Vivostat®
PRF


Sealing I Healing I Regeneration

Vivostat® PRF

Vivostat® PRF - Advanced Tissue Regeneration

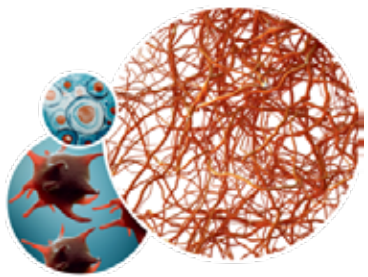
The Vivostat® system offers a fully automated process for the preparation of an autologous Platelet Rich Fibrin (PRF)

The presence of growth factors is essential to the process of tissue regeneration (e.g. soft tissue, connective tissue, muscle and bone). Using the Vivostat® system, you can prepare autologous platelets with multiple growth factors embedded in a fibrin sealant matrix. From 100-120 ml of the patient's own blood, 5-6 ml of Platelet Rich Fibrin (PRF) is prepared.

By combining a platelet concentrate with a fibrin sealant, it is possible to have a carrier, a controlled release, and a medium for tissue in-growth – all in one product, Vivostat® PRF.

Vivostat® PRF offers a number of advantages:

- The concentration of platelets in Vivostat® PRF is well above the baseline platelet count of 230 x 10^9/L
- The fibrin matrix ensures a slow release and protection of the growth factors[1]
- As the fibrin polymers in Vivostat® PRF are based on a thrombin-free fibrin 1 solution this leads to faster tissue repair[2]
- The specially designed Vivostat® application devices ensures easy, accurate and efficient application of Vivostat® PRF
- With instant polymerisation and excellent adhesion and elasticity of the fibrin sealant, the PRF matrix remains where it is applied – even when applied on vertical or inverted surfaces
- Application devices suitable for all kinds of surgical approaches



The Vivostat® system is designed with emphasis on user-friendliness.

You will find the system straightforward and easy to use. It can easily be moved between departments or even to the outpatient department if required. Furthermore, the innovative Danish design makes the system easy to operate, maintain and clean.

1) Bioactivity and stability of endogenous fibrogenic factors in platelet-rich fibrin · Lundquist R. et al. · Wound Repair and Regeneration 2008; 16(3): 356-365
2) Nonactivated versus Thrombin-activated Platelets on Wound Healing and Fibroblast-to-Myofibroblast Differentiation · Scherer S. et al. · Plastic and Reconstructive Surgery 2012; 129(1)


COMPLETE
REMOVE PREP UNIT

The Vivostat® system

The Vivostat® process is fully automated and easy to operate by the healthcare personnel

The uniqueness of the Vivostat® system is a novel pa-tented biotechnological process that enables reliable and reproducible preparation of autologous Platelet Rich Fibrin (PRF) without the need for a separate thrombin component. The Vivostat® system consists of three components:

- **The Processor Unit**
  The Processor Unit is used to process the patient's blood and prepare the Vivostat® PRF. The display keeps the user informed at all times about the process and the time remaining.

- **The Applicator Unit**
  The Applicator Unit controls the delivery of Vivostat® PRF to the site of treatment. The Co-Delivery Applicator, furthermore, allows drugs or cells to be co-delivered with the Vivostat® PRF.

- **The Disposable Set**
  The single-use set contains all components needed for preparation and application of Vivostat® PRF. It is available with a range of application devices each optimised for different types of applications.

During the procedure, the Applicator Unit informs about the volume of Vivostat® PRF available and allows the healthcare specialist to choose from a number of different spray modes that carefully control the delivery of Vivostat® PRF to the site of treatment.

The spray modes have been developed with focus on optimal application in open and minimally invasive surgery.

The Vivostat® Applicator Unit and Processor Unit

Vivostat® PRF

Three easy steps to prepare Vivostat® PRF

1. Draw blood from the patient
Prior to treatment, citrate supplied with the kit is added to the Preparation Unit. 120 ml of the patient's own blood is then drawn into the same unit.

