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TEN-YEAR ANALYSIS OF SCIENTIFIC EVIDENCE REGARDING THE USE OF THE STICK BONE TECHNIQUE IN MAXILLARY SINUS LIFT - LITERATURE REVIEW

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Abstract: The stick bone technique is a maxillary sinus augmentation technique that consists of associating the fibrin-rich platelet concentrate (PRF) membrane with freeze-dried bone. The objective of the present study is to present a literature review regarding the scientific evidence on the use of the stick bone technique. Therefore, searches for publications were carried out in the PubMed and Virtual Health Library databases, using the following inclusion criteria: theme; publication period from 2013 to 2023; Portuguese and/or English language. Only seven systematic reviews were found. No standards were observed in the composition of PRF and L-PRF. The results suggest that although stick bone is frequently used in implant dentistry, its use for the formation of mature bone remains inconclusive. Therefore, it is necessary for new studies to be carried out, based on randomized clinical trials, to provide results that can guide clinical decision-making, as well as to standardize and regulate preparation protocols for the implant installation procedure.
Keywords: maxillary sinus, maxillary sinus lift, platelet-rich fibrin

INTRODUCTION

The maxillary sinus is a pneumatic bone structure that commonly presents atrophy in its edentulous posterior areas and insufficient height for the installation of dental implants. Given this, several techniques were developed with the aim of enlarging the maxillary sinus in an attempt to overcome the challenge of rehabilitation of this region and increase the treatment success rate (BATHLA; FRY; MAJUMDAR, 2018; KARAGAH et al., 2022; LUNDGREN et al., 2017).

Maxillary sinus augmentation is a surgical technique that aims to reestablish the position of Schneider's membrane. This technique consists of using autogenous, xenogeneic or allogeneic bone grafts and biomaterials or a combination of both to adapt the recipient bone bed, allowing the adequate osseointegration process (STARCH-JENSEN; JENSEN, 2017). This surgical procedure has a relatively long healing time due to the low rate of vascularization of the sinus cavity. For this reason, platelet fibrin concentrate (PRF) has been increasingly used to promote vascularization and improve local healing (MIRON; PIKOS, 2018).

One of the maxillary sinus enlargement techniques is stick bone. This technique consists of associating the fibrin-rich platelet concentrate (PRF) membrane with freeze-dried bone. The stick bone technique has some advantages and has shown to produce extremely satisfactory results, allowing greater revascularization of the bone graft material and consequently better healing in less time. Furthermore, the cost-effectiveness ratio of PRF has been favorable for obtaining elastic and hemostatic fibrin from the patient's blood without concern about rejection (FORTUNATO et al., 2018; GURLER; DELILBASI, 2016; KERHWALD et al., 2021; OTERO et al., 2022)

Although the application of fibrin-rich platelet concentrate (PRF) for sinus floor augmentation has been widely investigated in the literature, its biological properties and the real efficacy of this product remain controversial (KARAGAH et al., 2022). According to Batas et al. (2019), the use of PRF surpassed the benefits of using first-generation cryoprotective agents (ACP), due to the addition of platelet-rich growth factors (PRGF), associated with Bio-Oss ® graft to increase the floor of the maxillary sinus. However, it did not improve bone growth six months after surgery when compared to bone grafting alone.

Therefore, the objective of this study is to present scientific evidence published in

the last ten years regarding the Stick Bone technique for maxillary sinus lifting.

METHODOLOGY

The literature review was carried out by searching for scientific articles in the PubMed Central (PMC) and Virtual Health Library (VHL) databases using the following Health Sciences Descriptors (DeCS): maxilla sinus; platelet-rich fibrin; sinus floor augmentation.

As inclusion criteria, all studies that addressed maxillary sinus lifting with xenogenic material associated with the use of fibrin-rich platelet concentrate and that were published in the last ten years (2013 – 2023) were considered. Furthermore, only studies carried out on humans and published in English and Portuguese were considered. As the number of randomized clinical trials and meta-analysis was very limited, all levels of evidence were included in this review. In a complementary way, some relevant bibliographic references were added to build a better understanding of the theme of this article.

LITERATURE REVIEW

The maxillary sinus after dental extractions undergoes reanatomization of the remaining bone due to osteoclastic activity, this change being one of the main factors in pneumatization of the site (ABLA et al., 2009).

