Return to Sport, what's new?

By: Miranda Huffman, DPT

RTP testing is still not great, how can it be better…[20, 21]

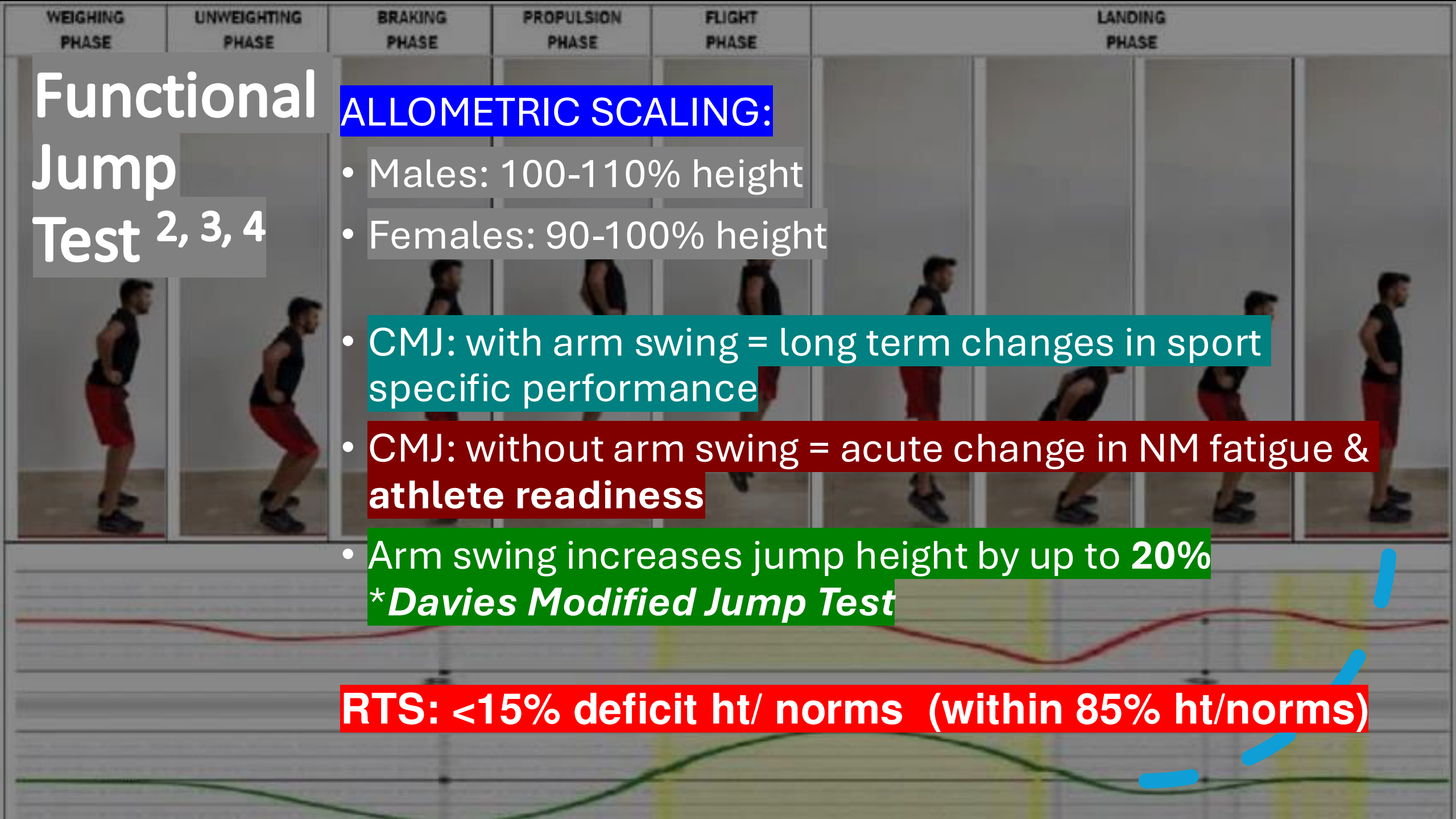
37% ACLR retear or tear contralat. 4x greater risk unmet RTP criteria

Allometric scaling: normalization method
-Absolute value (quantitative #) norm. to anatomy (height /weight)

Vertical / Multi-directional testing: missing element

Ecological validity: methods/materials and setting of the test must approximate the real-world that is being examined.

-Neuro/visual-cognitive, reactive, multi-task, fatigued conditions, chaotic environment.



Functional Jump Test [2, 3, 4]

ALLOMETRIC SCALING:

- Males: 100-110% height
- Females: 90-100% height

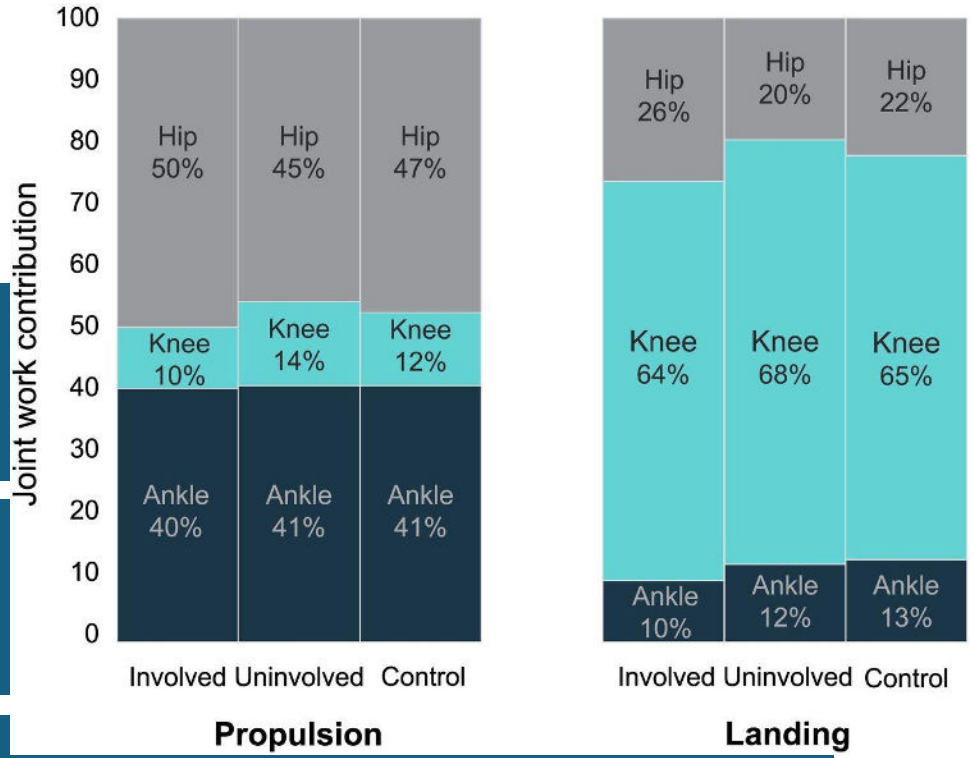
- CMJ: with arm swing = long term changes in sport specific performance
- CMJ: without arm swing = acute change in NM fatigue & **athlete readiness**
- Arm swing increases jump height by up to **20%**
  Davies Modified Jump Test

