



## Discipline Information

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The following dates are in (dd/mm/yyyy) format.

Code: RAL5899 - 1 Type: POS  
Name: Mechanical and Biomechanical Technology of Orthopaedic Implants  
Concentration area: Ciências da Saúde Aplicadas ao Aparelho Locomotor (17142)

Approval dates:

CCP: 02/12/2024 CPG: 04/02/2025 CoPGr:

Activation date: 04/02/2025 Inactivation date:

Workload:

Total: 60 h Theory: 4 h Practice: 8 h Study: 3 h

Credits: 4 Duration: 4 weeks

Professors: 300572 - Antonio Carlos Shimano - 04/02/2025 until today  
7961749 - Leonardo Rigobello Battaglion - 04/02/2025 until today

Objectives:

To introduce the basic concepts, theories and techniques of the biomechanical and mechanical technology of orthopaedic implants, together with their up-to-date applications. This will enable postgraduates to learn about the main types of measuring instruments, biomaterials, treatments and manufacturing processes for osteosynthesis and prostheses. And to present the main techniques for simulating and analyzing the mechanical parameters of samples or structures.

Rationale:

Quality control of products used in Orthopaedics and Traumatology should be a constant priority for professionals in the field. The main problems associated with osteosynthesis and prostheses are related to factors such as inadequate sizing, inaccurate specifications, types of biomaterials used, insufficient mechanical strength, design flaws and inconsistencies in manufacturing processes. Teaching focused on the mechanical and biomechanical technology of implants seeks to provide postgraduates with solid knowledge and technical information that can improve their skills and contribute directly to their professional activities.

Content:

### I - INTRODUCTION TO IMPLANT MECHANICS AND BIOMECHANICS

1. Fundamental Principles of Biomechanics
2. Metrology
3. Production of the main materials used in Mechanics
4. Standards and Regulations for Mechanical Testing

### II - BIOMATERIALS

1. Main types of materials used to make implants;
2. Recommendations for a good implant;
3. Types of corrosion that affect implants;
4. Applications;



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### III - BIOMECHANICS OF THE MAIN IMPLANTS:

1. Plates and screws;
2. Intramedullary rods
3. Internal fixator
4. Prostheses

### IV - TESTS AND MECHANICAL PROPERTIES

1. Static tests
2. Applications;
3. Dynamic tests;
4. Applications;

### V - SIMULATION AND PROTOTYPING TECHNIQUES

1. Finite Element Method
2. 3D printing

### Bibliography:

ARAÚJO, R.C.G. Influência das características geométricas de parafusos pediculares nas tensões geradas na vértebra lombar L5. 2021. 126 f. Dissertação (Mestrado em Ciências da Saúde Aplicadas ao Aparelho Locomotor) – Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, 2021.

BATTAGLION, L. R. Simulações biomecânicas de reforço preventivo para o extremo proximal de fêmur com osteoporose. 2024. 156 f. Tese (Doutorado em Ciências da Saúde Aplicadas ao Aparelho Locomotor) – Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, 2024.

BATTAGLION, L. R.; DE BARROS P.N, H.; MACEDO, A. P.; VOLPON, J. B.; SHIMANO, A. C. Novel hook plate for radial semilunar lip facet fragment fixation: a finite element analysis. *BMC Musculoskeletal Disorders*, v. 25, p. 885, 2024.

LEWIS, T. L. et al. Comparative biomechanical study of different screw fixation methods for minimally invasive hallux valgus surgery: A finite element analysis. *Foot and Ankle Surgery*, 2024.

FERRER, M. de A.; LOBO, M. de O.; ALMEIDA, L. M. P.; FREITAS, A.; MACEDO NETO, S. L. de; PAIVA, L. M.; BATTAGLION, L. R. Patellar fracture in anterior cruciate ligament reconstruction: in vitro analysis. *Acta Ortopédica Brasileira*, v. 31, 2023. DOI: 10.1590/1413-78.

CRUZ, M. A. F.; VOLPON, J. B.; BATTAGLION, L. R. Flexible intramedullary nails in pediatric subtrochanteric femur fracture: biomechanical study. *Acta Ortopédica Brasileira*, v. 31, 2023.

FREITAS, A. Análise mecânica do reforço femoral proximal com polimetilmetacrilato em forma de X (análise in vitro). Ribeirão Preto, 2022. 118 p. Dissertação/Tese (Doutorado em Ciências da Saúde Aplicadas ao Aparelho Locomotor) – Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, 2022.

