



King Saud University
College of Dentistry
Dept. of Oral Medicine & Diagnostic Sciences
Division of Oral & Maxillofacial Radiology

Course File

243 DDS

Physics of Diagnostic Radiology and Oral and Maxillofacial Radiology

Course Title: Physics of Diagnostic Radiology and Oral and Maxillofacial Radiology

Course No & Code: 243 DDS

Credit Hours: 4 (1 hour lecture, 3 hours practical)

Level: Second year undergraduate level

Academic Year: 2014-2015

1.0 Course Description:

This course is an introduction to dental radiology as a branch of dentistry for diagnostic treatment planning and follow-up of therapy. It is a one-year comprehensive course dealing with the correct procedures for production of different types of radiographs and examining the hidden parts of teeth and their supporting structures. The course consists of a series of weekly lectures and practical sessions extending over a period of two semesters.

2.0 Course Objectives:

On successfully completing the course, the student should be able to:

1. Discuss and explain the production and different interactions of x-radiation.
2. List and describe the different types of dental x-ray films and digital imaging used in dentistry and match their indications.

3. Recognize the different advanced imaging modalities used in maxillofacial imaging and their indications, uses, and limitations.
4. Produce complete intra-oral radiographic survey [CMS] on patients with minimal errors.
5. Identify both intraoral and extraoral radiographic anatomical landmarks.
6. Discuss the harmful effects of radiation, and apply radiation protection measurements.
7. Identify, and describe the radiographic appearance of dental caries, periodontal, periapical pathosis, various dental anomalies and regressive changes.
8. Write a detailed report of the abnormalities identified in a complete mouth survey (CMS).
9. Practice infection control measures in dental radiography.
10. Determine and justify the appropriate type of radiographic examination for a particular diagnostic task.

References:

1. **Dental Radiography- Principles and Techniques.** 4th edition
By:Joen H.lannucci and Laura Jansen Howerton
2. **Oral radiology- Principles and Interpretation.** 6th edition
By: White and Pharoah

Recommended reading:

Principles of dental imaging. 2nd edition
By: Langland, Langlais, and Preece

Additional reading: Separate recommendations for further reading will

be given at the end of each lecture.

3.0 Course Outline:

First Semester:

3.01 Radiation Physics I-

Reference: Chapter 2 (Dental Radiography-Principles and Techniques)

- ♦ Nature and properties of electromagnetic radiation- specifically x-rays
- ♦ Principles of x-ray production
- ♦ Components of x-ray machine
- ♦ Ideal requirements of x-ray machine

3.02 Radiation Physics II-

Reference: Chapter 2 (Dental Radiography-Principles and Techniques)

- ♦ Types of x-rays
- ♦ Interaction of radiation with tissues
- ♦ X-ray definitions
 - Primary radiation (useful beam), secondary radiation, scatter radiation, stray radiation, remnant radiation, soft and hard radiation
- ♦ Factors affecting the radiographic image

3.03 Dental X-ray Film-

Reference: Chapter 7 (Dental Radiography-Principles and Techniques)

- ♦ Types of films
- ♦ Composition of film
- ♦ Contents of film packets
- ♦ Packaging of film packets
- ♦ Film speed

- ♦ Extra-oral films
 - Intensifying screens
 - Cassette holders
- ♦ Duplicating films
- ♦ Film storage

3.04 Processing of X-ray Films-

Reference: Chapter 9 (Dental Radiography- Principles and Techniques)

- ♦ Latent image- how images are formed by processing
- ♦ Processing steps
- ♦ Chemistry of processing solutions and preparation
- ♦ Manual processing
 - Visual method
 - Fixed time-temperature method
- ♦ Automatic processing
 - Advantages and disadvantages
- ♦ Dark room requirements
 - Testing safelight

3.05 Image Characteristics-

Reference: Chapter 8 (Dental Radiography- Principles and Techniques)

- ♦ Visual characteristics
 - Density and affecting factors
 - Contrast and affecting factors
 - Subject contrast
 - Film contrast- latitude
 - Scales of contrast
 - kVp
 - Fogging
- ♦ Geometric characteristics

