Comparison of Methods for Point of Care Preparation of
Autologous Platelet Gel

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Abstract: A platelet gel (PG) is produced by the addition of calcium chloride and thrombin to a platelet concentrate (PC). PG releases multiple growth factors, which have the ability to initiate and stimulate one growth factor’s function in the presence of others. This finding has resulted in the use of PG in orthopedic, plastic, and reconstructive surgery. The study compared the commercial systems available for the preparation of PG. All procedures were performed according to the manufacturers’ directions. The devices were evaluated with respect to ease of use, collection efficiency, platelet quality, and growth factor release. The SmartPReP® requires only four processing steps compared to 12 to 24 required by other devices. The SmartPReP® and the CATS® were the most reproducible, as evidenced by their low coefficient of variation of 13% and 16%. The mean platelet yield was 72% for the SmartPReP®, 58% for the 3iPCCS, 54% for the Sequestra®, 31% for the Secquire®, 31% for the CATS®, 27% for the Interpore Cross®, and 42.6% for the Biomet GPS™. The mean total amount of PDGF-AB and TGF-B1 obtained from the SmartPReP® is greater than other systems evaluated. The SmartPReP® produced a consistent PC with a yield that was four times baseline range with the lowest coefficient of variation. Keywords: platelet gel, platelet yield, growth factors.

Most platelet preparations are used for transfusion in an effort to prevent or treat bleeding caused by thrombocytopenia. Platelets can also be used locally as a source of growth factors that play an essential role in wound and bone healing and in bone regeneration (1–4).

The body naturally heals damaged tissue at an injury site in a single manner that is well described and referred to as the “healing cascade”. The initial stages of this progression are clot formation, inflammation, and cell proliferation; these processes are controlled by proteins carried in platelets, white blood cells, and plasma. Specifically, clot formation involves the interaction of multiple proteins in the plasma and activated platelet membranes. Inflammation involves the migration of macrophages and white blood cells to the injury site and is controlled by proteins that are released from white cells and platelets. Cell proliferation and cell division to replace damaged and destroyed cells is really a combination of two cellular activities. The first is the migration of mesenchymal stem cells from surrounding healthy tissue into the injury site. The second is triggering these cells to divide. The proteins that control cell migration and cell division are carried in the platelets and white blood cells. These proteins are referred to as growth factors, and their mechanism of action has been described, and their contribution to cell proliferation is well known (5–7).

The ultimate purpose in preparing a platelet concentrate and, subsequently, platelet gel for local application, is to maximize the availability of the multiplicity of proteins at the injury site. The methods of preparation can directly affect the characteristics of the product. The purpose of this study was to compare seven commercial technologies for the preparation of an autologous platelet concentrate for local application.

MATERIALS AND METHODS

Donor Selection

The institutional review board for the Center for Blood Research approved the blood collection protocol. Blood was obtained from normal healthy donors (males and females) who met the blood donor requirements of the American Association of Blood Banks (AABB) and the FDA-CBER. Each donor served as his/her own control during the study. The cell salvage systems (CATS® and Sequestra®) required the collection of a unit of blood from
the donor. This precluded using the same donors to evaluate all of the devices.

Platelet Collection and Identification
Each donor was identified by number, which would enable a reviewer to identify and compare the test results. All procedures were performed according to the detailed instructions provided by the manufacturer.

