DEN8719
Summer 2021

Course Description:
This course entails small group discussions with a faculty member on biomaterial science concepts. Faculty-student interactions are designed to answer clinical-relevant questions regarding product selection and use. The seminars provide opportunities for students to review current evidence and to raise questions on product use, efficacy, and sustainability.

I. General Information

Course Director:

<table>
<thead>
<tr>
<th>Course Director:</th>
<th>Jean-Francois Roulet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office:</td>
<td>D9-26</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:JRoulet@dental.ufl.edu">JRoulet@dental.ufl.edu</a></td>
</tr>
<tr>
<td>Phone:</td>
<td>(352) 273-5850</td>
</tr>
<tr>
<td>Course Credits:</td>
<td>1</td>
</tr>
<tr>
<td>Semester:</td>
<td>Summer</td>
</tr>
</tbody>
</table>

Contributing Faculty

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mateus Garcia Rocha</td>
<td>(352) 392-0508</td>
<td><a href="mailto:MRocha@dental.ufl.edu">MRocha@dental.ufl.edu</a></td>
</tr>
<tr>
<td>Dayane Oliveira</td>
<td>(352) 273-6909</td>
<td><a href="mailto:doliveira@dental.ufl.edu">doliveira@dental.ufl.edu</a></td>
</tr>
</tbody>
</table>

Support Staff

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elina Buono</td>
<td>(352) 273-5850</td>
<td><a href="mailto:ebuono@dental.ufl.edu">ebuono@dental.ufl.edu</a></td>
</tr>
<tr>
<td>Grade Administrator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II. Course Goals

The goal of this course is to enable the student to compare and contrast the physical properties, and potential clinical performance of established and recently introduced materials, and to evaluate the potential biological hazards of specific dental materials. In addition, the student will learn how to review currently published research papers, and present the information in public and prepare a group report on the subject presented by the group.
III. Course Overview

This course is composed by two modules:

Module I - Online Review of Dental Materials

This module provides an in-depth review of dental biomaterials for NDBE Part II, for the semester final exam and as additional foundation knowledge for the group seminars/presentations.

The online module contains materials and manipulation techniques, which the student-dentist will use during his or her clinical training at this college and private practice as a dentist. The goal is to provide the senior student with the criteria for independent evaluation, rational selection, and proper clinical manipulation of commercial dental materials.

The specific objectives of the online module will enable the student to compare and contrast the physical properties, and potential clinical performance of established and recently introduced materials, and to evaluate the potential biological hazards of specific dental materials. The accomplishment of these specific aims should adequately prepare senior students to evaluate and select current dental materials for general private practice.

Module II - Dental Biomaterials: Scientific Thinking and Communication

This module requires you to review scientific journal articles and communicate scientific information to dentists and patients.

The class will be randomly divided in groups of 3 to 6 students (Ideally, 5 students per group). Each group will be assigned to a topic and the group have to review a given topic and produce a verbal, audio/visual or written, communication. The message should be directed to DMD or patient (lay person) language level.

IV. Course Outline

Module I

The dental materials review module consists of the following 10 subjects:

1) Properties of Dental Materials,
2) Dental Amalgams,
3) Dental Adhesives,
4) Dental Cements,
5) Resin Based Composites,
6) Impression and Model Materials,
7) Dental Metal Alloys,
8) Dental Ceramics,
9) Polymers in Prosthodontics,
10) Dental Implants

Module II
1. Lecture: the Publishing World has changed!
2. Assigned group work (search literature, validate literature, and apply it to project).
3. Online group discussions

V. Course Material
The HSC LibGuide contains e-book texts, including Phillips' Science of Dental Materials by Kenneth J. Anusavice; H. Ralph Rawls; Chiayi Shen

Canvas DEN8719C: Selection of Clinical Dental Materials

VI. Course Objectives
The course objectives of the online Semester 9 module are also posted on UF e-Learning in Canvas.

In Canvas, you are expected to pre-test yourself before reading the chapter. After reading through the chapter, you should take the quiz. A faculty member will be available via e-mail to answer questions on the reading materials.

