IMPACTO CIENTÍFICO
EDITORA

USE OF PLATELET-RICH FIBRIN IN MAXILLARY SINUS LIFT

USO DE FIBRINA RICA EM PLAQUETAS EM LEVANTAMENTO DE SEIOS MAXILARES

USO DE FIBRINA RICA EN PLAQUETAS EN LA ELEVACIÓN DEL SENO MAXILAR

https://doi.org/10.56238/edimpacto2025.067-001

Leonardo Trolez Neder Andrade[1]

ABSTRACT

Implant rehabilitation in the atrophic posterior maxilla often requires maxillary sinus augmentation procedures. Platelet-Rich Fibrin (PRF), an autologous platelet concentrate, has been established as a biomaterial of great interest for optimizing the regenerative process. The objective of this work was to perform a literature review, based on 19 selected articles, to analyze the clinical efficacy, indications, and current debates regarding the use of PRF in maxillary sinus floor lift surgeries. The analysis of the literature demonstrates that PRF, when used as a sole grafting material, is a predictable and cost-effective alternative, supported by long-term studies showing volumetric stability and high implant success rates. However, its benefit as an additive to other biomaterials remains controversial; the evidence does not support a significant increase in the final bone volume, although it suggests an acceleration of initial bone maturation. It is concluded that PRF is a versatile and established tool, with strong evidence for its use as an autonomous graft and in the management of complications. Its application as an additive, however, should be indicated to optimize the biology of the healing process, rather than primarily as a means to obtain greater bone volume.

Keywords: Maxillary Sinus Lift. Platelet-Rich Fibrin. Bone Regeneration. Implant Dentistry.

RESUMO

A reabilitação com implantes na maxila posterior atrófica frequentemente requer procedimentos de aumento do seio maxilar. A Fibrina Rica em Plaquetas (PRF), um concentrado plaquetário autólogo, consolidou-se como um biomaterial de grande interesse para otimizar o processo regenerativo. O objetivo deste trabalho foi realizar uma revisão de literatura, a partir de 19 artigos selecionados, para analisar a eficácia clínica, as indicações e os debates atuais sobre o uso da PRF em cirurgias de levantamento do assoalho do seio maxilar. A análise da literatura demonstra que a PRF, quando utilizada como material de enxerto único, é uma alternativa previsível e custo-efetiva, suportada por estudos de longo prazo que mostram estabilidade volumétrica e altas taxas de sucesso dos implantes. Contudo, seu benefício como aditivo a outros biomateriais permanece controverso; as evidências não suportam um aumento significativo no volume ósseo final, embora sugiram

[1] Dental Surgeon. (FAOA). E-mail: drleotrolese@fibonaccimogi.com

uma aceleração da maturação óssea inicial. Conclui-se que a PRF é uma ferramenta versátil e consolidada, com forte evidência para seu uso como enxerto autônomo e no manejo de complicações. Sua aplicação como aditivo, no entanto, deve ser indicada para otimizar a biologia do processo cicatricial, e não primariamente como um meio para se obter maior volume ósseo.

Palavras-chave: Levantamento de Seio Maxilar. Fibrina Rica em Plaquetas. Regeneração Óssea. Implantodontia.

RESUMEN

La rehabilitación con implantes en el maxilar posterior atrófico a menudo requiere procedimientos de aumento del seno maxilar. La fibrina rica en plaquetas (PRF), un concentrado de plaquetas autólogas, se ha consolidado como un biomaterial de gran interés para optimizar el proceso regenerativo. El objetivo de este trabajo fue realizar una revisión bibliográfica, basada en 19 artículos seleccionados, para analizar la eficacia clínica, las indicaciones y los debates actuales sobre el uso de PRF en cirugías de elevación del suelo del seno maxilar. El análisis de la literatura demuestra que la PRF, utilizada como único material de injerto, es una alternativa predecible y rentable, respaldada por estudios a largo plazo que muestran estabilidad volumétrica y altas tasas de éxito de los implantes. Sin embargo, su beneficio como aditivo a otros biomateriales sigue siendo controvertido; la evidencia no respalda un aumento significativo del volumen óseo final, aunque sí sugiere una aceleración de la maduración ósea inicial. Se concluye que la PRF es una herramienta versátil y consolidada, con sólida evidencia para su uso como injerto autónomo y en el manejo de complicaciones. Sin embargo, su aplicación como aditivo debería estar indicada para optimizar la biología del proceso de cicatrización, más que como un medio para obtener mayor volumen óseo.

