Force Plate Assessment & Practical Applications

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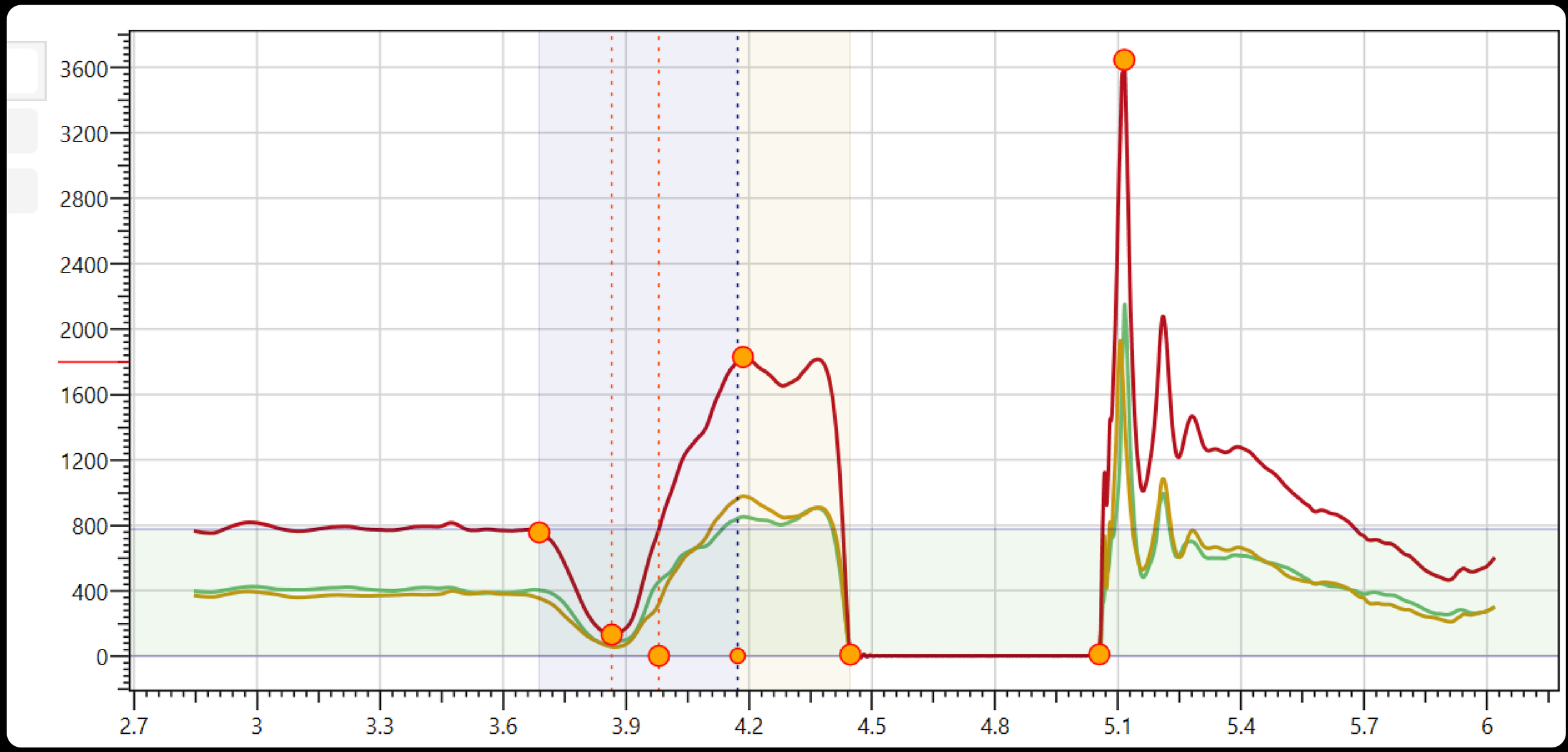
(BUCARAMANGA, COLOMBIA)

HEAD OF FORCEDECKS,
VALD PERFORMANCE

WHY AM I HERE?



Making sense of the "squiggly lines*" with over 100 sports teams and institutions.

**Jason Lake*

ACKNOWLEDGEMENTS & THANKS

Jeremy Holsopple, NBSCA and NSCA organizing team

- **Dr Tim Hewett** (Researcher, Mayo Clinic) - *Inspiration*
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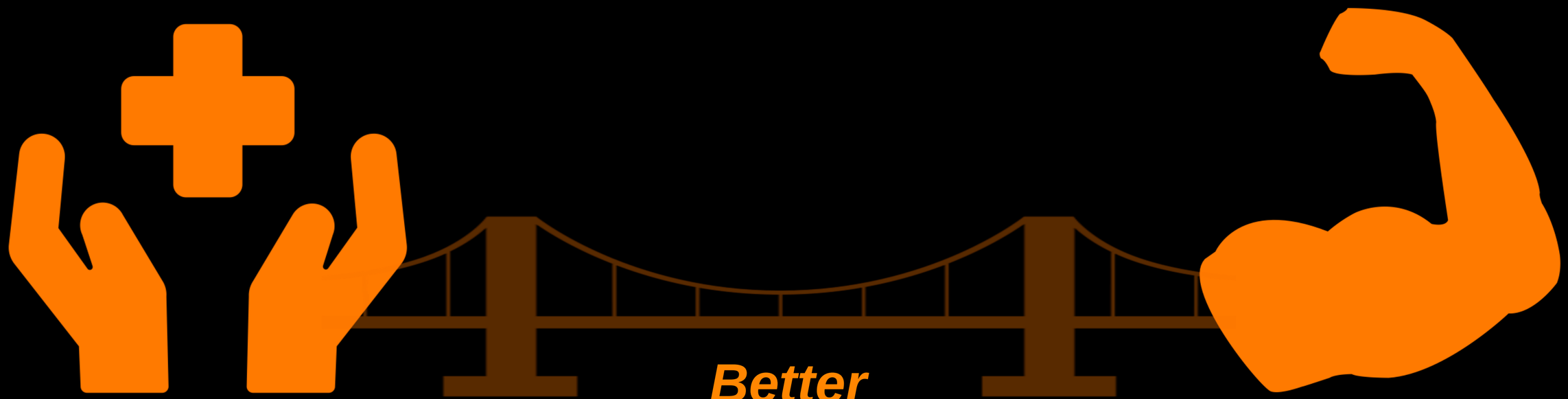
- **Dr Ben Rosenblatt** (ex-GB Women's Hockey, current Men's Lead Physical Performance Coach, English FA)
- **Ben Ashworth** (Physiotherapist-S&C, ex-Arsenal FC)-"Balancing science & compliance"
- **Matt Taberner** (Head of Rehabilitation, Everton FC) – *"Balancing art & science in rehab*"
- **Dave Howarth** (current Head of Performance Connaght Rugby, ex OKC Thunder) – *"simple things done ruthlessly well"*
- **Dr Chris Richter** (Biomechanist/Data Scientist, Sports Surgery Clinic, Dublin)
- **Jarrod Antflick (Physiotherapist**)!!!!

- **Dr Mauricio Serrato** (Head of Sports Medicine – Coldeportes Colombian institute of sport)
- **Rhys Morris** (Coventry University, UK), **Dr Esteban Betancur Valencia**, Universidad EAFIT (Medellin, Colombia)
- **Drew Cooper, Jake Schuster** and Vald Performance team (US, Australia)
- **Dr** Aaron Heishman, Bryce Daub (University of Oklahoma), Landon Evans (Iowa University)

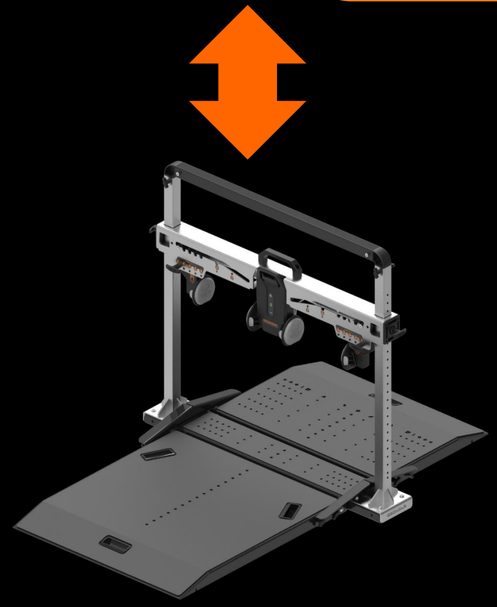
INTELLIGENCE ON NEUROMUSCULAR STATUS

OFTEN	CONFIRMS
SOMETIMES	REVEALS
ALWAYS	QUANTIFIES

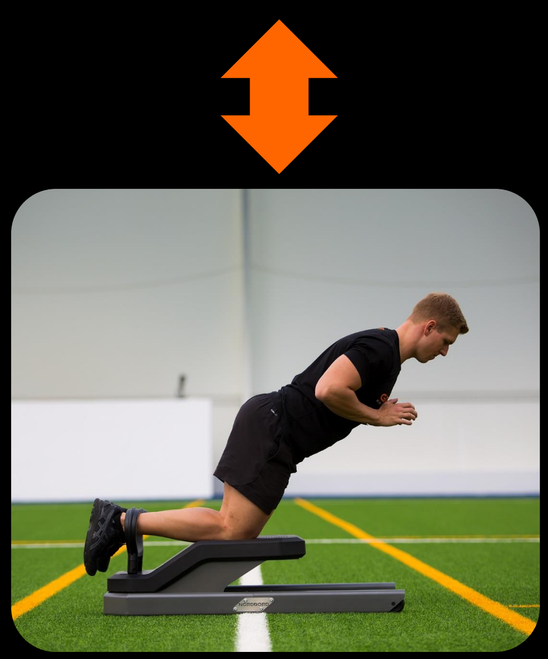


STRENGTH & POWER “NEUROMUSCULAR PERFORMANCE” ASSESSMENT TOOLS

Isometrics



Dynamic single-joint



Dynamic multi-joint

CMJ-LESS TESTING, MORE DATA

Why the emphasis on CMJ …. ?

