

Dr. Kwon's Golf Biomechanics Instructor Training Program - Level 1
Course Outline (15 hours)
(Last updated in June 2024)

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

- Golf swing biomechanics
- Main themes & key biomechanical principles
- Kinematics vs. kinetics
- Swing events & phases
- Types of motion
 - Linear
 - Angular
 - Examples: club & pelvis motions
 - Analysis strategies

Class 2: Basic kinematic concepts

- Scalar vs. vector quantities
 - Vector addition/subtraction
 - The tip-to-tail method
 - Vector components
 - Tangential & normal acceleration
- Linear kinematic quantities
 - Position
 - Velocity & speed
 - Acceleration
- Angular kinematic quantities
 - Angular position
 - Angular velocity
 - Angular acceleration

Class 3: Basic kinetic quantities

- Mass
 - Center of mass (CM)
 - Center of mass of the golfer's body
- Force
 - Properties
 - Various forces

- Properties
- Cause of motion
- Pressure
- Moment of force (torque)
 - Center of rotation
 - Point of action
 - Line of action
 - Plane of action
 - Moment arm
 - Moment of force (torque)
 - Example: swing weight
 - Moment of force in the frontal plane
 - Different swing styles
 - Moment vs. moment arm
- Types of force
 - Concentric
 - Eccentric
 - Force couple
- Net force & net moment

Class 4: Key mechanical laws & principles

- System & external force
- Newton's laws of motion
 - Inertia
 - Acceleration
 - Reaction
- Ground reaction force/moment
 - Foot-ground interaction
 - Center of pressure
 - Ground reaction moment
 - COP revisited
 - Net GRF & combined COP
 - Force plate vs. pressure mat/plate
- Momentum
 - Linear momentum
 - Angular momentum
- Impulse
 - Linear & angular impulse
 - Net linear impulse on golfer's body
 - Normal pattern
 - Stack & Tilt
 - Jumping off
 - Net angular impulse on golfer's body

- Frontal plane moment
- Newton's laws revisited
 - Momentum conservation
 - Newton's equation of motion
 - Momentum transfer

Class 5: Golfer's body

- Degrees of freedom (DOFs) in the golfer's body
- Types of muscle contraction
 - Concentric
 - Eccentric
 - Isometric
- Characteristics of skeletal muscle
 - Force-length relationship
 - Force-velocity relationship
 - Force-time relationship
- Stretch-shortening cycle (SSC)
 - Countermovement
- Countermovement vs. squat jump
- Countermovement & frontal-plane GRF moment

Class 6: Linear kinematics of the CM & pelvis

- Body CM motion
 - Horizontal
 - Vertical
- Positive/negative velocity/acceleration components
- Position-velocity-acceleration relationships
 - Horizontal rhythm
 - Vertical rhythm
- Pelvis CM motion
 - Forward/backward
 - Toward/away
 - Upward/downward
- Forces acting on the hips during the swing
- Horizontal motion of the pelvis CM vs. sacrum sensor

Class 7: 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 model
- Functional swing plane (FSP)

- Clubhead trajectory plane
- Motion of the lead hand
- Properties
- Position of FSP
- Trunk alignment
- Swing style & planarity bias
- Popular models revisited
 - Jim Hardy's
 - Hank Haney's
- Motion planes (MPs) of the joints
 - Motion planes of various joints
- Hand MP (HMP) and swing styles
 - Parallel alignment
 - Outward direction gap
 - Inward direction gap
- HMP direction vs. slope: hand path ellipse
- Clustering of the patterns
- Ideal swing?
- Upper-body vs. lower-body dominance

Class 8: Angular kinematics of the axle-chain system

- Inclined axle-chain system
- Functional double-pendulum (FDP)
 - On-plane motion
- Angular position
 - Upper & lower lever angles
 - X-factor & shoulder/hip line angles
 - X-factor stretch & separation styles
 - X-factor stretch strategies
 - Hip/shoulder line motion ranges
- Angular velocities
- Kinematic sequences
 - Backswing sequence
 - Transition sequence
 - Downswing sequence
- Normal vs. abnormal sequences
- Common issues
- Angular decelerations
- Rotation-based swing phases
- Club motion: linear vs. angular
 - Velocity relationship
 - Tangential & radial accelerations
- Centrifugal force
- Pelvis angular motions
 - Left/right rotation
 - Right/left lateral tilt

- Posterior/anterior tilt
- Pelvis motion during the backswing
- Angular motion of the thorax
 - Conventional vs. Kwon method
 - Lean direction, lean, and rotation angle

Class 9: Kinetics: golfer-ground interaction

- Golfer-ground interaction moments
 - GRF moments
 - Pivoting & foot contact moments
 - Net moment acting on the golfer-club system
 - Frontal-plane GRF moment pattern
 - Horizontal-plane pivoting moment pattern
- On the knees: Martin Borgmeier
- Forces acting on the hip joints & pelvis motion
- Stepping-like rhythm in golf swing
- Biomechanics of the two-step swing
- Two-step swing drills

Chapter 10: Kinetics: momentum generation & transfer

- Moment of inertia
 - MOI of a mass particle
 - MOI of an object

- MOI of the human body
- MOI of the club
- MOI of the club about the body CM
- Angular momentum of the club
 - Local angular momentum
 - Remote angular momentums
- Angular momentum of the golfer-club system
- Angular momentum conservation
- Angular momentum transfer
- Angular momentum generation & transfer
- Changes in angular momentums of the body & club

Class 11: Summary

- The K·GRAND=IO=SE swing principles
 - Ground-up
 - Rhythmic
 - Asynchronous
 - Natural
 - Dynamic
 - Impulsmart
 - Orchestrated
 - Safe
 - Effectificient
- Q & A