



# CLINICAL UPDATES IN PLATELET GEL

## Sports Medicine & Regenerative Injection Therapy

### ■ *Clinical Evidence*

The studies below suggest that protocols using Platelet Rich Plasma can have a dramatic impact on improving the healing rate in tendon, ligament and soft tissue injuries.

#### *Human Studies*

1. **Barett, S, Growth Factors for Chronic Plantar Fasciitis, *Podiatry Today*, 2004, 17:36-42**  
 Nine patients with hypoechoic and thickened plantar fascia were injected with PRP to evaluate the efficacy of PRP with 1 week, 2 week and 1, 3, 6, and 12 month follow-up. All patients had improvement that was noted on diagnostic ultrasound and 6 patients had complete resolution after 2 months. At 1 year, 7 of 9 patients were completely healed.
2. **Bielecki, T, et al, Percutaneous Injection of Autogenous Growth Factors in Patient with Nonunion of the Humerus. A Case Report, *Journal of Orthopaedics*, 2006; 3:e15**  
 This case report describes the efficiency of percutaneous injection of platelet rich plasma into the humeral diaphyseal nonunion gap as a minimally invasive treatment method offering the advantage of decreased morbidity associated with the classic grafting techniques.
3. **Fox, H, et al, Autologous Platelet Concentrate (APC+); An Exciting and Effective New Modality for Foot and Ankle Surgeons, May 7, 2005**  
 This paper provides a private practice overview and practical perspective regarding the use of PRP injections to effectively treat patients with ailments such as plantar fasciosis, posterior tibial dysfunction, and Achilles tenosynovitis.
4. **Mishra, A, et al, Treatment of Chronic Elbow Tendinosis with Buffered Platelet-Rich Plasma, *American Journal of Sports Medicine*, 2006, 34:1774-1778**  
 Twenty patients that failed non-operative treatment for chronic epicondylar pain were randomized to evaluate effectiveness of injecting growth factors from PRP. At 1, 2, and 6 months all PRP patients had lower pain and greater ROM than control (bupivacaine). The authors conclude that treatment of chronic epicondylar pain with PRP should be considered prior to surgical intervention.
5. **Sadati, K, et al, Platelet-Rich Plasma (PRP) Utilized to Promote Greater Graft Volume Retention in Autologous Fat Grafting, *American Journal of Cosmetic Surgery*, 2006, 23:203-211**  
 This 580 patient (2,033 grafts) retrospective injection study evaluated the effects of PRP on autologous fat grafts. The authors found that adding PRP to autologous fat aids in graft volume retention and survival when used clinically for soft tissue augmentation and reconstruction.
6. **Sanchez, M, et al, Plasma Rich in Growth Factors to Treat Articular Cartilage Avulsion: A Case Report, *Medicine & Science in Sports & Exercise*, 2003, 1648-1652**  
 This case report describes a new application for the use of growth factors from platelet rich plasma in the arthroscopic treatment of a large non-traumatic avulsion of articular cartilage in the knee. Despite the poor prognosis of this case, complete articular healing was considerably accelerated and the functional outcome was excellent, allowing a rapid resumption of symptom-free athletic activity.
7. **Sanchez, M, et al, Comparison of Surgically Repaired Achilles Tendon Tears Using Platelet Rich Fibrin Matrices, *American Journal of Sports Medicine*, Vol 35, No 2, 2007, 245-251**  
 In this 12 athlete retrospective study, the authors evaluated the use of platelet rich plasma with growth factors in complete achilles tendon tears. Compared to the historical group, patients receiving platelet rich plasma recovered their range of motion earlier, showed no wound complications, and took less time to resume running and general training activities.
8. **Scarpone, M, et al, PRP as a Treatment Alternative for Symptomatic Rotator Cuff Tendinopathy for Patients Failing Conservative Treatment, 2005 Advances in Blood Management Meeting Presentation**  
 This prospective pilot study evaluates the capacity of percutaneous injected growth factors from PRP to heal partial rotator cuff tears. Ultrasound guided injection of growth factors from PRP within the injured muscle enhances healing and functional recovery. Dr Scarpone concludes that this therapy should be recommended for patients considering surgery for partial rotator cuff tears.
9. **Ventura, A, et al, Use of Growth Factors in ACL Surgery: Preliminary Study, *Journal of Orthopaedic Traumatology*, 2005, 6:76-79**  
 Twenty patient prospective ACL pilot study with 6 month follow-up evaluating the efficacy of using the PRP growth factors as a potential treatment in anterior cruciate ligament (ACL) surgery. CT data showed that the transformation from autologous quadrupled hamstring tendon graft to ACL was faster in the PRP group than the controls.

