

Throwing and Striking

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Readings

1. Hamilton, N., & Luttgens, K. 2002. [Kinesiology, Scientific Basis of Human Motion](#), 10thed. Chapter 18, pp. 450-466.

Objectives: After studying this topic, the students will be able to

- identify the sequential movement and give examples
- classify sports activities involving sequential movements according to the nature of force application
- identify the mechanical factors that affecting to throwing, striking, or kicking

Sequential Movements of the Body Segments

Definition of Sequential Movement

- the movement that involves a sequential action of a chain of body segments, leading to a high-velocity motion of external objects (Hamilton & Luttgens, 2002, p.451)
 - results in the production of a summated velocity at the end of the chain of segment used
 - the path of the external object motion is curvilinear in nature
- examples
 - a pitcher throws a baseball
 - a young adult spikes a volleyball
 - a batter hits a baseball
 - an elderly drives a golf ball
 - a tennis player serves a tennis

Modification of Sequential Movement

- objectives of sequential movements
 - skill
 - speed
 - accuracy
 - distance
- components that are used to modify movement according to different objectives
 - numbers of body segment used
 - range of motion (ROM) used
 - lever length used

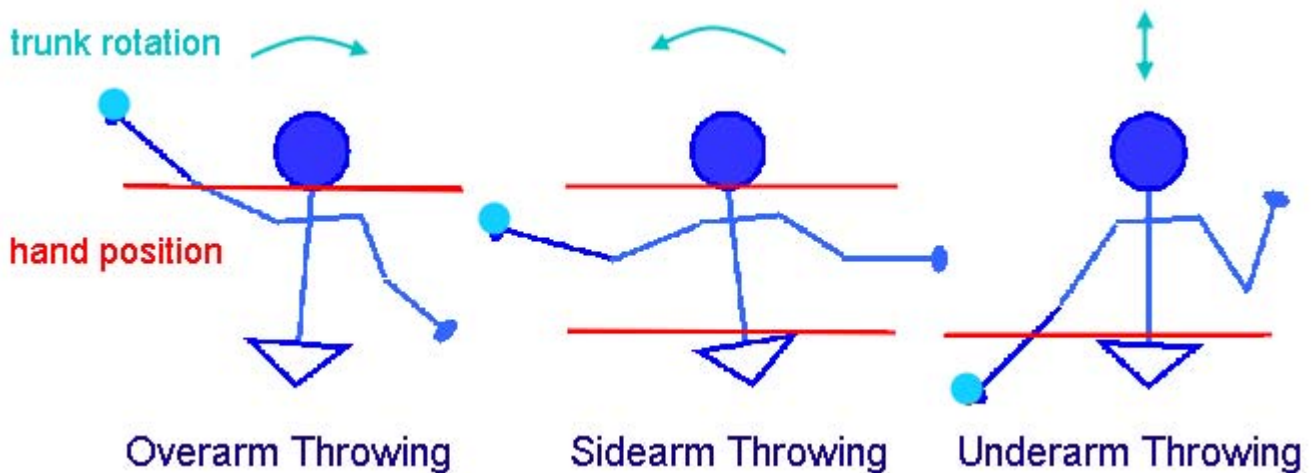
Classification by Nature of Force Application

- momentary contact
 - force imparted to an object through temporally contact with that object by a moving part of the body segment or by implement held or attached on the body segment
 - the object may be either stationary or moving
 - examples :
 - on moving object : baseball striking, soccer heading or kicking, volleyball set, or tennis driving
 - on stationary object : golf
- projection
 - force imparted to an object through the end of a chain of body segments in order to develop kinetic energy, followed by a high-velocity motion of that object
 - the object may be held in one hand or hands
 - examples :
 - for distance : shot put, javelin, or volleyball serving
 - for accuracy : baseball pitching or dart throw
- continuous application
 - force imparted to an object with the force continuously applying to that object
 - examples :
 - against large resistance : pushing a desk or lifting weight
 - maintain a position while waiting for a release : archery

Biomechanics of Baseball Throwing

Patterns of Throwing

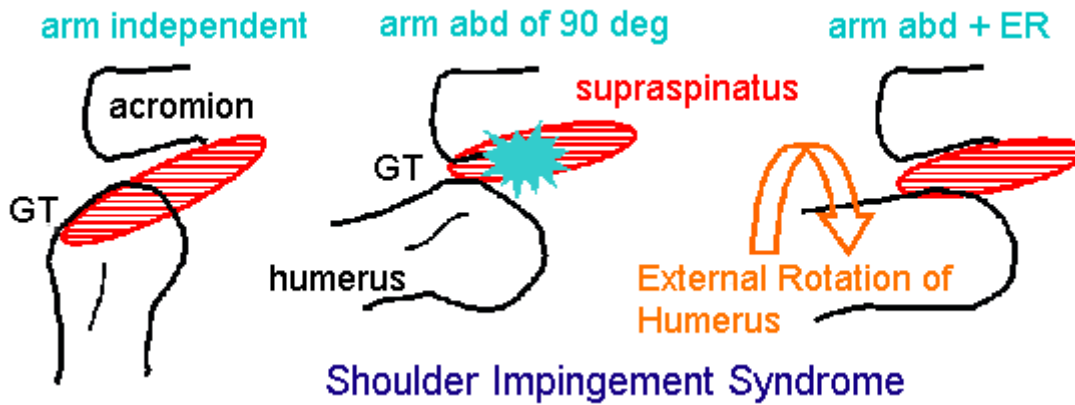
- overarm (overhead)
- sidearm
- underarm



