Progressions in Rehabilitation of Athletes | Preparing Athletes for Return to Sport

GAIN 2018

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ANCIENT TIMES

A BRIEF HISTORY OF EARLY WORLD PROGRESSIONS

AN INTRODUCTION TO THE STUDY OF ANCIENT HISTORY AND THE APPROACH OF EARLY CLINICIANS

BY

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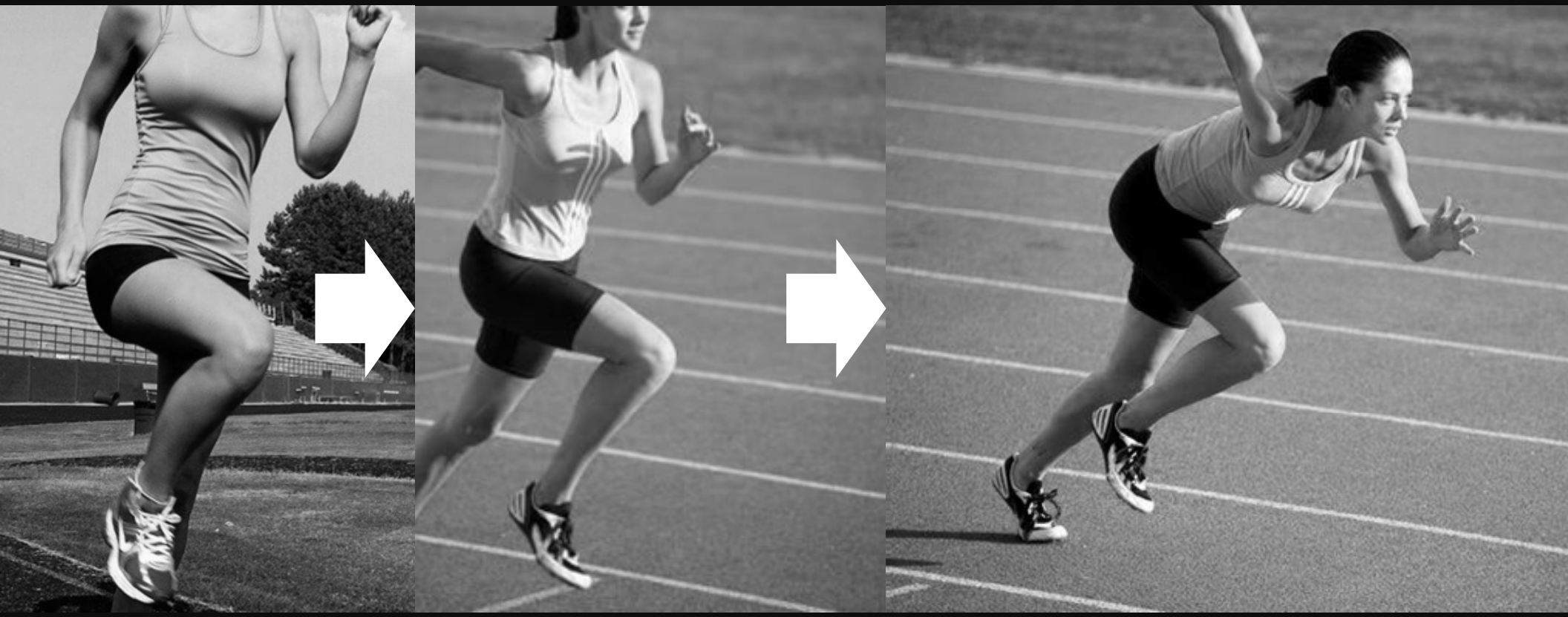


BSU
BEAVERS

The current state of return to sport (RTS)

Return to Competition

Return to Play

Return to Sport

Return to Activity

Plus, is return to participation or training any different or similar to sport, play, competition?


Competition at same role or lesser/different role than before?
Unrestricted?
Limited / Modified?
No further management of the injury?
What sport & what position within the sport?
What type of activities? All? Some?
(stability, strengthening, agility, speed etc.)

"The use of the term RTS must be accompanied by a detailed description of the individual characteristics of the athletes being studied (e.g sex and age), the use of protective equipment (e.g. taping, bracing), the intensity, duration and frequency of each exposure, the type of activity (pivoting, non-pivoting, contact, non-contact sports), level of activity (elite, competitive, recreational), level of performance (statistics), as well as the timing and duration of sports participation……"

-Dingenen & Gokeler; SM, 2017

“Criteria-based RTS”

Benchmarks

Common Benchmarks

✓ **Time** from the injury/surgery

✓ **Objective** measures:

(limb symmetry index: strength, rate of force development, hop distance etc.)

✓ **Subjective** measures:

(Patient Reported Outcomes, Disablement in the Physically Active etc.)

Strategic Assessment of Risk and Risk Tolerance (StARRT) framework for return-to-play decision-making

Ian Shrier

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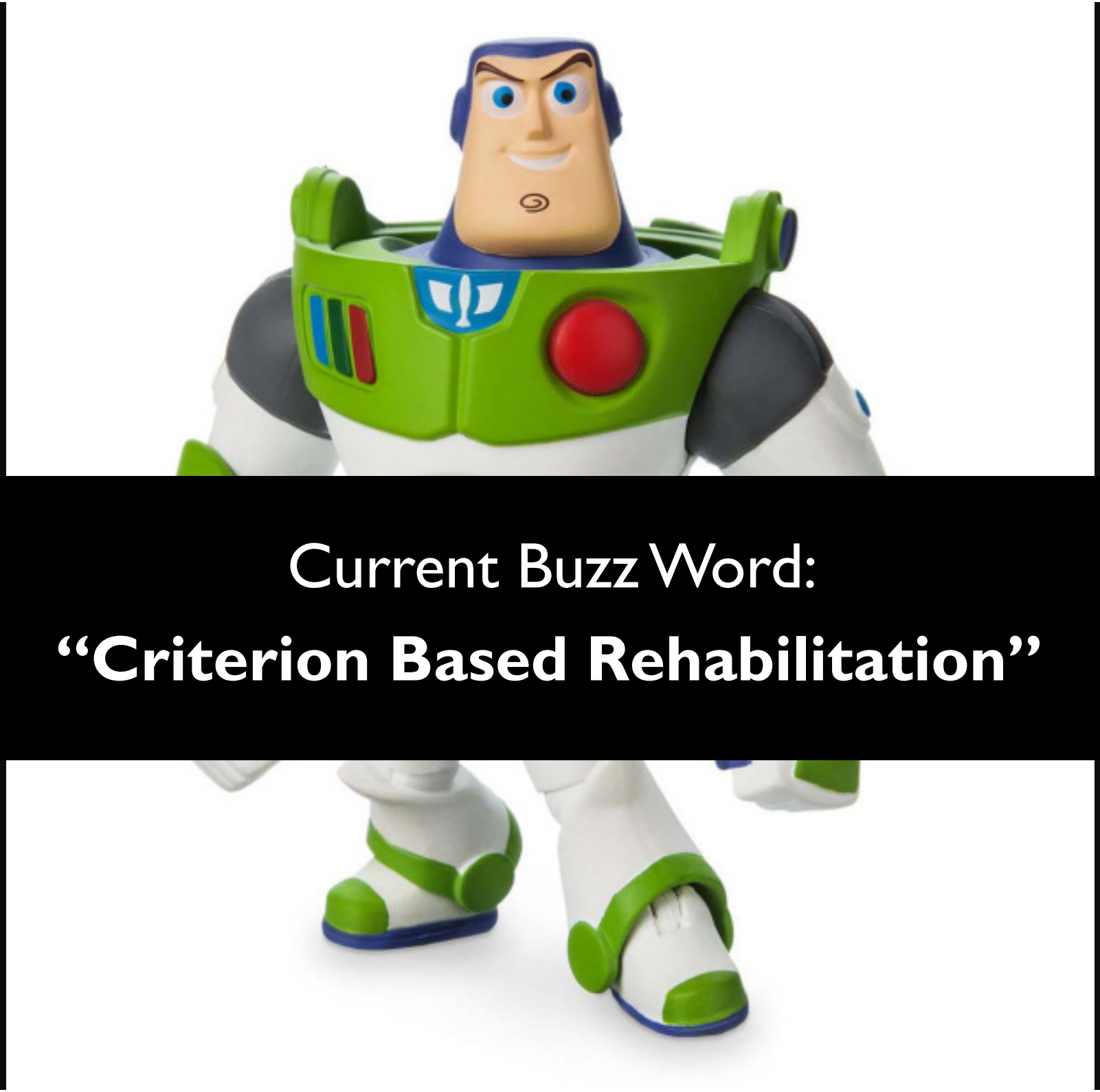
ABSTRACT
The sport medicine clinician is faced with return-to-play (RTP) decisions for every patient who wants to return to activity. The complex interaction of factors related to history, physical examination, testing, activity and baseline characteristics can make RTP decision-making challenging. Further, when reasoning is not explicit, unnecessary conflict can arise among clinicians themselves, or among clinicians and patients. This conflict can have negative health consequences for the patient. In 2010, a transparent framework for RTP decisions was proposed. However, some have identified limitations to the framework and found difficulties in its implementation. This paper presents a revised framework that addresses the limitations, and provides concrete examples of how to apply it in simple and complex cases.

