Importance of maintaining good oral hygiene <sup>19</sup>	NA
• Lifestyle changes, such as smoking cessation for those at high risk for MRONJ <sup>19</sup>	NA
• Very rare occurrence of MRONJ <sup>19</sup>	NA
Risk assessment and treatment planning - Potential risk factors for MRONJ:	
Oral risk factors:	
• Recent dentoalveolar trauma <sup>91-93</sup>	NA
• Dental extraction <sup>90,91</sup>	NA
• Dentoalveolar surgery <sup>91</sup>	NA
• Poor oral hygiene <sup>91</sup>	NA
• Oral infections <sup>91</sup>	NA
• Periodontal disease <sup>91</sup>	NA
Systemic risk factors:	
• Greater frequency of administration <sup>91</sup>	NA
• Larger BP dose <sup>91</sup>	NA
• Longer treatment regimens <sup>91</sup>	NA
• Radiation therapy <sup>91</sup>	NA
• Infectious disease <sup>91</sup>	NA
• Concomitant therapy with corticosteroids <sup>90,92</sup>	NA
• Compromised immune status or immunodeficiency <sup>92</sup>	NA
• Advanced age <sup>92</sup>	NA
• Chronic diseases <sup>92</sup>	NA

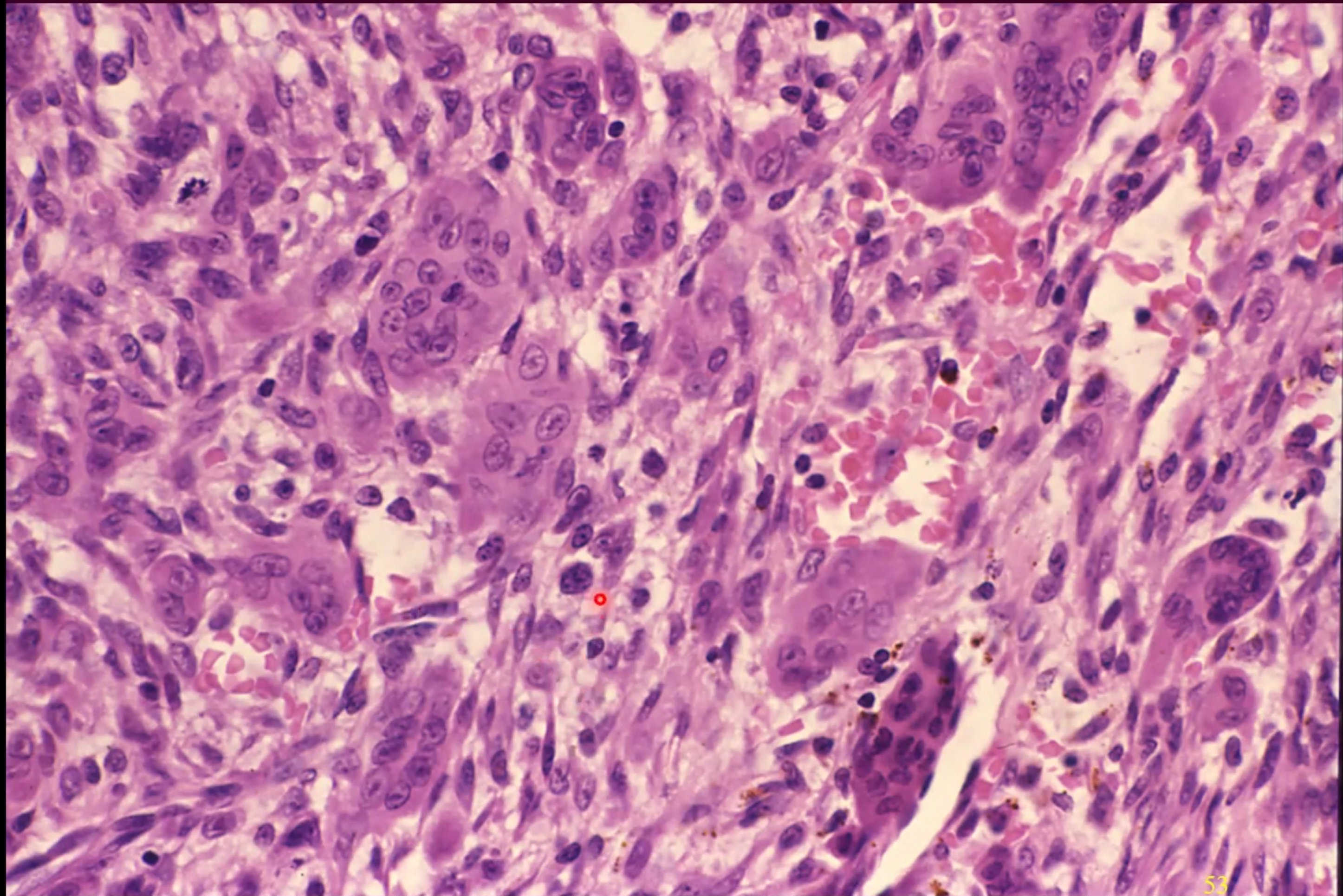


# Central Giant Cell Granuloma









# Central Giant Cell Granuloma

- Etiology: non-neoplastic – reactive lesion
- Age: wide range (60% < 30 years of age)
- Gender: female > male
- Site: anterior mandible (70%)
- Symptoms: painless expansion
- Radiograph:
  - unilocular to multilocular radiolucency
  - 0.5 – 10.0 cm

# Central Giant Cell Granuloma

## Histology:

- Multinucleated giant cells
- Spindled stroma
- Erythrocyte extravasation
- Hemosiderin deposits
- Fibrosis
- Osteoid formation

# Central Giant Cell Granuloma

- Treatment:
  - curettage
  - intra-lesional steroids
  - calcitonin
  - interferon alpha 2a
  - resection
- Prognosis:
  - non-aggressive
  - aggressive
  - recurrence (15-20%)

# Central Giant Cell Lesion

## Differential Diagnosis:

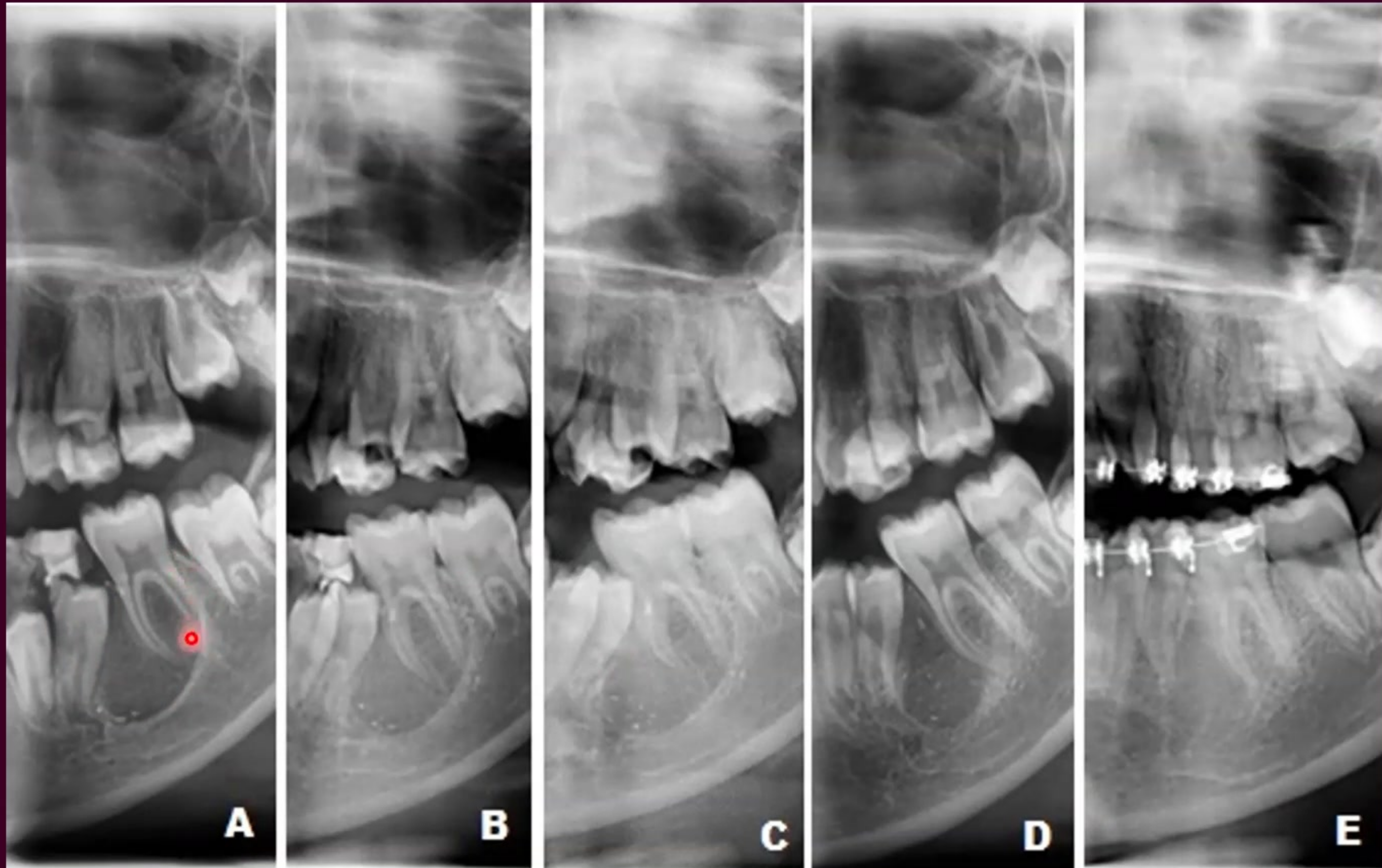
- Central giant cell granuloma
- Brown tumor – hyperparathyroidism
- Aneurysmal bone cyst
- Cherubism
- Giant cell tumor
- Benign fibro-osseous lesion

# Hyperparathyroidism

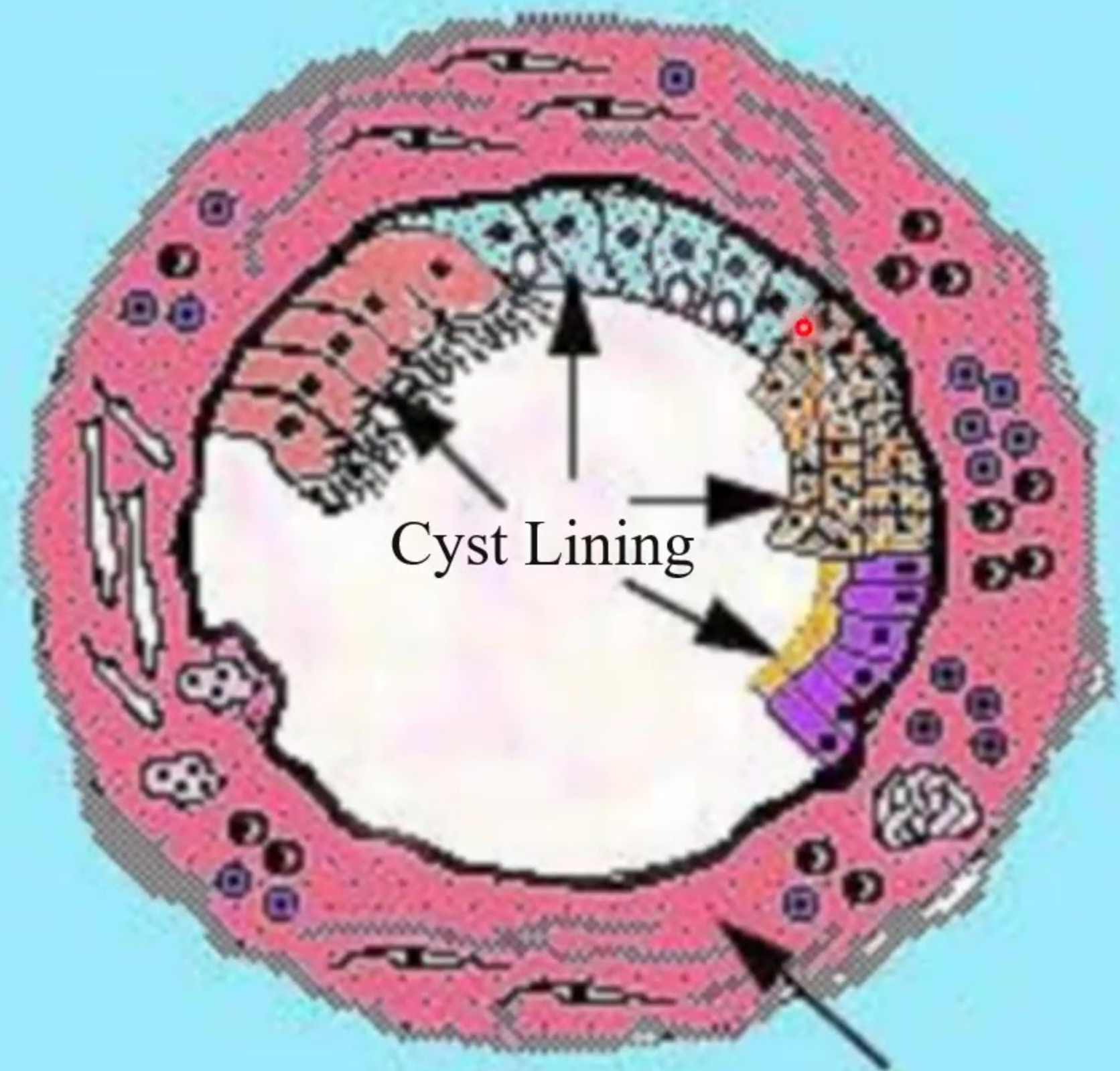
Brown tumour

(osteitis fibrosa cystica)





# Cysts of the jaws



Cyst Lining

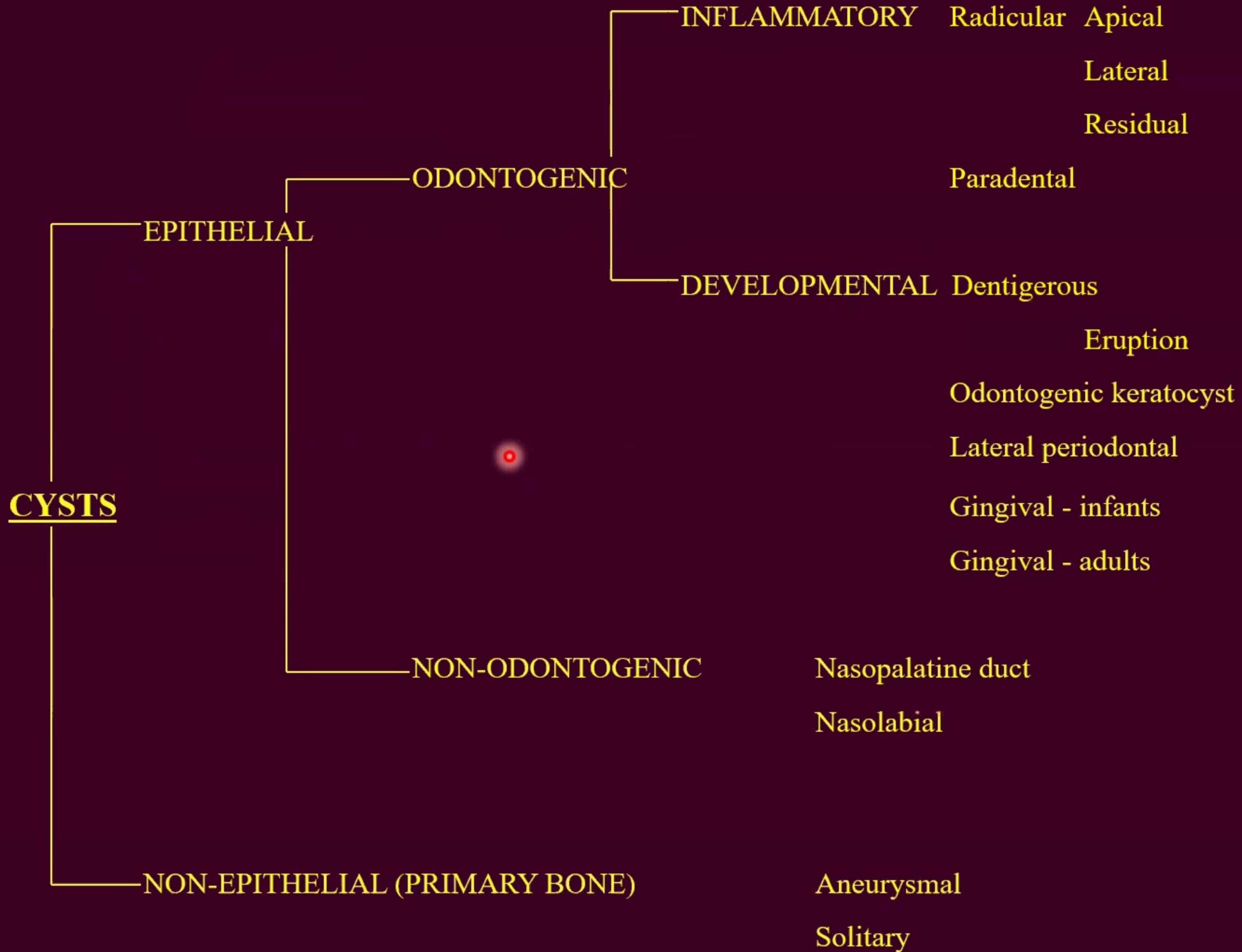
Cyst Wall

# Aetiology and pathogenesis

- Epithelial proliferation
- Hydrostatic or osmotic factors
- Keratin formation
- Bone resorbing factors (prostaglandins, collagenase)

# Clinical features

- Noticeable swelling
- Discharge into the mouth
- Pain due to secondary infection

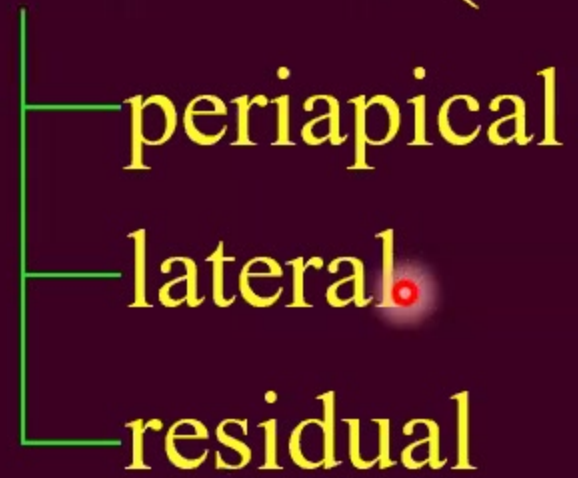


# Relative frequency

Odontogenic (90%)		Non-odontogenic (10%)	
<b>Radicular</b>	60-75%	Nasopalatine	5-10%
<b>Dentigerous</b>	10-15%	Others	1%
Keratocyst	5-10%		
<b>Paradental</b>	3-5%		
Gingival	< 1%		
Lateral periodontal	< 1%		

