

# Clinic Day

Métodos para hipertrofia muscular na reabilitação  
musculoesquelética

Prof. Igor Nasser

# Variáveis do Treinamento de força para hipertrofia muscular

## Treinamento de força

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graph LR; A[Treinamento de força] --- B[Amplitude de movimento]; A --- C[Métodos de treinamento]; C --- D[Intensidade]; C --- E[Volume]; C --- F[Intervalo]; C --- G[Seleção dos exercícios]; C --- H[Ação muscular]; D --- I[Sobrecarga]; E --- J[Frequência]; G --- K[Ordem]; H --- L[Duração de cada repetição]
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Amplitude de movimento

Métodos de treinamento

Intensidade

Sobrecarga

Volume

Frequência

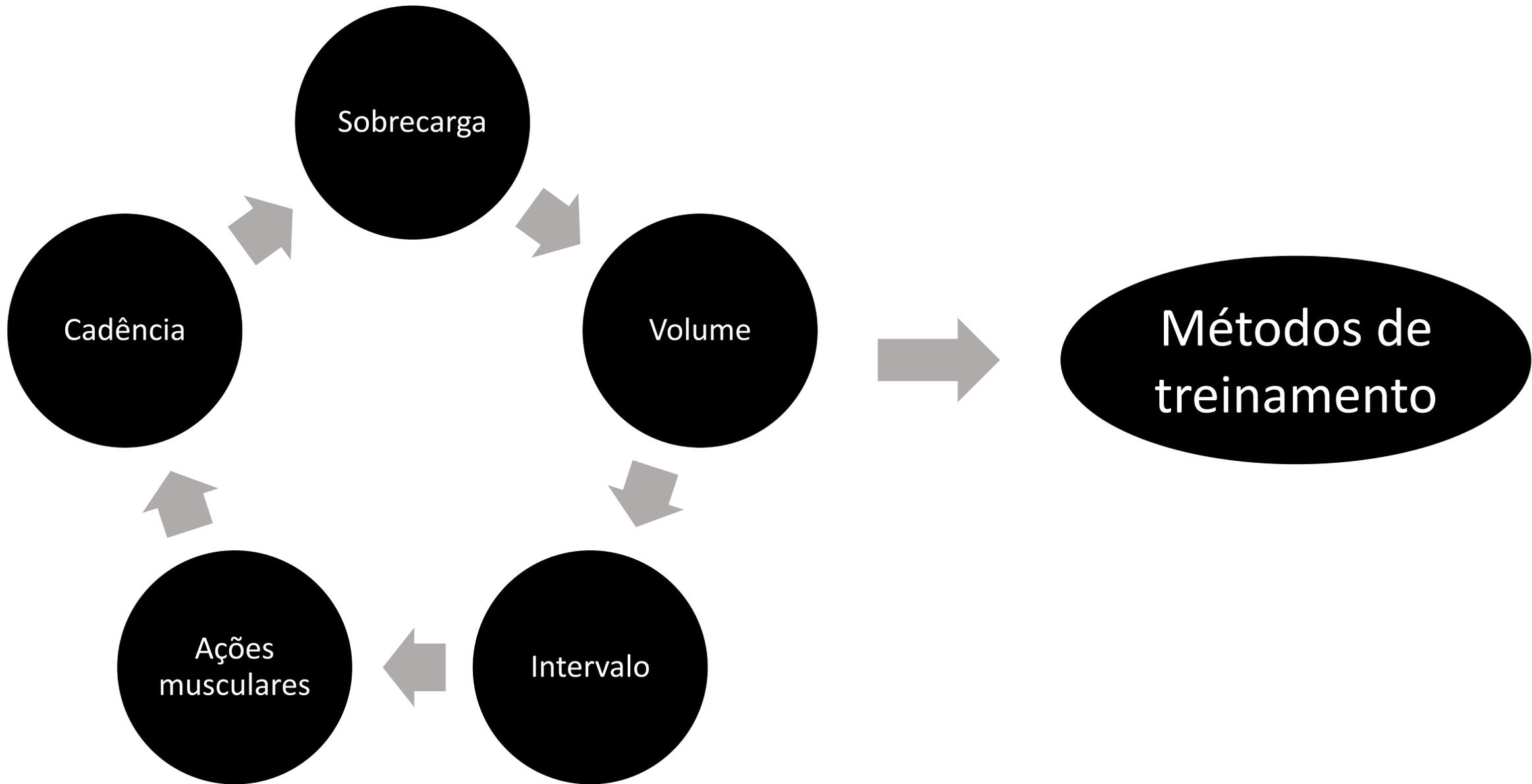
Intervalo

Seleção dos exercícios

Ordem

Ação muscular

Duração de cada repetição



# Modelo tradicional de treinamento

- Treinamento com exercícios dinâmicos, que combinem nos movimentos ações concêntricas e excêntricas
- Onde utiliza-se múltiplas séries, realizadas de forma sequencial, com intervalo interset, sem intervalo intraset e interrerepetições
- Os intervalos são fixos e as fases concêntricas ou excêntricas não sofrem manipulações em relação a sua duração
- Com faixa de repetições fixas, ou carga fixada, determinada por % de 1RM ou outra teste de RMs, prescritos a partir das ações concêntricas



## The Importance of Muscular Strength: Training Considerations

Timothy J. Suchomel<sup>1</sup> · Sophia Nimphius<sup>2</sup> · Christopher R. Bellon<sup>3</sup> · Michael H. Stone<sup>4</sup>

**Table 2** The theoretical potential of resistance training methods to benefit hypertrophy, strength, and power

Resistance training method	Hypertrophy	Strength	Power
Bodyweight exercise	+	+	++
Machine-based exercise	++	++	++
Weightlifting derivatives	+++	+++	+++++
Plyometrics	+	++	++++
Eccentric training	+++++	+++++	++++
Potential complexes	<sup>a</sup>	+++	+++++
Unilateral exercise	+++	++	+++
Bilateral exercise	++++	++++	+++
Variable resistance	+++++	++++	++++
Kettlebell training	++	++	+++
Ballistic training	++	+++	+++++

Resistance training methods ranked on scale from +, meaning low potential and +++++, meaning high potential

Assigned exercises, volume-load prescription, and an athlete's relative strength may influence adaptations

<sup>a</sup>Limited research available

# Caso 1

## Histórico da lesão:

Há aproximadamente **3 meses** começou a apresentar dor progressiva na região posterior do tornozelo direito durante a corrida. Inicialmente a dor aparecia apenas após treinos mais longos, mas evoluiu para desconforto já no início da atividade.

Foi diagnosticado com **tendinopatia do tendão de Aquiles por sobrecarga**, provavelmente associada a aumento abrupto no volume de corrida.

## Situação atual:

- Redução do volume de treinamento;
- Escala de dor 5/10 (na corrida)
- Dor principalmente pela manhã, ao pisar no chão
- Início de um trabalho de fortalecimento

## Objetivo:

- 1) *Reduzir a dor durante a corrida;*
- 2) *Retomar o volume de treino.*

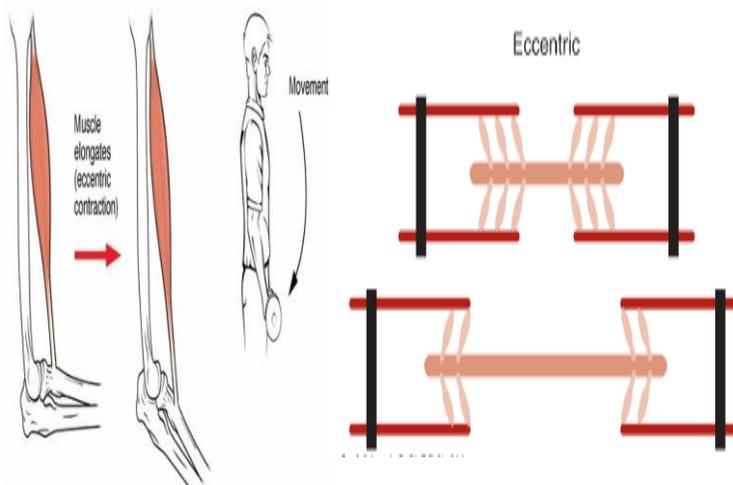
# Treinamento isométrico

- Método com ênfase na ação isométrica

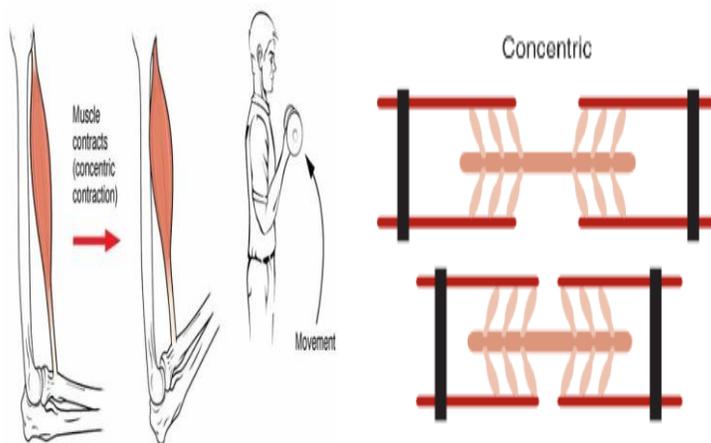
Treino convencional  
Dinâmico, que combinam  
ações concêntricas e  
excêntricas

Treino isométrico  
Estático, sem alteração do  
ângulo articular (tendão e  
sarcômero comprimento  
preservado)

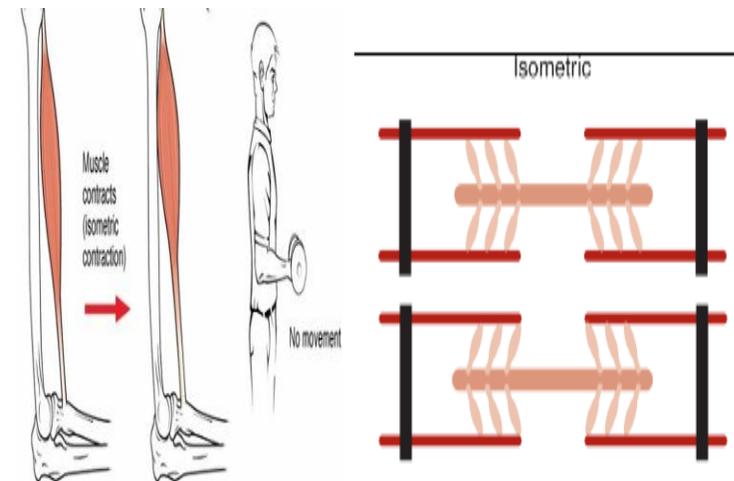
## Excêntrico



## Concêntrico

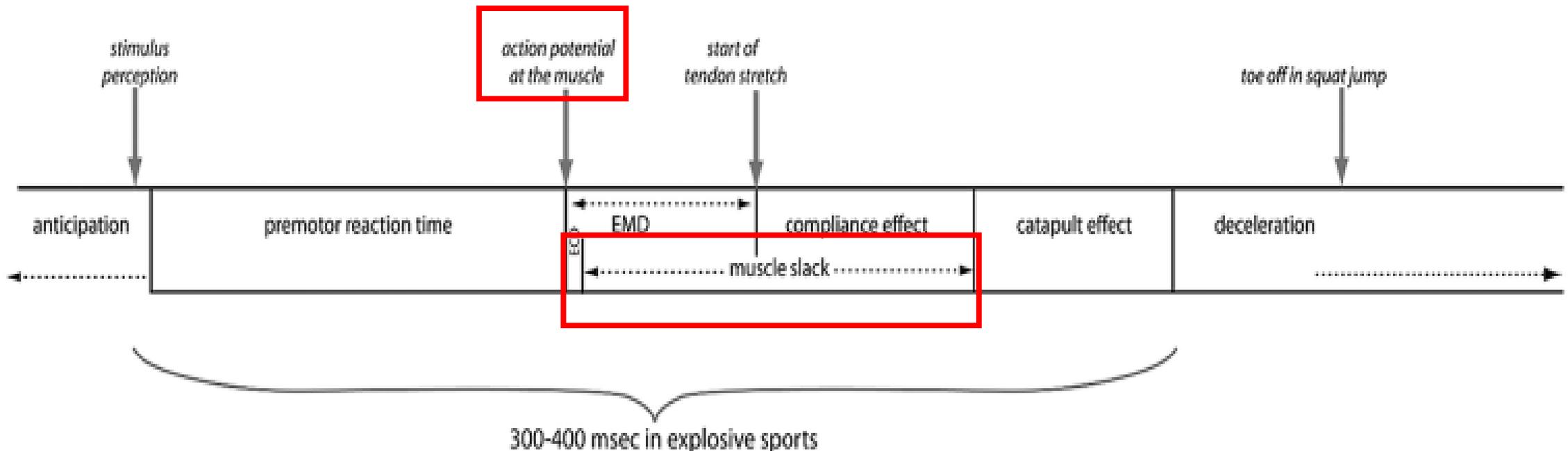


## Isométrico



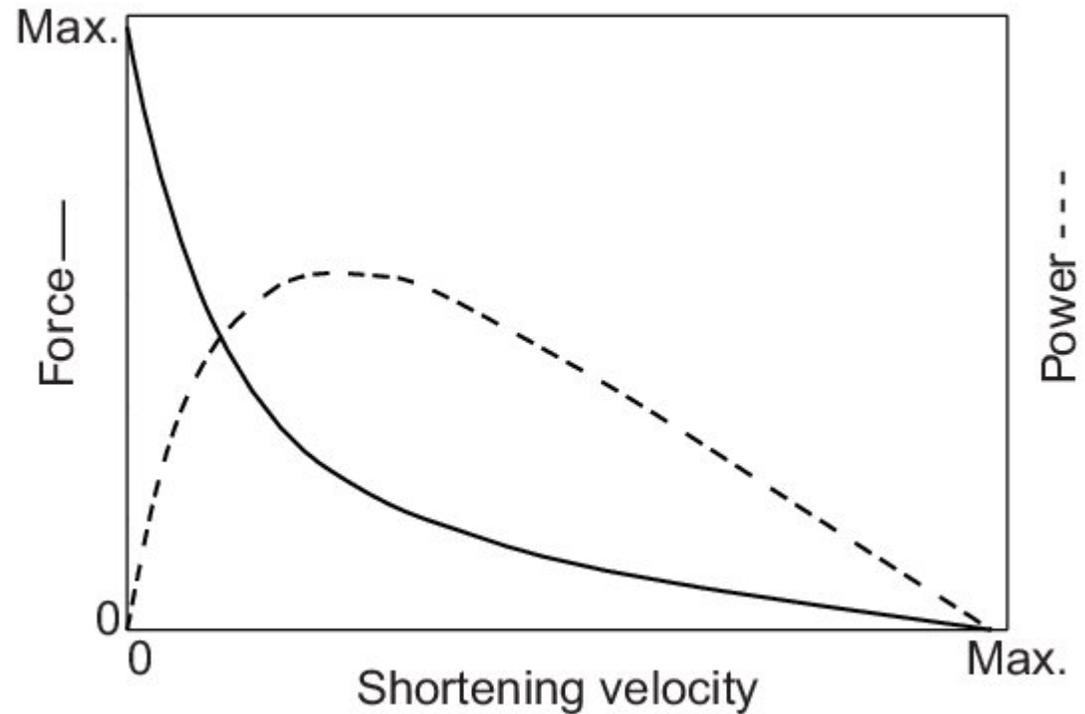
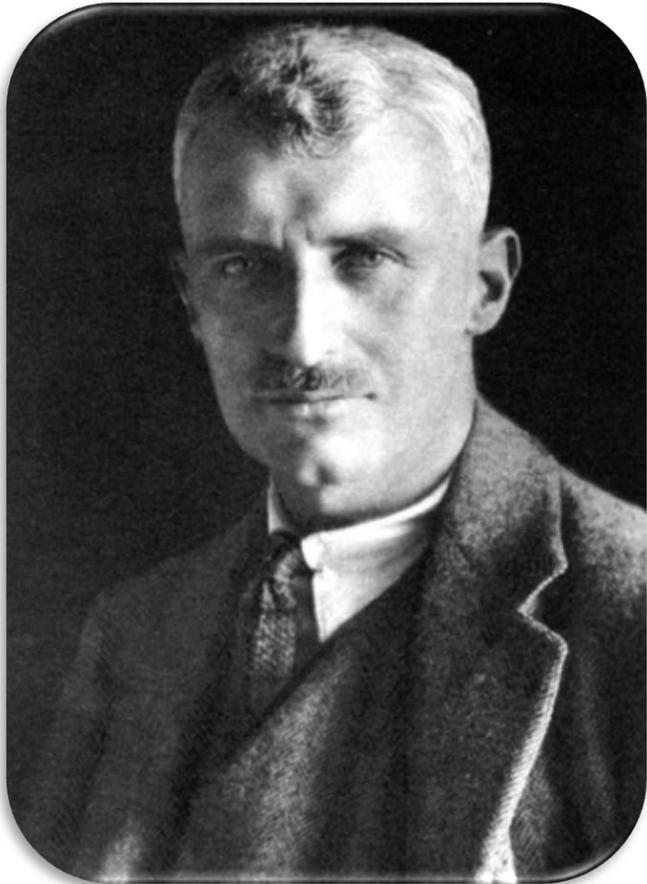
# Influence of Muscle Slack on High-Intensity Sport Performance: A Review

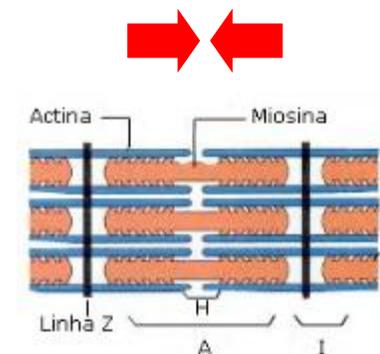
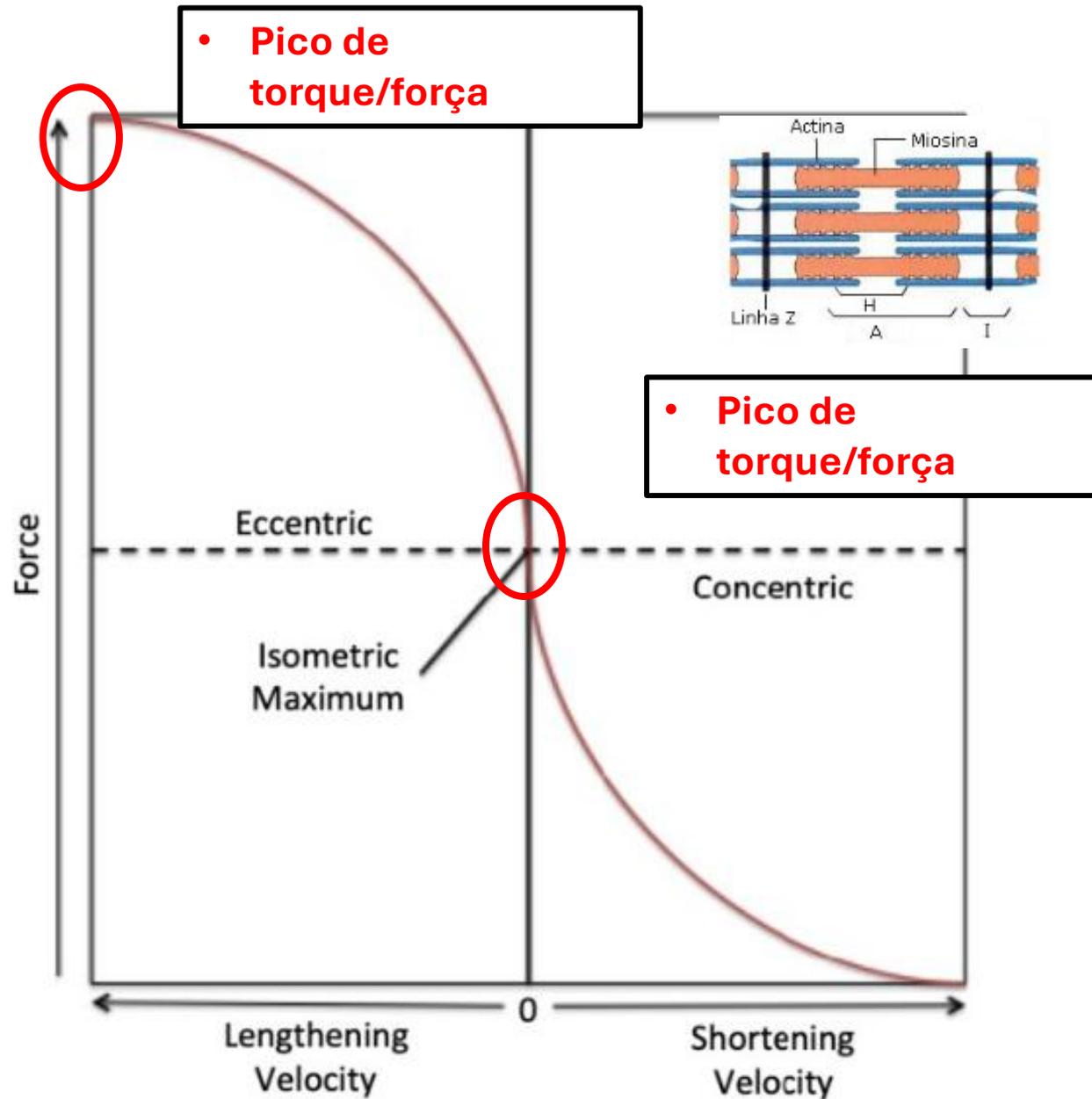
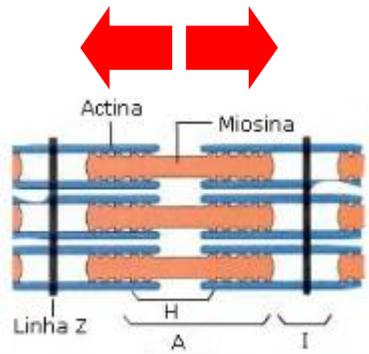
Bas Van Hooren, MSc and Frans Bosch, BSc  
Fontys University of Applied Sciences, School of Sport Studies, Eindhoven, the Netherlands



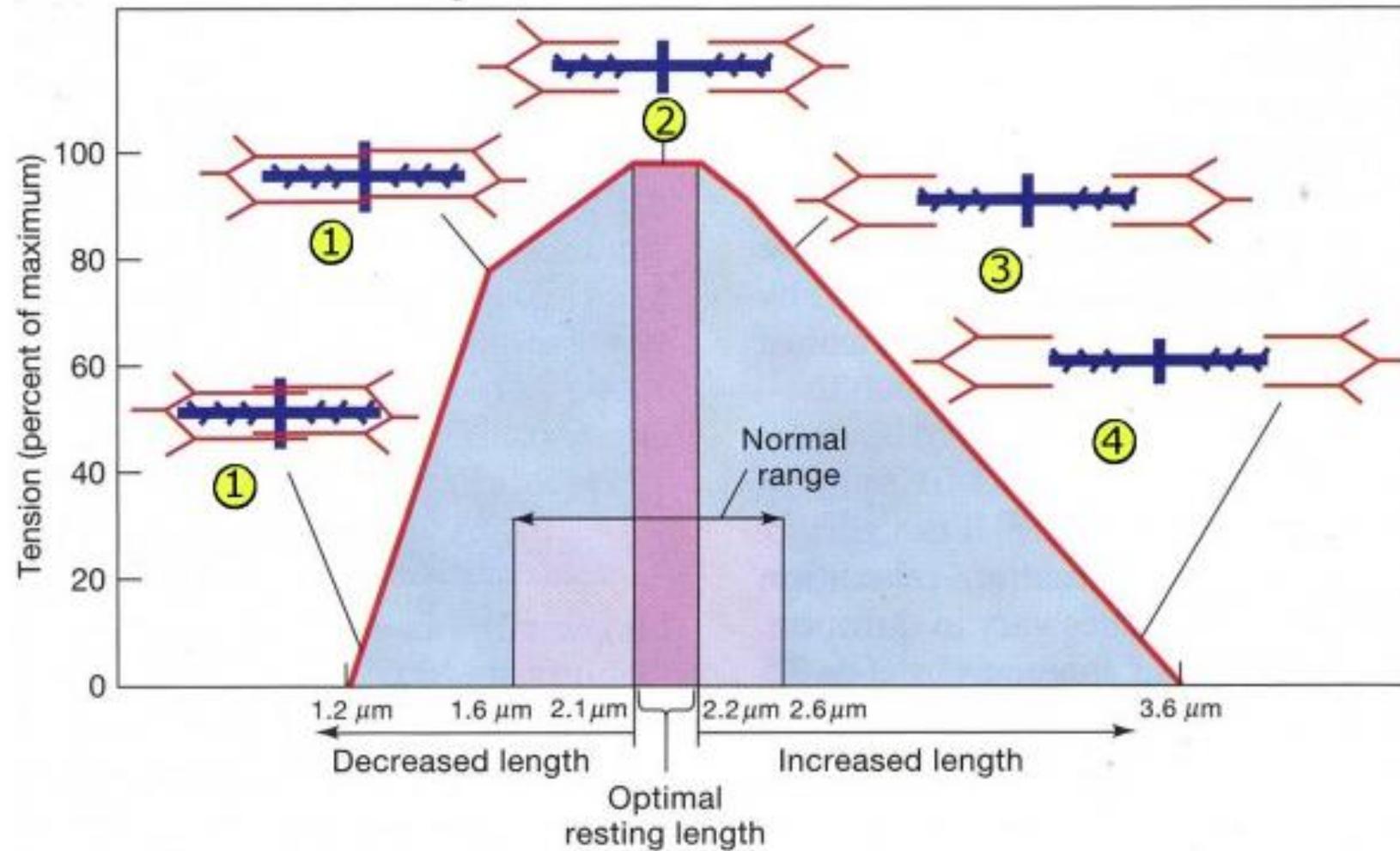
# Relação força-velocidade

- Proposto no estudo clássico de AV Hill (1938)





# Relação força-comprimento



# Relação força-tempo

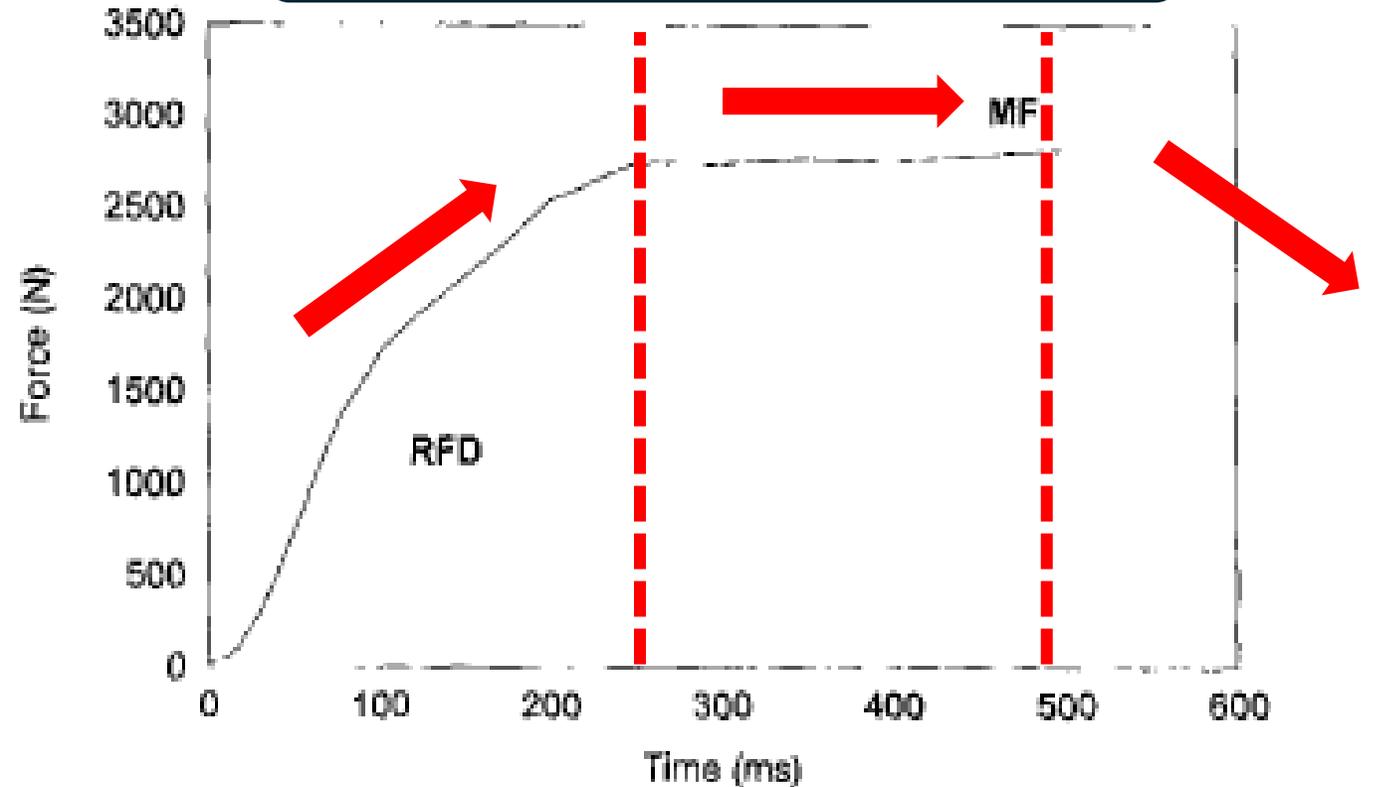
Journal of Strength and Conditioning Research, 1997, 11(4), 269-272  
© 1997 National Strength & Conditioning Association

## Force-Time Dependent Characteristics of Dynamic and Isometric Muscle Actions

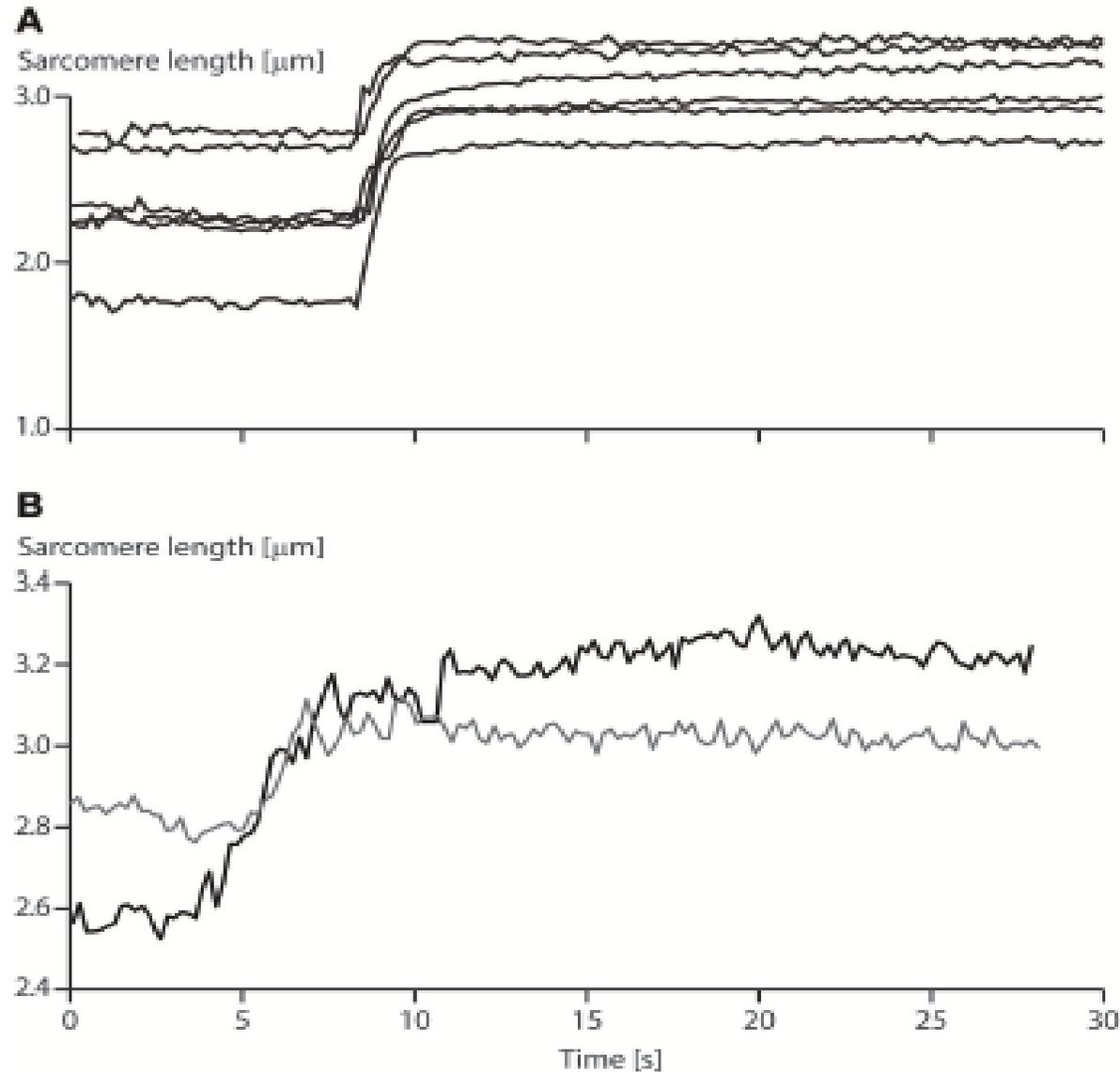
G. Gregory Haff, Michael Stone, Harold S. O'Bryant, Everett Harman<sup>†</sup>, Chris Dinan, Robert Johnson, and Ki-Hoon Han<sup>†</sup>

Biomechanics Laboratory, Appalachian State University, Boone, North Carolina 28608; <sup>†</sup>U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts 01760-5007.

