Dental Biomechanics

Biomechanics is a science that uses the principles of mechanics to explore biological problems. This includes bioengineering, the research and analysis of the mechanics of living organisms and the application of engineering principles to and from biological systems. Analytical, as well as experimental research in Dental Biomechanics is a trend in the current literature, many journals accept and publish original articles, surveys and perspective articles on dental biomechanics: design and analysis of dental tissues and prostheses; mechanics of chewing and temporomandibular joint simulation; mechanics of implants (geometry) and implant osseointegration.

Analytical research with the finite element method (FEM) when coupled with clinical data, for ex: computed tomography (CT) is a powerful tool in Dental biomechanics. However, substantial data is required for patient-specific modelling, therefore experimental methods can also supply data and validation to the FEM.

The aim of this module is to provide an overview on Dental Biomechanics. The topics addressed in this four hour PhD module programme are expected to provide the background needed to integrate this knowledge in a research project.

9h30 - Mechanical principles of stress and strain on dental implants and prosthesis.
Pedro Nicolau (Faculdade de Medicina da Universidade de Coimbra)

10h15 - The finite element method (FEM) and biomechanical models.
Augusta Neto (Fac. de Ciências e Tecnologia da Universidade de Coimbra)

11h00 - Experimental methods in biodental engineering.
Mário Augusto Pires Vaz (Fac. de Engenharia da Universidade do Porto)

12h15 - Methods of generating clinical data for FEM studies.
Pedro Nicolau (Faculdade de Medicina da Universidade de Coimbra)

References:
Clinical Research in Dental Biomaterials

Clinical research and randomized clinical trials (RCT) in particular are generators of a high level of evidence in the field of dental biomaterials, but have to follow strict rules in order to: bridge the gap between research and dental practice. The overwhelming number of new materials on the market in recent years bring more uncertainty to the dentist with less time to judge what material serves better in his practice. Therefore more RCTs are needed for this purpose. However, these type of clinical studies, impose ethical issues, that follow the declaration of Helsinki, and seek to gain ethic commissions approval. Study designs must follow tight protocols from patient recruitment to study termination. Reports should be performed accordingly to the guidelines in the Consolidated Standards of Reporting Trials (CONSORT) statement. Adequate reporting of clinical trials improves transparency, enables the interpretation and replication of studies and reduces the risk of bias. For this reason, many journals now require trials conformed to the guidelines in CONSORT statement.

The aim of this module is to provide an overview on clinical research on dental Biomaterials and how to design RCTs. The topics addressed in this Five hour PhD module programme are expected to provide the background needed to integrate this knowledge in a research project.

14h00 - Study design and ethical commission approval.
Pedro Nicolau (Faculdade de Medicina da Universidade de Coimbra)

14h45 - Evidence based research in RCTs in the literature.
António Mata (Faculdade de Medicina Dentária da Universidade de Lisboa)

16h00 - Expertise background in multicenter RCTs with bone graft materials and dental implants
Fernando Guerra (Faculdade de Medicina da Universidade de Coimbra)

16h45 - Reporting clinical data according to CONSORT guidelines.
Pedro Nicolau (Faculdade de Medicina da Universidade de Coimbra)

References:
18th May - Tuesday

Biomaterials in Operative Dentistry

The aims of this course are:

1. Presenting the most important biomaterials and research lines in Operative Dentistry

2. Presenting the microscopic techniques for ultramorphological evaluations of tooth tissues, restorative materials and respective interfaces.

3. Making a workshop with laboratory evaluations of tooth/restorations interfaces, namely with some adhesion tests and and electronic microscopic observations.

Seminars

9.00 – Adhesive interfaces evaluation in Operative Dentistry - João Carlos Ramos
9.45 – Scanning electronic microscopy techniques – Augusto Barros Lopes
10.30 - Transmission electronic microscopy techniques – Vanda Lopes

Practical workshops

11.30-12.30 – Workshop with laboratory demonstrations of tooth/materials interface adhesion tests

João Carlos Ramos – Assistant Professor, Coimbra Medical School, University of Coimbra
Augusto Barros Lopes – Assistant Professor, Dep. of Ceramics and Glass Engineering, University of Aveiro
Vanda Lopes – IBILI – Investigator, IBILI, Coimbra Medical School, University of Coimbra

References


19th May - Wednesday

**Biomaterials in periodontal regeneration**

9h00 - Characterization of pre-clinical periodontal lesions  
Isabel Poiares Baptista - Faculty of Medicine, Coimbra University

10h00 - Enamel Matrix Derivative – from biological principals to systematic reviews  
Isabel Poiares Baptista - Faculty of Medicine, Coimbra University

11h30 - Tissue engineering in periodontal regeneration – new perspectives  
Carlos Viegas - Faculty of Veterinary Sciences, Trás-os-Montes e Alto Douro University

14h00 – 16h00  Apresentação e discussão de artigos

**References:**

20th May - Thursday

Experimental Models in Dentistry

Experimental Models in Bone Regeneration

9h00 – Characteristics of Bone Tissue
   Maria Helena Figueiredo, Faculty of Medicine, Coimbra University

10h00 – Bone Graft Characterization (morphology, particle size, porosity, surface area)
   Margarida Figueiredo, Chemical Engineering Department, FCTUC

11h00 - Bone grafts and bone substitutes
   Sérgio Matos, Faculty of Medicine, Coimbra University

References:
21\textsuperscript{nd} May – Friday

**Biocompatibility tests for evaluation of dental materials**

10h00 - Initial tests (cytotoxicity, mutagenicity) – **Helena Raposo Fernandes**
11h00 – Usage tests in animal model for pulpdental complex – **João Carlos Ramos**
11.45 - **Practical workshop**
   Workshop with laboratory demonstrations of tissue histological processing.

In this concept, newly developed materials should be subjected to the three steps in the given sequence from the simple to the more complex test methods, from \textit{in vitro} to \textit{in vivo} animal tests, and from preclinical to clinical testing in humans.

Helena Raposo Fernandes – Faculty of Dental Medicine, Oporto University
João Carlos Ramos – Faculty of Medicine, Coimbra University

**References:**
- Protecções pulpares directas – avaliação histopatológica; João Carlos Ramos; dissertação de tese de Doutoramento

**Experimental models in Endodontics**

14h00 - \textit{In vitro} microleakage with dies and microbial tracers – **João Miguel Santos**
15h00 - Secondary tests and usage tests to evaluate endodontic materials - **João Miguel Santos**

João Miguel Santos – Faculty of Medicine, Coimbra University

**References:**