State of New Jersey

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NEW JERSEY RADIOLOGIC TECHNOLOGY BOARD OF EXAMINERS (BOARD)
DENTAL RADIOGRAPHY CURRICULUM REQUIREMENTS

The Board has adopted the following minimum curriculum requirements. It is the Board's goal that its curriculum requirements will provide graduates with the entry-level skills necessary to consistently produce high quality dental radiographic procedures while limiting radiation exposure to patients, self and others.

Schools are required to develop and implement a curriculum that, at a minimum, includes the required content and objectives contained within this document. The curricular requirements are divided into the following four components "General Requirements"; "Didactic Instruction", "Laboratory Instruction" and "Clinical Education". Each component contains the minimum requirements for achieving and maintaining Board approval.

GENERAL REQUIREMENTS

MINIMUM REQUIRED HOURS: Didactic - 25 hours; Laboratory - 20 hours. Minimum hours are calculated as actual lecture and instruction time and exclude breaks. Clinical – There is no minimum clinical hours; however, all clinical education requirements must be met.

METHOD OF TEACHING: Lecture, demonstrations, laboratory, and clinical practice

DIDACTIC AND LABORATORY INSTUCTOR QUALIFICATIONS:

Faculty must: (a) be either a New Jersey licensed dentist, New Jersey registered dental hygienist or a New Jersey licensed dental radiologic technologist; (b) have a minimum of two years full-time equivalent work experience performing dental radiographic procedures; and (c) document successful completion of a Board recognized course in educational theory and methodology or its equivalent as determined by the Board.

Faculty already approved by the Board, as of the approval date of this document, are exempted from (b) and (c) above, provided that the person remains employed in an approved school of dental radiologic technology. If an exempted faculty is inactive for greater than 18 months, prior to returning to a faculty position, he/she must meet the requirements of (a)-(c) above.

TEXBOOKS AND SUPPLEMENTAL MATERIALS:

Schools must identify and use a textbook(s) and supplemental materials that at a minimum, includes the content and objectives that are required by the Board. Textbook used must be approved by the Board. The most current edition of the approved textbook should be used. In addition, schools must provide to students with New Jersey regulations on radiologic technology (N.J.A.C 7:28-19) and the Board's accreditation standards for schools of dental radiologic technology.

DIDACTIC INSTUCTION

I. EXPOSURE AND EVALUATION OF RADIOGRAPHS

A. Ionizing Radiation, History of X-ray and X-ray Production

1. Content

a. Atomic structure
b. Ionizing and non-ionizing radiation
b. Electromagnetic spectrum
c. Natural and artificial sources of ionizing radiation
d. History of x-rays
e. Properties of x-rays
f. Role of radiology in modern dentistry
g. X-ray production
h. Components of the x-ray tube

2. Objectives

At the completion of this unit, the student will be able to:

a. Describe the atomic structure of an atom.
b. Define ionization.
c. Describe the electrometric spectrum and identify x-ray's position on the spectrum.
d. Identify sources of natural and artificial ionizing radiation.
e. Differentiate between ionizing and non-ionizing radiation.
f. Describe the properties of x-rays.

g. Discuss the discovery of x-rays and their importance. developments and use in dentistry.
h. Describe the principles of x-ray production.
i. Discuss the production of the primary x-ray beam. (i.e., bremsstrahlung and characteristic radiation).
j. Discuss the production of scattered (secondary) radiation.
k. Discuss the x-ray tube, the anode and cathode in terms of description, composition, and function.

B. Principles of X-ray Exposure and Radiographic Image Quality

1. Content

a. Components of the x-ray unit and their functions
b. Exposure concepts
c. Radiographic density
d. Radiographic contrast
e. Definition (recorded detail)
f. Size and shape distortion

