האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

BIOMECH. PRINC. & APPL. IN THE CRANIOFACIAL SYST - 97946

Last update 29-10-2017

HU Credits: *3*

Degree/Cycle: *2nd degree (Master)*

Responsible Department: *Bio-Medical Sciences in Dentistry*

Academic year: *0*

Semester: *1st Semester*

Teaching Languages: *English*

Campus: *Ein Karem*

Course/Module Coordinator: *Dr. Atalia Wasserstein and Prof. Stella Chaushu*

Coordinator Email: *ataliawa@gmail.com*

Coordinator Office Hours: *None*

Teaching Staff:
Prof Stel Chaushu,
Dr. Atalia Wasserstein,
Dr. ,
Dr. Omer Fleissig,
Dr. Zvi Muster,
Dr. ,
Dr.

Course/Module description:
This course provides a broad insight into both the theoretical and the clinical aspects of the mechanics and typical tissue responses to force systems used in orthodontic appliances.

Course/Module aims:
• Describe all tissue reactions associated with orthodontic tooth movement and discuss implications for planning force magnitude, direction and duration.
• Discuss tissue damage in response to orthodontic forces.
• List and discuss the major concepts and principles that are required to produce the diverse orthodontic movements.
• Define the concept "system equilibrium" and discuss the implications for planning orthodontic anchorage.
• Compare and contrast the terms "stress-strain diagram" and "load-deflection diagram".
• Compare and contrast the mechanical principles of different orthodontic appliances: standard edgewise brackets, preadjusted straight-wire brackets, Begg/Tip-Edge brackets, orthopedic and functional appliances.
• Define friction in orthodontics and understand how it is generated and how to reduce it.
• Compare different properties of materials used in orthodontics.

Learning outcomes - On successful completion of this module, students should be able to:
• Plan safe, predictable and efficient orthodontic treatment
• Integrate the knowledge on force and moments and be able to perform advanced clinical orthodontic biomechanics
• Describe and demonstrate appropriate biomechanics in multidisciplinary treatments
• Evaluate the most suitable wire material for each stage of treatment
• Interpret the side effects created by the reactive forces
• Design the most efficient mechanical strategy to avoid tissue damage

Attendance requirements(%):
80%

Teaching arrangement and method of instruction: Frontal lectures and seminars. Reading assignments for each seminar session is to provide background information for class discussions related to the scheduled topics.

Course/Module Content:
- *The periodontium- structure and function*
- *Tissue response to mechanical forces*
- *Signal transduction of mechanical force*
- *Bone biology*
- *Stress- strain diagrams*
- *Wire materials*
- *Basic concepts of tooth movement*
- *One couple systems*
- *Two couple systems*
- *Asymmetric mechanics*
- *Removable appliances vs. fixed appliances in generating forces*
- *Mechanics of springs, screws and elastics*
- *Friction in orthodontics*

Required Reading:
1. Rygh P: Ultrastructural changes in pressure zone of human periodontium incident to orthodontic tooth movement. Acta Odont Scand 31: 109-122, 1973.
2. Atherton JD: The gingival response to orthodontic tooth movement. Am J Orthodontics. 58: 179-186, 1970
3. Pilon J, Kuijpers-Jagtam AM, Maltha JC: Magnitude of orthodontic forces and rate of bodily tooth movement. Am J Orthod Dentofacial Orthop 110: 16-23, 1996.
4. Masella RS., Meister M: Current concepts in the biology of orthodontic tooth movement. Am J Orthod Dentofacial Orthop. 129: 458-468, 2006.
5. Hennenman S, Von der Hoff JW, Maltha JC: Mechanobiology of tooth movement. Eur J Orthod 30: 299-306, 2008.
6. Krishnan V, Davidovitch Z: Cellular, Molecular, and tissue-level reactions to orthodontic force. Am J Orthod Dentofacial Orthop. 129: 469 e 1-32, 2006.
7. Wise GE, King GJ: Mechanisms of tooth eruption and orthodontic tooth movement. J Dent Res. 87: 414-434, 2008.
8. Tyrovola JB, Spyropoulos MN: Effects of drugs and systemic factors on orthodontic treatment. Quintessence Int. 32: 365-71, 2001.

