Session Title: **Plyometrics for Everyone** *Presented by*: **Jonathan Ross, www.AionFitness.com; www.AbsRevealed.com**

Introduction

Many athletic movements as well as many everyday life movements require explosive and/or rapid muscle actions that require rapid rates of force production or power in addition to high levels of coordination and reactivity.

A. Power can be acyclic or cyclic in nature:

- **Acyclical** – a single, near- or maximum effort executed in a short period of time
  Examples: swinging a club or racquet; throwing a ball; performing a long or high jump; or Olympic weightlifting
- **Cyclical** – repeated efforts executed over a longer period of time
  Examples: sprinting or multiple jumps required for a number of sports, including football, soccer, basketball, rugby, lacrosse; power strokes in rowing or cycling

B. What Are Plyometrics?

- A training modality developed by Verkhoshanski in 1969 that employs high-speed controlled deceleration and muscle pre-stretching (eccentric loading) prior to executing rapid and powerful concentric contractions (concentric unloading)
  - Plyometric training harnesses the elasticity of the stretch-shortening cycle (SSC) by minimizing the transition between the eccentric (pre-stretch) and concentric (contraction) phases (called **amortization**).
  - This reduces "*energy leaks,*" or loss of elastic energy.
  - Plyometrics improve a muscle's proprioceptive function by eliciting an involuntary stretch reflex contraction.
  - As muscle spindles are rapidly stretched, they elicit a stretch reflex that provides:
    1. Additional involuntary muscle force that complements voluntary force-production
    2. Reduces reaction time in the alpha-motor units

Plyometrics increase sacromere length beyond the resting state to increase the unit's force-generating capacity further.

The Stretch-Shortening Cycle of Muscle Action

Phase	Action	Physiological Event
Eccentric (Loading)	Lengthening of the agonist muscle fibers	Elastic energy is stored in muscle elastic components (e.g., elastin). Muscle spindles are stimulated.
Amortization	Transition between the lengthening and shortening phases	Type Ia afferent nerves synapse with alpha motor neurons (nerve reflex). Alpha motor neurons transmit signals to agonist muscle group.
Concentric (Unloading)	Shortening of agonist muscle fibers	Elastic energy is released from muscle elastic components. Alpha motor neurons stimulate the agonist muscle group.

C. Precautionary Guidelines:

- Given the ballistic nature of many power and plyometric drills, appropriate levels of joint integrity, kinetic chain strength, flexibility, and proper mechanics are required to avoid injury.
- Screen individuals effectively and progress clients to higher-intensity plyometric exercises only when they can safely complete less challenging drills.

Prerequisite Guidelines for Higher-intensity Plyometric Drills

Plyometric Activity	Screen

Higher-intensity Lower Body	• Squat 1½ times body weight (NSCA standard) • Complete 5 squat repetitions at 60% of bodyweight in 5 seconds (recommended)
Higher-intensity Upper Body	Bench press 1RM should equal: - Bodyweight for larger athletes (> 220 lb or 100 kg) - 1½ x bodyweight for smaller athletes (< 220 lb or 100 kg) 5 full clap-push-ups

Training Considerations

To reduce the risk of injury, perform drills near the beginning of each training session when the athlete/participant is in a non-fatigued condition.

A. Volume and the Experience of the Athlete/Participant:

• Due to the stressful nature of plyometric exercise, beginners should start a program with *a low volume of lower-intensity exercises* and gradually progress to exercises requiring greater levels of skill and intensity.

• When teaching a drill or exercise to an athlete/participant, it is important to start with the foundational level of the exercise in order to teach the proper form and technique.

Example: For lower-body jumping exercises, teach proper landing mechanics *before* teaching jumping mechanics.

• As an athlete's skill and technique improves, the intensity and volume of training can increase.

• The number of foot contacts or upper-extremity contacts generally dictates training volume.

Plyometric Volume Guidelines

Athletic Level	**Low-intensity Drills**	**Moderate-intensity Drills**	**High-intensity Drills**
Beginner	80–100	60 (100–120 total*)	40 (100–120 total*)
Intermediate	100–150	80–100 (150–200 total*)	60–80 (150–200 total*)
Advanced	140–200	100–120 (180–220 total*)	80–100 (180–220 total*)

* Includes some low-intensity drills as movement preparation for the more advanced drills

B. Triple versus Double Extension:

• For jumping power, emphasize triple extension (through the ankle, knee, and hips)

• For jumping speed and rapid repetitions, emphasize double extension (knee and hips)

Teaching Jumping Technique

A. Take-off and Landing Mechanics:

• Hip-hinge (¼ squat) to toe-raise (triple extension) with shoulder flexion

• roll from the balls of the feet into the hips and bring the arms back down by the sides.

