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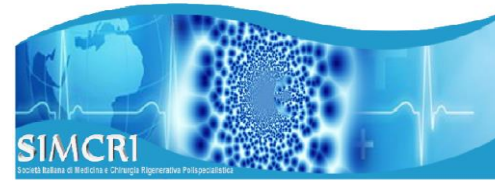
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*Campobasso*

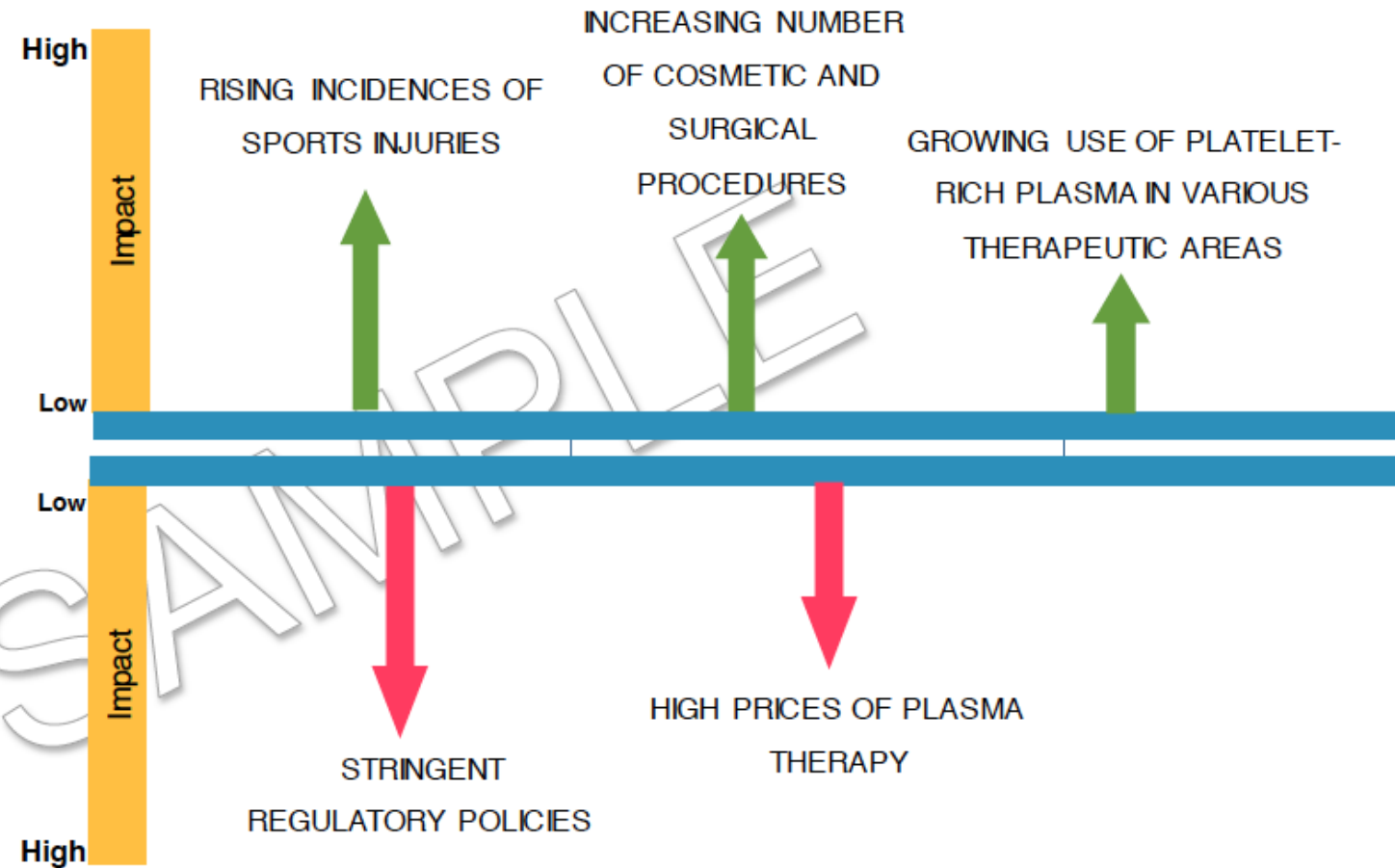
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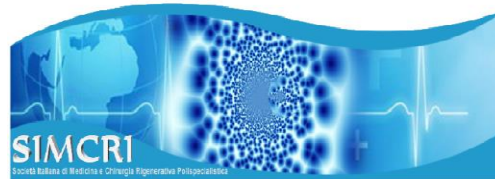
*IRCSS Multimedica*