# Inflammatory Odontogenic Cysts

- Radicular (dental) cyst



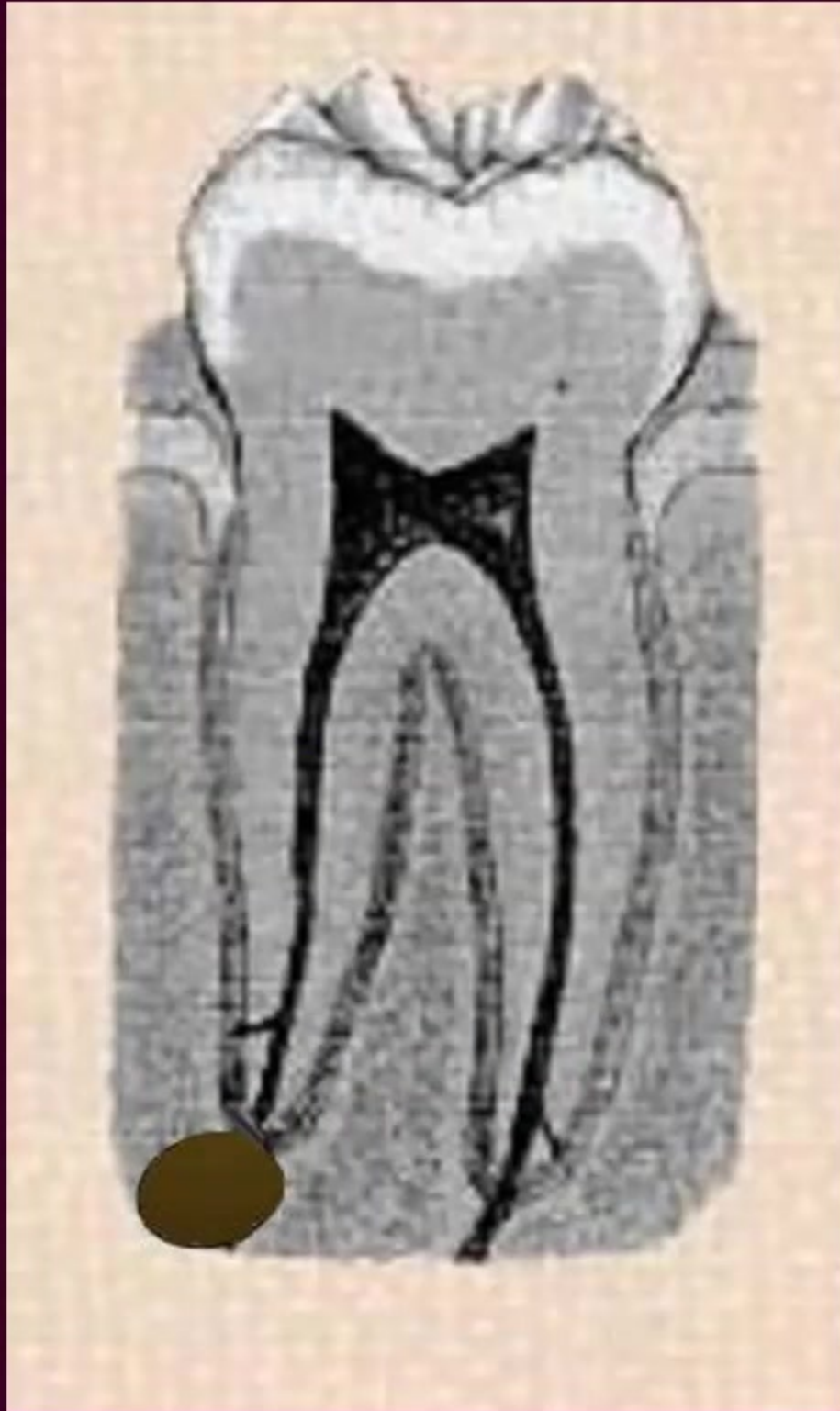
- Paradental cyst

# RADICULAR CYSTS

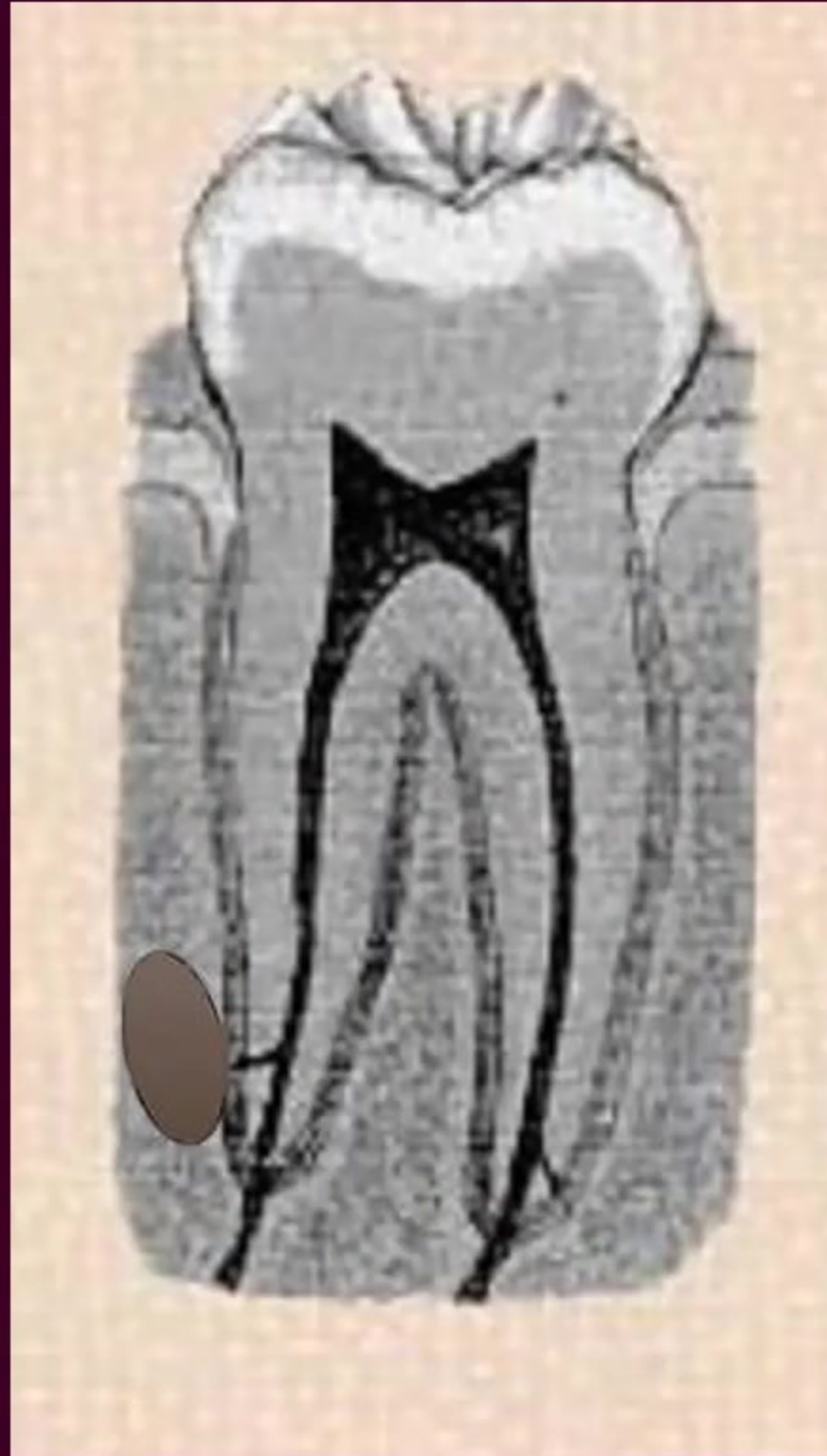
## Clinical Features

- 60-75% of all jaw cysts (Most Common)
- Peak in 4th and 5th decades
- Non-vital tooth
- Upper lateral incisor - most common tooth
- Rare in deciduous teeth
- Asymptomatic or expansion → springy → egg-shell crackling → fluctuation
- Infection → pain

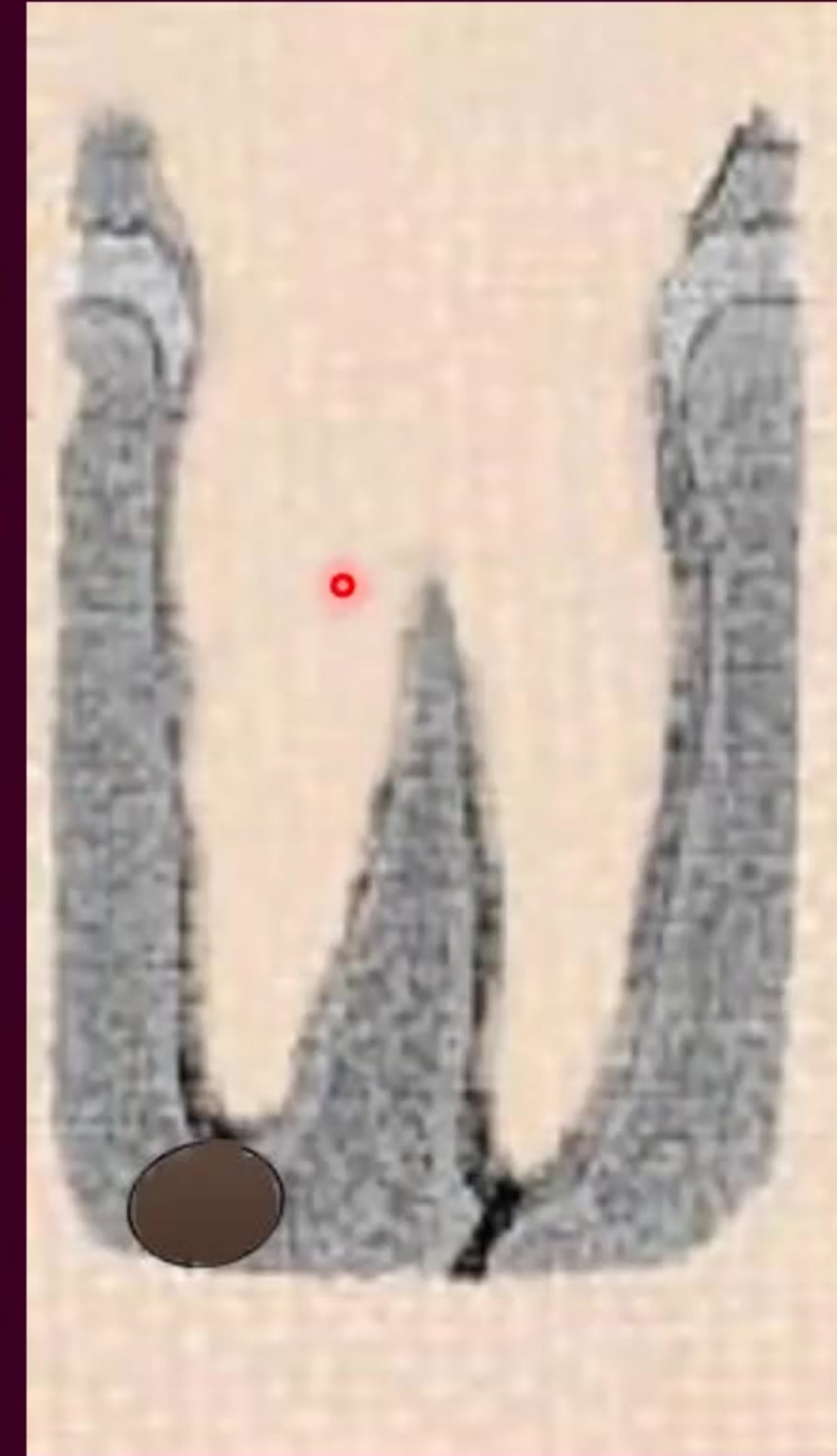
# Radicular Cyst



Apical



Lateral



Residual



# Radicular Cyst



# Radicular Cyst





Shape: Monolocular

Outline: Well defined

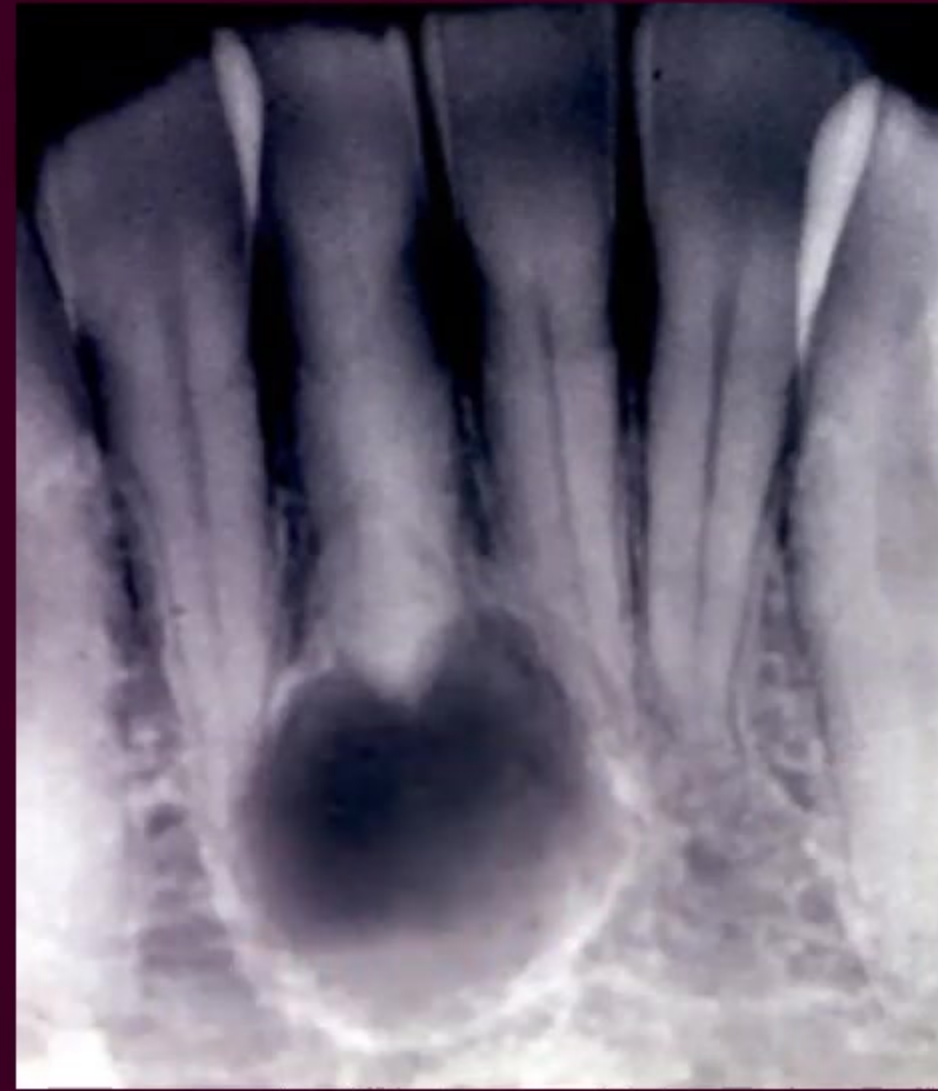
Well corticated

Radiodensity: Uniformly radiolucent

*Radicular cyst*



*Radicular cyst*

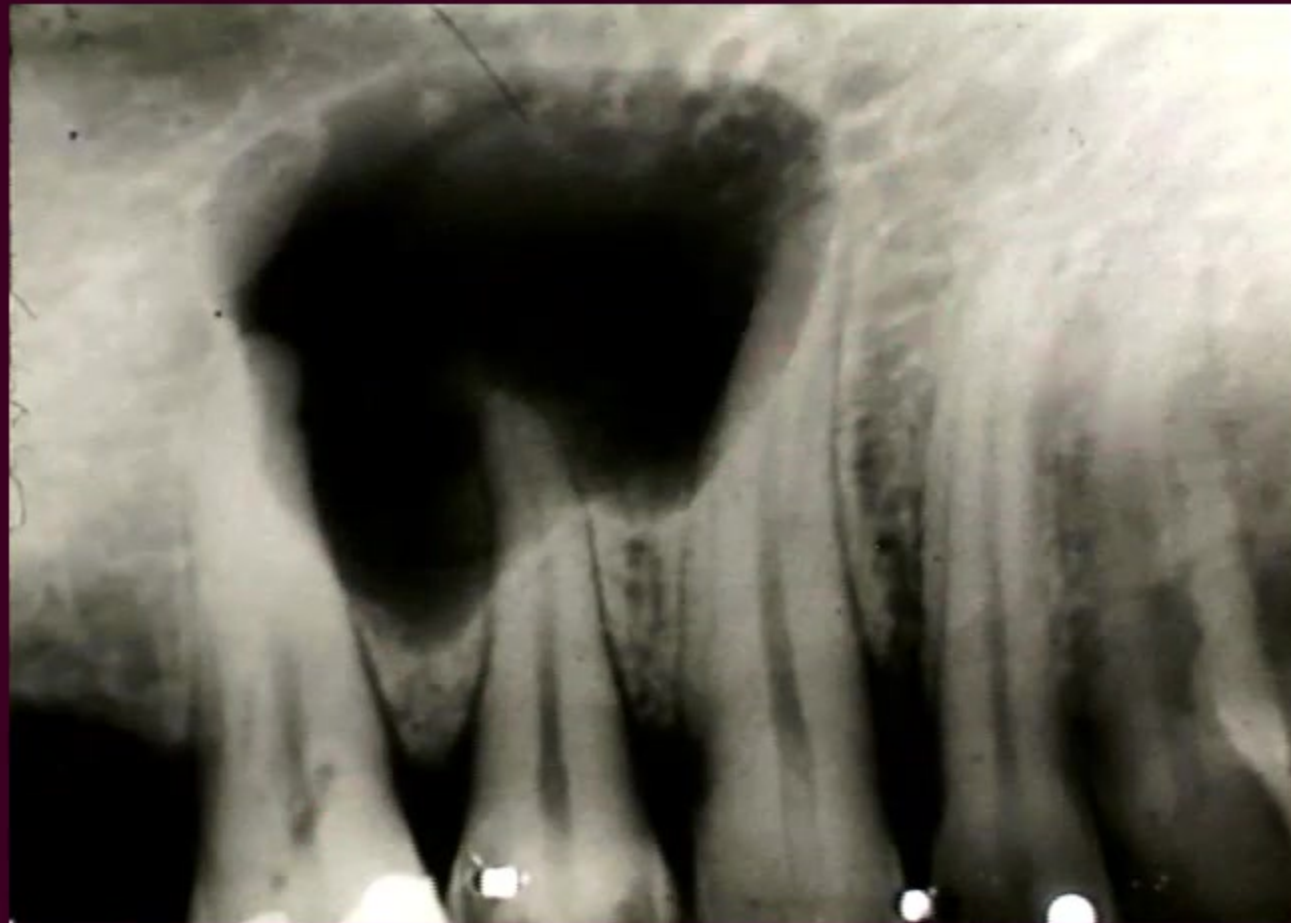
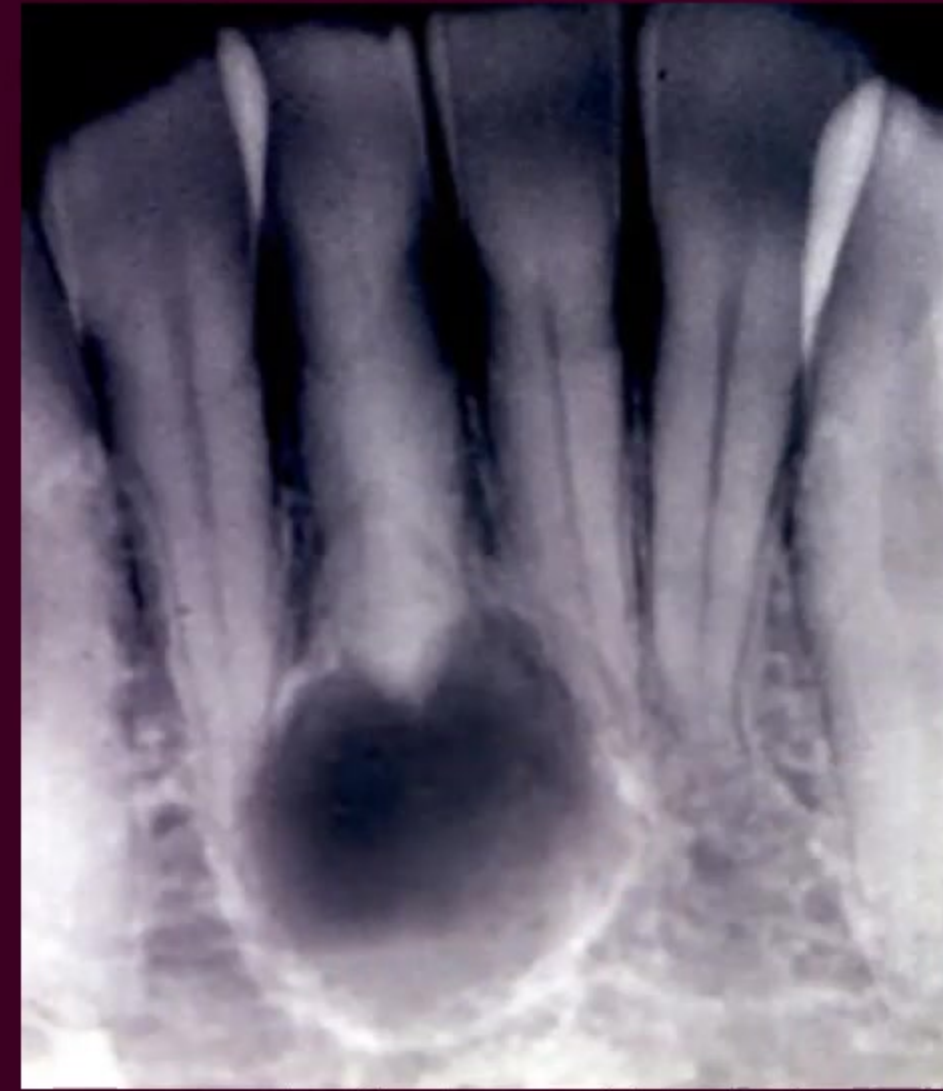


