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REVIEW ARTICLE

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Instructions for the use of L-PRF in different clinical indications

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Abstract

Autologous platelet concentrates (APCs) have demonstrated clear benefits across various clinical applications, including alveolar ridge preservation, guided tissue regeneration, guided bone regeneration, sinus floor elevation (both lateral window approach and transcrestal technique), endodontic surgery, the treatment of medication-related osteonecrosis of the jaw bones, and periodontal plastic surgery. To ensure an optimal clinical outcome, clinicians must adhere strictly to the protocol to prepare the APCs and, especially follow evidence-based surgical guidelines, often simple but crucial, to minimize the likelihood of errors. The majority of clinical trials reported on second-generation APCs [the leukocyte- and platelet-rich fibrin (L-PRF) family, including its modifications (A-PRF, A-PRF+, CGF, T-PRF, H-PRF, etc.)]. These second-generation APCs offer additional benefits compared to the first-generation APCs, making them the preferred choice for the development of clinical recommendations. These recommendations have been formulated through a meticulous examination of the available clinical data and the clinical experience of the authors of this paper.

KEYWORDS

alveolar ridge preservation, autologous platelet concentrates, flowcharts, guided bone regeneration, guided tissue regeneration, intra-bony defects, medication-related osteonecrosis of the jaw bones, plastic periodontal surgery, sinus floor elevation (lateral window technique, transcrestal technique)

1 | INTRODUCTION

Autologous platelet concentrates (APCs) including platelet-rich plasma, plasma rich in growth factors, as well as the L-PRF family (including A-PRF, A-PRF+, CGF, T-PRF, H-PRF, …) have the potential to enhance/facilitate soft- and hard tissue regeneration. Their plethora in capacities, including a controlled release of growth factors, a fibrous structure conductive to cell-attachment, an enhanced angiogenesis, an antibacterial and analgesic activity, the promotion of stem cell differentiation towards osteoblasts, and anti-inflammatory activity are explained in four basic science review papers.[1–4]

The number of studies reporting beneficial effects of APCs in various periodontal applications has increased significantly over the past two decades. This trend is evident in several papers featured in this special issue on APCs, which cover: alveolar ridge preservation,[5] 1 and 2-stage sinus floor elevation,[6] horizontal and vertical bone regeneration,[7] recession coverage,[8] regeneration of intra-bony defects around teeth,[9] the regeneration furcation defects,[10] third molar extractions,[11] implant osseointegration.[12] APCs also have their adjunctive benefit in the treatment of medication-related osteonecrosis of the jaw,[13] and endo surgery.[14] Even in the treatment of non-healing chronic wounds such as a diabetic foot, a venous leg ulcer, a Leprosy wound APCs have shown to enhance significantly the soft tissue regeneration.[15,16] However, these papers also identified a significant heterogeneity in preparation protocols and surgical techniques presenting different levels of clinical efficacy.

Hauser and co-workers (2013), for instance, demonstrated that the positive impact of an L-PRF application on alveolar ridge preservation diminishes when a flap is prepared for primary wound closure.[17] In another study, Castro and co-workers (2021)[18] reported that the reduction of alveolar ridge resorption was significantly less pronounced when treating multiple neighboring sockets simultaneously or when a removable denture was in contact with the healing socket. Furthermore, the final benefit was influenced by the number of L-PRF membranes/plugs and their condensation within the socket.[18] Finally, the necessity of a barrier membrane and its combination with a bone substitute were found to be dependent on the presence and extent of a bony dehiscence.[5]

In sinus floor elevation, the number of L-PRF membranes/plugs also plays a crucial role with a rule of thumb that per millimeter of bone gain at least one L-PRF membrane has to be used, irrespective of the approach (transcrestal or window). Moreover, during a lateral window approach, L-PRF membranes/plugs can only be used as single substrate in case of a 1-stage strategy, as implants are required as a kind of tent pols to counteract pneumatic forces in the sinus, preventing rapid resorption. In case of a wide sinus in the bucco-palatal direction, the single use of L-PRF membranes is not recommended due to potential sinus pneumatization leading to membrane collapse on the buccal and/or palatal site of the implant.[6]

For a lateral bone augmentation, the addition of a flowable PRF was found to enhance bone regeneration. However, it is crucial to mix the flowable PRF with the bone substitute within a short time after preparation (normally ≤30 min). This time can be extended by storing it in a cooler environment, keeping in mind that a long storage at low temperature might have a negative impact on platelet survival and function.[22] The necessity of a barrier membrane in this context is still debatable, since an L-PRF membrane seems to offer sufficient graft stability with less risk for a wound dehiscence.[7]

In recession coverage, L-PRF membranes can serve as an alternative to a connective tissue graft, albeit with slightly inferior aesthetic improvements. However, they often offer a significant reduction in postoperative pain, an aspect that is frequently overlooked. The number of L-PRF membranes (thickness of the graft) once again plays a significant role in achieving optimal results.[8]

For the regeneration of intra-bony defects around teeth or in furcation defects, various protocols have been tested with variable outcomes, making it challenging for a clinician to select the most optimal protocol.[9,10] Notably, in most applications, it was observed that the benefits with L-PRF clots were significantly inferior to those with L-PRF membranes.

The key determinant influencing the success of L-PRF in healing and regenerative therapy is the quality of its preparation. Numerous parameters must be carefully considered to achieve optimal quality matrices. These include the timing (between blood collection and centrifugation, between centrifugation and compression), blood tube selection, centrifugation protocol, centrifuge vibration, centrifugation temperature, conversion from clot into membrane, conservation of the membrane before use, etc.[19] A well-structured L-PRF clot, with its specific cellular content, matrix architecture, and growth factor release profile, cannot be generated if blood collection is slow (≤1 min between blood draw and centrifugation)[18,20] or if the centrifugation temperature is below 21°C.[21,22] In such cases, an inconsistent, crumbly mass of fibrin with unknown contents is likely to form.

The rotational speed and particularly the vibration of the centrifuge have a direct impact on the architecture and cell content of the L-PRF clot.[23] Therefore, a series of tips summarized by Quirynen and co-workers (2024) have to be taken into consideration.[19] Moreover, given the critical nature of forming a robust L-PRF clot, which is highly dependent on the inner surface of the blood tube, selecting the correct blood tubes is of utmost importance.[19] Finally, platelets and leukocytes are not equally distributed inside and on the surface of the L-PRF clot/membrane.[24] Therefore, when desiring growth factors, the platelet- and leukocyte-rich region adjacent to the red thrombus, should be used by placing the part of the membrane initially close to the thrombus closest to the grafting site. It is crucial never to cut this part away when collecting the clot from the tube.

All these examples and the recurrent conclusion in literature reviews, highlighting a lack of standardization, justify the need for clear and detailed clinical recommendations to ensure an optimal clinical outcome. This paper aims to propose such recommendations, promoting interventions with proven benefits, and the potential to reduce morbidity and improve patient's quality of life. Because the majority of clinical trials reported on second-generation APCs [leukocyte- and platelet-rich fibrin (L-PRF) family, including its modifications (A-PRF, A-PRF+, CGF, T-PRF, H-PRF, ...)], and because these second-generation APCs offer additional benefits compared to the first-generation APCs, they have been chosen for the development of these recommendations.[1–4]

2 | MATERIALS AND METHODS

These recommendations have been formulated based on comprehensive new literature reviews, published in this special Perio 2000 issue on APCs, conducted by groups of experts with extensive clinical experience in each respective application area (alveolar ridge preservation, third molar extraction, transcrestal, and 1- and 2-stage window sinus floor augmentation, lateral bone augmentation, regeneration of intra-bony defects, recession coverage).[5–11] Each review meticulously summarized the available data in similar tables, presenting details on the treatment strategy (number and type of matrices, technique), clinical benefits, and Patient-Reported Outcome Measures (PROMs).