Will applied stresses exceed stress tolerance of the tissues?

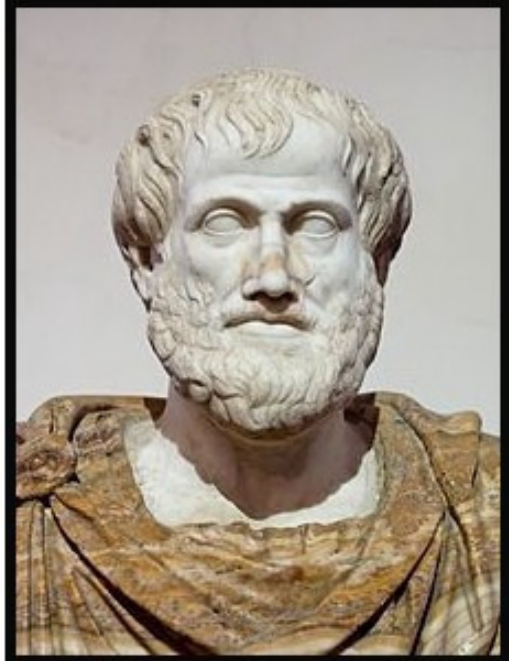
BJSM, 2015


COMMON PROBLEM
(aka “black hole”)
DESCRIPTION of benchmark goals
without EXPLANATION of how to
reach the benchmark?



Current Buzz Word:

“Criterion Based Rehabilitation”



A whole is that which has beginning, middle, and end.

(Aristotle)

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Masterclass

5. Functional phase

The goals of the functional phase include: 1) increasing the optimum length of the hamstrings; 2) decrease leg asymmetries in optimum length; 3) decrease leg asymmetries in concentric hip extension; 4) decrease leg asymmetries in horizontal force production during running; and, 5) improve torsional capabilities.

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Lifts to Avoid:

Hamstring Return to Train Progression

Returning to High Intensity Training:
- Avoid increasing the amount lifted by more than 10-15% at a time (~every 10-14 days)
- Avoid working to muscle failure
- Each novel exercise should progress from 15-20RM for Mm size & definition, 8-10RM for Mm size & strength, to finally 3-5RM for Mm force capacity)

PHASE	ACUTE (P1)	P2	P3	P4	P5	P6
EST. TIME (TBD by specific injury)						
TRAINING ROOM	Pain management Hip Mobility - special focus on quads & hip flexors (Gabbe et al 2006) Glute Med - Frontal Plane Exercises as able Trunk/ Pelvic Stability (Sherry & Best 2004) Glute Max - Hip Extension Exercises Standing Woodpeckers (pain free) Isometric Hamstring Exercises (pain tolerated lengths and ranges)	Soft Tissue Mobilization (avoid area of injury) Hip Mobility - special focus on quads & hip flexors HD Isolated Hamstring Strengthening - isometric & concentric KD Isolated Hamstring Strengthening - isometric & concentric Glute Med - Frontal Plane Trunk/ Pelvic Stability Foot/ Ankle Ex (PF & DF) Neural Tension Release Tech	Soft Tissue Mobilization as needed Hip Mobility - special focus on quads & hip flexors HD Integrated Hamstring Strengthening - isometric & concentric KD Integrated Hamstring Strengthening - isometric & concentric Eccentric Focused Exercises Advanced Trunk/ Pelvic Stability Foot/ Ankle Ex (PF & DF) Neural Tension Release Tech	Soft Tissue Mobilization as needed Hip Mobility - special focus on quads & hip flexors Triplanar Multisegmental Exercises Advanced Trunk/ Pelvic Stability	Soft Tissue Mobilization as needed Hip Mobility - special focus on quads & hip flexors Increased Load for HD Exercises Increased Intensity & Volume for KD Exercises Advanced Trunk/ Pelvic Stability	Soft Tissue Mobilization as needed Hip Mobility - special focus on quads & hip flexors
WEIGHT ROOM	Upper body Focused exercises Trunk/ Pelvic Stability	Double Leg Squat (pain free depth) HD Isolated Ham Strengthening (ie. Bridging, Goodmornings) -pain free ROM - focus on ROM not load) Step ups Frontal Plane Exercises (ie. lateral band walks)	Triple Extension Progression Single Leg Squat Split Squat/ Lunge Progression Hamstring Lengthening (ex.45deg Hypers, Loaded Goodmornings - progress to single leg focus)	Nordic Ham Curls Olympic Lifts as able Low Level Plyos/ Agilities	Exercises from previous phases (Hip & Knee Dominant Posterior Chain at least 2x week) Trunk/ Pelvic Stability Advanced Plyos/ Agilities	Exercises from previous phases (Hip & Knee Dominant Posterior Chain at least 2x week) Trunk/ Pelvic Stability
GENERAL CONDITIONING	UBE, Ropes Pool Walking	Walking (Marching), Frontal Plane Running Drills Pool Running (chest deep)	Slideboard, Wall Mechanics, Skip & Bound Progressions Pool Running (waist deep)	Land Running (low-moderate intensity >70% short distance) Incline Work (~15deg) Accelerations / Build-ups	Top Speed Mechanics Land Running (moderate-high intensity (70-90%), gradual increase in distance	Deceleration/COD, Position Specific Drills
SPECIAL CONSIDERATIONS	*Avoid passive static stretching of hamstring and concentric hamstring exercises *Goal: Minimize pain & edema while optimizing scar tissue formation	*Slow Controlled Movements, within pain free range Goal: Regain full voluntary control of injured muscle & painfree hamstring strength (over range)	Goal: Regain painfree hamstring strength (outer range)	Goal: Pain free running & power development	*Sprint Distances gradually increase 90-120 m 6-10X. Acute high speed running loads should be progressed gradually Goal: Normal/ Optimal Eccentric Strength & Symmetry. Return to full speed	Goal: Return to sport
CRITERIA FOR TRANSITION TO NEXT PHASE	Pain free walking gait High Knee March Test - pain free normal ROM	Supine ASLR (pain free unrestricted ROM) Strength Tests (Dynamometer) - isometric & concentric within 10% NI limb	Single Leg Suspended Bridge x3 (pain free) Single Leg Diver with Reach (pain free unrestricted ROM)	Dynamic High Step ups (5R/L at least 50% BW) Run (70% with normal pain free gait pattern) Distance/ Reps?	Strength Tests (Nordbord) - eccentric return to baseline and <10% asymmetry (Oakley et al 2017) Dynamic H Test (1X pain free) Sprint Test (~90% with normal pain free gait pattern) - Distance/ Reps? (3x40 yards)	Change of Direction Test (sport specific)

Return to Train Tests (administered at various times throughout the process as appropriate)

ROM	Standing Trunk Flexion	Supine ASLR
Strength	Dynamometer (Isometric & Concentr	Nordbord (eccentric)
Stability	Single Leg Suspended Bridge x3	Single Leg Good Morning (pain free unrestricted ROM)
Power	Dynamic Step up (5X50% BW)	Dynamic H Test
Speed/Endurance	Sprint Test	COD

References:
Sherry & Best (2004)
Oakley et al (2017)
Mendiguchia (2017)
van der Horst et al (2016)
Aspetar Hamstring Protocol (youtube)
Orchard et al (1997)
Gabbe et al (2006)
Askling et al (2003, 2013)