Shape: Monocular

Outline: Well defined

Well corticated

Radiodensity: Uniformly radiolucent



Shape: Monolocular

Outline: Well defined

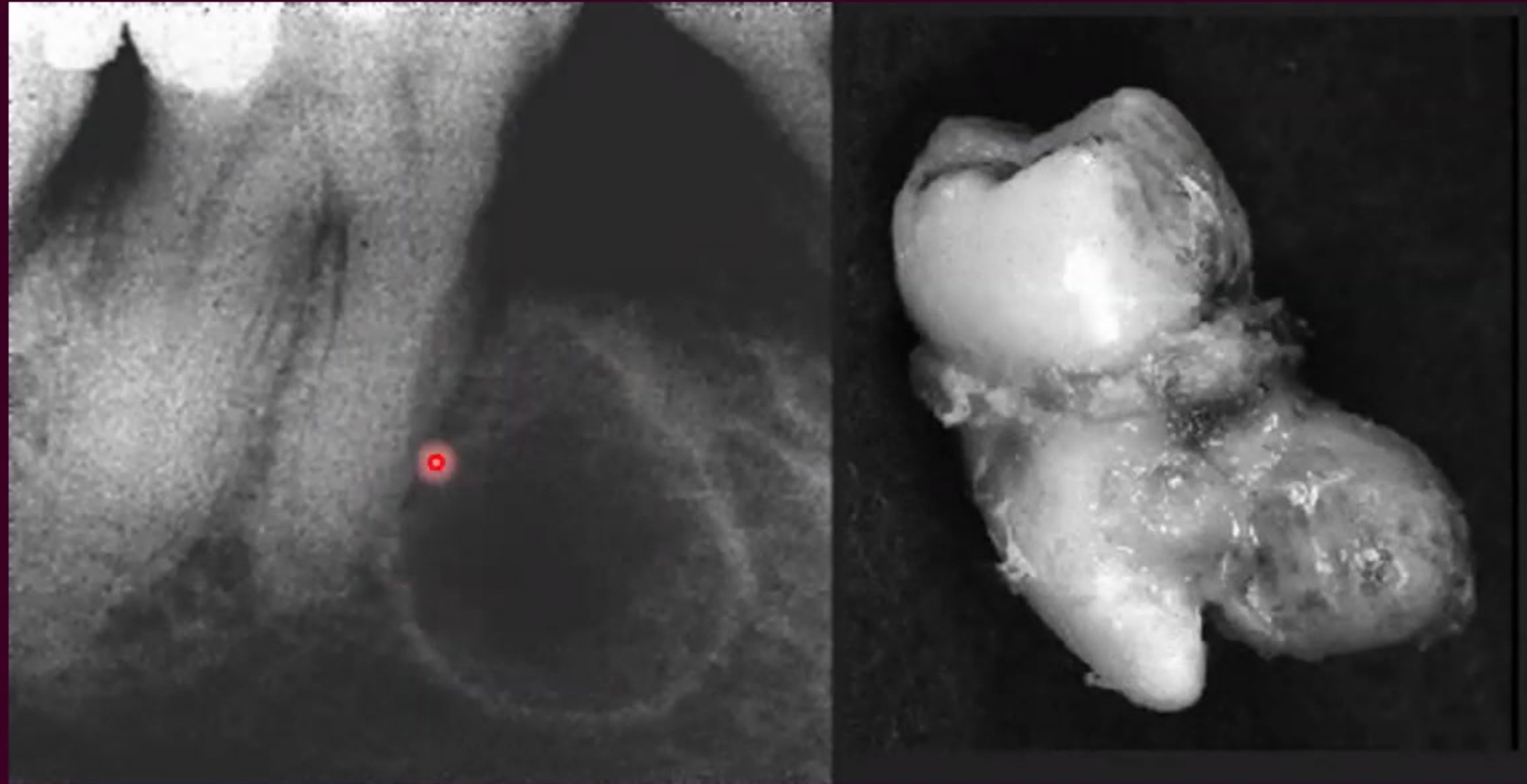
Well corticated

Radiodensity: Uniformly radiolucent

*Radicular cyst*

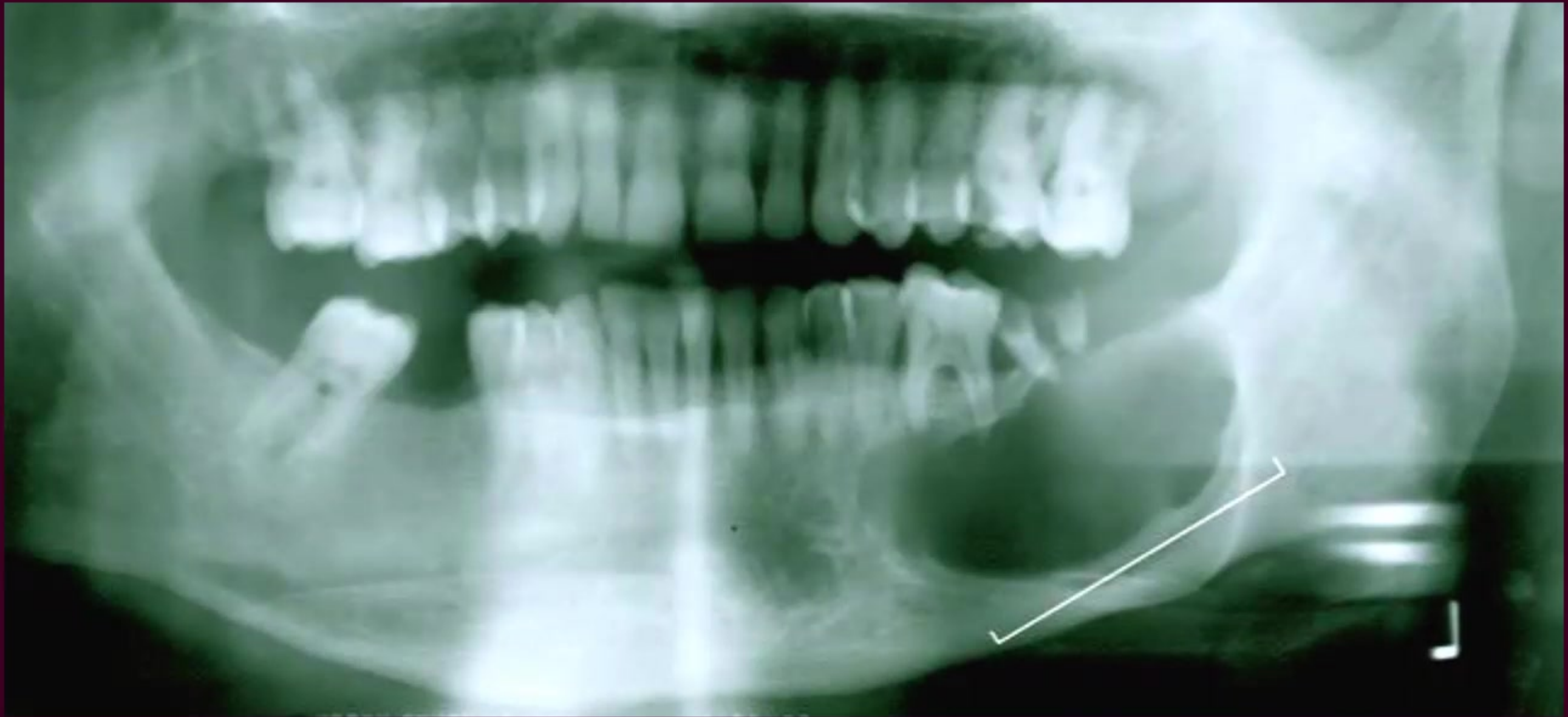


# Radicular Cyst



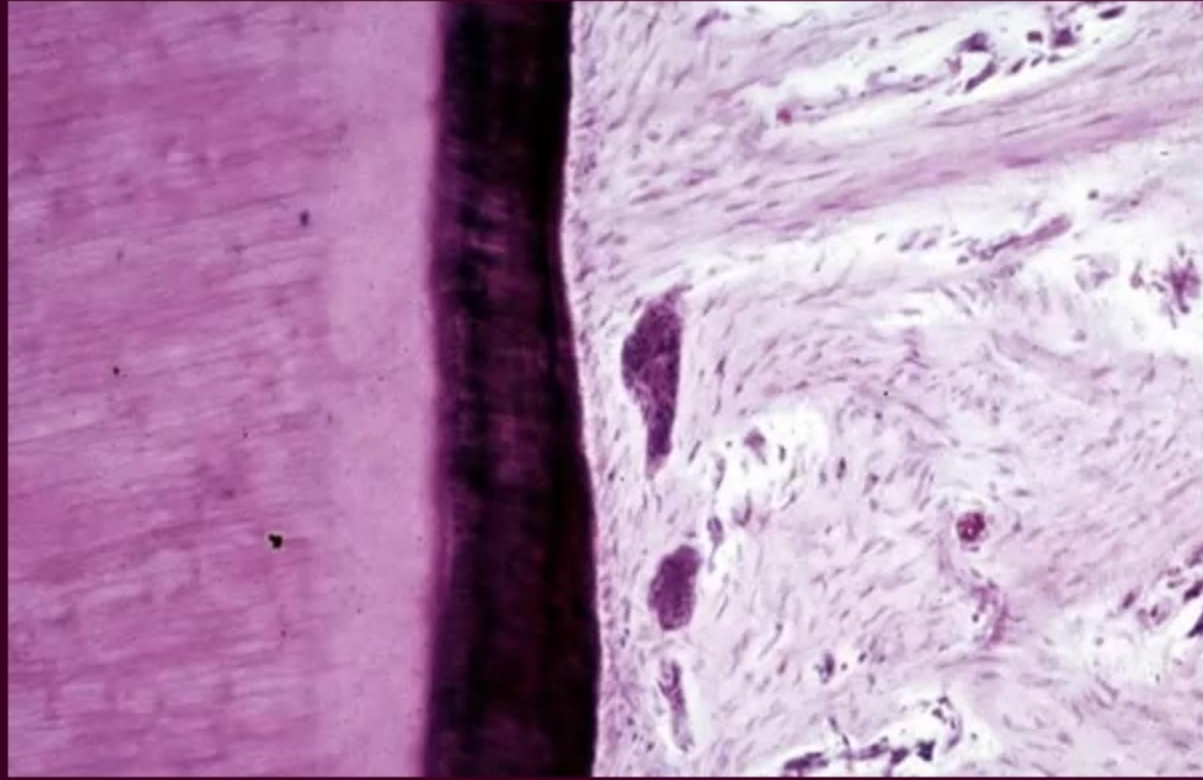
# Radicular Cyst





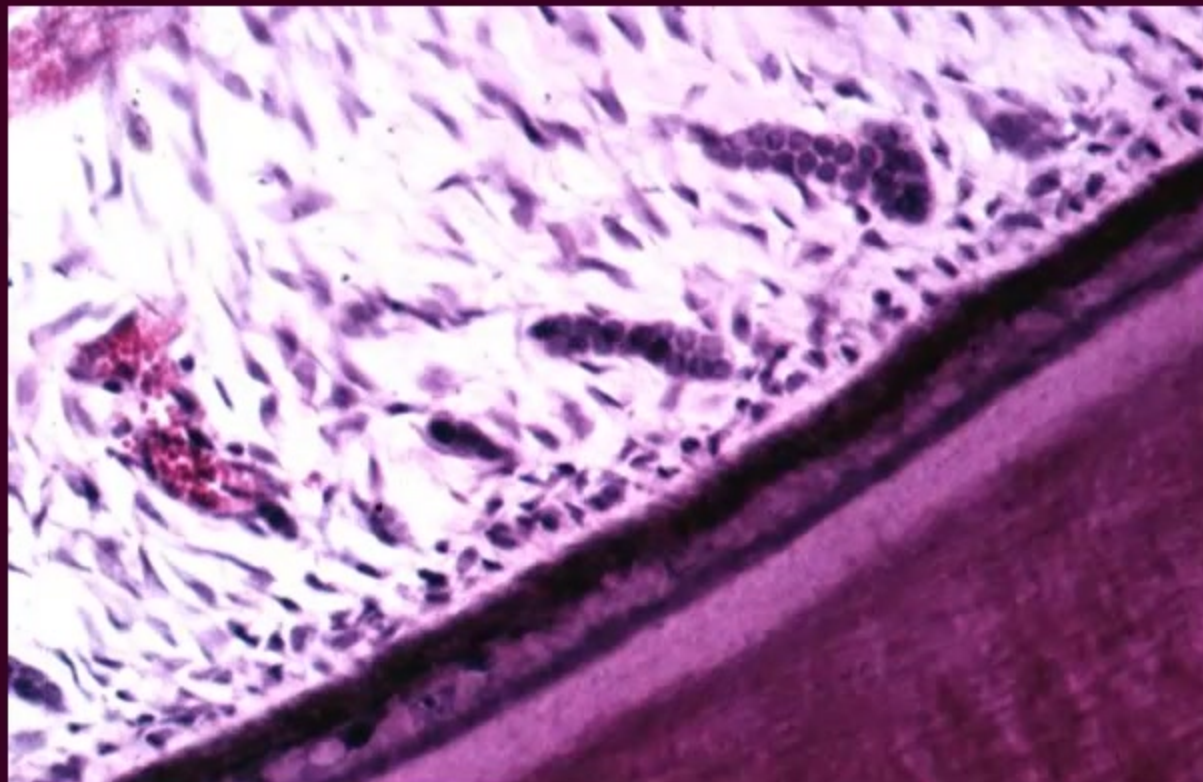
# RADICULAR CYST

## Pathogenesis



- **INITIATION**

- Cell rest of Malassez activated
- Activated by products of necrotic pulp

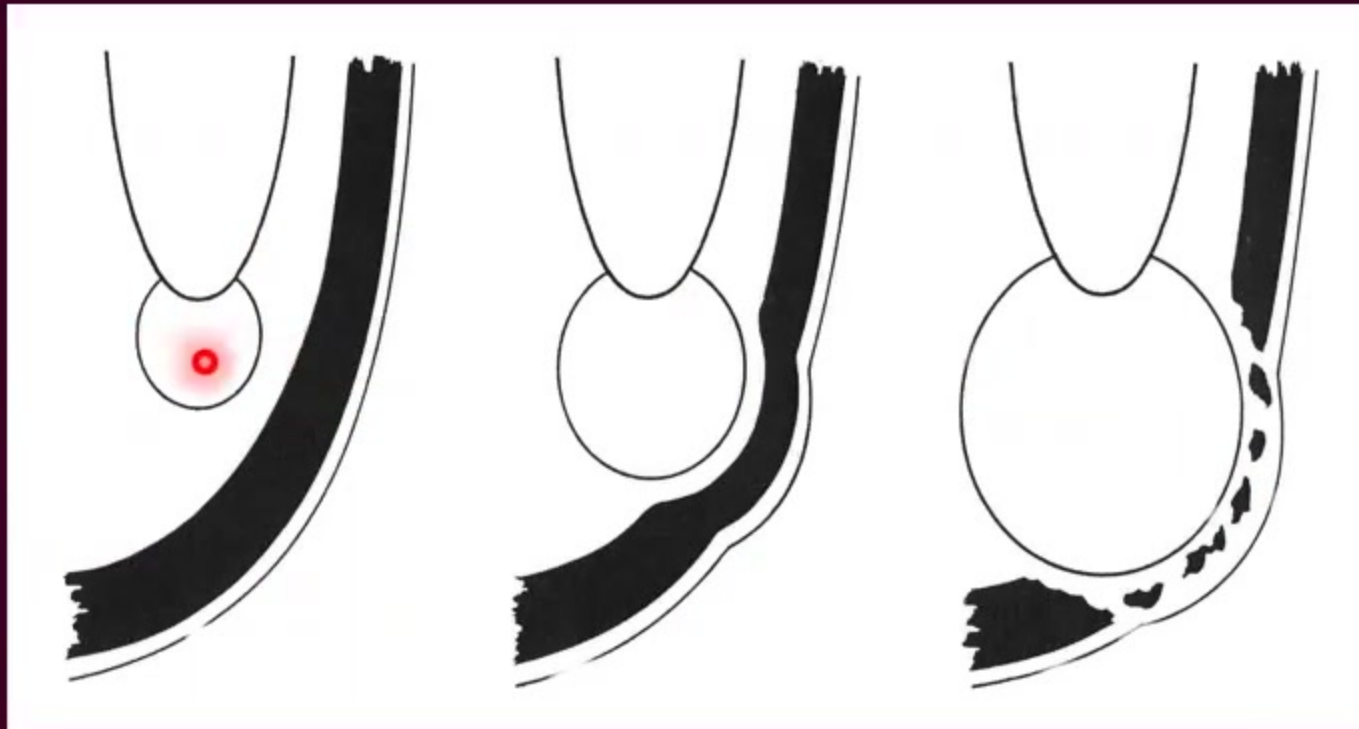


- **CYST FORMATION**

- Degeneration and death of central cells leads to cavitation

# RADICULAR CYST

## Pathogenesis

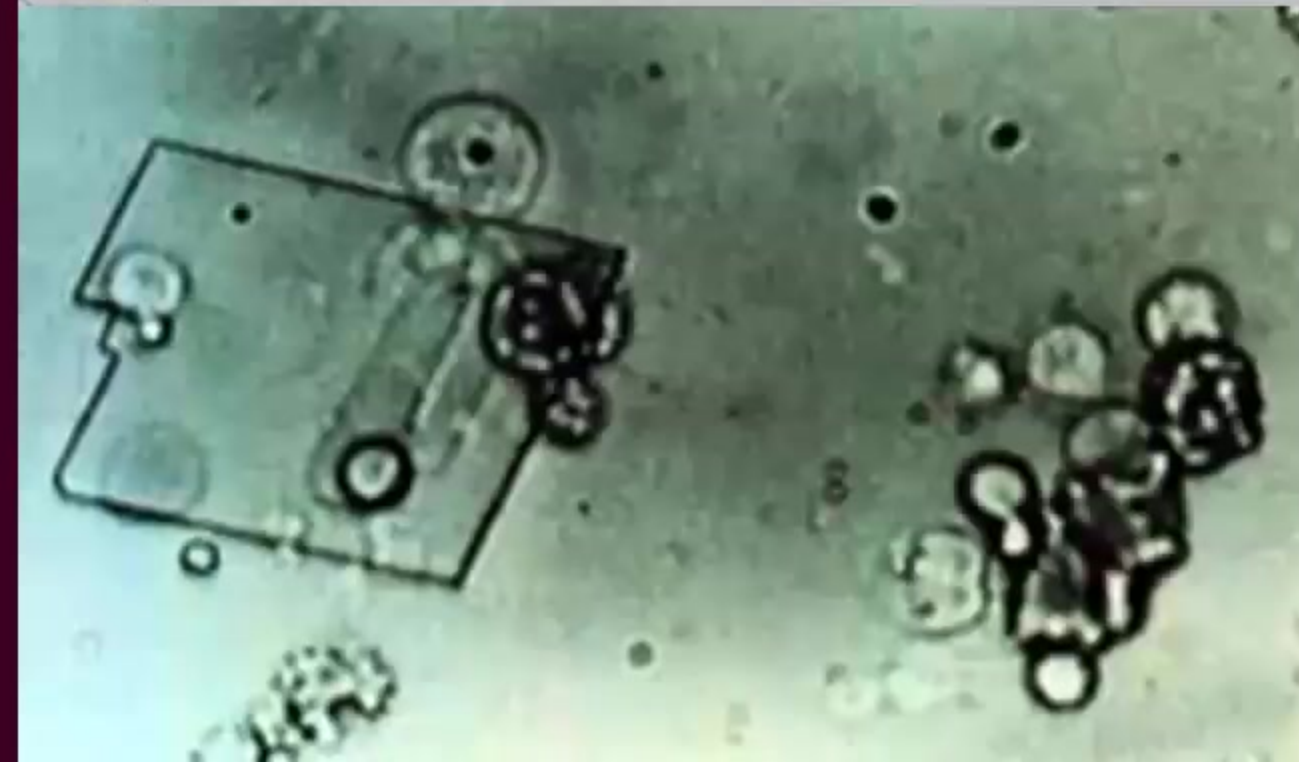
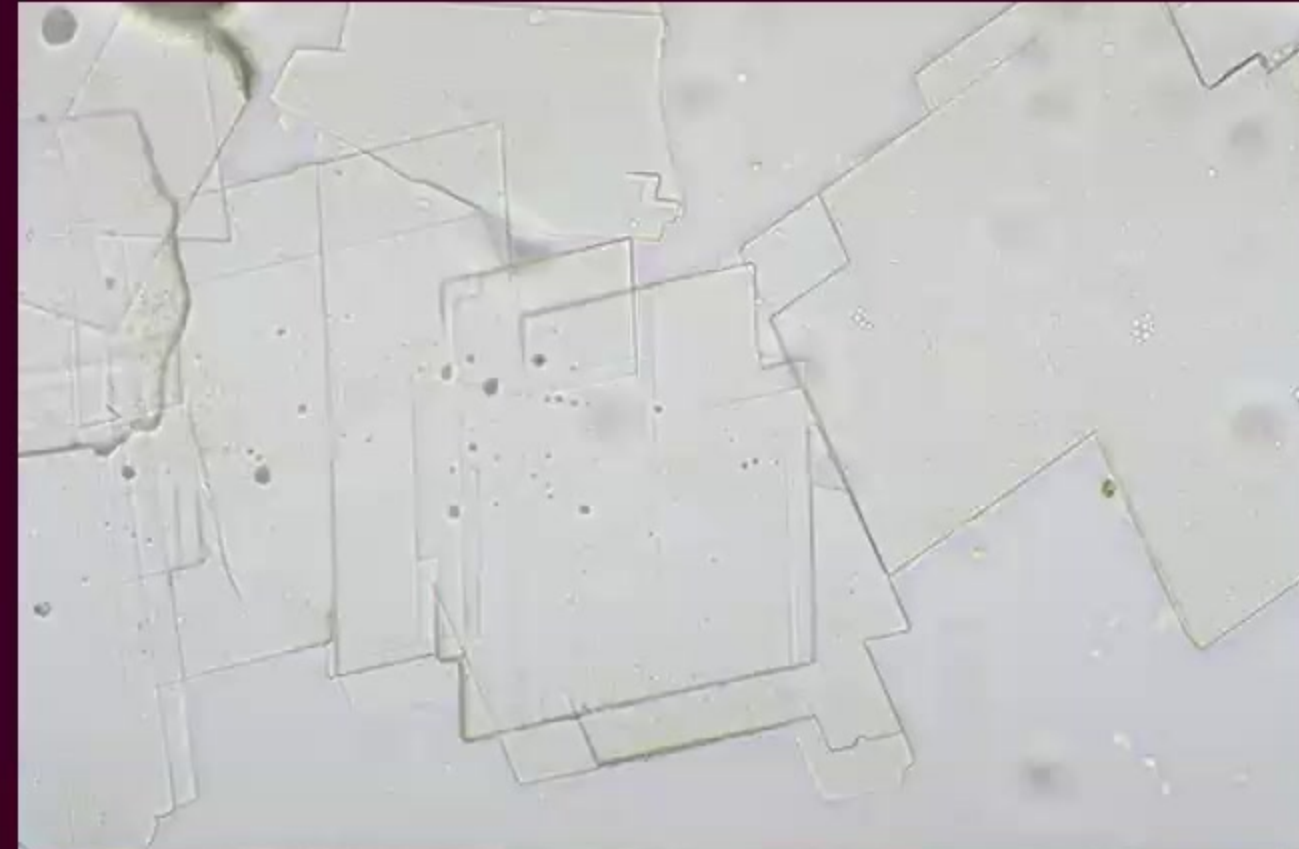


