Department: Oral Pathology, Radiology and Medicine

Course Title: Fundamentals of Oral Radiology

Course Number: 86:120

Curriculum Level: I year (Freshman)

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Students seeking academic accommodations for disabilities should contact the instructor and/or the Assistant Dean for Student Affairs.

I. COURSE DESCRIPTION

The fundamentals of the production and interaction of x rays are presented in lecture form. This is followed by the basics of radiation biology and radiation protection, production of the radiograph (physics, chemistry and technique), vision and perception, and the appearances of normal tissues and structures on the radiograph. An introduction to the principles of computerized tomography (CT) and of magnetic resonance imaging (MRI) of the head and neck round out the course. Some developmental dental anomalies are also covered. Some of the material presented previously in the anatomy course is a prerequisite to lectures 11 and 12, and all of it constitutes material that may be examined in this and subsequent courses.

The laboratory component will introduce the student to the clinic by allowing her/him to demonstrate the effects of varying the numerous factors that are operational in the production of radiographs.

II. SYNOPSIS OF GOALS

The student will be able to:

1. Describe the production of x rays at the atomic as well as machine level.

2. List and describe, in a simplified manner, the interaction of x rays with atoms as well as biological molecules.

3. Describe the effect of the electronic variables on the radiograph.

4. List and explain the function of the major components of processing solution.

5. Describe basic darkroom procedures.

6. List the tissues of the body by relative radiopacity as seen on analogue radiographic images.

7. Identify the major anatomical structures of importance for mounting and interpreting radiographs.

8. List the relative radiopacity of major tissues on CT.

9. List the relative T1 and T2 weighted signal intensities of major tissues.

III. COURSE OUTLINE - Lectures (Material can be reviewed in the appropriate textbooks)

Lectures Galagan 14C.

Nov. 9, 2006	0.	The Radiology of Caries (Introduction)
March 27 2007	1.	Production of the X Ray I
April 3, 2007	2.	Production of the X Ray II
April 13, 2007	3.	Attenuation of the X-Ray Beam
April 19, 2007	4.	Radiation Biology & 5. Current Guidelines for Radiation Protection (Start)
May 3, 2007	5.	Current Guidelines for Radiation Protection (Completion)
May 17, 2006	6.	Production of the Radiograph I
May 23, 2007	7.	Production of the Radiograph II
May 23, 2007	8.	Production of the Radiograph III
May 25, 2007	9.	Production of the Radiograph IV
May 30, 2007	10.	Tomography/Pantomography

June 1, 2007	11.	(Vision and Perception) WYSIWYG…or is it?
June 4, 2007	12.	Normal Radiographic Appearances
Anytime	12a.	Paralleling Technique (Videotape)
June 6, 2007	13.	Landmarks of the Mandible
June 8, 2007	14.	Landmarks of the Maxilla
June 11, 2007	15.	Anatomy on Pantomographs
June 13, 2007	16.	CT and CT Anatomy
June 15, 2007	17.	MRI and MRI Anatomy
June 18, 2007	18.	Biology of Bone
June 20, 2007	19.	Review/Open session
June 22, 2007	20.	Review/Open session
June 25, 2007		Final Exam (Galagan A, B, and C) (9:00-12:00)

IV. METHODOLOGY

Required Textbooks

Anderson, J.E. Grant's Atlas of Anatomy, 8th ed. Williams & Wilkins, Baltimore, 1983.

Reid, J.A., Ruprecht, A., Stoneman, D.W., Lam, E.W.N. Practical Radiation Physics. 14 ed. The University of Iowa, Iowa City, 2002.

White, S.C. and Pharoah, M.J. Oral Radiology. Principles and Interpretation. 5 ed. Mosby, St. Louis, 2004.

Required Other Reading

ADA Recommendations in radiographic practices: an update, 1988. JADA 118:115-117, Jan. 1989.

Kodak.Publications as handed out.

Langland, O.E. and Sippy, F.H. Anatomic Structures as Visualized on the Orthopantomogram. Oral Surg, Oral Med, Oral Pathol 26:475-484, 1968.