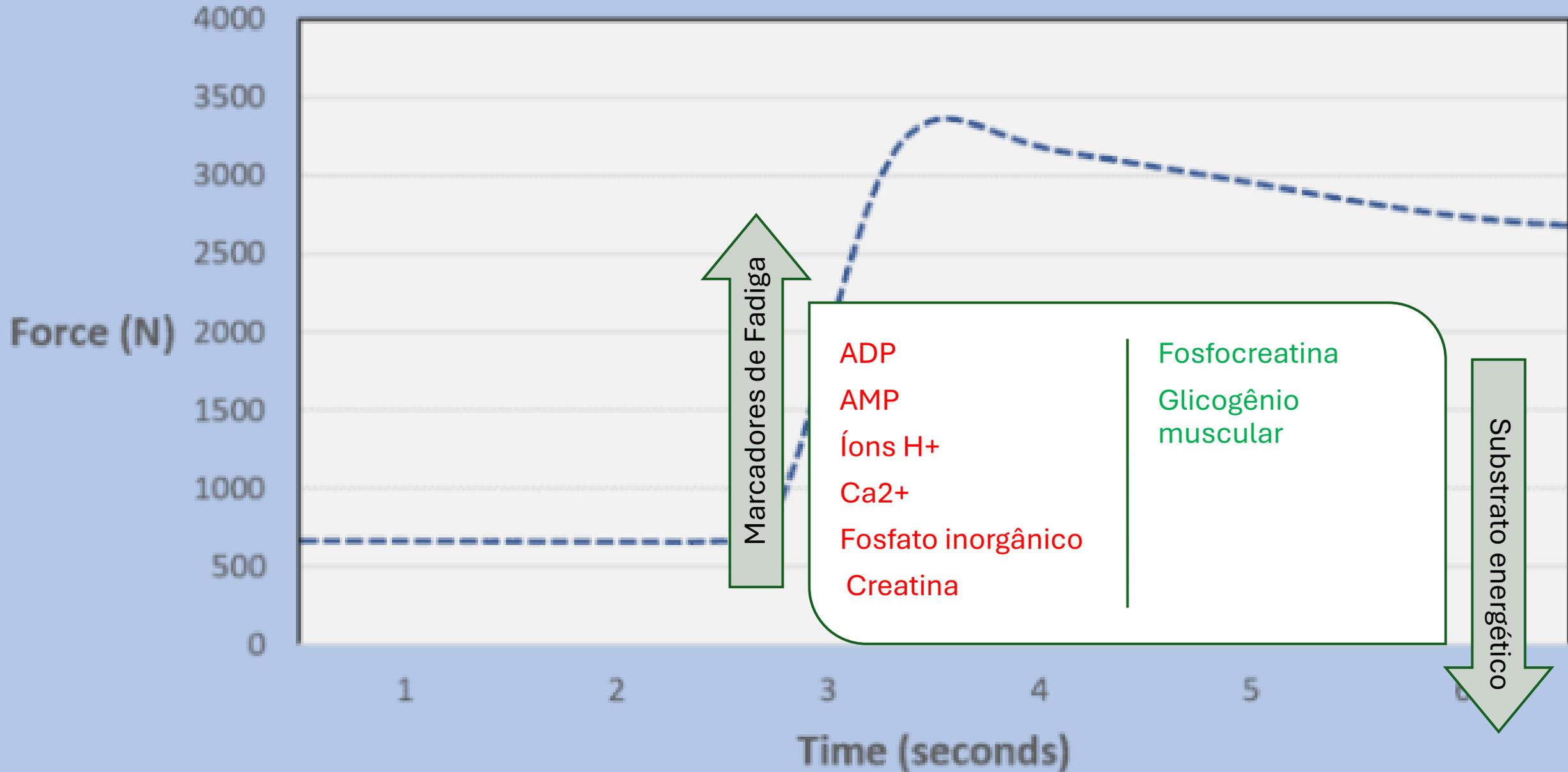
**Ação voluntária máxima**



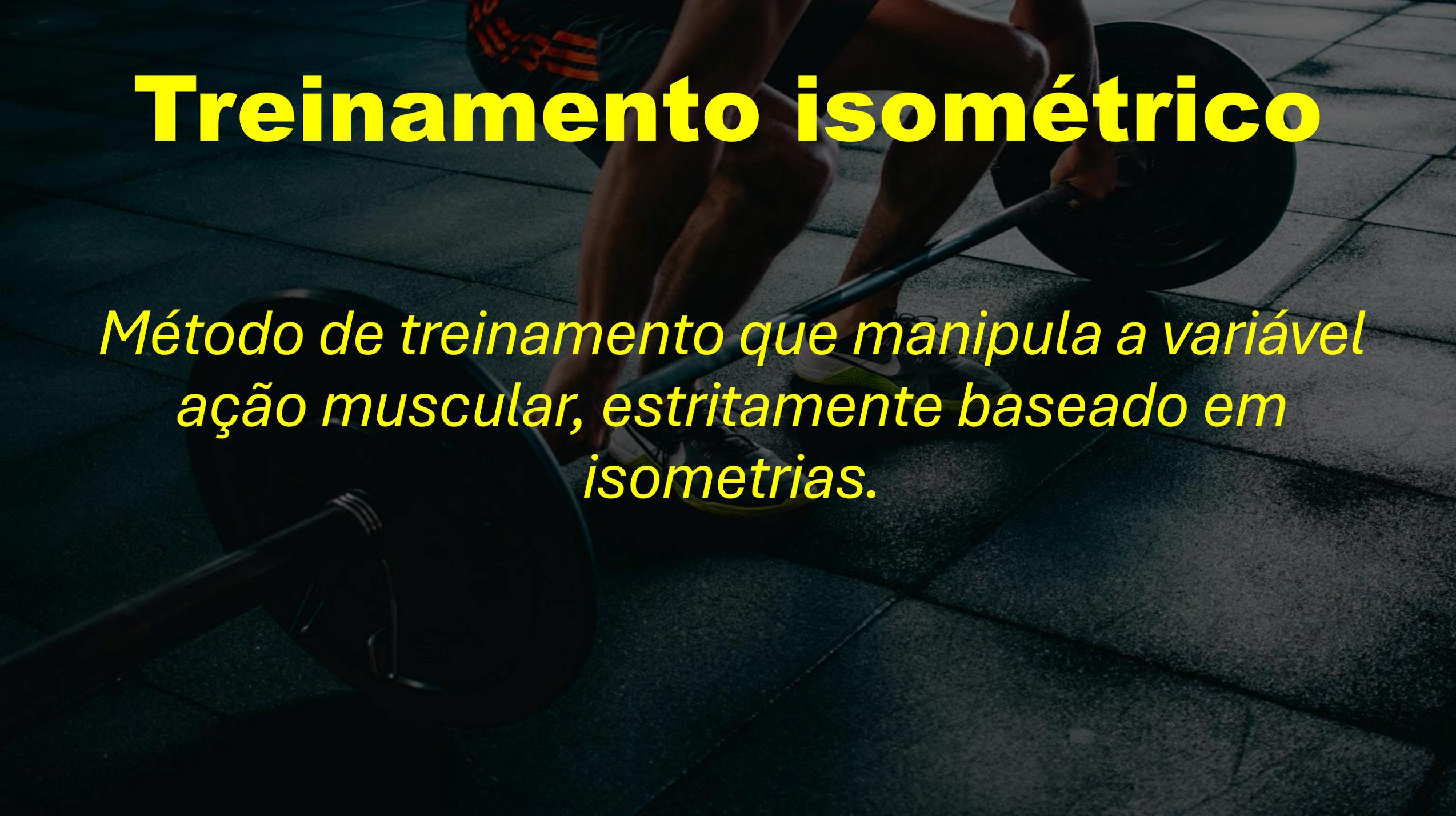
# Estado estável da contração isométrica



# IMTP Force Trace (no SSC)



# Treino isométrico

A person is shown from the waist down, performing a deadlift. They are wearing dark shorts with orange stripes and black sneakers with green accents. They are holding a barbell with both hands, positioned on a grey gym floor. The barbell has two large black weight plates on each end. The background is a dark, slightly blurred gym floor.

*Método de treinamento que manipula a variável ação muscular, estritamente baseado em isometrias.*

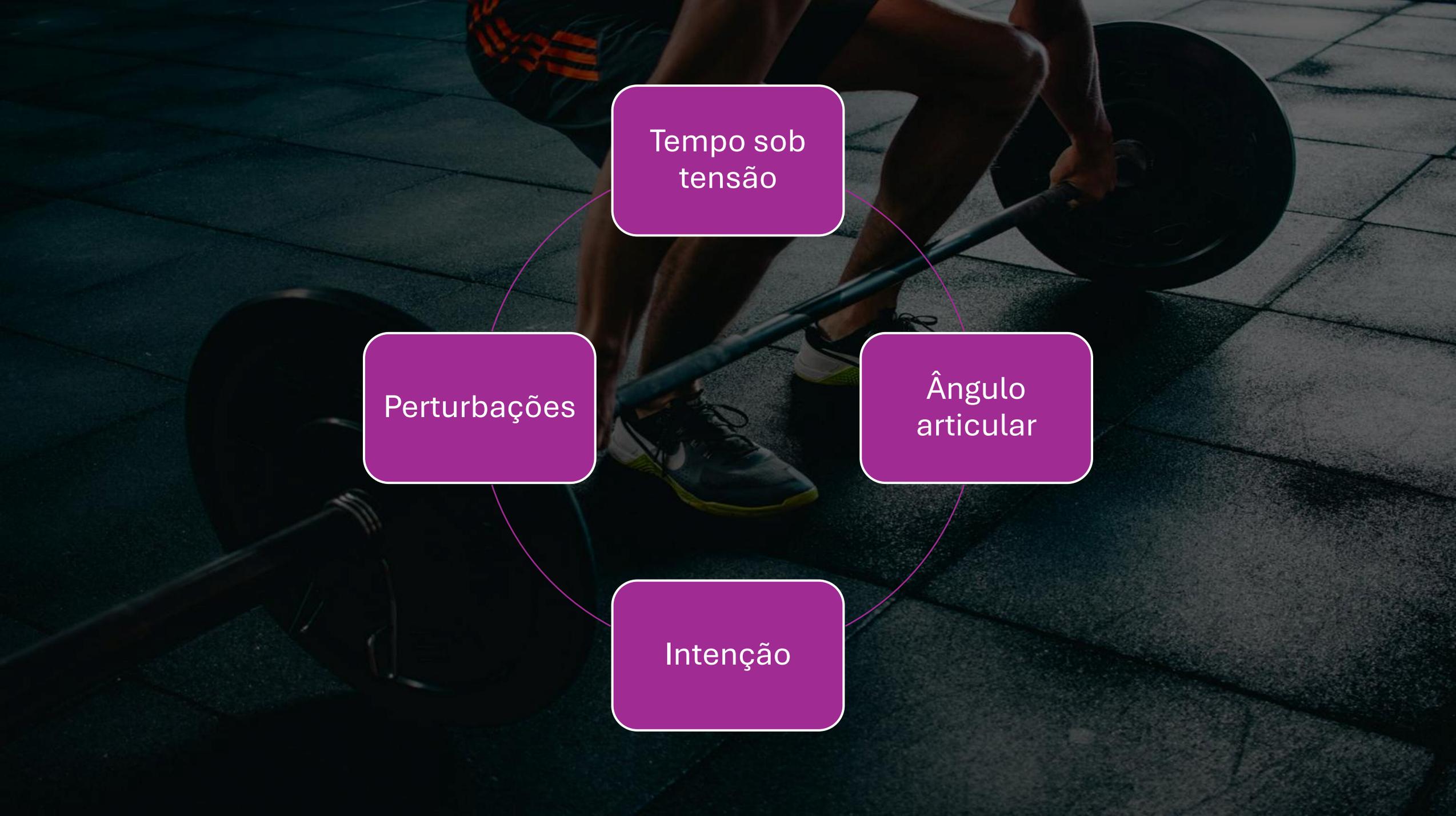
# Vantagens

*Aplicação controlada da força em limites angulares específicos durante um processo de reabilitação;*

*Meio de progressão – pico de força isométrica máxima pode ser maior que ações concêntricas*

*Pontos de fraqueza específicos ao longo de uma amplitude de movimento.*

*Efeito analgésico e capacidade de treinar com dores.*



Tempo sob  
tensão

Perturbações

Ângulo  
articular

Intenção

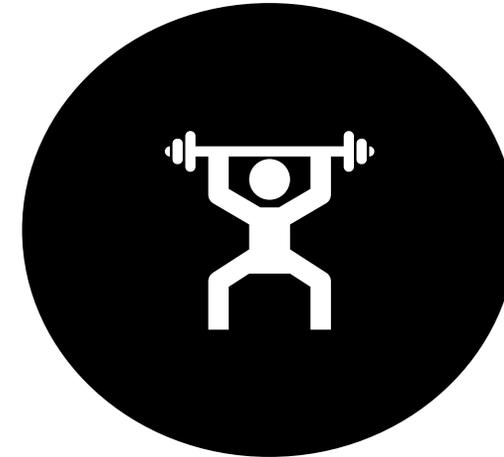
## Isometric training and long-term adaptations: Effects of muscle length, intensity, and intent: A systematic review

Dustin J. Oranchuk<sup>1</sup>  | Adam G. Storey<sup>1</sup> | André R. Nelson<sup>2</sup> | John B. Cronin<sup>1,3</sup>



### *Adaptação morfológica*

O treinamento isométrico promove **hipertrofia muscular**



### *Arquitetura muscular*

O treinamento isométrico promove **o aumento do comprimento do fascículo**

Tensão  
mecânica



Estresse  
metabólico

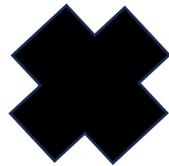
Dano  
muscular

TRAINING SPECIFIC FUNCTIONAL, NEURAL AND HYPERTROPHIC  
ADAPTATIONS TO EXPLOSIVE- VS. SUSTAINED-CONTRACTION STRENGTH  
TRAINING

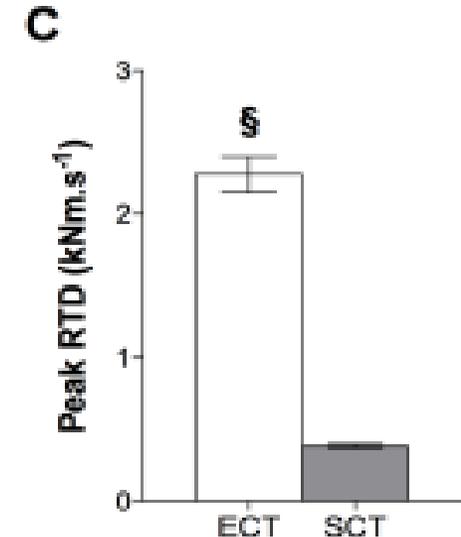
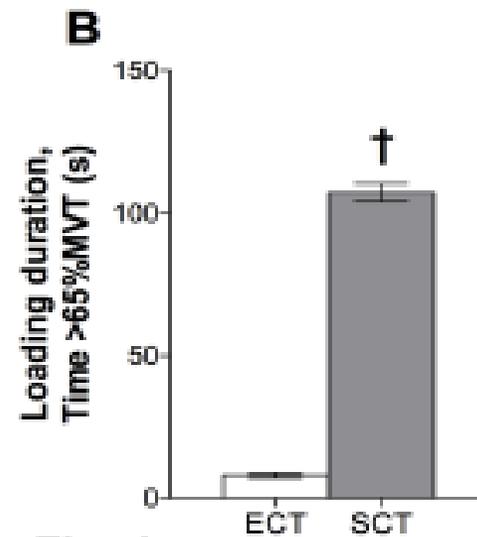
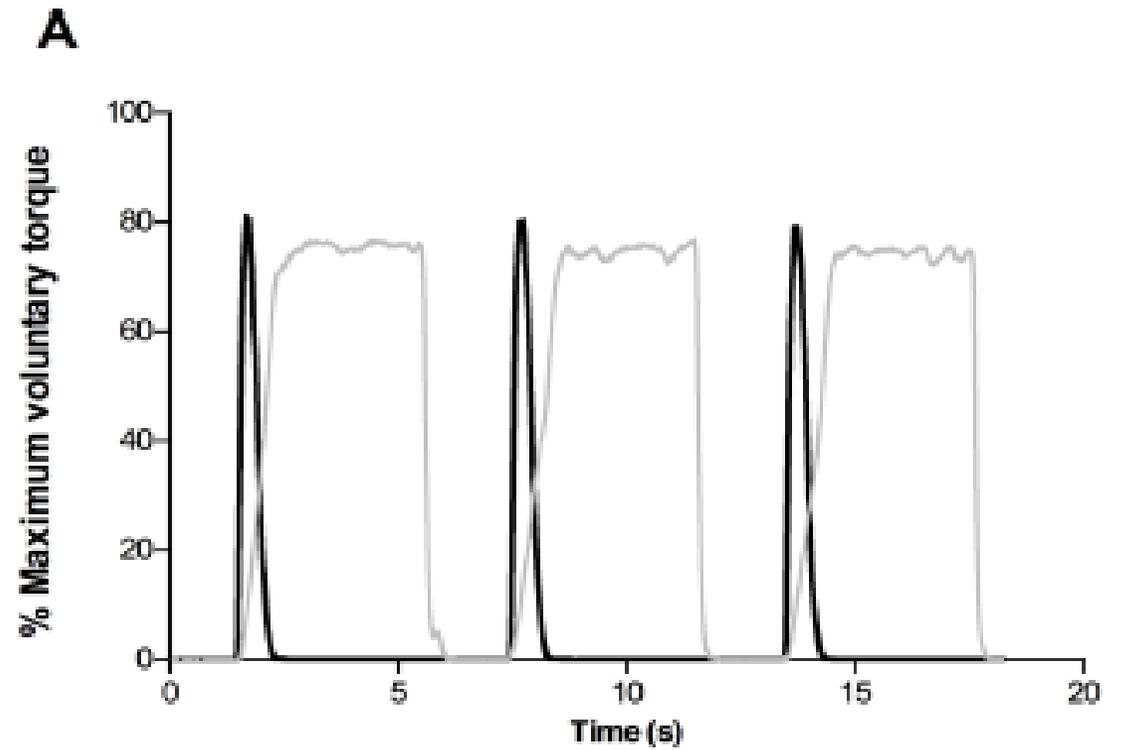
Authors:

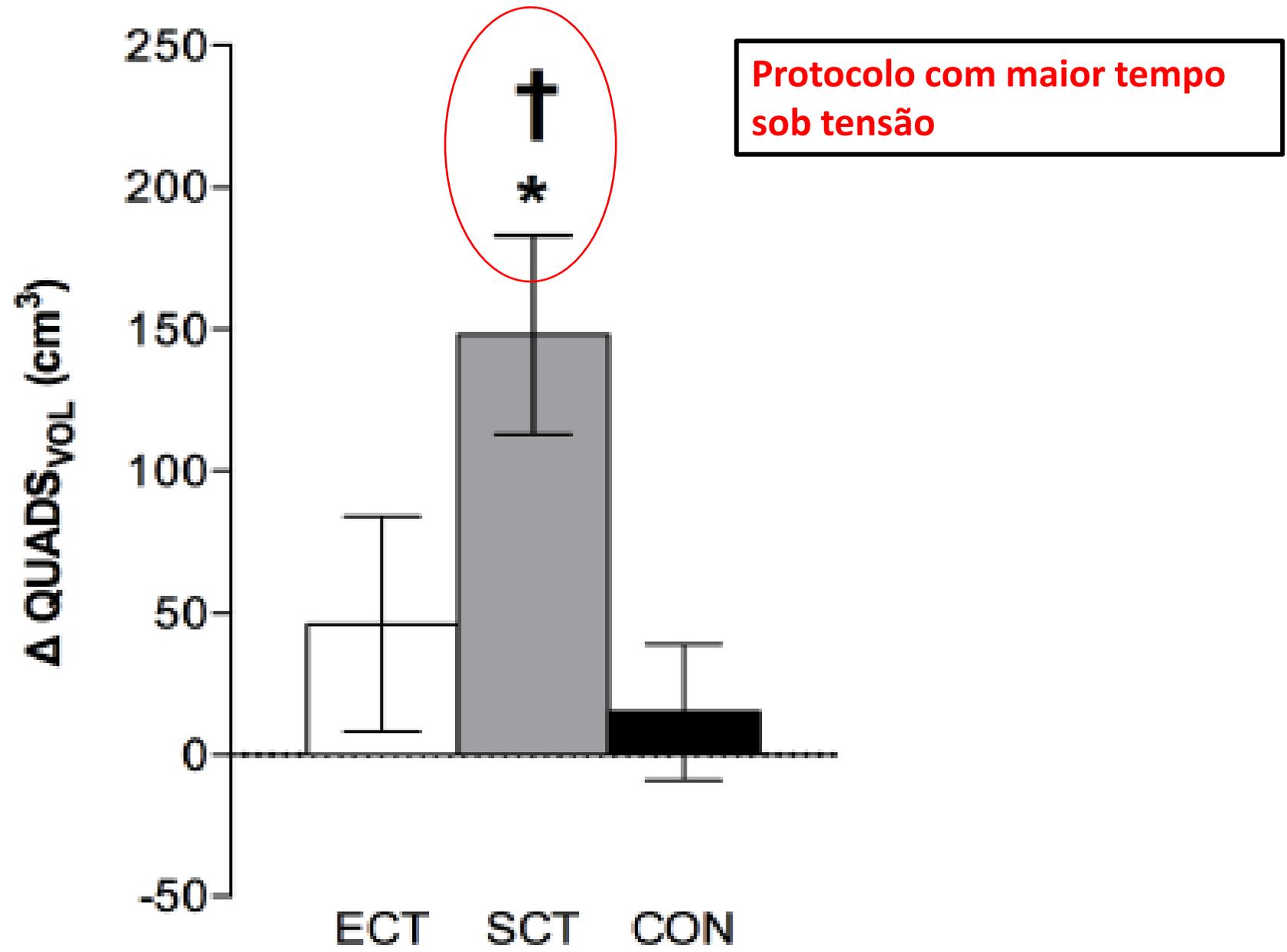
Thomas G. Balshaw<sup>1,2</sup>, Garry J. Massey<sup>1,2</sup>, Thomas M. Maden-Wilkinson<sup>2</sup>, Neale A. Tillin<sup>3</sup>,  
Jonathan P. Folland<sup>1,2</sup>

40 x 3" a 75% da MVIC



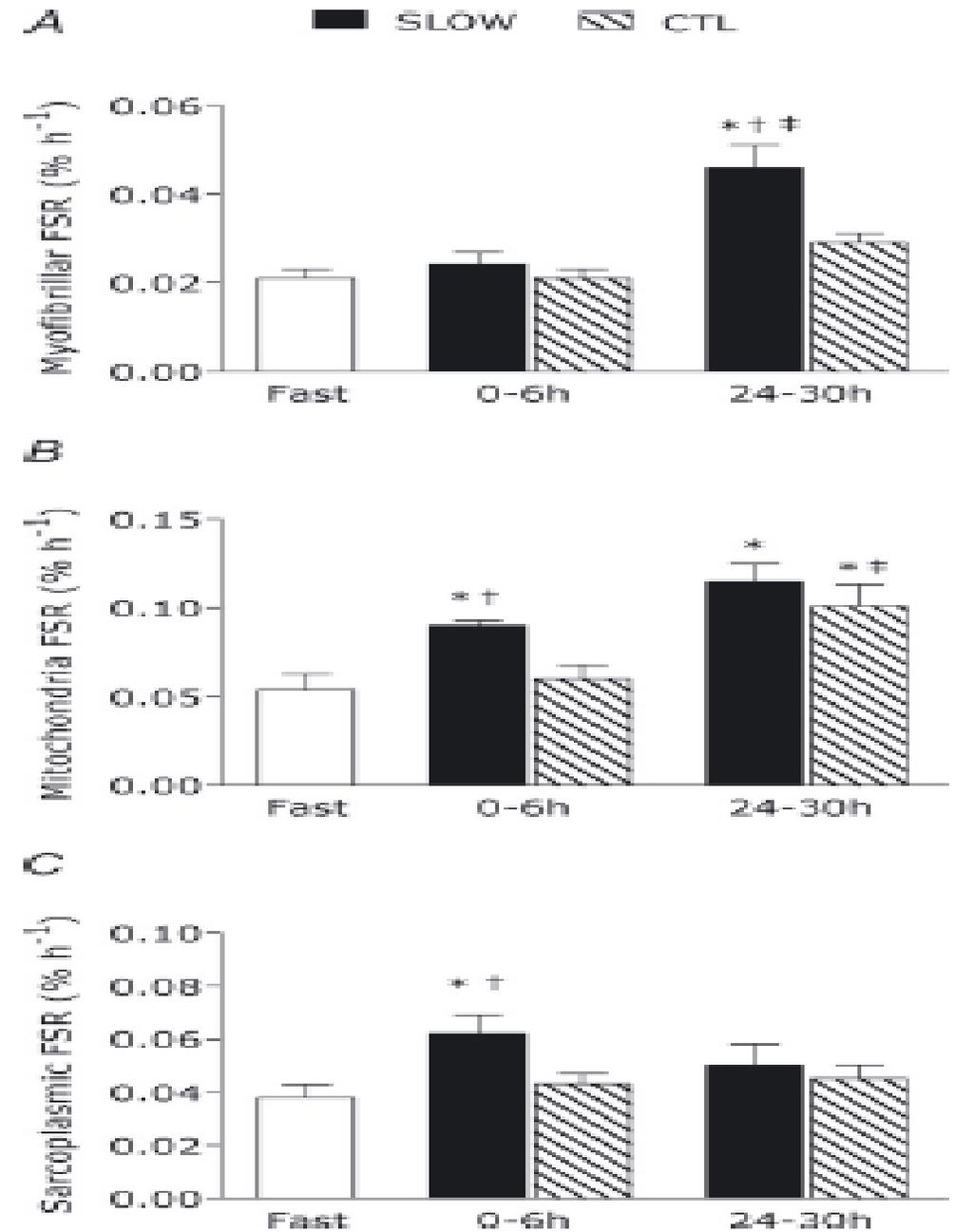
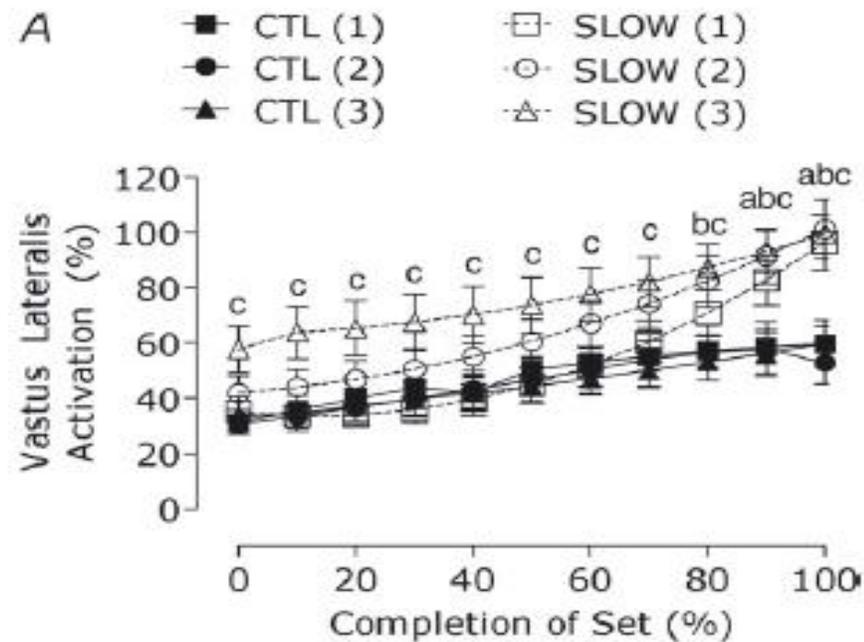
40 x 1" a 80% da MVIC





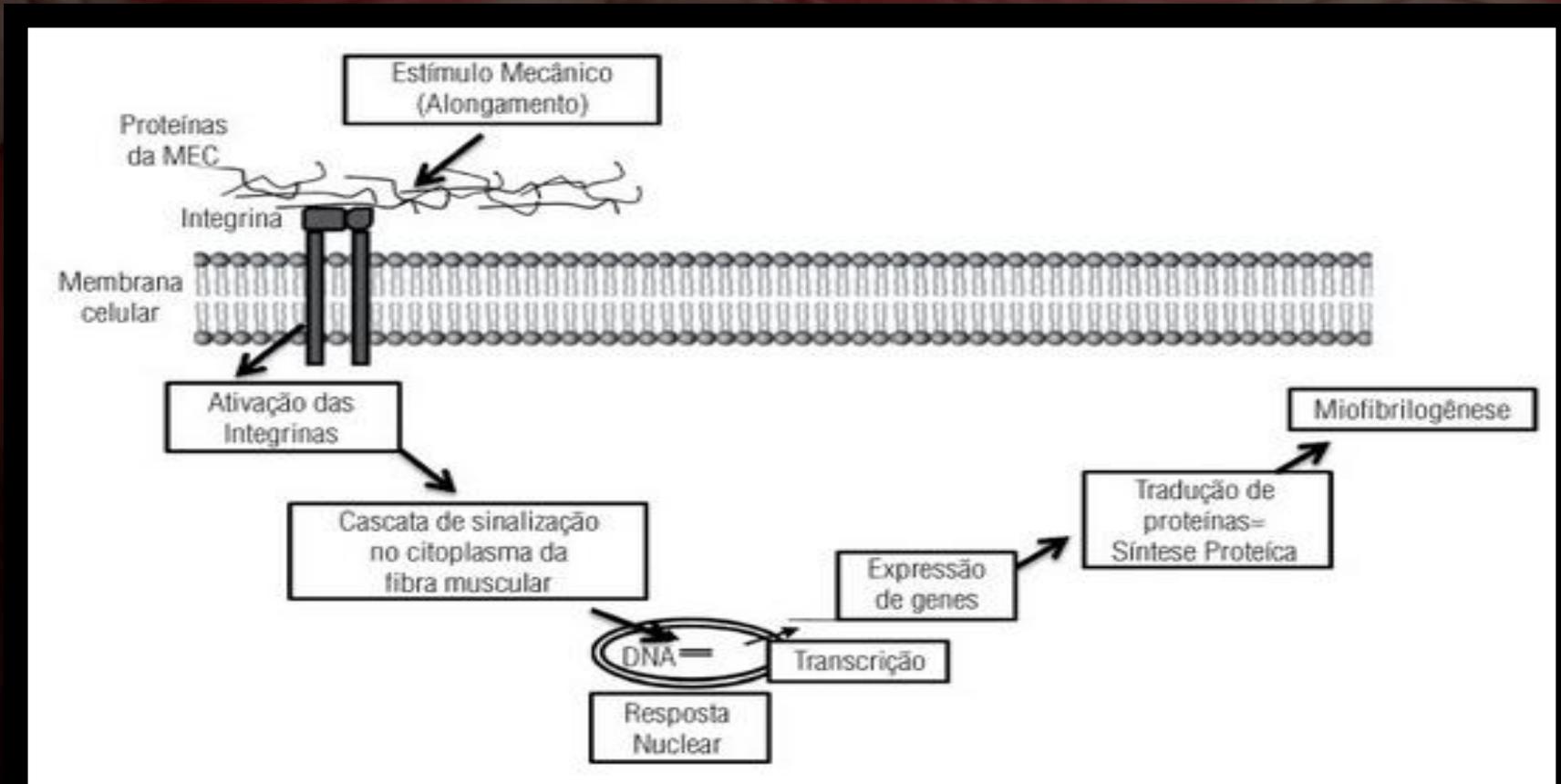
# Muscle time under tension during resistance exercise stimulates differential muscle protein sub-fractional synthetic responses in men

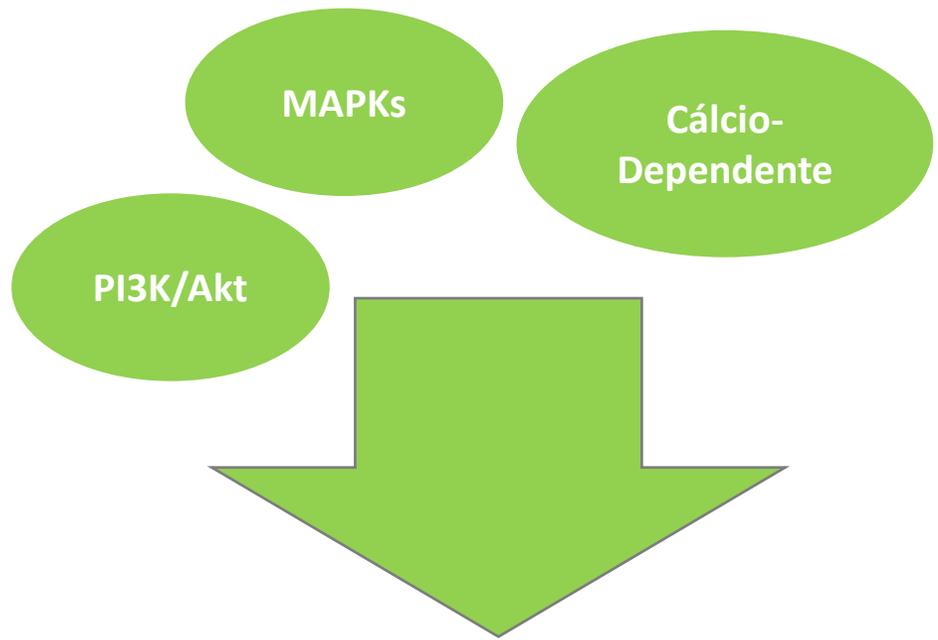
Nicholas A. Burd<sup>1</sup>, Richard J. Andrews<sup>1</sup>, Daniel W.D. West<sup>1</sup>, Jonathan P. Little<sup>1</sup>, Andrew J.R. Cochran<sup>1</sup>, Amy J. Hector<sup>1</sup>, Joshua G.A. Cashback<sup>2</sup>, Martin J. Gibala<sup>1</sup>, James R. Potvin<sup>2</sup>, Steven K. Baker<sup>3</sup> and Stuart M. Phillips<sup>1</sup>