At the end of this course, the students will make decisions in the selection of materials based on the clinical situation, patient need and sound scientific information.

A. Dental Amalgam
A1 Compare and contrast the compositions and setting reactions of the gamma 2 and non-gamma 2 types of amalgam alloys.

A2 Identify at least two brand names within each of the following groups: a) admixed and high copper dental amalgam alloys, and b) spherical and high copper dental amalgam alloys.

A3 Dental amalgam alloys, which exhibit excellent mechanical and physical properties, can perform clinically in a manner similar to products with inferior properties. Provide a reason for this situation and list the main manipulative variables that will influence the clinical performance of an amalgam restoration.

A4 Identify and discuss the factors to be considered in selecting a dental amalgam product.

A5 According to ADA Specification #1, an accepted product has to fulfill certain minimum requirements for initial compressive strength, setting expansion or contraction, and creep
resistance. Justify why these properties have been selected, and state which property is the most important to consider for each of the following: a) a conventional amalgam, b) a high copper amalgam, and c) an amalgam used on primary teeth.

A6 Identify both the advantages and drawbacks of spherical amalgams compared to lathe-cut amalgams of a specific composition.

A7 Cite information demonstrating that amalgam restorations are not permanent when it comes to survivability. List in decreasing order of importance the causes of amalgam failure and identify the time after placement at which 50% of amalgam restorations will require replacement.

A8 Recently there has been a debate about the biological hazards of dental amalgam as a restorative material. Demonstrate your awareness of both sides of this issue by summarizing known information which can be used to support both positions.

B. Resin-Based Composite

B1 Compare and contrast the composition of dental composites, and identify the three most important components of a composite related to strength.

B2 Identify at least one brand name within each of the following groups: a) composites containing microfill particles, b) composites containing barium glass particles, c) hybrid small-particle composite.

B3 For the materials identified in objective B2, characterize their filler fractions, filler sizes, ease of polishing, x-ray opacity, polymerization shrinkage, thermal expansion, water sorption potential, and modulus of elasticity.

B4 Compare amalgams and composites with respect to the modulus of elasticity, strength, setting expansion or contraction, thermal expansion, wear resistance, and susceptibility to plaque accumulation.

B5 Identify the advantages and drawbacks of visible light-cured composites vs. chemically-cured composites.

B6 Identify the weakest link of a dental composite and suggest methods to improve it.

B7 Discuss factors to be considered in selecting an insulation material to be used under a composite restoration.

B8 Cite information which demonstrates that composite restorations are not permanent. List in decreasing order of importance the causes of composite failure and determine the time after placement at which 50% of Class III and Class IV composite restorations will require replacement.

C. Sealants and Bonding Agents

C1 Identify the advantages and disadvantages of sealants.

C2 Identify the most significant problems related to bonding a sealant to an occlusal surface.
C3 Identify the most common reasons for the failure of a sealant and state the prognosis for sealant treatment after three years in service.

C4 Describe the step-by-step procedures required in the acid etch technique used for composites and sealants; (1) Describe the rationale for each procedure and the time required to perform it; (2) Identify the effects of fluoride and type of tooth (primary or permanent on etching effectiveness; and (3) Identify the potential problems related to each step of the conditioning and placement process.

C5 Describe different mechanisms, which are responsible for bonding restorative materials to tooth structures. Identify at least one example of a commercial product representative of each bonding mechanism.

C6 Describe the composition of the smear layer, its effect on bonding, and how it can be removed from a cut surface.

C7 A truly adhesive dental material would change dentistry and dental treatment dramatically. Describe the ways in which this may be demonstrated.

C8 The existing clinical data are not sufficient to suggest that a true adhesive is available or will be so within the next few years. List and describe the factors, which can explain this statement.