RTS: <15% deficit ht/ norms (within 85% ht/norms)

Single leg hops for distance [1]

ACLR achieved a 97% LSI in hop distance

LSI knee work during propulsion(take off) 69%



During landing, ACLR underload involved knee by compensating mostly at hip.

During landing, ACLR uninvolved knee significantly larger knee work when compared to **involved knee and control group.**

-might explain increased rates of contralateral injuries (overload)

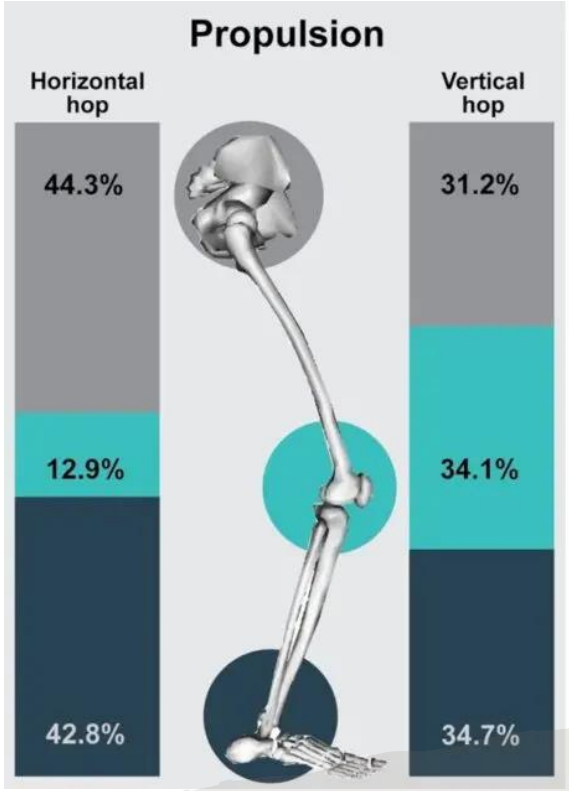
Horizontal vs. vertical hop? [5]

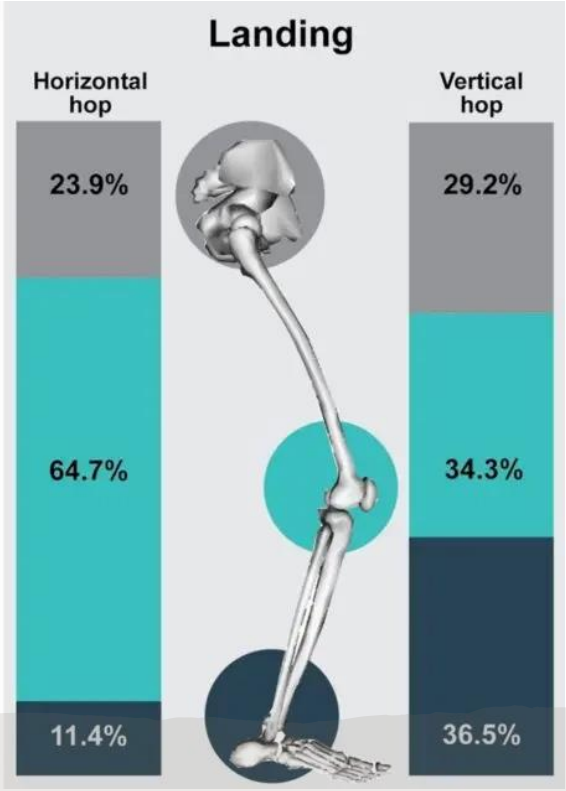
- Contributions of the hip, knee, ankle are almost **equal**
- 77% ACLR demonstrated LSI ≥ 90% on all horizontal hop tests 7-9 mo
- 33% ACLR demonstrated LSI ≥ 90% on SLVH.

- ACLR lower LSI on SLVH
  than on horizontal hop tests

- SLVH may detect deficits
  not identified by horizontal hop tests

  (apps, mats, wall mounts,
  standing structures)





Hop testing, change interpretation of data [4, 5]