# Mecanotransdução

Conversão do estímulo mecânico em uma sinalização intracelular química

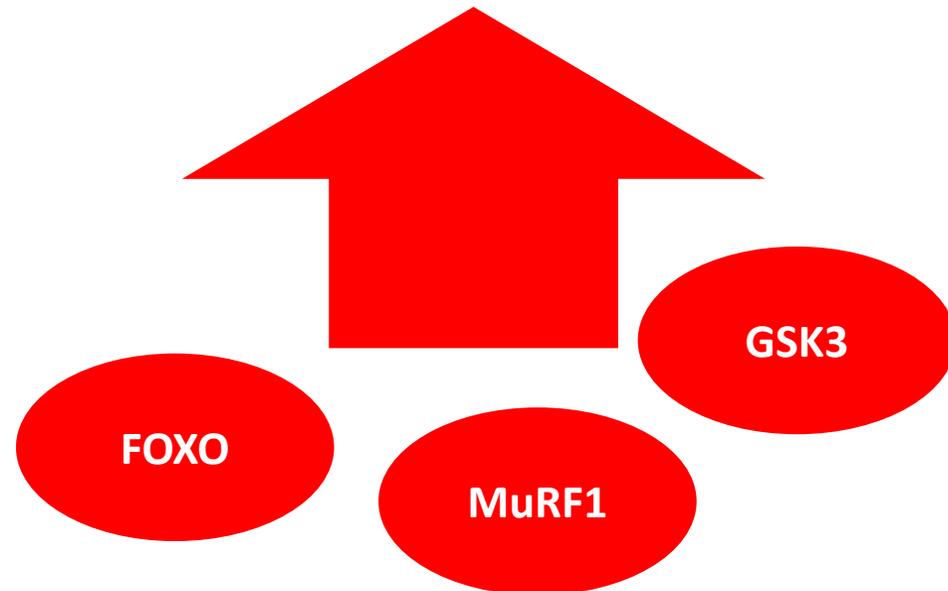




**Síntese proteica**



**Catabolismo proteico**



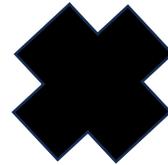
ORIGINAL ARTICLE

J. Schott · K. McCully · O.M. Rutherford

## The role of metabolites in strength training

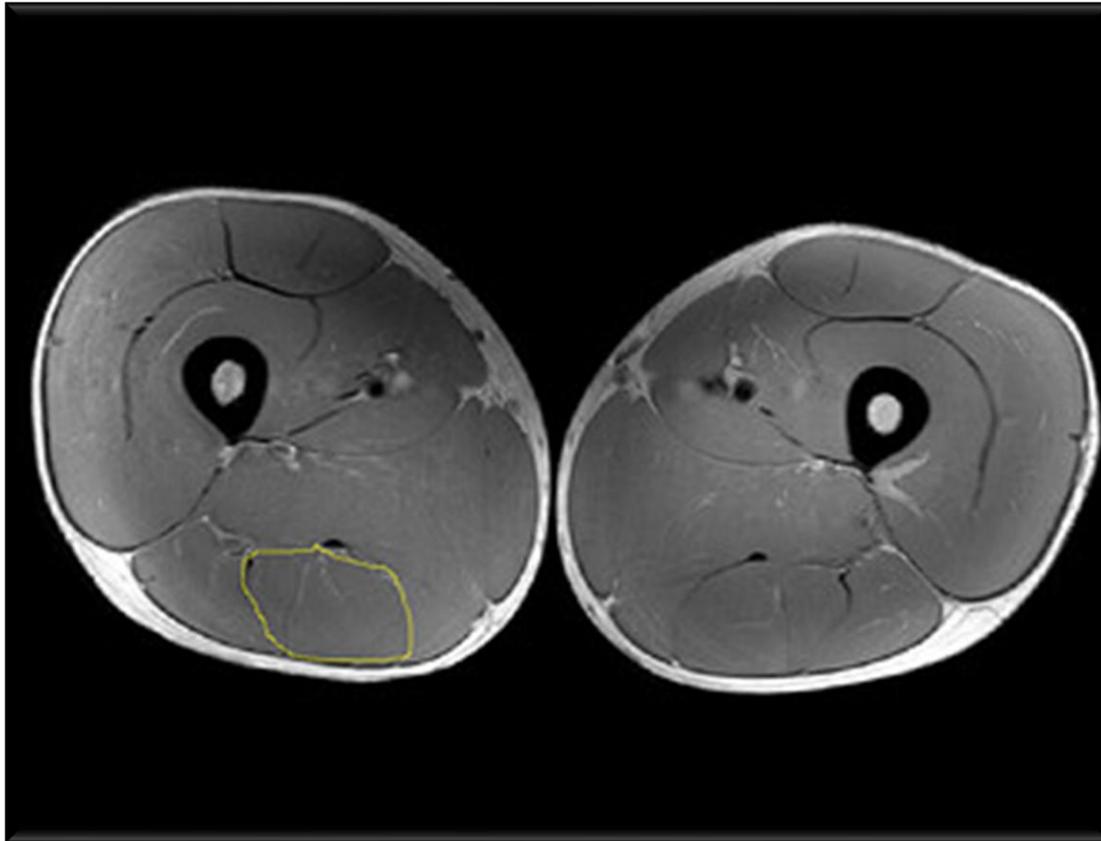
### II. Short versus long isometric contractions

4 x 30"



4 x 10 x 3"

**Protocolo com séries com tempo sob tensão constante**

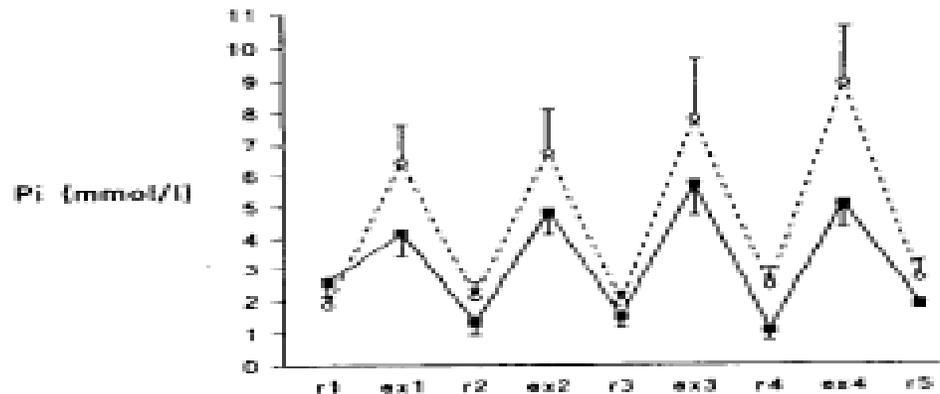


**Table 1** Median (range) percentage changes in quadriceps cross-sectional area at two scan levels

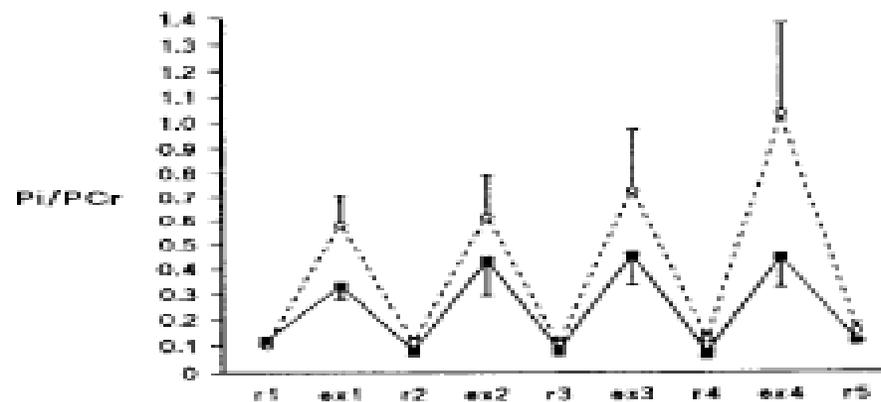
Protocol	Upper level (3/4 femur)	Lower level (1/4 femur)
IC	6.5 (- 5.5 to 29.6)	4.3 (- 1.3 to 23.9)
CC	10.1* (0.8 to 24.4)	11.1* (1.0 to 32.0)

\* Significantly different from pre-training,  $P = 0.022$

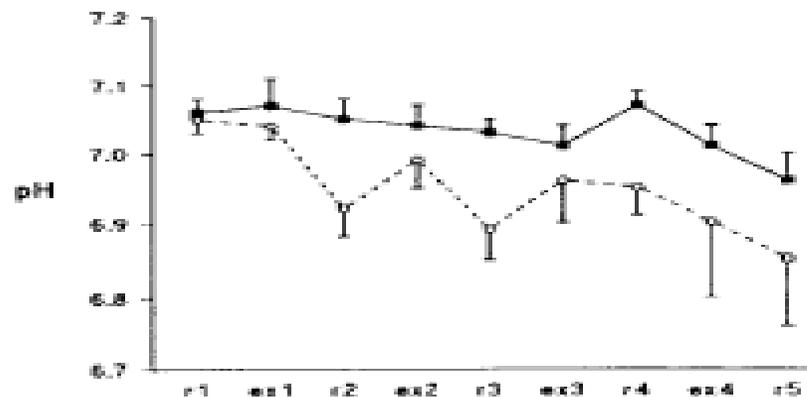
**Fosfato inorgânico**



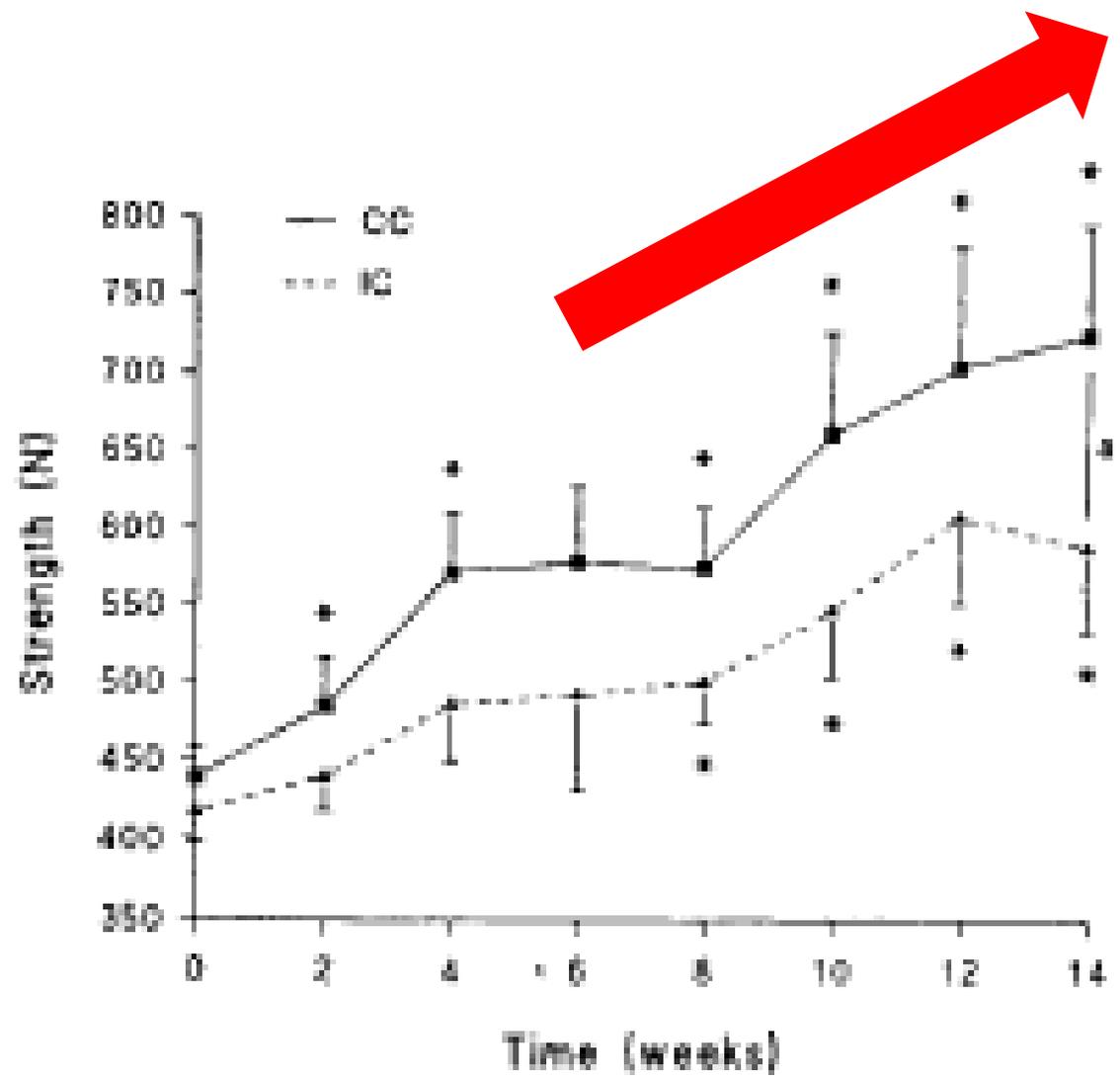
**Razão Pi/PCR**



**pH**



*Maiores alterações no protocolo com maior tempo sob tensão na série*



## Comprimento curto



65 - 30° KNEE FLEXION

## Comprimento longo

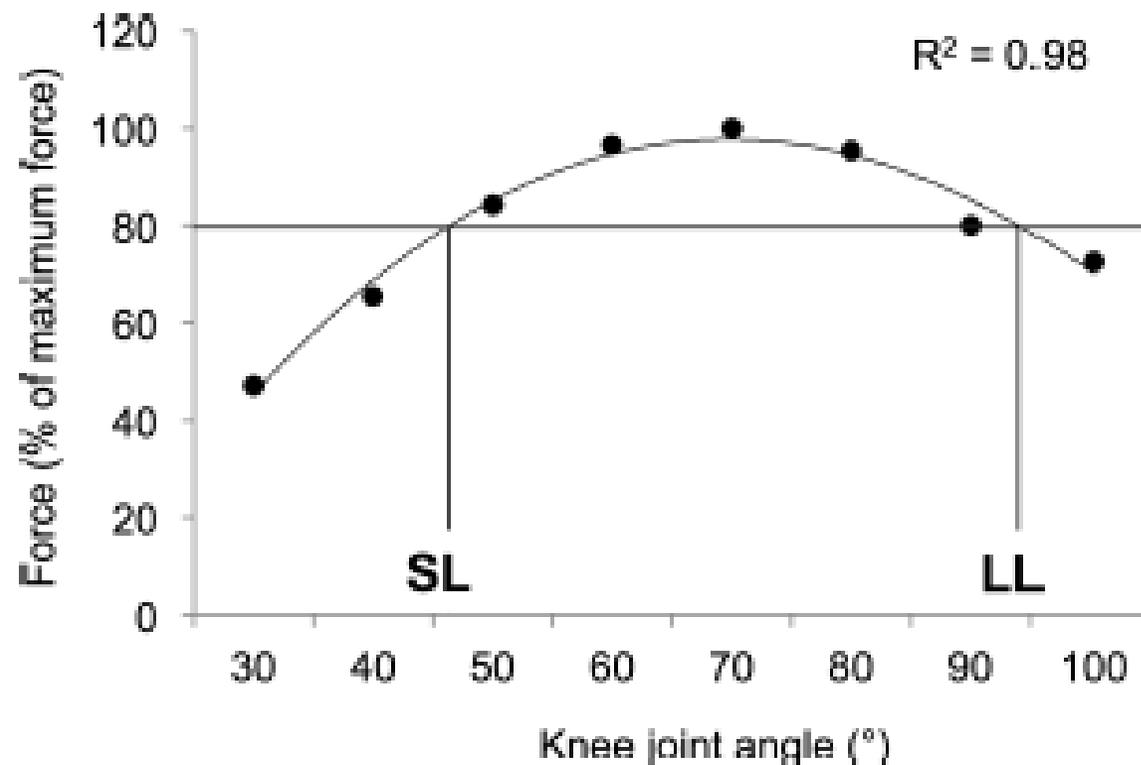


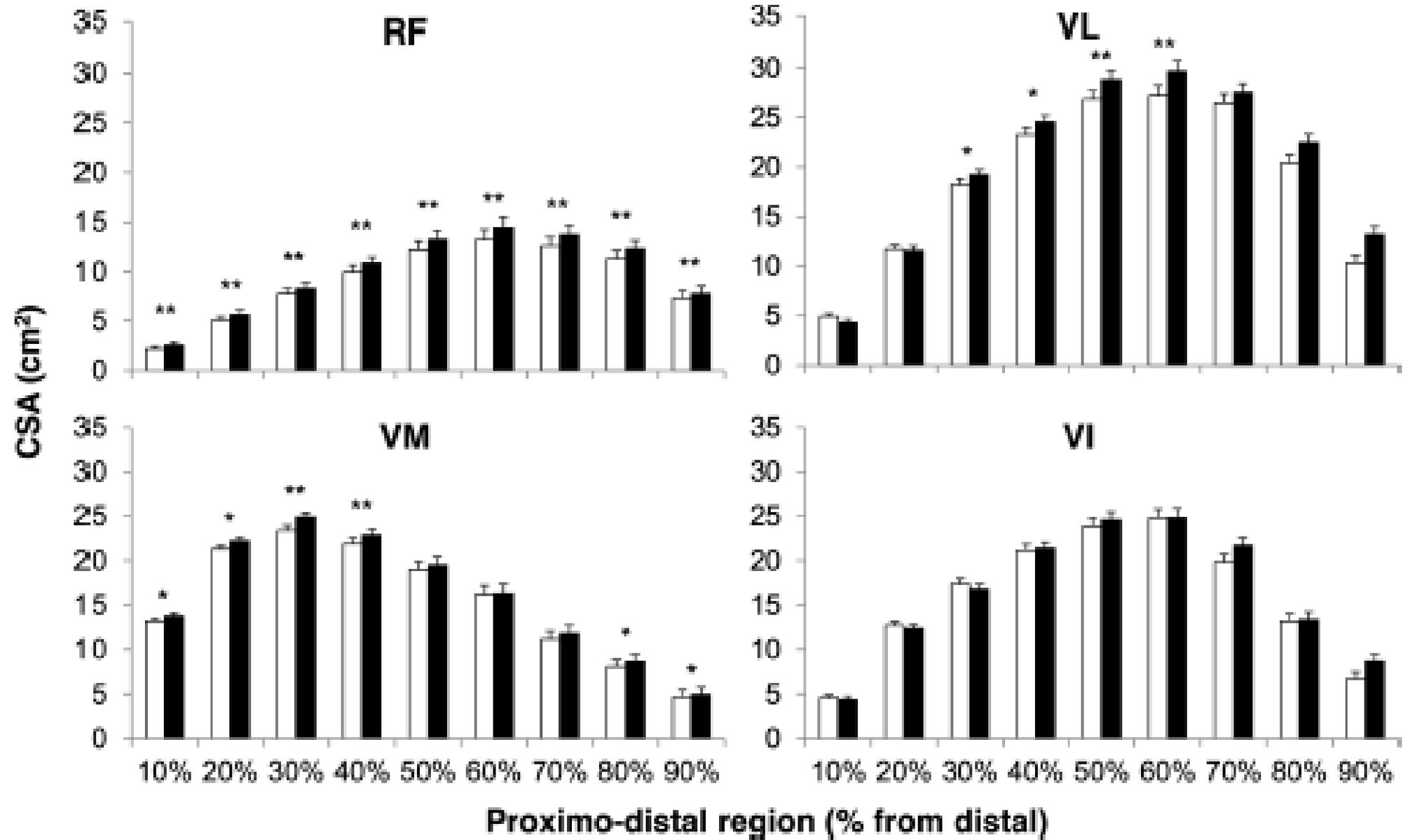
100 - 65° KNEE FLEXION

# Neuromuscular Adaptations Associated with Knee Joint Angle-Specific Force Change

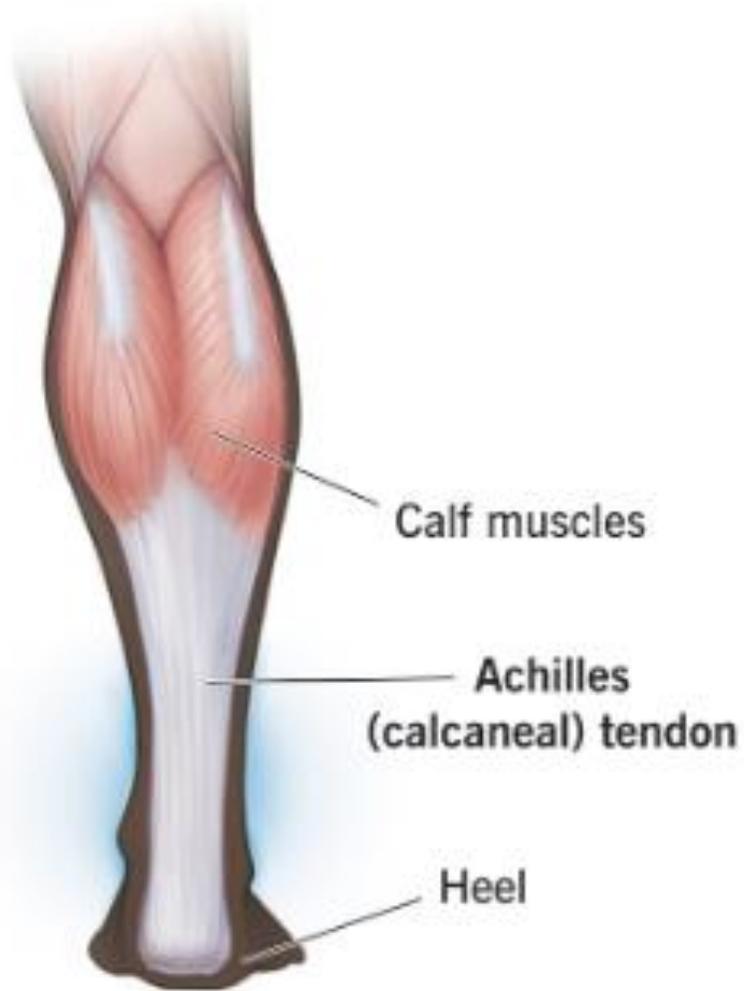
MARIKA NOORKÖIV, KAZUNORI NOSAKA, and ANTHONY J. BLAZEVIČH

*School of Exercise and Health Sciences, Centre for Exercise and Sports Science Research, Edith Cowan University, Joondalup, AUSTRALIA*





# Tendões



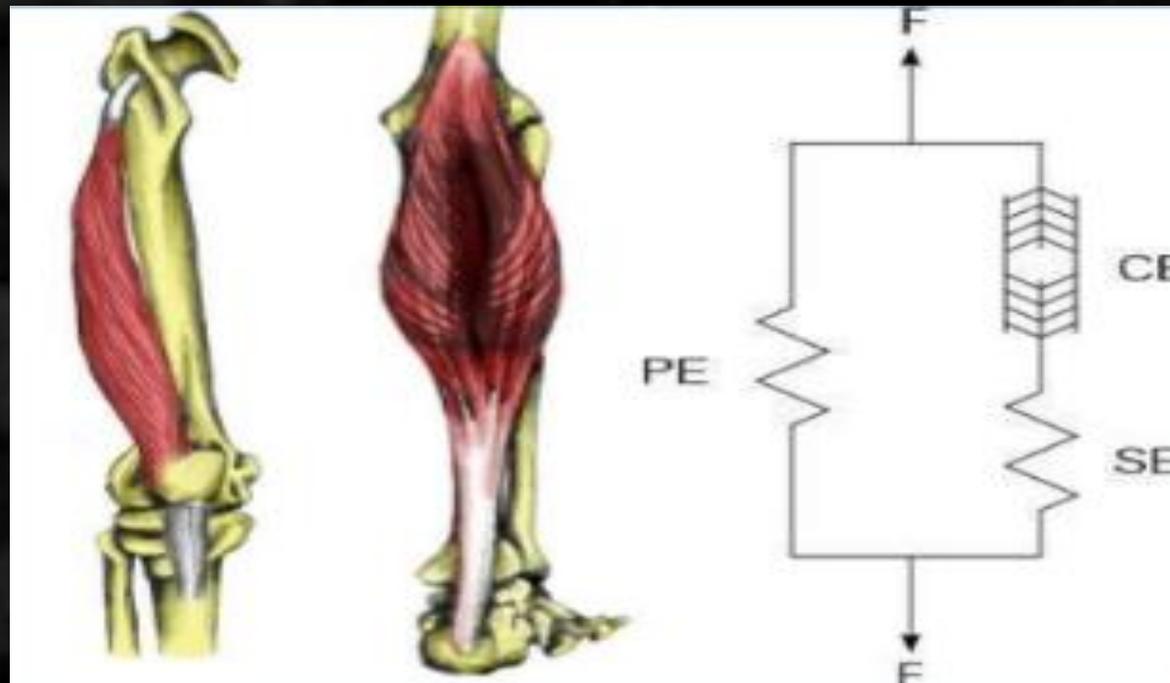
Aumento da espessura do  
tendão

Aumento da elasticidade

Aumento da rigidez

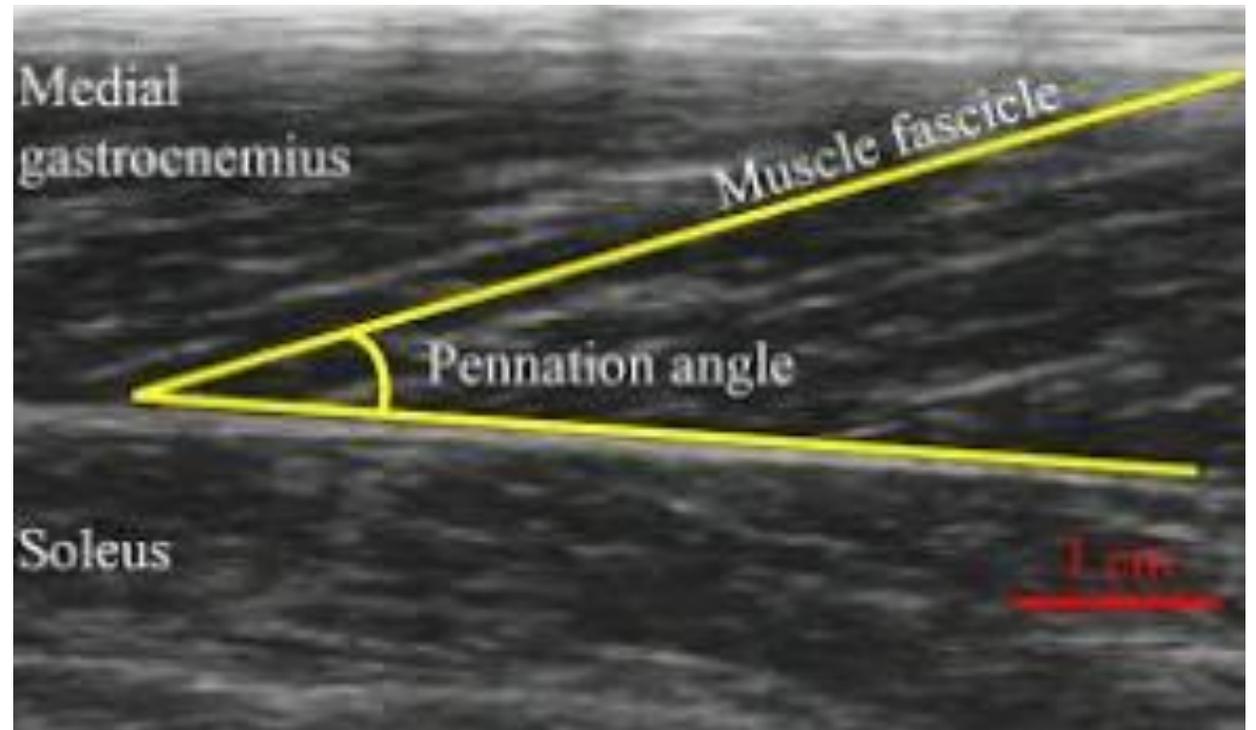
# Rigidez músculo-tendínea

- ✓ **Rigidez** – termo usado para explicar a resistência oposta a contração ou capacidade de deformar o seu tamanho original.



# Comprimento do fascículo

*O treinamento isométrico promove aumento do comprimento do fascículo especialmente em condições de comprimento alongado.*



# Treinamento excêntrico

## Concêntrica

- Momento de encurtamento muscular
- Diminuição do ângulo articular

## Isométrica

- Sem alteração do ângulo articular
- Produção de força variável

## Excêntrica

- Aumento do ângulo articular
- Mais ângulos, maior produção de força

***Fadiga muscular e sobrecarga no treinamento de força é determinada pela fase concêntrica***



## Treinamento excêntrico

- **Trabalhos acima da RM (110-140%)**
- **Controlar a descida (~5 seg) até que esse controle não seja possível**

DAVID HUDSON  
CONDITIONING



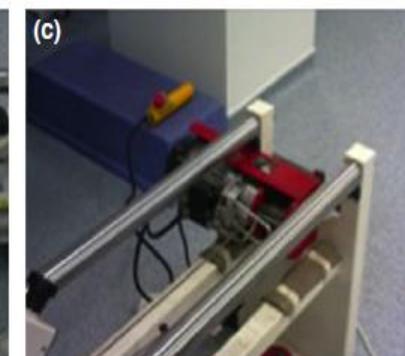
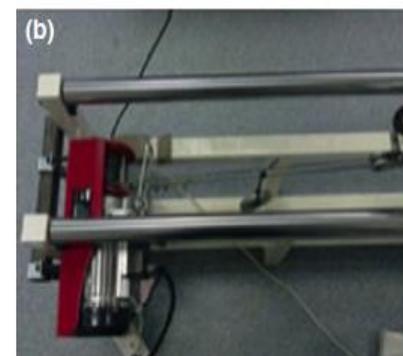
## Architectural, functional and molecular responses to concentric and eccentric loading in human skeletal muscle

M. V. Franchi,<sup>1,2</sup> P. J. Atherton,<sup>1</sup> N. D. Reeves,<sup>2</sup> M. Flück,<sup>3</sup> J. Williams,<sup>1</sup> W. K. Mitchell,<sup>1</sup> A. Selby,<sup>1</sup> R. M. Beltran Valls<sup>1</sup> and M. V. Narici<sup>1</sup>

- **Comparar o treinamento puramente concêntrico CON (n = 6) x puramente excêntrico ECC (n = 6) em 10 semanas de treinamento**

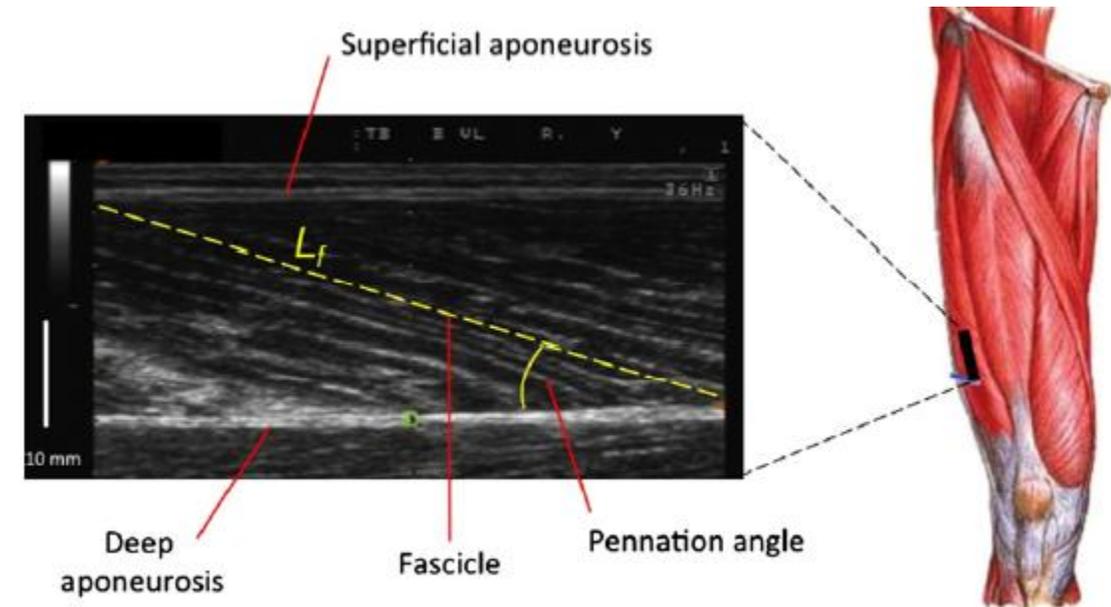
- **CON – 4 x 8 a 10 reps c/ 80% de 1 RM unil na fase concêntrica (tempo 3-0-2)**

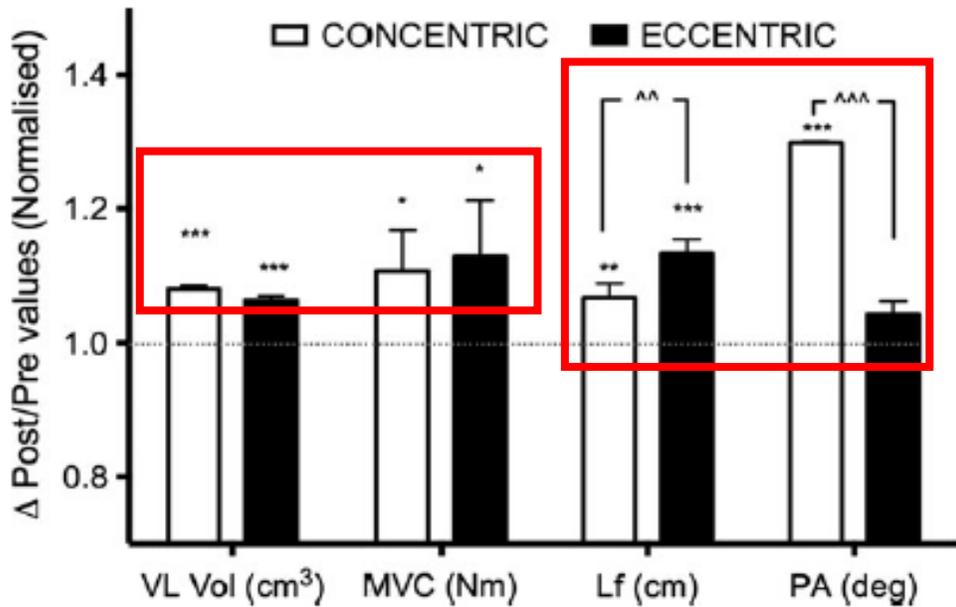
- **ECC – 4 x 8 a 10 reps c/ 80% de 1 RM unil na fase excêntrica (tempo 2-0-3)**



- **Força muscular – torque extensor isocinético em CVIM em diferentes angulações de joelho (90-150°)**
- **Drive neural do VL – RMS com EMG**
- **RMI – volume muscular e hipertrofia em diferentes regiões do VL (proximal, média e distal)**
- **Ultrassom – ângulo de penação e comprimento do fascículo**
- **Coleta aguda: sinalização molecular e marcadores inflamatórios a partir de biópsia**

**Figure 2** VL ultrasound image captured at rest: pennation angle and the visible part of a muscle fascicle is shown.





**Figure 3** Post-/Pre-training ratios of muscle volume, isometric MVC and muscle architecture in the concentric and eccentric exercise groups. Y = 1 represent the baseline value. Data normalized to pre-values; means  $\pm$  SEM (\* $P < 0.05$  \*\* $P < 0.001$  \*\*\* $P < 0.0001$  - ^^, ^^^ = significantly different between groups:  $P < 0.01$  and  $P < 0.001$ , respectively).

