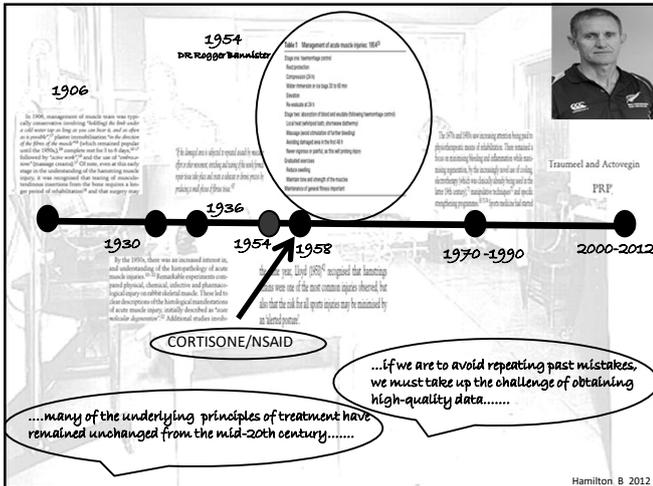


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4

Where are we?

References	ACUTE phase	Sub-acute phase	FUNCTIONAL phase
Worrell (1994)	RICE NSAIDs Restore normal gait patterns Active knee Flex- Ext- Stretching	Isolated strengthening (iso-con- exc) Eccentric "Swing Catches" Static and advanced stretching Swimming pool exercises, cross training	Sports demanding movements Jog- run- sprint progression
"ASPETAR" Tol et al (2014) and Hamilton et al (2015)	RICE NSAIDs	1 leg bridge Stretching	Single leg bridge Eccentric (nordic, arabesque)

S T R E T

STRENGTH

SPRINT

R T P

References	ACUTE phase	Sub-acute phase	FUNCTIONAL phase
Heiderscheit et al. (2010), Silder et al. (2013), Sherry and Best (2004)	RICE NSAIDs Restore normal gait patterns Active knee Flex- Ext- Stretching	NSAIDs Side shuffle Grapevine jog Boxer shuffle Rotating body bridge Supine bent knee bridge with walk outs Eccentric + lumbopelvic stabilization (BW)	Slipping Running technique Forward- backward accelerations Eccentric + lumbopelvic integration (dumbbell) Sport specific drills
Asking et al. (2013 a,b)	RICE NSAIDs Restore normal gait patterns Active knee Flex- Ext- Stretching	Bike Stepping in place Jogging Eccentric: "The Extender," "The Diver" "y" "The Glider"	High speed drills Sprint training

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Where are we?

References	ACUTE phase	Sub-acute phase	FUNCTIONAL phase
Worrell (1994)	inflammation ↓	None	Pain free sport movements at 100%
"ASPETAR" Tol et al (2014) and Hamilton et al (2015)	Painless single leg squat Painless bike, 150W 5 min Full knee extension supine	Run ≥70% patient rated ROM hamstrings ≥75% uninvolved side ROM SLR ≥75% uninvolved side	100% running speed Painless high-speed direction changes Pain free sport specific drills
Verrall et al. (2006)	Pain free	Pain free	Pain free
Petersen & Holmich (2005)	inflammation ↓	None	Pain free sport movements at 100%
Hunter & Speed (2007)	Approx. 5 days post-injury	Full ROM Force generation capacity Control eccentric movement	Pain free sport movements 100%
Heiderscheit et al. (2010); Silder et al. (2013); Sherry and Best (2004)	Normal walking stride without pain Very low-speed jogging without pain Pain-free isometric contraction against submaximal (50%-70%) resistance during prone knee flexion (90°) manual strength test	Full strength (5/5) without pain during a 1-repetition maximum effort isometric manual muscle test in prone with the knee flexed at 90° Forward and backward jogging at 50% maximum speed without pain	<5% isokinetic functional ratio between limbs 4 consecutive maximum reps (90° and 15°) Pain free full ROM Pain free sport movements at 100%
Asking et al. (2013 a,b)	Pain free		Subjective clinical exam ( strength and ROM) Asking H test

