

DEN6430C: Principles of Endodontics

Fall 2020

Course Description:

This course is designed to teach pulp and periapical pathology, endodontic diagnosis, the treatment of teeth with various levels of pulpal involvement and the principles of non-surgical endodontic therapy.

I. General Information

Course Director:

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II. Course Goals

The goal of this course is to contribute to the student's foundation knowledge of the biology of the dental pulp, as well as an overview of the specialty of endodontics. Emphasis will be placed on understanding pulp and periapical pathology. The student will be introduced to vital pulp therapy procedures as well as to the principles of nonsurgical treatment of irreversibly inflamed

or necrotic dental pulps. Understanding the etiology, diagnosis, prevention and treatment of diseases of the dental pulp and periradicular tissues will assist the student in obtaining an endodontic diagnosis on which rational treatment will be based. The course will also emphasize the principles of cleaning, shaping and obturating the canal.

III. Course Overview

This is a lecture based course with one Team Based Learning (TBL) class. The TBL class will incorporate evidence based information in diagnosing endodontic conditions.

IV. Course Outline

A. Biological Principles of Endodontics (Pulpal Biology)

1. Histology of the normal dental pulp (Lecture to be given by Dr.Pileggi)
 - a. Intercellular substance
 - b. Blood vessels
 - c. Cells
 - d. Nerves
2. Pulpal biology (*Lecture to be given by Dr.Pileggi*)
 - a. Functions of the dental pulp
 - b. Theories of dentin sensitivity
 - c. Aging and dystrophic changes in the dental pulp
 - d. Pulp irritants and protective mechanisms
3. Pulp and periapical diagnosis (*Lecture to be given by Dr.Cerrud*)
 - a. Pulpitis, pathophysiology of pulp necrosis, and pathogenic mechanisms
 - b. Pulp-induced inflammatory periapical lesions
 - c. Classification of pulpal and periapical diseases

B. Clinical Signs and Symptoms and Their Relation to Pulpal and Periapical Pathology

1. Clinical evaluation and testing procedures
2. Characteristics of pulpal and periapical lesions

C. Vital Pulp Therapy (*Lecture to be given by Dr.Pileggi*)

1. Objectives of vital pulp therapy

2. Vital pulp therapy procedures
 - a. Excavation and sedation
 - b. Caries control
 - c. Direct pulp capping
 - d. Indirect pulp capping
 - e. Pulpotomy
3. Apexogenesis and apexification

D. Microbiologic Aspects of Endodontics (*Lecture to be given by Dr.Pileggi*)

1. Routes of access of microorganisms to the root canals
 2. Identification of microorganisms found in root canals and their significance to the health of the host
 3. Immunological aspects of the root canal contents
 4. Indications for use of antibiotics in endodontic therapy
- E. Root canal morphology (*Lecture to be given by Dr. Marchesan*)
1. Objectives to be satisfied in establishing access to root canals
 2. Pulp morphology
 3. Access preparations
- F. Endodontic armamentarium (*Lecture to be given by Dr. Bakiri*)
1. Introduction to the instruments utilized during endodontic therapy
- G. Principles of Cleaning and Shaping the Root Canal (*Lecture to be given by Dr. Haddix*)
1. Design of basic endodontic instruments and rationale for their use
 2. Principles of preparation
 3. Rationale for irrigants and medicaments employed during canal preparation
- H. Principles of Obturating the Root Canal System
1. Rationale for filling
 2. Principles employed
 3. Materials used in canal obturation

Preparation of the Patient (and Tooth) for Endodontic Treatment (move to DEN6432C)

1. Use of local anesthesia
2. Rationale for application of rubber dam
3. Preparation of a tooth with a compromised crown

V. Course Material

Required text:

Principles and Practice, Torabinejad, Fouad, and Walton, 5th Edition, Publisher: Saunders, St. Louis, MO, 2014. ISBN-10: 1465754102 and ISBN-13: 978-1455754106

Recommended texts:

Cohen's Pathways of the Pulp. Hargreaves and Berman, 11th Edition, Publisher: Mosby, St. Louis Missouri, 2011. ISBN # 978-0-323-09635-5

Teeth selection for DEN 6432C:

Please collect the following teeth for sim lab sessions:

#9: Maxillary left central incisor (2)

#10: Maxillary left lateral incisor or #11

#3: Maxillary right first molar (2)

#5: Maxillary right first and second premolar (2)

#6: Maxillary right canine or #7 maxillary right lateral incisor

#12: Maxillary left premolar

#14: Maxillary left first molar

#19: Mandibular left molar

#20: Mandibular left premolar

#25- #24 Mandibular central or lateral incisors

#30 Mandibular right molar

Please collect teeth that are caries and restoration free. Collect as many teeth as possible and you will be able to screen them radiographically, to find the best teeth for the endo exercises. Please follow the UFCD protocol for extracted teeth disinfection.