Criterion Based Rehabilitation for ACL-Reconstruction

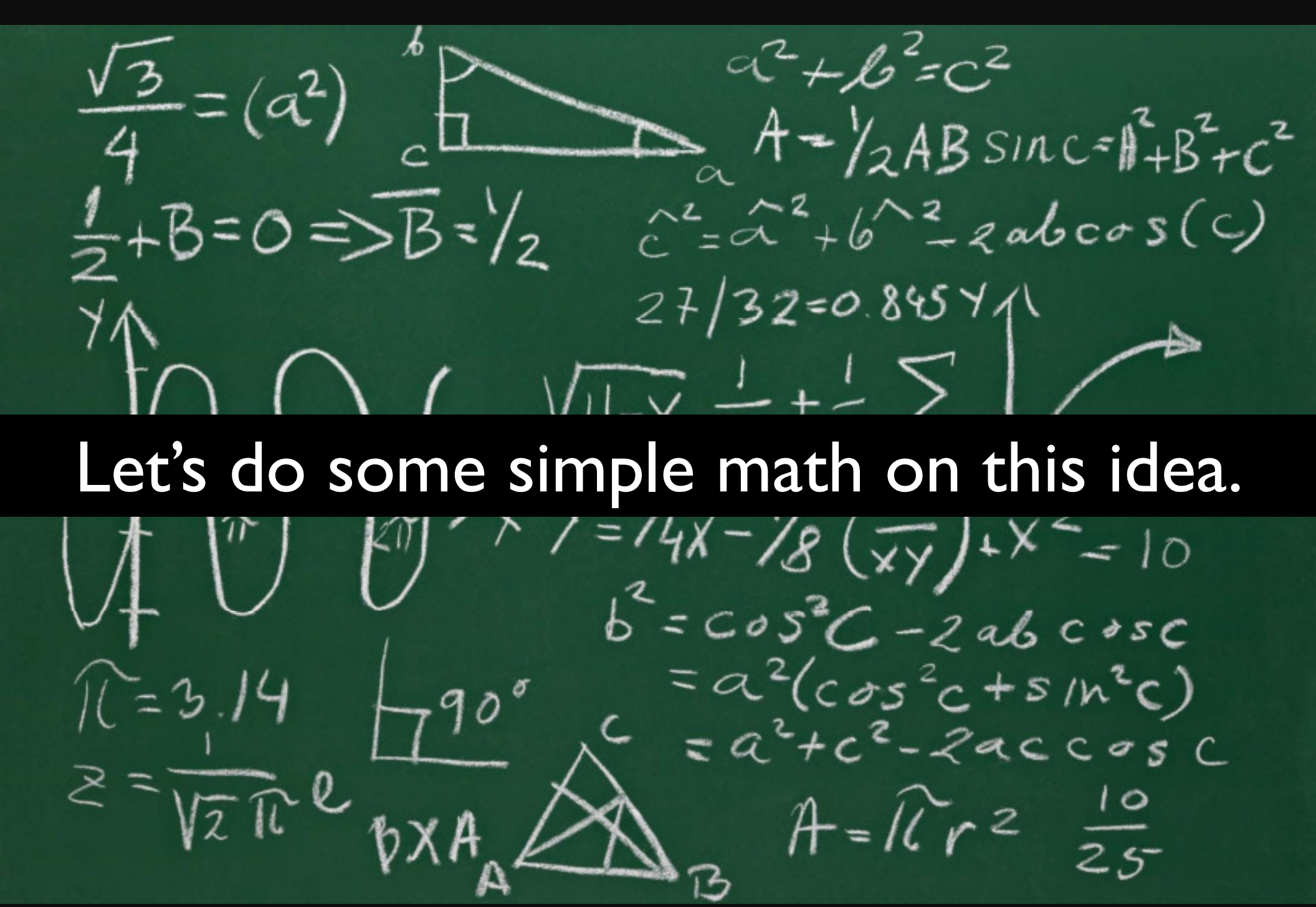
(Adams et al. JOSPT, 2012)

Running Progression

Quadriceps Index @ 80% Strength --- allowed to begin running.

Dose: 2mile (3.2km)- alternating walking and jogging (gradually progressive)

"What did you say?"


Let's do some simple math on this idea.

"Progress to alternating walking and jogging for 2 miles."

VGRF:

R = 1.2 - 2.5 x BW

walking @ 1.5 m/s (3.4mph) - running @ 6.0 m/s (13mph)

Slow jogging = 50% higher VGRF compared to walking and faster running. (Keller et al. CB, 1996)

"Average" number of strides/mile:

540-1951

pace @ 6min/mile - 12 min/mile

load (lbs) ≅ 202K-365K per mile or 101-182 tons/mile* (Hoeger et al. ACSM Journal 12(1))

* for 150lb individual

More "good news"

"Neuromuscular evaluation " with single-leg squat @ 6mo ACLR

(Hall et al. OJSM, 2015)

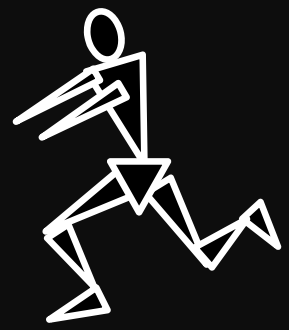
45% of patients had poor SLS performance at 6 months.

Were these individuals already running, cutting etc.?

Why should we allow someone to run and perform agility drills post-injury who has poor SLS squat performance?

Derive Alternatives

Use the SLS performance as criteria for progressing ***to*** running, hopping etc.



Qualitative analysis of single leg loading

Date: Patient:

Condition: Left Right Bilateral

QASLS	Task: Single leg squat; Single leg step down; Single leg hop for dist	Left	Right
Arm strategy Trunk alignment	Excessive arm movement to balance Leaning in any direction		
Pelvic plane	Loss of horizontal plane		
	Excessive tilt or rotation		
Thigh motion	NWB thigh moves into hip adduction		
	NWB thigh not held in neutral		
Knee position	Patella pointing towards 2nd toe (noticeable valgus)		
	Patella pointing past inside of foot (significant valgus)		
Steady stance	Touches down with NWB foot		
	Stance leg wobbles noticeably		
	Total		

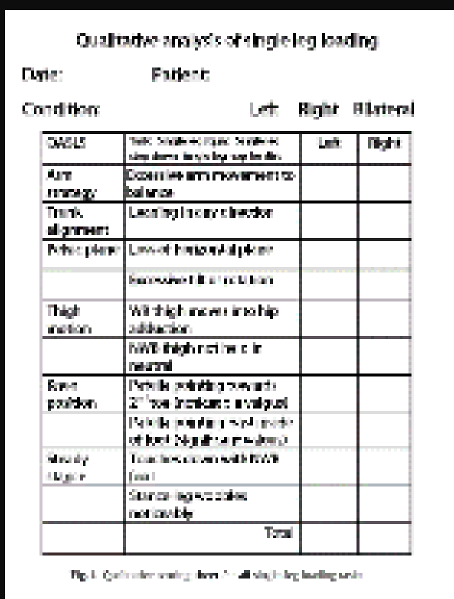
Fig. 1. Qualitative scoring sheet for all single-leg loading tasks.

Systematically assess "quality of the movement" (Qualitative Analysis of Single Leg Loading: QASLS; Herrington et al. 2013)

But also some "metric" of muscular performance.

E.g. SLS Squat Test

Goal: 70 reps in 2 min
3 sets total
2 min rest b/w sets
Ideal: 90° deg flexion
but 70-90° acceptable.