- CYST ENLARGEMENT
  - increased osmolality due to breakdown products becoming smaller and more osmotically active
  - wall acts as semi-permeable membrane

# RADICULAR CYST

## Cysts Contents

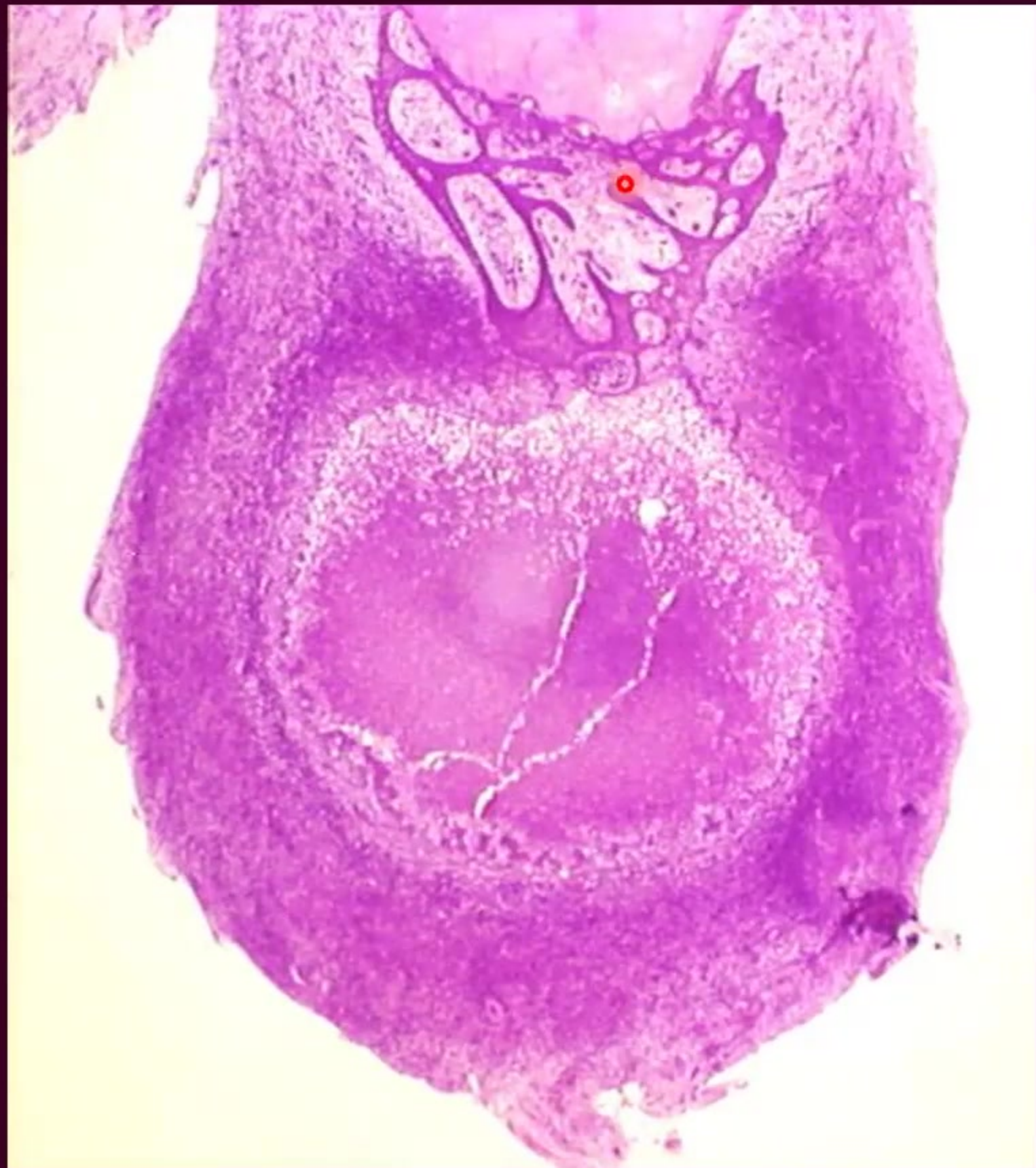
- Breakdown products of cells
- Serum proteins
- Water and electrolytes
- Cholesterol crystals

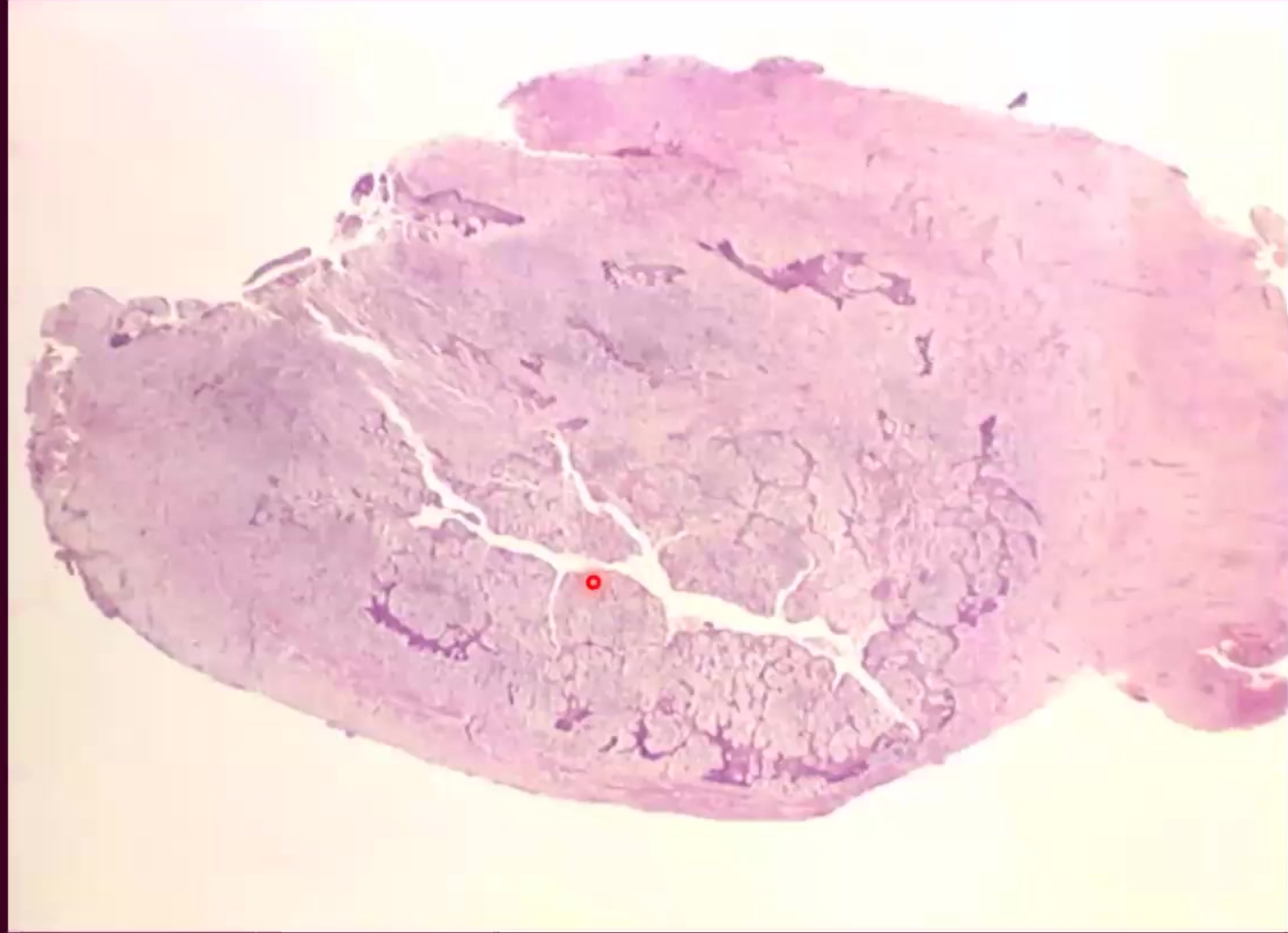


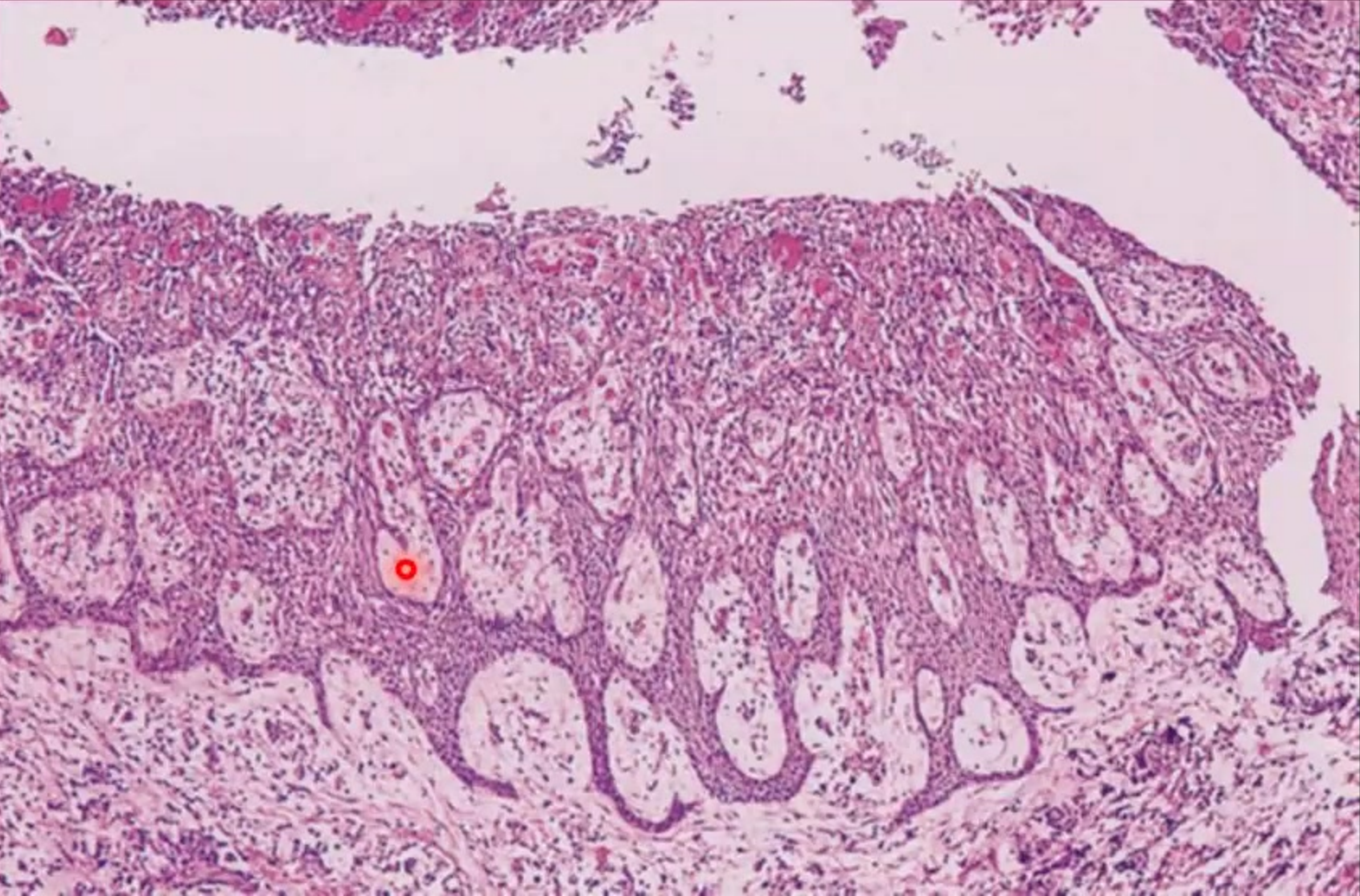
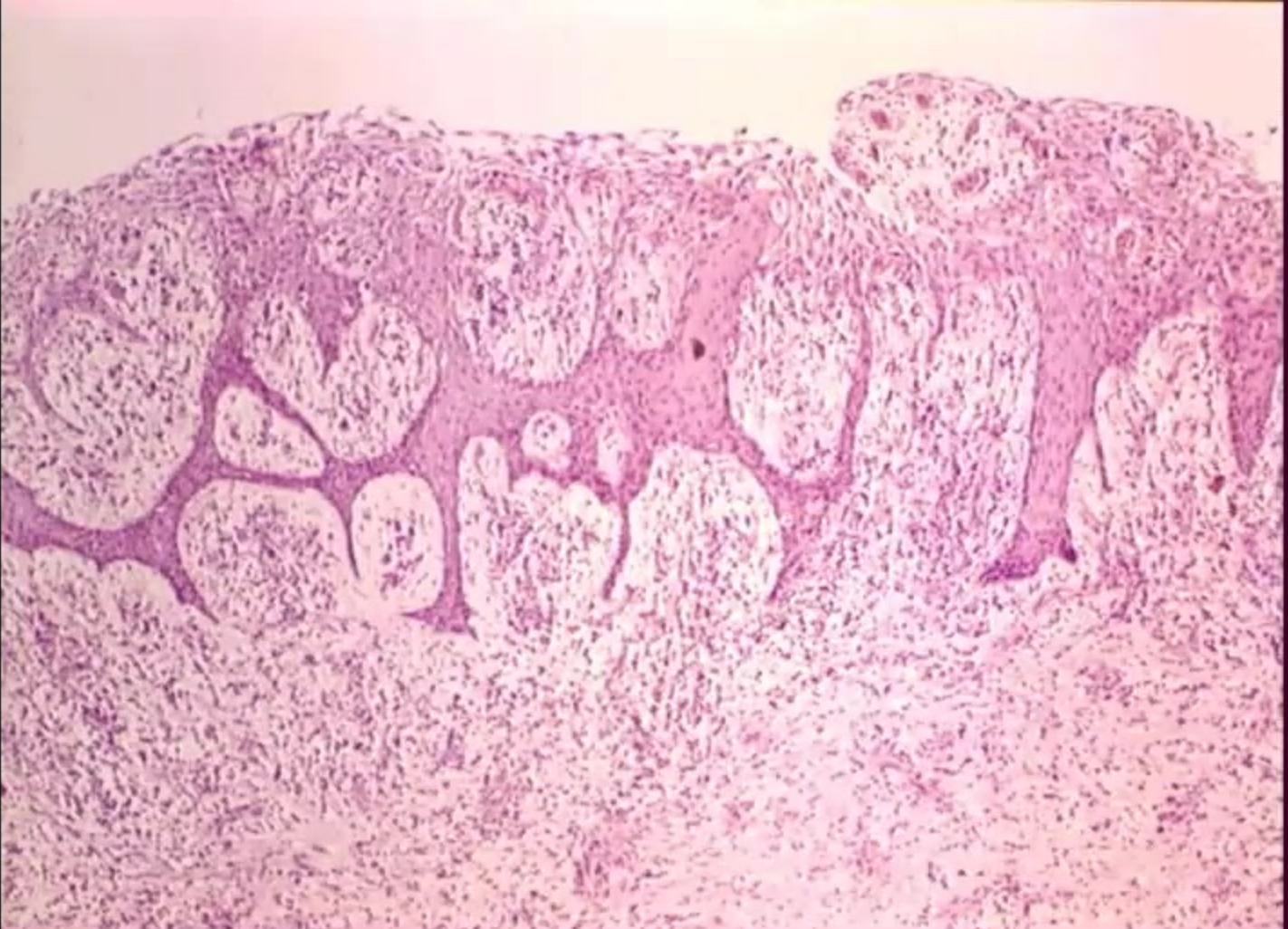
# RADICULAR CYST

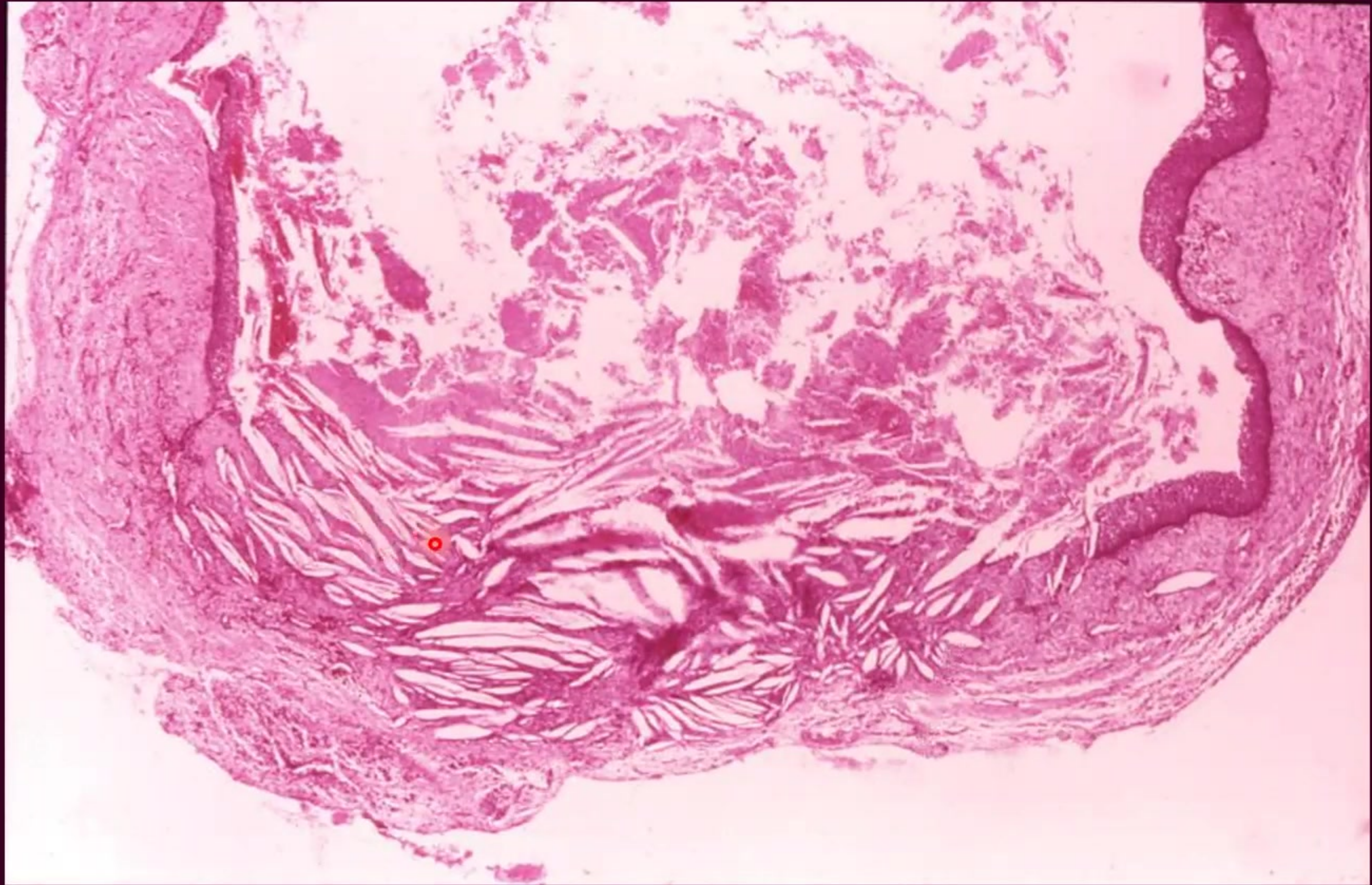
## Histopathology

- Periapical granuloma with epithelial proliferation - polymorphs in epithelium
- Cyst lined by irregular, non-keratinised stratified squamous epithelium
- Foam cells, lymphocytes, plasma cells, cholesterol clefts, surrounding fibrosis
- Lining becomes thinner and less inflamed
- 10% contain hyaline (Rushton) bodies

