

SYLLABUS

COURSE: DHBS 3105 Dental Radiology I
SEMESTER: Fall
CREDIT HOUR: 3.0

REVISED: 2001
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COURSE DIRECTOR: Kenneth Abramovitch, D.D.S., M.S.

GOAL

The purpose of this course is to introduce the dental hygiene student to the basic radiologic principles of intraoral imaging for dento-alveolar structures. The radiographic examination plays an integral role in the diagnostic process in dentistry in conjunction with the clinical examination. The dental hygienist must be proficient with intraoral techniques to fulfill their roles as health care providers.

As clinicians, dental hygienists must have an understanding of the basic concepts of radiographic imaging modalities in order to maximize the diagnostic potential of these procedures for their patients. The preclinical laboratory sessions are designed to perfect technical skills and familiarize dental hygiene students with the variability of normal radiographic anatomy seen on intraoral radiographs.

OBJECTIVES

I. RADIATION HISTORY

1. Explain the historical contribution each of the following scientists made to the development of dental radiography.
 - 1.1 Wilhelm Conrad Roentgen
 - 1.2 Otto Walkhoff
 - 1.3 C. Edmund Kells
2. Define and discriminate between the following terms:
 - 2.1 radiology
 - 2.2 radiography
 - 2.3 radiation.
3. List the uses of dental radiographs.

II. RADIATION PHYSICS

1. Describe how electrons, protons and neutrons are arranged in the structural integrity of the atom.
2. Differentiate between particulate (corpuscular), gamma, and electromagnetic radiations.
3. Correlate the significance of an electron's binding energy and the location of its orbital shell from the nucleus of the atom.
4. Define ionization.
5. List four (4) common characteristics of electromagnetic radiations.
6. Describe the relationship between wavelength and frequency to the energy level in electromagnetic radiations.
7. Compare the relative wavelength frequency of x-radiation to other commonly utilized radiations in the electromagnetic spectrum.
8. Identify the parts and components of a dental X-ray machine. (Fig. 2-11)
9. Identify the following components of an x-ray tube and state their function:
 - 9.1 Cathode -
 - 9.1.1 molybdenum (focusing) cup
 - 9.1.2 tungsten filament
 - 9.2 Anode
 - 9.2.1 tungsten target
 - 9.2.2 copper stem
 - 9.3 Leaded glass housing (Glass envelope)
 - 9.4 Collimator
 - 9.5 Window
 - 9.6 Positioning-Indicating Device (PID, a.k.a. BID)

9.7 Aluminum Disks (Filters)

10. Define thermionic emission and state its function in x-ray production
11. Differentiate between the low voltage transformer, high voltage transformer and the autotransformer.
12. Describe and quantify the main type of energy conversion occurring at the anode.
13. Define and differentiate between characteristic and Bremsstrahlung (i.e., braking) radiation.
14. Define the terms "ampere", "volt" and "resistance" as they relate to electrical conductivity.
15. Discuss the relationship between alternating current (AC) and direct current (DC) on:
 - 15.1 rectification of the electrical circuits in the x-ray machine
 - 15.2 impulse production at the target of an x-ray tube
16. Discuss how the controls for milliamperage (mA), kilovoltage (kVp), and time (impulses) affect the output of x-ray production in a dental x-ray machine.
17. State three (3) possible outcomes for X-ray photons that penetrate a patient.
18. State four (4) types of x-ray beam absorption.

III. RADIATION AND DENTAL X-RAY CHARACTERISTICS

1. Identify the components of a dental x-ray unit control panel. (Fig 3-1)
2. State the relationship between focal spot size and image definition.
3. State the effect of mA and exposure time on beam intensity.
4. State the effect of kV on beam intensity.
5. Define the half value layer.
6. Define the Inverse Square Law.
7. Calculate intensity and distance variables using the Inverse Square Law.
8. Define "density" and "contrast".
9. Describe how variations in mA, exposure time (impulses) and kilovoltage (kVp) will affect the radiographic image.
10. Differentiate between short-scale (high) and long-scale (low) contrast.
11. Define penumbra and describe how it is affected by changes in source-object and object-film distances.
12. Describe how magnification is affected by source-object and object-film distances.