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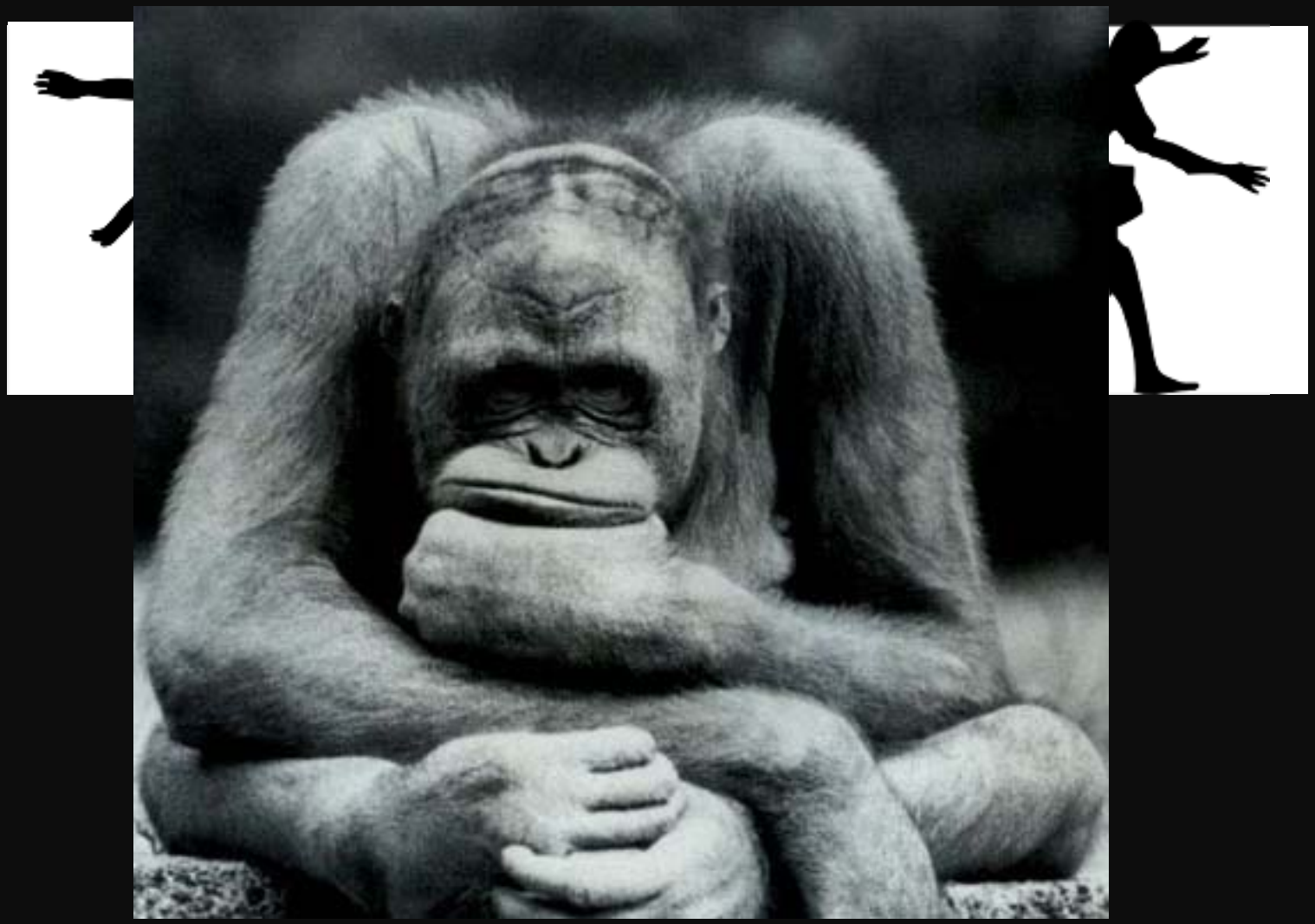
Hop Testing

✓Quality Assessment

✓ Limb Symmetry Index

But…… what is the progression leading to hopping?



We don't even designate hops vs. jumps vs. leaps correct in the literature!

e.g. "single-leg hopping"

2.7. Unilateral load acceptance activity

2.7.1. Aim
Progressing athlete from bilateral load acceptance activities to full unilateral load acceptance activities in multiple planes of

2.7. Unilateral load acceptance activity

2.7.1. Aim

Progressing athlete from bilateral load acceptance activities to full unilateral load acceptance activities in multiple planes of movement. Alongside progressing strength and force development training and work capacity of key lower limb muscles.Typical rehabilitation activities

- Muscle strengthening and work capacity training
- Unilateral load acceptance activities in multiple planes and reactive landings situations
- Bilateral multi-plane and unilateral single plane plyometric activitiesTarget criteria to be achieved prior to progression to sport specific task training activities

Lifts to Avoid:
- Open chain knee extensions

ACL-R Return to Train Progression

Returning to High Intensity Training:
- Avoid increasing the amount lifted by more than 10-15% at a time (~every 10-14 days)
- Avoid working to muscle failure
- Each novel exercise should progress from 15-20RM for Mm size & definition, 8-10RM for Mm size & strength, to finally 3-5RM for Mm force capacity)
- at least 2 leg days per week

PHASE	ACUTE (P1)				P5	P6
EST. TIME (TBO by specific injury)	Protective Phase (~0-2 weeks)	ROM & Neu		ent (Locomotor) eeks	Transitional (COD) ~16-24 weeks	Return to Train
TRAINING ROOM	Early ROM & Muscle Re-education Pain Management Isometric Quad & Hamstring Hip Ab/Adduction Weight Shifting/ Balance Ex Patellar Mobilization Wound Care	Address lingg Isolated Quad Hip Mobility Trunk & Hip S Patellar Mob Balance/ Pro Standing clos squats, side Gait Retrainin			Agility & cutting mechanics Maintain flexibility and strength Recovery strategies as need (soft tissue, compression) Monitor pain and swelling post activity	Maintain flexibility and strength (2x week) Recovery strategies as need (soft tissue, compression) Monitor pain and swelling post activity
WEIGHT ROOM	Upper Body as able* Contralateral Limb work as able* 4 way Hip Machine* Trunk Stability as able*	Body Weight ROM & move Hip Dominan mornings, Hi Step ups	Trunk Stability	Triple H	Full Clean (as able)	Resume normal programming, addressing any additional areas of opportunity
GENERAL CONDITIONING	UBE, Seated Ropes*	NWB Aerobic exercises as ROM allows (Bike, Stairmaster, Versiclimber, Aquajog per wound healing	Bike, Elicpitcal, Pool Progression	Running Speed I cross tr DL Plyo		working into nique)
SPECIAL CONSIDERATIONS	0-120 Flexion AROM; 0-90 for meniscal repair (first 4 weeks) Extension should be focus Brace locked at zero degrees	Weight bearing as tolerated Open brace for increased ROM. Discontinue brace 3-4 weeks during ambulation as dictated by quad strength and available knee	Emphasize closed chain for co-contraction Gradual increase in intensity of exercise	Running lateral Graft i	Running focus on increasing loads & deceleration techniques (gradually add soft cuts) Unilateral Plyometric Progression Soft cuts	ins for 12 ually ess back into ing post ecessary

P5

Transitional (COD) ~16-24 weeks

Agility & cutting mechanics

Maintain flexibility and strength

Recovery strategies as need (soft tissue, compression)
Monitor pain and swelling post activity

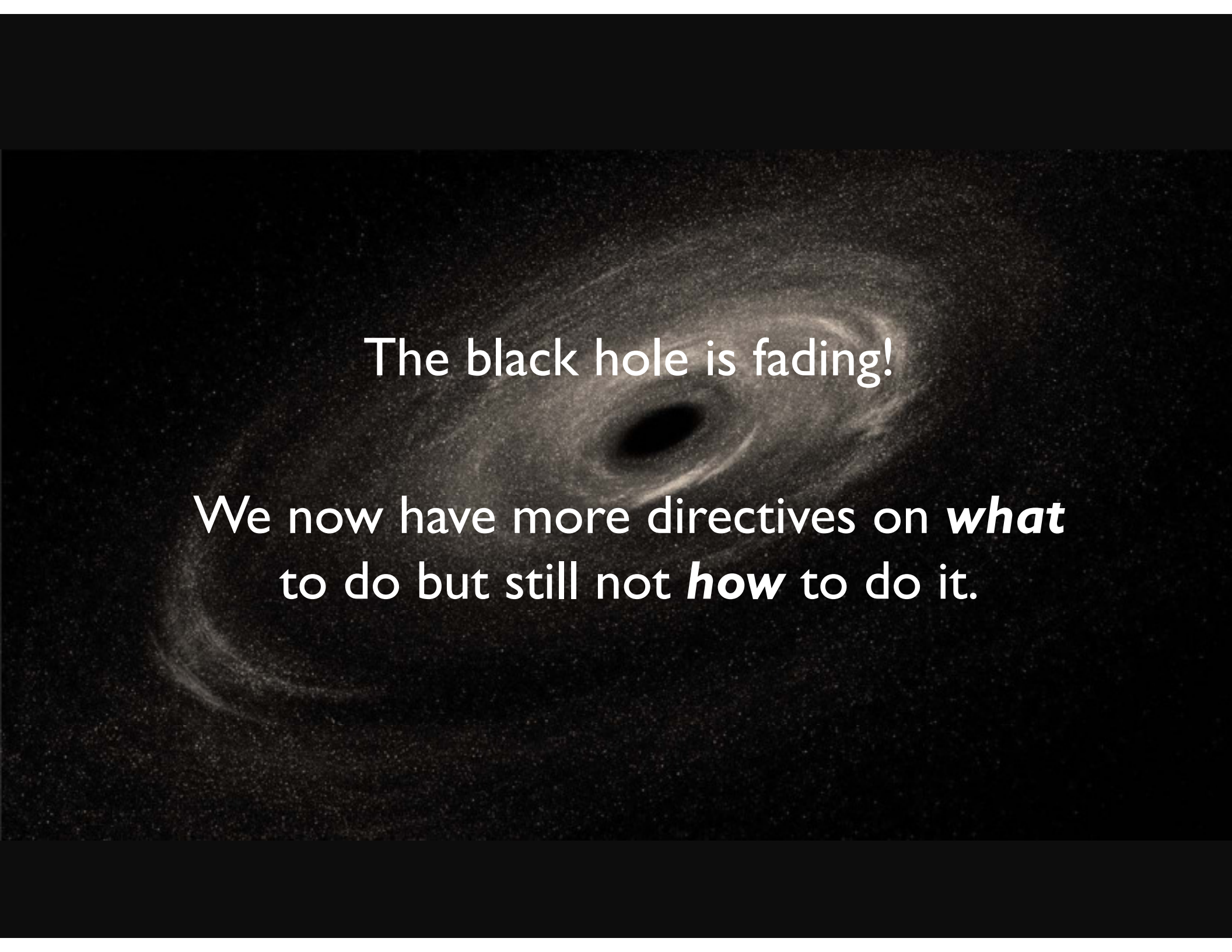
Running focus on increasing loads & deceleration techniques (gradually add soft cuts)

