Arthrex ACP® Double-Syringe System

Autologous Conditioned Plasma

Arthrex®
Vet Systems

For the safe and rapid preparation of platelet-rich plasma

Autologous blood products have become increasingly popular in a number of orthopedic therapies. Platelet-rich plasma are beneficial because they are believed to release growth factors, which may result in a healing response.

Arthrex ACP® Double-Syringe System

Features and Benefits

- The Arthrex ACP (autologous conditioned plasma) system allows for rapid and efficient concentration of platelets and growth factors from autologous blood for use at the treatment site
- The unique double-syringe design allows for convenient and safe handling as the whole preparation process takes place in a closed system
- The ACP system is more affordable, easier to use, and has a faster processing time when compared to other conventional platelet-rich plasma (PRP) devices[1]
- White blood cells, specifically neutrophils, are NOT concentrated within the ACP system. These cells can have a detrimental effect on the healing process due to release of degradative proteins and reactive oxygen species[2,3]

Cap for
Double Syringe

Double Syringe

Rotor Set With Buckets

ACP Cart and Centrifuge

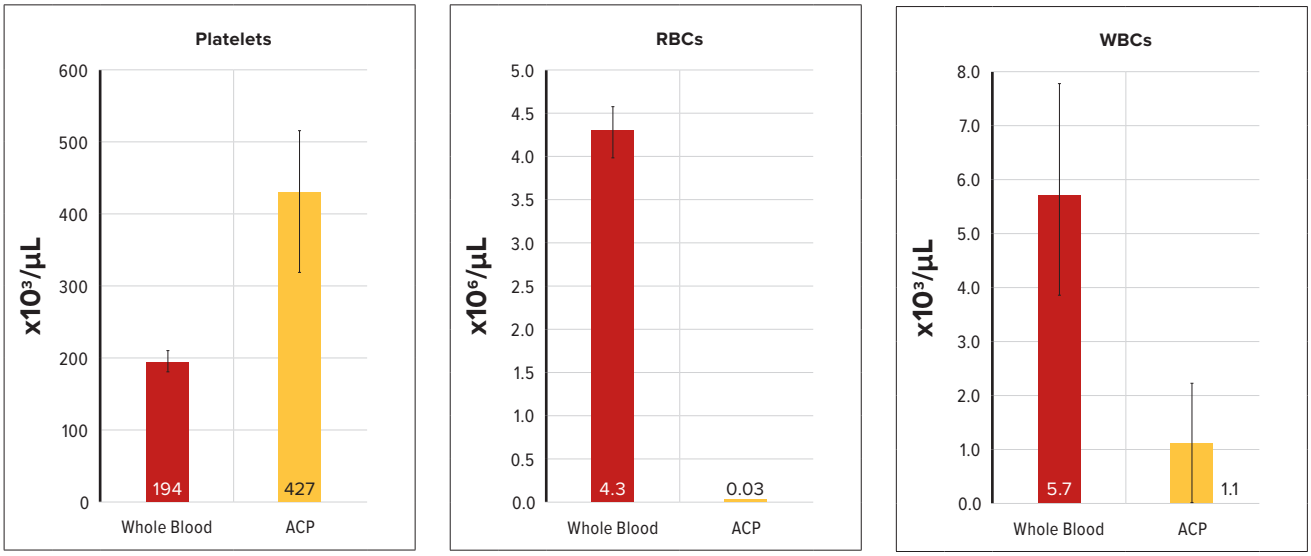
Product Description	Item Number
Centrifuge, Horizon 24 Flex-AV, w/ Rotor	**00389-129-001K**
ACP/Double Syringe w/ Cap	VAR-**1200S**
Counterbalance	ABS-**10027**
Centrifuge, Hettich w/o rotor	**1206-33**
Swing Out Rotor, 4 × 100 mL bucket w/ covers	VAR-**1261**
ACP Cart	ABS-**10100**

Mechanism of Action

Outside the bloodstream, platelets become activated and release proliferative and morphogenic proteins. They appear to work synergistically to invoke the following benefits[4-6]:

- Induce proliferation and differentiation of various cell types (eg, progenitor cells, osteoblasts, epidermal cells)
- Enhance/modulate production of collagen, proteoglycans, and tissue inhibitor of metalloproteinases (TIMP)
- Stimulate angiogenesis and chemotaxis

In order to evaluate the differences between ACP and whole blood, ACP was prepared from the venous blood of 20 healthy donors and the concentrations of platelets, red blood cells (RBCs), and white blood cells (WBCs) were measured with a standard complete blood cell count. We found the density of platelets to be more than twice as high in the ACP versus whole blood.[7] From the same report, there was an average reduction of 80% WBCs (specifically 99.9% reduction of neutrophils) and 99.4% RBCs.

