Masterclass in Clinical Practice

Implant Dentistry
with

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Platelet Rich Fibrin in implant surgery

Scan to see videos by Dr J Choukroun

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Introduction

Platelet rich fibrin (PRF) is a second-generation platelet concentrate, which does not require the addition of any anticoagulants or additives. PRF is therefore the only platelet concentrate system that is fully autologous. PRF was developed by Choukroun et al. (2001) and is used to benefit hard and soft tissue healing.[1, 2]

Modifications in centrifugation speed, G-force and time have led to the development of two products that can be used in implant surgery namely, advanced PRF (A-PRF) and standard PRF (S-PRF).[3, 4]

Specific tubes with a glass surface initiate the coagulation cascade and activate platelets during centrifugation. The resulting PRF consists of a fibrin scaffold that contains platelets, leukocytes, and plasma proteins. After centrifugation, the resulting 3D matrix of the PRF clot serves as a reservoir of growth factors.[5]

The major role of fibrin in wound repair is haemostasis, but fibrin also provides a matrix for the migration of fibroblasts and endothelial cells that are involved in angiogenesis and remodelling of new tissue. Platelet activation in response to tissue damage and vascular exposure results in the formation of a platelet plug and blood clot as well as the secretion of growth factors, which includes platelet-derived growth factor (PDGF), transforming growth factor β (TGF-β), vascular endothelial growth factor (VEGF) and epidermal growth factor (EGF).[4, 6]

The use of a platelet concentrate like PRF, is a method of introducing high concentrations of growth factors to the surgical site, thereby enriching the natural blood clot and creating an optimal environment for hard and soft tissue healing.[5, 7, 8] In addition to creating sticky bone by combining S-PRF with bone filler material, S-PRF may also be used to infuse other biomaterials (Fig.1) used in augmentation procedures to enhance the osteogenic potential and bioactivity.[8, 9]

Figure 1: Membrane being soaked in S-PRF to increase bioactivity

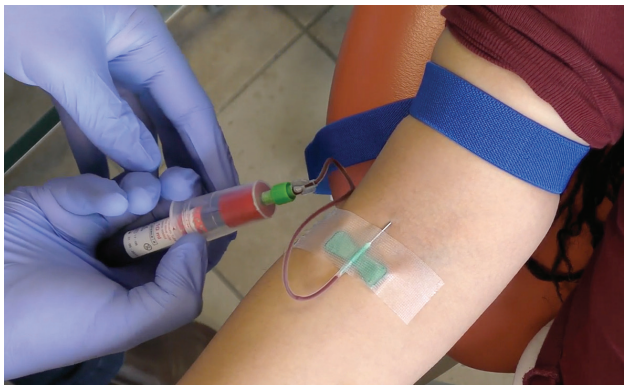

Figure 2: Phlebotomy with a butterfly needle

Figure 3: PRF tubes in the tube holder

Preparation of PRF (Protocol developed by Choukroun et al)

A-PRF membranes

Step 1: Phlebotomy to collect blood in the red tubes. A butterfly needle is recommended to perform the phlebotomy (Fig. 2). The time from starting the phlebotomy to initiating the centrifugation has an influence on the fibrin clot size and should ideally be within two minutes.[10]

Step 2: Place the tubes in the centrifuge (DUO Quattro), in a balanced way, close the lid and start the program A-PRF+ (13 x 100 rpm/14min).

Step 3: Remove the tubes from the centrifuge, remove the tube caps and place the tubes in the tube-holder (Fig. 3). Wait for five minutes before removing the fibrin clots from the tubes.

Step 4: Using sterile PRF forceps, remove the fibrin clot from the tubes (Fig 4a). Place the clot on a sterile gauze and remove the red cell clot from the fibrin clot (Fig 4b).

Step 5: Place the PRF clots on the box grid, cover them with the tray and close the lid. The A-PRF membrane will be ready to use after two minutes (Fig. 5).

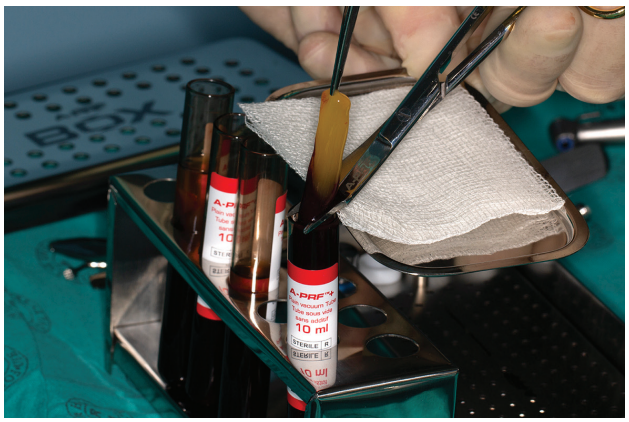

Figure 4a: Fibrin clot removed with PRF forceps and blood clot cut off with scissors

