

# PRP

## Fundamentos e aplicações

PROADI-SUS

Seminário Internacional  
Sobre o Uso e a Regulação do  
Plasma Rico em Plaquetas

Dr. Adriano Marques de Almeida



HOSPITAL  
SÍRIO-LIBANÊS



PROADI-SUS



Agência Nacional  
de Vigilância Sanitária



MINISTÉRIO  
DA SAÚDE

## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

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MBA - Fundação Getúlio Vargas

**NÃO POSSUO CONFLITOS DE INTERESSE COM  
RELAÇÃO A ESTA APRESENTAÇÃO**

**DISCLOSURES: NONE**

# PRP

## CONCENTRADO DE PLAQUETAS

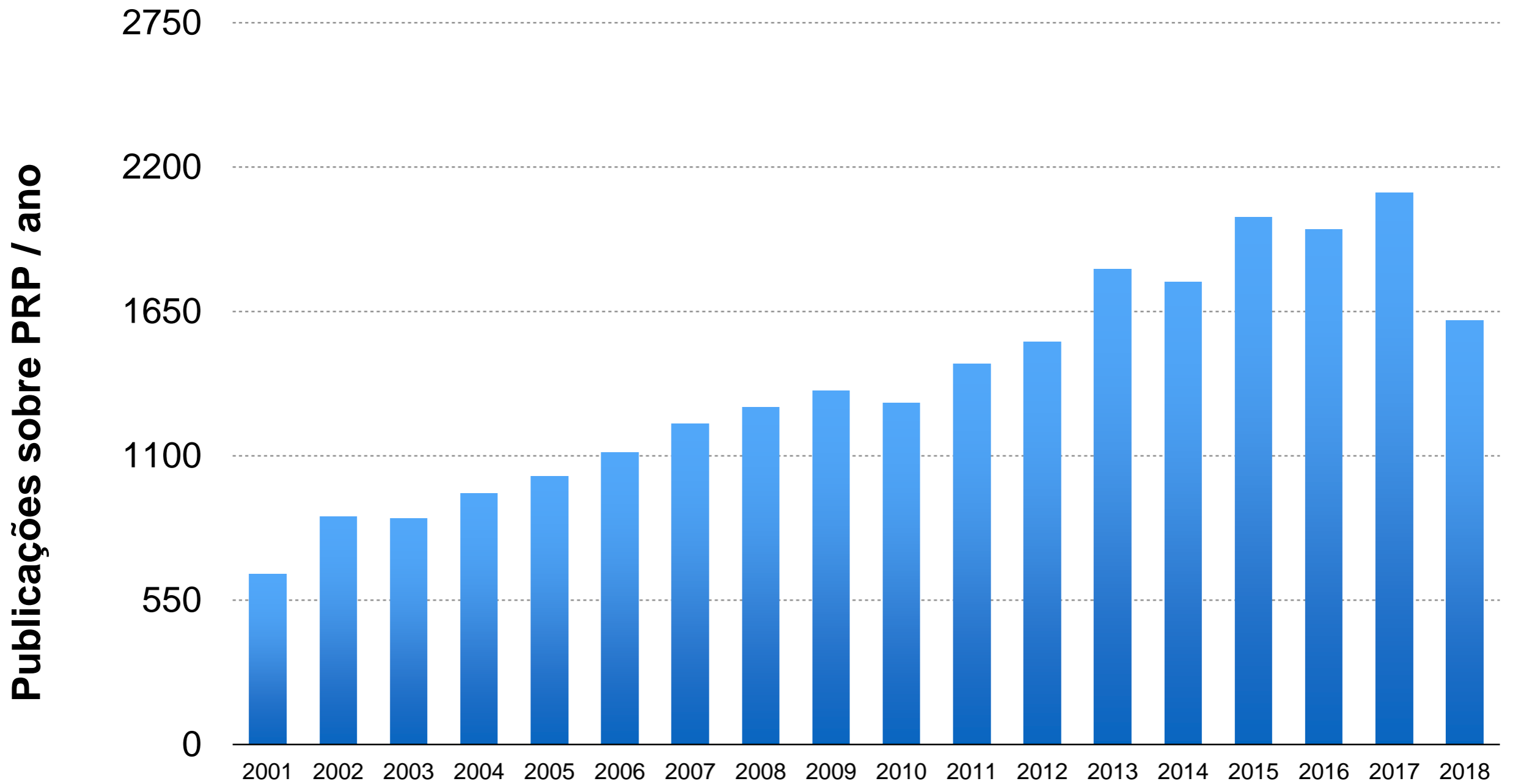
AUTÓLOGO  
NÃO TRANSFUSIONAL



## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

- PRP
- PRGF
- ACP
- ACS
- L-PRP
- P-PRP
- PRF
- PRFM

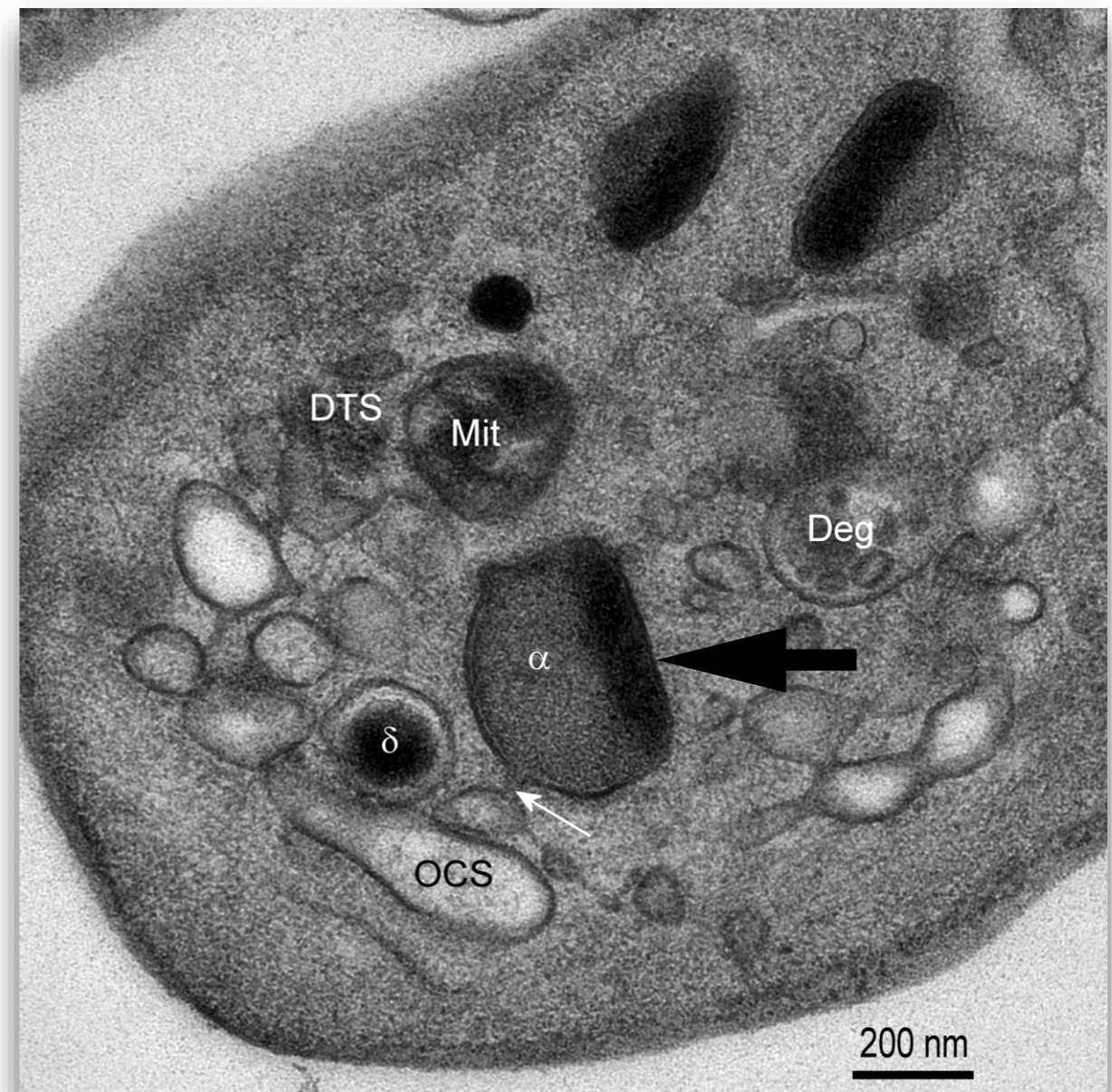
# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



**Termos: PRP, platelet-rich plasma, PRGF, plasma rich in growth factor, PRF, PRFM, platelet-rich fibrin matrix**

## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

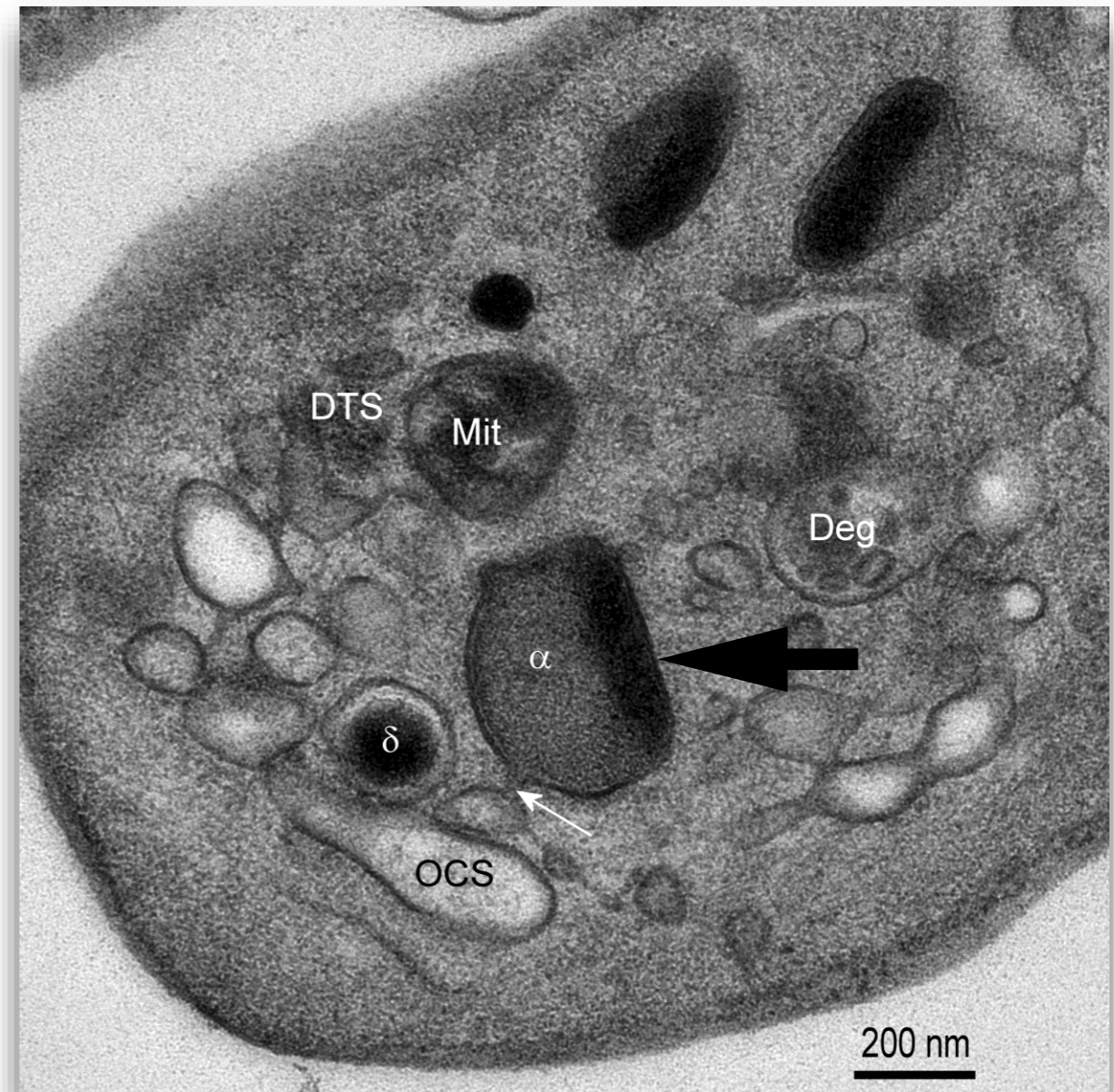
- Alfa-grânulos
- Proteínas de adesão
  - Fibrinogênio
  - Fibronectina
  - Vitronectina
- Fatores de coagulação
- Proteases



Foster et al. Platelet-rich plasma: from basic science to clinical applications. Am J Sports Med 2009; 37:2259-72.

## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

- Fatores de crescimento
  - TGF-beta
  - PDGF
  - IGF
  - FGF
  - EGF
  - VEGF

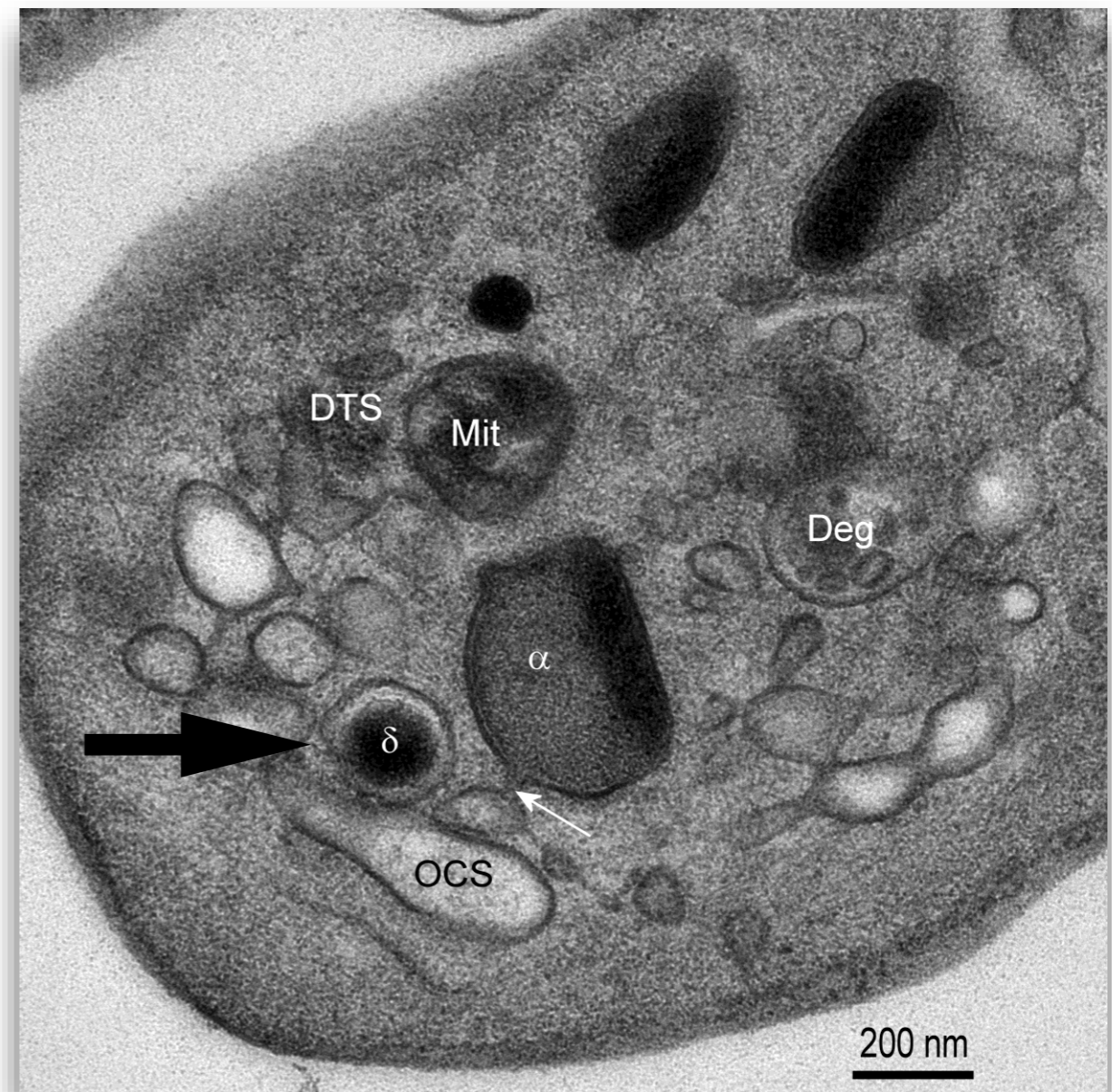


Foster et al. Platelet-rich plasma: from basic science to clinical applications. Am J Sports Med 2009; 37:2259-72.