IV. PARALLELING AND BISECTING TECHNIQUE

1. Differentiate between "paralleling" and "bisecting angle" techniques for intraoral radiographic projections.

V. RADIATION BIOLOGY

1. Differentiate between ionization, excitation and free radical formation.
2. Differentiate between direct and indirect effects of ionizing radiation.
3. List three (3) factors which determine a cell's response to radiation exposure.
4. Identify the deleterious sequelae of ionizing radiation on water.
5. Define the standard and metric terms used to measure radiation:
 - 5.1 Roentgen
 - 5.2 Rad
 - 5.3 Rem
 - 5.4 Gray
 - 5.5 Sievert.
6. Define "Quality Factor" and its relationship to dose equivalence.
7. State sources of background radiation and the average daily whole body dose.
8. List the four (4) critical organs that are more susceptible to the effects of dental radiographic procedures. State the relative risk associated with each organ and the threshold dose necessary to acquire this risk.
9. Compare the relative risk of morbidity from dental x-rays to common industrial activities and social behaviors.
10. Rank common human tissue cell types into a relative order of radiosensitivity.
11. Define the "latent period" with regard to radiation exposure.
12. Define "lethal dose", "threshold dose" and "LD_{50/30}" as they relate to the dose response curve.
13. List three (3) determinants of radiation injury.
14. List five (5) symptoms of the "Acute Radiation Syndrome".
15. List the deleterious (harmful) effects of high radiation doses on the tissues of the oral cavity.
16. Describe the pathologic processes associated with "radiation caries" and "osteoradionecrosis".
17. Discuss the significance of a risk versus benefit ratio in radiology.

VI. RADIATION PROTECTION

1. Define Maximum Permissible Dose (MPD)

2. List the Maximum Permissible Doses for:
 - 2.1 occupationally exposed individuals
 - 2.2 non-occupationally exposed individuals
 - 2.3 occupationally exposed but pregnant individuals
3. State the determination of the Maximum Accumulated Dose.
4. Differentiate between “inherent” and “added” filtration.
5. State the NCRP total aluminum filtration recommendations for different kV beams.
6. List seven (7) variables that minimize somatic exposure of patients.
7. Describe the optimal operator positioning during radiographic exposures of the patient.
8. Identify the type of radiation monitoring device used in dental offices.
9. State the importance of radiation monitoring devices.

VII. RADIOGRAPHIC ANATOMY OF THE DENTO-ALVEOLAR PROCESS

1. Based on their radiographic appearance, differentiate between maxillary and mandibular anterior teeth.
2. Based on their radiographic appearance, differentiate between maxillary and mandibular posterior teeth.
3. Identify characteristic periapical anatomy in different parts of the maxilla and mandible based on their radiographic appearance.
4. Identify the intraoral radiographic appearance of restorative materials that restore:
 - 4.1 parts or most of the dental crown
 - 4.2 root canal space
 - 4.3 entire segments of missing teeth

VIII. DENTAL FILM AND PROCESSING

1. Identify the components of an intraoral film packet.
2. List the component layers that make up a sheet of dental film.
3. Differentiate between the sizes and speeds of commercially available intraoral film.
4. List the hazards from which dental film must be protected during storage.
5. Define the “latent image.”
6. List the major components and their functions for a typical:
 - 6.1 x-ray developer solution
 - 6.2 x-ray fixer solution
7. List the sequential steps for manual and automatic processing of x-ray films.