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# Periodization

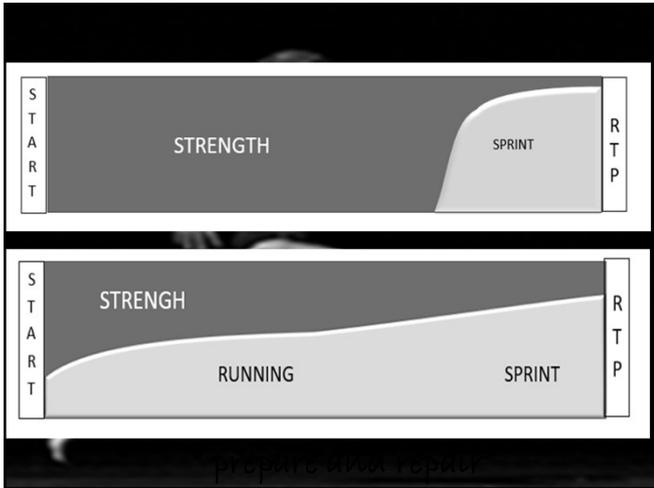
- Number of reps, series ? 3X 10? (vol.)
- Intensity? BW?
- Every day? Daily content planification (interference??)

(Toussaint et al 2014; Silder et al 2013; Verrall et al 2006)

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what do we propose?

