

Selection Criteria for Radiographic Examinations

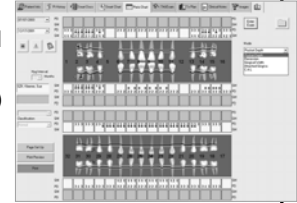
Steven R. Singer, DDS
srs2@columbia.edu
 212.305.5674



Radiographic Selection

The selection of appropriate radiographs is based on:

- Patient complaint(s)
- Medical and dental history
- Significant clinical findings



Radiographic Selection

- Radiographs are only appropriate when:
 - Diagnostic information cannot be obtained in a less invasive manner
 - The history and clinical data do not yield enough information for complete evaluation of the patient's condition
 - The information is necessary for formulating a treatment plan

Radiographic Selection

- Radiographs are only appropriate when:
 - The patient will benefit from information that is clinically useful.
 - The potential benefit to the patient outweighs the potential risk



Decision making

- Prevalence of the disease
- Ability to detect the disease clinically and radiographically
- Consequence of undetected and, therefore, untreated disease
- Impact of asymptomatic variations, detected radiographically, on treatment outcome

Adapted from White & Pharoah, Chapter 14

Decision making

- It is inappropriate to use radiographs as a screening tool
- There is neither a law nor a rule calling for a full mouth series of radiographs for each patient
- Radiographs are seldom used in medicine for screening purposes, with the exception of mammography

Decision making

- The most common diseases of the jaw are:
 - Periodontal disease
 - Caries
 - Periapical disease
- Other lesions are uncommon. Further, they are unlikely to be found on routine dental radiographs, such as a Full Mouth Series

History



A mid-20th century dental office

History

- After World War II, high quality radiographic equipment and film became readily available to dentists.
- Caries rates were high, possibly due to the lack of fluoride in the drinking water
- Knowledge of the effects of low-dose radiation was sparse

EDISON FEARS
HIDDEN PERILS
OF THE X-RAYS.

History

- Fluoroscopes, such as this example, were used to ascertain correct fit in shoe stores

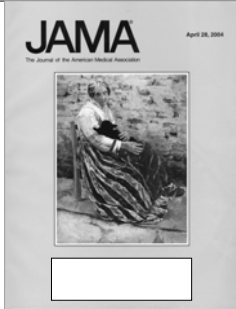


History

- With ongoing research about the effects of low dose radiation, our concern for our patients' wellbeing grows
- Therefore, radiographs should only be prescribed after a clinical examination
- There is no **"one size fits all"** radiographic examination



History



- Antepartum Dental Radiography and Infant Low Birth Weight *Hujoel PP, Bollen A, Noonan CJ, del Aguila MA. JAMA. 2004; 291:1987-1993*

History

- JAMA. 2004 Apr 28;291(16):1987-93 [Related Articles, Links](#)
 - Comment in:
 - JAMA. 2004 Sep 1;292(9):1019-20. [author reply 1020-1](#).
 - JAMA. 2004 Sep 1;292(9):1019. [author reply 1020-1](#).
 - JAMA. 2004 Sep 1;292(9):1019. [author reply 1020-1](#).
 - JAMA. 2004 Sep 1;292(9):1019. [author reply 1020-1](#).
 - JAMA. 2004 Sep 1;292(9):1020. [author reply 1020-1](#).
 - Antepartum dental radiography and infant low birth weight.