Single leg jump – *better*

Bosco Jump Protocol

- Countermovement jump (CMJ)
- Squat jump (SJ)
- Single leg jump
- Drop jump (DJ)
- *Repeated*

Squat jump - *better con phase evaluation? But:*

- Evaluation of both eccentric and concentric phases of take-off and SSC capability

Drop jump *-better fast SSC assessment? But:*

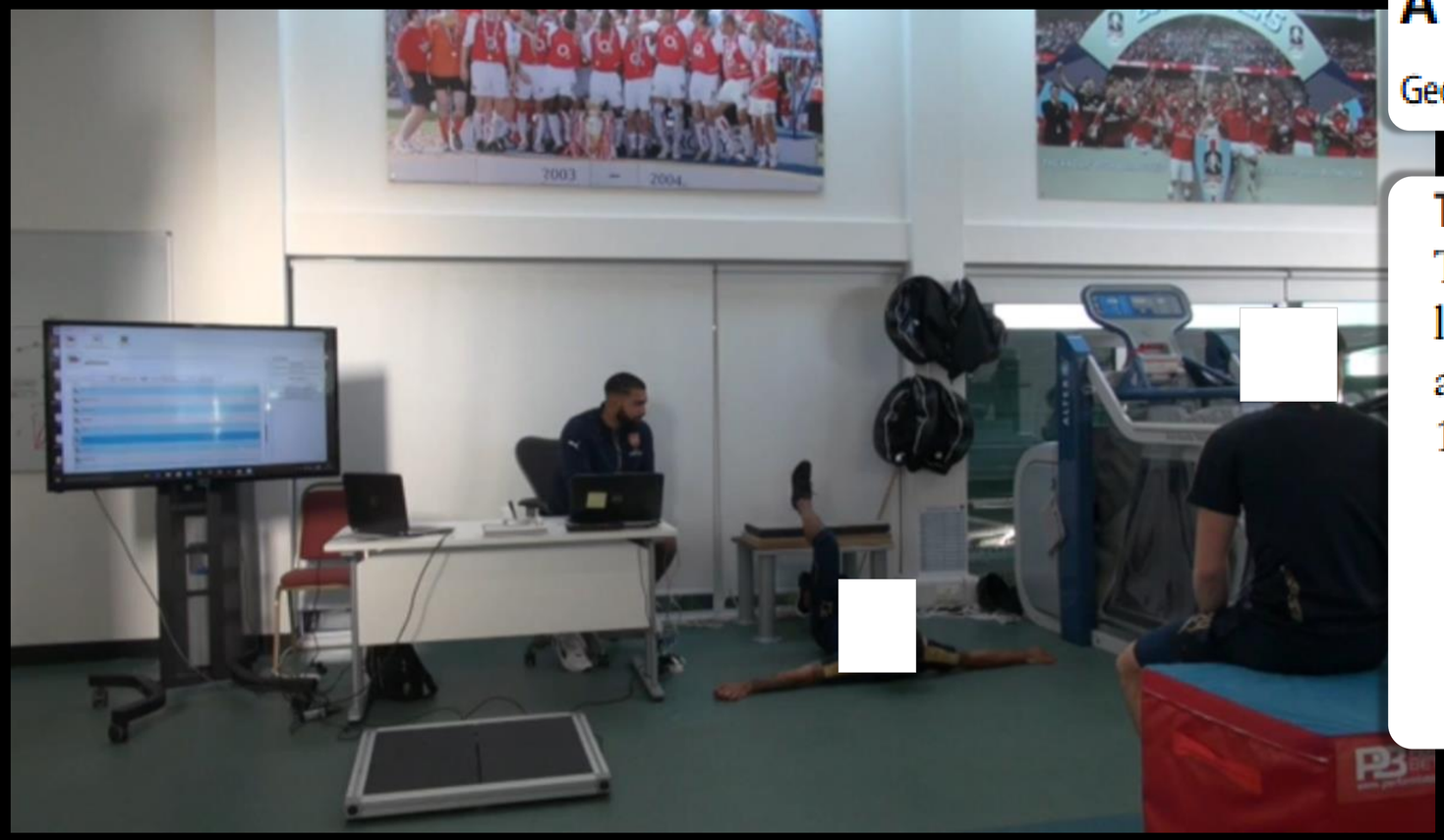
- Greater reliability and shorter familiarisation period
- Can be used earlier in
- nce players in-

*"**High repeatability** and **fatigu**
in NM fatigue detection … In comparis
NM changes of recovery (> 24 h) and S
Compared with DJ was associated wit*

*e most valid test
pacity to detect
rcise phase.
2015)*

PRESEASON TESTING IS GREAT **BUT…**

- *What does this tell us about neuromuscular status in-season, after months of competition and …*
- Neuromuscular performance response to acute and chronic load
- "Abnormal" changes in response – after establishing *individual variability*



Is workload associated with injuries and performance in elite football? A call for action

George P Nassis,[1] Tim J Gabbett[2,3]

TALK IS CHEAP: IT'S TIME FOR ACTION

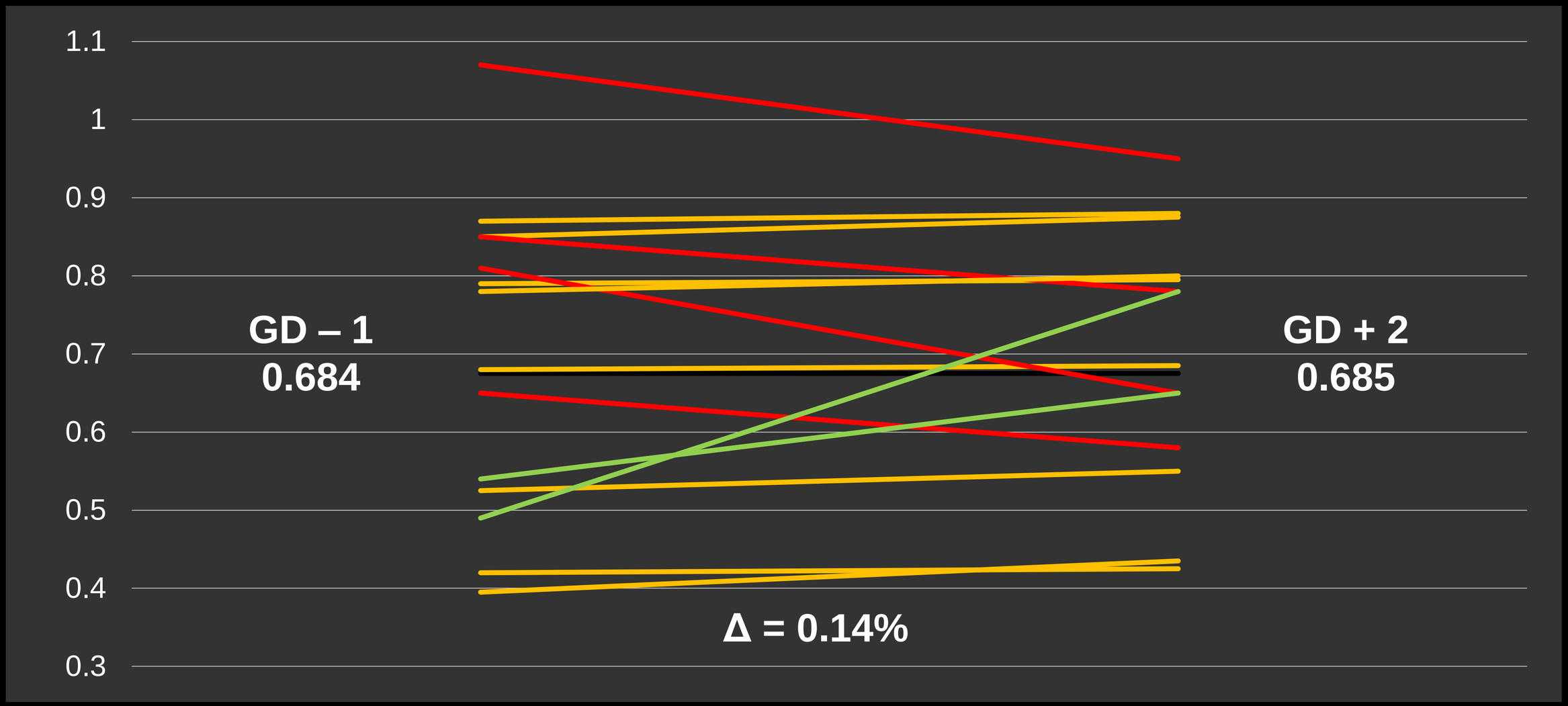
To shed light on the interaction of workloads and injuries, we propose two actions:

1. Team strength and conditioning staff should implement more objective assessments of the player's physical capacity and readiness to play, and we should move towards assessing the outcome of training.

MONITORING & UNDERSTANDING RESPONSE

Changes in a CMJ neuromuscular performance marker post competitive soccer

1 day pre-game (GD-1) v 2 days post-game (MD+2)



Merlagh et al., unpublished

SELECTED CMJ CONCENTRIC & ECCENTRIC CHARACTERISTICS OF

STABLE VS LARGE RESPONSE PLAYERS

Con Peak Power / Jump Height *[W.Kg / cm]*	Con Impulse *[Ns]*	Ecc Deceleration Impulse *[Ns]*
55/42	191	129
56/43	232	242
NS	***NS***	***P<0.001***

“BALANCING SCIENCE & COMPLIANCE”

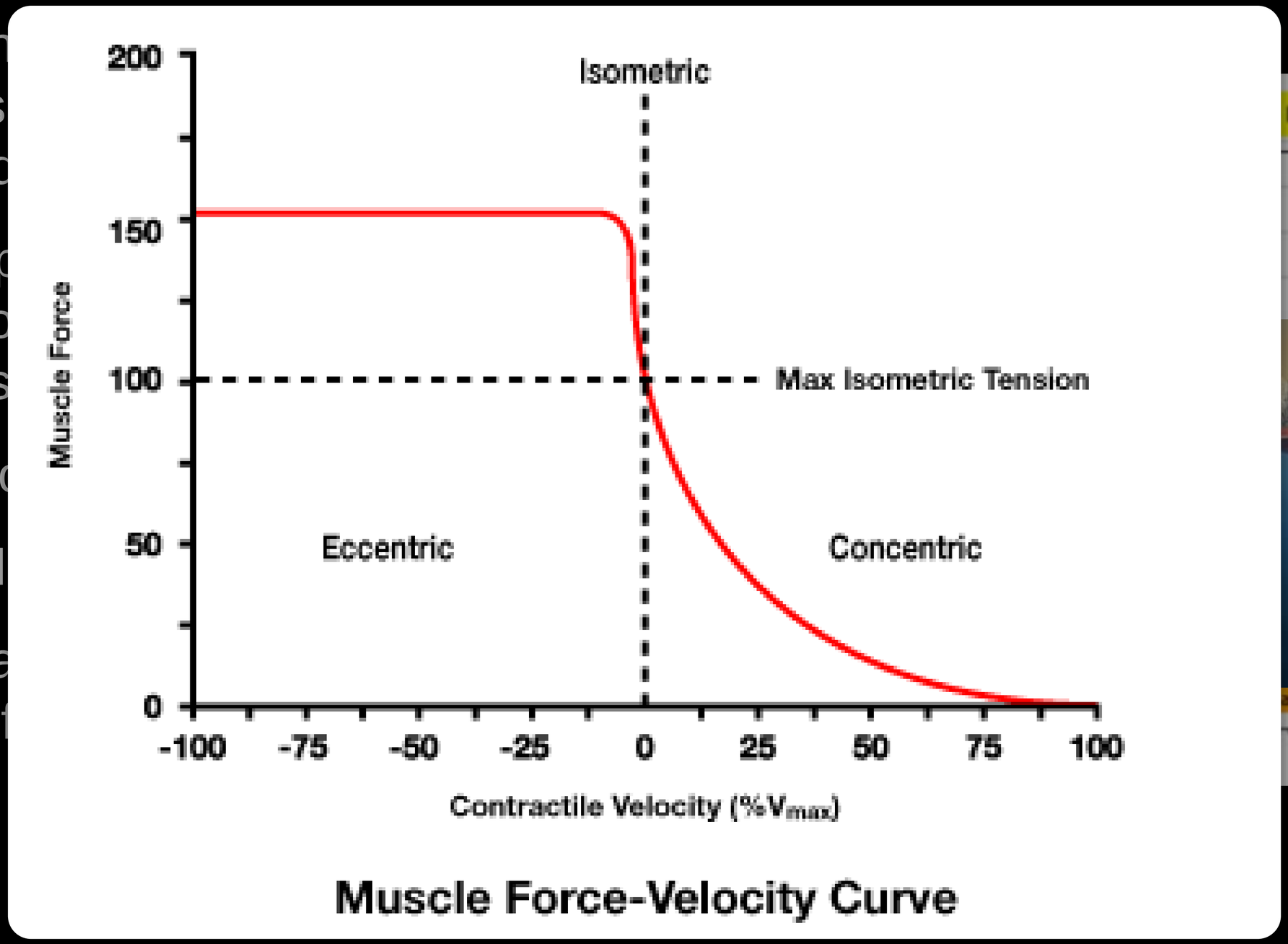
Create the CULTURE

APPLICATIONS OF FORCE PLATFORM **JUMP** *AND* **ISOMETRIC TESTING**

- **Profiling**
  - Performance
  - Asymmetry
- **Monitoring**
  - Response to training & competition load
  - Fatigue/Readiness/Adaptations
- **Rehabilitation**
  - Benchmarking
  - Progression/Return to play/***Post-hab***

