National coach development weekend

The Biomechanics of Sprinting
Acceleration Blocks

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Key objectives for acceleration

Application of force:

• Through the correct direction.
• Through a range of motion.
• Reduce ground contact time.
• Reduce recovery time through the air.
100m Race Model based on Usain Bolt 9.58s Berlin, 2009

- **Drive**
  - Distance: 10-30m
  - Velocity: 0-3.78s
  - Max V: 73%, 85%, 93%, 96%

- **Transition**
  - Distance: 30-60m
  - Velocity: 3.78s-6.29s
  - Max V: 99%

- **Max Velocity**
  - Distance: 60-90m
  - Velocity: 6.29s-9.58s
  - Max V: 100%

- **Speed Maintenance**
  - Distance: 90-100m
  - Velocity: 9.58s
  - Max V: 98%

**Steps**
- 7, 11.5, 15.5, 19.5, 23.5, 27, 30.5, 34.5, 38, 41

**Shin Angle**
- 45°, 90°, 90°, 90°, 90°

**Torso Angle**
- Arrows pointing upwards
Warm up

- Core activation.
- Recruit and activate stabiliser muscles.
- Dynamic mobility exercises.
- Diagnostic exercises included.
- Drills to reinforce correct neuro-muscular pathways of sprinting.
- Note NO passive stretching. Flattens neuro-muscular energy levels.
Biomechanical Concepts

Pushing behind COM causes forward rotation around COM.

Centre of Mass (COM)

Forward rotations created by:
> push off leg
> rear arm

Forward rotations counterbalanced by:
> "free" swing leg
> front arm

Pushing inline with COM does NOT result in rotation.

Low heel recovery during drive phase reduces time to recover leg.

Cues could include:
> "Piston" action with legs
> Sweep toe across ground

Scottish Athletics
Drive Phase Mechanics

**Centre of Mass (COM)**

**Block Clearance**

1. **Start of Drive Phase:**
   - Shin angles at 45° to facilitate maximum displacement from blocks
   - Torso angle matches shin angle on foot strike (straight line head to toe)
   - Extremely exaggerated arm action to counterbalance extreme forward rotations

2. **Key Coaching Points:**
   - Monitor smooth transition of 1. Shin angles and 2. Torso angle
   - Other key points to focus on: 3. Arm action, 4. Good posture (straight back, head in neutral position relative to spine), 5. Piston legs and low heel recovery

3. **End of Drive Phase:**
   - Shin angle at foot strike is perpendicular to ground
   - Torso remains slightly inclined
   - Arm action still slightly exaggerated to counterbalance slight forward rotation resulting from incline body lean

**Shin Angle**

45°

**Torso Angle**

0%

**Foot Strike**

90°

**Negative shin angles & forward body lean facilitate rapid acceleration**

**+ 6-7° per Stride**

**+ 2-3° per Stride**
Acceleration...

F – fixed
A – angle
C – contact
E – extension
S – stability
Continue outside on the track...
Wall Drills

Specific to acceleration and increasing shin angles to 6/7 degrees per stride.

Toe under knee.

Ballistic movement of foot off the ground – do not engage hip flexors.
Back foot demonstration

Rear foot is behind centre of mass, front foot has to wait until centre of mass has moved above it.

Load up rear foot on block - Stored elastic energy.

Double foot push off the blocks.
Arm width

Strong support structure with hands under shoulder.

Joint-any wider requires strength and makes it difficult to get hips high enough in set position.

Head and torso in line with each other.
Which foot forward?

Take off foot for long/high jump should be front foot.

So long as it matches dominant hand.
Feet on blocks

Low on front block for all- keep front foot on floor-stretch big toe engages neuro-muscular pathway throughout the leg.

Low on rear block for young, lack strength to manage power in low angle of drive off block.

However older athletes can place Rear foot high on blocks, if blocks are high-need stretch reflex.

Knee angles 90% for front – powerful position. 130%approx for rear. But angle of rear leg is led by hips high and loading up rear leg.

Must take all slack out of rear ankle. Foot – pretension stored elastic energy.
Angles of blocks

Used to be fixed front 45% Rear 90%. Accepted without evidence that rear should be steeper than front.

Ralph Mann has demonstrated rear should have a lower angle of 38% compared with 45% for front. Enables rear ankle to be stiff on block to achieve pre-tension.
Arm Action

Throw arm back rotates body forward.
Throw arm up rotates body backwards.
Look under front arm and throw rear high.

Foot Recovery Drive Phase

Foot over grounded ankle.
Reduce air time-only accelerating if applying horizontal force to ground.
Reduce time on ground – foot dorsi-flexed. Planta flex and ankle will collapse and increase time on ground.
Transition

• Hardest section of race, must be gradual/Seamless.
• Error is coming up too soon or too late.
• Coming up too soon? **Cure** think Foot over grounded calf.
• Staying too low? **Cure** is do not keep head down, and kick heels into butt on recovery.
• Breathe as you enter transition.
QUESTIONS?