Hujoel PP, Bollen AM, Noonan CJ, del Aguila MA

Department of Dental Public Health Sciences, University of Washington, Seattle, WA 98195, USA. hujopel@u.washington.edu

CONTEXT: Both high- and low-dose radiation exposures in women have been associated with low-birth-weight offspring. It is unclear if radiation affects the hypothalamus-pituitary-thyroid axis and thereby indirectly birth weight, or if the radiation directly affects the reproductive organs. **OBJECTIVE:** To investigate whether antepartum dental radiography is associated with low-birth-weight offspring. **DESIGN:** A population-based case-control study. **PARTICIPANTS AND SETTING:** Enrollees of a dental insurance plan with live singleton births in Washington State between January 1985 and December 2000. Cases were 117 women with low-birth-weight infants (<2500 g), of whom 336 were term low-birth-weight infants (1501-2499 g and gestation >= 37 weeks). Four control pregnancies resulting in normal birth-weight infants (>= 2500 g) were randomly selected for each case (n = 448). **MAIN OUTCOME MEASURES:** Odds of low birth weight and term low birth weight by dental radiographic dose during gestation. **RESULTS:** An exposure higher than 0.4 milligray (mGy) during gestation occurred in 21 (1.8%) mothers of low-birth-weight infants and, when compared with women who had no known dental radiography, was associated with an adjusted odds ratio (OR) for a low-birth-weight infant of 2.77 (95% confidence interval [CI], 1.11-4.66, P = .03). Exposure higher than 0.4 mGy occurred in 10 (3%) term low-birth-weight pregnancies and was associated with an adjusted OR for a term low-birth-weight infant of 3.61 (95% CI, 1.46-8.92, P = .005). **CONCLUSION:** Dental radiography during pregnancy is associated with low birth weight, specifically with term low birth weight.

PMID: 15113817 [PubMed - indexed for MEDLINE]

Cost versus Benefit

- Although the individual risk to any patient from unproductive radiographs is minimal, the cost to society in terms of wasted healthcare dollars is great.
- Further, while the potential risk for harm from radiation is small for each patient, the radiation risk to the population becomes significant

Administrative Radiographs

- These are radiographs exposed solely for non-diagnostic purposes including:
 - Improved grades
 - Proof of completion of procedure for insurance purposes
 - In lieu of charting or examination
- They are considered completely inappropriate, and are therefore, forbidden!

Administrative Radiographs



Caries

- Caries is the most common disease of the oral cavity
- Affects people of all ages
- Does not affect all populations equally
- Bitewing radiographs are the most effective projection for assessing interproximal caries

Caries

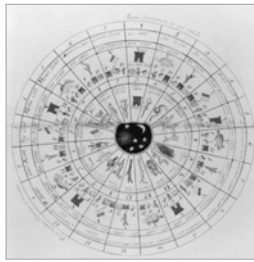
- Caries on the buccal, lingual and occlusal surfaces can usually be detected clinically
- In most individuals, caries takes months to years to progress through the enamel and into the dentin
- Only 50% of all lesions actually progress beyond the enamel

Caries

- Frequency of bitewing examination depends on:
 - Age
 - Medical condition
 - Medications
 - Diet
 - Oral hygiene
 - Prior caries history

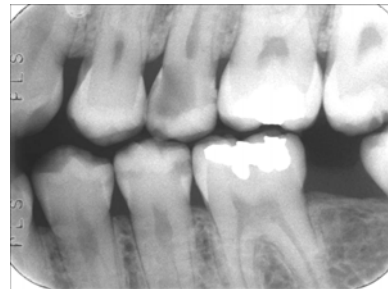
Caries

- Certainly, no less than 6 month intervals are appropriate.
- As disease is controlled, examination interval increases to 12, 18, or 24 months

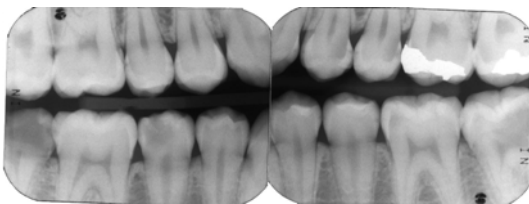


Reproduction of a traditional Mexican Calendar

Caries



Caries



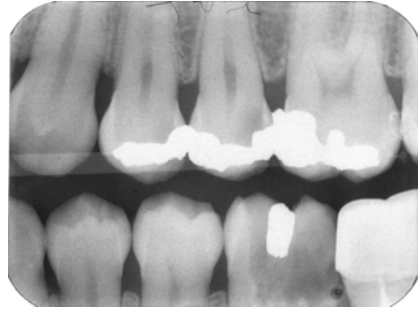
Periodontal Disease

- Marginal periodontitis affects an estimated 24% of the adult population in this country
- It is responsible for a substantial number of teeth that are lost
- Anterior periapical and posterior bitewings are the best projections for detecting and assessing the extent of the disease process