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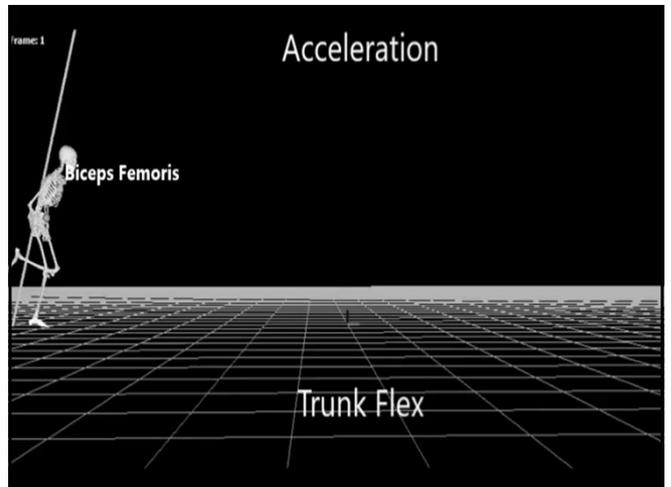
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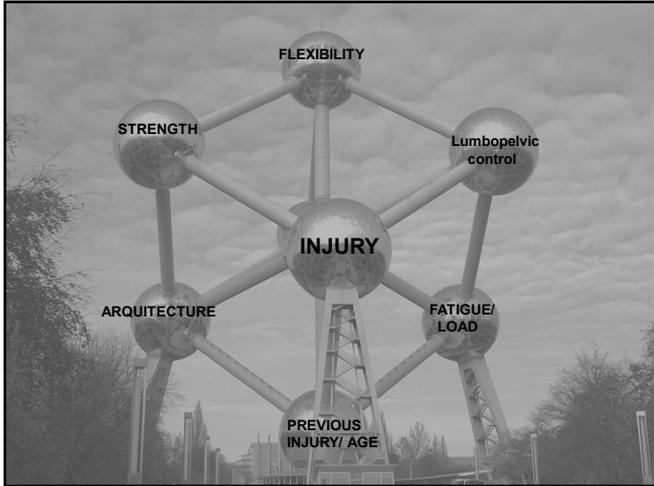
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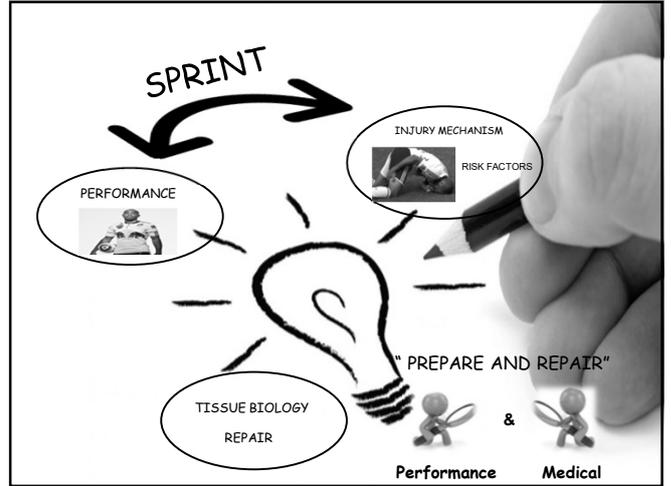
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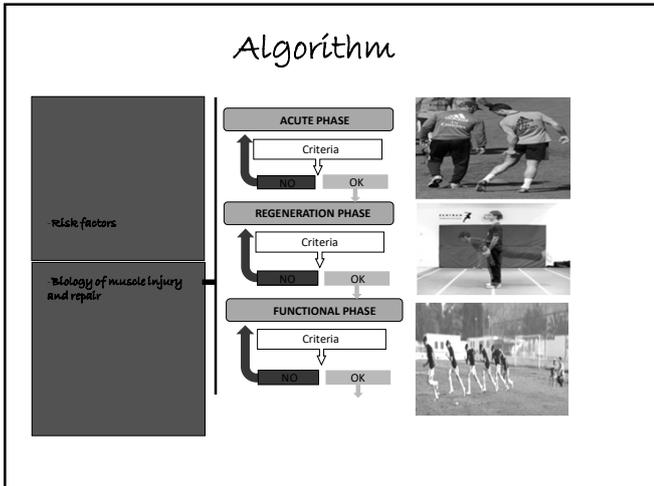
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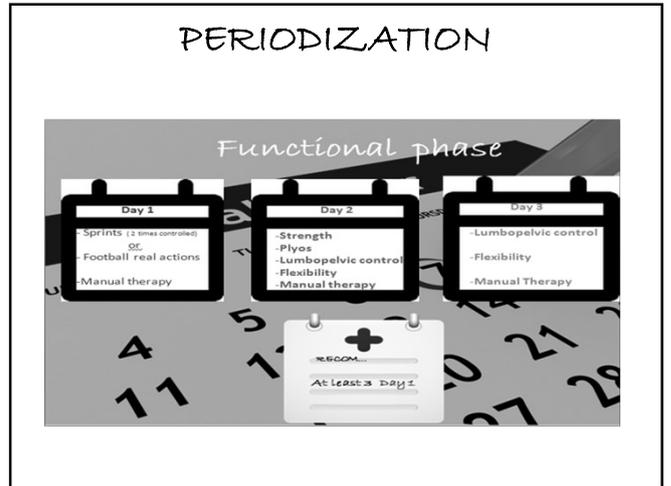
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### PERIODIZATION: REAL CASES

#### Game Profile - AVG

PLAYER GAME PROFILE - AVERAGE VALUES									
Name	Position	#Minutes Played	TD	Duration	Att	Goal	Assist		
Total Distance (m)	3021	100	104	104	104	3	# Acc (24x4x0)	3	
TD (0-23 km/h)	303	10	10	10	10	37%	Max Speed	32 km/h	Distance Acc (24x4x0)
TD (14-18 km/h)	772	10	10	10	10	15%	Longest Sprint Distance	25 m	# Acc (34x4x0)
TD (18-23 km/h)	303	10	10	10	10	6%			
TD (23 km/h)	22	10	10	10	10	1%			# Acc (24x4x0) to Sprint (23 km/h)
Goalkeeper TD (s)	18	10	10	10	10		# Acc (24x4x0)	12	
Lowest Time Over 30km/h	276	10	10	10	10		# Acc (24x4x0)	10	
# Acc (24x4x0) to 30 km/h	17	10	10	10	10		Ratio Acc (24x4x0)	0.8	
# Dec (24x4x0) to 30 km/h	13	10	10	10	10		Ratio Acc (24x4x0)	0.2	

