LEARNING OBJECTIVES

✦ Define plyometrics and list the three primary components

✦ Identify and describe each sub-component within the three primary components of plyometrics

✦ Describe the performance and injury prevention benefits associated with plyometrics

✦ Identify and design effective plyometric programming relative to individual differences and session demand
What should we consider when trying to optimize transfer from the weight room to sport?

Strength Demands...
Speed Demands...

Sport Demands...
‘Shock-method’ was first proposed by Dr. Yuri Verkhoshansky and popularized through the use of ‘depth/drop jumps’

The term PLYOMETRICS was later proposed by western track coach Fred Wilt

Plyometrics represent a category of movements that are meant to improve overall speed-strength qualities
DEFINING PLYOMETRICS

Drills aimed at linking optimal strength and speed during fundamental movement patterns (speed-strength)

Defined as a quick, powerful movements that utilize the stretch-shortening cycle (SSC)

SSC is defined as a rapid muscle lengthening followed immediately by a rapid muscle shortening
+ SSC optimizes the use of the stretch reflex and stored elastic energy

**PLYOMETRIC COMPONENTS**

**MOVEMENT**
Based on the dominant motor patterns being taught within the following Movement Skills session

**DIRECTION**
Based on dominant force vectors being taught within the following Movement Skills session

**INITIATION**
Based on the dominant contraction types being taught within the following Movement Skills session
PLYOMETRIC: MOVEMENT

**JUMP**
Two foot take-off followed by a two-foot landing

**BOUND**
Single foot take-off followed by an opposite single foot landing

**HOP**
Single foot take-off followed by the same single foot landing

**MOVEMENT (JUMP)**

Continuous Lin-Vert Jump

Continuous Lin-Vert Box Split Jump
01 MOVEMENT (BOUND)

Countermovement Lat-Horiz Bound  

Countermovement Lat-Horiz 45° Bound

01 MOVEMENT (HOP)

Drop Hop (Plyo Prep)  

Countermovement Lin-Vert Box Hop
**PLYOMETRIC: DIRECTION**

**LINEAR**
Movement direction includes Linear-Vertical and Linear-Horizontal

**LATERAL**
Movement direction includes Lateral-Vertical and Lateral-Horizontal

**ROTATIONAL**
Movement direction includes Rotational-Vertical and Rotational-Horizontal

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**02 DIRECTION (LINEAR)**

- Continuous **Lin-Vert**
- Alternating Split Jump

- Double Contact **Lin-Horiz**
- Hurdle Hop
02 DIRECTION (LATERAL)

Countermovement Lat-Vert Box Hop  
Countermovement Lat-Horiz Hurdle Hop

02 DIRECTION (ROTATIONAL)

Countermovement Rot-Vert 180° Jump  
Countermovement Rot-Horiz 90° Bound
**PLYOMETRIC: INITIATION**

- **NON COUNTER-MOVEMENT**: No lengthening action prior to shortening action (Concentric only)
- **COUNTER-MOVEMENT**: Rapid lengthening action prior to an immediate shortening action (SSC)
- **DOUBLE CONTACT**: Lengthening action preceded by a rapid ground contact and followed by a shortening action (SSC)
- **CONTINUOUS**: Linking multiple SSC repetitions together in quick succession (SSC)
- **DEPTH/DROP JUMP**: Lengthening action preceded by a rapid ground contact from a box and followed by a shortening action (SSC)

**03 INITIATION (NON-COUNTERMOVEMENT)**

- NCM Lin-Vert Jump
- NCM Lin-Vert Box Split Jump
03 INITIATION (COUNTERMOVEMENT)

CM Lat-Horiz Hurdle Hop-Lateral  CM Lat-Horiz Hurdle Hop-Medial

03 INITIATION (DOUBLE CONTACT)

DC Lat-Horiz Hurdle Hop-Lateral  DC Lat-Horiz Hurdle Hop-Medial
03 INITIATION (CONTINUOUS)

CONT Lin-Horiz Hurdle Hop-Lateral

CONT Lin-Horiz Hurdle Hop-Medial

CHECK FOR LEARNING

- List the 3 primary components of plyometrics and the associated 3-5 sub-components

- Write down 3-5 different plyometric movements using the appropriate labeling
PLYOMETRICS

+ OPTIMIZING TRANSFER
PLYOMETRICS: PRIMARY GOAL

Apply optimal force (strength) and velocity (speed) in the correct direction within the shortest time (efficiency)

