Platelet-Rich Plasma (PRP)

During the past several years, much has been written about a preparation called platelet-rich plasma (PRP) and its potential effectiveness in the treatment of injuries. Many athletes and others have received PRP for various problems, such as muscle strains, sprained knees and chronic tendon injuries. These types of conditions have typically been treated with medications, physical therapy, or even surgery. Some athletes have credited PRP with their being able to return more quickly to competition.

PRP has received extensive publicity, but if you are thinking about PRP treatment, you should be informed. The following is provided as educational material to help with your decision. It is not intended as medical advice.

Blood is composed of plasma, red and white blood cells, and platelets. Platelets are important in clotting and they contain hundreds of different types of proteins called growth factors which help with healing of injuries.

PRP is plasma which is concentrated with platelets. The concentration of platelets and their growth factors can be 5 to 10 times greater than normal.

Preparation of PRP

Blood is drawn from a patient and placed in a centrifuge which separates the platelets and plasma from the other components in blood. The platelets and growth factors are concentrated by this process which increases the platelet concentration by 5-10 times that normally found in whole blood. This is typically an office-based procedure, but can also be performed during surgical procedures to help aid healing.

Why PRP is used

Studies have shown that the increased concentration of growth factors in PRP can potentially speed up the healing process. This can be done in one of two ways:

PRP can be injected in the office for conditions such as tennis elbow or lateral epicondylitis, ulnar collateral ligament or UCL sprains, medial collateral ligament or MCL sprains, patellar or achilles tendonitis, and osteoarthritis. PRP is injected directly into the injured tissue with ultrasound guidance if needed. The pain may increase for the first week after a tendon injection and it may be 2-6 weeks before it improves.

PRP may also be used to improve healing during surgical procedures such as anterior cruciate ligament (ACL) reconstruction, tendon repairs, meniscus repairs, and cartilage restoration procedures.

PRP effectiveness

Research studies have been and are currently being conducted to evaluate the effectiveness of PRP treatment. At this time, the results of many of these studies are inconclusive because there are many different types and preparations of PRP and the effectiveness of these various PRP preparations can vary. Factors that influence the effectiveness of PRP treatment include the type of PRP being used, number of injections, type of tissue being treated, the health of the patient, and whether the injury is acute or chronic.

Chronic Tendon Injuries

According to some research studies, PRP is very effective in the treatment of chronic tendon injuries, especially patellar tendinitis and tennis elbow. PRP has been found to have beneficial effects on damaged tendons to promote repair. Tendons are known to have low metabolic rates and tend to heal slowly after injury. In vitro studies on severed sheep tendons have shown that PRP promotes the proliferation and secretion of growth factors which stimulate blood vessel formation and reduce inflammation. Similar results have been reported in rat models where PRP has been found to promote tendon-to-bone healing and tendon remodeling. In a study on human rotator cuff tendons by Jo et al. (2012), it was found that PRP led to an increased synthesis of collagen and glycosaminoglycan, the building blocks of tendons. Basic science evidence suggests that PRP has the ability to promote tendon cell proliferation. However, the optimal platelet concentration or the PRP composition needed for an effective treatment of tendon problems is not clear. At this time, there is not enough evidence to state that PRP will heal rotator cuff tears.

Chronic tennis elbow or lateral epicondylitis is a common problem thought to be due to microtears of the tendon attachment to bone. Standard treatment is nonoperative consisting of rest, rehabilitation, counterforce strap, anti-inflammatories, and sometimes cortisone injections.

Although commonly performed, Cortisone may have significant negative effects. Cortisone inhibits tendon cell proliferation and cell recruitment with reduced collagen synthesis, depletes the pool of tendon stem cells, suppresses type I collagen, enhances fatty and cartilage-like tissue changes that can lead to tendon ruptures. This treatment can also result in skin depigmentation and cause subcutaneous atrophy. It may have some temporary pain improvement, but the results are usually not lasting.

In 10-15% of patients with chronic lateral epicondylitis, nonoperative measures are not successful and surgery is required. The success rate of the various surgeries done for this condition is generally approximately 85% and it can take 4-6 months to fully recover.

PRP has been shown to be a safe, less invasive alternative to surgery. It also does not have the negative effects of cortisone. In a double-blind, prospective, multi-center, controlled trial (RCT) of 230 patients, Mishra demonstrated a statistically significant effect of PRP in treating lateral epicondylitis. Success rates for patients with 24 weeks of follow-up were 83.9% in the PRP group compared with 68.3% in the control group. This is essentially the same success rate, without the risks or cost, of surgery.