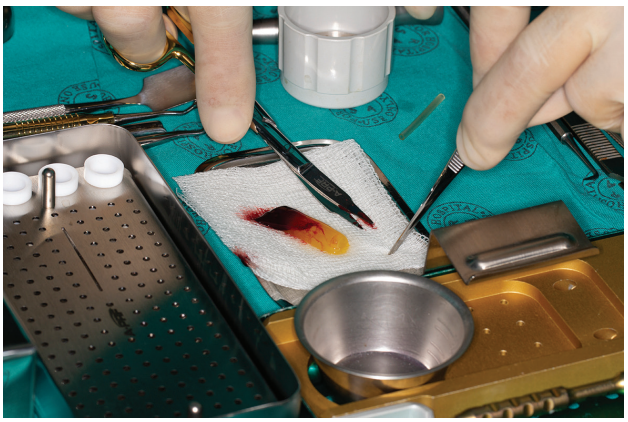

Figure 4b: Place on gauze and scrape blood clot off

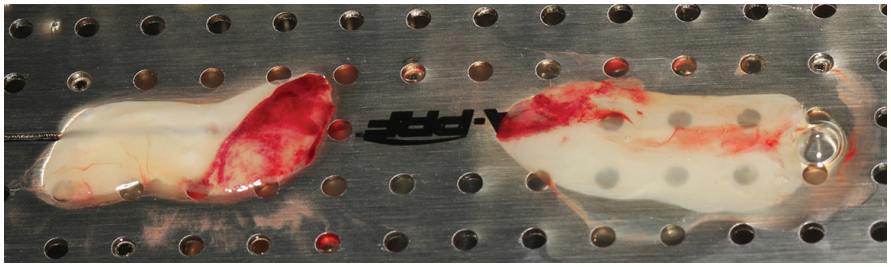

Figure 5: Membranes created from the A-PRF clot

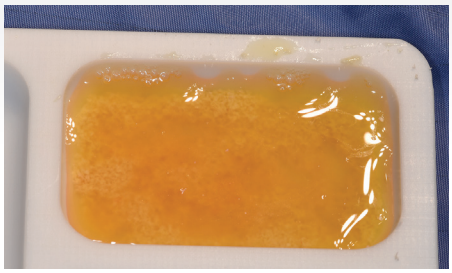

Figure 6: PRF liquid applied onto biomaterial

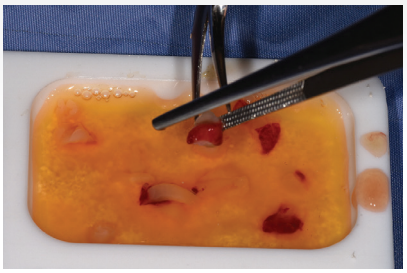

Figure 7: A-PRF membrane cut into small pieces and added to biomaterial and PRF liquid

Figure 8: Sticky bone with excellent handling properties folded into a square

S-PRF for sticky bone

Step 1: Phlebotomy to collect blood in the green tubes (as many as needed) and at least one red tube for A-PRF (see below).

Step 2: Place the tubes (red and green) in the centrifuge (DUO Quattro), in a balanced way, close the lid and start the program A-PRF+ (13 x 100 rpm/14min).

Step 3: Remove the tubes from the centrifuge, remove the tube caps and place the tubes in the tube-holder.

Step 4: A-PRF membranes are prepared as described previously, from the red tubes. Using a 2ml syringe, draw up the straw coloured liquid from the top of the green tubes. Apply this liquid onto the biomaterial in a tray (Fig. 6). To accelerate clotting and the formation of sticky bone, cut one A-PRF clot into small pieces and add to liquid and biomaterial (Fig. 7). The sticky bone is ready to use in 3 minutes (Fig. 8).

Clinical applications of PRF in implant dentistry

1: Sinus augmentation and membrane repair

When performing a sinus floor elevation, be it trans-crestal or with a lateral window technique, perforation of the Schneiderian membrane remains the biggest complication. This may be managed by using A-PRF membranes to seal the perforation if it is a small tear. The A-PRF will adhere to the membrane and repair the tear to enable filler material to be placed. The filler material can then be mixed with S-PRF to create sticky bone (Fig. 9), further limiting the chances of loose particles of bone to spread through the tear, as the sticky bone becomes a coagulum binding all the particles together. Should the tear be bigger than 10mm, we do not recommend this approach, but rather use A-PRF membranes in combination with A-PRF plugs (created in special containers in the PRF kit). This will keep the sinus membrane lifted, without the risk of particles spreading into the maxillary sinus and may well create sufficient new bone growth for later implant placement.