Systems Evaluated
1. SmartPReP® (Harvest Technologies, Plymouth, MA distributed by Depuy, Warsaw, IN as Symphony). The system can use one or two dual chamber disposables. Whole blood is added to the first chamber, and the centrifuge is activated. The red blood cells (rbcs) and the platelet-rich plasma (PRP) are separated. The PRP is automatically decanted into the second chamber and concentrated by centrifugation. A portion of the platelet-poor plasma (PPP) is removed and the platelets resuspended in the remaining plasma (7–10 mL). The newest version of this system, SmartPReP®2, has a floating shelf and will process 22.5 to 60 mL of anticoagulated whole blood per disposable, yielding a concentrate of 3 mL or 7 to 10 mL. Two 60-mL disposables can be processed simultaneously if 20 mL of PC are required.
2. Sequestra® (Medtronics, Minneapolis, MN). The Sequestra is an intraoperative salvage device that uses the classic Latham bowl technology to separate PRP from a unit of whole blood.
3. CATS® (Fresenius, Wilmington, DE). This system is an intraoperative blood salvage device that is a modification of their apheresis (platelet collection) system. Processing requires the collection of a unit of whole blood.
4. Ultraconcentrator (Interpore Cross®, Irvine, CA). This system is a hollow fiber hemoconcentrator that utilizes 60 mL of the product obtained from an intraoperative salvage device. A specific workstation must be used to provide housing for the syringes, hemoconcentrator and air flow. During our evaluation, the Sequestra was used to provide the platelet product.
5. PCCS® (3i, Palm Beach Gardens, FL). This is a miniaturization of a double pack blood collection system used in blood collection facilities. Following the centrifugation steps, the transfers from a primary to a secondary pack require the injection and removal of specific volumes of air through designated entry ports. The system provided by the manufacturer provides only a single disposable. A volume of 60 mL of anticoagulated whole blood can be processed.
6. Secquire® (PPAI Medical, Fort Myers, FL). This system utilizes a modified 50 mL plastic centrifuge tubes. The caps of the tubes have modified entry ports that have plastic inserts that must be removed when loading the system with whole blood and subsequent removal of PPP and platelet concentrate (PC). Two different centrifugation steps are required to complete the process. Two disposables can be processed simultaneously.
7. GPS™ (Biomet Co., Warsaw, IN). This technology utilizes a modified flat bottom 60-mL plastic centrifuge tube. The test tube contains a buoy and an internal coiled device located in the tube cap, which must be lowered to remove the PPP following centrifugation. Manufacture instructions require that sterile gloves must be worn to maintain sterility of the product. The volume of buffy coat (BC) that can be removed is not adjustable (±5.0 mL).

Evaluations Performed
The assays performed on the donor blood samples and the prepared platelet products as well as the purpose of each test are summarized in Table 1. The qualitative assays performed to evaluate platelet function and viability are the same assays performed on platelet products prepared for transfusion. To evaluate the effect of the secondary ultraconcentration process of the Interpore Cross® system, samples were evaluated following separation with the Sequestra® (prefiltration) and after passage through the hemoconcentrator (postfiltration).

Statistics
When provided, statistical comparisons were performed using the Student’s t-test for paired comparisons (two-tailed). Differences were considered to be significant if p < .05. Means and standard deviations (SD) for at least five samples (n = 5) are reported unless otherwise noted.

RESULTS
Processing Details
Table 2 compares the operating parameters of each of the systems evaluated. The SmartPReP® has the least number of processing steps (5), the shortest total processing time (13 minutes) and the least investment in operator time. The salvage devices (CATS® and Sequestra®) require a unit of blood for processing. All other systems evaluated, except for the Interpore Cross® device require only 50–60 mL of whole blood for processing. The Interpore Cross® requires 60 mL of the platelet product from a salvage device for processing. The number of sterile barrier entries is similar for all the devices. However, neither the Secquire® or the GPS™ have entry ports that can be prepped as per the accepted hospital practice. The Secquire® has a removable plastic plug during processing, and the GPS™ mandates the use of sterile gloves. In an unrelated study, we have cultured the SmartPReP® PC aerobically and anaerobically throughout an 18-day period with negative results.

Comparison of the Platelet Products
Table 3 compares the characteristics of the platelet
product produced by the various systems. It is important to note that the SmartPReP®®, Secquire®, and GPS™ can all simultaneously process an additional disposable. The PC volume of the SmartPReP®® can be adjusted from 7–10 mL by varying the volume of the PPP supernatant for resuspension of the PC by utilizing specific spacers. The 3i PCCS™ and Secquire® PCs are fixed by the process at 8–10 mL. The GPS™ produces a ±5 mL platelet concentrate (see Table 7). The newest modification of the SmartPReP®® can use either a 60-mL or a 20-mL disposable. The latter produces a 3.3 mL PC (see Table 7).