A meta-analysis conducted in 2016 by Arirachakaran, et al. included 10 randomized controlled trials (RCTs); 7 compared PRP to either autologous blood or steroids. PRP was shown to have a significant reduction in pain scores. Functional outcomes, as measured by the Disabilities of the Arm, Shoulder, and Hand (DASH) score, displayed a significant benefit of PRP versus steroids and autologous blood at three-month follow-up.

Acute Muscle Injuries

A literature review of studies from 1966 to 2011 was conducted looking at hamstring strain injuries and factors that lead to injury and reinjury. Track and field hamstring injuries accounted for 26%

of all injuries, while football was 12% and rugby was 15%. It was found that 27% of all hamstring injuries were recurrences of previous injuries in the Australian Football League and 32% in American Football. Given the significant competitive and financial effect these injuries can have in sports, there have been many attempts to prevent them or shorten recovery times.

There has been a fair amount of publicity about PRP treatment of acute sports injuries such as ligament and muscle injuries. PRP has been used to treat professional athletes with injuries like strained hamstring muscles and elbow or knee sprains.

Basic science research has demonstrated that muscle formation and regeneration are dependent on growth factors. In a study of gastrocnemius tears in a rat model, PRP was shown to enhance muscle healing and decrease inflammation.

Mejia and Bradley reported on a case series of PRP injections given to National Football League (NFL) players with acute hamstring injuries within 24–48 hours of injury. They noted that there was an earlier return to play by 3 days for grade 1 hamstring strains and 5 days for grade 2 hamstring strains, which was equivalent to a one game difference. They also noted that there was a 0% recurrence rate in this population.

Rossi et al. compared the time for return to play and risk for recurrence after acute grade 2 muscle strains in recreational and competitive athletes who were treated with conservative measures with or without PRP. The PRP group contained 34 patients and the control group had 38, and all athletes subsequently had progressive rehabilitation. Mean time to play was 21.1 days for PRP and 25 days for the control group, which was found to be statistically significant ($p = 0.001$). Pain improved for both treatment regimens, without a significant difference between the two. While PRP shortened the time to return to sports after acute grade 2 muscle strain versus control, the rate of recurrence was not significantly different between the groups.

A meta-analysis by Grassi et al. looked at six studies, two of which were randomized control trials, and analyzed the effect of PRP for the treatment of acute muscle injuries versus at least one control group including patients treated with placebo injection or physical therapy. The time to return to sport evaluated in all six studies was significantly shorter in patients treated with PRP with a mean difference of 7.17 days ($p < 0.05$). Looking at only the two double-blind studies or the three studies including only hamstring injuries, there were no significant differences.

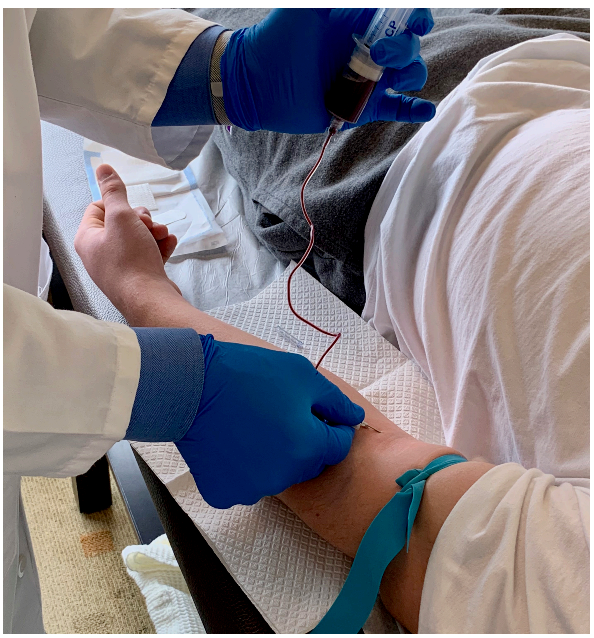
Ligament Injuries

In animal models, PRP has been found to enhance the growth of ligament cells. This has also been found in human harvested grafts where the addition of PRP has been linked to increased concentrations of growth factors and an overall increase in the gene expression of collagen, the structural protein that makes up ligaments and tendons.

