

Platelet Rich Plasma & It's Use In Musculoskeletal Pain Treatment

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The Three Layers of Musculoskeletal Pain

- Muscle Spasms – symptom
- Connective Tissue Damage – ligaments, tendons, fascia, cartilage
- Autonomic Nervous System Dysfunction – Usually sympathetic hypertonia

History of PRP

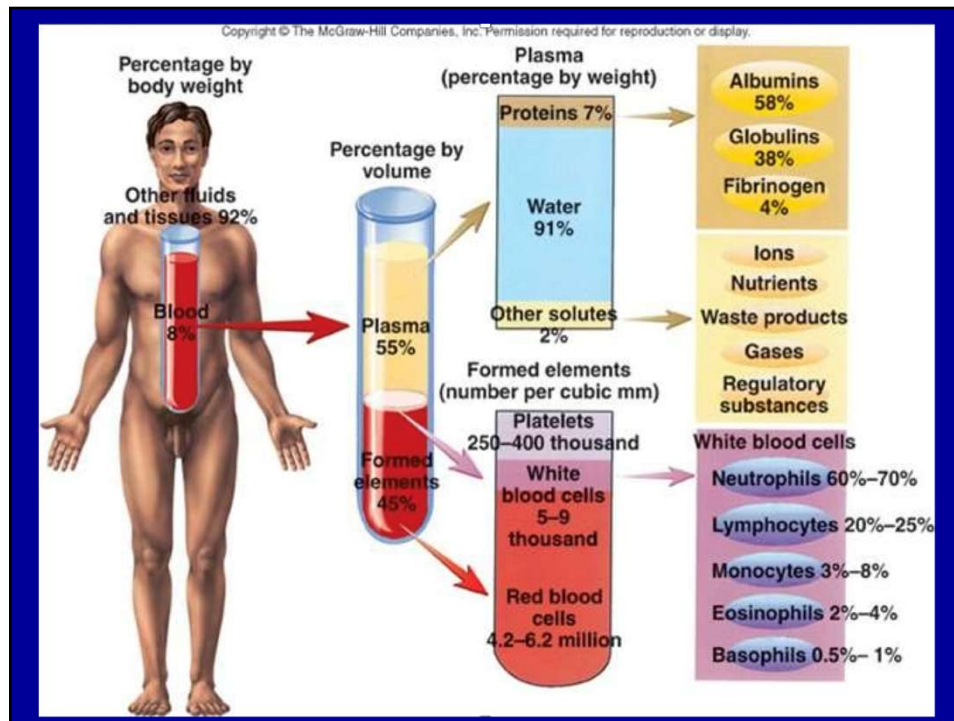
- The use of autologous PRP was first used in 1987 by Ferrari et al. following an open heart surgery, to avoid excessive transfusion of homologous blood products.

- 1990 PRP is used as a surgical glue to seal difficult incisions (ie open thoracic surgery, plastic surgery large skin flaps)
- 1991 PRP Is used by oral surgeons to enhance wound healing in cancer patients with jaw reconstruction
- 1998 Orthopedic surgeons begin using PRP as one of several tools to repair bone fractures that are resistant to mending
- 1999 Introduction of PRP in sports medicine; Steve Bono (QB 49ers) for Achilles tendon
- 2002 Allan Mishra injects PRP to treat chronic elbow tendonitis

- 2006 American Journal of Sports Medicine (11/2006) – research substantiates that PRP accelerates tissue / wound healing. For a 2006 study published by The American Journal of Sports Medicine, Mishra used the treatment on 15 of 20 patients who chronic elbow tendinosis who were considering surgery; the five others received only anesthetic. Two months later, the patients receiving PRP therapy noted a 60 percent improvement in pain measurements, compared with 16 percent for the control group.
- 2008 Dr. Joseph Greco and Robert Brandt received a research grant from the International Society of Hair Restoration to study the “Effects of Autologous PRP and Various Growth Factors in Non Transplanted Hair”
- 2009 Hines Ward becomes MVP of Super Bowl after high ankle sprain 2 weeks prior injected with PRP

Here are some star athletes who have used PRP:

Tiger Woods – Golf
 Takashi Saito – Dodgers Pitcher
 Troy Polamalu – Steelers Defense
 Hines Ward – Steelers Receiver



Types of PRP

- Leukocyte-rich PRP (Red PRP) – Original PRP and the one most systems currently available produce. Contains concentrated platelets, plasma, leukocytes and significant quantities of erythrocytes.
- Pure- PRP – Retains the platelets, but has most of the leukocytes and RBC's removed.
- Both of these types may be activated into a dense gel form denoted fibrin-rich L-PRP, and fibrin-rich P-PRP. These forms cannot be injected, but are used as scaffolding and fillers for surgical applications.