A similar approach was used for the formulation of technical guidelines on how to prepare L-PRF matrices, flowable PRF, and an L-PRF bone-block, considering the data from additional new literature reviews in this special issue on APCs.[1–4,19]

The authors utilized this information to create the clinical recommendations, which underwent further scrutiny and were approved by a panel of clinical experts.

2.1 | L-PRF clot, membrane, plug, exudate, liquid fibrinogen, L-PRF bone-block, sticky bone

To achieve the most favorable outcomes when using L-PRF, special attention must be given to its preparation. While the preparation process itself is not complex, a small deviation to the protocol can result in unfavorable clinical outcomes. Therefore, a step-by-step protocol has been created, for each L-PRF construct.

A. Preparation of L-PRF clots (Figure 1):

1. Collect four to eight (9–10 mL) tubes of blood, utilizing special tubes (glass tubes or plastic tubes coated on the inside with a silica layer) that promote coagulation, preferably use a 21G butterfly needle. Rotate the tubes immediately after blood draw to increase the contact between the inner tube surface and blood, speeding up the coagulation. *Special titanium tubes (T-PRF) can also be used.*
2. Place the first two tubes of blood immediately after collection in the centrifuge, opposite each other, to ensure centrifuge balance. Close the cover and start the centrifugation.
3. While the centrifuge is running, collect the third and fourth tubes of blood from the patient, stopping the centrifuge when the fourth tube is half-filled. Add the new tubes to the centrifuge promptly. Repeat this procedure for the remaining tubes. *The centrifuge is loaded incrementally, two tubes at a time, with centrifugation occurring between the collection of new tubes. If blood collection is very slow, load the centrifuge one at a time, using a different tube filled with the same volume of saline solution to maintain balance.*
4. Centrifuge at 408 g (relative centrifugal force) in the area where the L-PRF clot is generated (near the center of the tube) for at least 12 min after the last tubes are loaded in the centrifuge (this is the most frequently used L-PRF protocol). *The g force and centrifuge time differs between different L-PRF modifications (A-PRF, A-PRF+, CGF, H-PRF). Consider the influence of the radius of the centrifuge on the final g force, and ensure the centrifuge is on a stable table to prevent vibration (for more info see Quirynen and co-workers 2024).*[19]
5. If the patient takes anticoagulant medication, extend the centrifugation time to 18–20 min (*counting from the last tube that is loaded in the centrifuge*).
6. After the required time has elapsed, remove the L-PRF (fibrin) clots from the tubes and carefully separate them from the red blood cells. Do not cut the face portion away; this is the most biologically active part.

B. Creation of L-PRF membranes (Figure 1):

1. Place the L-PRF clots in a compression box (e.g., Xpression™ *Intra-Lock*, *Boca Raton*, *FL*, *USA*) for gentle compression by gravity using the light metal plate and cover.
2. Five minutes later, the L-PRF membranes are ready for use.
3. The viability of L-PRF membranes lasts at least 3 h, as long as they remain covered in the compression box, preventing them from drying out.

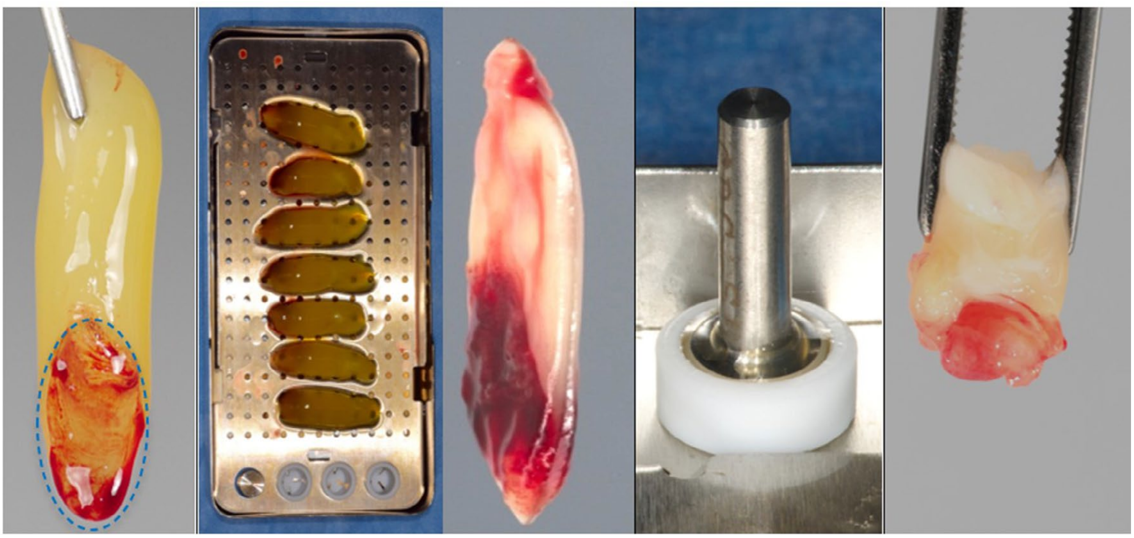

FIGURE 1 Images of L-PRF clot/membrane/plug. After centrifugation, the L-PRF clots can be collected from the blood tube with tweezers, and the adhering red blood cells must be removed. Since most platelets and leukocytes are concentrated just underneath the red blood cells (in the area indicated by the dotted blue line), this step has to be performed very gently. After compression (compression box) strong L-PRF membranes are generated (one membrane can carry a weight up to 500 g). A cylinder and piston (in the compression kit) can be used to make cylindrical L-PRF plugs, suitable for filling extraction sockets or bone cavities. The fluid leaking out of the clots into the lower part of the box during compression is called the exudate.

C. Preparation of liquid fibrinogen and L-PRF bone-block for lateral bone augmentation (Figure 2).

1. Collect eight (9–10 mL) tubes of blood following the standard protocol: six special blood tubes (that promote coagulation) and two plastic non-coated tubes, the latter is drawn last and is added to the other tubes in the centrifuge as last (following the same centrifugation procedure, 408 *g*, as described in the previous protocol).
2. Once all tubes are placed in the centrifuge, run it for 3 min, then interrupt the centrifugation and remove both plastic non-coated tubes.
3. Immediately restart the centrifuge with the six remaining tubes and run for an additional 9 min.
4. Aspirate as soon as possible the yellow fluid (=liquid fibrinogen) from the two plastic non-coated tubes with a plastic syringe, getting as close as possible to the red blood cells without aspirating them. Keep the liquid in the plastic syringe.
5. After full centrifugation of the remaining six tubes, take out the L-PRF clots and gently compress them into membranes (using the previous protocol).
6. Chop two membranes into very small pieces (±2–3 mm).
7. Combine the chopped membranes and bone substitute in a small dish in a ratio of two membranes to 0.5 g biomaterial (corresponding to a volume of roughly 50/50), ensuring to obtain a homogenous mixture.
8. Spray the liquid fibrinogen abundantly over the mixture and stir gently for approximately 15 seconds to bring the liquid fibrinogen in contact with the entire mixture. The fibrinogen will immediately start to clot into a 3D fibrin network, which will trap the biomaterial to form the L-PRF bone-block. *Even though the liquid fibrinogen is sitting in a plastic syringe, it will begin to spontaneously coagulate after about 30 min (timing is critical).*
9. The mixture can be shaped into the desired form in approximately 1 min, after which it will hold its shape.