2. Objectives

At the completion of this unit, the student will be able to:

a. Identify the components of an x-ray unit.
b. Describe the purpose of the following: kilovoltage (kVp) control; milliampere (mA) control; exposure time control; line voltage compensator, exposure switch; tube housing; collimation; and filtration.
c. Define radiographic exposure concepts, including: film speed; kilovoltage; milliamperage; exposure time; collimation; filtration and film density.
d. Define factors that influence the quantity and quality of exposure such as: mA setting; exposure time; kVp setting; primary beam angles (horizontal and vertical) and PID (cone length).
e. Define radiographic density, radiographic contrast, definition, and distortion and identify each of their influencing factors.
f. Calculate milliampere-seconds (mAs).
g. Discuss the inverse square law and how it is used to maintain density when distance is changed**.**

C. Imaging Receptors and the Latent Image

1. Content

   a. Film systems
   b. Digital systems
   c. Storage and care of imaging receptors
   d. Image receptor holders
   e. Formation of the latent image

2. Objectives:

   At the completion of this unit, the student will be able to:

   a. Identify the parts that make up x-ray film, x-ray film. packets, cassettes and intensifying screens and describe the function of each part.
   b. Identify the different film sizes and film speeds (sensitivity) and their use in dental radiography.
   c. Compare film speed and its effect on image quality and patient exposure.
   d. Describe and understand the differences in direct and indirect (storage phosphor) digital radiography systems.
   e. Describe the types and sizes of digital receptors.
   f. Explain advantages and disadvantages of digital imaging as compared with film systems.
   g. Properly inspect cassettes, intensifying screens and digital receptors and perform routine maintenance.
   h. Inspect and evaluate film storage areas for proper temperature, humidity, radiation protection and inventory control.
   i. Identify and correct errors related to improperly storing exposed and unexposed radiographic film.
   j. Store digital receptors in according with manufacturer's recommendations.
   k. Describe the types and use of image receptor holders
   l. Describe the purpose and advantages of dual (double) film packets.
   m. Describe the formation of the latent image on film.
   n. Describe the formation of the digital image for both direct and indirect digital systems.

D. Intraoral and Extraoral Procedures

1. Content:

   a. Intraoral procedures: periapical; bitewings; full mouth series for adults and children and occlusal radiography using paralleling and bisecting angle techniques.
   b. Extraoral procedures: panoramic and cephalometric radiography.

2. Objectives:

   At the completion of this unit, the student will be able to:

   a. Describe the use and purpose of various intraoral and extraoral radiographic procedures and type of x-ray equipment needed.
   b. Properly position patient, imaging receptor and x-ray tube for intraoral procedures using paralleling technique.
   c. Properly position patient, imaging receptor and x-ray tube for intraoral procedures using bisecting angle technique.
   d. Describe the advantages and disadvantages of paralleling and bisecting angle techniques.
   e. Describe the number and types of exposures that make up a full mouth series for adults and children.
   f. Describe the purpose, advantages and use of accessories for radiographic techniques, including image receptor holders, cotton rolls, bitewing tabs, bite blocks, lead apron and thyroid collar.
   g. Select the appropriate film size and film speed depending on patient characteristics and exposure technique indicated.
   h. Select the appropriate image receptor and exposure factors to examine caries; temporomandibular joint; periodontal conditions; apical pathology; sinus areas; dental anomalies, such as supernumerary teeth; edentulous arches; localization of impacted teeth, foreign objects, etc. and dental implants.
   i. Identify patient variations that affect exposure factors, such as: patient age, weight, body type, edentulous arches, and pathology.
   j. Apply the proper technical factors to produce a radiographic image of acceptable diagnostic quality with minimum exposure to the patient.
   k. Describe the appropriate patient positioning technique and exposure factors for panoramic and cephalometric radiography.

l. Describe features of a diagnostically acceptable radiographic image.
m. Identify and correct errors related to intraoral procedures, including: elongation; foreshortening; horizontal overlapping; cone cutting; light image; dark image; film bending; reverse film (herringbone effect); blank (clear) film; blurred image; superimposed image; double exposure; film placement errors and black film.
n. Identify and correct errors related to panoramic and cephalometric procedures, including patient positioning errors.
o. Identify normal radiographic anatomy on intraoral and extraoral images.

Note: The following procedures/projections are not in the scope of practice of a licensed dental radiologic technologist: lateral oblique jaw, TMJ, water's, PA skull and submentovertex, cone beam computed tomography, computed tomography, nuclear medicine. However, some textbooks cover them. If a school wishes to provide students with didactic instruction in these procedures/ projections, students must be informed in writing that they cannot be performed on patients by either a student or a licensed dental radiologic technologist.

