TECHNICAL CONSIDERATIONS FOR THE MEN'S SPRINT HURDLES

OVERVIEW

General Observations

Applied Functional Anatomy

Hurdle Skill Components

Key Performance Indicators

Unfortunately, like in many other endeavors, we too often cling to what we know rather than constantly examine and evaluate what we are doing to get the results we are achieving. This all important self-evaluation enables us to selectively discard ineffective practices and replace them with better ones.

Gary Winckler

Limiting Variables

- Height of barriers
  - 42” hurdles
  - Average height of elite hurdler is 5’11-6’1
- Distance to hurdle one & between subsequent hurdles
  - 13.72m/9.14m
  - Not sufficient distance or time to apply large amounts force
    - Average step length during in 1st 10m of 100m sprint….
    - Average stride length at max velocity approx. 2.30m-2.50m….average stride length between hurdles 1.85m

Criteria for Success…*Objectives*

- Develop highest attainable velocity
  - Poor: 7.69m/s; Ave.: 8.34m/s; Good: 8.99m/s (*Elite approx. (9.33 m/s)
- Maintaining highest velocity (rhythm)
- Ability to navigate the ground
- Technical competency

What can we influence….what can we coach

- Max Strength
- Rate of Force Dev.
- Muscle Elasticity
- Leg Stiffness
- Joint Stiffness
- Force application
- Max Velocity
- Proprioception
- Coordination
- Hurdle skill

Applied Functional Anatomy

Mono & Biarticular Muscles

MONOARTICULATING (MA)

Short head of Bicep Femoris

Vastus muscles

*Gluteus Maximus

*Tensor Fasciae Latae

Adductors

Soleus

BIARTICULATING (BA)

Psoas Major

Hamstrings

Bicep Femoris

Semimembranosus

Semitendinosus

Rectus Femoris

Gracilis

Gastrocnemius

Muscle Function: Monoarticular muscles

Stability and leverage

Force & work generators

Lose tension in quick movements

Muscle Function: Biarticular muscles

- High speed movements
- Energy Transfer…
- Save energy by allowing concentric work to be done at one end and eccentric at another
- Transfer energy while resisting moments across adjacent joints (isometric function)
- "Effects of timing of muscle activation on performance in human vertical jump"

Where the rubber meets the road….

Navigating the ground

- 42 Steps….10 hurdles

"Teach landings before take-offs"

Stable yet dynamic

Foot & Ankle Function

Foot function

- 12 bones, 14 phalanges, 108 ligaments, 20 muscles
- Very little movement outside of the ankle
- Receptors in sole of foot similar in function to that in the hand; provide essential information

"Plantar feedback contributes to the regulation of leg stiffness" Fiolkowski et. al., 2005.

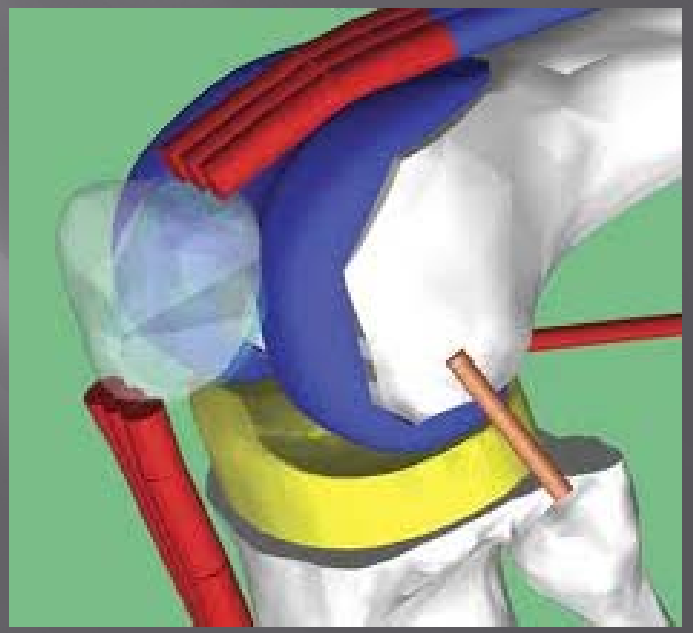
- Tibial nerve block
- Afferent ~Efferent
- Significant drop in leg stiffness

Foot & Ankle Function

- Spring model
- Creating leg & joint stiffness
- Spring function
- In support phase energy is stored and then released by muscle, tendons & ligaments