- Sharpness and affecting factors
- Magnification and affecting factors
- Distortion and affecting factors

3.06 Quality Assurance and Infection Control in Dental Radiography-

References: **Quality Assurance:** Chapter 7
(Oral Radiology- Principles and Interpretation)

Infection Control: Chapter 15
(Dental Radiography- Principles and Techniques)

- ◆ Quality assurance
 - Importance
 - Tasks (daily- weekly- monthly- yearly)
- ◆ Infection control
 - The aseptic technique
 - Universal precautions
 - Barriers
 - Disinfection
 - Methods of taking radiographs using the aseptic technique
 - Barrier protection
 - Re-gloving technique
 - Two-person technique

3.07 Intra-Oral Radiographic Techniques I-

References: Chapter 16 and 17 (Dental Radiography- Principles and Techniques)

- ◆ Types of Intra-oral radiographs and indications
- ◆ Principles of production of periapical radiographs
 - Indications
 - Positional requirements

- ♦ Paralleling technique
 - Technique
 - Advantages and disadvantages
 - Positional difficulties

3.08 Intra-Oral Radiographic Techniques II-

References: Chapter 18 and 19 (Dental Radiography- Principles and Techniques)

- ♦ Bisecting angle technique
 - Technique
 - Advantages and disadvantages
 - Special considerations
- ♦ Principles of production of bitewing radiographs
 - Indications
 - Technique
 - Advantages and disadvantages
- ♦ General guidelines for intra-oral radiography

3.09 Normal Radiographic Anatomy-

Reference: Chapter 27 (Dental Radiography- Principles and Techniques)

- ♦ Teeth and surrounding structures
- ♦ Types of bone in dental radiographs
- ♦ Anatomical structures seen in:
 - Maxillary anterior projection
 - Maxillary premolar-molar projection
 - Anterior mandible
 - Mandibular premolar-molar projection
 - Mandibular posterior region

3.10 Radiation Biology-

Reference: Chapter 12 (Principles of dental imaging) (pp 299-306)

- ♦ Sources of radiation
- ♦ Irradiated study populations
- ♦ Interaction of radiation with atoms
 - Direct and indirect effects
- ♦ Biologic effects of radiation
 - Effect on cells, tissues, and organs, organism (somatic and genetic)
- ♦ Determinants of radiation injury
 - Radiation factors
 - Host factors
 - Other influencing factors
- ♦ Biologic effects
 - Dose response (deterministic and stochastic effects)
- ♦ Radiation effects on oral cavity
- ♦ Risk estimates

3.11 Radiation Protection-

References: Chapter 4 (pp 43- 46) and Chapter 5 (Dental Radiography- Principles and Techniques)

- ♦ Radiation measurements (exposure, dose, dose equivalent)
- ♦ Protection from effects of radiation
 - Patient protection
 - Before exposure (prescribing radiographs, proper equipment)
 - During exposure (protective shields, films and film holding devices, exposure factor selection, proper technique)
 - After exposure (proper film handling and processing)
 - Operator protection

- Protection guidelines (position, distance, shielding recommendations)
 - Radiation monitoring (equipment, personnel)
- Radiation exposure guidelines
 - Legislation
 - Maximum permissible dose
 - Maximum accumulated dose
- ◆ ALARA concept
- ◆ Radiation protection and patient education

Second Semester:

3.12 Common Causes of Unsatisfactory Radiographs and Their Correction-

References: Chapter 9 (Dental Radiography- Principles and Techniques)

- ♦ Types of errors:
 - Technical
 - Exposure errors
 - Projection errors
 - Handling errors
 - Processing
 - Developing
 - Fixation
 - Contamination
 - Lighting
- ♦ Recognition and cause of:
 - Light/dark radiographs; white/black artifacts; insufficient contrast; yellowish-brown discoloration; reticulation; film placement errors; PID placement and angulation errors.

