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APRF+ BIOMATERIALS IN DENTISTRY: MECHANISMS, CLINICAL APPLICATIONS AND PERSPECTIVES

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Abstract

APRF+ (Advanced Platelet-Rich Fibrin Plus) is an innovative biomaterial, derived from autologous blood, which plays an essential role in dental regenerative medicine. Through a specific centrifugation process, APRF+ obtains a three-dimensional matrix rich in fibrin, platelets and leukocytes, capable of gradually releasing essential growth factors, such as PDGF, TGF-β and VEGF. This controlled release stimulates angiogenesis, cell proliferation and osteogenesis, being useful in various clinical applications such as guided bone regeneration, sinus lifting, periodontal treatments and dental implant integration. Among its advantages are high biocompatibility, reduction of post-operative complications and the ability to accelerate the healing of soft and hard tissues. However, APRF+ also has limitations, such as the variability of outcomes depending on the patient's health and the limited duration of growth factor release. Future research focuses on integrating APRF+ with nanotechnology and other biomaterials to expand its efficacy and clinical applications. APRF+ represents an important step in dentistry, with the potential to turn regenerative treatments into a standard of practice.

Keywords: APRF+, dental regeneration, angiogenesis, osteogenesis, regenerative biomaterials, biocompatibility.

Introduction

APRF+ (Advanced Platelet-Rich Fibrin Plus) is an advanced technology derived from autologous blood, which consists of a three-dimensional fibrin matrix rich in platelets and leukocytes. It is obtained through a specific centrifugation process, without the use of anticoagulants or other chemicals. APRF+ differs from other forms of platelet-rich fibrin, such as PRF and i-PRF, by the higher concentration of growth factors and their release over the longer term, facilitating tissue regeneration [1-3].

The use of PRF and its derivatives in dentistry began as an extension of PRP (platelet-rich plasma) therapy, which was originally used in orthopedic and cosmetic surgery. PRF was introduced as a simpler and safer option, eliminating the need for anticoagulants. Over time, APRF+ has been developed to improve regenerative performance by optimizing the centrifugation process and active biological content [1-4].

APRF+ represents a major innovation in dentistry due to its ability to accelerate the regeneration of soft and hard tissues. It is used in various procedures, such as guided bone regeneration, periodontal treatments, and implantology. Its importance increases with the global trend towards minimally invasive techniques and personalized solutions for patients. Investigating APRF+ is essential for understanding how it can improve clinical outcomes and reduce post-operative complications (Fig. 1) [2-4].

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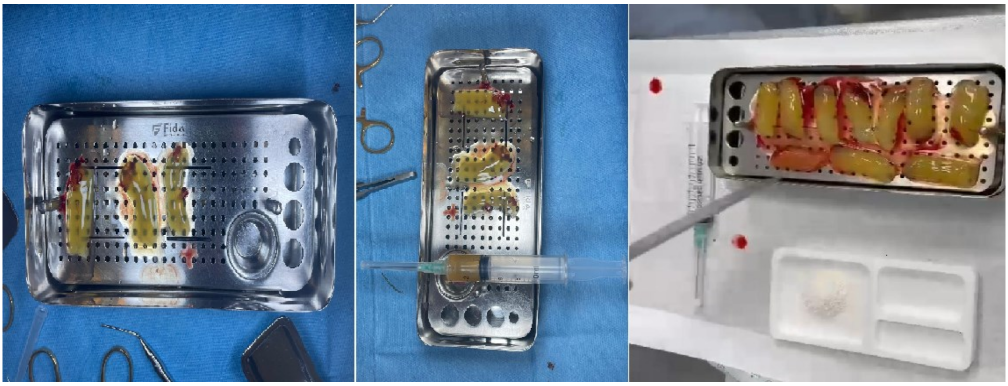

Fig. 1. The image shows stages in the preparation of A-PRF+

Biological mechanisms of APRF+

APRF+ is composed of autologous fibrin, rich in platelets and leukocytes, which acts as a three-dimensional matrix that supports tissue regeneration. This matrix contains a high concentration of growth factors, such as platelet-derived growth factor (PDGF), beta transformation factor (TGF-β), and vascular endothelial growth factor (VEGF). In addition to these, APRF+ includes cytokines and essential proteins that promote cell migration and proliferation. This unique composition ensures a gradual and sustained release of the active components, promoting the effective regeneration of soft and hard tissues [2-4].

Obtaining APRF+ involves collecting autologous blood from the patient, followed by centrifugation using a specific protocol that optimizes the separation of blood elements. Unlike classic PRF, centrifugation for APRF+ is performed at lower speeds and longer times, which allows a matrix richer in leukocytes and growth factors to be obtained. This method minimizes protein degradation and promotes a prolonged release of bioactive components [2-5].

The mechanism of action of APRF+ is closely related to the slow and continuous release of growth factors. This process is crucial for stimulating angiogenesis, fibroblast proliferation and osteogenesis. Unlike other biomaterials that release their content quickly, APRF+ provides long-term support, contributing to a more stable and sustainable regeneration. VEGF, for example, promotes the formation of new blood vessels, essential for oxygenation and nutrition of the affected tissues, while PDGF stimulates the migration of progenitor cells to the lesion area [2-5].

APRF+ interacts directly with host cells by stimulating complex processes such as chemotaxis, cell proliferation, and osteoblastic differentiation. The presence of leukocytes in the matrix ensures an immunomodulatory function, reducing the risk of infections and promoting an optimal environment for regeneration. In addition, the fibrin in the composition of APRF+ acts as a physical support for the cells involved in healing, contributing to their efficient migration and the formation of a structural network that facilitates the deposition of new tissues [3-6].