Thus, bone augmentation techniques have been increasingly recommended to restore adequate bone height and volume for treatments with dental implants, especially in severely atrophic posterior maxilla, where perforation of Schneider's membrane is a very common complication and elevation or of the sinus floor is often considered a standard procedure (DAMSAZ et al., 2020).

According to Batista et al. (2011), the osseointegration of implants, placed in the maxilla associated with the elevation of the maxillary sinus, takes into consideration, the height of the remaining bone, the size of the access window to the maxillary sinus and the selection of bone height, which is one of the fundamental conditions to perform an examination of the maxillary sinus. Therefore, when the height of the remaining alveolar bone of the posterior maxilla is between 1 and 4 mm, it is most appropriate to perform a traumatic lifting of the maxillary sinus, wait for the graft to heal and then install the implant. When the remaining bone is between 5 and 7 mm, installation of the implant associated with lifting the maxillary sinus (amount of bone that guarantees primary stability) is indicated. And finally, when this height is equal to or greater than 8 mm, the use of osteotomes is permitted to elevate the maxillary sinus without trauma (BATISTA; JUNIOR; WICHNIESKI, 2011).

In addition to maxillary sinus lifting techniques, various biomaterials and bone substitutes can be used to augment the region. Cytokines and growth factors, for example, have the function of stimulating angiogenesis, increasing bone formation, as well as improving the healing and recovery period, either alone (with a single filling material) or in combination with materials bone substitutes (DAMSAZ et al., 2020).

Bone reconstructions have been recommended through grafts, in blocks or particles, with osteoinductive, osteoconductive and osteogenic properties, depending on the type of graft used. When the graft involves a lyofinized bone matrix associated with platelet-rich fibrin, it will be known as Stick Bone (KERHWALD et al., 2021), a technique with satisfactory regeneration of maxillary bone tissue, as it allows a vertical increase of more than 9 mm (SANTOS et al., 2017; WU et al., 2012). Platelet concentrates are the result of simple centrifugation of whole blood samples collected from the patient, immediately before

surgery, represented by fibrin-rich platelet concentrate (PRF) or pure platelet-rich fibrin (P-PRF) and leukocytes and platelet-rich fibrin. or subclasses (L-PRF) are receiving the most attention in treatment, due to their simplicity, speed, ease of use/malleability and cost-effectiveness with promising clinical results (DAMSAZ et al., 2020).

Regarding the obtaining of platelet-rich fibrin in liquid phase, this occurs through chemical intervention in the coagulation cascade, promoting its delay due to non-activation, which makes its methodology very different from platelet-rich plasma (PRP). Thus, there is evidence that there is an optimized angiogenic and reparative response with the use of a clot enhanced by concentrating a denser fibrin network, enriched by adhesive glycoproteins, a high concentration of platelets, circulating microparticles and mononuclear leukocytes. Furthermore, neovasculogenesis and the accommodation of undifferentiated cells orchestrating new bone formation can be favored by synergism with blood elements and bone grafts (SANTOS et al., 2017).

Despite the evidence cited above, the use of L-PRF in maxillary sinus augmentation procedures in ridge augmentation procedures could not be adequately evaluated due to the scarcity of studies on the subject in the literature. The limited evidence on the effects of L-PRF in intraoral bone grafting procedures highlights the need for further research to fully evaluate its clinical indications, with an emphasis on applying standardized protocols for the preparation of this autologous product (DRAGONAS et al., 2019).

According to Strauss et al (2018), breast lift procedures are highly effective but not free from complications. Complications associated with sinus floor elevation include graft resorption, membrane perforation, or sinusitis. Two studies met the inclusion criteria in the systematic review. According to Nizam et al. (2018), after 1 year of follow-up, the implant survival rate was 100%, the same rate observed by Tatullo et al (2012) after 3 years, regardless of the use of PRF. Both studies combined PRF with DBBM (deproteinized bovine bone mineral). Furthermore, PRF did not change bone formation, soft tissue area, resorption of residual bone grafts and increased bone height (NIZAM et al., 2018). It is important to highlight that because these studies did not report membrane perforations and sinusitis, making it impossible to draw any conclusions about its potential benefit in the management of complications.

Although in vitro and preclinical data encourage the use of PRF in sinus floor elevation (MIRON et al., 2017), clinical evidence collected to date does not support its use. In summary, inconclusive results are reported on PRF in sinus floor elevation procedures, and well-designed studies with appropriate outcomes are needed. Therefore, the effect of PRF on bone regeneration during sinus floor elevation remains questionable.