3.13 Interpretation of Dental Caries-

References: **Caries:** Chapter 17 (Oral radiology- Principles and Interpretation)- Caries

Restorative materials: Chapter 31 (Dental Radiography- Principles and Techniques)

- ♦ Detection of caries
- ♦ Interpretation of caries
 - Aids in interpretation
 - Factors influencing interpretation
- ♦ Radiographic appearance of:

- Interproximal (incipient, moderate, advanced, severe)
- Occlusal (incipient, moderate, severe)
- Buccal and lingual
- Root caries
- Recurrent
- Rampant
- Radiation caries
- Restorative materials

3.14 Interpretation of Periapical Inflammatory Pathosis-

References: Chapter 20 (Oral radiology-Principles and Interpretation)

- ◆ Cause and sequelae of periapical inflammatory lesions
- ◆ General clinical and radiographic features
- ◆ Clinical and radiographic differential diagnosis of:
 - granuloma, cyst, abscess, scar, surgical defect
- ◆ Periapical anatomic radiolucencies

3.15 Interpretation of Periodontal Pathosis-

References: Chapter 18 (Oral radiology-Principles and Interpretation)

- ◆ Definitions and sequelae of gingivitis and periodontitis
- ◆ Contribution of radiographs in assessment of periodontal condition
- ◆ Limitations of radiographs
- ◆ Technical procedures
 - Types of films used for periodontal evaluation
 - Correct placement of films
 - Criteria assuring correct position of teeth relative to alveolus
- ◆ Special considerations and techniques
- ◆ Radiographic appearance of normal periodontium

- ♦ Types of alveolar bone loss and radiographic appearance
 - According to orientation (horizontal- vertical)
 - According to location (localized- generalized)
 - According to extent (mild- moderate- severe)
 - Interdental craters
 - Buccal or lingual cortical plate loss
 - Furcation involvement
- ♦ Dental conditions associated with periodontal disease
- ♦ Evaluation of periodontal therapy
- ♦ Radiographic criteria of successful periodontal therapy

3.16 Dental Anomalies I-

References: Chapter 19 (Oral radiology- Principles and Interpretation)

Definition, clinical and radiographic features, and differential diagnosis of the following anomalies according to:

- ♦ Size (microdontia- macrodontia)
- ♦ Shape (germination- fusion- concrescence- dilacerations- talon cusp- enamel pearl- dense in dente- dense invaginatus- taurodontism)
- ♦ Number (missing teeth- supernumeraries)
 - Associated conditions (Gardner's syndrome- Gorlin Goltz syndrome- Cleido cranial dysostosis- ectodermal dysplasia)

3.17 Dental Anomalies II-

References: Chapter 19 (Oral radiology- Principles and Interpretation)

Definition, clinical and radiographic features, and differential diagnosis of the following developmental anomalies of structure:

- ♦ Amelogenesis imperfecta (hypoplastic- hypocalcification- hypomaturation)
- ♦ Dentinogenesis imperfecta (type I and II- associated osteogenesis imperfecta)
- ♦ Dentin dysplasia (type I and II)

- ♦ Odontodysplasia
- ♦ Turner's hypoplasia
- ♦ Congenital syphilis

Definition, clinical and radiographic features, differential diagnosis, and management of the following acquired anomalies:

- ♦ Attrition- abrasion- erosion- resorption (internal and external)- secondary dentin- pulp calcification- pulp stones- hypercementosis

3.18 Traumatic Injuries to the Teeth-

References: Chapter 29 (Oral radiology- Principles and Interpretation)

- ♦ Use of radiographs in trauma
- ♦ Imaging procedure selection
- ♦ Radiographic signs of fracture
- ♦ Traumatic to supporting structures of teeth
 - Concussion
 - Luxation and subluxation
 - Avulsion
 - Alveolar process fractures
- ♦ Fractures of the teeth
 - Crown fractures (infracture- uncomplicated- complicated)
 - Root fractures
 - Vertical root fractures
 - Crown-root fractures
- ♦ Effect of trauma on teeth
 - Localized enamel hypoplasia (Turner's tooth)
 - External root resorption
 - Pulp necrosis
 - Pulp calcification

3.19 Occlusal Radiography/ Localization Techniques

References: Chapter 21 (Dental Radiography- Principles and Techniques)