- Allometric scaling: distance as a % of height

Males

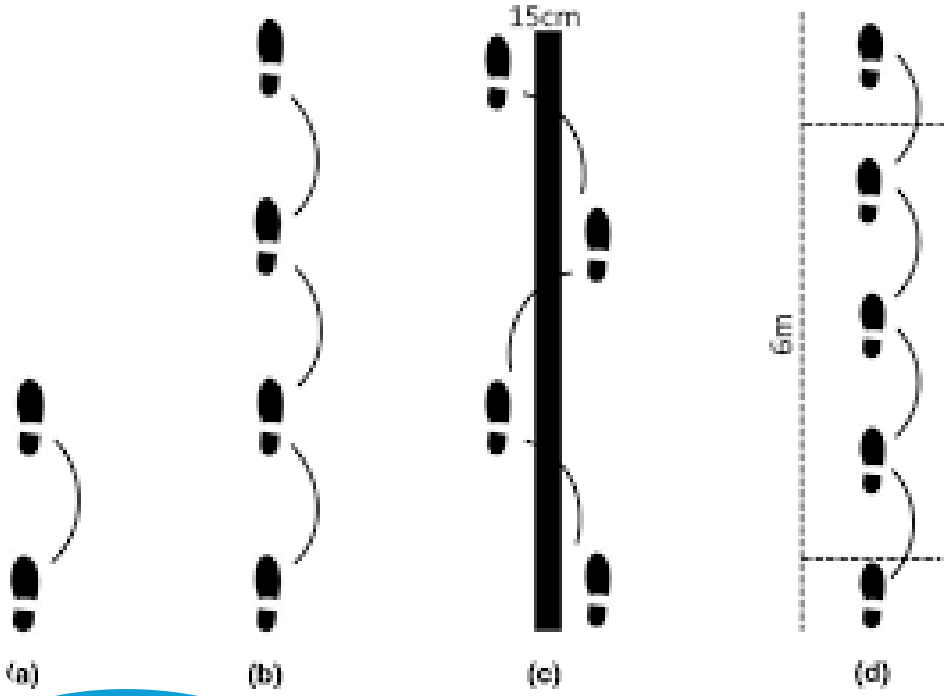
Hop test: 100% LSI plus 90-100% to height (norm)

Females

Hop test: 100% LSI plus 80-90% to height (norm)

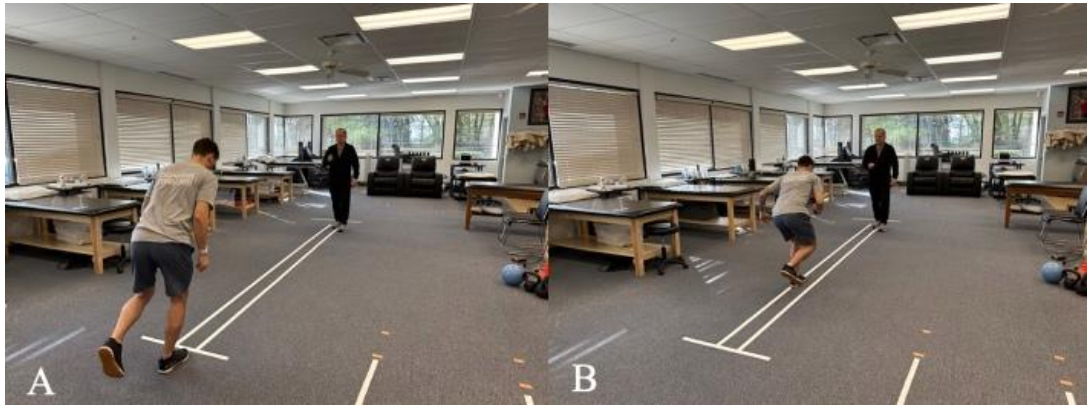
RTP: <10%ht; <10% bilateral comparison = 90%ht and 90% LSI

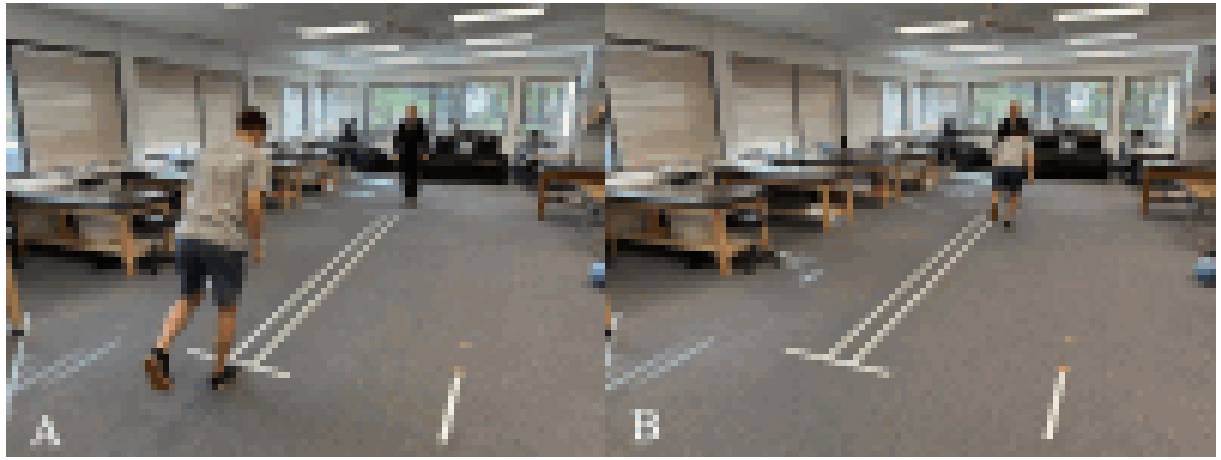
Hop testing...ecologically valid? [6,7]



- Main 4, not ecologically valid. (predetermined, not reactive or multitask)
- Injuries typically occur - failed control of unanticipated, reactive movements.
- **Neurocognitive hop testing** : more dynamic, reactive, chaotic; reflective of sporting environments.
- (Test the brain too) Neuroplasticity post ACLR: altered input to CNS- reduced/ impaired communication btw brain and muscles/joints.