What about WBC in PRP?

- New Research suggests- Neutrophils and therefore WBCs should be as low as possible
- Neutrophils are high in MMPs ,TNF alpha and Interlukin-1B, IL-6 which are all responsible for detrimental inflammation that impairs healing.
- WBC's are good for topical application to non-healing wounds.

WBC's in PRP

- Recommendation- Leukocyte poor probably best for joints and acute and chronic tendon injuries.
- But, Most Tendon research done with PRP w/ Leukocyte Rich systems and shows good* efficacy, DeVos, Rodeo

RBC's Recommendation

- RBC poor PRP best for joints- iron catabolizes hyaline cartilage.
- Blood is toxic to hyaline cartilage
- Tendons- probably OK either way.

PRP

- Normal platelet concentration = 200,000 platelets/ml.
- Studies have shown that clinical efficacy can be expected with a minimum increase of 4-5x this baseline, or 1.2M-1.5M platelets/ microltr
- Studies have also shown that clinical efficacy of a PRP prep w/2-3X baseline has no more potential to heal than PPP

THE IMPORTANCE OF PLATELET CONCENTRATION

Concentration of Platelet Effect

Rughetti et al studied the relationship between the concentration of platelets in platelet gel and changes in the functional activity of human endothelial cells.

The proliferation of endothelial cells and its migration and the invasion of endothelial cells occurred in a bell-shaped manner. The authors found that the stimulation for proliferation of endothelial cells peak at 1.25×10^6 platelets / μ l and angiogenesis at 1.5×10^6 platelets / μ l , respectively.

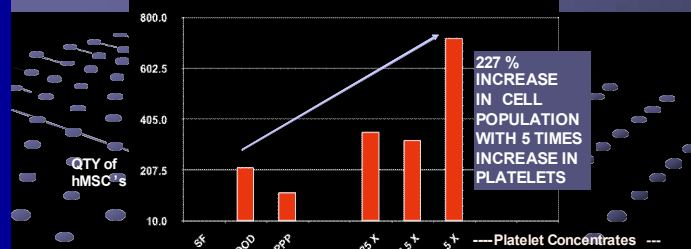
This signifies the fact that a PRP platelet count 1 million/mL has become the working definition for therapeutic PRP and also reasons out the criticism on not getting the expected best results of PRP, which might be due to lower concentrations of platelets.

Rughetti A, Giusti I, D'Ascenzo S, Leocata P, Carta G, Pavan A, et al. Platelet gel-released supernatant modulates the angiogenic capability of human endothelial cells. Blood Transfus. 2008;6:12-7. [PMCID: PMC2626859] [PubMed: 18661919]

PRP Concentration

How Many Platelets Is Enough?

Dose-Dependent Mitogenic Effects of Platelet Release on hMSC 's



Conclusions

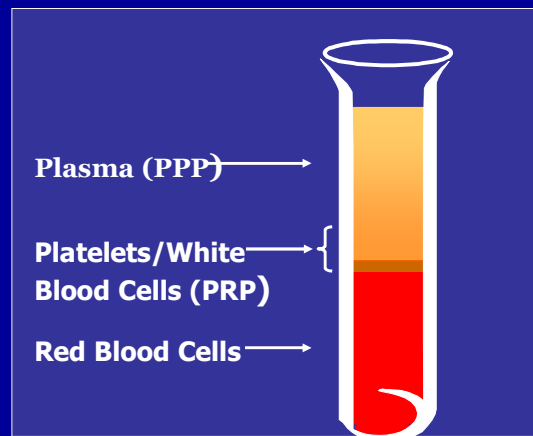
- Platelet Concentrate and VEGF stimulate chemotactic migration of hMSC 's in a dose -dependent manner.
- Platelet Concentrate stimulates proliferation of hMSC 's in a dose -dependent manner

Mitogenic Stimulation of Human Mesenchymal Stem Cells by Platelet Release Suggests a Mechanism for Enhancement of Bone Repair by Platelet Concentrate, Poster AAOS Meeting 2002
Haynesworth, S.E.; Kadyala, S.; Liang, L.; Bruder, S.P.; DePuy Acromed, DePuy Orthopedics, and Case Western Reserve University

PRP Centrifuge



Centrifugal Blood Separation



Commercially Available PRP Systems. Vol, volume; CaCl₂, Calcium chloride; NS, not specified