D. Preparation of sticky bone.

The preparation of "sticky bone" is quite similar, with the exception that chopped L-PRF membranes are not added to the mixture. *Liquid fibrinogen can be replaced by i-PRF or C-PRF or flowable first-generation APCs (for more info see Quirynen and co-workers 2024).*[19] The clinical efficacy of an L-PRF bone-block or sticky bone, as well as how and when to use them, are highlighted in several chapters.[5–7,9]

In order to further clarify the preparation of L-PRF matrices or an L-PRF bone-block you can use this QR code which will bring you to a webpage from Marc Quirynen with short videos summarizing the procedure. You can also use this URL: https://www.l-prf4all.com/lprfperio2000additionalvideos

SCAN ME

2.2 | Alveolar ridge preservation

The treatment strategy depends on the presence and size of a bony dehiscence (mostly located at the buccal site). Based on the available literature following protocols are recommended. For more details on the clinical benefits see Siawasch et al. 2024.[5] Each of the protocols below is supported by clinical trials, but a rule of thumb for when to move from one strategy to another is not yet evidence based.[5]

A. Flow chart for an alveolar ridge preservation in case of a nearly intact extraction sockets (L-PRF only, Figure 3):

1. Extract the tooth as a-traumatically as possible with maximal preservation of alveolar bone (consider root separation in case of a multi-rooted tooth).
2. Do not reflect a flap and do not make releasing incisions; this reduces the blood supply and, as such, jeopardizes the outcome.

FIGURE 2 L-PRF bone-blocks have the physical characteristics of gummy bears (candy), exhibiting intrinsic form memory.

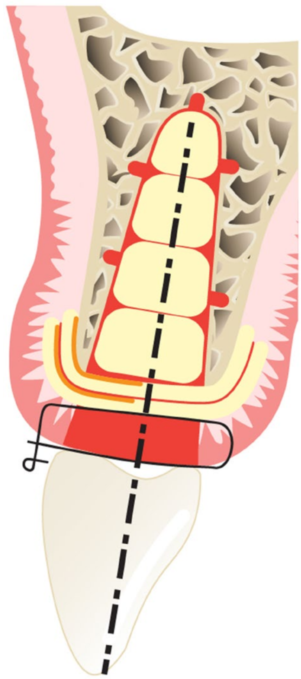

FIGURE 3 Alveolar ridge preservation with L-PRF for a nearly intact extraction socket. Several L-PRF plugs are tightly packed (good condensation) throughout the entire area. The entrance to the socket is sealed with two L-PRF membranes. Place the face portion (in orange, i.e., the area with the highest concentration of platelets and white blood cells) towards the socket. L-PRF membranes are slid under the periosteum over the bony socket borders (in the envelope created between the periosteum and bony borders, covering 3–5 mm of bone). Suturing is completed without any attempt to close the wound; its only purpose is to keep the L-PRF in the socket (healing by secondary intention). Small perforations can be created in the bony socket walls to improve the vascularization, and as such optimize the healing/bone formation. Figure adapted from Quirynen & Pinto (2022).[25]

3. Make an effort to preserve the papillae (in case of very small and thin papillae, it is advisable to remove the mesial and distal portions of the tooth crown and cervical root 2 weeks before surgery in order to give the papillae space to increase in thickness and width).
4. De-epithelialize the gingival borders along the socket (removing the pocket epithelium, a so-called inner flap treatment).
5. Thoroughly remove all granulation tissue (the use of a degranulation bur is highly recommended).
6. Prepare an envelope (about 3–5 mm in width) between the bony borders of the socket and the overlying periosteum and soft tissues (not including the papillae) so that the L-PRF membranes, used to cover the socket, can be inserted (step 10).
7. Prepare small perforations in the socket wall in case of poor vascularization.
8. Use L-PRF exudate obtained from the compression of the L-PRF clots, aspirated in a sterile syringe, to rinse and clean the socket.
9. Insert ≥3–5 L-PRF plugs or membranes in the extraction socket (one by one), compressing firmly (optimal condensation is essential) with a graft condenser (similar to an amalgam condenser), and absorb surplus exudate with a gauze. If a blood clot has already formed, remove it before applying L-PRF.
10. Cover the socket with a double layer of L-PRF membranes by sliding their margins between soft and hard tissues (i.e., into the envelope created earlier, step 6, and slightly under the papillae) to seal the socket entrance to prevent epithelium and/or connective tissue growth underneath the membranes instead of over the membranes.
11. Suture the gingival margins with, for example, a modified internal mattress or external mattress technique without applying traction, not with the goal of achieving primary closure but only to keep the membranes in place (healing by secondary intention).
12. The sutures have to be placed over, and supported by, the alveolar bone in order to avoid pulling on the soft tissues and/or creating pressure on the L-PRF graft.

To avoid interfering with the early soft tissue healing, the use of chlorhexidine might be delayed until day 3–5. Since only autologous products are used, and considering the antibacterial properties of L-PRF, antibiotics are in fact not needed.

B. Flow chart for an alveolar ridge preservation in case of a major bony dehiscence (L-PRF only, Figure 4):

The procedure is similar as for alveolar ridge preservation in case of a quasi-intact extraction socket, but following specific modifications have to be considered:

- Extend the envelope (between bone and periosteum) up to ≥5 mm around the bony dehiscence.
- Slide a double layer of L-PRF membranes (eventually attached to each other via absorbable sutures) in the extended envelope over the bony dehiscence, extending at least 3–5 mm over its bony borders. You can use a suture to guide these membranes in the correct position; the face portion of the inner membrane should be oriented towards the bony dehiscence!
- Seal the entrance to the socket with the remainder of the previously applied double layer of L-PRF membranes; slide their margins between soft and hard tissues (i.e., into the envelope at the palatal or vestibular site, depending on where the dehiscence is), forcing the epithelium and connective tissue to grow over, instead of underneath, the membranes.
- Because of the bony dehiscence, ensure the sutures in that area are placed over, and supported by, the alveolar bone in order to avoid pulling on the soft tissues and/or creating pressure on the L-PRF graft.