Reactive hop tests [7]





4 new neurocognitive single-leg hop tests that provide more ecological validity [8, 9]

- **Single- leg central-reaction hop** (1 central stimuli) *2 colors
- **Single- leg peripheral-reaction crossover hop** (reaction time between 2 peripheral stimuli) *2 colors peripheral R/L
- **Single leg memory triple hop reaction** (memorized stimulus with distractor stimuli) *1/6 colors
- **Single leg pursuit 6 m hop** (requiring visual field tracking and spatial navigation)

Physical performance and reaction time (cognitive performance)

Valid & Reliable for testing, **reduced performance up to 10% on cross over and triple compared to traditional.**

From: Millikan N, Grooms DR, Hoffman B, Simon JE. The Development and Reliability of 4 Clinical Neurocognitive Single-Leg Hop Tests: Implications for Return to Activity Decision-Making. ***Journal of Sport Rehabilitation. ;28(5):. doi:10.1123/jsr.2018-0037***

DOI: https://doi.org/10.1123/jsr.2018-0037

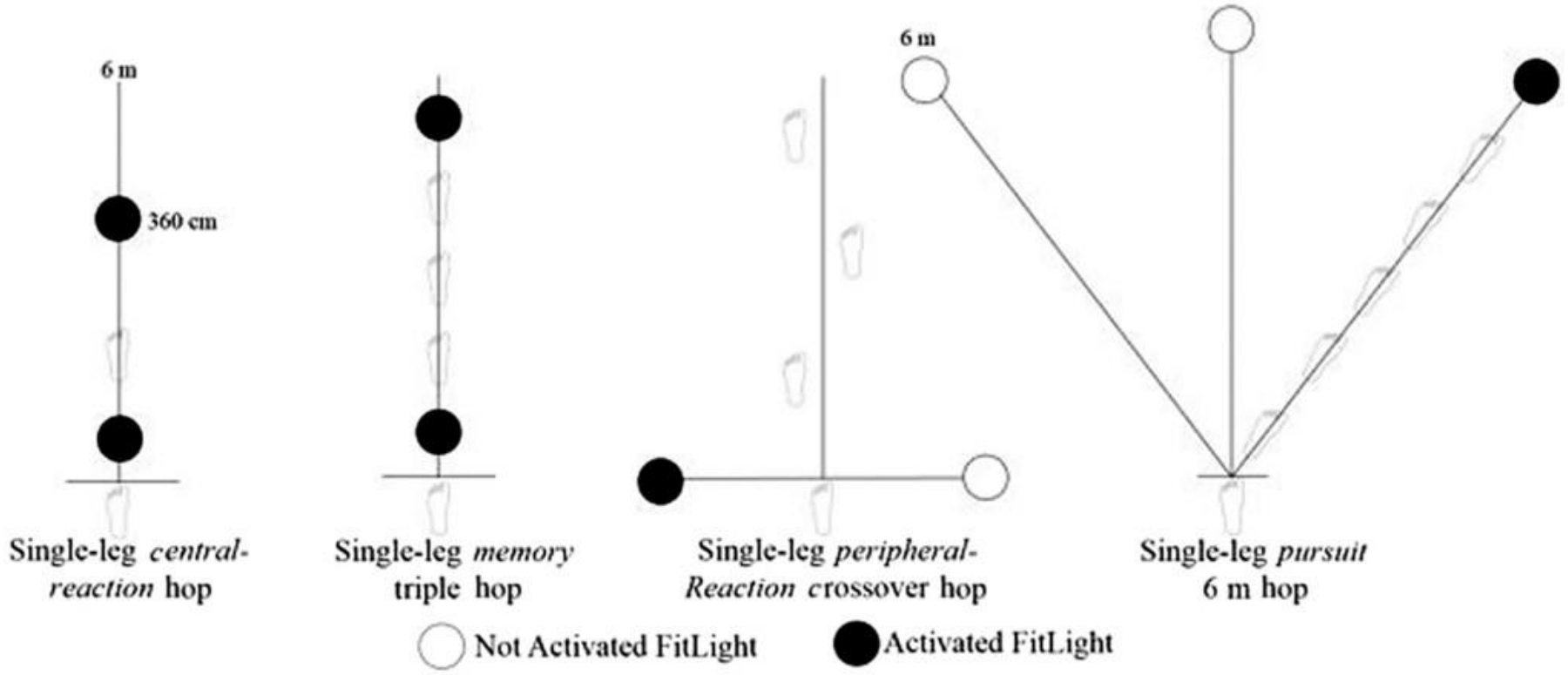


Figure 1 —Schematic of 4 new neurocognitive single-leg hop tests.

2/4 hop tests of same plane, plenty! [10]

- More than **2 hop tests** does not appear to be necessary due to high collinearity and no greater sensitivity to detect abnormality.
- Measure movement **quality** as well!
- Other hop tests in **different planes** may better detect knee function

Medial, Lateral, Posterior, Multi-directional

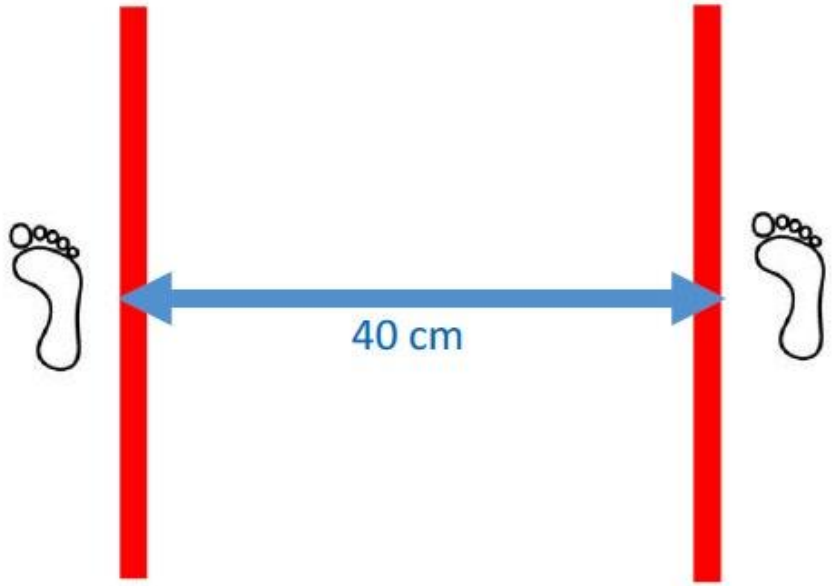
Medial hop test for distance + Visual-cognitive medial hop [13,14,22]

- Valid, reliable
- Performance **deficit 9.96%** during **VCMH** compared to traditional medial hop.
- 166% **body height** = normal
- **90% LSI**
- **90%ht/norm**

Side hop test [11, 23]