The SmartPReP®® system, as shown in Table 3, has the greatest percentage yield (72%) and the most reproducible product as demonstrated, having the lowest coefficient of variation (CV = 13%). The percentage yield is a measure of the system’s efficiency in isolating platelets from a volume of whole blood processed. CV is a measure of the device’s capability to produce a consistent product reliably. The low CV values for both the SmartPReP®® and the CATS®® should be expected because both systems are automated. However, the CATS®® has a mean platelet yield of only 31%. The mean platelet yield for the 3i PCCS®® was 58%, which is comparable to the mean yield obtained by blood banks for a random donor platelet concentrate (obtained from a unit of whole blood). However, the markedly elevated CV demonstrates that the system does not produce a consistent product. For the Sequestra®® to produce a platelet yield comparable to a random donor platelet concentrate, multiple bowl cycles are required.

Table 1. Quantitative and qualitative analyses performed.

<table>
<thead>
<tr>
<th>Tests Performed</th>
<th>Samples Evaluated</th>
<th>Method</th>
<th>Test Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete blood counts</td>
<td>Baseline/post-processing</td>
<td>Automated coulter (Coulter Max-M)</td>
<td>Quantitative assay: Counts used to assess overall collection efficiency and resulting platelet counts in final product.</td>
</tr>
<tr>
<td>P-Selection</td>
<td>Post-processing</td>
<td>Flow cytometric assay</td>
<td>Qualitative assay used to assess platelet viability: Measurement of the P-selectin glycoprotein of unstimulated platelets investigates the preservation of platelet activity (lower values indicate less platelet activation). Increased expression of P-selectin following exposure to a platelet agonist such as ADP demonstrates that platelet viability is maintained.</td>
</tr>
<tr>
<td>Platelet aggregation</td>
<td>Post-processing</td>
<td>Optical aggregometry following exposure to collagen agonist (200 µg/mL)</td>
<td>Qualitative assay used to assess platelet function assessed by measuring the extent of platelet aggregation when a sample of the platelet product is exposed to a physiologic platelet activator.</td>
</tr>
<tr>
<td>Albumin</td>
<td>Baseline/post-processing</td>
<td>1. Radio immunodiffusion (The Binding Site Inc., San Diego, CA) 2. Chemical assay</td>
<td>Albumin used as a marker for efficiency of protein collection measured using: 1) an antigenic quantitative assay (radio immunodiffusion) and 2) qualitative chemical assay.</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>Baseline/post-processing</td>
<td>1. Radio immunodiffusion (The Binding Site Inc., San Diego, CA) 2. Clotting assay (Klaus technique)</td>
<td>Test selected to: 1) assess fibrinogen levels in final product (antigenic quantitative assay) and, 2) evaluate the quality/function of the available fibrinogen (qualitative assay) in the plasma supernatant of the prepared platelet products.</td>
</tr>
<tr>
<td>Fibronectin</td>
<td>Baseline/post-processing</td>
<td>Radio immunodiffusion (The Binding Site Inc., San Diego, CA)</td>
<td>Quantitative antigenic assay to measure the levels of fibronectin in the plasma supernatant of the prepared platelet products.</td>
</tr>
<tr>
<td>Adhesion molecules</td>
<td>Post-processing</td>
<td>ELISA (R&amp;D systems)</td>
<td>Quantitative antigenic assay of Stem Cell Factor (SCF) and Soluble Vascular Adhesion Molecule-1 (sVACAM-1) in the plasma supernatant of the prepared platelet products.</td>
</tr>
<tr>
<td>Growth factors</td>
<td>Post-processing*</td>
<td>ELISA (R&amp;D systems)</td>
<td>Quantitative antigenic assay of PDGF-AB and TGF-β1.</td>
</tr>
</tbody>
</table>

*Quantitative analysis of growth factors performed following platelet activation with 1000 U/mL of calcified bovine thrombin.
The Interpore Cross® system had the lowest level of measurable platelets, even though it was volume reduced by 2.6-fold. Passage through the hollow fiber hemocenterator resulted in platelets that were fragmented, clumped, and/or bound to the hollow fibers. The end product is a platelet releasate rather than a viable platelet concentrate.

Another useful measure of a PC product is the relative increase in platelet count above the baseline platelet count in the whole blood sample. Only the SmartPReP® and the CATS® produce a product that is at least four times baseline.