MacDonald, J.C., Reid, J.A. and Berthoty, D. Drywall construction as a dental radiation barrier. Oral Surg, Oral Med, Oral Pathol 55:319-326, March 1983.

*Ruprecht, A. Radiologic Anatomy. University of Iowa, Iowa City, 1987.

Sewerin, I.P. Mechanically induced images on dental x-ray films. Oral Surg, Oral Med, Oral Pathol 63:241-248, Feb, 1987.

Smith, C.J. and Fleming, R.D. A comprehensive review of normal anatomic landmarks and artifacts as visualized on Panorex radiographs. Oral Surg, Oral Med, Oral Pathol 37:291-304, Feb, 1974.

Tyndall, D.A. and Bedsole, S.M. Exposure reduction and image quality for pantomographic radiography. Radiol Tech 59:51-53, 1987.

The Dental Radiographic Selection Panel and Joseph, L.P. The Selection of Patients for X-Ray Examinations: Dental Radiographic Examinations. HHS Publication FDA 88-8873, Rockville, 1987.

Oral and Maxillofacial Radiology Policy, Procedures and Information Manual. 2004. http://ruprecht.radiology.uiowa.edu

Recommended Other Reading

Gregory, R.L. Eye and Brain: The Psychology of Seeing. McGraw-Hill, New York, 1977.

Jaffe. C.C., Medical Imaging, Vision, and Visual Psychophysics. Medical Radiography and Photography 60:1-48, July, 1984.

Ruprecht, A. 86:145 Introduction to Clinical Oral Radiology, The University of Iowa, UPACS

Audiovisual Aids

Ruprecht, A. *The Paralleling Technique.* Videotape. The University of Saskatchewan, 1980.

Ruprecht, A. *Anatomy of the Mandible on Intraoral Radiographs.* Autotutorial Section of http://ruprecht.radiology.uiowa.edu

Ruprecht, A. *Anatomy of the Maxilla on Intraoral Radiographs.* Autotutorial Section of http://ruprecht.radiology.uiowa.edu

Ruprecht, A. *Anatomy on Pantomographs.* Autotutorial Section of http://ruprecht.radiology.uiowa.edu

Ruprecht, A. *Normal Anatomy on Magnetic Resonance Images.* Autotutorial Section of http://ruprecht.radiology.uiowa.edu

V. PRE-REQUISITES AND/OR CO-REQUISITES

A. Pre-requisites

Physics
Gross Anatomy 60:101

VI. BEHAVIORAL OBJECTIVES (LECTURES)

0.01 The student will be introduced to the radiographic appearances of caries and how caries extends into the tooth.

1.01 The student will be able to identify the parts of a stylized x-ray unit circuit.

1.02 The student will be able to explain how a transformer works.

1.03 The student will be able to explain how an autotransformer works.

1.04 The student will be able to explain what is meant by cycles and frequency.

1.05 The student will be able to explain what is meant by thermionic emission.

1.06 The student will be able to explain what is meant by full and half-rectification and why it is important.

2.01 The student will be able to explain the difference between a stationary and rotating target (anode) tube and why each is necessary.