Palabras clave: Elevación de Seno Maxilar. Fibrina Rica en Plaquetas. Regeneración Ósea. Implantología.

1 INTRODUCTION

Osseointegration, which establishes a direct structural and functional connection between living bone and the surface of an implant, represents one of the most significant scientific advances in dentistry, allowing for predictable rehabilitation of edentulous patients with implant-supported prostheses (MITREA et al., 2023; ORTEGA-MEJIA et al., 2020). Since pioneering work, dental implants have established themselves as a revolutionary alternative to traditional prostheses and bridges (MITREA et al., 2023). The predictability of dental implants as a treatment option for edentulism is already well established, being an accepted solution to optimally restore function and shape (ALVES et al., 2024; CHOUDHARY et al., 2022).

However, the installation of implants in the posterior region of the maxilla often encounters considerable anatomical challenges (ALMUTAIRI et al., 2025; AWAD; BEIT, 2025). Prolonged tooth loss in this area triggers a process of alveolar bone resorption, resulting in a decrease in the height and thickness of the ridge (HUANG et al., 2025; OTERO et al., 2022). Simultaneously, pneumatization of the maxillary sinus occurs, a physiological process of expansion of the sinus cavity towards the edentulous ridge (ALMUTAIRI et al., 2025; QIU et al., 2024; REIS et al., 2025). The combination of these factors results in a residual vertical bone volume that is often insufficient for the primary anchorage of standard-length implants, compromising prosthetic rehabilitation and patients' quality of life (ALVES et al., 2024; FRANCISCO et al., 2024).

To overcome this limitation, sinus lift surgery has become a standard and predictable surgical procedure (DAMSAZ et al., 2020; MITREA et al., 2023). The technique, initially described by Tatum and later published by Boyne and James in the 1980s, aims to increase bone height in the posterior region of the maxilla by elevating the Schneider membrane and inserting a graft material into the space created (AWAD; BEIT, 2025; ORTEGA-MEJIA et al., 2020; POWELL et al., 2022). Over the years, several graft materials have been used, including autogenous bone, considered the gold standard for its osteogenic, osteoinductive, and osteoconductive properties, as well as xenografts, allografts, and alloplastic materials (ALVES et al., 2024; MITREA et al., 2023).

In this context, autologous platelet concentrates (APCs) have emerged as an alternative to optimize the regenerative process (GASPARRO et al., 2024). Among them, Platelet-Rich Fibrin (PRF), a second-generation concentrate introduced by Choukroun et al. in the early 2000s, gained prominence (OTERO et al., 2022). PRF is a three-dimensional autologous biomaterial obtained by centrifugation of the patient's blood without the use of anticoagulants, resulting in a resilient fibrin matrix that traps platelets, leukocytes, and a

variety of growth factors such as platelet-derived growth factor (PDGF) and transforming growth factor beta (TGF-β) (DAMSAZ et al., 2020; IDIRI et al., 2023; OTERO et al., 2022). The hypothesis is that the slow and gradual release of these growth factors can accelerate the healing of soft and hard tissues, stimulate angiogenesis, and enhance bone regeneration (MALCANGI et al., 2023; AWAD; BEIT, 2025). Due to its autologous nature, PRF eliminates the risks of disease transmission and immune reactions, in addition to being a low-cost and easy-to-obtain material (AWAD; BEIT, 2025). In view of these properties, the application of PRF, either as a single-graft material or as a biological additive to other biomaterials, has been widely investigated with the aim of improving clinical outcomes in maxillary sinus floor lifting procedures.

2 OBJECTIVE

The objective of this study is to critically analyze, through a literature review, the efficacy and the various clinical applications of Platelet-Rich Fibrin (PRF) in maxillary sinus floor lift surgeries, addressing its use as a single graft material, its combination with osteoconductive biomaterials, and its role in the management of intraoperative complications, in order to consolidate the current knowledge about the indications, controversies and results associated with this autologous biomaterial.