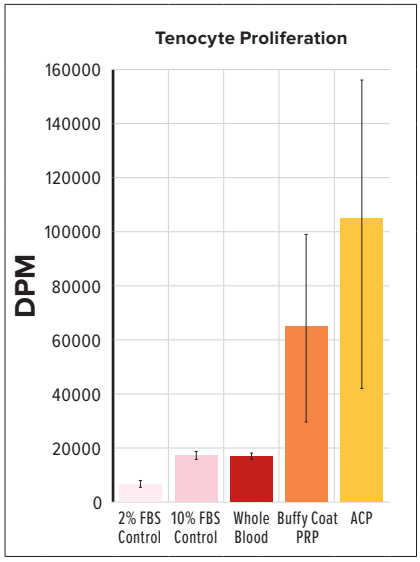


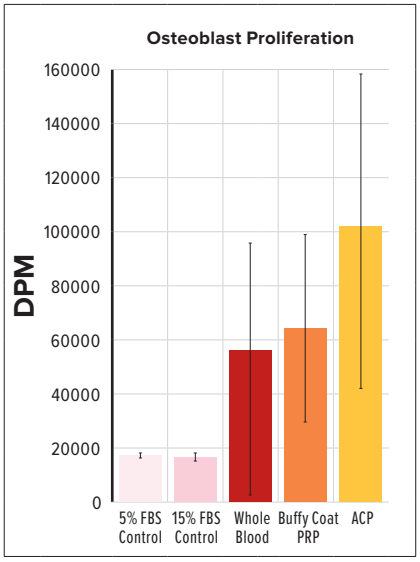
In order to determine the effect ACP has on particular cell lines, in vitro culture work was done with human tenocytes, osteoblasts, and myocytes.

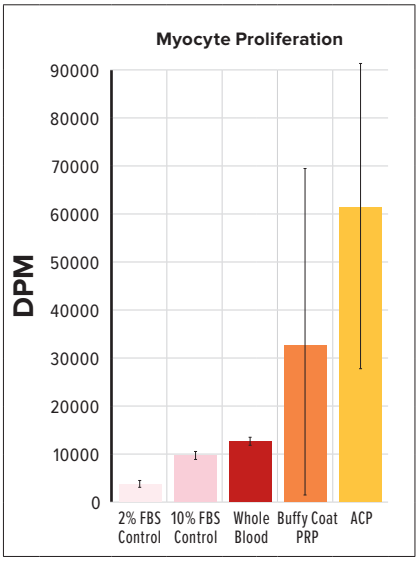
Peripheral blood was obtained from 8 donors and proliferation of the cell lines was measured for the following 5 culture groups: (1) negative control, cells cultured with 2% or 5% fetal bovine serum (FBS); (2) positive/proliferative control, cells cultured with 10% or 15% FBS; (3) whole blood; (4) a buffy coat-based PRP system containing 7× platelet concentration and 4× WBC concentration; and (5) ACP.

An ANOVA statistical analysis was completed to compare the different culture groups. ACP resulted in an increase in proliferation that was statistically significant (P <.05) over the negative control, positive control, and whole blood culture groups for each of the three cell lines. ACP-induced proliferation was also statistically greater than the buffy coat-based PRP culture group for the osteoblast and myocyte cell lines. ACP was not statistically different from the buffy coat PRP for tenoctyes, but it did approach significance and had an increased proliferative mean.[8]

Mechanism of Action (Cont.)







The increased proliferation for ACP compared to the other four groups could be caused by a number of factors. There may be a cellular dose response indicating that only a certain level of growth factors released from platelets are needed in order to elicit maximum proliferation. After reaching this proposed threshold, over concentrating platelets and growth factors may cause a paradoxical inhibitory effect on cell proliferation.[9,10]