- O treinamento excêntrico gerou maior estresse mecânico (maior carga; maior VTT)
- *Aumento de volume e do drive neural semelhante com o treinamento, bem com CVM*

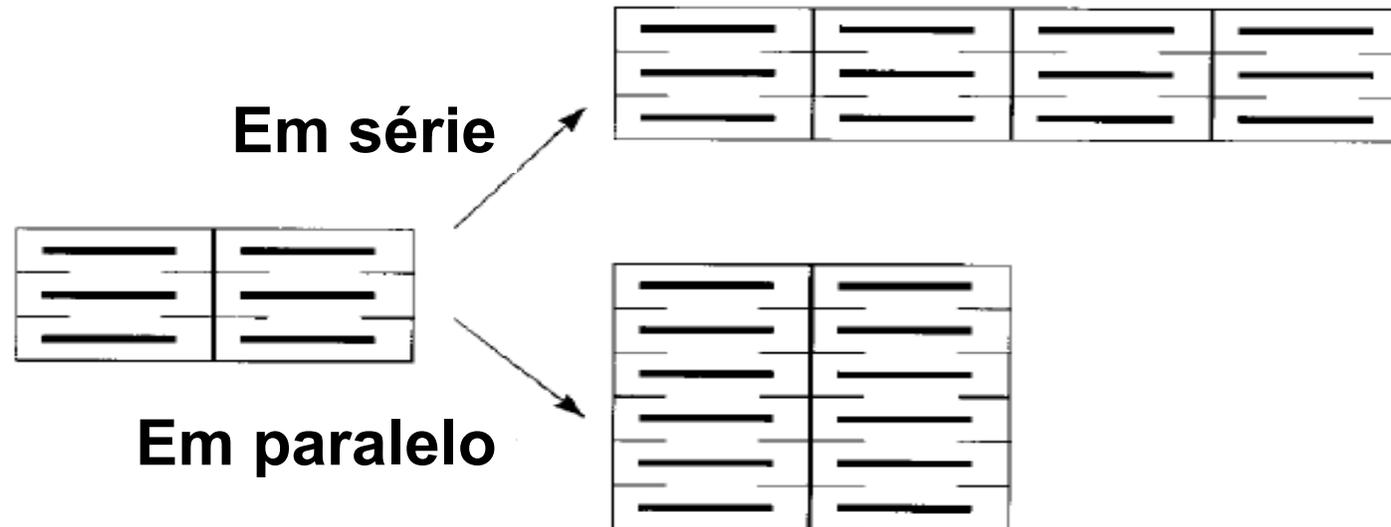
- *Aumento de Lf e PA em ambos os treinamentos, porém Lf > no treinamento ECC e PA > no treinamento CON.*

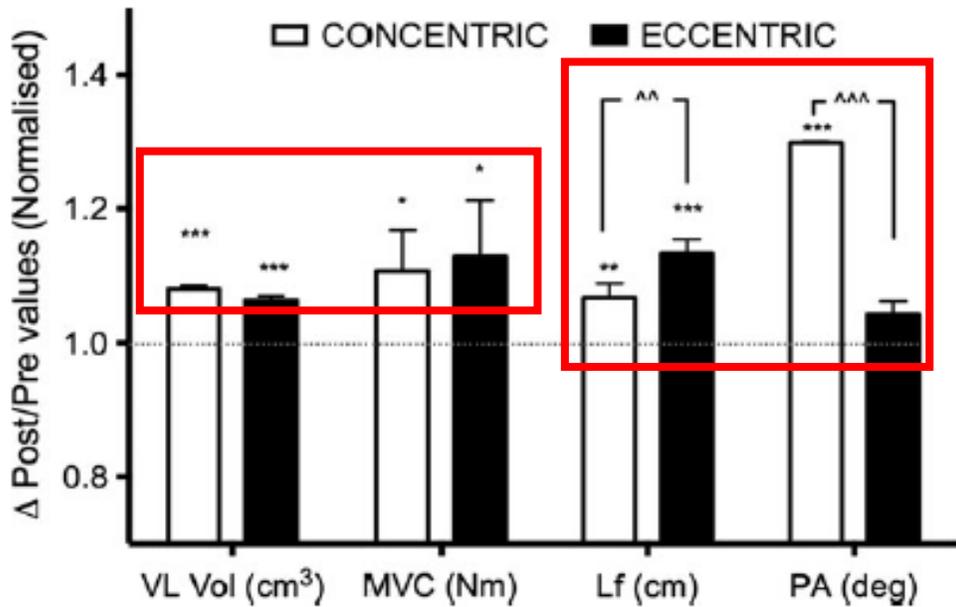
# Adição de sarcômeros em série e em paralelo

Form follows function: how muscle shape is regulated by work

*J. Appl. Physiol.*  
88: 1127–1132, 2000.

BRENDA RUSSELL, DELARA MOTLAGH, AND WILLIAM W. ASHLEY  
*Department of Physiology and Biophysics, College of Medicine,  
University of Illinois at Chicago, Chicago, Illinois 60612*

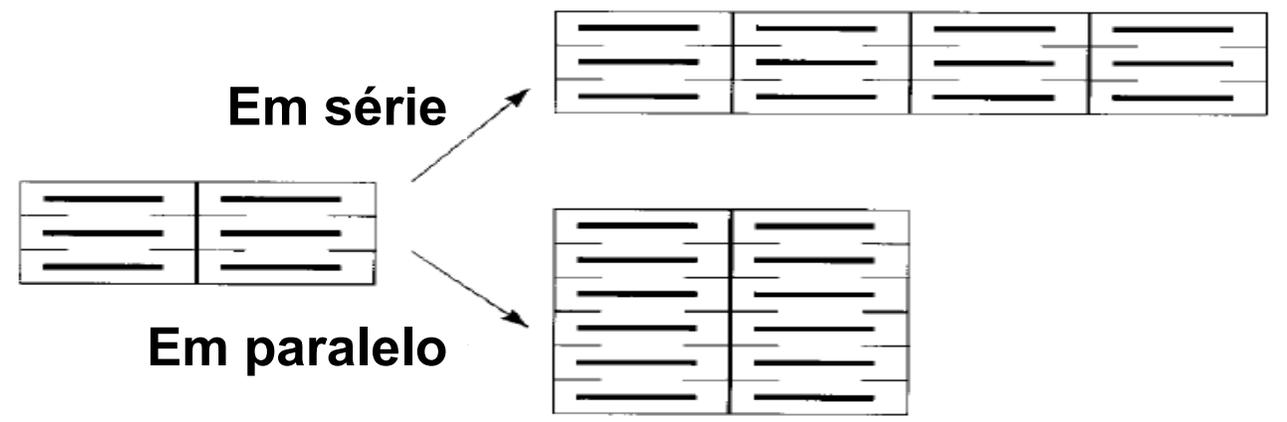




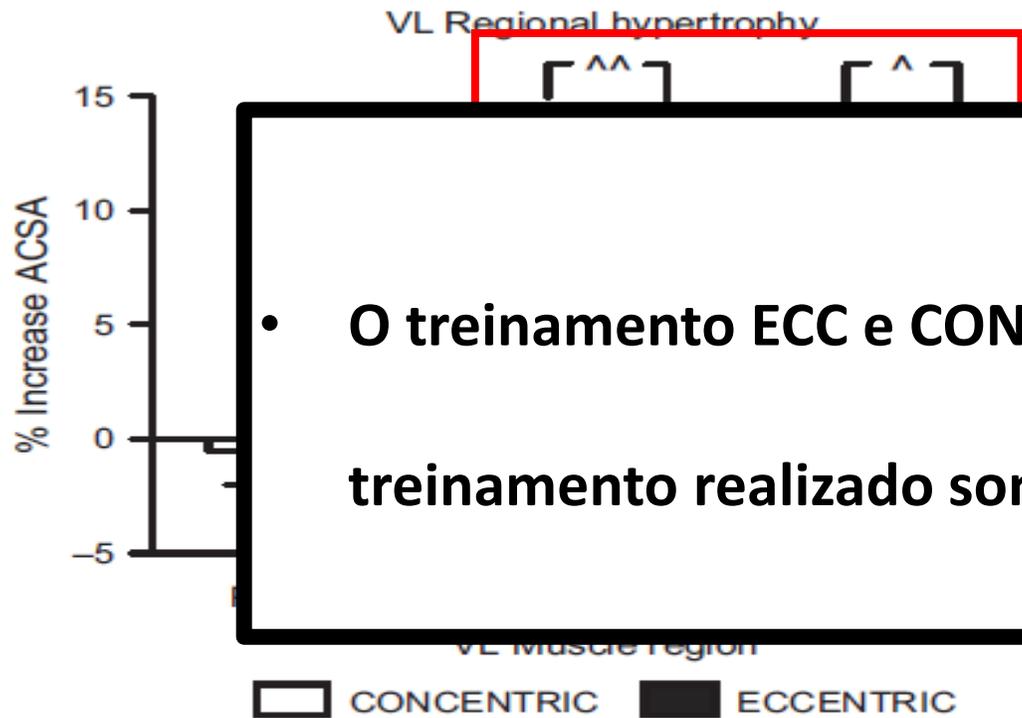
**Figure 3** Post-/Pre-training ratios of muscle volume, isometric MVC and muscle architecture in the concentric and eccentric exercise groups. Y = 1 represent the baseline value. Data normalized to pre-values; means  $\pm$  SEM (\* $P < 0.05$  \*\* $P < 0.001$  \*\*\* $P < 0.0001$  - ^^, ^^ = significantly different between groups:  $P < 0.01$  and  $P < 0.001$ , respectively).

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- Aumento de volume e do drive neural semelhante com o treinamento, bem com CVM

- Aumento de Lf e PA em ambos os treinamentos, porém Lf > no treinamento ECC e PA > no treinamento CON.



- Hipertrofia muscular em regiões distintas do quadríceps, com porção média > em CON e porção distal em ECC.*



- O treinamento ECC e CON geraram adaptações distintas com o treinamento realizado somente com cada fase

o com os

n marcadores

**Figure 4** Regional Hypertrophy of VL muscle (ACSA = Anatomical Cross-Sectional Area) after concentric and eccentric training. Data are means  $\pm$  SEM (\*\* $P < 0.01$  \*\*\* $P < 0.001$  - ^, ^^ = significantly different between groups:  $P < 0.05$ ,  $P < 0.01$ ).

# Adaptações morfológicas

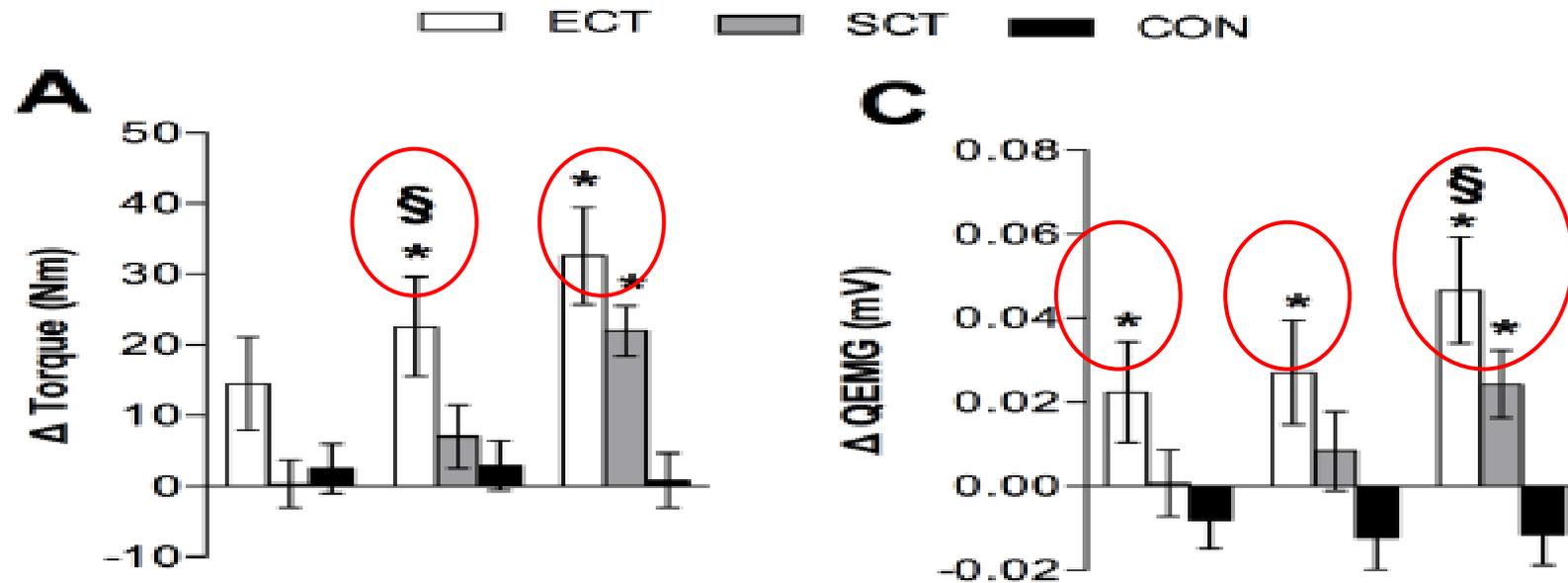
- ✓ *Treinamento em comprimento alongado*
- ✓ *70-75% da contração voluntária máxima*
- ✓ *Séries em torno de 30''*
- ✓ *Volume de 80-150'' por sessão*

**Title:**

TRAINING SPECIFIC FUNCTIONAL, NEURAL AND HYPERTROPHIC  
ADAPTATIONS TO EXPLOSIVE- VS. SUSTAINED-CONTRACTION STRENGTH  
TRAINING

**Authors:**

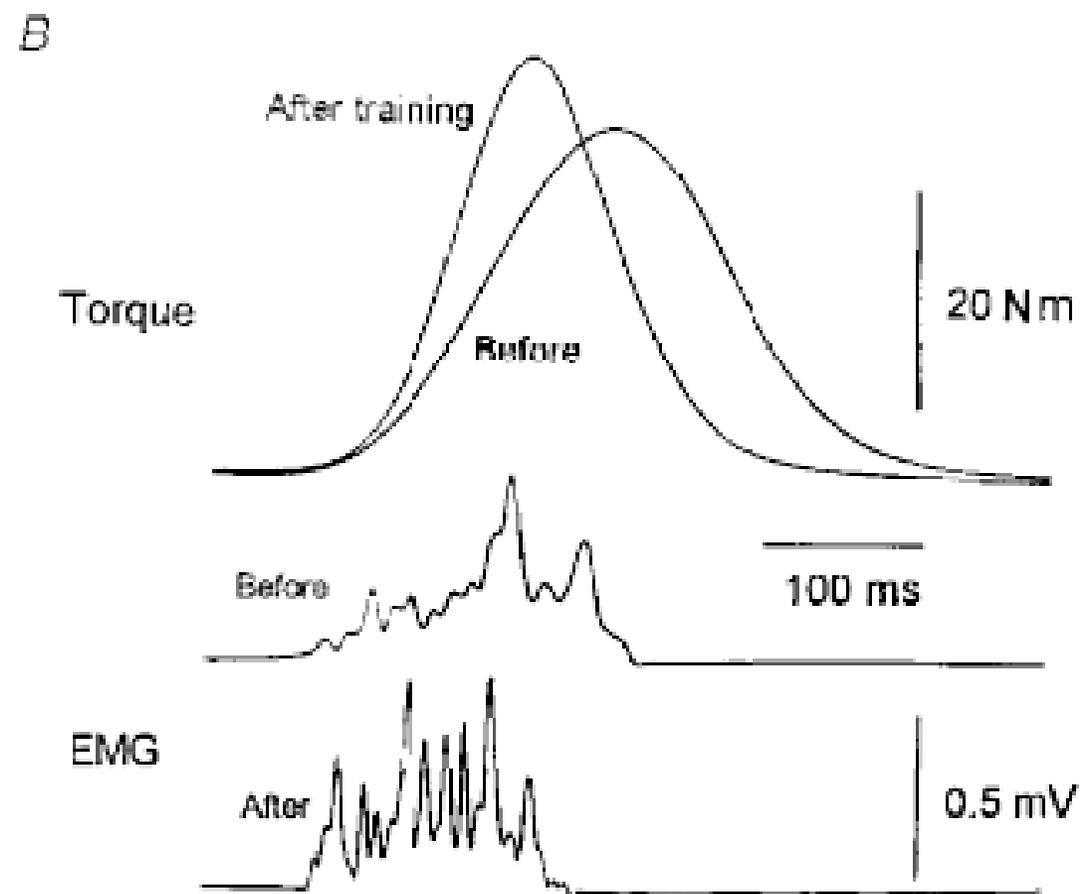
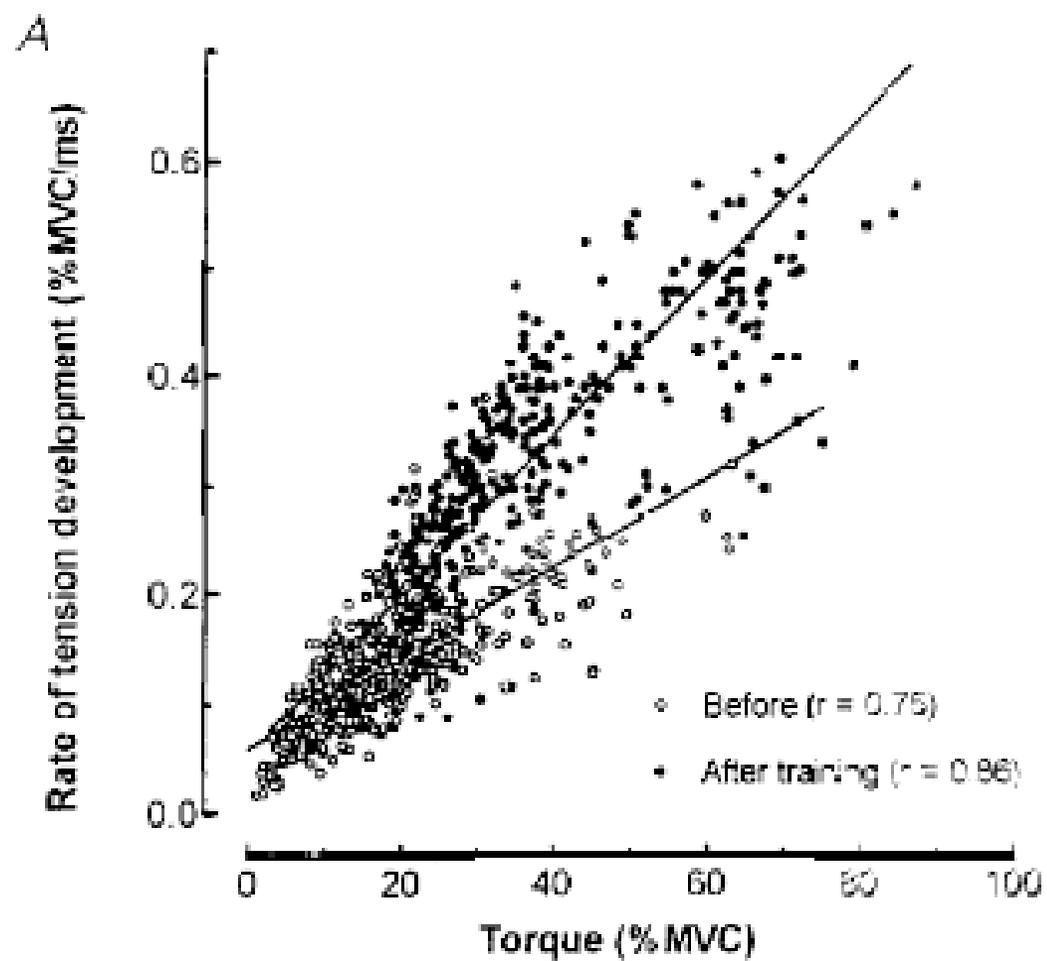
Thomas G. Balshaw<sup>1,2</sup>, Garry J. Massey<sup>1,2</sup>, Thomas M. Maden-Wilkinson<sup>2</sup>, Neale A. Tillin<sup>3</sup>,  
Jonathan P. Folland<sup>1,2</sup>



*Aumento no pico de torque em ambos os grupos*

	ECT		SCT		CON		ANCOVA interaction (P value)
	Pre	Post	Pre	Post	Pre	Post	
<b>Absolute (Nm):</b>							
MVT	232 ± 27	272 ± 37***	239 ± 48	295 ± 46***	257 ± 49	259 ± 57	<0.001
T <sub>50</sub>	43 ± 20	57 ± 23 <sup>±</sup>	47 ± 21	47 ± 19	39 ± 19	42 ± 19	0.058
T <sub>100</sub>	132 ± 25	155 ± 29**	138 ± 28	145 ± 22	138 ± 26	141 ± 27	0.036
T <sub>150</sub>	177 ± 27	210 ± 35***	182 ± 34	204 ± 25***	192 ± 31	193 ± 35	<0.001

*Aumento no TDT 50-100 ms apenas em intenção balística*



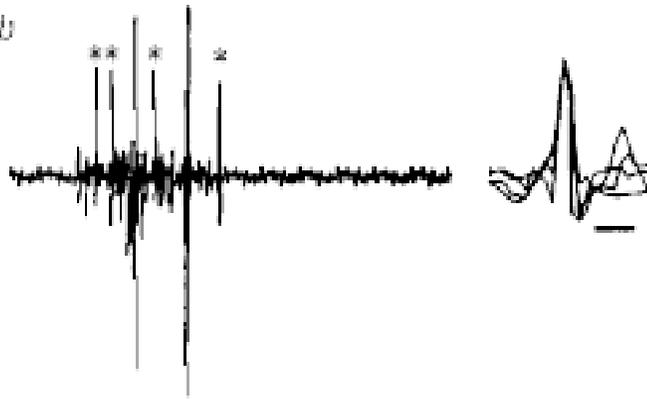
A<sub>a</sub>



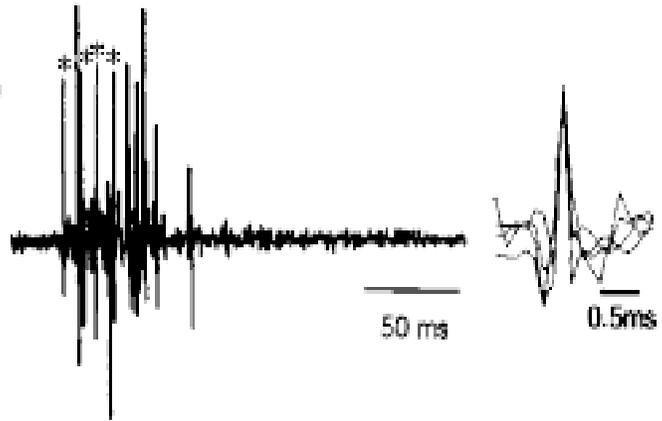
B<sub>a</sub>



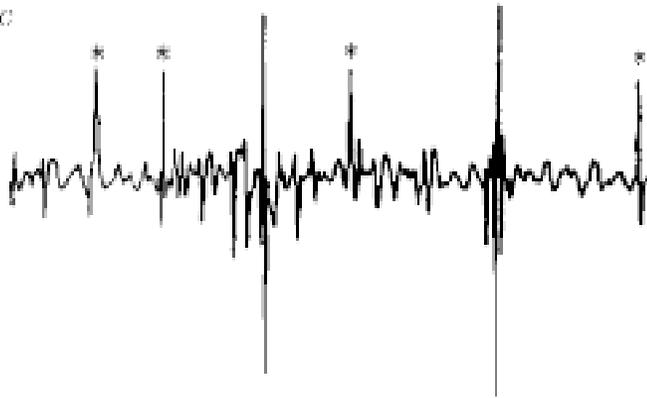
b



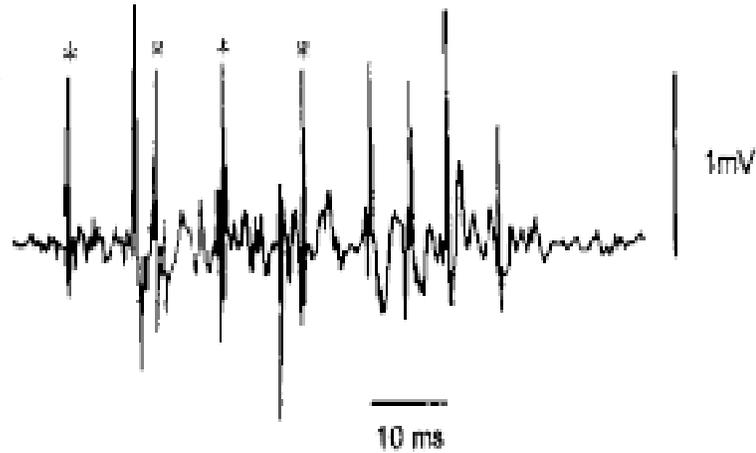
b



c



c

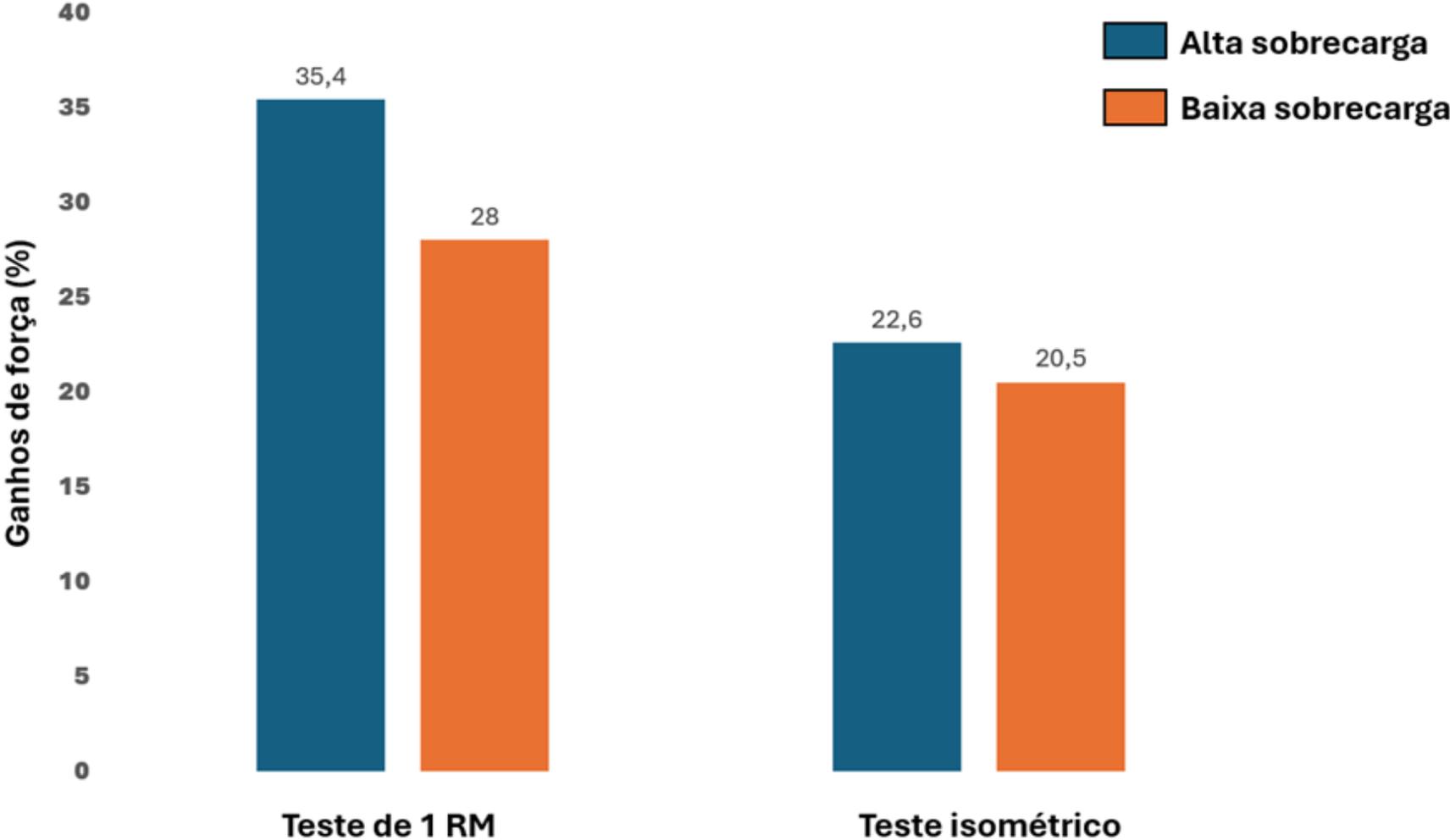


## Disparos duplos

*Presença de interspike  
com intervalos  $\leq 5$  ms*

# STRENGTH AND HYPERTROPHY ADAPTATIONS BETWEEN LOW- vs. HIGH-LOAD RESISTANCE TRAINING: A SYSTEMATIC REVIEW AND META-ANALYSIS

BRAD J. SCHOENFELD,<sup>1</sup> JOZO GRGIC,<sup>2</sup> DAN OGBORN,<sup>3</sup> AND JAMES W. KRIEGER<sup>4</sup>



# Adaptações de força e potência

- ✓ *80-100% da contração voluntária máxima; 1-5 segundos de sustentação e 30-90 segundos por sessão;*
- ✓ *Para potência, realizar o movimento com intenção balística (atingir o contração voluntária máxima o mais rápido possível);*
- ✓ *As adaptações são ângulo dependentes;*
- ✓ *A transferência para ações dinâmicas ainda necessitam de estudos.*

Isometria de  
sustentação  
(yielding/holding)

Isometria  
intenção máxima  
(pushing)

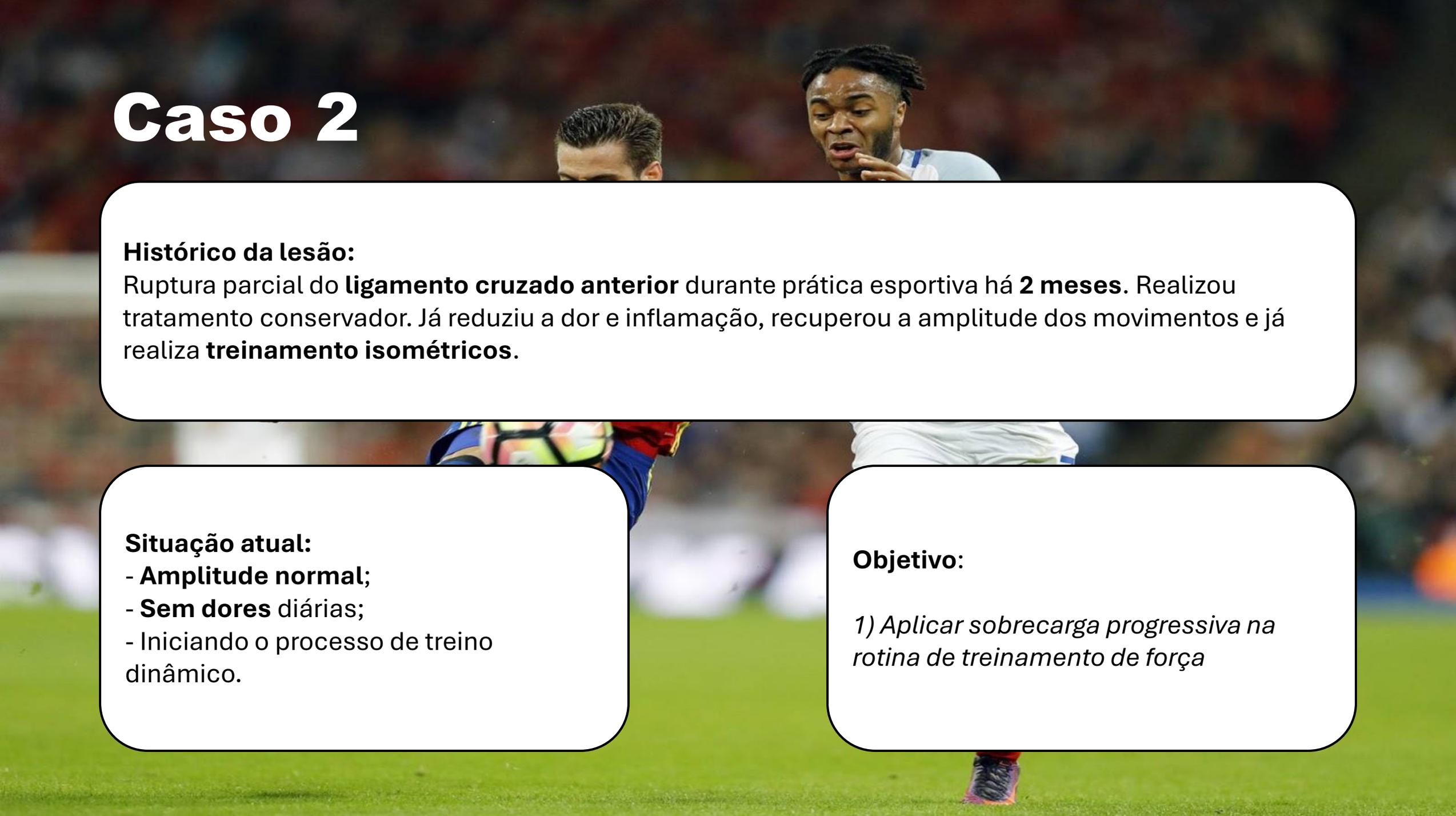
Isometria de  
sustentação  
(yielding/holding)  
– mais intenso

Isometria  
intenção máxima  
(pushing) – mais  
intenso

Exercícios	Prescrição	Vídeos
Isometria de Tornozelo Joelho Flexionado	2-4 séries / 20-40” / PC / Amplitude máxima	<a href="https://www.youtube.com/shorts/A-DdGxa5eBQ">https://www.youtube.com/shorts/A-DdGxa5eBQ</a>
Isometria de Tornozelo Joelho Estendido	2-4 séries / 20-40” / PC / Amplitude máxima	<a href="https://www.youtube.com/shorts/qT5lqT-d5lc">https://www.youtube.com/shorts/qT5lqT-d5lc</a>
Isometria de Tornozelo Joelho Flexionado	2-3 séries / 6-10” / Intenção submáxima	<ul style="list-style-type: none"> <li data-bbox="1671 711 2400 811">• <a href="https://www.youtube.com/shorts/lBi8iPWL-lo">https://www.youtube.com/shorts/lBi8iPWL-lo</a></li> </ul>
Isometria de Tornozelo Joelho Estendido	2-3 séries / 6-10” / Intenção submáxima	<ul style="list-style-type: none"> <li data-bbox="1671 901 2400 1001">• <a href="https://www.youtube.com/watch?v=oAn7lxbQ4sl">https://www.youtube.com/watch?v=oAn7lxbQ4sl</a></li> </ul>
Isometria de Tornozelo Joelho Estendido (diferente plano)	2-3 séries / 6-10” / Intenção submáxima	<ul style="list-style-type: none"> <li data-bbox="1671 1090 2400 1190">• <a href="https://www.youtube.com/shorts/9QgfBL5CM1l">https://www.youtube.com/shorts/9QgfBL5CM1l</a></li> </ul>

Exercícios	Prescrição	Vídeos
Isometria de Tornozelo Joelho Flexionado com carga	3-6 séries / 10-30” / PC / Amplitude máxima	<a href="https://www.youtube.com/shorts/kq0Cbw2BA50">https://www.youtube.com/shorts/kq0Cbw2BA50</a>
Isometria de Tornozelo Joelho Estendido com carga	3-6 séries / 10-30” / PC / Amplitude máxima	<a href="https://www.youtube.com/shorts/M8OkXQ_5W7g">https://www.youtube.com/shorts/M8OkXQ_5W7g</a>
Isometria com perturbações	3-6 séries / 10-30” / PC / Amplitude máxima	<a href="https://www.tiktok.com/@niklas.sportphysio/video/7520984728376200480">https://www.tiktok.com/@niklas.sportphysio/video/7520984728376200480</a>
Isometria de Tornozelo Joelho Flexionado	2-3 séries / 2-5” / Intenção máxima	<ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/shorts/lBi8iPWL-lo">https://www.youtube.com/shorts/lBi8iPWL-lo</a></li> </ul>
Isometria de Tornozelo Joelho Estendido	2-3 séries / 2-5” / Intenção máxima	<ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=oAn7lxbQ4sl">https://www.youtube.com/watch?v=oAn7lxbQ4sl</a></li> </ul>
Isometria de Tornozelo Joelho Reativo	2-3 séries / 2-5” / Intenção máxima	<ul style="list-style-type: none"> <li>• <a href="https://www.youtube.com/watch?v=7J-BgFYw-xl">https://www.youtube.com/watch?v=7J-BgFYw-xl</a></li> </ul>

# Caso 2



## Histórico da lesão:

Ruptura parcial do **ligamento cruzado anterior** durante prática esportiva há **2 meses**. Realizou tratamento conservador. Já reduziu a dor e inflamação, recuperou a amplitude dos movimentos e já realiza **treinamento isométricos**.