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### Training Demands

With Ball (Crosses)										No ball ( Full field sprint)									
Name	Position	#Minutes Played	TD	Duration	Att	Goal	Assist			Name	Position	#Minutes Played	TD	Duration	Att	Goal	Assist		
Total Distance (m)	47	10	10	10	10	10	# Sprint (23 km/h)	1	# Acc (24x4x0)	Total Distance (m)	47	10	10	10	10	10	# Sprint (23 km/h)	1	# Acc (24x4x0)
TD (0-23 km/h)	47	10	10	10	10	10	Max Speed	28 km/h	Distance Acc (24x4x0)	TD (0-23 km/h)	47	10	10	10	10	10	Max Speed	28 km/h	Distance Acc (24x4x0)
TD (14-18 km/h)	17	10	10	10	10	10	Longest Sprint Distance	25 m	# Acc (34x4x0)	TD (14-18 km/h)	17	10	10	10	10	10	Longest Sprint Distance	25 m	# Acc (34x4x0)
TD (18-23 km/h)	17	10	10	10	10	10				TD (18-23 km/h)	17	10	10	10	10	10			
TD (23 km/h)	11	10	10	10	10	10			# Acc (24x4x0) to Sprint (23 km/h)	TD (23 km/h)	11	10	10	10	10	10			# Acc (24x4x0) to Sprint (23 km/h)
Goalkeeper TD (s)	0	10	10	10	10	10	# Dec (24x4x0)	0	# Dec (24x4x0)	Goalkeeper TD (s)	0	10	10	10	10	10	# Dec (24x4x0)	0	# Dec (24x4x0)
Lowest Time Over 30km/h	0	10	10	10	10	10	# Acc (24x4x0) to 30 km/h	0	# Acc (24x4x0) to 30 km/h	Lowest Time Over 30km/h	0	10	10	10	10	10	# Acc (24x4x0) to 30 km/h	0	# Acc (24x4x0) to 30 km/h
# Acc (24x4x0) to 30 km/h	0	10	10	10	10	10	Ratio Acc (24x4x0)	0	Ratio Acc (24x4x0)	# Acc (24x4x0) to 30 km/h	0	10	10	10	10	10	Ratio Acc (24x4x0)	0	Ratio Acc (24x4x0)
# Dec (24x4x0) to 30 km/h	0	10	10	10	10	10	Ratio Acc (24x4x0)	0	Ratio Acc (24x4x0)	# Dec (24x4x0) to 30 km/h	0	10	10	10	10	10	Ratio Acc (24x4x0)	0	Ratio Acc (24x4x0)

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## GOALS

- Help the football player and guide him as safely as possible
- \*Flexible\* WORKING FRAMEWORK (skeleton)
- OBJECTIVE criteria (quantifiable)
- INDIVIDUALIZE (monitor) rehab process
- .....until Return to Play



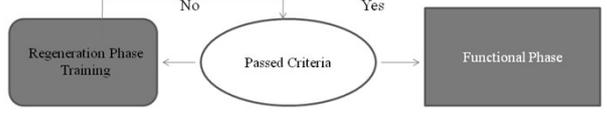

...if we are to avoid repeating past mistakes we must take up the challenge of obtaining high-quality data.....

- Constant FEEDBACK and re-evaluation of the Rehabilitation Process as well as being able to establish reference normative values

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## Regeneration phase



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## Functional phase



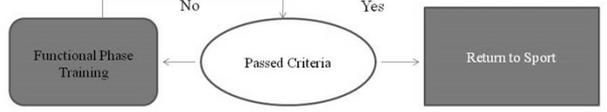



Figure 2. Criteria used to progress a football player through each phase of rehabilitation algorithm.

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## Summary of concepts

until now....

S T A R T

HAMSTRING STRENGTH      PROTOCOL      SPRINT

R T P

BUT.....Are we missing something?????

our proposal....

