BIOMECHANICAL PRINCIPLES IN THE THROWS
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- B.S. 1969, Chicago State University
- M.S. 1971, Chicago State University
- Ph.D. 1980, University of Illinois at Urbana-Champaign
- Director of SPHER at Courage Center 1978 – 1990
- Executive Director SLWAA 1991- 1996
- Special Education Teacher – 1996 – 1998
- Secretary General, IWBF – 1999 – 2002
- Adapted Physical Educator – 2003 - 2007
Coach or Administrator

- All Paralympic Games from 1976 – 2002
- All Pan American Wheelchair Games from 1975 – 1990
- All International Stoke Mandeville Games from 1975 – 1997
- Founder & first commissioner of NWBA Junior Division
- 5 NWWBT Championships
- USA Wheelchair Sports Hall of Fame
- NWBA Hall of Fame
Coach or Administrator

- WASUSA Board 1976 – 2001
- IWAS – 1988 - 1996
Athletes

• Sharon Hedrick
• Susan Hagel
• Carlee Hofmann
• Liz Stone
• Deb Sunderman
• Karen Casper
• Mina Mojahedi
• Shawna Culp
• Patty Cisneros
• Hope Chafee
• Ella Chafee
• Lloyd Zeise
• Mark Knutson
BIOMECHANICAL PRINCIPLES IN THE THROWS
PROJECTILE

a body projected by external force and continuing in motion by its own inertia

http://www.merriam-webster.com/dictionary/projectile
PROJECTILES IN SPORT

- BALLS
- JAVELINS
- DISCUSES
- BODIES
EXTREME SPORTS
OBJECTIVES

• to fly for a long time (a lob in tennis)
• to reach a peak height (a shot in basketball)
• to be displaced horizontally as far as possible (putting a shot).
QUESTION

WHAT BIOMECHANICAL PRINCIPLES CAN ASSIST IN PROPELLING THE PROJECTILE THE HIGHEST OR THE FARTHEST?
WHAT FORCES ACT ON A PROJECTILE?

- GRAVITY
- AIR
GRAVITY

The gravitational attraction of the mass of the earth, the moon, or a planet for bodies at or near its surface

http://www.merriam-webster.com/dictionary/gravity
GALILEO AT THE TOWER OF PISA
PROJECTILE IN FLIGHT

Falls toward the ground accelerating at 32ft/sec/sec

How far will dropped object fall in one second?

16.1 feet
What is one thing a person can do to keep a projectile he or she drops in the air longer?

Drop it farther from a higher spot.
PRINCIPLE 1

• The farther from the ground the release point is the longer the projectile will stay in the air.
HORIZONTAL DISPLACEMENT

• Making projectiles go farther
• Driving for a set amount of time, how can one go farther?
WHAT DO WE KNOW?

• Throw a projectile **parallel** to the ground from 16 feet above the ground.
• It will hit the ground in **one** second(s).
• Does the mass of the projectile matter?

**absolutely not**
Once the projectile is released it accelerates downward

TRUE or FALSE?
Once the projectile is released the thrower can accelerate it horizontally.

TRUE or FALSE?
INCREASE HORIZONTAL DISPLACEMENT

- Horizontal displacement is a function of horizontal velocity and time.

\[ \Delta x = v \Delta t \]

- \( x \) = horizontal displacement
- \( v \) = velocity
- \( t \) = time

The faster it flies and the longer it is in the air, the farther it will go.
WHAT HAVE WE DETERMINED

Horizontal displacement of a thrown object is a function of initial horizontal velocity and initial height.
PRINCIPLE 2

• The faster the projectile is moving at the point of release, the farther it will go.
ANGLE OF RELEASE

• Time in the air has been a constant based on the height of release and vertical acceleration downward.

• If the thrower keeps the release height and the release velocity constant, how can he or she keep the projectile in the air longer?
Which of these is true?

A. The higher a projectile is at release and the faster it is moving upward at release the higher it will go.

B. The faster a person can throw an object the farther it will go.

C. If the initial velocity of the projectile is totally vertical, there is no horizontal velocity, thus no horizontal displacement.

D. All of the above
ANGLE OF RELEASE

VERTICAL

HORIZONTAL
• The higher the release from the ground, the longer the projectile will be airborne.

• The athlete can focus more power horizontally than vertically, so the angle of release may be less than 45°.
PRINCIPLE 3

• The optimal angle of release for an object that is minimally subject to the effect of air resistance approximates, but is less than 45°.
DISCUS & JAVELIN

• Discus 33 – 38
• Javelin 27 – 35
• Shot 32 - 40
TASK OF THE THROWER

• Change the velocity of the projectile from zero to an optimal level.
  – Force acting over time – impulse
• Control the force by the power of the muscles and muscle groups involved.
• Control the duration of time the projectile is accelerated.
• Automobiles
\[ \Sigma F \Delta t = m(v_f - v_i) = \text{impulse} \]

\( \Sigma F = \) average net force

\( \Delta t = \) length of time of acting force

\( m = \) mass of the object

\( v_f = \) final velocity

\( v_i = \) initial velocity
Principle 4

- Throwing lighter objects – duration of force is more important (technique)
- Throwing heavier objects – the force applied is more important (power)
Charge as Coaches

• Rules
• Athlete’s abilities