Radiographic Techniques for the Pediatric Patient

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Continuing Education Units: 2 hours


Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

The purpose of this course is to provide a discussion on the guidelines for radiographic exposure intervals for the reduction of ionizing radiation and innovative techniques that are helpful in conducting radiographic examinations for the pediatric patient. Also, suggestions for communicating with patients and parents about radiation safety and the need for radiographs are covered.

Conflict of Interest Disclosure Statement
• Dr. Schwartz is a member of the dentalcare.com Advisory Board.

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Overview
Clinicians are in agreement the foundation of an accurate diagnosis and treatment plan is based on a comprehensive medical and dental history, a thorough clinical examination, and diagnostic radiographs. Of the three, obtaining diagnostic radiographs in the pediatric dental patient is probably the most difficult to accomplish, not only from a technical standpoint but because of parental fears and misconceptions.

Learning Objectives
Upon completion of this course, the dental professional should be able to:
- Discuss with patients and parents radiation safety and the need for radiographs.
- Understand guidelines for radiographic exposure intervals for young patients for the reduction of ionizing radiation.
- Use innovative techniques for conducting radiographic examinations for the pediatric patient.

Course Contents
- The Principles for Proper Radiographic Examination
- Radiographic Techniques and Indications
  - Bitewing Radiographs
  - Periapical/Occlusal Radiographs
- Guidelines for Prescribing Radiographs in the Pediatric Patient
- Management Techniques
- Positioning the Radiograph
- Desensitization Techniques
- Procuring Posterior Radiographs
- Conclusion
- Course Test Preview
- References
- About the Author

The Principles for Proper Radiographic Examination
Clinicians are in agreement the foundation of an accurate diagnosis and treatment plan is based on a comprehensive medical and dental history, a thorough clinical examination, and diagnostic radiographs. Of the three, obtaining diagnostic radiographs in the pediatric dental patient is probably the most difficult to accomplish, not only from a technical standpoint but because of parental fears and misconceptions.

With the news media reporting on a daily basis the environmental insults experienced by the human body, parents are preoccupied with the effects of diagnostic and treatment procedures on the child’s health. Limiting children to the possible deleterious effects of preventive and restorative materials, sterilization protocols, and diagnostic techniques are a concern to parents and dentists.

Parents’ resistance to the use of radiographs may be reduced by apprising parents of the need for radiographs to derive an accurate diagnosis, as well as educating them of the newer philosophies and techniques for acquiring radiographs. At the time the parent schedules the first appointment, information should be offered explaining that for the dentist to perform a thorough dental examination and derive a correct assessment of a child’s dental health there may be a need for x-rays. Also when parents and the dentist look at the teeth in a child’s mouth, all that is seen is literally the tip of the iceberg. Visual examination reveals only three of the five surfaces of the teeth. If the child’s teeth are close together, the interproximal surfaces cannot be seen. The roots of the teeth anchored into the bone cannot be seen, nor the inside of the teeth, or the permanent teeth developing in the jawbone.

Parents should be informed radiographs enable the dentist to detect the start of visually undetectable cavities between teeth, infections of the teeth, gums and bones, the shape of unerupted permanent teeth, missing permanent teeth, future orthodontic problems, cysts, tumors, and a host of other pathological conditions.

Parents should be made aware that although excessive radiation exposure can result in cancer, birth defects, and genetic defects, the amount of radiation emitted by the newer x-ray units and the increased sensitivity of the x-ray film used by dentist has significantly reduced the amount of radiation to which patients are exposed. The newest technique for x-ray exposure, digital radiography, reduces the amount of exposure to a bare minimum.
Along with the above explanation and use of the proper equipment, the dentist should follow guidelines as recommended by a panel comprised of representatives from the Academy of General Dentistry, American Academy of Dental Radiology, American Academy of Oral Medicine, American Academy of Pediatric Dentistry, American Academy of Periodontology, and the American Dental Association.¹

• X-rays should not be taken routinely. Children's teeth should be first examined by a dentist or hygienist before deciding on the number and types of radiographs. The number and types of radiographs necessary is dependent on the age of the child, the presence of decay that can be detected visually, the child's and family's history of dental treatment, and spaces between teeth.