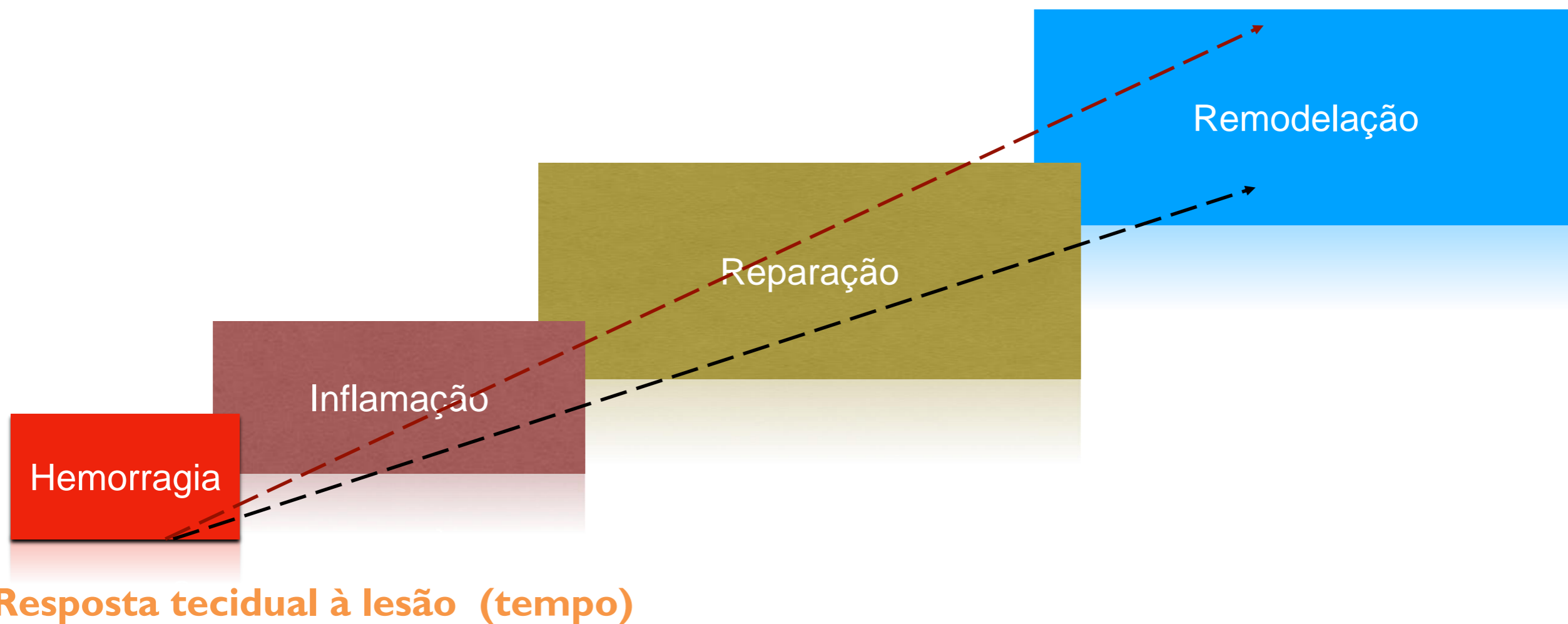
## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

- Grânulos densos
  - Serotonina
  - Histamina
  - Dopamina
  - ADP
  - ATP
  - Cálcio
  - Catecolaminas



Foster et al. Platelet-rich plasma: from basic science to clinical applications. Am J Sports Med 2009; 37:2259-72.

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

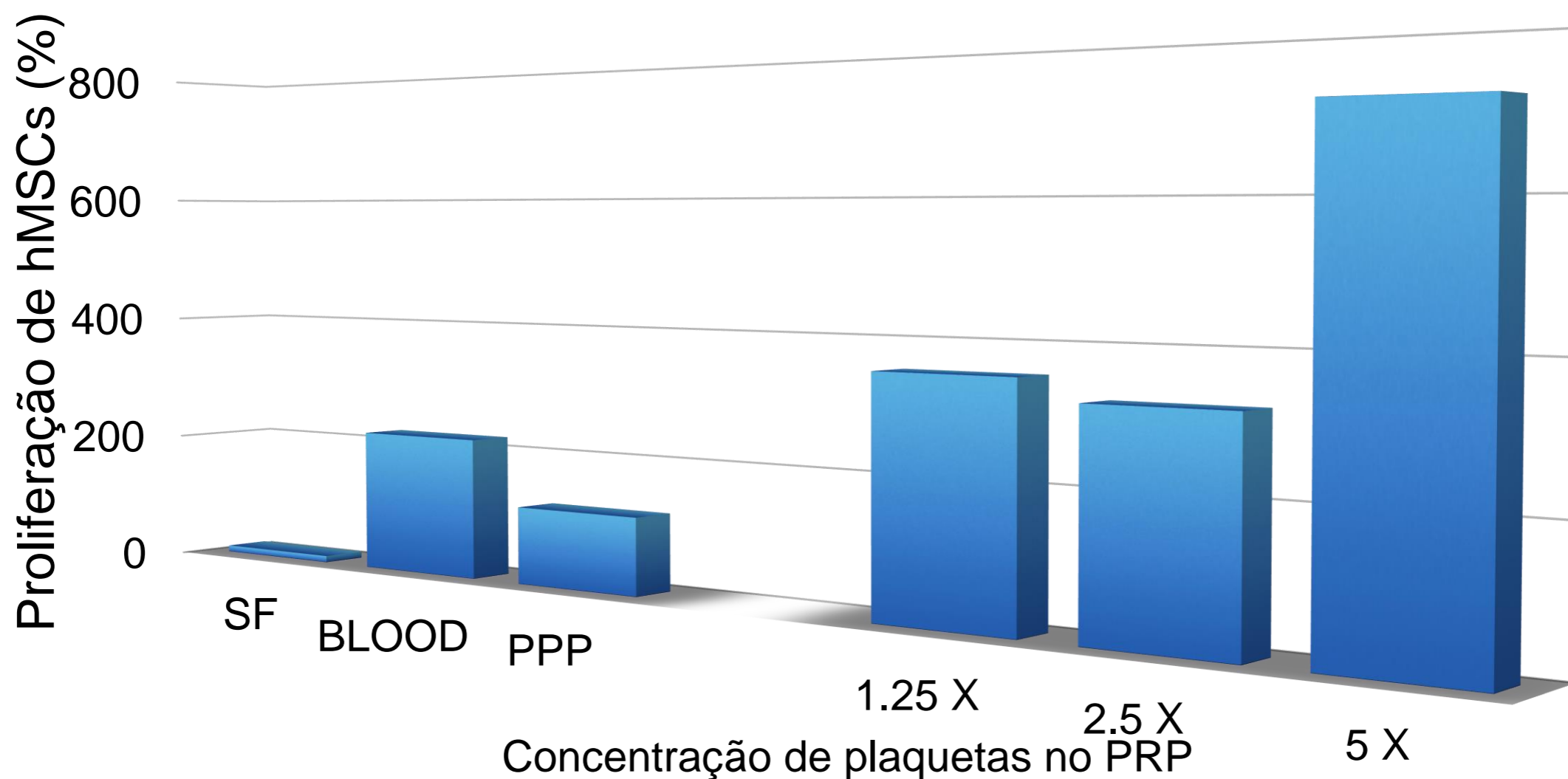


Com fator de crescimento



Fatores de crescimento presentes nos concentrados plaquetários podem estimular a reparação tecidual.

## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



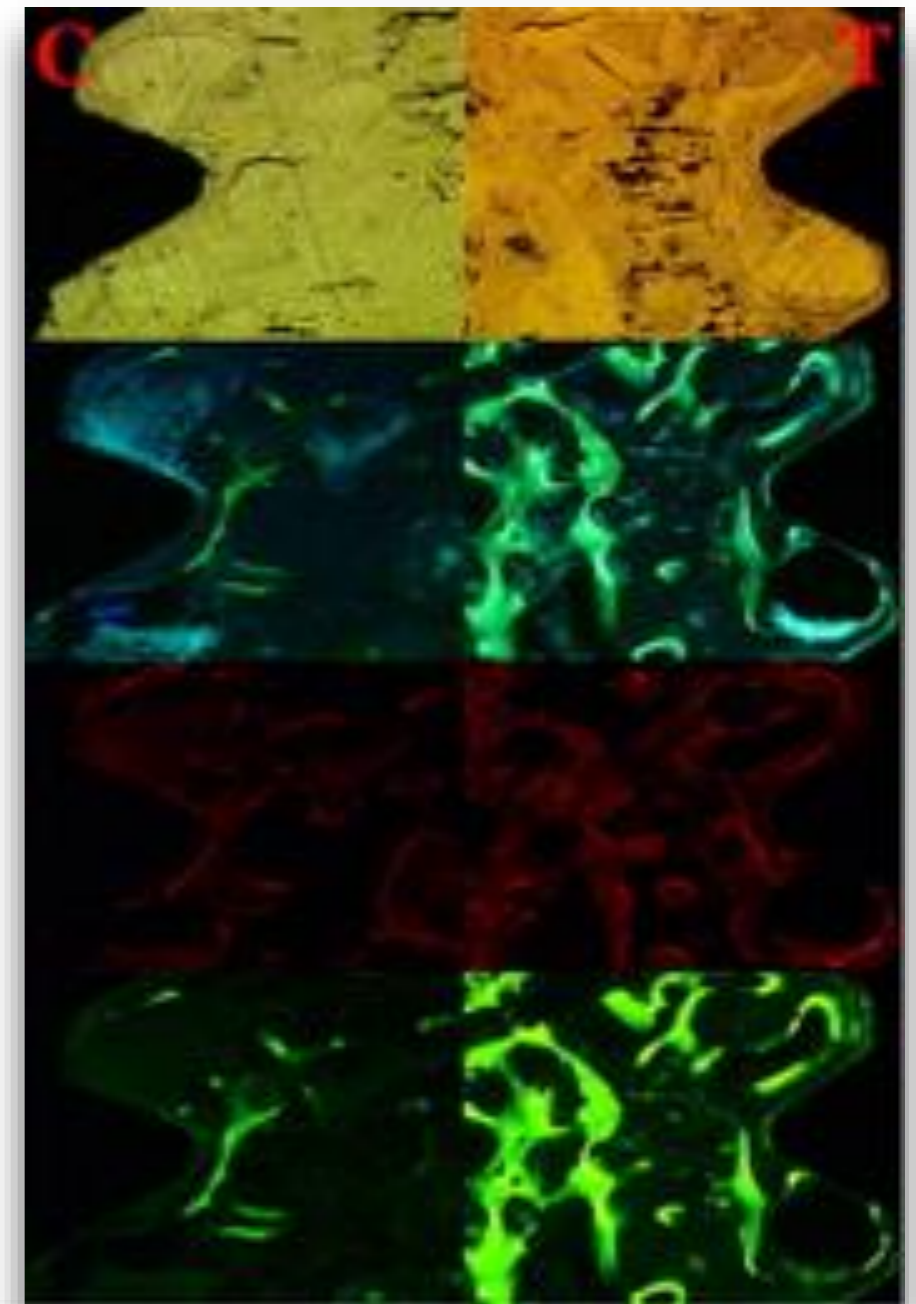
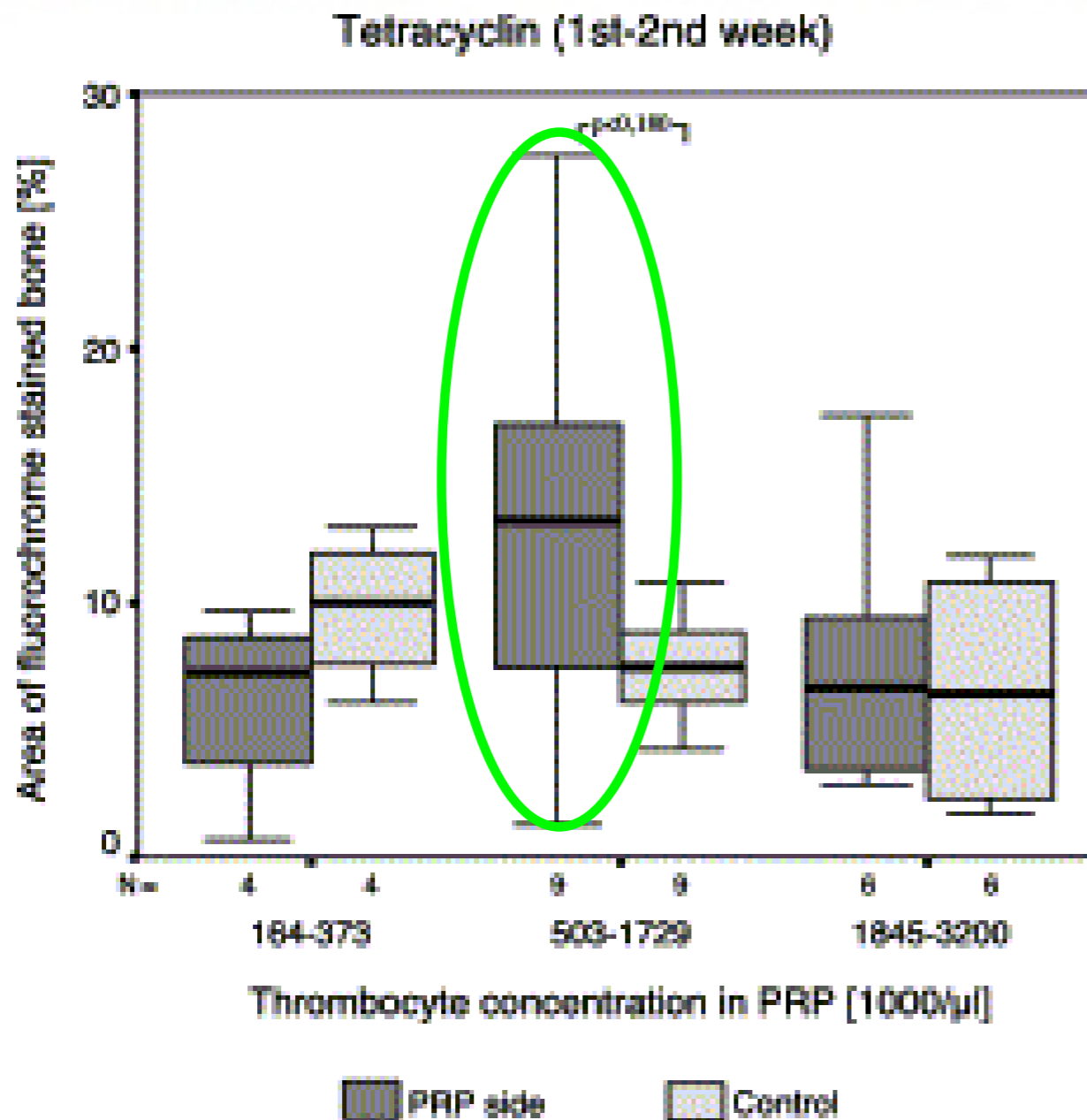
1.000.000/ $\mu$ l