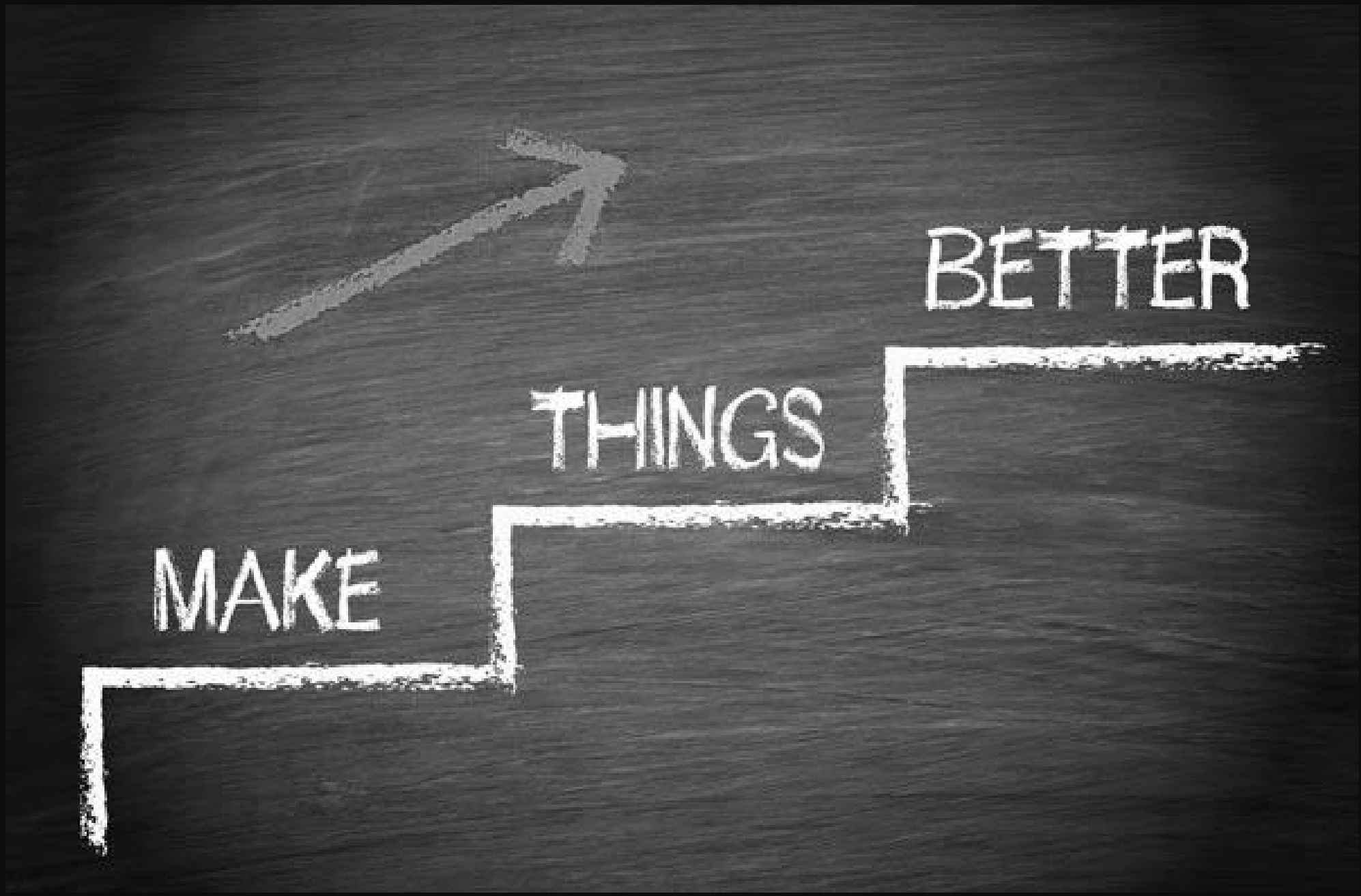
Unilateral Plyometric Progression

Soft cuts

CRITERIA FOR TRANSITION TO NEXT PHASE	*Weight room work only after athlete is off pain meds except at night	Limb Symmetry & pain free ROM Normal Movement Pattern with Squat	Single Leg Coordination Test - Functional Squat Yosmaoglu (2011) SRM 70-80% BW Front Squat Pain free walking 30 min	SRM >50% BW RFESS Countermovement jump 15% Single Leg Endurance Squat Test (<10%LSS) LQYBT (<10%LSS)	Single Leg Hop Tests (<10%LSS) Triple Hop Cross Over (<10% LSS) Timed Hop (<10% LSS) Reid et al (2007)	Return to Play Criteria: Met all previous criteria & athlete confident Cuts on Force plate (RFP) Countermovement Jump 10% Modified Agility T Test (Hickey et al 2009) / Pro Shuttle/ Field Test? Reactive? Sport Specific

ROM	Goniometer			sport
Strength	Front Squat	RFESS		
Stability	Coordination Test	Single Leg Endurance Test		
Power	Squat Jump (force plate)	Horizontal Hop Tests (SL)	Vertical SL	
Endurance	SL Endurance Test			


The black hole is fading!
We now have more directives on *what* to do but still not *how* to do it.


MAKE
THINGS
BETTER

Your life does not get better
by chance,
it gets better by
CHANGE.

-Jim Rohn

How do we ***change*** what we do related to the progression and development of agility in athletes with lower extremity injury?

Develop multi-directional speed and agility without re-injury "anxiety" during recovery & improved capacity for return to sport.

MDSA Requirements:

Body control and awareness (whole body and it's parts, awareness relative to goal of movement)

Starting and first step (first overcoming inertia, second stepping in correct direction)

Acceleration: attaining optimal speed rather than absolute speed

Footwork: ground up relationship of foot to the hip

Change of direction: initiated by shifting COG outside BOS and then regaining control and moving in intended direction

Stopping: proportional and controlled loading/bending of ankle-knee-hip-trunk in order to control high eccentric loads (absorption of forces- self and opponents)

Recognition and reaction

-Vern Gambetta

My perspective

MDSA is the combination of cyclical locomotor skills expressed in serial organization (short bursts), with the transitions between skills accented with discrete skills.

The beginning and ending matter!


Body Control & Awareness
Starting & First Step
Acceleration
CONNECT THE DOTS!
Change of Direction
Stopping
Footwork
Recognition & Reaction

Train/recondition each of these subcomponents during rehabilitation……

then

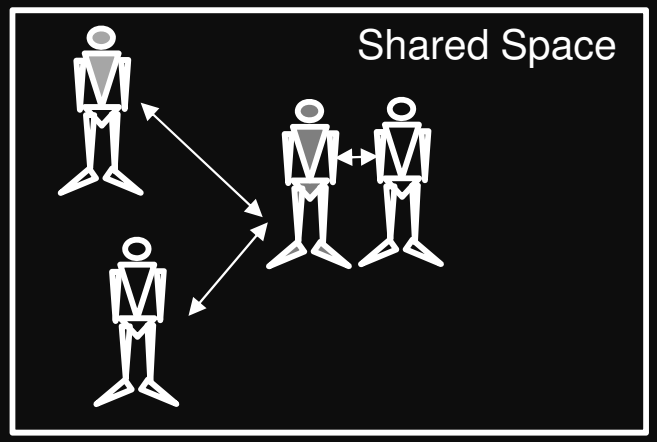
….progressively create movement experiences in which all subcomponents are combined, resulting in MDSA performances.