C. Flow chart for an alveolar ridge preservation in case of a major bony dehiscence applying a L-PRF bone-block (Figure 5)

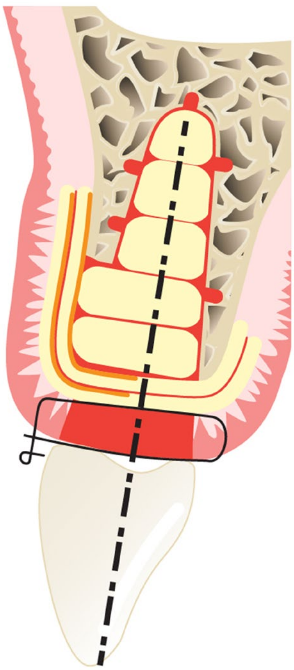

FIGURE 4 Alveolar ridge preservation with L-PRF for a socket with bony dehiscence. The bone dehiscence is covered by a double layer of L-PRF membranes (extending 5 mm beyond the bony borders of the dehiscence). The face portion of the inner L-PRF membrane is facing the bone dehiscence. L-PRF plugs are tightly packed throughout the entire area, including the bony dehiscence. The entrance to the socket is also sealed with the above-mentioned double layer of L-PRF membranes. Suturing is completed without any attempt to close the wound, its only purpose is to keep the L-PRF in the socket (healing by secondary intention). Deeper sutures should not run over the bony dehiscence because it might push the L-PRF out of the socket; sutures must be supported by bone. Small perforations can be created in the bony socket walls to improve the vascularization, and as such optimize the healing/bone formation. Figure adapted from Quirynen & Pinto (2022).[25]

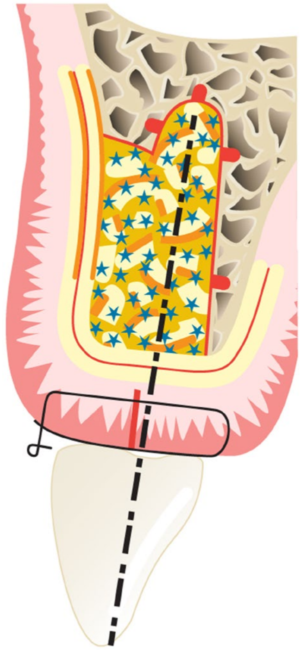

FIGURE 5 Alveolar ridge preservation using a bone substitute in combination with L-PRF. A double layer L-PRF membranes covers the bony dehiscence (extending 5 mm beyond the bony borders of the dehiscence). The inner L-PRF membrane is positioned with the face portion towards the bony dehiscence. The entire space is densely packed with the L-PRF bone-block (a combination of a bone substitute (blue stars), liquid fibrinogen (orange), and small pieces of L-PRF membrane). The entrance to the socket is also sealed with the above-mentioned double layer of L-PRF membranes. Suturing can be done without any attempt to close the wound, its only purpose is to keep the graft in the socket (healing by secondary intention), or one can opt for healing by primary intention (safer). Deeper sutures should not run over the bony dehiscence because it might push the graft out of the socket; sutures must be supported by bone. Small perforations can be created in the bony socket walls to improve the vascularization, and as such optimize the healing/bone formation. Figure adapted from Quirynen & Pinto (2022).[25]

The procedure is similar as for alveolar ridge preservation in case of a major bony dehiscence, but the following specific modifications have to be considered:

- Place the L-PRF bone-block (a combination of bone substitute, liquid fibrinogen, and small pieces of chopped L-PRF membranes) in the extraction socket, compress firmly, and dab away any extra exudate with a gauze. If a blood clot has already formed, remove it before inserting the graft.
- One may opt for primary wound closure or for a healing by secondary intention (suturing without traction, just to hold the membranes in place).

To avoid interfering with the early soft tissue healing, the use of chlorhexidine might be delayed until day 3–5. Because of the bone substitute, the use of antibiotics is recommended.

2.3 | Sinus floor augmentation

When a sinus floor elevation is required to increase the residual bone height, one can either use a transcrestal approach (Summer technique) or a lateral window approach. APCs, and especially L-PRF can be used as filling material, the latter because of its better physical characteristics. Based on the available literature following protocols are recommended. For more details on the clinical benefits as well as a decision tree on when to use the different techniques are highlighted in the paper by Valentini and co-workers (2024).[6]

A. Flow chart for a transcrestal sinus floor augmentation with L-PRF membranes as sole filling material (Figure 6):

1. Make a crestal incision and, if necessary to gain access, small releasing incisions.

2. Reflect a full-thickness flap to uncover the crestal bone.
3. Prepare the osteotomy up to 1 mm distance from the Schneiderian membrane (different techniques can be used, including the use of piezo instruments).
4. Place one L-PRF membrane in the osteotomy to serve as a cushion when fracturing the last mm of the bony floor of the sinus (step 5).
5. Carefully fracture the remaining floor of the sinus with an osteotome. Be aware that there are several options for removing the final part of the bony floor of the sinus (e.g., osseo-densifying burs, piezo instruments).
6. Elevate the Schneiderian membrane by carefully inserting several L-PRF membranes (one at the time) into the sinus through the osteotomy, tapping carefully with osteotomes.
7. Ensure that at least three to five L-PRF membranes are placed (per osteotomy) in the sinus, assuming that each membrane will finally lift the sinus mucosa by about 1 mm.
8. Insert implant(s).
9. Suture to achieve primary closure. *One can eventually apply one L-PRF membrane over the alveolar bone and implant, underneath the incision to speed up the soft-tissue healing.*
10. Depending on the initial implant stability, the abutment can either be connected immediately or after a few months of healing.

Give the patient instructions to refrain from blowing their nose for 1 week as well as from flying, diving, forceful sneezing, or playing wind instruments for at least 6 weeks. Prescribe painkillers and a nose spray, eventually corticosteroids (the latter for e.g., 3 days, to prevent swelling of the Schneiderian membrane). Since besides the dental implant only autologous products are employed, and considering the antibacterial qualities of L-PRF, antibiotics are not always required.

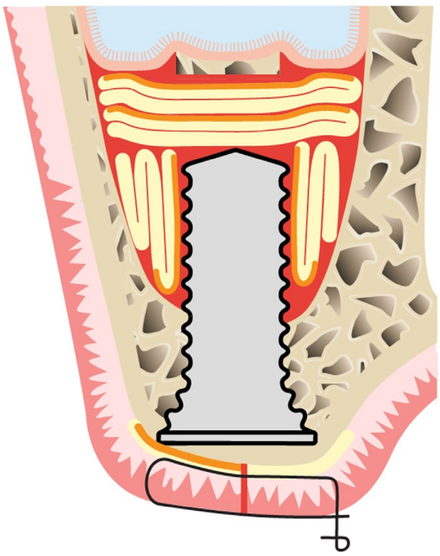

FIGURE 6 Final situation after a transcrestal (trans-alveolar) approach for sinus augmentation using L-PRF as the only grafting material. A small part of the floor of the sinus and several L-PRF membranes separate the Schneiderian membrane from the apex of the implant. Several membranes fill the space around the implant and the exposed inner bony walls of the sinus. In total, three to five membranes are required for a single implant in order to gain 3–4 mm of bone height. Figure adapted from Quirynen & Pinto (2022).[25]

B. Flow chart for a 1-stage sinus floor augmentation (window-technique) with L-PRF as the sole filling material (Figure 7):

