SYLLABUS

ORT 664 Biomechanics

Course Director: E. Preston Hicks

Course Description

This is a one credit-hour seminar course. The purpose of the course is to introduce the foundational concepts for understanding both the laws of mechanics and the typical tissue responses to force systems used in orthodontic appliances. Students will learn theory-guided approaches to planning safe, predictable and efficient orthodontic treatment. Students will be expected to read and critique background material in assigned textbooks and journal articles for seminar discussions. This course will supplement subject matter covered in the typodont course, ORT 662.

Course Objectives

1. List and discuss the major concepts and principles that are required to produce:
   a. safe tooth movement
   b. predictable tooth movement
   c. efficient tooth movement
2. Define the concept "system equilibrium" and discuss the implications for planning orthodontic anchorage.
3. Compare and contrast the terms "stress-strain diagram" and "load-deflection diagram."
4. Define the term "anchorage" and list the types often used in orthodontic force systems.
5. Describe all tissue reactions associated with orthodontic tooth movement and discuss implications for planning force magnitude, direction, and duration.
6. Describe soft tissue adaptations to tooth movement during the retention stage of treatment and discuss implications for timing and duration of retention.
7. Describe the principles and applications of loops in arch wire design and compare with the use of low modulus arch wire materials.
8. Define and describe biomechanical approaches common to stage 1, 2, and 3 mechanics.
9. Describe the mechanical concepts of loop designs.
10. Distinguish the biomechanical concepts between “ideal” and “optimal” arch wire forms.
11. Compare and contrast standard edgewise brackets with preadjusted brackets.
12. Describe the biomechanics of maxillary expansion and compare slow expansion protocols with rapid expansion protocols.
13. Describe the mechanics of headgear designs and discuss common orthodontic applications.
14. Describe typical biomechanical management strategies in the mixed dentition.
15. Describe biomechanical approaches to the management of deep overbite and open bite occlusal discrepancies.
16. Describe the biomechanical management of Class II and Class III occlusal discrepancies.
17. Describe the concepts of skeletal anchorage in planning orthodontic tooth movement.
18. Describe the diagnostic and mechanical principles of Tweed treatment protocols.
19. Describe the finishing methods related to establishing stable arch forms and smile esthetics.
20. Discuss periodontal implications in planning orthodontic therapy in children and adults.
21. Describe and discuss methods and principles for planning retention, integrating the biologic rationale for various retention protocols.

Instructional Methodology

This is a seminar-based course designed to shape students' understanding of basic concepts and theories related to the planning and design of orthodontic force systems. Reading assignments for each seminar session is to provide background information for class discussions related to the scheduled topics. Much of the preparatory reading is directed to textbook sources. In addition, journal articles are assigned to focus on application of principles in the contemporary practice of orthodontics. In some sessions students will identify additional journal articles on their own to supplement the reading assignments. The last two sessions in the course will be devoted to PowerPoint presentations of biomechanical plans of the patients identified in ORT 660. The purpose of these presentations is to reinforce in practical terms the basic concepts and principles taught during the course.

Course Evaluation

Grades for this course will be determined by the quality of participation during the seminar sessions and by the results of a multiple choice examination given at the conclusion of the course. The exam will test for mastery of concepts covered in the course objectives listed above.

Textbook Resources:

Graber, Thomas, Robert Vanasrdall, and Katherine Vig. Orthodontics: Current Principles and Techniques, 4th ed. St. Louis: Elsevier, Inc, 2005.

Nanda, Ravindra. Biomechanics and Esthetic Strategies in Clinical Orthodontics. St. Louis: Elsevier, Inc., 2005.

Marcotte, Michael. Biomechanics in Orthodontics. Burlington, ON: B.C. Decker, Inc., 1990.

Proffit, William, and Henry Fields. Contemporary Orthodontics, 3rd ed. St. Louis: Mosby, Inc., 2000.

