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Approval: Secretary General for Administrative and Technical Affairs	**Signature:**	**Date of Approval:** 4 / 2 /2025

Protocol Subject: The protocol for using dental X-rays in clinics establishes a critical framework to ensure the safe, effective, and precise use of radiographic imaging during dental procedures. Dental X-rays are indispensable for diagnosing conditions, planning treatments, and monitoring oral health over time. This protocol outlines recommendations for patient selection, appropriate imaging techniques, exposure settings, and safety measures to minimize radiation risks while maximizing diagnostic value. By adhering to this protocol, dental professionals can improve diagnostic accuracy, enhance treatment outcomes, and promote patient confidence through a unified approach that prioritizes safety, efficiency, and high-quality care

Target Groups:

1. Dentists (specialists, general practitioners, and interns)
2. Radiology technicians/ assistant.
3. Oral Health Technicians.
4. Oral Health Technician assistants.
5. Patients.

وزارة الصحة
مديرية التطوير المؤسسي وضبط الجودة
السياسات والإجراءات
Policies & Procedures
٤ شباط ٢٠٢٥
معتمد
Approved

6. the Head of Department/Health Center.

Protocol Objectives:

1. Enhance Patient Safety by Adhering to precise standards and procedures for using dental radiography, including risk assessments to determine the necessity of X-rays before each procedure.
2. Minimize Radiation Exposure by Employing the ALARA (As Low as Reasonably Achievable) principle by using appropriate imaging techniques, shielding, and optimized exposure settings tailored to the patient's age, medical history, and clinical needs.
3. Improve Diagnostic Accuracy by Utilizing the latest imaging technology and techniques to ensure high-quality diagnostic images while minimizing the need for repeat exposures.
4. Ensure dental professionals are adequately trained in radiographic techniques, interpretation, and safety measures to optimize diagnostic outcomes and patient care.
5. Develop Individualized Imaging Plans by Considering each patient's medical history and oral health status when determining the frequency, type, and scope of dental X-rays required.
6. Monitor Equipment and Quality Assurance by Implementing regular maintenance and calibration of radiographic equipment to ensure consistent image quality and safety compliance.

Definitions:

1. **Effective dose** is a measure used in radiology and radiation protection to estimate the overall risk of exposure to ionizing radiation.
2. **digital receptor** is a device used in radiology to capture and convert X-ray images into digital data for visualization, storage, and analysis. Unlike traditional film-based systems, digital receptors produce images that can be immediately processed and displayed on a computer
3. **Geriatric Patients:** Individuals typically aged 65 years and older, characterized by physiological and psychological traits that may affect their overall health and medical needs.
4. The **focal spot:** refers to the small area on the anode of the X-ray tube where the X-rays are generated. The **focal spot size** is the physical dimension of

this area and plays a crucial role in determining the quality of the radiographic image

5. **Cone cut:** This results in a portion of the image being missing, leading to incomplete or poor-quality diagnostic images
6. **Film fogging**: refers to the unintended exposure of radiographic film to light or radiation, leading to a cloudy or unclear image.
7. **Sjögren's syndrome** is a chronic autoimmune disorder in which the body's immune system mistakenly attacks its own moisture-producing glands, particularly the salivary glands and lacrimal (tear) glands.
8. **OSL** in radiology refers to **Optically Stimulated Luminescence**, a technique used in radiation dosimetry to measure ionizing radiation exposure

Forms/Attachments:

- Carries risk assessment forms.
- Dental radiology Competency Assessment Checklist.

Responsibilities and Tasks:

Dentist:

1. Conduct a thorough assessment of the patient's health status and medical history to determine the necessity and safety of radiographic imaging.
2. Inform the patient about the purpose, benefits, risks, and potential side effects of X-ray procedures, ensuring they understand the need for imaging and provide informed consent.
3. Develop an individualized imaging plan that takes into account the patient's medical condition, age, and oral health, specifying the type of X-ray needed and the frequency of exposure.
4. Check with female patients if they are pregnant or not.
5. The doctor should explain to the pregnant patient the benefits and risks of the X-ray, as well as its importance in her condition, and then have her sign an informed consent form According to protocols before taking radiographs.
6. Insure proper protection for pregnant women before taking radiographs.
7. Perform intraoral radiographs when there is no Oral Health Technician or Oral Health Technician Assistant, or they can't perform it.
8. Ensure accurate positioning of the patient and the X-ray equipment to minimize unnecessary exposure and capture the necessary diagnostic images.

9. Monitor the patient's comfort and safety during the X-ray procedure, ensuring minimal discomfort and exposure to radiation.
10. Ensure proper radiation protection measures are followed, including the use of lead aprons, thyroid collars, and proper collimation to reduce unnecessary radiation exposure.
11. Document all relevant details of the radiographic procedure, including the type of X-ray performed, settings used, and any unusual occurrences or complications.
12. Maintain clear communication with the patient before, during, and after the procedure to address any concerns, explain results, and ensure they understand any follow-up actions.

Radiology technician / assistant:

1. perform extra-oral radiographs.
2. Document all relevant details of the radiographic procedure, including the type of X-ray performed, settings used, and any unusual occurrences or complications.
3. Ensure that all equipment used in radiography, are properly sterilized or disinfected to maintain infection control standards.
4. Ensure accurate positioning of the patient and the X-ray equipment to minimize unnecessary exposure and capture the necessary diagnostic images.
5. Monitor the patient's comfort and safety during the X-ray procedure, ensuring minimal discomfort and exposure to radiation.
6. Regular inspection of medical equipment and machines within the radiology department, ensuring its usability and compliance with standards.

Oral Health Technicians.:

1. Requesting, capturing, developing, and preparing intraoral and extra-oral radiographs, and preparing the report.
2. Prepare the clinic and Ensure that all surfaces and equipment used in radiography, including sensors and film holders, is properly sterilized or disinfected to maintain infection control standards.
3. Performing Preventive Maintenance on Equipment and machines.
4. Ensure that patients wear a lead apron and thyroid collar during the radiographic procedure to protect against radiation exposure.
5. Check with female patients if they are pregnant or not.