• If possible, obtain any prior radiographs (from another office, if available).

• Use only those views needed to complete the diagnostic task.

• The patient should be protected with a lead apron and thyroid collar to reduce body exposure to radiation.

• Follow recommendations to reduce radiation as low as possible (ALARA).

• Use the fastest image receptor available.
  - Intraoral: changing from D to F speed film or to digital image receptors reduces dose by factors of at least 2.
  - Extraoral: high speed (400 or greater) rare earth screen film systems or digital imaging systems or equivalent.

• Rectangular collimation: reduces radiation dose by factor or 4 to 5 without adverse influence on image quality.

• Beam receptor alignment devices (e.g., XCP) for routine periapical radiography (only marginally effective for bitewing radiographs).

• Use 70 kvp or higher intraoral radiograph techniques.

• Use leaded apron with thyroid collar whenever possible.

• For conventional radiographs:
  - The highest speed and largest size film the child can tolerate should be used to reduce the number of x-rays needed to obtain the necessary information.
  - Use the proper time and temperature for processing as recommended by manufacturers.

• Review in an environment free from distraction.

• Reduce room illumination to level of displayed images.

• Eliminate glare.

• Use magnification.

• Use opaque mount.

• View with variable illumination.

• For digital radiographs:
  - Use software that permits adjustments of contrast, brightness and negative-positive viewing.²

Parents may have the right to insist the dentist refrain from taking x-rays. However, if the dentist is of the opinion not taking the x-ray compromises the patient's treatment, he has the right to refuse to treat the child. Parents cannot offer to release the dentist from liability from subsequent damages that a radiograph might have prevented.

**Radiographic Techniques and Indications**

**Bitewing Radiographs**

Bitewing radiographs are indicated primarily to detect or monitor interproximal caries if the proximal surfaces of the teeth cannot be visually or tactilely examined. Occlusal caries, crestal alveolar bone level and secondarily for eruption patterns, caries and restoration proximity to pulp spaces, primary molar furcation pathology and developmental anomalies may also be detected with bitewing radiographs. The frequency of bitewing radiographic examination is based on caries risk assessment. As the risk status may change over time, the radiographic recall interval may change. A patient with a high caries risk assessment will require bitewing radiographs more frequently (every 6 months) than a patient with a low caries risk assessment (12-24 months). Orientation of the film packet may be vertically or horizontally positioned. Placement of the film packet reveals the coronal halves of the maxillary and mandibular teeth, interproximal contacts and portions of the interdental septa, beginning at distal of the canine and proceeding posteriorly to the mesial half of the last erupted molar. One to two films may be necessary depending on the tooth and jaw size.

**Periapical/Occlusal Radiographs**

Periapical/occlusal radiographs are indicated for identifying or confirming pathosis, evaluating dental
development, dentoalveolar trauma, deep carious lesions, periapical pathology and oral involvement of systemic disease.

Occlusal radiographs are also indicated as a supplement for an unsatisfactory panoramic radiograph due to an abnormal incisor relationship, localizing tooth position, assessing the position of supernumerary teeth, pathological lesions and traumatic injury to bone. They are not taken routinely in the primary dentition. Various aids may be used to position radiographs (hemostats, Snap-a-Ray®, XCP).

Guidelines for Prescribing Radiographs in the Pediatric Patient
See Table 1.

Management Techniques
One of the most challenging tasks for the clinical staff is to obtain diagnostic quality radiographs on a young patient (under three years of age) without psychological trauma.

The first step is to desensitize the child to the dental experience by explaining to the child what you plan to do in words easily comprehended by the child. Using a “tell, show, do” technique, the clinician explains to the child a tooth picture will be taken of the child’s tooth with tooth film and a tooth camera. The child is allowed to touch and examine the radiographic film and camera. The child is positioned to gain maximum cooperation. In the child less than three years of age it may be necessary for the child to sit in the parent's lap while the radiograph is exposed.