COURSE SCHEDULE
ORT 664

Session	Topic	Instructor
1	Principles of Biomechanics/Principles of Bracket and Band Placement	Dr. Hicks
2	Biologic Mechanisms of Orthodontic Tooth Movement	Dr. Beeman
3	Treatment in the Mixed Dentition/ Headgear	Dr. Hicks
4	Stage 1 Mechanics/Slow vs Rapid Maxillary Sutural Expansion	Dr. Hicks
5	Stage 2 Mechanics/Management of Deep Overbite Discrepancies	Dr. Hicks
6	Stage 3 Mechanics/Management of Open Bite Discrepancies	Dr. Hicks
7	Biomechanic Strategies for Non-extraction Class II Malocclusions/ Extraction Space Closure	Dr. Hicks
8	Class III Management	Dr. Hicks
9	Orthodontic Skeletal Anchorage	Dr. Hicks
10	Tweed Mechanics/Concepts of Arch Form/Differential Moments	Dr. Hicks
11	Orthodontic/Periodontic Interrelationships	Dr. Hicks
12	Biomechanical Factors in Surgical Orthodontics/Biomechanic Strategies for Optimal Finishing	Dr. Hicks
13	Esthetics in Tooth Display and Smile Design/Principles of Retention	Dr. Hicks
14	Treatment Plan Presentations (2) (ORT 660 patient)	Dr. Hicks
15	Treatment Plan Presentation (1) (ORT 660 patient)/Course Review	Dr. Hicks
16	Written Exam	Dr. Hicks

Reading Assignments

Session 1: Principles of Biomechanics/Principles of Band & Bracket Placement Dr. Hicks

Kuhlberg and Nanda, Biomechanics and Esthetic Strategies in Clinical Orthodontics, Chapter 1: Principles of Biomechanics, pp 1-16.

Graber text, Chapter 14: Bonding in Orthodontics, pp 579-659.

Isaacson, R.J., Lindauer, S.J., and Davidovitch, M. (1993). On tooth movement. *Angle Orthod*, 63(4), 305-9.

Study Guide by Dr. Hicks (attached to course syllabus)

Session 2: Biologic Mechanisms in Orthodontic Tooth Movement Dr. Beeman

Nanda text, Chapter 2: Biologic Mechanisms in Orthodontic Tooth Movement, pp 17-37.

Proffit text, Chapter 9: The Biologic Basis of Orthodontic Therapy, pp 296-325.

Session 3: Treatment in the Mixed Dentition/Headgear Mechanics Dr. Hicks

Marcotte text, Chapter 4: Headgear, pp 83-97.

Braun, S., Kong-Geun, L., and Legan, H.L. (1999) A Reexamination of Various Extraoral Appliances in Light of Recent Research Findings. *Angle Orthod*, 69(1): 81-4.

Graber text, Chapter 13: Treatment of Patients in the Mixed Dentition, pp 543-77.

Each student will select and abstract one journal article published within the last 30 years on headgear design.

Session 4: Stage 1 Mechanics/Slow vs Rapid Maxillary Sutural Expansion Dr. Hicks

Proffit text, Chapter 16: The First Stage of Comprehensive Treatment: Alignment and Leveling, pp 526-51.

Proffit text, Chapter 8, pp 256-60; Chapter 13, pp 435-40; Chapter 15, pp 508-11; Chapter 16, pp 534-38

Each student will select and abstract one “evidence-based” article regarding therapeutic outcomes of maxillary expansion.

Session 5: Stage 2 Mechanics/Management of Deep Overbite Discrepancies Dr. Hicks

Nanda text, Chapter 7: Management of Deep Overbite Malocclusion, pp 131-55.

Proffit text, Chapter 17: The Second Stage of Comprehensive Treatment: Correction of Molar Relationship and Space Closure, pp 552-77.

Session 6: Stage 3 Mechanics/Management of Open Bite Discrepancies Dr. Hicks

Proffit text, Chapter 18: The Third Stage of Comprehensive Treatment: Finishing, pp 578-96.

Nanda text, Chapter 8: Management of Open Bite Malocclusion, pp 156-76.

Session 7: Biomechanic Strategies for Nonextraction Class II Discrepancies/ Biomechanical Basis for Extraction Space Closure Dr. Hicks

Nanda text, Chapters 9 and 10: Biomechanic Strategies for Nonextraction Class II Malocclusions, pp 177-93; Biomechanic Basis of Extraction Space Closure, pp 194-210.

Viecilli, Rodrigo F. (2006) Self-corrective T-loop design for differential space closure. *Am J Orthod Dentofacial Orthop*, 129(1): 48-53.

Katona, T.R., Le, Y.P., and Chen, J. (2006) The effects of first- and second-order gable bends on forces and moments generated by triangular loops. *Am Journal Orthod Dentofacial Orthop*, 129(1): 54-9.