6. Ensure accurate positioning of the patient and the X-ray equipment to minimize unnecessary exposure and capture the necessary diagnostic images.
7. Monitor the patient's comfort and safety during the X-ray procedure, ensuring minimal discomfort and exposure to radiation.

Oral Health Technician's assistants:

1. Prepare the clinic and Ensure that all surfaces and equipment used in radiography, including sensors and film holders, is properly sterilized or disinfected to maintain infection control standards under dentist's supervision.
2. Performing Preventive Maintenance on Equipment and machines.
3. Performing and developing intraoral radiographs.

The Patient:

1. Provide complete and accurate information about their medical history, including any previous X-ray exposures, allergies, and conditions that may impact the safety of the radiographic procedure (e.g., pregnancy).
2. Follow instructions from the dentist regarding positioning, staying still, and other protocols to ensure a clear and accurate image and minimize radiation exposure.

Head of Department/Health Center:

1. Ensure that dental professionals receive proper training on the safe and accurate use of X-ray equipment, radiation protection protocols, and the interpretation of radiographic images.
2. Ensure the availability and maintenance of essential resources, such as properly calibrated X-ray machines, protective gear (e.g., lead aprons, thyroid collars), and emergency equipment, to ensure patient safety during radiographic procedures.
3. Ensure all x-ray machines have contentious quality control procedures and logbook.

Protocol:

Abbreviations

ADA	**American Dental Association**
ACOG	**American College of Obstetricians and Gynecologists**
MSv dose	**(Millisievert: This is a unit of measurement for effective radiation**
kVp voltage	**Kilovoltage Peak: This is a unit of measurement for X-ray tube**
CBCT	**(Cone Beam Computed Tomography)**
AAPD	**American Academy of Pediatric Dentistry**
(CRA)	**Caries Risk Assessment Forms**
ICRP	**(International Commission on Radiological Protection)**
FDA	**Food and Drug Administration**
MA	**(Milliampere)**

General recommendations

General recommendations that are applicable to all categories of patients:

- Radiographic screening for the purpose of detecting disease before clinical examination should not be performed. A thorough clinical examination, consideration of the patient history, review of any prior radiographs, caries risk assessment and consideration of both the dental and the general health needs of the patient should precede radiographic examination.
- It's important to avoid repetition and reduce the number of obtained images for the patient to the minimum necessary to obtain essential diagnostic information.
- Intraoral radiography is useful for the evaluation of dento-alveolar trauma. If the area of interest extends beyond the dento-alveolar complex, extra-oral imaging may be indicated.
- Care should be taken to examine all radiographs for any evidence of caries, bone loss from periodontal disease, developmental anomalies and occult disease.
- Its recommended to use faster image receptors compatible with the diagnostic task, (such as F-speed films or digital films)
- Use Proper film exposure and film processing techniques.

Effective dose

- The effective dose is a measure used in radiation protection to estimate the risk of exposure to ionizing radiation, accounting for the type of radiation and the sensitivity of the exposed tissues. It's expressed in units of sieverts (Sv), with smaller exposures often measured in millisieverts (mSv).
- Dental X-rays produce very low levels of radiation

TABLE 3-3 Effective Dose from Radiographic Examinations and Equivalent Background Exposure

Examination	Effective Dose (μSv)	Equivalent Background Exposure (days)
INTRAORAL		
Rectangular collimation		
Posterior bitewings: PSP or F-speed film	5	0.6
Full-mouth: PSP or F-speed film	35	4
Full-mouth: CCD sensor (estimated)	17	2
Round collimation		
Full-mouth: D-speed film	388	46
Full-mouth: PSP or F-speed film	171	20
Full-mouth: CCD sensor (estimated)	85	10
EXTRAORAL		
Panoramic[1,3]	9–24	1–3
Cephalometric[1,4]	2–6	0.3–0.7
Cone-beam CT[2,5]		
Large field of view	68–1073	8–126
Medium field of view	45–860	5–101
Small field of view	19–652	2–77
Multislice CT		
Head: Conventional protocol[1]	860–1500	101–177
Head: Low-dose protocol[1]	180–534	21–63
Abdomen[1]	5300	624
Chest[1]	5800	682
Plain films[1]		
Skull	70	8
Chest	20	2
Barium enema	7200	847

CCD, Charge-coupled device; *PSP*, photostimulable phosphor.

1. Data from Ludlow JB, Davies-Ludlow LE, White SC: Patient risk related to common dental radiographic examinations: the impact of 2007 international commission on radiological protection recommendations regarding dose calculation, *J Am Dent Assoc* 139:1237-1243, 2008.

Most common Types of radiographs used in dentistry

1. Intraoral Radiographs

A. **Bitewing**: Typically used during routine exams, especially to check for dental caries and monitor bone loss due to periodontal disease.
B. **Periapical**: Indicated when there is suspected pulp pathology, periapical infection, or trauma affecting a tooth or surrounding bone.
C. **Occlusal**: Used to assess developmental anomalies, impacted teeth, fractures, or foreign bodies.

2. Extra-oral Radiographs

A. **Panoramic (OPG)**: Ideal for assessing overall dental health, detecting third molars, jaw fractures, and TMJ pathology.
B. **Cephalometric**: Used in orthodontics to study jaw relationships and for planning tooth movement.
C. **CBCT**: Essential for 3D imaging needs, including implant placement, endodontic diagnosis, and TMJ assessment.

Identification of patient's caries risk

Defining caries risk in dental patients involves evaluating several factors, including medical history, dietary habits, oral hygiene, fluoride exposure, and previous caries history. The (ADA) and the (AAPD) provide structured criteria for assessing caries risk in children, adolescents, and adults. Here's a detailed guide to defining caries risk based on these criteria:

A. Low Caries Risk

Patients in this category have minimal or no signs of caries activity and demonstrate strong preventive factors.

- **Criteria**:

- No caries lesions or restorations in the past 1–3 years.
- Consistently good oral hygiene practices, with regular brushing and flossing.
- Regular dental visits and preventive care, including professional fluoride treatments.
- Limited sugar intake and healthy dietary habits.
- Adequate fluoride exposure, either from fluoridated water, toothpaste, or other sources.
- Lack of dry mouth or systemic conditions that impact salivary flow (e.g., not on medications that cause dry mouth, no history of radiation therapy to the head and neck).