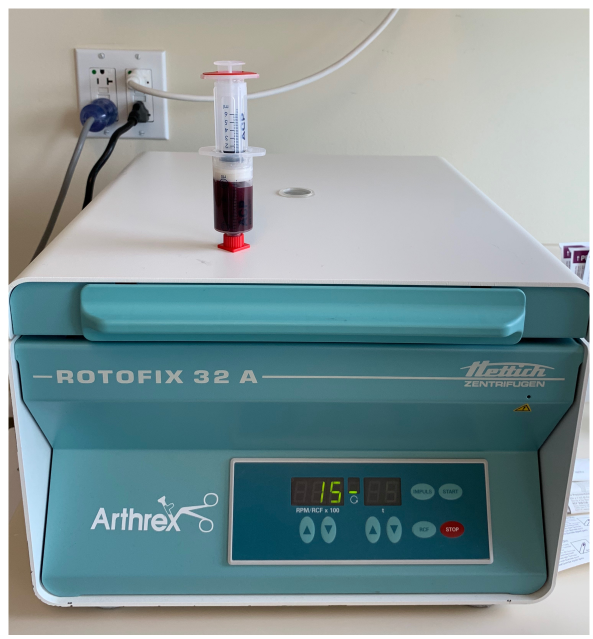
Injuries to the Ulnar Collateral Ligament (UCL) are common in baseball. Complete tears require Ulnar Collateral Ligament Reconstruction otherwise known as Tommy John Surgery. Partial UCL tears are often treated without surgery. Nonoperative treatment usually includes rest and rehabilitation followed by an interval throwing program. Recently, there has been interest in PRP injection to improve the results of nonoperative treatment.

Podesta et al. followed the progress of 34 throwing athletes being treated for partial tears of the UCL with a single PRP injection. They found that 30 of 34 athletes or 88% were able to return to the same level of play or higher at an average of 12 weeks. A similar study conducted by Dines et al. retrospectively evaluated the progress of 44 baseball players being treated for partial UCL tears with PRP injections. They found that 32 of 44 or 73% had good to excellent results with a return to play by 12 weeks. In a larger case series, Deal et al. conducted a case series on 25 athletes with grade 2 UCL sprains or partial tears that were treated with two injections of leukocyte-rich PRP. The study found that 22 of 25 or 88% were able to return to play, with 20 of the 22 demonstrating a fully reconstituted UCL on MRI. Despite these various case reports, there are no available randomized controlled trials examining the effectiveness of PRP.

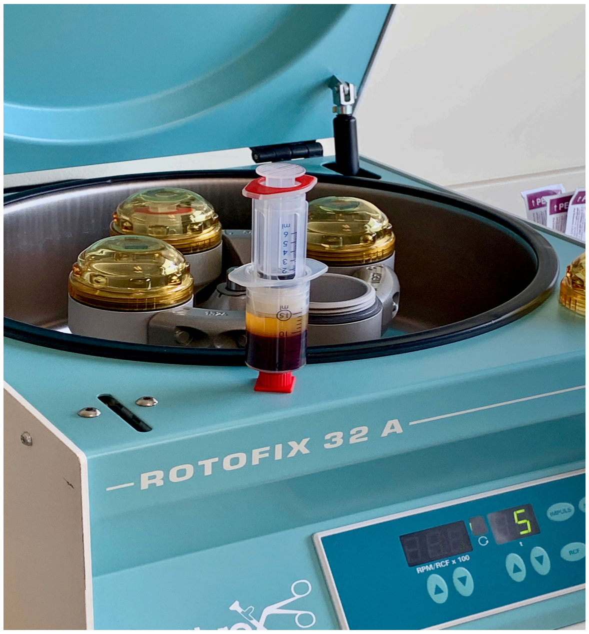
In our practice, we generally use PRP for Grade 2 UCL Sprains or partial tears. This is done under ultrasound guidance.