Periodontal Disease

- Local factors, such as overhanging restorations and calculus can be seen on radiographs
- Anomalies and variations on normal anatomy (supernumerary or impacted teeth, etc.) can also be detected
- After treatment is completed, follow-up radiographs are used to assess therapy

Periodontal Disease



Periodontal Disease

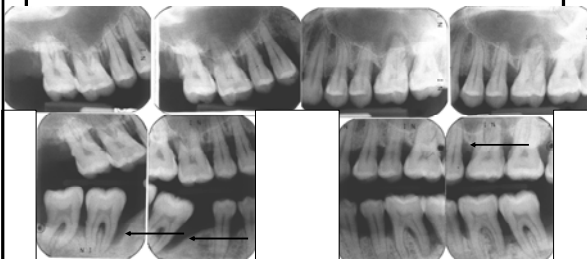


Periodontal Disease



Moderate Horizontal Bone Loss

Periodontal Disease



Apical Inflammatory Lesions

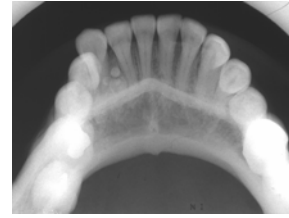


Dental Anomalies

- Dental anomalies generally affect the permanent dentition more than the primary
- In general, it is inappropriate to screen young children for anomalies, as treatment is usually initiated later
- Panoramic radiographs are optimal for assessing anomalies such as congenitally missing teeth, supernumerary teeth in all quadrants

Dental Anomalies

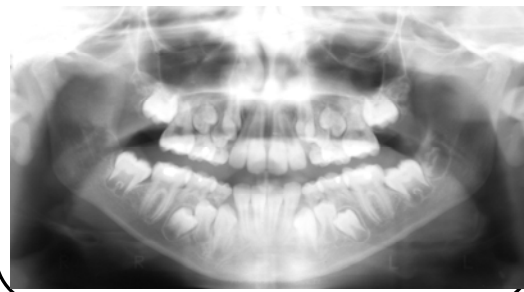
- Occlusal or periapical films can be used for localized anomalies



Growth and Development

- Generally, radiographs to assess growth and development are prescribed by the orthodontist, after a thorough clinical examination
- These may include periapical, panoramic, cephalometric, and occlusal radiographs
- Photographs, clinical data, and study models should be used, wherever possible, to make diagnoses and treatment decisions

Growth and Development



Occult Disease

- Refers to disease that has no clinical signs and symptoms
- May be dental, such as interproximal caries, or intraosseous, such as a cyst or tumor
- Most serious disease in the jaws is rare
- Often, there is actually a clinical sign or symptom that suggests the presence of a pathology

Occult Disease

- Radiology. 1987 Mar;162(3):691-5. [Related Articles](#), [Links](#)

Dental radiography: efficacy in the assessment of intraosseous lesions of the face and jaws in asymptomatic patients.

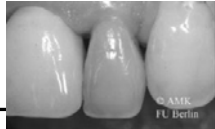
Zeichner SJ, Ruttimann UE, Webber RL.

In this investigation the efficacy of dental radiography for the detection of occult intraosseous lesions of the face and jaws was evaluated. An analysis of 30 million health insurance records indicated that the period prevalence of malignant lesions was less than 5 cases/million/year, and for benign lesions approximately 100 cases/million/year. Data from a controlled observer-performance study showed that radiographic sensitivities ranged between 50% and 80%. The cost per true-positive finding was estimated to be +8.6 million per malignant case and +430,000 per benign case. An assessment of the dosimetric literature indicated that the benefits of radiographic screening as a means for early detection of a malignancy appear to be counterbalanced by the risk of causing a radiation-induced malignancy. Taken together, these data demonstrate that dental radiography is not efficacious for the purpose of detecting occult lesions.