CONTACT MATS VS. FORCE PLATFORMS

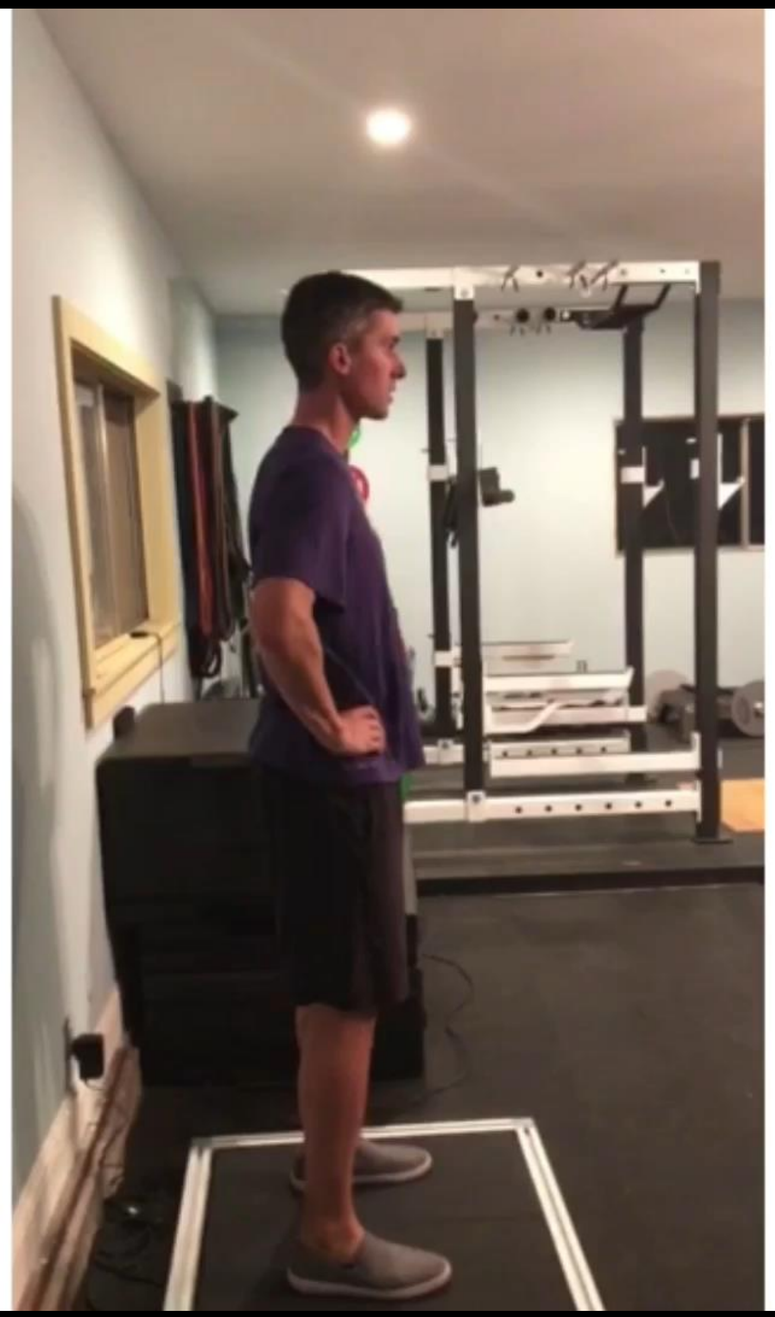
- Jump h
  assess
  metho
- Force p
  is perfo
  time as
  - Ecc, C
  - Dual pl
  - Simulta
    phase f



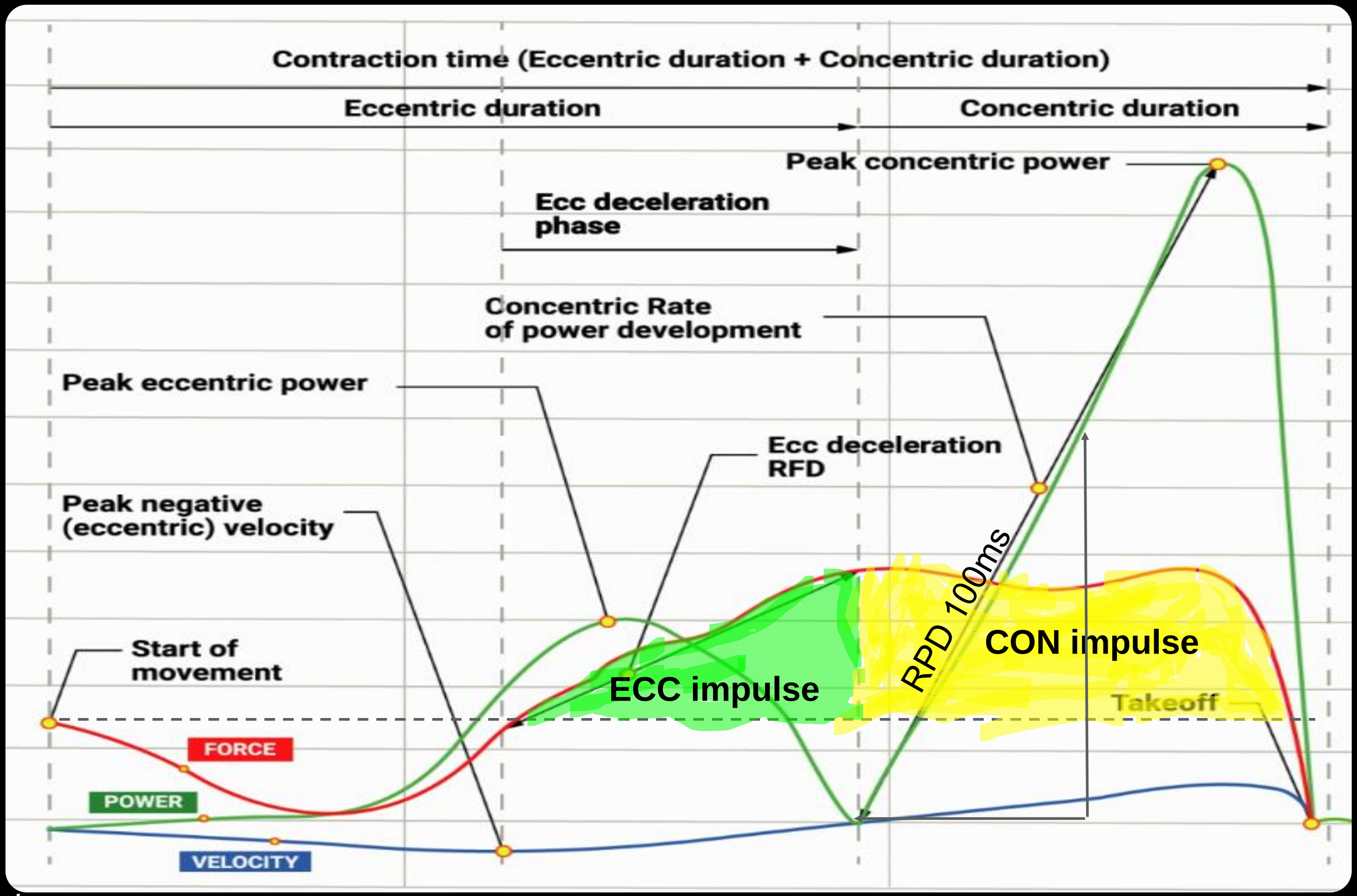
Muscle Force-Velocity Curve

CMJ VARIABLES:

INTELLIGENCE ON THE NEUROMUSCULAR SYSTEM



SOME CMJ VARIABLES ….



jumpers.

Power-Time, Force-Time, and Velocity-Time Curve Analysis of the Countermovement Jump: Impact of Training

Prue Cormie,[1,2] Jeffrey M. McBride,[2] and Grant O. McCaulley[2]

[1]School of Exercise, Biomedical and Health Sciences, Edith Cowan University, Perth, Australia; and [2]Neuromuscular Laboratory, Department of Health, Leisure and Exercise Science, Appalachian State University, Boone, North Carolina

ANAEROBIC FITNESS

International Journal of Sports Physiology and Performance, 2008, 3, 359-374

Neuromuscular and Endocrine Responses of Elite Players to an Australian Rules Football Match

Stuart J. Cormack, Robert U. Newton, and Michael R. McGuigan

International Journal of Sports Physiology and Performance, 2013, 8, 373-378

INTERNATIONAL JOURNAL OF SPORTS PHYSIOLOGY AND PERFORMANCE
www.IJSPP-Journal.com
ORIGINAL INVESTIGATION

Influence of Neuromuscular Fatigue on Accelerometer Load in Elite Australian Football Players

Stuart J. Cormack, Mitchell G. Mooney, Will Morgan, and Michael R. McGuigan

Countermovement Jump Height: Gender and Sport-Specific Differences in the Force-Time Variables

Guillaume Laffaye,[1] Phillip P. Wagner,[2] and Tom I. L. Tombleson[2]

[1]Department of Sport Sciences, UR CIAMS–Motor Control and Perception Group, University of South Paris, Orsay, France; and [2]Sparta Performance Science, Menlo Park, California

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Human Movement Science

journal homepage: www.elsevier.com/locate/humov

The effect of strength training, recreational soccer and running exercise on stretch–shortening cycle muscle performance during countermovement jumping

Markus Due Jakobsen [a,b,c,*], Emil Sundstrup [a,b,c], Morten Bredsgaard Randers [b], Michael Kjær [c], Lars L. Andersen [a], Peter Krustrup [b,d], Per Aagaard [e]

Effect of Acute Fatigue and Training Adaptation on Countermovement Jump Performance in Elite Snowboard Cross Athletes

Rob J. Gathercole,[1,2] Trent Stellingwerff,[1,2] and Ben C. Sporer[1,2]

[1]School of Exercise Science, Physical and Health Education, University of Victoria, Victoria, Canada; and [2]Canadian Sport Institute Pacific, Victoria, Canada

sports

MDPI

Article

Countermovement Jump Inter-Limb Asymmetries in Collegiate Basketball Players

Aaron Heishman [1,2,*], Bryce Daub [2], Ryan Miller [1], Brady Brown [1,2], Eduardo Freitas [1] and Michael Bemben [1]

1 Department of Health and Exercise Science, University of Oklahoma, Norman, OK 73019, USA; ryanmiller1@ou.edu (R.M.); brownbrady3@ou.edu (B.B.); eduardofreitas@ou.edu (E.F.); mgbemben@ou.edu (M.B.)
2 Department of Athletics, Basketball Strength and Performance, University of Oklahoma, Norman, OK 73019 USA; bdaub@ou.edu
* Correspondence: aaronheishman@ou.edu