Foster E, Am J Sports Med, 2009

Haynesworth S, AAOS Meeting 2002

Proliferação de hMSCs in vitro e concentração de plaquetas

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



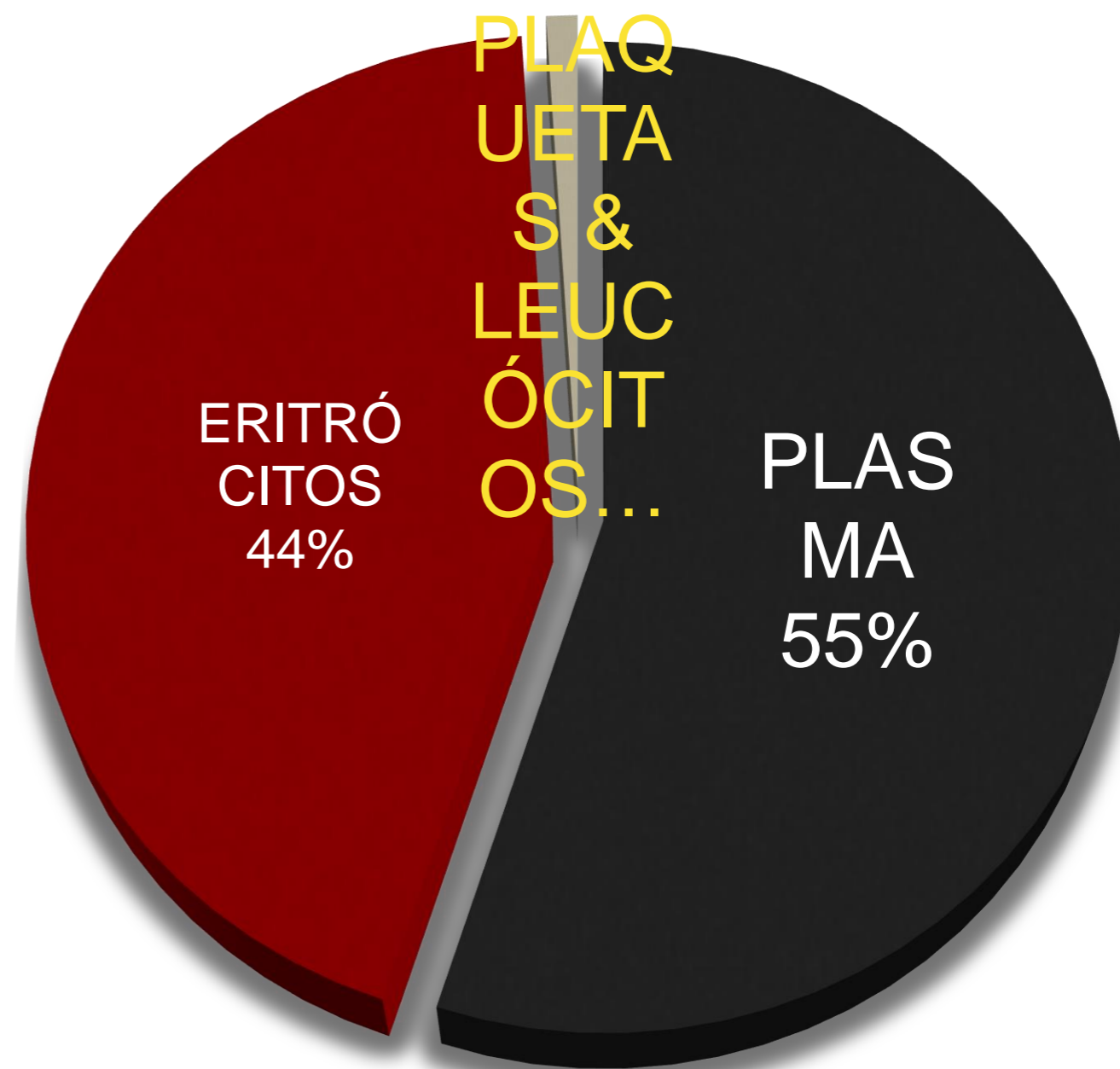
G Weibrich, T Hansen, W Kleis, R Buch, W.E Hitzler

Effect of platelet concentration in platelet-rich plasma on peri-implant bone regeneration

Bone, Volume 34, Issue 4, 2004, 665-671

## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

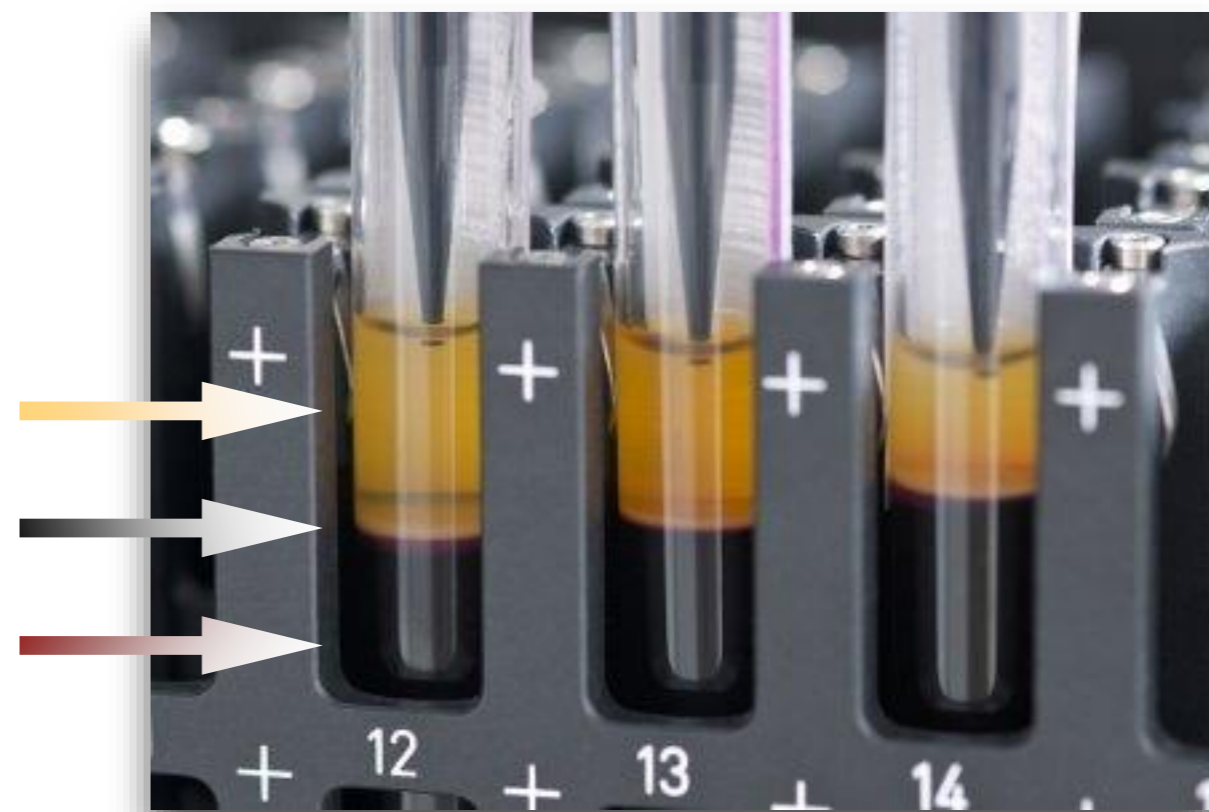
- ERITRÓCITOS
- PLAQUETAS
- LEUCÓCITOS
  - Neutrófilos
  - Eosinófilos
  - Basófilos
  - Linfócitos
  - Monócitos



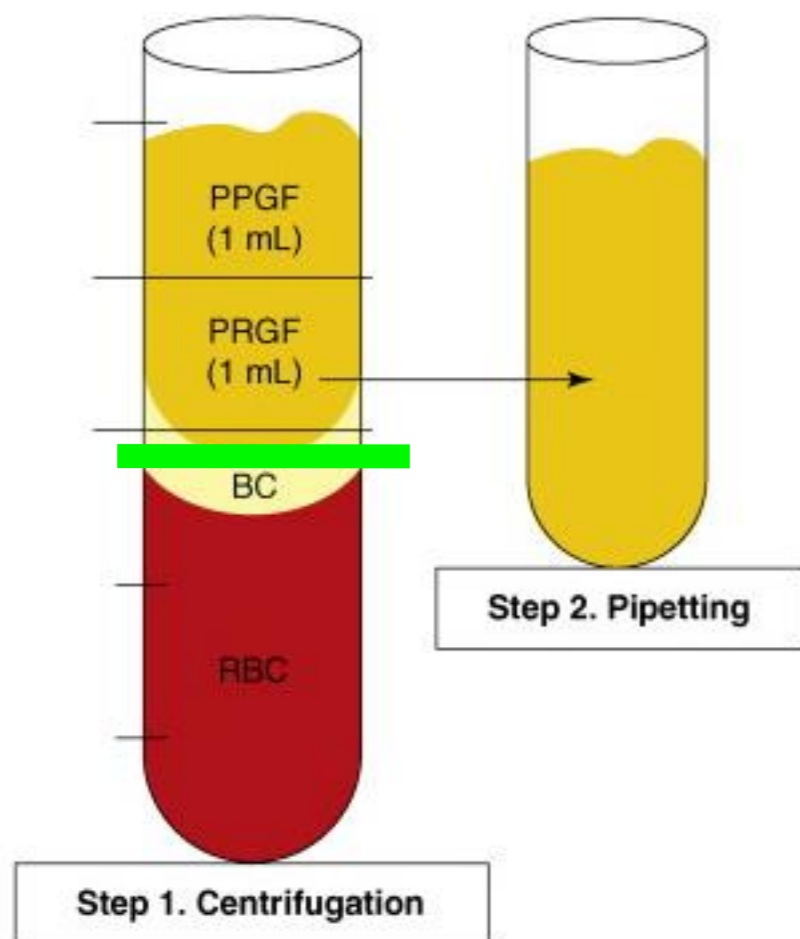
# Centrifugação



"buffy coat"

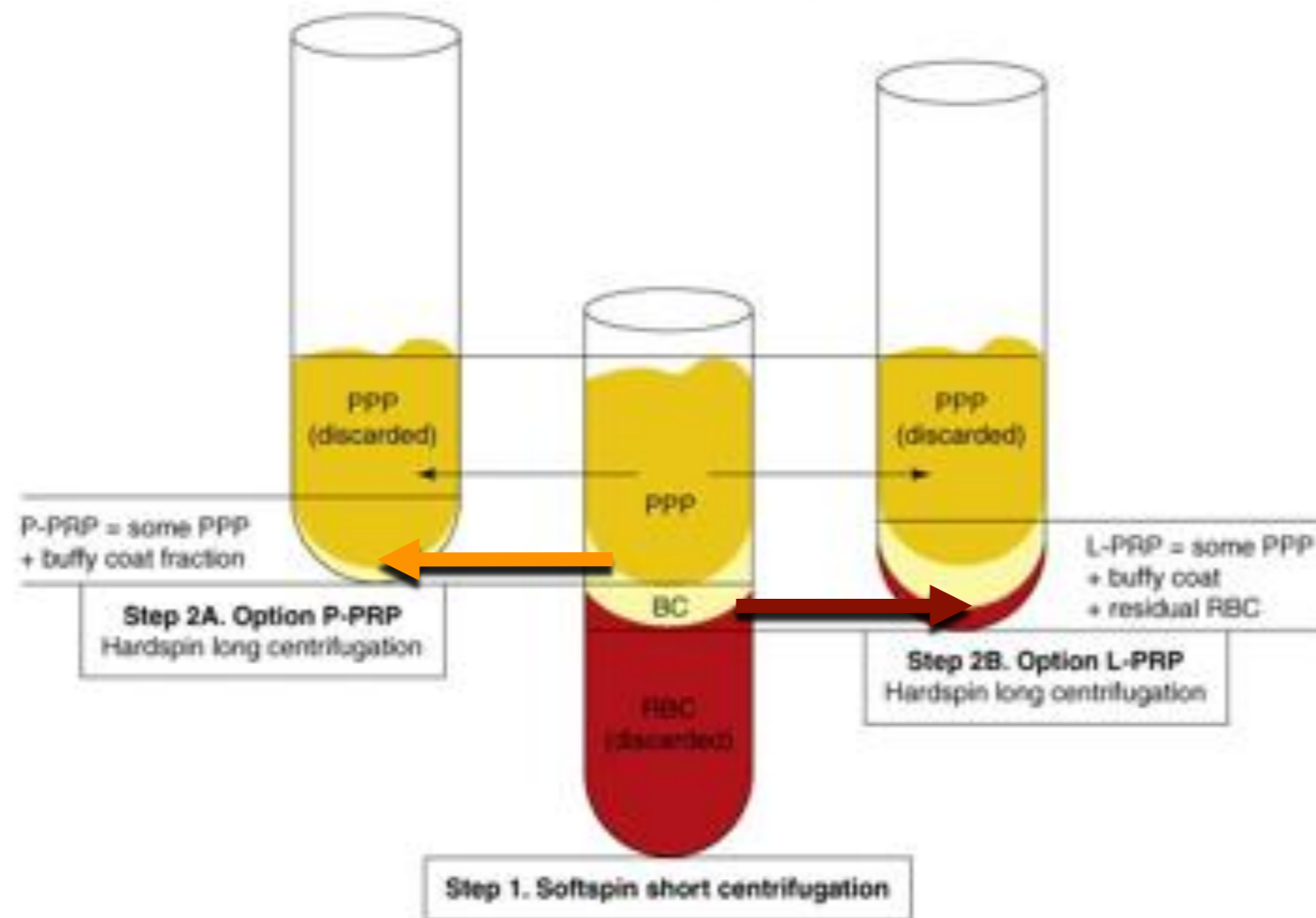


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- Centrifugação a 460g por 8 minutos
- Tubo com anticoagulante
  - Citrato de sódio
  - não usar EDTA
    - lesão da membrana plaquetária (Landesberg, 2000)
- **PRGF**
- Plasma Rich in Growth Factors
  - 2 - 3 vezes [plaquetas]
  - pobre em leucócitos
  - Endoret, BTI Institute

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- 1ª Centrifugação 100 a 300 g por 5 a 10'
- Separação do plasma e *buffy coat*
- 2ª Centrifugação por 100 a 500 g por 10'



## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



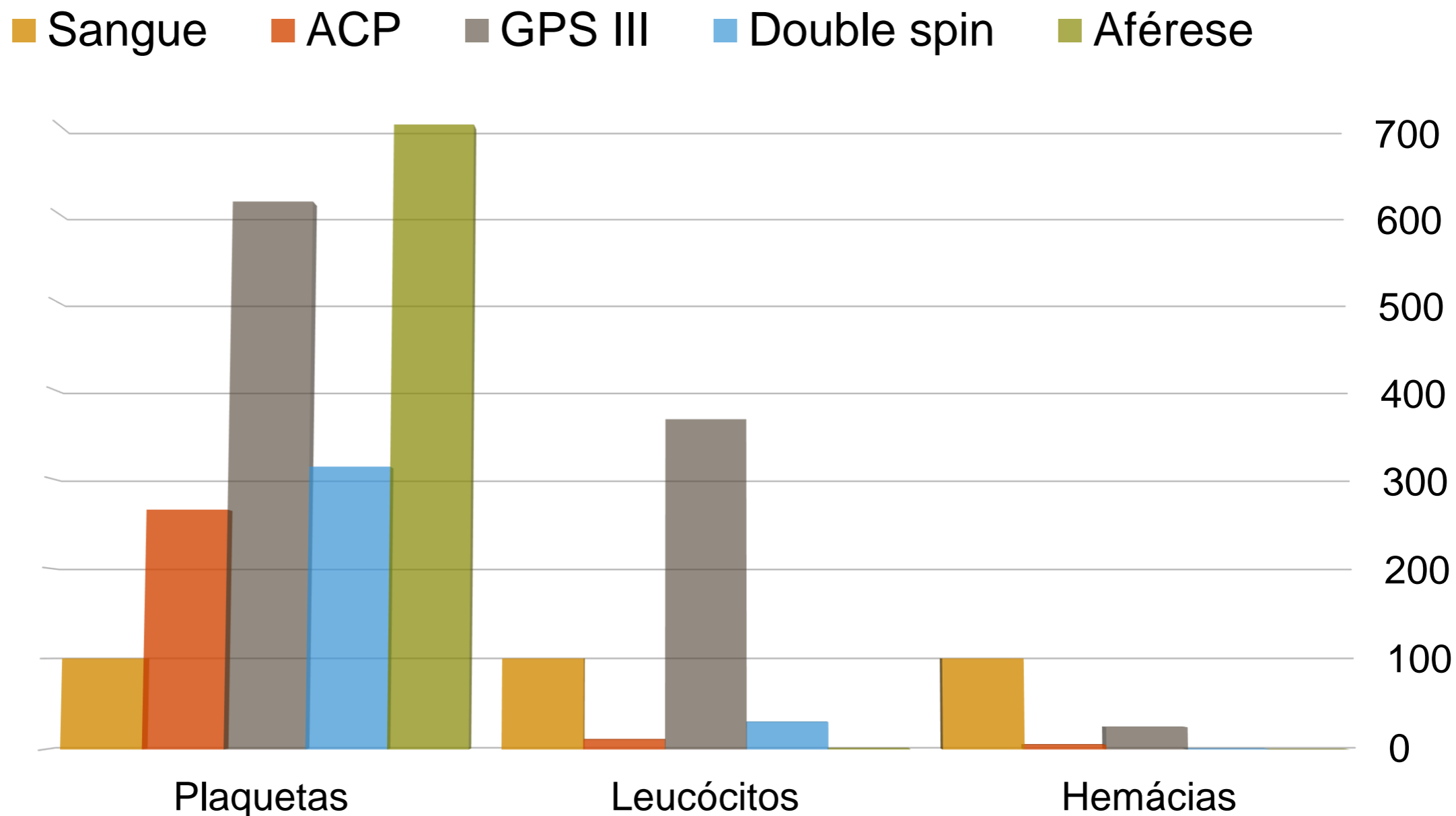
Fonte: Shutterstock

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## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

Celularidade de acordo com o método de obtenção do PRP.



A.D. Mazzocca, M.B. McCarthy, D.M. Chowaniec, et al.  
Platelet-rich plasma differs according to preparation method and human variability  
J Bone Joint Surg Am, 94 (2012), pp. 308–316

Plasma-Based and Buffy Coat–Based PRP Systems					
Device Name	Centrifuge Time (min)	Initial Blood Volume (mL)	Final PRP Volume (mL)	Platelet Concentration From Baseline	WBC Content
<b>Plasma-based PRP systems</b>					
ACP Arthrex (Naples, FL)	5	16	4 - 7	2x-3x	Minimal to none
Cascade MTF Fibrinet	6 (plasma); 21 (clot)	9	4.5 (plasma); 2 (clot)	1.3x-1.7x (plasma)	Minimal to none
PRGF BTI (Vitoria-Gasteiz, Spain)	8	9	2 - 3	2x-3x	Minimal to none
<b>Buffy coat–based PRP systems</b>					
GPS II/III Biomet (Warsaw, IN)	12 - 15	30 or 60	3 or 6	2x-8x	Increased over baseline
SmartPReP 2 Harvest (Plymouth, MA)/Symphony II DePuy (Warsaw, IN)	12 - 15	20 or 60	3 or 7-10	3x-7x	Increased over baseline
Magellan Arteriocyte Medtronic (Minneapolis, MN)	14-20	30 or 60	3 - 10	3x-7x	Increased over baseline
Genesis CS Emcyte (Fort Myers, FL) Accelerate Exactech (Gainesville, FL)	12	30 or 60	3 or 10	7x-10x	Increased over baseline
<b>Apheresis</b>	25-30	400	30-40	7-10x	Minimal to none

Platelet-Rich Plasma: The PAW Classification System  
 Jeffrey M. DeLong, Ryan P. Russell, Augustus D. Mazzocca  
**Arthroscopy**, 2012.

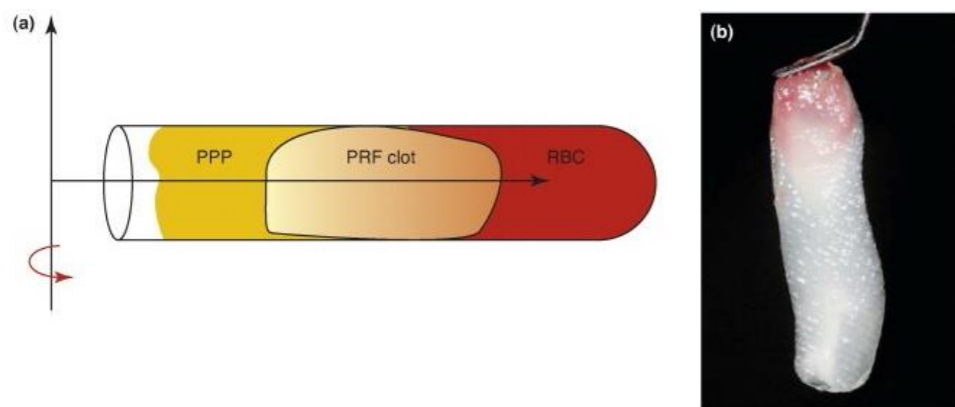
## Contributions for classification of platelet rich plasma – proposal of a new classification: MARSPILL

Jose Fabio Santos Duarte Lana [✉](#), Joseph Purita, Christian Paulus, Stephany Cares Huber, Bruno Lima Rodrigues, Ana Amélia Rodrigues, Maria Helena Santana, João Lopo Madureira Jr, Ângela Cristina Malheiros Luzo, William Dias Belangero & Joyce Maria Annichino-Bizzacchi

Published Online: 31 Jul 2017 | <https://doi.org/10.2217/rme-2017-0042>

Letter	Relates to	Type
<b>M</b>	Method	Handmade (H) Machine (M)
<b>A</b>	Activation	Activated (A+) Not activated (A-)
<b>R</b>	Red blood cells	Rich (RBC-R) Poor (RBC-P)
<b>S</b>	Spin	One spin (Sp1) Two spins (Sp2)
<b>P</b>	Platelet number (folds basal)	PL 2–3 PL 6–8 PL 4–6 PL 8–10
<b>I</b>	Image guided	Guided (G+) Not guided (G-)
<b>L</b>	Leukocyte concentration	Rich (Lc-R) Poor (Lc-P)
<b>L</b>	Light activation	Activated (A+) Not activated (A-)

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

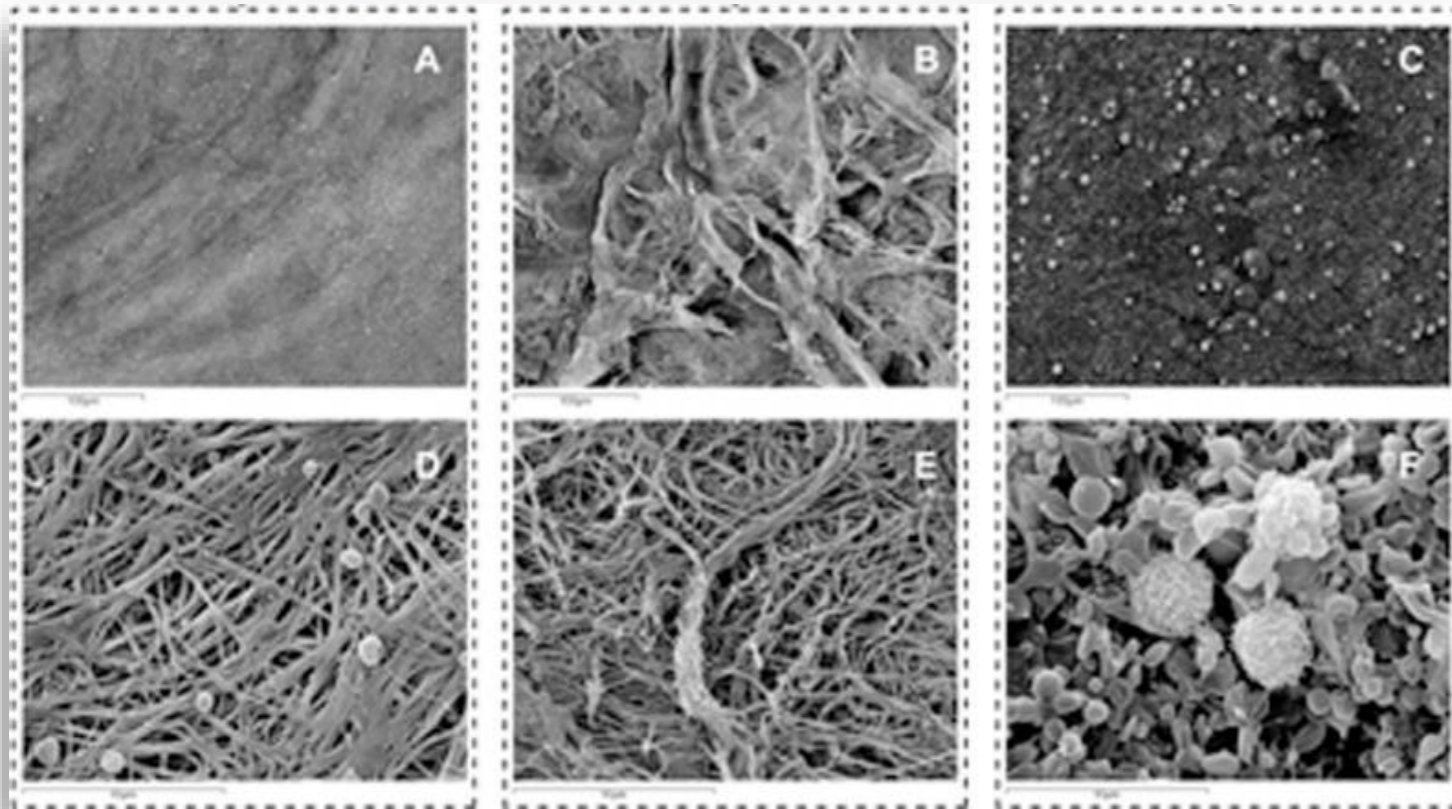


Dohan Ehrenfest D, Rasmusson L, Albrektsson T. Trends in Biotechnology, 2009

- **PRF**
- Platelet-rich fibrin
- Tubo sem anticoagulante
  - Centrifugação a 460g por 10 minutos
  - J. Choukroun



Dohan D, Choukroun J, Diss A. Oral Surg, 2006.



- **PRFM**
- Platelet-rich fibrin matrix
- Centrifugação com citrato
  - Centrifugação do PRP com  $\text{CaCl}_2$
  - Cascade MTF / Fibrinet

Stress  
KPa

Elongation  
%

Elastic modulus  
Kpa

**1476 ± 526.3**

**146.3 ± 33.8**

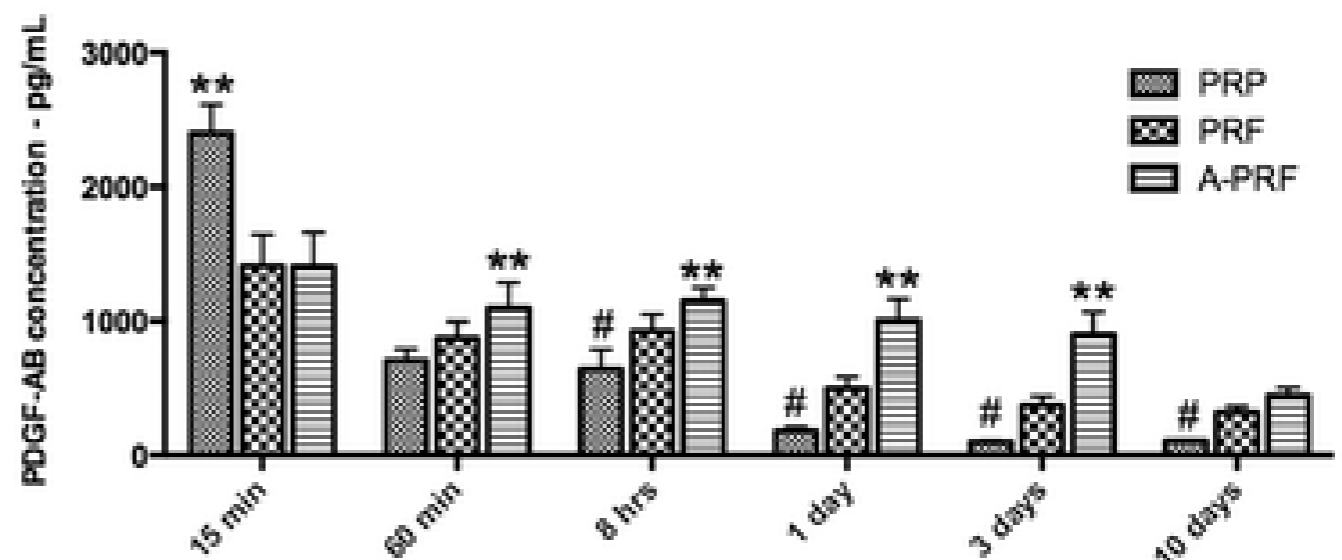
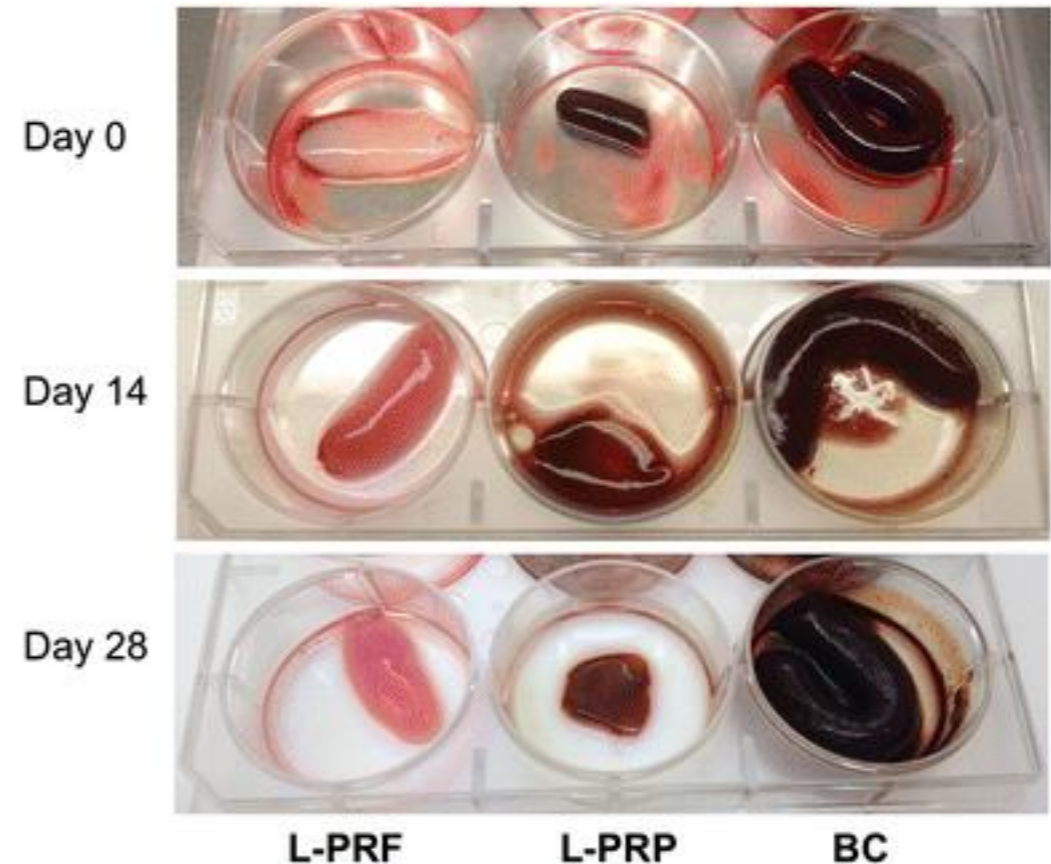
**937.3 ± 314.6**

A RECENTLY DEVELOPED BIFACIAL PLATELET-RICH FIBRIN MATRIX  
 E. Lucarelli, et al. European Cells and Materials, 2010.