What else should we consider?

Gain perspectives on how your athlete needs to use "space" when moving….

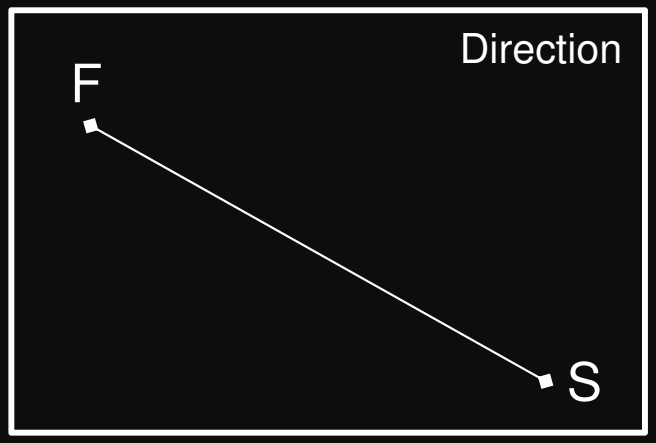
Space Awareness

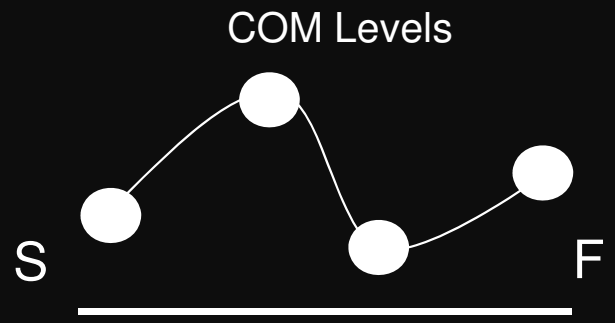
Divisions: self vs. shared space

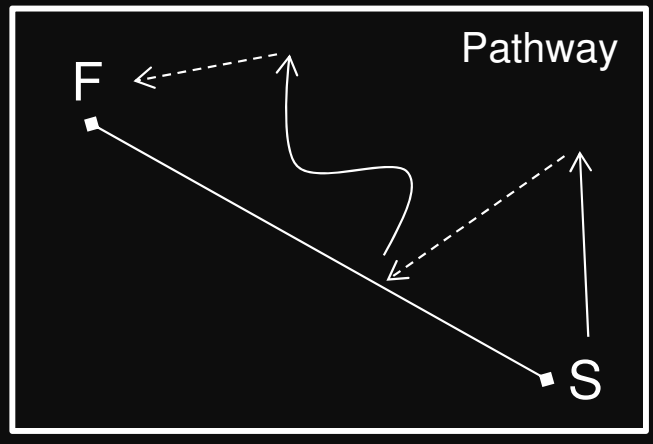


Relationship between the mover and other movers & objects.

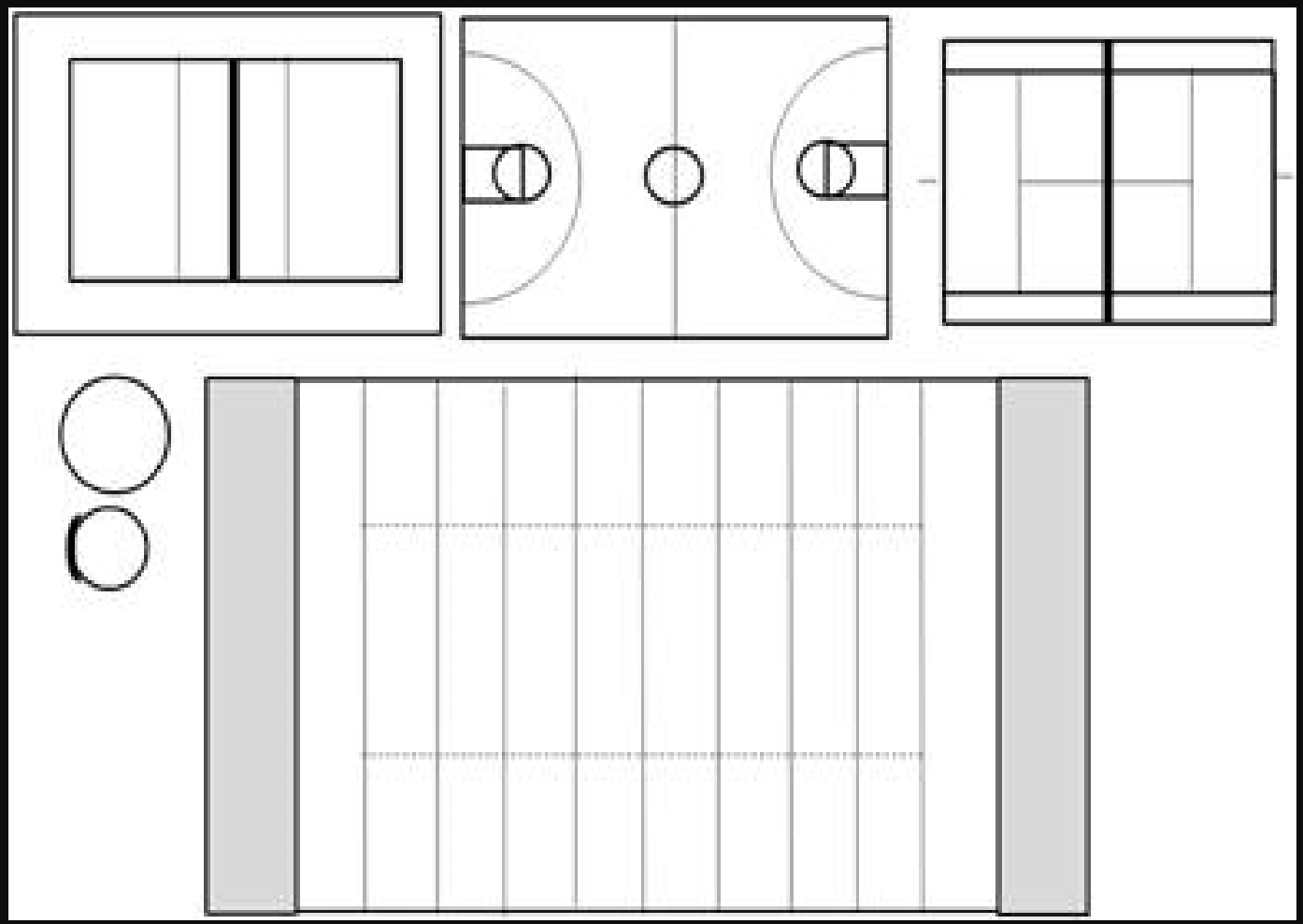
Dimensions: direction, levels, pathways, &……







……available space (dimensionality of playing area)



These characteristics of movement skills….

can be utilized as the

basis for making progressions

between activities/tasks/exercises.

Creating a Holistic Approach

Focus on what the patient CAN DO!

Creatively and purposeful work around the injury.

Train (progress) appropriately!