D. Dental Cements

D1 Certain powder or liquid components are found in common in various cements, excluding resin cement. Draw a block diagram illustrating the compositional relationship between these cements. The diagram should include ZOE, zinc phosphate, silicophosphate, zinc polycarboxylate, and glass ionomer cements.

D2 One clinical study showed that no significant difference existed between the percentages of loosened castings cemented with either zinc phosphate or reinforced ZOE cement. List and compare the properties and technique factors, which you think may influence the longevity of a cemented casting. Identify the properties responsible for this clinical result and justify your choices.

D3 Although zinc polycarboxylate cement can adhere to tooth structure, comparable force is required to remove inlays cemented with zinc polycarboxylate cement, zinc phosphate cement, or reinforced ZOE cement. Explain why the retention is comparable and suggest a method to improve the retentiveness of a restoration luted with polycarboxylate cement.

D4 Removing excess cement from the marginal area of any fixed prosthesis often requires special care. Describe the best method and the best time to remove an excess of the following three cements: zinc phosphate, polycarboxylate, glass ionomer, and resin.

D5 In spite of its superior physical property characteristics, glass ionomer cement has not demonstrated clinical performance that is superior to that of zinc phosphate cement. Identify and explain the factors that may lead to this surprising result.
D6 Hydraulic pressure may cause post-cementation sensitivity. State how inadequate liquid-powder proportioning may affect the post-cementation sensitivity and describe a method to reduce this effect when the powder-liquid ratio is correct.

D7 List the major uses of Type II cements and their relative advantages and disadvantages.

D8 Describe the major applications and drawbacks of resin cements in dentistry.

D9 Given a list of clinical conditions of cementing crowns, select the best dental cement for the stated conditions and justify your selection.

E. Impression Materials

E1 Compare and contrast the properties of the four commonly used elastomeric impression materials, namely, condensation silicone, polysulfide, polyether, and addition silicone. You should place emphasis on the following properties and parameters: 1) working and setting time, 2) flow characteristics, 3) ability to recover shape, 4) setting shrinkage, 5) tear resistance, 6) flexibility and ease of removal, 7) cost and 8) waiting period before pouring.

E2 A sales representative attempts to sell you a new impression material. What questions should you ask him and what specific information should you obtain before making a decision to purchase the product for clinical use?

E3 You just opened a new tube of elastomeric impression material and find that a clear liquid, segregated from the material, is flowing from the tube. Identify the clear liquid and the cause and the effect of this segregation. State whether or not you can use the material effectively and explain your answer.

E4 Compare and contrast the advantages and disadvantages of the putty-wash technique and the conventional direct technique of making impressions.

E5 List the three methods of making dies from elastomeric impressions and identify the impression materials and the conditions capable of producing accurate dies. Also, state the reason that certain methods might not work on some materials.

E6 Discuss the effect of latex glove on the setting of polyvinylsiloxane impression materials.

E7 The strength of agar impression material is adequate when manipulated properly, yet you often experience tearing of the impression at undercut areas. Identify the reasons for tearing and describe the correct method to avoid this problem.

E8 A bridge that fits exactly on the die and model does not fit when it is tried in the mouth. State the most likely cause of this problem and how it can be solved.

E9 Given a clinical situation and a list of impression materials, select the appropriate material that you believe will yield accurate impressions and provide a rationale for your selection.

E10 Identify the brand names and generic types of impression materials used in the Operative and Prosthodontic clinics at UF.
F. Denture Materials

F1 Briefly describe the following three categories of materials and their applications in dentistry: a) denture materials, b) soft liner materials, and c) maxillofacial materials.

F2 A Compare the following three methods of processing denture bases: a) compression molding, b) injection molding, and c) pour-type acrylics.

F3 Your assistant has attempted to make temporaries for you, and the following two conditions occurred during removal: a) the temporary sticks to the preparation and b) the temporary separates easily but appears to be soft. State the possible causes of these problems and how you would instruct your assistant to avoid these problems in the future.