1. Make a crestal incision and, to gain access, and small releasing incisions.
2. Reflect a full-thickness mucoperiosteal flap adequately apically and distally to have a clear view on the surgical area.
3. Prepare a lateral window with piezoelectric or ultrasonic instruments (or with a diamond round burr). Check for possible arteries in the lateral sinus wall using the CBCT images.
4. Meticulously elevate the Schneiderian membrane.
5. If possible, the bony window should ideally be pushed inside to serve as a new bony floor of the sinus (prevent sharp edges that could lead to membrane tears).
6. Once the membrane is elevated, the implant osteotomy site can be prepared.
7. Before or after the preparation of the osteotomy, but before implant placement, apply L-PRF membranes on the Schneiderian membrane and bony window to patch and heal any potential sinus membrane tears, which may or may not be visible. Make sure the Schneiderian membrane is covered with at least two layers of double-folded L-PRF membranes where the apices of the upcoming implants will be placed.
8. In case of insufficient blood supply, extra perforations of the sinus walls can be considered.
9. Put several membranes against the palatal/mesial walls of the uncovered sinus.
10. Insert implant(s). Rotating the implant(s) will further distribute the membranes and create additional space.
11. Add more L-PRF membranes in the newly created space and buccally (in the window).
12. Seal the window with at least a double-folded L-PRF membrane with the face portion facing the sinus.
13. Close the flap without moving the latter L-PRF membranes.
14. Suture to achieve primary closure. *One can eventually apply* one *L-PRF membrane over the alveolar bone and implant, underneath the incision to speed up the soft-tissue healing.*
15. After 4–6 months of healing, the abutment(s) can be placed and loaded if the implant(s) is/are well integrated.

Give the patient instructions to refrain from blowing their nose for 1 week as well as from flying, diving, forceful sneezing, or playing wind instruments for at least 6 weeks. Prescribe painkillers and a nose spray, eventually corticosteroids (the latter for e.g., 3 days, to prevent swelling of the Schneiderian membrane). Since, besides the dental implant, only autologous products are used, and

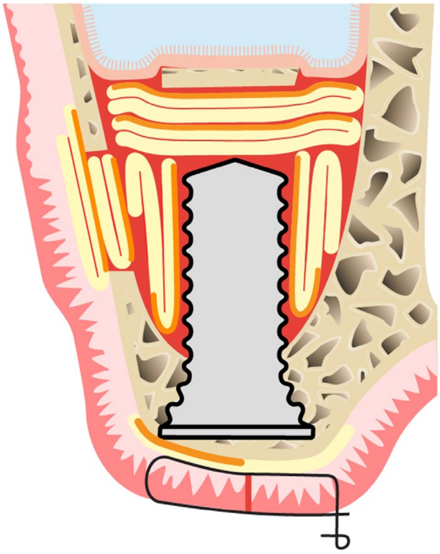

FIGURE 7 Final situation after a lateral window approach for sinus augmentation with immediate implant placement using L-PRF as the only grafting material. Two double-folded L-PRF membranes, with their face portions facing the sinus, are used to cover the Schneiderian membrane and the bony window. The entire space between the implant and bony walls, as well as the window, is filled with L-PRF membranes. The entrance to the sinus is sealed with another L-PRF membrane (face portion towards the sinus). Perforations in the alveolar bone (eventually trough and trough) can increase the blood supply to the sinus and as such optimize the healing/bone formation in the sinus. Figure adapted from Quirynen & Pinto (2022).[25]

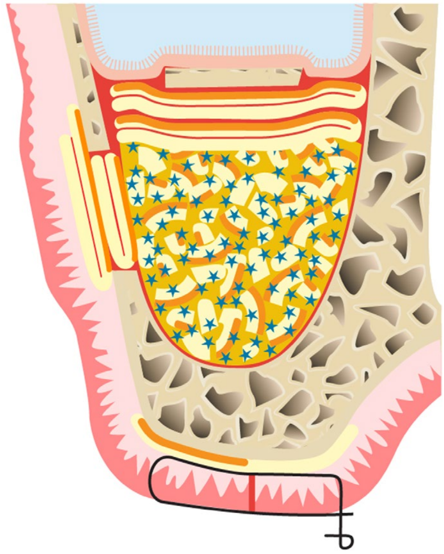

FIGURE 8 Final situation after a sinus augmentation via a lateral window approach with an L-PRF bone-block for a two-stage procedure. The Schneiderian membrane (and bony window) is covered with two double-folded L-PRF membranes (face portion towards sinus). The entire created space in the sinus is densely packed with pieces of a L-PRF bone-block (a combination of bone substitute (blue stars), liquid fibrinogen (orange), and small pieces of L-PRF membrane). The window is filled and sealed with a double-folded L-PRF membrane. Perforations in the alveolar bone (eventually made through and through) can increase the blood supply to the graft, and as such optimize the healing/bone formation in the sinus. Figure adapted from Quirynen & Pinto (2022).[25]

considering the antibacterial qualities of L-PRF, antibiotics are not always required.

C. Flow chart for a two-stage sinus floor augmentation (window-technique) using L-PRF and a bone substitute (Figure 8):

1. Make a crestal incision (and 1 or 2 releasing incisions).
2. Reflect a full-thickness mucoperiosteal flap adequately apically and distally to have a clear view on the surgical area.
3. Prepare a lateral window with piezoelectric or ultrasonic instruments (or with a diamond round bur). Check for possible arteries in the lateral sinus wall using the CBCT images.
4. Meticulously elevate the Schneiderian membrane.
5. If possible, the bony window should ideally be pushed inside to serve as a new bony floor of the sinus (prevent sharp edges that might lead to membrane tears).
6. In case of insufficient blood supply, extra perforations of the sinus walls can be considered.
7. Cover the Schneiderian membrane and bony window with two double-folded L-PRF membranes to patch and heal any potential sinus membrane tears (preferably not bigger than 5 mm in diameter), which may or may not be visible.
8. Apply the L-PRF bone-block (in pieces), making sure the space is well packed and paying special attention to the palatal and anterior areas.
9. Fill the window with an L-PRF membrane and cover the window with at least a double layer of L-PRF membranes (folded L-PRF membrane with face portion towards the sinus).
10. Close the flap without moving these L-PRF membranes (primary healing). *One can eventually apply one L-PRF membrane over the alveolar bone and implant, underneath the incision to improve soft-tissue healing.*
11. Suture to obtain primary closure.
12. After 4–6 months of healing, the implants can be inserted.

Give the patient instructions to refrain from blowing their nose for 1 week as well as from flying, diving, forceful sneezing, or playing wind instruments for at least 6 weeks. Prescribe painkillers and a nose spray, eventually corticosteroids (the latter for, e.g., 3 days, to prevent swelling of the Schneiderian membrane). Because of the use of a bone substitutes, systemic antibiotics may be considered.

3 | LATERAL BONE AUGMENTATION WITH AN L-PRF BONE-BLOCK

During a lateral bone augmentation, flowable APCs can be mixed with the bone substitute to speed up the bone regeneration, and to glue to bone particles in order to improve graft stability (sticky bone). When using the second-generation APCs, chopped pieces of L-PRF membranes can be used to create open areas in the graft which can easily be replaced by ingrowing bone. The clinical benefits of the protocol presented below are supported by some clinical trials (for details see Blanco et al. 2024).[7]

Flowchart for a lateral bone augmentation with an L-PRF bone-block (Figure 9):

1. Make crestal incision and minimal releasing incisions.
2. Reflect a full-thickness flap to reveal the bony defect, trying to avoid damage to the periosteum.
3. Remove remnants of periosteum and connective tissue from the native bone.
4. Prepare several small perforations in the native bone to improve the blood supply to the future graft and to ensure a good connection between the graft and native bone.
5. Fix a membrane apically at the buccal site, or at the lingual/palatal site, depending on the area where the augmentation is needed. Use a slow-absorbing (cross-linked) collagen membrane or a non-resorbable membrane for a non-contained defect (safer than the use of L-PRF membranes only). In case of a well-contained defect, "eventually" use L-PRF membranes only, preferably in a double layer.