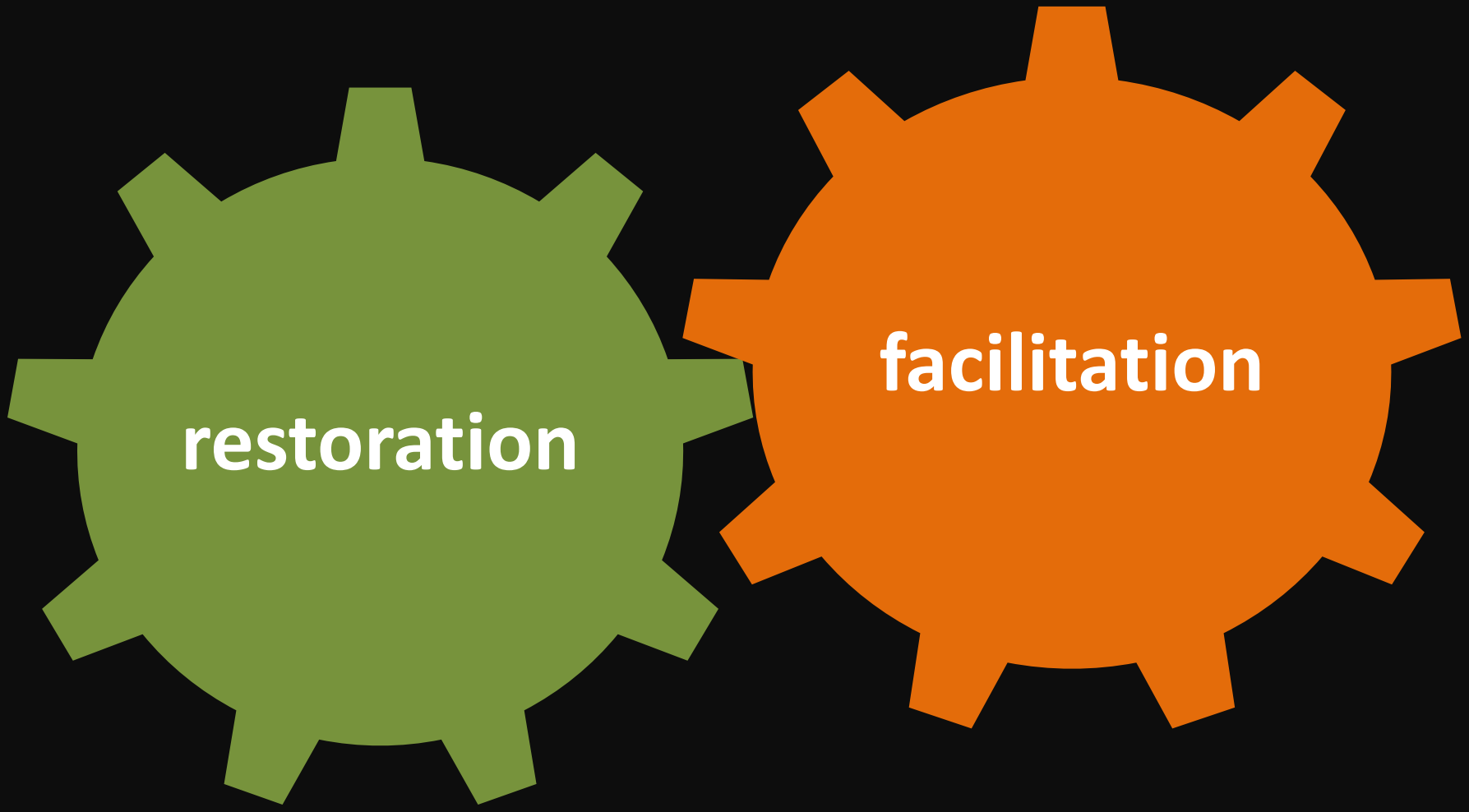
(open to closed chain skills, closed to open environments etc.)

Facilitate adaptation.

Strive for movement competence.

Stages are only as long as needed to reach goals.

Include activities based upon patient's mastery.



Never assume your athlete can do the basic things well (athletically)….be engaged by observing and teaching!

How??


BACK TO THE
BASICS

Tenet 1

Start Simply!

Initially practice and evaluate locomotor (& *discrete*) skills in **isolation**

Simply also means considering:

Plane of movement pattern:

Sagittal → frontal → transverse → combinations

Continuous plane vs. Multiple plane

Direction of movement pattern:

Forward → backward → sideways → diagonal

Continuous direction vs. Multiple direction

Relative the type of injury!

Fundamental before athletic specific before specialized

Examples of Locomotor Skills

General/Fundamental	Athletic specific/Inter-sport	Specialized/Intra-Sport, Position-specific
Walking	Acceleration skip	Tempo: jog to sprint (changing gears)
Running	Carioka	Speed: straight ahead sprint
Galloping	Shuffles: lateral gallop	Forward or Backward Slides (Zig-Zag)
Skipping	Defensive slides	*Agility combinations (LSA/MDSA):*
Jumping	Heelers	Backpedal-sprint
Hopping	High knees	Sprint-backpedal
Leaping	Backpedal	Slides-sprint
	Backward Run	Carioca-sprint
	Lateral crossover run	Performing set agility patterns
	Forward cross-over skip	Creating patterns: proactive
	Backward skip	Responding patterns: reactive
	Backward cross-over skip	Sport / Position Specific Patterns
	Lateral Skip	
	Carioka Skip	

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	Backward skip	Responding patterns: reactive
	Backward cross-over skip	Sport / Position Specific Patterns
	Lateral Skip	
	Carioka Skip	

Develop the Skill (based upon the 5 Cs)

(correctly, confidently, with coordination, with concentration, without compensation)

Evaluate quality of movement!!

If they can- great!

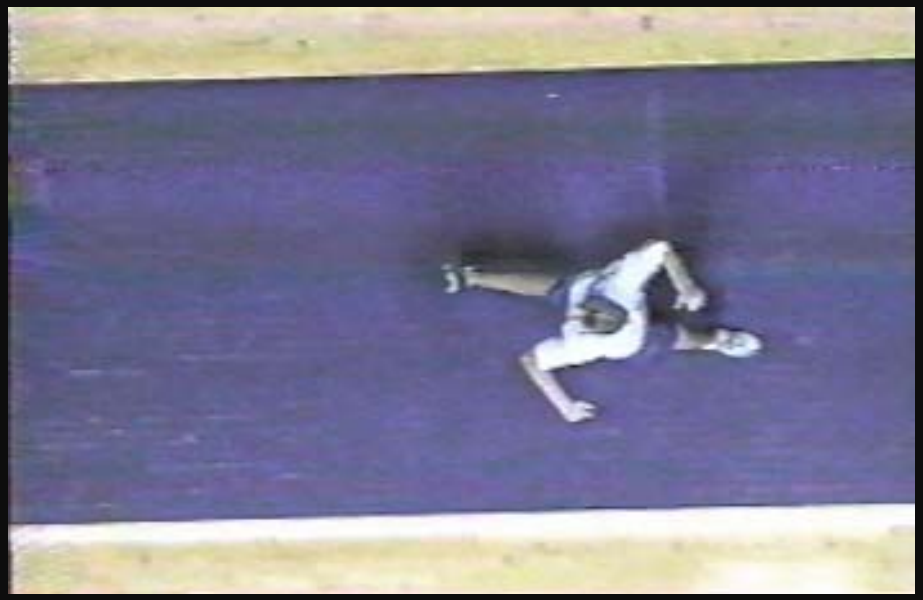
If they can't- help them get better!

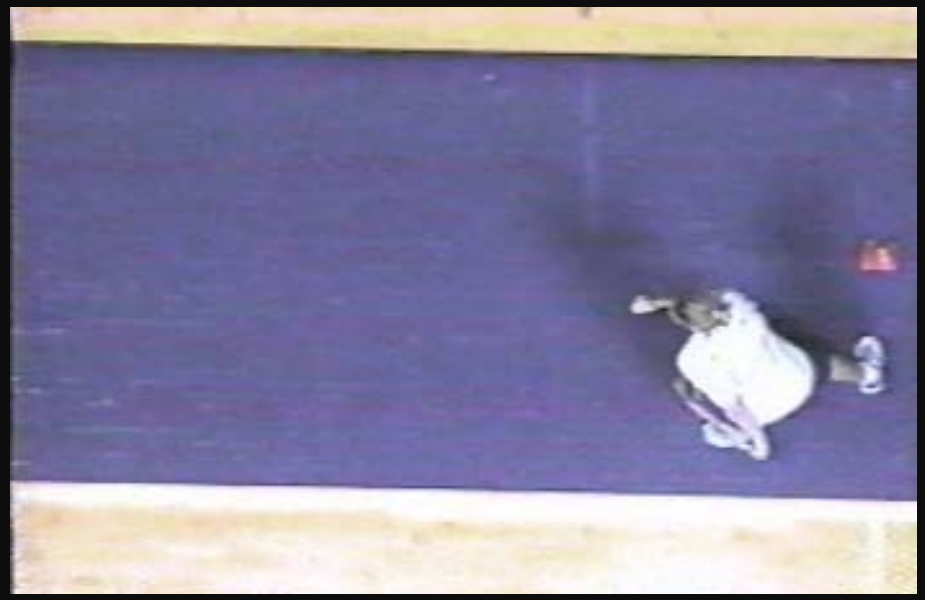
In other words….

