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REVIEW ARTICLE

Regenerative potential of platelet- and leukocyte-rich fibrin (L-PRF) in bone and periodontal health of oral tissues

Potencial regenerativo de la fibrina rica en plaquetas y leucocitos (L-PRF) en la salud ósea y periodontal de los tejidos bucales

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ABSTRACT

Introduction: the use of different types of biomaterials in oral tissue regeneration is currently being advocated, with platelet- and leukocyte-rich fibrin being one of the most widely used.
Objective: to describe the mechanisms of action of platelet- and leukocyte-rich fibrin and its efficacy as a material with regenerative potential in clinical dental practice.
Methods: PRISMA methodology was used to examine the published studies for this article. The reviews of different databases made it possible to obtain 18 sources, which were selected for their quality, relevance and pertinence.
Results: platelet- and leukocyte-rich fibrin is a second generation of platelet concentrates, which significantly improves wound healing in soft and hard tissues. Its importance in the regeneration of oral and periodontal bone tissues is highlighted. Its use as filling and antihemorrhagic material during dental extractions constitutes an effective option in cardiac surgery patients under anticoagulant therapy. At the same time, it is cheaper than fibrin.
Conclusion: unlike other compounds, this biomaterial is a fibrin membrane generated from the centrifugation of whole blood in a precipitator tube that does not contain anticoagulant, resulting in a fibrin clot that has abundant growth factors and cytokines, favoring the process of tissue regeneration.

Keywords: Periodontal; Platelet-Rich Fibrin; Tissues.

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RESUMEN

Introducción: en la actualidad se aboga por la utilización de diferentes tipos de biomateriales en la regeneración tisular bucal, siendo la fibrina rica en plaquetas y leucocitos, uno de los más empleados.
Objetivo: describir los mecanismos de acción de la fibrina rica en plaquetas y leucocitos, así como su eficacia como material con potencial regenerativo en la práctica clínica odontológica.
Métodos: para la realización de este artículo se empleó la metodología PRISMA para examinar los estudios publicados. Las revisiones de diferentes bases de datos permitieron la obtención de 18 fuentes, las cuales fueron seleccionadas por su calidad, relevancia y pertinencia.
Resultados: la fibrina rica en plaquetas y leucocitos una segunda generación de concentrados plaquetarios, que mejora significativamente la cicatrización de heridas en tejidos blandos y duros. Se destaca su importancia en la regeneración de tejidos óseos bucales y periodontales. Su uso como material de llenado y antihemorrágico durante las extracciones dentales constituye una opción eficaz en pacientes de cirugía cardiaca bajo terapia anticoagulante. A su vez, el mismo es más barato que la fibrina.
Conclusión: a diferencia de otros compuestos, este biomaterial es una membrana de fibrina generada de la centrifugación de la sangre entera en un tubo precipitador que no contiene anticoagulante, dando como resultado un coágulo de fibrina que tiene abundantes factores de crecimiento y citoquinas, favoreciendo el proceso de regeneración tisular.

Palabras clave: Periodontales; L-PRF; Tejidos.

INTRODUCTION

Over the last few decades, a significant increase in the development of regenerative medicine has been observed. This has been motivated by the constant search for more efficient and effective methods to replace lost tissues at different levels, including the oral cavity, ranging from the use of bone grafts to the design of new synthetic materials. In this field, leukocyte- and platelet-rich fibrin (L-PRF) has been one of the most widely used and recognized materials in bone regeneration therapies, overcoming limitations shown by other materials and offering promising results in the regeneration of said tissues.[1]

L-PRF, initially used as an autologous biomaterial, unlike other platelet-rich products, does not require anticoagulant or bovine thrombin, constituting the second generation of platelet concentrate. Since this product does not require anticoagulant, it allows most platelets to activate within minutes of contacting the tube walls, initiating the coagulation cascade. Fibrinogen, for its part, is concentrated at the beginning of the process in the upper portion of the tube, above the circulating thrombin, which is transformed into fibrin. As a result, a fibrin clot forms in the middle of the tube, between the erythrocytes (located below) and the acellular plasma (at the top).[2]

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The importance of using this method is that it guarantees greater speed from the blood extraction process to its transfer to the centrifuge, without the use of anticoagulants. This ensures that blood samples begin to clot almost immediately upon contact with the test tube, and within a few minutes after centrifugation, a fibrinogen concentrate is obtained in the middle and upper part of the tube. This element allows tissue regeneration, which is achieved by a variety of intra- and extracellular actions, controlled by different signaling proteins, obeying a complex process that includes stages such as cell binding, migration, and proliferation.[3]

In this context, L-PRF improves osteoblast growth and proliferation. This approach significantly reduces soft tissue recovery time and reduces postoperative pain. This method is notable for harnessing the patient's own biological resources, minimizing rejection risks, and offering an autologous approach aligned with the principles of personalized medicine.[4] This review was conducted with the aim of describing the mechanisms of action of platelet- and leukocyte-rich fibrin and its efficacy as a regenerative material in clinical dental practice.

