NATURAL DEVELOPMENT AND TRAINABILITY OF PLYOMETRIC ABILITY DURING CHILDHOOD

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The truth.......  

- Youth are not as active as they used to be,  
- Decline in regular physical activity is observable by age 6 years.  
- Next generation of athletes have a decline muscular strength and motor skill performance.  
- So it needs to be trained!
What is Plyometrics?

- Used in conjunction with other training to develop explosive quick movements.
- Mainly some form of jumping, throwing or rebounding.
- Enhanced neuromuscular coordination.
- The goal of plyometric training: to increase the rate of stretching and shortening of muscle so that the stored elastic energy transfers more rapidly to the next explosive movement.
Definitions

- Concentric Contraction – muscle actively shortening (Bicep curl)
- Isometric contraction – Muscle held at a fixed length (Carrying an object out in front of you)
- Eccentric contraction – muscle actively lengthening (Setting an object down gently)
Mechanics of plyometrics

1. Eccentric “stretching” of the muscle,
2. is rapidly terminated by a powerful isometric contraction, thus initiating a stretch reflex, where elastic energy is stored.
3. Stored energy increases force in the subsequent concentric action.

- **Stretch-shortening cycle (SSC),**
- SSC combines mechanical and neurophysiological mechanisms.
- Plyometrics is a means to develop stretch shortening cycle ability.
Children are not mini adults

- So we cannot train them in the same way.
The research

- Limited number of controlled studies.
- Misconceptions surrounding safety and ethical issues.
- Consensus:
  - supervised
  - able to follow instructions
  - individualization is applied
  - developmental age considered.
- This is a very effective method.
Principles for Plyometric training

- Mechanically efficient functional movement skills before attempting more complex plyometric drills.
- High repetition velocity at all times.
- Gradual Increases.
- Increase in intensity and decrease in volume with increased eccentric loading.
Windows of Opportunity

- Unique periods within a child’s development where a heightened sensitivity to training adaptation is possible in response to the correct training stimulus.
- 5 and 11 years
- Neuromuscular system is somewhat “plastic” and so adapts to the training stress.
- A secondary spurt onset of puberty. (Beunen, 1997),
Factors effecting performance - so why should children be trained differently?

- **Structural components:**
  - Muscle tendon size and architecture,
  - Tendon stiffness (the ability of the tendon to resist changes in length),
  - Joint stiffness, defined as the ratio of the change in joint torque to joint angular displacement

- **Neural factors:**
  - Motor unit recruitment,
  - Neural coordination
  - Pre activation before ground contact,
  - Stretch reflex responses immediately after ground contact.
Children vs Adults

- Younger children:
  - more inhibitory mechanisms
  - reduced neuromuscular efficiency
  - greater levels of antagonist activation immediately after ground contact
  - lower stretch reflex responses than adults.
Muscle activation strategies transition:

- CHILDREN = reactive, protective inhibition,

- ADULT = preparatory, performance enhancing excitation

- May be susceptible to further enhancement with exposure to the appropriate training stimulus.
RISKS

- Concerns related to damage to immature epiphyseal growth plates.
- No cases reported in the studies, although limited.
- Exhaustive exercise involving SSC actions can reduce joint stiffness and alter neuromuscular recruitment strategies = fatigue.
- Intensity, intensity, intensity.
Benefits

- Increased/Improved:
  - Muscle strength
  - Muscle power
  - Bone strength
  - Balance
  - Agility
  - Speed
  - Resistance to injury
  - Sports performance
  - Outlook on physical activity
  - 4 weeks to see improvement
Tests to establish if an athlete can move to advanced plyometrics:

- Fully back squat 1.5 times their own body weight
- Bench press 1RM should be at least 1.0 – 1.5 times the body weight
- Perform five clap push-ups in a row.
- Perform 5 reps @60% in 5 seconds
- Balance – stand on 1 leg for 30 sec without falling
- Avoid depth jumps with beginners
GUIDELINES FOR DEVELOPING YOUR PLYOMETRIC PROGRAMME
TRAINING INTENSITY

- The amount of stress placed on muscles, connective tissues, and joints.
- Begins with low intensity drills
- Gradually over time, advances to higher intensity drills.
- It is controlled primarily by the type of plyometric drill.
Factors affecting intensity

- Points of contact
- Speed
- Height of the drill
- Body weight
TRAINING VOLUME

- Previously total number of foot contacts performed during a single session
- 1x 6–10 repetitions, progressing up to 2–3 sets of 6–10 repetitions
- Total ground contacts for a child might range from 50 to 150
- Lower loads for higher intensity exercises
- Quality is more important than the total volume
- Mean contact times of approximately 185 and 230 milliseconds for 13-16 year olds
- Sets and repetitions performed should be flexible.
TRAINING FREQUENCY

- Twice weekly on non consecutive days
- Using soreness to monitor training is deemed inappropriate.
- A measure of ground contact time during submaximal hopping, which could reveal neural fatigue without placing excessive physical demands on the child.
Warm Up

- Marching
- Jogging
- Skipping
- Footwork/direction changes
- Lunging
RECOVERY

- Plyometrics require longer rest periods
- Enable full neuromuscular recovery, maximize performance, and reduce injury risk.
- Pool work can achieve rapid SSC without the impact.
- Stretching
Summary for Youth Plyometrics

- **Training intensity**: based on eccentric loading, progress from low-intensity to high-intensity exercises.

