PLATELET RICH PLASMA (PRP): A PRIMER

A brief overview of PRP, its constituents, applications, and processing considerations.

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Platelet rich plasma is a volume of plasma that has a platelet concentration well above baseline and contains at least seven growth factors. The major growth factors are: platelet derived growth factor (PDGF-AB), transforming growth factor beta-1 (TGF-B1), vascular endothelial growth factor (VEGF), and endothelial growth factor (EGF). Platelet alpha granules release these growth factors in specific ratios to one another. Growth factors act locally to recruit undifferentiated cells to the site of injury and trigger mitosis in these cells. Upon activation, platelets also secrete stromal cell derived factor 1alpha (SDF-1α). This factor supports primary adhesion and migration of progenitor cells.[1-5] When used for local application, PRP must always be prepared from the patients own blood—i.e. autologous. This eliminates the possibility of transmission of bloodborne diseases.[1,6-8]

The application of PRP in both soft tissue and osseous healing has been a subject of great interest for the past two decades. There have been hundreds of papers published in this time frame discussing the use and benefit of PRP in several clinical applications including: oral and maxillofacial, podiatric, orthopedic, spine, plastic, ent, and cardiovascular surgery—as well as for treating chronic wounds and for injection therapy to treat pain and injury in joints, tendons, and ligaments.

It is important that the process for preparing PRP be capable of concentrating as many platelets from the blood sample as possible and that these platelets maintain their ability to release a high concentration of growth factors upon activation. The more growth factors that can be delivered to the injury site, the greater the potential to enhance the healing process. The quality of PRP must be evaluated by two in vitro tests: platelet aggregation and P-selectin. The latter test has been demonstrated to correlate with in vivo platelet survival.

The process of preparing PRP can vary from the use of test tube collection and laboratory centrifuges to the more sophisticated device utilizing a floating shelf technology. When selecting a centrifuge unit, be sure to evaluate the viability, functionality, quantity of platelets, and concentration of growth factors. Such parameters should be confirmed by scholarly, peer-reviewed journals (not just manufacturers' claims). A comparison of PRP preparations must always take into consideration the volume of the PRP product. Clinical studies have determined that an increase of three- or four-fold above baseline (in 10ml) is the acceptable standard. It is essential that the PRP volume be documented when using this type of comparison among different processors. Any reduction in volume will obviously increase the platelet concentration in the PRP product per milliliter and artificially increase the times baseline number.

FIGURE 1. *PRP processing unit (Smart PReP™2 by Harvest Technologies).*

Criteria for Selecting PRP Systems

To be considered an effective PRP system, it is the authors' recommendation that the following conditions be met:

1. Platelets must be both viable and functional as measured by platelet aggregation and P-selectin testing.
2. Platelets must be consistently and reliably increased by at least 3 to 4 times above baseline level in a 10ml volume.
3. The sequestering system must minimize platelet clumping and premature activation.
4. The manufacturer should document the relationship between platelet count and growth factor (protein) levels.
5. The manufacturer must have FDA clearance for their device(s).

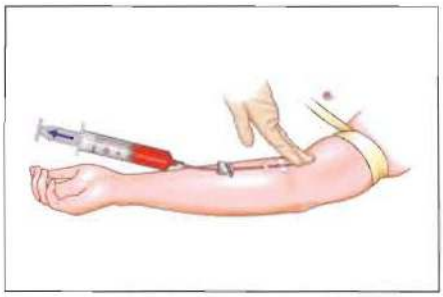

FIGURE 2. *Step 1 – Illustration of venipuncture blood draw.*

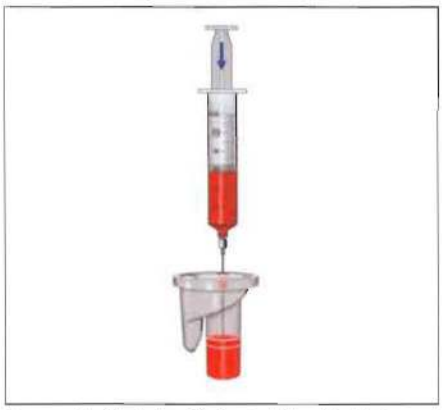

FIGURE 3. *Step 4 – Collected blood is dispensed into dual chamber disposable utilized for blood processing.*

PRP Processing System

For this discussion, the Smart PReP™-2 (Harvest Technologies; Plymouth, Mass.) was used (see Figure 1). This centrifuge unit utilizes a dual chamber disposable. The first chamber into which the whole blood sample is placed contains a floating shelf of a specific density. During the initial centrifugation phase the red blood cells are separated from the plasma, which contains white blood cells and platelets. The plasma is then automatically decanted into the second chamber and concentrated by centrifugation. This second spin produces the PRP and separates it from the platelet poor plasma.

This system offers the clinician a variety of PRP process volumes: 3, 10, or 20 mL of PRP—depending on the application. The included disposable kits include the necessary components required to prepare the venipuncture, draw blood, and process the blood to produce PRP.

The major steps for producing PRP are:
(1) preparing the venipuncture,
(2) drawing the blood (phlebotomy),
(3) processing the blood, and
(4) platelet re-suspension.

FIGURE 4. *Step 5 – Dual chamber disposable is loaded into the centrifuge.*

Step-by-Step Process

Following are the basic steps in preparing PRP for use:

1. Prepare venipuncture; add ACD-A to the blood draw syringe (all included in kit).
2. Draw 20 or 60mL of blood depending on volume required; the 20mL kit produces 3mL of PRP. The 60 mL kit produces 10mL of PRP (see Figure 2 for illustration of venipuncture).
3. Invert the syringe several times to ensure adequate mixing of the blood and anticoagulant.
4. Attach blunt needle (included) to the blood filled syringe and dispense contents into the blood chamber of the process disposable (see Figure 3).
5. Load dual chamber disposable into the centrifuge. Insert counter balance (included) into the opposite bucket (see Figure 4).
6. Close lid of centrifuge and press green button.
7. When centrifuge cycle is complete (about 14 minutes), remove the dual chamber disposable.
8. Using the plasma syringe with blunt cannula and white spacer (included), withdraw the plasma volume from plasma chamber—until air enters the syringe (see Figure 5).
9. The remaining volume left is the highly concentrated PRP and—based upon the authors' studies—remains stable for up to 8 hours (note: cultured samples remain sterile for a total incubation period of 18 days).

Note that excess blood products should be disposed of in accordance with policies for disposal of biohazardous waste. ■

FIGURE 5. *Step 8 – Plasma volume is removed from the plasma chamber (leaving PRP in the second chamber).*

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