enrichment readings

Pinkham – 4th edition
pages 304-308
& 506-510

McDonald - 9th edition
chapter 5
overview

- x-ray physics/biological impact
- risks vs. benefits
- indications
- common radiographs taken in the pediatric population
- technique overview
- protocol
- patient management
- digital radiography
x-ray physics
biological impact
x-rays

high energy electromagnetic radiation produced by the collision of a beam of electrons with a metal target in an x-ray tube
radiograph

the film of internal structures of the body produced by exposure of film specially sensitized to x-rays
supplemental information to a thorough intra- and extraoral examination

data gathering
ionizing radiation

- imparts some of its energy to the matter it traverses
- dislodge orbiting electrons causing the radiolysis of water
- can damage, destroy and/or alter living tissue

Exposure of cells to ionizing radiation induces high-energy radiolysis of $H_2O$ water molecules into $H^+$ and $OH^-$ radicals, which are themselves reactive. These in turn recombine to produce a variety of highly reactive radicals such as superoxide ($H_2O_2$) and peroxide ($H_2O_2$), which are capable of producing oxidative damage within the cell.
and where do you think 90% of the total man-made radiation dosage comes from?

well, it's not all from us, but the most frequent radiographic examinations on children DO come from dental radiographs
...and guess what, ladies and gentlemen?

- optimal diagnosis and treatment requires their use

- childhood is that time of maximum dental caries activity

- as well as the period of great dentofacial growth and development
effective doses example

**Effective Doses from Various Dental X-Ray Procedures**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Effective Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panoramic</td>
<td>6-11 microsieverts</td>
</tr>
<tr>
<td>Cephalometric</td>
<td>6-11 microsieverts</td>
</tr>
<tr>
<td>TMJ tomogram</td>
<td>2 microsieverts</td>
</tr>
<tr>
<td>Full-mouth intraoral</td>
<td>10-15 microsieverts</td>
</tr>
<tr>
<td>Bitewings (4 x rays)</td>
<td>2-3 microsieverts</td>
</tr>
<tr>
<td>Mandible CT</td>
<td>150-700 microsieverts</td>
</tr>
<tr>
<td>PA and lat. chest x-ray (for comparison)</td>
<td>170 microsieverts</td>
</tr>
<tr>
<td>Background radiation (for comparison)</td>
<td>3,600/y microsieverts</td>
</tr>
</tbody>
</table>

*source: health physics society*
much information about high levels of radiation and subsequent damage is available
effects of low levels on biologic systems are virtually unknown
assumptions of damage are based on extrapolation of data from high levels to lower levels of radiation
risks to patients

somatic vs genetic

acute vs chronic exposure
somatic versus genetic acute versus chronic exposure

somatic
- carcinogenesis
- teratogenesis
  - malformations

have a threshold response
- i.e., a certain amount of radiation is necessary before the response is seen
genetic versus somatic exposure

- genetic tissue
  - gonads
- mutation
  - believed to have no threshold
critical tissue area

- skin
  - cancer
- bone marrow
  - leukemia
- gonads
  - mutation
  - infertility
  - fetal mutation
- eyes
  - cataracts
- thyroid
  - cancer
- breasts
  - cancer
- salivary glands
  - cancer
risk reduction

- modern equipment
- collimated beam
- ultra high speed film
- lead body shield
- thyroid collar
- technique

(digital)
risk/benefit ratio

if the radiographic examination is done on the basis of well established, indicated needs, the risk from ionizing radiation *is the same* but the benefit of identifying or ruling out pathology *is greater* to the patient than if the same radiographic examination were to be performed with little or no indication
benefits/indications

- evaluation
  - caries activity
  - growth & development
  - anomalies
  - genetic defects
  - pathological conditions
  - trauma
caries activity
caries activity
growth & development
anomalies
anomalies
anomalies
tom
genetic defects
pathology
pathology

radicular cyst
and this?
trauma
an unproductive examination is not the same as a negative examination
parental resistance

its their choice – permission is needed
explain to them

- guidelines set up by panel of experts assembled by the FDA
- endorsed by all major dental organizations
- taken when it benefits the patient's diagnosis or treatment plan
  - early intervention minimizes treatment
    - prevents patient from experiencing
      - dental pain
      - extraction
      - emotional stress
  - eruptive or developmental problems can be discovered
- radiation for needed radiographs equivalent to a few hours of natural background radiation and less than that from being in the mountains or an airplane
common radiographs for the pediatric patient
types commonly used for the pediatric dental patient