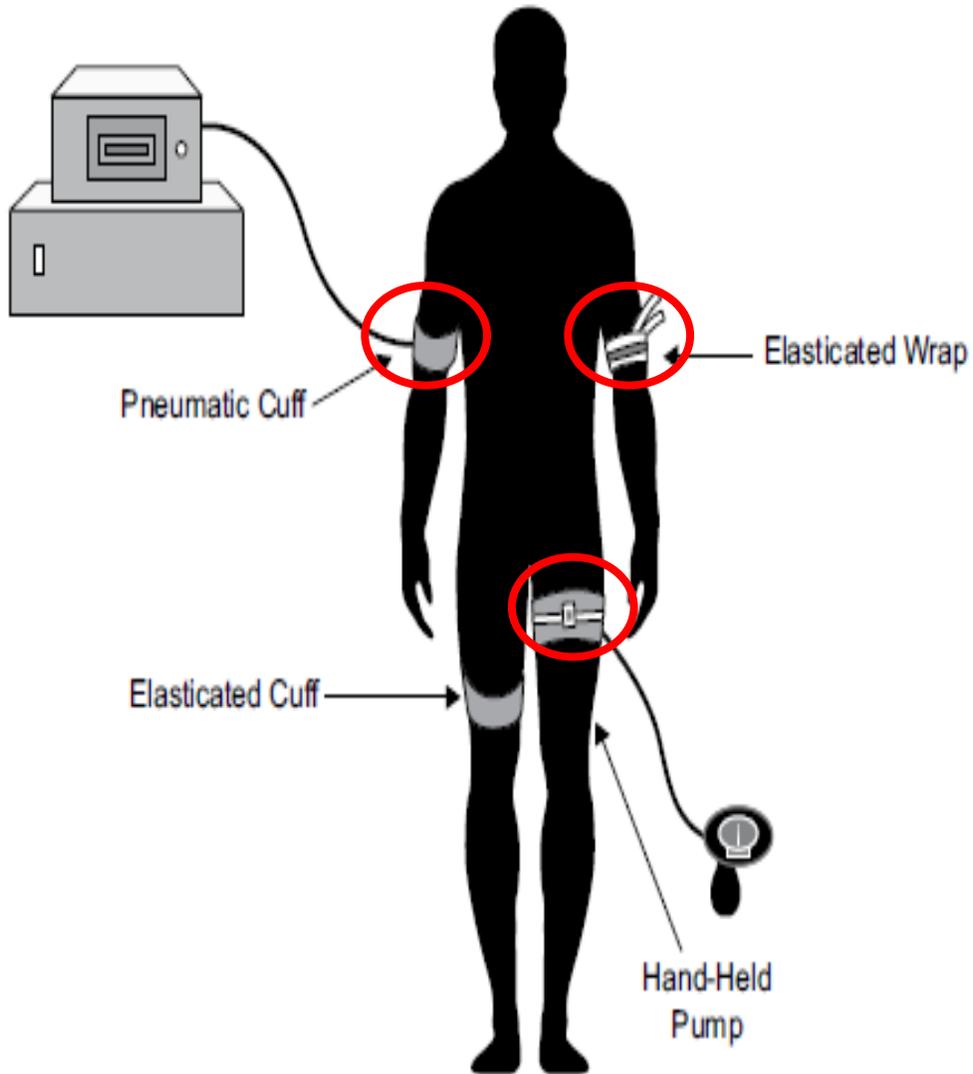
## Situação atual:

- **Amplitude normal;**
- **Sem dores** diárias;
- Iniciando o processo de treino dinâmico.

## Objetivo:

- 1) *Aplicar sobrecarga progressiva na rotina de treinamento de força*

# Treinamento com Restrição de Fluxo



Treinamento que **combina a restrição do fluxo sanguíneo**, usando principalmente manguitos ou fitas elásticas, e **baixas sobrecargas** nos exercícios

- Ganhou popularidade como kaatsu training
- Utilização dos manguitos em regiões próximas
- Visa obstruir a circulação venosa

# Treinamento com Restrição de Fluxo



**Fluxo preservado**



**Fluxo venoso restrito**



**Fluxo venoso e arterial restrito**

**Figure 1.** Viewing criteria of no restriction (A), vascular restriction (B), and complete arterial and vascular restriction (C).

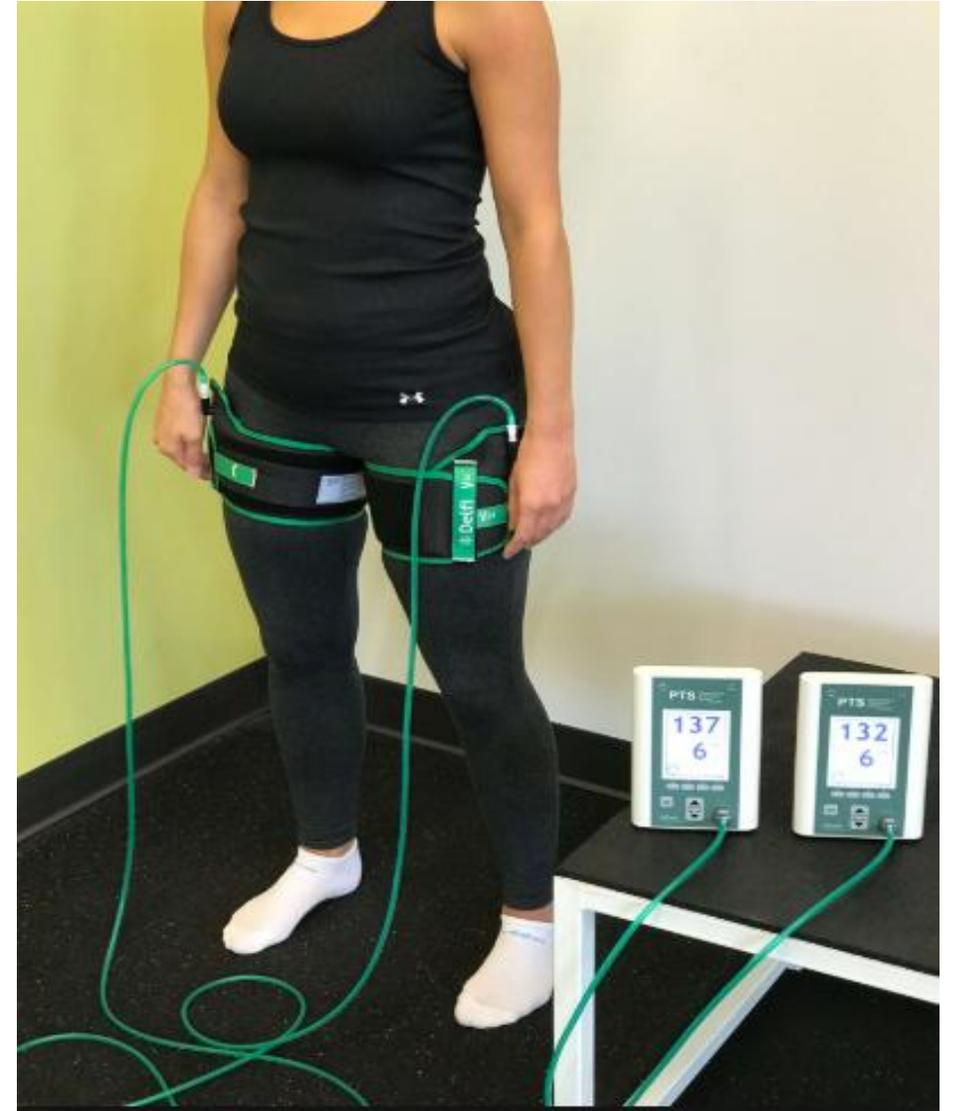
# Treinamento com Restrição de Fluxo

## Métodos de determinação do fluxo

- Valores fixos para todos os participantes
- Valores como referência a PAS
- Individualização dos valores
- Modelos aplicados na prática
  - Escala de percepção de dor
  - Fluxo radial e na região posterior do joelho

# Treinamento com Restrição de Fluxo

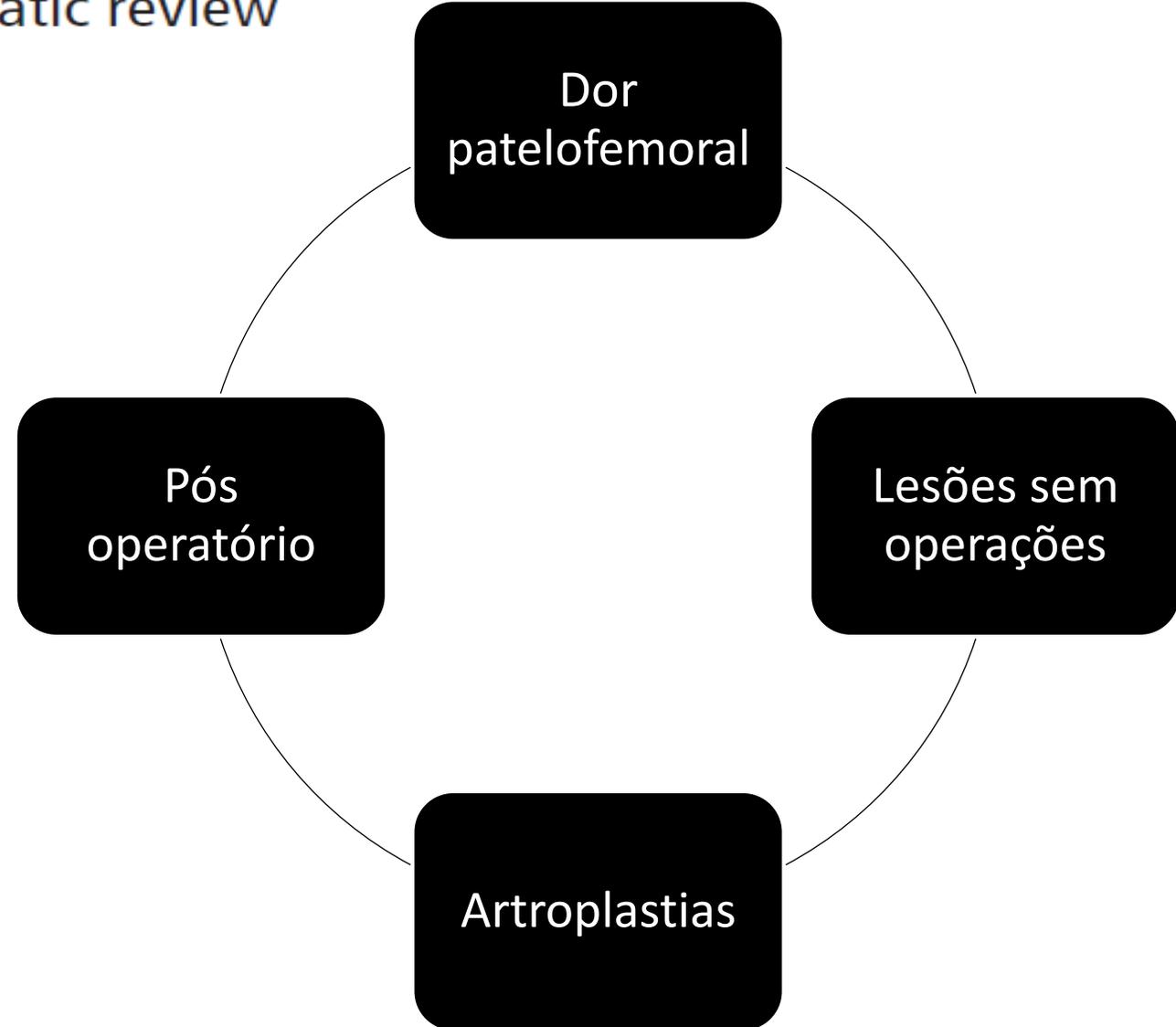
- Espessura do manguito
  - Valores variam entre 3-18 cm
  - Estudos indicam que quanto menor o manguito, maior deve ser a pressão
- Material
  - Nylon e elásticos mais comuns
- Características individuais
  - Circunferência de membros



# Blood flow restriction training in clinical musculoskeletal rehabilitation: a systematic review and meta-analysis

Luke Hughes,<sup>1</sup> Bruce Paton,<sup>2</sup> Ben Rosenblatt,<sup>3</sup> Conor Gissane,<sup>1</sup> Stephen David Patterson<sup>1</sup>

- Atenua a perda de força
- Mantém aspectos fisiológicos e a massa muscular
- Tempo de recuperação? Sensação de dor?



Exercícios	Vídeos	Prescrição
Flexão de Quadril Perna Estendida	<a href="https://www.youtube.com/shorts/khnALX2LAOs">https://www.youtube.com/shorts/khnALX2LAOs</a>	<ul style="list-style-type: none"> <li>• 80% da pressão máxima de oclusão</li> <li>• 20-30% de 1 RM (PSE 7-8)</li> <li>• 30/15/15/15 repetições</li> <li>• 30-seg intervalo entre séries</li> <li>• 2-3 vezes por semana</li> <li>• 8-12 semanas</li> </ul>
Isometria Squat	<a href="https://www.youtube.com/shorts/fMwiX1mIQu8">https://www.youtube.com/shorts/fMwiX1mIQu8</a>	
Squat	<a href="https://www.youtube.com/shorts/Q0fTjfe9Z6s">https://www.youtube.com/shorts/Q0fTjfe9Z6s</a>	
Extensão isolada de joelho	<a href="https://www.youtube.com/shorts/5RryKw6IJbQ">https://www.youtube.com/shorts/5RryKw6IJbQ</a>	
Lateral Step Down	<a href="https://www.youtube.com/shorts/OZYpyRL288o">https://www.youtube.com/shorts/OZYpyRL288o</a>	
Side Lying Abd de Quadril	<a href="https://www.youtube.com/shorts/fN98Kc71vd4">https://www.youtube.com/shorts/fN98Kc71vd4</a>	

# **Magnitude of Muscle Strength and Mass Adaptations Between High-Load Resistance Training Versus Low-Load Resistance Training Associated with Blood-Flow Restriction: A Systematic Review and Meta-Analysis**

Sports Med

DOI 10.1007/s40279-017-0795-y

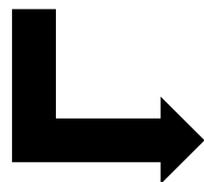
Published online: 17 October 2017

Manoel E. Lixandrão<sup>1</sup> · Carlos Ugrinowitsch<sup>1</sup> · Ricardo Berton<sup>1</sup> · Felipe C. Vechin<sup>1</sup> · Miguel S. Conceição<sup>1</sup> · Felipe Damas<sup>1</sup> · Cleiton A. Libardi<sup>2</sup> · Hamilton Roschel<sup>1</sup>

- **Treinamento de força de alta intensidade (>65% de 1 RM) superior na força em comparação ao treinamento de oclusão (< 50% de 1 RM)**

- **Para hipertrofia, a resposta é semelhante entre as duas estratégias.**

- **Para força muscular, a preferência é o treinamento com maiores sobrecargas**



- **Considerações do método, como pressão, tipo de manguito, não influenciaram nas adaptações**

## Tradicional

10 reps

10 reps

10 reps

## Decrescente

6 reps

8 reps

10 reps

## Crescente

10 reps

8 reps

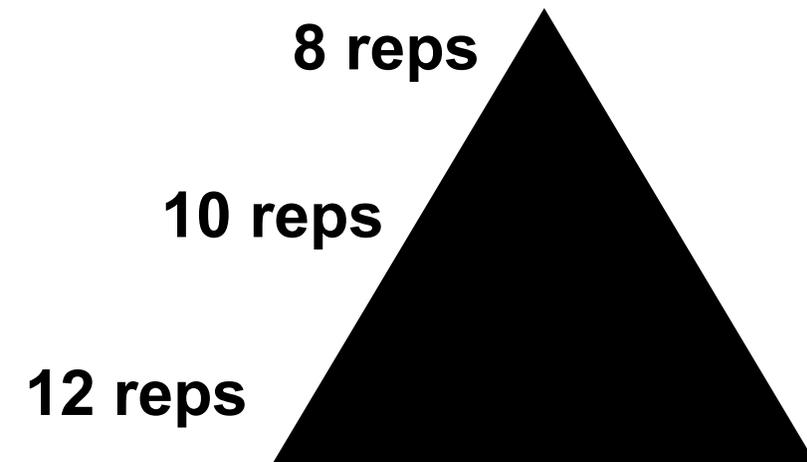
6 reps

# EFFECTS OF DIFFERENT RESISTANCE TRAINING SYSTEMS ON MUSCULAR STRENGTH AND HYPERTROPHY IN RESISTANCE-TRAINED OLDER WOMEN

ALEX S. RIBEIRO,<sup>1</sup> ANDREO F. AGUIAR,<sup>1</sup> BRAD J. SCHOENFELD,<sup>2</sup> JOÃO P. NUNES,<sup>3</sup>  
EDILAINÉ F. CAVALCANTE,<sup>3</sup> EDUARDO L. CADORE,<sup>4</sup> AND EDILSON S. CYRINO<sup>2</sup>

32(2)/545-553

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- **Tradicional – 3 séries de 8 a 12 repetições / 2 min int entre séries / 3 min entre exercícios**
- **Supino reto, leg hor, remada, rosca bíceps, cad flexora, cadeira extensora, rosca tríceps e flexão plantar.**

• **Aumento de força semelhante entre grupos**

**TABLE 4.** Muscular strength and body composition outcomes in older women at pretraining and posttraining according to resistance training system.\*†

	Constant (n = 16)		Pyramid (n = 17)		Between		
<b>Muscular strength</b>							
Chest press (kg)							
Knee extension (kg)							
Preacher curl (kg)							
Total strength (kg)							
<b>Body composition</b>							
Skeletal muscle mass (kg)							
Upper limb LST (kg)							
Lower limb LST (kg)							
Trunk LST (kg)							
Body fat (%)							
Total body water (L)							
Intracellular water (L)							
Extracellular water (L)	13.8 ± 1.9	13.7 ± 2.1	-0.7	13.4 ± 2.3	13.6 ± 2.2	1.5	0.14
ICW/SMM	0.81 ± 0.09	0.82 ± 0.10	1.2	0.83 ± 0.11	0.84 ± 0.10	1.2	0.67

• **O treinamento em pirâmide e tradicional geraram adaptações semelhantes entre os grupos**

**massa magra semelhante entre grupos**

\*LST = lean soft tissue; ICW/SMM = ratio between intracellular water and skeletal muscle mass.  
 †Data are expressed as mean and SD.  
 ‡p ≤ 0.05 vs. week 1.

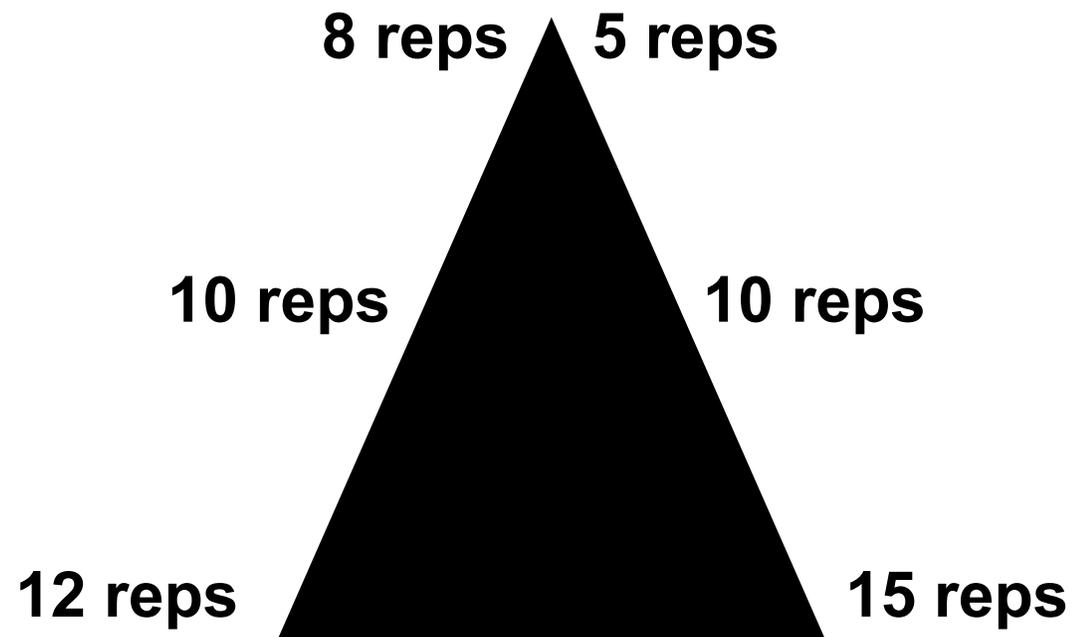
## Effects of Modified Pyramid System on Muscular Strength and Hypertrophy in Older Women

### Authors

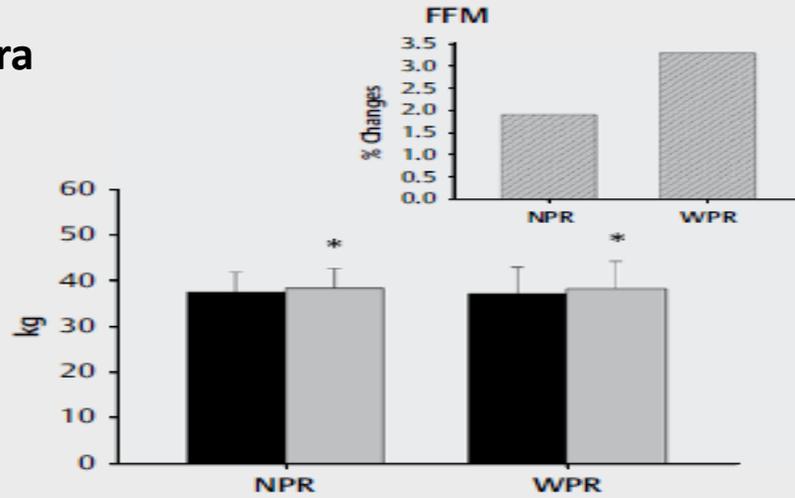
Leandro dos Santos<sup>1</sup>, Alex S. Ribeiro<sup>2</sup>, Edilaine F. Cavalcante<sup>1</sup>, Hellen C. Nabuco<sup>1</sup>, Melissa Antunes<sup>1</sup>, Brad J. Schoenfeld<sup>3</sup>, Edilson S. Cyrino<sup>1</sup>

**Pequena variação (n = 20)**

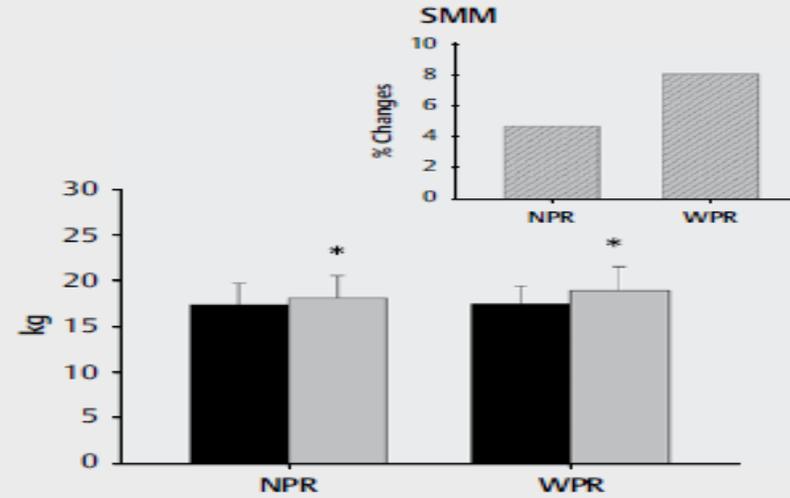
**Grande variação (n = 19)**



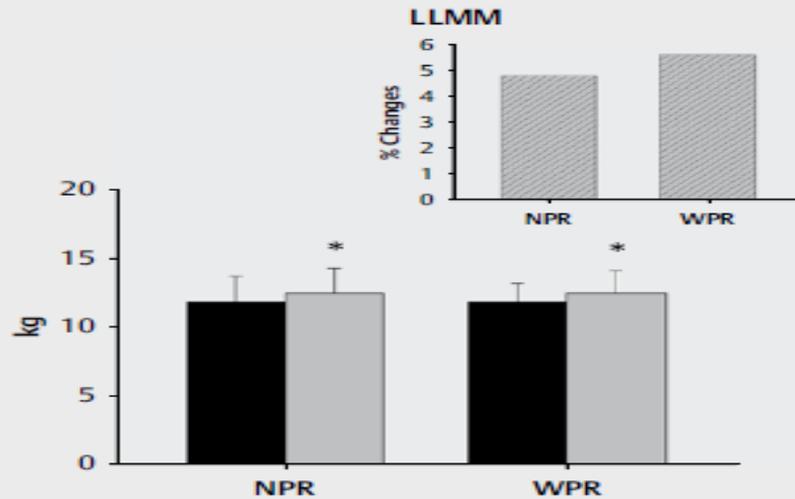
Massa magra



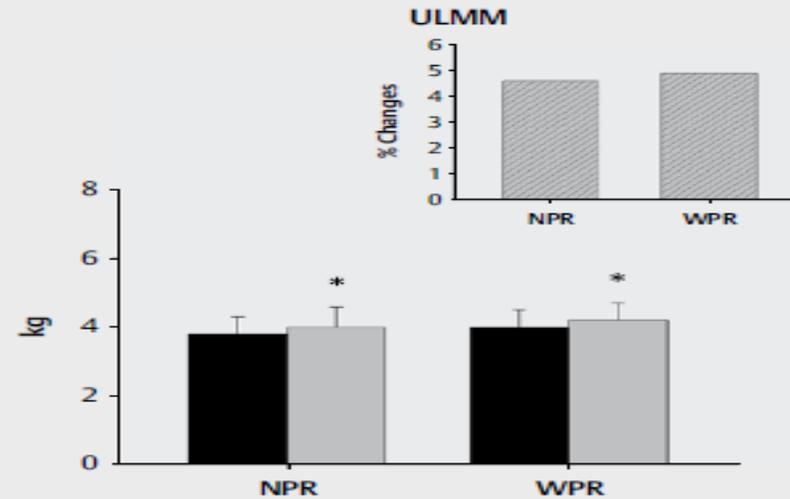
Massa muscular



MMII



MMSS



■ Pre □ Post

► **Fig. 1** Pre- to post-training scores and percentage changes of fat-free mass (FFM), skeletal muscle mass (SMM), lower limb muscle mass (LLMM), and upper limb muscle mass (ULMM) by group (NPR, narrow zone repetition, and WPR, wide zone of repetition). There were no significant group vs. time interactions for any variables ( $P > 0.05$ ). \*  $P < 0.05$  vs. pre-training.

Chest Press

% Changes



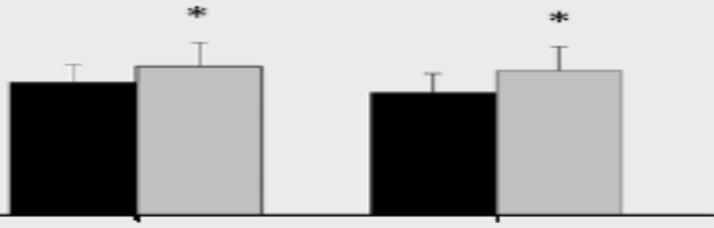
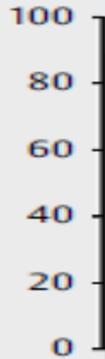
Knee Extension

% Changes



• *Os diferentes modelos de treinamento em pirâmide proporcionaram adaptações similares*

kg

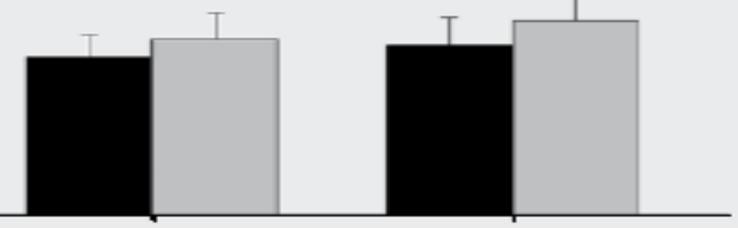


NPR

WPR

■ Pre □ Post

kg



NPR

WPR



**Diferentes  
configurações de  
treinamento**

Configurações de carga e repetições na sessão	Treino
<b>Carga:Repetição fixa</b>	<ul style="list-style-type: none"> <li>• <b>5 x 5 reps @ 75% 1 RM</b></li> <li>• <b>5 x 4-6 reps @ 75% 1 RM</b></li> </ul>
<b>Pirâmide Crescente Original</b>	<ul style="list-style-type: none"> <li>• <b>1 x 10 @ 70%; 1 x 8 @ 75%; 1 x 6 @ 80%; 1 x 8 @ 75%; 1 x 10 @ 70%</b></li> <li>• <b>1 x 10-12 @ 70%; 1 x 8-10 @ 75%; 1 x 6-8 @ 80%; 1 x 8-10 @ 75%; 1 x 10-12 @ 70%</b></li> </ul>
<b>Pirâmide Decrescente Original</b>	<ul style="list-style-type: none"> <li>• <b>1 x 6 @ 80%; 1 x 8 @ 75%; 1 x 10 @ 70%; 1 x 8 @ 75%; 1 x 6 @ 80%</b></li> <li>• <b>1 x 6-8 @ 80%; 1 x 8-10 @ 75%; 1 x 10-12 @ 70%; 1 x 8-10 @ 75%; 1 x 6-8 @ 80%</b></li> </ul>
<b>Pirâmide Crescente</b>	<ul style="list-style-type: none"> <li>• <b>1 x 10 @ 70%; 1 x 8 @ 75%; 1 x 6 @ 80%; 1 x 4 @ 85%</b></li> <li>• <b>1 x 10-12 @ 70%; 1 x 8-10 @ 75%; 1 x 6-8 @ 80%; 1 x 4-6 @ 85%</b></li> </ul>
<b>Pirâmide Decrescente</b>	<ul style="list-style-type: none"> <li>• <b>1 x 4 @ 85%; 1 x 6 @ 80%; 1 x 8 @ 75%; 1 x 10 @ 70%</b></li> <li>• <b>1 x 4-6 @ 85%; 1 x 6-8 @ 80%; 1 x 8-10 @ 75%; 1 x 10-12 @ 70%</b></li> </ul>

Configurações de carga e repetições na sessão	Treino
Step Load	<ul style="list-style-type: none"> <li>• <b>1 x 5 reps @ 70% 1 RM; 1 x 5 reps @ 75% 1 RM; 1 x 5 reps @ 80% 1 RM; 1 x 5 reps @ 85% 1 RM</b></li> <li>• <b>1 x 4-6 reps @ 70% 1 RM; 1 x 4-6 reps @ 75% 1 RM; 1 x 4-6 reps @ 80% 1 RM; 1 x 4-6 reps @ 85% 1 RM</b></li> </ul>
Ondas	<ul style="list-style-type: none"> <li>• <b>1 x 5 reps @ 70% 1 RM; 1 x 5 reps @ 80% 1 RM; 1 x 5 reps @ 75% 1 RM; 1 x 5 reps @ 85% 1 RM</b></li> <li>• <b>1 x 4-6 reps @ 70% 1 RM; 1 x 4-6 reps @ 80% 1 RM; 1 x 4-6 reps @ 75% 1 RM; 1 x 4-6 reps @ 80% 1 RM</b></li> </ul>
Progressivo	<ul style="list-style-type: none"> <li>• <b>1 x 2 reps @ 70% 1 RM; 1 x 2 reps @ 75% 1 RM; 1 x 2 reps @ 80% 1 RM; 3 x 2 reps @ 85% 1 RM.</b></li> <li>• <b>1 x 2 reps @ 70% 1 RM; 1 x 2 reps @ 75% 1 RM; 1 x 2 reps @ 80% 1 RM; 3 x 2-4 reps @ 85% 1 RM.</b></li> </ul>
Back Off	<ul style="list-style-type: none"> <li>• <b>1 x 2 reps @ 70% 1 RM; 1 x 2 reps @ 75% 1 RM; 1 x 2 reps @ 80% 1 RM; 3 x 5 reps @ 70% 1 RM.</b></li> <li>• <b>1 x 2 reps @ 70% 1 RM; 1 x 2 reps @ 75% 1 RM; 1 x 2 reps @ 80% 1 RM; 3 x 4-6 reps @ 70% 1 RM.</b></li> </ul>

*Step Load como estratégia de potencialização*

Método	Exercício	Prescrição
Step Load	Agachamento	<b>1 x 5 reps @ 70% 1 RM; 1 x 5 reps @ 75% 1 RM; 1 x 5 reps @ 80% 1 RM; 1 x 5 reps @ 85% 1 RM</b>
Back Off	Leg Press	<b>1 x 2 reps @ 70% 1 RM; 1 x 2 reps @ 75% 1 RM; 1 x 2 reps @ 80% 1 RM; 3 x 4-6 reps @ 70% 1 RM.</b>
Pirâmide Decrescente	Cadeira Extensora	<b>1 x 4 @ 85%; 1 x 6 @ 80%; 1 x 8 @ 75%; 1 x 10 @ 70%</b>

*Organizar pirâmide crescente antes da decrescente*

Método	Exercício	Prescrição
Pirâmide Crescente	Agachamento	<b>1 x 10 @ 70%; 1 x 8 @ 75%; 1 x 6 @ 80%; 1 x 4 @ 85%</b>
Pirâmide Decrescente	Leg Press	<b>1 x 4 @ 85%; 1 x 6 @ 80%; 1 x 8 @ 75%; 1 x 10 @ 70%</b>
Carga:Repetição fixa	Cadeira Extensora	<b>4 x 4-6 reps @ 75% 1 RM</b>

# Caso 3

## Histórico da lesão:

Após um período de 4 meses afastado devido a uma **lesão muscular grau II no bíceps femoral**, completou a reabilitação fisioterapêutica e está liberado para treinamento de força..

## Situação atual:

- **Amplitude normal;**
- **Sem dores** diárias;
- Redução significativa da massa muscular.