PLYOMETRICS: PERFORMANCE BENEFIT

- Increased explosive strength due to improved rate of force development (RFD)
- Increased reactive strength due to greater storage and reutilization of elastic energy
- Improved ability to transfer force through the joints and minimize energy leaks

(Aagaard at al., 2002, Komi, 2003 and Turner and Jeffreys, 2010)
FORCE-VELOCITY RELATIONSHIP

- MAXIMAL STRENGTH
- SPEED STRENGTH
- SPEED

PLYOMETRICS

Force (N) vs. Velocity (M/S) vs. Time (s)

(Plyometrics for 300ms)

MAXIMAL STRENGTH
SPEED STRENGTH
SPEED

PLYOMETRICS

FORCE-VELOCITY RELATIONSHIP (Newton & Kraemer, 1994)

EXOS

RANGE OF FORCE DEVELOPMENT

- Heavy resistance training
- Explosive plyometric training
- Untrained

Force (N) vs. Time (s)

RFD

0 200ms 500ms

(Newton & Kraemer, 1994)

EXOS

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What are the mechanisms underpinning the performance benefit of plyometrics?

Stretch-Shortening Cycle (SSC)

Movements utilizing a stretch-shortening cycle have been shown to increase performance by 10-15% compared to movements that do not.

(Turner & Jeffreys, 2010)
SSC: Mechanisms

STRETCH-SHORTENING CYCLE (SSC)

<table>
<thead>
<tr>
<th>FORCE POTENTIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTRACTILE CONTRIBUTION</td>
</tr>
<tr>
<td>INCREASED ACTIVATION TIME</td>
</tr>
<tr>
<td>STRETCH REFLEX</td>
</tr>
<tr>
<td>STORAGE OF ELASTIC ENERGY (MUSCLE)</td>
</tr>
<tr>
<td>STORAGE OF ELASTIC ENERGY (TENDON)</td>
</tr>
</tbody>
</table>

(Blazevich, A., 2011)

SSC: Contractile

Afferent Signal + Stretch

Contractile Element + Parallel Elastic Component (PEC)

Muscle Spindle + Stretch Reflex

Efferent Signal + Contract

(Modified from Hill’s model for muscle contraction)
SSC: ELASTIC

Slow SSC >250ms:
- Walking
- Jogging
- CMJ

Fast SSC <250ms:
- Sprinting
- Change of Direction
- DC/Depth Jumps

Contractile Element +
Parallel Elastic Component (PEC)

Tendon+
Series Elastic Component (SEC)

(Modified from Hill’s model for muscle contraction)

(Schmidtbleicher, p. 381-395, 1992)

INJURY PREVENTION

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PLYOMETRICS: SECONDARY GOAL

Decrease risk of injury through increased tolerance to stretch loads at various speeds, loads, and directions.

PLYOMETRICS: INJURY PREVENTION BENEFIT

+ Injuries primarily occur during unexpected over-lengthening of muscle/ligaments during landing and deceleration tasks.

+ Many of these injuries occur when an athlete finds themselves in a position for which they do not have a robust motor response.

+ Plyometrics improve an athlete’s ability to handle rapid stretch loads and supports enhanced coordination of movement during reaction and rapid change of direction tasks.

Plyometrics have been shown to improve performance factors while decreasing biomechanical risk factors associated with ACL tears

**Design:**
- Females: N=18 (F) underwent 8 weeks of plyometrics training and N=18 (F) acted as a control and did no physical activity

**Results:**
- The plyometric group improved hop based performance measures while improving lower limb kinematics during single leg movement

Baldon et al., 2014

A 2012 Meta-Analysis showed that males and females involved in neuromuscular based ACL prevention programs including plyometrics have a significant reduction in ACL tears (M: 85%; F: 52%)

Sadoghi et al., 2012
CHECK FOR LEARNING

- List at least 3 factors that contribute to the performance improvements seen during SSC opposed to non-SSC movement (i.e. NCM Jump vs. CM Jump)

- Write down 3-5 sentences describing the role of plyometrics in preventing non-contact injuries (ex. ACL injury)
**PROGRAMMING CONSIDERATIONS**

- Frequency
- Volume
- Intensity
- Methods

### FREQUENCY, VOLUME & INTENSITY

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>VOLUME</th>
<th>INTENSITY</th>
<th>MOVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly: 2x (15-20min)</td>
<td>Contacts: 40-60/session</td>
<td>Sets/Reps: 2-3sets/4-6reps</td>
<td>Movements: 3-5</td>
</tr>
<tr>
<td></td>
<td>Total: ≤120/wk</td>
<td>Rest Set/Session: 1-3min/72hrs</td>
<td>Directions: 1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Initiations: 2-3</td>
</tr>
<tr>
<td>Focus: Speed-Strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total: ≤120/wk</td>
<td>Rest Set/Session: 1-2min/24hrs</td>
<td>Directions: 1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Initiations: 2-3</td>
</tr>
</tbody>
</table>

(de Villarreal et al., 2009)
Studies on plyometrics do not factor in total training volume (ex. inclusion of strength and movement skills) and make recommendations solely based on plyometric training.