2. Process the patient's blood
The Preparation Unit is placed in the Processor Unit. At the touch of a button the process starts; after approx. 26 minutes, an autologous Vivostat® PRF is ready for use.

3. Load the Applicator Unit and spray
The Vivostat® PRF is easily loaded into the Applicator Unit and is applied to the site of treatment using one of the different application devices.

Application devices for all situations

The Vivostat® system offers a range of unique application devices, designed for the delivery of Vivostat® PRF to the site of treatment in a precise and targeted manner, with minimum waste and without blockage

Each application device has been developed using the knowledge of healthcare professionals to improve product performance. Vivostat can therefore offer application devices adapted to each surgical setting. Whether you are performing open surgery, work in an endoscopic setting, need to treat fistulas or cavity wounds Vivostat has the solution. In the right column examples of Vivostat® application devices are listed.

The application devices are used in conjunction with the Applicator Unit and are all based upon the well-known Vivostat® micro-spray technology.

Spraypen Kit (also in a Co-Delivery version)
The Vivostat® Spraypen is a central and unique component of the Vivostat® system. It enables the surgeon to apply Vivostat® PRF accurately and intermittently throughout the entire procedure.

Endoscopic Kit (also in a Co-Delivery version)
The Vivostat® Endoscopic Applicator is used in various types of Minimally Invasive Surgery. The single-use endoscopic application catheter is easily loaded into the endoscopic handle, which is inserted via a 5 mm trocar. The pre-bent spraytip enables the surgeon to manipulate the tip and spray in multiple directions.

Endoscopic Kit-Straight
The Vivostat® Endoscopic Kit-Straight is developed for the application of Vivostat® PRF in deep wounds and fistulas. More over, it can be used in different endoscopic solutions e.g. Colonoscopes, Bronchoscopes, Laparoscopes or Gastroscopes.


5.3 ml
HIGH
Vivostat®

Vivostat® Co-Delivery

Vivostat® PRF Co-Delivery acts like an active autologous healing platform for co-application of different substances such as medications and cells.

The opportunities with the Vivostat® Co-Delivery system are vast and the system allows the surgeon to apply a selected substance easily and effectively. Furthermore, it may be possible to reduce the total cost of a procedure by using the Vivostat® Co-Delivery system[1].

Options for Co-Delivery include:

Medications
- Antibiotics
- Chemotherapeutics
- Pain medications

Cells
- Stem cells (i.e. BMAC)
- Chondrocytes
- Keratinocytes

Co-delivering drugs, stem cells, skin cells etc. with the Vivostat® PRF solution offers the surgeon and the patient a number of benefits:

- Topical application
- Targeting affected/desired area
- Possible higher local dose
- Possible lower systemic impact
- Improved compliance

Moreover, no thrombin is added to Vivostat® PRF. This is beneficial to the Co-Delivery system as thrombin activation has been shown to have a negative effect on cell survival.

The fibrin membrane found in Vivostat® PRF has, furthermore, been shown to postpone the release process of the substance. This means that the fibrin membrane ensures a slow and sustained release of the substance offering a prolonged effect[2].

How does it work

It is possible to co-deliver more than 5 ml of substance together with the Vivostat® PRF solution. The substance is applied using one of the different Vivostat® Co-Delivery application devices, which enable the surgeon to apply the substance accurately and intermittently throughout the entire procedure.

The substance and the Vivostat® PRF solution is mixed as it leaves the tip of the application device and polymerises immediately upon application - this way the substance stays where it is intended to act.

1) Use of autologous bone marrow cells concentrate enriched with platelet-rich fibrin on cortico-cancellous bone allograft for posterolateral multilevel cervical fusion Vadalà et al. · Journal of Tissue Engineering and Regenerative Medicine 2008; 2: 515–520.