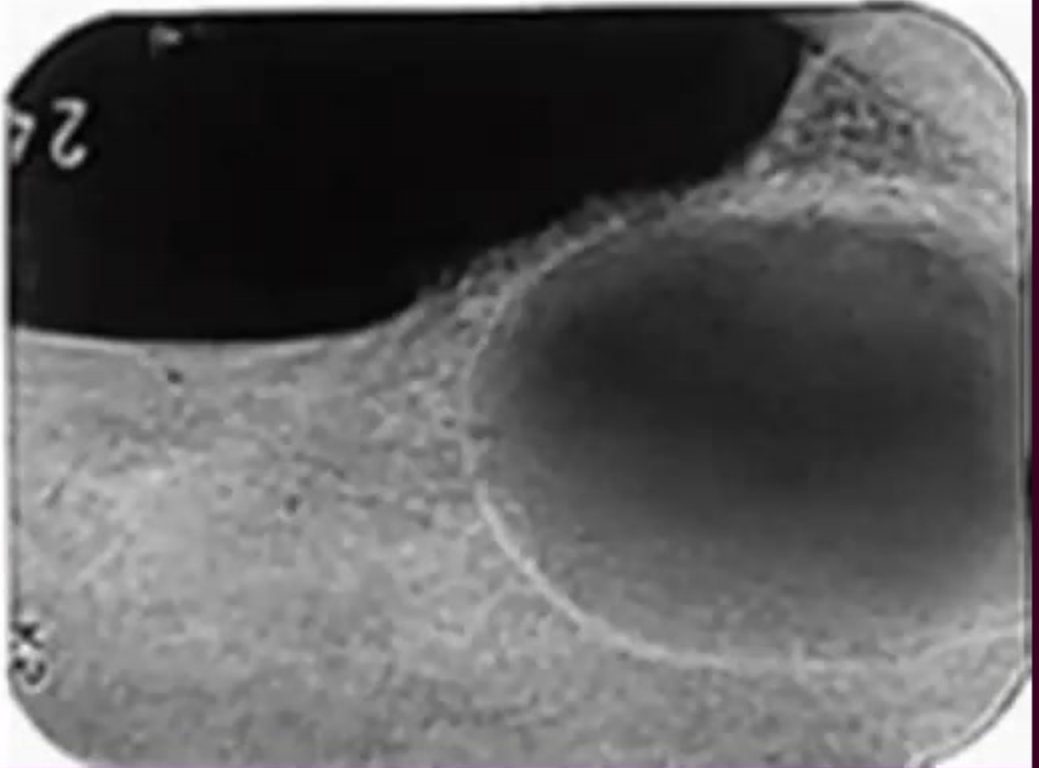
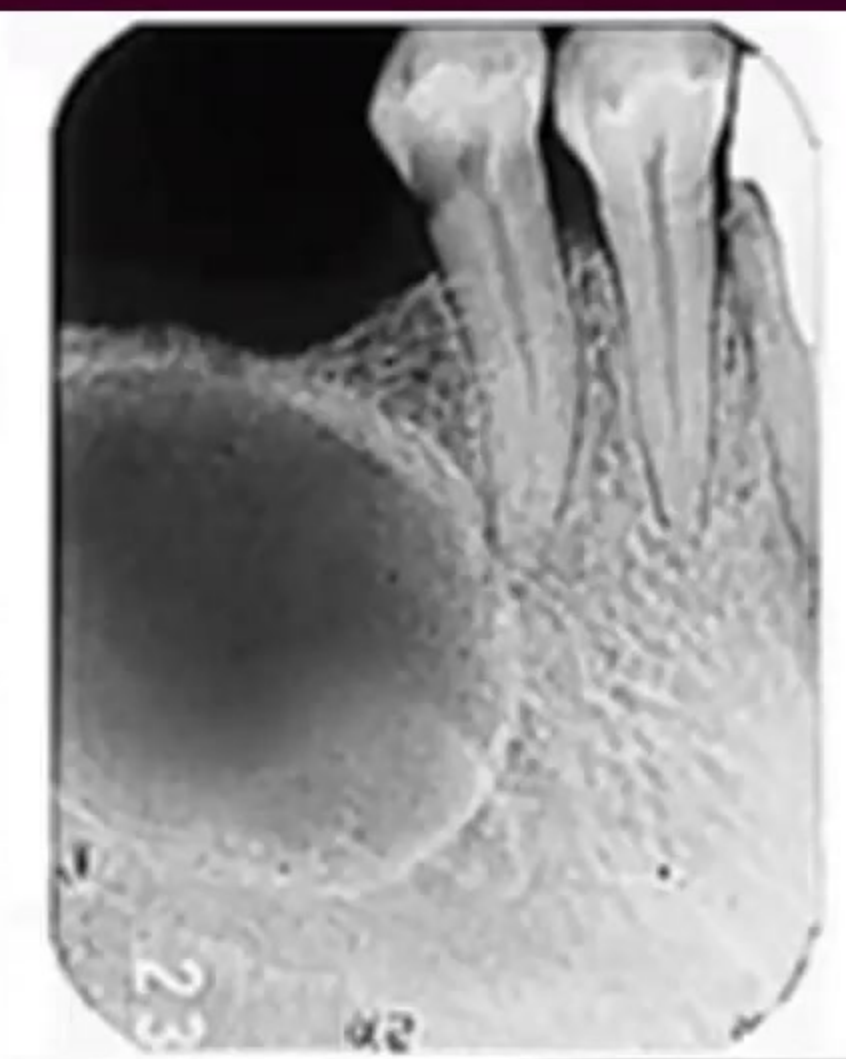
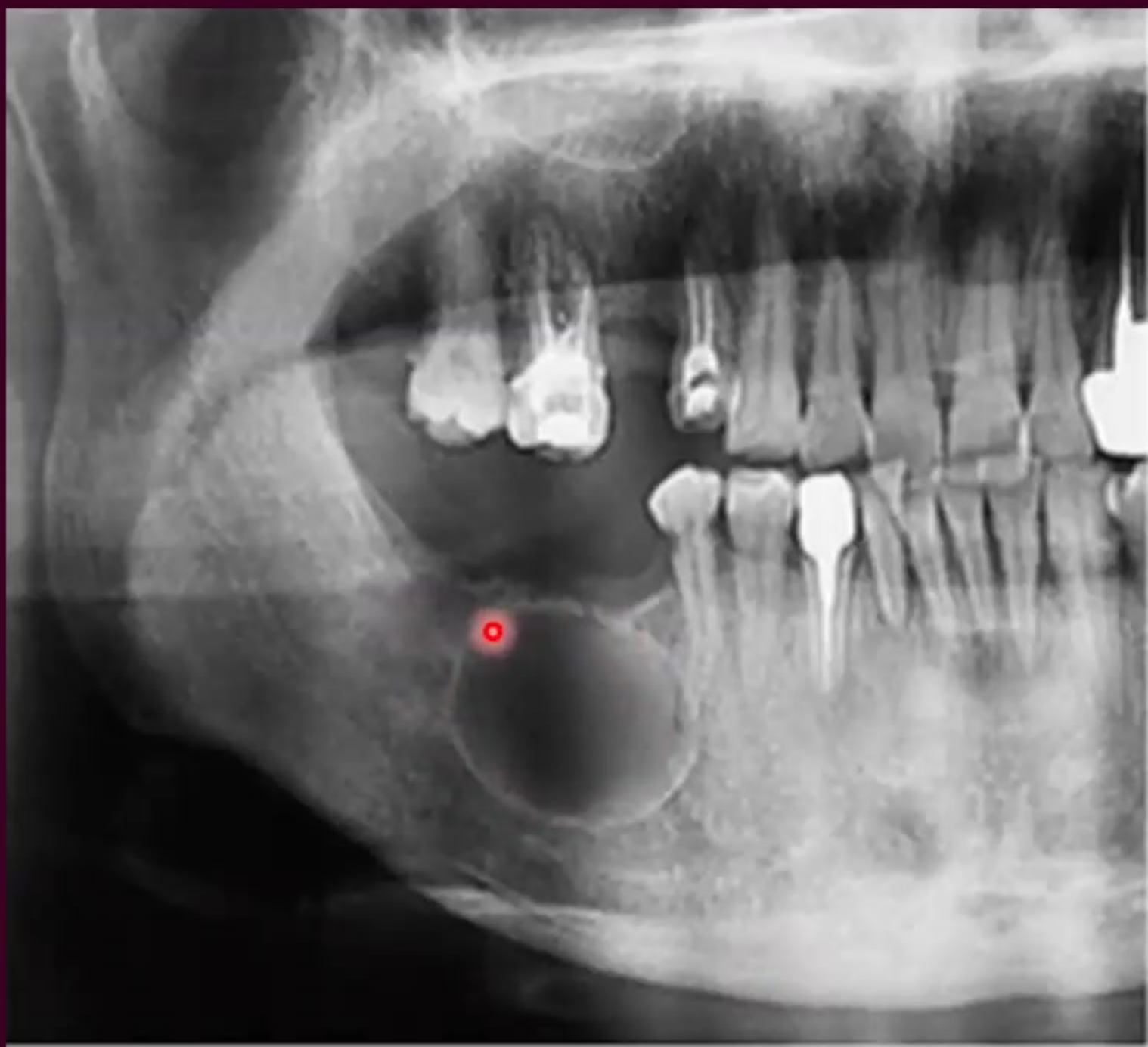






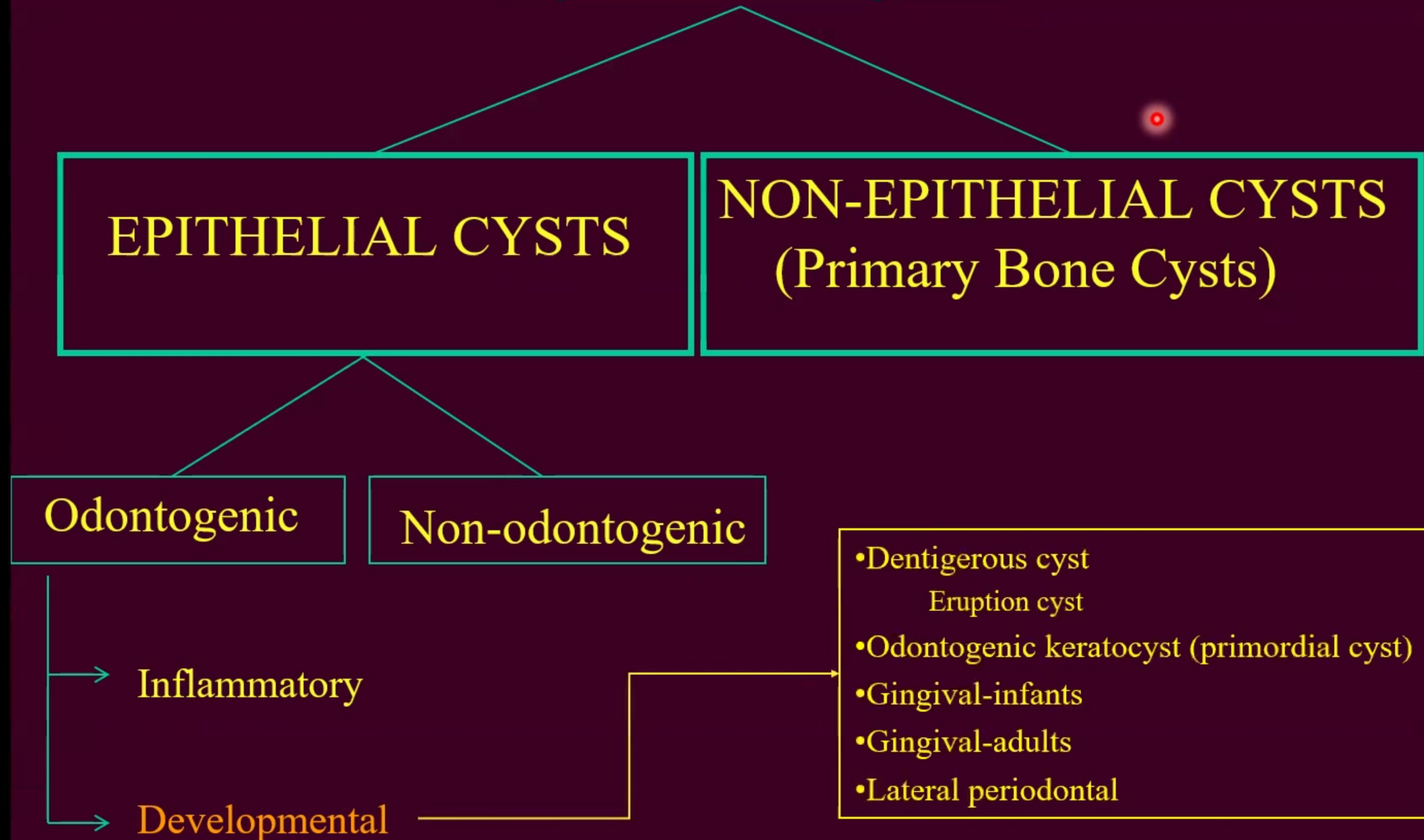






# CLASSIFICATION

## Cysts of the jaws



# DENTIGEROUS CYST

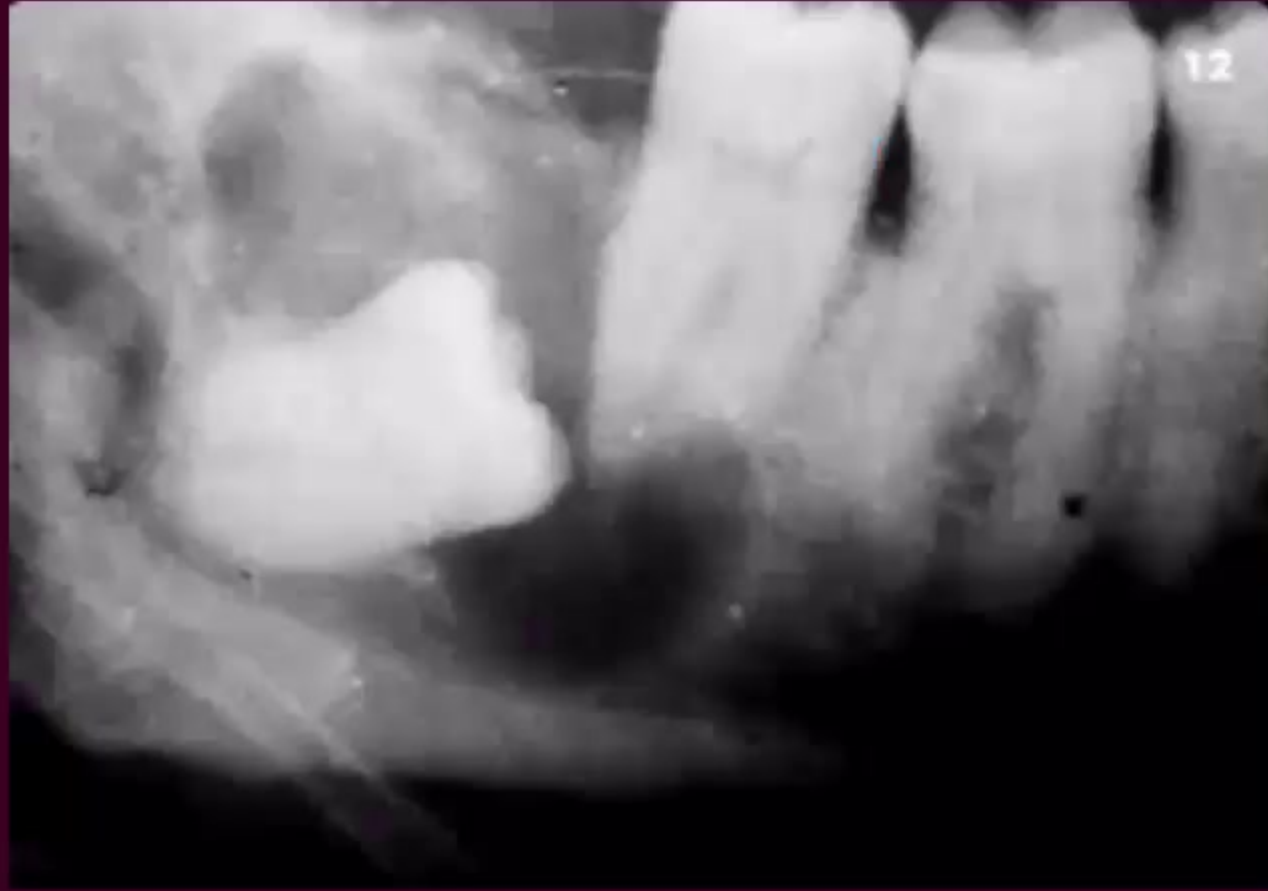
- Cyst enclosing crown of an unerupted tooth
- Attached to cemento-enamel junction
- Follicular cyst

# PATHOGENESIS

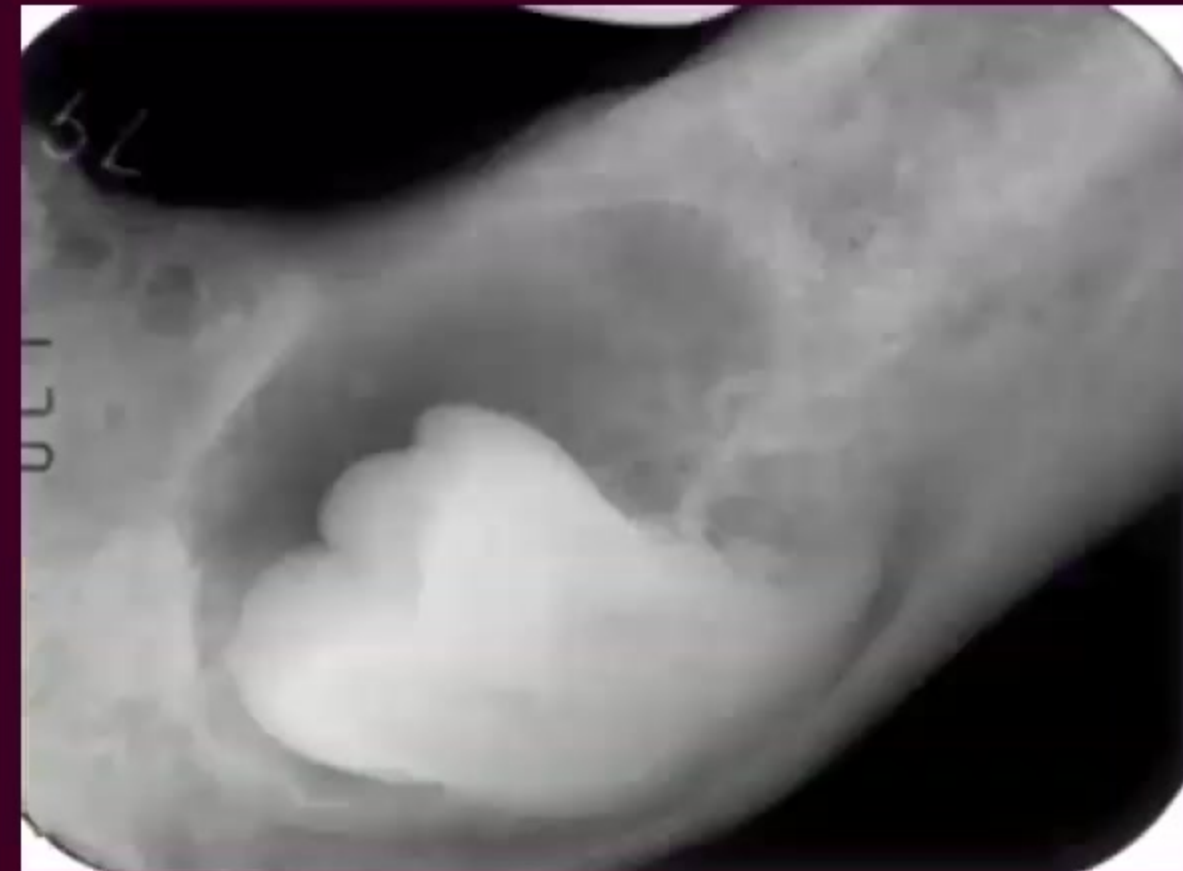
- Intrafollicular fluid accumulates between REE and enamel
- Pressure of tooth on impacted follicle
  - Obstruction of venous outflow
  - Serum transudation
  - Exudation