- **Training volume**: use performance thresholds (e.g., ground contact time or RSI). However, 1 x 6–10 repetitions, progressing to multiple sets of 6–10 repetitions as a general guideline is supported.

- **Training frequency**: 2 sessions per week on nonconsecutive days.

- Maximize motivation and performance quality.

- Recovery: 60–180 seconds inter set rest period for low level plyometrics; Increase for high eccentric loading.
Combining plyometrics with other forms of training

- Not with heavy resistance unless advanced athlete.
- Multifaceted programme
- Combine opposite body segments with resistance training and plyometrics.
- Should be done before aerobic training
Plyometric Progression Model

- **TRAINING TO WIN**
  - Males 19+ years, Females 18+ years
  - Highly Structured & Sport-Specific
  - Stage 6: High Intensity Plyometrics (HIP2), Drop Jumps
  - High Eccentric Loading

- **TRAINING TO COMPETE**
  - Males 16-23 years, Females 13-21 years
  - Highly Structured
  - Stage 5: High Intensity Plyometrics (HIP1), Bounding (Multiple Unilateral Hopping)
  - Moderate-High Eccentric Loading

- **TRAINING TO TRAIN 2**
  - Males 14-16 years, Females 13-15 years
  - Moderate-High Structure
  - Stage 4: Medium Intensity Plyometrics 2 (MIP2), Box Jumps, Obstacle Jumps
  - Moderate-High Eccentric Loading

- **TRAINING TO TRAIN 1**
  - Males 12-14 years, Females 11-13 years
  - Moderate Structure
  - Stage 3: Medium Intensity Plyometrics 1 (MIP1), Multiple Bilateral Hopping and Jumping
  - Moderate Eccentric Loading

- **LEARNING TO TRAIN**
  - Males 9-12 years, Females 8-11 years
  - Low Structure
  - Stage 2: Low Intensity Plyometrics (LIP), Jumps in-place and Standing Jumps
  - Low Eccentric Loading

- **FUNDAMENTALS**
  - Males 6-9 years, Females 6-8 years
  - Unstructured Play
  - Stage 1: Fundamental Movement Skills (FMS)
  - Minimal Eccentric Loading
STAGE 1

- Proper landing mechanics
- Competent basic movement patterns.
- Agility, balance, and coordination
- Kinesthetic and spatial awareness.
- Closed kinetic chain exercises requiring triple extension at the ankles, knees, and hips.
- Games.
- Progression to stage 2 only when fundamental movement skills are fully competent.
Fully extend your ankles as shown here
Preparatory Plyometrics
STAGE 2: LOW-INTENSITY PLYOMETRICS—JUMPING

- Jumping and landing bilaterally or unilaterally
- Landing mechanics, including a heel-toe landing,
- Avoid excessive valgus knee displacement
- Maintain good posture at the point of ground contact,
- Coordination of the upper and lower limbs throughout the exercise.
- E.g. Skipping, throwing, own body weight and propulsion.
Landing techniques

• The shoulders are in line with the knees, which helps to place the centre of gravity over the body’s base of support
• Land Mid foot with heel support before pushing from the ball of the foot for take off.
STAGE 3: MEDIUM-INTENSITY PLYOMETRICS 1—MULTIPLE BILATERAL HOPPING AND JUMPING

- Horizontal distance is introduced.
- **Children should be introduced to:**
  - ground contact on the balls of their feet,
  - only using a heel-toe foot strike when stopping.
  - Requiring fast ground contact times
  - A degree of pre activation, which require the child to use their lower limbs as “stiff springs.”
  - E.g split together up, bounding, lateral hopping
Bilateral hopping
STAGE 4: MEDIUM-INTENSITY PLYOMETRICS 2—BOX JUMPS

- Competent at stages 1–3 and entered adolescence.

- Move onto low-intensity box jumps (jumping onto and stepping down from a box),

- “obstacle” drills such as the use of hurdles, and multiple jumps.

- Increase eccentric loading,

- Maintaining the speed of movement

- E.g. Barrier jump, incremental, med ball
BOX Jumps

- (76 to 81 cm) being the norm
- Velocity is of the highest value not height
STAGES 5 AND 6: HIGH-INTENSITY PLYOMETRICS

- Young adulthood
- Bounding and Drops
- Multidirectional, bilateral,
- Unilateral alternating foot contacts,
- Cover maximum distance with minimal ground contact time,
- Start at a low intensity (drop heights ≤20 cm),
- Should not be increased to an intensity that promotes an inhibitory protective strategy that reduces reflex activation.
Medicine Balls

- Upper body strength is poorly developed in many sports.
- Children often struggle with push ups.
- Medicine ball help create complex movements that mimic natural body positions, speeds that occur in daily life and game situations.
- Conditions the body to function as a unit parts.
Beginner exercises

1. Lateral jumps 01311

2. Pogo jumps 05312

3. Star jumps 01303

4. Split jumps 01387
Intermediate exercises

1. Lateral box jumps 06202

2. Incremental jumps 00386

3. Hopping rotation 01453

4. Depth jumps/battery jumps 01358
Advanced exercises
References