- **Examples**:
  - A child with good brushing habits, regular dental visits, no recent caries, and access to fluoridated water.
  - An adult who hasn't had cavities in several years and consistently practices good oral hygiene.

B. Moderate Caries Risk

Moderate caries risk patients may show occasional caries and some risk factors but also have protective factors that mitigate high risk.

- **Criteria**:
  - One or two carious lesions or restorations in the past 1–3 years.
  - Good oral hygiene but may occasionally miss proper brushing or flossing.
  - Moderate sugar intake, especially if combined with irregular fluoride exposure.
  - Some fluoride exposure, but not consistent (e.g., toothpaste use without additional fluoride sources).
  - Few health factors impacting caries risk but may include occasional xerostomia or certain medications (e.g., antihistamines, antidepressants).
- **Examples**:
  - An adolescent with a previous cavity and occasional sugary snack consumption.

- An adult who practices reasonable oral hygiene but has mild dry mouth due to medication.

C. High Caries Risk

High caries risk patients have active caries or are at significant risk due to various behavioral or health factors.

- **Criteria**:
  - Multiple carious lesions or restorations within the past year.
  - Poor or inconsistent oral hygiene practices.
  - High frequency of sugar intake (e.g., frequent snacking on sugary foods or drinks).
  - Limited or no fluoride exposure.
  - Medical conditions or medications that reduce salivary flow, such as Sjögren's syndrome, radiation therapy, or medications causing dry mouth (e.g., antihistamines, diuretics).
  - Socioeconomic or behavioral factors that hinder access to regular dental care or fluoride exposure (e.g., low access to preventive care or limited knowledge about oral health).
- **Examples**:
  - A young child with frequent consumption of sugary snacks and irregular brushing.
  - An adult undergoing head and neck radiation therapy resulting in xerostomia, combined with high sugar intake.

D. Additional Tools and Resources for Assessing Caries Risk

- **Caries Risk Assessment Forms (CRA)**: Developed by the ADA and AAPD, these forms provide a structured way to assess risk by considering factors such as medical history, fluoride exposure, and dietary habits. They are available for various age groups (infants, children, adolescents, adults).

***Factors increasing risk for caries may be assessed using the ADA Caries Risk Assessment forms (0 – 6 years of age and over 6 years of age).** See the attachments on page 30-31

Safety Guidelines and Recommendations

A. ALARA Principle

Maintain exposures "As Low as Reasonably Achievable," which is a foundational radiation safety concept, that includes:

- **Use Digital receptors rather than conventional radiography:** Digital radiography reduces exposure by up to 70-80% compared to traditional film; where possible, use digital systems.
- Using the lowest radiation dose possible to achieve the desired result.
- Limiting exposure time and frequency, especially for vulnerable populations like children and pregnant women.
- Shielding sensitive organs as much as possible.

B. Record-Keeping and Documentation:

- Document each radiograph, including the date, indication, and findings and comprehensive patient history.
- document consent forms for pregnant women.

E. Use of Protective Equipment

- Lead Aprons and Thyroid Collars: Essential for protecting the body and sensitive thyroid area from scatter radiation. Lead aprons should cover the torso, and thyroid collars are particularly recommended for children and pregnant patients.
- The protective aprons should be hung and not folded, and the manufacturer's instructions should be followed.
- Digital Radiography: Digital X-ray systems reduce radiation exposure by 70-80% compared to conventional radiology.

F. Equipment Maintenance and Calibration

- **Regular Equipment Inspection**: Dental X-ray machines should undergo periodic maintenance and calibration to ensure they operate within safe parameters.
- **Quality Assurance Programs**: Implement and document quality control checks to verify that machines are functioning as expected. Testing for tube head stability, accuracy, and radiation output should be routine.

G. Training and Certification of Personnel

- Only licensed dental professionals or certified radiographers should operate X-ray machines.
- Staff should undergo continuous education on safe practices, equipment usage, and radiation hygiene to stay up-to-date with advancements in radiation safety.

Dental radiographs and pregnant patients :

A. Radiation Safety and Risks for Pregnant patients:

- Dental X-rays produce very low levels of radiation, typically around 0.005–0.01 mSv per image, which is far below the threshold considered harmful for fetal development.
- Studies and guidelines by the American Dental Association (ADA) and the American College of Obstetricians and Gynecologists (ACOG) indicate that dental X-rays are safe for pregnant patients, especially when essential for diagnosis or treatment planning.
- The fetal radiation exposure from dental X-rays is negligible compared to other sources, making dental imaging generally safe if clinically justified.

B. Guidelines for Dental X-Rays in Pregnancy

ADA and ACOG Recommendations:

- Dental X-rays should be limited to those that are clinically necessary. Non-urgent or elective X-rays (e.g., routine check-ups) may be postponed until after delivery.
- If X-rays are necessary, they can be performed at any stage of pregnancy, but some clinicians prefer the second trimester when the fetus is less vulnerable to environmental influences.
- Lead aprons with thyroid collars should be used to minimize exposure to the abdomen and neck, even though scatter radiation to the fetus is minimal.

Scenarios for X-ray Use:

- **Emergencies**: If a pregnant patient has acute dental pain, infection, or trauma, X-rays may be essential to provide accurate diagnosis and effective treatment.
- **Treatment Planning**: For procedures that are critical and cannot be postponed, such as those involving infections or severe pain, X-rays are often necessary to proceed safely.

C. Patient Safety Precautions During Imaging

- Lead aprons with a thyroid collar are required to block any potential radiation scatter from reaching the abdomen.
- Digital X-rays are preferred as they generally require lower radiation doses than conventional radiology, reducing exposure even further.
- When possible, limit the number of images to those essential for diagnosis and treatment. Bitewing or periapical X-rays might suffice in place of panoramic or cone beam computed tomography (CBCT), which use higher radiation doses.
- Insure good conning to the area of interest to minimize the unnecessary radiation.

D. Risk-Benefit Communication with Patients

Patients often have concerns about radiation exposure during pregnancy, so it's important to:

- Explain the low levels of radiation used in dental X-rays and the safety measures in place.
- Discuss the importance of addressing dental issues during pregnancy, as untreated infections and pain can impact both maternal and fetal health.
- Reassure them that the benefits of necessary dental care, such as resolving infection or severe pain, outweigh the minimal radiation exposure risks.