• Loading at the hips comes from hip hinge/hip flexion.

• Emphasize motor pattern of loading into hips and driving from hip flexion into triple extension with the legs and arms.

• Maintain thoracic extension and neutral lumbar spine

"Nose over toes" or *"Chest over knees"* (at bottom of take-off/landing)

"Neutral, braced trunk"

• 8-10 repetitions of squats with arm swing and triple extension

Jumping Techniques: Landing Checklist for Jumping, Bounding, and Hopping Activities

Advise your clients that they should **NOT** participate in jumping activities until they have learned how to land properly.
Land softly. Land with the mid-foot, then allow weight transfer backwards onto the heel to absorb impact forces. Avoid landing on the heel, as it increases the impact forces. Avoid landing on the ball of the feet, as joints lock out and forces cannot be dissipated throughout the kinetic chain.
Engage the hips – eccentrically load them by pushing the hips backwards then downwards to absorb forces through bigger muscles. This eccentrically stretches the glutes to facilitate a more powerful concentric contraction.
Avoid locking out any joints upon impact, which increases forces across that joint.
Maintain alignment of the hips and knees over the second toe during landing, especially in women due to the potential for injury given their Q-angles.
Engage the core to stiffen the torso to protect the spine and allow for increased force transfer during the subsequent contraction.
Land with the trunk inclined slightly forward and the head in neutral position or facing upward slightly.

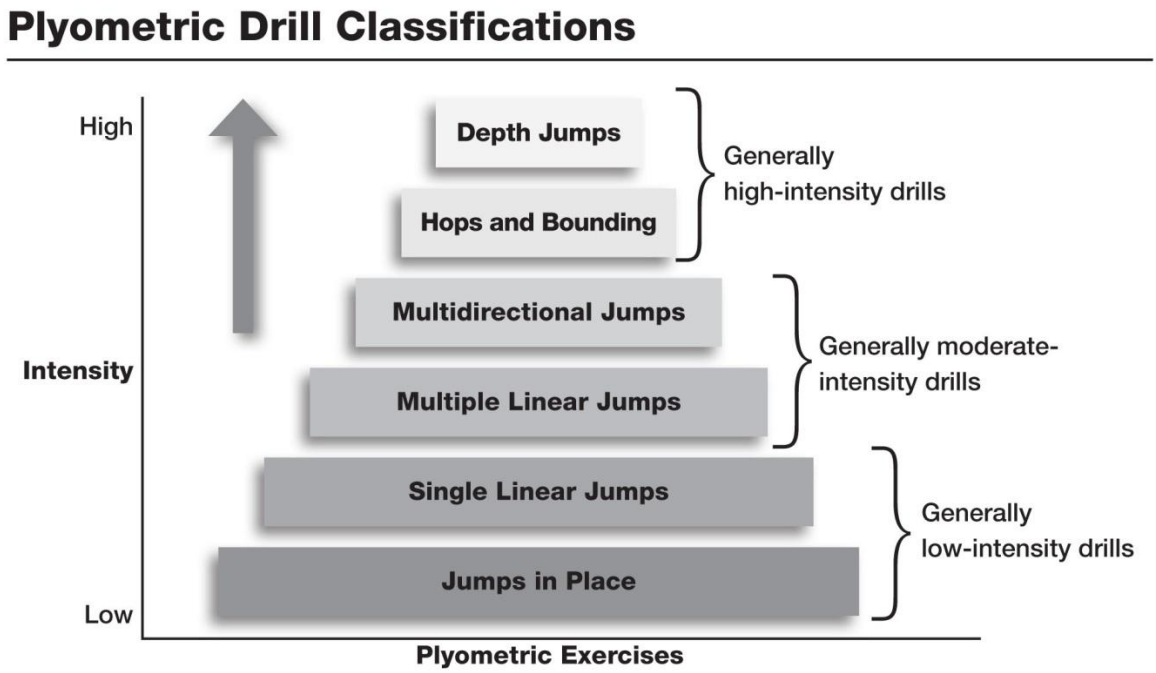

Figure 4-3
A Plyometric Drill Classification Model

Reference: Adapted from Chu, 1998.