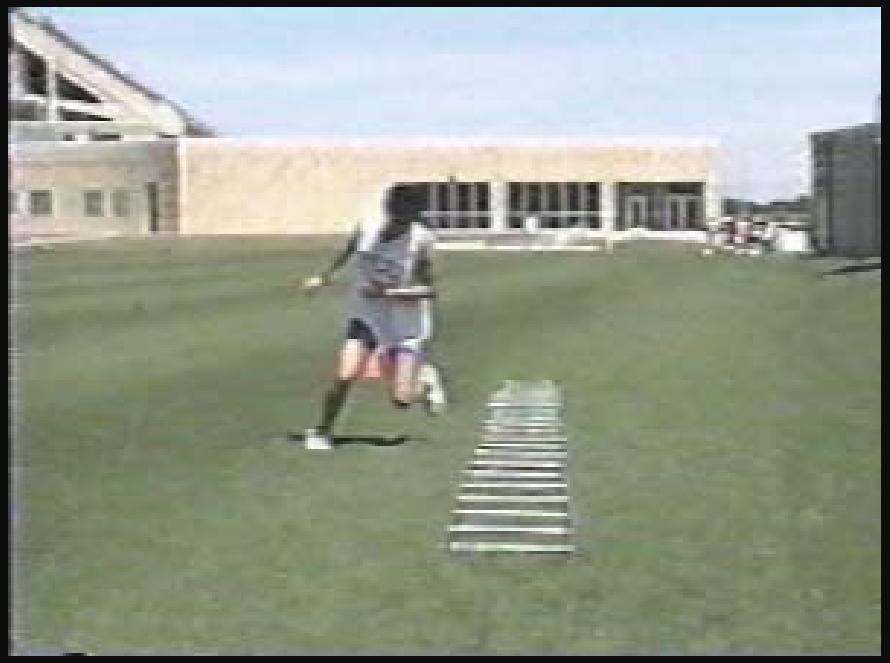
"Find the athlete's envelope of function and work the edges."

Joe Przytula, ATC

Let's observe for compensatory movement behaviors.







Tenet 2

Common agility tests should not serve as the primary training stimulus or pathway in progression.

(assumes the athlete already has the ability to combine a variety of discrete and cyclical skills together)

e.g. T drill, Pro-agility (5-10-5) drills, Illinois agility drills, Figure-8 hop test, etc.

These might be good RTP/S tests ……however a good progression in agility can prepare them to be successful at these tests/drills.

If we intelligently create combinations of locomotor skills through a logical combination of planes and direction, we prepare for the “tests”.

Tenet 3

"The order we combine locomotor skills influences acceleration or deceleration exposure."

Train acceleration and first step-quickness before deceleration (e.g. post-op ACLR)

Most injuries occur in "deceleration" so save this for a "bit" later in agility training.

Early deceleration work begins with various permutations of lunges and other strengthening exercises.

Tenet 4

Add discrete skills in transitions for directional and plane changes.

They should have already been trained separate from this serial application.

Tenet 5

Be mindful of how what you are doing today is preparing the athlete for what they need to do later.

(effectively use "Lead-up tasks")

Example of Lead-Up Task Approach

Additional Unilateral Overloading Progression Ideas


Let's **connect the dots & apply the why** in creating agility progressions:

THE PHASES REALIZED

Progressively combining cyclical locomotor skills!

Creating "serial skill" movement expression in order to prepare for future agility training.

Emphasizing **movement assessment** competence and confidence!

Phase I

CONTINUOUS DIRECTION + CONTINUOUS PLANE

Phase 2:

CONTINUOUS DIRECTION + MULTIPLE PLANE

Phase 3:

MULTIPLE DIRECTION + MULTIPLE PLANE

Phase 4:

MULTIPLE DIRECTION + CONTINUOUS PLANE

MULTIPLE DIRECTION (*DISCRETE SKILL*) CONTINUOUS PLANE

Cutting Progressions &
Combined Cyclical & Discrete Skills

Not enough "space" for agility training?

Consider a variety of footwork drills:

Quick foot drills (some examples- there are more!):

Anterior-posterior repeaters; Posterior-anterior repeaters

Unilateral in & outs; Bilateral in & outs

Repeat cross-overs: with and without hip rotation

Drop-step repeaters

Repeat Cha-Cha-Cha

Add directional travel: Forward, Lateral L, R, Backwards, Diagonal Patterns

Box drills:

Anterior-posterior Up-Downs (Lead L, Lead R)

Lateral Up-Downs (L, R, bilateral)

Single box, multiple box (same height), multiple box (variable height)

Other useful types of progressions

Don’t forget to include sport and position specific alternatives!

Sometimes you need to use what’s available to create challenges!

Sport and Position Specific

Making use of resources

Making use of resources

Making use of resources

Making use of resources

Acceleration

Multiple Starts

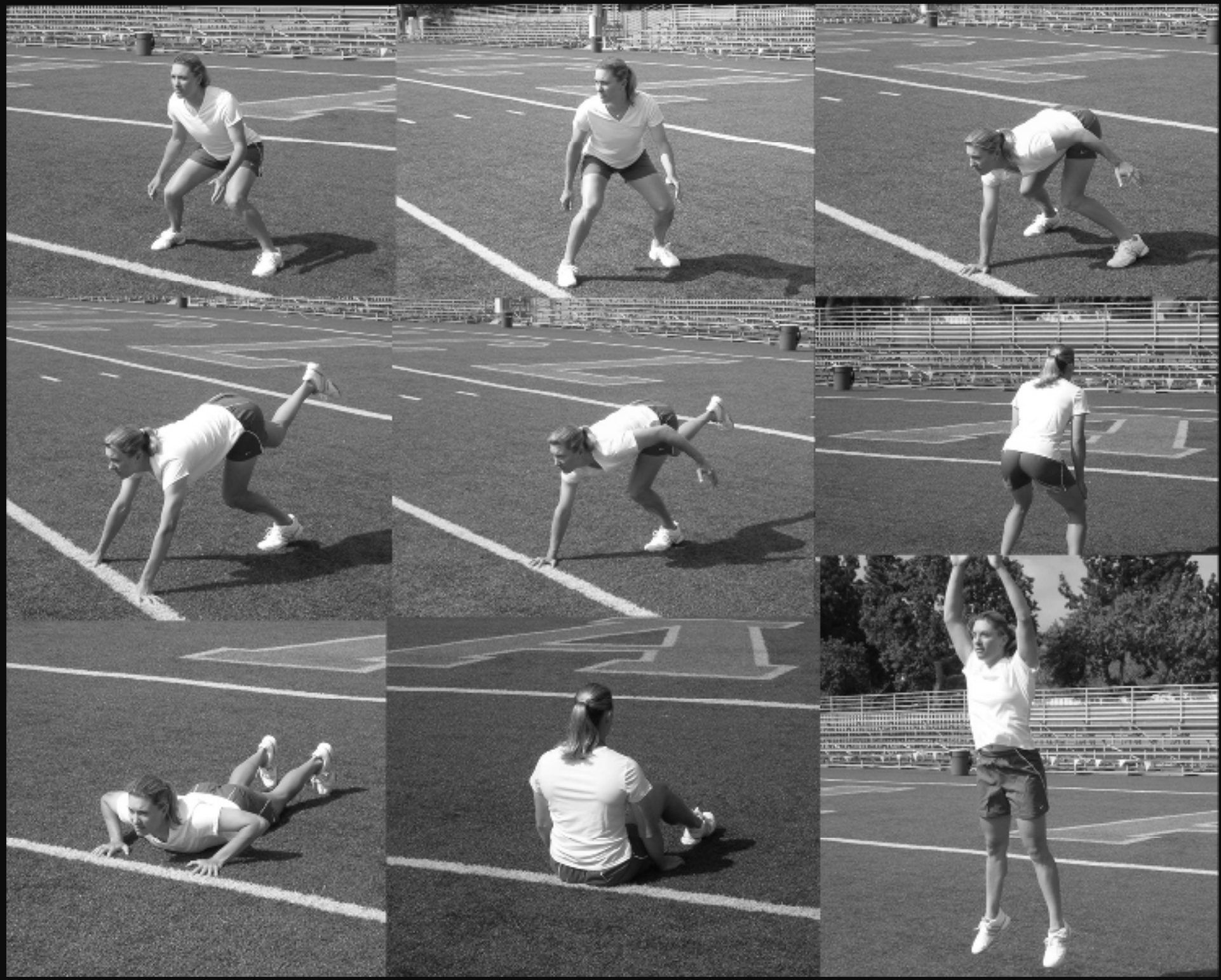
Vary stance (# ground contacts),

Direction you are facing (forward, lateral, retro),

Direction your are heading (forward, lateral, retro),

Which foot you start with (direct or cross-over),

Where you start in reference to the ground (high, low, off the ground)



Video examples


Final Thoughts.

Credits and Special Thanks!

Coach Radcliffe- who inspired my earliest understanding of purposeful progression.

Vern- who invited my participation and has inspired my belief in clinical integration.

All the athletes who allowed me to formulate my approach!

THE END….