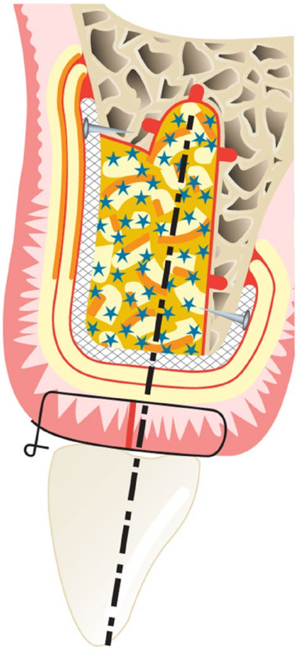

FIGURE 9 L-PRF bone-block for lateral bone augmentation. The L-PRF bone-block is well adapted to the native bone. The small perforations in the cortical bone guarantee optimal blood supply and a strong connection between graft and native bone. The slow-absorbing or non-absorbable membrane (in white) and membrane tacks provide extra stability to the graft. L-PRF membrane(s) protects the regenerate in case of a wound dehiscence. Primary closure will facilitate healing. So far it is not well understood whether and when a slow- or non-absorbable membrane is required. Figure adapted from Quirynen & Pinto (2022).[25]

6. Apply an L-PRF bone-block in the envelope between the deepest membrane and the recipient bone (with approximately 20% overfill to compensate for graft resorption).
7. Fix the membrane(s) at the palatal site or apically at the buccal site, ensuring an adequate graft stability.
8. If a collagen membrane (or non-resorbable membrane) has been used, cover it with L-PRF membranes to speed up soft tissue healing, and to facilitate wound closure in the event of a wound dehiscence.
9. Achieve a tension-free flap, making a periosteal incision when necessary to allow coronal advancement of the flap.
10. Suture with monofilament non-absorbable sutures using a combination of different suturing techniques. Healing by primary intention is strongly recommended.

Prescribe painkillers and systemic antibiotics (since a bone substitute is used), and ensure that there is no pressure on the wound. If a removable denture is placed, make sure it does not come into contact with the regenerating area. Instead, consider using an acid-etched crown or temporary small-diameter implants to support the denture. Sutures can be removed after 10 days. In case of a wound dehiscence, the L-PRF membranes (covering the graft and/or the absorbable membrane) will facilitate spontaneous wound closure within weeks. After 4–6 months of healing, the implant(s) can be placed.

4 | REGENERATION OF INTRA-BONY DEFECTS AROUND TEETH DURING OPEN FLAP DEBRIDEMENT

A large number of studies confirmed the adjunctive impact of applying APCs during an open flap debridement. Different approaches have been used, but the strategy below seems to be the best choice. The advantages of each technique are summarized by Miron and coworkers (2024).[9] The large variety of treatment strategies/protocols and the lack of comparative studies makes it virtually impossible to identify the most beneficial strategy.

Flow chart for the use of L-PRF during open flap debridement (Figure 10):

1. After completion of Step 1 and Step 2 of periodontal therapy (as defined by the EFP S-3 clinical guidelines), in areas where Step 3 therapy is indicated and in the presence of intra-bony defects, use a minimally invasive surgical technique (e.g., MIST or M-MIST) and avoid vertical releasing incisions.
2. Complete thorough root planing and removal of granulation tissue.
3. Rinse the defect with L-PRF exudate (collected at the bottom of the Xpression™ kit after compressing the clots).
4. Create some perforations in the bony defect in case of insufficient blood supply.
5. Apply chopped pieces of an L-PRF membrane in the intra-bony defect, preferably the face portion of the membrane.

6. Cover the bony defect with an L-PRF membrane extending 3–5 mm over the bony borders around the defect (inside the envelope between the surrounding bone and the periosteum) in order to seal the defect and to force the soft tissues to grow over, instead of underneath the membrane.
7. Suture the flap with a combination of modified vertical mattress sutures and single interrupted sutures in order to achieve primary closure of the interdental papillae in the absence of tension (5–0 or 6–0 monofilament non-absorbable sutures).

The patient should preferably be restricted to soft food intake, with no biting/chewing in the treated area, and no mechanical cleaning of the treated area for 1 week. The patient should rinse with 0.12% chlorhexidine twice a day for 1 min for at least 3 weeks. Prescribe painkillers.

5 | RECESSION COVERAGE USING L-PRF MEMBRANES DURING CORONALLY ADVANCED FLAP

L-PRF membranes improve the outcome of a coronally advanced flap (CAF) for recession coverage, and can be used as an alternative for a soft-tissue graft. For the latter, the clinical benefits are slightly inferior, but the significant reduction in post-operative pain is a major advantage. For more details on the clinical benefits see Barootchi and co-workers 2024.[8]

Flow chart for the use of L-PRF membranes only, during a CAF procedure (Figure 11):

1. Prepare two horizontal beveled incisions (±3 mm in length), mesial and distal to recession, at a distance from the tip of the anatomical papillae, equal to the depth of the recession plus 1 mm.
2. Prepare two beveled oblique, slightly divergent, incisions starting at the end of the two horizontal incisions and extending to the alveolar mucosa.
3. Elevate the resulting trapezoidal-shaped flap with a split-full-split approach in the coronal-apical direction. *Split thickness for the surgical papillae, full thickness for the soft tissue immediately apical to the root exposure, split-thickness for the vertical releasing incisions, and split thickness apical to the previously exposed bone.*[3]
4. De-epithelialize the papillae and complete optimal root planing *(eventually with root conditioning).*
5. Suture at least two and preferably three or four L-PRF membranes (with the correct dimension) together with absorbable 6-0 sutures.

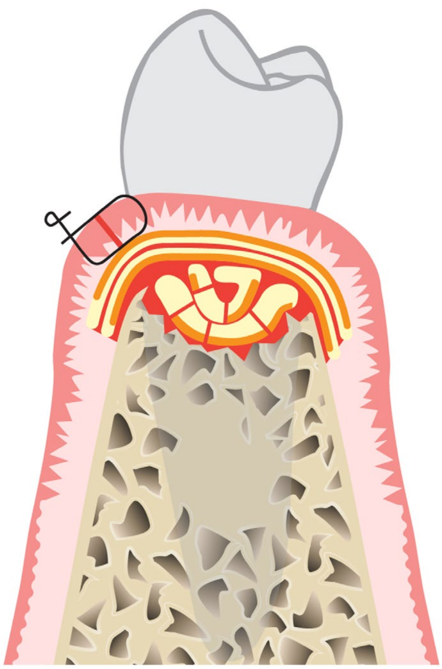

FIGURE 10 Final situation after the use of L-PRF for the regeneration of an intra-bony defect around a tooth. The intra-bony defect is filled with chopped L-PRF membrane parts (preferably the face portion) and covered with L-PRF membranes, with the face portion of the inner membrane oriented towards the bony defect. Care should be taken to ensure the membranes extend over the buccal and lingual bony borders. Primary closure should be obtained. (Several strategies have been proposed, but this protocol seems to be the most logical). Figure adapted from Quirynen & Pinto (2022).[25]