Commercial System	Blood Vol (ml)	Centrifugation (#of Spins)	PRP Vol (ml)	Platelet Concentration	Activator (+/-)	Leukocytes (+/-)
<i>Cascade</i> [®]	9-8	1	4-9	1-1.5x	CaCl ₂	-
<i>GPS III</i>	60	1	10	9.3x	Trombin	+
<i>ACF</i> [®]		9	1	3	2-3x	None
<i>Smart PRP2</i> [®]	20-120	2	3-20	4-6x	Trombin	+
<i>PRGF</i> [®]	9-72	1	4-32	2-3x	CaCl ₂	-
<i>Magellan</i> [®]	30-60	2	6	3-7x	CaCl ₂	+
<i>Angel</i> [®]	40	2	4	1-18x	None	+/-
<i>Genesis CS</i> [®]	30-60	1	4-10	9x	CaCl ₂	NS
<i>Sequire</i> [®]	50	2	5	1.6x	Trombin Bovine	NS
<i>Platelex</i> [®]	50	2	4-6	NS	Batroxobin	+
<i>Symphony II PCS</i> [®]	55-110	1	NS	3-6x	Thrombin Bovine CaCl ₂	NS

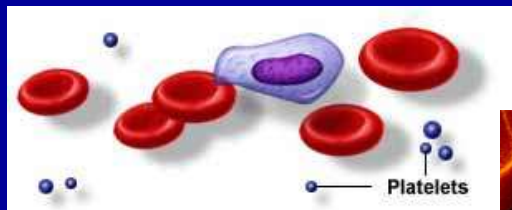
PRP Defined

- What we must produce for therapy in Regenerative Medicine is a Concentrated Platelet Product (CPP)
- At least 4-5X Baseline

Platelets

- Platelets = small discoid blood cells made in bone marrow
- Lifespan of 7–10 days
- Contain two types of granules
- Dense granules, involved in clotting
- The alpha granules contain the growth factors released in the healing process
- Granules release the growth factors, which stimulate the inflammatory healing cascade

Platelets, cont.



Types of Growth Factors

- Platelet-Derived Growth Factor (PDGF)
- Fibroblast Growth Factors (FGFs)
- Transforming Growth Factors-b (TGFs-b)
- Transforming Growth Factor-a (TGF-a)
- Erythropoietin (Epo)
- Insulin-Like Growth Factor-I (IGF-I)
- Insulin-Like Growth Factor-II (IGF-II)
- Interleukin-1 (IL-1)
- Interleukin-2 (IL-2)
- Interleukin-6 (IL-6)
- Interleukin-8 (IL-8)
- Tumor Necrosis Factor-a (TNF-a)
- Tumor Necrosis Factor-b (TNF-b)
- Interferon-g (INF-g)
- Colony Stimulating Factors (CSFs)
- Granulocyte-colony stimulating factor (G-CSF)
- Granulocyte-macrophage colony stimulating factor (GM-CSF)
- Nerve growth factor (NGF)
- Neurotrophins
- Erythropoietin (EPO)
- Thrombopoietin (TPO)
- Myostatin (GDF-8)
- Growth Differentiation factor-9 (GDF9)
- Epidermal growth factor (EGF)
- Hepatocyte growth factor (HGF)

Platelets, cont.

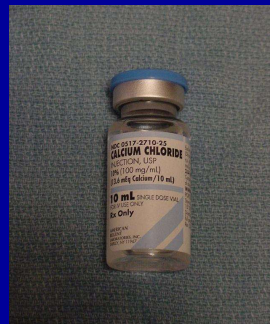
- Platelet-derived growth factor (PDGF)
 - Stimulates cell replication
 - Promotes angiogenesis
 - Promotes epithelialization
 - Promotes granulation tissue formation
- Transforming growth factor (TGF)
 - Promotes formation of extracellular matrix
 - Regulates bone cell metabolism

Platelets, Cont.