PMID: 3809483 [PubMed - indexed for MEDLINE]

Occult Disease

- For example, a history of trauma or a discolored tooth may suggest that there will be an apical inflammatory lesion present. In this instance, a more thorough history and clinical examination would have revealed the need for a radiograph.



Occult Disease

- Edentulous patients presenting for dentures often receive a panoramic radiograph, even in the absence of significant clinical findings.
- Since the most common radiographic findings on these radiographs are of impacted teeth and root remnants, and are usually of no clinical consequence, some researchers feel that these radiographs are not necessary

Occult Disease

- Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998 Sep;86(3):353-9 [Related Articles](#), [Links](#)
A study of the impact of screening or selective radiography on the treatment and postdelivery outcome for edentulous patients.

Bohay RN, Stephens RG, Kogon SL.

University of Western Ontario, Canada.

OBJECTIVE: The purpose of this study was to assess the impact of radiographic findings on complete denture treatment and on the postdelivery course of those patients who had pretreatment radiographs (the screening group) and those who did not (the selection group).
METHOD: In total, 375 cases were randomly selected by systematic sampling. Data collected included patient demographic information and denture history, pretreatment fabrication radiographic findings, and postdenture delivery complaints. **RESULTS:** Of the screening patients, 100% had pretreatment radiographs made; this compared with 13.5% of the selection patients. In the screening group, 68.3% of patients had one or more positive radiographic findings recorded. Of the screening patients, 8.3% received treatment before denture fabrication; this compared with 1.2% of the selection patients. Of the 375 cases, 2 screening patients had postdelivery complaints that required management other than denture adjustment. **CONCLUSION:** The results indicate that there is weak scientific support for the guideline recommending routine pretreatment radiography for new denture patients.

PMID: 9768428 [PubMed - indexed for MEDLINE]

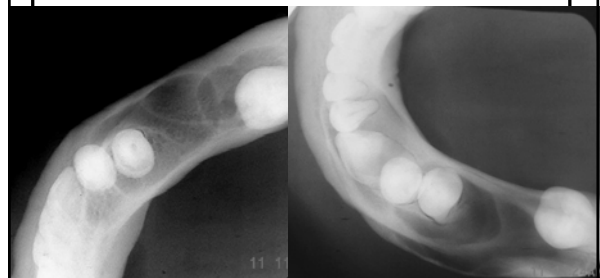
Pathoses of the Jaws

- Small lesions can often be visualized on periapical radiographs
- Larger lesions may require occlusal and/or panoramic radiographs
- If expansion of the buccal and lingual cortices is suspected, an occlusal radiograph, exposed at 90 degrees to the original film, is indicated

Pathoses of the Jaws



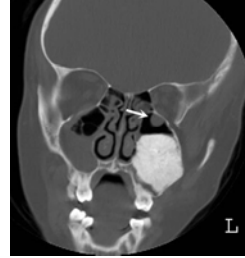
Pathoses of the Jaws



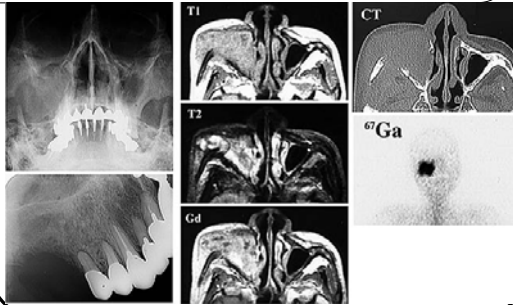
Pathoses of the Jaws

- If the lesion is suspected or observed to extend beyond the jaws, for example, into the maxillary sinus, advanced imaging is indicated
- Examples of advanced imaging include CT, CBCT, MRI