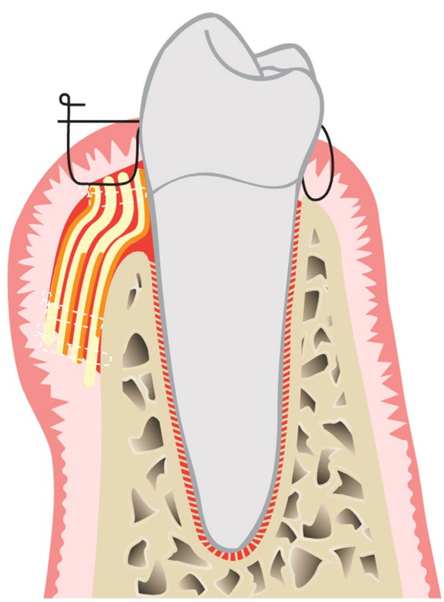

FIGURE 11 Final situation after gingival recession coverage with CAF and L-PRF membranes. Several (in this case 4) L-PRF membranes are placed on the receptor bed and over the recession (with the face portion of the deepest membrane oriented towards the exposed root). These membranes are sutured to the periosteum to increase graft stability. The flap is coronally advanced over the recession(s), and sutured in the new position. Figure adapted from Quirynen & Pinto.[25]

6. Place the L-PRF graft on the exposed connective tissue (receptor bed), over the recession(s) and the exposed bone, and suture it to the periosteum.
7. Suture with a coronally advancement of the flap (which should stay passively in position) in order to cover the graft (stabilize with interrupted sutures, sling sutures in the most coronal aspect of the papillae). Use non-absorbable monofilament sutures.

The patient should preferably be restricted to soft food intake, with no biting/chewing in the treated area, preventing any pressure or forces on the graft site. Mechanical cleaning of the treated area is forbidden for 1 week. The patient should rinse with 0.12% chlorhexidine (from day 3 on) twice a day for 1 min for at least 3 weeks. Prescribe painkillers.

6 | CLINICAL VIDEOS ON THE DIFFERENT PROCEDURES

SCAN ME

For more information on the use of L-PRF matrices in the above-mentioned clinical indications, you may wish to visit a webpage from Marc Quirynen with short videos summarizing the different procedures. Just scan this QR code. Following videos are available: alveolar ridge preservation, sinus floor elevation, lateral bone augmentation (GBR), open flap debridement combined with infra-bony defect fill. You can also use this URL: https://www.l-prf4all.com/lprfperio2000additionalvideos

7 | DISCUSSION

In this PERIO 2000 special volume on APCs all reviews confirmed the benefits of adding APCs during periodontal surgery.[5–11] However, one of the main challenges in reviewing the evidence on the use of APCs for soft- and hard-tissue regeneration is the heterogeneity of preparation protocols, and of treatment protocols/concepts.[26] Moreover, RCTs with direct comparison of the use of APCs with the so called "golden standard" therapy are still scares. The regenerative power of these APCs is also illustrated by their significant beneficial impact in the management of chronic wounds (e.g., diabetic foot, venous leg ulcers, leprosy wounds, and pressure ulcers) as highlighted in several review papers.[15,16] The enhanced healing when using APCs is scientifically explained and supported by several basic science papers in this special issue.[1–4]

This manuscript aims to extrapolate the outcome of these papers into detailed clinical recommendations for periodontal surgery, primarily based on the scientific evidence but also taking into consideration the clinical experience of the authors. For each application (alveolar ridge preservation, sinus floor augmentation, lateral bone augmentation, the treatment of intra-boy defects, and root coverage) a variety of protocols have been published making it difficult to identify the "most optimal" one.[26] However, for nearly all applications (especially alveolar ridge preservation, sinus floor augmentation, intra-bony and furcation defects, root coverage) the large majority of the studies/protocols identified adjunctive beneficial effects when APCs, especially the second-generation APCs, were added to the surgical protocol.[5–11] In cases where this was not observed, there was often a significant violation from the "optimal" surgical protocol and/or the treatment was performed by less experienced clinicians.

There are, of course, limitations in the proposed recommendations. The most important limitation is that, when different treatment steps/options/concepts were available, a selection was made that, by itself, was not always based solely on scientific evidence (e.g., a randomized clinical trial, a controlled clinical trial), but also partially on expert opinions. This introduces a potential source of bias. However, it is essential to note that none of the authors of this manuscript have a commercial/financial conflict of interest when working with APCs, and because most of them possess extensive clinical experience with the use of APCs in periodontal surgery, this should reduce the risk of major bias. Moreover, since the financial revenue for companies offering consumables/centrifuge for APC preparation is very low, the risk of industrial pressure or influence is limited, both in relation to publication bias as well as in relation to their impact on opinion leaders.

Another limitation is that the guidelines are primarily for the second-generation APCs (the L-PRF family including L-PRF, A-PRF, A-PRF+, CGF, H-PRF, T-PRF, etc.). This focus is justified by the fact that these second-generation APCs, offer several additional advantages compared to first-generation APCs.[2,3] However, the recommendations can partially be extrapolated to the first-generation APCs (see details in the respective tables reporting the data of both first- and second-generation APCs in periodontal surgery).[5–11]

The guidelines for the preparation of L-PRF are up to a certain extent supported by a large number of in vitro studies, highlighting the importance of the timing (between blood collection and centrifugation, between the end of centrifugation and preparation of the membranes), the role of the inner surface of the blood tubes, the centrifugation process itself (speed, vibration, temperature…), the centrifuge, and the compression of the clot into a membrane.[19]

The quality of clinical guidelines can be classified, for example, by applying the AWMF register (for details see Nothacker et al. 2014).[27] A first requirement is, of course, the exclusion of any conflicts of interest. None of the authors of this manuscript have a commercial/financial conflict of interest when working with APCs. S1 guidelines are based only on recommendations by experts, whereas S2 guidelines require a structured consensus process with a representative committee (S2k) or a systematic literature review and synthesis of the evidence (S2e), and S3 guidelines (the highest quality) include both elements. The authors believe the proposed recommendations reach the S2e level. The proposed recommendations:

- depict the current state of knowledge via extensive reviews for each indication,[5-11]
- assess the body of knowledge from a methodological and clinical standpoint,
- weigh the benefits and harm of different approaches (cfr detailed tables clarifying the benefits of APCs in a transparent manner),
- explain opposing observations,
- take into account PROMs.

The next step should be the involvement of medical societies (e.g., the European Federation of Periodontology, the European Association for Osseointegration) with a structured consensus process.