9. Bartzela T, Turp JC, Motschall E, Maltha JC: Medication effects on the rate of orthodontic tooth movement: A systematic review. Am J Orthod Dentofacial Orthop 135: 16-26, 2009.
10. Kusy RP: A review of contemporary archwires. Their properties and characteristics; Angle Orthod. 67: 197-208, 1997.
11. Kusy RP: Orhodontic biomaterials: From the past to the present. Angel Orthod. 72: 501-12, 2002
12. Wilkinson P: Load-deflection characteristics of superelastic nickel-titanium orthodontic wires Am J Orthod Dentofacial Orthop 121: 483-495, 2002.
13. Burstone CJ, Qin B, Morton JY: Chinese NiTi wire: A new orthodontic alloy. Am J Orthod, 87: 445-452, 1985.
14. Santoro M, Nicolay OF, Cangialosi TJ: Pseudoelasticity and thermoelastisity of nickel-titanium alloys: A clinically orientd review. Part I: Temperature transitional ranges. Am J Orthod Dentofacial Orthop 119: 587-93, 2001.
15. Santoro M, Nicolay OF, Cnagialosi TJ: Pseudoelasticity and thermoelastisity of nickel-titanium alloys: A clinically oriented review. Part II: Deactivation forces. Am J Orthod Dentofacial Orthop 119: 587-603, 2001.
16. Ewoldsen N, Demke R: A review of orthodontic cements and adhesives. Am J Orthod Dentofacial Orthop.120: 45-48, 2001.
17. Karamouzos A: Clinical characteristics and properties of ceramic brackets. Am J Orthod Dentofacial Orthop. 112: 34-40, 1997.
18. Bishara SE, Fehr DE: Ceramic brackets: something old, something new, a review. Semin Orthod. 3: 178-88, 1997.
19. Kusy R, Tulloch C: Analysis of moment to force ratios in the mechanics of tooth movements. Am J Orthod Dentofacial Orthop. 90: 127-131, 1986.
20. Burstone CJ, Koenig HA: Force systems from an ideal arch. Am J Orthod 65: 270-289, 1974.
21. Smith RJ, Burstone CJ: Mechanics of tooth movement. Am J Orthod 85: 294-307, 1987.
22. Lindauer SJ, Isaacson RJ: One-couple orthodontic appliance systems. Semin Orthod 1: 12-24, 1995
23. Burstons CJ: Biomechanics of deep overbites correction. Semin Orthod, 7: 26-34, 2001.
24. Burstone CJ, Koenig HA: Force systems from an ideal arch. Am J Orthod 65: 270-289, 1974.
25. Davidovitch M., Rebellato J: Two-Couple Orthodontic Appliance Systems. Utility Arches: A Two-Couple Intrusion Arch. Semin Orthod, 1: 25-30, 1995.
26. Burstone CJ, Koenig H: Creative wire bending— The force system from step and V bends. Am J Orthod Dentofacial Orthop. 93: 59-67, 1988.
27. Isaacson R, Rebelato J: Two-couple orthodontic appliance systems: Torquing arches. Semin Orthod 1: 31-36, 1995.
28. Siatkowski RE: Force system analysis of v-bend sliding mechanics. J Clin Orthod 28: 539-546, 1994.
29. Asymmetries: Diagnosis and treatment. Seminars in Orthodontics. 1998,4:133-198.
30. van Steenbergen E, Nanda R: Biomechanics of orthodontic correction of dental

asymmetries. Am J Orthod Dentofacial Orthop 107: 618-24, 1995.
31. 1.Removable Appliances. In Proffit WR and Fields HW. Contemporary Orthodontics. 4rd Ed p 395-430.
32. 2.The Tweed-Merrifield Edgewise Appliance. In Orthodontics. Current Principles and Techniques. Graber TM, Vanarsdall RL, Vig KWL 4th Ed. Ch. 16, p. 675-676,p 689-698
33. Tselepis M: The dynamic frictional resistance between orthodontic brackets and archwires. Am J Orthod Dentofacial Orthop, 106: 131-138, 1994.
34. Kusy RP, Whitley JQ: Friction between different wire-bracket configurations and materials. Semin Orthod. 3: 166–177, 1997.
35. Articolo LC, Kusy RP: Influence of angulation on the resistance to sliding in fixed appliances. Am J Orthod Dentofacial Orthop. 115: 39–51, 1999.
36. Thorstenson GA, Kusy RP: Resistance to sliding of self-ligating brackets versus conventional stainless steel twin brackets with second-order angulation in the dry and wet (saliva) states. Am J Orthod Dentofacial Orthop, 120: 361–370, 2001.

Additional Reading Material:
None

Course/Module evaluation:
End of year written/oral examination 100 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:
None