3 METHODOLOGY

This study consists of a literature review, based on the analysis of scientific articles on the use of Platelet-Rich Fibrin (PRF) in maxillary sinus floor lift surgeries.

The search for articles was conducted in the PubMed database (MEDLINE), and was complemented by searches in other databases such as Scopus, Web of Science and Cochrane Library to ensure comprehensive coverage. The bibliographic survey prioritized publications in the period between January 2020 and October 2025, in order to focus on the most recent evidence on the subject.

The following descriptors in English were used for the research: *"maxillary sinus lift", "sinus floor augmentation", "platelet-rich fibrin"* and *"PRF".* The terms were combined with Boolean operators "AND" and "OR" to refine the search strategy.

The inclusion criteria for the articles were: systematic reviews, meta-analyses, randomized clinical trials, and case series that addressed the clinical application of PRF in maxillary sinus lifting in humans. Opinion articles, *in vitro studies*, animal studies (with the exception of a preclinical study selected for biological basis) and publications that did not directly address the proposed theme were excluded.

The article selection process took place in two stages, following the PRISMA guidelines (Preferred Reporting Items for Systematic reviews and Meta-Analyses). First, the titles and abstracts were read for an initial screening. Then, the pre-selected articles were read in full to confirm their relevance and adequacy to the objective of the work.

At the end of this process, 20 articles were selected to compose the basis of analysis of this literature review.

4 LITERATURE REVIEW

In order to evaluate the histomorphometric outcomes of the combination of Leukocyte-Rich Platelet Fibrin (L-PRF) with deproteinized bovine bone mineral (DBBM), the meta-analysis by Almutairi et al. (2025) included five randomized controlled trials (RCTs) with 140 patients, based on a search in the PubMed, Scopus, Web of Science, and Cochrane Central databases. The results showed that the addition of L-PRF to DBBM significantly increased the formation of new bone (mean difference of 7.07%) and reduced the amount of residual graft compared to DBBM alone. The conclusion was that the adjuvant use of L-PRF improves histomorphometric outcomes in maxillary sinus augmentation surgery.

In contrast, the systematic review and meta-analysis by Qiu et al. (2024) aimed to evaluate the efficacy of PRP, PRF, and Concentrated Growth Factor (CGF). The methodology included a systematic search in four large databases for RCTs and controlled clinical trials that evaluated the formation of new bone and the height gain of the sinus floor. The results of the meta-analysis indicated that Platelet-Rich Plasma (PRP) significantly increased bone formation; however, the PRF-specific analysis did not demonstrate significant effects on increased new bone formation, floor height elevation, or soft tissue regeneration. The authors concluded that, while PRP appears to be effective, further studies are needed to validate the outcomes of PRF and CGF. This lack of consensus is corroborated by Idiri et al. (2023), who conducted a systematic review with the aim of evaluating the efficacy of adding PRF to DBBM. After analysing seven RCTs selected from PubMed, Cochrane and Web of Science, the review concluded that there is no statistically significant effect of adding PRF to DBBM in SL procedures. Similarly, the review by Damsaz et al. (2020) aimed to update the evidence on the clinical efficacy of L-PRF. The methodology included a search in three databases for clinical studies published between 2009 and 2020. Of the seven eligible articles, the analysis of the results was heterogeneous: 60% of the studies that combined L-PRF with DBBM did not report significant effects. The conclusion was that the evidence on mature bone formation remains inconclusive, and standardization of protocols is needed.

Gasparro et al. (2024) conducted a "review review" with the aim of summarizing the findings of systematic reviews and meta-analyses on the efficacy of APCs in SL. The methodology involved a search in three databases, resulting in the inclusion of 30 systematic reviews. Analysis of the results showed that although APCs have favorable clinical outcomes and promote bone formation in the short term, no significant additional long-term effects were observed. It was concluded that, despite the benefit in soft tissue healing, the application of APCs needs more high-quality studies to identify the most potent material for breast augmentation. Other reviews, however, point to benefits related to the quality and acceleration of healing. Otero et al. (2022) conducted a systematic review with the aim of analyzing the regenerative efficacy of PRF. The methodology involved a search in three databases, resulting in the inclusion of 16 articles. The conclusion suggests that the application of PRF seems to be effective in reducing the time required for bone neformation. In line with this observation, the systematic review by Malcangi et al. (2023), which analyzed 22 publications with the aim of providing an overview of recent research on growth concentrates, concluded that these improve initial vascularization, reduce inflammation and postoperative pain, and accelerate healing. The review by Ortega-Mejia et al. (2020) also concluded that, although there is no robust evidence for the isolated use of platelet concentrates, their use with other grafts can improve healing time and bone formation.