Additional Resource:

Dental Lib Guide: <http://guides.uflib.ufl.edu/dental>

VI. Course Objectives

Part A. Biological Principles of Endodontics

Modern therapy is predicated on the principle that a diagnosis must be made before treatment is initiated. Knowledge of the biology of the normal dental pulp and the etiology and development of pulp and periapical pathosis is essential for making an accurate diagnosis, determining a treatment plan and making a prognosis for repair.

Objectives:

1. Describe the various parts of the pulp cavity (pulp horn, pulp chamber, root canals, accessory canals, and apical foramen).
 2. List the structural layers of the dental pulp and describe the components of each layer. Describe the components of the intercellular substance, blood vessels, and nerves.
 3. Describe the current theories on mechanisms of pain perception and transmission in the dental pulp.
 4. List and describe the various functions of the dental pulp.
 5. List and describe the causes of inflammation of the dental pulp, how the inflammation spreads in the pulp, and the factors which modify the pulpal inflammation.
 6. Describe the principal histopathologic features which are involved in the transition from normal dental pulp to total pulpal necrosis. Include degenerative or age changes of a pulp that could lead to reduced pulpal resistance in your discussion.
 7. Define internal resorption and describe how it develops.
 8. Describe the genesis of the pulp-induced inflammatory periapical lesion.
 9. Describe the development and histopathologic features of:
 - a. Asymptomatic Apical Periodontitis (cyst and granuloma)
 - b. Chronic apical abscess
 - c. Acute apical abscess
 - d. Symptomatic apical periodontitis
 - f. Condensing osteitis
- and describe the concept that they are all ONE lesion and that the changing pathologic status is a reaction of the battle between root canal irritants, host defenses, and reactive potential of the tissue found in the periapical region.
10. List the factors which transform a chronic periapical lesion into an acute periapical lesion.

Part B. Clinical Signs and Symptoms and Their Relation to Pulp and Periapical Pathology

With a knowledge of the dynamics of pulpal and periapical inflammation, a tentative endodontic diagnosis may be made from the patient's history and symptoms and from a clinical and radiographic examination.

Objectives:

11. A history, clinical examination, clinical testing, and radiographic evaluation must be performed before arriving at an endodontic diagnosis. Describe how and why each is performed. Given a clinical history, clinical test results, patient's symptoms and radiographic findings, arrive at an endodontic diagnosis.

12. Describe the proper clinical use of the electric pulp test, thermal test, percussion and palpation tests, periodontal evaluation, test cavity, and anesthetic test. List the indications and limitations of these tests. State the significance of the information obtained.
13. Define what is meant by a sinus tract and state why it is important to trace this tract prior to making an endodontic diagnosis on a specific tooth.
14. Define the differences between cracked tooth and vertical root fracture. List the symptoms of a tooth with this condition, the methods of diagnosis, and the mode of treatment.
15. Define pulpal pain and describe the differences in clinical symptoms between reversible and irreversible pulpal inflammation (pulpitis).
16. State why a patient may experience pulpal pain and be unable to isolate the pain to a specific tooth.
17. Given an endodontic diagnosis, select those characteristics (clinical signs and symptoms, radiographic findings, and clinical test results) that indicate a specific pulpal or periapical condition.
18. Explain how and why pain may be felt in a region distant from the pain-producing site. Describe the procedure used to arrive at the primary pain site.
19. Differentiate between pulpal pain and the pain of maxillary sinusitis.

Part C. Vital Pulp Therapy

This section will help you develop a proper technique for vital pulp therapy. It will also inform you of the various medications that are available. You are responsible for assimilating this information into a philosophy of using the proper technique with the best medication when treating a tooth with reversible pulp involvement.