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Abstract: The purpose of the present study was to establish the intrasession and intersession reliability of variables obtained from a force plate that was used to quantitate lower extremity

FLIGHT TIME:CONTRACTION TIME/RSI MOD*

HOW Vs HOW MUCH

Cormack et al, 2008

Table 3 CMJ ES ±90% Confidence Interval Change, Qualitative Descriptor, and Percentage Change Compared with 48pre

Variable/Time	Post	24post
CMJ1	–0.31 ± 0.57 unclear	–0.17 ± 0.57 unclear
CMJ1 Flight time:Contraction time (s)	–0.32 ± 0.26 substantially↓ –7.5%	–0.33 ± 0.17 substantially↓ –7.8%

Competition led to:

- Trivial changes in jump height (FT)
- Substantial change in **how** jump performed as identified by FT:CT/RSImod (driven by increased contraction time)

CMJ FLIGHT TIME:CONTRACTION TIME CHANGES ASSOCIATED WITH SPRINT PERFORMANCE

Cormack et al, 2013

Jump
Performance

Predicts

Reduced high intensity

Sprint
Performance

(> 15 km/h)

FATIGUE-RECOVERY HOW V HOW MUCH

CMJ variables 72 hrs post high intensity (intermittent sprint) activity

Time to Peak Power

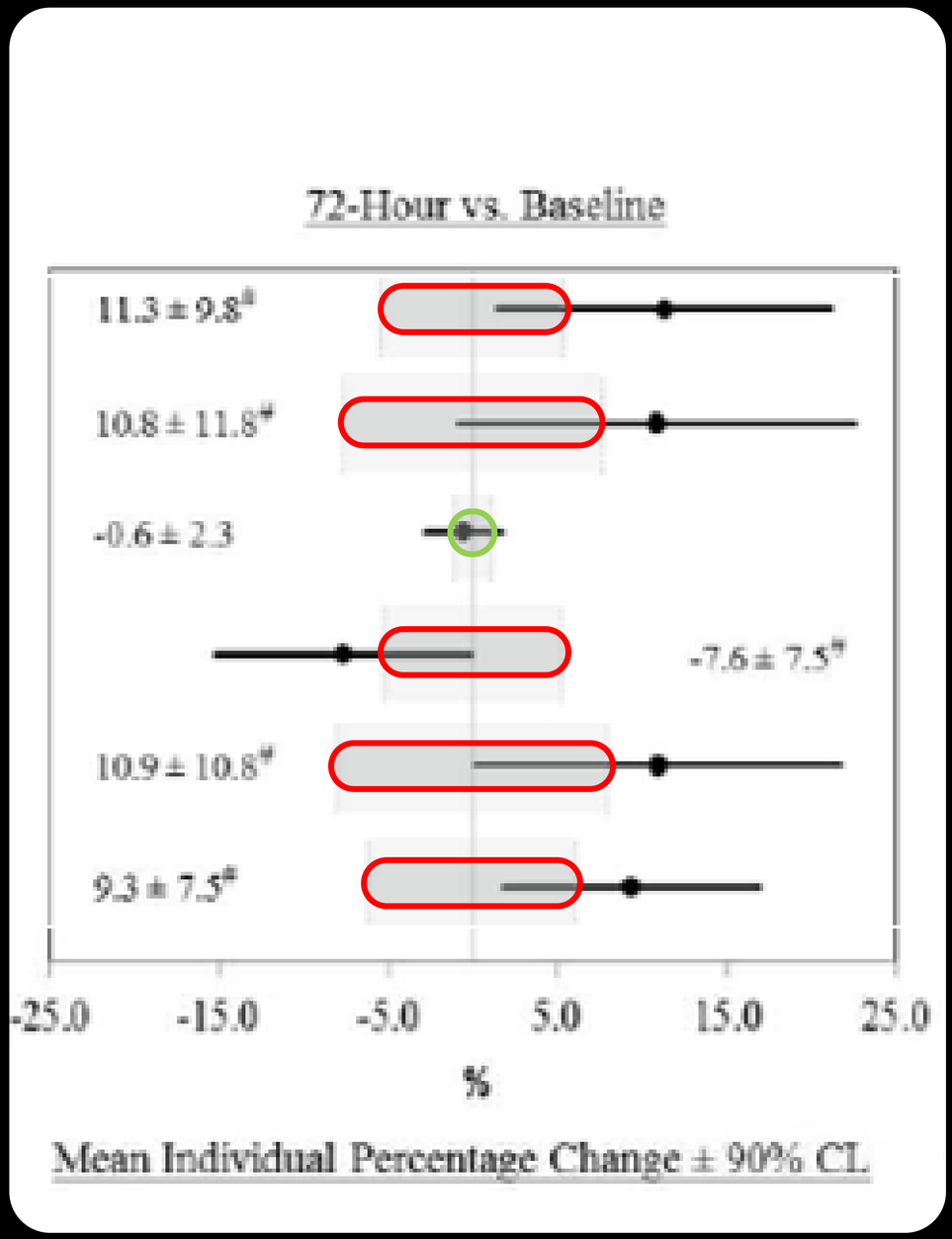
Time to Peak Force

Flight Time

Flight Time: Contraction Time

Eccentric Duration

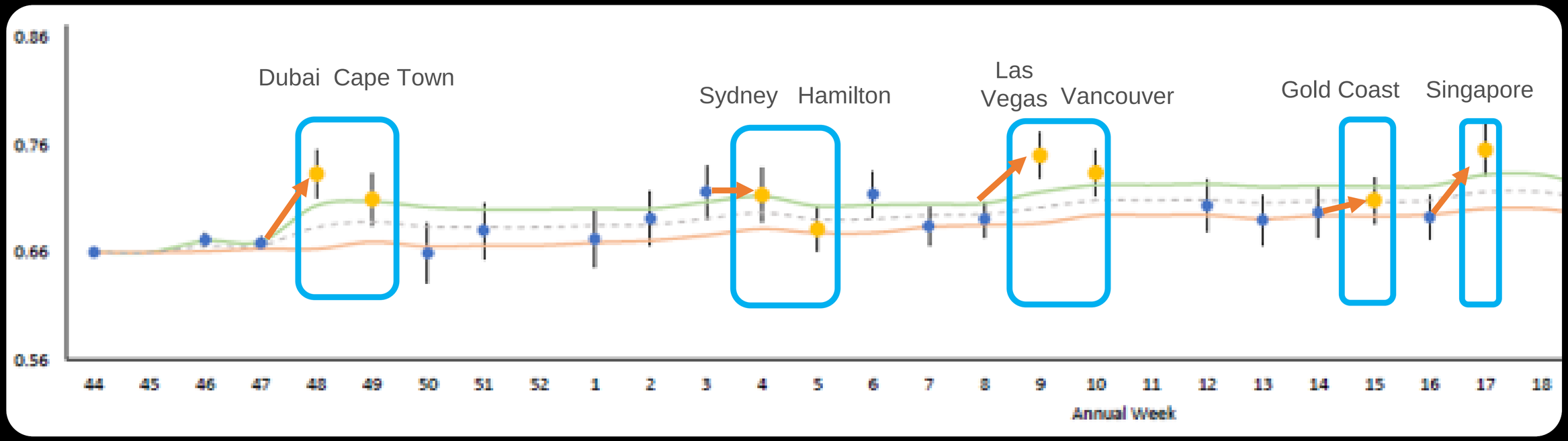
Total Duration

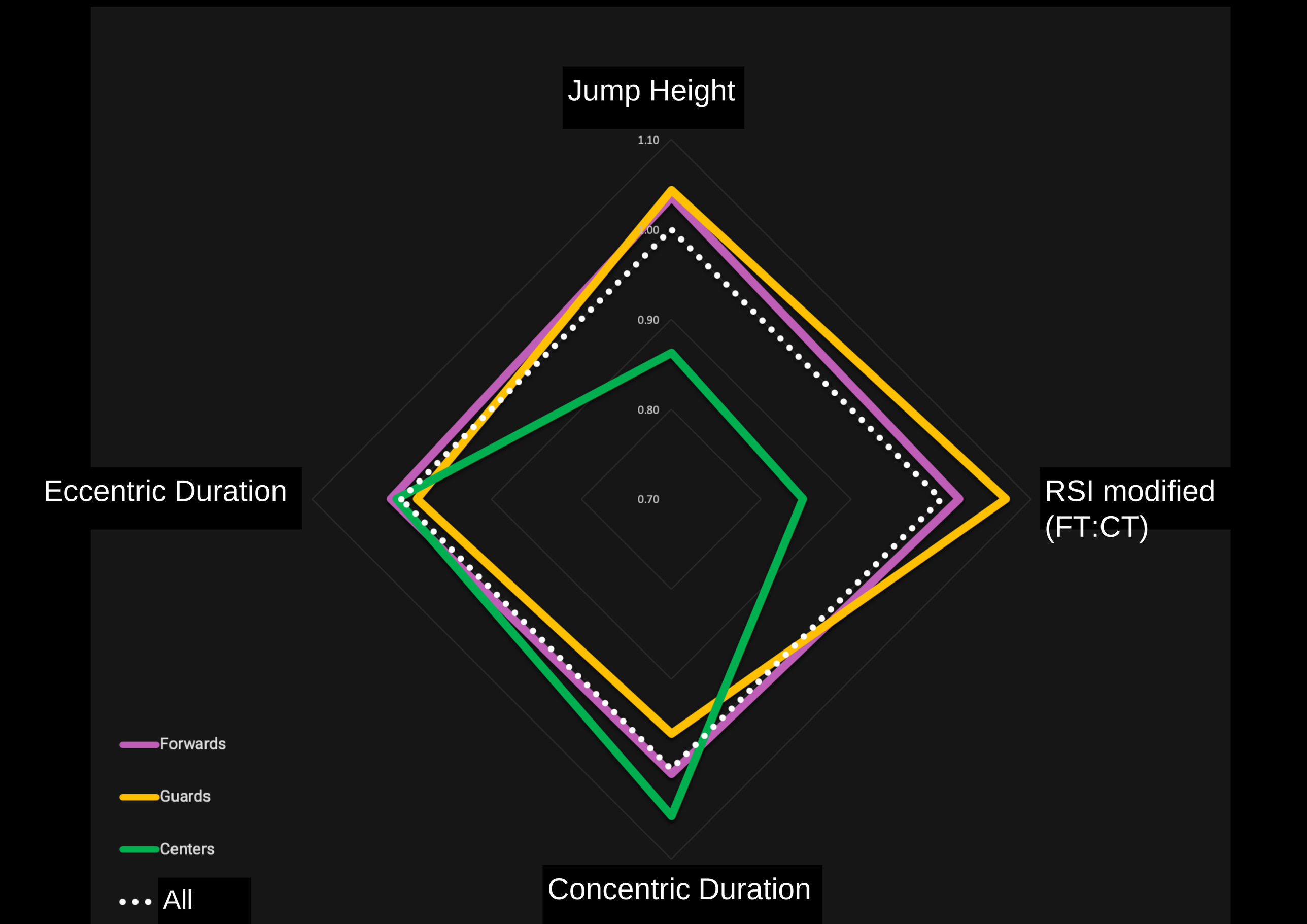


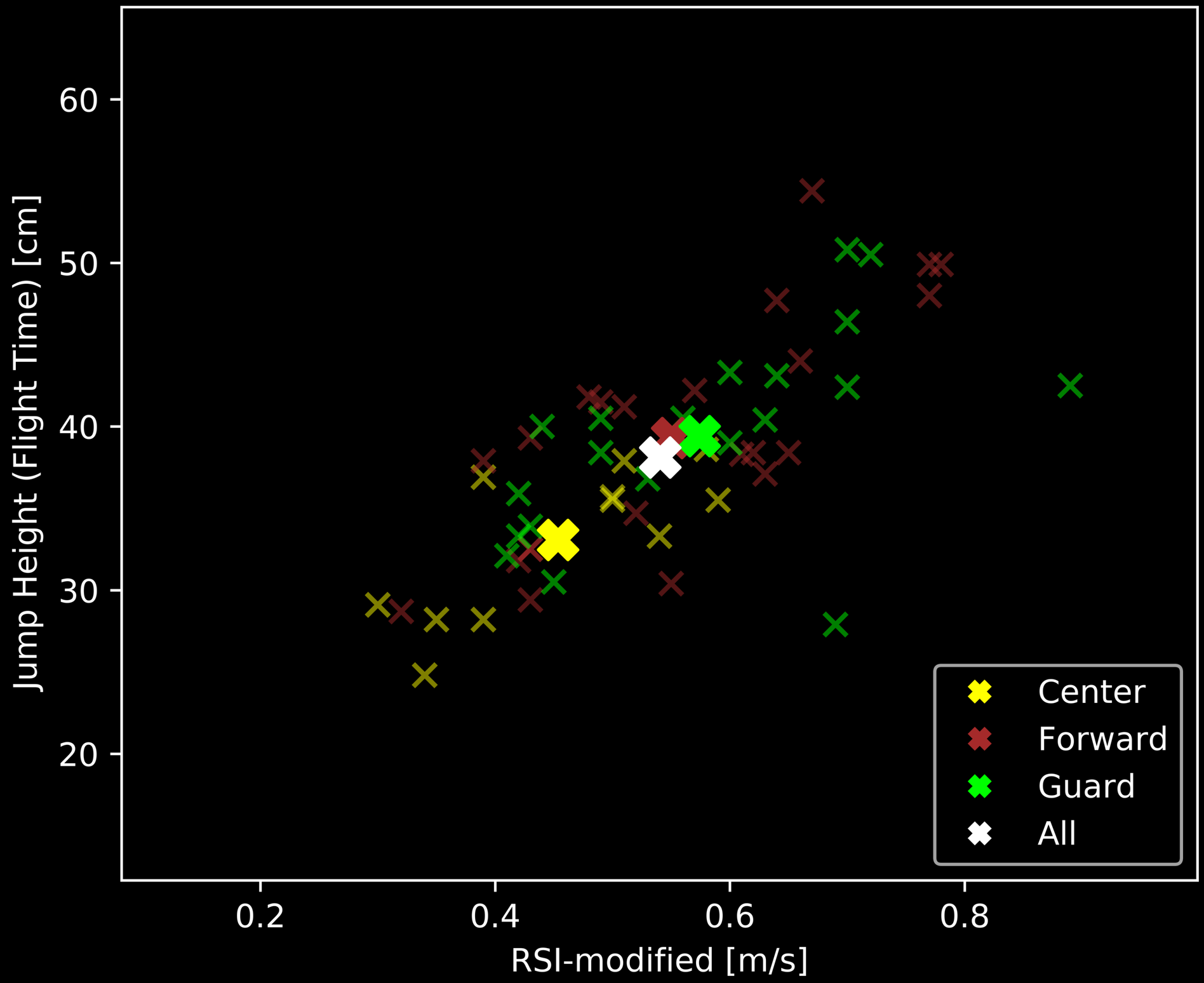
Gathercole et al. (2014) *Int J Sports Physiol Perform*. 2015 Jan;10(1)84-92.

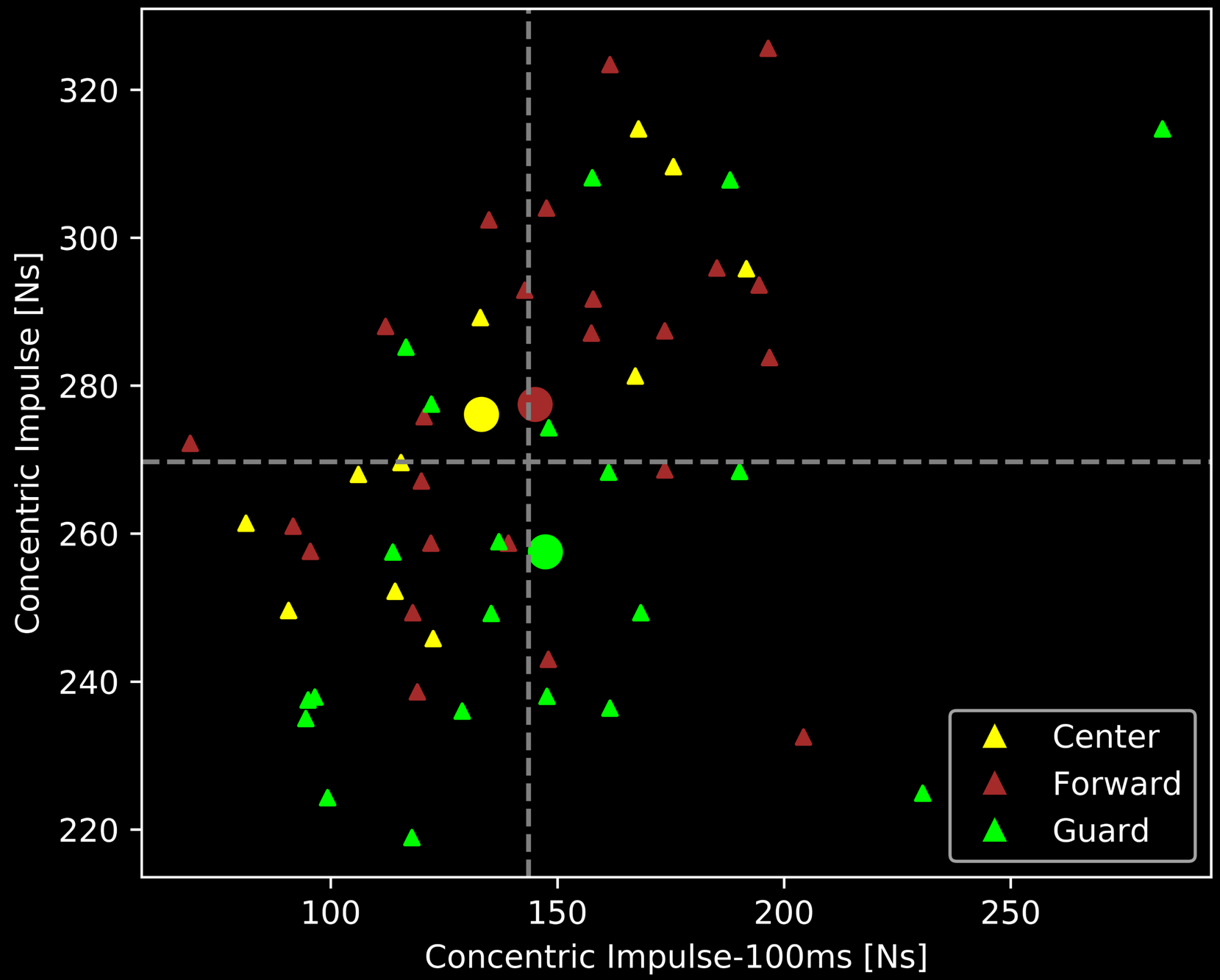
FATIGUE…READINESS!

FLIGHT TIME:**CONTRACTION** TIME (RUGBY 7’S)

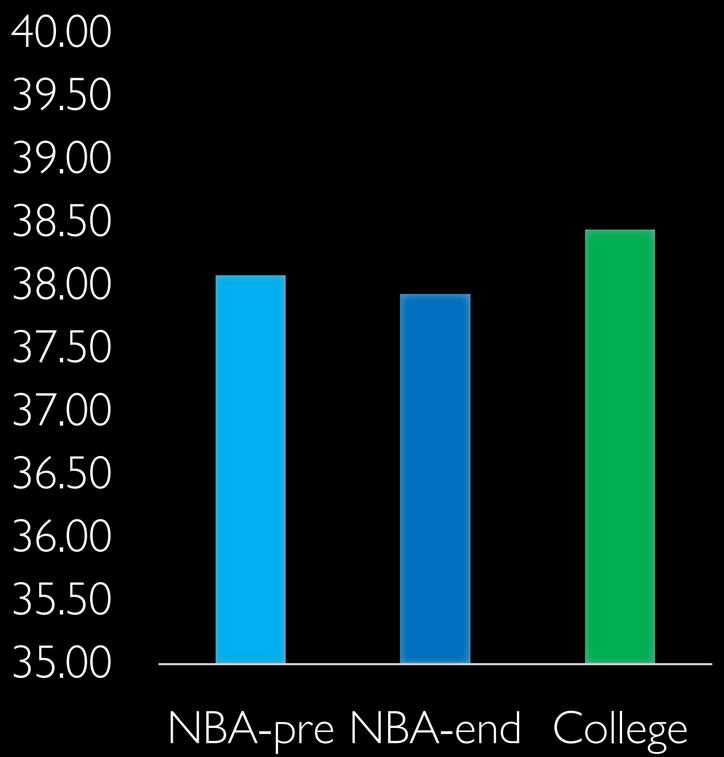



Jump Height
1.10
1.00
0.90
0.80
0.70
Eccentric Duration
RSI modified (FT:CT)
Concentric Duration
Forwards
Guards
Centers
All

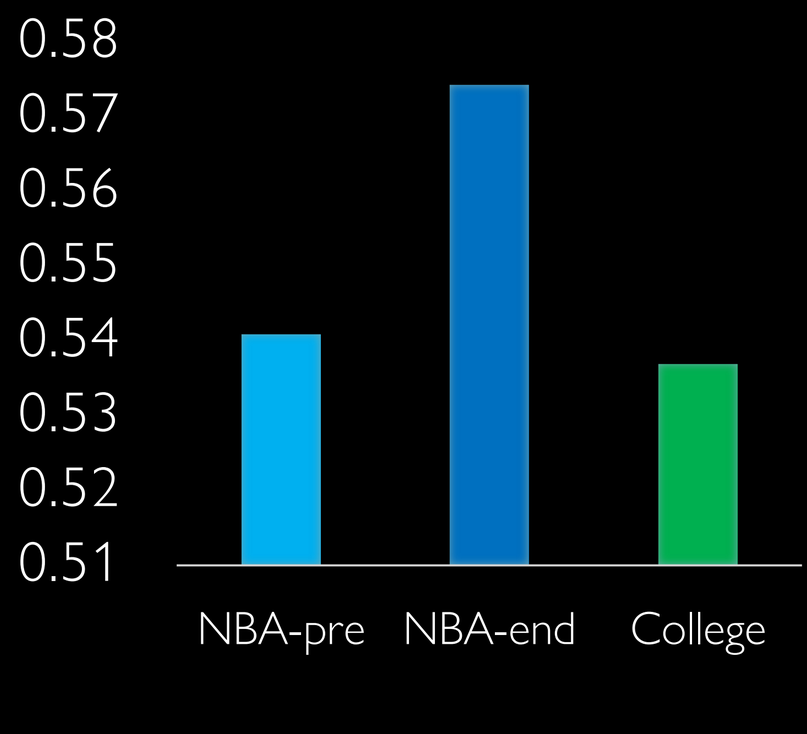

60
50
40
30
20
Jump Height (Flight Time) [cm]
0.2
0.4
0.6
0.8
RSI-modified [m/s]
Center
Forward
Guard
All