- *intraoral*
  - bitewing
  - periapical
  - occlusal

- *extraoral*
  - orthopantomograph
  - ceph
  - lateral view
  - special views
    - Hand/Wrist
    - Towne
    - Waters
bitewing

- caries detection
- film type 0 & 2
  - (sometimes 1)
bitewing
vertical bitewings

rotation of the film pack by 90 degrees
technique
technique
technique - 4 bitewings

central beam aimed through contact area
a word about positioning devices

- they do decrease retakes
- Dentsply Rinn
a word about positioning devices

- positioners may be uncomfortable
  - children's palates and the floor of the mouth are shallow
- lose some information due to holder thickness versus paper tabs
reverse bitewing

- gaggers and other non-compliants
- place film between teeth in question and the cheek, film side towards tooth (not lead side)
- bite on tab as usual
- align cone below mandible on opposite side
- point towards teeth in question
- exposure time is increased three-fold
periapical

- structural evaluation
- secondarily - caries detection
- film type 0, 1 & 2
periapical

#1 size

#0 size
periapicals
periapicals
periapicals
techniques – parallel & bisecting angle

parallel

bisecting
don’t bend the film

pressing the film directly against the palate will distort the image
buccal object rule

the image of any buccally oriented object appears to move in the opposite direction from a moving x-ray source
buccal object rule

The x-ray source moved to the right.

The star - which is buccal - moved in the opposite direction on the film in reference to the circle.

The triangle - which is lingual - moved in the same direction on the film in reference to the circle.
buccal object rule

The x-ray source moved to the left.
The star - which is buccal - moved in the opposite direction on the film in reference to the circle.
The triangle - which is lingual - moved in the same direction on the film in reference to the circle.
occlusal

- structural evaluation
- caries detection
- film type 2 & 3
occlusal

- structural evaluation
- caries detection
- film type 2 & 3
occlusal
Technique

- #2 film - longer side from canine to canine
- Maxillary: +45 to +65 degrees from the plane of the film
- Mandible: -45 degrees from the plane of the film
- #3 film: position is dependent upon information desired
case - 6 yo (thanks to dr. scott goldman)
panoramic orthopantomograph panorex “pan”

- visualize structural relationships
uses

- visualize the relationship of the various structures in the child’s developing dentition
- monitor eruption
- confirm presence or absence of teeth
- position of unerupted teeth
- pathology detection
  - cysts
  - tumors
  - bone loss
compare to fmx

- shows more anatomy
- considerably easier to use than the intraoral technique
- lower cost (sometimes)
- less radiation

- lacks sufficient image detail (?)
- poor at caries detection
- false rotations
- missed supernumerary
- supplemental radiographs may be needed
compare to fmX
to compare

thanks to john polivka
compare

06/2009
technique dependent upon manufacturer – in most, the film and radiation source rotate around the subject, who remains still
Planmeca Proline XC
age 6
age 11
schematic
panorex versus fmx

- The concept of having a full-mouth survey routinely performed on each patient is not consistent with current FDA/ADA recommendations.
- These criteria have been augmented by "Parameters of radiologic care: An official report of the American Academy of Oral and Maxillofacial Radiology"\(^2\)
- Refer to Dr. Monahan.
cephalometric

- quantitative assessment
  - precise source, subject and film position
- lateral skull projection
- posterioanterior projection
- discussed in ortho series
schematic
schematic
other lateral views
trauma evaluation - mandible
lateral jaw (after McDonald)
Epiglottis
Cornu of the hyoid bone
Posterior border of tongue
Palatal soft tissue
External oblique ridge
Third molar region
Mental foramen
Body of the hyoid bone
Corne of the hyoid bone
hand/wrist

- ossification
- bone versus chronological age
- current studies
  - cervical vertebrae
example
reverse towne

- condyle
  - fracture of the condylar neck
  - condylar displacement
- refer to your lectures from OMFS
- following image from
  - www.dental.louisville.edu/current_student/coursework/suhd_813/ExtraoralReview_selfreview.ppt
Extraoral Radiographs: Radiographic Anatomy Self test