Such positioning reduces the child's anxiety to such a degree that minimal restraint may be needed to successfully take the radiograph. The child is seated in the parent's lap with the parent resting their arms around the child's upper body and their legs wrapped around the child's lower body. Not only does this provide additional emotional security for the child and, thus, increased cooperation but also enables the parent to adequately restrain the child should there be any unexpected sudden movements.

Obtaining the least difficult radiograph first (such as an anterior occlusal) desensitizes the child to the procedure. Since many children have difficulty keeping the film in their mouth for
Table 1. Guidelines for Prescribing Radiographs in the Pediatric Patient.1,2,3

<table>
<thead>
<tr>
<th>Type of Encounter</th>
<th>Primary Dentition (prior to eruption of first permanent tooth)</th>
<th>Transitional Dentition (after eruption of first permanent tooth)</th>
<th>Permanent Dentition (prior to eruption of third molars)</th>
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</thead>
<tbody>
<tr>
<td><strong>New Patient</strong></td>
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<tr>
<td>New patient* being evaluated for dental diseases and dental development.</td>
<td>Individualized radiographic exam consisting of selected periapical/occlusal views and/or posterior bitewings if proximal surfaces cannot be visualized or probed. Patients without evidence of disease and with open proximal contacts may not require a radiographic exam at this time.</td>
<td>Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images.</td>
<td>Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images. A full mouth intraoral radiographic exam is preferred when the patient has clinical evidence of generalized dental disease or a history of extensive dental treatment.</td>
</tr>
<tr>
<td><strong>Recall Patient</strong></td>
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<tr>
<td>Recall patient* with clinical caries or increased risk for caries.**</td>
<td>Posterior bitewing examination at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe.</td>
<td>Posterior bitewing examination at 6-18 month intervals.</td>
<td>Posterior bitewing examination at 24-36 month intervals.</td>
</tr>
<tr>
<td>Recall patient* with no clinical caries or increased risk for caries.**</td>
<td>Posterior bitewing examination at 12-24 month intervals if proximal surfaces cannot be examined visually or with a probe.</td>
<td>Posterior bitewing examination at 24-36 month intervals.</td>
<td>Posterior bitewing examination at 24-36 month intervals.</td>
</tr>
<tr>
<td>Recall patient* with periodontal disease.</td>
<td>Clinical judgment as to the need for and type of radiographic images for the evaluation of periodontal disease. Imaging may consist of, but not limited to, selected bitewing and/or periapical images of areas where periodontal disease (other than non-specific gingivitis) can be identified clinically.</td>
<td>Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development.</td>
<td>Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development. Panoramic or periapical exam to assess developing third molars.</td>
</tr>
<tr>
<td>Patient for monitoring of growth and development.</td>
<td>Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development.</td>
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</tr>
<tr>
<td>Patient with other circumstances including but not limited to, proposed or existing implants, pathology, restorative/endodontic needs, treatment periodontal disease and caries remineralization.</td>
<td>Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring in these conditions.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Clinical situations for which radiographs may be indicated include but are not limited to:

**A. Positive Historical Findings**
1. Previous periodontal or endodontic treatment
2. History of pain or trauma
3. Familial history of dental anomalies
4. Postoperative evaluation of healing
5. Remineralization monitoring
6. Presence of implants or evaluation for implant placement

**B. Positive Clinical Signs/Symptoms**
1. Clinical evidence of periodontal disease
2. Large or deep restorations
3. Deep carious lesions
extended periods of time, be certain the correct settings are made on the apparatus and the x-ray head is properly positioned before placing the film in the child's mouth. A positioning device such as a Snap-A-Ray can be used to aid the parent in positioning and securing the film. Be sure to adequately protect the parent and child with lead aprons to reduce radiation exposure.

If the child is uncooperative, then additional restraint by a second adult may be necessary to successfully obtain the radiograph. With the first adult restraining the child as described previously, a second adult stabilizes the child's head with one hand while the other hand positions the x-ray holder in the patient's mouth. Under no circumstances should staff be asked to perform this task.

If a second adult is not available, it may be necessary to place the child in a mechanical restraining device (Papoose Board) to adequately restrain the child. This frees the parent to stabilize the child's head and properly position the radiograph in the child's mouth.