Pathoses of the Jaws: Odontoma



Pathoses of the Jaws: Squamous Cell Carcinoma



Images courtesy of Ashai
University School of Dentistry

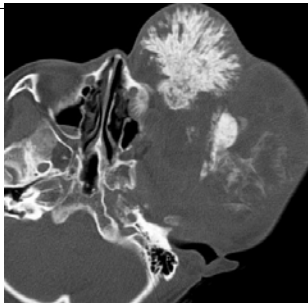
Pathoses of the Jaws: Osteosarcoma



PA View

Images courtesy of Nagasaki
University School of Dentistry

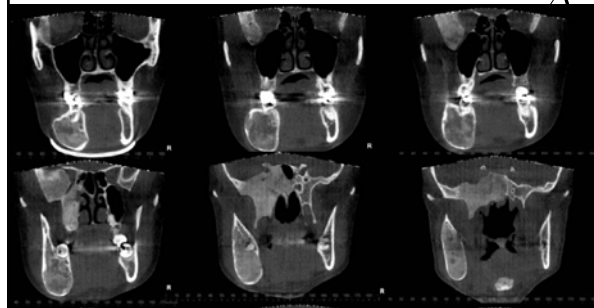
Pathoses of the Jaws: Osteosarcoma



Axial CT Bone window

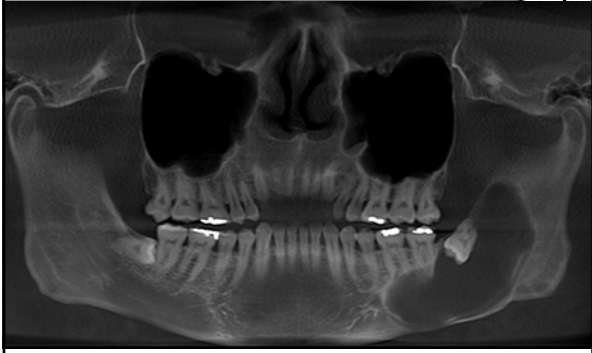
Images courtesy of Nagasaki
University School of Dentistry

Extent of Disease

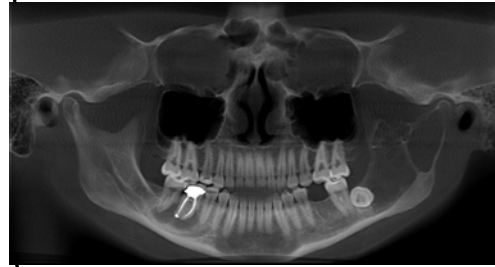


Courtesy
Dr D. Hatcher

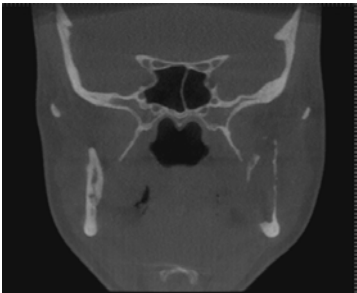
Extent of Disease



Extent of Disease



Extent of Disease



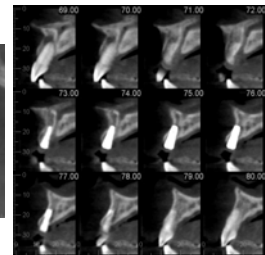
Implant Imaging

- Prior to the placement of root-form implants, precise measurements of the amounts of bone available for placement are crucial
- It is imperative that the dentist be aware of the relationship of the implant site to structures such as the maxillary sinus and inferior alveolar canal