E. Pregnant worker Safety Precautions During Imaging

If it's possible that the pregnant employee may need to take patient radiographs, it's recommended that you:

- Using an (OSL) dosimeter with a lead apron is essential for monitoring radiation exposure during diagnostic imaging.

- Lead aprons with a thyroid collar are required to block any potential radiation scatter from reaching the abdomen.
- If shielding is not possible, the pregnant employee should stand at least 2 meters Away at 90–135 Degrees: If she must stay in the room, she should keep a minimum 6-foot distance from the source and maintain the recommended angle.
- Necessary exposures are kept as low as reasonably achievable (i.e., ALARA).

F. How to use OSL :

- The OSL dosimeter should be worn **outside the lead apron** to measure the radiation exposure that reaches the worker, accounting for the protective effect of the apron. Typically, the dosimeter is clipped to the collar or chest area.
- a secondary dosimeter may be worn **underneath the lead apron** near the abdomen or waist to estimate the effective dose to the body.
- Ensure the front face of the OSL dosimeter (the side with the detector) faces outward for accurate readings.
- Attach the dosimeter securely to avoid displacement during procedures.

Pediatric and geriatric Considerations

A. Pediatric patients:

- Children are more sensitive to radiation, so imaging should be based on caries risk and clinical indicators.
- Use child-specific exposure settings to reduce dose; prioritize only necessary images based on caries risk or developmental needs.
- Children are more susceptible to radiation effects due to their developing tissues and longer lifespan, which increases the cumulative exposure risk. A thyroid collar should always be used for children when taking dental X-rays
- Avoid multiple unnecessary images and repetition.
- an individualized radiographic examination consisting of selected periapical/occlusal views and/or posterior bitewings if proximal surfaces

cannot be examined visually or with a probe is recommended. Patients without evidence of disease and with open proximal contacts may not require radiographic examination at this time.

B. geriatric patients:

- Consider specific conditions, such as bone density and the presence of restorations, which may require specific settings to achieve diagnostic images without overexposure.
- Consider the presence of restorative work or edentulous ridges ; adjust exposure settings accordingly to prevent overexposure.

Protection of thyroid gland when taking Radiographs:

A. Understanding Thyroid Sensitivity to Radiation

- The thyroid is one of the most radiosensitive organs, particularly in children and young adults. Repeated exposure, even at low doses, has been associated with a slightly increased risk of thyroid cancer over time.
- Dental X-rays emit a very low level of radiation, especially with digital imaging (e.g., 0.005–0.01 mSv per image), which is considerably less than the exposure from other medical imaging like CT scans. However, protection of the thyroid remains essential.

B. Best Practices for Thyroid Protection During Dental X-rays

Use of Thyroid Collars:

- A lead thyroid collar is highly recommended for dental X-rays to shield the thyroid from scatter radiation, especially during intraoral imaging like bitewing and periapical radiographs.
- The use of thyroid collars is especially crucial for pediatric patients and for those with a known history or predisposition to thyroid disorders.
- In some cases, such as panoramic or cone beam computed tomography (CBCT) imaging, the thyroid collar may interfere with the quality of the

image. In these situations, assess the clinical need and minimize exposure time.

- Where available, digital X-ray systems should be used because they require lower radiation doses compared to traditional film X-rays.

C. Communication with Patients

- Explain the minimal risk associated with dental X-rays when thyroid collars are used, and discuss how digital X-ray technology has reduced radiation exposure.
- For patients with thyroid concerns, providing information about the procedure and protective measures can help alleviate worries, especially if the patient has a history of thyroid disease.

Steps for taking dental radiographs

A. Prepare and Check Equipment

- **Check the X-ray Unit**: Make sure the machine is calibrated and settings (kVp, mA, exposure time) are appropriate for the type of radiograph, patient size, and age.
- **Set Up the Image Receptor**: Use the appropriate receptor (sensor or film) for digital or traditional X-rays, with holders suitable for the type of radiograph.

B. Ensure Radiation Safety

- use a lead apron and thyroid collar for the patient. This is especially important for children and pregnant patients (if X-rays are essential).
- Double-check kVp, mA, and exposure time based on the patient's requirements.
- Confirm that settings are as low as reasonably achievable to minimize radiation exposure.

C. Position the Patient Properly

- **For Intraoral Radiographs (Bitewing, Periapical)**:
  - Seat the patient upright with their head stabilized.
  - Align the patient's head so that the occlusal plane (the plane between the upper and lower teeth) is parallel to the floor.
- **For Panoramic X-rays**:
  - Position the patient with their chin resting on the chin rest, ensuring they bite on a positioning guide.
  - Adjust head supports and have the patient close their lips around the guide, keeping their tongue against the roof of the mouth to reduce air spaces that may obscure details.
  - Remove all metal objects and position the patient in a stable, comfortable posture.

D. Place the Image Receptor and Positioning Device

- Use a Sensor Holder if available
- Align with the Area of Interest
- Instruct the Patient to Hold Still

E. Align the X-ray Tubehead and Set Angulation

- Center the X-ray tubehead with the receptor to avoid cone cuts (areas where the image may be cut off).
- The intraoral radiograph system shall be configured so that the distance from the x-ray tube focal spot to the skin entrance surface (source-to-skin distance) is not < 20 cm.
- **Set Angulation**:
  - For bitewing radiographs, position the tubehead perpendicular to the receptor.
  - For periapicals, adjust vertical and horizontal angulation based on the location in the mouth (upper or lower teeth, anterior or posterior).
  - For panoramic X-rays, align the tube and machine as per the manufacturer's instructions for a full arch image.

F. Take the Exposure

- **Step Back**:

- Leave the Room if Possible: This is the safest option. Exiting the room eliminates direct and scatter exposure for the operator.
- Stand at least 2 meters Away at 90–135 Degrees: If you must stay in the room, keep a minimum 6-foot distance from the source and maintain the recommended angle.
- Use a Barrier if Available: Some dental operatories are equipped with lead-lined barriers or walls designed for protection. Stand behind these if you need to remain in the room.

- **Activate the X-ray**: Use the exposure button to take the radiograph, ensuring you maintain safety distance during the exposure.