*Milano*

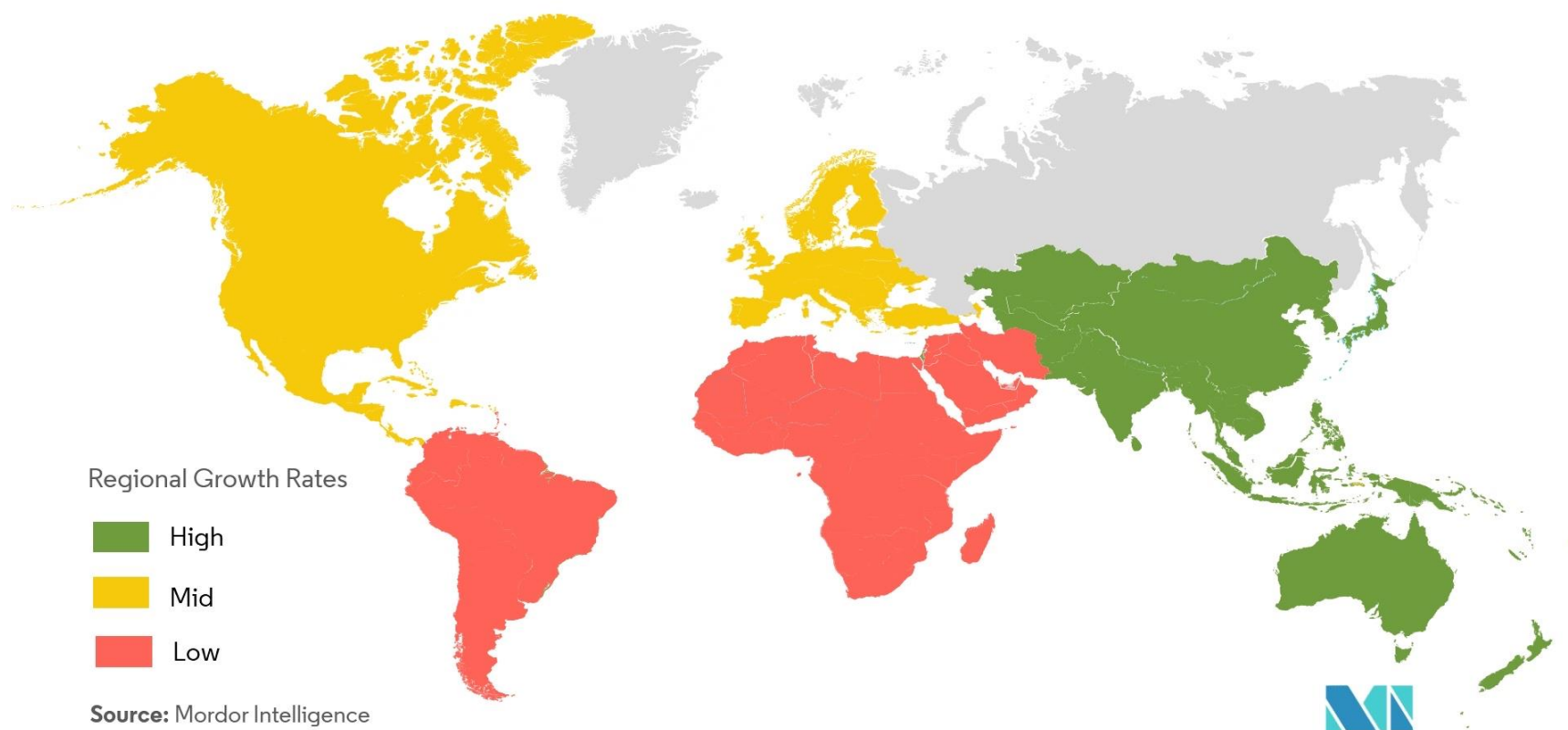


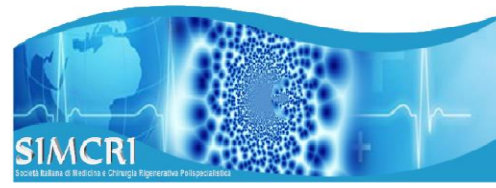
## Platelet Rich Plasma economic impact and regulatory policies