## Objetivo:

- 1) *Aumentar a força máxima e potência para níveis pré lesão;*
- 2) *Aumentar massa muscular.*

# Factors Modulating Post-Activation Potentiation and its Effect on Performance of Subsequent Explosive Activities

*Neale Anthony Tillin<sup>1,2</sup> and David Bishop<sup>1,3</sup>*

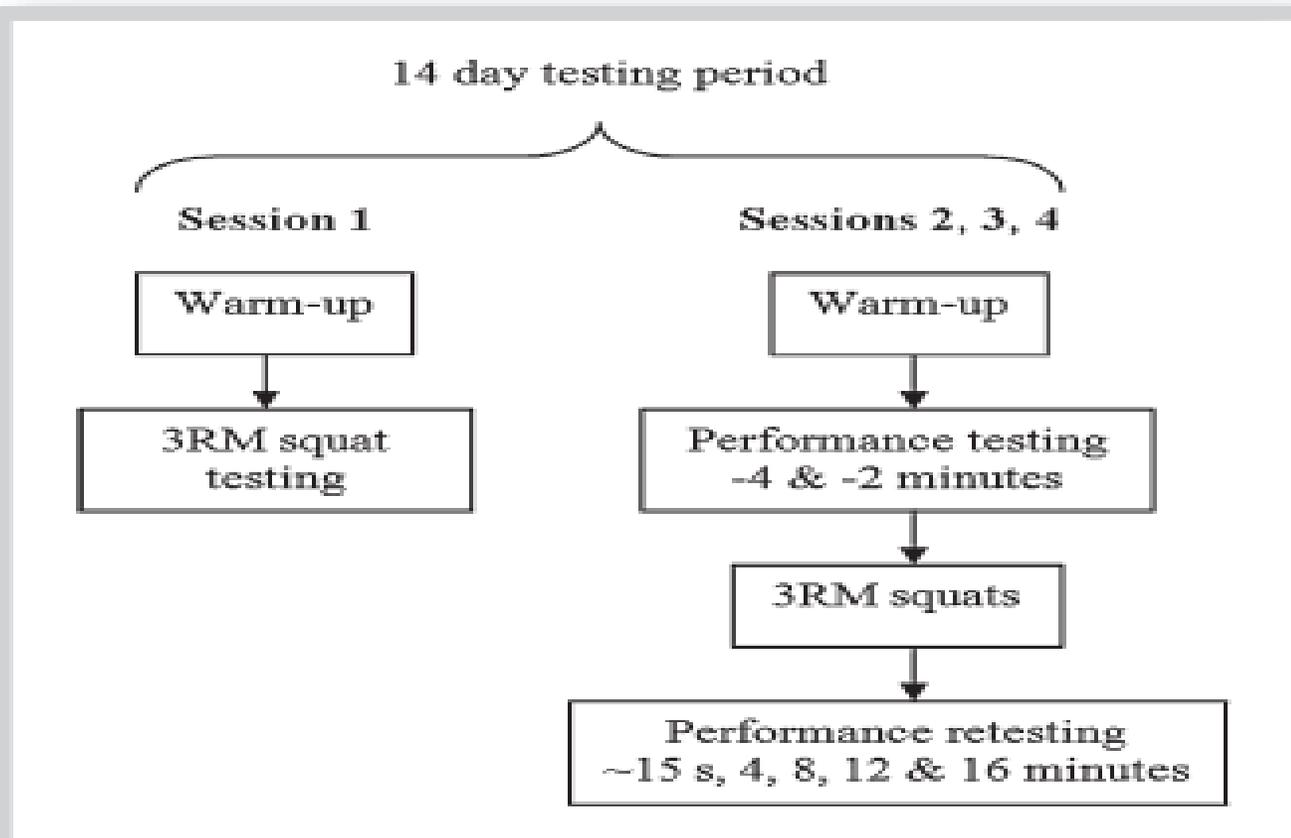
*A potencialização pós ativação consiste em um fenômeno agudo de aumento da **capacidade contrátil** muscular após uma **atividade condicionante**.*



- Contração condicionante máxima ou próximo ao máximo.
- Pré-condicionante para movimentos rápidos sem carga.

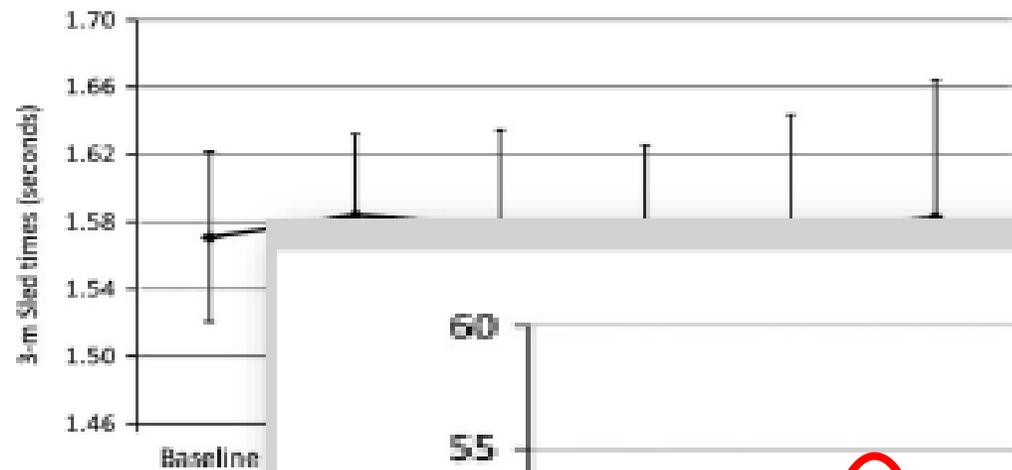
# THE ACUTE POTENTIATING EFFECTS OF BACK SQUATS ON ATHLETE PERFORMANCE

BLAIR T. CREWHER,<sup>1</sup> LIAM P. KILDUFF,<sup>2</sup> CHRISTIAN J. COOK,<sup>1,3,4</sup> MATT K. MIDDLETON,<sup>5</sup>  
PAUL J. BUNCE,<sup>5</sup> AND GUANG-ZHONG YANG<sup>1</sup>

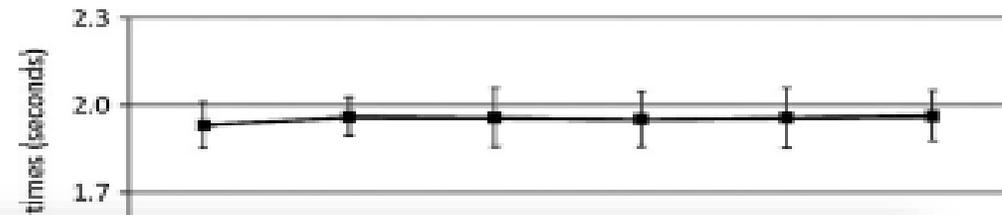


**Figure 1.** Experimental design. 3RM = 3 repetition maximum.

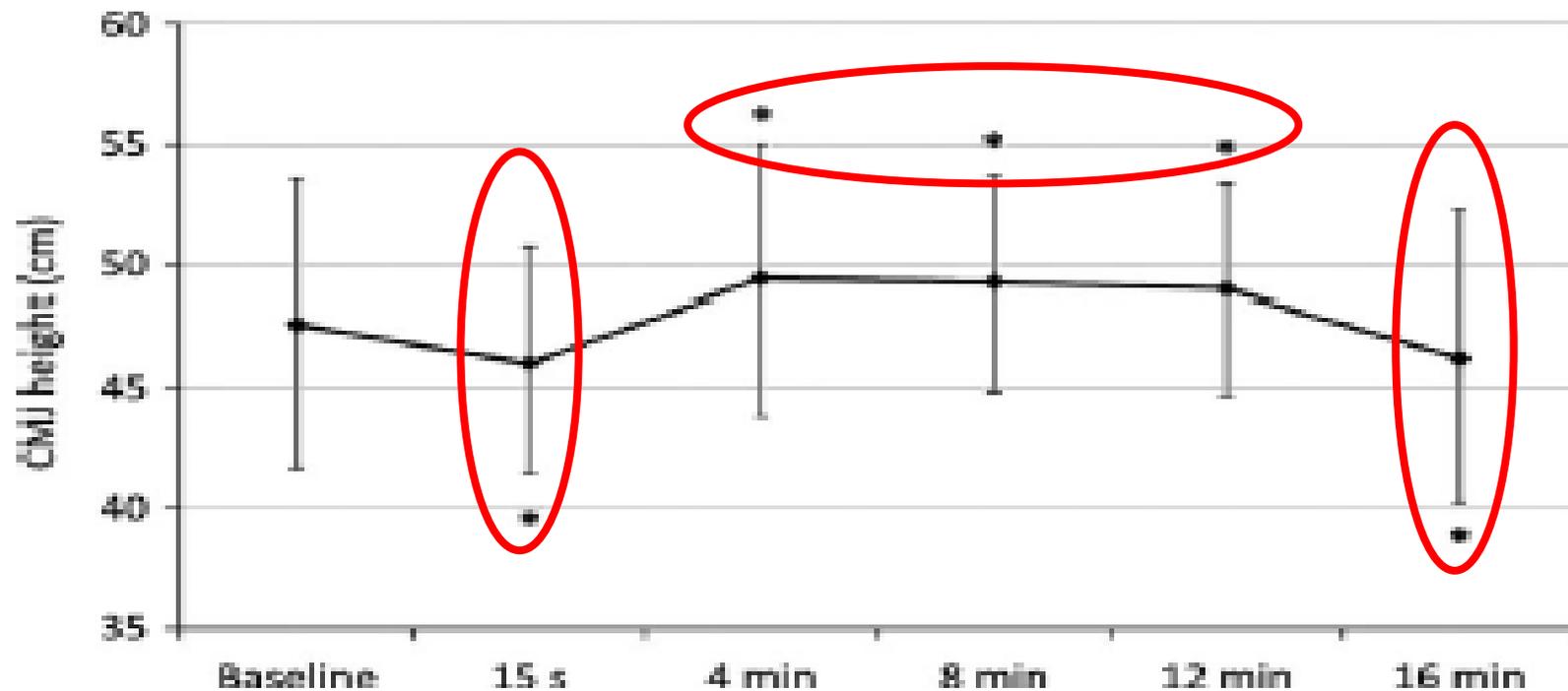
- Avaliar os efeitos da potencialização no agachamento em testes de velocidade e potência.
- Salto Vertical, Sprints (5- e 10-metros) e 3-metros trenó.



**Figure 4.** Horizontal squats (mean  $\pm$  SD)



6 min  
um squats



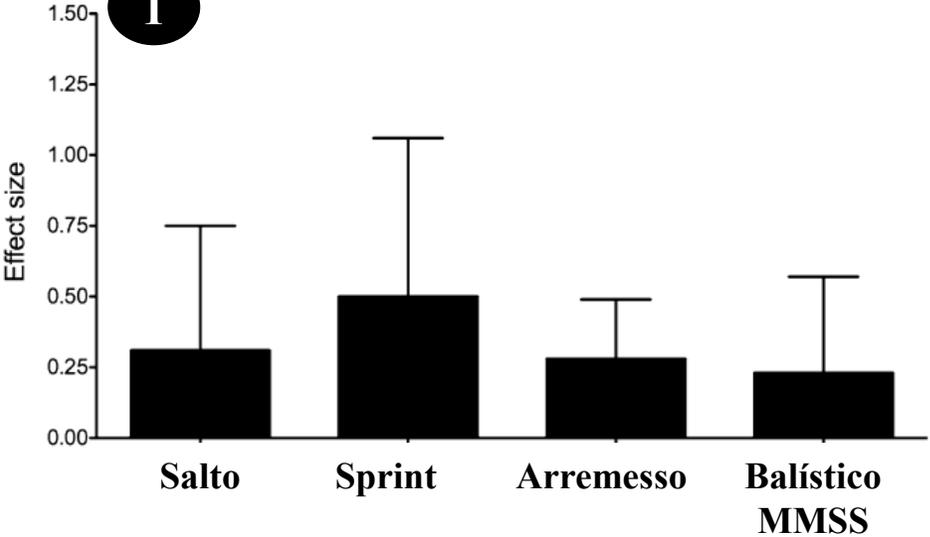
**Figure 3.** Countermovement jump height before and after the 3 repetition maximum squats (mean  $\pm$  SD). \*Significantly different from baseline  $p < 0.01$ .

2

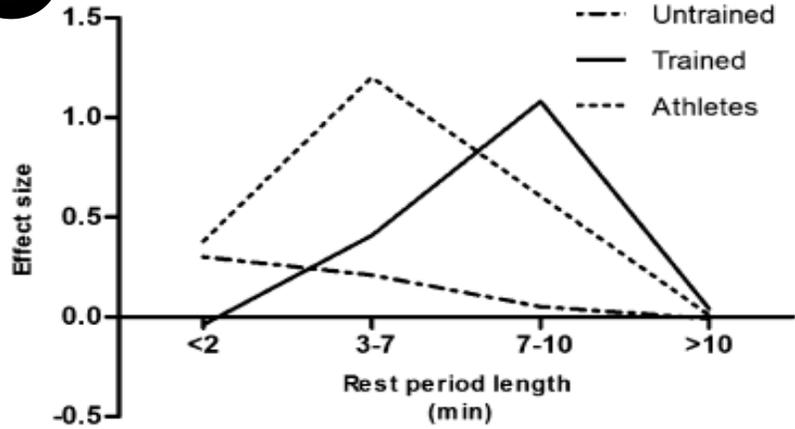
Exercícios dinâmicos (agachamento, levantamento terra etc);

- Alta intensidade (principalmente) >85% de 1 RM
- Séries únicas ou múltiplas

1

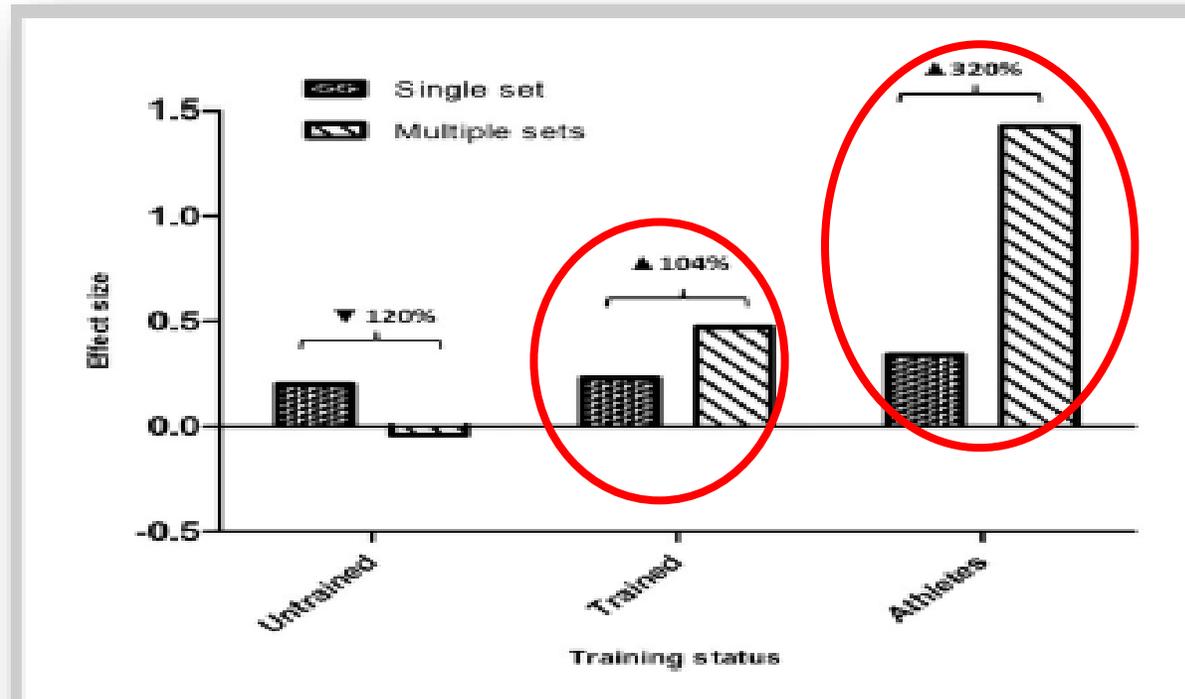


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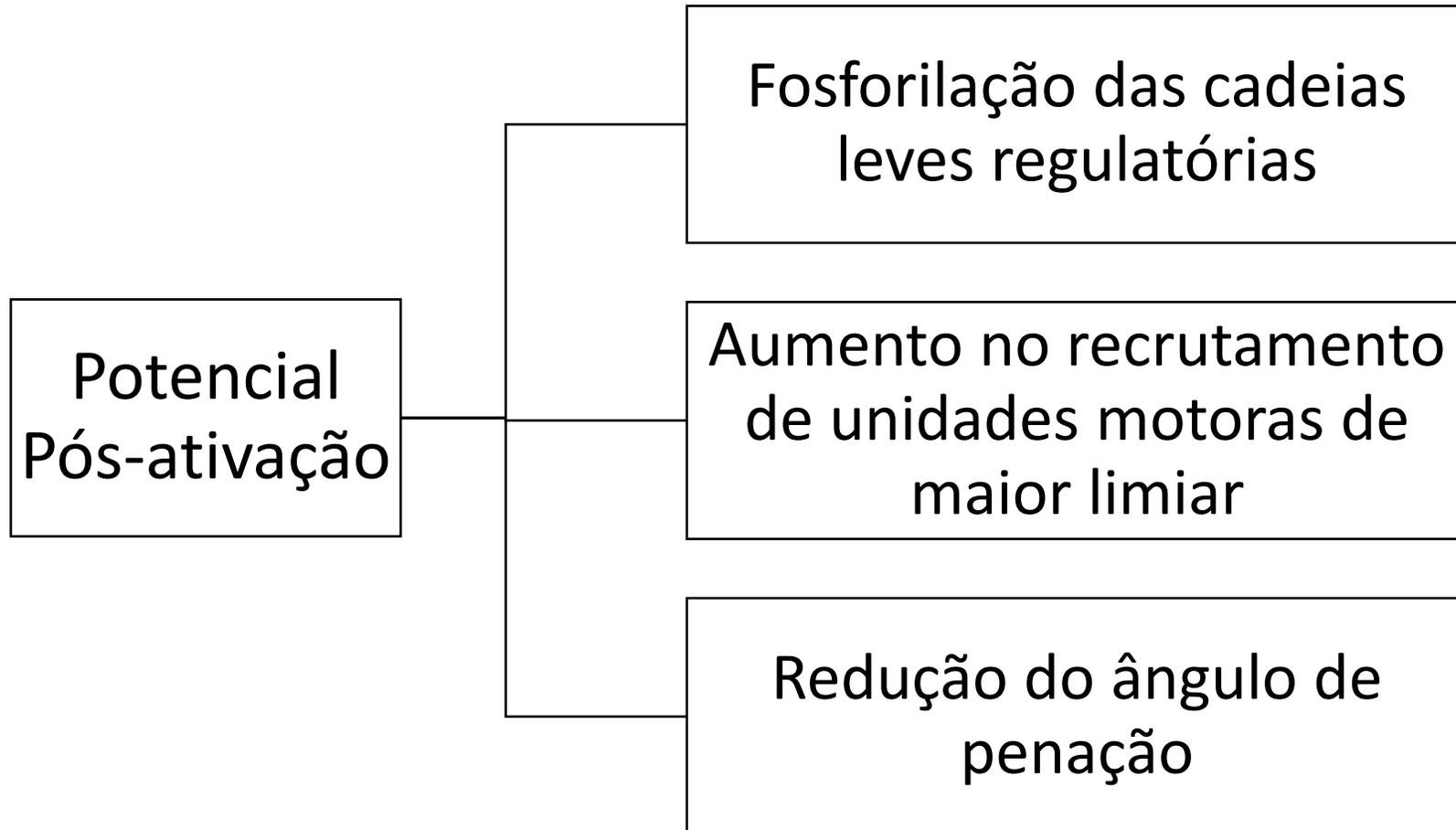


# META-ANALYSIS OF POSTACTIVATION POTENTIATION AND POWER: EFFECTS OF CONDITIONING ACTIVITY, VOLUME, GENDER, REST PERIODS, AND TRAINING STATUS

JACOB M. WILSON,<sup>1</sup> NEVINE M. DUNCAN,<sup>1</sup> PEDRO J. MARIN,<sup>2,3</sup> LEE E. BROWN,<sup>4</sup>  
JEREMY P. LOENNEKE,<sup>5</sup> STEPHANIE M.C. WILSON,<sup>6</sup> EDWARD JO,<sup>7</sup> RYAN P. LOWERY,<sup>1</sup> AND  
CARLOS UGRINOWITSCH<sup>8</sup>



**Figure 1.** Effects of a single vs. multiple sets conditioning mode protocol on power in untrained, trained, and athletic populations.

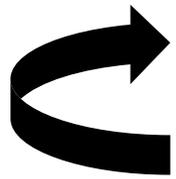


# Role of Calcium Sensitivity Modulation in Skeletal Muscle Performance

Brian R. MacIntosh

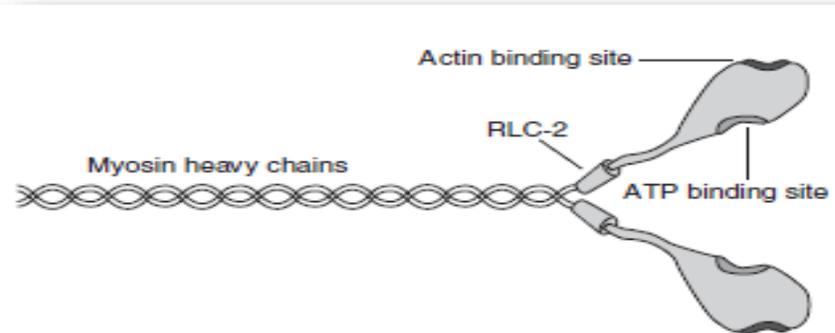
Faculty of Kinesiology and Faculty of Medicine, University of Calgary, Calgary, Alberta T2N 2N4, Canada

## Contração voluntária e fosforilação das cadeias leves regulatórias

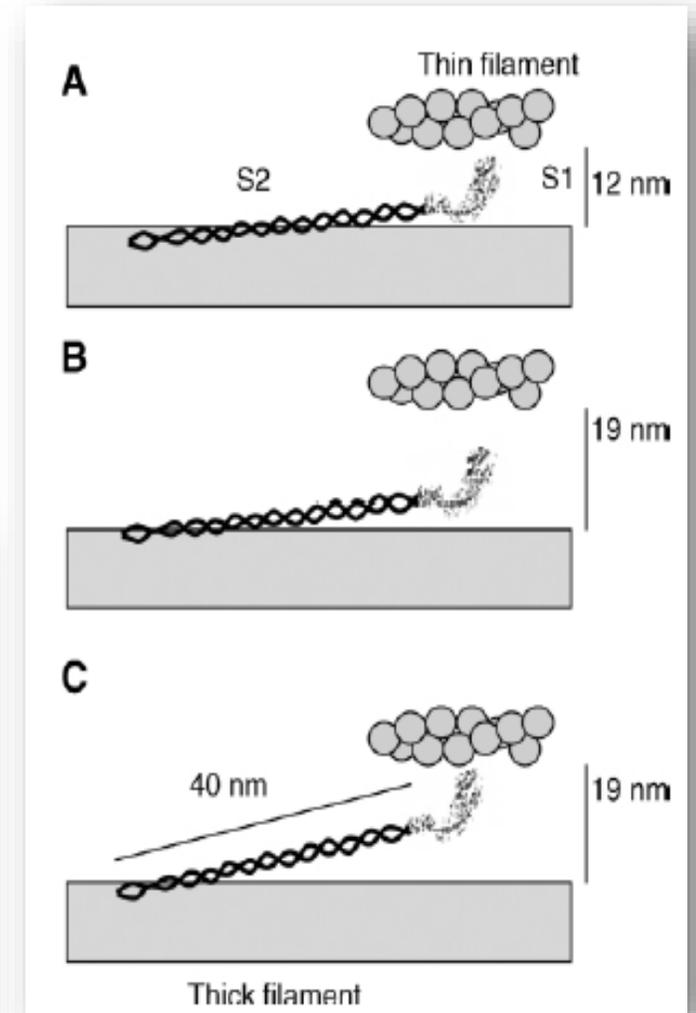


Entrada de cálcio  
no citoplasma

Quinase  
das cadeias  
leves



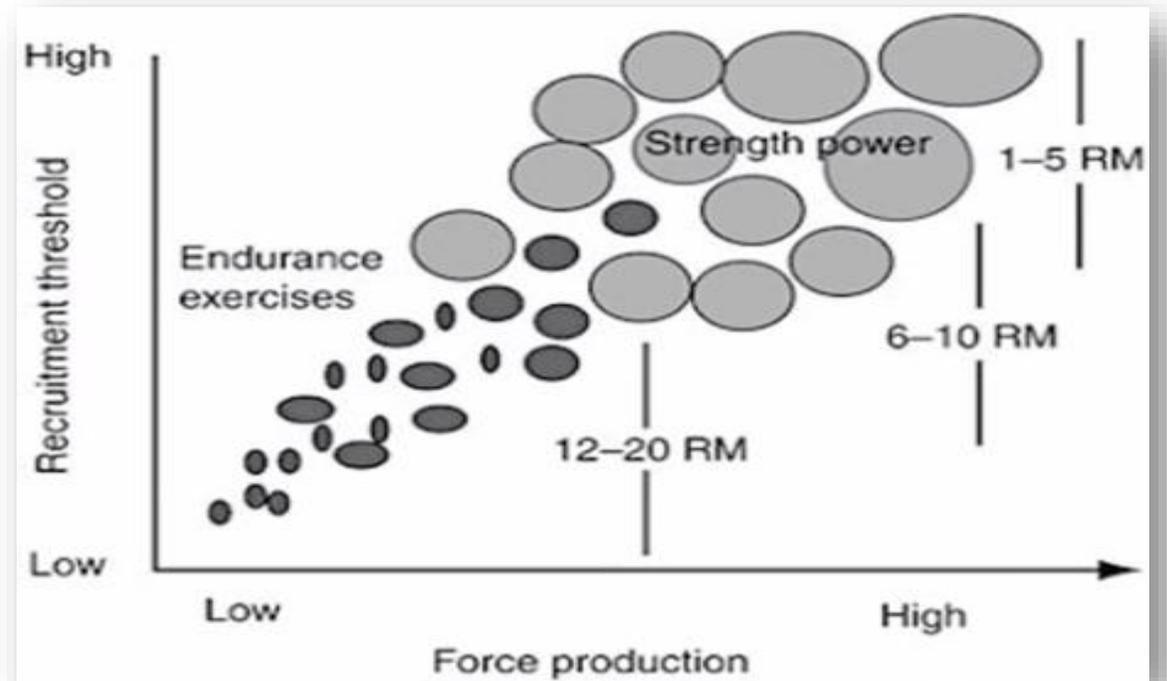
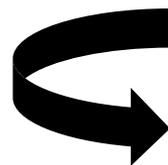
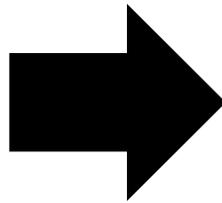
**Fig. 1.** One myosin molecule. Each myosin molecule is composed of two myosin heavy chains. Regulatory light chain (RLC)-2 represents a pair of RLCs positioned at the neck of a myosin head. Each RLC can incorporate a phosphate molecule, altering the structure of the myosin head. At each myosin head there is an actin and adenosine triphosphate (ATP) binding site.



# Contração voluntária e aumento no recrutamento de fibras de maior limiar



Fosforilação de fibras de maior limiar



- ✓ Aumento da excitabilidade
- ✓ Alteração da resposta neural

RESEARCH ARTICLE

# Short-term adaptations following Complex Training in team-sports: A meta-analysis

Tomás T. Freitas<sup>1</sup>, Alejandro Martinez-Rodriguez<sup>2</sup>, Julio Calleja-González<sup>3</sup>, Pedro E. Alcaraz<sup>1,4\*</sup>

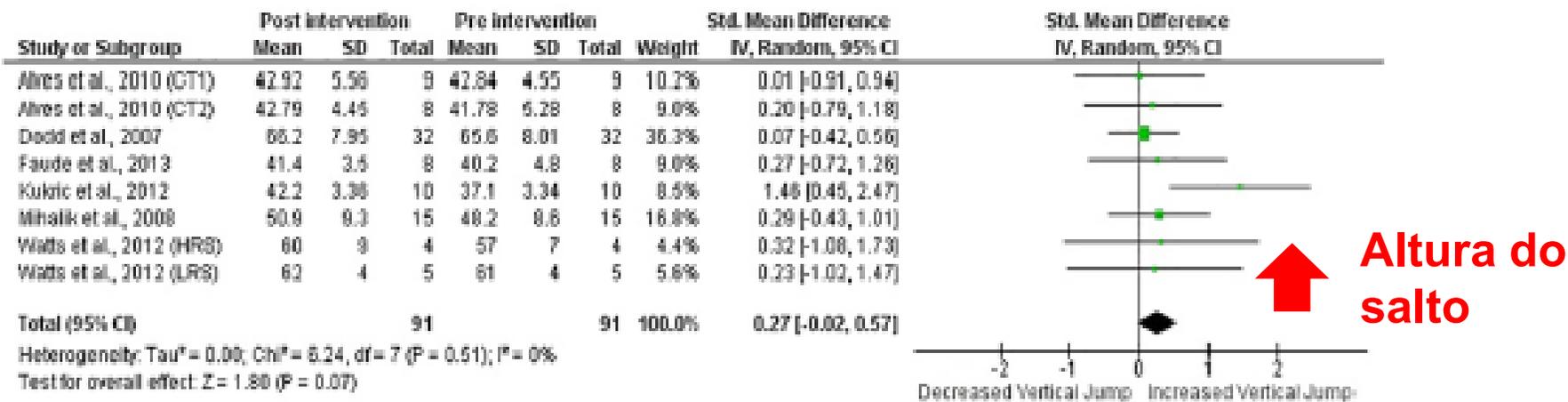


*A intervenção aguda do complex training (ou PPA) pode trazer benefícios crônicos em modalidades de potência?*

*1. Intervenções de membros inferiores de padrão motor similar.*

*2. Treinamento com altas sobrecargas combinados com pliométricos em uma mesma sessão.*

*3. Pelo menor 4 semanas de intervenção, que avaliaram Sprint ou salto vertical.*



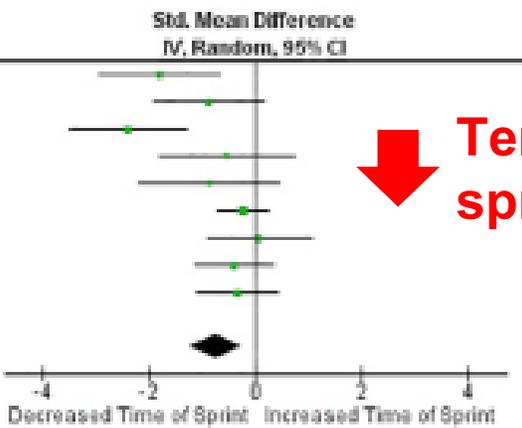
**Fig 3. Standardized mean difference (SMD) between post and pre-intervention VJ height in CT-trained subjects.** Squares represent the SMD<sup>a</sup> for each trial. Diamonds represent the pooled SMD across trials.



- *Efeito **pequeno** pré x pós.*
- *Altura ligeiramente maior x controle.*

Study or Subgroup	Post intervention			Pre intervention			Weight	Std. Mean Difference IV, Random, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Aves et al., 2010 (CT1)	2.38	0.08	8	2.56	0.1	8	8.4%	-1.00 [-2.94, -0.66]
Aves et al., 2010 (CT2)	2.49	0.07	8	2.57	0.1	8	10.3%	-0.88 [-1.92, 0.16]
Enio et al., 2014	3.05	0.07	12	3.25	0.09	12	9.8%	-2.40 [-3.48, -1.30]
Caraco et al., 2014 (CT1)	2.59	0.18	5	2.72	0.25	5	8.3%	-0.54 [-1.82, 0.74]
Caraco et al., 2014 (CT2)	2.46	0.15	5	2.6	0.14	5	7.9%	-0.87 [-2.20, 0.46]
Dodd et al., 2007	2.88	0.09	32	2.9	0.09	32	16.5%	-0.22 [-0.71, 0.27]
Faude et al., 2013	4.27	0.09	8	4.26	0.15	8	10.9%	0.08 [-0.90, 1.06]
McMaster et al,2014 (CTH)	2.99	0.07	14	3.02	0.08	14	13.4%	-0.39 [-1.14, 0.36]
McMaster et al,2014 (CTL)	3	0.09	14	3.03	0.08	14	13.4%	-0.34 [-1.09, 0.41]
<b>Total (95% CI)</b>			<b>107</b>			<b>107</b>	<b>100.0%</b>	<b>-0.74 [-1.22, -0.25]</b>

Heterogeneity: Tau<sup>2</sup> = 0.30; Chi<sup>2</sup> = 19.99, df = 8 (P = 0.01); I<sup>2</sup> = 60%  
 Test for overall effect: Z = 2.99 (P = 0.003)



**Fig 2. Standardized mean difference (SMD) between post and pre-intervention sprint time in CT-trained subjects.** Squares represent the SMD<sup>a</sup> for each trial. Diamonds represent the pooled SMD across trials.



- Efeito *moderado* pré x pós.
- Redução do tempo quando comparado ao grupo controle.

# Short-term adaptations following Complex Training in team-sports: A meta-analysis

Tomás T. Freitas<sup>1</sup>, Alejandro Martinez-Rodriguez<sup>2</sup>, Julio Calleja-González<sup>3</sup>, Pedro E. Alcaraz<sup>1,4\*</sup>

## Frequência

- Realizar no máximo 3 x por semana
- Pelo menos 12 sessões (ou 6 semanas).

## Variáveis

- Aplicar com intensidade < 85% da RM.
- Intervalo entre complex sets de 2 min.