2.02 The student will be able to explain how bremsstrahlung (braking radiation) is produced in the target of tube.

2.03 The student will be able to explain how characteristic radiation is produced in the tube.

2.04 The student will be able to explain the heel effect and where it is useful.

3.01 The student will be able to describe and explain the inverse square law.

3.02 The student will be able to explain Thomson effect.

3.03 The student will be able to explain photoelectric effect.

3.04	The student will be able to explain Compton effect.
3.05	The student will be able to explain the relationship among frequency, wavelength, and energy levels of radiation.
3.06	The student will be able to explain HVL.
3.07	The student will be able to explain how secondary and scatter radiation are produced.
4.01	The student will be able to describe and differentiate between direct and indirect effects of radiation on biological molecules.
4.02	The student will be able to explain ionization and radical production.
5.01	The student will be able to explain the proper procedures for radiation protection of the patient, staff and operator in a clinic where x rays are used to make radiographs.
5.02	The student will be able to explain by example the concept of MPD (MAD).
5.03	The student will be able to explain, in simple terms, the concept of average annual effective dose.
5.04	The student will be able to explain the concept of occupational dose limits.
6-9.01	The student will be able to explain density.
6-9.02	The student will be able to explain contrast.
6-9.03	The student will be able to explain detail.
6-9.04	The student will be able to explain definition.
6-9.0	The student will be able to explain the effect of kVp on density, contrast, detail and definition.
6-9.06	The student will be able to explain mA.
6-9.07	The student will be able to explain the effect of time on exposure.
6-9.08	The student will be able to list the major components of developer and their role in processing.

6-9.09 The student will be able to list the major components of fixer and their role in processing.

6-9.10 The student will be able to list the types of distortion and their cause.

6-9.11 The student will be able to describe the major components of a film packet, their location and role.

6-9.12 The student will be able to describe an x-ray film and tell for what the components are used.

6-9.13 The student will be able to describe a film-screen system and what each part is for.

6-9.14 The student will be able to describe and explain stationery and movable grids.

6-9.15 The student will be able to recognize and explain the cause of major radiographic clinical darkroom technique errors.

6-9.16 The student will be able to explain the role of the collimator.

6-9.17 The student will be able to explain the role of the filter.

6-9.17 The student will be able to explain the difference between DR and CR digital imaging

10.01 The student will be able to explain the principle underlying tomography.

10.02 The student will be able to explain the principle underlying pantomography.

10.03 The student will be able to explain why a slit beam is used for pantomography.

11.01 The student will be able to explain, in simple terms, the Mach effect.

11.02 The student will be able to explain the need for blocking of light and reduced illumination when looking at radiographs.

12.01 The student will be able to explain the meaning of the terms radiolucent versus radiopaque.

12.01 The student will be able to explain the meaning of the term density, and how it differs from radiopacity

12.01 The student will be able to list the various common tissues and material in the proper order of radiopacity and radiolucency as seen on dental radiographs.

12.01 The student will be able to identify and explain the generic appearances of various tissues and anatomical structures as seen on radiographs used by the practicing dentist.

12a.01 The student will be able to describe the placement of film for the various radiographs to a paralleling technique CMS, film size used and the variations from the standard set-up for the canine views.

13.01 The student will be able to identify the various major anatomical structures and landmarks of the mandible seen on intra-oral radiographs. This will be reinforced in the clinical courses.

14.01 The student will be able to identify the various major anatomical structures and landmarks of the maxilla seen on intra-oral radiographs. This will be reinforced in the clinical courses.

15.01 The student will be able to identify the various major anatomical structures and landmarks seen on pantomographs. This will be reinforced in the clinical courses.

16.01 The student will be able to explain the principle of computerized tomography and identify the major anatomical structures of the maxillofacial region, as they are depicted on CT radiographs.

16.02 The student will be able to list the relative radiopacity of major tissues on CT.

17.01 The student will be able to explain the basic principles of magnetic resonance imaging.

17.02 The student will be able to list the relative T1 and T2 weighted signal intensities of major tissues.

18.01 The student will appreciate that bone is a living changing tissue whose response to stress and disease may result in a wide variety of appearances, normal and pathological.

VII. MEASUREMENT AND EVALUATION

The student will be evaluated on the basis of quizzes for almost each period, which, in their entirety, will constitute 30 % of the final mark.

The final examination, which is written, constitutes 70% of the final mark.

The laboratory will be evaluated on the basis of the student having attended all sessions and completed all exercises and assignments. Failure to do so will result in a incomplete, which, if not removed will become a failing grade (F). The didactic material of this component is evaluated as part of the written examinations.

Daily quizzes	30%
Final exam	70%
Lab/Clinic	P/F
	100%

The criteria of terminal behavior will be a grade of 70% or above on the final composite mark, a 60% (based on 100) or better on the final examination, and a pass in the laboratory component.