2) Intrapleural topical application of cisplatin with the surgical carrier Vivostat increases the local drug concentration in an immune-competent rat model with malignant pleuromesothelioma · Lardinois et al. · Journal of Thoracic and Cardiovascular Surgery.2006;131:697-703

Vivostat® PRF

Platelets play an active role in immunity

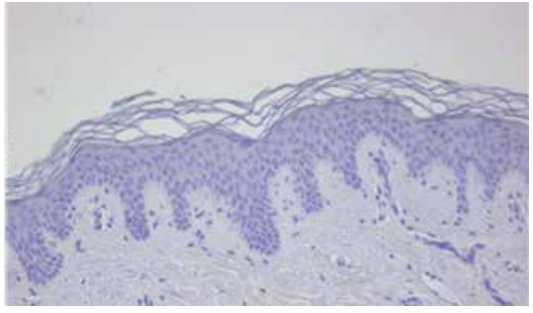
Adaptive Immunity

Activated platelets are able to participate in adaptive immunity, interacting with antibodies.

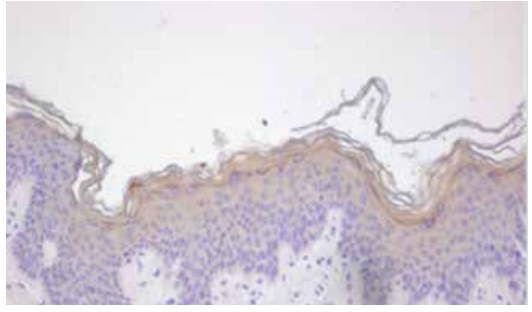
When activated and bound to IgG opsonized bacteria, the platelets subsequently release reactive oxygen species, antimicrobial peptides, defensins, kinocidins and proteases, killing the bacteria directly

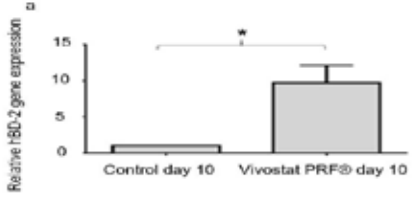
Vivostat® PRF induce the antimicrobial peptide human beta-defensin-2 in primary keratinocytes

Control day 0

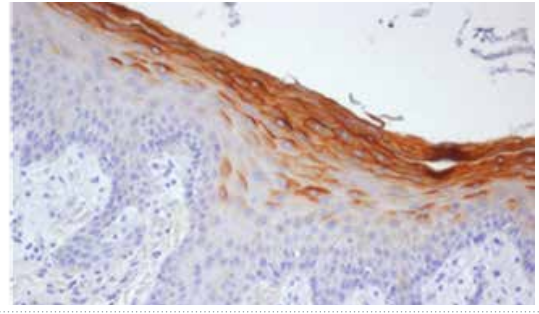


Control day 10





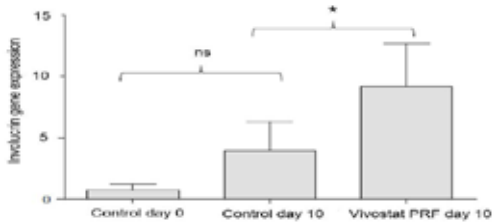
Vivostat® PRF day 10



1) Platelet-released growth factors induce the antimicrobial peptide human beta-defensin-2 in primary keratinocytes · Bayer A. et al. · Experimental Dermatology 2016; 25: 460-465
2) Platelet-released growth factors induce psoriasin in keratinocytes: Implications for the cutaneous barrier. Bayer A. et al. · Annals of Anatomy 2017; 25-32

Vivostat® PRF stimulates regeneration of tissue

Influence of Vivostat® PRF on differentiation of human keratinocytes



- Involucrin is a protein component of human skin
- Involucrin is a highly reactive, soluble, transglutaminase substrate protein present in keratinocytes of epidermis. It first appears in the cell cytosol, but ultimately becomes cross-linked to membrane proteins by transglutaminase
- Involucrin is cross linked by the transglutaminase enzyme that makes it highly stable. Thus it provides structural support to the cell, thereby allowing the cell to resist invasion by micro-organisms