Schools that elect not to include cephalometric radiography in laboratory must, at a minimum, provide demonstration on how to properly perform cephalometric radiography.

E. Patient Management and Infection Control

1. Content

a. Principles of patient management
b. Informed consent
c. Infectious diseases and precautions
d. Aseptic techniques

2. Objectives

At the completion of this unit, the student will be able to:

a. Perform patient management techniques before, during and after radiographic exposure to include patient concerns about ionizing radiation associated with a dental radiographic procedure, including informed consent and patient refusal of the radiographic procedure.

b. Describe techniques for patient management while exposing radiographs, including patients with special needs.
c. Identify the sources and modes for transmission of infectious diseases that are common in the dental office.
d. Protect the patient and operator from disease transmission through the selection of infection control techniques and barriers according to ADA/CDC guidelines and OSHA standards.
e. Perform proper hand washing.
f. Maintain aseptic conditions, including the use of aseptic techniques for image receptors and holders, x-ray equipment to include digital and positioning devices.
g. Practice infection control for radiographic processing, following ADA/CDC guidelines and OSHA standards.

II. IMAGE PROCESSING AND QUALITY ASSUARANCE

A. Darkroom and Processing Techniques

1. Content

a. Solution chemistry
b. Darkroom equipment and safe lighting
c. Automatic film processing
d. Manual film processing
e. Film processing errors
f. Storage and disposal of chemical agents

2. Objectives

At the completion of this unit, the student will be able to:

a. Identify the components of automatic and manual processing cycles and the specific action for each component.
b. Describe the functions of processing solutions.
c. Prepare, maintain, and replenish film processing solutions for manual and automatic processors.
d. Discuss the function, location and proper types of the darkroom safelights.
e. Inspect and evaluate darkroom area for proper temperature, humidity and radiation protection.
f. Identify optimum conditions and techniques for processing radiographic film in both manual and automatic processors.

g. Process intraoral and extraoral film using automatic and manual processing free for processing and film handling errors.
h. Identify and correct errors and artifacts related to improperly darkroom conditions and processing, including: fogging; light and dark images; clear (blank) film; partial images and overlapped films.
i. Identify and correct errors and artifacts due to improper film handling, including: scratches; white or black lines; static electricity artifacts and fingerprints.
j. Properly store chemical agents used in processing in compliance with the OSHA hazard communication standard.
k. Properly dispose of all chemical agents and other materials used in dental radiography procedures.
l. Process digital images for both direct and indirect digital systems in according with manufacturer's protocols.

Note: Schools that do not include manual film processing in laboratory must, at a minimum, provide demonstration on manual processing techniques.

B. Quality Assurance

1. Content

a. Components of a processor quality assurance program
b. Importance of a good quality assurance program

2. Objectives

At the completion of this unit, the student will be able to:

a. Discuss the components of a good processor quality assurance program.
b. Describe how a good processor quality assurance program will reduce processing errors and a patient's exposure to x-ray radiation.
c. Implement quality assurance procedures, including daily recording of solution temperatures, dates of solution changes, test film runs, darkroom fog testing, recording of equipment maintenance, knowledge of periodic inspections, etc.
d. Perform manufacturer's recommended maintenance of processing equipment.

III. MOUNTING AND LABELING RADIOGRAPHIC IMAGES

A. Image Mounting

1. Content

a. Anatomical landmarks essential to film mounting
b. Film mounting procedures
c. Digital imaging procedures
d. Image identification and legal requirements
e. Confidentiality of patient records
f. Duplication of radiographs

2. Objectives

At the completion of this unit, the student will be able to:

a. Mount images using buccal (Facial) view.
b. Identify anatomical landmarks that aid correct mounting.
c. Match specific tooth views to specified tooth mounting windows.
d. Demonstrate appropriate technique for optimum viewing.
e. Identify anatomical structures, dental materials, and patient information on images, including differentiating between radiolucent and radio opaque areas.
f. Identify information that must legally appear on the mount label.
g. Adhere to the Health Insurance Portability and Accountability Act of 1996 (HIPAA) as it applies to patient records.
h. Identify the reasons for exposing and retaining radiographs.
i. Discuss the process for duplicating radiographs.
j. Discuss the methods of duplicating digital images.