- Vascular endothelial growth factor (VEGF)
 - Promotes angiogenesis
- Epidermal growth factor (EGF)
 - Promotes cell differentiation and stimulates re-epithelialisation, angiogenesis and collagenase activity
- Fibroblast growth factor (FGF)
 - Promotes proliferation of endothelial cells and fibroblasts
 - Stimulates angiogenesis

What about Activating Platelets? Medications

- Bovine Thrombin Powder (10ml vial)
- 10% Calcium Chloride (10ml vial)



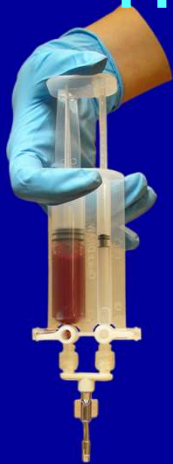
What about Activating Platelets? Application Method



QuickDraw Delivery
System



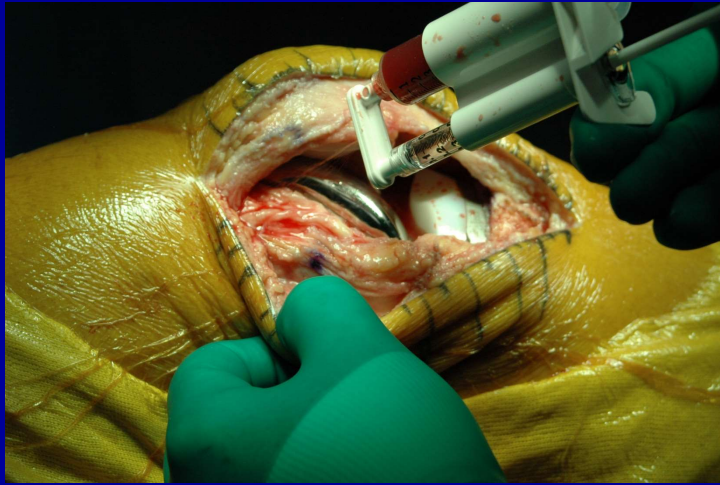
What about Activating Platelets? Application Method



QuickDraw Delivery
System



What about Activating Platelets? Spray On All Exposed Tissue



What about Activating Platelets? Spray PRP After Each Closure



What about Activating Platelets?

- Studies are mixed.
- Scherer-showed PRP w/out activation promotes increased healing response in wound study
- Activation probably not needed for tendons and joints routinely, Filardo.
- For larger tears or focal cartilage lesions may make sense to activate and gel PRP to keep it on location.

For Advanced: PRP Lysates and Releasates

- Activating PRP and reprocessing creates a releasate with no cell bodies but all GFs suspended in Plasma
- Very potent anti-inflammatory effects
- Suppresses IL-1B induced inflammation by elevating IL-1 receptor antagonist (23,000X higher than IL-1B in PRP)

What About Local Anesthetics?

- Studies are mixed in vitro.
- Lidocaine and Bupivacaine at full strength are toxic to chondrocytes, synoviocytes and tenocytes as well as muscle and stem cells.
- No in vivo studies, but most in-vivo studies use anesthetics in tendons and don't use anesthetics in O/A studies and both outcomes are still good.
- Can we improve outcomes w/ or w/out?

Anesthetic Recommendations

- OK to use in low concentration.
 - Ropivacaine at 0.2% is safe for all tissues
 - Lidocaine - drop dose down to 0.2% for all tissues except stem cells, drop it down to 0.1%
 - Marcaine above 0.25% is unsafe for all tissues. Some in-vitro studies show below 0.25% OK in some tissues except stem cells
 - Procaine - No studies on platelet safety, but has been shown to be toxic to stem cells

Why Even Consider PRP?



Introduction

- According to the World Health Organization (WHO), musculoskeletal injuries are the most common cause of severe long-term pain and physical disability, and affect hundreds of millions of people around the world.*

*Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. Bull World Health Organ. 2003;81:646–56.

Epidemiology

- Soft tissue injuries, including tendon and ligament trauma, represent 45% of all musculoskeletal injuries in the USA.

Anitua M, Sanchez E, Nурden A, Nурden P, Orive G, Andia I. New insights into and novel applications for platelet-rich fibrin therapies. Trends Biotechnol. 2006;24(5):227–34.
Praemer AF. Musculoskeletal conditions in the United States. 2nd ed. Rosemont: American Academy of Orthopaedic Surgeons; 1999.

Indications

- Tendinosis/tears
- Ligamentous/laxity/tears
- Muscle Tears
- Osteoarthritis
- Cartilage injury (OCD)
- Labral, Meniscal Tears
- Wound healing
- Fracture non-unions
- Stress fractures
- Intradiscal Degeneration/ Derangement