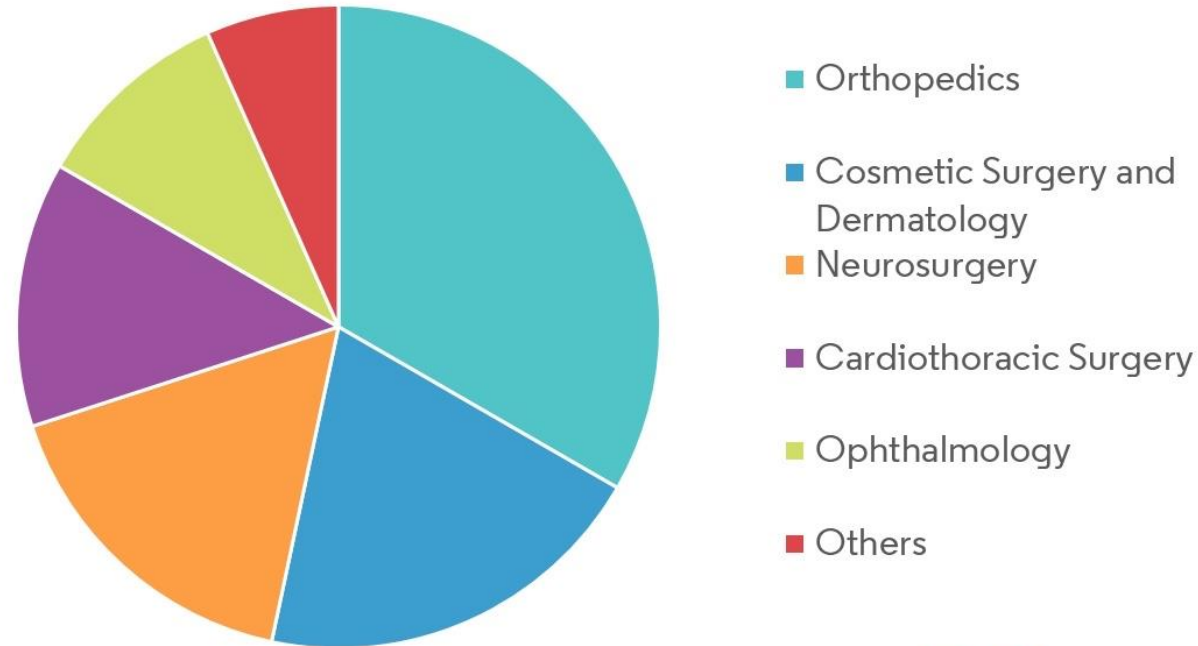


## Platelet Rich Plasma Market - Growth Rate by Region (2018)



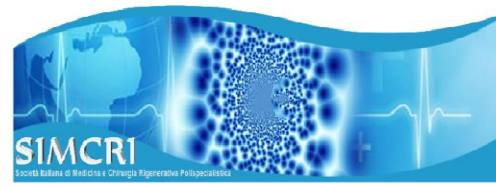


## Platelet Rich Plasma Market: Revenue Share (%), by Application, Global, 2018

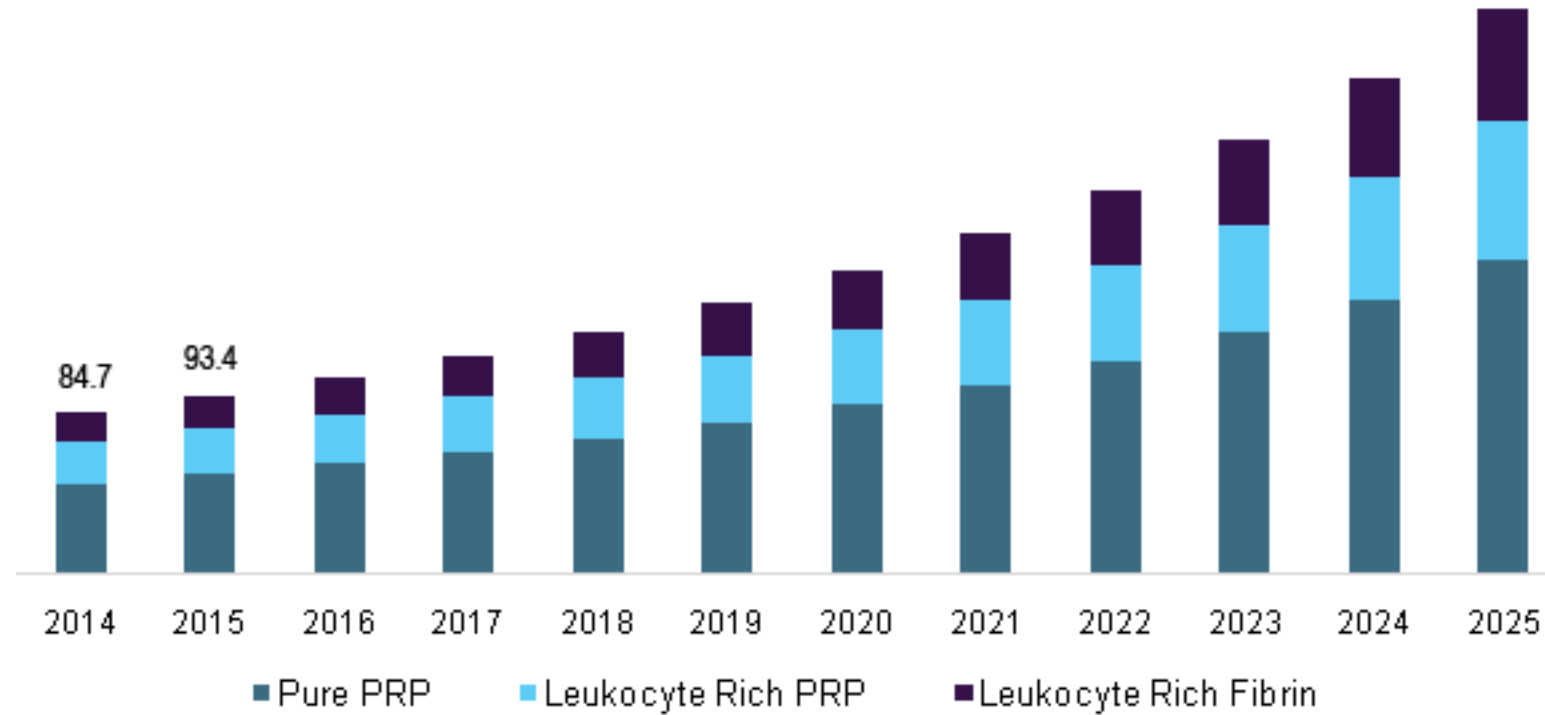


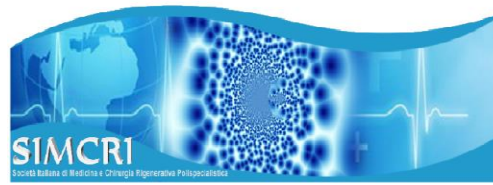
Source: Mordor Intelligence



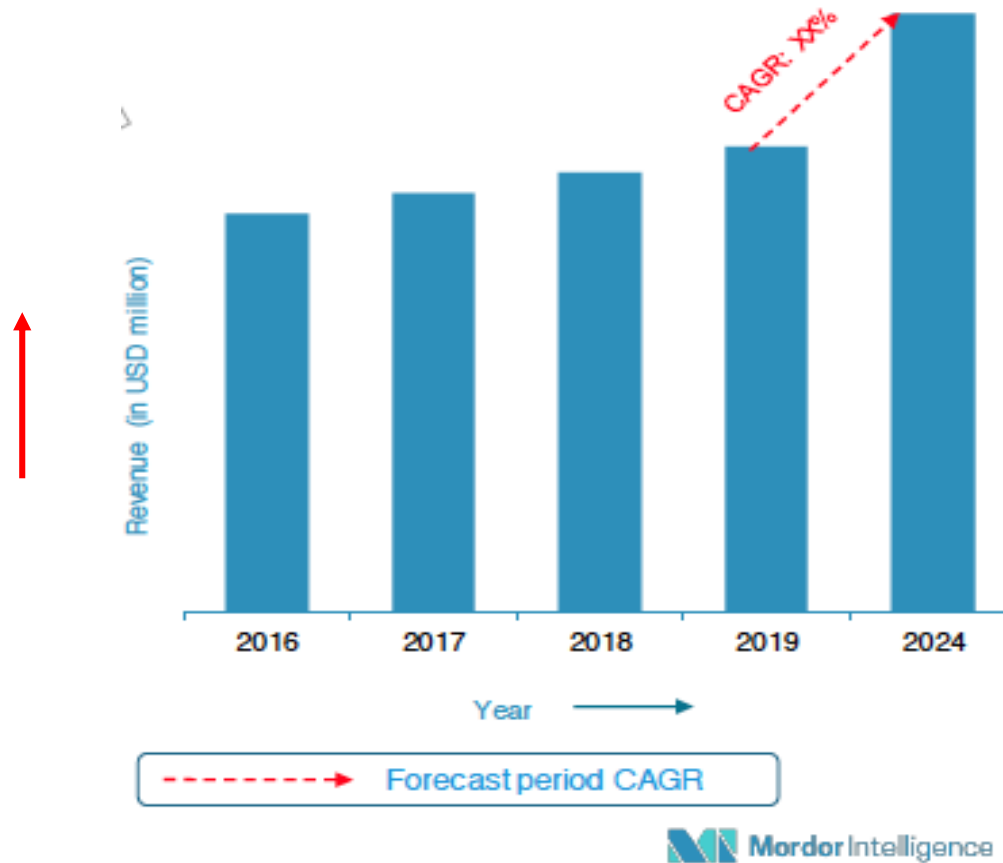


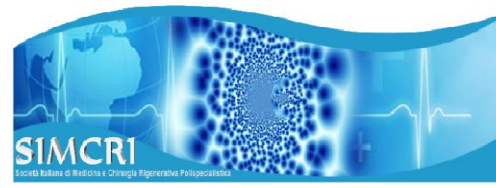
## U.S. platelet-rich plasma (PRP) market revenue, by product, 2014 - 2025 (USD Million)