Grading is 90+ = A; 80-89 = B; 70-79 = C; <70 = F. +/- is not used.

Remediation

A student who does not attend all the preclinical and clinical sessions for valid reasons (sudden illness or similar problem for the student or a member of her/his family, or who has previously arranged, with approval of the course director, to be absent for a valid reason) can arrange to have a make-up sessions for missed preclinical procedures, provided such make-up sessions are arranged as soon as possible after the problem and are completed prior to the end of the semester, unless there is a valid reason for an extension being granted. All decisions in this regard are made by the course director, and that decision will be final.

A student who fails to achieve a passing grade may, if approved by the course director, be granted a supplemental examination. The decision will be partially based upon the course director's evaluation of the student's knowledge base, and whether a review of material by the student should allow her/him to adequately understand the material. Passing such an examination will result in a grade of C regardless of the mark achieved upon the examination. Failure will require the student to repeat the course and achieve a passing grade. A supplemental examination is not a right, nor is it automatic. Students should not plan their studies upon such a contingency.

Radiology Preclinical Physics Exercises

1. The number at the head each column is the exercise.

2. The groups are each scheduled for 3/4 hour.

3. Group members are to be prepared prior to attending each session by having previously read the exercise, having decided who in each group will do what, and getting started on time. **All members are to take part in the exercises, as they are as much to familiarize students with the units as to understand the effects of the various items being studied.**
   For this reason, attendance is taken.
   Failure to attend will result in an incomplete or failing grade.

4. Questions at the end of each section are for the guidance of the participant.

5. Students are to present themselves approximately 15 minutes prior to their start time, so that time will not be wasted if exercises take less time than scheduled (Not all exercises are precisely the same length). This allows the next group to start earlier, thereby finishing earlier. Groups further down the list, e.g. at 10:30 and 11:15 p.m. should also check during the afternoon to see if things are moving at a faster pace.

   The radiology laboratory and preclinical exercises are carried out in the clinic. ***The clinic dress code applies. Shorts, flip flops, T-shirts, etc. are not permitted. Students who do not appear with appropriate attire will not be allowed into the clinic. Make-up sessions will only be allowed as time and staffing permit.***

   Failure to make up such sessions will result in an incomplete grade.

6. Beginning on June 2, for each session. those groups who are in the exercises for the second half of the morning, there will be a review session for the previous week's exercises during the first half of the morning, and vice versa, for those groups who are in the exercises for the first half of the morning, there will be a review session for the previous week's exercises during the second half of the morning.

   The radiology laboratory and preclinical exercises are carried out in the clinic.

   The clinic dress code applies.

	Wednesday May 30
8:00	Lecture
9:00	Lecture

	Friday May 25		**Wednesday May 30**	
	ex. 1	**ex. 2**	**ex. 1**	**ex. 2**
8:00	Lecture		Lecture	

9:00	E	A	A	E
9:45	F	B	B	F
10:30	G	C	C	G
11:15	H	D	D	H

	Friday June 1		**Monday June 4**	
	ex. 3	**ex. 4**	**ex. 3**	**ex. 4**
8:00	Lecture		Lecture	
9:00	D	H	E	A
9:45	C	G	F	B
10:30	B	F	G	C
11:15	A	E	H	D

	Wednesday June 6		**Friday June 8**	
	ex. 5	**ex. 6**	**ex. 5**	**ex. 6**
			Videotape of the paralleling technique	
8:00	Lecture		Lecture	
9:00	G	F	C	B
9:45	H	E	D	A
10:30	A	D	E	H
11:15	B	C	F	G

	Monday June 11	**Wednesday June 13**
	Skull	**Skull**
8:00	Lecture	Lecture
9:00	Group 1	Group 3
10:30	Group 2	Group 4

	Friday June 15	**Monday June 18**
	Skull	**Skull**
8:00	Lecture	Lecture
9:00	Group 5	Group 7
10:30	Group 6	

	Wednesday June 20	**Friday June 22**
8:00	Review/Open Session	Review/Open Session
9:00		

Monday June 25

9:00-12:00	Final Exam