**Evaluation with Respect to Platelet Viability**

The in vitro indicators of platelet viability and function used in transfusion medicine are P-selectin and platelet aggregation. These markers have also been used to examine platelet activation during preparation (8–10). A brief description of these tests is presented in Table 1. The results of our studies are shown in Tables 4 and 5. During the latter phase of our studies, we modified our technique for P-selectin using a double antibody technique, which has high sensitivity for the detection of minor changes in surface antigen density that occur during platelet activation. This technique was used to compare the SmartPReP® with the Secquire® (Table 5).

The P-selectin values for the SmartPReP®, CATS®, 3i PCCS®, and the Secquire® are similar. The Secuestra® had slightly elevated levels of P-selectin, probably because of the multiple bowl fills during product preparation. The P-selectin expression of the PCs prepared by these devices increased following challenge with the agonist ADP, indicating that platelet viability is preserved. P-selectin expression for the Interpore Cross product without ADP was significantly greater than for the other systems ($p = .018$). P-selectin expression for the Interpore Cross product, with and without the agonist ADP, were identical (42 ± 14% and 43 ± 27%, respectively), indicating that there was no residual stimulatory activity.

The CATS® and SmartPReP® have the same mean aggregation response. This is to be expected because the CATS® is a modified platelet apheresis device, and the SmartPReP® has a step that prevents the formation of platelet aggregates. All other systems have visible platelet aggregates that will dispense upon standing. This probably accounts for their low normal aggregation response. Platelet aggregation of the Interpore Cross samples were impaired by the ultraconcentration process as demonstrated by the low post-filtration aggregation response, mean 17 ± 21% as compared to the prefiltration response of 75 ± 4% (Secuestra®).

**Fibrinogen, Albumin, and Adhesion Molecules**

During the course of this study, we evaluated the fibrinogen levels using both an antigenic assay and by the Klauss technique (functional assay used in coagulation laboratories). The data for three of the systems are shown in Table 6. The levels of fibrinogen, quantified, using the antigenic assay, was significantly greater in the Interpore

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**Table 2.** Processing details of systems evaluated.

<table>
<thead>
<tr>
<th>System</th>
<th>Anticoagulated Blood Processed (mL)</th>
<th>Sterile Barrier Entries</th>
<th>Number of Processing Steps</th>
<th>Operator Time (min)</th>
<th>Process Time (min)</th>
<th>Total Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartPReP® n = 25</td>
<td>60</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>3i PCCS® n = 10</td>
<td>60</td>
<td>5</td>
<td>24</td>
<td>15</td>
<td>17</td>
<td>32</td>
</tr>
<tr>
<td>Secquire® n = 5</td>
<td>50</td>
<td>6</td>
<td>12</td>
<td>10</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>CATS® n = 5</td>
<td>450</td>
<td>4</td>
<td>16</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Secuestra® n = 5</td>
<td>450</td>
<td>4</td>
<td>20</td>
<td>10</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Interpore Cross® n = 5</td>
<td>60</td>
<td>3</td>
<td>15</td>
<td>10</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>GPS® BIOMET</td>
<td>60</td>
<td>7</td>
<td>23</td>
<td>15</td>
<td>12</td>
<td>27</td>
</tr>
</tbody>
</table>

*All systems were compared to SmartPReP® using a split donor sample.
†Utilized 60 mL of Sequestra product.

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**Table 3.** Comparison of the platelet products.*

<table>
<thead>
<tr>
<th>System</th>
<th>Baseline Platelet Count ×10^3/μL</th>
<th>Platelet Conc. Vol-mL</th>
<th>Platelet Conc. Count ×10^3/μL</th>
<th>Platelet Yield (%)</th>
<th>Platelet Increase over Baseline</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartPReP®</td>
<td>251 ± 55</td>
<td>9.3 ± 1.8</td>
<td>1016 ± 389</td>
<td>72 ± 10</td>
<td>4.0</td>
<td>13</td>
</tr>
<tr>
<td>3i PCCS®</td>
<td>268 ± 59</td>
<td>8.2 ± 1.2</td>
<td>978 ± 367</td>
<td>58 ± 22</td>
<td>3.6</td>
<td>38</td>
</tr>
<tr>
<td>Secquire®</td>
<td>220 ± 13</td>
<td>9 ± 0.5</td>
<td>348 ± 194</td>
<td>31 ± 15</td>
<td>1.6</td>
<td>48</td>
</tr>
<tr>
<td>CATS®</td>
<td>239 ± 46</td>
<td>29 ± 0.6</td>
<td>992 ± 162</td>
<td>31 ± 5</td>
<td>4.1</td>
<td>16</td>
</tr>
<tr>
<td>Secuestra®</td>
<td>225 ± 33</td>
<td>83 ± 6</td>
<td>582 ± 128</td>
<td>54 ± 11</td>
<td>2.6</td>
<td>20</td>
</tr>
<tr>
<td>Interpore Cross®</td>
<td>582 ± 128</td>
<td>23 ± 0.6</td>
<td>356 ± 233</td>
<td>27 ± 22</td>
<td>0.6</td>
<td>81</td>
</tr>
</tbody>
</table>