If the child is still too uncooperative, it may be necessary to manage the child pharmacologically with inhalation, oral, or parental sedatives.

Older children may also be uncooperative for a variety of reasons. These can range from the jaw

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**Factors increasing risk for caries may include but are not limited to:**

1. High level of caries experience or demineralization
2. History of recurrent caries
3. High titers of cariogenic bacteria
4. Existing restoration(s) of poor quality
5. Poor oral hygiene
6. Inadequate fluoride exposure
7. Prolonged nursing (bottle or breast)
8. Frequent high sucrose content in diet
9. Poor family dental health
10. Developmental or acquired enamel defects
11. Developmental or acquired disability
12. Xerostomia
13. Genetic abnormality of teeth
14. Many multi-surface restorations
15. Chemo/radiation therapy
16. Eating disorders
17. Drug/alcohol abuse
18. Irregular dental care

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### Table 1. Continued.

4. Malposed or clinically impacted teeth
5. Swelling
6. Evidence of dental/facial trauma
7. Mobility of teeth
8. Sinus tract (“fistula”)  
9. Clinically suspected sinus pathology
10. Growth abnormalities
11. Oral involvement in known or suspected systemic disease  
12. Positive neurologic findings in the head and neck
13. Evidence of foreign objects
14. Pain and/or dysfunction of the temporomandibular joint
15. Facial asymmetry
16. Abutment teeth for fixed or removable partial prosthesis
17. Unexplained bleeding
18. Unexplained sensitivity of teeth
19. Unusual eruption, spacing or migration of teeth
20. Unusual tooth morphology, calcification or color
21. Unexplained absence of teeth
22. Clinical erosion
Unfortunately will reduce the amount of detectable tooth structure on the radiograph.

**Positioning the Radiograph**

Positioning the radiograph vertically in the mouth for both periapical and bitewing radiographs reduces the distal extension of the radiograph and may result in greater tolerance by patients, especially those with a mild gag reflex. The vertical bitewing radiograph provides greater detail of the periapical area.

The Snap-A-Ray is also useful for those patients that have a fear of swallowing the radiograph.

For the child with the small mouth, use the smallest size film available (size 0 film). Roll the film (do not place sharp bends) to allow the film to accommodate the shape of the jaw and not impinge on the soft tissues.

Use of the Snap-A-Ray as a bitewing tab will reduce impingement on the soft tissue but

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exposing the child to new stimuli or experiences of increasing intensity. An example of this is introducing the patient to x-rays by initially taking an anterior radiograph which is easier to tolerate than a posterior radiograph.

Another example of desensitization is the “Lollipop Radiograph Technique.” The child is given a lollipop to lick (preferably sugarless). After a few licks, the lollipop is taken from the child and a radiograph is attached to the lollipop using an orthodontic rubber band. The lollipop with the attached film is returned to the child, who is told to lick the lollipop again. After a few licks, the child is told to hold the lollipop in his mouth while we take a tooth picture. The exposure is made.

The child has now associated the radiograph procedure with a pleasurable experience (the licking of the lollipop) and has been desensitized to the extent the more difficult posterior radiographs can be attempted.

**Procuring Posterior Radiographs**
Procuring posterior radiographs can be made more pleasant by associating it with a pleasurable taste….bubble gum. Before placing the radiograph

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**Desensitization Techniques**
Desensitization is defined as gradually

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Figure 12.

Figure 13.

Figure 14.

Figure 15.

Figure 16.
in the patient's mouth apply bubble gum flavored toothpaste to the film. The child will be more accepting of the radiograph.

Some patients, young and old, have an exaggerated gag reflex. The etiology of an exaggerated gag reflex had been attributed to psychological and physical factors. There are numerous techniques to control the gag reflex during the radiograph procedure.

The easiest is through diversion and positive suggestion. The operator suggests to the patient the gag reflex can be reduced by concentrating on something other than the procedure. The patient can hum a song, raise a leg, or look at themselves in a mirror. However, this technique is not always successful so other techniques must be brought into play. The patient's palate can be sprayed with a topical anesthetic to reduce the sensation of the radiograph on the palate and tongue. This technique is more successful with adults than children since a pleasant tasting topical anesthetic has yet to be invented and children often object to the numb feeling.