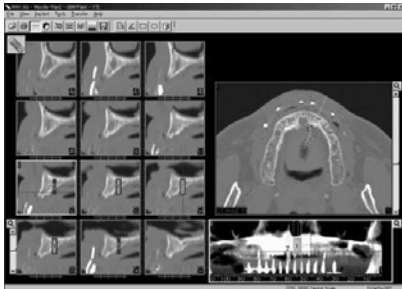
Implant Imaging

- Three dimensional imaging, such as that acquired using reformatted CT or Cone Beam CT scans are used to acquire precise measurements.
- Additional software, such as Simplant, help the dentist to plan the surgical aspects of implant restorations

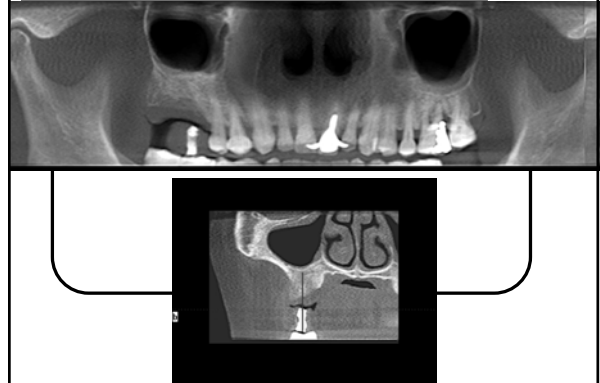
i-CAT for Implants



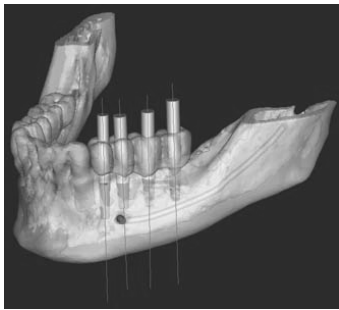
Implant Imaging



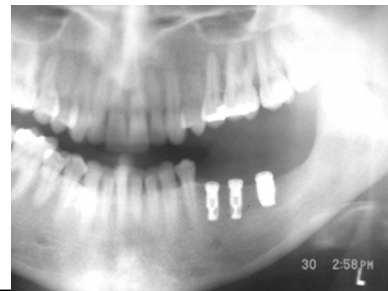
Radiographic guides



Implant Imaging



Implant Imaging



Evaluation of Trauma

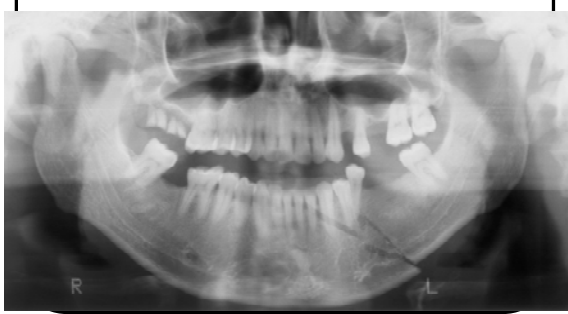
- First, clinically assess the full extent of the trauma
- Injuries to individual teeth may be assessed using individual periapical radiographs
- Panoramic radiographs are useful, for diagnosing fractures to the mandible. An occlusal view exposed at 90 degrees to the original film can be helpful

Evaluation of Trauma

- If there is a fracture to the body or angle of the mandible, a second fracture, usually in the neck of the condyle, may be seen. A reverse Towne's view is the optimal projection.



Evaluation of Trauma



Panoramic View

Evaluation of Trauma



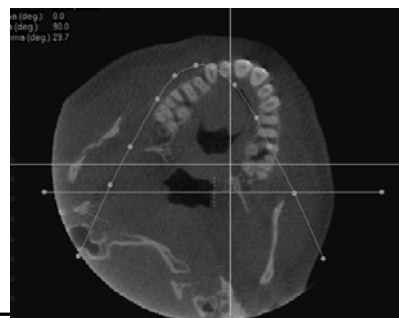
Reverse Towne's View

Evaluation of Trauma



Panoramic View

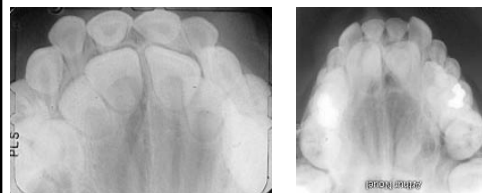
Evaluation of Trauma



Evaluation of Trauma

- Root fractures may be difficult to see on a radiograph, unless the plane of the fracture is perpendicular to the film
- Patients who are in pain may not be able to tolerate periapical films. Occlusal views and panoramic projections may be used. Keep in mind that panoramic projections do not provide optimal views of the anterior