G. Process and Review the Image

- **For Digital X-rays**: Images are typically available immediately for review. Check the image quality and coverage to ensure it's diagnostic.
- **For Film**: Process the film using appropriate techniques (manual or automatic processing) and evaluate the image quality.

H. Document and Record Findings

- **Document**: Note the type of radiograph taken, any adjustments made, and record findings in the patient's chart.
- **Store and Review**: Save the digital image or film in the patient's records, ensuring all images meet diagnostic needs before ending the procedure.
- **Insure tagging patients information to his radiographs**.

Settings on the x-ray machine

Determining the best X-ray machine settings for each case in dentistry involves adjusting parameters like **kilovoltage peak (kVp)**, **milliampere (mA)**, **exposure time**, and, if applicable, **focal spot size**. Here's a step-by-step approach to help you achieve the optimal settings based on the patient's needs, type of radiograph, and diagnostic requirements:

A. Consider the Patient's Size and Age

- Pediatric Patients: Lower doses are generally required for children due to their smaller anatomy and increased radiation sensitivity. Start with lower mA and kVp and gradually adjust as necessary.
- Adults and Larger Individuals: Larger or denser anatomy may need higher kVp and mA settings to ensure the X-rays penetrate sufficiently.

B. Adjust kVp for Image Contrast

- kVp (Kilovoltage Peak) controls the penetration power of the X-rays. Higher kVp results in lower contrast, which is useful for imaging dense areas, while lower kVp provides higher contrast.
- Intraoral radiography units should be operated at a minimum of 60 kV and not exceed 80 kV..
- Panoramic X-rays: Often between 70–90 kVp to capture the entire jaw.

C. Set mA for Image Density

- mA (Milliampere) impacts the number of X-rays produced. Higher mA means more radiation, which increases image density (brightness).
- Intraoral X-rays: Commonly range from 4–15 mA depending on the machine.
- Panoramic X-rays: Typically around 10–15 mA for clear images.

D. Adjust Exposure Time

- Exposure Time affects the duration of radiation. Shorter exposure times are preferred for children and smaller regions, while longer times may be needed for larger areas or dense anatomy for intraoral radiographs its usually : Short (0.1–0.3 seconds)
- Automatic Exposure Control (AEC): Some modern machines come with AEC, which adjusts exposure time based on patient density. Use this feature if available for optimal results.

E. Consult Manufacturer's Guidelines and Preset Protocols

- Many machines come with recommended presets for different procedures (e.g., bitewing, panoramic, pediatric, adult). Use these as starting points and adjust based on patient needs.

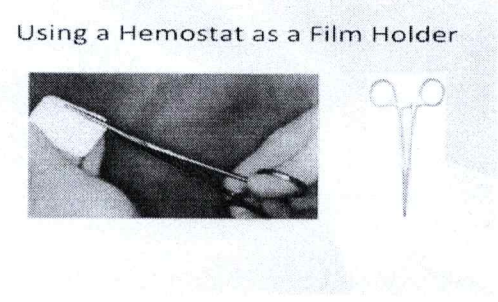
F. Implement ALARA Principles

ALARA (As Low As Reasonably Achievable): For every patient, set the lowest possible settings that still produce diagnostic-quality images. Always shield sensitive areas, especially for children and pregnant patients.

intraoral projection techniques

A. Paralleling technique (we use holder)

- The film should be placed in the mouth parallel to the long axis of the tooth.
- Central rays should be directed 90 degrees (perpendicular) on the film and on the long axis of the tooth (since both are parallel to each other).
- In order to achieve this parallelism we need a film holder
- Why do we have to do that? In order to get the most accurate representation with minimal magnification and minimal geometric distortion.((of course it does not exclude magnification and distortion because it is still a 2D image))
- Two important things in intraoral radiograph :
  - the distance between the object (tooth) and the film. Should be kept as short as possible in order to decrease magnification.
  - the distance between the actual tube (from which the central rays are produced) and the film. Should be kept as long as possible to decrease magnification.
  - In parallel technique we have to use film holder some of them are sophisticated and some of them just aim to hold the film like:

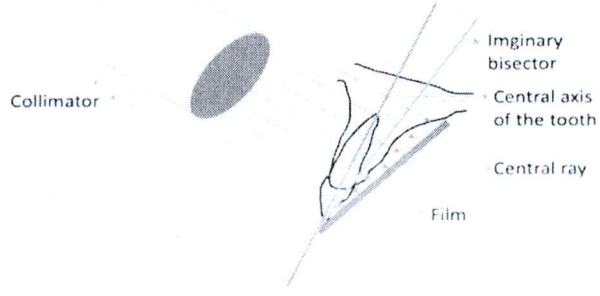


- Problems we may face while using film holder :

- shallow palate: If a patient has a very shallow palate you can either:
  a. change the vertical angulation of the film but in a way not on the expenses of parallelism .
  b. use cotton rolls (between the bite block and the opposing dentition to stabilize the film in place without pushing it towards the palate) in order to avoid bending of the film. (We sacrifice some parallelism so we can avoid bending).
- Bony growth (tori): If a patient has a torus that affects the position of your film then you can place the film behind the torus to avoid distorting parallelism (thus increasing distant between the teeth and the film). The torus will appear on your x-ray but will not affect the quality of your image - you can still identify teeth and other anatomical features as it is.

B. Bisecting angle technique

- This technique relies on the rule of isometry of an equilateral triangle bisected by a perpendicular line (getting 2 equal triangles with a shared side) primary beam is directed perpendicular to an imaginary line that bisects the angle between image receptor and tooth, and the image receptor is placed as close to tooth as possible.



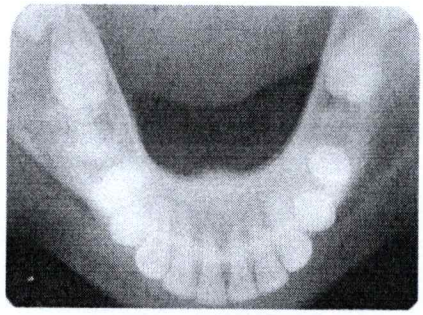
Diagramatic representation of Bisecting angle technique

- So to get a good bisecting technique central beam should be perpendicular to the bisecting line (imaginary line between long axis of tooth and x ray film) .