## Modalidades e grupos

- Resposta melhor em jovens (< 20 anos)
- Melhor resposta em treinos de sprints
- Atletas apresentam melhores respostas

## Complex

Agachamento + CMJ	4 x 5 (80% de 1 RM)	4 x 10
Hip Thrust + Bounds horizontais	4 x 5 (80% de 1 RM)	4 x 4 + 4
Sled Sprint + Sprint máximo	4 x 3 metros (25% peso corporal)	4 x 20 metros

# **Complex and Contrast Training: Does Strength and Power Training Sequence Affect Performance-Based Adaptations in Team Sports? A Systematic Review and Meta-analysis**

Patrick Cormier,<sup>1</sup> Tomás T. Freitas,<sup>1</sup> Jacobo Á. Rubio-Arias,<sup>2</sup> and Pedro E. Alcaraz<sup>1,2</sup>

<sup>1</sup>UCAM Research Center for High Performance Sport—Catholic University of Murcia, UCAM, Spain; and <sup>2</sup>Faculty of Sport Sciences—Catholic University of Murcia, UCAM, Spain

*Combinação de treinos com diferentes relação de força-velocidade, no qual se inicia com exercícios com altas sobrecargas (> 85% de 1 RM) e finaliza com baixas sobrecargas (peso corporal).*

## Sequenciamento Constat Training

Ordem	Exercício	Classificação	Prescrição
1	Back squat	Tradicional	4 x 4 / >85% 1 RM
2	Hip thrust	Tradicional	4 x 4 / >85% 1 RM
3	Power clean	Balístico	4 x 6 / 60% 1 RM
4	Jammer press	Balístico	4 x 6 / 60% 1 RM
5	Bounds alternados	Top speed	4 x 8
6	Sprints	Top speed	4 x 30 metros / 4 min int

# Cluster sets

## THEORETICAL AND PRACTICAL ASPECTS OF DIFFERENT CLUSTER SET STRUCTURES: A SYSTEMATIC REVIEW

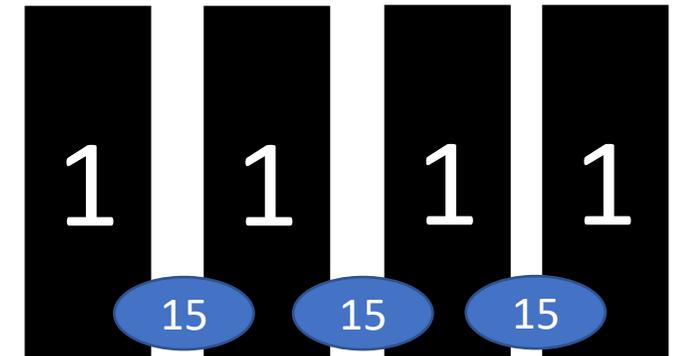
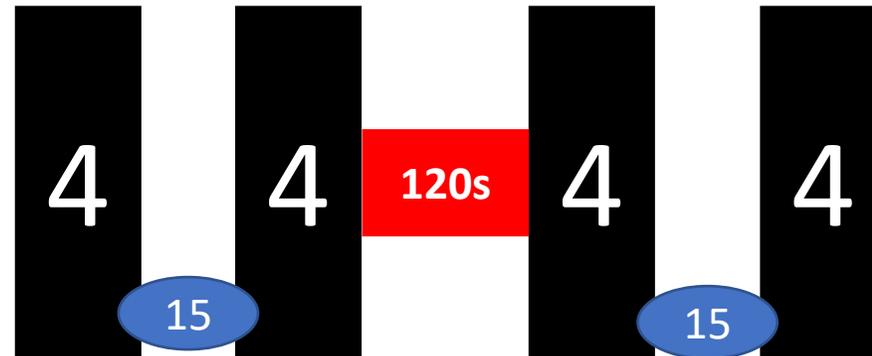
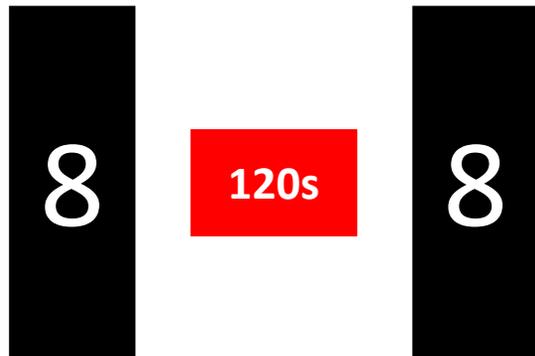
JAMES J. TUFANO,<sup>1,2</sup> LEE E. BROWN,<sup>3</sup> AND G. GREGORY HAFF<sup>1</sup>

<sup>1</sup>Center for Exercise and Sport Science Research, Edith Cowan University, Joondalup, Australia; <sup>2</sup>Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic; and <sup>3</sup>Center for Sport Performance, Department of Kinesiology, California State University, Fullerton, California

*Intervalo entre séries*

*Intervalo intra série (cluster sets)*

*Intervalo entre repetições*

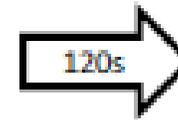


# Acute response to cluster sets in trained and untrained men

2015

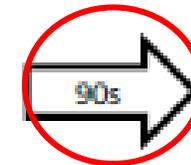
Jonathan M. Oliver<sup>1</sup> · Andreas Kreutzer<sup>1</sup> · Shane Jenke<sup>1</sup> · Melody D. Phillips<sup>1</sup> ·  
Joel B. Mitchell<sup>1</sup> · Margaret T. Jones<sup>2</sup>

Traditional (TRD)



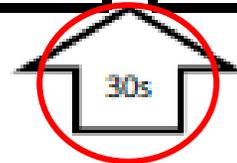
X 4

Cluster (CLU)



X 4

70% de 1 RM



C



Blood Draw



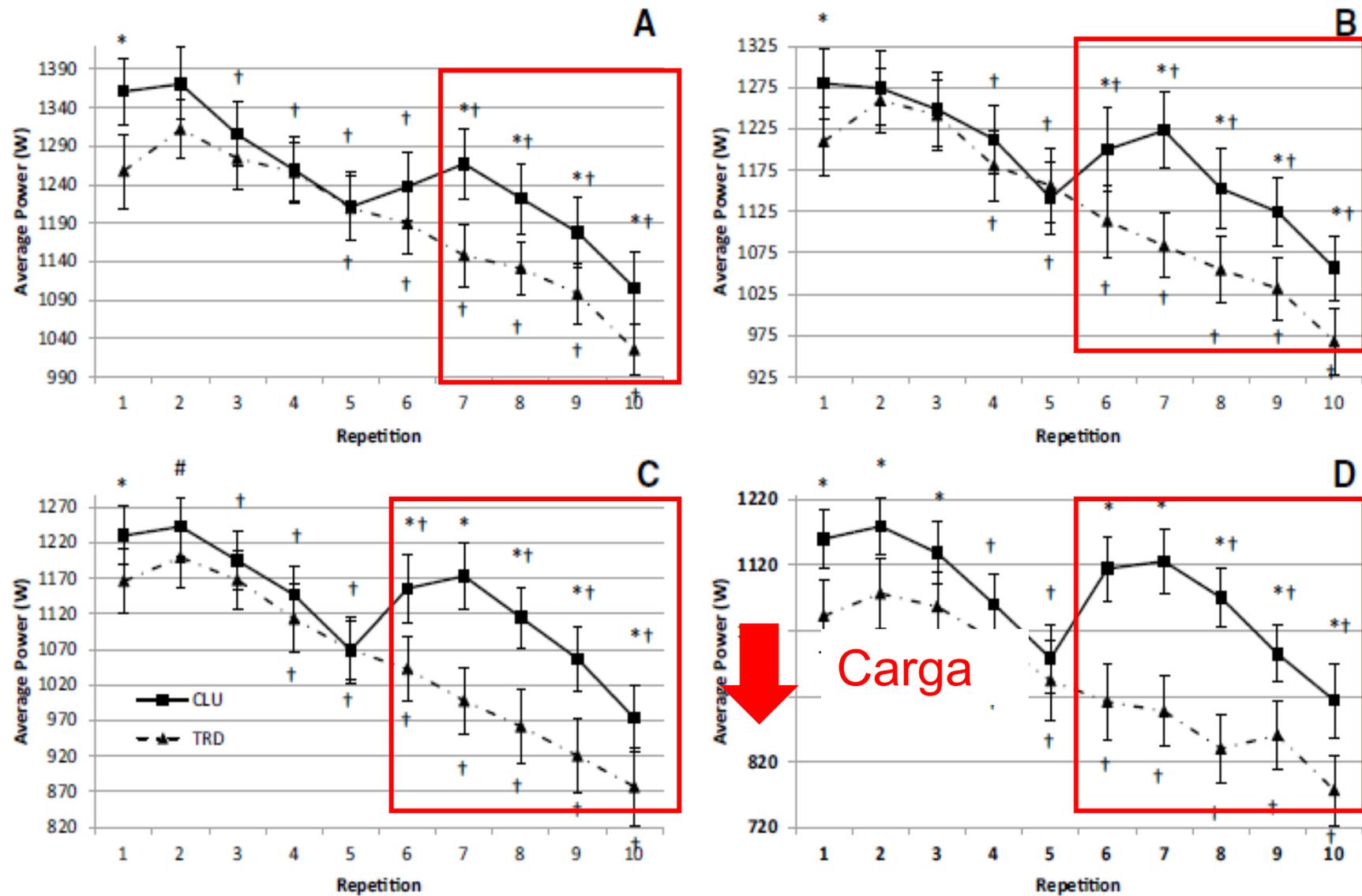
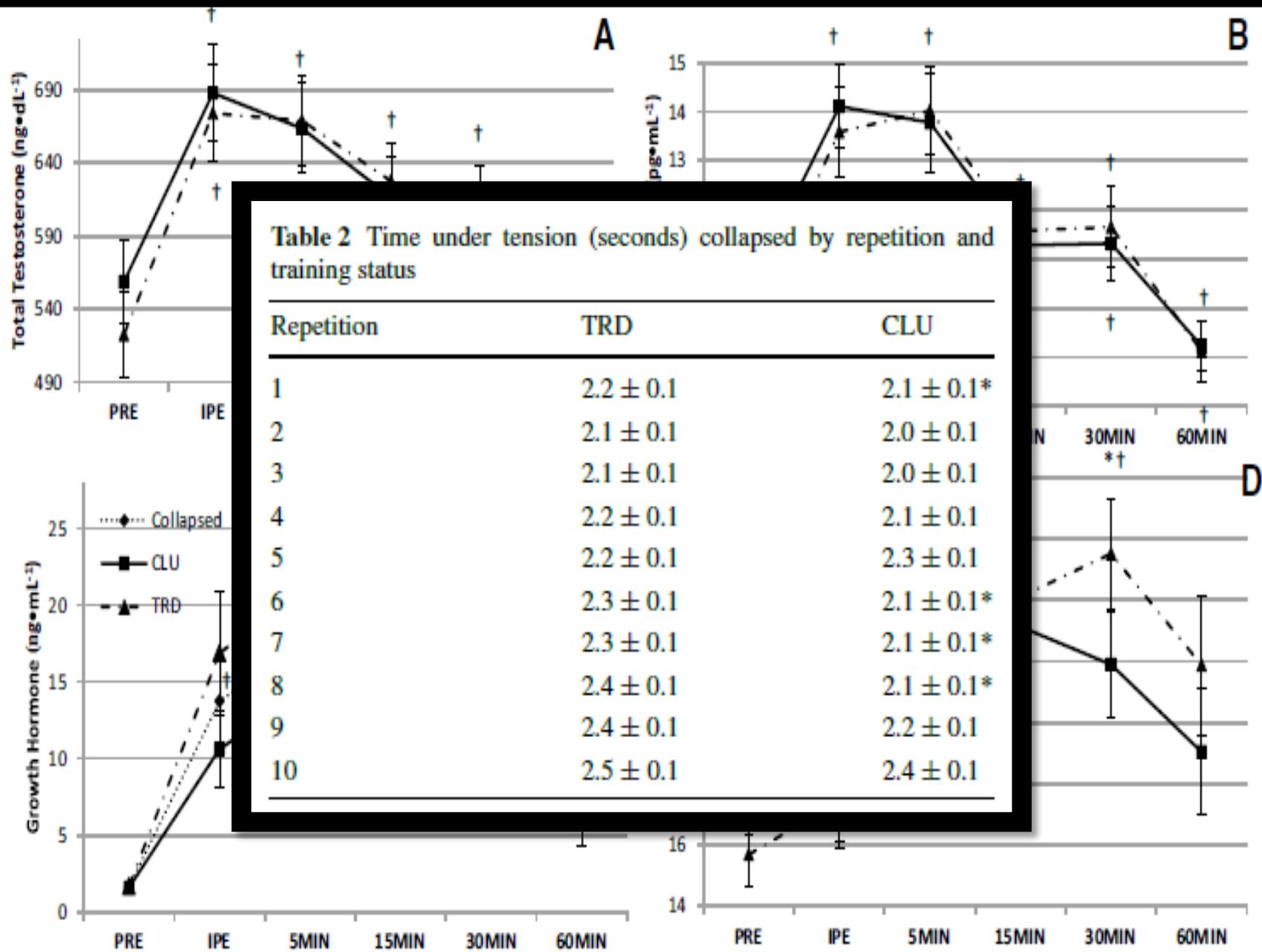


Fig. 2 Average power per repetition for Set 1 (a), Set 2 (b), Set 3 (c), Set 4 (d). †Significant difference from peak value during respective set ( $p < 0.05$ ); \*significant difference between conditions ( $p < 0.05$ ); #significant difference between conditions ( $p < 0.10$ )



# Acute response to cluster sets in trained and untrained men

Jonathan M. Oliver<sup>1</sup> · Andreas Kreutzer<sup>1</sup> · Shane Jenke<sup>1</sup> · Melody D. Phillips<sup>1</sup> ·

[Joel B. Mitchell<sup>1</sup>](#) · Margaret T. Jones<sup>2</sup>

- ***O treinamento em cluster permitiu manutenção da potência nas repetições finais***

Séries tradicionais



Maior resposta metabólica (aumento de metabólitos e hormonal)

Séries Cluster



Maior estímulo mecânico

# GREATER GAINS IN STRENGTH AND POWER WITH INTRASET REST INTERVALS IN HYPERTROPHIC TRAINING

JONATHAN M. OLIVER,<sup>1,2</sup> ANDREW R. JAGIM,<sup>1</sup> ADAM C. SANCHEZ,<sup>3</sup> MICHELLE A. MARDOCK,<sup>4</sup> KATHERINE A. KELLY,<sup>5</sup> HOLLY J. MEREDITH,<sup>6</sup> GERALD L. SMITH,<sup>3</sup> MIKE GREENWOOD,<sup>1</sup> JANET L. PARKER,<sup>5</sup> STEVEN E. RIECHMAN,<sup>1</sup> JAMES D. FLUCKEY,<sup>1</sup> STEPHEN F. CROUSE,<sup>1</sup> AND RICHARD B. KREIDER<sup>1</sup>

- Comparar adaptações de força, potência e composição corporal em um treinamento tradicional x cluster de 12 semanas

TABLE 1. Baseline group characteristics.\*†

	TRD	ISR	Combined	<i>p</i>
Age (y)	25 ± 5	25 ± 4	25 ± 5	0.790
Height (cm)	179.71 ± 6.18	179.71 ± 3.90	179.71 ± 5.04	1.000
Body mass (kg)	81.7 ± 11.6	82.5 ± 10.0	82.1 ± 10.6	0.878
Lean mass (kg)	61.9 ± 8.9	63.3 ± 7.0	62.6 ± 7.9	0.689
Fat percentage (%)	14.3 ± 2.7	12.9 ± 5.5	13.6 ± 4.3	0.466
Years trained	6.5 ± 4.0	6.0 ± 5.0	6.5 ± 4.5	0.815
# Days trained	3.5 ± 2.0	3.5 ± 2.0	3.5 ± 2.0	1.000

\*TRD = traditional rest; ISR = intraset rest intervals; Combined = collapsed across time.

†Data are mean ± SD.

<b>Familiarization, nutrition seminar, and muscle biopsy (1 week prior to baseline)</b>	
<b>Body composition, strength and power testing - Baseline</b>	
<b>Standard Rest (STD) Protocol</b>	<b>Intra-Set Rest (ISR) Protocol</b>
4 x 10 with 120 sec rest compound lifts 3 x 10 with 90 sec rest assistive lifts <b>Week 1</b> - 65% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 2</b> - 70% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 3</b> - 75% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 4</b> - 60% 1RM (2 days • wk <sup>-1</sup> )	8 x 5 with 60 sec rest compound lifts 3 x 10 with 90 sec rest assistive lifts <b>Week 1</b> - 65% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 2</b> - 70% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 3</b> - 75% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 4</b> - 60% 1RM (2 days • wk <sup>-1</sup> )
<b>Body composition, strength and power testing - Week 4</b>	
4 x 10 with 120 sec rest compound lifts 3 x 10 with 90 sec rest assistive lifts <b>Week 5</b> - 65% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 6</b> - 70% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 7</b> - 75% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 8</b> - 60% 1RM (2 days • wk <sup>-1</sup> )	8 x 5 with 60 sec rest compound lifts 3 x 10 with 90 sec rest assistive lifts <b>Week 5</b> - 65% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 6</b> - 70% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 7</b> - 75% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 8</b> - 60% 1RM (2 days • wk <sup>-1</sup> )
<b>Body composition, strength and power testing - Week 8</b>	
4 x 10 with 120 sec rest compound lifts 3 x 10 with 90 sec rest assistive lifts <b>Week 9</b> - 65% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 10</b> - 70% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 11</b> - 75% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 12</b> - 60% 1RM (2 days • wk <sup>-1</sup> )	8 x 5 with 60 sec rest compound lifts 3 x 10 with 90 sec rest assistive lifts <b>Week 9</b> - 65% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 10</b> - 70% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 11</b> - 75% 1RM (4 days • wk <sup>-1</sup> ) <b>Week 12</b> - 60% 1RM (2 days • wk <sup>-1</sup> )
<b>Body composition, strength, power testing, and muscle biopsy - Week 12</b>	

**Figure 1.** Testing and training program design.



- ✓ **Composição corporal (DEXA)**
- ✓ **Isoforma de MHC (biópsia – pré e pós)**



- ✓ **1 RM supino reto e agachamento**

- ✓ **Salto vertical**
- ✓ **Potência agachamento e supino a 60% de 1 RM (transdutor linear)**

**TABLE 6.** Power measures at baseline, 4, 8, and 12 weeks of training.\*†

	TRD	ISR	<i>p</i>
Back squat power (W)¶	2,025 ± 215	2,020 ± 154	<i>T</i> = 0.001
Vertical jump power (W)¶			
Baseline	1,378 ± 237	1,389 ± 179	<i>T</i> = 0.001
4 wks	1,418 ± 214	1,434 ± 152	<i>G</i> = 0.205
8 wks	1,452 ± 210§	1,470 ± 149§	<i>T</i> × <i>G</i> = 0.036
12 wks	1,470 ± 215§	1,537 ± 150‡§  #	
Vertical jump to body mass ratio¶			
Baseline	16.83 ± 1.36	17.12 ± 2.05	<i>T</i> = 0.001
4 wks	16.93 ± 1.28	17.71 ± 1.98§	<i>G</i> = 0.243
8 wks	17.27 ± 1.22	18.01 ± 1.76§	<i>T</i> × <i>G</i> = 0.001
12 wks	17.36 ± 1.13	18.68 ± 1.72‡§  #	
Vertical jump to lean mass ratio¶			
Baseline	22.19 ± 1.37	22.40 ± 1.95	<i>T</i> = 0.001
4 wks	22.40 ± 1.10	22.16 ± 1.72	<i>G</i> = 0.141
8 wks	22.66 ± 1.11	23.41 ± 1.42§	<i>T</i> × <i>G</i> = 0.004
12 wks	22.89 ± 1.11	24.40 ± 1.38‡§  #	

\*TRD = traditional rest; ISR = intraset rest intervals; *T* = time effect; *G* = group effect; *T* × *G* = time × group interaction effect.

†Data are mean ± SD.

‡Significantly different from TRD.

§Significantly different from baseline.

||Significantly different from 4 weeks.

¶One subject was excluded because of failure to follow protocol.

#Significantly different from 8 weeks.

TABLE 7. Strength measures (1RM) at baseline, 4, 8, and 12 weeks.\*†

- *ISR apresentou maiores ganhos de potência no supino e no salto vertical.*
- *Na potência de agachamento, os resultados favoreceram o ISR*
- *Maiores ganhos de força no supino e no agachamento foram verificados no ISR*
- *Adaptações de composição corporal e MHC foram similares*

§Significantly different from baseline.

|Significantly different from 4 weeks.

†Significantly different from 8 weeks.

**Cluster set, redistribuição  
volume:intervalo e outras  
possibilidades práticas**

## Cluster Sets

- Utilização de intervalos intraset

## Redistribuição Volume:Intervalo

- Não necessita de intervalos intraset; apenas redistribuir volume e intervalo

## Intervalos entre repetições

- Fazer intervalos a cada repetição

Método	Exercício	Série/Repetição	Intervalo	Carga	Volume de treino
Tradicional	Agachamento	<ul style="list-style-type: none"> <li>• 10</li> <li>• 10</li> <li>• 10</li> </ul>	<ul style="list-style-type: none"> <li>• 120" entre séries</li> </ul>	<ul style="list-style-type: none"> <li>• 75% 1 RM</li> </ul>	<ul style="list-style-type: none"> <li>• 30 repetições</li> </ul>
Cluster Sets	Agachamento	<ul style="list-style-type: none"> <li>• 5 + 5</li> <li>• 5 + 5</li> <li>• 5 + 5</li> </ul>	<ul style="list-style-type: none"> <li>• 120" entre séries</li> <li>• 20" entre clusters</li> </ul>	<ul style="list-style-type: none"> <li>• 75% 1 RM</li> </ul>	<ul style="list-style-type: none"> <li>• 30 repetições</li> </ul>
Redistribuição volume:intervalo	Agachamento	<ul style="list-style-type: none"> <li>• 5</li> <li>• 5</li> <li>• 5</li> <li>• 5</li> <li>• 5</li> <li>• 5</li> </ul>	<ul style="list-style-type: none"> <li>• 48" entre séries</li> </ul>	75% 1 RM	30 repetições

## Cluster + intervalo entre reps

Exercício	Série/Repetição	Carga	Intervalo
Agachamento	<ul style="list-style-type: none"><li>• 10 reps</li><li>• 8 reps</li><li>• 3+3</li><li>• 2+2</li><li>• 1+1</li></ul>	<ul style="list-style-type: none"><li>• 70%</li><li>• 75%</li><li>• 80%</li><li>• 85%</li><li>• 90%</li></ul>	<ul style="list-style-type: none"><li>• 120" entre séries</li><li>• 30" entre clusters</li><li>• 20" entre repetições</li></ul>

Exercício	Série/Repetição	Carga	Intervalo
Agachamento	<ul style="list-style-type: none"><li>• 10 reps</li><li>• 4+4 reps</li><li>• 3+1+1+1</li><li>• 2+1+1</li><li>• 1+1</li></ul>	<ul style="list-style-type: none"><li>• 70%</li><li>• 75%</li><li>• 80%</li><li>• 85%</li><li>• 90%</li></ul>	<ul style="list-style-type: none"><li>• 120" entre séries</li><li>• 30" entre clusters</li><li>• 20" entre repetições</li></ul>

# THEORETICAL AND PRACTICAL ASPECTS OF DIFFERENT CLUSTER SET STRUCTURES: A SYSTEMATIC REVIEW

JAMES J. TUFANO,<sup>1,2</sup> LEE E. BROWN,<sup>3</sup> AND G. GREGORY HAFF<sup>1</sup>

<sup>1</sup>Center for Exercise and Sport Science Research, Edith Cowan University, Joondalup, Australia; <sup>2</sup>Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic; and <sup>3</sup>Center for Sport Performance, Department of Kinesiology, California State University, Fullerton, California

## Rest-Pause Method

Another method of varying a set structure is what can be termed as the "rest-pause" method (Figure 2E) (4,17,23,51,62).

## Rest-pause

Falha muscular

Intervalo curto

Novas repetições > volume

## Cluster-set

- ✓ Utiliza o intervalo para reduzir a fadiga e evitar falha muscular

**STRENGTH AND MUSCULAR ADAPTATIONS FOLLOWING 6 WEEKS OF REST-PAUSE VERSUS TRADITIONAL MULTIPLE-SETS RESISTANCE TRAINING IN TRAINED SUBJECTS**

**Running Head: Rest-pause method and resistance training**

**Laboratory: Physical Education - Catholic University of Brasilia – Laboratory of Strength and exercise.**

**Jonato Prestes<sup>1</sup>, Ramires Alsamir Tibana<sup>1</sup>, Eduardo de Araujo Sousa<sup>1</sup>, Dahan da Cunha Nascimento<sup>1</sup>, Pollyanna de Oliveira Rocha<sup>1</sup>, Nathalia Ferreira Camarço<sup>1</sup>, Nuno Manuel Frade de Sousa<sup>3</sup>, Jeffrey M. Willardson<sup>2</sup>**

- **Comparar 6 semanas de treinamento rest-pause vs tradicional para força, hipertrofia, resistência e composição corporal.**

**Rest pause**

80% de 1 RM até a falha  
20 seg de intervalo  
+ reps até completar 18 reps

**Tradicional**

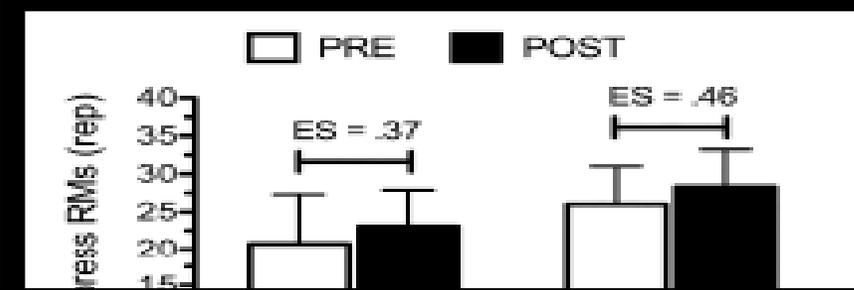
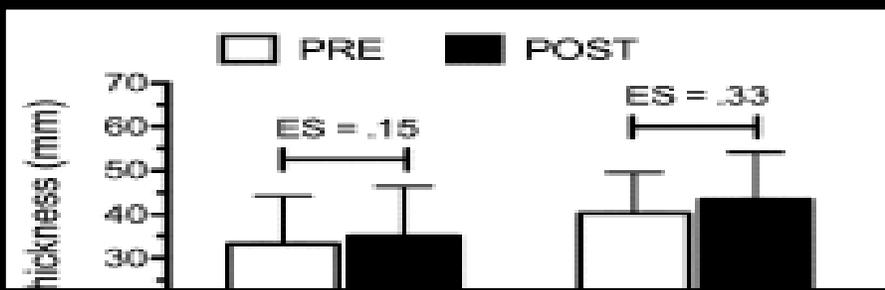
80% de 1 RM  
3 séries de 6 reps  
2 min intervalo

Table 1. Resistance training protocol during 6 weeks of the rest-pause and traditional multiple-sets methods RT program. \*

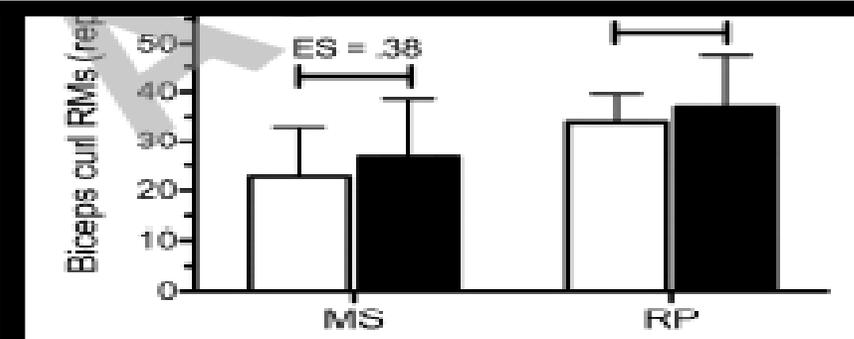
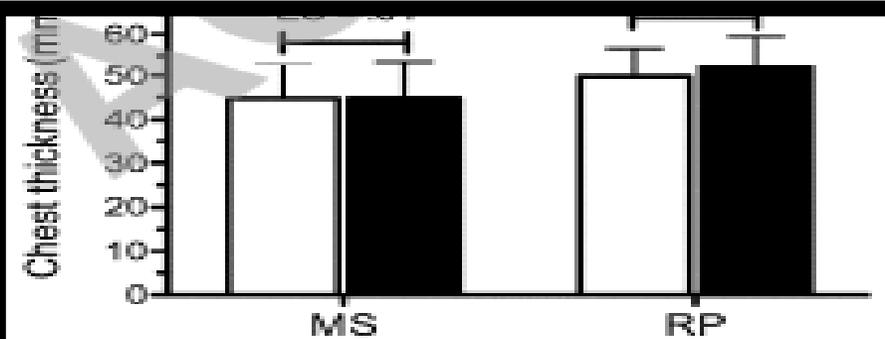
Routine A (Sessions 1 and 3)	Routine B (Session 2 and 4)
Barbel Bench Press	Squat
Dumbbell Incline Press	45° Leg Press
Cable Cross	Leg Curl
Military Press	Front Lat Pull-Down
Lateral Raise	Seated Row
Triceps Pulley	Dumbbell Lateral Row
Barbell Triceps Extension	Standing Barbell Elbow Curl
	Preacher Curl

✓ **Teste de 1 RM**  
 ✓ **RML – 60% de 1 RM máx reps**

\*Four weekly sessions, routine A was performed 2 days per week (Monday and Wednesday) and routine B was performed 2 days per week (Tuesday and Thursday).



- *Hipertrofia de coxa e resistência muscular de membros inferiores tiveram melhores respostas no método rest-pause*
- *Para força os resultados foram semelhantes*



# Dropsets

- 20 a 25%

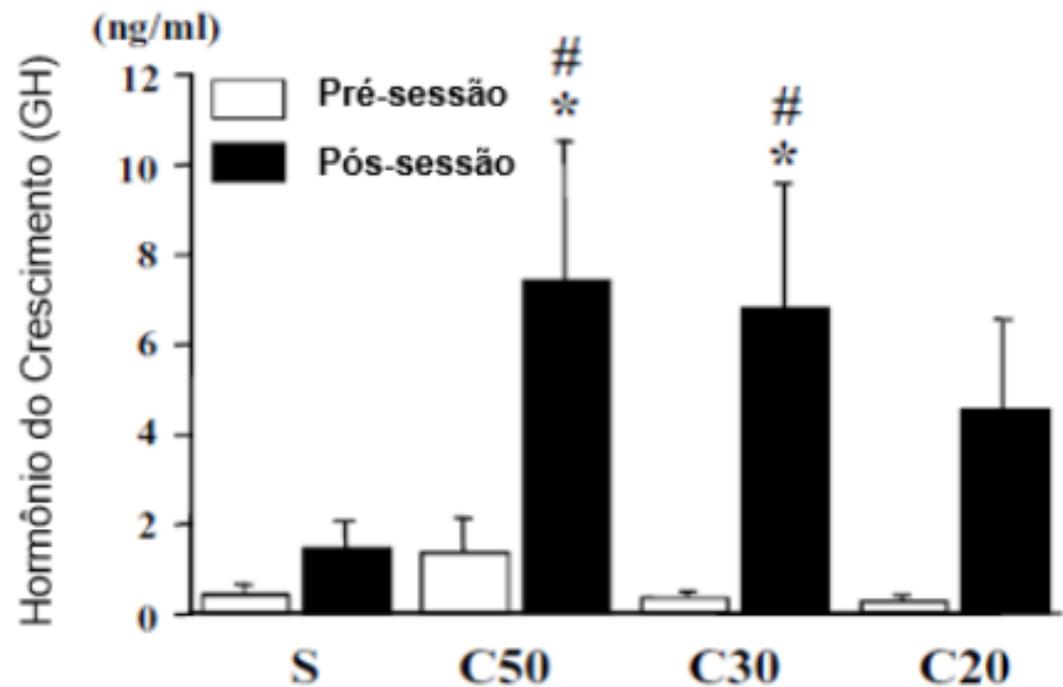
Repetições máximas – 10 RMs

Repetições máximas – 6 RMs



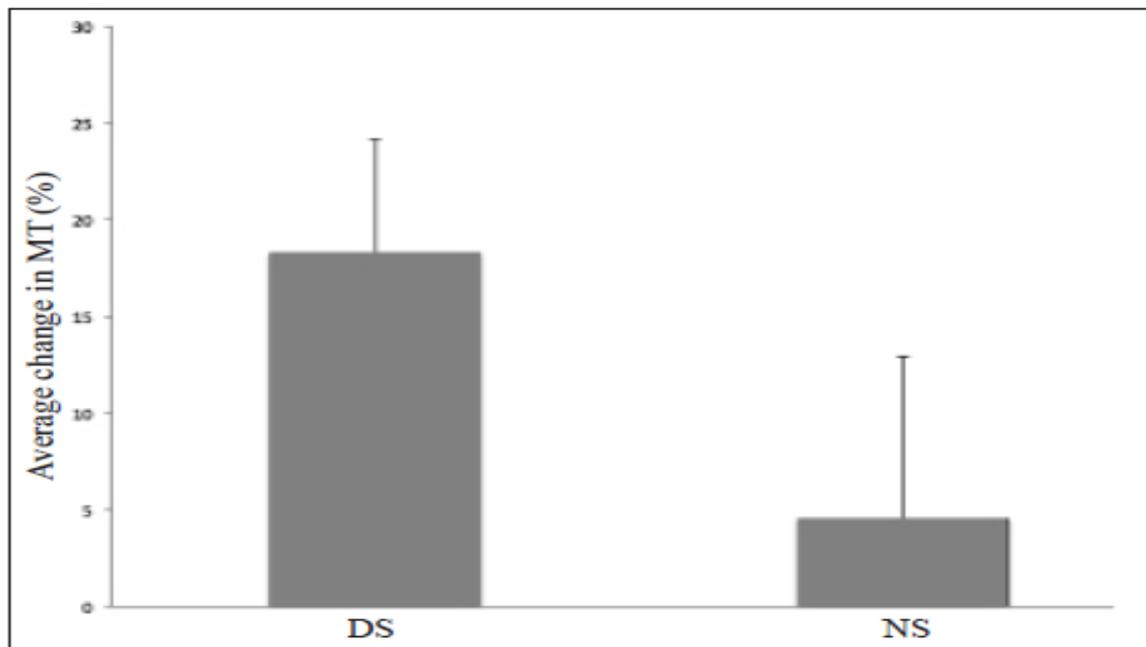
- *A falha mecânica muscular não reflete fadiga total do músculo*
- *Dropsets podem ser benéficos para hipertrofia muscular*
- *Entretanto, a literatura não apresenta um modelo padrão*

*Redução de 50, 30 ou 20%  
da carga e mais repetições*



Goto et al., 2004

*Maior inchaço muscular  
após dropset*



Schoenfeld et al., 2018

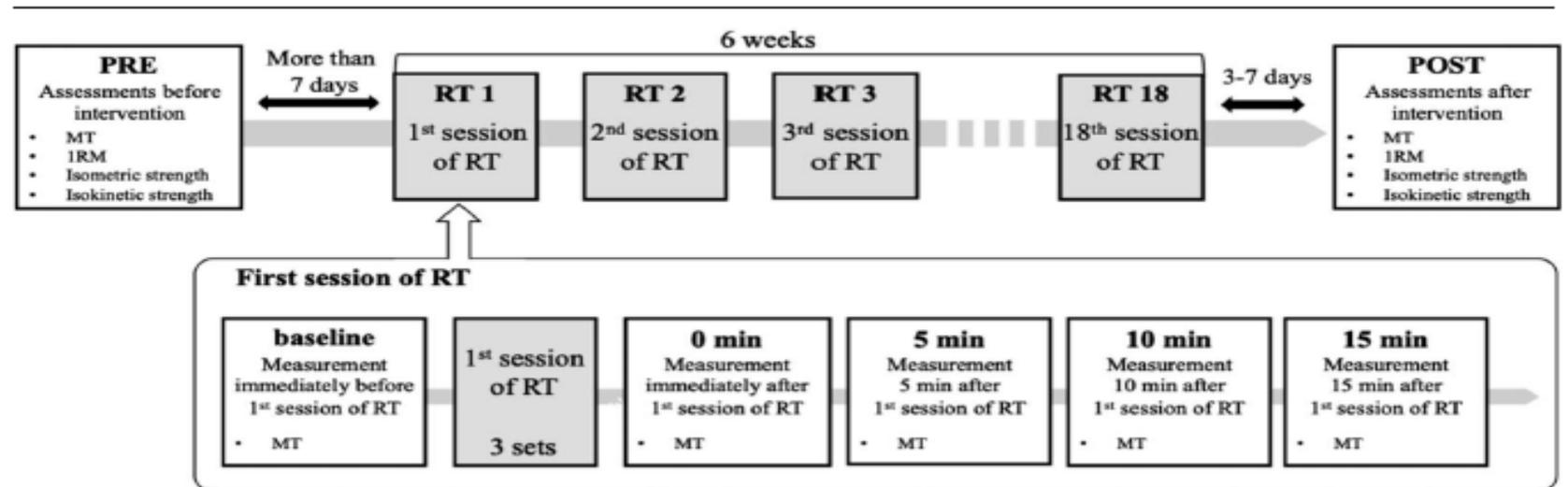


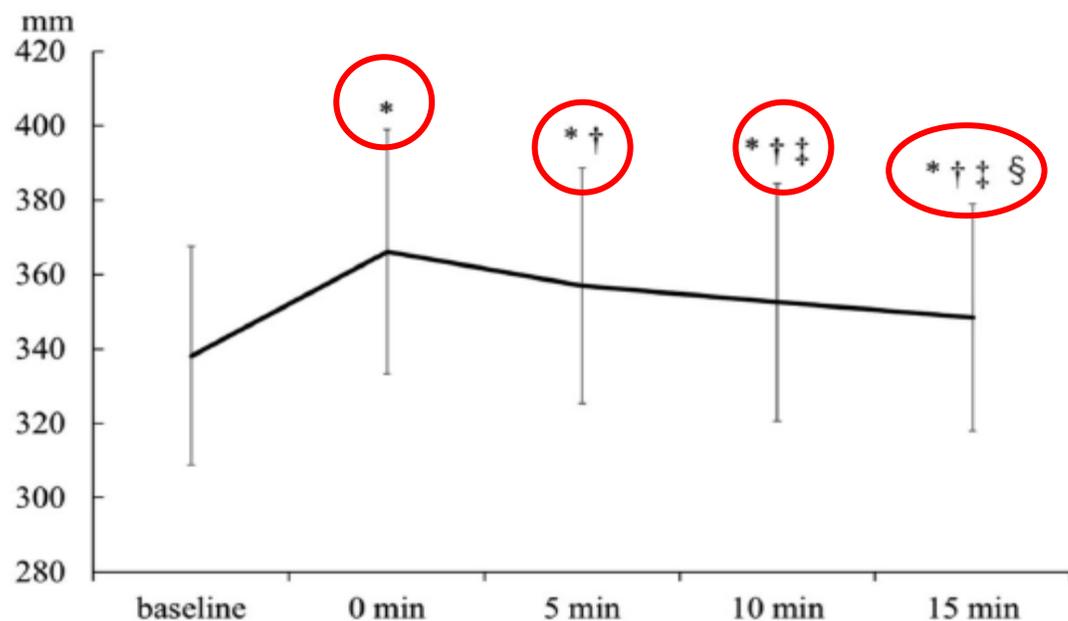
# Relationship Between Muscle Swelling and Hypertrophy Induced by Resistance Training