F4 You have just delivered a complete denture. Describe the denture cleaning method you would recommend. Describe how you would respond to patient’s questions about products advertised on television commercials (such as Polident or Efferdent).

F5 Given a list of problems in the clinical use of dentures, identify the possible causes of the problems and give methods to reduce these problems.

F6 List and describe applications of denture liners. Emphasize the differences between the chairside application of liners and laboratory-processed liners.

F7 A List the ideal properties of resilient soft liners. Identify the advantages and disadvantages of resilient denture base materials.

F8 Review the list of materials that have been used for constructing maxillofacial prostheses and differentiate the required physical properties, such as tensile strength, tear strength, and Shore A hardness.

F9 A maxillofacial prosthesis is often unaesthetic if the entire mass is one color. State what you would do to characterize various areas independently.

G. Noble Metal Alloys for Metal-Ceramic Restorations

G1 Identify the definitions of the following terms: high noble, noble, and predominantly base metal used to classify alloys.

G2 Which element in high noble and noble alloys is believed to cause adverse health effects in parts of Europe?

G3 Although porcelain greening should not be a major problem because of improved porcelain formulations, certain alloys and conditions may cause a slight porcelain discoloration (greening). List the alloy types that are most likely to cause this problem and the conditions that may further cause an unacceptable shade match.

G4 Identify the 6 main factors that control the thermal compatibility of a metal-ceramic prosthesis during firing and after cooling to room temperature and the effect of each one on the potential risk for producing residual tensile stress in the porcelain.
G5 List and describe the possible adverse effects resulting from the use of an incompatible metal-porcelain system.

G6 Of the available PFM alloys, low-expansion alloys such as Olympia are incompatible with high-expansion porcelains (\(\alpha_M < \alpha_P\)). Is this situation better, worse, or the same for Jelstar (a high-expansion alloy) bonded to a low-expansion porcelain (\(\alpha_M > \alpha_P\))? Why? Note: \(\alpha_M\) is the thermal expansion coefficient of the metal and \(\alpha_P\) is the coefficient for the porcelain.

G7 How can residual incompatibility stress either increase or decrease the effective strength of a metal-ceramic restoration under an applied intraoral force?

G8 Compare and contrast similarities and differences in the properties of gold-based and palladium-based alloys for metal-ceramic restorations.

G9 Given a set of clinical conditions, select the alloy types that are best suited for these conditions and provide a rationale for your selection.

H. Base Metal Alloys for Metal-Ceramic Restorations

H1 Identify the potential biocompatibility effects of nickel, beryllium, and cobalt on laboratory technicians, patients, and dentists. Which of these elements is most toxic to technicians who melt and grind these alloys?

H2 Compare and contrast the general similarities and differences between the properties of Ni-Cr-Be alloys and high noble and noble alloys used for metal-ceramic restorations.

H3 A female patient reports that she has a previous allergy to certain metals. Your dental laboratory fabricates metal-ceramic and all-metal crowns and fixed partial dentures exclusively with base metal alloys. What treatment choices are available to you if crowns and bridges are required and which would be the safest option?

H4 Describe or identify the specific questions you should ask to determine the potential allergic response of a female patient to nickel?

H5 Considering the high noble, noble, and predominantly base metal alloys used for metal-ceramic restorations, identify and describe the principal types of alloy.

H6 Identify the potential clinical problems or failures that may result from: (1) excessive alloy creep; (2) improper metal oxide characteristics; (3) soldered connectors, (4) cast-joined connectors; and (5) ultrathin (<0.1 mm) metal copings.

H7 Recognize the benefits and drawbacks of commercially pure titanium and Ti-6Al-4V for use in dentistry.