- ♦ Definition and uses of occlusal radiographs
- ♦ Production of the different occlusal views, and their uses and limitations
 - Maxillary anterior (topographic)
 - Maxillary lateral
 - Mandibular topographic
 - Mandibular cross-sectional
 - Mandibular lateral occlusal
- ♦ Localization techniques
 - Right angle technique
 - Buccal object rule

3.20 Digital Radiography-

References: Chapter 7 (Oral radiology- Principles and Interpretation) (pp 78-84)

- ♦ Components of digital radiography systems and their function
 - Image receptors: digital sensors, and image plates
 - Analogue-digital converter
 - Computer
- ♦ Types of digital systems:
 - Real-time systems
 - Storage phosphor systems
- ♦ The digital image

3.21 Digital Image Processing-

References: Chapter 7 (Oral radiology- Principles and Interpretation) (pp 86-98)

- ◆ Quality of Digital Images
 - Contrast resolution: and spatial resolution
 - Detector latitude and detector sensitivity
- ◆ Image Enhancement and Analysis
- ◆ Applications of Digital Imaging
- ◆ Data Management
 - Collective and integrated files
 - Networks and teleradiology
 - The DICOM standard
 - Image storage
- ◆ Advantages and Disadvantages of Digital Radiography

3.22 Panoramic Radiography-

References: Chapter 22 (Dental Radiography- Principles and Techniques)

- ◆ Principles of panoramic radiography (tomography- scanography- focal trough- center of rotation)
- ◆ Equipment
 - X-ray machines
 - Films
 - Cassettes
- ◆ Indications of panoramic radiography
- ◆ Advantages
- ◆ Disadvantages
- ◆ Exposure of a panoramic film (equipment and patient preparation- patient positioning)
- ◆ Errors in panoramic radiography

- Patient preparation errors (ghost images- lead apron artifacts)
- Patient positioning errors
- Other errors (incomplete image- handling errors)

3.23 Panoramic Anatomical Landmarks-

References: Chapter 11 (Oral radiology- Principles and Interpretation) (pp 183- 190)

- ◆ Features of panoramic images
- ◆ Types and features of images in a panoramic radiograph
 - Single real image
 - Double real image
 - Ghost image
- ◆ Mandibular landmarks and surrounding structures
- ◆ Midfacial landmarks and surrounding structures
- ◆ Soft tissue and neck structures
- ◆ Air spaces
- ◆ Ghost images
- ◆ Interpreting panoramic images

3.24 Extra-oral Radiography-

References: Chapter 23 (Dental Radiography- Principles and Techniques)

- ◆ General indications
- ◆ Production of and indications for:
 - Lateral views
 - Lateral skull
 - Lateral cephalometric
 - Lateral oblique views

- Mandibular body projection
- Mandibular ramus projection
- o Postero-anterior (PA) views
 - True PA
 - PA cephalometric
 - Water's view
 - Submentovertex
 - Reverse Town's

3.25 Advanced Imaging Modalities-

References: Chapters 13, 14 (Oral radiology- Principles and Interpretation)

Basic principles, image appearance, indications, and limitations of:

- ♦ Conventional tomography
- ♦ Computed tomography
- ♦ Cone beam computed tomography
- ♦ Magnetic resonance imaging
- ♦ Ultrasound
- ♦ Nuclear medicine

3.26 Guidelines for Prescribing Radiographs-

References: Chapter 14 (Oral radiology- Principles and Interpretation)

- ♦ Risk vs. benefit of radiographs
- ♦ Determinants of decision to take radiographs
- ♦ Clinical situations which may indicate the need for radiographs
- ♦ Role of radiographs in disease detection and monitoring of:
 - o Caries
 - o Periodontal disease
 - o Dental anomalies
 - o Occult disease
 - o Jaw pathology
 - o Oral surgery

- TMJ
- Implants
- Trauma
- ◆ Choice of radiographic examinations
 - Intraoral radiographs (periapical- bitewing- occlusal)
 - Extraoral radiographs (panoramic- advanced imaging modalities)
- ◆ Special considerations: children, pregnancy, and radiotherapy

4.0 Evaluation and Grades:

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| Continuous assessment | 60 % |
| Final exam | 40 % |
| Total | 100 % |