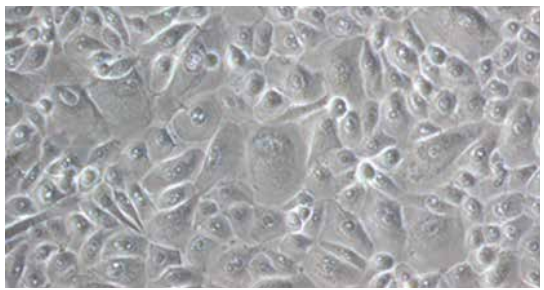
Vivostat PRF®:

- induces antimicrobial peptides in human keratinocytes in vitro and artificially generated human skin wounds in vivo
- causes differentiation of human keratinocytes
- causes proliferation of human fibroblasts

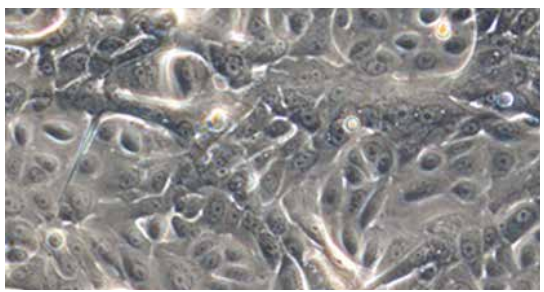
Angiogenesis

Tissue regeneration

Killing of wound bacteria



Control



Vivostat PRF® stimulated

3) Platelet-released growth factors induce differentiation of primary keratinocytes · Bayer A. et al. · Mediators of Inflammation 2017
4) The antimicrobial peptide human beta-defensin-3 is induced by platelet-released growth factors in primary keratinocytes. Bayer A. et al. · Mediators of Inflammation 2017

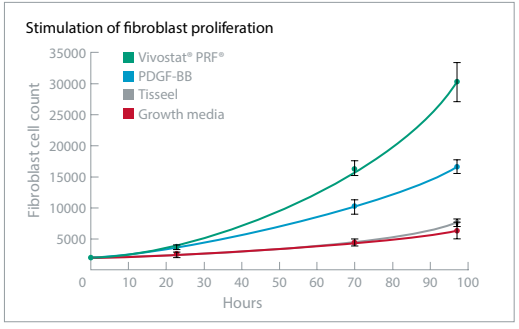
Vivostat® PRF

The ideal combination of platelets and fibrin

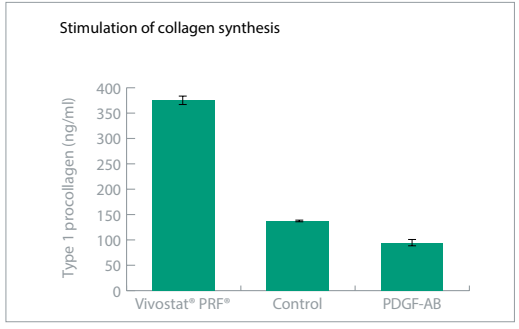
Clinical studies have demonstrated the beneficial effect of combining a platelet concentrate with a high concentration of fibrin[1]

Vivostat® PRF provides a unique combination of platelets and fibrin. The fibrin polymers serve as a scaffold for cell migration and provides structure during tissue regeneration. Platelets in the PRF matrix contain a large variety of growth factors among others TGF-β, PDGF-AB, PDGF-BB, FGF-2 and VEGF[2]. These growth factors serve different purposes in the complex process of tissue regeneration, and their presence in volume and variety is thus key to successful tissue repair.