FREITAS, A ; LOBO, M.O; ALVES, GLEYCON, H.D ; BARBOSA, R.F.C ; BLANCO, L.G. R. ; Shimano, A.C. . TEMPORARY REMOVAL: In vitro mechanical analysis of X-shaped femoroplasty with polymethyl methacrylate boundary a fall on the greater trochanter. *INJURY-INTERNATIONAL JOURNAL OF THE CARE OF THE INJURED* , v. 23, p. 00375-3, 2023.

FREITAS, A; RAMOS, L. S. ; DANTAS; GIORDANO N V ; GODINHO, PATRICK F. ; Shimano, A. C. . Ensaio biomecânico após retirada de parafusos canulados do fêmur proximal (análise in vitro). *Revista Brasileira de Ortopedia*, v. 54, p. 416-421, 2019.

GIORDANO, V.; FREITAS, A.; PIRES, R. E.; BATTAGLION, L. R.; LOBO, M. de O.; BELANGERO, W. D. Evaluation of a locking autocompression screw model in Pauwels type-3 femoral neck fracture: in vitro analysis. *Bioengineering (Basel)*, v. 9, p. 464, 2022.

MARTURELLO, D. M.; WEI, F.; DÉJARDIN, L. M. Characterization of the torsional structural properties of feline femurs and surrogate bone models for mechanical testing of orthopedic implants. *Veterinary Surgery*, v. 48, n. 2, p. 229-236, fev. 2019. DOI: 10.1111/vsu.13136.

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ROSA, R. C.; SILVA, P.; SHIMANO, A. C.; DEFINO, H. L. A. Influência do instrumento de perfuração do orifício piloto nas propriedades mecânicas dos parafusos vertebrais. *Coluna/Columna*, v. 10, p. 193-196, 2011.

SAITO, M. K.; DE OLIVEIRA, B. K.; MACEDO, A. P.; SORRENTINO DOS SANTOS, C.; LOPES, R. T.; YAMANAKA, J. S.; SHIMANO, A. C. Cafeteria diet can affect bone microarchitecture in sedentary and trained male rats. *Journal of Clinical Densitometry*, v. 27, p. 101467-101478, 2024.

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FREITAS, A.; LOBO, M. de O.; ALVES, G. H. D.; BARBOSA, R. F. C.; BLANCO, L. G. R.; SHIMANO, A. C. Temporary removal: in vitro mechanical analysis of X-shaped femoroplasty with polymethyl methacrylate boundary a fall on the greater trochanter. *Injury - International Journal of the Care of the Injured*, 2023.

YAMANAKA, J. S.; OLIVEIRA, A. C.; BASTOS, A. R.; FERNANDES, E. M.; REIS, R. L.; CORRELO, V. M.; SHIMANO, A. C. Collagen membrane from bovine pericardium for treatment of long bone defect. *Journal of Biomedical Materials Research Part B: Applied Biomaterials*, v. 110, p. 35148, 2022.

BUCKLEY, Richard E.; APIVATTHAKAKUL, Theerachai; MORAN, Christopher G. *Princípios AO do Tratamento de Fraturas*. 2. ed. Capa dura. São Paulo: Editora, 2020. 1116 p.

DE PAIVA, M. B.; PEGORIN BRASIL, G. S.; CHAGAS, A. L. D.; MACEDO, A. P.; RAMOS, J.; ISSA, J. P. M.; GANGRADE, A.; FLORIANO, J. F.; CAETANO, G. F.; LI, B.; FARHADI, N.; MANDAL, K.; DOKMECI, M. R.; JUCAUD, V.; HERCULANO, R. D.; SHIMANO, A. C. Latex-collagen membrane: an alternative treatment for tibial bone defects. *Journal of Materials Science*, v. 57, p. 22019-22041, 2022.

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SORIANO, H. L. *Método de elementos finitos em análise de estruturas*. São Paulo: Editora da Universidade de São Paulo, 2003.

BROWN, T.; HARVIE, F.; KLUSS, D. Testing mechanical properties of silicone gel-filled breast implants and their degradation. *Aesthetic Plastic Surgery*, v. 48, n. 17, p. 3362-3369, set. 2024.

### Type of Assessment:

- 1 - Written presentation of the subjects covered (weight 2)
- 2 - Oral presentation of the subjects covered (weight 2)
- 3- Participation and resourcefulness in practical activities, with reports (weight 3)

### Note:

The methodological development of the subject will be:

- 1 - Methodology: The relationship with the students will be through theoretical and practical classes with dialogues and discussions of the information and knowledge of the subjects covered.
- 2 - Strategy: The subjects covered in lectures will be presented in practice in the research laboratory.
- 3 - Resources: Oral presentations using the board and/or powerpoint. Seminar presentations. Guest speakers.