The University of British Columbia
School of Human Kinetics
Human Kinetics 351

Mechanical Properties of Tissues – From Myosin to Movement

Summary

The objective of this course is to provide the student with the opportunity to explore the mechanics of muscular contraction and to examine how the mechanical properties of the muscle, ligaments, tendons, and bone work synergistically. The primary tool for this exploration will be electromyography. Electromyography, or EMG, is a recording of the electrical activity associated with contracting muscle. It, therefore, provides a means to visualise the muscular activity much in the same way as ECG indicates heart activity and EEG can be used to quantify and describe brain wave activity. Using EMG we will explore muscular contractions and how they are affected by such variables as the mechanical properties of skeletal muscle and other tissues, joint angle and fatigue. There will be seven, two-hour laboratory classes. In each of these labs, students will be given a problem to solve and the means to solve that problem.

Dates: Term 2. Lectures Tuesday and Thursday, 2:00 - 3:30 p.m.
Instructor: Dr. David Sanderson, room 29, War Memorial Gym
Office hours: Monday, Wednesday, Friday, 9:30 - 10:20 am or by appointment

Prerequisites:

Biomechanics 151
School Core

Required Reading

On-line materials provided on the web site.

Textbook (Recommended)

Title: Neuromechanical Basis of Kinesiology, 2nd Edition
Authors: Roger Enoka
Publisher: Human Kinetics, 1994

Title: Basic Biomechanics of the Skeletal System, 2nd Edition
Authors: Margareta Nordin and Victor Frankel
Publisher: Lea and Febiger, 1989

Title: Skeletal Muscle Structure and Function
Authors: Richard Lieber
Publisher: Williams and Wilkins, 1992

Course Learning Objectives

1. Demonstrate an understanding of the elements of the human musculo-skeletal system and how their properties interact during human movement.
2. Be able to use the concepts of force-length, force-velocity, hysterisis, compression, tension, shear, stress, strain, Young's Modulus, to explain musculo-skeletal adaptation.
3. Apply knowledge of applied anatomy to describe human movement and motor skills in both anatomical and mechanical terms.
4. Become familiar with the interaction of the mechanical properties of the musculo skeletal system as they affect human movement.

5. Be able to apply surface electrodes over appropriate anatomical landmarks and record from muscles during a range of human movements.
6. Use computer programs such as Microsoft Excel to analyse biomechanical data such as joint angle, force, torque, and electromyography.
7. Become familiar with the conceptual framework for EMG analysis of human movement and understand the physiological and biomechanical basis for recording electrical potentials from striated muscles using surface electrodes.
8. Have demonstrated personal and social responsibility towards class participation.
9. Be able to facilitate active learning, critical thinking, and problem solving skills in the qualitative analysis of human musculo-skeletal system.

Course Content

1. **Biomechanics of Tissues: structure of muscle, tendon, ligament, and bone**
   - Elements of analysis of structures: statics
   - Skeletal muscle structure
   - Connective tissue
   - Bone
2. **Electromyography: Muscles come alive**
   - Hill's model of skeletal muscle
   - How joint position affects electromyographic recordings
   - Evidence for load sharing between muscles
3. **From myosin to movement**
   - Muscle, connective tissue, and bone adaptation to increased use
   - Muscle, connective tissue, and bone adaptation to decreased use
   - Control of muscle during trunk flexion and extension

Course Structure

The lecture component will be two 90-minute seminars. The seminars will include lecturing in addition to discussions around pre-assigned topics. Students will be requested to prepare for these discussion with readings handed out at the beginning of the course. Involvement in the discussion will be the basis upon which participation will be assessed.

Course Participation: personal and social responsibility

As there is a component of group problem solving in this course, credit will be given for leadership, critical contribution, interpersonal skills, support activities, punctual attendance, on-time completion of class activities, positive attitude and effort according to the following schedule.

10	Outstanding	Continual encouraging and supportive of others, outstanding leadership, critical contribution and interpersonal skills. Volunteers, facilitates the learning of others. Excellent attitude and effort. 100 % punctual attendance
8	Very good	Demonstrates leadership and active support with colleagues. Very high level of critical contribution. Near 100 % punctual attendance. Positive attitude and very high level of effort throughout course.
6	Adequate	Works well with others, willing to contribute towards class discussion. Only 2-3 sessions non-punctual /non-attendance.

		Satisfactory effort and attitude.
4	Minimal	Little contribution and support given during class processes. More than 2-3 sessions of non-punctual/non-attendance. Motivation and initiative low. Minimal level of effort.
1	Poor	Zero contribution and support given during class processes. Poor punctual and attendance Attitude, participation, and effort do not meet acceptable standard.

Evaluation Profile

Learning objective	*Method*	*Value*
1, 2, 3, 4, 5, 6, 7	Written examinations (3)	
	Mid-term 1	30
	Mid-term 2	30
	Final	60
	Total	100 marks