## Comparative release of growth factors from PRP, PRF, and advanced-PRF

Eizaburo Kobayashi, Laura Flückiger, Masako Fujioka-Kobayashi, Kosaku Sawada, Anton Sculean, Benoit Schaller, Richard J. Miron

- Liberação rápida de GFs pelo PRP
- PRF libera gradualmente e em quantidade total maior
  - Liberação de fatores de crescimento por até 14 dias
- Durabilidade maior do PRF



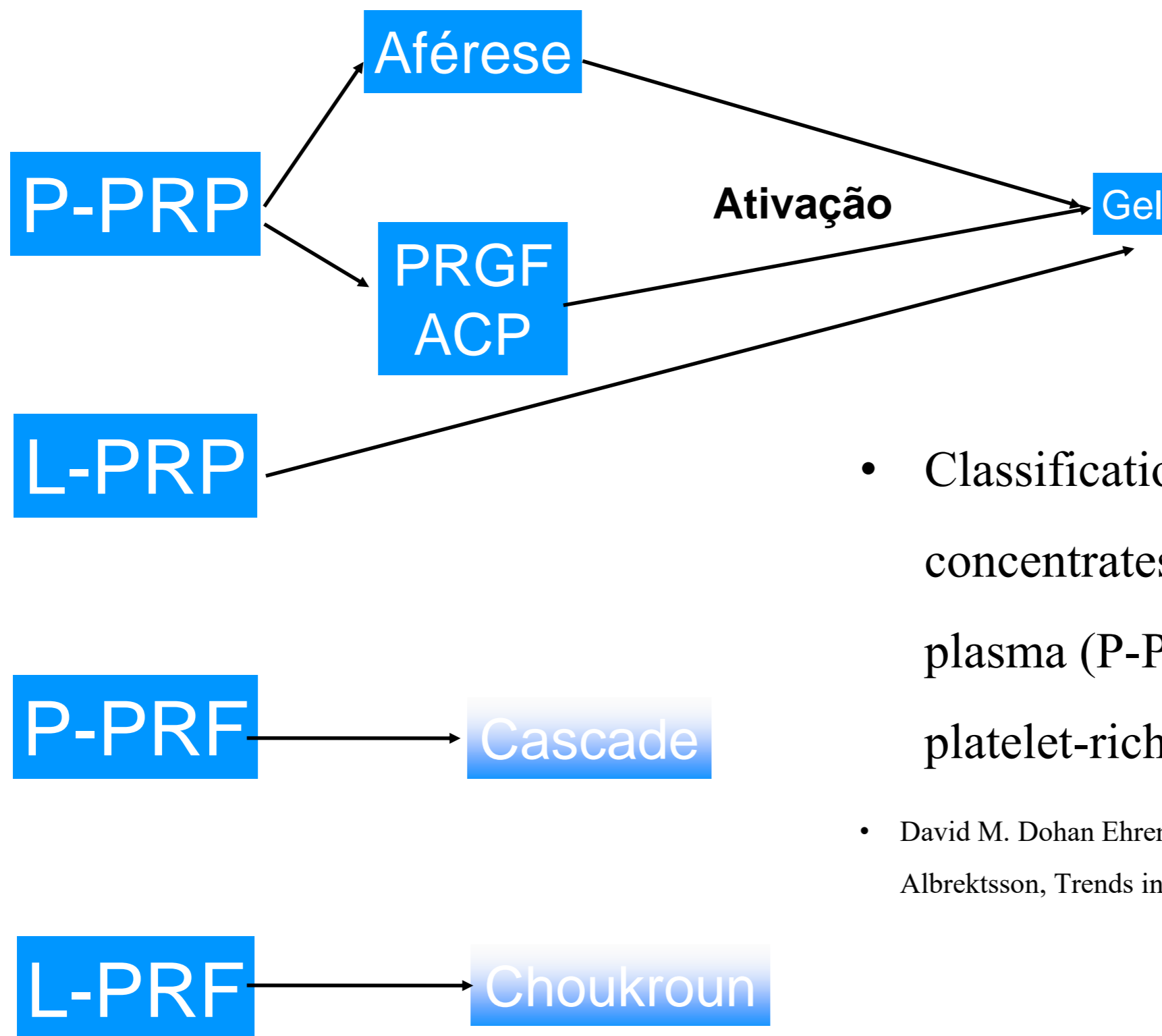


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Sanchez M *et al.* Comparison of surgically repaired Achilles tendon tears using platelet-rich fibrin mat

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



- Classification of platelet concentrates: from pure platelet-rich plasma (P-PRP) to leucocyte- and platelet-rich fibrin (L-PRF)
- David M. Dohan Ehrenfest, Lars Rasmusson and Tomas Albrektsson, Trends in Biotechnology, 2009

## Utilização em ortopedia e medicina esportiva

- Tendinopatias
- Lesões musculares
- Lesões ligamentares
- Lesões condrais
- Osteoartrite

# Tendinopatia patelar

# PÓS





## **The Efficacy of Platelet-Rich Plasma on Tendon and Ligament Healing**

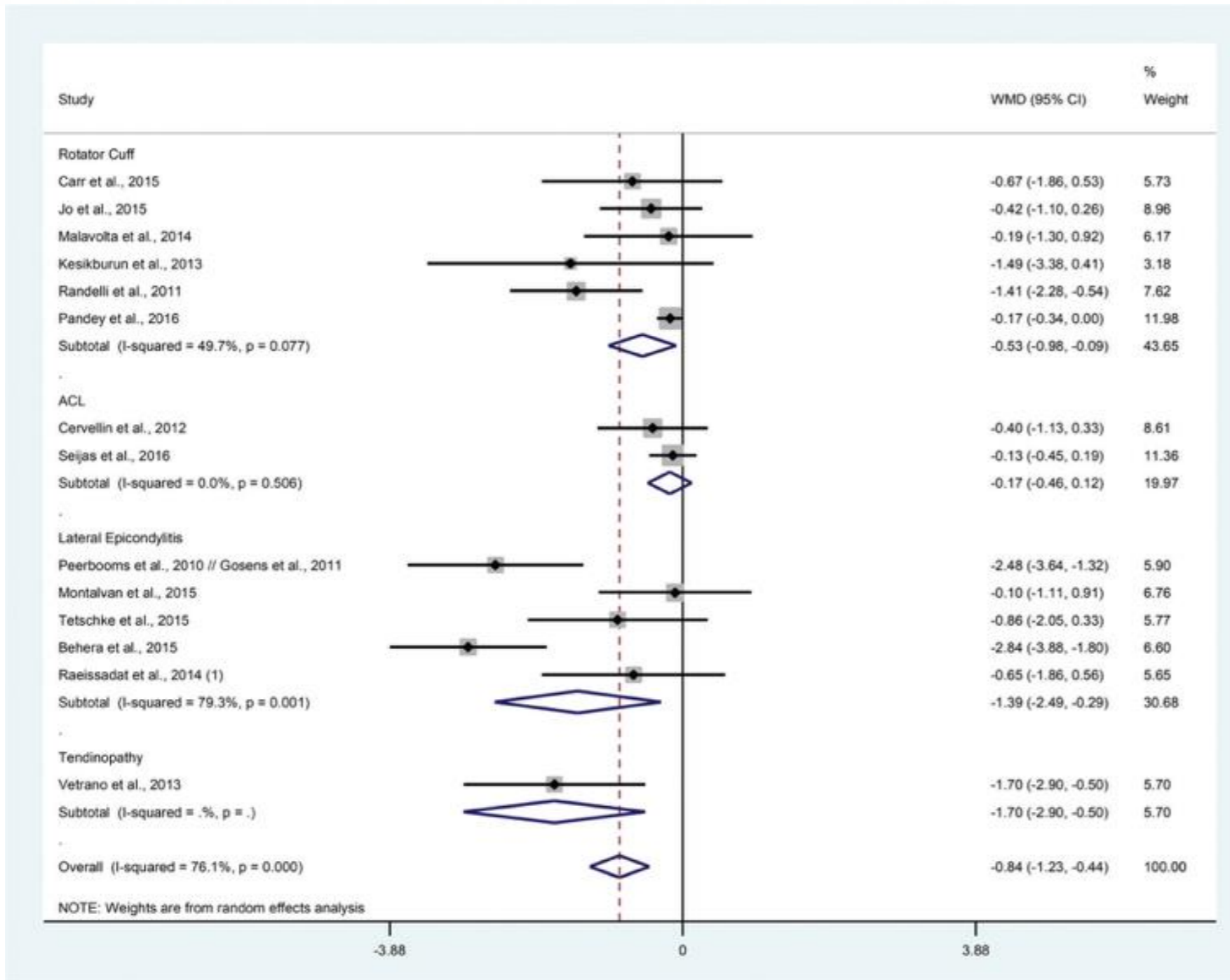
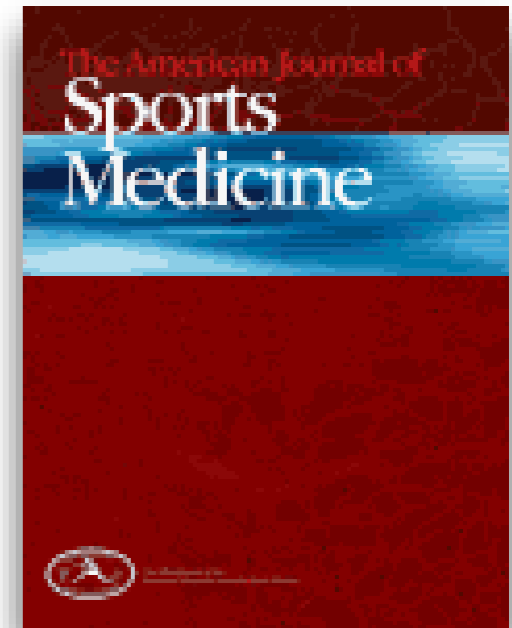


### **A Systematic Review and Meta-analysis With Bias Assessment**

Xiao Chen,<sup>\*</sup> BA, Ian A. Jones,<sup>\*</sup> BA, Caron Park,<sup>†</sup> PhD, and C. Thomas Vangsness Jr,<sup>\*‡</sup> MD  
*Investigation performed at Keck School of Medicine of USC, Los Angeles, California, USA*

- 37 artigos (nível I de evidência)
- 21 artigos incluídos para metanálise

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



Published in: Xiao Chen; Ian A. Jones; Caron Park; C. Thomas Vangsness Jr; *Am J Sports Med* 46, 2020-2032.

DOI: 10.1177/0363546517743746

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- 18 kits diferentes (7 estudos não descreveram)
  - GPS III (9 estudos); ACP (4 estudos)
- 40% dos estudos quantificaram plaquetas
- 24% dos estudos quantificaram leucócitos
- Nenhum (0) efeito adverso importante



TABLE 2  
PRP Metrics<sup>a</sup>

	No. of Studies Reporting Value	Volume or Concentration, Mean $\pm$ SD
PRP volume, mL	31	5.30 $\pm$ 5.76
Platelet concentration, platelets/ $\mu$ L	15	845,897 $\pm$ 298,003
WBC concentration in leukocyte-poor PRP, WBCs/ $\mu$ L	6	131 $\pm$ 279
WBC concentration in leukocyte-rich PRP, WBCs/ $\mu$ L	3	8481 $\pm$ 2769

<sup>a</sup>PRP, platelet-rich plasma; WBC, white blood cell.

Published in: Xiao Chen; Ian A. Jones; Caron Park; C. Thomas Vangsness Jr; *Am J Sports Med* 46, 2020-2032.

