Platelet-rich Plasma Injection for Proximal Plantar Fasciitis

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Abstract: Platelet-rich plasma (PRP) has generated a significant amount of interest from both the medical community and the mainstream media because of its potential to aid in the healing process. Concentration of growth factors has been shown in animal models to enhance the rate and quality of healing, particularly for tendinopathy. Despite the increase in the use of PRP over the past 10 years, there is much to be learned with respect to where, when, why, and how it can best be used. The technique of procuring PRP and its delivery for the treatment of proximal plantar fascia is presented.

Key Words: platelet-rich plasma, growth factors, tendinopathy, plantar fascia, healing

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HISTORICAL PERSPECTIVE

Proximal plantar fasciitis remains one of the most common conditions treated by physicians. Up to 1 million Americans complain of heel pain every year. Conservative treatment in the form of stretching, nonsteroidal anti-inflammatories, night splinting, strapping, orthoses, and shoe modifications are effective for 90% of cases. Ten percent remain recalcitrant to these treatments necessitating more aggressive intervention including injection therapy, extra corporeal shock wave treatments, and in some instances surgical release of the origin of the plantar fascia.

Although less invasive than open surgery, extra corporeal shock wave therapy can require several treatment sessions with costs up to $3000.00. Surgical intervention carries the risk of infection and injury to adjacent nerves.

In the last 10 years, there has been an increased use of platelet-rich plasma (PRP) for a myriad of enthesopathies taking advantage of the body's autologous platelets to stimulate the inflammatory response and promote organized healing, remodeling, and maturation of fibroblasts.[1,2]

PHYSIOLOGY OF TISSUE HEALING

Muscle, tendon, ligament, and bone recover from injury in a stepwise manner depending upon the inflammatory process. The 3 phases of this process include bleeding/inflammation, fibroblastic proliferation, and maturation of the differentiated cells into a mature scar. In proximal plantar fasciitis, and other enthesopathies, repetitive overload on the tissues allows for insufficient time for recovery to occur. The result is degeneration of the fibroblasts along with chronic inflammatory change. The tissues cannot properly remodel and a dense inelastic scar forms, not well suited to proper function.

Growth factors play an integral role in the natural process of healing. They promote the inflammatory response allowing the completion of 1 phase and progression to the next. In phase 1, bleeding into the area of injury causes platelet aggregation then coagulation so as to prevent excessive bleeding and to release growth factors.[3] There is an increase in vascular permeability, initiation of angiogenesis, chemotactic migration of monocytes and macrophages, and induction of fibroblasts to synthesize collagen and extracellular matrix.[4,5]

Type III collagen peaks after several days. Monocytes elicit an immune response, which promotes fibroblasts to proliferate over the first 7 days.[3–5]

Collagen is deposited by the fibroblasts and this takes place for several weeks. Tissues gradually transition from cellular to fibrous. Collagen type I increases and collagen type III decreases at approximately 10 weeks and the remodeling process begins, which can last up to 2 years.[6]

As 1 stage of the inflammatory process completes itself, the next stage is stimulated. Adjunctive use of growth factors has been studied in animal models to promote soft tissue and bone repair. Delivery of platelets into connective tissue augments the fibroblastic response followed by new cell formation and finally collagen proliferation.[3–6]

Platelets are consisted of α granules and dense granules, which carry specific growth factors and proteins. Growth factors are contained in α granules.[3] Degranulation and release of specific growth factors from the platelets can be induced and delivered directly into the injured tissue to stimulate a physiologic response.[6]

The 4 basic growth factors include: Platelet-derived growth factor, which attracts monocytes and stimulates fibroblasts; transforming growth factor, which stimulates all major cell types involved with healing; vascular endothelial growth factor, which stimulates new blood vessel formation increasing vascularity; and fibroblast growth factor, which promotes the growth of extracellular matrix.