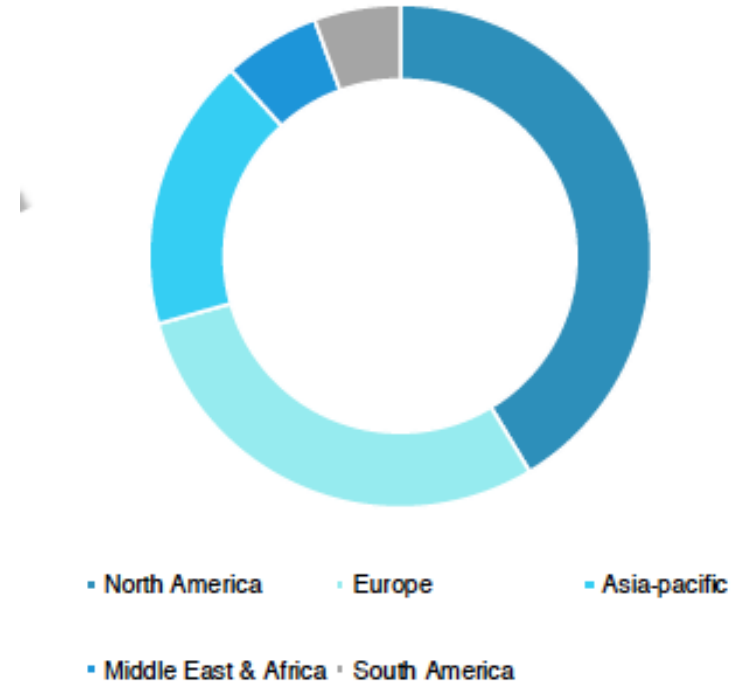


## Platelet-rich Plasma Market : Revenue in USD million, Orthopedics, Global, 2016-2024





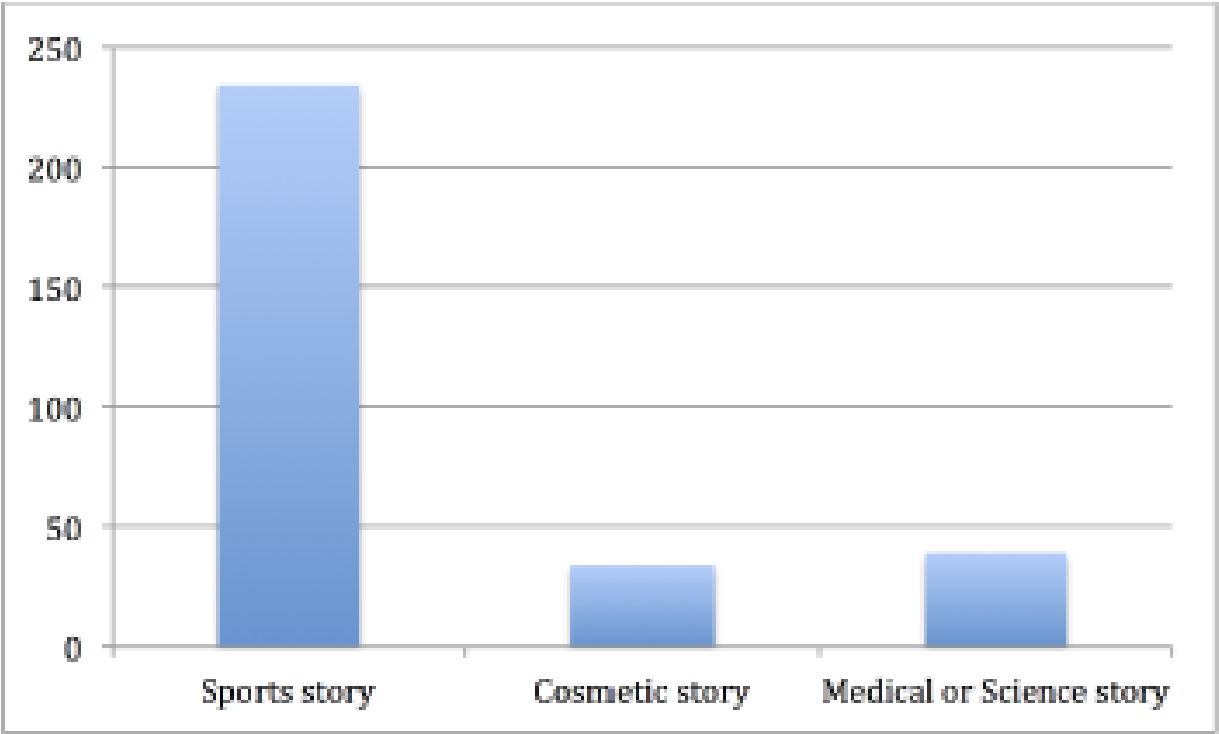
- Platelet-rich Plasma Market: Revenue Share (%), by Geography, Global, 2018





Rachul, C., Rasko, J. E. J., & Caulfield, T. (2017). Implicit hype? Representations of platelet rich plasma in the news media. *PloS One*, 12(8), e0182496. <http://doi.org/10.1371/journal.pone.0182496>

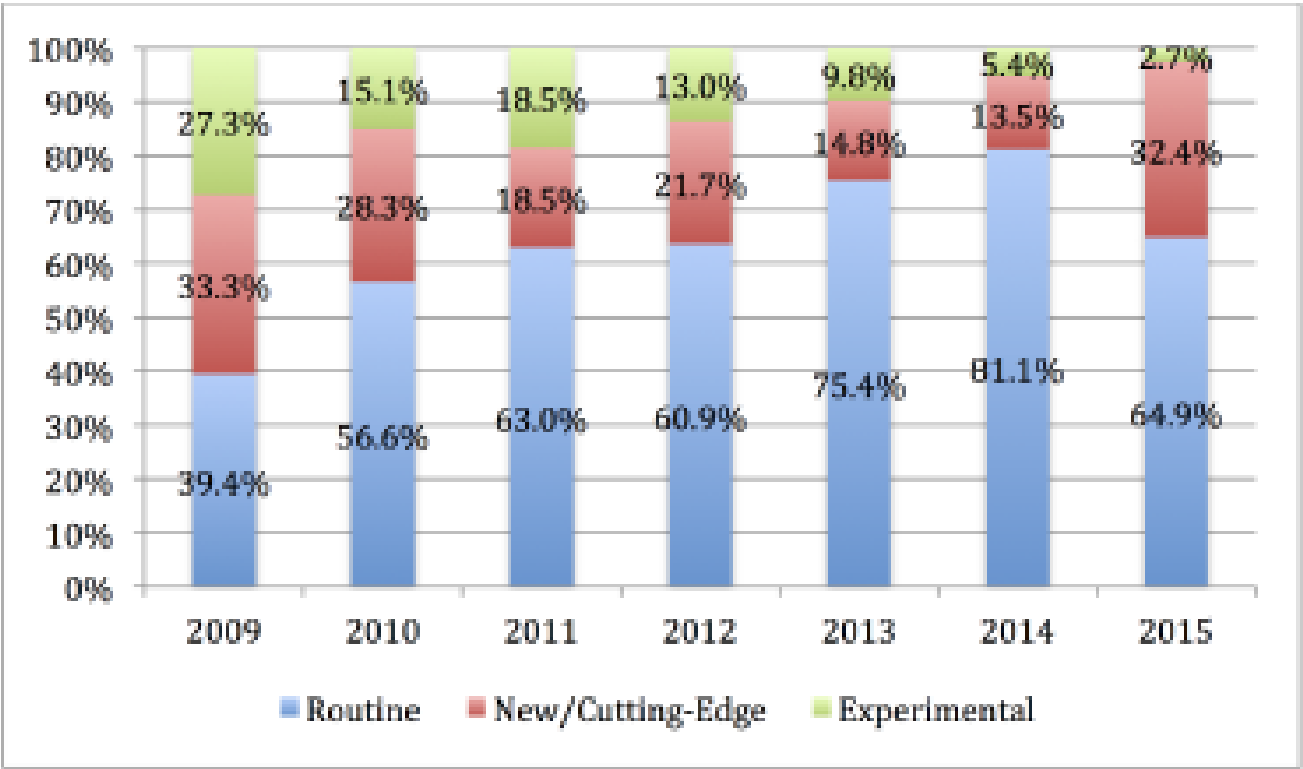
# of articles by main frame.





Rachul, C., Rasko, J. E. J., & Caulfield, T. (2017). Implicit hype? Representations of platelet rich plasma in the news media. *PloS One*, 12(8), e0182496. <http://doi.org/10.1371/journal.pone.0182496>

