

IMPLANT TRIBUNE

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A patient's growth factors

Prof. Liviu Steier and Gabriela Steier discuss how growth factors are a valuable addition to regenerative dentistry



Preoperative x-ray showing upper and lower jaw.

Blood clots are extremely valuable for initiating healing and regeneration for both soft and hard tissue. Platelet rich plasma (PRP) is becoming more accepted as a way of accelerating and enhancing natural wound healing, and has been successfully used for decades in orthopaedic surgery as well as in dermatology.

Growth factors

A variety of proteins and growth factors interact with each other to induce wound repair.

In a once-injured vessel, the platelets will start to stick to exposed collagen proteins and will

release adenosine diphosphate, serotonin and thromboxane, contributing to the clotting cascade and hemostatic process, as well as to the platelet plug formation. The platelet plug is reinforced by an insoluble protein fibre meshwork as a product of the clotting cascade.

It's important to note the fact that platelets actively extrude growth factors, such as:

- Well-researched growth factors**
1. Platelet-derived growth factor = PDGF
 2. Transforming growth factor-, = TGF-,
 3. Insulin like growth factor = IGF-I.

Under research

4. Transforming growth factor-alpha = TGF-, etc
5. Epidermal growth factor = EGF
6. Vascular endothelial growth factor = VEGF
7. Hepatocyte growth factor = HGF.

Here I will attempt to explain a bit about some of the benefits of these well-researched growth factors:

PDGF

- Proliferative activity on periodontal ligament fibroblast
- Promotes collagen and protein synthesis
- Enhances proliferation of bone cells.

TGF-,

- Activates intracellular proteins
- Promotes extracellular matrix production for example in periodontal ligament fibroblasts
- Stimulates the proliferative activity of periodontal ligament fibroblasts
- Stimulates biosynthesis of type I collagen and fibronectin.

IGF-I

- In combination with PDGF will stimulate cementogenesis
- Bone formation; and many more.

It was Marx who in 1998 published a paper on the significance of increased bone formation and bone density after using thrombocyte growth factor. Rutherford et al. (1992) and Anitua (1999) published a paper on platelet concentrates for coating dental implants.

Commercial systems available for PRP

- Smart Prep autologous platelet concentrate system (Harvest Autologous Hemobiologics, Norwell, Massachusetts)
- Tisseel system (Baxter Heath corp., Deerfield, Illinois)
- Curasan PRP kit (Curasan, Kleinostheim, Germany)
- Friadent-Schuetze PRP (Friadent-Schuetze, Vienna, Austria)

- PRGF by Anitua (G.A.C. Medicae San Antonio, Vitorio Espana).

How the systems differ:

1. Cycles of centrifugation
2. Speed of centrifuge
3. Amount of blood to be collected
4. Addition yes/no of bovine thrombine.

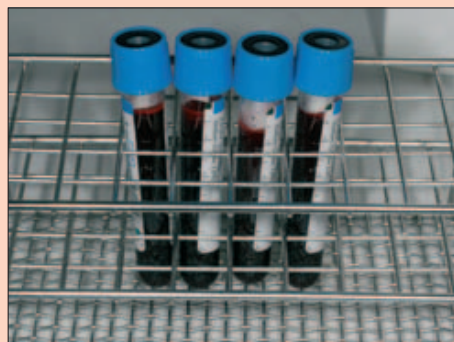
I have used the Curasan approach for many years and switched to the PRGF technique almost three years ago. For the purpose of exemplification the latter technique will be briefly described.

As such, based on the technique used, the platelet count as well as the growth-factor content may differ. Differentiation of the above number may occur as well as a consequence of the donor.

The Anitua technique:

- Venous blood (between 10-50mL) has to be collected in office and drawn into two to six sterile tubes containing an anticoagulant (here 3.8 per cent sodium citrate).
- Centrifugation: Eight minutes at 1800 rpm.
- Three different blood fractions will be identified and isolated by pipetting: Fraction 1 = platelet poor plasma (the above 0.5ml)

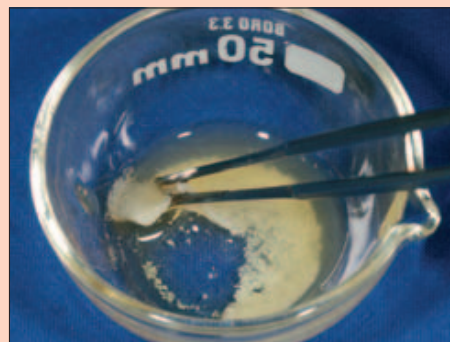
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Venous blood, which has been collected in office and drawn into four sterile tubes containing an anticoagulant (here 3.8 per cent sodium citrate) before centrifugation and further manipulation.



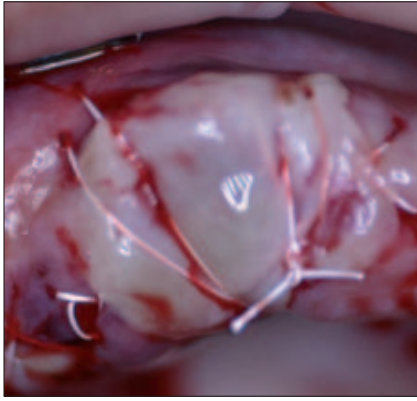
Non-activated PRGF used to coat the implants before insertion (Biohorizons implant).



BioOss (Geistlich) soaked in PRGF.