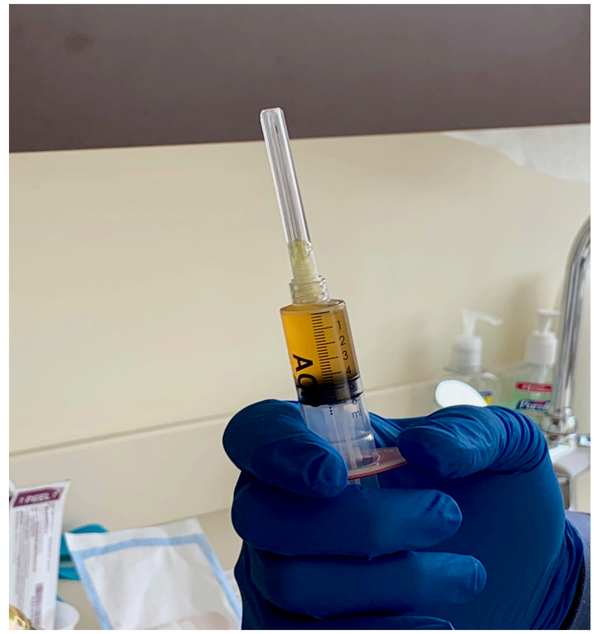
Drawing blood for PRP

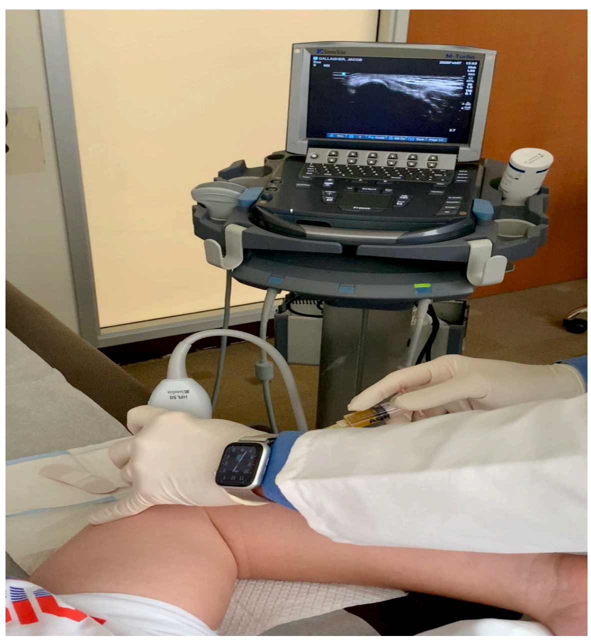


Syringe and Centrifuge for PRP



PRP separated from other blood components


PRP ready for injection


PRP injected into UCL under Ultra-
sound Guidance

Surgery

PRP has been used during certain types of surgery to help tissues heal. It was first thought to be beneficial in shoulder surgery to repair torn rotator cuff tendons. However, the results so far show little or no benefit when PRP is used in Rotator Cuff Repairs.

PRP has been used in Anterior cruciate ligament (ACL) reconstruction. Some studies have shown decreased pain and improved healing at the patellar tendon graft donor site.

PRP has been shown to increase the healing rate of meniscus repairs

Knee Arthritis

On a molecular level, for degenerative conditions such as osteoarthritis, in vitro (laboratory) studies have found that the use of PRP stimulates chondrocytes (cartilage cells) and synoviocytes (joint capsule cells) to produce cartilage matrix while also down-regulating key molecules that are mediators of the inflammatory response. Additionally, studies have shown that PRP also increases proteoglycan and type II collagen synthesis, two biological molecules which are important for structural organization of the cartilage framework.

A systematic review of basic science evidence on use of PRP for osteoarthritis found 15 of 21 in vivo (studies performed on patients) and in vitro studies reported that PRP promotes the proliferation of chondrocytes, increases proteoglycan production, and leads to a greater deposition of type II collagen. PRP was also found by three of the studies to promote chondrocyte viability and

by five of the studies to promote mesenchymal stem cell differentiation.
Wu, et al. performed a meta-analysis on a total of 10 randomized controlled trials (RCTs), incorporating 526 patients injected with PRP and 537 injected with hyaluronic acid (HA). They evaluated trials using a similar injection protocol of three injections of PRP or HA given one week apart. They found PRP was better than HA with respect to improving pain and function using standardized measurement tools (VAS, IKDC, WOMAC scores).

McCarty et al., in their recent meta-analysis of 18 RCTs comparing 811 patients undergoing PRP injections and 797 patients undergoing HA injections, found significant improvements in the PRP group versus the HA group at 11 month follow up.

There are many preparations and injection regimens of PRP. In our experience, a regimen of 3 injections of LP-PRP or leucocyte poor PRP has worked well to manage the symptoms of osteoarthritis.

Conclusion

Treatment with PRP holds promise, however, more research studies are needed. PRP has been shown to be beneficial in some situations, the risks associated with PRP are minimal, but more studies are needed for definitive scientific confirmation. Although PRP is not ‘FDA-approved,’ it can be legally used ‘off label’ for musculoskeletal conditions. Perhaps the biggest downside of PRP is that it is not usually covered by insurance and is an out of pocket expense.