- 2 lines 40 cm apart
- For **30 seconds**
  hop as many times over the lines
  with hands behind back

- One hop over is 1 rep. back is 2 etc.
- Landing on or within the lines NOT a rep
- Rest 4 mins and repeat on other side
- **NORM 55 MALE and 41 FEMALE**

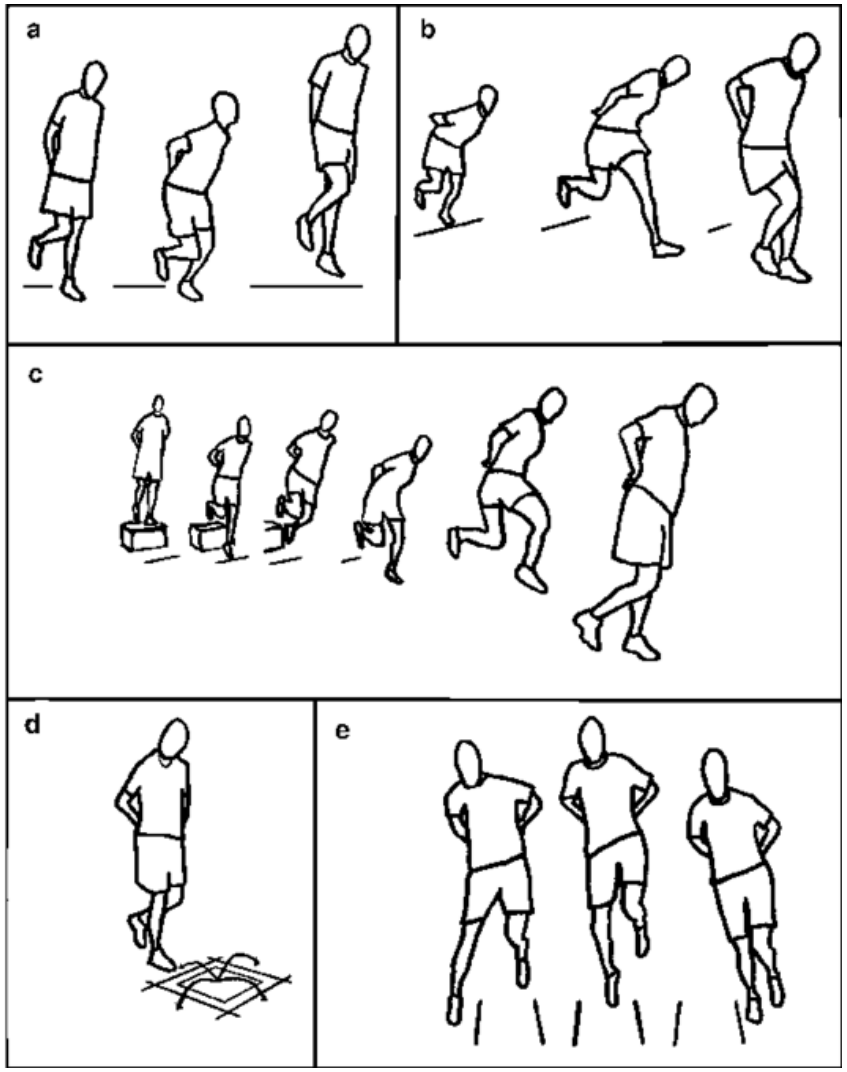


40 centimeters between the ends of the lines

Side hop test, part of test battery [12]

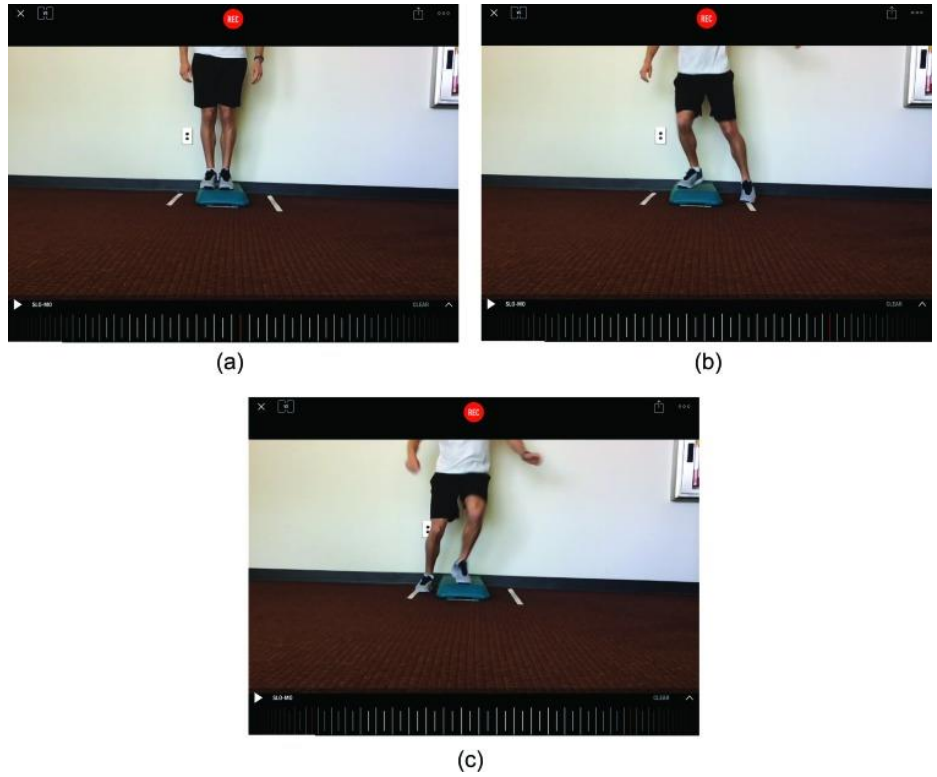
- Five hop tests were analyzed with ACLR and ACL injury.
- 3 tests discriminate btw involved and uninvolved: **SLVH, the hop for distance, and the side hop.**
- High level of sensitivity and accuracy when **one of the three** tests **abnormal**. **PASS ALL THREE.**
- ALL THREE: higher values than any of the 3, alone.