An alternative is the use of nitrous oxide analgesia. One of the effects of nitrous oxide analgesia is it reduces the gag reflex, but unlike general anesthesia it does not affect the cough reflex.

Another alternative is to place the radiograph in such a manner to not come in contact with the palate or tongue. This is accomplished by either extraoral placement of the film or placing the film between the cheek and the tooth and exposing the film from the opposite jaw. Figure 22 illustrates the typical placement of a radiographic film between the teeth and tongue.

In the reverse radiograph the film is placed on the buccal surface of the tooth between the tooth and the cheek. The film side of the packet (the solid color side) is facing the buccal surface of the tooth.

The x-ray head is placed at the opposing side, and the cone is positioned under the angle of the ramus on the opposite side. The radiation is directed through the tongue, through the tooth structure, and onto the film. As the x-ray beam is traveling a longer distance to the film than in the typical positioning, it is necessary to double the exposure time.
Some of the newer digital panoramic radiographic units, i.e., Planmeca Promax, have programs that can take bitewing radiographs extraorally using less radiation than conventional radiographs yet providing diagnostic quality.

**Conclusion**

Through the use of proper and innovative radiographic techniques, the dentist and staff can obtain diagnostic radiographs with minimum harm and maximum comfort for the pediatric patient.
Figure 27.

Figure 28.
Course Test Preview
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1. If the foundation of an accurate diagnosis and treatment plan are a comprehensive medical and dental history, a thorough clinical examination, and diagnostic radiographs, the most difficult to obtain is ________________.
   a. a comprehensive medical and dental history
   b. a thorough clinical examination
   c. diagnostic radiographs
   d. They all exhibit the same difficulty.

2. A parent’s resistance to the use of radiographs may be reduced by ________________.
   a. apprising parents of the need for radiographs to derive an accurate diagnosis
   b. educating parents of the newer philosophies and techniques for acquiring radiographs
   c. insurance companies not paying benefits without them
   d. A and B

3. Radiographs are necessary because ________________.
   a. visual examination reveals only three of the five surfaces of the teeth
   b. if the child's teeth are close together you cannot see the interproximal areas
   c. the insides of neither the teeth nor the permanent teeth developing in the jawbone can be seen
   d. All of the above.

4. According to guidelines issued by various dental associations, ________________.
   a. radiographs should be taken routinely every 6 months
   b. children's teeth should be first examined by a dentist or hygienist before deciding on the number and types of radiographs
   c. every patient should have a full mouth series of radiographs at the initial visit
   d. the dentist should not rely on radiographs from another office even if they are recent

5. If a parent refuses to have their child undergo radiographic examination, ________________.
   a. the dentist may refuse to treat the child if the child's treatment may be compromised by not taking radiographs
   b. the parent may offer to release the dentist from liability from subsequent damages that a radiograph might have prevented
   c. the dentist should treat only the problems that are visual
   d. the dentist should treat all suspicious areas

6. For a new patient in the primary dentition, the prescription of radiographs should be limited to ________________.
   a. individualized radiographic examination consisting of periapical/occlusal views and posterior bitewings or panoramic examination and posterior bitewings
   b. posterior bitewings, at the minimum, in all situations
   c. individualized radiographs consisting of posterior bitewings and selected periapicals and a full mouth radiographic examination
   d. None of the above.
7. For a new patient in the transitional dentition, the prescription of radiographs for assessment of dental disease should be limited to ________________.
   a. posterior bitewing examination, if proximal surfaces of primary teeth cannot be visualized or probed
   b. individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images
   c. individualized radiographs consisting of posterior bitewings and selected periapicals and a full mouth radiographic examination
   d. None of the above.