Knee Dynamics

- Stiffness around joint is significant…will vary throughout stance
- Acted on by ankle and hip
- Directs force as oppose to generating force



Pelvis & Hip

35 muscles originate or end

Energy generators (Glutes)/amplifiers

Relatively limited movement within pelvis

Oscillation & orientation allow for force/energy absorption and distribution

Pelvis stability is paramount for optimum translation of elastic energy into force/movement

Hurdle Skill Components

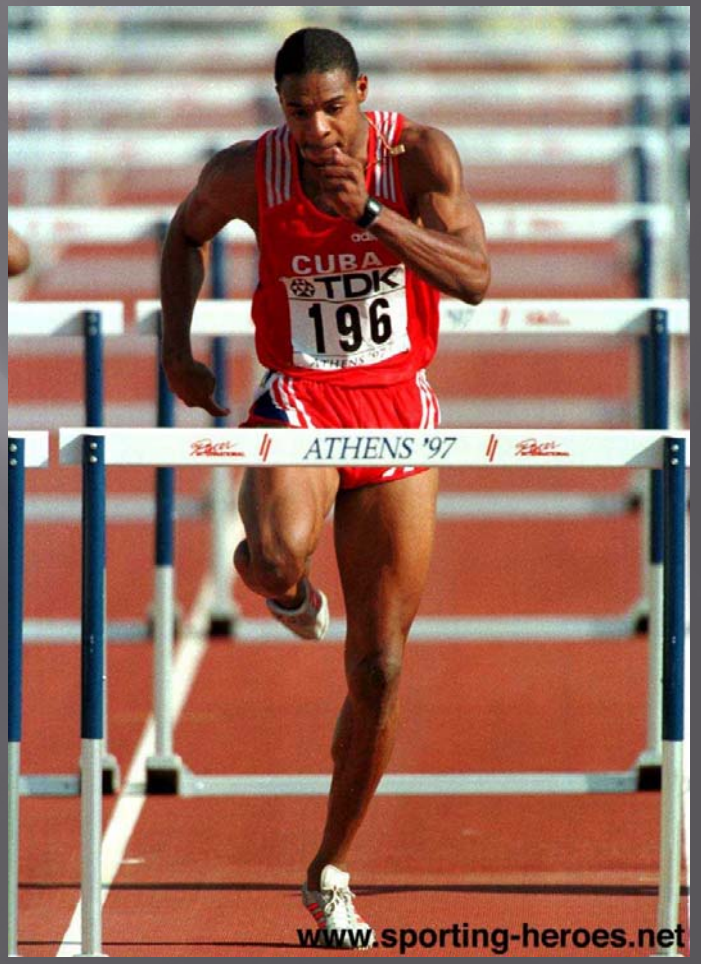
Application of the sprint model
Take Off & Penultimate
The Pitch
Hurdle Clearance
Interhurdle Sprinting

Application of the Sprint Model

Penultimate Step & Take Off

Penultimate Step & Take Off

- *Aggressive* run at the hurdle
- *Pelvic orientation
- Minimizing vs. Optimizing ground contact times
- Minimizing losses in velocity…"braking"
- Maximizing GRF …Magnitude vs. Direction



Penultimate Step & Take Off

Penultimate Step & Take Off

- Active recovery of the thigh of penultimate step
- Rapid switch from open chain to closed chain
- Transfer of energy via pelvic musculature to take-off leg
- Active (force full) extension of contra-lateral (Take off leg) hip

Penultimate Step & Take Off

- Again…teach landings before take-offs
- Effective coordination of dorsi to plantar flexion
- Optimum release of elastic energy

Undesirable model…

…etc…etc…

Hurdle Clearance…*The Pitch*

- Encourage large angle of separation between legs
- Lead knee is driven up and at the hurdle
- Avoid premature termination of take-off (don't rush the trail leg)
- *"Lean"* at the point of contact…then waist…if necessary

Hurdle Clearance…*The Pitch*

Hurdle Clearance…*The Pitch*

Hurdle Clearance

- A management of rotations
- Angle of trajectory determined by take off distance relative to COM….& barrier
- Facilitated by large hip extension at take off…*Extensor Reflex*

Hurdle Clearance

- The body likes to be in balance…*Timing is everything*
- Lead arm….bent or straight?
  - Long smaller lever (arm) vs. shorter larger lever (trail leg)
- Trail arm…how does one evaluate it's effectiveness? How much does it matter?
- How much or how little trunk flexion is necessary for effective flight?