Some Structures Treatable With PRP

CRANIAL: TENDONS, TMJ, GLABELLER MEMBRANE, **CERVICAL:** FACET AND NUCHAL LIGAMENTS AND TENDONS, **THORACIC:** RIB TENDONS, COSTO-TRANSVERSE JOINTS, COSTO-STERNAL JOINTS, FACET AND SUPRASPINOUS LIGAMENTS, VERTEBRAL BODY TENDON INSERTIONS, **SHOULDER:** SC AND AC JOINT/LIGAMENT, CARTILAGE AND LABRUM DAMAGE, LIGAMENT STRUCTURE, ROTATOR CUFF TENDONS, OTHER TENDONS ON HUMERUS, ACROMION, AND SCAPULA, **ELBOW:** LIGAMENT STRUCTURE, TENDON ORIGINS AND INSERTIONS, **WRIST:** COLLATERAL AND CARPAL LIGAMENTS, **HAND AND FINGERS:** LIGAMENTS, (CMC, MCP, PIP, DIP) TENDON BODIES AND TENDON INSERTIONS, CARTILAGE LOSS IN JOINTS, **TRUNK:** FASCIAL DEFECTS, UMBILICAL HERNIAE, **LUMBAR SPINE:** FACET AND SUPRASPINOUS LIGAMENTS AND VERTEBRAL BODY TENDON INSERTIONS, TRANSVERSE PROCESS ATTACHMENTS OF LUMBODORSAL FASCIA AND PSOAS FASCIA, **PELVIS:** LIGAMENTS: INGUINAL, SI, IL, ST, ET AL, AND SYMPHYSIS JOINT AND SYMPHYSIS LIGAMENT, JOINTS: SI AND SYMPHYSIS PUBIS, TENDONS: TRUNK MUSCLES TO ILIAC BRIM, GLUTEAL MUSCLES, ADDUCTOR, EXTENSOR, FLEXOR, ABDUCTOR AND ROTATOR MUSCLE TENDONS ORIGINS AND INSERTIONS, INCLUDING ILIACUS M., AND PUBOCOCYGEUS, IT BAND ORIGIN, **COCCYX:** LIGAMENTS AND SACROCOCCYGEAL JOINT, **HIP:** JOINT CARTILAGE AND LABRUM DAMAGE, ILIOFEMORAL, ISCHIOFEMORAL, AND CAPITIS FEMORIS LIGAMENTS, TROCHANTER TENDON INSERTIONS, IT BAND AT TROCHANTER AND DOWN FEMUR, FEMORAL TENDON INSERTIONS ANTERIOR, LATERAL, POSTERIOR, PSOAS, AND HAMSTRING MUSCLE TEAR, **KNEE:** CARTILAGE LOSS AND DEFECTS, MENISCAL TEARS, POST SURGICAL DAMAGE TO TENDON HARVEST SITES AND INCISED CONNECTIVE TISSUE STRUCTURES, LIGAMENTS: ACL, PCL, MCL, LCL, CORONARY, TRANSVERSE, TIBIOFEMORAL, PATELLAR, JOINT CAPSULE, TENDONS: QUADRICEPS, ADDUCTORS, HAMSTRINGS, POPLITEUS, GASTROCNEMIUS, SOLEUS, IT BAND, ET AL, **ANKLE:** LIGAMENTS OF TIBIA, FIBULA, AND ANKLE COMPLEX, TENDON BODIES AND INSERTIONS, INCLUDING ACHILLES, JOINTS WITH CARTILAGE LOSS, PLANTAR FASCIA ORIGIN, BODY, AND INSERTIONS, **FOOT:** ALL TENDON AND LIGAMENT STRUCTURES (TMT, MTP, PIP), INTEROSSEUS M TENDONS ET AL.

Injection Technique

- Injections are usually performed at the enthesis, but can be done in the body of the ligament or tendon as well as into the tendon sheath around the tendon.
- Can use a two injection technique; injecting anesthetic first followed by PRP, or can mix PRP with anesthetic/activator as long as anesthetic concentrations are within acceptable limits and injectate is used quickly.
- Can use ultrasound guidance or by anatomical landmarks if the practitioner is experienced.

Treatment Number & Frequency

- In clinical practice it usually takes from 2-6 treatments of PRP to effect a satisfactory outcome
- Treatments are typically performed at 6-8 week intervals

Recovery

- Realistic expectations:
 - Expect 2-3 months to feel significantly better- Acute Injury.
- Chronic symptoms- expect 6-9 months to feel significantly better.