METHODS

The literature review focused on providing a comprehensive update on oral soft tissue changes in patients with oral cancer undergoing chemotherapy and radiotherapy based on recent evidence. Initially, a thorough search of databases including PubMed, Scielo, Redalyc, and Google Scholar was conducted, ensuring coverage of the available literature.

During the information search, 200 sources were obtained and thoroughly reviewed for selection. The full texts of these articles were then evaluated to confirm their applicability and quality, ensuring that each selected source offered significant value to the review. This rigorous and structured methodology ensured that the literature review, which included 18 references, was not only exhaustive but also up-to-date and relevant, shedding light on current innovations in diagnosis and therapeutics, providing a solid foundation for understanding and effectively managing the disease.

RESULTS

L-PRF is a solid fibrin biomaterial with leukocytes, respectively. It is developed without the addition of activating elements in the extracted blood, resulting in a strong fibrin structure. It is also defined as an optimized autologous blood clot, from which a strong fibrin membrane is obtained, formed by autologous cells and enriched with growth factors and matrix proteins.[5]

To obtain this material, 10 cc of blood is extracted from the patient's antecubital vein and immediately centrifuged without adding anticoagulants at 3,000 rpm for 10 min or at 2,700 rpm for 12 min. The literature indicates an increase in centrifugation speed in patients on anticoagulant therapy for 18 min. Each tube extracted constitutes an L-PRF membrane.[6]

At the base of the tube, red blood cells are deposited, forming a clot of that color. At the top of the tube, there is a serum with little cellular content, and between them is the fibrin matrix loaded with platelets and leukocytes.[2] Once the upper and lower portions are removed, the L-PRF is obtained, which will be in the form of a gel, and which can be used directly or pressed to obtain a membrane, as shown in Figure 1.

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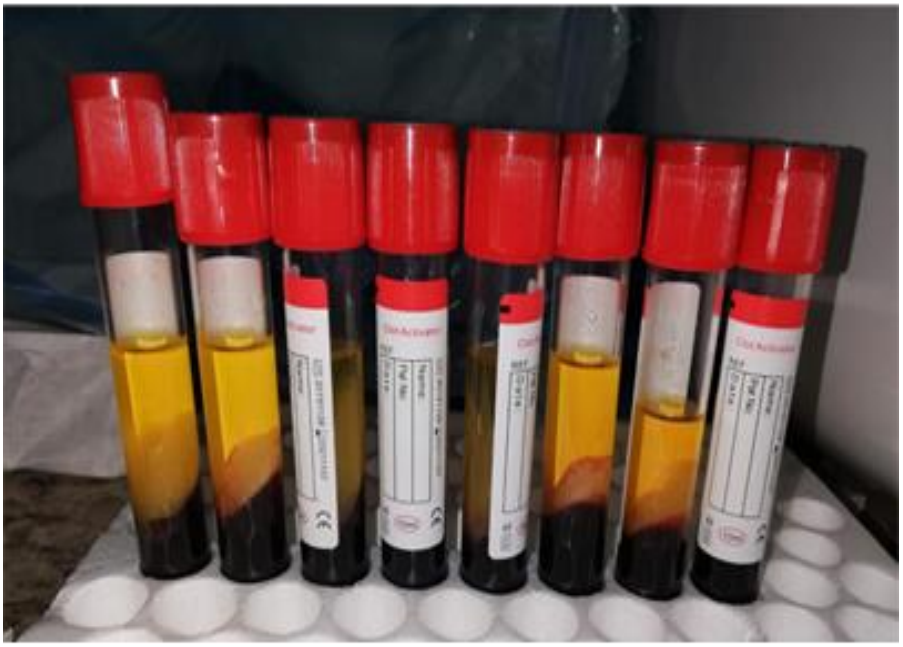

Fountain: Image obtained from the author

Fig. 1 Platelet- and leukocyte-rich fibrin preparations.