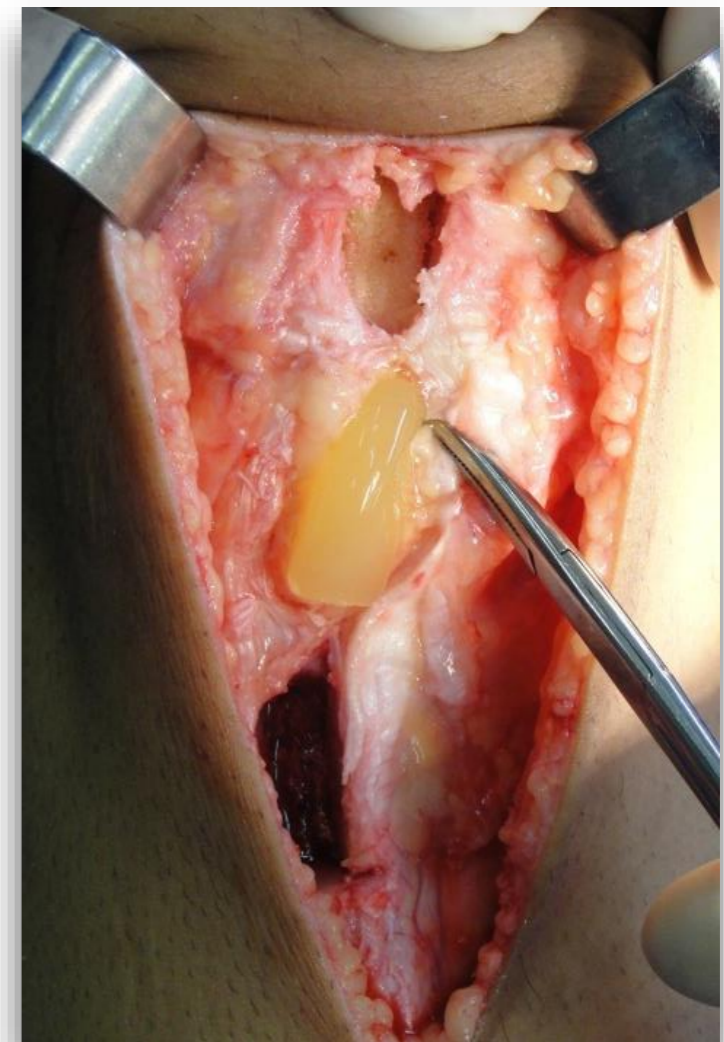
DOI: 10.1177/0363546517743746

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# Patellar Tendon Healing With Platelet-Rich Plasma

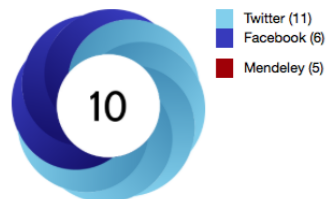
## A Prospective Randomized Controlled Trial

Adriano Marques de Almeida,<sup>\*†</sup> MD, MS, Marco Kawamura Demange,<sup>†</sup> MD, PhD, Marcel Faraco Sobrado,<sup>†</sup> Marcelo Bordalo Rodrigues,<sup>†</sup> MD, André Pedrinelli,<sup>†</sup> MD, PhD, and Arnaldo José Hernandez,<sup>†</sup> MD, PhD



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## Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas



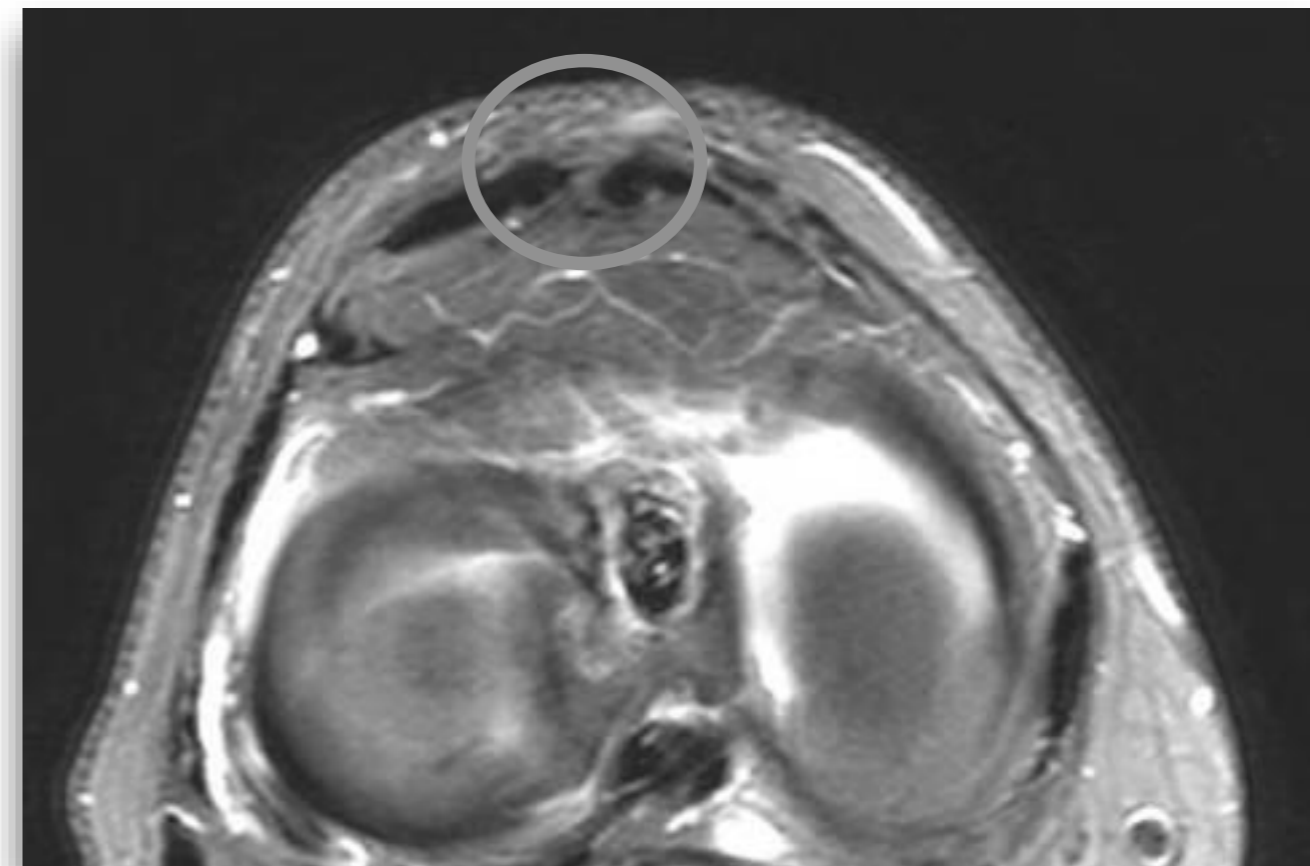
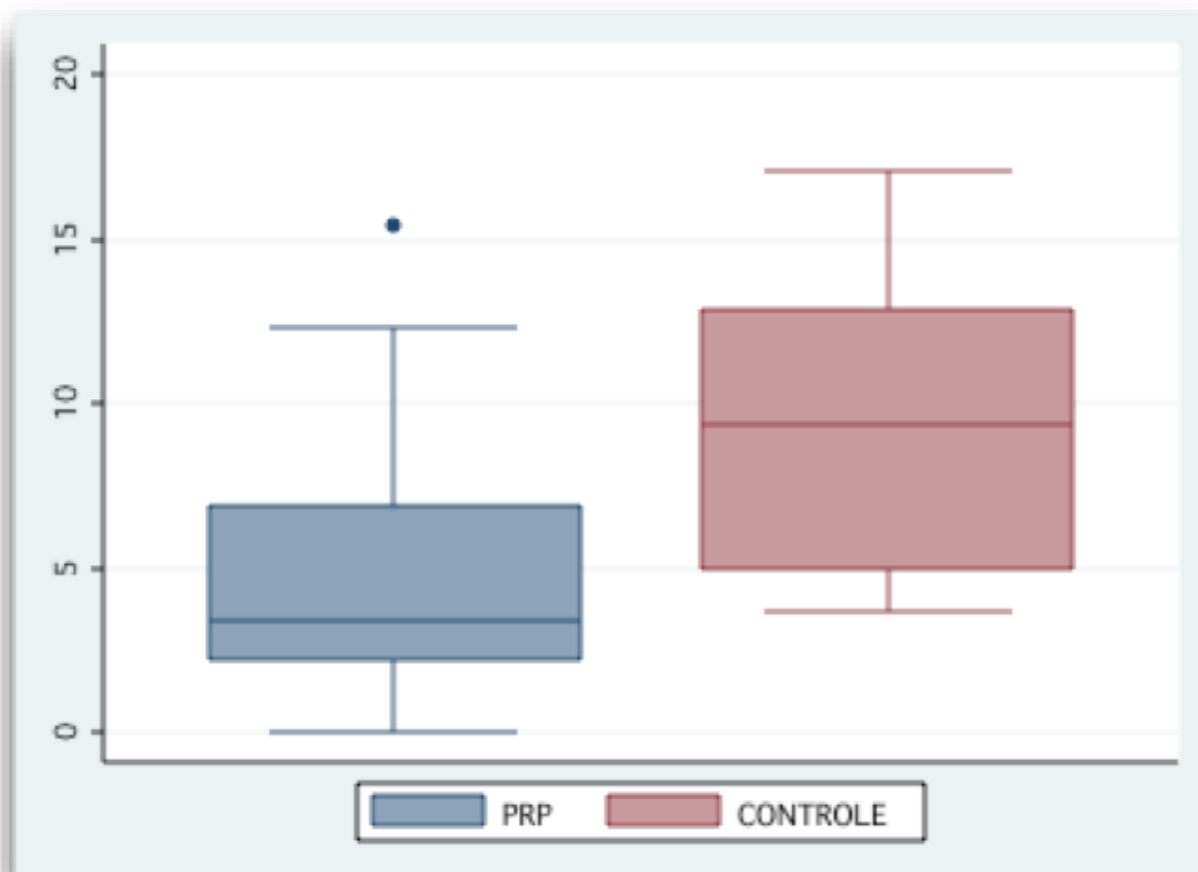
- Ativação para formação de gel
  - Colágeno tecidual
  - Trombina
    - bovina
    - autóloga
  - Cloreto de cálcio



# Patellar Tendon Healing With Platelet-Rich Plasma

## A Prospective Randomized Controlled Trial

Adriano Marques de Almeida,<sup>\*†</sup> MD, MS, Marco Kawamura Demange,<sup>†</sup> MD, PhD, Marcel Faraco Sobrado,<sup>‡</sup> Marcelo Bordalo Rodrigues,<sup>†</sup> MD, André Pedrinelli,<sup>†</sup> MD, PhD, and Arnaldo José Hernandez,<sup>†</sup> MD, PhD





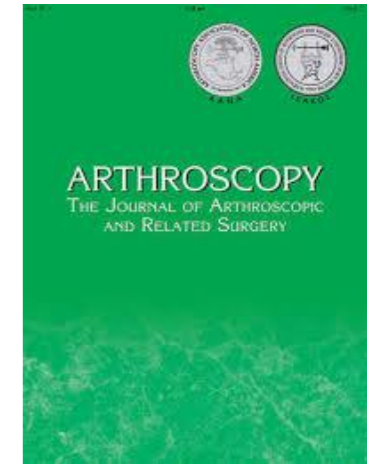
## Effect of Intraoperative Platelet-Rich Plasma Treatment on Postoperative Donor Site Knee Pain in Patellar Tendon Autograft Anterior Cruciate Ligament Reconstruction

### A Double-Blind Randomized Controlled Trial

Brian L. Walters,<sup>\*†</sup> MD, David A. Porter,<sup>†</sup> MD, Sarah J. Hobart,<sup>†</sup> MD, Benjamin B. Bedford,<sup>†</sup> MD, Daniel E. Hogan,<sup>‡</sup> MS, Malachy M. McHugh,<sup>‡</sup> PhD, Devon A. Klein,<sup>§</sup> MD, Kendall Harousseau,<sup>‡</sup> PA, and Stephen J. Nicholas,<sup>†</sup> MD  
*Investigation performed at Lenox Hill Hospital, New York, New York, USA*

	Plaquetas (mm <sup>3</sup> )	x basal	Leucócitos (mm <sup>3</sup> )
Almeida et al	1.185.166	7,65X	0,91
Walters et al	n.c	2-3x	n.c

Seminário Internacional Sobre o Uso e a  
Regulação do Plasma Rico em Plaquetas



*Efficacy of Platelet-Rich Plasma in the Treatment of Knee Osteoarthritis:*

*A Meta-analysis of Randomized Controlled Trials*

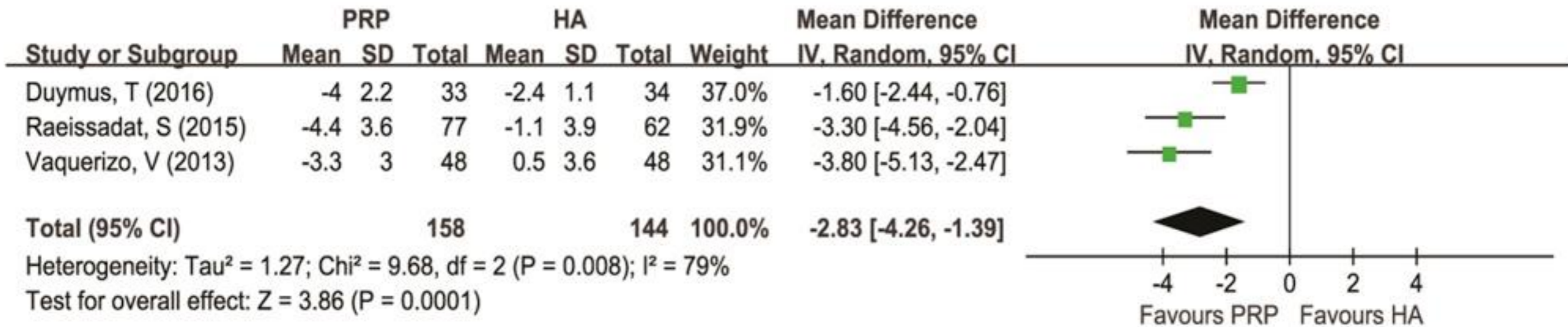
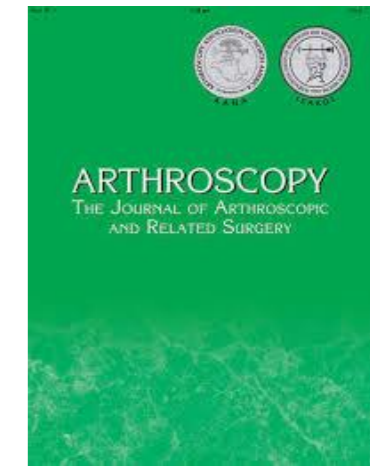
*Wen-Li Dai, M.Sc., Ai-Guo Zhou, M.D., Hua Zhang, M.D., Jian Zhang, M.D.*

*Wen-Li Dai, M.Sc., Ai-Guo Zhou, M.D., Hua Zhang, M.D., Jian Zhang,*

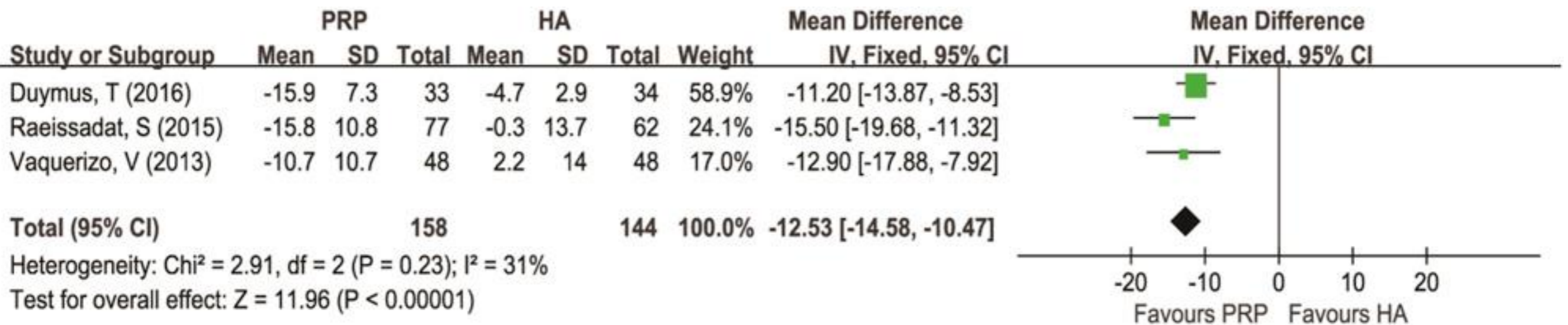
*M.D. Arthroscopy*

Volume 33, Issue 3, Pages 659-670.e1 (March 2017)