Acknowledgements:
Exercise Radiographs provided and reproduced with kind permission of Stuart C. White, DDS, PhD., UCLA School of Dentistry Normal Radiographic Anatomy Online Course in Oral Radiology (DS451c) http://www.dent.ucla.edu/sod/depts/oral_rad/courses/DS451c/

Anatomic/Radiographic Correlations
water’s projection
occupitomental projection

- variation of the PA View
- evaluation of the maxillary sinuses
- coronoid process
- refer to your lectures from OMFS
protocol
protocol

- first visit – primary dentition
- recall visit
- early transitional dentition
- early permanent dentition
- special circumstances
- emergency evaluation
first visit

if contacts are closed or cannot be visualized or probed and no recent films are available, take bitewings
repeat or recall visits

with past evidence of caries progression, or a history of high caries activity, take bitewing radiographs at intervals of 6 to 12 months; otherwise, every 12 – 24 months
early transitional dentition

a radiographic examination that includes all toothbearing areas for assessment of the dental age, identifying pathoses and to aid in the early diagnosis of developmental anomalies – may include panoramic, bitewing and supplemental films.
early permanent dentition as before and to evaluate the development of the third molars
book advise

after Pinkham
3 to 6 years (after Pinkham)

- may find it difficult to cooperate
  - defer until behavior improves or can be managed
- tell-show-do
  - dry run
- preposition/preset everything
- size the film properly
  - bend the corners a bit (distortion)
  - rotate the film
    - shortens the A-P dimension
- easiest film first
6 to 12 years (after Pinkham)

- identify ‘not normal’
  - missing teeth, supernumerary
- developmental status of succedaneous teeth
- potential eruption problems
  - ectopic
  - impaction
- increase in physical size allows/requires more complex surveys
  - larger films (size 2 vs. size 0)
  - panoramic survey
- how many bitewings – 2 or 4?
adolescents (after Pinkham)

- transition into what is appropriate for an adult
- still based on other factors in your data gathering
  - caries rate
  - trauma
  - pathological conditions
- growth & development
- how many bitewings – 2 or 4?
special circumstances

- deep or rampant caries
- history of pain
- evidence of swelling
- trauma to teeth or jaws
- mobility of teeth
- unexplained bleeding
- deep periodontal pocketing
- fistula formation
- unexplained sensitivity
- evaluation of sinus condition
- unusual eruption pattern
- unusual spacing or tooth migration
- lack of response to treatment
- unusual tooth morphology
- unusual calcification or color
- altered occlusal relationship
- aid in diagnosing systemic disease
- familial history of dental anomalies
- postoperative evaluation
- pre-orthodontic evaluation
high risk for caries

increased frequency for radiographic evaluation
high risk for caries

- high level of caries experience
- history of recurrent caries
- existing restorations of poor quality
- poor oral hygiene
- inadequate fluoride exposure
- prolonged nursing
- diet with high sucrose frequency

- poor family dental health
- developmental enamel defects
- developmental disability
- xerostomia
- genetic abnormality of teeth
- many multi-surface restorations
- chemo/radiation therapy
patient management

tell-show-do
helpful hints

- be patient
- explain things
- let the child touch the packet
- use vinyl packets
- describe the feeling
- preposition things

- start out easy
- keep up the chatter
- reinforce good behavior
- fixed focus
- short exposure time
introducing a child to intraoral radiography – *Pinkham* p. 305

- use a tell-show-do introduction with a camera analogy
introducing a child to intraoral radiography – Pinkham p. 305

- it helps to do a ‘dry run’ showing an unexposed packet of film and an exposed radiograph to explain the process
by positioning the film and the x-ray machine, the dentist can also determine whether a child will be cooperative for an exposure, preventing unproductive irradiation
introducing a child to intraoral radiography – Pinkham p. 305

- obtain the least difficult radiograph first to acquaint the child with the procedures
  - anterior occlusal films are usually the easiest
introducing a child to intraoral radiography – *Pinkham p. 305*

- position machine before film
  - be certain that all settings are made on the machine and that the apparatus is positioned before positioning the film
- some children can hold a film only for a short period of time because of
  - the gag reflex
  - discomfort, or
  - a short attention span
introducing a child to intraoral radiography – Pinkham p. 305