Once the membranes are obtained, the clots are placed in the Xpression kit for gentle gravity compression, with the help of the tray plate (Figure 2).[7]

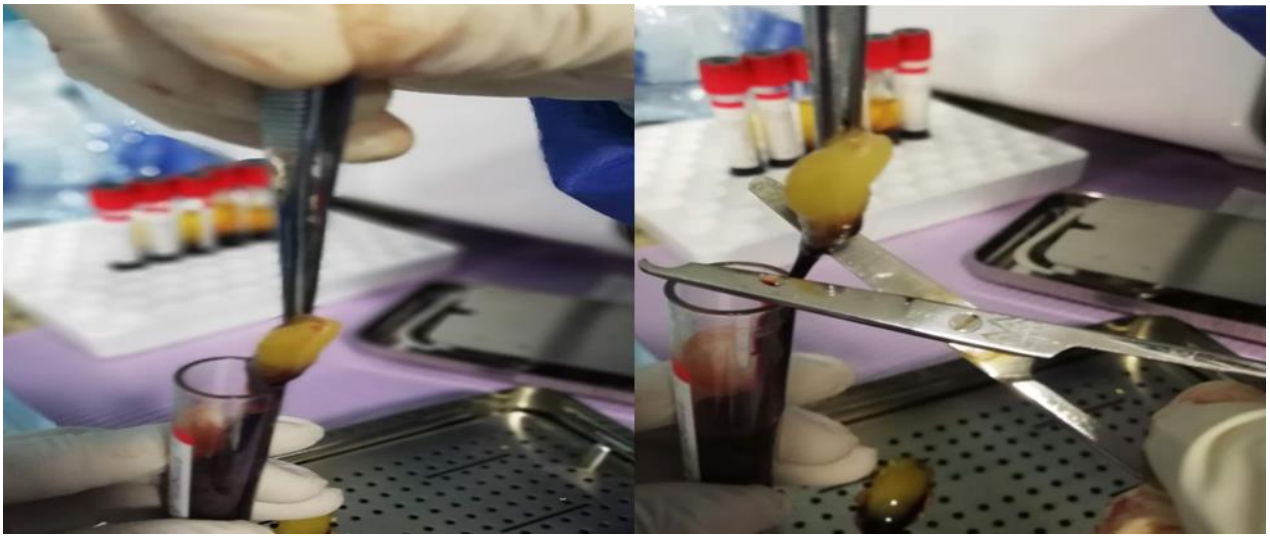

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Fig. 2 Placing clots in the Xpression kit.

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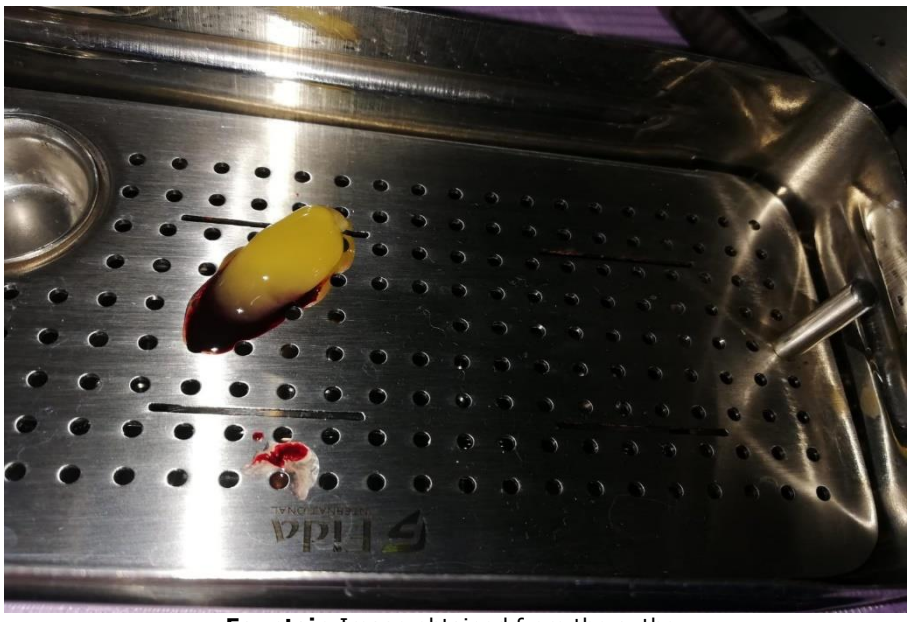
After five minutes the membranes are ready for use (Figure 3) and can be handled within 2.5-3 hours, irrigated with exudate to prevent dehydration.



Fountain: Image obtained from the author

Fig. 3 Membrane ready for use.