The PRGF membrane ready to be placed.



PRGF membrane sutured in place.



Postoperative x-ray showing the implants in place as well as the fully augmented upper jaw.



X-ray taken at 12 months recall.

BIO HORIZONS

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Fraction 2 = plasma containing a number of platelets (next 0.5ml)
 Fraction 3 = platelet rich growth factor (remaining plasma above the buffy coat) ← this is the most important fraction.

The platelet then needs activation using 10 per cent calcium chloride (0.05ml per 1ml PRGF).

The coagulation will occur in five to eight minutes (best at 37 degrees Celsius – incubator).

Weibrich et al (2002) measured 46+/- 7.45 per cent PRGF collection efficiency.

The same study confirmed the absence of leucocytes in all three fractions.

One can use the gained material as follows:

- a. Not activated for coating implants before seating
- b. Activated:
 1. To be mixed with graft materials
 2. To make membranes.

Strengths of the technique

1. Needle-free approach which drops infection risk for practitioner
2. Duration for the preparation is about 20–25 min
3. Reduced centrifugation time
4. No need of additional bovine thrombin.

Weakness of the described technique

1. Lack of leukocyte might lead to a reduced anti-infective protection
2. High number of pipetting procedures (up to 50)
3. The use of a so-called “open system” implicates high sterilisation criterion.

Conclusion

PRP is a new tissue-engineering application suitable for the clinician. Among the different procedures available, the author describes the approach which in his hands currently works best. The use of the PRP here PRGF technique significantly changed the treatment outcomes in my practice: less complications, better healing and higher predictability of regeneration procedures.

Disclaimer

The author has no financial interests in any of the presented products or systems.

Implant Tribune

Aesthetic Risk Factors	Low (score 1)	Medium (score 2)	High (score 3)
Medical status	Healthy patient and intact immune system		
Smoking habit	Non-smoker		Heavy smoker (>10 cigfd)
Patient's esthetic expectation		Medium	
Smile line		Medium	
Biotype		Medium-scalloped. medium-thick	
Biotype		Normal	
Shape of tooth crowns	Square	Rectangular Oval	Triangular
Infection at implant site	None	Chronic	
Bone level at adjacent teeth	< 5mm to contact point		
Restorative status of neighboring teeth			Crowns
Width of edentulous span			2 teeth or more
Soft-tissue anatomy			Soft-tissue defects and recession >1
Height of existing papilla and evenness of FGM (GAL)			Long or absent papillae and GAL class 4
Bone anatomy			Vertical bone deficiency
Bone contour		Minimal buccal dip	
Tooth position (immediate placement)	Regular tooth alignment		
Socket integrity and anatomy			Multi-rooted, sever bone deficiency
Aesthetic risk score			> 36

Clinical case study

A 54-year-old female patient presented to our practice requesting rehabilitation of the upper jaw with implant-supported fixed restorations.

The patient had not received dental assistance for the last 12 years and had no medical problems. The patient's chief complaint was non-satisfactory chewing efficacy. She requested rehabilitation of the upper jaw with implant supported fixed restorations.

Her oral hygiene was adequate so she underwent a rigorous oral hygiene programme for three months. The soft tissue examination revealed no problems; MJ and muscles showed no acute problems; occlusal assessment revealed a lack of occlusal support; implant assessment showed suspect teeth: 16, 13, 12, 22, 25, 26; available bone is moderate to poor; treatment plan includes planned extractions of teeth 16, 13, 12, 22, 25, 26 and a total of seven implants.

Esthetic risk analysis

We explained to the patient the high risks of smoking and it was agreed that the patient would attend a stop-smoking programme. Three months after starting, the patient did stop smoking and treatment began.

The following treatment plan was agreed and discussed with the patient:

- Planned extractions: 16, 13, 12, 22, 25, 26.
- Number of implants: 7
- Position of implants: 15, 14, 13, 12, 22, 26, 27.
- Bone graft using: BioOss (Geistlich) and PRGF (Anitua technique).
- Type of prosthetic restoration: single crowns.
- Surgical template: conventional lab made surgical guide.

Consent was received and the treatment started. The first treatment step comprised extractions and the fitting of a temporary restoration. Ten weeks later, impressions were taken, castes were mounted in a semi-adjustable articulator and sent to the lab for manufacturing of a surgical guide. PRGF, implant insertion and bone graft (a mixture of Grafton, Biohorizons, and BioOss, Geistlich soaked in PRGF) were performed concomitant in local anesthesia. Antibiotic coverage was assured for seven days.


The patient was asked not to wear temporary prosthesis for 10 days and an antibiotic regimen was prescribed.

The second-stage surgery was performed six months later. After a gingival healing/maturation time of 14 days, definitive impressions were taken, bite registered and a face bow made.

After two try-in sessions the definitive restorations were fitted.

The 12-month x-ray proved a stable outcome and it is expected that the patient will come back for rehabilitation of the lower jaw.

Conclusion

Wound-healing deficiencies do not often impose an obstacle in guided bone regeneration (GBR) procedures when associated with implant placement. The use of PRP techniques in medicine go a long way back and its application into dentistry represented a change of paradigm. The author can only anecdotally affirm, based on his own experience, that since using PRP (latest PRGF) techniques, wound-healing problems never occurred again and GBR procedures seem to gained more predictability. 

References are available on request.

About the author



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About the author



Author name
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PRECISION