Objectives:

20. Define vital pulp therapy, list and discuss the factors influencing vital pulp therapy, list and discuss the clinical procedures used in vital pulp therapy and identify signs, symptoms, and tests that indicate failure of vital pulp therapy.
21. Describe the clinical evaluation (history, clinical examination, vitality testing, and radiographic evaluation) necessary before undertaking vital pulp therapy.
22. Define, list the indication and contraindications for, and discuss the clinical technique for:
 - a. Excavation and sedation
 - b. Indirect pulp capping
 - c. Direct pulp capping
 - d. Pulpotomy
 - e. Apexogenesis
 - f. Apexification
 - g. Pulpal Revascularization
23. Discuss the histopathologic changes in the pulp induced by progression of caries up to and including exposure of the pulp.

28. State what is meant by a pulp exposure. List the ways in which the pulp can become exposed.

Part D. Treatment Planning and Patient Education

Having established a diagnosis of irreversible pulpal pathology, which indicates that a tooth must receive non-surgical or surgical endodontic treatment (or be extracted), you must evaluate certain criteria to determine whether treatment is indeed feasible.

Objectives:

24. Define, list and discuss the indications and contraindications for, list and discuss the clinical procedures for, and list and discuss the criteria for success for apexogenesis and apexification.

30. Design an appropriate treatment plan given specific information about the pulpal and periapical diagnosis. The treatment plan should address case selection appropriate for a general practitioner versus cases which should be referred to a specialist and cases which would require a medical consultation.

25. Describe the relationship, responsibilities, and communication modes among general dentists, patients, and endodontists.

Part E. Preparation of the Patient (and Tooth) for Endodontic Treatment

Having determined that the tooth requires nonsurgical endodontic therapy and that treatment is feasible and within your competence, you must next prepare the patient and the tooth when necessary.

Objectives:

26. Discuss the application of radiography to endodontics, include a discussion of Clark's rule (buccal-object rule) into your response.

27. Discuss the difficulties encountered in pain control in endodontics and the methods used for pain management in patients who are difficult to anesthetize. Your discussion should include the use and appropriateness of supplemental injections such as local infiltration, PDL injections, intrapulpal injections, and intraosseous injections.

28. Discuss periodontal objectives in preparing for endodontic therapy a tooth crown that is seriously involved by caries or fracture (nearly reaching to crestal bone level).

29. Describe the recommended techniques for temporarily restoring coronal integrity prior to initiating endodontic therapy.

30. List the reasons for employing a rubber dam during root canal therapy and discuss the methods of placement.

31. Be able to perform an endodontic consultation with a patient by discussing the procedures in lay terms, describing viable alternatives, discussing the normal course of treatment with potential complications, discuss the prognosis of the tooth and discuss the financial aspects of the procedure.

32. Discuss the importance of restoring endodontically-treated teeth, the need for recall examination, and the signs and/or symptoms of failure of treatment.

Part F. Internal Anatomy, Morphology, and Endodontic Access

After you have prepared the patient (and tooth) for endodontic therapy, the next step in your treatment is to obtain access to the pulp cavity through the crown of the tooth. The root canal(s) of a tooth cannot be completely instrumented and filled unless the coronal approach to the canal is properly made.

Gaining access to the root canal(s) does not consist simply of providing a large opening into the pulp chamber. The objectives in gaining access are (1) to remove the roof of the pulp chamber in such a way that all pulp horns and crevices hiding carious tooth structure and pulp tissue are completely exposed; (2) to preserve all anatomical landmarks of the pulp chamber, particularly the floor of the chamber; (3) to remove enough tooth structure so that endodontic instruments have an unobstructed access into the orifice of each root canal; (4) to remove enough tooth structure so that the endodontic instruments can obtain direct line access to the apical foramen; and (5) to permit the dentist to have complete authority over the enlarging Instruments.

It is very important to take radiographs of the tooth being treated from several different angles. These will show the size and shape of the pulp cavity as well as the curvature, direction, and number of root canals present. It is essential to visualize these pulp spaces in three dimensions within the tooth, as well as to have a thorough knowledge of root canal anatomy.

Objectives:

33. List the objectives for achieving proper access to the root canal(s) of any tooth.
33. Provided with a schematic drawing of any tooth, outline the pulp spaces (pulp chamber and root canals) and describe the most common root and pulp anatomy (numbers and curvature of roots and canals).
34. Discuss the location, morphology, and importance of accessory, lateral, and extra canals.