  ONLY 1/10 patients restored hop performance 11 months post ACL injury & 6 months ACLR.
- Fatigue factor: hop performance while developing fatigue?!



COLD TEST "Change of Lateral Direction"[16]

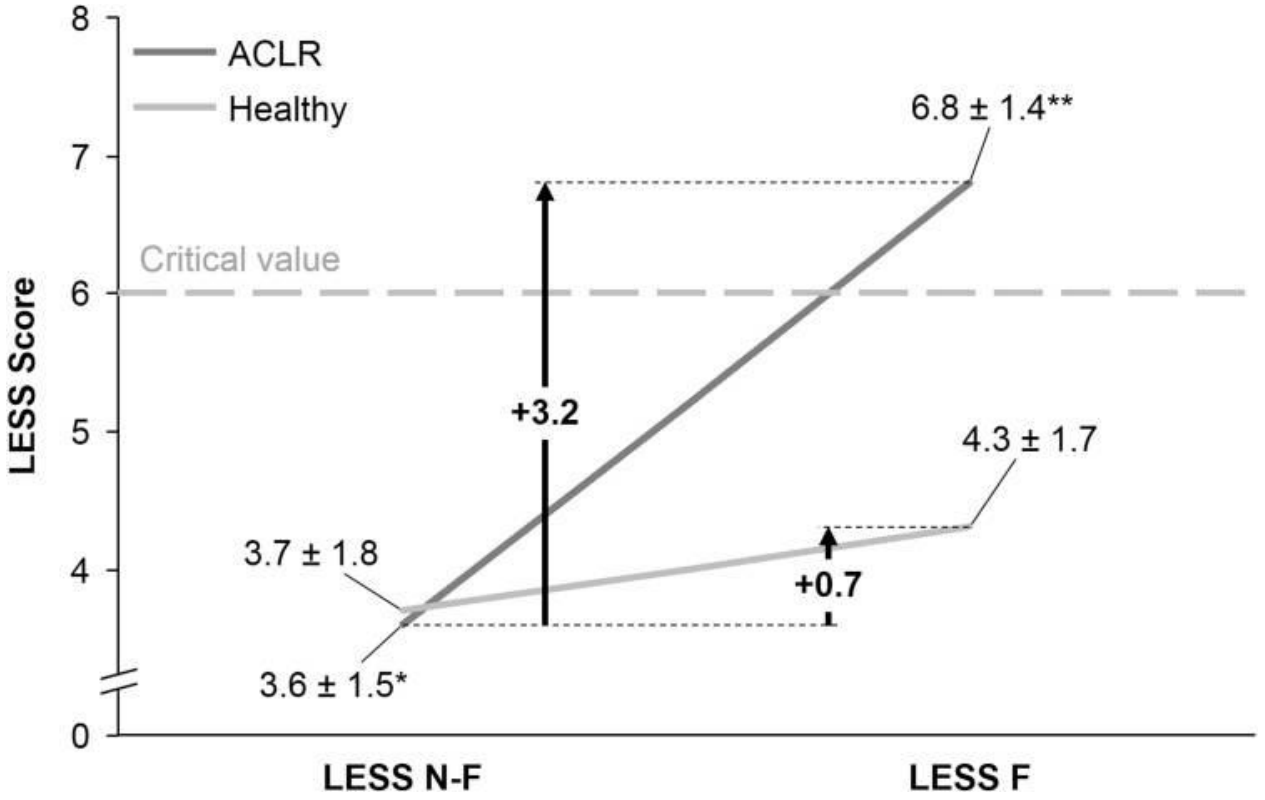
- Standard 4" step, rapidly altered stepping to tape markers on either side of step as many times as possible for 30 seconds.
- Total number of steps achieved in **30 seconds**
- **Fatigue effect** occurred at **21-30 seconds** for **all** (step rate decreased)



Fatigue factor [15]

- ACLR & normal soccer players.
  -matched playing level/training

- Hop tests / CMJ performed
  -**fatigued & non fatigued states**



- Movement **quantity- hop tests**
  -did **NOT** differ between ACLR & normals

- Movement **quality-CMJ with LESS**
  -decreased in ACLR in **fatigued state** compared to non-fatigued state

Testing needs to be completed in non-fatigued and fatigued states!

New concept: “Fatigue Index” [24]

Overlooked with RTP testing?

- Research: Open and closed chain RTP UE testing

-UE pretest, workout to fatigue, post test

- Normal fatigue = drop 20%
- Test in **non fatigued** state if **WNL** THEN test in **fatigued state**
- **If both WNL then DC RTS**
- **If fatigued state does not pass, continue rehab to increase work capacity and endurance.**

Multidirectional?!
T – Drill Hop TEST [19]