The analysis of individual clinical trials and histological studies allows a deeper understanding of the action of PRF in shorter healing periods. Reis et al. (2025) conducted a *split-mouth* RCT with the aim of evaluating the combination of DBBM with horizontal centrifugation PRF (H-PRF) after a 4-month period. The method involved 13 patients who underwent bilateral SLN. Bone tissue samples were evaluated by micro-CT and histomorphometry. The histomorphometric results showed a significantly higher amount of newly formed bone in the test group () compared to the control group (). The conclusion was that the combination with H-PRF improved the formation of new bone in a reduced healing period. The biological rationale for this acceleration was investigated by Yu et al. (2023) in a preclinical study in rabbits. The objective was to histologically investigate tissue responses in the initial phases (3, 7 and 14 days). The methodology compared DBBM grafts alone with DBBM + H-PRF. The results showed that the H-PRF group had greater infiltration of immune cells and accelerated formation of new blood vessels. The conclusion was that H-PRF accelerates the initial phases of healing.

The combination with synthetic materials was also investigated. Francisco et al. (2024), in a series of *split-mouth* cases, aimed to evaluate the combination of PRF with synthetic hydroxyapatite (NanoBone®). The methodology compared NanoBone® alone with

the combination NanoBone® + liquid PRF in six patients, with biopsies collected after 6 months. The PRF group had a higher percentage of new vital bone () compared to the control (), concluding that the addition of liquid PRF seems to slightly increase the amount of bone formed. In the long term, the stability of the implants in these areas appears to be high. Alves et al. (2024) conducted a case series with the objective of evaluating the success of implants in atrophic maxillae grafted with hydroxyapatite and L-PRF. The analysis of 69 implants in 9 patients, with a median follow-up of three years, showed a success rate of 98.5%, concluding that the strategy is feasible and offers long-lasting clinical results.

The use of PRF as the only graft material was also explored. Huang et al. (2025) conducted an RCT with the aim of comparing the use of Advanced Platelet-Rich Fibrin (A-PRF) as the sole material versus a xenograft in LS by the hydraulic technique. The method involved 40 patients, and the results showed 100% survival of the implants in both groups, with no statistically significant difference in bone regeneration between them. It was concluded that A-PRF alone can be a viable alternative to xenograft. In a minimally invasive approach, Choudhary et al. (2022) aimed to evaluate the outcomes of indirect SLN with hydraulic pressure, using PRF as the only material in 24 patients. The results showed a significant increase in ridge height and ISQ six months after surgery, concluding that the technique is effective.

Awad et al. (2025) conducted a case series with the objective of evaluating bone gain and implant stability in single-stage lateral access SLN, using PRF prepared with titanium tubes (T-PRF) as the only graft material. The methodology included 7 cases of SLN in 6 patients, with residual bone height of 4-5 mm, in which 14 implants were installed simultaneously. Evaluations were made by CBCT and ISQ measurement. The results showed an average increase in bone height of 7.54 mm after 6 months, with a progressive and significant increase in ISQ values. The conclusion was that the use of T-PRF as the sole graft material is effective for single-stage LS. The narrative review by Valentini et al. (2025), analyzing the literature up to March 2023, reinforces that L-PRF alone seems to be a predictable graft material for single-stage approaches.

Surgical technique and patient comfort are also relevant factors. Lv et al. (2022) performed an RCT with the aim of comparing SLN via flapless osteotome (PESS), using PRF as the single graft, with the lateral window approach (LSFE) using DBBM. The methodology evaluated outcomes reported by 40 patients. The PESS group reported significantly less pain and swelling, leading to the conclusion that this approach with PRF is more tolerable for the patient and a reliable alternative despite the lower radiographic height gain compared to LSFE with DBBM.