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

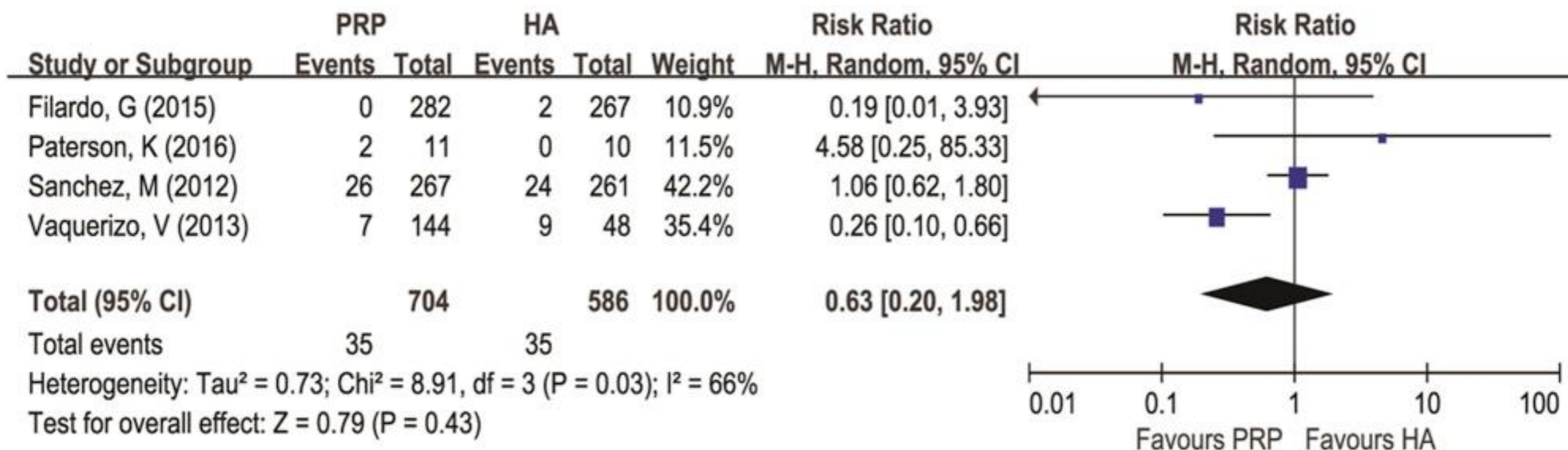
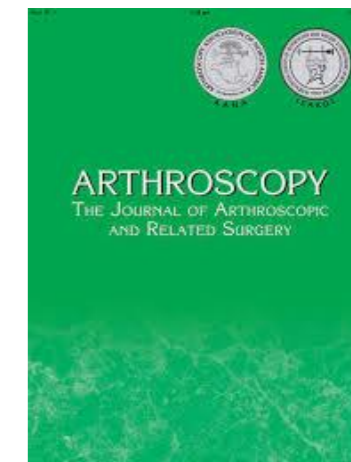


WOMAC pain score at 12 months



WOMAC function score at 12 months

# Seminário Internacional Sobre o Uso e a Regulação do Plasma Rico em Plaquetas

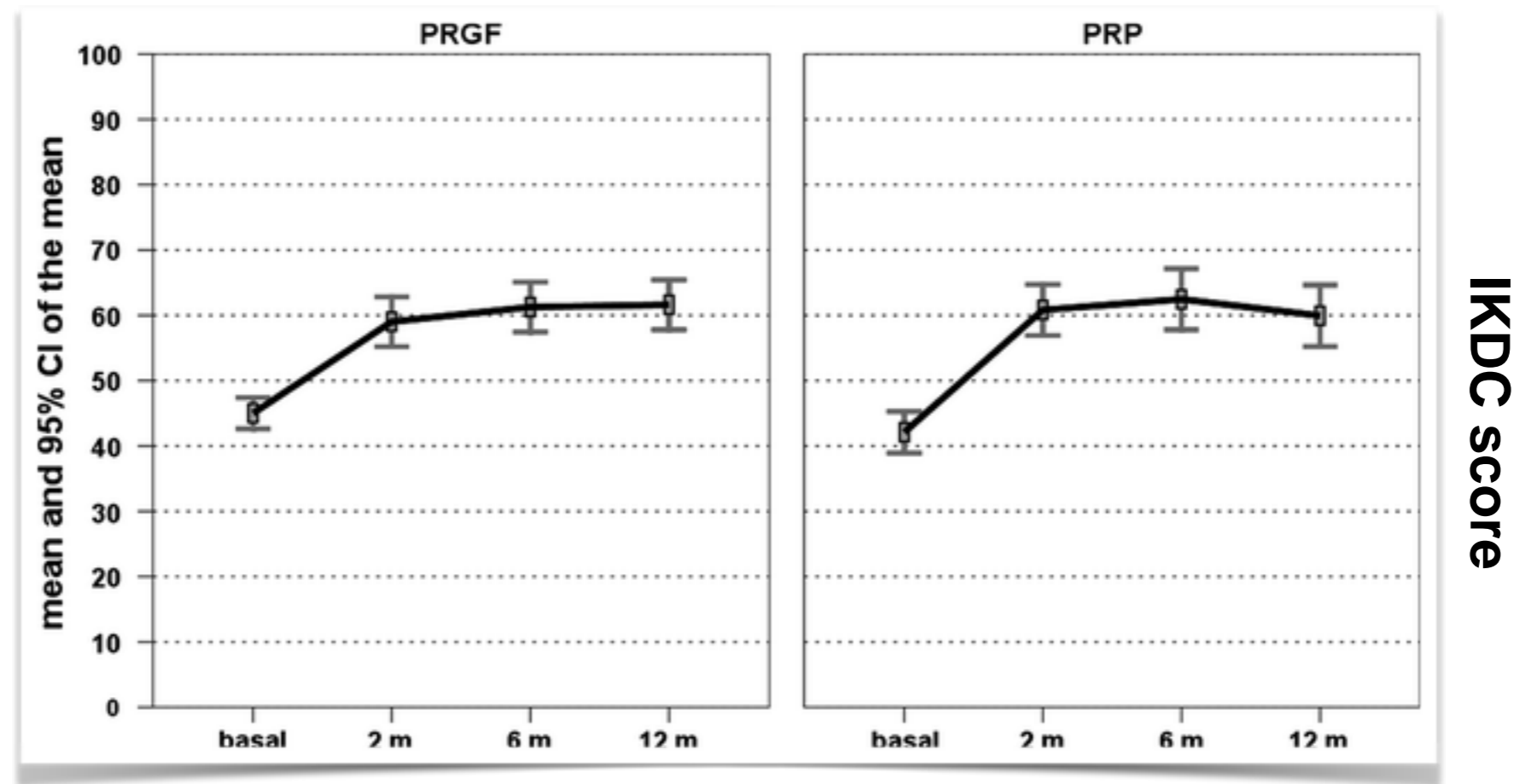


## Efeitos adversos

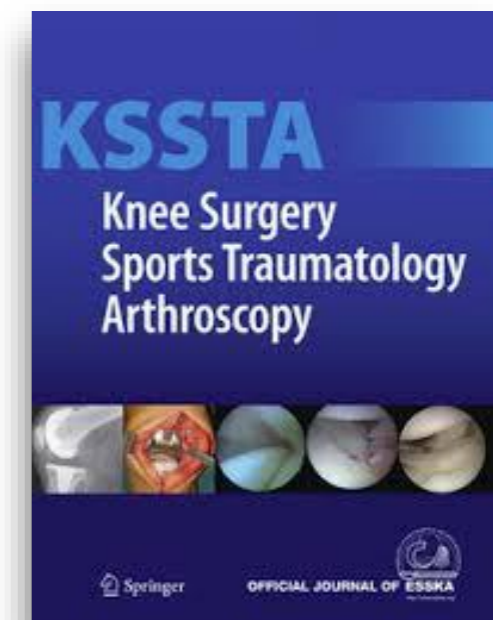
- No aplicações - 1 a 3
- Centrifugação - única / dupla
- Plaquetas - <5x / >5x
- Leucócitos - LP / LR
- Ativação - sim / não
- Viés - sim

Platelet-rich plasma intra-articular injections for cartilage degeneration and osteoarthritis: single- versus double-spinning approach. Anitua et al, [Knee Surgery, Sports Traumatology, Arthroscopy](#), 2012.

October 2012



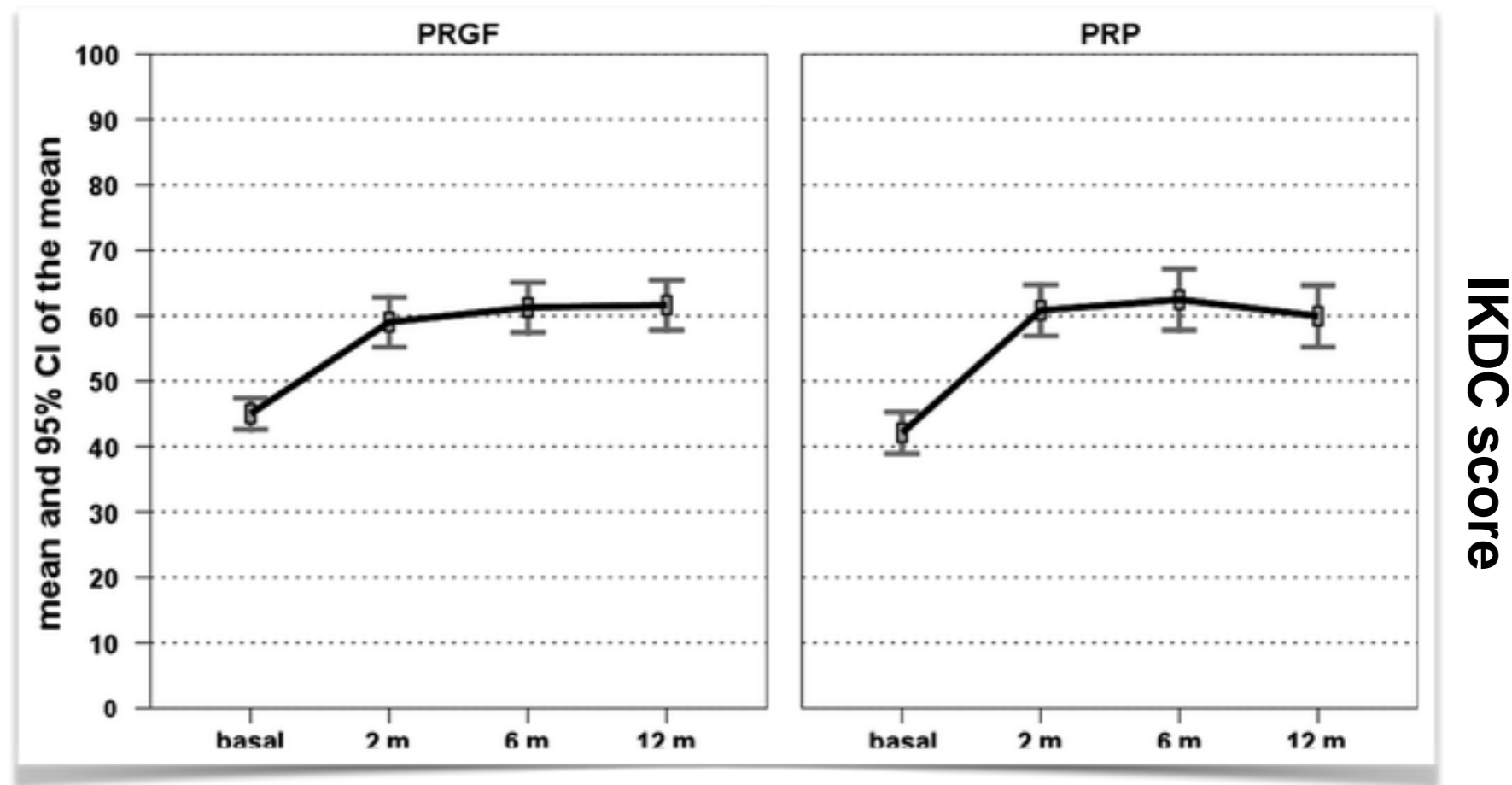
	Plaquetas (mm <sup>3</sup> )	Basal (X)	Leucócitos (mm <sup>3</sup> )	Basal (X)
<b>PRGF</b>	315000	1,5	0	0
<b>L-PRP</b>	949000	4,7	8300	1,4



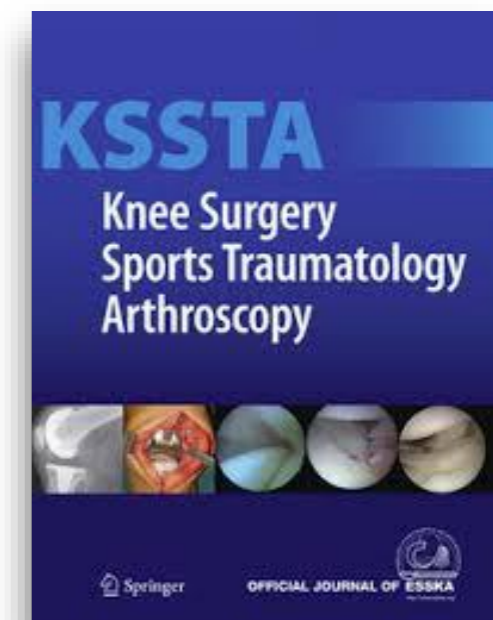


Platelet-rich plasma intra-articular injections for cartilage degeneration and osteoarthritis: single- versus double-spinning approach. Anitua et al, [Knee Surgery, Sports Traumatology, Arthroscopy](#), 2012.

October 2012



	Dor			Derrame		
	Leve	Moderado	Intenso	Leve	Moderado	Intenso
PRGF	58 81%	9 12%	5 7%	53 74%	16 22%	3 4%
L-PRP	24 33%	34 47%	14 20%	40 56%	21 29%	11 15%



# Platelet-Rich Plasma Injections in Acute Muscle Injury

N Engl J Med 2014; 370:2546-2547 | June 26, 2014 | DOI: 10.1056/NEJMc1402340

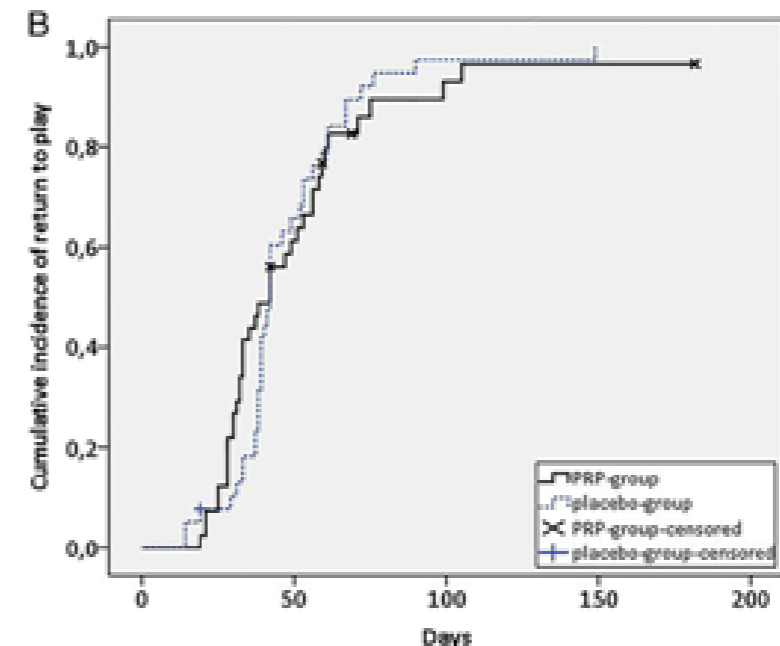
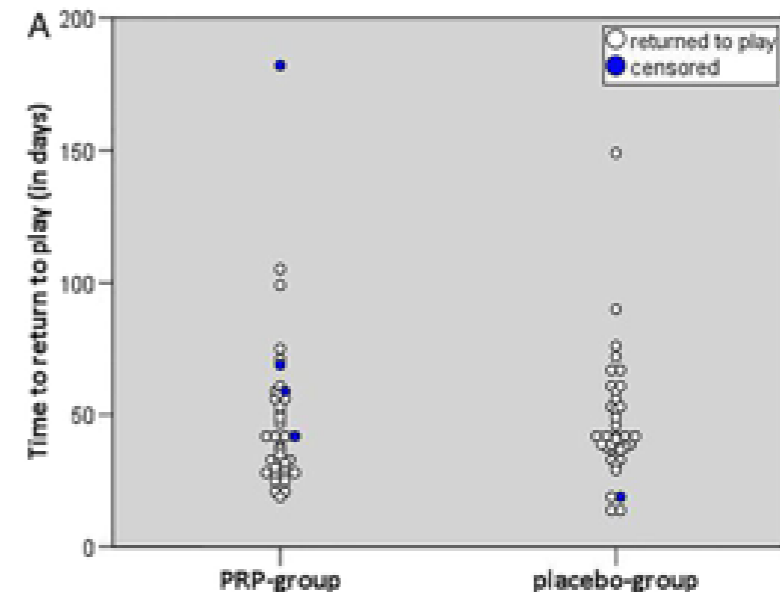
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To the Editor:

- RCT, duplo-cego, randomizado
  - 80 pacientes
  - PRP vs salina
- RTS
  - PRP = 42 dias
  - Controle = 42 dias



plaquetas	leucócitos	ativação
433 X 10 <sup>3</sup>	1,9 x 10 <sup>3</sup>	n.c.