According to the meta-analysis produced by Liu et al. (2019) PRF does not provide additional benefits compared to non-PRF groups regarding bone formation, although it may help reduce healing time. The results of these studies indicate no differences in survival rate, new bone formation, contact between newly formed bone and bone substitute, percentage of residual bone graft, and soft tissue area between non-PRF and PRF groups. Furthermore, PRF preparation, which is time-consuming, and blood collection can contribute to patient discomfort. Therefore, the use of PRF as an adjuvant material to bone grafting in breast augmentation is not currently recommended for routine use due to limited evidence. Therefore, the authors state that new studies must still be carried out, because different PRF preparation techniques can contribute to a large bias and future clinical

trials must be better designed, adopting long-term follow-ups to support decision-making based on evidence. more robust.

The authors Damsaz et al (2020) did not observe any significant effect in studies that used deproteinized bovine bone mineral in combination with L-PRF, only 40% of these declared positive effects. Of the two articles that used allogeneic bone grafting, 50% declared no significant effects and 50% acclaimed positive effects. Only one study used L-PRF as the sole graft material and reported a positive effect. Due to the heterogeneity of the included studies, this review is limited by the inability to perform an adequate systematic meta-analysis. Mature bone formation remains inconclusive in sinus lift procedures. More studies are eagerly awaited to prove the beneficial or harmful effects of PRF, as well as to reach a conclusion on the effect of leukocytes (and their inclusion) on inflammation or edema and pain; a call for standardization in PRF and L-PRF composition reporting and regulation of preparation protocols.

According to a systematic review on PRP in maxillary sinus augmentation by Ortega Mejia et al. (2020), there is no robust evidence regarding the beneficial effects of the exclusive use of platelet concentrates. However, some studies have shown favorable results regarding implant survival, bone gain and bone height. The use of PRF with other graft biomaterials does not appear to provide additional beneficial effects in breast lift procedures, but may improve the healing period and bone formation. The authors further suggest that further well-conducted randomized controlled trials (RCT) are needed to confirm the available results to provide recommendations for clinical practice. However, it is worth highlighting that in the studies analyzed in the systematic review organized by Ortega-Mejia et al. (2020) present limitations regarding the lack of high-quality evidence and the results must be interpreted with caution. Most available studies are heterogeneous in terms of intervention, comparison, and outcome measures, making direct comparisons on a much larger scale difficult and making it impossible to accurately estimate the beneficial effects of PRF.

This way, Ortega-Mejia et al. (2020) warn that there is a lack of evidence provided by randomized studies related to the effects of PRF as the sole graft material in atrophic maxillary sinus lifting procedures (< 5 mm). Preliminary studies have described positive results in one-stage implant placement protocols regarding bone gain and implant survival, but it is necessary to compare the use of PRF alone with the use of other biomaterials or the use of PRF in addition to other biomaterials to evaluate its effectiveness.

In a systematic review organized by the authors Canellas et al (2021), six bone substitute materials were analyzed: Bio-Oss® (Geistlich Pharma), InduCera® Dual Coat, Lumina-Bone Porous® (Critéria), Osseous® (SIN - System of Implants Nacional), THE Graft® (Purgo Biologics), and Osteoplant Osteoxenon® (Bioteck). P-score estimation showed that Osteoplant Osteoxenon® produced the most newly formed bone and resorbed faster than other xenograft materials after six months. The combination of Bio-Oss® plus bone marrow aspirate concentrate (BMAC) significantly increased the percentage of newly formed bone compared to Bio-Oss® alone. In contradiction, the addition of Emdogain® (Straumann) and leukocyte and platelet rich fibrin (L-PRF) to Bio-Oss® did not significantly improve the amount of regenerated bone. Study-level data indicated that the percentage of newly formed bone differs between commercially available xenograft materials. Only Osteoplant Osteoxenon® appears to result in the greatest amount of new bone in maxillary sinus lifting.

In another systematic review, Otero et al (2022) suggest that there is a greater risk of implant failure after a breast lift in patients with residual bone ≤ 4 mm, however the application of PRF was effective, suggesting a reduction in the time needed for bone formation new on site. These authors analyzed several studies published between 2006 and 2020, verifying results of maxillary sinus elevation in clinical studies, using PRF (second generation) alone or in conjunction with other biomaterials, regarding the clinical outcome associated with bone density gain. in at least three months of follow-up. They found a consensus that several biomaterials could be used in sinus elevation procedures, due to the high osteogenic potential of the Schneiderian membrane. However, the adjuvant biomaterial most used by researchers was Bio-Oss® (Geistlich Pharma AG, Wolhusen, Switzerland).