8. List the requirements of an efficient darkroom.
9. State the requirements for proper darkroom safelights
10. Identify and correct technical errors on intraoral film that are related to:
 - 10.1 film positioning
 - 10.2 film exposure
 - 10.3 film handling
 - 10.4 film processing

IX. INTERPROXIMAL, PERIAPICAL AND PERIODONTAL EVALUATION OF TEETH

1. List two (2) types of intraoral radiographic techniques useful for the recognition of interproximal dental caries.
2. State the horizontal and vertical angulation criteria necessary for the recognition of interproximal dental caries.
3. List the caries incidence for the different teeth in the permanent dentition.
4. State the frequency interval for bitewing radiographic examinations.
5. Differentiate between cervical, cemental, recurrent and arrested caries.
6. Define four (4) relative categories of interproximal caries severity.
7. Describe how cervical burnout occurs.
8. Describe the periapical radiographic changes occurring with apical periodontitis.
9. Differentiate the radiographic appearance of periapical disease from:
 - 9.1 superimposing anatomic foraminae
 - 9.2 developing root apices
10. Differentiate between the following radiographic changes in periapical diseases
 - 10.1 apical abscess
 - 10.2 apical granuloma
 - 10.3 apical cyst
 - 10.4 internal and external root resorption
 - 10.5 condensing osteitis
11. List six (6) predisposing factors to periodontal disease that can be recognized on intraoral radiographs.
12. List the advantages and disadvantages of intraoral radiography in evaluating a patient's periodontal status.
13. List four (4) radiographic signs of early to moderate periodontal disease.
14. List four (4) radiographic signs of severe periodontal disease.
15. Differentiate between horizontal and vertical bone loss.

16. Define the "crown:root" ratio and describe its usefulness in radiographic evaluations of periodontal prognosis.

X. INFECTION CONTROL IN DENTAL RADIOLOGY

1. Describe the reason that infection control is necessary for radiographic procedures.
2. List the modes of disease transmission seen in clinical procedures.
3. List the types of instrument classifications used that are dependent on the risk of transmitting infection and the need to sterilize them.
4. State the instruments used for intraoral radiography that require sterilization.
5. State the infection control policy regarding the use of protective eyewear and facial masks for intraoral radiography.
6. List the surfaces in the radiology cubicle and adjacent the radiology cubicle that require barrier protection.
7. Describe the two types of infection control procedures for dental film.
8. State the infection control protocol used in the darkroom(s) of the Dental Branch radiology clinics.

RESOURCES

I. Media Resources

Printed Media

Required textbook

Haring, J.I. and Jansen, L.J.
Dental Radiograph, Principles and Techniques, 2nd Ed.
W.B. Saunders Company 2000, 569p

Langlais, R.P.
Exercises in Oral Radiography and Interpretation, 4th Ed.
W.B. Saunders, 2004, 381p.

II. Human Resources

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Course Director

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Lab Coordinator

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Sr. Support Specialist

STUDY PLANS AND REQUIREMENTS

This course is to be completed by the end of the Fall semester of the first year of the dental hygiene program.

Attendance

You must attend all lectures and the lab sessions to which you are assigned. Punctuality is essential; we have limited facilities and the scheduling is complex. We therefore regret that the laboratory sessions cannot be re-assigned. Each lab session is of 50 minutes duration.

You will be penalized for any unexcused absence as stipulated in the evaluation methods. Students must also be on time. Late arrivals are disruptive. Consequently students arriving later than 10 minutes after the hour will be counted as an unexcused absence.

The schedules for the lectures and lab sessions are listed on the following four pages. Laboratory sessions will be held in the Radiology Clinic area.

To prepare for this course:

1. Review the objectives.
2. Study the appropriate sections in *Dental Radiography, Principles and Techniques*, 2nd ed., by Haring, J.I. and Jansen, L.
3. Pay particular attention to all illustrations found in these sections of your text.

Term Paper

In November 2004, the revised edition of *The Selection of Patients for Dental Radiographic Examinations*¹ was released jointly by the U.S. Food and Drug Administration and the American Dental Association. These guidelines succeed the original 1987 FDA document *The Selection of Patients for X-Ray Examinations: Dental Radiographic Examinations*.² The need and justification for these guidelines is well documented.³⁻⁵

The revised edition reinforces ALARA concepts that stress the proverb of exposing patients to the minimum amount of radiation necessary. Radiographs are used to diagnose and monitor oral diseases, to monitor craniofacial development and to monitor the progress or prognosis of treatment. With respect to the former reason, radiographs are to be ordered after a thorough clinical examination to corroborate the clinical presence or the clinical risk of acquiring dental disease.