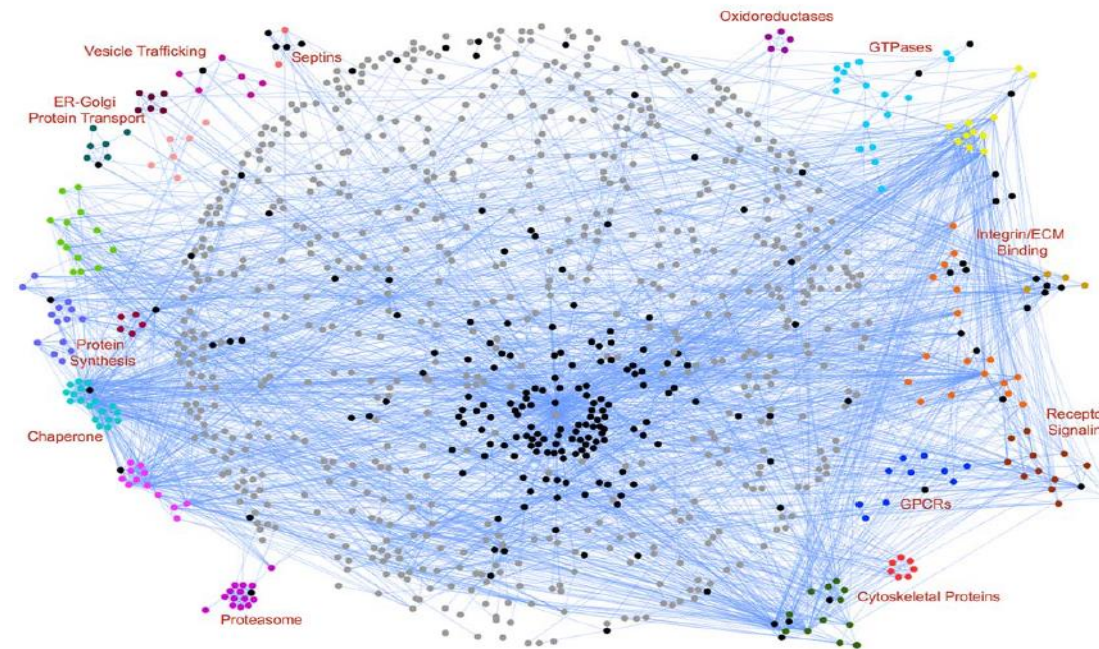
Portrayal of PRP over time as routine, new, or experimental.



Qureshi, A. H. et al. (2009). Proteomic and Phospho-Proteomic Profile of Human Platelets in Basal, Resting State: Insights into Integrin Signaling.  
*PLoS ONE*, 4(10), e7627. <http://doi.org/10.1371/journal.pone.0007627>

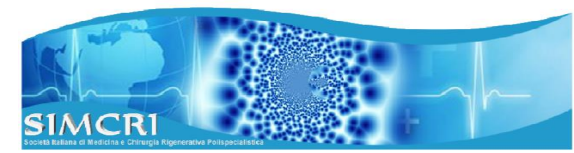
1507 unique proteins in platelets. Platelet proteome assembled to date and includes 190 membrane-associated and 262 phosphorylated proteins

### Platelet Protein-Protein Interaction (PPI) network

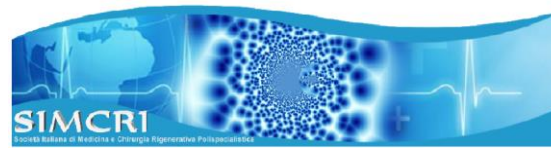




## Platelet Rich Plasma

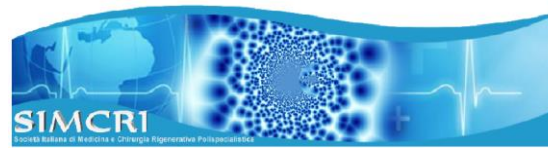


- Low: Less Than 1 X (Less Than Baseline): insufficient tissue response
- Moderate: Greater Than 1x to Less Than 4x(Greater Than Baseline to 750,000 platelets/xL) : positive response
- High: 4x to 6 x(>750,000 to 1,800,000 platelets/ xL) positive response
- Super: Greater Than 6x (>1,800,000 platelets/ x L) may be harmful



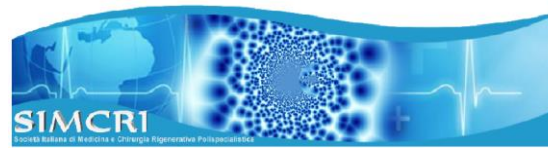
## Platelet Concentrate Class and Terminology

- P-PRP (Pure Platelet-Rich Plasma), before activation
- (P-PRP gel, after activation)
- L-PRP (Leukocyte- and Platelet-Rich Plasma), before activation
- L-PRP gel, after activation
- P-PRF (Pure Platelet-Rich Fibrin)
- L-PRF (Leukocyte- and Platelet-Rich Fibrin)



## Fattori che influenzano la composizione del PRP

- Numero di piastrine
- Presenza di WBC ( linfociti, Neutrofili, Monociti, Cellule mononucleate)
- Presenza o assenza di attivatori
- Modalità di preparazione
- Materiali utilizzati



## Anticoagulation importance in PRP

### ***EDTA impairs platelet function***

White, J. G. (2009). EDTA-induced changes in platelet structure and function: clot retraction. *Platelets*, 11(1), 49–55. <http://doi.org/10.1080/09537100075805>

**pH and ion concentration impair platelet function** : ACD-A has a pH 4.9, trisodium citrate has a pH 7.8

Dhurat, R., & Sukesh, M. (2014). Principles and Methods of Preparation of Platelet-Rich Plasma: A Review and Author's Perspective. *Journal of Cutaneous and Aesthetic Surgery*, 7(4), 189–197. <http://doi.org/10.4103/0974-2077.150734>

Murray IR, Geeslin AG, Goudie EB, Petrigliano FA, LaPrade RF. Minimum Information for Studies Reporting Biologics in Orthopaedics (MIBO): Platelet Rich Plasma and Mesenchymal Stem Cells. J Bone Joint Surg Am 2017;99:809-19.

## MINIMUM INFORMATION for studies reporting BIOLOGICS MIBO

### PRP characteristics

PRP format (for example: liquid, gel, or membrane)

PRP platelet, differential leukocyte, and red cell analysis of all samples

### Activation

Activation described sufficiently to enable replication (including volume and concentration of activating agent)

### Delivery

Point of delivery (intraoperative and/or postoperative or serial)

PRP delivery described sufficiently to enable replication (including volume delivered, concomitant use of stem cells or cytokines, and details of carrier or scaffold)

### Postoperative care

Rehabilitation protocol sufficiently described to enable replication (including immobilization and physical therapy)

### Outcome

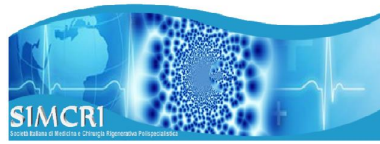
Outcome assessments include functional outcomes and recording of complications (including infection and need for further surgery); if performed, radiographic outcomes, physical examination findings, return to activities, and satisfaction



Andia, I., & Maffulli, N. (2018). A contemporary view of platelet-rich plasma therapies: moving toward refined clinical protocols and precise indications.  
*Regenerative Medicine*, 13(6), 717–728. <http://doi.org/10.2217/rme-2018-0042>

PRP formulations and commercial brands .