Specific Skills Trained by Plyometric Drills

Skill	Jumps in place	Standing Jumps	Multiple Jumps	Box Drills*	Bounding	Depth Jumps
Start speed	X	X	X			X
Acceleration			X	X	X	
Change of direction		X	X	X		X
Vertical jump	X	X	X	X		X
Horizontal jump		X	X	X	X	

Reference: Adapted from Chu ,1998.

*** Box Drill Height:**

- Measure vertical jump height – start at a 10% lower height
- For more experienced athletes – height of the iliac crest

The Big Mistakes of Box Jumps…and Plyometrics in General

- Hard landings
- Barely high enough landings
- Believing you need a higher and higher box

Lower-Body Plyometric Drills

- Jumping Jacks
  - Tri-Planar Options – choose sagittal, frontal, or transverse plane for both upper and lower body
  - Choose movement "in sync" or "out of sync"
- Alternating Box Push-Offs
- Standing Long/Vertical Jump s
- Front or Lateral Box Jump
- Knee Tuck Jumps
- Front/Lateral/Rear Cone Jumps
- Skater Hops
- Hops
- Depth Jumps

REMEMBER to think of ways to REGRESS all of the above exercises to use with ANY population

Upper-Body Plyometric Drills

- Throws – solo or with partner
  - Bilateral – pass/throws/slams
  - Unilateral – pass/throws
- Catches – solo or with partner
  - Bilateral
  - Unilateral – lighter resistance; eccentrically loads throwing motion
- Plyometric Pushes and Pulls
  - Push-Ups – elevated >> floor >> BOSU >> Stability Ball
  - Pulls – bodyweight rows; pullups
  - Overhead Presses
    - Overhead MB Drive
    - Push Press

REMEMBER to think of ways to REGRESS all of the above exercises to use with ANY population

Program Design Variables for Plyometric Training

Variable	Description
Exercise Selection	✓ ***Single-response drills*** involve only single maximal effort/repetition. ○ Reset body position between repetitions (e.g., jumping for height or distance, distance throwing). ✓ ***Multiple-response drills*** involve repeated multiple efforts with no rest or reset between repetitions. ○ Double extension to maximize the number of repetitions over a given distance or time (e.g., jumping or hopping over cones and hurdles).
Intensity	✓ Refers to the quantity of stress imposed upon involved muscles, connective tissues, joints, and skeleton. ○ Low-intensity exercises focus on bilateral jumps. ○ High-intensity exercises focus more upon hops and bounds, but can include depth jumps. ✓ ***Intensity*** and ***volume*** have an inverse relationship: as drill intensity *increases,* the volume (number of repetitions and sets) should *decrease.* ✓ The intensity of plyometric exercises can be manipulated by: ○ Increasing the number of repetitions or sets (volume) ○ Increasing the height or distance of jumps, hops, bounds, or throws ○ Increasing exercise complexity/adding external resistance
Repetitions	✓ 1–8 repetitions per set, ✓ Due to the ballistic nature of plyometrics, the number of repetitions for a particular drill should be limited to ensure maximal force output. ○ Follow the ***10% rule:*** as soon as the client loses 10% of the height or distance of the exercise, he or she is fatigued and should do no more repetitions; continuing plyometric drills in a fatigued state greatly increases the risk of injury.
Sets	✓ 1–8+ sets, but the number is truly dictated by the nature of the drills (i.e., single-response drills vs. multiple-response drills), training experience, skill level, specific goals, and available training time.
Volume	✓ Expressed as the number of repetitions and sets performed during a specific training session ✓ Follow guidelines presented in Table 4-4
Rest Interval	✓ *DO NOT* consider plyometric exercises conditioning to be exercises for the energy systems, although they must be respected. ○ Due to high work-rate per unit of time, adequate rest is required between repetitions or sets. ○ Single-response drills taxing the phosphagen system require 1:12–1:20 WTR ratios. ○ Multiple-response drills lasting >10 sec taxing the lactate system require 1:3–1:5 WTR ratios.
Recovery	✓ Recommend 48–72 hours of recovery and rest between plyometric training sessions for intermediate and advanced individuals. ✓ Recommend ≥48 hours of recovery and rest between training sessions for beginners.
Frequency	✓ The number of training sessions per training cycle ○ ***Pre-season conditioning phase:*** up to 3x/week. ○ ***Competition phase:*** 1–2x/week ✓ General guideline: Train 2–3x/week on non-consecutive days with ≥48 hours recovery between training sessions.

Contact:
Jonathan Ross, www.AionFitness.com
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