- match film size to comfort
  - many children have difficulty with the film impinging on the lingual soft tissue of the mandible (remember tori?)
  - in some cases, bending the anterior corners help
    - but this may lower the diagnostic quality of the radiograph
- another technique is to place the film vertically to minimize anteroposterior size
gagging

the salt trick
special patients

- occlusal films
- extraoral films
- packet held in mouth by third person
- film packet modification
- film holders
- velcro straps
- mouth props
- medicolegal issues
  - informed consent
alternatives to radiographic evaluation of deep structures

- transillumination

- interproximal caries detection
- crown fractures
- some soft tissue pathology
- very limited
• **fiberoptic transillumination**
  - devise ~ 2000 lux with a 0.5 mm tip
• *in vitro* studies showed comparable with bitewings
• other investigators *in vivo* show differing results
KaVo DIAGNOdent laser
for more information

see blackboard for
Dr. G W Milicich’s presentation
for Kavo and DIAGNOdent
digital radiography

unique to the department

images recorded on an electronic sensor instead of film
digital radiography

defer to Dr. Monahan regarding the particulars on how it works
sensors

- the direct sensor systems
  - charge-coupled-device (CCD)-based systems
    - on a cord
    - instantly send image to computer

- storage phosphor plates (SSPs)
  - reusable photostimulated screen
  - similar looking to analog film
  - must be scanned in a separate step to computer
advantages/drawbacks

(+) CCD sensors
- offer more rapid image acquisition
- better resolution

(-) CCD sensors
- stiff sensor
- connects directly to computer
- dangling cord
- sensor costs are higher

(+ ) SPPs
- flexible
- do not have an electrical cord
- are other advantages

(-) SPPs
- need for additional time to readout the image
- readout device to scan the plates adds to the cost
- plates must be exposed to light to erase the residual image before reusing
- scratch easily and must be replaced
advantage

both offer a reduction in radiation dose to the patient
air techniques system
scanner & eraser
film packets

- same size as traditional films
  - 0, 1, 2, & 3
  - panoramic and cephalometric
- thinner
- can use with film holders
  - may require folding envelope
barrier envelopes

- film is placed in envelope and sealed via means of an adhesive strip
- discarded before placing in scanner/eraser
- film cleansed with cotton gauze and alcohol
handling phosphor plates

- avoid touching with long fingernails
- you may bend and flex, but do not fold or crease
  - permanent artifact
- positioning devices should not have sharp teeth
  - company recommends filing teeth
air techniques system

film fed through front where it is scanned and erased with light

note that ambient light will also erase image
OpTime

- similar to air techniques
- film in three sizes
- must be wrapped in barrier
- must be scanned
- scanning/erasing more ‘automated’
OpTime

$10,000
dexis

- instantaneous readout
- use same sensor
  - ‘move it around the mouth’

(disclaimer)
dexis

- plugs in to computer
- utilizes holders and sheathes
dexis

- bulky
- expensive
  - ~$5,000- 8,000 each
  - very brittle
“Comparison of direct digital and conventional radiography for the detection of proximal surface caries in the mixed dentition.” *J. Ped Dent.*, 22(1) 2000

**Authors:** Kristen K. Uprichard, DMD Brad J. Potter, DDS, MS Carl M. Russell, DMD, PhD Tara E. Schafer, DMD, MS

**Results:** Experienced examiners were significantly more accurate in diagnosis of proximal surface caries using either D-speed or E-speed Plus films than they were using the direct digital receptor. The results also indicated that selected viewers’ accuracy increased when viewing the direct digital images a second time.

**Conclusion:** CCD based direct digital radiography was not as accurate as conventional film images for the purpose of diagnosing proximal surface caries in the mixed dentition. However, the results imply that with increased experience, direct digital images may be as accurate as conventional film based images for diagnosis.
patient exposure record

- actual number of exposures
- including retakes
- automatically recorded in axiUm
The benefit from the judicious, reasonable use of diagnostic dental radiography is improved dental health. The risk to the child appears to be extremely low. Despite the low risk, the dentist must minimize the exposure to ionizing radiation by using sound clinical judgment to determine what radiographs are necessary and to provide children with optimal protection.