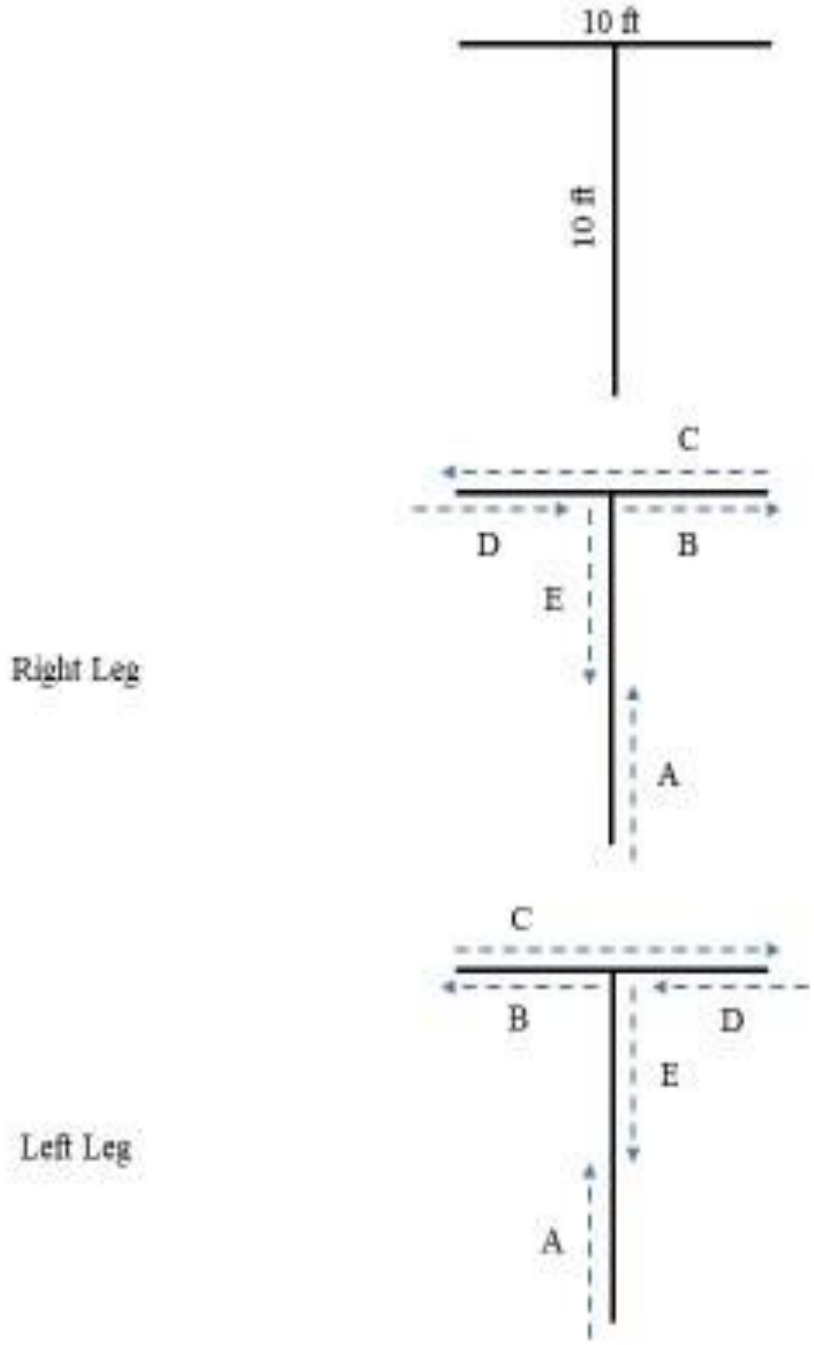
- 10 ft long, 5 ft wide on each side of center T line.
- Hands on hips, hopping on the specified leg
- Forward, Lateral, Medial, Retro hopping!
- Reliable & efficient! 2 – timed max speed trials
- No difference btw D & ND/100% LSI ; limited norms

Even Better…

Neuro-cognitive Reactive T-Drill hop test: (react to visual/verbal cues!)

Neuro-cognitive Reactive Multi-Sensory Recall T-Drill hop test: (visual/auditory/tactile cues, randomly process sensory info)

-NEXT GENERATION TESTING!

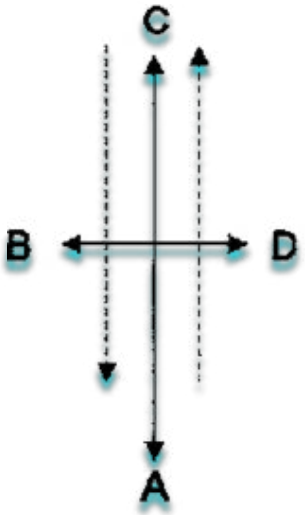


LEFT [25]

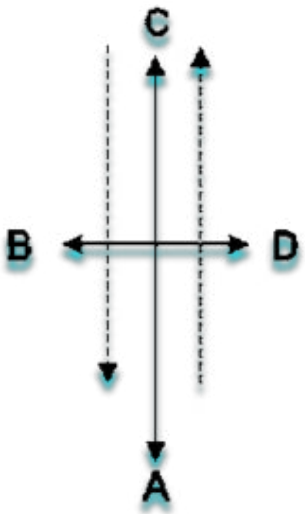
- M-1:30
- F-2:00 minutes

Requires memory, agility, LE stressors- both ways.

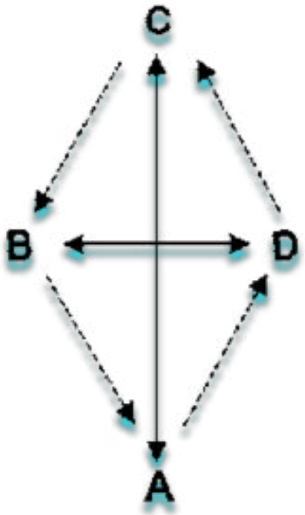
Test in Non-fatigued and **Fatigued state!**



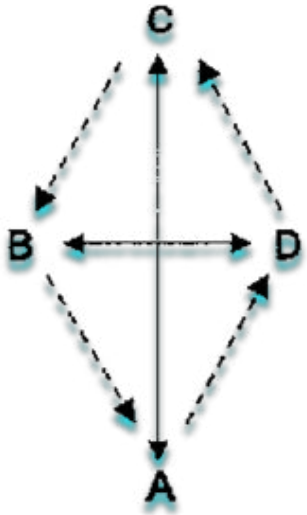
Forward run



Retro run



Side shuffle



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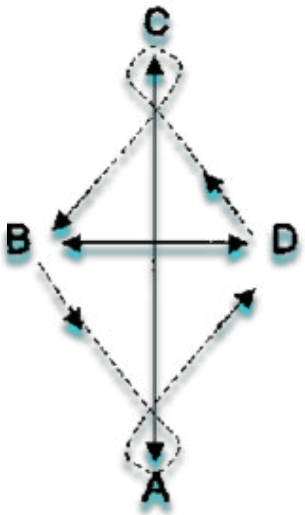
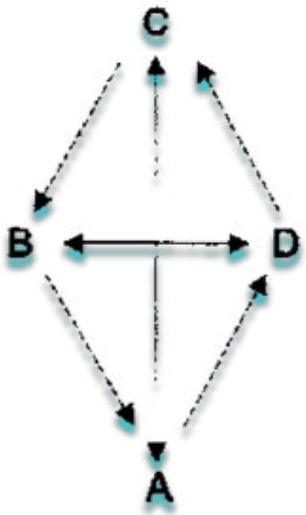
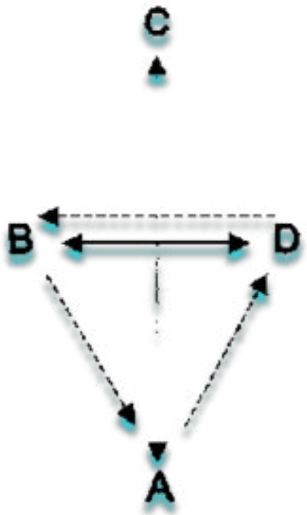