Session 8: Management of Class III Discrepancies Dr. Hicks

Nanda text, Chapters 11, 12, and 13: Clinical Practice Guidelines for Developing Class III Malocclusion, pp 211-42; Treatment Strategies for Developing Class III Patients, pp 243-63; Biomechanical Aspects of a Modified Protraction Headgear, pp 264-77.

Moullas, A.T., J.M. Palomo, J.R. Gass, B.D. Amberman, J. White, and Gustovich, D. (2006) Nonsurgical treatment of a patient with a Class III malocclusion. *Am Journal Orthod Dentofacial Orthop*, 129(4.S1): S111-18.

Session 9: Orthodontic Anchorage and Skeletal Implants/Bioefficiency Dr. Hicks

Nanda text, Chapters 14 and 15: Orthodontic Anchorage and Skeletal Implants, pp 278-294; A Bioefficient Skeletal Anchorage System, pp 295-309.

Park, H., Kwon, O., Sung, J. (2004) Uprighting Second Molars with Micro-Implant Anchorage. *J Clin Orthod*, 38(2), 100-3.

Park, H., Kwon, O., Sung, J. (2004) Nonextraction Treatment with Microscrew Implants. *Angle Orthod*, 74(4): 539-49.

Session 10: Tweed Mechanics/Concepts of Arch Form /Differential Moments Dr. Hicks

Graber text, Chapter 16: The Tweed-Merrifield Edgewise Appliance: Philosophy, Diagnosis, and Treatment, pp 675-715.

Demange, C. (1990) Equilibrium situations in bend force systems. *Am J Orthod Dentofacial Orthop*, 98(4), 333-39.

Smith R., and Burstone, C. (1984) Mechanics of tooth movement. *Am J Orthod Dentofacial Orthop*, 85(4), 294-307.

Rajcich, M.M., and Sadowsky, C. (1997) Efficacy of intraarch mechanics using differential moments for achieving anchorage control in extraction cases. *Am J Orthod Dentofacial Orthop*, 112(4), 441-8.

Hart, A., Taft, L., and Greenberg, S.N. (1992) The effectiveness of differential moments in establishing and maintaining anchorage. *Am J Ortho Dentofacial Orthop*, 102(5), 434-42.

Braun,S., Kusnoto, B., and Evans, C.A. (1997) The Effect of Maxillary First Molar Derotation on Arch Length. *Am J Orthod Dentofacial Orthop*, 112 (5), 538-44.

Session 11: Orthodontic / Periodontic Interrationships Dr. Hicks

Nanda text, Chapter 18: Interrelationship of Orthodontics with Periodontics and Restorative Dentistry, pp 348-72.

Graber text, Chapter 22: Periodontal-Orthodontic Interrelationships, pp 901-36.

Session 12: Biomechanical Factors in Surgical Orthodontics/Biomechanical Strategies for Optimal Finishing Dr. Hicks

Nanda text, Chapters 16 and 17: Biomechanical Factors in Surgical Orthodontics, pp 310-29; Biomechanic Strategies for Optimal Finishing, pp 330-47.

Session 13: Esthetics and Smile Design/Intro Principles of Retention Dr. Hicks

Nanda text, Chapters 6 and 17: Esthetics in Tooth Display and Smile Design, pp 110-30; Biomechanic Strategies for Optimal Finishing, pp 330-47.

Graber text, Chapter 27: Retention and Relapse, pp 1123-51.

Isiksal, Erdal, Serpil Hazar, and Sercan Akyalcin. (2006) Smile esthetics: Perception and comparison of treated and untreated smiles. *Am J Orthod Dentofacial Orthop*, 129(1), 8-16.

Session 14: Case Presentations (2 patients from ORT 660 exercise)

Each presentation will include the following elements:

1. Provide a brief overview of the problem list and treatment goals identified previously in ORT 660
2. Show the biomechanical treatment sequence using the Biomechanics Planning Form, explaining the anchorage considerations derived from force diagram analysis
3. Describe wire designs for achieving for each mechanical stage of treatment (use force diagrams as necessary to show the active and reactive forces to be employed)
4. Describe retention requirements for each arch

Session 15: Case Presentation (1 patient) / Course Review

Session 16: Final Examination

Multiple choice and short answer test covering the 21 learning objectives listed in the course syllabus