Tetsuya Hirono,<sup>1,2</sup> Tome Ikezoe,<sup>1</sup> Masashi Taniguchi,<sup>1</sup> Hiroki Tanaka,<sup>1,3</sup> Junya Saeki,<sup>2,4</sup> Masahide Yagi,<sup>1</sup> Jun Umehara,<sup>1,2</sup> and Noriaki Ichihashi<sup>1</sup>

<sup>1</sup>Human Health Sciences, Graduate School of Medicine, Kyoto University, Kyoto, Japan; <sup>2</sup>Japan Society for the Promotion of Science, Tokyo, Japan; <sup>3</sup>Rehabilitation Unit, Kyoto University Hospital, Kyoto, Japan; and <sup>4</sup>Faculty of Sport Sciences, Waseda University, Saitama, Japan

- Determinar se o aumento de força muscular e hipertrofia alteram de acordo com a disponibilidade hormonal





**Table 1**

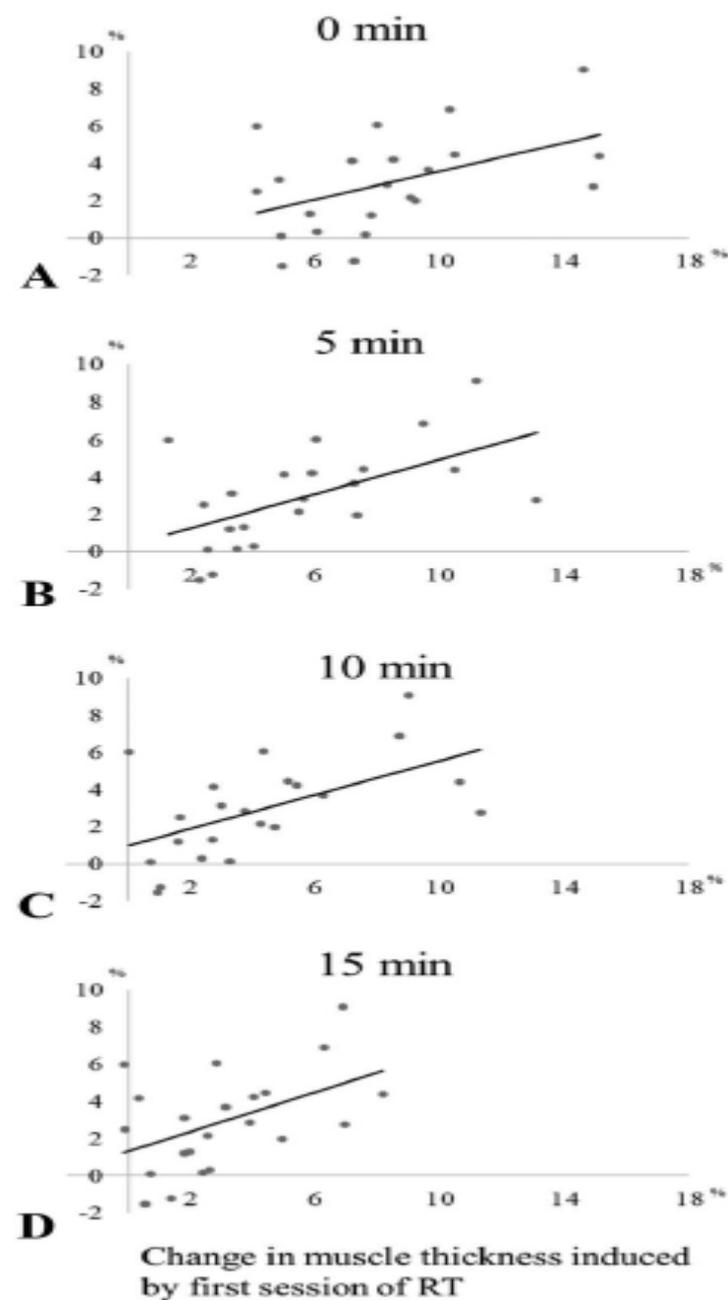
Changes in muscle strength and muscle thickness after the 6-week resistance training.\*†

	Before RT	After RT	<i>p</i>	Percent changes [%]	Effect size ( <i>r</i> )	95% confidence intervals
1RM (N·m)	192.3 ± 35.3	240.7 ± 43.9	<0.001	25.4 ± 9.8	0.93	40.0–56.9
Maximum isometric strength at 90° (N·m)	196.4 ± 44.9	237.0 ± 44.5	<0.001	22.2 ± 15.3	0.87	30.2–50.9
Maximum isometric strength at 70° (N·m)	236.7 ± 47.7	266.2 ± 50.7	<0.001	13.2 ± 12.0	0.74	17.2–41.9
Maximum isokinetic strength at 90·s <sup>-1</sup> (N·m)	165.1 ± 32.8	199.3 ± 25.0	<0.001	24.5 ± 25.9	0.80	22.5–46.0
Maximum isokinetic strength at 180·s <sup>-1</sup> (N·m)	132.0 ± 24.0	151.4 ± 18.4	<0.001	17.0 ± 18.7	0.74	11.5–27.3
Muscle thickness of the quadriceps femoris (mm)	340.1 ± 30.2	349.9 ± 29.6	<0.001	2.9 ± 2.7	0.76	6.0–13.6

\*1RM = one repetition maximum; RT = resistance training.

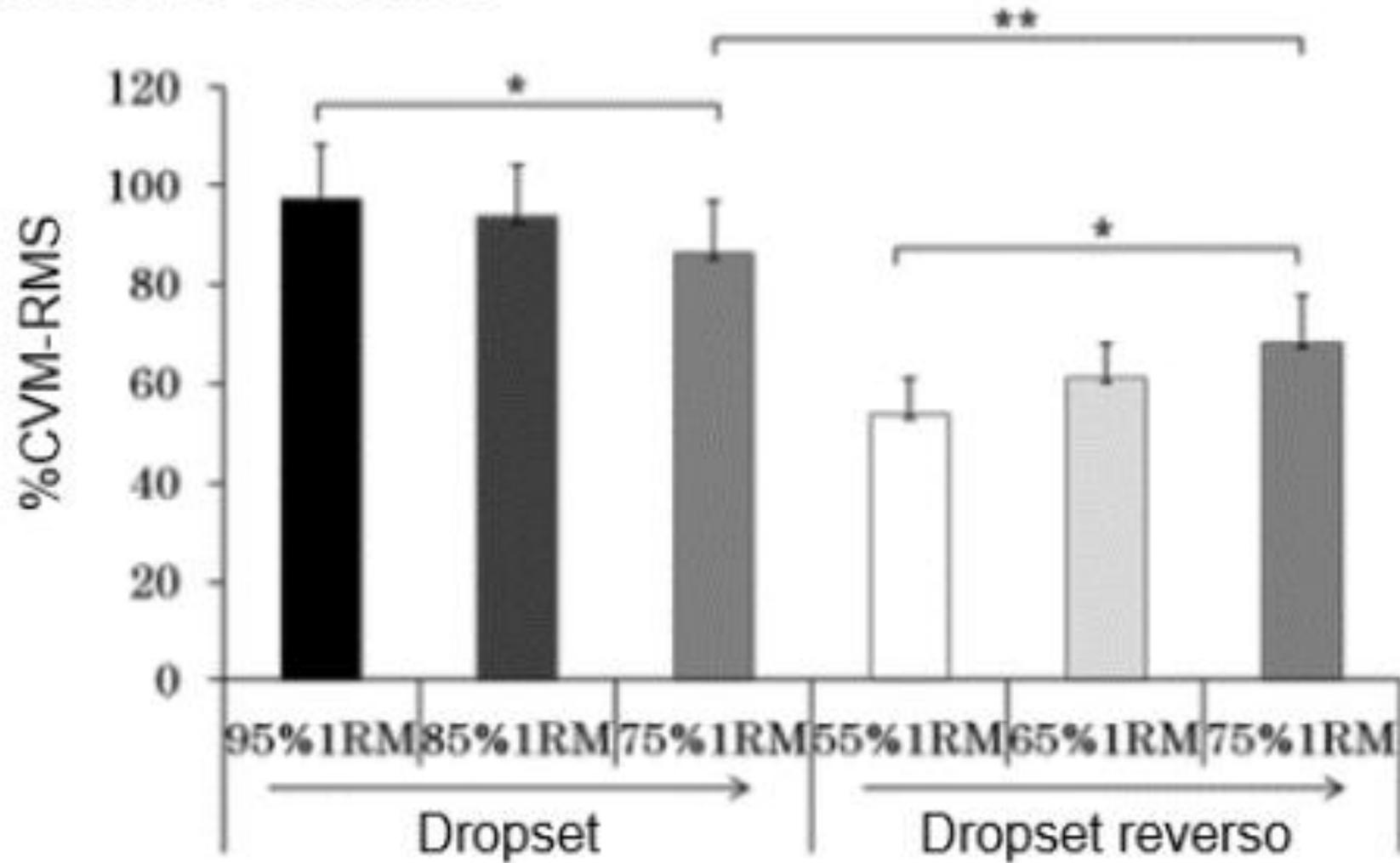
†Values are mean ± SD. Muscle thickness of the quadriceps femoris was calculated by the sum of 9 measurement sites.

Change in muscle thickness after 6-week RT intervention



*Maior recrutamento de unidade motoras nos modelos de redução de carga*

## Indivíduos Treinados



ORIGINAL ARTICLE

# **Crescent pyramid and drop-set systems do not promote greater strength gains, muscle hypertrophy, and changes on muscle architecture compared with traditional resistance training in well-trained men**

Vitor Angleri<sup>1</sup> · Carlos Ugrinowitsch<sup>2</sup> · Cleiton Augusto Libardi<sup>1</sup>

- Comparar os efeitos de um treinamento tradicional, pirâmide crescente e dropsets nas adaptações musculares

- *32 indivíduos jovens do sexo masculino com experiência de 4 anos em TF*

*Tradicional*

*16 pernas dom/16 pernas não-dom*

*Dropsets*

*8 pernas dom/8 pernas não-dom*

*Pirâmide crescente*

*8 pernas dom/8 pernas não-dom*

## **Cadeira extensora e leg press**

### **Tradicional**

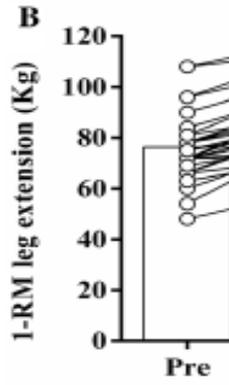
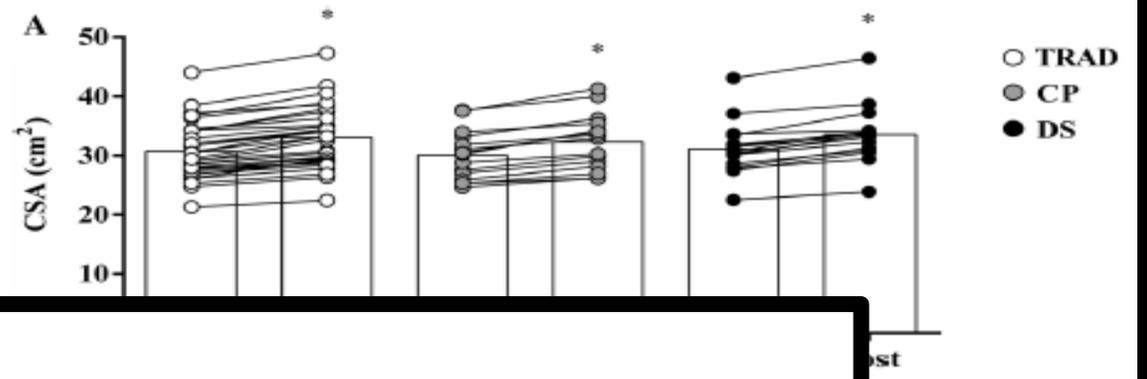
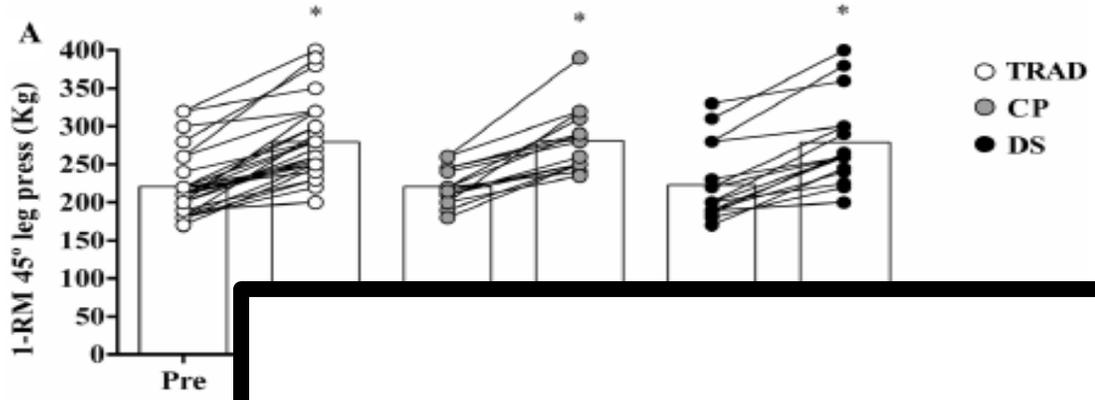
- **3 a 5 séries /6 a 12 reps/75% 1 RM**

### **Pirâmide crescente**

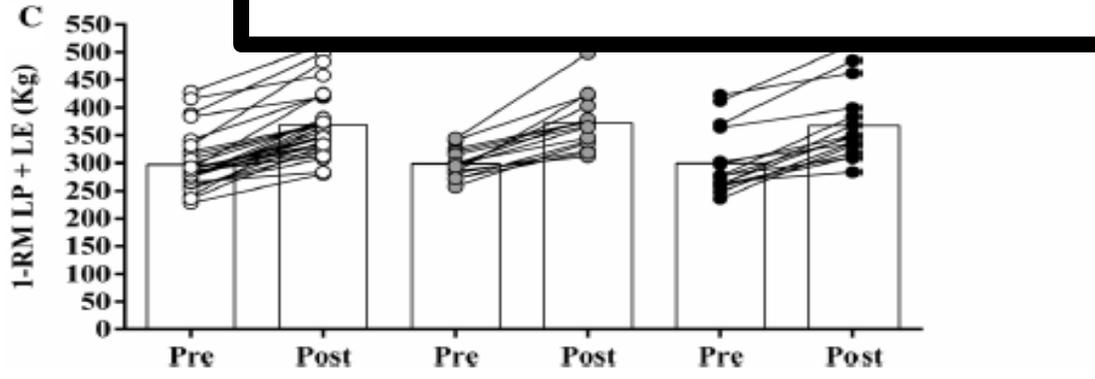
- **15 reps a 65% 1 RM; 12 reps a 70%; 10 reps a 75%; 8 reps a 80%; 6 reps a 85%**

### **Dropsets**

- **75% de 1 RM até a falha => redução de 20% e mais repetições até atingir mesmo número de repetições**



• *O métodos de treinamento não diferiram em relação as adaptações de força e hipertrofia*



ORIGINAL ARTICLE  
EXERCISE PHYSIOLOGY AND BIOMECHANICS

# Effects of drop set resistance training on acute stress indicators and long-term muscle hypertrophy and strength

Julius FINK<sup>1\*</sup>, Brad J. SCHOENFELD<sup>2</sup>, Naoki KIKUCHI<sup>3</sup>, Koichi NAKAZATO<sup>1</sup>

## *Tradicional*

- *Triceps polia*
- *3 séries de 12 RM e 90”  
int*

## *Dropsets*

- *Triceps polia*
- *1 série com 12 RM com  
duas reduções de 20%*

✓ ***Volume de treino semelhante, mas menor  
duração***

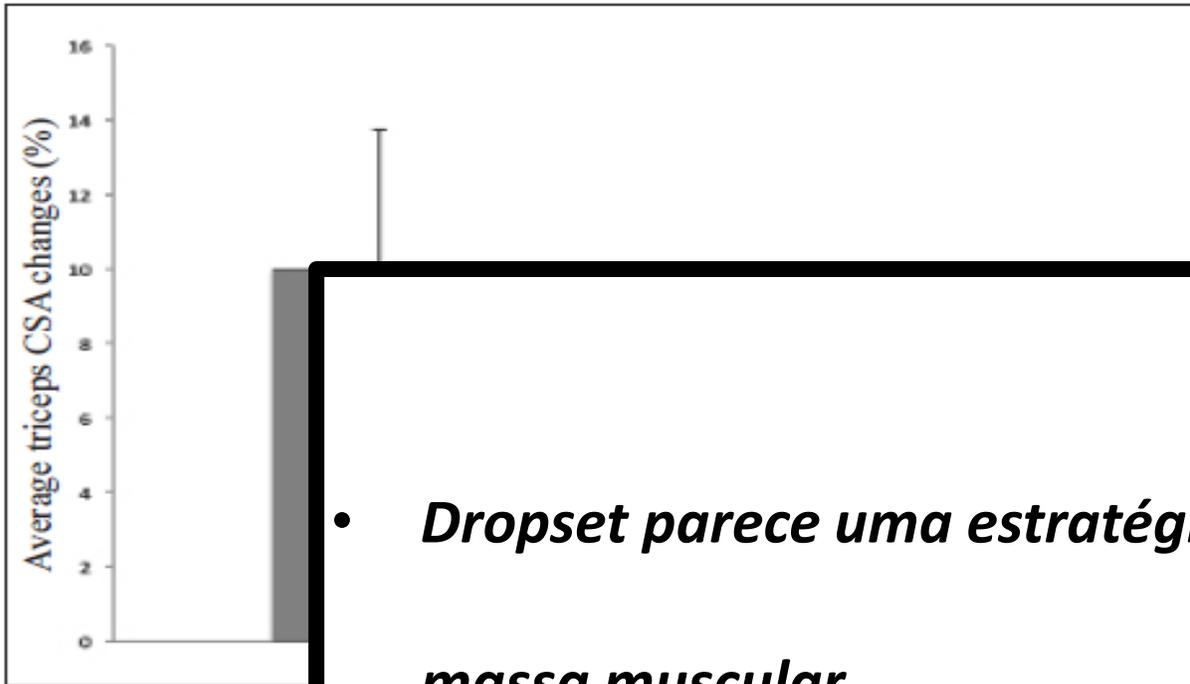
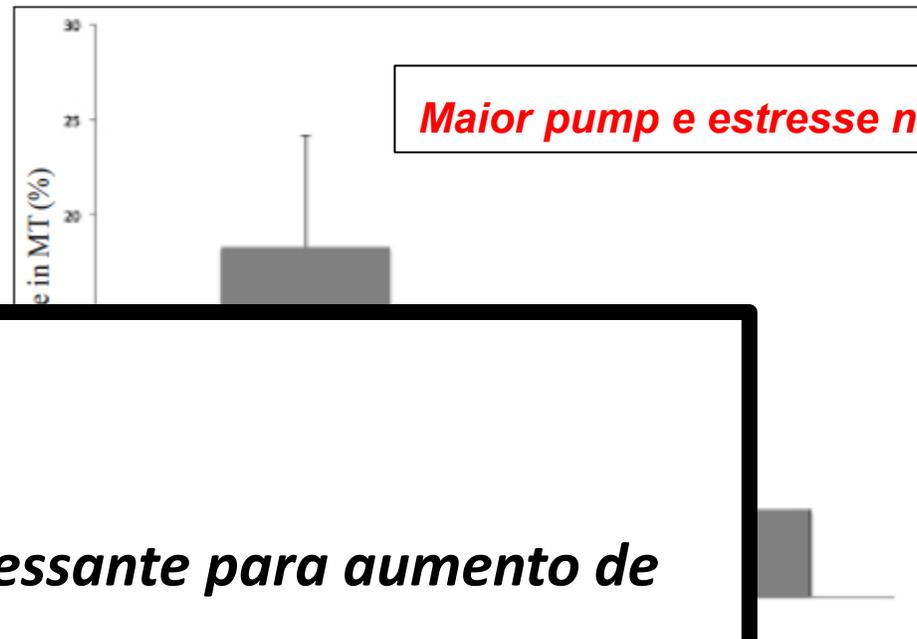


Figure 1.—Average triceps CSA changes (%) for drop set (DS) or normal set (NS).



**Maior pump e estresse no DS**

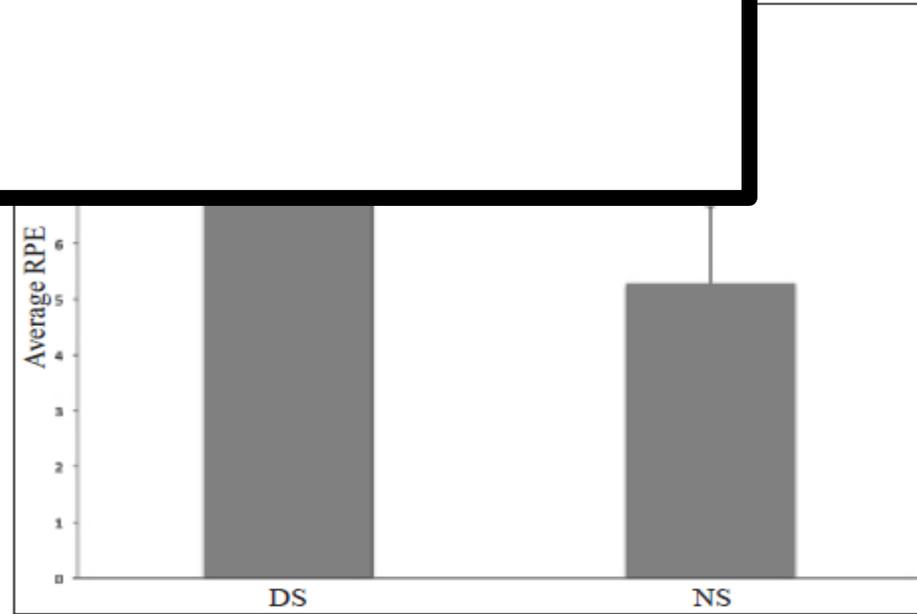
• ***Dropset parece uma estratégia interessante para aumento de massa muscular***

TABLE I.—CSA Changes.

	DS			NS		
	Pre (arbitrary units)	Post (arbitrary units)	ES	Pre (arbitrary units)	Post (arbitrary units)	ES
CSA	7.0±1.3	7.7±1.6*	0.47	6.9±1.4	7.25±1.4*	0.25

**maior efeito pa**

Pre and post values (mean±SD) for the cross-sectional area (CSA) of the triceps for the DS (drop set) and NS (normal set) groups.  
 ES: effect size of training.  
 \*P<0.05 significant increase compared to pre values.



## Rest-pause and drop-set training elicit similar strength and hypertrophy adaptations compared to traditional sets in resistance-trained males

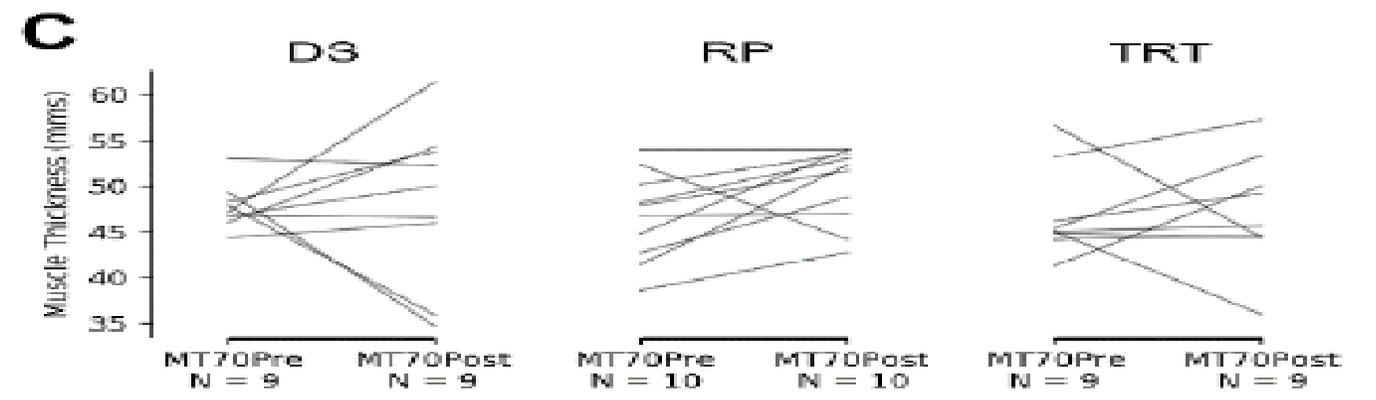
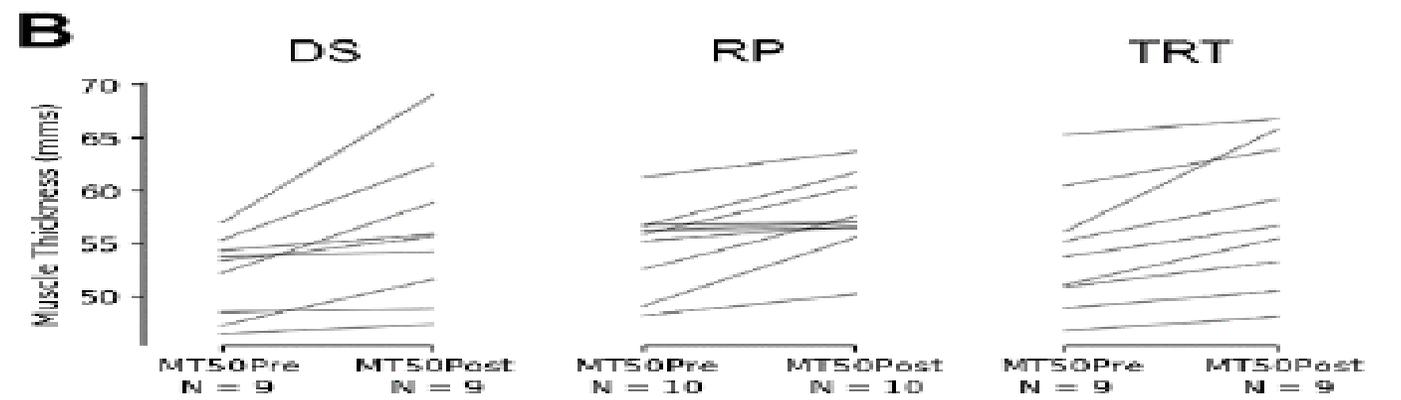
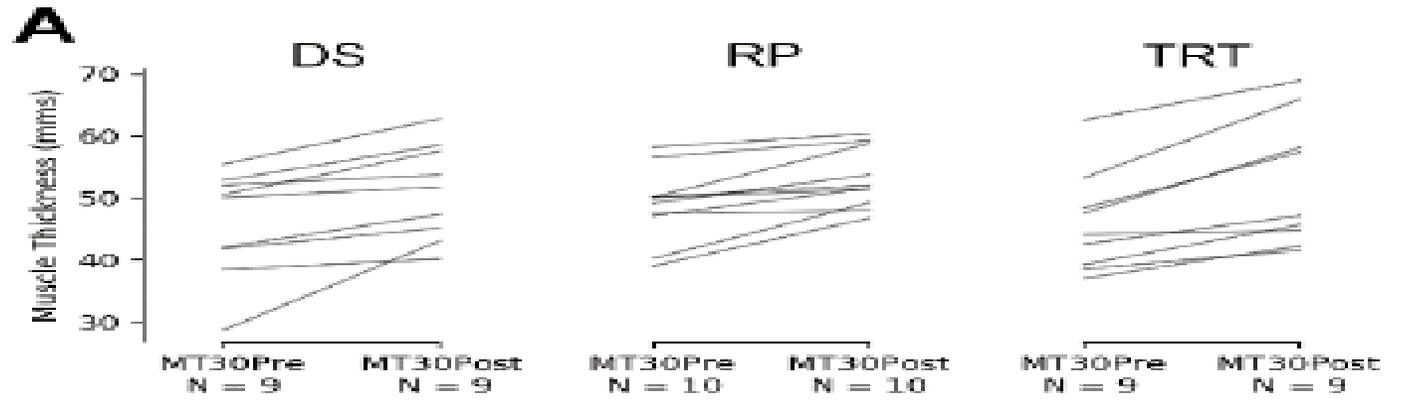
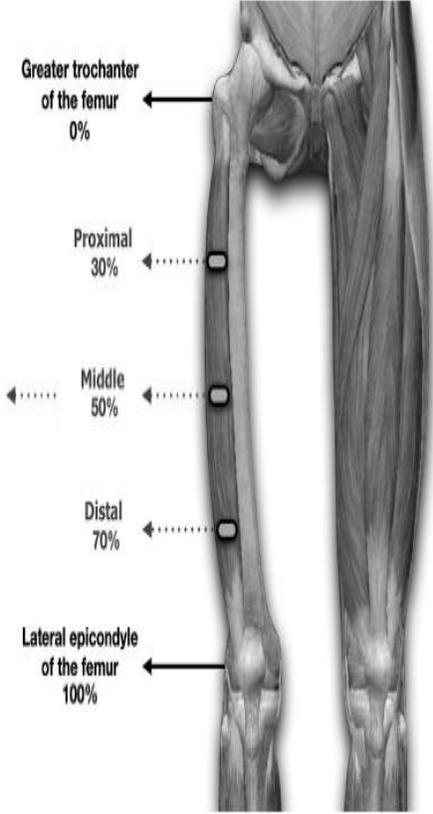
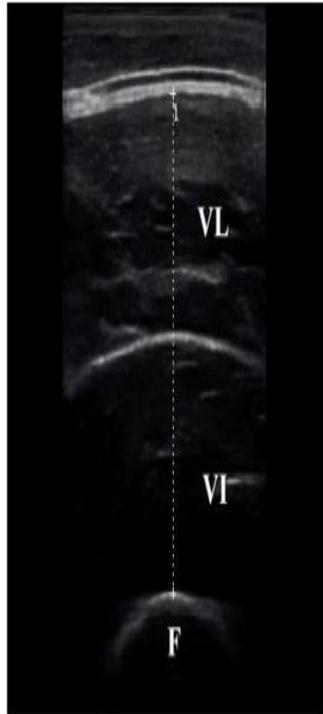
### Running head: Strength and hypertrophy adaptations in resistance training systems

Alysson Enes<sup>1</sup>, Ragami C. Alves<sup>1</sup>, Brad J. Schoenfeld<sup>4</sup>, Gustavo Oneda<sup>2</sup>, Samuel C. Perin<sup>1</sup>, Thiago B. Trindade<sup>3</sup>, Jonato Prestes<sup>3</sup>, Tácito P. Souza-Junior<sup>1</sup>

**Table 1.** Training protocols for rest-pause, drop-set and traditional resistance training.

Group	Sets	Reps	Load	Rest Interval
DS	3	10 + 6	75% 1RM 55% 1RM	120s between sets
RP	3	10 + 6	75% 1RM	Intra-set: 20s Between sets: 120s
TRT	4	12	70% 1RM	120s between sets

DS = Drop-set; RP = Rest-pause; TRT = Traditional Resistance Training; RM = repetition maximum; s = seconds.



# Recomendações práticas para uso de dropsets

Variável	
Sobrecarga	<ul style="list-style-type: none"><li>• Treinar em uma zona alvo (10 RM), reduzir 20-25% da carga e tentar alcançar mesma zona</li><li>• Reduções maiores geraram um TUT maior (~50%), e mais estresse metabólico. Redução menor (5-10%) compromete o volume de repetições</li></ul>
Intervalo	<ul style="list-style-type: none"><li>• Somente o suficiente para troca de carga</li></ul>
Volume	<ul style="list-style-type: none"><li>• Normalmente são 2-3 reduções de carga em um modelo dropset</li></ul>
Tempo	<ul style="list-style-type: none"><li>• Recomendações convencionais do treinamento</li></ul>
Seleção dos exercícios	<ul style="list-style-type: none"><li>• Pode ser aplicado em mono- e multi-articulares, porém, dar preferência a mono-articulares</li></ul>
Frequência	<ul style="list-style-type: none"><li>• Pode ser utilizado em semanas, mas o uso contínuo pode levar a um overtraining</li></ul>

Método	Exercício	Prescrição
Cluster set	Supino reto	5 x 5 / 90" int
Cluster set	Puxada aberta	5 x 5 / 90" int
Tradicional	Supino maquina	3 x 8 a 10
Tradicional	Remada neutra	3 x 8 a 10
Restpause	Biceps barra reta	1 x 40
Dropset	Triceps cross	1 x 40

Método	Exercício	Prescrição
Cluster set	Agachamento	6 x 3 / 90" int
Cluster set	Terra	6 x 3 / 90" int
Excêntrico	Flexão nórdica	3 x 8 a 10
Excêntrico	Passada Smith	3 x 8 a 10
Restpause	Cadeira extensora	1 x 50
Dropset	Cadeira flexora	1 x 50