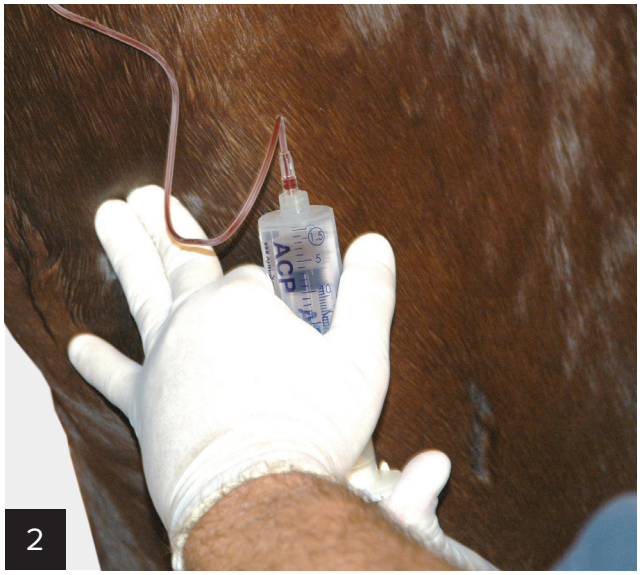
The inclusion of WBCs, specifically neutrophils, within a PRP product may prevent maximal growth potential due to release of degradative enzymes and reactive oxygen species.[2,3] Overall, this in vitro study demonstrates that ACP is the ideal PRP for cellular proliferation when compared to a buffy coat-based PRP.

	Arthrex ACP	Other PRP Systems
Volume of patient blood drawn	16 mL	60 mL to 120 mL
Is anticoagulant (ACD-A) required?	No	Yes
Centrifugation steps	1×	1 to 2×
Centrifugation time	5 min	15 to 30 minutes
Does it concentrate RBCs and WBCs?	No: reduces	Yes: concentrates
Can be clotted prior to surgical delivery?	Yes	Yes

Procedure

1

Prior to withdrawing the anticoagulant citrate dextrose solution A (ACD-A), prime the outer and inner syringes by pulling each plunger completely back and forward. Withdraw approximately 1.5 mL ACD-A into the syringe. **Note: If ACP is going to be used within 30 minutes of blood withdrawal, the use of ACD-A is not required.**



2

Use an 18 ga to 20 ga butterfly needle to perform the blood draw. Slowly withdraw by pulling back on the red wings. Fill the syringe to a maximum of 16 cc of venous blood at a rate of 1 cc every 2 seconds and seal the syringe with the red cap.

3

Gently rotate the syringe to mix the blood and the ACD-A. Place the syringe into one bucket and an appropriate-size counterbalance in the opposite bucket.

4

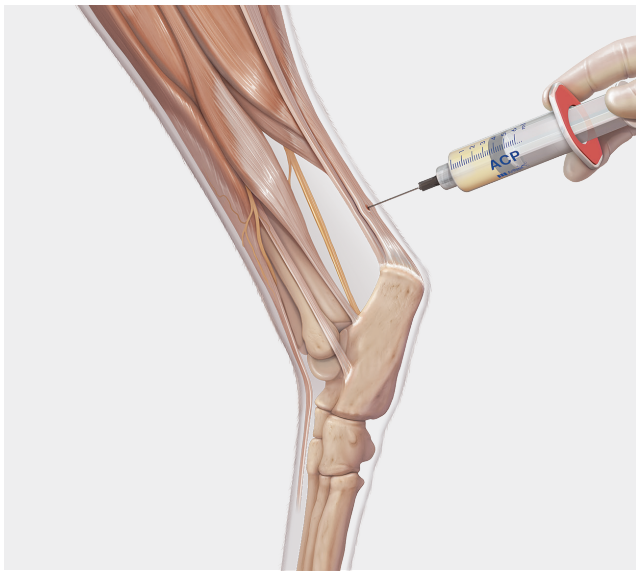
For both equine and canine, run the centrifuge at 1500 rpm for 5 minutes. Remove the syringe, taking care to keep it in an upright position to avoid mixing the plasma and red blood cells.

Procedure (Cont.)