Contra-indications

- Anti-platelet / anti-inflammatory medication
 - Coumadin, NSAIDS, heparin, etc...
 - High dose fish oil, other anti-inflammatory supplements
- Bleeding / clotting disorder
- Thrombocytopenia- <50K
- Cigarette smoking?
- Auto-immune disease?
 - RA
 - PRP does help resolve synovial proliferation!
- Nutritional / Hormonal deficiency- relative

Complications of PRP

- Immediate pain- within 60 minutes/ inflammation, swelling for a few days (can require steroids, NSAIDS)
- Allergic reaction to anesthetics
- Infection
- Nausea, vomiting
- Vasovagal reaction
- No Guarantee
- *Not easy to learn*

Low Success Areas

- Large rotator cuff tears with retraction
- Advanced Bone on Bone O/A
- Large unstable cartilage tears
- Hip joint
- Knee OA with synovial proliferation
 - Takes ~5 treatments and only lasts 1 year or so

Show Me The Studies



PRP Research and Cases



PRP Injection Helps

Treatment of chronic elbow tendinosis with buffered platelet-rich-plasma

Mishra A, Pavelko T.

1: Am J Sports Med. 2006 Nov;34(11):1774-8. Epub 2006 May 30. Links

METHODS: One hundred forty patients with elbow epicondylar pain were evaluated in this study

RESULTS: Eight weeks after the treatment, the platelet-rich plasma patients noted 60% improvement in their visual analog pain scores versus 16% improvement in control

At 6 months, the patients treated with platelet-rich plasma noted 81% improvement in their visual analog pain scores ($P = .0001$)

At final follow-up (mean, 25.6 months; range, 12-38 months), the platelet-rich plasma patients reported **93% reduction** in pain compared with before the treatment ($P < .0001$)

PRP IN THE LITERATURE

- de Vos, RJ. Platelet Rich Plasma Injection for **Chronic Achilles Tendinopathy**: A Randomized, Controlled Trial. JAMA, 2010; 303(2): 144-149.
- Results: **No significant difference** PRP vs. Saline

PRP IN THE LITERATURE

- Monto, RR. et. al. Platelet Rich Plasma Therapy for **Chronic Achilles Tendinosis**. Foot and Ankle Intl., 2011; 33(5): 379-385
- Results: PRP **"improved clinical outcomes" in 93%** N=30
- Murawski, CD et.al., A Single PRP Injection for Chronic Midsubstance **Achilles Tendinopathy**. Foot Ankle Spec., 2014 online
- Results: **78% asymptomatic** with 6 month f/u. N=32

noted. By comparison, in a 30 patient case series, Monto concluded that PRP improved clinical outcomes in 93% of patients who had previously failed conservative treatment. In addition, the author described that 93% of patients showed resolution of their pretreatment imaging abnormalities at 6 months following treatment, as assessed by MRI and ultrasound.¹³

Magnetic resonance imaging was performed on all patients prior to and 6 months after injection. Twenty-five of 32 patients (78%) reported that they were asymptomatic at the 6-month follow-up visit and were able to participate in their respective sports and daily activities. The remaining 7 patients (22%) who reported symptoms that did not improve after 6 months

PRP IN THE LITERATURE

- Monto, RR et. al., Platelet Rich Plasma Efficacy vs. Corticosteroid Injection for Chronic Severe **Plantar Fasciitis**. Foot and Ankle Intl. 2014; 35(4): 313-318.
- Results: PRP improved **AOFAS score 57 > 90+** (3-24 mo.)
PRP superior to corticosteroid for treatment.

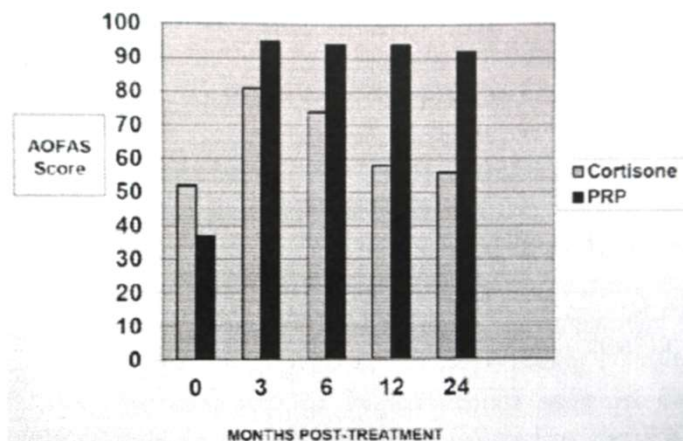


Figure 3. Graph demonstrating the clinical superiority of PRP versus cortisone for severe chronic Achilles tendinosis over a 2-year period ($P = .001$, 95% CI).