Part G. Microbiologic Aspects of Endodontics

Since the demonstration of bacterial forms in necrotic pulpal tissue almost 100 years ago and recent scientific data identifying these bacteria, the importance of bacteria in the pathogenesis of pulp and periapical pathosis is unquestioned. This section deals with the role of microorganisms in the pathogenesis of pulp and periapical diseases and the control of these microorganisms during endodontic treatment.

Objectives:

35. List and define the routes by which microorganisms can gain access to the pulp spaces of a tooth and describe the role they play in the development of pulpal and periapical pathology.
36. Name the microorganisms most often encountered in infected root canals.
37. Describe the immunological interactions between root canal contents and periapical tissues.
38. Compare the incidence of bacteremia following nonsurgical endodontic therapy with those occurring during other dental procedures (periodontal therapy, extraction).

39. Describe clinical situations in which the use of systemic antibiotics is indicated in endodontic therapy.

Part H. Principles of Cleaning and Shaping the Root Canal

Biological considerations dictate that preparation of the canal be performed with minimal irritation to the surrounding tissue. For this reason, all cleaning and shaping must be performed short of the root apex. In general, the objectives of cleaning and shaping the root canal are as follows:

Objectives:

40. To eliminate any focus of irritation in the pulp spaces. This includes the following:
 - a. Removal of all organic pulp remnants and toxic protein degradation products from the canal by thorough instrumentation and liberal irrigation.
 - b. Removal of the roughened, partially calcified predentin lining of the canal, down to normal dentin.
 - c. Removal by instrumentation and irrigation of most microorganisms and their products.
 - d. Chemical destruction of those microorganisms susceptible to drug action.
41. To enlarge, taper, and smooth the canal walls in order to create a definite preparation to receive the desired filling material.
42. Name the various kinds of root canal instruments; discuss their physical characteristics, advantages, disadvantages, and the manner in which they are employed in root canal preparation.
 - a. Describe the differences in design of various root canal instruments.
 - b. List the materials with which root canal instruments are made. Discuss their advantages and disadvantages.
 - c. Demonstrate a knowledge of the landmarks of a standardized instrument by doing the following: given a diagram of a standardized K-type root canal file, label various key points and measurements in the design.
 - d. Describe the difference between "reaming action," "filing action," and "circumferential filing." What is the "watch-winding" motion?
43. Discuss the apical percolation (hollow tube) theory and coronal irritant theory (coronal leakage). State the significance of these theories relative to nonsurgical endodontic therapy.
44. Utilizing a drawing of a longitudinal section of a tooth, identify the anatomical structures in the apical region of a root canal, describe and illustrate the ideal position for termination of a root canal preparation, define working length and list factors which would cause the terminus of a root canal to vary from the ideal position.
45. Discuss the difference between a step back preparation and crown down preparation.
46. Define the term master apical file (MAF) or final instrument (FI). Discuss the criteria to be met by the MAF (apical stop, size, length).
47. Define the term backfilling or shaping and state its purpose.
48. List and discuss the various chemical aids used during a root canal procedure including:
 - a. irrigating solutions
 - b. intracanal medicaments

- c. lubricants and chelating agents
- d. gutta-percha and sealer solvents

49. Discuss why the root canal system is routinely sealed at the end of a cleaning and shaping appointment with calcium hydroxide paste and a sterile, unmedicated cotton pellet and temporary?

50. List and discuss the most effective temporary sealing agents used in endodontics.

51. List the various errors which can occur during root canal preparation. State how each is caused and how each can be avoided.

Part I. Principles of Obturating the Root Canal System

Once the criteria for filling a root canal have been achieved (proper biomechanical preparation, intact temporary restoration, and a dry canal), the canal is ready to be filled. The objective in filling the canal is to obturate the entire root canal system. The apical termination of this filling should be 0.5 to 0.75mm short of the point of internal canal emergence.

Any spaces that are not filled properly and are allowed to remain may communicate with the periodontal ligament through the apex or through lateral canals. Tissue exudate, accumulating in these voids, is a hospitable medium for the nurture and multiplication of residual or bloodborne microorganisms. Microbial toxins and residual protein degradation products constitute a continuing source of irritation to the periodontal ligament and its supporting bone and will prevent healing. The health of the dentin will be achieved only if these sources of irritation are eliminated by the thorough cleansing, shaping, disinfection, and filling of the root canal.