*All values are mean ± SD.
†Utilizes 60 m of Sequestra product – volume reduction 2.6×.
results in a higher concentration of the attachment proteins (fibronectin and adhesion molecules) in the PC plasma. However, the Interpore Cross® product has a significantly higher hematocrit because less plasma is available, the total amount of the various attachment proteins is comparable for the devices.

Growth Factors

Three of the systems (CATS®, Sequestra®, Interpore Cross®) require seven times more blood for the initial platelet separation than that required by the other devices evaluated. The volume of the PCs for three of these systems (SmartPReP®, 3i PCCS®, Sequire®) is ±10 mL; whereas, that of the GPS™ is only ±5 mL. To account for the differences in blood processing volumes, and the volume of the PC, the total amount of growth factor released was compared equalizing the volume of blood processed for each system to 60 mL. The data are shown in Figure 1. Given the same quantity of blood processed, the mean total amount of PDGF-AB and TGF-β-1 released is slightly greater for the SmartPReP® than the 3i PCCS® but significantly greater than the other systems evaluated ($p < .05$).

DISCUSSION

Autologous platelet concentrate combined with thrombin and calcium has been used to prepare a platelet gel that releases biologically active proteins stored in platelet vesicles and granules. In contrast to recombinant growth factors, autologous PCs and, subsequently, platelet gel modulates and upregulate one growth factor’s function in the presence of a second or third. Recombinant growth factors focus only on a single generation pathway. This source of autologous growth factors and other proteins can contribute to the healing process. As documented in oral–maxillofacial, spinal, and plastic surgery, as well as in the treatment of chronic wounds (1–4).

The ultimate objective in preparing a platelet concentrate at point of care is to maximize the availability of this multiplicity of proteins directly at the injury site. A recent study by Haynesworth et al. concluded that a dose response could be demonstrated for the effect of platelet gel on the migration and proliferation of human mesenchymal stem cells (hMSC) (11). This study supports previous stud-
ies that have used platelet concentrates to demonstrate that the delivery of growth factors from platelets’ secretory granules is dependent upon the binding of fibrinogen to a platelet membrane integrin (12,13). It is, therefore, critical that the method of platelet concentrate preparation optimizes protein availability. As demonstrated by the study results, the presently available systems for the point of care preparation of a platelet concentrate have very significant differences. The clinician needs comparative information to decide which system is most likely to offer the best protein product reliably and consistently.

The results of this study address the need for standardization of preparative methods and from the point of view of transfusion medicine and molecular biology, the characterization of the components obtained.

The differences in the end product are, for the most part, because of the volume of blood collected and the method of platelet concentration used by the systems evaluated. As shown in Table 2, three of the systems require a unit of blood (400–500 mL) for processing. Many patients undergoing major surgery predeposit several units of blood, which is often done up to 72 hours before surgery. A collection of only 60 mL or less of whole blood would be more acceptable to most anesthesiologists. The SmartPReP® is the most automated system, requiring only 2 minutes of operator time and one-third of the processing steps required by the other devices. Thus, there is virtually no increase in the workload of the often over-burdened operating room personnel. Two of the devices (Secquire® and GPS™) do not have entry ports that can be sanitized in keeping with standard hospital practice.