PRP IN THE LITERATURE

- Randelli, PS, Autologous PRP for Arthroscopic Rotator Cuff Repair. Disability and Rehab., 2008; (1): 1-6.
- Results: addition of **PRP** at time of **surgical repair** reduced pain, increased ROM, and lead to **faster recovery**.
- Gawenda, K. Treatment of **Achilles Tendinopathy** with Platelet Rich Plasma. Intl. Jour. Sports Med., 5/4/2010 online.
- Results: **AOFAS 55 > 96, VISA 24 > 96** at 18 mo. N=14

PRP IN THE LITERATURE

- Ferraro, G. Ultrasound Guided Injection of Platelet Rich Plasma in **Chronic Achilles and Patellar Tendinopathy**. Journal of Ultrasound, 2012; 15: 260-266.
- Results: **29% 'excellent', 43% 'good', 28% 'poor'**. N=58.

Overall results related to all tendons are reported in Table 3.

At the 6-month follow-up, overall satisfaction was rated by patients in whom patellar tendon was treated as positive in 20 tendons (71%; excellent = 8/28 tendons; good = 12/28 tendons) and poor in 8 tendons (29%).

At the 6-month follow-up, overall satisfaction was rated by patients in whom Achilles tendon was treated as positive in 21 tendons (70%; excellent = 10/30 tendons; good = 11/30 tendons) and poor in 9 tendons (30%).

Overall satisfaction at the 6-month follow-up was rated by patients of both groups as positive in 41 tendons (70%; excellent = 18/58 tendons; good = 23/58) and poor in 17 tendons (30%).

PRP IN THE LITERATURE

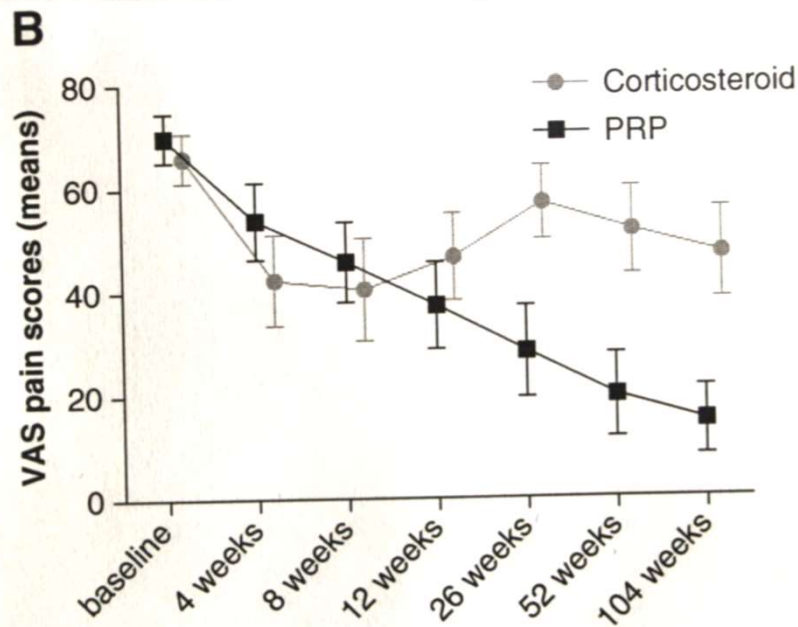
- Kon, E. Platelet Rich Plasma: New Clinical Application. A Pilot Study for Treatment of **Jumper's Knee**. *Injury*; 2009; 40:599-603.
- Results: '100% Resolution' - 30%; 'Marked Impvt.' - 40%; 'Mild Impvt.' - 10%; 'No Impvt.' - 20%

The evaluation of functional recovery showed six men with complete recovery, eight with marked improvement, two with mild improvement and, in four cases, no improvement. Participant satisfaction, defined as satisfied or not satisfied with results of treatment, was 80% (16/20).

PRP IN THE LITERATURE

- Gosens, T. Ongoing Positive Effect of Platelet Rich Plasma vs. Corticosteroid Injection in **Lateral Epicondylitis**. Amer. Jour. Sports Med, 2010; 39(6): 1200-1208.
- Results: 37 of 50 PRP patients had 'success', defined as a 25% reduction in DASH score and no re-intervention in a 2 year period.

and the nonsuccessfully treated group. The protocol-compliant group was defined as the group of patients who did not need a reintervention (ie, reinjection, crossover, or surgery). Successful treatment was defined as more than 25% reduction on the VAS pain score and the DASH total scores without a reintervention after 2 years compared with the preinjection scores. This 25% reduction closely resembles the MCID (minimum clinically important difference), which is 10.2 points for the DASH score.²¹ To



Successful Treatment (DASH Symptom Score)