Currently, there is an advanced platelet-rich fibrin (APRF) which is obtained by modifying centrifugation procedures to further improve tissue regeneration. (A-PRF) is centrifuged at lower speeds (1500 rpm, 14 min).[7] The modification of the procedure has resulted in increased platelet counts and improved behavior of phagocytic cell lines such as monocytes and macrophages, as well as a higher number of live progenitor cells compared to (L-PRF), so the subsequent significant increase in total protein release may present additional advantages for clinical use. [8,9]

Bareiroy cols,[6] corroborate the natural regenerative potential of A-PRF by accelerating the healing of both soft and hard tissues, reducing postoperative edema and pain, improving the evolution of the surgical process, the results, and patient satisfaction. L-PRF in Implantology can be used both in immediate implants and in implants placed at a deferred time, as well as in different presentations: membrane, mixed with particulate bone. When evaluating the effectiveness of L-PRF in implants placed immediately after extraction, it is observed that L-PRF can produce improvements in terms of implant stability or peri-implant bone regeneration, although these improvements are not significant.[10]

Placing fibrin clots as close as possible to a bone defect could be useful for enhancing healing in the presence of synthetic bone implants. This opens the new field of surface chemistry-controlled blood clots in biomaterial implants and may serve as therapeutic agents for enhancing bone regeneration. It is also conceivable that incorporating optimal blood clots or platelet-rich plasma (PRP)/fibrin clots with porous scaffolds will provide a nutritionally rich microenvironment for bone tissue engineering.[11]

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L-PRF can be used in oral surgery when maxillary sinus perforations occur, as a membrane it can also be used as a protective wall in bone lesions to contain hydroxyapatite biomaterial, such as in the management of bone fenestrations, and it can also be used by placing another biological material between two membranes performing the Stick bone technique.[4,12]

Our analysis agrees with complete root coverage with excellent gingival tissue status after six months, in which the PRF membrane was used along the laterally displaced fin for the treatment of an isolated recession defect. [13] It was observed that the PRF application exhibited a reduction in the pocket and gain in clinical insertion along with an increase in postoperative radiographic density in the treated defects.

L-PRF contains 50 % leukocytes from the initial clot, in addition to leukocytes and 97 % platelets, which give rise to a strong fibrin matrix capable of releasing the highest levels of growth factors and cytokines, as well as other elements involved in the coagulation cascade, which are involved in the tissue recovery process, for more than seven days in vitro, promoting cell differentiation and proliferation.[11,14]

This platelet concentrate has a simple preparation process in which, from obtaining a blood sample from the patient, which is then subjected to a specific centrifugation procedure, resulting in a fibrin membrane, rich in leukocytes and growth factors, stimulating bone and soft tissue growth. It also presents the capacity for cell proliferation and migration, and angiogenesis. Given that it is an economical procedure with proven benefits, its systematic use in oral and maxillofacial surgery should be considered as a relevant clinical option.[13,15]

Unlike PRP, L-PRF, generated from solid blood components, does not contain an anticoagulant. The membrane has a dense, three-dimensional fibrin matrix enriched with platelets and abundant growth factors. L-PRF is a popular adjunct in surgery due to its superior handling characteristics and suturability at the injury site.[14]

The literature details how modifications in alveolar ridge dimensions and bone structure are better after tooth extraction when L-PRF or APRF+ were used compared to unaided socket healing. Twenty patients were included. The results showed that the mean horizontal and vertical changes at 1 mm below the ridge (buccal and palatal sides) were similar for the three 10 sites ($p > 0.05$). For alveolar filling, L-PRF (85,2 %) and A-PRF+ (83,8 %) showed higher values than the control (67,9 %). [16,17]

CONCLUSIONS

L-PRF is an effective and cost-effective alternative as an antihemorrhagic plug in dental extractions in anticoagulated cardiac patients, surpassing commercial collagen or fibrin membranes in cost. Although its immediate handling (between extraction and placement) is a limitation, the use of titanium cages allows it to be stored for up to three hours without losing functionality. Its application prevents recurrence in maxillary sinus lesions, reduces morbidity by avoiding second interventions (such as flaps), and, after three months, demonstrates superiority in radiographic alveolar filling. However, it does not minimize dimensional changes following multiple maxillary extractions. In complex wounds, it is a safe and low-cost option compared to grafts or dermal substitutes, reducing hospital costs. Innovations such as A-PRF+ improve its tensile strength and fibrillar morphology, optimizing its surgical handling, although further studies are required to determine its direct impact on specific clinical applications.

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