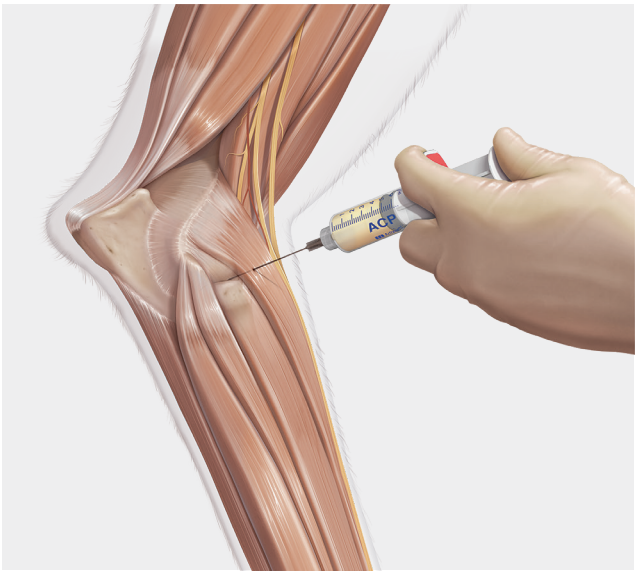
In order to transfer 2 mL to 3 mL of ACP from the larger outer syringe into the small inner syringe, slowly push down on the outer syringe's red wings while slowly pulling up the plunger of the small inner syringe.

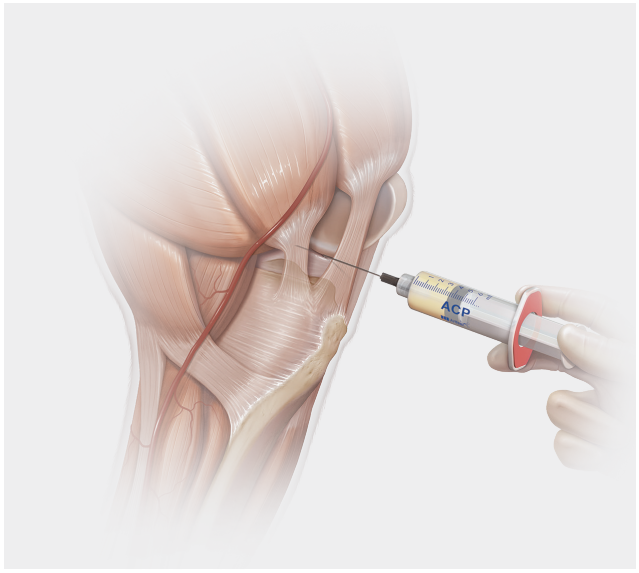
Unscrew the small inner syringe. The ACP is ready for use at the point of care. The ACP can also be transferred into a sterile cup on the sterile field and transferred into a 10 mL syringe for use. The ACP should be used within 4 hours after the blood draw when ACD-A is used.

Clinical and Surgical Applications

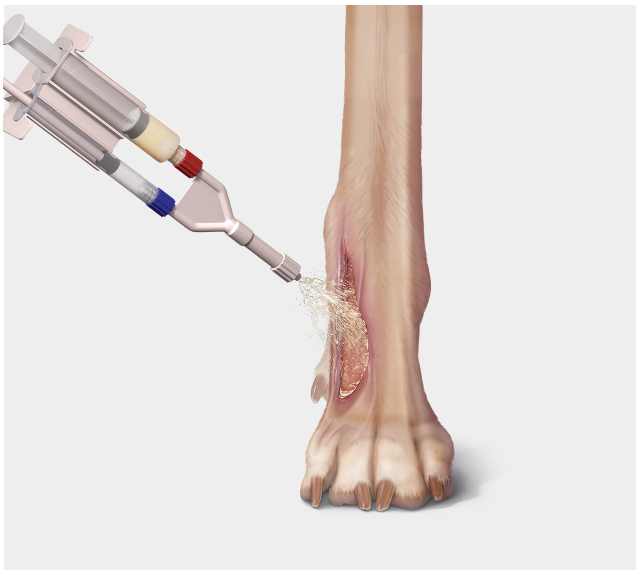


Intratendinous Therapy
Acute or chronic tendonitis and tendinopathy can be treated with PRP injections. PRP can also be used to augment any tendon repair procedure intraoperatively. PRP has been demonstrated to increase anabolic and extracellular matrix gene expression, induce cell proliferation, improve neovascularization, advance range of motion, and promote early recovery through a number of in vitro, in vivo, and clinical studies with respect to tendon therapies.[11-16]