The best possible mechanism to reduce a patient's radiation exposure is to limit the number of radiographs necessary. The new guidelines further elaborate the clinical indications and scenarios for utilizing radiography in an efficient manner.

The data formulating these recommendations and conclusions follow the rigors of a scientific systematic review. Despite abiding by the evidence-based parameters of caries and other oral disease progression rates, compliance with the previous recommendations has been poor.⁶⁻⁸

With the assistance of, but not limited to the appended list of review papers and their bibliographies, compose a position paper that either supports or opposes the revised document. You may consider

reviewing the updated guidelines and new guidelines in the revised document. A significant part of the paper should also be on formulating suggestions that would improve the compliance rate of adopting the revised documents recommendations into clinical practice.

The body of the paper should be a minimum of six to eight double-spaced, typewritten pages. Pages should have 1" margins with 12-pitch font size. Include the following subheading in your paper.

- A. Title page: your name, course name, name of paper and due date.
- B. Body: Introduction
presentation of controversial conclusions
defense or counter-argument to these conclusions and,
your concluding summary
- C. Bibliography and References: Papers that you cited or referenced for your paper

The six to eight double-spaced, typewritten pages in the body of the paper excludes the title page and bibliography. Consequently, include the bibliography and references by appending it to the paper. The pages for the bibliography and references are not to be considered as pages in the body of the paper.

This paper is worth 10% of your final grade and is due no later than **Friday November 11, 2005**.

List of Potential References:

1. U. S. Department of Health and Human Services. The selection of patients for dental radiographic examinations. (Revised 2004) HHS Publ 2004.
URL: <<http://www.fda.gov/cdrh/radhlth/adaxray-1.html>>
2. U. S. Department of Health and Human Services. The selection of patients for x-ray examinations: dental radiographic examinations, HHS Publ FDA 88-8273, Rockville, Md., 1987.
3. Key updates to radiograph guidelines. ADA News January 20, 2005,
URL: <<http://www.ada.org/prof/resources/pubs/adanews/adanewsarticle.asp?articleid=1231>>
4. Berthold M. New Radiograph Guidelines; Joint FDA ADA Update. ADA News January 2005,
URL: <<http://www.ada.org/prof/resources/pubs/adanews/adanewsarticle.asp?articleid=1230>>
5. ADA Council on Scientific Affairs. An update on radiographic practices: information and recommendations. J Am Dent Assoc. 2001;132:234-8.
6. White SC. A survey of selection criteria compliance in 32 dental schools. Abstract. J Dent Educ 1993
7. Brooks SL. A study of selection criteria for intraoral radiography. OOO&E 62:234-239, 1986
8. Atchison KA et al. Assessing the FDA guidelines for ordering dental radiographs. JADA 126:1372, 1995.