The overall platelet collection efficiency is shown in Table 3. The SmartPReP® has the greatest percentage yield (72%) and is the most reproducible, as demonstrated by having the lowest coefficient of variation, only slightly under that of CATS®. However, the efficiency of the SmartPReP® system allows it to produce a comparable product to the CATS, with much less blood and without the need for a specially trained dedicated operator. The platelet collection efficiency was lowest for the Interpore Cross® system, and it was the least reproducible (CV 81%). Following filtration, the volume of the Interpore

**Table 7. Comparison of the SmartPReP® with Biomet GPS™.**

<table>
<thead>
<tr>
<th>Anticoag. Blood Processed mL</th>
<th>Platelet Count ( \times 10^9/\mu L )</th>
<th>Platelet Concentrate Vol mL</th>
<th>Platelet Concentrate Count ( \times 10^9/\mu L )</th>
<th>Platelet Yield %</th>
<th>CV %</th>
<th>Platelet Increase Over Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartPReP® 22.5 mL ( n = 10 )</td>
<td>244 ± 38</td>
<td>3.3 ± 0.1</td>
<td>1083 ± 233</td>
<td>65 ± 9.0</td>
<td>14.0</td>
<td>4.4 ± 0.6</td>
</tr>
<tr>
<td>SmartPReP® 60 mL ( n = 10 )</td>
<td>241 ± 38</td>
<td>10 ± 0.12</td>
<td>1151 ± 164</td>
<td>80 ± 3.4</td>
<td>4.2</td>
<td>4.8 ± 0.2</td>
</tr>
<tr>
<td>SmartPReP® 60 mL ( n = 4 )</td>
<td>221 ± 36</td>
<td>7 ± 0.3</td>
<td>1675 ± 88</td>
<td>86.8 ± 3.4</td>
<td>4.0</td>
<td>7.6 ± 0.3</td>
</tr>
<tr>
<td>Biomet GPS™ 60 mL ( n = 6 )</td>
<td>192 ± 48</td>
<td>5.5 ± 0.2</td>
<td>809 ± 396</td>
<td>42.6 ± 9.0</td>
<td>21.0</td>
<td>4.1 ± 0.8</td>
</tr>
</tbody>
</table>

*If SmartPReP® product volume was the same as the GPS™ (5.5 mL), the platelet increase over baseline would be 9.6.
†All values are mean ± SD.

**Figure 1.** Total growth factors released from platelet concentrate preparations. All systems adjusted to 60 mL processed volume.
Platelet aggregation and P-selectin are two standard assays used to evaluate the quality and function of platelets (8–10). Platelet aggregation evaluates the ability to function (aggregate) when exposed to a physiologic platelet agonist (e.g., collagen). The alpha-granule membrane protein, P-selectin, is sequestered on the internal membrane of the alpha-granule on resting platelets. Expression of P-selectin is, therefore, an indicator of the extent of platelet activation with larger values of P-selectin correlating with a greater degree of activation. The Interpore Cross system has a markedly reduced platelet aggregation (17%) and a high value for direct P-selectin (without ADP-43%). The failure to obtain an increase in P-selectin (17%) and a high value for direct P-selectin (without ADP-43%) would be consistent with platelets prepared for transfusion. Normal values for collagen-induced aggregation of platelets prepared for transfusion are shown in Table 7. The Smart PreP-2™ system contains a floating shelf of a specific density to separate theuffy coat and uppermost layer of red cells from the concentrated red cells during centrifugation. The system will process either 22.5 or 60 mL of anticoagulated whole blood. This finding is not unexpected because the SmartPreP® system contains a buoy and an internal device consisting of a plunger and tubing to remove the PPP and, subsequently, theuffy coat following centrifugation. The volume of the product is set at ±5 mL, which is obtained from 60 mL of anticoagulated whole blood.

CONCLUSION

There are several devices available for point of care preparation of autologous platelet concentrates and, subsequently, platelet gel. Our studies comparing the different devices demonstrated variations in both quality and quantity. The SmartPreP® produced a consistent PC in the four times baseline range, with the lowest coefficient of variation (13%) while requiring only a small volume of blood. This finding is not unexpected because the SmartPreP® is the most automated system. Elimination of manual manipulation, as would be expected, does result in reduced variability. The ability to produce a PC that is four to five times baseline consistently should result in a protein load to enhance wound healing and bone regeneration based on the currently available in vitro and in vivo data.
ACKNOWLEDGMENTS

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REFERENCES