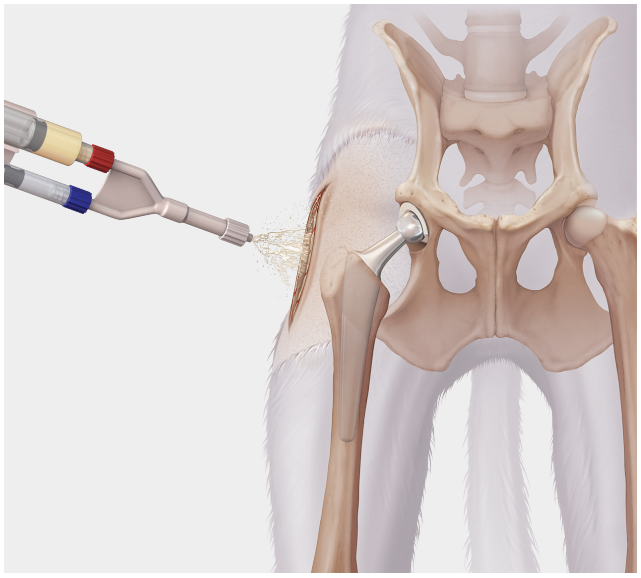


Intra-articular Therapy
PRP has shown some significant promise with respect to intra-articular therapy for treatment of cartilage, the meniscus, and the disease of osteoarthritis. Studies have described using PRP to increase chondrocyte extracellular matrix production and synovial hyaluronic acid production and to improve patient pain/function in osteoarthritis.[17-22] Osteoarthritis is a catastrophic joint disease that severely affects veterinary clients. It is advantageous for a practice to provide an autologous therapy to help relieve the pain associated with osteoarthritis.



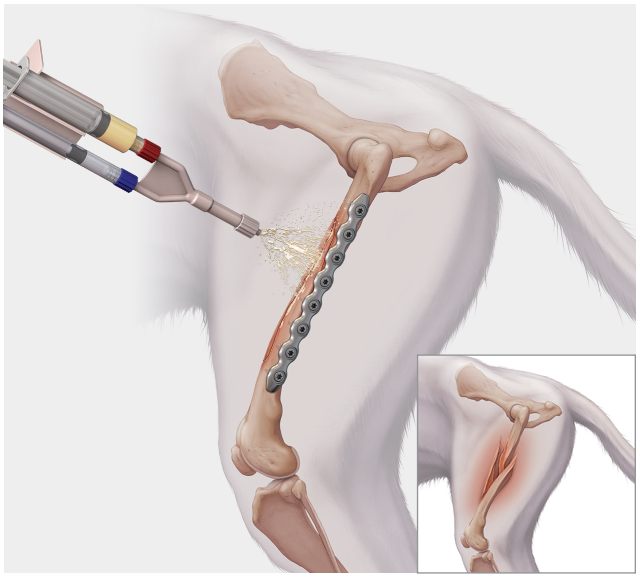
Wound and Ulcer Restoration

Cutaneous ulceration and cutaneous wounds are common problems within veterinary practices. Impairment of the healing process may prevent these lesions from closing. Supplementation with platelets from PRP promotes the release of growth factors and the formation of fibrin matrices, which will induce angiogenesis, extracellular matrix formation, and re-epithelialization leading toward the eventual closure of these defects.[23-28]



Augmenting Total Joint Replacements

The use of joint prosthetics requires invasive procedures that come with significant rehabilitation concerns and the possibility of major complications. PRP has been used for many years in patients receiving a total joint replacement to help reduce the incidence of arthrofibrosis, improve postoperative range of motion, decrease the risk of infection, enhance wound healing, prevent excess blood loss due to increased hemostasis, and reduce pain levels with less narcotic medications required.[29-33]



Promoting Osseous Regeneration

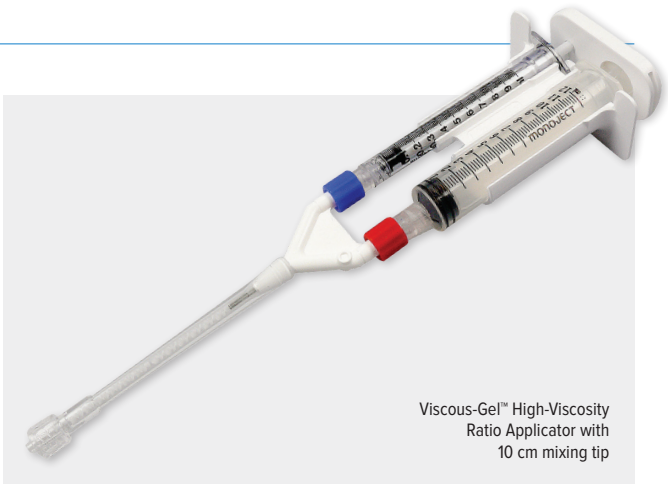
Bone healing is imperative within veterinary orthopedics when managing fractures, osteotomies, and fusions. A major concern is limiting the numbers of malunions and nonunions that occur by considering the mechanical and biological factors that are required for osseous formation. Leukocyte-reduced, platelet-rich plasma has been found to improve bone regeneration within defect models, for nonunions, in combination with stem cells, and for fusions.[34-39]