I. Ceramic Restorations

I1 Contrast the similarities and differences including the major benefits and drawbacks of ceramic products (In-Ceram Spinell, In-Ceram Alumina, In-Ceram Zirconia, Procera AllCeram, IPS Empress 2, OPC, and OPC-3G) used to produce totally ceramic and bridge prostheses.
I2 Identify two major deficiencies of conventional feldspathic porcelains, i.e., PFM ceramics such as Ceramco, Vita, Excelco, Will-Ceram, Duceram, and Biobond that make them unsuitable for the fabrication of all-porcelain crowns.

I3 Compare and contrast the advantages and disadvantages of anterior and posterior alumina core ceramic crowns (In-Ceram Alumina and Procera AllCeram) compared with PFM crowns. What are the two main disadvantages of zirconia core crowns that may not be apparent for several years?

I4 List the five methods of producing ceramic prostheses and the main benefit and drawback of each process relative to marginal accuracy and fracture susceptibility.

I5 Identify the main benefits and risks of using resin-based cements for all-ceramic restorations.

I6 Identify the differences between copy-milling, hot-pressing, minimal sintering/glass infiltration, die enlargement, and CAD-CAM milling, which are methods used to produce ceramic prostheses quickly and with accurate margins.

I7 Identify from a list of ceramic products a brand name for each of the processes listed in objective I6.

J. Selection Criteria of Dental Materials

J1 Which 5 of the 14 features of an advertisement are not useful or reliable for selecting the best products for your practice?

J2 What two specific item of information about a product should be recorded in the patient’s treatment record (chart)?

J3 What benefits are derived from using an ADA certified or accepted product? Why are products not classified as “ADA Accepted” in advertisements? List 4 reasons.

J4 What information are you unlikely to find in an advertisement on a specific dental material?

J5 List the specific information in ads that you can trust.

J6 List or identify 9 questions you should answer to fully evaluate a product.

VII. Course Competencies

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

Domain I: Critical Thinking

1: Critical Thinking: Use critical thinking and problem-solving, including their use in the comprehensive care of patients, scientific inquiry and research methodology.
2: Evidence-Based Patient Care: Access, critically appraise, apply and communicate scientific and lay literature as it relates to providing evidence-based patient care.

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

VIII. Evaluation

Course Evaluation & Grading:

Formative evaluation: online questions in each module.

Summative evaluation:

Module 1 - Online Review of Dental Materials (80 %)

Quizzes - 50%

- Quiz # 1 - Properties of Dental Materials (5 %)
- Quiz # 2 - Dental Amalgams (5 %)
- Quiz # 3 - Dental Adhesives (5 %)
- Quiz # 4 - Dental Cements (5 %)
- Quiz # 5 - Resin-Based Composites (5 %)
- Quiz # 6 - Impression and Model Materials (5 %)
- Quiz # 7 - Dental Metal Alloys (5 %)
- Quiz # 8 - Dental Ceramics (5 %)
- Quiz # 9 - Polymers in Prosthodontics (5 %)
- Quiz # 10 - Dental Implants (5 %)

All quizzes are online and must be taken. No quiz can be dropped.

NBDE II - Mock Exam - 30%

Module 2 - Dental Biomaterials: Scientific Thinking and Communication (20 %)

Group Assignment - 20%

Remediation:

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

**DEN8719C Grade Scale**

<table>
<thead>
<tr>
<th>Method</th>
<th>Scale</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>0.5 (Final letter grades within this range will be rounded up.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>95 - 100</td>
</tr>
<tr>
<td>A-</td>
<td>90 - 95</td>
</tr>
<tr>
<td>B+</td>
<td>86 - 90</td>
</tr>
<tr>
<td>B</td>
<td>82 - 86</td>
</tr>
<tr>
<td>B-</td>
<td>80 - 82</td>
</tr>
<tr>
<td>C+</td>
<td>74 - 80</td>
</tr>
<tr>
<td>C</td>
<td>72 - 74</td>
</tr>
<tr>
<td>E</td>
<td>0 - 72</td>
</tr>
</tbody>
</table>