Note: Schools that do not include duplication of radiographs in laboratory must, at a minimum, provide demonstration on duplication of radiographs.

IV. RADIATION PROTECTION

A. Radiation Biology

1. Content

a. Interaction of ionizing radiation with cells

b. Factors influencing biological response of cells to ionizing radiation
c. Somatic and genetic effects of ionizing radiation
d. Cumulative effects of ionizing radiation

2. Objectives

At the completion of this unit, the student will be able to:

a. Discuss the interactions that ionizing radiation has with the cell.
b. Characterize types of cells in groups according to their degree of sensitivity to ionizing radiation.
c. Describe short-term (Acute) and long-term (Chronic) effects of ionizing radiation.
d. Understand of concepts of radiation dose and effective dose and their effect of cells.
e. Describe the somatic and genetic effects of ionizing radiation.
f. Identify the cumulative effects of ionizing radiation.

B. Radiation Protection of the Patient

1. Content

a. Patient radiation protection methods
c. Non-occupational annual radiation exposure limit
d. As Low As Reasonably Achievable (ALARA)
e. Special precautions for children, female patients in their childbearing years and for pregnant patients
f. Guidelines for frequency of radiographic procedures
g. X-ray machine malfunctions

2. Objectives

At the completion of this unit, the student will be able to:

a Apply the principles of radiation protection and health physics and hazards in the operation and maintenance of radiographic equipment.
b. Demonstrate understanding of how filtration, lead aprons, thyroid collars, film speed, mA, kVp, exposure time, collimation, proper film processing, cone (PID) length influences patient dose.
c. Practice patient safety measures to provide protection from x-ray radiation.

d. Identify ways to reduce radiation exposure to patients (ALARA).
e. List and practice special precautions for children, female patient in their childbearing years and for pregnant patients.
f. Define non-occupational individuals.
g. Define the non-occupational annual dose limit as currently published by the National Council on Radiation Protection and Measurement (NCRP).
h. Identify ADA/FDA current guidelines determining the frequency of radiographic procedures.
i. Identify major causes of unnecessary x-ray exposure to the patient.
j. Identify x-ray equipment malfunctions and the protocol for reporting suspected malfunctions.

C. Radiation Protection of the Operator/Other Staff

1. Content

a. Radiation protection methods
b. As Low As Reasonably Achievable (ALARA)
c. Radiation monitoring devices
d. Units of ionizing radiation measurement
e. Annual occupational dose limit
f. Embryo-Fetus exposure limits of an occupational worker

2. Objectives

At the completion of this unit, the student will be able to:

a. Identify sources of radiation exposure to the operator/other staff during x-ray exposure.
b. Identify and practice safety measures to reduce operator and other staff from x-ray exposure.
c. Describe the ALARA principle as related to operator safety.
d. Define the occupational annual dose limit as currently published by the National Council on Radiation Protection and Measurement (NCRP).
e. Define the monthly embryo-fetus dose limits of a pregnant occupational worker as currently published by the NCRP.
f. Explain the function and use of personal monitoring device to assure that the occupational and the embryo-fetus doses are within acceptable limits of radiation exposure.

g. Define the conventional units of ionizing radiation measurement in terms of Roentgen (R); radiation absorbed dose (Rad); and roentgen equivalent man (Rem).
h. Define the SI units of ionizing radiation measurement in terms of Coulomb/Kg (C/kg); Gray (Gy) and Sievert (Sv) and convert these units to conventional units.
i. Convert Rem to mSv and mRem to mSv and vice versa.
j. Define the minimum acceptable distance that an operator should stand from the x-ray tube when the exposure switch is located within the x-ray room.