8 | CONCLUSION

Over the past two decades, the therapeutic use of APCs, particularly L-PRF, to accelerate and enhance tissue healing and regeneration has garnered significant attention from clinicians worldwide for several compelling reasons. This biomaterial, derived entirely from the patient's own blood (100% autologous), stands out for its natural origin. Its ease of preparation, immediate chair-side production, and minimal risk of rejection reactions (foreign body response) contribute to its widespread appeal. APCs, with the L-PRF family at the forefront, offer a multitude of benefits, such as the controlled release of growth factors, a fibrous structure conductive to cell-attachment, enhanced angiogenesis, an antibacterial and analgesic activity, the promotion of stem cell differentiation towards osteoblasts, an anti-inflammatory activity, and a shift in macrophage polarization from an M1 towards an M2 phenotype. The 3D architecture of L- PRF membranes, characterized by high density, elasticity, flexibility, and strength, makes them exceptionally well-suited for handling, manipulation, and suturing. These distinct characteristics not only facilitate wound healing/repair, but also play a crucial role in supporting both soft and hard tissue regeneration.

The proposed recommendations aim to assist clinicians in maximizing the benefits when applying the second-generation APCs across various clinical applications, including alveolar ridge preservation, guided tissue regeneration, guided bone regeneration, sinus floor elevation (both lateral window approach and transcrestal technique), endodontic surgery, the treatment of medication-related osteonecrosis of the jaw bones, and periodontal plastic surgery.

CONFLICT OF INTEREST STATEMENT

All (co)-authors declare that they have no conflict of interest in relation to this chapter, even though they might have received research support from different companies including: BioHorizon Inc., Bti, Camlog, Dentsply Sirona, Geistlich, Hu-Friedy, Henry Schein, Straumann, TiCare, DENTAID.

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REFERENCES

1. Bartold M, Ivanovski S. Biological processes and factors involved in soft and hard tissue healing. *Periodontol 2000*. 2025;97:16-42.
2. Calciolari E, Dourou M, Akcali A, Donos N. Differences between first- and second-generation autologous platelet concentrates. *Periodontol 2000*. 2025;97:52-73.
3. Blanco J, García Alonso A, Hermida-Nogueira L, Castro A. How to explain the beneficial effects of L-PRF. *Periodontol 2000*. 2025; 97:74-94.
4. Gruber R. How to explain the beneficial effects of platelet-rich plasma? *Periodontol 2000*. 2025;97:95-103.
5. Siawach SAM, Yu J, Castro AB, et al. Autologous Platelet concentrates (APCs) in alveolar ridge preservation (ARP): a systematic review & meta-analyses. *Periodontol 2000*. 2025;97:104-130.
6. Valentini P, Calciolari E, Monlezun S, Akcalı A, Donos N, Quirynen M. APCsin sinus floor augmentation. *Periodontol 2000*. 2025;97: 254-270.
7. Blanco J, Caramês J, Quirynen M. A narrative review on the use of autologous platelet concentrates during alveolar bone augmentation: Horizontal (simultaneous/staged) & vertical (simultaneous/ staged). *Periodontol 2000*. 2025;97:236-253.
8. Barootchi S, Tavelli L, Galarraga Vinueza ME, Pinto N, Sanz A, Wang H-L. Effect of autogenous platelet concentrates and their centrifugation protocols on the outcomes of root coverage: A systematic review & network meta-analysis. *Periodontol 2000*. 2024.
9. Miron RJ, Moraschini V, Estrin N, et al. Periodontal regeneration using platelet-rich fibrin. Intrabony defects: a systematic review with meta-analysis. *Periodontol 2000*. 2024.
10. Miron RJ, Moraschini V, Estrin N, et al. Periodontal Regeneration using Platelet- Rich Fibrin. Furcation defects: a systematic review with meta-analysis. *Periodontol 2000*. 2025;97:191-214.
11. Siawach SAM, Yu J, Castro AB, Temmerman A, Teughels W, Quirynen M. Autologous Platelet concentrates after 3rd molar extraction: a systematic review. *Periodontol 2000*. 2025;97: 131-152.
12. Ivanovski S, Lee RSB, Fernandez-Medina T, Pinto N, Andrade C, Quirynen M. Impact of autologous platelet concentrates on the osseointegration of dental implants. *Periodontol 2000*. 2025;97: 271-286.
13. Bennardo F, Barone S, Antonelli A, Giudice A. Autologous Platelet concentrates as adjuvant in the surgical management of medication-related osteonecrosis of the jaws (MRONJ). *Periodontol 2000*. 2025;97:287-307.
14. Sabeti M, Gabbay J, Al A. Endodontic surgery and platelet concentrates: A comprehensive review. *Periodontol 2000*. 2025;97: 308-319.
15. Perussolo J, Calciolari E, Dereka X, Donos N. Platelet-Rich plasma (PRP) and plasma-Rich in growth factors (PRGF) in extra-oral wound care. *Periodontol 2000*. 2025;97:320-341.
16. Pinto NR, Yu J, Koirala S, et al. L-PRF in extra-oral wound care. *Periodontol 2000*. 2025;97:342-362.
17. Hauser F, Gaydarov N, Badoud I, Vazquez L, Bernard JP, Ammann P. Clinical and histological evaluation of postextraction platelet-rich fibrin socket filling: a prospective randomized controlled study. *Implant Dent*. 2013;22:295-303.
18. Castro AB, Andrade C, Li X, Pinto N, Teughels W, Quirynen M. Impact of g force and timing on the characteristics of platelet-rich fibrin matrices. *Sci Rep*. 2021;11:6038.

19. Quirynen M, Siawasch SAM, Yu J, Miron RJ. Essential principles for blood centrifugation. *Periodontol 2000*. 2025;97:43-51.
20. Miron RJ, Dham A, Dham U, Zhang Y, Pikos MA, Sculean A. The effect of age, gender, and time between blood draw and start of centrifugation on the size outcomes of platelet-rich fibrin (PRF) membranes. *Clin Oral Investig*. 2019;23:2179-2185.
21. Crisci A, Lombardi D, Serra E, Lombardi G, Cardillo F, Crisci M. Standardized protocol proposed for clinical use of L-PRF and the use of L-PRF wound box®. *J Unexplored Med Data*. 2017;2:77-87.
22. Miles J, Bailey SL, Obenaus AM, et al. Storage temperature determines platelet GPVI levels and function in mice and humans. *Blood Adv*. 2021;12:3839-3849.
23. Dohan Ehrenfest DM, Kang BS, Del Corso M, et al. The impact of the centrifuge characteristics and centrifugation protocols on the cells, growth factors and fibrin architecture of a leukocyte and Platelet-Rich Fibrin (L-PRF) clot and membrane. Part 1: evaluation of the vibration shocks of 4 models of table centrifuges for L-PRF. *Poseido*. 2014;2:129-139.
24. Andrade Aldana C, Ugarte Amenabar F, Inostroza Silva C, et al. The impact of gender and peripheral blood parameters on the characteristics of L-PRF membranes. *J Oral Biol Craniofac Res*. 2022;12:753-759.
25. Quirynen M, Pinto N. *Leukocyte- and Platelet-Rich Fibrin in Oral Regenerative Procedures*. Quintessence Publishing; 2022.
26. Quirynen M, Sculean A, Blanco J, Wang H-L, Donos N. Introduction and overview on Autogenous Platelet Concentrates. *Periodontol 2000*. 2025;97:7-15.
27. Nothacker MJ, Muche-Borowski C, Kopp IB. Guidelines in the register of the Association of Scientific Medical Societies in Germany - A quality improvement campaign. *Geburtshilfe Frauenheilkd*. 2014;74:260-266.

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