2: Socket grafting for ridge preservation

There are two scenarios where PRF can be used in socket grafting. If an early placement protocol is followed, then A-PRF can be used as membranes or plugs as the sole grafting material to enhance healing (Fig. 10a&b). The PRF will help healing and suppress infection. It does not interfere with new bone formation as it is an autologous super clot full of growth factors at much higher levels than a normal blood clot. If the objective is to graft the socket to preserve the ridge for delayed implant placement, even for years later,

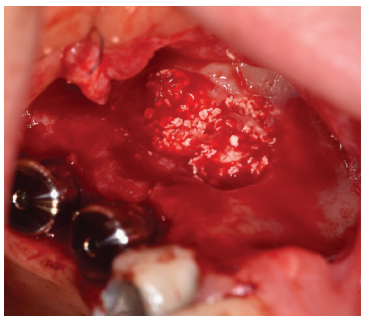

Figure 9: Sticky bone coagulum used in lateral window sinus floor elevation

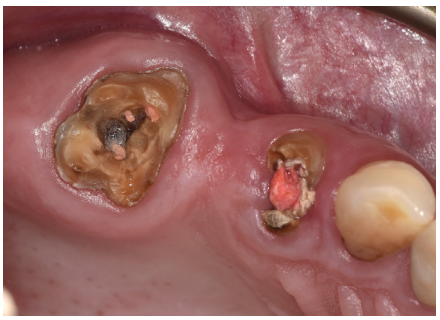

Figure 10a: Teeth scheduled for surgical removal

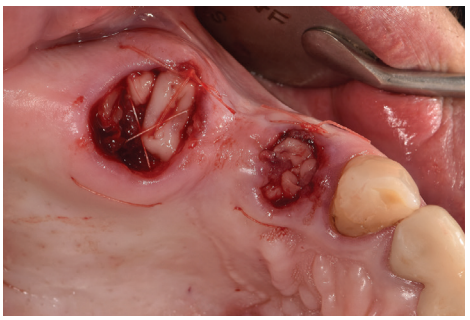

Figure 10b: Socket filled with A-PRF

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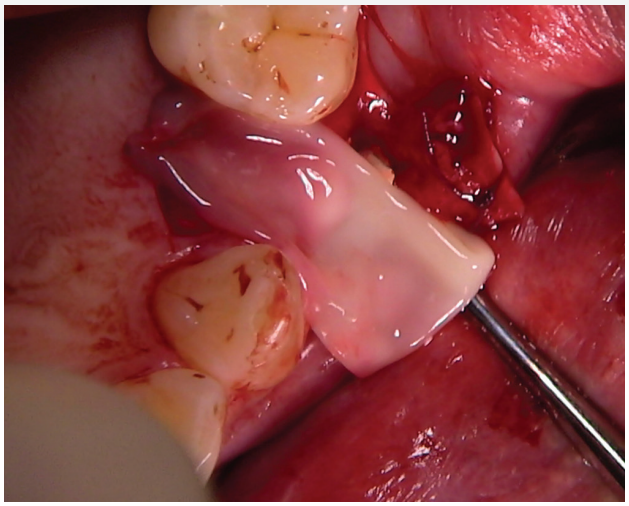

Figure 11: A-PRF membrane used to cover socket after grafting

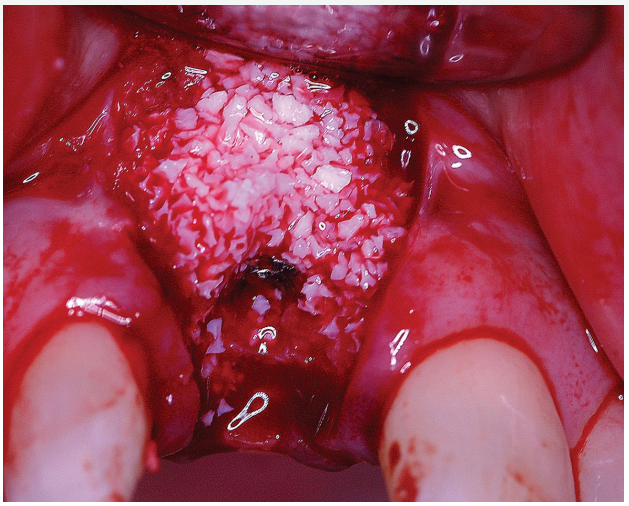

Figure 12: Loose particles during contour augmentation may be a clinical challenge

then a filler material should be used to create sticky bone. The socket can be packed with a slow or fast resorbing filler material depending on how long it will be left before implant placement. Once the socket is filled, an A-PRF membrane can be placed over the socket to protect the healing for the first few days (Fig. 11).

3: Contour augmentation

One of the challenges in doing contour augmentation, is keeping the particulate graft contained over the facial bone wall. The graft particles tend to flow away if there is bleeding at the surgical site. The danger also exists of the assistant getting too close with the suction as the particles are lying loose until covered by a membrane (Fig. 12). Creating sticky bone as in Figure 8, creates a mouldable coagulum that can be shaped or cut to fit the defect precisely, without the danger of particles being lost. In addition, it also provides improved bone and soft tissue healing.

4: Immediate implant placement jump gap augmentation

If the jump-gap is large enough to require augmentation, PRF will again create a mouldable graft and not only provide improved bone healing, but also lower the risk of infection from the removed tooth.

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