

Guided bone regeneration in the anterior maxilla after tooth extraction and implant removal with sticky bone and L-PRF membrane in two surgical approaches

Regeneração óssea guiada na maxila anterior após exodontia e remoção de implante com osso misto e membrana de L-PRF em duas abordagens cirúrgicas

Regeneración ósea guiada en el maxilar anterior después de la extracción dental y la eliminación del implante con hueso mixto y membrana de L-PRF en dos abordajes quirúrgicos

Received: 08/15/2021 | Reviewed: 08/22/2021 | Accept: 08/23/2021 | Published: 08/24/2021

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Abstract

The main requirement for the insertion of dental implants is a good bone and gum condition and guided bone regeneration (GBR) combines grafts and membranes to increase such parameters in tissue deficiencies and thus achieve treatment success. This clinical case reports the oral rehabilitation of the anterosuperior area by the association of bone graft, autologous membrane and implantodontic therapy. Female patient, 45 years old, normosystemic, reported aesthetic complaint and implant mobility in the maxilla. Upon clinical and radiographic examination, an implant was diagnosed in the region of tooth 11 with unfavorable esthetics, mobility, inadequate prosthesis and bone loss, and tooth 22 with suppuration, fracture line and periapical radiolucency. The treatment consisted of removal of the implant and tooth 22, with immediate GBR using filling with Bio-Oss® and liquid leukocyte- and platelet-rich fibrin (L-PRF) and coating with L-PRF membrane. After 7 months, the second GBR was performed with the installation of 2 dental implants. After 6 months, healers were placed and 20 days after the adaptation of the provisional implant-supported single prostheses. There was a good gain in thickness and mucogingival limit, bone dimensions in height and thickness, and the case continues to be followed up until the final prosthesis is completed. This case suggests that sticky bone and L-PRF membrane can contribute to multiple GBR in the anterior maxillary region, favoring bone gain and osseointegration.

Keywords: Bone regeneration; Transplantation, autologous; Platelet-rich fibrin; Biocompatible materials.

Resumo

O requisito básico para inserção de implantes dentários é uma boa condição de osso e gengiva e a regeneração óssea guiada (ROG) conjuga enxertos e membranas para aumentar tais parâmetros em deficiências teciduais e assim alcançar o sucesso do tratamento. Este caso clínico relata a reabilitação oral de área anterossuperior pela associação de enxerto ósseo, membrana autóloga e terapia implantodôntica. Paciente do sexo feminino, 45 anos, normossistêmica, relatou queixa estética e mobilidade de implante em maxila. Ao exame clínico e radiográfico, foi diagnosticado na região do dente 11 um implante com estética desfavorável, mobilidade, prótese inadequada e perda óssea e dente 22 com supuração, traço de fratura e radiolucência periapical. O tratamento constou de remoção do implante e do dente 22, com ROG imediata usando preenchimento com Bio-Oss® e fibrina rica em plaquetas e leucócitos (L-PRF) líquida e recobrimento com membrana de L-PRF. Após 7 meses, segunda ROG foi realizada junto a instalação de 2 implantes dentários. Após 6 meses, foram posicionados cicatrizadores e 20 dias após feita a adaptação das próteses unitárias implantossuportadas provisórias. Houve bom ganho de espessura e limite mucogengival, das dimensões ósseas em altura e espessura e o caso continua a ser acompanhado até a finalização das próteses definitivas. Esse caso sugere que

osso misto e membrana de L-PRF podem contribuir para ROG múltipla em região anterior de maxila favorecendo ganho ósseo e osseointegração.

Palavras-chave: Regeneração óssea; Transplante autólogo; Fibrina rica em plaquetas; Materiais biocompatíveis.

Resumen

El requisito básico para la inserción de implantes dentales es un buen estado de los huesos y las encías y la regeneración ósea guiada (ROG) combina injertos y membranas para aumentar dichos parámetros en las deficiencias tisulares y así lograr el éxito del tratamiento. Este caso clínico reporta la rehabilitación oral de la zona anterosuperior mediante la asociación de injerto óseo, membrana autóloga y terapia implantodóncica. Paciente mujer de 45 años normosistémica que refirió molestia estética y movilidad del implante en el maxilar. Al examen clínico y radiográfico se diagnosticó un implante en la región del diente 11 con estética desfavorable, movilidad, prótesis inadecuada y pérdida ósea, y diente 22 con supuración, línea de fractura y radiolucidez periapical. El tratamiento consistió en la extracción del implante y del diente 22, con ROG inmediato mediante relleno con Bio-Oss® y fibrina rica en plaquetas y leucocitos líquida (L-PRF) y recubrimiento con membrana de L-PRF. A los 7 meses se realizó la segunda ROG con la instalación de 2 implantes dentales. A los 6 meses se colocaron curanderos y 20 días después de la adaptación de las prótesis unitarias provisionales implantosoportadas. Se obtuvo una buena ganancia de grosor y límite mucogingival, dimensiones óseas en altura y grosor, y se continúa el seguimiento del caso hasta completar la prótesis definitiva. Este caso sugiere que hueso mixto y membrana de L-PRF pueden contribuir a múltiples ROG en la región anterior del maxilar, favoreciendo la ganancia ósea y la osteointegración.