INJECTABLE FORMULATIONS	TRADE BRANDS
<b>Plasma + platelets = pure PRP</b> PurePR-lysate can be prepared by repeated freeze/thawing cycles or sonication Pure PR-releasate can be prepared by coagulation, incubation at 37°C, and centrifugation <b>Plasma + platelets + leukocytes = L-PRP</b> L-PR-lysate can be prepared by freeze/thawing or sonication L-PR-releasate can be prepared by coagulation, incubation at 37°C, and centrifugation <b>ACS</b> (serum incubated with beads) <b>Plasma (PPP) Alpha2-macroglobulin</b>	COBE Spectra LRS Turbo Caridian BCT, Lakewood Co USA Arthrex ACP, Naples, FL, USA SephylCascade medical enterprises, LLC, Wayne, USA PRGF-endoret, BTI, vitoria-Gasteiz, Spain, PRP Proteal, Barcelona Spain  ISTO Biologics (Arteriocyte Magellan; Nuo Therapeutics (Cytomedix Angel System), Regen Lab SA, DePuySynthes Inc.,; AdiStem Ltd. (photoactivation technology Adilight, tb ADSCs), Zimmer Biomet (GPS III, platelet concentrate system), Exactech Inc., Cesca Therapeutics Inc Stryker Corp., and Harvest Technologies Corp (Smart PReP System); In Japan, KYOCERA Medical corporation, Osaka Japan, KYOCERA Medical PRP kit and JP200 from BS Medical Co. Ltd Tokyo Japan; In Korea, Dr Shin's System THROMBO KIT GRAND AESPIO IMC Seoul Korea and Prosys PRS(PRP) Bio Kit ProdizenInc, Seoul, Korea, TriCell <i>PRP</i> , <i>REV-MED</i> , Seoul Korea; GLO PRP, Glofinn Oy, Salo, Finland; Plateltex, PLATELTEX S.R.O. Praha Czech Republic OrthoGen, AG, Dusseldorf; Arthrokinex™ Orthokine Osteoarthritis, Cytonics AZM, USA
NON INJECTABLE FORMULATIONS	
Pure PRF L-PRF Fibrin (insoluble proteins obtained after coagulation and clot retraction)	Cascade Autologous Platelet System (Musculoskeletal Transplant Foundation, NJ, USA); Vivostat PRF, Denmark Choukroun PRF system; APRF, Process Nice France By-product of the PR-releasateprocedure



## Platelet Rich Plasma

Hesseler, M. J., & Shyam, N. (2019). Platelet-Rich Plasma and Its Utilities in Alopecia. *Dermatologic Surgery*, 1–10. <http://doi.org/10.1097/DSS.0000000000001965>

Nineteen articles met the inclusion criteria for analysis including 3 alopecia areata studies with a total of 71 patients and 16 androgenetic alopecia studies with a total of 389 patients. Although the heterogeneity of the studies prevented direct comparisons and subsequent statistical analysis, the majority demonstrated that platelet-rich plasma produced successful hair growth in androgenetic alopecia and alopecia areata.

**CONCLUSION** This review advocates for the use of platelet-rich plasma in 3 to 4 monthly sessions for the treatment of alopecia. Future studies should include a detailed description of the platelet-rich plasma isolation process to allow for comparison among studies, provide reproducibility, and generate a standardized treatment protocol.

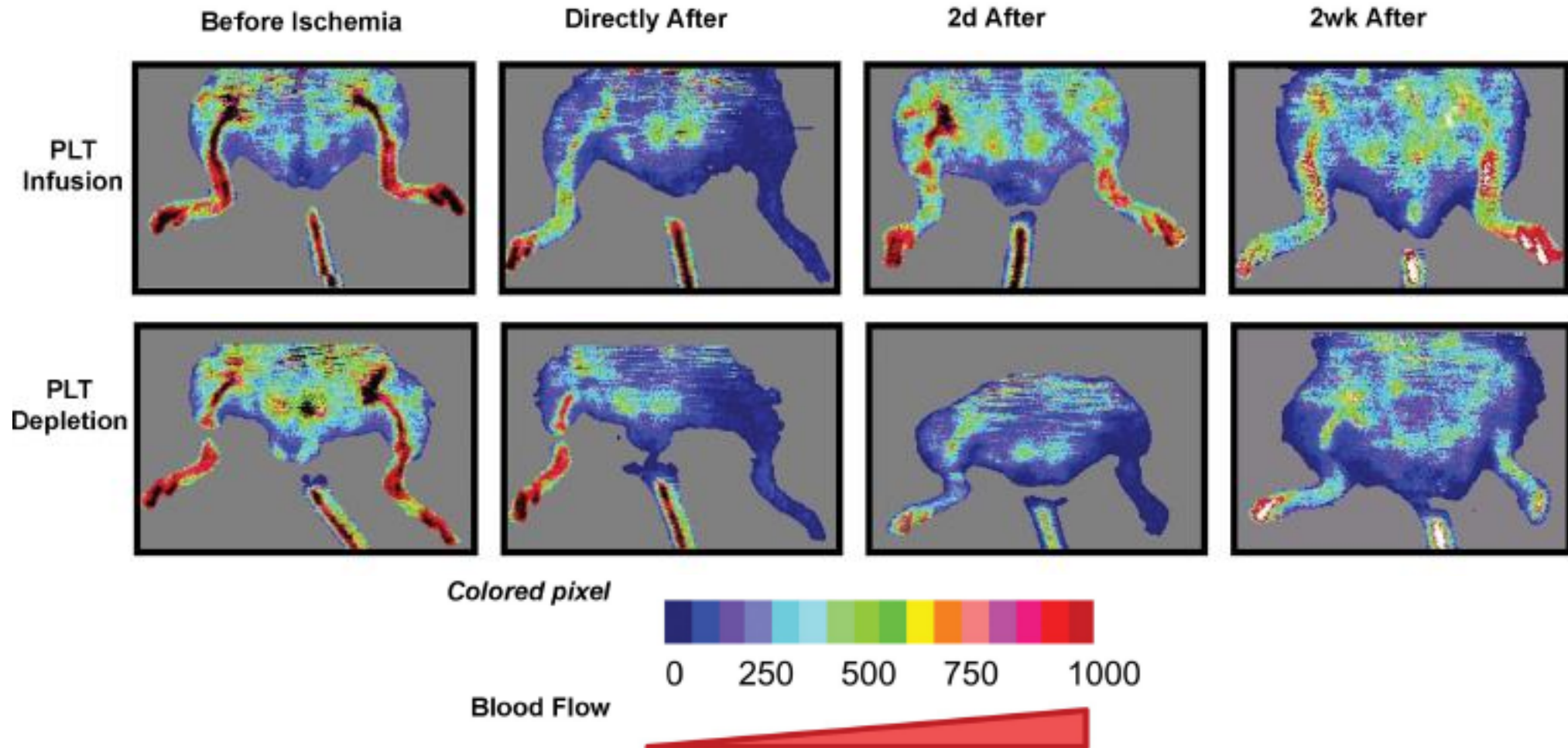
Mujahid, N., Shareef, F., Maymone, M. B. C., & Vashi, N. A. (2019). Microneedling as a Treatment for Acne Scarring. *Dermatologic Surgery*, 1–7. <http://doi.org/10.1097/DSS.0000000000002020>

**RESULTS** All 33 articles evaluated showed improvement of acne scar appearance after microneedling treatment. Evidence was inconsistent when comparing microneedling monotherapy to dual therapy or to fractional laser treatment.

**CONCLUSION** Microneedling improves acne scarring, and further studies are needed to compare microneedling with other minimally invasive treatments.