**KEY CONSIDERATION**

**METHODS (EX. JUMP – BOUND – HOP)**

<table>
<thead>
<tr>
<th>INTENSITY</th>
<th>LINEAR (VERTICAL TO HORIZONTAL)</th>
<th>LATERAL (VERTICAL TO HORIZONTAL)</th>
<th>ROTATIONAL (VERTICAL TO HORIZONTAL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTINUOUS</td>
<td>Lin-Vert Jump Lin-Horiz Bound</td>
<td>Lat-Horiz 45° Bound Lat-Horiz Hurdle Hop</td>
<td>Rot-Vert 180° Jump Rot-Vert 90° Hop</td>
</tr>
<tr>
<td>DOUBLE CONTACT</td>
<td>Lin-Horiz Hurdle Jump Lin-Horiz Hurdle Hop</td>
<td>Lat-Horiz Bound Lat-Horiz Hurdle Hop</td>
<td>Rot-Vert 270° Jump Rot-Horiz 180° Bound</td>
</tr>
<tr>
<td>COUNTER-MOVEMENT</td>
<td>Lin-Vert Jump Lin-Horiz Bound</td>
<td>Lat-Horiz 45° Bound Lat-Horiz Hurdle Hop</td>
<td>Rot-Vert 180° Jump Rot-Vert 90° Hop</td>
</tr>
<tr>
<td>NON COUNTER-MOVEMENT</td>
<td>Lin-Vert Box Jump Lin-Vert Hurdle Hop</td>
<td>Lat-Vert Bound Lat-Vert Hurdle Hop</td>
<td>Rot-Vert 90° Jump Rot-Horiz 90° Bound</td>
</tr>
</tbody>
</table>
## EXAMPLE PROGRAMMING: PLYOMETRICS

### PLYOS: Linear Movement Skills

**Novice Athlete (4x per week)**

- **Movement 1:**
  - NCM Lin-Vert Box (12in) Jump
  - 2 x 5 repetitions

- **Movement 2:**
  - CM Lin-Horiz (12in) Hurdle Jump
  - 1 x 5 repetitions

- **Movement 3:**
  - CM Lin-Horiz (6in) Hurdle Hop
  - 2 x 5 repetitions each

**Total Contacts: 25**

### PLYOS: Multi-Movement Skills

**Advanced Athlete (2x per week)**

- **Movement 1:**
  - CM Lat-Horiz Bound (Quick-Stick)
  - 2 x (3x3) repetitions each

- **Movement 2:**
  - Continuous Lat-Horiz 45° Bound
  - 2 x 5 repetitions each

- **Movement 3:**
  - DC Lat-Horiz (12in) Hurdle Hop
  - 1 x 5 repetitions each (medial & Lateral)

**Total Contacts: 38**

## GUIDELINES

- **Movement (Jump – Bound – Hop)**
  - More Stable to Less Stable

- **Direction (Linear – Lateral - Rotational)**
  - General to Specific (Vertical to Horizontal)

- **Initiation (NCM – CM – DC – CONT – DJ)**
  - Low Force to High Force (Progression & Continuum)

- **Equipment (Low Box – Ground – Hurdle – High Box)**
  - Low Force to High Force
CHECK FOR LEARNING

Create a single 10 min plyometric program based on a 4x week intermediate athlete preparing for linear speed sessions (Note: Only create the plyometric portion and include as much detail on volume and intensity as possible)
**MOVEMENT**

Movements are selected based on the level of athlete (2-leg to 1-leg) and the specific movement characteristics in need of development (movement skills & sport).

**DIRECTION**

Movement directions are selected based on the level of athlete (linear to rotational) and the specific directional force characteristics in need of development (movement skills & sport).
Movement initiations are selected based on the level of athlete (NCM to DJ) and the specific speed-strength characteristics in need of development (strength & movement skills).
APPENDIX


APPENDIX

APPENDIX