320
300
280
260
240
220
Concentric Impulse [Ns]
100
150
200
250
Concentric Impulse-100ms [Ns]
Center
Forward
Guard

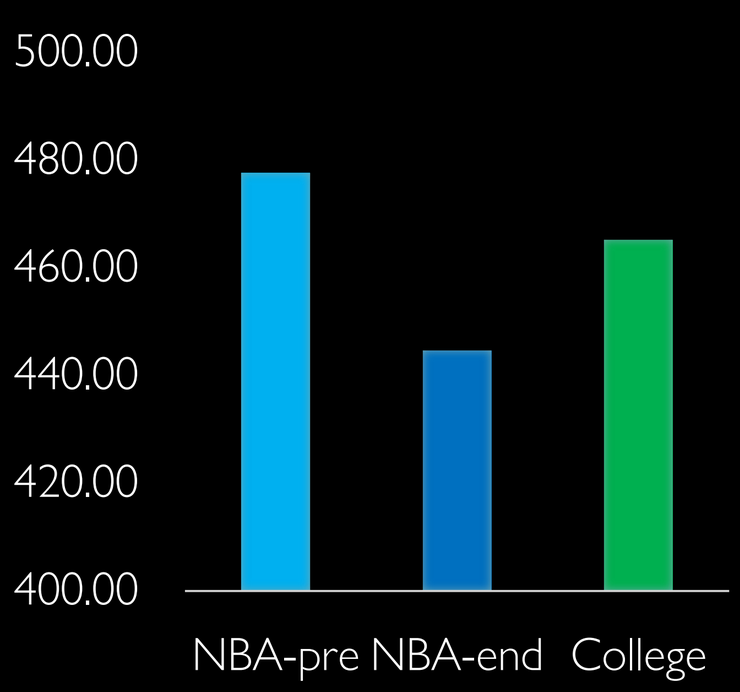
JUMP HEIGHT



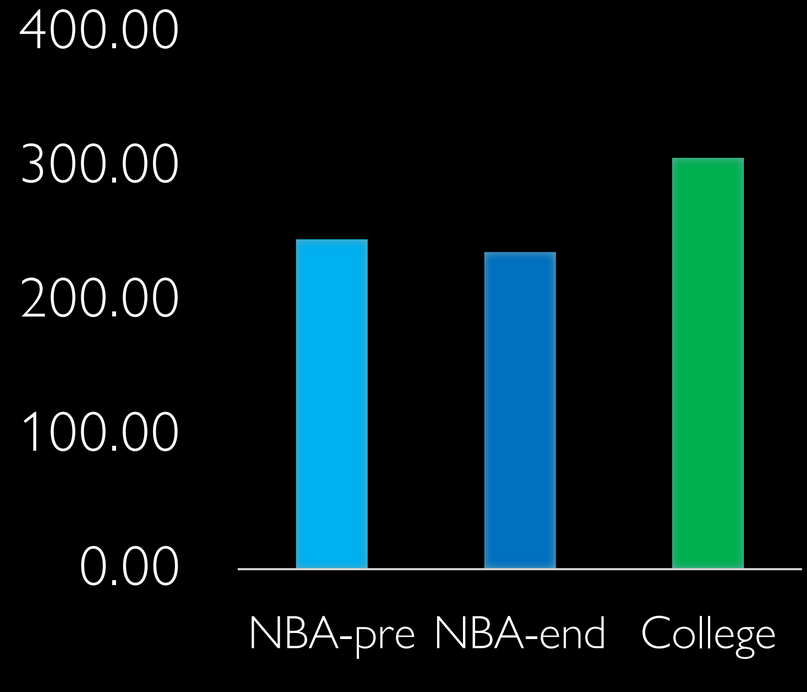
RSI-MOD



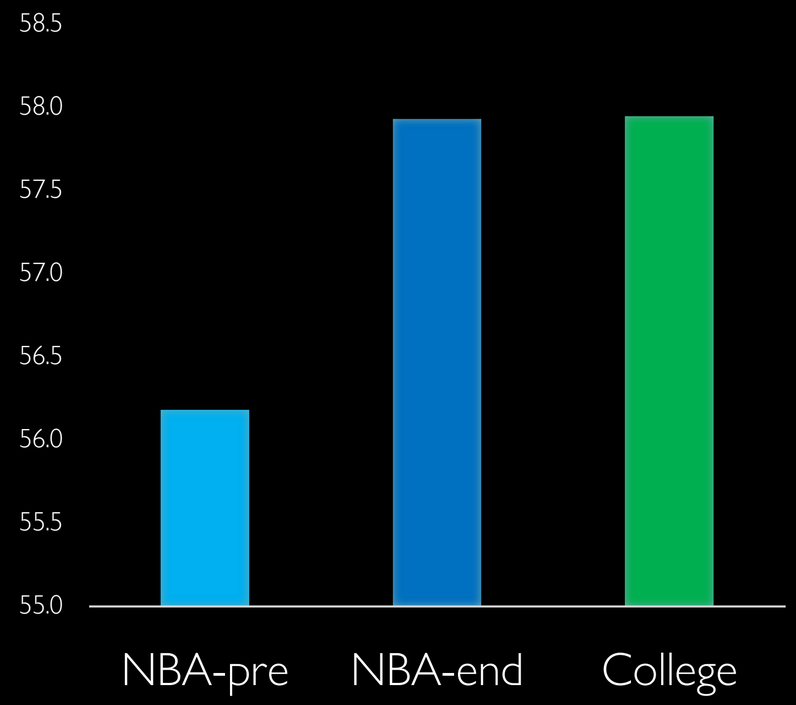
ECCENTRIC DURATION



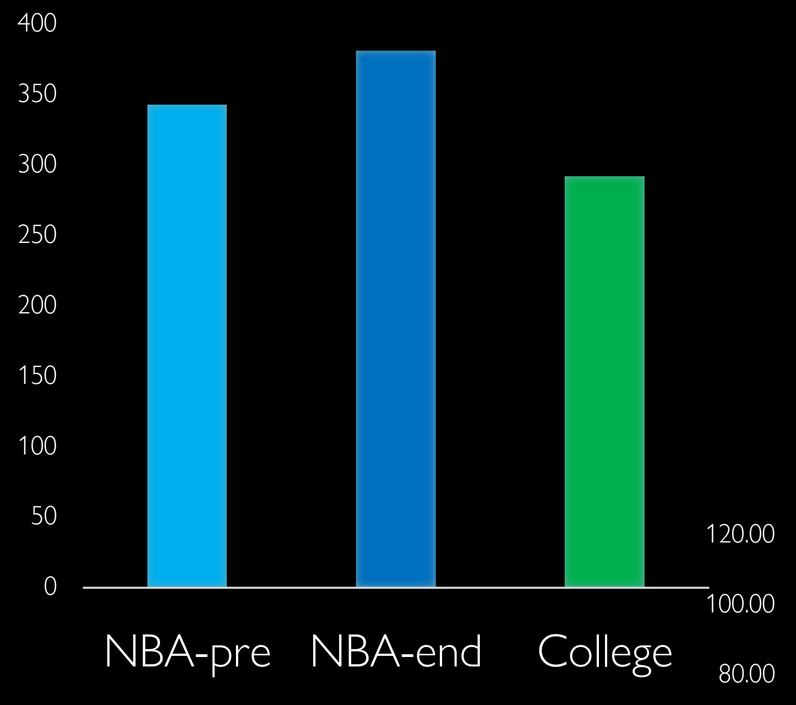
CONCENTRIC DURATION



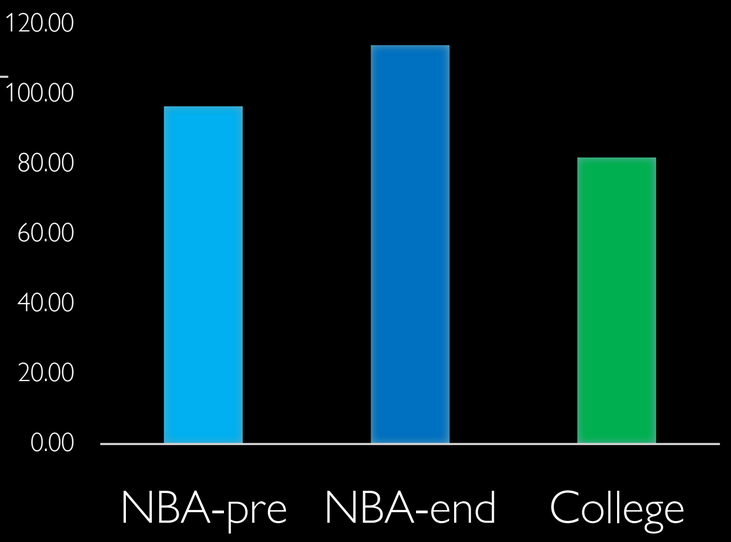
PEAK POWER / BW



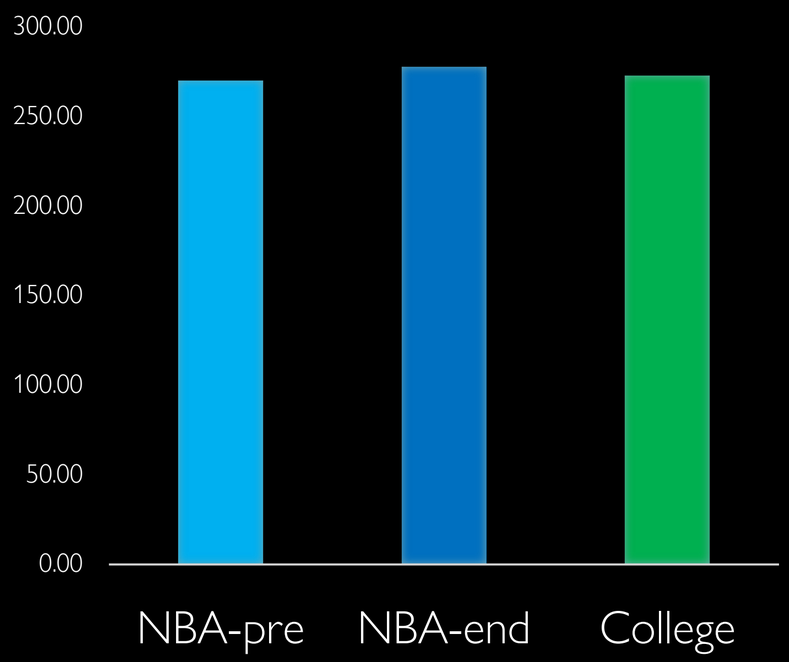
CON RPD / BW



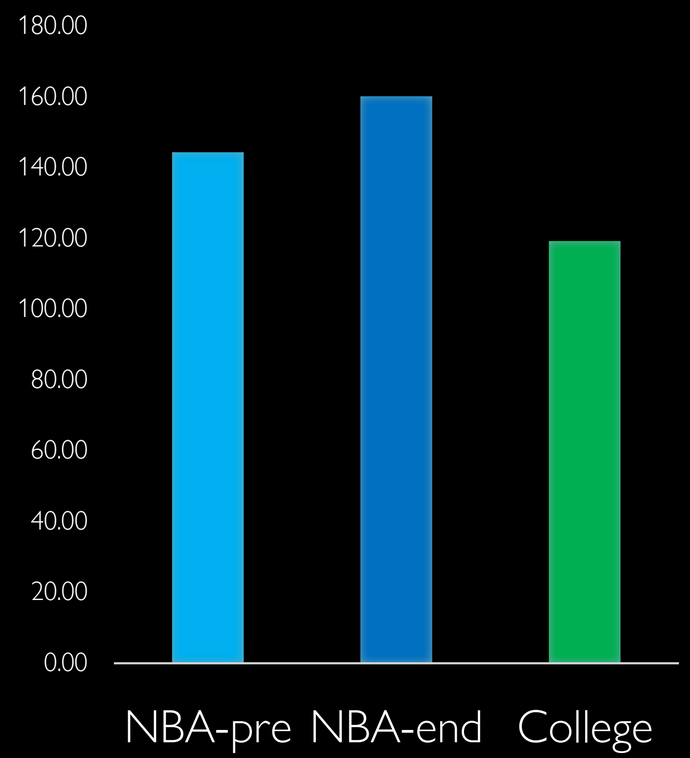
ECCENTRIC DECEL RFD/BM



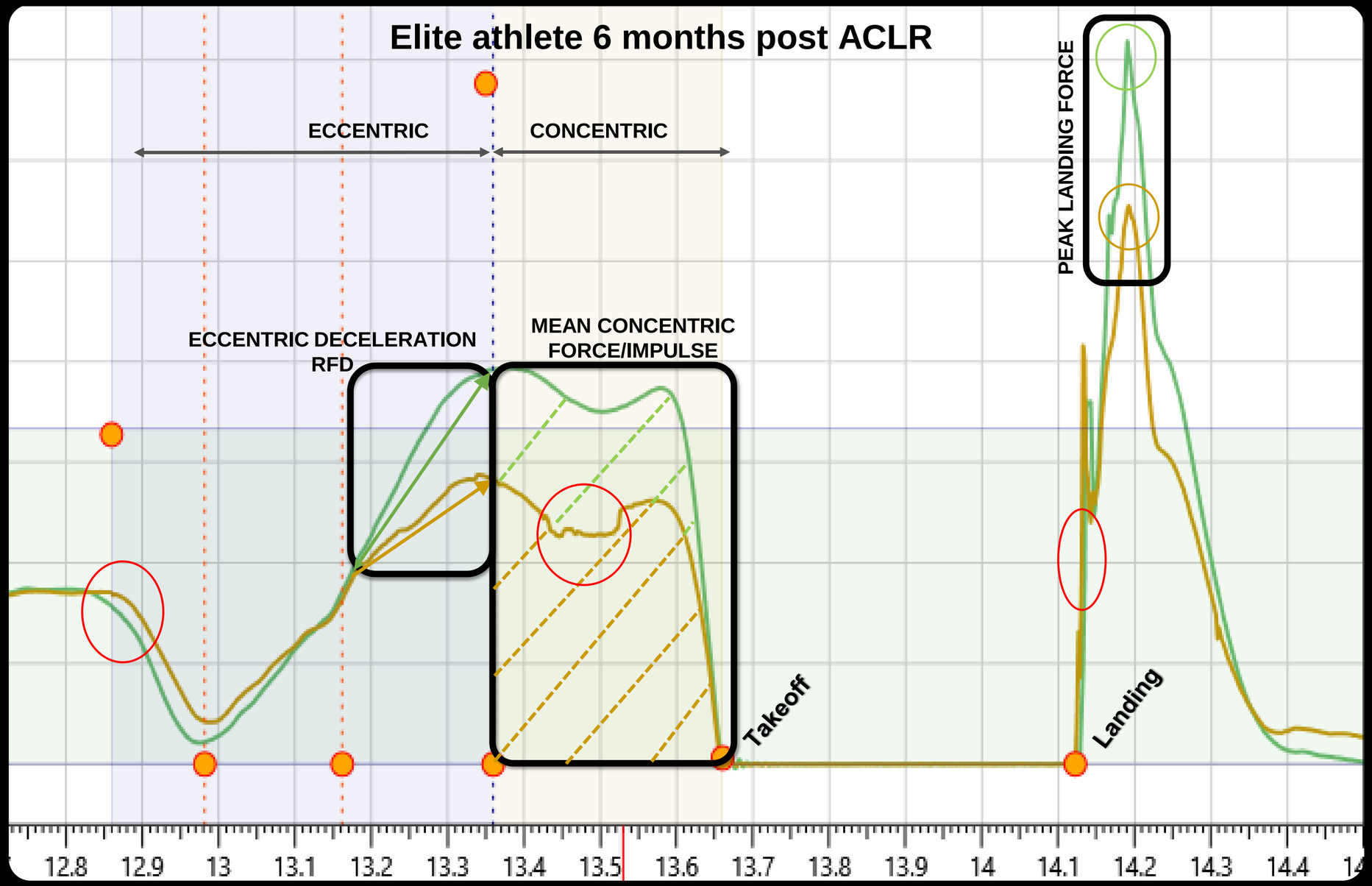
CON IMP



CON IMP100



SELECTED ASYMMETRIES - BILATERAL CMJ



CMJ ASYMMETRY IN AN ASYMMETRICAL SPORT