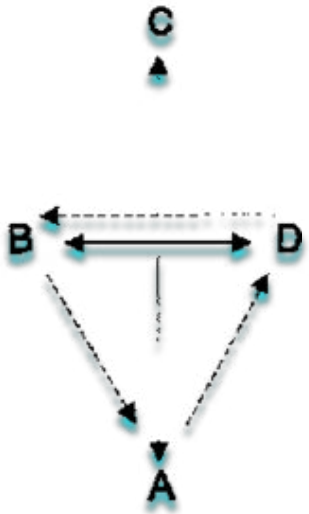
Figure-8 run



45° cuts



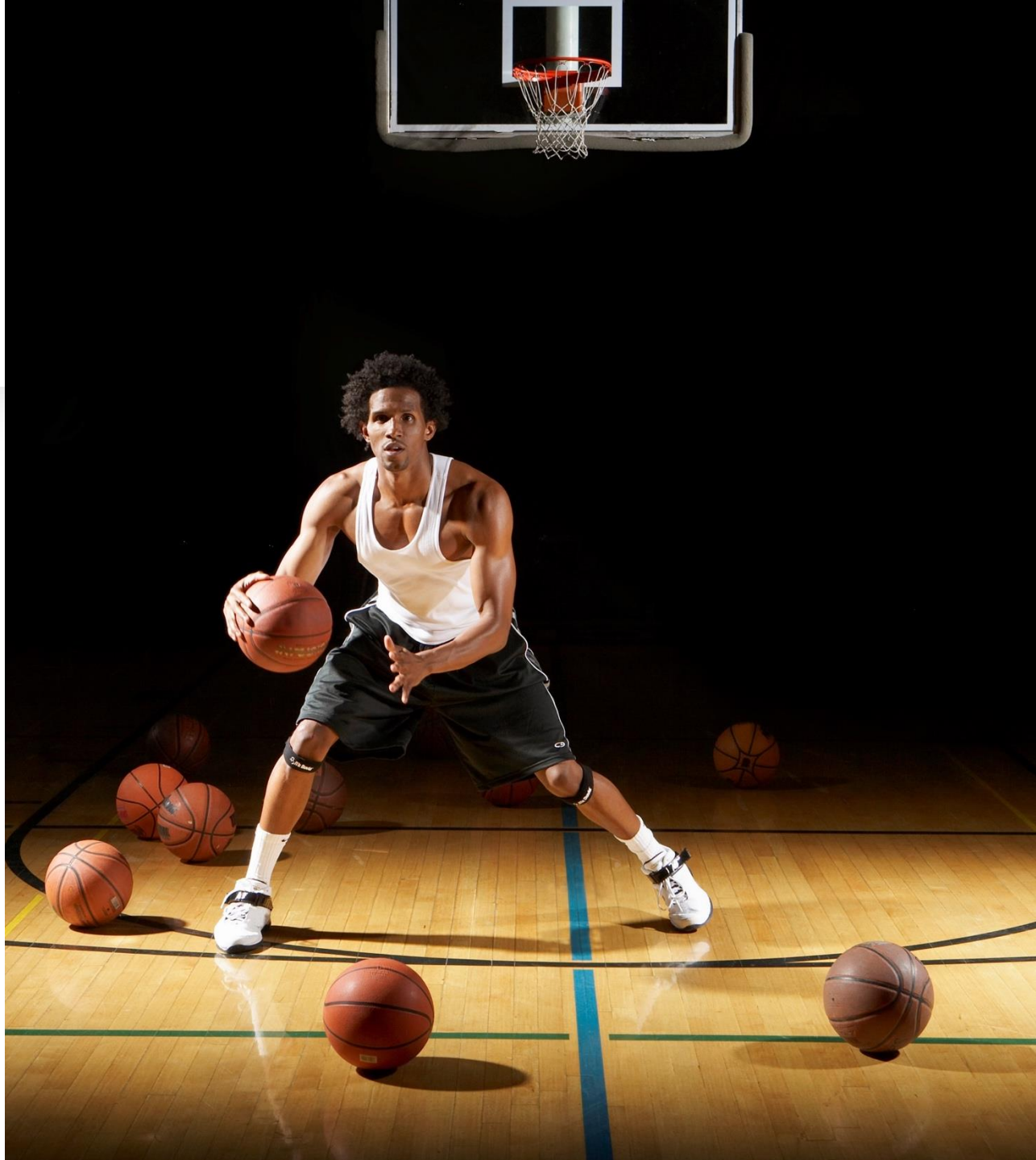
90° cuts



90° crossover cuts

Train for RTS criteria!

- Neuro cognitive training with plyometrics, strength training.
- Reactive drills / movements
- Less predetermined movement patterns
- Multi sensory cognition with workouts
- Make patient’s mirror you! - unpredicted



Functional Testing Algorithm

- Balance Testing: MSEBT 90%+ LSI and < 4 cm ant. reach
- JUMP - <15% Ht.; Norms. NO arm swing

- HOP Tests -< 10%Ht.; <10% LSI
  - 2 traditional
  - Neurocognitive reactive tests: <10% LSI/ norms
  - Various planes: SIDE hop test, T-drill hop
  - SLVH - <10% LSI
- Assess QUALITY of hop/ jump tests too!
- LEFT
- Consider testing all in a non-fatigued THEN fatigued state!

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