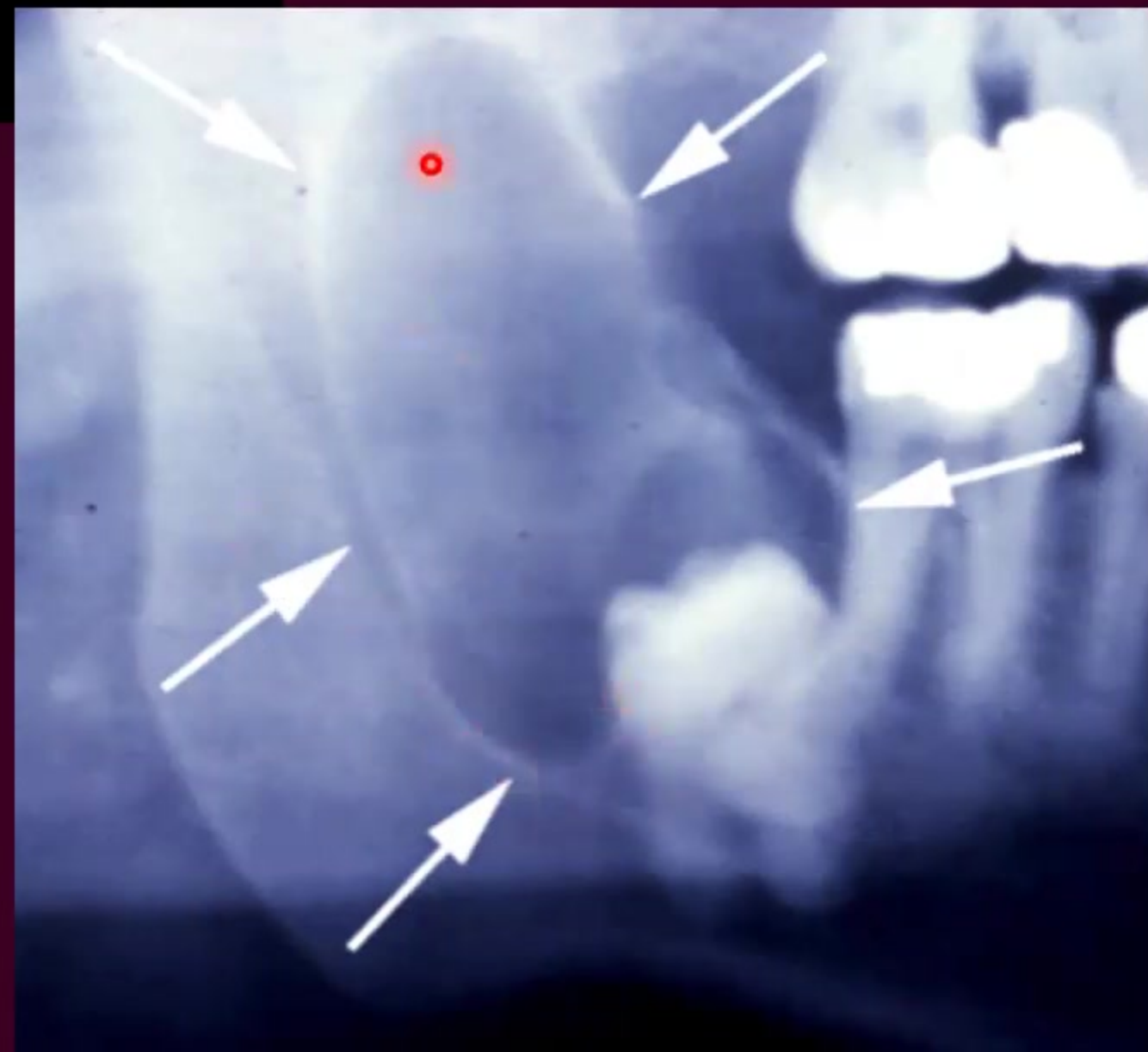
# CLINICAL FEATURES

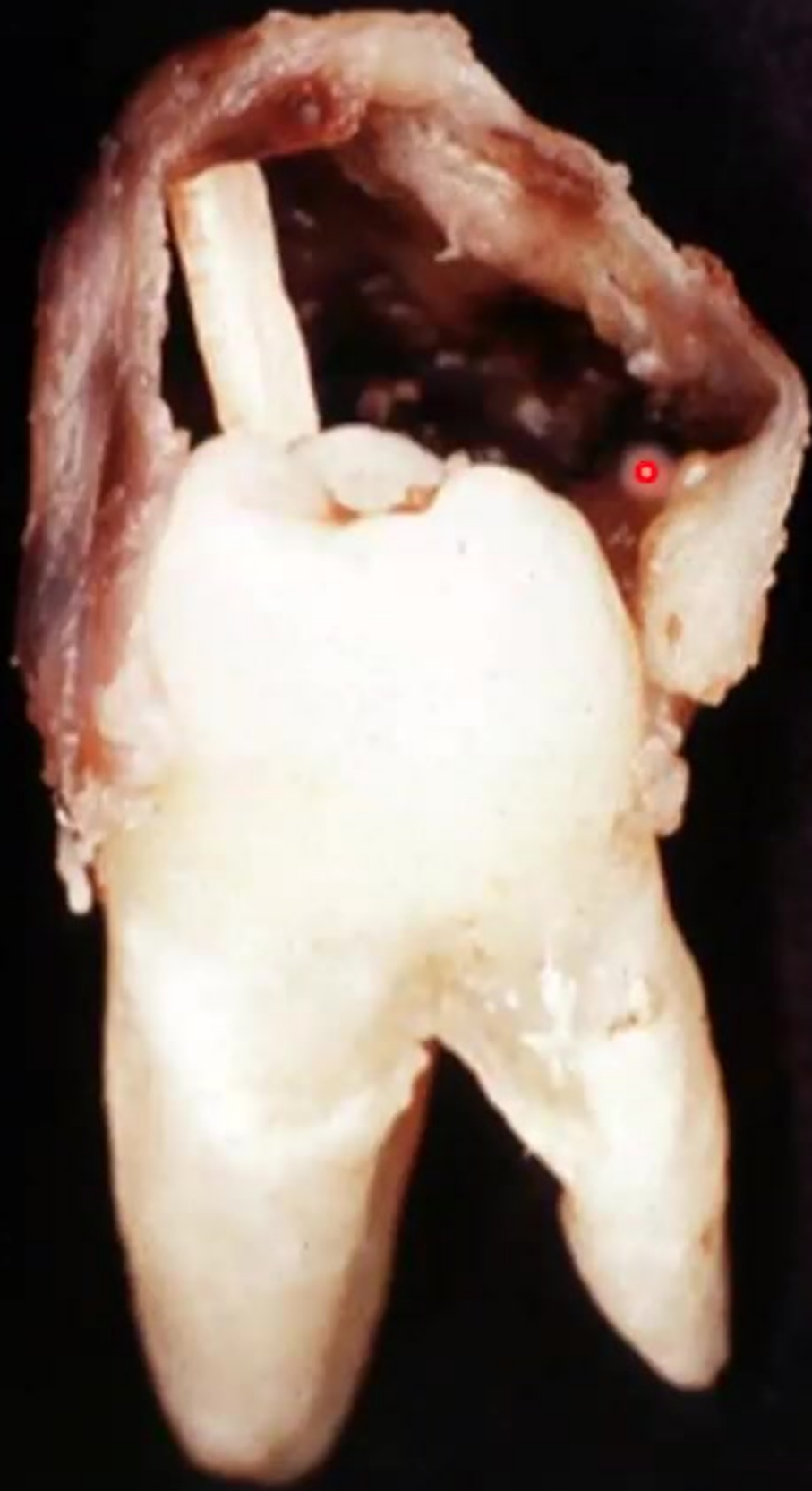
- 10-15% of cyst
- Children and young adults
- Permanent teeth
- Upper canine and lower 3<sup>rd</sup> molar – teeth likely to be impacted
- M:F 1.6:1
- Painless enlargement – missing tooth
- Tilting of tooth
- Root resorption



# Dentigerous cyst





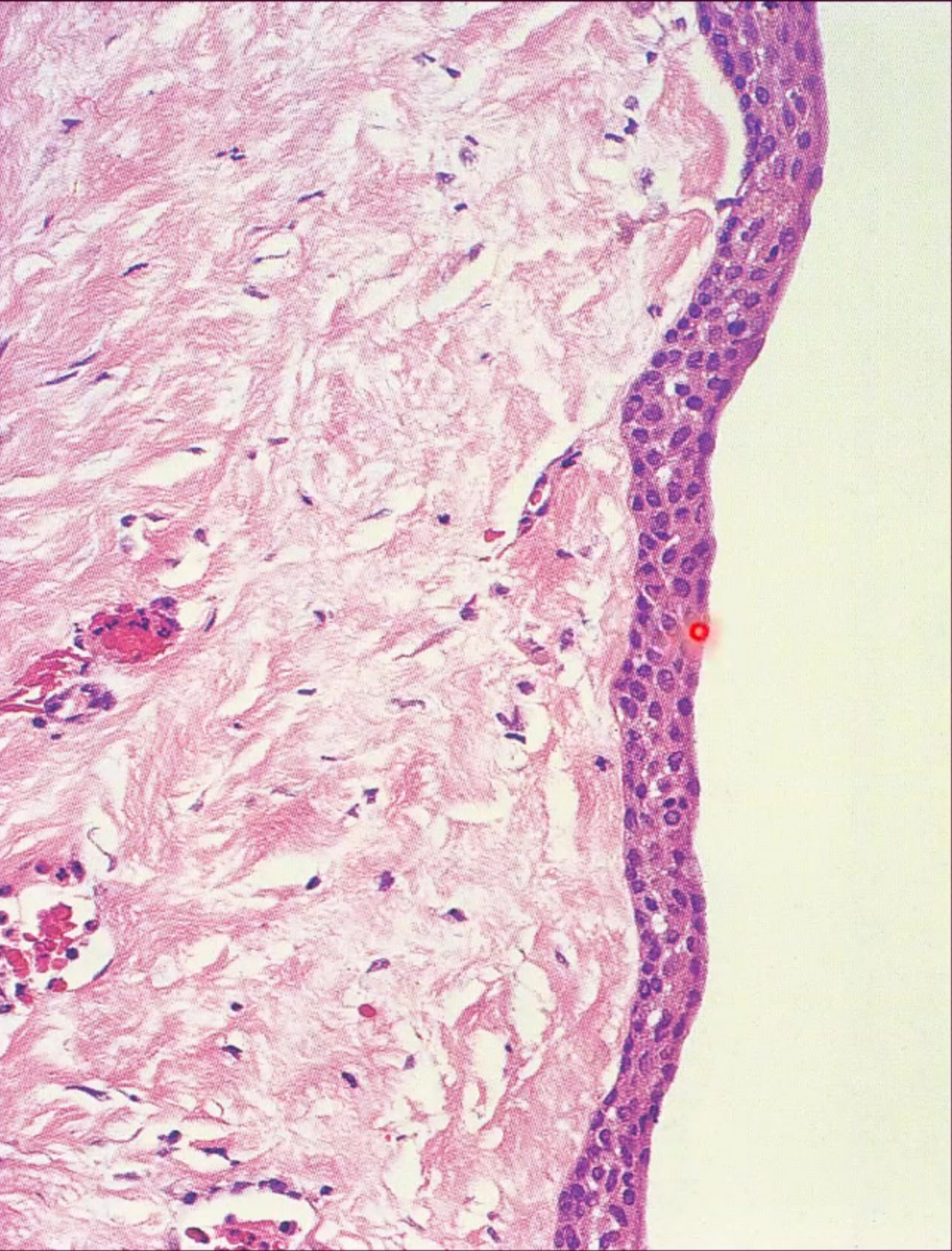


# PATHOLOGY

- Clear yellow fluid – cholesterol
- Purulent if infected
- Lined by flattened, non-keratinised stratified squamous epithelium
- Continuous with reduced enamel epithelium
- Mucous and ciliated columnar metaplasia
- Fibrous wall with variable inflammation



*Dentigerous cyst*



# Eruption cyst

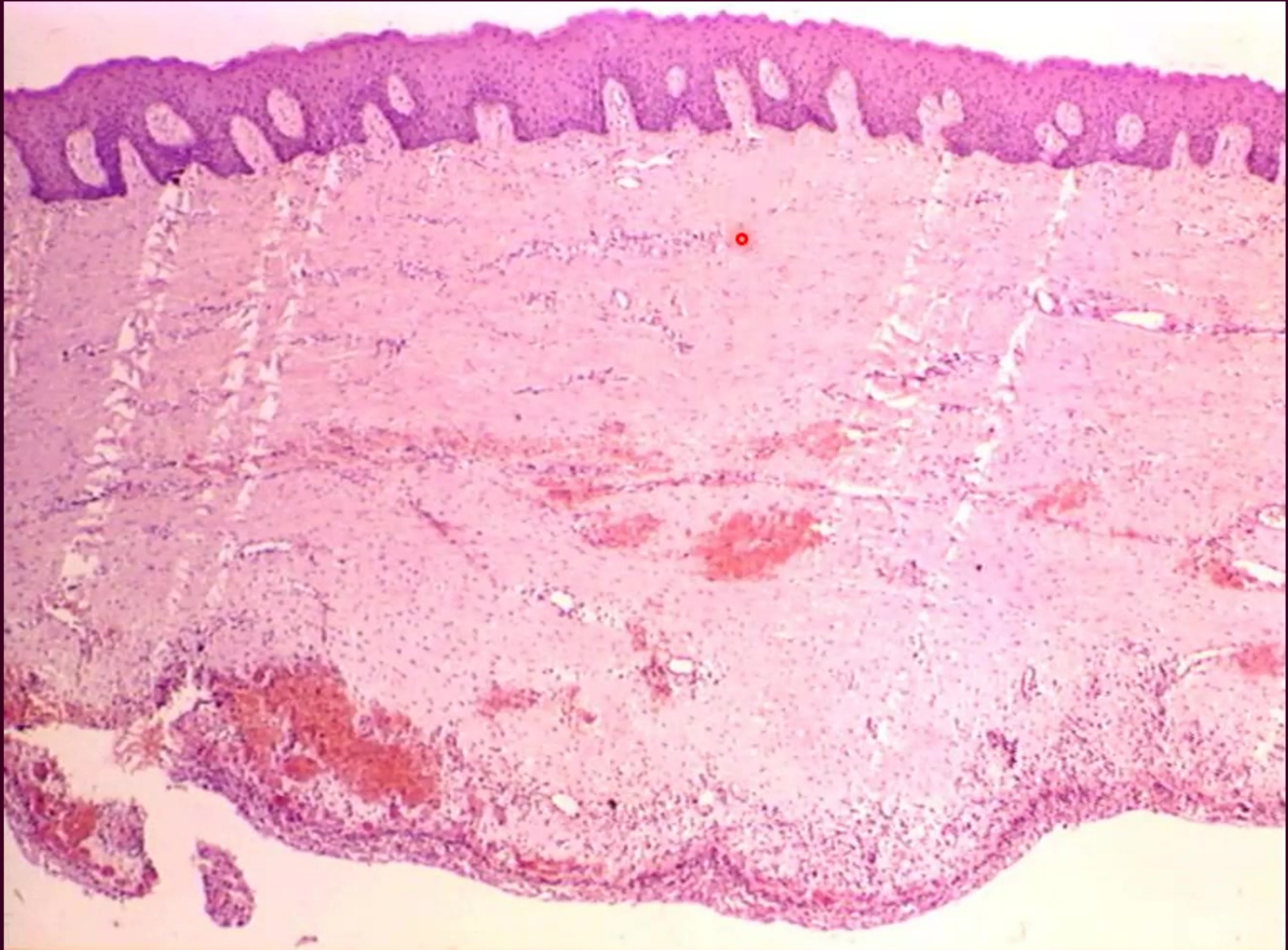


# ERUPTION CYST

- Extra-alveolar dentigerous cyst
- Deciduous tooth or permanent molar
- Fluctuant bluish swelling
- Haemorrhage into cyst common
- Most spontaneously resolve
- Marsupialise





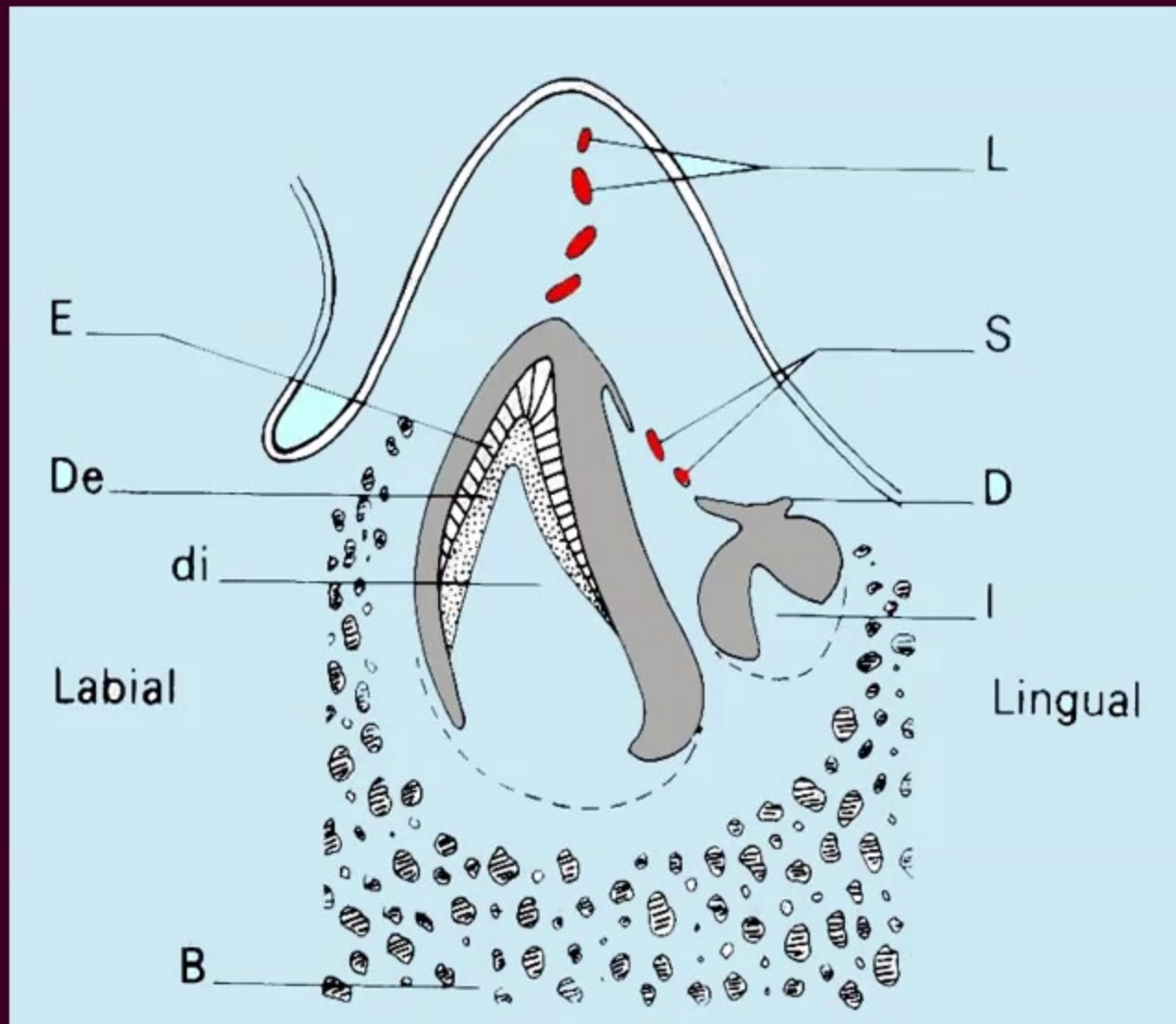


# ODONTOGENIC KERATOCYST

## CLINICAL

- 5-10% of all jaw cysts
- SITE
  - 70-80% mandible
  - 50% angle/ramus
- Often asymptomatic
- M>F
- Swelling, discharge, pain, pathological fracture, tooth displacement, rarely buccal expansion
- 10% multiple
- High recurrence rate

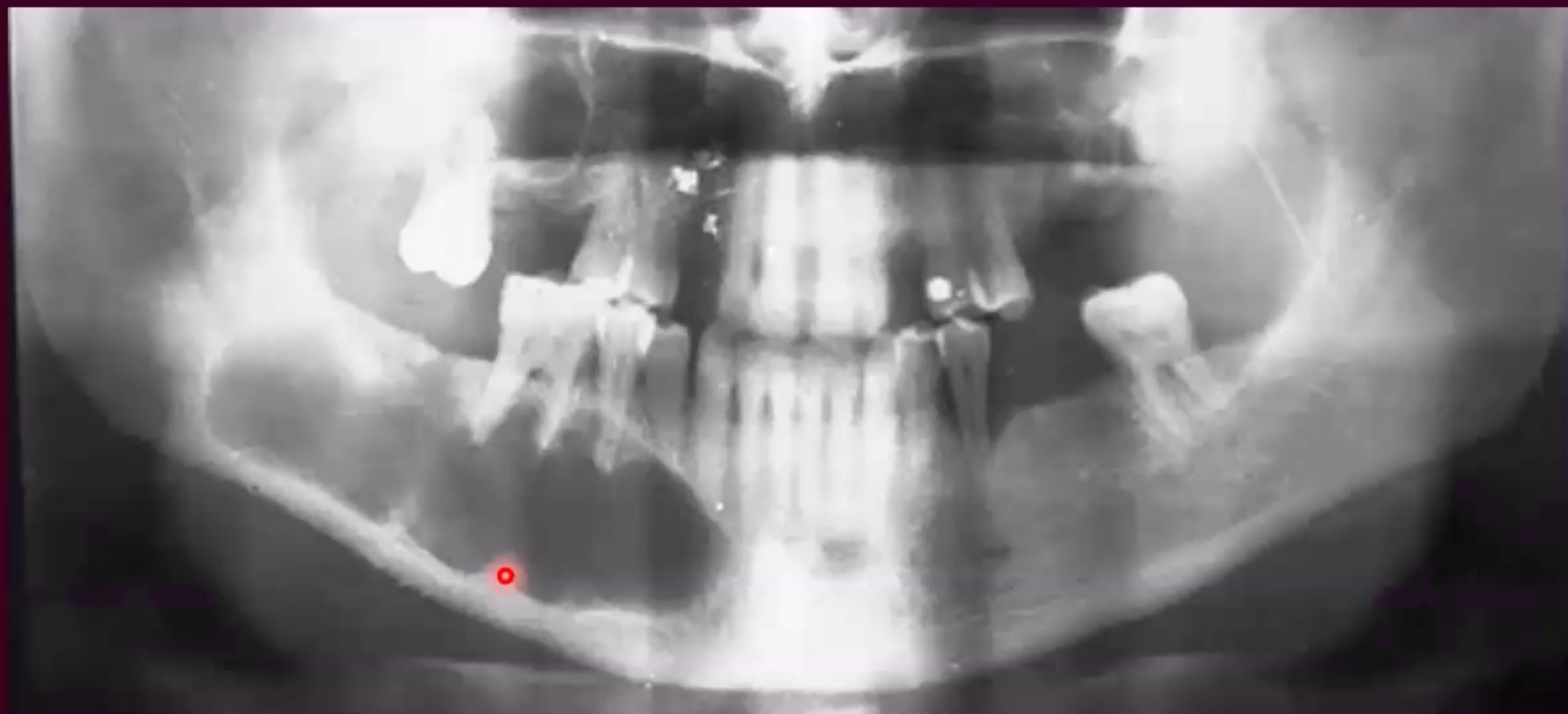
# PATHOGENESIS



- Derived from the dental lamina or its remnants - cell rests of Serres
- Originate from enamel organ (tooth primordium) of a tooth before hard tissues develop:
  - normal tooth
  - supernumerary

# RADIOLOGICAL APPEARANCE

- Well demarcated radiolucency
- Pseudolocular or multilocular, often with scalloped periphery
- Root or tooth displacement