Unlike PRP, which requires the use of anticoagulants and other additives, APRF+ is completely autologous and contains no exogenous components. This gives it superior biocompatibility and eliminates the risks associated with allergic or inflammatory reactions. Compared to classic PRF, APRF+ provides a higher concentration of leukocytes and growth factors, which translates into improved regenerative capacity. Also, its three-dimensional matrix is denser and more stable, making it easier to use in more complex procedures such as sinus lifts or major bone reconstructions [4-6].

In the case of soft tissues, APRF+ stimulates angiogenesis and fibroblast proliferation, which leads to rapid healing and reduces the risk of unsightly scarring. In terms of hard tissues such as bone, APRF+ plays an essential role in promoting osteogenesis and bone remodeling. The released growth factors support the differentiation of progenitor cells into osteoblasts, thus accelerating the bone regeneration process [4-7].

A key aspect of APRF+ is its ability to gradually release bioactive factors in a controlled manner. This mechanism is particularly important in complex dental procedures, where regeneration requires long-term support. In the absence of this prolonged release, the healing process could be compromised, increasing the risk of failure of the intervention [5-7].

The biological mechanisms of APRF+ are fundamental to understanding its clinical efficacy. Its ability to combine a stable matrix with the controlled release of growth factors makes it an ideal biomaterial for dentistry. By supporting regenerative processes in both soft and hard tissues, APRF+ demonstrates its potential as a modern and effective solution in dental treatments. This detailed understanding of its biological mechanisms provides a starting point for its extensive use in clinical practice and for the development of new applications in regenerative medicine [5-8].

Clinical applications in dentistry

APRF+ is widely used in oral and maxillofacial surgery to accelerate the healing process and tissue regeneration. In complicated tooth extractions, APRF+ is placed directly into the post-extraction alveolus to stimulate bone tissue formation and reduce the risk of complications such as alveolar osteitis. It is also used in sinus lift procedures, where it acts as a biological support that promotes osteogenesis, facilitating bone graft integration or bone regeneration without additional material [5-9].

In periodontal treatments, APRF+ plays an essential role in the regeneration of connective tissue and the restoration of tooth support structures. It is used in combination with guided tissue regeneration (GTR) techniques to treat deep periodontal defects. Due to its high content of growth factors and their gradual release, APRF+ stimulates the proliferation of periodontal cells while reducing local inflammation. In surgical treatments such as gum grafts, APRF+ accelerates healing and improves the aesthetic appearance of soft tissues [6-9].

One of the most common areas of application of APRF+ is implantology. APRF+ is used to increase the success rate of dental implants, improving bone integration and reducing the time it takes to heal. It is placed around the implants to stimulate bone formation and ensure long-term stability. In cases of guided bone regeneration, APRF+ is combined with other biomaterials to achieve a synergistic effect, creating an optimal environment for osteoconduction and osteoinduction [7-9].

In endodontics, APRF+ is investigated for its potential to support pulp regeneration in cases of apexification or root perforations. It is also used in apical surgery to promote bone regeneration in periapical lesions. Other applications include aesthetic rehabilitation treatments, such as gum tissue regeneration around prosthetic restorations, and treatments for post-traumatic or pathological bone defects [6-10].

APRF+ is a versatile biomaterial that has proven its effectiveness in various branches of dentistry. From bone regeneration in implantology and oral surgery to treating periodontal defects and exploring it in endodontics, APRF+ continues to be a basic tool in regenerative dentistry. Clinical results promise a reduction in complications and a significant improvement in healing [7-11].

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Advantages of using APRF+

One of the biggest advantages of APRF+ is its biocompatibility, due to the fact that it is an autologous material, obtained from the patient's blood. This significantly reduces the risk of allergic reactions, inflammation or rejection. In addition, the absence of chemical additives or anticoagulants makes APRF+ a safe option for clinical use, especially in cases of patients with high sensitivity [14-16].

APRF+ promotes accelerated regeneration of both soft and hard tissues due to the prolonged release of growth factors such as PDGF, TGF-β and VEGF. These factors stimulate angiogenesis, cell proliferation and osteoblastic differentiation, facilitating faster healing of the treated areas. This mechanism is essential in complex procedures such as sinus lifts or guided bone regeneration [14-17].

Due to its anti-inflammatory and immunomodulatory properties, APRF+ helps minimize the risk of post-operative complications such as infections or excessive inflammation. The presence of leukocytes in the matrix helps maintain a clean and favorable environment for healing, reducing the need for excessive use of antibiotics [16-20].

The gradual release of the bioactive components from APRF+ ensures the support of the regeneration process over a long period. This advantage makes it superior to other biomaterials that have a shorter and more intense effect, but without long-term support. In dentistry, this feature is crucial for optimal implant integration and long-term bone stability [18-23].

Conclusions

APRF+ represents a major innovation in dentistry due to its ability to accelerate the regeneration of soft and hard tissues. It is used in various procedures, such as guided bone regeneration, periodontal treatments, and implantology. Its importance increases with the global trend towards minimally invasive techniques and personalized solutions for patients. Investigating APRF+ is essential for understanding how it can improve clinical outcomes and reduce post-operative complications.

The biological mechanisms of APRF+ are fundamental to understanding its clinical efficacy. Its ability to combine a stable matrix with the controlled release of growth factors makes it an ideal biomaterial for dentistry. By supporting regenerative processes in both soft and hard tissues, APRF+ demonstrates its potential as a modern and effective solution in dental treatments. This detailed understanding of its biological mechanisms provides a starting point for its extensive use in clinical practice and for the development of new applications in regenerative medicine.

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Through its biocompatibility, regenerative capacity and reduction of complications, APRF+ represents a modern and effective solution in dentistry, offering significant benefits for patients and clinicians.

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