DHBS 3105 DENTAL RADIOLOGY I
2005 Fall Semester Lecture Schedule

Day/Time: Monday & Friday, 10:00-10:50 am; Room 446

DATE	DAY	SESSION TOPICS	REFERENCE TEXT
1 - 08/15 10:00 – 11:50 am	Mon	Introduction: Review of Lab Techniques Course Overview – History of Dental Radiology	1) Chapter 17-19 1) Chapter 1
2 - 08/19	Fri	Review of XCP Training Tape	
3 - 08/22	Mon	Physics of Radiation I	1) Chapter 2
4 - 08/26	Fri	Physics of Radiation II	1) Chapter 2
5 - 08/29	Mon	The X-Ray Machine	1) Chapter 2, 3
6 - 09/02	Fri	Production and Interactions of X-Radiation	1) Chapter 2
09/05	Mon	<i>Labor Day Holiday</i>	
7 - 09/09	Fri	Principles of X-Ray Tube Operation	1) Chapter 3, 6
8 - 09/12	Mon	Technical Aspects of Radiation Production I	1) Chapter 8, 17, 18
9 - 09/16	Fri	Technical Aspects of Radiation Production II	1) Chapter 8, 17, 18
10 - 09/19	Mon	Examination: Written	ROOM 207
11 - 09/23	Fri	Radiation Biology I	1) Chapter 4
12 - 09/26	Mon	Radiation Biology II	1) Chapter 4 Handout
13 - 09/30	Fri	Radiation Protection I	1) Chapter 4
14 - 10/03	Mon	Radiation Protection II	1) Chapter 5
15 - 10/07	Fri	Radiographic Anatomy in the Maxilla	1) Chapter 25 2) Section 1
16 - 10/10	Mon	Radiographic Anatomy In The Mandible	1) Chapter 25 2) Section 1
17 - 10/14	Fri	Radiographic Appearance of Restorative Materials	2) Section 3
18 - 10/17	Mon	Examination: Written	ROOM 207
19 - 10/21	Fri	Examination: Recognition of Radiographic Anatomy And Restorative Materials	ROOM 207
20 - 10/24	Mon	X-Ray Film and Processing	1) Chapter 7
21 - 10/28	Fri	Troubleshooting Radiographs I	1) Chapter 9, 10 2) Section 2
22 - 10/31	Mon	Troubleshooting Radiographs II	1) Chapter 9, 10 2) Section 2

DATE	DAY	SESSION TOPICS	REFERENCE TEXT
23 - 11/04	Fri	Troubleshooting Radiographs III	1) Chapter 9, 10 2) Section 2
24 - 11/07	Mon	Troubleshooting Radiographs IV	1) Chapter 9, 10 2) Section 2
25 - 11/11	Fri	Examination: Recognition of Faulty Radiographs	ROOM 207
26 - 11/14	Mon	The Interproximal Examination: Caries Detection	1) Chapter 28
27 - 11/18	Fri	<i>No Class</i>	
28 - 11/21	Mon	The Periapical Examination: Recognition of Pathology	1) Chapter 30
11/25	Fri	<i>Thanksgiving Holiday</i>	
29 - 11/28	Mon	The Periodontal Evaluation	1) Chapter 29
30 - 12/02	Fri	Exam Review Course Evaluation	
12/14	Wed	Final Comprehensive Written Examination 8:00 - 9:50 am	ROOM 207

REFERENCE TEXTS:

- 1) Haring, J.I. and Jansen, L., *Dental Radiography. Principles and Techniques*, 2nd ed., W.B. Saunders Company 2000, 569p.
- 2) Langlais, R.P., *Exercises in Oral Radiology and Interpretation*. 4th ed., W.B. Saunders, 2004, 381p.

DHCT 2105 DENTAL RADIOLOGY I
2005 Fall Semester Laboratory Schedule

Day/Time: Tuesday, Wednesday, Thursday & Friday (8-8:50 am)

DATE	DAY	GROUP	PROCEDURE
08/16	Tue	A	Demonstration of equipment, Dental X-ray Teaching and Training Replica (DXTTR), control panel, exposure factors, processors and darkroom. Quiz – Slide Recognition of XCP components
08/17	Wed	B	
08/18	Thu	C	
08/19	Fri	D	
08/23	Tue	A	Using XCP, expose maxillary and mandibular anteriors. Process and mount
08/24	Wed	B	
08/25	Thu	C	
08/26	Fri	D	
08/30	Tue	A	Using XCP, expose right maxillary and mandibular posterior periapicals. Process and mount
08/31	Wed	B	
09/01	Thu	C	
09/02	Fri	D	
09/06	Tue	A	Using XCP, expose left maxillary and mandibular posterior periapicals. Process and mount
09/07	Thu	B	
09/08	Thu	C	
09/09	Fri	D	
09/13	Tue	A	Using XCP, expose right and left premolar and molar bitewings (BW's) Process and mount
09/14	Wed	B	
09/15	Thu	C	
09/16	Fri	D	
09/20	Tue	A	Evaluate and turn in completed Full Mouth Survey (FMS) radiographs
09/21	Wed	B	
09/22	Thu	C	
09/23	Fri	D	
09/27	Tue	A	Using XCP, expose entire right side i.e., periapicals and BW's Process and mount.
09/28	Wed	B	
09/29	Thu	C	
09/30	Fri	D	
10/04	Tue	A	Using XCP, expose entire left side i.e., periapicals and BW's Process and mount. Evaluate and turn in completed FMS as pre-requisite for taking the practical exam.
10/05	Wed	B	
10/06	Thu	C	
10/07	Fri	D	