- This technique depend on experience and good knowledge, its hard but not impossible, also if it's done properly its quality will be high.
- When you're using the bisecting technique you have to actively think about the angulation ,A wrong angulation results in an overlap.
- Wrong horizontal angulation (more or less than 90 degrees to contacts between teeth) that results in an overlap between the proximal areas thus caries detection will be difficult.
- When the patient has severe crowding in his teeth and I cannot benefit from an x-ray, I relay on my clinical examination.
- Vertical angulation: increasing the vertical angulation, making it steep (according to occlusal plane, in maxilla too far up, in mandible to far down) results in "shortened" teeth, and decreasing (flattening it) the vertical angulation results in elongated teeth.

C. Occlusal projection:

- Sometimes we need to use a supplemental technique called "Occlusal Radiography"
- For this method we use a big film (size 4), the patient bites on the film, (the white side faces the dentition of interest).
- Indications:
    - (Salivary glands stones can be detected using this type of radiographs)
    - Evaluation of the Impacted Teeth.
    - Assessment of Trauma or Fractures
    - Cysts or Tumors



Infection control precautions when using dental xray

A. Pre-radiographic procedures:

- **Prepare the area before the patient sits down**: The area should be prepared before the patient enters, as proper preparation helps reduce the chances of microbial contamination in the room, promoting a safer environment for both patients and staff.
- **Sterilization of tools used in the mouth**: Tools that are used in the patient's mouth must either be single-use and disposed of after each use, or sterilized using appropriate sterilization methods to prevent the transmission of infections.
- **Cover surfaces with single-use plastic barriers**: Surfaces that are frequently touched, such as control panels, handles, and other equipment, should be covered with single-use plastic barriers to maintain a clean and safe environment during radiographic procedures.

B. Procedures to Follow During Radiographic Imaging:

- **Wear rubber gloves** (e.g., latex) when taking radiographic images or handling contaminated film packets to prevent direct contact with potentially infectious materials.
- **Wear a medical mask** during radiographic imaging to minimize the risk of airborne transmission and maintain a sterile environment.
- **Wear personal protective equipment** (such as protective glasses and a plastic apron) if there is a risk of blood or bodily fluid splattering, ensuring additional protection for the individual performing the procedure.

C. Procedures to Follow After Radiographic Imaging:

- **Clean and dry the film** with gauze or paper towels to remove any excess blood or saliva, and place it in a container (e.g., a plastic cup) for transportation to the processing area.
- **Avoid touching surfaces** such as doors, tables, or film processing equipment with dirty gloves during transportation to prevent contamination.
- **Remove gloves** and clean hands thoroughly to maintain hygiene.

- **Change plastic barriers** on the control panel and radiographic tube head to prevent cross-contamination.
- **If barriers were not used**, clean and disinfect these parts after use with an intermediate-level disinfectant approved by the manufacturer.
- **Clean and disinfect lead aprons and thyroid shields** daily and as needed to ensure they are free from contamination.
- **Remove the lead apron from the patient** after the radiograph procedure using radiation technologist gloves. To avoid the need for cleaning and disinfection, the technologist should avoid touching the apron with contaminated gloves.
- **Place the lead apron on the patient** before wearing new gloves to conduct the radiograph procedure.
- **After completing the imaging procedure**, the method for removing the lead apron depends on whether the radiographs were taken in the radiology department or in the clinic.
- **In the Radiology Department**:
- **If the patient was not asked to hold the film**, direct the patient to remove the lead apron and place it in the designated area.
- **If the patient was asked to hold the film**, the radiology technologist should remove the apron after removing the contaminated gloves.
- **In the Clinic**:
- The radiology technologist should remove the lead apron after removing the contaminated gloves.

D. Digital Sensor Devices for Radiographic Imaging:

- **Intraoral sensor**: These devices are used for all patients. Since these devices may be sensitive or may not tolerate sterilization or disinfection according to the manufacturer's recommendations, they should be protected with a plastic barrier to reduce contamination during use.
- **Use of disposable film holders**: Film holders should be single-use, except in cases where reusable holders are used. If reusable holders are used, they should be sterilized between each patient.
- **Clean and disinfect other parts of the device**: Other parts of the device should be cleaned and disinfected with an intermediate-level disinfectant after each patient, according to the manufacturer's recommendations.
- **Cleaning and disinfection procedures for digital radiographic sensors and other high-tech oral devices, including computer components**:

Appropriate cleaning and disinfection methods should be followed for digital radiographic sensor devices, other high-tech oral equipment, and computer components to ensure patient and equipment safety.

Common mistakes when taking intraoral radiographs

A. Blurring of Images
Cause: Patient movement, incorrect exposure settings, or equipment instability.
B. Poor Image Contrast or Density
Cause: Incorrect exposure settings (e.g., kVp, mA, and exposure time), under or overexposure, or improper processing.
C. Elongation and Foreshortening
Cause: Incorrect vertical angulation of the X-ray beam.
D. Overlapping of Adjacent Teeth
Cause: Incorrect horizontal angulation of the X-ray beam.
E. Cone-Cut Error
Cause: Misalignment of the X-ray beam with the image receptor (film or sensor).
F. Double Exposure
Cause: Using the same film or sensor for multiple exposures by mistake.
G. Backscatter Radiation
Cause: Inadequate shielding or poor sensor/film orientation.
H. Artifacts Due to Foreign Objects
Cause: Presence of removable metal objects (e.g., jewelry, glasses) or failure to remove prosthetic appliances.
I. Film Fogging
Cause: Exposure of the film to light or improper storage.
J. Digital Artifacts
Cause: Malfunction or glitches in digital sensors or image processing software.

Panoramic x-ray

A. Indications :

- Tooth and jaw alignment, growth assessment
- Position, impaction, surgical planning

- Detect abnormal growths and lesions
- Basic assessment of joint structures
- Evaluate fractures or injury to jaw structures
- Bone assessment for implant viability
- Bone structure assessment in edentulous patients
- Monitor bone changes related to systemic disease

B. when do you need to retake the panorama:

1. Poor Image Quality

- If the patient moved or there was a technical error causing blurriness, the image may lack the detail necessary for diagnosis.
- When the image is too dark or too light, critical details might be lost, compromising the diagnostic quality.