	Status	Mean asymmetry	Effect size
Concentric Impulse	Prev. Injured	7.74 ± 3.71*	1.14
	Uninjured	4.07 ± 2.82	
Concentric Peak Force	Prev. Injured	9.32 ± 5.88*	1.40
	Uninjured	3.38 ± 2.26	
Eccentric Deceleration RFD	Prev. Injured	20.52 ± 10.64*	1.05
	Uninjured	10.52 ± 8.24	
Eccentric Deceleration Impulse	Prev. Injured	12.11 ± 8.63	0.24
	Uninjured	10.25 ± 7.28	

Wells et al, unpublished

Hart et al, in press

ASYMMETRIES NBA

Absolute Asymmetries (%) - Preseason to Early Season

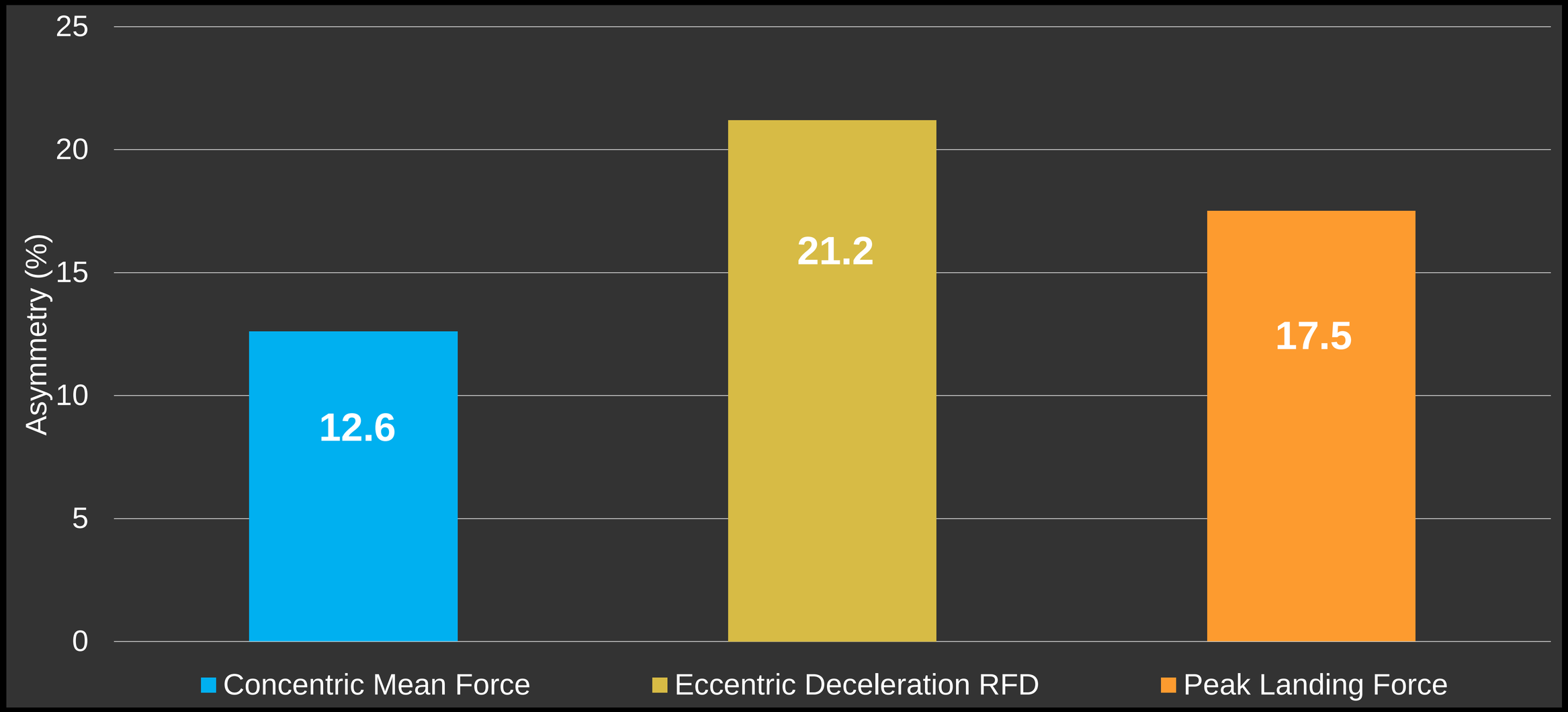
	Concentric Peak Force	Eccentric Deceleration RFD	Peak Landing Force
Preseason	9.3	27.0	14.1
Early Season	6.7	23.9	17.7

Preseason conditioning reduces concentric and eccentric asymmetries?