Kinematics of Overarm Throwing

- windup (cocking) phase
 - shoulder horizontal abduction and fully external rotation (closed-packed position)
 - trunk left rotation
 - prone to have shoulder impingement syndrome
- acceleration phase
 - shoulder internal rotation
- deceleration phase
 - checked by shoulder external rotators
- follow-through phase
 - trunk rotation





Kinematics of Sidearm Throwing

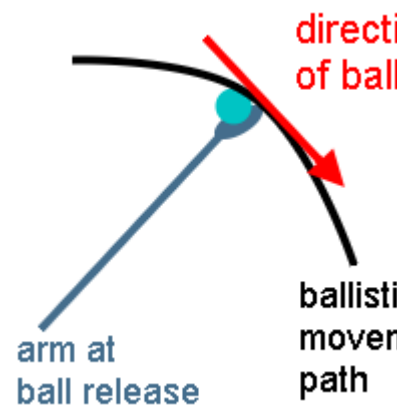
- preparation phase
 - shoulder horizontal abduction only
 - trunk right rotation
- acceleration phase
 - shoulder horizontal adduction
- deceleration phase
 - checked by deltoid posterior
- follow-through phase
 - opposite hip internal rotation

Kinematics of Underarm Throwing

- preparation phase
 - shoulder extension
 - elbow extension
- acceleration phase
 - shoulder flexion (arm flexion)
- deceleration phase
 - checked by shoulder extensors
- follow-through phase
 - trunk rotation

Mechanical Factors of Throwing

- ballistic movement of one segment
- imparting force must overcome the inertial of an object
 - mass of object
 - internal resistance
 - friction between object and supporting surface
 - resistance to surrounding medium
- force needed dependent on
 - speed of object
 - distance of throwing
 - accuracy of target : related to direction of the object after its release
- direction of the object after release dependent on
 - direction of the object at the moment of release : path tangential to the arc of motion
 - gravity
 - air or water resistance
 - spin of the object
- timing pattern of movement part
 - The slowest or heaviest part must start to move first, and the quickest and lightest last
 - to facilitate use of stretch reflex



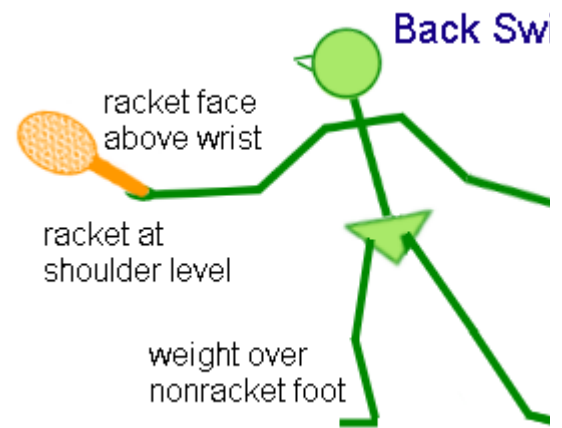
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Biomechanics of Striking

Forehand Drive in Tennis

- action : the player takes the racket to hit the ball and send it into the opponent's court
 - type of movement : ballistic movement
 - participating lever : racket, racket-side arm, and trunk
 - location fulcrum : the hip joint at non-racket side
 - skill requirement : high speed and moderate accuracy
- motion description
 - back swing phase
 - the player pivots his body to have the non-racket side face forward

- the racket is taken back at the shoulder level
- the body weight is over the foot of the racket side
- the head of the racket is kept above the wrist



- forward swing phase
 - the player lowers down his body by flexing the knee to have the racket below the intended contact point
 - the trunk rotates forward to shift the weight to the foot of the non-racket side
 - the racket is perpendicular to the ground at the moment of impact
- follow-through phase
 - the body continues forward
 - the racket arm swings across the body and up toward the chin
- the effect of body spinning
- mechanical factors contributing the impact to the ball : the greater impart force will impart more momentum to the ball, leading to speed up the ball on its return flight
 - increase the lever-arm length by using a long-arm racket, keeping the arm straight
- firmness of grip depends on
 - muscle strength of wrist and finger flexors
 - the angle of the racket face at ball hitting because the angle of rebound is highly correlated to the angle of incidence
 - actually, the ball is not a rigid body so that the angle of rebound is slightly less than the angle of incidence

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