2. Incorrect Patient Positioning

- **Chin Too High or Low**: This can distort the occlusal plane, causing a "frowning" or "smiling" appearance. If the distortion is severe, important structures like the condyles or apices of teeth may be unclear.
- **Patient Not Centered**: If the head is not properly centered, structures on one side may appear stretched or compressed, making diagnosis of asymmetric issues challenging.
- **Patient Too Far Forward or Back**: This can cause the anterior teeth to appear either narrow or wide, leading to poor visibility of structures in that area

3. Presence of Artifacts

- **Metal Artifacts or Ghost Images**: Jewelry, glasses, or prosthetic devices can create artifacts that obscure important structures. If these are not removed before imaging, a retake may be necessary.
- **Double Exposure**: If the sensor or film is accidentally used twice, overlapping images will be present, leading to a confusing, unusable result.

4. Missing Areas of Interest

- **Cut-Off Structures**: If the area of interest (e.g., temporomandibular joint or mandibular condyles) isn't visible or has been cut off, a retake might be required to capture the entire region.
- **Incorrect Field of View**: In cases where the panoramic image does not capture the entire dental arch or jaw structures, a retake with proper field alignment is necessary.

Minimizing Retakes

To avoid unnecessary retakes, careful attention should be paid to patient preparation, positioning, and equipment calibration before the initial exposure.

RECOMMENDATIONS FOR PRESCRIBING DENTAL RADIOGRAPHS

- These recommendations are subject to clinical judgment and may not apply to every patient. They are to be used by dentists only after reviewing the patient's health history and completing a clinical examination. Even though radiation exposure from dental radiographs is low, once a decision to obtain radiographs is made it is the dentist's responsibility to follow the ALARA Principle (As Low as Reasonably Achievable) to minimize the patient's exposure.

TYPE OF ENCOUNTER	PATIENT AGE AND DENTAL DEVELOPMENTAL STAGE				
	Child with Primary Dentition (prior to eruption of first permanent tooth)	**Child with Transitional Dentition** (after eruption of first permanent tooth)	**Adolescent with Permanent Dentition** (prior to eruption of third molars)	**Adult, Dentate or Partially Edentulous**	**Adult, Edentulous**
New Patient* being evaluated for oral diseases	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.	Individualized radiographic exam consisting of posterior bitewings with panoramic exam or posterior bitewings and selected periapical images.	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 oral disease or a history of extensive dental treatment.		Individualized radiographic exam, based on clinical signs and symptoms.
Recall Patient* with clinical caries or at increased risk for caries**	Posterior bitewing exam at 6-12 month intervals if proximal surfaces cannot be examined visually or with a probe			Posterior bitewing exam at 6-18 month intervals	Not applicable
Recall Patient* with no clinical caries and not at increased risk for caries**	Posterior bitewing exam at 12-24 month intervals if proximal surfaces cannot be examined visually or with a probe		Posterior bitewing exam at 18-36 month intervals	Posterior bitewing exam at 24-36 month intervals	Not applicable

TYPE OF ENCOUNTER (continued)	**Child with Primary Dentition** (prior to eruption of first permanent tooth)	**Child with Transitional Dentition** (after eruption of first permanent tooth)	**Adolescent with Permanent Dentition** (prior to eruption of third molars)	**Adult, Dentate and Partially Edentulous**	**Adult, Edentulous**
Recall Patient* with periodontal disease	Clinical judgment as to the need for and type of radiographic images for the evaluation of periodontal disease. Imaging may consist of, but is not limited to, selected bitewing and/or periapical images of areas where periodontal disease (other than nonspecific gingivitis) can be demonstrated clinically.				Not applicable
Patient (New and Recall) for monitoring of dentofacial growth and development, and/or assessment of dental/skeletal relationships	Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development or assessment of dental and skeletal relationships		Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of dentofacial growth and development, or assessment of dental and skeletal relationships. Panoramic or periapical exam to assess developing third molars	Usually not indicated for monitoring of growth and development. Clinical judgment as to the need for and type of radiographic image for evaluation of dental and skeletal relationships.	
Patient with other circumstances including, but not limited to, proposed or existing implants, other dental and craniofacial pathoses, restorative/endodontic needs, treated periodontal disease and caries remineralization	Clinical judgment as to need for and type of radiographic images for evaluation and/or monitoring of these conditions				

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

A. Routine Screening as prescribed in tables on page 28.

B. 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, previous implant-related pathosis or evaluation for implant placement

C. Positive Clinical Signs/Symptoms

1. Clinical evidence of periodontal disease
2. Large or deep restorations
3. Deep carious lesions
4. Malposed or clinically impacted teeth
5. Swelling
6. Evidence of dental/facial trauma
7. Mobility of teeth
8. Sinus tract ("fistula")
9. Growth abnormalities
10. Oral involvement in known or suspected systemic disease
11. Positive neurologic findings in the head and neck
12. Evidence of foreign objects
13. Pain and/or dysfunction of the temporomandibular joint
14. Facial asymmetry
15. Abutment teeth for fixed or removable partial prosthesis
16. Unexplained bleeding
17. Unexplained sensitivity of teeth
18. Unusual eruption, spacing or migration of teeth
19. Unusual tooth morphology, calcification or color
20. Unexplained absence of teeth
21. Clinical tooth erosion
22. Peri-implantitis

attachments:

ADA American Dental Association®
America's leading advocate for oral health

Caries Risk Assessment Form (Age 0-6)