Touch down…*The Getaway*

- Trunk extension vs. Hip extension
- Anticipate the ground
- "Delayed" run off
- Tension or stiffness in ankle = same result at knee

Interhurdle Sprinting…
The Shuffle

- Step Length vs. Step Frequency
- Step management in many ways is intuitive
- A skill to be developed
  - i.e., 20-30m fly's with reduced step length

Interhurdle Sprinting…
The Shuffle

1st Step → 17 % of dist → 65 % of max. stride

2nd Step → 22.5% of dist → 85 % of max. stride

3rd Step → 21% of dist → 80 % of max. stride

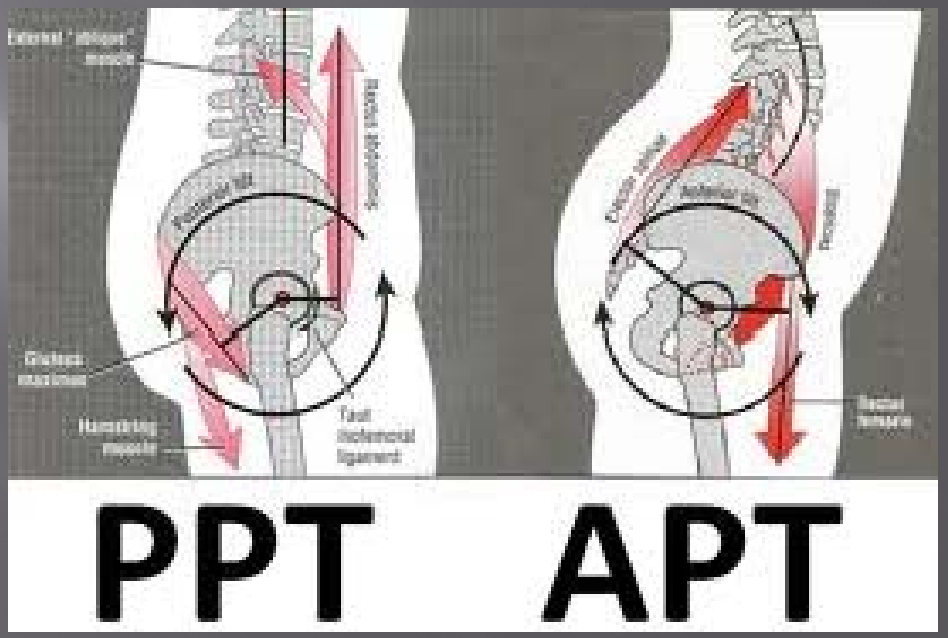
Steps between hurdles are approx. 77% of the ave. stride at Vmax

Interhurdle sprinting very specific skill

Can be impaired by competitive sprinting (ie., Tramel)

Interhurdle Sprinting: Spinal Engine & The Pelvic "Junction"

- Pelvis stability not rigidity
- "Transverse plane hip oscillation"
- Rapid repeated extension & flexion of hips
- Elastic capacity of pelvic musculature



Interhurdle Sprinting…
The Shuffle

Stepping down on each contact

Enhanced by a parallel (or close to) lower leg to the track

Increased knee flexion results in casting of the lower leg

Key Performance Indicators (KPI)

1.) Air Time: toe off to touch down

2.) Flight Distance: distance from toe off to touch down

3.) Pelvic Projection: vertical displacement from mid stance to apex

4.) Apex Displacement: distance from hurdle to highest point of flight path.

5.) Hurdle Cycle Split: duration of time between one complete hurdle sequence

Questions for exploration…

Why haven't we've seen the growth similar to that in other sprint events?

Who are great "ground" hurdlers and who are great "air" hurdlers?

Lead arm; what does it do and what characteristics does it require.

Trail arm; what does it do and what characteristics does it require?

Torso in and out of the hurdle and torso on the ground?

Thanks…
Randy Ballard
"Dr." Andy Eggerth
Carl Valle
Tony Veney
Gary Winckler
…etc…etc…

Thank you…

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Penultimate Step & Take Off

- VIDEO OF TRIPLE JUMP….IF POSSIBLE

A subtle manipulation of forces at take off….