8. For a new patient with a permanent dentition, the prescription of radiographs for the assessment of dental disease should be limited to ________________.
   a. posterior bitewing examination, if proximal surfaces of primary teeth cannot be visualized or probed
   b. individualized radiographic examination consisting of periapical/occlusal views and posterior bitewings or panoramic examination and posterior bitewings
   c. individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images. A full mouth intraoral radiographic exam is preferred when the patient has clinical evidence of generalized dental disease or a history of excessive dental treatment
   d. None of the above.

9. For a recall patient in the primary dentition exhibiting clinical caries or high risk factors for caries, the prescription of radiographs should be limited to ________________.
   a. posterior bitewing examination at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe
   b. posterior bitewing examination at 12 month intervals or until no carious lesions are present
   c. posterior bitewing examination at 18 month intervals
   d. posterior bitewing examination at 24 month intervals

10. For a recall patient in the transitional dentition exhibiting clinical caries or high risk factors, the prescription of radiographs should be limited to ________________.
    a. posterior bitewing examination at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe
    b. posterior bitewing examination at 12 month intervals or until no carious lesions are present
    c. posterior bitewing examination at 18 month intervals
    d. posterior bitewing examination at 24 month intervals

11. For a recall patient in the permanent dentition exhibiting clinical caries or high risk factors for caries, the prescription of radiographs should be limited to ________________.
    a. posterior bitewing examination at 6 month intervals or until no carious lesions are evident
    b. posterior bitewing examination at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe
    c. posterior bitewing examination at 18 month intervals
    d. posterior bitewing examination at 24 month intervals

12. For a recall patient in the primary dentition exhibiting no clinical caries or no risk factors for caries, the prescription of radiographs should be limited to ________________.
    a. posterior bitewing examination at 6 month intervals
    b. posterior bitewing examination at 12-24 month intervals if proximal surfaces cannot be examined visually or with a probe
    c. No radiographs should be taken.
    d. None of the above.
13. For a recall patient in the transitional dentition exhibiting no clinical caries or no risk factors for caries, the prescription of radiographs should be limited to ______________.
   a. posterior bitewing examination at 6 month intervals
   b. posterior bitewing examination at 12-24 month intervals if proximal surfaces cannot be examined visually or with a probe
   c. posterior bitewing examination at 18-36 month intervals
   d. No radiographs should be taken.

14. For a recall patient in the permanent dentition exhibiting no clinical caries or no risk factors for caries, the prescription of radiographs should be limited to ______________.
   a. posterior bitewing examination at 6 month intervals
   b. posterior bitewing examination at 12-24 month intervals
   c. posterior bitewing examination at 18-36 month intervals
   d. No radiographs should be taken.

15. Which of the following is not an example of “tell, show, do?”
   a. The dentist explains to the child that a tooth camera will be used to take a picture of the tooth.
   b. The radiographic film is given to the child to touch and examine.
   c. The child watches in a mirror while the radiograph is exposed.
   d. The child is restrained in a mechanical restraining device while the radiograph is exposed.

16. If a patient is uncooperative, which of the following is not performed?
   a. The parent restrains the child while seated in his/her lap.
   b. The parent restrains the child's body while a friend or family member restrains the child's head and stabilizes the radiograph.
   c. The parent restrains the child's body while a staff member restrains the child's head and stabilizes the radiograph.
   d. The child is restrained in a mechanical restraining device and the parent stabilizes the radiograph.

17. Which of the following is effective in reducing hyper gag reflex problems in children while taking radiographs?
   a. Place the radiograph in a vertical position.
   b. Allow the child to watch in a mirror.
   c. Administer nitrous oxide during radiographic exposure.
   d. All of the above.

18. Starting with an anterior radiograph is an example of ____________.
   a. desensitization
   b. bribery
   c. reward
   d. punishment

19. The “Lollipop Radiographic Technique” is an example of ____________.
   a. desensitization
   b. bribery
   c. reward
   d. punishment

20. In the “Reverse Radiograph Technique” the exposure time is ____________.
   a. the same
   b. halved
   c. doubled
   d. tripled
References

About the Author

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Dr. Steven Schwartz is the director of the Pediatric Dental Residency Program at Staten Island University Hospital and is a Diplomat of the American Board of Pediatric Dentistry.

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