### *In-Vitro Research*

10. Anitua, E, et al, **Autologous Preparations Rich in Growth Factors Promote Proliferation and Induce VEGF and HGF Production by Human Tendon Cells in Culture**, *Journal of Orthopaedic Research*, 2005, 23:281-286  
This in vitro study evaluated the effect of a platelet concentrate medium on the proliferation of tendon cells. Platelet-supplemented medium induces and stimulates cell proliferation, maintains the differentiated function of the human cells, and promotes synthesis of angiogenic factors during healing.
11. Mishra, A, et al, **Human Skin Fibroblast Proliferation in Buffered Platelet Rich Plasma**, *American Academy of Orthopaedic Surgeons Poster Presentation*, March, 2006  
In vitro study to determine the effect of a platelet concentrate on the proliferation of human skin fibroblasts. The authors found that inactivated buffered PRP augments human fibroblast proliferation when compared to control; which may have significant implications for either wound or tendon healing.
12. Schnabel, L, et al, **Platelet Rich Plasma (PRP) Enhances Anabolic Gene Expression Patterns in Flexor Digitorum Superficialis Tendons**, *Journal of Orthopaedic Research*, 2006, 230-240  
An in vitro study evaluating gene expression patterns, DNA, and collagen content of equine flexor digitorum superficialis tendon cultured in media consisting of PRP and other blood products. The authors found that PRP at 100% concentration stimulated the greatest number of matrix molecule genes without increasing expression of the pro-inflammatory mediators. The authors suggest that the results of this study support the application of PRP for treatment of tendonitis.

### *Animal Research*

13. Aspenberg, P, et al, **Platelet Concentrate Injection Improves Achilles Tendon Repair in Rats**, *Acta Orthop Scand*, 2004; 75:93-99  
The study evaluated the efficacy of a platelet concentrate injection to improve Achilles tendon repair in a critical defect rat model. The study results showed a single injection of platelet concentrate increased callus strength and stiffness by 30% after 1 week, which persisted for as long as 3 weeks after injection. The authors conclude that platelet concentrate may prove useful for treatment of Achilles tendon rupture.
14. Menetrey, J, et al, **Growth Factors Improve Muscle Healing In Vivo**, *The Journal of Bone & Joint Surgery (Br)*, 2000; 82-B:131-137  
This mouse study assessed the effect of growth factors (b-FGF, IGF-1, and NGF) injected on muscle regeneration after injury and evaluated their influence on muscle healing. The authors found at one month, muscles injected with IGF-1 and b-FGF showed improved healing and significantly increased fast-twitch and tetanus strengths.
15. Murray, M, et al, **Collagen-Platelet Rich Plasma Hydrogel Enhances Primary Repair of the Porcine Anterior Cruciate Ligament**, *Journal of Orthopaedic Research*, 2007, 25:81-91  
A biomechanical porcine study was conducted to determine the effect of supplementing ACL suture repair by injecting a collagen-PRP provisional scaffold on the contralateral side. The authors found that supplementation of suture repair with a collagen-PRP hydrogel resulted in significant improvements in load at yield, maximum load, and linear stiffness at 4 weeks. The study suggested that the use of a collagen-PRP hydrogel may stimulate healing resulting in improved biomechanical properties after suture repair.
16. Murray, M, et al, **Use of a Collagen-Platelet Rich Plasma Scaffold to Stimulate Healing of a Central Defect in the Canine ACL**, *Journal of Orthopaedic Research*, 2006, 24:820-830  
A biomechanical canine study was conducted to determine the effect of supplementing a central ACL defect by injecting a collagen-PRP provisional scaffold on the experimental knee and leaving the contralateral defect empty. The authors found that biomechanically, the treated ACL defects had a 40% increase in strength at 6 weeks, which was significantly higher than the 14% increase in strength previously reported for untreated defects (p<0.02). The study concluded that the placement of a collagen-PRP scaffold in a central ACL defect may stimulate healing of the ACL histologically and biomechanically.
17. Virchenko, O, et al, **How can one Platelet Injection after Tendon Injury Lead to a Stronger Tendon after 4 Weeks?**, *Acta Orthopaedica*, 2006, 77:806-812  
In a rat Achilles tendon transaction model, the effects of platelets from a single PRP injection on Achilles tendon regeneration were evaluated. The authors suggested that platelets influence only the early phases of regeneration, but this allows mechanical stimulation to start driving neo-tendon development at an earlier time point which kept the PRP treated group constantly ahead of the controls.
18. Weiler, A, et al, **The Influence of Locally Applied Platelet-Derived Growth Factor-BB on Free Tendon Graft Remodeling after Anterior Cruciate Ligament Reconstruction**, *American Journal of Sports Medicine*, 2006, 32:881-891  
A biomechanical sheep study was conducted to determine the influence of platelet derived growth factors on tendon graft remodeling. The study found that the local application of platelet derived growth factors alter the tissue's mechanical properties during free tendon graft remodeling after ACL reconstruction. The authors suggest that growth factors present a promising tool toward the complete mechanical restitution of a healing ligament substitute.
19. Yasuda, K, et al, **The Effect of Growth Factors on Biomechanical Properties of the Bone-Patellar Tendon-Bone Graft after Anterior Cruciate Ligament Reconstruction**, *American Journal of Sports Medicine*, 2004, 32:870-880  
A biomechanical canine study was conducted to evaluate the impact of seeding autogenous bone-patellar tendon-bone graft after ACL reconstruction. The authors conclude that the application of growth factors improves the structural properties of autograft after ACL repair.