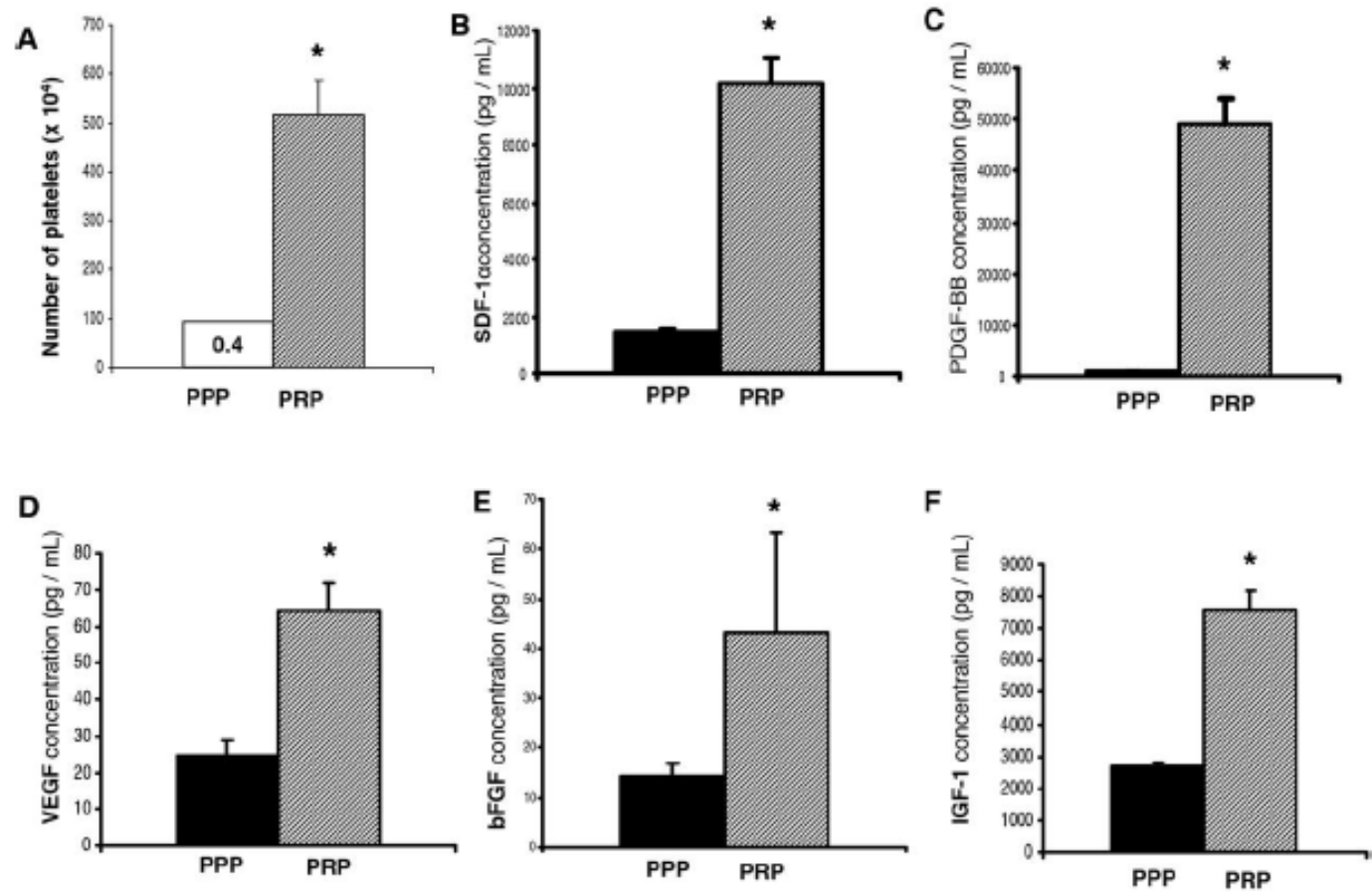
A novel role for platelet secretion in angiogenesis: mediating bone marrow–derived cell mobilization and homing

Weiyi Feng et al. Blood, 7 april 2011 volume 117, number 14



Bir, S. C. et al. (2009). Angiogenic properties of sustained release platelet-rich plasma: Characterization in-vitro and in the ischemic hind limb of the mouse.  
*Journal of Vascular Surgery*, 50(4), 870–879.e2. <http://doi.org/10.1016/j.jvs.2009.06.016>

L-PRP vs PPP



Hassanien, M., et al. (2019).  
Perineural Platelet-Rich Plasma for Diabetic Neuropathic Pain, Could It Make a Difference?  
*Pain Medicine*, 33(10), 2285–13. <http://doi.org/10.1093/pm/pnz140>

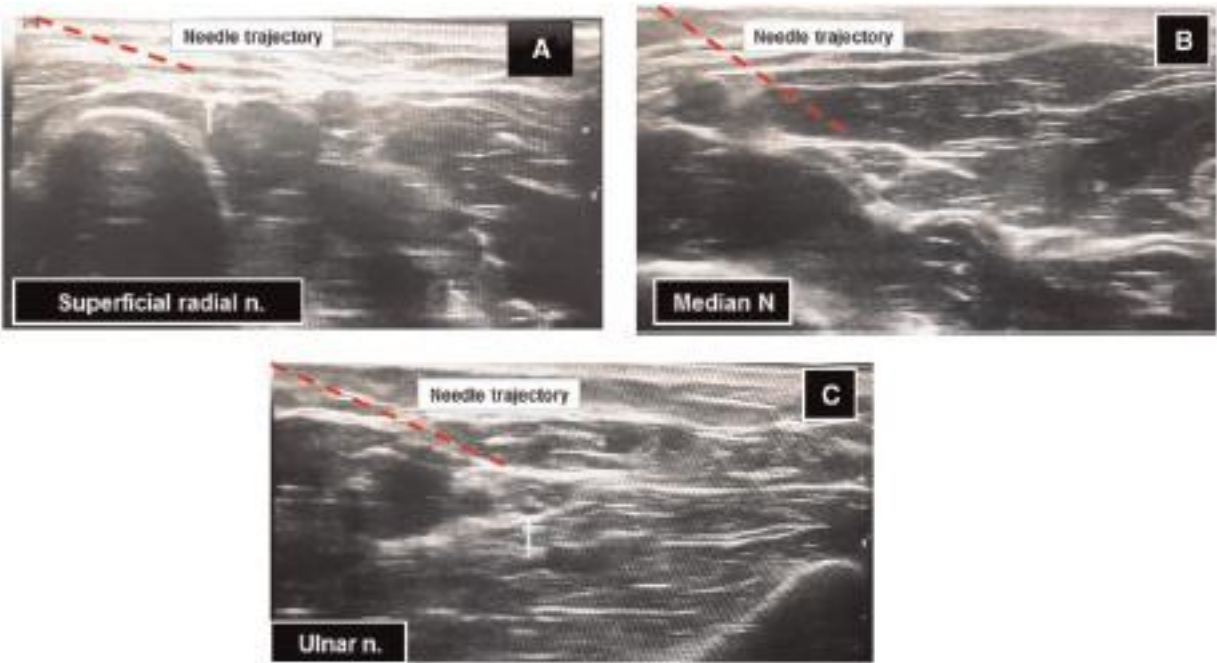
Nerve conduction study in the lower limb