Despite this information, it is important to highlight that the systematic review by Otero et al (2022) has limitations due to confounding variables that can affect the success of breast lift treatment, making direct comparison of published reports difficult due to the wide variety of study designs, as well as patient age and sex, smoking status or not, implants placed or not, follow-up intervals, use or not of a PRF or collagen membrane to cover the graft, and amount of residual bone height between the sinus floor and the alveolar crest (OTERO et al., 2022).

Still regarding limitations observed in the last systematic review mentioned, it is important to highlight that the exact amount of bone gain was not reported by all the studies analyzed. Some have relied solely on two-dimensional x-ray images to demonstrate a significant amount of bone gain. Regarding the implant stability quotient, it was reported in two ways, using implant resistance or resonance frequency analysis (RFA), an important measure to evaluate the stability of the dental implant that can be measured from 1 to 100, being the range of 55 to 85 is considered adequate to declare the stability of the implant and the comprehensive development of osseointegration (OTERO et al., 2022).

RESULTS AND DISCUSSION

Seven systematic reviews published within the proposed methodology were found, 01 article from 2018, 02 articles from 2019, 02 articles from 2020, 01 article from 2021 and 02 articles from 2022. The studies presented published evidence with a careful analysis of 58 studies selected by the authors to evaluate the use of PRF in Implant Dentistry, according to table 1, gathering information based on randomized clinical studies or control groups for analysis. Thus, it was possible to obtain the results of evidence on healing, preservation of the bone ridge, in use in association with other materials, comparison of materials in the process of maxillary sinus enlargement,

The studies by Canellas et al. (2021), Damsaz et al. (2020), Ortega-Mejia et al. (2020), Santos et al. (2017) corroborate each other that the use of platelet concentrates and evidence of angiogenic, reparative and neovasculogenesis responses are important for new bone formation. However, in the systematic reviews by Dragonas et al. (2019) and Strauss et al. (2018), Ortega-Mejia et al. (2020), Damsaz et al. (2020) and Canellas et al. (2021) point out that there is limited evidence on the effects of L-PRF in intraoral bone graft procedures and highlight the need for more research to fully evaluate its clinical indications, although it can help reduce the time of healing.

Regarding the percentage of newly formed bone, according to the systematic review by Canellas et al. (2021), differs between commercially available xenograft materials. The studies by Damsaz et al. (2020) and

The use of platelet-rich fibrin to enhance the outcomes of implant therapy: A systematic review - (STRAUSS; STÄHLI; GRUBER, 2018).
Moderate evidence for ridge preservation and in the initial phase of osseointegration; there was no conclusion as to whether the use of PRF helps reduce pain and improve soft tissue healing; no meta-analysis was performed due to the heterogeneity of study designs.
Effects of leukocyte– platelet- rich fibrin (LPRF) in different intraoral bone grafting procedures: a systematic review (DRAGONAS et al., 2019).
Modest positive effect of LPRF use compared to natural healing in extraction sockets due to decreased postoperative pain and ridge remodeling; no positive effect was observed with the use of L-PRF on maxillary sinus enlargement because it was reported by only one study; it was not possible to analyze the use of LPRF for ridge augmentation.
Effectiveness of platelet-rich fibrin as an adjunctive material to bone graft in maxillary sinus augmentation: a metanalysis of randomized controlled trails (LIU et al., 2019).
Evidence supporting the addition of PRF to bone graft for sinus augmentation is limited; It is still unknown whether the addition of PRF to bone grafts improves the effectiveness of maxillary sinus augmentation; no meta-analysis was performed due to the heterogeneity of study designs.
Evidence-based clinical efficacy of leukocyte and plateletrich fibrin in maxillary sinus floor lift, graft and surgical augmentation procedures (DAMSAZ et al., 2020).
Several techniques for preparing the LPRF were observed, demonstrating that the conclusion about the comparison of these studies requires caution; most studies reported that L-PRF as a graft material in maxillary sinus augmentation and restorative procedures (alone or combined); it was inconclusive whether the use of L-PRF in maxillary sinus elevation, treatment of Schneider membrane and formation of mature bone is better than other techniques; authors suggest standardization in PRF and L-PRF composition reports and regulation of preparation protocols; no adequate meta-analysis was performed due to the heterogeneity of study designs.
Platelet-rich plasma in maxillary sinus augmentation: systematic review (ORTEGA-MEJIA et al., 2020)
There is no robust evidence to make conclusions about the beneficial effects of exclusive use of platelet concentrates in enlarged sinusitis; there were favorable results in relation to implant survival, bone gain and bone height.; The combination of PRF with other biomaterials does not appear to be better for breast lifting, but may improve the healing period and bone formation.
Xenograft materials in maxillary sinus floor elevation surgery: a systematic review with network meta-analyses (CANELLAS et al., 2021)
The proportion of newly formed bone differed between commercialized xenograft materials; the greatest amount of new bone (maxillary sinus enlargement) appears to be observed with Osteoplant Osteoxenon®.
Sinus lift associated with leucocyte-plateletrich fibrin (second generation) for bone gain: a systematic review (OTERO et al., 2022).
Despite the limitations of the study, it was suggested that the greater risk of implant failure may be associated with an increase in residual bone ≤ 4 mm; the use of PRF may be associated with shorter time for new bone formation.