In total, 56 of 100 patients (56.0%) were successfully treated, which was defined as a reduction of 25% on the DASH score without a reintervention after 2 years. Patients in the PRP group were more often treated successfully ($n = 37$; $P < .0001$) compared with the corticosteroid group ($n = 19$). However, compared with baseline DASH scores,

patient receiving a PRP injection. Regarding the patients who failed their initial treatment, those who crossed over to the PRP group significantly improved on both VAS pain scores ($P < .001$) and DASH disability symptom scores ($P = .019$). However, patients who received surgery or a reinjection with corticosteroids did not benefit when their VAS and DASH scores at 2 years were compared with their baseline scores. No complications were seen con-

Tennis Elbow PRP vs Surgery

- Ford 2014- Compared PRP single treatment to Operative debridement
- 28-PRP vs 50 Surgery
- Followed 48 wks PRP vs 52 weeks Surgery
- Pain Relief 89% PRP vs 84% Surgery

Non-Healing Wounds

- PRP has been shown to be effective in the treatment of non-healing wounds

Hom DB, Linzie BM, Huang TC, 'The healing effects of autologous platelet gel on acute human skin wounds', Arch Facial Plast Surg, 9(3) (2007), pp. 174-183.

O'Connell SM, Impeduglia T, Hessler K, Wang XJ, Carroll RJ, Dardik H, 'Autologous platelet-rich fibrin matrix as cell therapy in the healing of chronic lower extremity ulcers', Wound Repair Regen, 16(6) (2008), pp. 749-756.

Cervelli, Valerio MD; Lucarini, Lucilla MD, 'Use of Platelet-Rich Plasma and Hyaluronic Acid in the Loss of Substance with Bone Exposure', Advances in Skin & Wound Care, 24(4) (2011), pp. 176-181

Hair Loss

- PRP has been found to be effective for androgenic alopecia

Swapna S Khatu, Yuvraj E More, Neeta R Gokhale, Dipali C Chavhan, and Nitin Bendsure **Platelet-Rich Plasma in Androgenic Alopecia: Myth or an Effective Tool** J Cutan Aesthet Surg. 2014 Apr-Jun; 7(2): 107–110.

Picard F1, Hersant B2, Niddam J2, Meningaud JP2 **Injections of platelet-rich plasma for androgenic alopecia: A systematic review.** J Stomatol Oral Maxillofac Surg. 2017 Oct;118(5):291-297. doi: 10.1016/j.jormas.2017.06.011. Epub 2017 Jul 1.

Gentile P1, Garcovich S2, Bielli A3, Scioli MG3, Orlandi A3, Cervelli V4. **The Effect of Platelet-Rich Plasma in Hair Regrowth: A Randomized Placebo-Controlled Trial.** Stem Cells Transl Med. 2015 Nov;4(11):1317-23. doi: 10.5966/sctm.2015-0107. Epub 2015 Sep 23.

Skin Rejuvenation

- PRP has been found to be effective in cosmetic rejuvenation of the skin.

Dae Hun Kim, M.D., Young Jin Je, M.S., Chang Deok Kim, Ph.D., Young Ho Lee, M.D.,1 Young Joon Seo, M.D., Jeung Hoon Lee, M.D., and Young Lee, M.D.corresponding author **Can Platelet-rich Plasma Be Used for Skin Rejuvenation?** Evaluation of Effects of Platelet-rich Plasma on Human Dermal Fibroblast Ann Dermatol. 2011 Nov; 23(4): 424–431.

Elghblawi E1. J Cosmet Dermatol. **Platelet-rich Plasma, The Ultimate Secret for Youthful Skin Elixir and Hair Growth Triggering.** 2018 Jun;17(3):423-430. doi: 10.1111/jocd.12404. Epub 2017 Sep 8.

Hara T1,2, Kakudo N3, Morimoto N4, Ogawa T4, Lai F4, Kusumoto K **Platelet-rich plasma stimulates human dermal fibroblast proliferation via a Ras-dependent extracellular signal-regulated kinase 1/2 pathway.** J Artif Organs. 2016 Dec;19(4):372-377. Epub 2016 Jul 7.

Other Areas PRP Reported to be Effective, but Lacking Controlled Studies

- Peripheral arterial disease
- Erectile dysfunction
- Urinary incontinence & sexual dysfunction in women
- Peripheral neuropathy
- Nebulized and inhaled for COPD and asthma

Reimbursement

- Has a CPT code – 0232T
- Unfortunately, at this time, most major insurance companies do not cover
- A few smaller faith-based insurance-like programs do cover (Samaritan Ministries and others)

**Thank You for Your
Attention**

Questions?