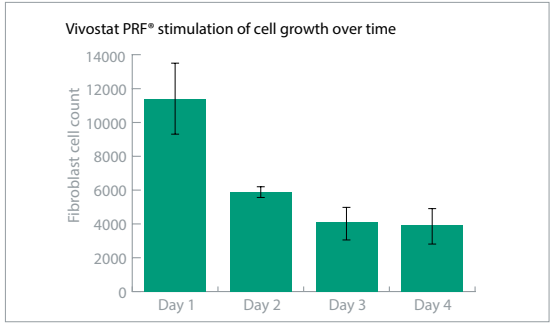
Several in-vitro investigations confirm the unique characteristics of Vivostat® PRF and its ability to stimulate cell growth.

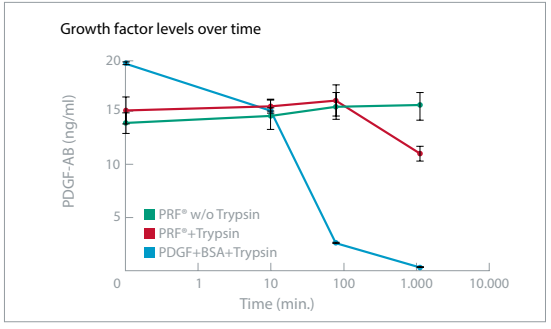


Stimulation of fibroblast proliferation[3]
As illustrated, Vivostat® PRF increases the growth of normal human skin fibroblasts compared to control and performs significantly better than PDGF-BB (commercial growth factor)[4].



Stimulation of fibroblast collagen synthesis[3]
Vivostat® PRF contains multiple growth factors, which in in-vitro studies have illustrated the positive effect of on the ability of fibroblasts to synthesise collagen.





Release of growth factors over time[6]
Following application of the Vivostat® PRF solution, the fibrin matrix will naturally be broken down by fibrinolytic processes (fibrinolysis), and during this process the growth factors contained in the platelets are gradually released to the site of treatment[7].

Protection against proteolytic degradation[3]
The autologous fibrin matrix in Vivostat® PRF has shown to protect endogenous growth factors against proteolytic degradation and thereby preserve their biological activity.

1) Basic Studies on the Clinical Applications of Platelet-Rich Plasma · Yazawa M, Ogata H, Nakajima T, Mori T, Watanabe N, Handa M · Cell Transplantation 2003; 12: 509–518

2) Growth factor and proteinase profile of Vivostat platelet-rich fibrin linked to tissue repair · Ågren M. et al. · Vox Sanguinis 2013; 107(1), 37-43

3) Bioactivity and stability of endogenous fibrogenic factors in platelet-rich fibrin · Lundquist R. et al. · Wound Repair and Regeneration 2008; 16(3): 356-63

4) Fibroblast proliferation, measured by ViaLight Plus (Cambrex), shows exponential growth over a 96-hour treatment period. Data are presented as mean ± SEM (n = 8). The recombinant human PDGF-BB (Sigma-Aldrich) was used at 10 ng/ml.

5) Synthesis of collagen by confluent and quiescent normal human dermal fibroblasts over a 24-hour treatment period. Data are presented as mean ± SEM (n = 6). Recombinant human PDGF-AB (Chemicon) was used at 10 ng/ml.

6) Vivostat Technical Report No. 1005 · Data on file at Vivostat A/S.

7) PRF® clots were incubated in culture medium at 37°C for the indicated time periods and then assessed for proliferative bioactivity using the ViaLight Plus method.

Vivostat® PRF is used in various surgical procedures

Vivostat® PRF can be used intermittently in lengthy surgeries - 8 hrs at room temperature after preparation

Vivostat® PRF can be prepared and used intermittently throughout a lengthy operation without loss of properties and effectiveness. Studies have shown that storage of Vivostat® PRF for 8 hours at room temperature after preparation has no significant effect on the advanced physical properties of the derived sealant.

- Abdominal Surgery
- Burn Surgery
- Cardiac Surgery
- ENT Surgery
- Fistula Surgery
- Maxillofacial
- Neurosurgery
- Orthopaedic Surgery
- Spine Surgery
- Wound Treatment

Vivostat® PRF

Did you know that Vivostat® PRF is used…?