Patient Name:				
Birth Date:			Date:	
Age:			Initials:	
		Low Risk	Moderate Risk	High Risk
	Contributing Conditions	**Check or Circle the conditions that apply**		
I.	Fluoride Exposure (through drinking water, supplements, professional applications, toothpaste)	☐ Yes	☐ No	
II.	Sugary Foods or Drinks (including juice, carbonated or non-carbonated soft drinks, energy drinks, medicinal syrups)	Primarily at mealtimes ☐	Frequent or prolonged between meal exposures/day ☐	Bottle or sippy cup with anything other than water at bed time ☐
III.	Eligible for Government Programs (WIC, Head Start, Medicaid or SCHIP)	☐ No		☐ Yes
IV.	Caries Experience of Mother, Caregiver and/or other Siblings	No carious lesions in last 24 months ☐	Carious lesions in last 7-23 months ☐	Carious lesions in last 6 months ☐
V.	Dental Home (established patient of record in a dental office)	☐ Yes	☐ No	
	General Health Conditions	**Check or Circle the conditions that apply**		
I.	Special Health Care Needs (developmental, physical, medical or mental disabilities that prevent or limit performance of adequate oral health care by themselves or caregivers)	☐ No		☐ Yes
	Clinical Conditions	**Check or Circle the conditions that apply**		
I.	Visual or Radiographically Evident Restorations/ Cavitated Carious Lesions	No new carious lesions or restorations in last 24 months ☐		Carious lesions or restorations in last 24 months ☐
II.	Non-cavitated (incipient) Carious Lesions	No new lesions in last 24 months ☐		New lesions in last 24 months ☐
III.	Teeth Missing Due to Caries	☐ No		☐ Yes
IV.	Visible Plaque	☐ No	☐ Yes	
V.	Dental/Orthodontic Appliances Present (fixed or removable)	☐ No	☐ Yes	
VI.	Salivary Flow	Visually adequate ☐		Visually inadequate ☐

Overall assessment of dental caries risk: ☐ Low ☐ Moderate ☐ High

Instructions for Caregiver:

attachment 1

ADA American Dental Association®
America's leading advocate for oral health

Caries Risk Assessment Form (Age >6)

Patient Name:	
Birth Date:	Date:
Age:	Initials:

		Low Risk	Moderate Risk	High Risk
Contributing Conditions		**Check or Circle the conditions that apply**		
I.	Fluoride Exposure (through drinking water, supplements, professional applications, toothpaste)	☐ Yes	☐ No	
II.	Sugary Foods or Drinks (including juice, carbonated or non-carbonated soft drinks, energy drinks, medicinal syrups)	Primarily at mealtimes ☐		Frequent or prolonged between meal exposures/day ☐
III.	Caries Experience of Mother, Caregiver and/or other Siblings (for patients ages 6-14)	No carious lesions in last 24 months ☐	Carious lesions in last 7-23 months ☐	Carious lesions in last 6 months ☐
IV.	Dental Home: established patient of record, receiving regular dental care in a dental office	☐ Yes	☐ No	
General Health Conditions		**Check or Circle the conditions that apply**		
I.	Special Health Care Needs (developmental, physical, medical or mental disabilities that prevent or limit performance of adequate oral health care by themselves or caregivers)	☐ No	Yes (over age 14) ☐	Yes (ages 6-14) ☐
II.	Chemo/Radiation Therapy	☐ No		☐ Yes
III.	Eating Disorders	☐ No	☐ Yes	
IV.	Medications that Reduce Salivary Flow	☐ No	☐ Yes	
V.	Drug/Alcohol Abuse	☐ No	☐ Yes	
Clinical Conditions		**Check or Circle the conditions that apply**		
I.	Cavitated or Non-Cavitated (incipient) Carious Lesions or Restorations (visually or radiographically evident)	No new carious lesions or restorations in last 36 months ☐	1 or 2 new carious lesions or restorations in last 36 months ☐	3 or more carious lesions or restorations in last 36 months ☐
II.	Teeth Missing Due to Caries in past 36 months	☐ No		☐ Yes
III.	Visible Plaque	☐ No	☐ Yes	
IV.	Unusual Tooth Morphology that compromises oral hygiene	☐ No	☐ Yes	
V.	Interproximal Restorations - 1 or more	☐ No	☐ Yes	
VI.	Exposed Root Surfaces Present	☐ No	☐ Yes	
VII.	Restorations with Overhangs and/or Open Margins; Open Contacts with Food Impaction	☐ No	☐ Yes	
VIII.	Dental/Orthodontic Appliances (fixed or removable)	☐ No	☐ Yes	
IX.	Severe Dry Mouth (Xerostomia)	☐ No		☐ Yes

Overall assessment of dental caries risk: ☐ Low ☐ Moderate ☐ High

Patient Instructions:

These forms are not a substitute for a dentist's clinical judgment. The assessments cannot address every aspect of a patient's health, and should not be used as a replacement for the dentist's experience and judgment. Additional or more focused assessment may be appropriate for patients with specific oral health concerns. As with other forms, this assessment may be only a starting point for evaluating the patient's total health status.

attachment 2

name : title :

Dental radiology Competency Assessment Checklist

	Evaluation (check one)			Date	initials	Observation Method				Comments
	C	ATN	N			D	O	W	V	
Patient Assessment before taking radiographs										
Lead aprons available and used when needed										
Thyroid collars available and used when needed										
lead aprons and thyroid collars are hung or laid flat and not folded, and the manufacturer's instructions are followed										
A monthly visual and manual inspection is conducted for all protective aprons to ensure they are free from damage (such as cracks or folds)										
Type of x-ray taken and how many repetitions										
Cases where x-rays are recommended										
Use of fast receptors (like digital ones)										

Take the minimum number of x-rays necessary to obtain essential diagnostic information.										
Use Proper film exposure and film processing techniques.										
good conning to the area of interest										
Staff training on the use of dental radiology										
Periodic Inspection and quality control of Equipment and x-ray machines										
Documentation and Record Keeping for patients radiographs										

References:

1. American Dental Association (ADA) Radiographic Exposure Guidelines.
2. American Academy of Pediatric Dentistry (AAPD) Radiographic Guidelines
3. American Dental Association (ADA) Guidelines - ADA Radiation Safety.
4. World Health Organization (WHO) - Radiation Safety in Dental Practice.
5. American Dental Association (ADA). "Caries Risk Assessment Forms"
6. American Academy of Pediatric Dentistry (AAPD). "Guideline on Caries-risk Assessment and Management for Infants, Children, and Adolescents."
7. What Parents Should Know about the Safety of Dental Radiology https://www.imagegently.org/Portals/6/What%20Parents%20Should%20Know%20aboutthe%20Safety%20of%20Dental%20Radiology%20-%20Latest%208.8.2018.pdf?ver=2018-08-08-122946-217
8. Oral radiology principles and interpretation edition 7.