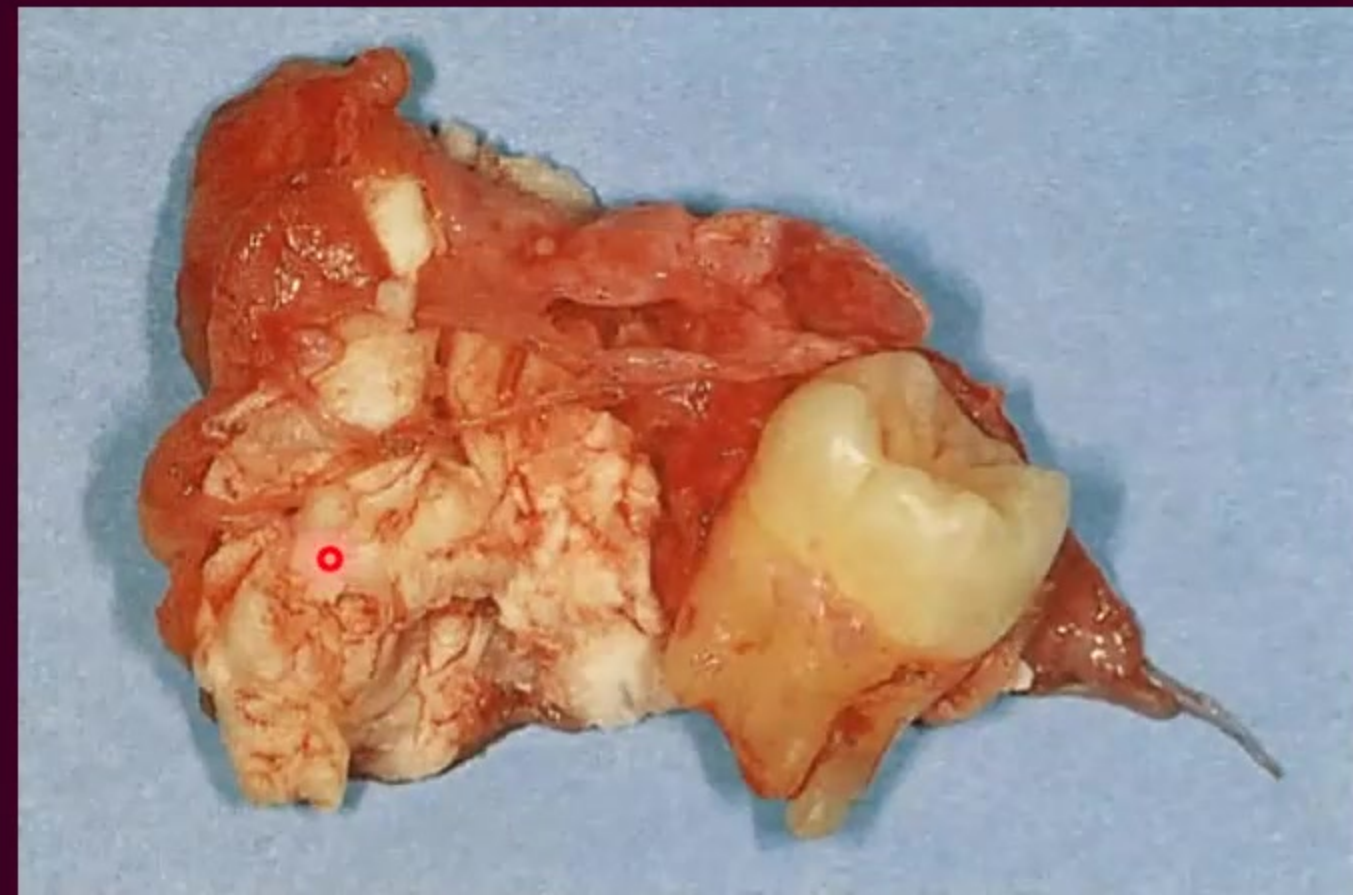




*Odontogenic keratocyst*



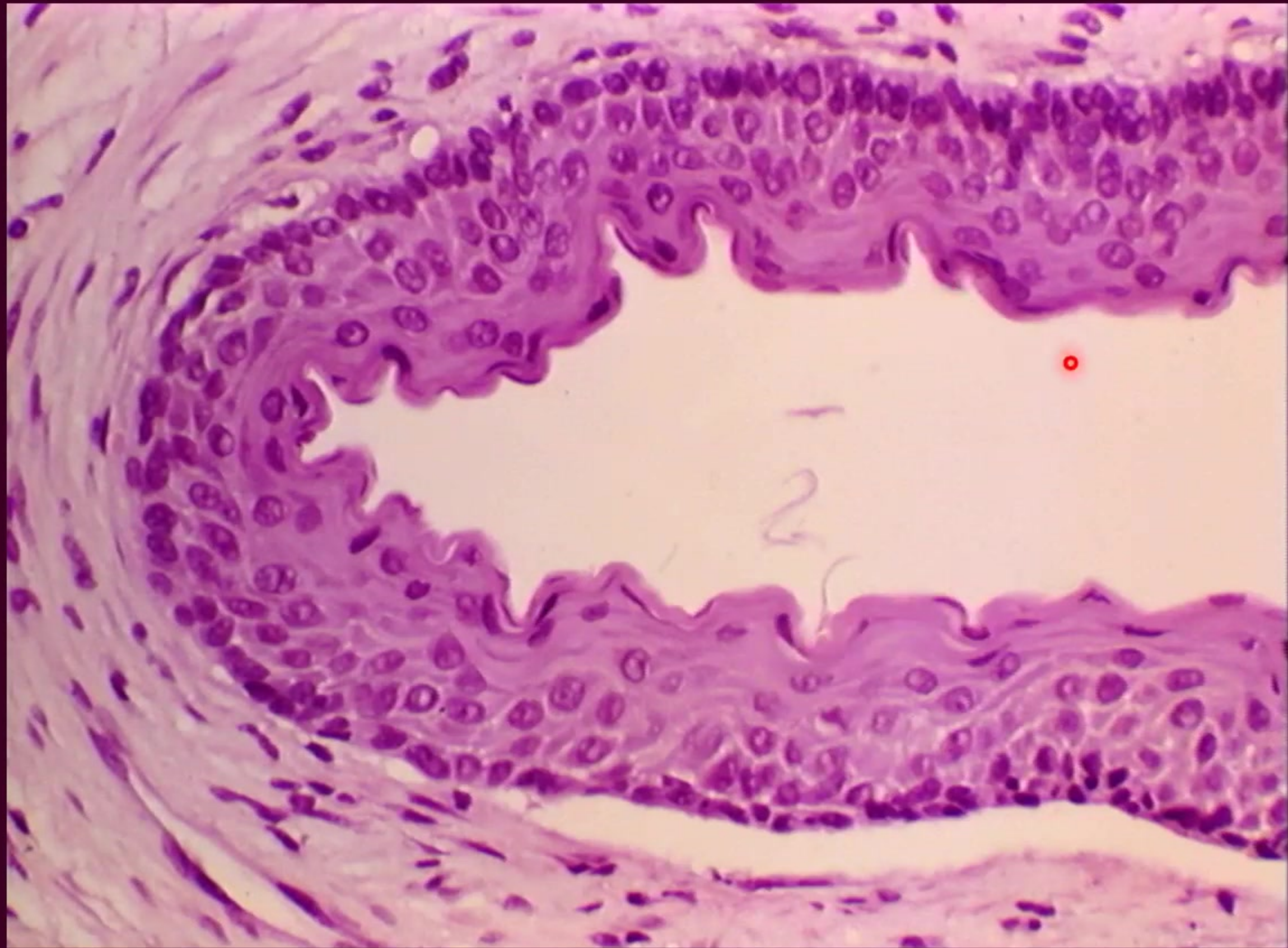
*Odontogenic keratocyst*



# HISTOPATHOLOGY

- Regular stratified squamous epithelium
- Thin epithelial layer (5-8 cells thick)
- Palisaded basal layer
- Corrugated surface which can be parakeratinised or orthokeratinised
- Thin, friable fibrous capsule - little inflammation
- Satellite (daughter) cysts



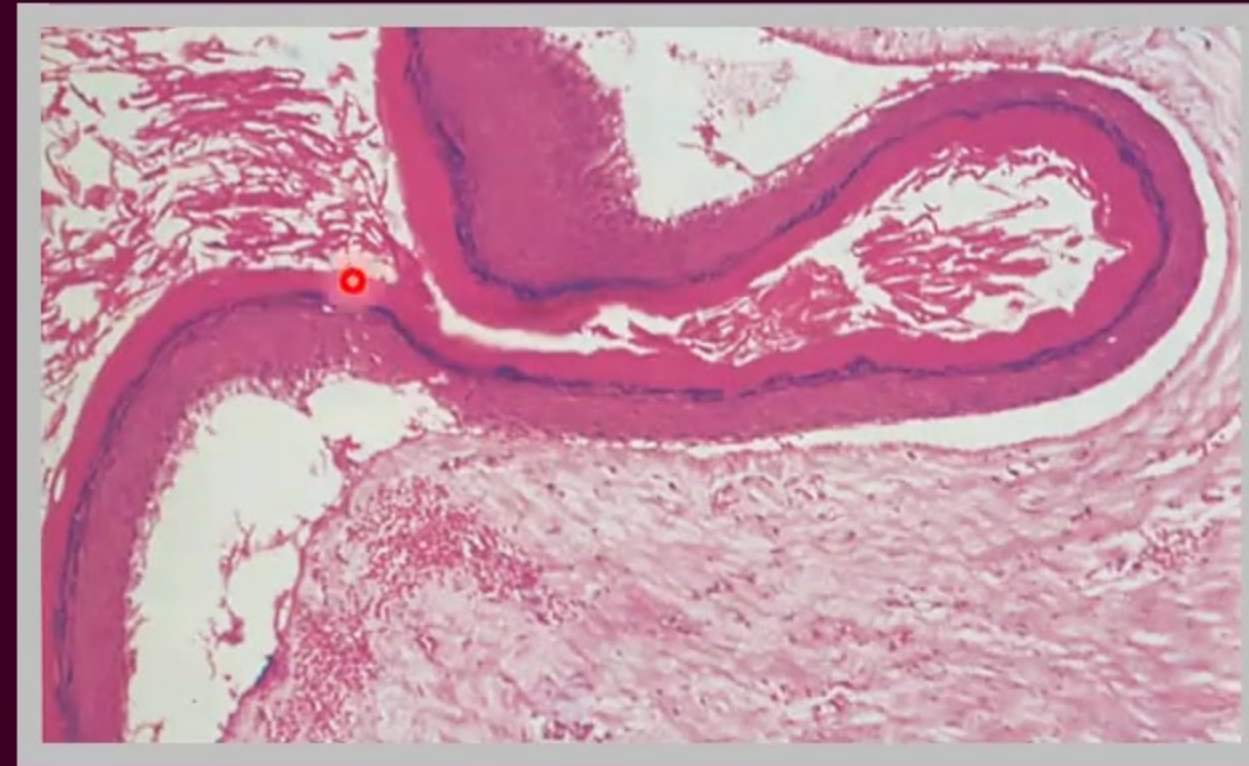


# ENLARGEMENT

- Cancellous enlargement antero-posteriorly
- Little or no bucco-lingual expansion → large, especially in angle and ramus of mandible

# RECURRENCE

- Up to 60%
- Size and infiltrative nature
- Tendency to multiplicity and satellite cysts
- Intrinsic growth potential
- Thin, friable capsule
- Genetic - multiple basal cell naevus syndrome (Gorlin-Goltz)



# GORLIN - GOLTZ SYNDROME



- Multiple keratocysts
- Multiple basal cell naevi  
→ carcinomas
- Skeletal abnormalities
  - bifid ribs
  - spine defects
- Frontal bossing and hypertelorism
- Calcification of the falx cerebri







# NON-ODONTOGENIC DEVELOPMENTAL CYSTS

- Nasopalatine duct cyst
- Nasolabial (naso-alveolar) cyst

*\*Median cysts ✗*

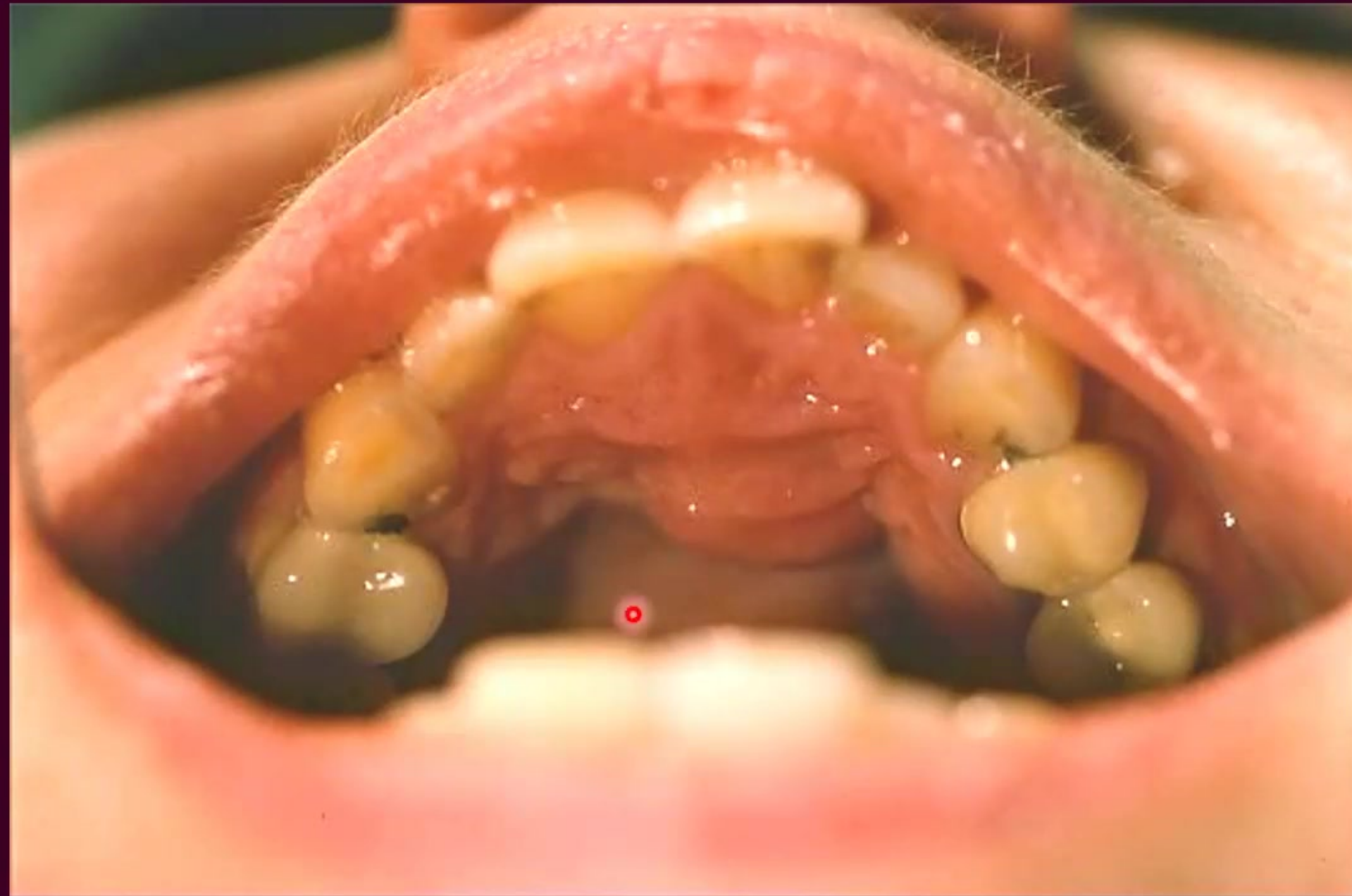
*\*Globulomaxillary cyst ✗*

# NASO-PALATINE DUCT CYST

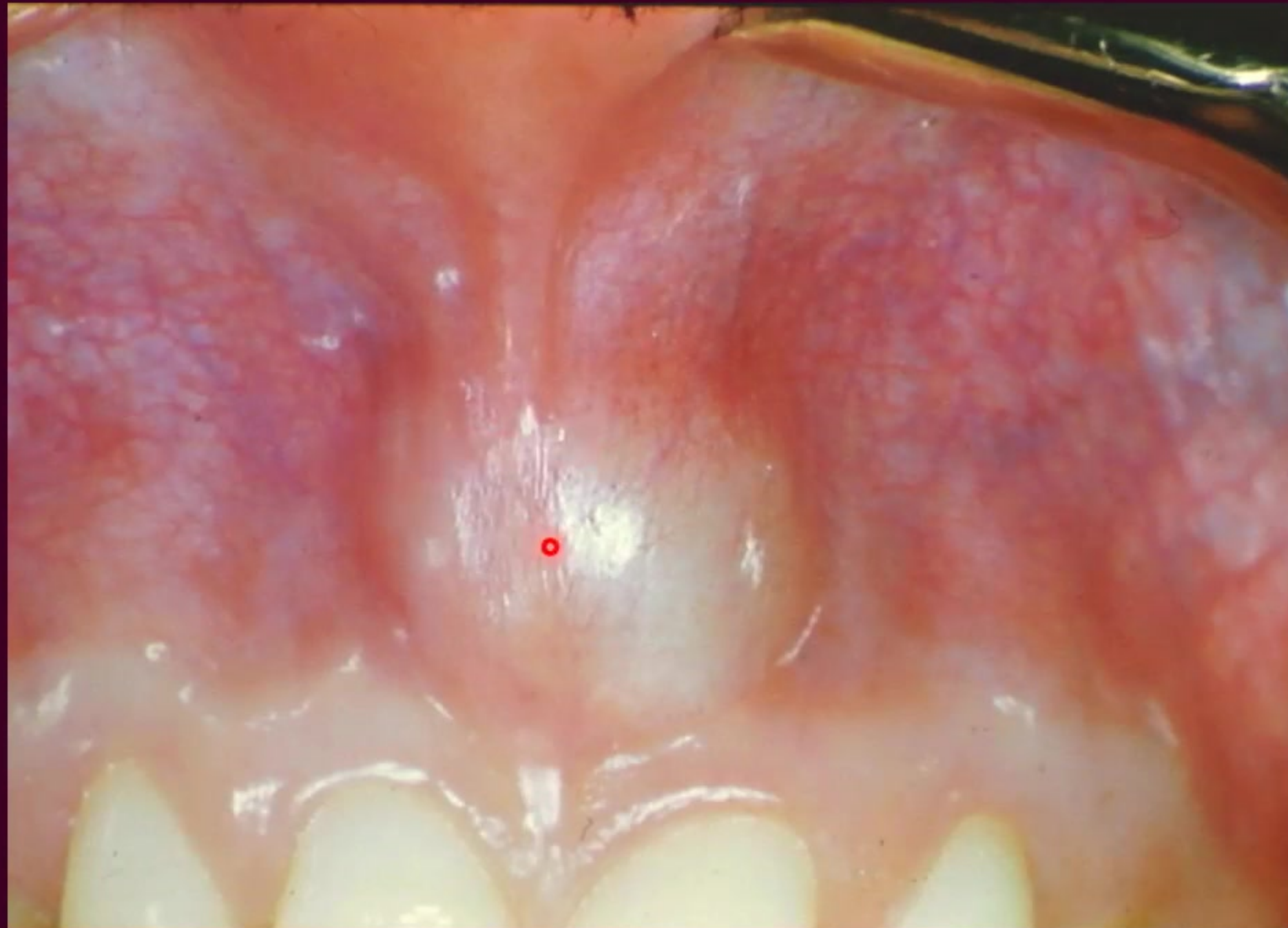


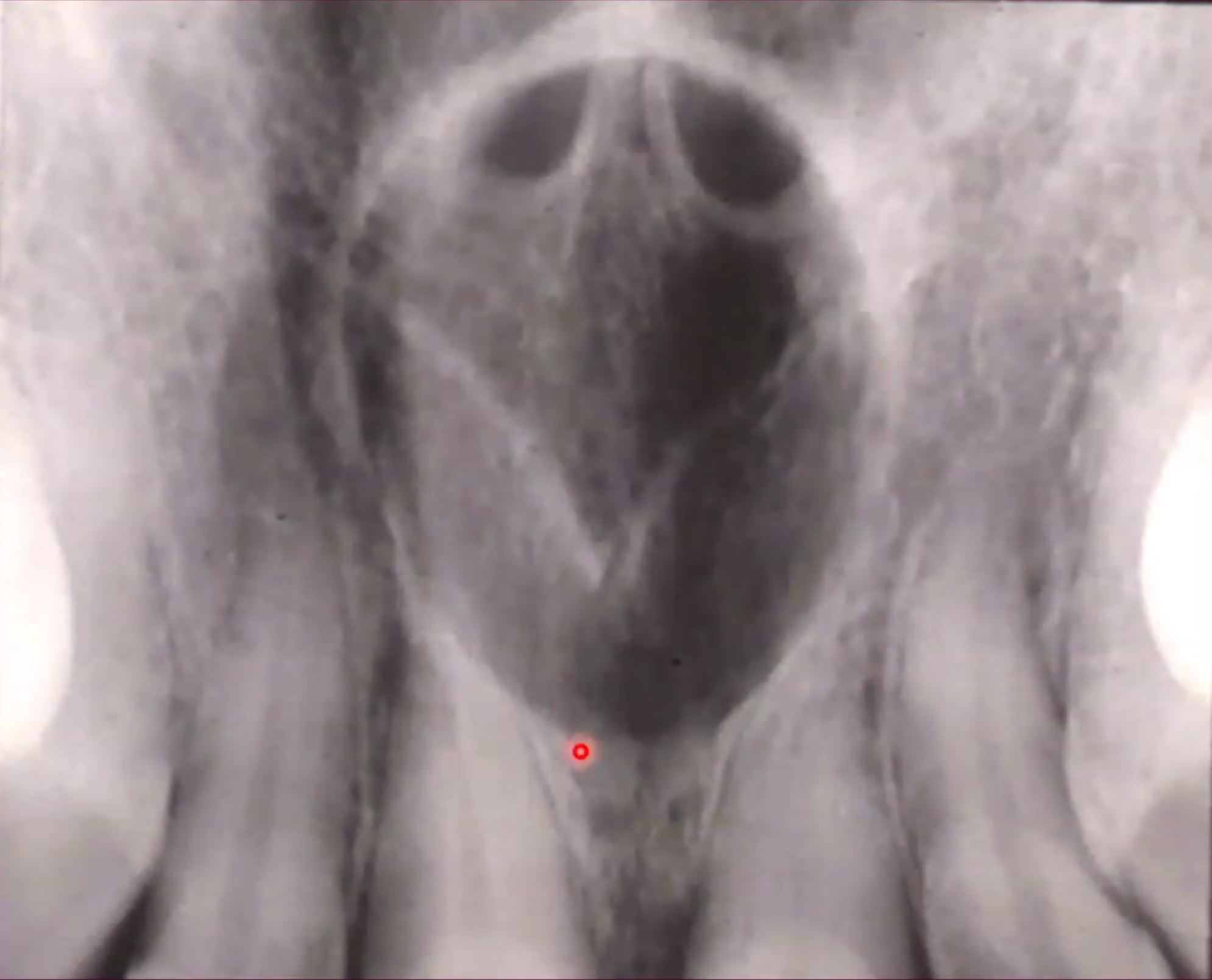
- Incisive canal cyst
- Remnants of nasopalatine duct
- M:F 4:1
- 30-60 years
- Swelling of midline of palate
- Pain and discharge
  - Mucoïd and salty
- Vitality of anterior teeth