DATE	DAY	GROUP	PROCEDURE
10/11	Tue	A	REVIEW
10/12	Wed	B	"
10/13	Thu	C	"
10/14	Fri	D	"
10/18	Tue	A	PRACTICAL EXAMINATION
10/19	Wed	B	" "
10/20	Thu	C	" "
10/21	Fri	D	" "
10/25	Tue	A	Using Stabe bite blocks expose the mandibular right and left
10/26	Wed	B	posterior periapical radiographs.
10/27	Thu	C	Process and mount.
10/28	Fri	D	
11/01	Tue	A	Using Stabe bite blocks expose the maxillary and mandibular
11/02	Wed	B	anterior periapical radiographs.
11/03	Thu	C	Process and mount.
11/04	Fri	D	
11/08	Tue	A	Using Snap-a-ray film holding device, expose the maxillary right and left
11/09	Wed	B	posterior periapical radiographs.
11/10	Thu	C	Process and mount.
11/11	Fri	D	
11/15	Tue	A	Using disposable tabs expose the right & left, molar & premolar bitewings.
11/16	Wed	B	Using disposable tabs expose the right and left Pedo bitewings.
11/17	Thu	C	Process and mount.
11/18	Fri	D	Evaluate and turn in completed FMS and Pedo bitewings as pre-requisite for taking the final practical exam.
11/29	Tue	A	Using disposable tabs & XCP instruments expose one set of vertical BW's on an adult DXTTR
11/30	Wed	B	Using Snap-a-ray and XCP instruments, expose one set of horizontal BW's on a pedo DXTTR
12/01	Thu	C	on a pedo DXTTR
12/02	Fri	D	Process, mount & turn in as pre-requisite for taking the final practical exam.
12/06	Tue		FINAL PRACTICAL EXAMINATION (Groups and times to be announced)

EVALUATION METHODS

LECTURE

There will be two written examinations; two slide recognition examinations and a comprehensive examination for this course. The material on the examinations will include all information pertinent to oral and maxillofacial radiology as covered in the lecture series and reference pages.

LABORATORY

Students are expected to complete all lab exercises in order to obtain a final course grade. Penalty points will be deducted from the final grade for each incomplete lab assignment to a maximum of 25% of the final course grade.

Students must attend the lab period to which they have been assigned by the Office of Academic Affairs. If a student cannot attend an assigned lab period due to medical reasons, they may be able to switch a lab period with a consenting classmate. Such changes must be approved by the Lab Coordinator no later than twenty-four (24) hours prior to the scheduled lab.

ATTENDANCE

Attendance is mandatory for all lectures and lab sessions. A student will be penalized for any lecture or lab session missed without an excused absence as determined by the Student Guide to Academic Studies. Students must also be on time. Late arrivals are disruptive. Consequently students arriving later than 10 minutes after the hour will be counted as absent (unexcused).

GRADES

The course grade will be assigned according to the following criteria:

LECTURE (65% of final grade)			TERM PAPER (10% of final grade)			LAB (25% of final grade)		
Examination - Written	2.5%		Term Paper	10%		Pre-lab Practical Exam	02%	
Examination - Written	7.5%					Lab Practical Exam	10%	
Examination - Slide (Recognition of Normal Anatomy and Restorative Materials)	7.5%					Final Lab Practical Exam	13%	
Examination – Slide (Recognition of Faulty Radiographs)	7.5%							
Final comprehensive written exam	40%							
Total	65%		Total	10%		Total	25%	

Students must pass both the lecture and the lab components for successful completion of the course in order to perform patient radiographic procedures. Students with a failing grade in either component are required to remediate the specific component to attain a passing grade for the course.