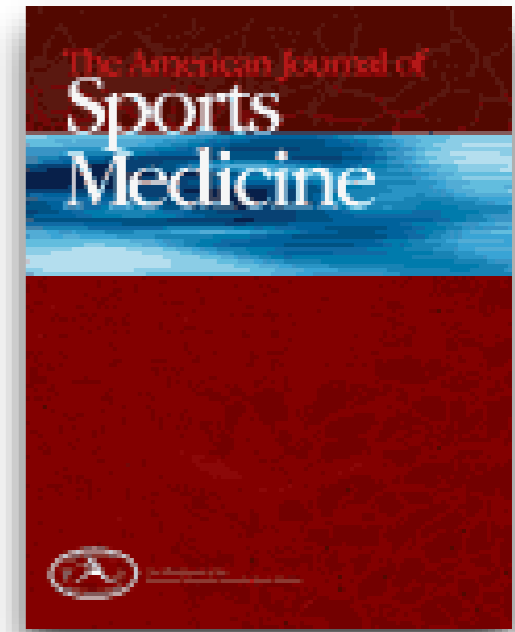
# Platelet-Rich Plasma Injections for the Treatment of Hamstring Injuries

## A Randomized Controlled Trial

Mohamad Shariff A Hamid; Mohamed Razif Mohamed Ali; Ashril

Yusof; John George; Leena Poh Chen Lee; *Am J Sports Med* 42,

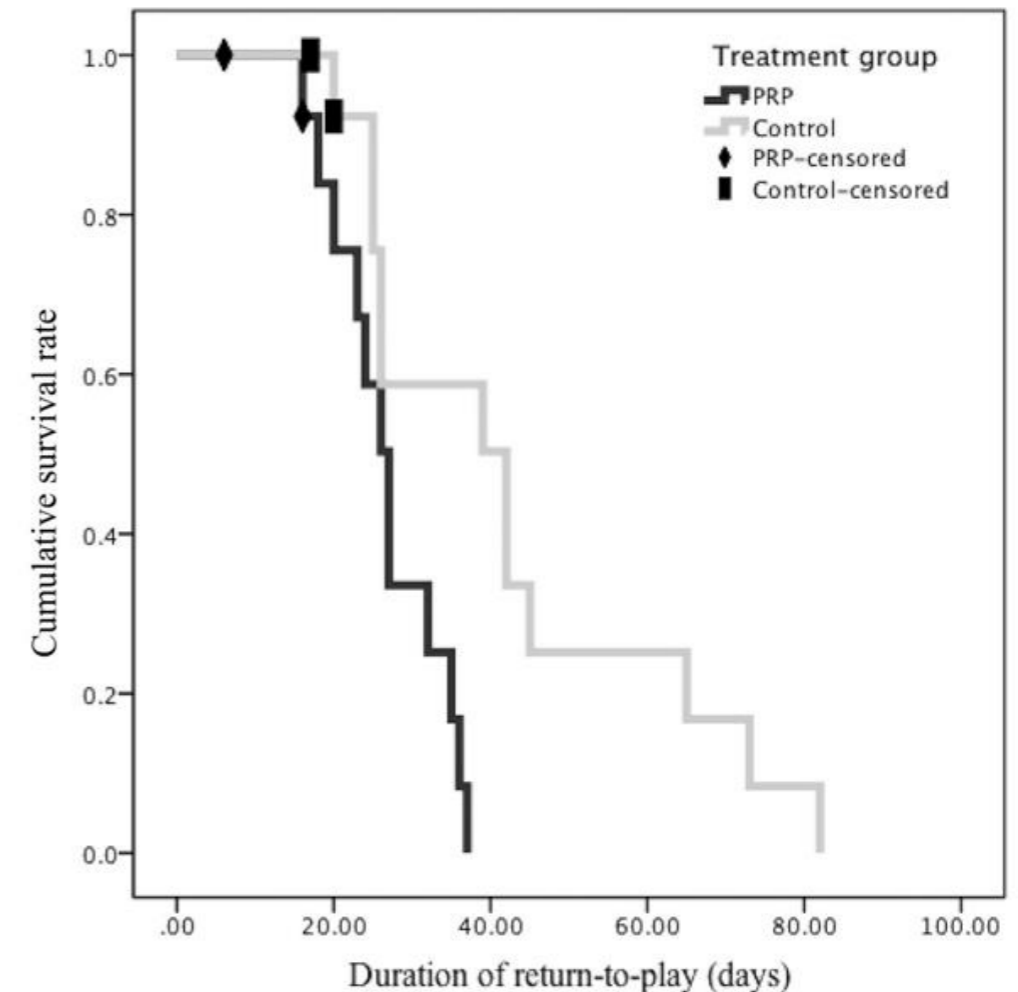
2410-2418.



- RCT randomizado
  - 24 pacientes
  - PRP vs controle
- RTS
  - PRP = 26 dias
  - Controle = 42 dias

plaquetas	leucócitos	ativação
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1297 X 10 <sup>3</sup>	38,3 x 10 <sup>3</sup>	n.c.
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# The New York Times

## *A Promising Treatment for Athletes, in Blood*

By ALAN SCHWARZ FEB. 16, 2009

Two of the Pittsburgh Steelers' biggest stars, Hines Ward and Troy Polamalu, used their own blood in an innovative injury treatment before winning the Super Bowl. At least one major league pitcher, about 20 professional soccer players and perhaps hundreds of recreational athletes have also undergone the procedure, commonly called platelet-rich plasma therapy.





## Nova técnica corta dor e cicatriza lesão mais rápido



Estudo de ortopedistas brasileiros mostra sucesso de aplicação do plasma sanguíneo rico em plaquetas em lesões de músculos e tendões

Fernanda Bassette, de O Estado de S. Paulo,  
20 Novembro 2011 | 18h16

Ortopedistas brasileiros estão usando com sucesso uma técnica que utiliza o plasma sanguíneo rico em plaquetas do próprio paciente para acelerar a cicatrização de lesões

**SIGA O ESTADÃO**



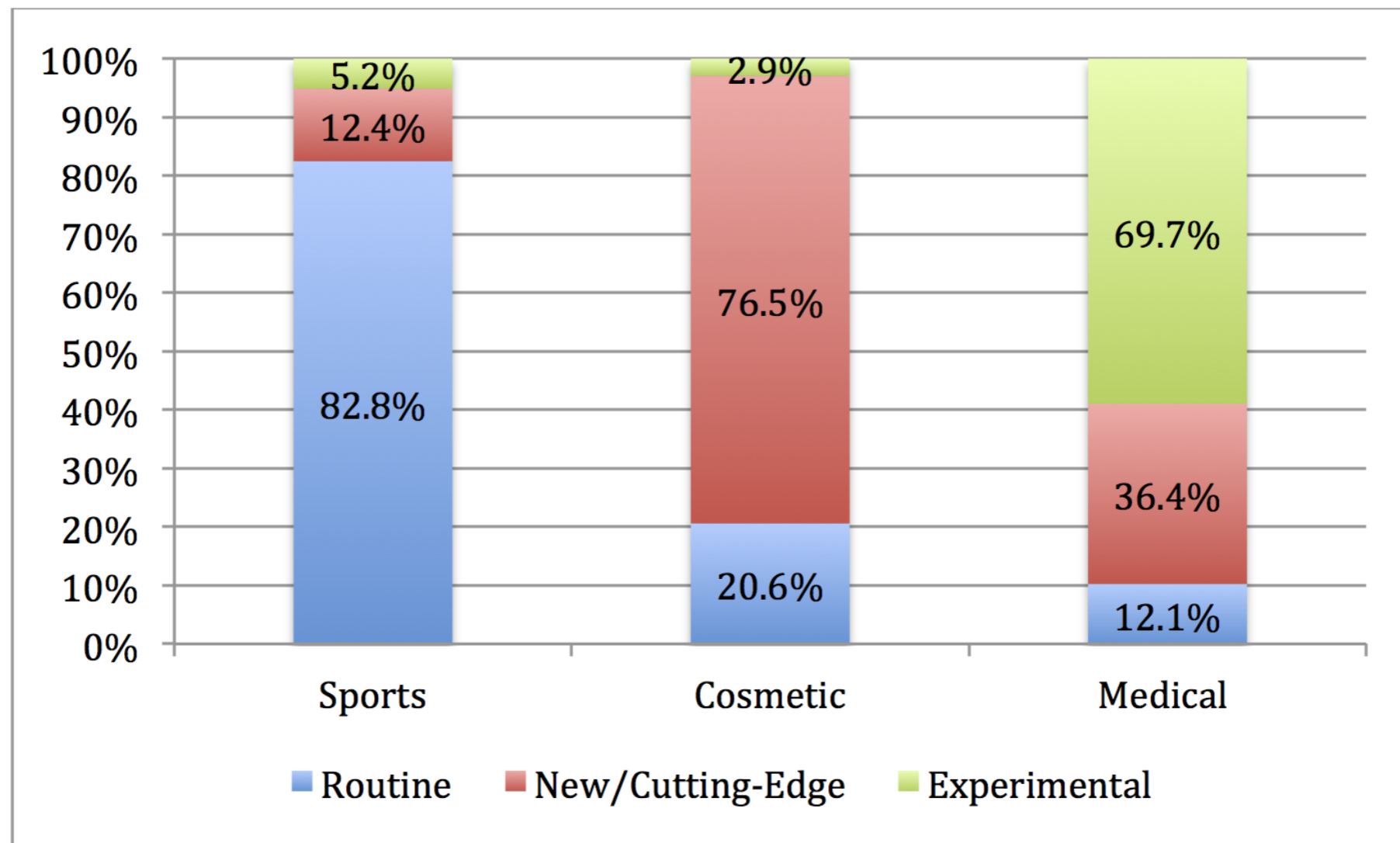
# Implicit hype? Representations of platelet rich plasma in the news media

Christen Rachul<sup>1</sup>\*, John E. J. Rasko<sup>2,3,4</sup>\*, Timothy Caulfield<sup>5</sup>\*

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\* These authors contributed equally to this work.

\* caulfield@ualberta.ca



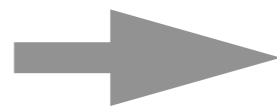
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**VEÍCULO DE FATORES DE CRESCIMENTO**

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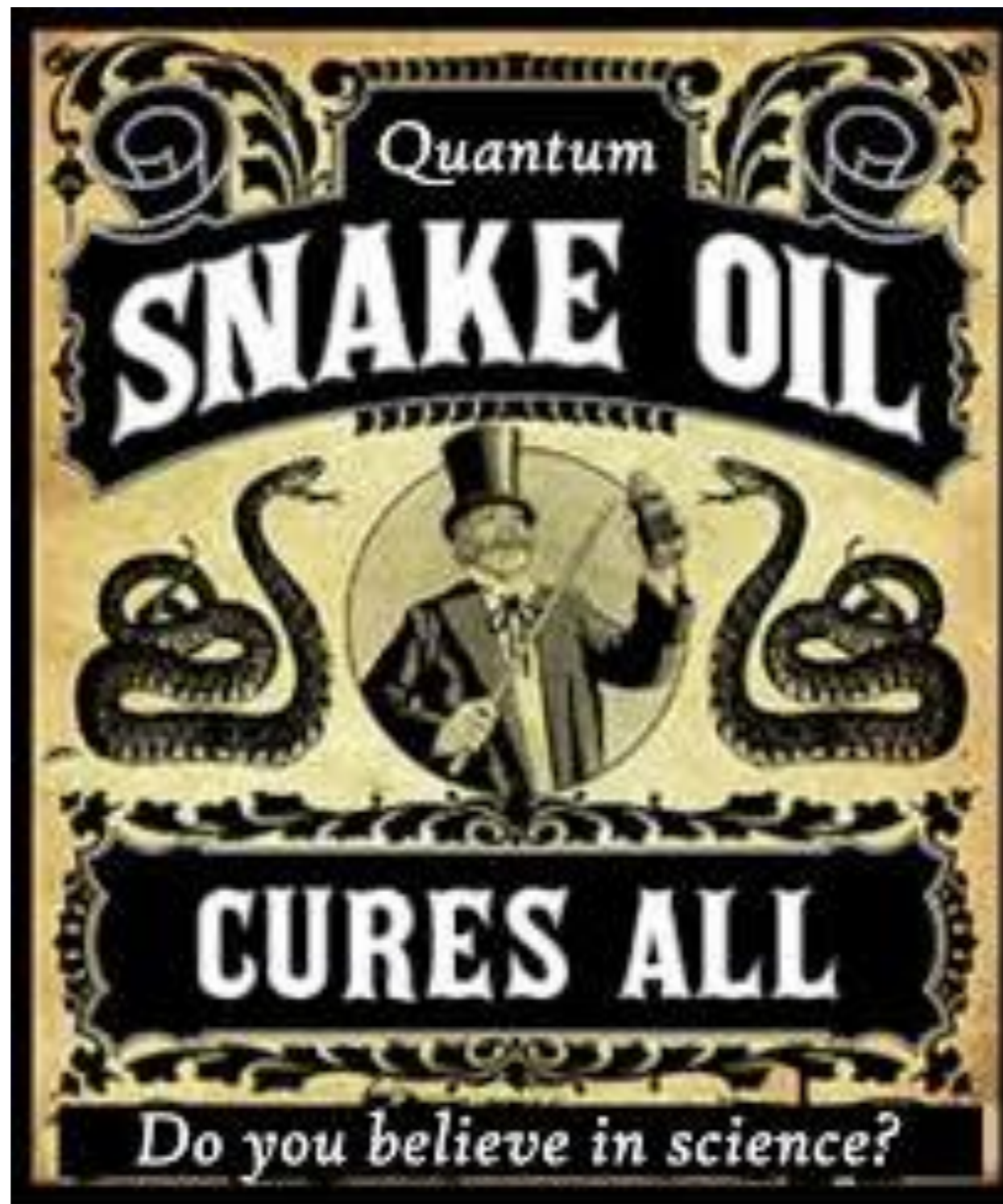


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