Viscous Delivery Systems

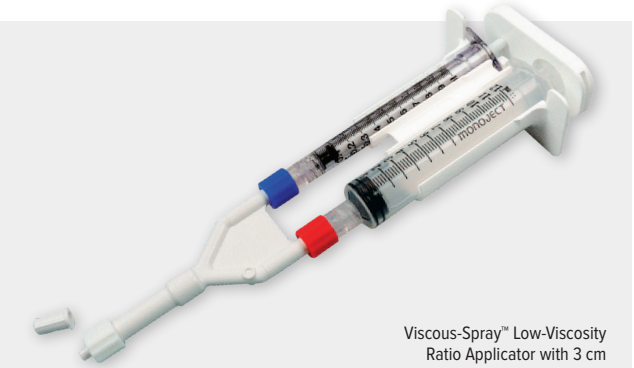
Key Features

- Use to facilitate mixing and delivery
- Quick and simple to attach/detach
- Easy to fill and no need to disassemble
- 11:1 ratio allowing homologous mixture of two fluids
- Use to provide a low- or high-viscosity fluid
- ACP/PRP can be mixed with allograft or autograft prior to application to an orthopedic surgical site as a spray, gel, or clot
- Extra long, blunt, fenestrated, and beveled delivery needles

Product Description	Item Number
Viscous-Gel High-Viscosity Applicator	ABS-**10050**
Viscous-Spray Low-Viscosity Applicator	ABS-**10051**
Viscous-Spray II Low-Viscosity Applicator	ABS-**10052**
Fenestrated Delivery Needle	ABS-**20000**
Tuohy Delivery Needle	ABS-**21000**
Cannula Bending Tool	AR-**6650**



Viscous-Gel™ High-Viscosity Ratio Applicator with 10 cm mixing tip



Viscous-Spray™ Low-Viscosity Ratio Applicator with 3 cm mixing/spray tip

Viscous-Spray II Low-Viscosity Ratio Applicator with a clog-resistant mixing/spray tip