Table 1 – Presentation of the conclusion of studies of scientific evidence from systematic reviews over the last ten years

Santos et al. (2017) corroborate each other regarding the use of platelet concentrates and the evidence of angiogenic and reparative response, neovasculogenesis are important for new bone formation. The systematic reviews by Dragonas et al. (2019) and Strauss et al. (2018), Ortega-Mejia et al. (2020) and Damsaz et al. (2020) point out that there is limited evidence on the effects of L-PRF in intraoral bone graft procedures and highlight the need for more research to fully evaluate its clinical indications, even though it can help reduce healing time (OTERO et al., 2022).

From the analysis of six bone substitute materials, Canellas et al. (2021) stated that the addition of Emdogain® (Straumann) and leukocyte and platelet rich fibrin (L-PRF) to Bio-Oss® did not significantly improve

the amount of regenerated bone and the Osteoplant Osteoxenon® material appears to result in the greatest amount of new bone in maxillary sinus lifting, without the use of PRF, that is, they suggest that the use of PRF would not be considered a primary factor for successful treatment. However, the scientific evidence indicated by the study by Otero et al. (2022) suggests a reduction in bone formation time with the use of PFR and a gain in bone density in at least three months of follow-up.

The most current systematic review on the subject still warns about there being a greater risk of implant failure after maxillary sinus elevation in patients with residual bone ≤ 4 mm, a risk not mentioned in any other systematic review. There was consensus in the scientific evidence analyzed about the limitations of the studies due to confounding variables to allow comparisons of results, in addition to the lack of standardization in study designs, different samples and study materials, different follow-up intervals and many of the studies did not analyze adequately determine the amount of residual bone height between the sinus floor and the alveolar crest (OTERO et al., 2022).

Finally, it is worth mentioning that variations in blood collection techniques to obtain leukoplatelet fibrin are a critical point in the method. To minimize the time preceding centrifugation is essential so that the fibrin mesh only forms during centrifugation and in the absence of red blood cells for use in dentistry. Furthermore, the centrifugation force applied to obtain PRF can generate different types of products, which may compromise technical results. Thus, the lack of standardization of procedures and different types of publication designs may result in inconclusive results.

FINAL CONSIDERATIONS

The association of the platelet concentrate membrane rich in fibrin (PRF) with freeze-dried bone in maxillary sinus lifting, a technique also called Stick Bone, despite being recommended in dentistry, still has important knowledge gaps that make clinical decision-making impossible. Thus, several studies point to the need for further investigations, based on randomized clinical trials, to provide more robust results, considering that in the last ten years, only seven systematic reviews have been published on the subject, demonstrating a lack of scientific evidence in the period.

The formation of mature bone remains inconclusive in sinus lift procedures and the need for standardization in PRF and L-PRF composition reports and regulation of preparation protocols in dentistry is suggested and it is important to highlight that the use of the Stick technique Bone must also consider the biological responses of each patient and try to verify the PRF formation technique, because they can compromise the formation of clots early and interfere with the success of the treatment.

Dental surgeons who wish to use the Stick Bone technique must also consider each patient's biological responses and try to verify the PRF formation technique because it can compromise clot formation early and interfere with the success of the treatment.

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