S T A R T

HAMSTRING STRENGTH    GLUTEUS STRENGTH    HAMSTRING FLEXIBILITY    LUMBOPELVIC CONTROL    HIP FLEXOR FLEXIBILITY

NEURAL MOBILIZATION    PERIODIZATION/LOAD    INDIVIDUALIZED    ANKLE STRESS    TECHNIQUE    SPRINT

R T P

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## What we did??

### RCT

# Algorithm vs Protocol

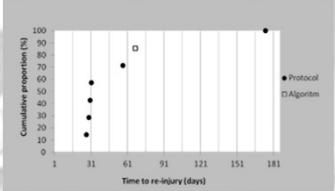
1. HOW MANY? REINJURY number
2. WHEN? TIME to return
3. HOW they RTP (Performance)?

Mendiaguiria et al 2017

23

## Re-injuries

	Protocol vs. Algorithm				
	Protocol	Algorithm	Relative risk (90% CI)	Chances for beneficial/harmful	Clinical inference
Re-injury number (%)	6 (2.5%)	1 (4%)	6.3 (1.1; 34.7)	95/2.3	Very likely beneficial



Mendiaguiria et al 2017

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**TIME to return**  
**Algorithm vs Protocol**

$25.5 \pm 7.8$  days       $23.2 \pm 11.7$  days

Mendiola et al. 2017

25

**Sprint vs lesion**

www.runalho7.net

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**UP TO 2015...**

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**ACCELERACION vs TOP SPEED**

RF and Drf correlation with 100m and 400m (Morin et al. 2011)

Vertical forces correlation with Top Speed (Morin et al. 2011, 2012, weyand et al. 2010)

Direction and velocity vs Magnitud (Morin et al. 2011, 2012, weyand et al. 2010)

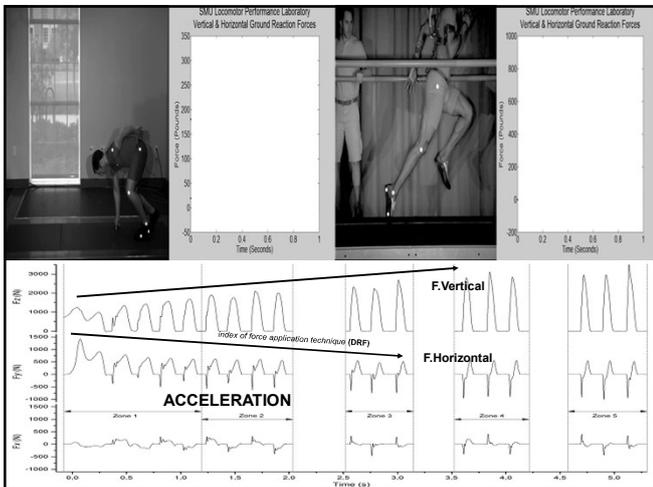
Fatigue reduce Drf → Horizontal forces more than vertical (Morin et al. 2011)

$$RF = \frac{F_H}{F_{Tot}}$$

$$\alpha = \tan^{-1} \left( \frac{F_H}{F_V} \right)$$

$$RF = \sin \alpha$$

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**Hamstring vs Horizontal Force**

ISOK. ECC. KNEE FLEX.      EMG BF Late swing      HORIZONTAL FORCE

+

=

Morin et al. 2015

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### Field → Maths / Lab / Papers → Field