V. NEW JERSEY REGULATIONS

A. X-ray Equipment Requirements

1. Content

a. Registration of x-ray equipment
b. Radiation safety survey
c. Operating procedures

2. Objectives

At the completion of this unit, the student will:

a. State that, in accordance with N.J.A.C 7:28-3.1(b), within 30 days of taking possession of an x-ray unit, the facility owner must register the x-ray unit with the Department for Environmental Protection.
b. Explain that, in accordance with N.J.A.C. 7:28-16.8(a)1 and 2, within 60 days of taking possession of an x-ray unit or after making any change to the equipment, equipment location or shielding, the facility owner must have a radiation survey performed and the survey results submitted to the Department.
c. State and adhere to the Operating Procedures published at N.J.A.C. 7:28-16.10.

B. Technologist and School Requirements

1. Content

a. N.J.A.C. 7:28-19
b. Radiologic Technology Board of Examiners' Accreditation Standards for School of Dental Radiologic Technology

2. Objectives

At the completion of this unit, the student will be able to:

a. Discuss general provisions published at N.J.A.C. 7:28-19.3. (Note: N.J.A.C. 7:28-19.3(a)2 and (e) can be omitted)
b. Define the scope of practice of dental radiologic technology published at N.J.A.C. 7:28-19.4(a) and (e).
c. Discuss the requirements for licensure as a dental radiologic technologic technologist published at N.J.A.C. 7:28-19.7.
d. Discuss the requirements for license renewal published at N.J.A.C. 7:28-19.9.
e. Identify acts of unethical conduct published at N.J.A.C. 7:28-19.5 and possible penalties that may be imposed in accordance with N.J.A.C. 7:28-19.3(p).
g. Understand the Board's accreditation standards for schools and policies that apply to students.

LABORATORY INSTRUCTION

Required Components of Laboratory Instruction:

For each of the following activities/procedures listed below, a school must develop and implement a laboratory curriculum that includes: (1) Instructor's demonstration of the activity/procedure to students, (2) Adequate time for students to practice the activity/procedure, while under the direct supervision of the instructor and (3) Evaluation of student proficiency of the activity/procedure by the instructor and recorded on forms approved by the Board:

<u>Activity/Procedure</u>

1. Identifying x-ray unit components;
2. Identify types of film and digital receptors;
3. XCP assembly;
4. Full mouth series using paralleling technique*;
5. Bitewings and periapicals of various areas of the mouth using bisecting angle technique*;
6. Occlusal radiography*;
7. Automatic film processing (free from artifacts and processing errors);
8. Mount FMS film radiographs;
9. Arrange FMS digital radiographs for monitor display:
10. Infection control of x-ray equipment, imaging receptors, holders, and image processing;
11. Identify imaging errors and artifacts;
12. Identify anatomical structure of interest and landmarks; and

13. Implement one of five laboratory options (A-E) as contained in the "Laboratory and Clinical Flowchart" on page 15.

* Procedures must include actual x-ray exposures made by students on a dental x-ray manikin.

In addition to the above requirements, laboratory evaluations are needed on a panoramic procedure and intraoral procedures using either simulated or fully functional digital receptors. The Board has identified five possible options for performing these required evaluations. Each school is required to choose an option and implement it as part of its curriculum.

These options and the minimum laboratory evaluation requirements for the panoramic procedure are published in the flowchart" on page 15.

Laboratory evaluation forms must be developed and implemented that include: (1) all required elements in Section II.C of the document entitled "Board's accreditation standards"; (2) the individual tasks/objectives that make up the activity/procedure being evaluated and (3) grading criteria. The school can elect to evaluate each of the above separately or group them into a larger evaluation. Evaluations can be graded utilizing either a "Pass/ Fail" or a numeric grading system.

Dental Radiography Laboratory and Clinical Flowchart

Minimum Laboratory Evaluation Requirements

1. Identifying x-ray unit components;
2. Identify types of film and digital receptors;
3. XCP assembly;
4. Full mouth series using paralleling technique;
5. Bitewings and periapicals of various areas of the mouth using bisecting angle technique;
6. Occlusal radiography;
7. Automatic film processing;
8. Mount FMS film radiographs;
9. Arrange FMS digital radiographs for monitor display;
10. Infection control of x-ray equipment, imaging receptors, holders and image processing;
11. Identify imaging errors and artifacts;
12. Identify anatomical structure of interest and landmarks; and
13. One of the following Lab Options.