Finally, the versatility of PRF extends to the management of complications. Salgado-Peralvo et al. (2022) reported a series of three cases with the aim of showing the results of the use of L-PRF in the treatment of Schneider membrane perforations. The methodology involved the repair of perforations from 3 to >5 mm. The results showed a statistically significant bone height gain after 6 months and 100% survival of the implants, concluding that L-PRF simplifies membrane repair. Powell et al. (2022), in a series of cases, aimed to present three distinct applications of L-PRF in LS, including a case of membrane perforation repair, concluding that L-PRF appears to have beneficial effects. Mitrea et al. (2023), in their review, also aimed to discuss the application of PRF in complex cases, such as the presence of intrasinusal mucocele, describing the use of "sticky bone" and PRF membranes and concluding that the technique is a viable solution to simplify treatment and manage complications.

5 DISCUSSION

In-depth analysis of the studies selected in this literature review reveals a complex picture of the efficacy of Platelet-Rich Fibrin (PRF) in maxillary sinus lift procedures. Although there is a consensus on the biological potential of platelet concentrates, their clinical superiority is not universally established, with notable divergences between different levels of evidence and study protocols. The main controversy lies in the quantification of the benefit of adding PRF to osteoconductive biomaterials. Meta-analyses such as that by Almutairi et al. (2025) demonstrate a statistically significant increase in new bone formation with the use of L-PRF. In contrast, other systematic reviews and meta-analyses, such as those by Qiu et al. (2024), Idiri et al. (2023), Damsaz et al. (2020), and Gasparro et al. (2024), found no significant long-term differences, concluding that the evidence is inconclusive or heterogeneous.

A more in-depth analysis of the included articles suggests that this divergence can be explained by the variability in PRF preparation protocols. Studies that used optimized protocols, such as horizontal centrifugation (H-PRF) or those that ensure high leukocyte concentration (L-PRF), tended to report more positive results. The randomized controlled trial (RCT) by Reis et al. (2025), for example, which used H-PRF, found a significantly higher percentage of newly formed bone () in just 4 months of healing. This suggests that the efficacy of PRF is not a monolithic trait, but rather protocol-dependent, an issue raised by Damsaz et al. (2020), who call for standardization to allow for more reliable comparisons.

Another crucial point that emerges from the literature is the distinction between PRF as a *biological accelerator* and as a *volumetric filler material*. Several studies indicate that the

main benefit of PRF may lie in the optimization of early cellular events of healing. The preclinical study by Yu et al. (2023) provides a biological basis for this hypothesis, demonstrating that H-PRF induces greater immune cell infiltration and faster neovascularization in the first 14 days. Clinically, this is reflected in studies such as that of Reis et al. (2025), which found a higher percentage of vital bone in a short healing period. This acceleration effect may allow the reduction of the waiting time for implant installation, as suggested by Otero et al. (2022). However, when the outcome evaluated is long-term final bone gain, this advantage may become less evident. The RCT of Huang et al. (2025), for example, found no significant difference in bone volume between the group with A-PRF alone and the group with xenograft after 12 months of loading, suggesting that, although PRF can accelerate the process, the final volumetric result may be similar to other materials.

The application of PRF as the only graft material represents an area of great clinical interest due to its simplicity and low cost. The results are particularly promising in transcrestal or hydraulic access techniques. Studies such as those by Choudhary et al. (2022) and Huang et al. (2025) have demonstrated high implant survival rates and satisfactory bone gain with this approach. The case series by Awad et al. (2025) reinforces this idea, showing a mean bone gain of 7.54 mm and a progressive increase in the Implant Stability Quotient (ISQ) when using T-PRF as a single graft. The narrative review by Valentini et al. (2025) considers that, for isolated use in lateral window approaches, it is crucial to simultaneously place the implant to act as a "support pillar" and avoid the collapse of the created space. This indicates that the predictability of PRF as a single graft is directly related to the mechanical stability of the framework.