References

1. Arthrex, Inc. Data on file (APT 2470). Naples, FL; 2014.
2. Scott A, Khan KM, Roberts CR, Cook JL, Duronio V. What do we mean by the term "inflammation"? A contemporary basic science update for sports medicine. *Br J Sports Med*. 2004;38(3):372-380. doi:10.1136/bjsm.2004.011312
3. Jiang N, Tan NS, Ho B, Ding JL. Respiratory protein-generated reactive oxygen species as an antimicrobial strategy. *Nat Immunol*. 2007;8(10):1114-1122. doi:10.1038/ni1501
4. Borzini P, Mazzucco L. Tissue regeneration and in loco administration of platelet derivatives: clinical outcome, heterogeneous products, and heterogeneity of the effector mechanisms. *Transfusion*. 2005;45(11):1759-1767. doi:10.1111/j.1537-2995.2005.00600.x
5. Edwards DR, Murphy G, Reynolds JJ, et al. Transforming growth factor beta modulates the expression of collagenase and metalloproteinase inhibitor. *EMBO J*. 1987;6(7):1899-1904.
6. Lynch SE, Nixon JC, Colvin RB, Antoniades HN. Role of platelet-derived growth factor in wound healing: synergistic effects with other growth factors. *Proc Natl Acad Sci U S A*. 1987;84(21):7696-7700. doi:10.1073/pnas.84.21.7696
7. Arthrex, Inc. Data on file (APT4153). Naples, FL; 2019.
8. Arthrex, Inc. LA0810. Naples, FL; 2019.
9. Graziani F, Ivanovski S, Cei S, Ducci F, Tonetti M, Gabriele M. The in vitro effect of different PRP concentrations on osteoblasts and fibroblasts. *Clin Oral Implants Res*. 2006;17(2):212-219. doi:10.1111/j.1600-0501.2005.01203.x
10. Weibrich G, Hansen T, Kleis W, Buch R, Hitzler WE. Effect of platelet concentration in platelet-rich plasma on peri-implant bone regeneration. *Bone*. 2004;34(4):665-671. doi:10.1016/j.bone.2003.12.010
11. Anitua E, Sanchez M, Nurden AT, et al. Autologous fibrin matrices: a potential source of biological mediators that modulate tendon cell activities. *J Biomed Mater Res A*. 2006;77(2):285-293. doi:10.1002/jbm.a.30585
12. Anitua E, Andía I, Sanchez M, et al. Autologous preparations rich in growth factors promote proliferation and induce VEGF and HGF production by human tendon cells in culture. *J Orthop Res*. 2005;23(2):281-286. doi:10.1016/j.orthres.2004.08.015
13. Anitua E, Sanchez M, Nurden AT, et al. Reciprocal actions of platelet-secreted TGF-beta1 on the production of VEGF and HGF by human tendon cells. *Plast Reconstr Surg*. 2007;119(3):950-959. doi:10.1097/01.prs.0000255543.43695.1d
14. Bosch G, Moleman M, Barneveld A, van Weeren PR, van Schie HT. The effect of platelet-rich plasma on the neovascularization of surgically created equine superficial digital flexor tendon lesions. *Scand J Med Sci Sports*. 2011;21(4):554-561. doi:10.1111/j.1600-0838.2009.01070.x
15. Georg R, Maria C, Gisela A, Bianca C. Autologous conditioned plasma as therapy of tendon and ligament lesions in seven horses. *J Vet Sci*. 2010;11(2):173-175. doi:10.4142/jvs.2010.11.2.173
16. Sánchez M, Anitua E, Azofra J, Andía I, Padilla S, Mujika I. Comparison of surgically repaired Achilles tendon tears using platelet-rich fibrin matrices. *Am J Sports Med*. 2007;35(2):245-251. doi:10.1177/0363546506294078
17. Anitua E, Sánchez M, Nurden AT, et al. Platelet-released growth factors enhance the secretion of hyaluronic acid and induce hepatocyte growth factor production by synovial fibroblasts from arthritic patients. *Rheumatology (Oxford)*. 2007;46(12):1769-1772. doi:10.1093/rheumatology/kem234
18. Kon E, Buda R, Filardo G, et al. Platelet-rich plasma: intra-articular knee injections produced favorable results on degenerative cartilage lesions. *Knee Surg Sports Traumatol Arthrosc*. 2010,18(4):472-479. doi:10.1007/s00167-009-0940-8
19. Saito M, Takahashi KA, Arai Y, et al. Intraarticular administration of platelet-rich plasma with biodegradable gelatin hydrogel microspheres prevents osteoarthritis progression in the rabbit knee. *Clin Exp Rheumatol*. 2009;27(2):201-207.
20. Sampson S, Reed M, Silvers H, Meng M, Mandelbaum B. Injection of platelet-rich plasma in patients with primary and secondary knee osteoarthritis: a pilot study. *Am J Phys Med Rehabil*. 2010;89(12):961-969. doi:10.1097/PHM.0b013e3181fc7edf
21. Sánchez M, Anitua E, Azofra J, Aguirre JJ, Andia I. Intra-articular injection of an autologous preparation rich in growth factors for the treatment of knee OA: a retrospective cohort study. *Clin Exp Rheumatol*. 2008;26(5):910-913.
22. Sánchez M, Azofra J, Anitua E, et al. Plasma rich in growth factors to treat an articular cartilage avulsion: a case report. *Med Sci Sports Exerc*. 2003;35(10):1648-1652. doi:10.1249/01.MSS.0000089344.44434.50
23. Anitua E, Aguirre JJ, Algorta J, et al. Effectiveness of autologous preparation rich in growth factors for the treatment of chronic cutaneous ulcers. *J Biomed Mater Res B Appl Biomater*. 2008;84(2):415-421. doi:10.1002/jbm.b.30886