Lab Option A

1. Panoramic via demonstration without use of a panoramic unit
2. Intraoral procedure using simulated digital receptors

Clinical Option A

1. FMS using paralleling technique
2. Four exposures using bisecting angle technique
3. Panoramic procedure

At least 1 of the above must be digital procedure

Lab Option B

1. Panoramic via demonstration without use of a panoramic unit.
2. Intraoral procedure using fully functional digital receptors

Clinical Option B

1. FMS using paralleling technique
2. Four exposures using bisecting angle technique
3. Panoramic Procedure

Lab Option C

1. Panoramic using a unit w or w/o x-ray production capability.
2. Intraoral procedure using simulated digital receptors

Clinical Option C

1. FMS using paralleling technique
2. Four exposures using bisecting angle technique

At least 1 of the above must be digital procedure

Lab Option D

1. Panoramic using a unit w or w/o x-ray production capability.
2. Intraoral procedure using fully functional digital receptors

Clinical Option D

1. FMS using parallel technique
2. Four exposures using bisecting angle technique.

Lab Option E

1. Panoramic w fully functional digital panoramic unit
2. Intraoral procedure with simulated digital receptors

Clinical Option E

1. FMS using paralleling technique
2. Four exposures using bisecting angle

Lab Evaluation Notes: (1) For Panoramic Options A and B: At a minimum the lab evaluation must include patient head and body positioning and image evaluation for errors. (2) For Panoramic Options C-E: At a minimum the lab evaluation must include patient head and body positioning, unit rotation and image evaluation for errors.

Clinical Evaluation Notes: (1) Prior to the competency evaluation, the following procedures must be successfully performed on patients: 2 FMS using paralleling technique; a total 12 Bitewing (BW)/Periapical (PA) exposures using bisecting angle technique and Panoramic = 1. If 2 patient FMS procedures are not available, prior to the competency evaluation a total of 8 BW and 28 PA exposures must be successfully performed on patients in various areas of the mouth. (2) If a FMS is not available for competency testing on a patient, the evaluation must include a total 4 BW and 14 PA exposures on patients in various areas of the mouth.

CLINICAL EDUCATION

After a student has successfully passed both the didactic and laboratory components of the school's curriculum and a clinical affiliate application(s) has been approved by the Bureau of X-ray Compliance, the school can permit the student to start clinical education. The school shall determine the period of time of each student's clinical education. Once completed, students are no longer permitted to operate x-ray equipment until licensed by the Department.

The goal of clinical education is to provide students sufficient opportunity to apply within the dental office setting, the knowledge and skills they have gained through didactic and laboratory education. During clinical education, the student must demonstrate that they can competently perform dental radiographic procedures while minimizing exposure to the patient, self and others.

During clinical education, a student must be deemed competent in performing dental radiographic procedures. The actual procedures needed will depend on the Laboratory Option chosen and implemented by the school. The school must implement the Clinical Option that corresponds to the Laboratory Option. (Example: if the school has chosen Laboratory Option A, Clinical Option A must be implemented.) These Clinical Options are published on the flowchart on page 15.

Additionally, before a procedure can be evaluated for clinical competency, the student must successfully perform that procedure on a minimum number of patients as specified in the flowchart on page 15.

The Board has developed the attached Clinical Affiliate Application and Clinical Competency Evaluation forms that must be used by the school and clinical facility to record and document the student's clinical competency in the required radiographic procedures.

The school must provide the above forms to the clinical facility and inform them of the clinical competency requirements.

Board approval dates:

February 11, 1981
Revised March 25, 1984
Revised March 19, 1987
Revised June 13, 1991
Revised January 7, 1993
Revised December 11, 1997
Revised July 31, 2012
Revised October 29, 2014 (to include a change on page 15 regarding the number practice FMS procedures needed prior to a clinical competency evaluation using paralleling technique. Additionally the "Paralleling and Bisecting Angle Clinical Competency

Evaluation Form" was also revised to reflect the changes on page 15. These changes go into effective with the first class enrolled after January 1, 2015.