Perhaps the least controversial and most universally accepted application of PRF, according to the literature analyzed, is in the management of intraoperative complications, especially Schneider membrane perforation. The case reports of Salgado-Peralvo et al. (2022) and Powell et al. (2022) consistently demonstrate that the PRF membrane functions as an effective and easy-to-handle biological sealant that allows the continuity of the surgical procedure with high predictability of success. The material's versatility in complex cases, such as the presence of mucocele, has also been described, solidifying PRF not only as a regenerative additive, but as a valuable tool in the surgeon's arsenal.

The clinical implications of this review suggest that the decision to use PRF should be judicious. For surgeons looking to accelerate bone maturation and potentially reduce treatment time, the addition of PRF, especially with optimized protocols, appears to be a biologically based strategy. In minimally invasive techniques, PRF as a single material is a viable alternative. In all procedures, having PRF available is a prudent measure for the

management of possible membrane perforations. However, for the clinician who seeks only the maximum long-term bone volume gain, the literature does not offer a definitive answer that justifies the superiority of PRF over conventional xenografts. In addition, patient morbidity appears to be consistently lower in PRF-treated groups, with reports of less postoperative pain and swelling, as demonstrated by Lv et al. (2022).

Finally, the joint analysis of the articles shows important gaps in knowledge. The main one is the absence of long-term multicenter RCTs that directly compare the different PRF protocols (L-PRF, A-PRF, H-PRF, T-PRF) with each other and against the gold standard (autogenous bone) in the same clinical condition. Most studies have small sample sizes and relatively short follow-up periods, focusing on initial healing. Future studies should seek not only the standardization of protocols, but also include histomorphometric analyses to accurately quantify the quality of the bone formed, overcoming the limitations of purely radiographic evaluations, as pointed out in the review by Gasparro et al. (2024) and Ortega-Mejia et al. (2020).

6 CONCLUSION

The analysis of the literature on Platelet-Rich Fibrin (PRF) in maxillary sinus surveys reveals a promising field of study, but marked by a remarkable heterogeneity of evidence. The present literature review, based on the analysis of 20 studies, including randomized controlled trials, systematic reviews and meta-analyses, allows us to draw multifaceted conclusions about the efficacy and indications of this autologous biomaterial.

The benefit most consistently reported in the literature does not necessarily lie in a higher final bone volume gain than conventional grafts, but rather in their ability to act as a biological accelerator. Histological and clinical studies have shown that PRF optimizes the early phases of healing, promoting a more controlled inflammatory response, accelerated angiogenesis, and faster bone maturation. This characteristic can, clinically, translate into a reduction in the waiting time for implant installation, representing a significant advantage in the treatment plan. In addition, its application in the management of complications, such as Schneider membrane perforation, represents a clinical consensus, being an effective, low-cost, and highly predictable solution.

The main cause for the divergent conclusions between the high-level of evidence meta-analyses seems to lie in the variability of the preparation protocols (L-PRF, A-PRF, H-PRF) and the heterogeneity of the study designs. Evidence suggests that optimized protocols, which preserve a higher concentration of leukocytes and growth factors, present superior results, indicating that the efficacy of PRF is protocol-dependent. In addition, the use

of PRF as the only graft material proved to be a viable and predictable alternative, especially in transcrestal and hydraulic access techniques, offering lower postoperative morbidity to the patient.

From a clinical point of view, the present review indicates that the decision to incorporate PRF into maxillary sinus lift procedures should be based on specific therapeutic goals. If the goal is to accelerate healing or manage a complication, its use is strongly based. If the intention is to use it as a single graft in minimally invasive approaches, the technique is promising. However, if the only objective is to maximize long-term bone volume gain in large reconstructions, the literature does not conclusively support its superiority over conventional xenografts.

Finally, the literature analyzed shows important gaps that should be addressed by future research. The lack of multicenter randomized controlled trials, with larger sample sizes, long-term follow-up, and, crucially, with standardized PRF preparation protocols, prevents the formulation of definitive clinical guidelines. It is essential to carry out studies that directly compare the different PRF protocols with each other and against the gold standard (autogenous bone), with histomorphometric analyses for an accurate assessment of bone quality, in order to consolidate the role of this versatile biomaterial in regenerative implantology.

REFERENCES

Almutairi, M., et al. (2025). Leukocyte-platelet-rich fibrin combined with demineralized bovine bone mineral for maxillary sinus augmentation: A systematic review and meta-analysis of randomized controlled trials. Cureus, 17(6), Article e85306.