Root canal morphology may tend to dictate the method of filling. You should be aware of other materials and techniques presented in your reading material in light of the principles involved. Whereas, the gutta-percha lateral condensation technique has been the standard, dependable, and predictable obturation technique of the past, current endodontic trends seem to favor the thermoplastic gutta-percha obturation techniques.

Objectives:

52. List the objectives and reasons for root canal obturation and discuss the criteria which determine that a root canal is ready to be filled.

53. List the requirements of an ideal root canal filling material and list and discuss materials currently used to fill root canals, comparing their composition, advantages and disadvantages.

54. Define the term mastercone and list and discuss the two styles of gutta-percha cones that are available.

55. List the requirements of an ideal root canal sealer; list the reasons for using a root canal sealer and know the components of the commonly used root canal sealers.

56. List and describe various methods used to obturate a root canal.

57. Discuss how you would evaluate the quality of a root canal filling using the terms ideal filling, overfilling, overextension and underextension.

VII. Course Competencies

This course teaches the following competencies in the "Competencies for the New Dental Graduate".

Domain I: Critical Thinking

3: Apply biomedical science knowledge in the delivery of patient care.

Domain II: Professionalism

6: Appropriate Referral Provide oral health care within the scope of general dentistry to include recognizing the complexity of patient treatment and identifying when referral is indicated.

Domain III: Communication and Interpersonal Skills

7: Communication Skills: Apply the fundamental principles of behavioral sciences using patient-centered approaches for promoting, improving and maintaining oral health.

Domain VI: Patient Care - A. Assessment, Diagnosis, and Treatment

12: Patient Assessment, Diagnosis, Treatment Planning and Informed Consent: Provide oral health care within the scope of general dentistry to include patient assessment, diagnosis, comprehensive treatment planning, prognosis, and informed consent.

Domain VI: Patient Care - B. Establishment and Maintenance of Oral Health

14: Assessment of Treatment Outcomes: Provide oral health care within the scope of general dentistry to evaluate the outcomes of treatment, recall strategies and prognosis.

15: Patient Management: Provide oral health care within the scope of general dentistry to patients in all stages of life.

16: Emergency Treatment: Provide oral health care within the scope of general dentistry to include dental emergencies.

24: Provide oral health care within the scope of general dentistry to include pulpal therapies.

VIII. Evaluation

Evaluation in this course will consist of five (5) quizzes, one final exam, one lab session for teeth selection, and a Team based learning class.

Quizzes will be taken during the first 5 minutes in each lecture. Online quizzes, multiple choice in Canvas. All of them will be counted. There are no make up quizzes.

Team based learning class: students must attend and participate in this graded learning activity. The students will answer case based questions individually, and as a group and the average of the 2 grades will comprise 20% of the grade for the course.

Lab session and tooth selection will count for 5% of the course grades.

Final Exam: multiple choice exam.

| Examination | Total |
|---|--------------|
| 5 Quizzes (The highest 4 out of the 5 quiz scores will be counted towards your final grade for this course.) | 25% |
| 1 TBL | 20% |
| Lab session for teeth selection | 5% |
| Final exam | 50% |

Remediation Policy: in the event that the student's cumulative score is below 70, it is the student responsibility to meet with the course director within a week after the final scores are announced, to set up a remediation exam.

Faculty Evaluation

“Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://ufl.bluera.com/ufl/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.”

IX. Administrative Practices

Administrative practices for all UFCD courses are universally applied. Exceptions to or deviations from these practices are stated in the individual syllabi by the course director. When not individually stated in the syllabus, course administrative practices default to those identified under "Course Policies" on the DMD Student Website:

<https://dental.ufl.edu/education/dmd-program/course-policies/>

X. Grade Scale

DEN6430C Grade Scale

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|---|
| Method: Letter Grade |
| Scale: 100 |
| Tolerance: 0.5 (Final letter grades within this range will be rounded up.) |
| A: 95-100 |
| A- : 92-95 |
| B+: 88-92 |
| B: 84-88 |
| B-: 80-84 |
| C+: 76-80 |
| C: 70-76 |
| E: 0-70 |