INDICATIONS/CONTRAINDICATIONS

The use of concentrated platelets injected with or without thrombin as an activator has proven useful in the treatment of plantar fasciitis, lateral epicondylitis, Achilles tendinosis, and trochanteric bursitis.[7] PRP is not appropriate to use in degenerative arthritis, chondral injury, or neural injury. For patients with calcaneodynia secondary to neural injury or entrapment, PRP is not effective.[8] As an adjunct to healing, PRP is easy to procure, easy to administer, and there are no reports of harm with its use. It is not engineered or cultured, and comes directly from the patient's own body. Using PRP is a simple way to take advantage of the body's autologous healing potential.[9]

In my practice, I will offer PRP injection to patients with proximal plantar fasciitis who have tried and failed corticosteroid injection, night splints, strapping, and orthoses. I am quick to consider its use for any patient who cannot tolerate nonsteroidal anti-inflammatory medication.

I will not use PRP in patients who have neural entrapment or earlier surgery including endoscopic plantar fascial release or open plantar fascial release. PRP is reserved for patients who have recalcitrant heel pain not complicated by factors

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such as, excessive or reactive scar formation, or cutaneous neuroma after earlier surgical attempts for treatment of a painful heel.

PREOPERATIVE PLANNING

For the office setting, patients should be selected who can tolerate administration of nerve block and the peripheral blood draw. If a patient is morbidly obese with difficult location of peripheral veins, or 1 who has very friable veins that "blow" making the peripheral blood draw difficult, this procedure should not be considered. Administration of Xanax 0.25 mg preoperatively, 45 minutes before the procedure, can be helpful to relieve anxiety.

When looking for veins to use for the peripheral blood donation, the upper extremities are considered first, but in some instances use of the saphenous vein or dorsal foot veins can be a better choice.

For proximal plantar fasciitis, Achilles tendinopathy, pes bursitis, or lateral epicondylitis, 20 to 30 mL of blood is harvested depending on the centrifugation system chosen. The author uses the Harvest System, which requires 20 to 60 mL of blood depending on the amount of PRP desired. The blood is spun down for 15 minutes segregating platelet rich from platelet poor plasma (Figs. 1–3). Twenty mL of blood yields approximately 3 mL of platelet rich substrate. 60 mL of blood yields 10 mL of PRP. To neutralize the pH, $\frac{1}{2}$ mL of sodium bicarbonate is then added. For administration of the PRP, a 23-gauge $1\frac{1}{2}$-inch needle is used.

TECHNIQUE

The sites of maximal tenderness are located before administration of the regional nerve block (Fig. 4). Thumb pressure over the origin of the plantar fascia will identify 3 to 4 points of maximal tenderness. These are marked with a skin marker.

The posterior tibial nerve and particularly the medial calcaneal branch are injected with 0.5% Naropin 1 finger-breadth behind and distal to the medial malleolus (Figs. 5A, B). Ethyl chloride spray is applied before the injection of local anesthetic. Eight to 10 mL of local anesthesia is delivered and then gentle thumb massage applied for 30 seconds over the zone of injection. Once adequate local anesthesia is documented the injection of PRP can begin. Adequate local anesthesia is critical to successfully administrating the PRP.

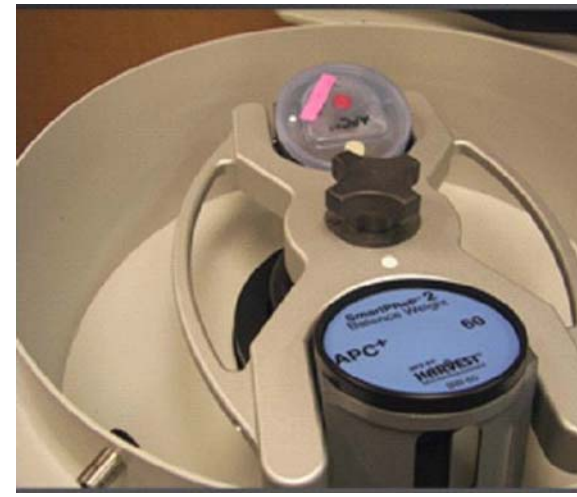

FIGURE 2. The specimen must be counter balanced by an equal volume of liquid for proper centrifugation.