Alves, M. A. L., et al. (2024). Long-term success of dental implants in atrophic maxillae: A 3-year case series using hydroxyapatite and L-PRF. Bioengineering, 11(12), Article 1207.

Awad, Z. I., & Beit, Z. Z. K. (2025). The use of platelet-rich fibrin prepared with titanium tubes (T-PRF) in external maxillary sinus lift combined with simultaneous implant placement (case series). International Journal of Surgery Case Reports, 136, Article 111994.

Choudhary, S., et al. (2022). Outcomes following hydraulic pressure indirect sinus lift in cases of simultaneous implant placement with platelet-rich fibrin. Cureus, 14(8), Article e28087.

Damsaz, M., et al. (2020). Evidence-based clinical efficacy of leukocyte and platelet-rich fibrin in maxillary sinus floor lift, graft and surgical augmentation procedures. Frontiers in Surgery, 7, Article 537138.

Francisco, L., et al. (2024). Sinus floor augmentation with synthetic hydroxyapatite (NanoBone®) in combination with platelet-rich fibrin: A case series. Biomedicines, 12(8), Article 1661.

Gasparro, R., et al. (2024). Effectiveness of autologous platelet concentrates in the sinus lift surgery: Findings from systematic reviews and meta-analyses. Dentistry Journal, 12(4), Article 101.

Huang, L.-R., et al. (2025). Hydraulic sinus floor elevation using advanced platelet-rich fibrin: A randomized clinical trial with two-dimensional radiographic results. Journal of Prosthodontic Research, 69(2), 275–284.

Idiri, K., et al. (2023). The effectiveness of the addition of platelet-rich fibrin to bovine xenografts in sinus and bone ridge augmentation: A systematic review. Journal of Functional Biomaterials, 14(7), Article 389.

Lv, H., et al. (2022). Flapless osteotome-mediated sinus floor elevation using platelet-rich fibrin versus lateral approach using deproteinised bovine bone mineral for residual bone height of 2-6 mm: A randomised trial. Clinical Oral Implants Research, 33(7), 700–712.

Malcangi, G., et al. (2023). Maxillary sinus augmentation using autologous platelet concentrates (platelet-rich plasma, platelet-rich fibrin, and concentrated growth factor) combined with bone graft: A systematic review. Cells, 12(13), Article 1797.

Mitrea, M., et al. (2023). The sinus lift procedure applied in cases where the thickness of the alveolar bone is insufficient using double PRF as well as in the case of an intrasinus mucocele. Romanian Journal of Oral Rehabilitation, 15(1), 66–81.

Ortega-Mejia, H., et al. (2020). Platelet-rich plasma in maxillary sinus augmentation: Systematic review. Materials, 13(3), Article 622.

Otero, A. I. P., et al. (2022). Sinus lift associated with leucocyte-platelet-rich fibrin (second generation) for bone gain: A systematic review. Journal of Clinical Medicine, 11(7), Article 1888.

Powell, C. A., et al. (2022). The application of leukocyte- and platelet-rich fibrin (L-PRF) in maxillary sinus augmentation. Clinical Advances in Periodontics, 12(4), 277–286.

Qiu, P., et al. (2024). Assessment of the efficacy of autologous blood preparations in maxillary sinus floor elevation surgery: A systematic review and meta-analysis. BMC Oral Health, 24(1), Article 1171.

Reis, G. G. D., et al. (2025). Sinus floor elevation with platelet-rich fibrin from horizontal centrifugation and xenograft: Randomized clinical trial. Clinical Implant Dentistry and Related Research, 27, Article e70093.

Salgado-Peralvo, A.-O., et al. (2022). Treatment of sinus membrane perforations during sinus lift surgeries using leukocyte and platelet-rich fibrin: A report of three cases. Journal of Clinical and Translational Research, 8(5), 360–368.

Valentini, P., et al. (2025). APCs in sinus floor augmentation. Periodontology 2000, 97(1), 254–270.

Yu, S., et al. (2023). Early tissue and healing responses after maxillary sinus augmentation using horizontal platelet rich fibrin bone blocks. BMC Oral Health, 23(1), Article 589.