Variables	Group I (PRP) (N = 31)	Group II (Medical) (N = 29)	P Value
Mean motor NCV (posterior tibial n. medial planter branch) (normally 41+ m/s)			
Baseline	34.5 ± 8.3	33.5 ± 9.2	0.1
6 mo	48.2 ± 4.7*	40.7 ± 6.5*	0.05
Mean motor NCV (deep peroneal n.) (normally 44+ m/s)			
Baseline	35.4 ± 9.3	35.7 ± 10.3	0.5
6 mo	49.1 ± 3.5*	40.9 ± 6.3*	0.01
Mean DML (posterior tibial n. medial planter branch) (normally 6.1 m/s)			
Baseline	6.3 ± 0.22	6.2 ± 1.06	0.5
6 mo	5.6 ± 1.2*	5.8 ± 0.7*	0.07
Mean DML (deep peroneal n.) (normally 6.5 m/s)			
Baseline	6.2 ± 1.02	6.2 ± 1.25	0.8
6 mo	5.7 ± 1.0*	5.9 ± 0.9*	0.1
Mean sensory NCV (superficial peroneal n.) (normally 40+ m/s)			
Baseline	17.3 ± 9.8	17.6 ± 10.6	0.7
6 mo	37.05 ± 1.2*	18.6 ± 9.7	0.001
Mean sensory NCV (saphenous n.) (normally 40+ m/s)			
Baseline	20.4 ± 8.8	20.6 ± 8.6	0.6
6 mo	35.5 ± 2.2*	21.9 ± 8.2	0.001
Mean sensory NCV (posterior tibial n. medial planter branch) (normally 35+ m/s)			
Baseline	19.7 ± 9.1	19.6 ± 9.6	0.5
6 mo	37.4 ± 1.04*	20.2 ± 7.2	0.001
Sural n. NCV (normally 46–64 m/s)			
Baseline	17.00 ± 10.86	17.38 ± 12.36	0.7
6 mo	36.18 ± 3.21*	19.42 ± 11.34	≤0.001

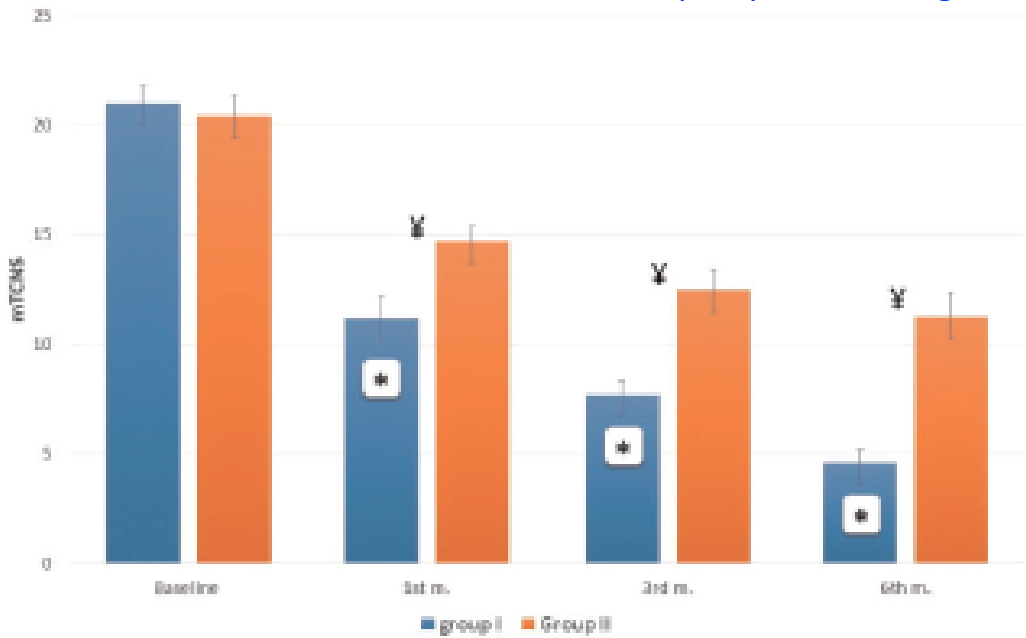


Hassanien, M., et al. (2019).  
Perineural Platelet-Rich Plasma for Diabetic Neuropathic Pain, Could It Make a Difference?  
*Pain Medicine*, 33(10), 2285–13. <http://doi.org/10.1093/pm/pnz140>

Platelet Rich Plasma effect on diabetic Neuropathy



Modified Toronto Clinical Neuropathy Score change



Correa Jose, Cortés Henry, Abella Patricia, García Edwin: Epidural Plasma Rich in Growth Factors for Degenerative Disc Disease: A Valuable Alternative to Conventional “Palliative Medicine.” (2020)., International Journal of Anesthesia and Clinical Medicine 2019; 7(1): 1–6. <http://doi.org/10.11648/j.ijacm.20190701.11>

Platelet Rich plasma for degenerative Disc Disease

Study design: Prospective observational, nonrandomized, single-center

Patients enrolled : 250

Modified Macnab Criteria.

- |  |
|--|
| <ol style="list-style-type: none"><li>1. Excellent: No pain. No restriction of mobility. Return to normal work and level of activity.</li><li>2. Good: Relief of presenting symptoms. Occasional back or leg pain of sufficient severity to interfere with the patient’s ability to do his normal work or his capacity to enjoy himself in his leisure hours. Able to return to modified work.</li><li>3. Fair: Improved functional capacity, but handicapped by intermittent pain of sufficient severity to curtail or modify work or leisure activities. Still handicapped and/or unemployed.</li><li>4. Poor: No improvement or insufficient improvement to enable increase in activities. Continued objective symptoms of root involvement. Probable further operative intervention needed, irrespective of length of postoperative follow-up.</li></ol> |
|--|



Correa Jose, Cortés Henry, Abella Patricia, García Edwin: Epidural Plasma Rich in Growth Factors for Degenerative Disc Disease: A Valuable Alternative to Conventional “Palliative Medicine.” (2020)., International Journal of Anesthesia and Clinical Medicine 2019; 7(1): 1–6. <http://doi.org/10.11648/j.ijacm.20190701.11>

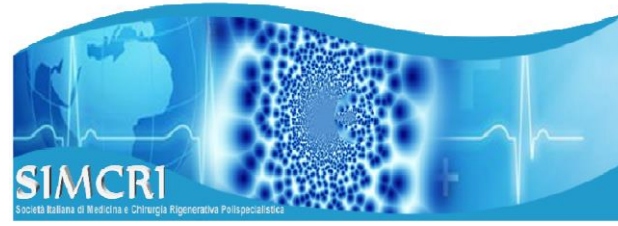
Platelet Rich plasma for degenerative Disc Disease

Study design: Prospective observational, nonrandomized, single-center

Patients enrolled : 250

*Outcome of patients after Epidural PRGF injections.*

Outcome assessment	Mean VAS scale	Mean MACNAB score	Opioid rescue
Previous to PRGF injection	9/10	POOR	96% of patients
Two months after two doses of epidural-PRGF	4/10	FAIR	20% of patients
Six months after two doses of epidural-PRGF	3/10	GOOD	none
One year after two doses of epidural-PRGF	2/10	EXCELLENT	none



## Take Home Message

- The application field of PRP is constantly increasing;
- The Global Platelet Rich Plasma (PRP) market is expected to reach \$383.56 million by 2023 growing at a CAGR of 13.4%
- Platelet rich plasma is not only platelets
- The controlled use should be allowed in order to avoid an uncontrolled black market