Dry needling, also called peppering, is used to locally "injure" the soft tissue to stimulate the inflammatory response. Concomitant delivery of the PRP then modulates (enhances) the healing response. Some have advocated the use of ultrasound to properly locate the delivery zone[10] but this author has not found that to be necessary for success. Each marked point of tenderness is penetrated with a 23-gauge needle until the underlying periosteum is touched. A gristly, crunchy texture is audibly and palpably noted as the needle is advanced. After contacting the periosteum, the needle is gently partially withdrawn then advanced in a fan-like wheel (peppering) the area 7 to 10 times. Next, 1 mL of the PRP is injected as this peppering maneuver is continued. This process is then carried out at each marked site (Figs. 6A, B). It is incorrect to simply inject the PRP into 1 area of the painful heel. The point of needle entry should be more medial than plantar.

POST INJECTION CARE

Although some have advocated a short period of immobilization in cast or walker boot, this author has not found it to be

FIGURE 1. High velocity centrifuge provided by the vendor used in the separation process.

FIGURE 3. The separation canister containing the platelet rich plasma (red) and the platelet poor component (yellow).

FIGURE 4. Markings on the heel at points of maximal tenderness at the origin of the plantar fascia.

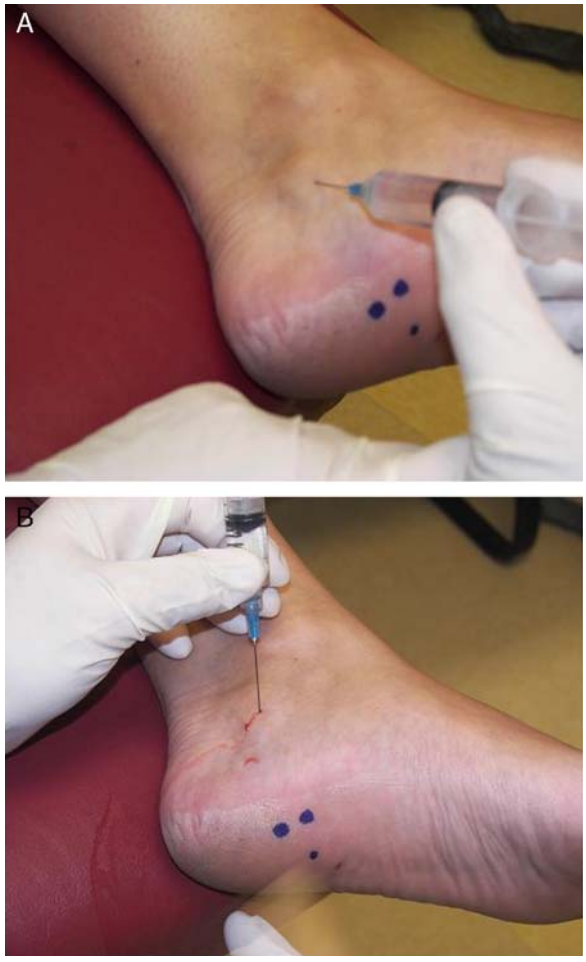

FIGURE 5. A and B, A posterior tibial nerve block must be administered to allow for the proper and painless dry needling and platelet-rich plasma injection into the plantar fascia origin.