# NASO-PALATINE DUCT CYST



# NASO-PALATINE DUCT CYST





# NASOLABIAL CYST



- Swelling in nasolabial fold below alae and leading to loss of fold
- Sometimes bilateral
- Swelling, pain, difficulty in nasal breathing

# Simple Bone Cyst

## Clinical:

- Empty intra-osseous bone cavity
- Etiology: uncertain
- Trauma – intra-medullary hemorrhage
- Age: 10-20 years
- Gender: male > female (60%)
- Site: mandibular body (molar-premolar)
- Asymptomatic - painless swelling

# Simple Bone Cyst

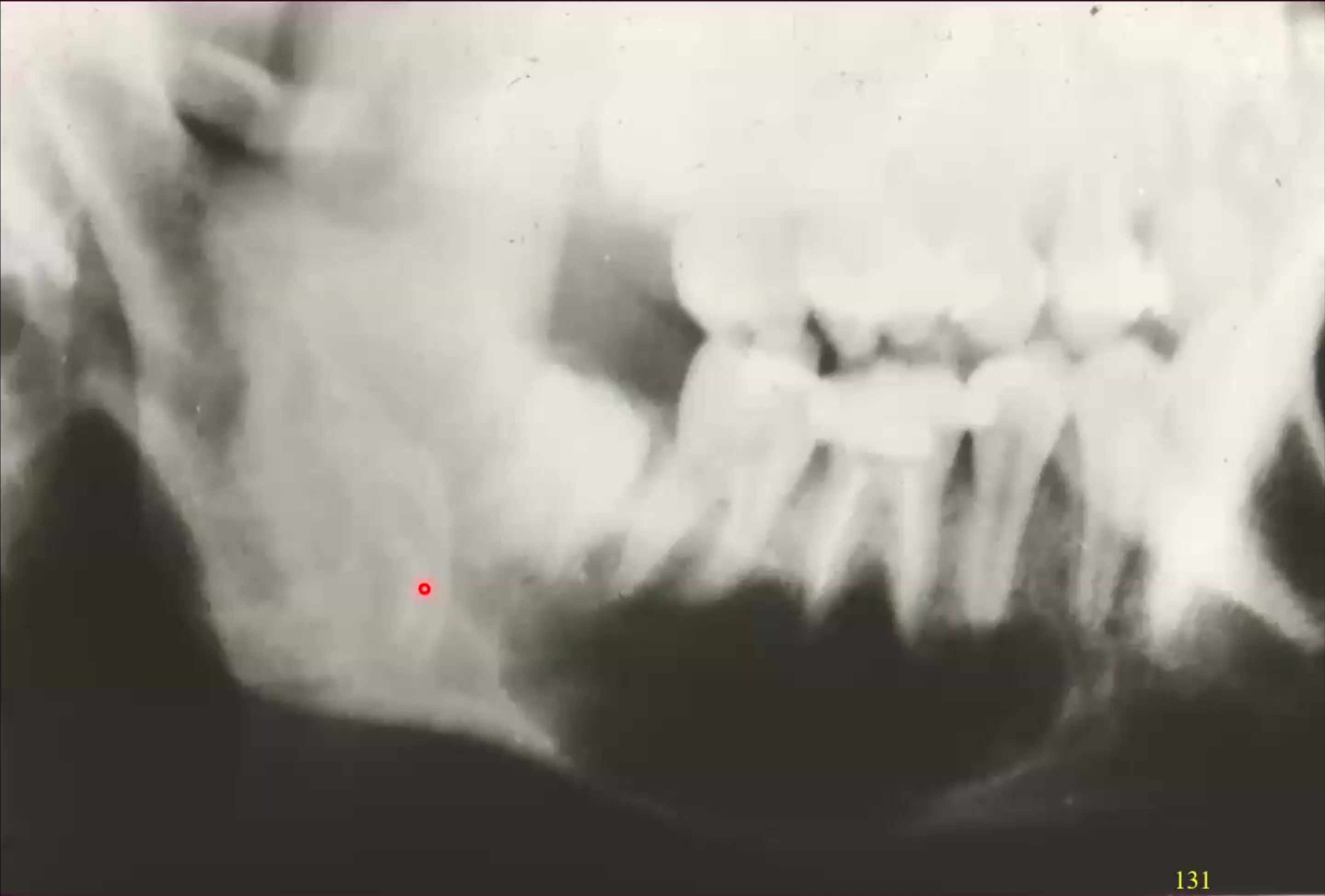
## Radiographic Findings:

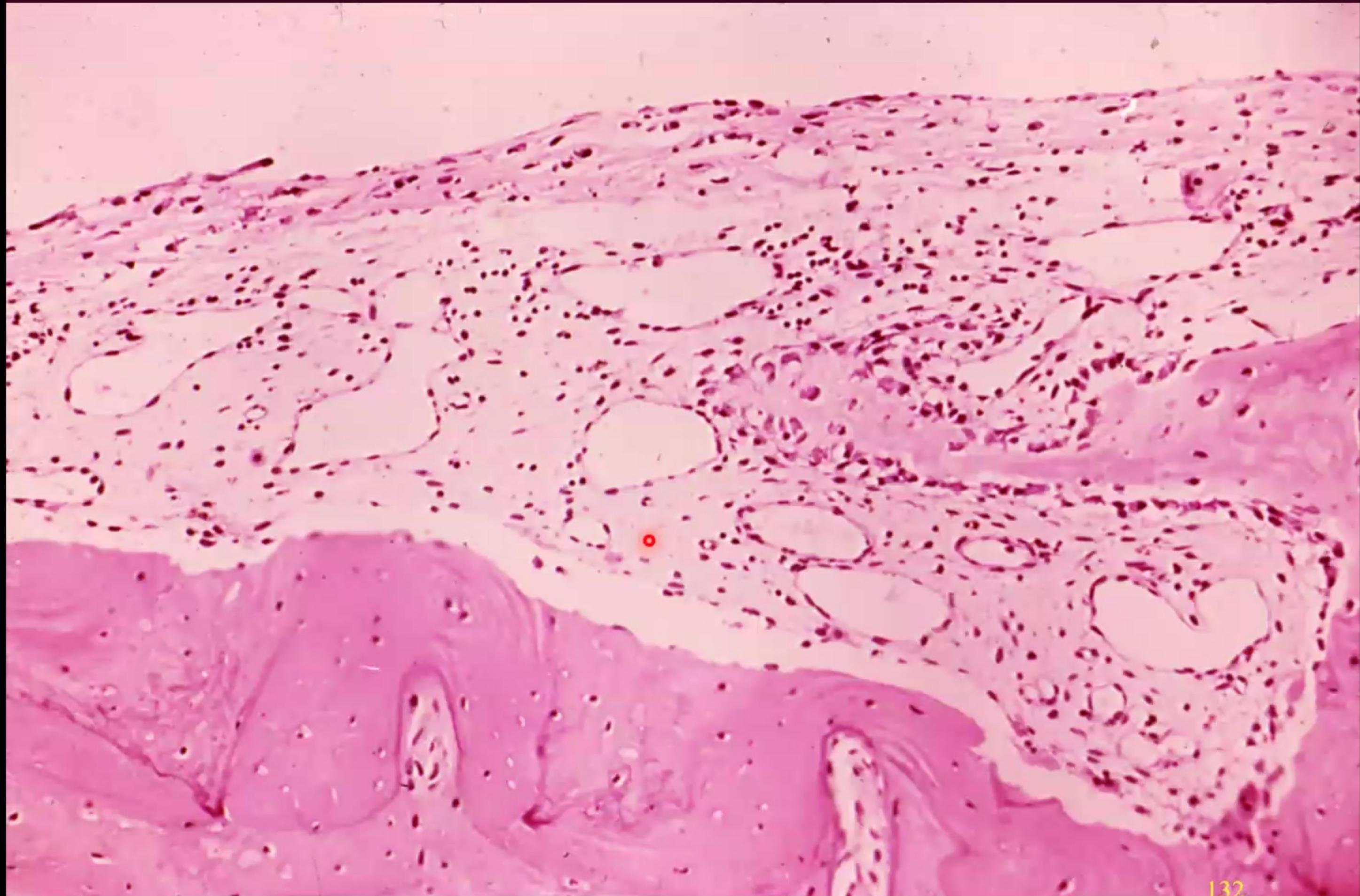
- Incidental finding
- Radiolucency
- Well to ill defined
- Size: 1-10 cm
- Scalloping between tooth roots
- Vital teeth
- No root resorption

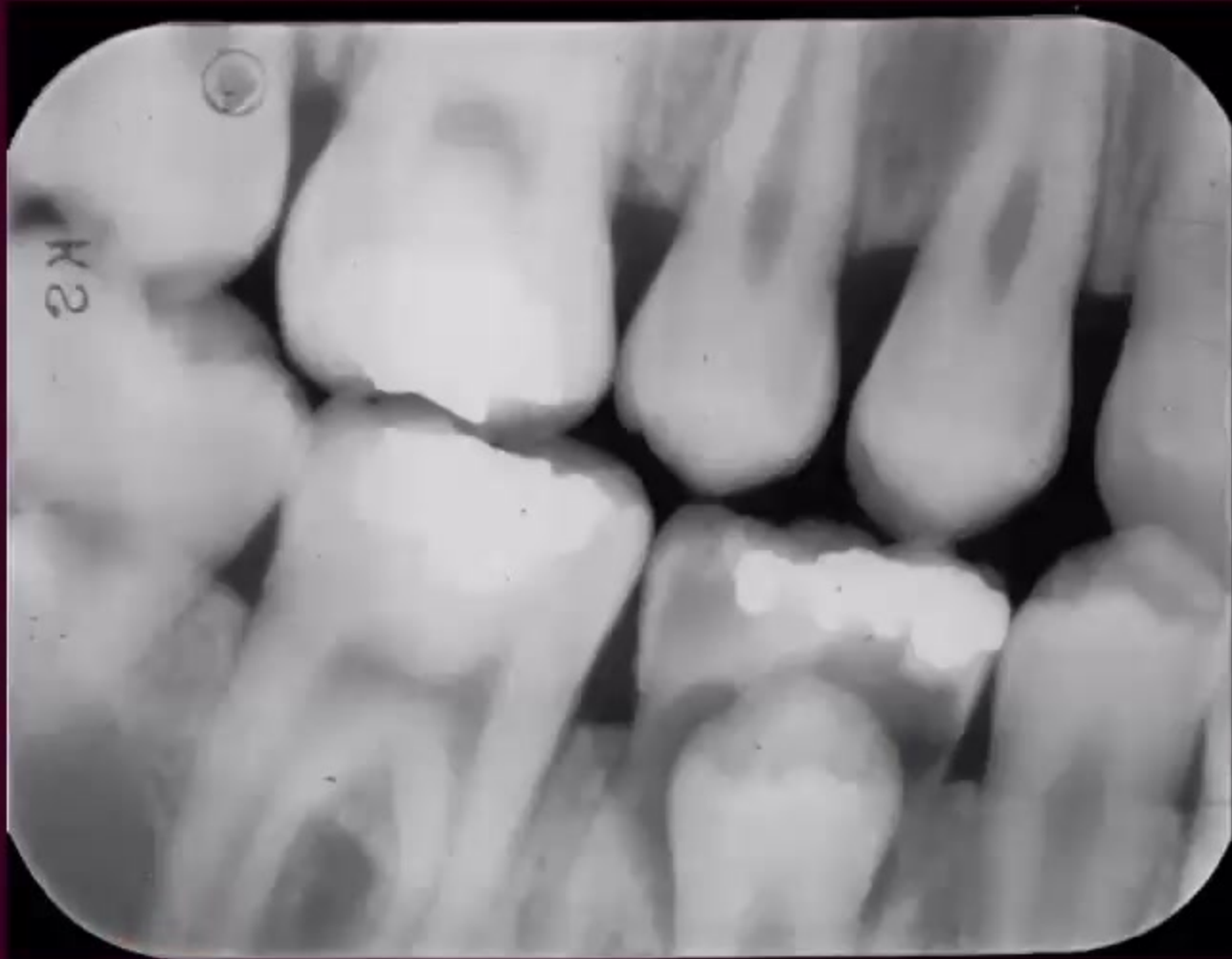
# Simple Bone Cyst

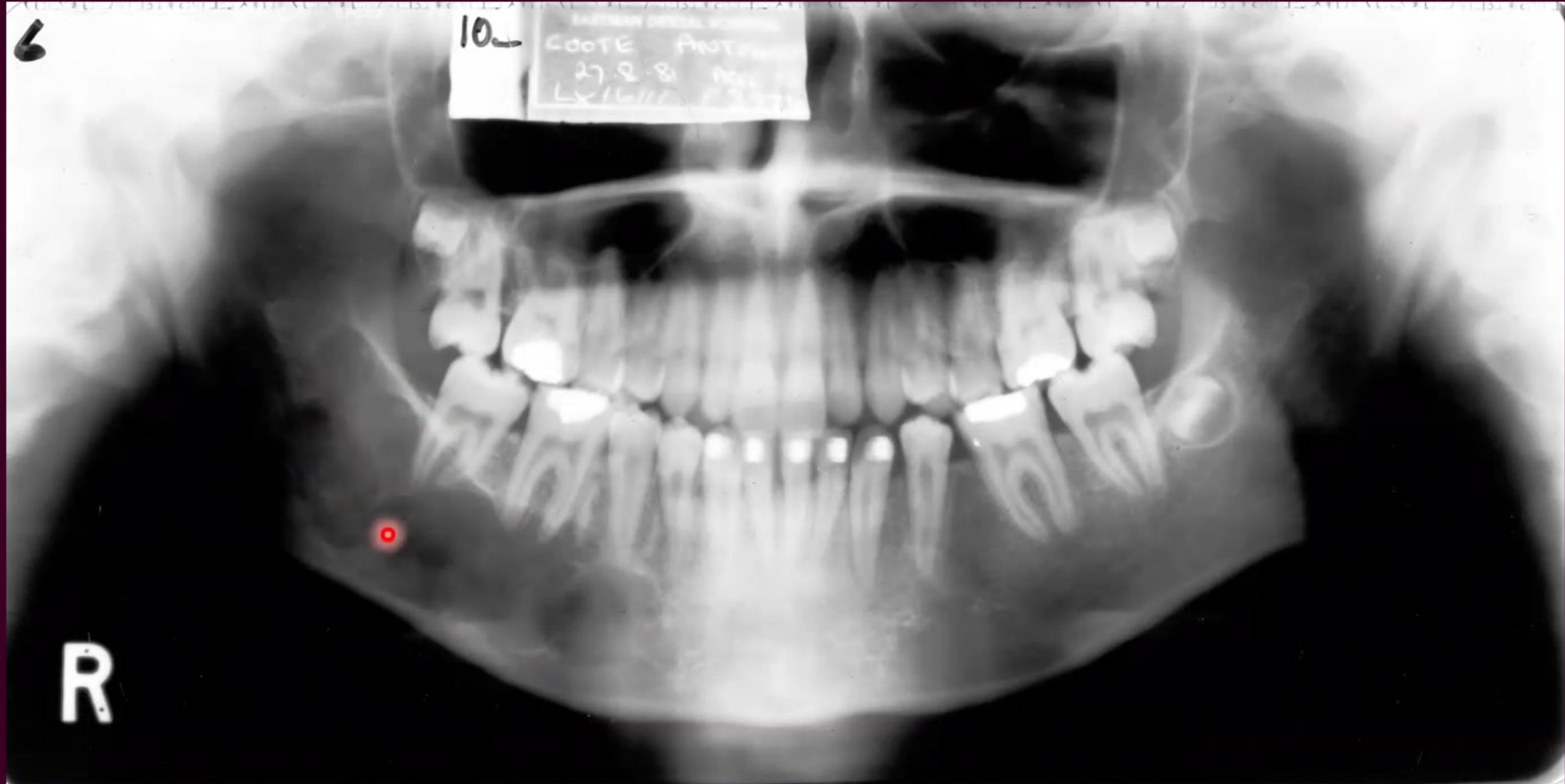
## Histology:

- Cortical bone cap
- Bone resorption - remodeling
- Membranous fibrovascular tissue
- Fibrin - hemorrhage
- No epithelial lining







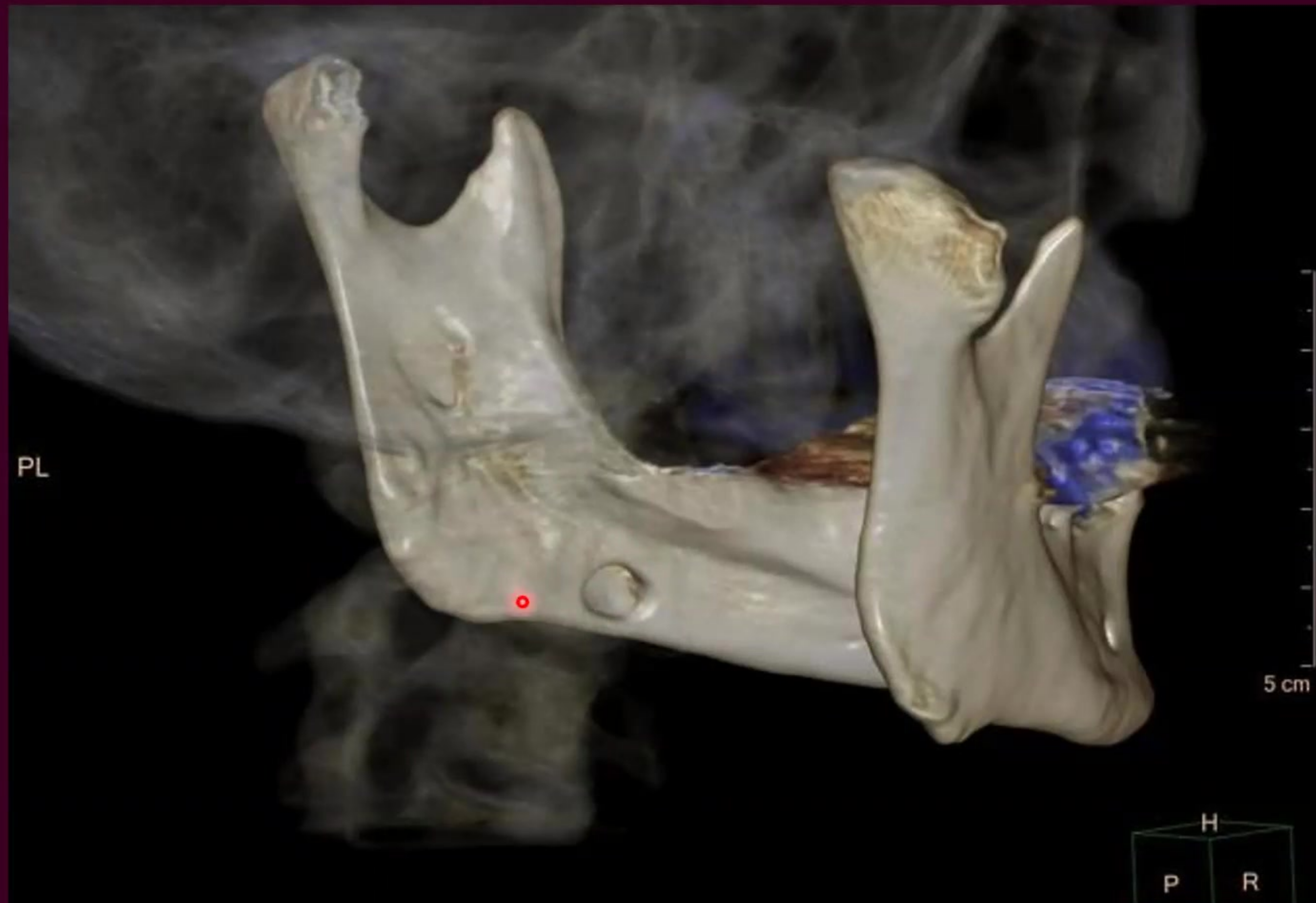


# Stafne cysts

- Static bone cavity of the mandible or lingual salivary gland inclusion defect
- middle-aged men
- Estimated prevalence ranges around 0.10-0.48%



- <https://radiopaedia.org/articles/stafne-cyst><sup>137</sup>



- <https://radiopaedia.org/articles/stafne-cyst><sub>138</sub>

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