Evaluation of Trauma



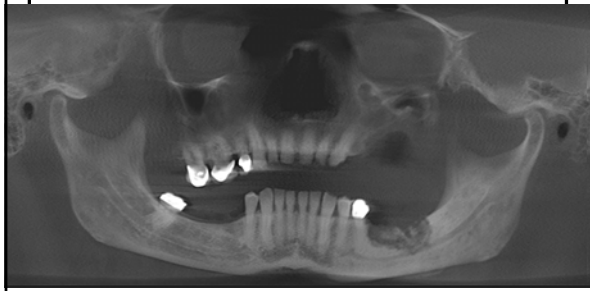
Modifications

- **Pregnancy**
 - Although the dose received by a fetus during pregnancy from a FMS is negligible, our sensibilities tell us to limit dental radiographs to diagnosis and treatment of emergency conditions only
- **Radiation Therapy**
 - The dose received by patients undergoing radiation therapy for cancers is several orders of magnitude higher than from a FMS. Further, therapeutic radiation to the head and neck can diminish or eliminate salivary flow, setting the stage for rampant caries

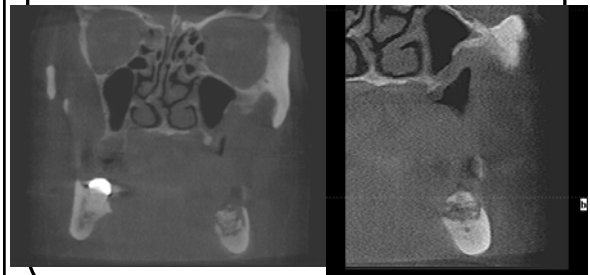
Modifications

- **Radiation Therapy (continued)**
 - Further, the patient may also receive chemotherapy for bone metastases (bisphosphonates). Bisphosphonate therapy has been linked with a form of osteomyelitis in the mandible. Detection and elimination of potential sources of infection are imperative for these patients

Bisphosphonate-related ONJ



Bisphosphonate-related ONJ



Radiographic Selection Criteria

- Please familiarize yourselves with the contents of this document. You may wish to print it out and bring it to radiology clinic during your rotations