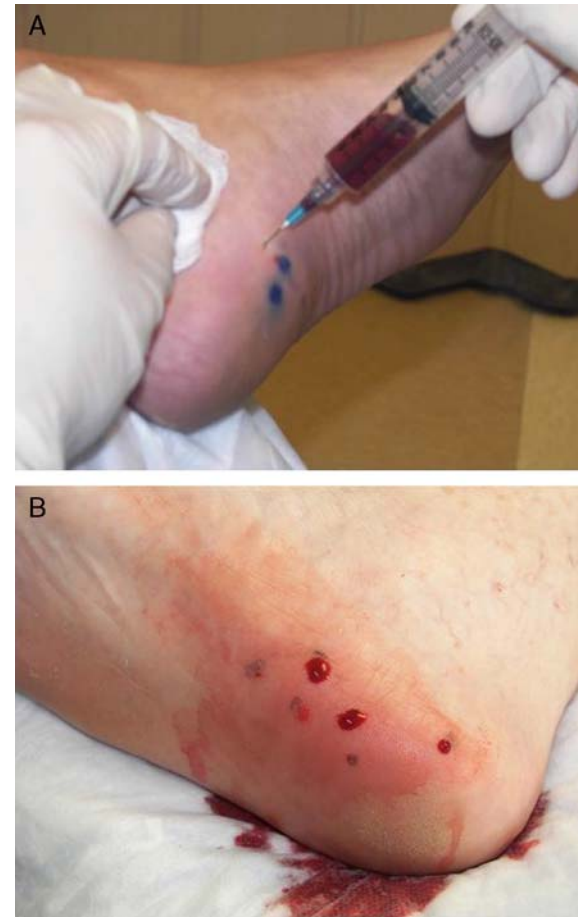

FIGURE 6. A and B, 2.5 mL of platelet-rich plasma is injected into each of the marked spots with the dry needling technique to initiate local trauma and stimulate the inflammatory response.

mandatory for success after PRP injection. Crutches are likewise optional and used on a case-to-case basis. No aggressive running or jumping activities are allowed for 2 weeks. Night splinting is used for comfort. Therefore, as not to blunt the inflammatory response, nonsteroidal anti-inflammatory drugs are usually discontinued for 7 to 10 days. Gradual return to activities is allowed after 3 weeks. Patients are advised that up to 6 weeks can pass before a benefit is realized, but in the author's experience patients often note decreased pain after as little as 3 weeks. Follow-up is at 6 weeks and 12 weeks. Stretching is to be continued. Orthoses are prescribed infrequently but may be used as indicated.

Potential complications include infection and elevated compartment pressure in the deep compartment of the foot.

RESULTS

The author has performed PRP injection for proximal plantar fasciitis in 30 feet. All but 2 patients benefitted noting marked reduction in first-step pain, post-rest pain, and improved ability to stand and walk. Two patients failed, requiring open surgery. Two patients had repeat injections, 1 at 6 months and the other at 9 months after the initial PRP application with good relief of pain at 1 year.

The augmented healing response facilitated by administration of PRP, its safety, and ease of use make this treatment

method attractive. Unlike corticosteroid injection, risks of plantar fascia rupture and soft tissue atrophy have not been seen. Indeed Sconfienza report of 95% efficacy (42 of 44 cases) of plantar fasciitis injected with corticosteroid under ultrasound guidance was impressive, but the follow-up was <6 months.

With respect to other enthesopathies such as, lateral epicondylitis, Achilles pathology, patellar tendinosis, and trochanteric bursitis, PRP has been shown to be effective.[7,11–13]

PRP has also been shown to be effective in treatment of meniscal tears and meniscal transplantation and anterior cruciate ligament repair.[14–16]

Concerns/Future of Technique

Many orthopedic surgeons feel there is adequate documentation to support the use of PRP for refractory cases of lateral epicondylitis, plantar fasciitis, Achilles tendinosis, patellar tendinosis, and trochanteric bursitis. Arnoczky et al[9] has pointed out that with the major expansion in the use of PRP on a myriad of pathologies, consistent results are difficult to quantify.[8] There is no specific formulation that has a proven level of bioactivity and the autologous PRP derived from each patient differs significantly. In addition, questions remain unanswered whether PRP alone versus PRP and white blood cells produce similar results. There is debate in the literature that PRP is universally effective when used. Arnoczky et al[9] further points out that PRP is not a panacea and physicians should temper expectations and judiciously interpret the science and proper indications for its use.[8]

Certainly PRP is a simple way of taking advantage of the body's autologous healing potential. Further studies are necessary to clarify its role in orthopedics. It has clearly been shown to benefit enthesopathies recalcitrant to conservative measures.

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