- In the treatment of CSF leak with Co-Delivery of antibiotics
- In transsphenoidal surgery for dural sealing, bone closure and sinus/nasal cavity healing
- To cover the drive line in LVADs implantations
- In the treatment of local infection in patients with LVADs with Co-Delivery of antibiotics
- In the treatment of deep sternal wounds and fistulas with Co-Delivery of antibiotics
- In the treatment of broncho pleural fistulas
- In pancreatic resections for postoperative pancreatic fistula formation prevention
- In radical prostatectomy for better nerve preservation and prevention of seroma formation
- In the treatment of infected non-healing chronic wounds with Co-Delivery of antibiotics

Vivostat® PRF

Vivostat® offers a full portfolio of autologous sealants

Vivostat® Fibrin

Vivostat® Fibrin Sealant- a sealant for various surgical procedures with excellent sealing, gluing and haemostatic properties with immediate polymerisation, high elasticity and strong adhesive capabilities.

Vivostat® PRF

Vivostat® PRF- a sealant with high concentration of non-activated platelets with advanced sealing, healing and regenerative properties. Combining a fibrin sealant and a platelet concentrate generates a carrier and controlled release of growth factors.

Obsidian® ASG

Obsidian® ASG - an autologous, bioactive platelet rich sealant for anastomotic reinforcement and protection following gastrointestinal resection surgery. Obsidian® ASG is designed to effectively seal and heal anastomoses and is associated with a low rate of anastomotic leaks.

Vivostat® Co-Delivery

The Vivostat® Co-Delivery System enables surgeons to co-apply a substance such as medications and different kind of cells together with the choice of autologous Vivostat® product. The benefits include topical application targeting affected areas specifically, slow release of the substance over days, improved compliance, possible higher local dose and lower systemic impact.

ArthroZheal®

ArthroZheal®- a platelet rich fibrin sealant for arthroscopic surgery with bioactive and biocompatible properties offering synergistic effects for sealing, healing and regeneration of ligaments, tendons and cartilage. ArthroZheal® can be co-applied with stem cells, BMAC, chondrocytes or antibiotics by using the Vivostat® Co-Delivery System.

Obsidian® RFT

Obsidian® RFT - an autologous, bioactive platelet rich sealant for treatment of fistulas providing a sphincter-sparing minimally invasive procedure. Obsidian® RFT is designed to close and heal fistulas and can be co-delivered with antibiotics embedded in Obsidian® RFT.

For more information please visit **www.vivostat.com**

Vivostat® PRF

Product and order information

Vivostat® Fibrin Sets

(Preparation Kit and Application Kit)

Code	Product Description
VS 302	Fibrin Set
VS 312	Fibrin Set- Concorde
VS 322	Fibrin Set- Co-Delivery
VS 323	Fibrin Set- Endoscopic

Vivostat® PRF Sets

(Preparation Kit and Application Kit)

Code	Product Description
VS 400	PRF Set
VS 410	PRF Set- Concorde
VS 420	PRF Set- Endoscopic
VS 422	PRF Set- Co-Delivery

Application Kits

(Including all necessary components for Application)

Code	Product Description
VS 305	Spraypen® Kit
VS 315	Spraypen® Kit- Concorde
VS 325	Endoscopic Kit
VS 335	Spraypen® Kit- Co-Delivery
VS 345	Endoscopic Kit- Straight
VS 355	Endoscopic Kit- Co-Delivery

Preparation Kits

(Including all necessary components for Preparation)

Code	Product Description
VS 306	Fibrin Preparation Kit
VS 406	PRF Preparation Kit

Durables

Code	Product Description
APL 400	Applicator Unit
APL 404	Applicator Unit Co-Delivery
PRO 800	Processor Unit
VS 220	Endoscopic Applicator Handle
VS 222	Foot Switch

Other

Code	Product Description
VS 510	Vivostat Split Kit

Vivostat®
PRF

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