

Dr. Kwon's Golf Biomechanics Instructor Training Program - Level 1

Course Outline

(Last updated in January 2018)

Objectives

- To introduce basic mechanical quantities/concepts relevant to golf swing
- To introduce key biomechanical principles of human movement
- To provide the mechanical/biomechanical framework of a "mechanically good golf swing"

Class 1: Introduction

- Orientation
- Golf swing biomechanics
- Main themes & expected outcomes
- Kinematics vs. kinetics
- Types of motion
 - Linear
 - Angular
 - General: club & pelvis
 - Analysis strategies
- Scalar vs. vector
 - Vector addition/subtraction
 - The tip-to-tail method
 - Vector components
 - Tangential & normal acceleration
- Swing events & phases

Class 2: Basic mechanical concepts

- Basic kinematic quantities
 - Position
 - Velocity & speed
 - Acceleration
- Angular kinematics
 - Angular position
 - Angular velocity
 - Angular acceleration
- Mass
 - Center of mass (CM)
- Force
 - Properties
 - Various forces
 - Pressure
- Moment of force (torque)
 - Center of rotation

- Point of action
- Line of action
- Plane of action
- Moment arm
- Moment of force (torque)
- Moment vs. moment arm
- Types of force
 - Concentric
 - Eccentric
 - Force couple
- Net force & net moment
- Pivoting moment
- Mechanical system & external force
- Newton's laws of motion
 - Inertia
 - Acceleration
 - Reaction
- Momentum
 - Linear momentum
 - Angular momentum
- Newton's laws revisited
 - Newton's equation of motion
- Principles of mechanically flowing swing motion
 - Minimization of force exertion in wrong directions
 - Involvement of as many segments/joints as possible
 - Smooth acceleration/deceleration
 - Angular momentum generation
 - Utilization of the angular momentum

Class 3: Golfer's body

- Degrees of freedom (DOFs) in the golfer's body
- Joint flexibility and range of motion
- Types of muscle contraction
- Hill's muscle model
- Force-length relationship
- Force-velocity relationship
- Force-time relationship
- Stretch-shortening cycle (SSC)
 - Countermovement

- Countermovement jump

Class 4: Linear kinematics

- Body CM of the golfer's body
- Body CM motion
 - Horizontal
 - Vertical
- Position-velocity-acceleration relationships
- Pelvis CM motion
 - Forward/backward
 - Toward/away
 - Upward/downward

Class 5: Functional swing plane

- Popular swing planes
 - Ben Hogan's shoulder plane
 - Hank Haney's shaft plane
 - Jim Hardy's shoulder/arm lines
 - Double-pendulum & triple-pendulum
- Functional swing plane (FSP)
 - Clubhead trajectory plane
 - Properties
 - Position of FSP
- Swing style classification based on FSP
- Popular models revisited
 - Jim Hardy's
 - Hank Haney's
- Motion planes (MPs) of the joints
 - Motion plane orientation
 - Hand MP and swing styles
- Upper body- vs. lower body-dominant swing

Class 6: Angular kinematics

- Functional double-pendulum (FDP)
 - On-plane motion
- Angular position
 - Upper & lower lever angles
 - X-factor & shoulder/hip line angles
 - Hip/shoulder line motion ranges
- Angular velocities
- Kinematic sequence
 - Normal vs. abnormal sequences
 - Common issues
- Angular accelerations

- Club motion: linear vs. angular
 - Velocity relationship
 - Acceleration relationships
- Pelvis angular motions
 - Left/right rotation
 - Right/left lateral tilt
 - Posterior/anterior tilt

Class 7: Linear & angular kinetics

- Ground reaction force & moment
 - Ground reaction force (GRF)
 - Center of pressure (CP)
 - Ground reaction moment (GRM)
 - Combined COP
 - Force plate vs. pressure mat/plate
 - Two plates vs. one plate: pivoting moment
- Angular momentum generation
- Foot-ground interaction
 - GRF moments
 - Pivoting & foot contact moments
- Ground-up swing
- Biomechanics of the two-step drill
- Moment of inertia
 - Radius of gyration
 - Human body
- MOI of the club
- Angular momentum conservation
- Angular momentum of the club
 - Local angular momentum
 - Remote angular momentums
- Angular momentum transfer
- Angular momentum generation & transfer
- Mid-hand force & moment
 - Moments acting on the club
 - Moving mid-hand reference frame
 - Tangential & normal force
 - Mid-hand force moment
 - Mid-hand moment
- Mid-trunk moment

Summary and Closing

- Mechanically good swing?
- Q & A

Typical Course Schedule-Level 1

Day 1

- 8:30-9:00a Registration
- 9:00-10:20a Introduction
- 10:30a-12:20p Basic mechanical concepts
- 12:30-1:30p Lunch
- 1:30-2:50p Golfer's body
- 3:00-4:20p Linear kinematics
- 4:30-5:50p Functional swing plane

Day 2

- 9:00-10:20a Angular kinematics
- 10:30a-12:20p Kinetics 1
- 12:30-1:30p Lunch
- 1:30-3:20p Kinetics 2
- 3:30-4:00p Summary and closing