24. Carter CA, Jolly DG, Worden CE Sr, Hendren DG, Kane CJ. Platelet-rich plasma gel promotes differentiation and regeneration during equine wound healing. *Exp Mol Pathol*. 2003;74(3):244-255. doi:10.1016/s0014-4800(03)00017-0
25. Eppley BL, Woodell JE, Higgins J. Platelet quantification and growth factor analysis from platelet-rich plasma: implications for wound healing. *Plast Reconstr Surg*. 2004;114(6):1502-1508. doi:10.1097/01.prs.0000138251.07040.51
26. Molina-Miñano F, López-Jornet P, Camacho-Alonso F, Vicente-Ortega V. The use of plasma rich in growth factors on wound healing in the skin: experimental study in rabbits. *Int Wound J*. 2009;6(2):145-148. doi:10.1111/j.1742-481X.2009.00592.x
27. Lopez-Vidriero E, Goulding KA, Simon DA, Sanchez M, Johnson DH. The use of platelet-rich plasma in arthroscopy and sports medicine: optimizing the healing environment. *Arthroscopy*. 2010;26(2):269-278. doi:10.1016/j.arthro.2009.11.015
28. Nurden AT, Nurden P, Sanchez M, Andia I, Anitua E. Platelets and wound healing. *Front Biosci*. 2008;13:3532-3548.
29. Berghoff WJ, Pietrzak WS, Rhodes RD. Platelet-rich plasma application during closure following total knee arthroplasty. *Orthopedics*. 2006, 29(7):590-598. doi:10.3928/01477447-20060701-11
30. Floryan KM, Berghoff WJ. Intraoperative use of autologous platelet-rich and platelet-poor plasma for orthopedic surgery patients. *AORN J*. 2004;80(4):668-678. doi:10.1016/s0001-2092(06)61320-3
31. Everts PA, Devilee RJ, Oosterbos CJ, et al. Autologous platelet gel and fibrin sealant enhance the efficacy of total knee arthroplasty: improved range of motion, decreased length of stay and a reduced incidence of arthrofibrosis. *Knee Surg Sports Traumatol Arthrosc*. 2007;15(7):888-894. doi:10.1007/s00167-007-0296-x
32. Everts PA, Devilee RJ, Brown Mahoney C, et al. Platelet gel and fibrin sealant reduce allogeneic blood transfusions in total knee arthroplasty. *Acta Anaesthesiol Scand*. 2006;50(5):593-599. doi:10.1111/j.1399-6576.2006.001005.x
33. Zavadil DP, Satterlee CC, Costigan JM, Holt DW, Shostrom VK. Autologous platelet gel and platelet-poor plasma reduce pain with total shoulder arthroplasty. *J Extra Corpor Technol*. 2007;39(3):177-182.
34. Anitua E, Prado R, Orive G. Bilateral sinus elevation evaluating plasma rich in growth factors technology: a report of five cases. *Clin Implant Dent Relat Res*. 2012;14(1):51-60. doi:10.1111/j.1708-8208.2009.00233.x
35. Anitua E, Orive G, Pla R, Roman P, Serrano V, Andía I. The effects of PRGF on bone regeneration and on titanium implant osseointegration in goats: a histologic and histomorphometric study. *J Biomed Mater Res A*. 2009;91(1):158-165. doi:10.1002/jbm.a.32217
36. Molina-Miñano F, López-Jornet P, Camacho-Alonso F, Vicente-Ortega V. Plasma rich in growth factors and bone formation: a radiological and histomorphometric study in New Zealand rabbits. *Braz Oral Res*. 2009;23(3):275-280. doi:10.1590/s1806-83242009000300009
37. Gallo I, Sáenz A, Artiñano E, Esquide J. Autologous platelet-rich plasma: effect on sterna healing in the sheep model. *Interact Cardiovasc Thorac Surg*. 2010;11(3):223-225. doi:10.1510/icvts.2010.237776
38. Niemeyer P, Fechner K, Milz S, et al. Comparison of mesenchymal stem cells from bone marrow and adipose tissue for bone regeneration in a critical size defect of the sheep tibia and the influence of platelet-rich plasma. *Biomaterials*. 2010;31(13):3572-3579. doi:10.1016/j.biomaterials.2010.01.085
39. Sanchez M, Anitua E, Cugat R, et al. Nonunions treated with autologous preparation rich in growth factors. *J Orthop Trauma*. 2009;23(1):52-59. doi:10.1097/BOT.0b013e31818faded

Arthrex® Vet Systems

This is not veterinary advice and Arthrex recommends that veterinarians be trained in the use of any particular product before using it in surgery. A veterinarian must always rely on their own professional clinical judgment when deciding whether to use a particular product. A veterinarian must always refer to the package insert, product label, and/or directions for use before using any Arthrex product. Products may not be available in all markets because product availability is subject to the regulatory or veterinary practices in individual markets. Postoperative management is patient-specific and dependent on the treating professional's assessment. Individual results will vary and not all patients will experience the same postoperative activity level or outcomes. Please contact your Arthrex representative if you have questions about availability of products in your area.

View U.S. patent information at www.arthrex.com/corporate/virtual-patent-marking

arthrexvetsystems.com