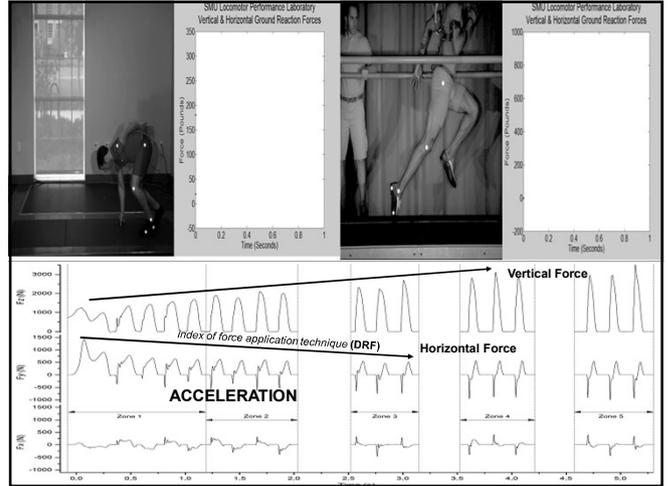
Fundamentally Applied Science

	Vmax theoretical V0 (m/s)	Fmax theoretical F0 (N)	Fmax theoretical F0 (N/kg)	Pmax (W)	Max Horizontal Power Pmax (W/kg)	Force-Velocity profile
Time	0.00	0.00	0.00	0.00	0.43	0.00
Speed	0.00	0.46	0.43	0.00	0.43	0.00
	0.05	0.97	0.43	0.01	0.43	0.01
	0.10	1.45	0.43	0.03	0.43	0.03
	0.15	1.93	0.43	0.04	0.43	0.04
	0.16	2.42	0.42	0.06	0.42	0.06
	0.19	2.90	0.42	0.08	0.42	0.08
	0.22	3.38	0.42	0.10	0.42	0.10

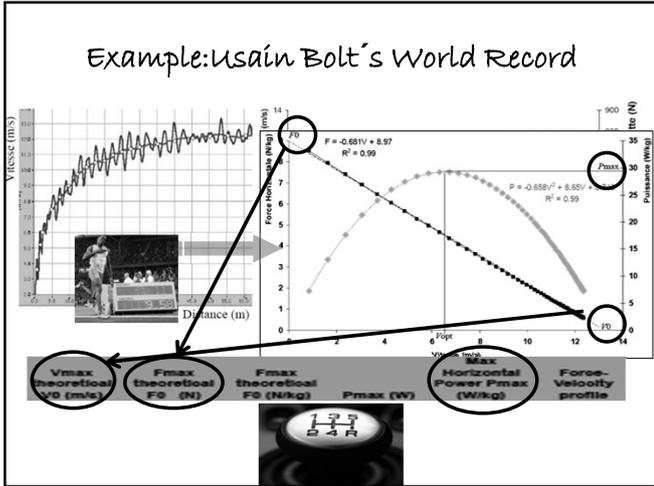
	Reference Method	Single Method	Bias	Absolute Bias (%)
$F_0$ (N)	654 ± 80	636 ± 89	-170 ± 37.9	5.18 ± 3.83
$v_0$ (m/s)	10.20 ± 0.36	10.32 ± 0.72	0.34 ± 0.52	4.75 ± 3.39
$P_{max}$ (W)	1669 ± 253	1679 ± 289	9.57 ± 62.78	2.81 ± 2.68

Samozino et al. 2016

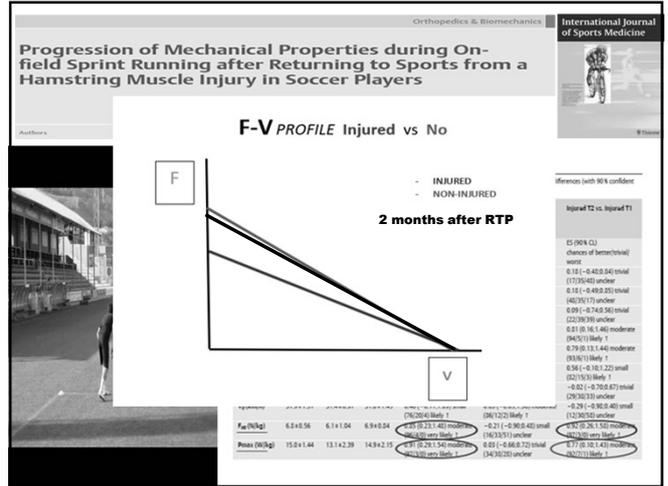
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### Take home message.....

- SPRINT (performance) "core" aspect of the rehabilitation process "win-win strategy"
- MULTIFACTORIAL approach
- CRITERIA based
- Individualized and periodized

### "PREPARE AND REPAIR"

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