CON PEAK FORCE +1.9
ECCENTRIC DECELERATION RFD +4.9
PEAK LANDING FORCE +6.0

Increased asymmetries across Season?:

ELITE FOOTBALLERS DURING REHAB AFTER ACLR

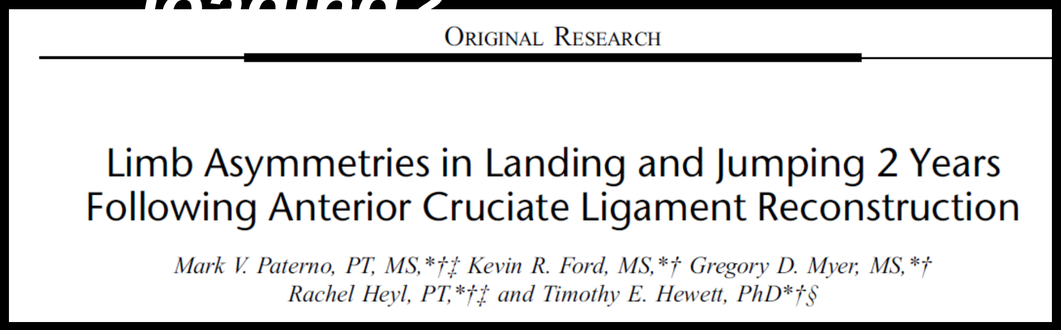


n=23

Wells et al., unpublished

RESIDUAL LANDING FORCE ASYMMETRIES post-ACL: DROP JUMP

- **Significant PERSISTENT inter-limb asymmetry in bilateral Drop Jump peak landing force and RFD > 2 years post ACL injury in female athletes**
  - **Potential mechanism: Differences in stiffness/neural feedforward (compensatory unloading)?**
  - ***Increased risk of injury on uninvolved side due to additional loading?***

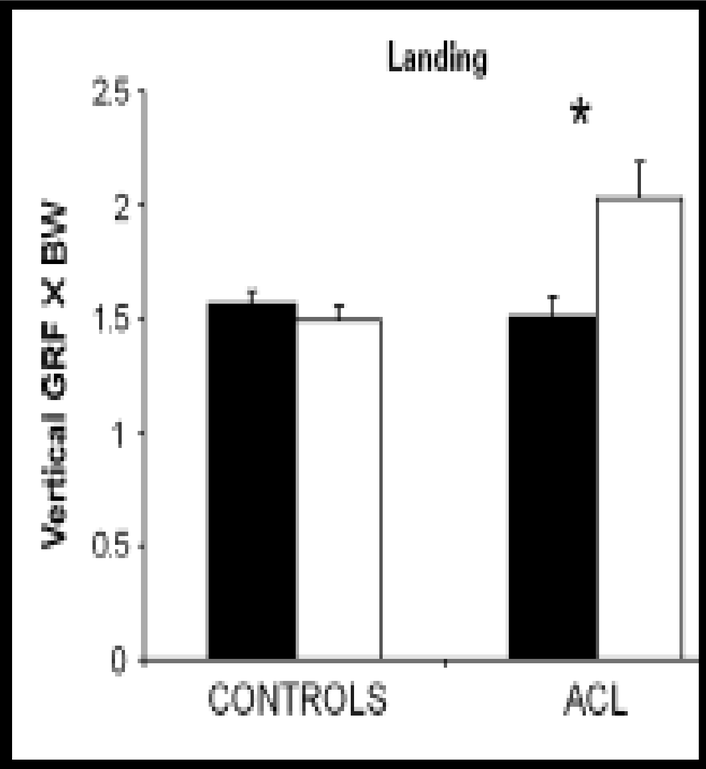


ORIGINAL RESEARCH

Limb Asymmetries in Landing and Jumping 2 Years Following Anterior Cruciate Ligament Reconstruction

Mark V. Paterno, PT, MS,†‡ Kevin R. Ford, MS,*† Gregory D. Myer, MS,*† Rachel Heyl, PT,*†‡ and Timothy E. Hewett, PhD*†§*

Peak landing force higher on uninvolved side



- **Residual of prior injury**
- **Potential risk factor for injury recurrence**
- **Potential return to sport criterion**
- **(Hewett, Myer, Paterno , others from 2000)**

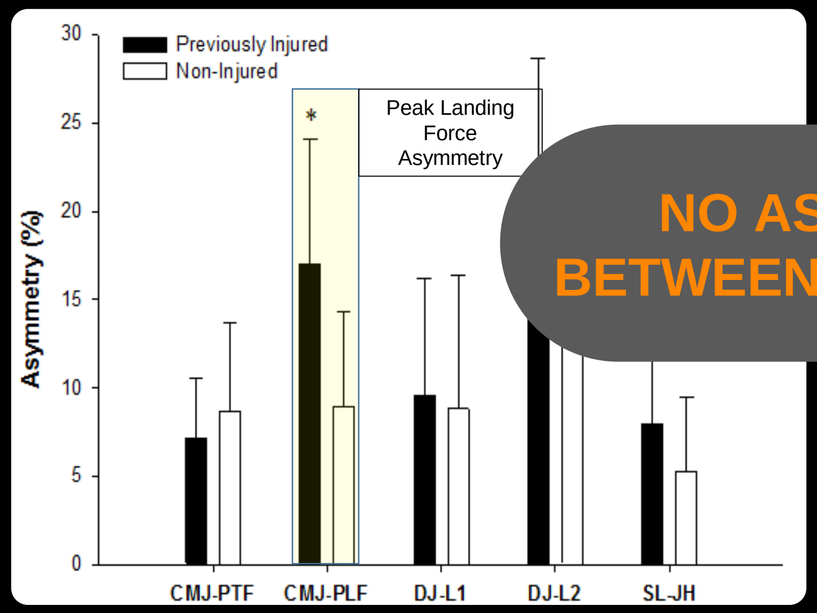
CMJ PEAK LANDING ASYMMETRIES

53

ARE FORCE ASYMMETRIES MEASURED IN JUMP TESTS ASSOCIATED WITH PREVIOUS INJURY IN PROFESSIONAL FOOTBALLERS?

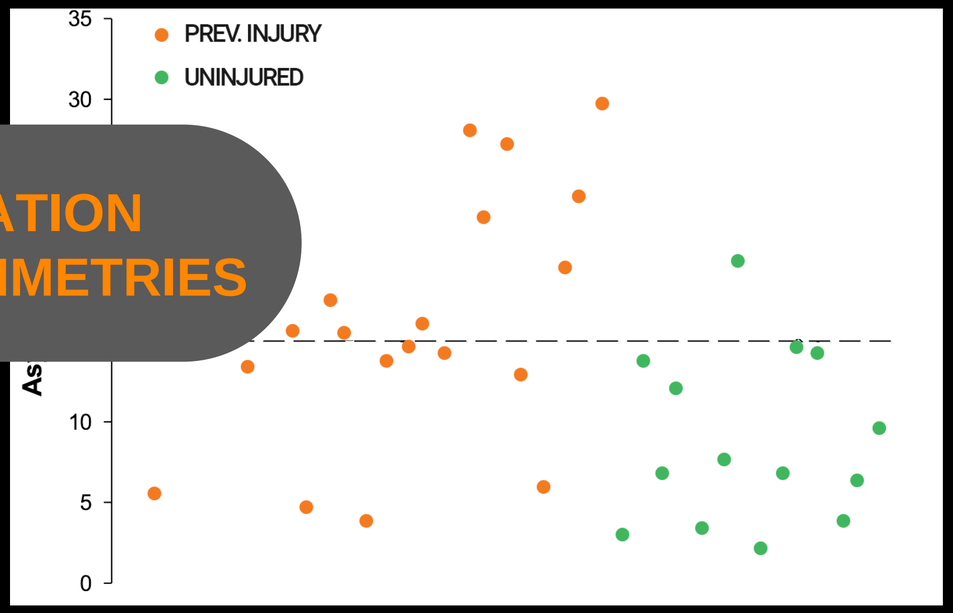
D Cohen,[2] N Clarke,[3] S Harland,[1] C Lewin[1]. [1]*Arsenal Football Club, London, United Kingdom;* [2]*Universidad de Santander, Bucaramanga, Colombia;* [3]*Coventry University, Coventry, United Kingdom*

+ Healthy players tested at start of preseason.
+ Defined as previously injured if any lower extremity injury leading to > 7 consecutive days missed in previous season



Mean asymmetry in countermovement jump take-off peak force (CMJ-PTF), peak landing force (CMJ-PLF) and first (DJ-L1) and second (DJ-L2) drop-jump peak landing and single leg jump height (SL-JH). *Asymmetry was significantly higher in previously injured players for CMJ-PLF (P=0.001; d=1.27)

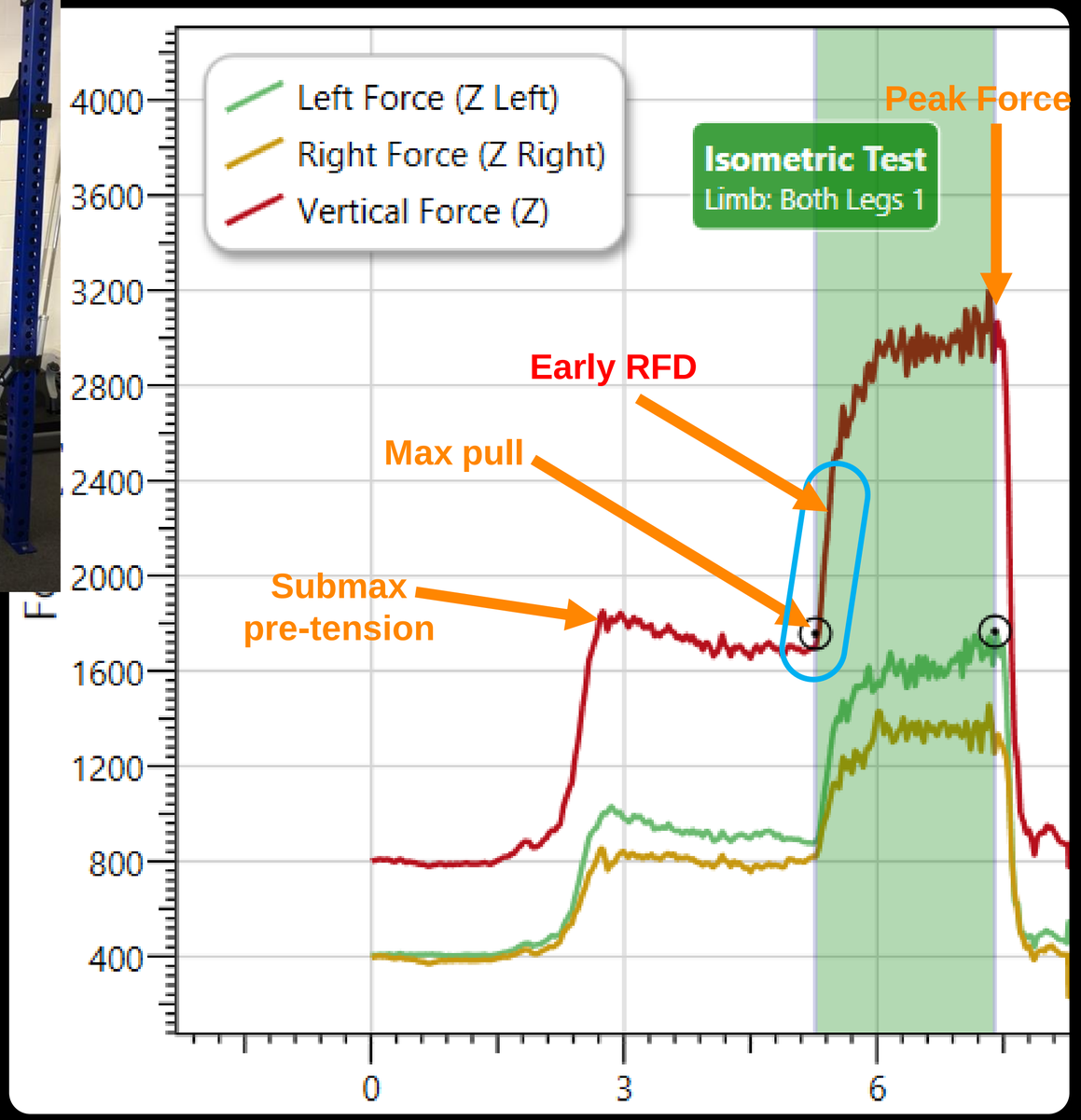
NO ASSOCIATION BETWEEN ASYMMETRIES



Individual asymmetry in countermovement jump peak landing force asymmetry in previously injured (●▼■) and non-injured (◇) players.

ISOMETRIC STRENGTH TESTS

- Isometric mid thigh pull (IMTP)
- Squat
- Leg press
- Posterior chain
- Calf
- Push-up
- ASH test (Shoulder IYT)



Thanks for listening!

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