http://www.ada.org/prof/resources/topics/topics_radiography_examinations.pdf

Radiographic Selection Criteria

Clinical situations for which radiographs may be indicated include: 1. Routine dental findings 2. History of acute trauma 3. Periodontal evaluation of existing dentition 4. Periodic dental X-ray/trauma 5. Clinical evidence of periodontal disease 6. Long-standing dentures 7. Long-standing orthodontics 8. Treatment of clinically impacted teeth 9. History of facial trauma 10. History of facial infection 11. History of facial surgery 12. Current dental work 13. Oral examination of bone or radiopaque lesions 14. Radiographic finding on the radiograph 15. Evidence of foreign objects 16. High clinical suspicion of the following: 17. Oral anomalies 18. Abnormal growth or development 19. Unexplained dental caries 20. Unexplained dental trauma 21. Unexplained eruption, swelling or migration of teeth 22. Unexplained tooth mobility 23. Unexplained tooth loss 24. Missing teeth with unknown history	Patient Category	Child Primary Dentition (prior to eruption of the permanent teeth)	Transitioned Dentition (during eruption of the permanent teeth)	Adolescent Prior to eruption of the permanent teeth	Adult Dentition	Members
	All new patients to assess dental disease and growth and development	Panoramic examination if general radiograph of primary teeth cannot be visualized or needed	Individualized radiographic examination consisting of panoramic radiograph and periapical radiographs of impacted teeth and permanent dentition	Individualized radiographic examination consisting of panoramic radiograph and periapical radiographs of permanent dentition	Individualized radiographic examination consisting of panoramic radiograph and periapical radiographs of permanent dentition	Individualized radiographic examination consisting of panoramic radiograph and periapical radiographs of permanent dentition
Recall Patient* Clinical status or high risk factors for caries**	Panoramic examination at 6 to 12-month intervals or oral or caries lesions are evident	Panoramic examination at 6 to 12-month intervals or oral or caries lesions are evident	Panoramic examination at 6 to 12-month intervals or oral or caries lesions are evident	Panoramic examination at 12 to 18-month intervals	Not applicable	
No clinical caries and no high-risk factors for caries**	Panoramic examination at 12 to 24-month intervals if general radiographs of primary teeth are visualized or needed	Panoramic examination at 12 to 24-month intervals	Panoramic examination at 12 to 24-month intervals	Panoramic examination at 24 to 36-month intervals	Not applicable	
Periodontal disease or a history of periodontal treatment	Individualized radiographic examination consisting of selected panoramic and/or periapical radiographs for areas where periodontal disease (ultra shallow) or resorption (gingival) can be demonstrated clinically	Individualized radiographic examination consisting of selected panoramic and/or periapical radiographs for areas where periodontal disease (ultra shallow) or resorption (gingival) can be demonstrated clinically	Individualized radiographic examination consisting of selected panoramic and/or periapical radiographs for areas where periodontal disease (ultra shallow) or resorption (gingival) can be demonstrated clinically	Individualized radiographic examination consisting of selected panoramic and/or periapical radiographs for areas where periodontal disease (ultra shallow) or resorption (gingival) can be demonstrated clinically	Not applicable	
Growth and development assessment	Usually not indicated	Individualized radiographic examination consisting of a panoramic radiograph or panoramic examination	Individualized radiographic examination consisting of a panoramic radiograph or panoramic examination	Individualized radiographic examination consisting of a panoramic radiograph or panoramic examination	Usually not indicated	Usually not indicated

Exercise #1

- 48 yo male presents for initial examination with a request for cleaning
- Past medical history is unremarkable
- Most recent radiographs were exposed >3 yrs ago
- Clinical examination revealed multiple large amalgam and composite restorations throughout the dentition, caries at the margin of several restorations, >3 mm probing depths, and a fractured mesiolingual cusp on tooth #19. The patient reports that he had "2 or 3 root canals"

Exercise #2

- 25 yo dental student presents for initial examination with a request for a check up and complaint of occasional transient sensitivity to cold in the posterior teeth
- Past medical history is unremarkable
- The patient has never had a Full Mouth Series of Radiographs
- Clinical examination revealed 3 small posterior composite restorations. All third molars were missing, due to extractions (as reported by patient). Gingiva is healthy and there are no probeable carious lesions. Perio probing depths are < 3mm

Exercise #3

- 64 yo female presents with chief complaint of "bleeding gums"
- Past medical history is significant for diabetes type II, which is controlled by diet and medication, as well as controlled hypertension
- Last radiographs were exposed "many years ago"
- Clinical examination revealed a full dentition, no restorations, spacing between maxillary and mandibular anterior teeth, no caries, and probing depths >5mm. Patient states that the anterior spacing is of recent onset

Exercise #4

- 19 yo college student presents "because his mom scheduled the visit."
- Past medical history is non-contributory
- Last radiographs were bitewing projections from 2 years ago. They revealed healthy proximal surfaces
- Intraoral exam revealed 28 teeth, a few small, occlusal restorations, and 2 new occlusal caries. There was slight bleeding on probing, but no significant probing depths. Orthodontic treatment has left his teeth well-aligned