Palabras clave: Regeneración ósea; Trasplante autólogo; Fibrina rica en plaquetas; Materiales biocompatibles.

1. Introduction

The harmony of the smile in the anterior region of the edentulous maxilla or with an indication for dental extraction challenges the dentist, who seeks the integrity of the support structures for the satisfactory placement of osseointegrated implants and dental prostheses on the implants (Souza *et al.*, 2015). Gingival and bone contours are essential for good esthetics, using surgical techniques for bone and/or gingival filling and implant placement which include: greater vertical apical positioning, distance ≥ 3 mm to another implant or adjacent tooth, adaptation to 2 mm of the cement-enamel junction of the adjacent tooth and fixation in bone dimension to ensure the primary stability of the implant (Tomm & Mezzomo, 2017; Souza *et al.*, 2015).

The maintenance of the alveolar ridge in height and thickness is limited, as the local blood supply decreases with tooth and periodontal loss and there is more accelerated bone atrophy, especially of the thin buccal wall (Ponte, Araújo, Araújo & Castro-Silva, 2019). Some unsatisfactory results in the medium and long term with implants in the esthetic zone may be related to patients with a high smile line, due to the darkening of the gingival margin after rehabilitation, as well as the verticalization of the incisors with aging, whereas the implants seem to become more protrusive (Sobral, 2020).

Whether for technical or physiological reasons, the failure of a dental implant, which needs to be removed or is lost, is another complication that must be diagnosed in time to avoid continuous alveolar bone loss and great aesthetic damage, with a relationship between early failures and overheating, contamination, surgical trauma, low bone quantity or quality, lack of primary stability and indication of incorrect immediate loading, while late failures would result from periimplantitis, occlusal trauma and overload (Levin, 2008). The implant site can be a predictor of its survival, as verified by Fouda (2020) in the systematic review of international thematic studies, with an average of 6.2% of failures in the anterior region of the maxilla greater than 2.5% found in the anterior region of the mandible, related to low maxillary bone density. In a Brazilian sample of 166 patients, there were higher failure rates of grafts and implants in the anterior region of the maxilla (2.4% and 2.6%, respectively) and in patients older than 40 years (Salmen *et al.*, 2017).

Natural ceramic bone grafts and collagen barrier membranes, both of animal or xenogeneic origin, are the most used dental materials for the purpose of Guided Bone Regeneration (GBR) (Araújo *et al.*, 2021; Araújo *et al.*, 2020; Liu & Kerns, 2014). In oral surgery, this technique contributes to the treatment of small to moderate bone defects resulting from periodontal or endodontic disease, filling the socket after extraction, lifting the maxillary sinus or rehabilitation of bone atrophy before

implants and even large bone defects caused by trauma, anodontia, congenital deformities, pathologies and infections involving the maxillofacial complex (Araújo *et al.*, 2020).

Over the last four decades in Brazil, multidisciplinary and translational research has sought to develop and characterize different biomaterials for clinical use (Castro-Silva *et al.*, 2021). In this country, there is high professional satisfaction and its cost is considered moderate, despite the low participation of the patient in choosing the product and the imported origin is greater than national, with greater application in private practice and without associated inflammatory or infectious complications (Araújo *et al.*, 2020). Despite the large multifactorial demand for orofacial bone loss, the use of biomaterials for GBR in public health is still incipient, given the chronic underfunding in the care network for this type of therapy in Brazil (Castro-Silva, Lima & Granjeiro, 2014).

Leukocyte- and platelet-rich fibrin (L-PRF) is an autologous matrix obtained by immediate centrifugation of blood collected from the patient in the dentist's office, according to the Resolution of the Federal Council of Dentistry n. 158/2015, exhibiting a high concentration of growth factors and defense cells that provide angiogenic, osteogenic and antibacterial effects, reducing surgical sequelae of pain and infection (Castro-Silva, 2018; Takamori, Teixeira, Menezes, Carias & Borojevic, 2018). The absence of ethical conflicts, non-immunogenicity, high plasticity for different host beds, low morbidity and practicality of obtaining it can make the treatment with PRF very attractive (Ponte *et al.*, 2019). The multiplicity of PRF preparation protocols and clinical uses, such as barrier membrane for dental socket, filling buffer or gel for association with bone graft fragments (sticky bone) contributes to the heterogeneous results reported in the literature regarding the regeneration of soft and hard tissue in isolated form or associated with biomaterials (Castro-Silva, 2018).

The aim of this study was to report a clinical case of oral rehabilitation of the anterior maxillary region by the use of guided bone regeneration, by the association of mixed bone graft and autologous membrane, combined with implantodontic and prosthetic therapy.

2. Methodology

The study followed a clinical case report typology. According to Pereira, Shitsuka, Parreira and Shitsika (2018), a case report consists of a description and analysis, as detailed as possible, of a condition that presents some particularity that makes it special and contributes to scientific knowledge. It is an empirical investigation of a contemporary phenomenon within its real-life context, with a tendency to try to clarify decisions; why they were taken, how they were implemented and what were the results (Yin, 2015). This case report was carried out in accordance with the international requirements of the CARE guide for clinical reporting (Riley *et al.*, 2017).

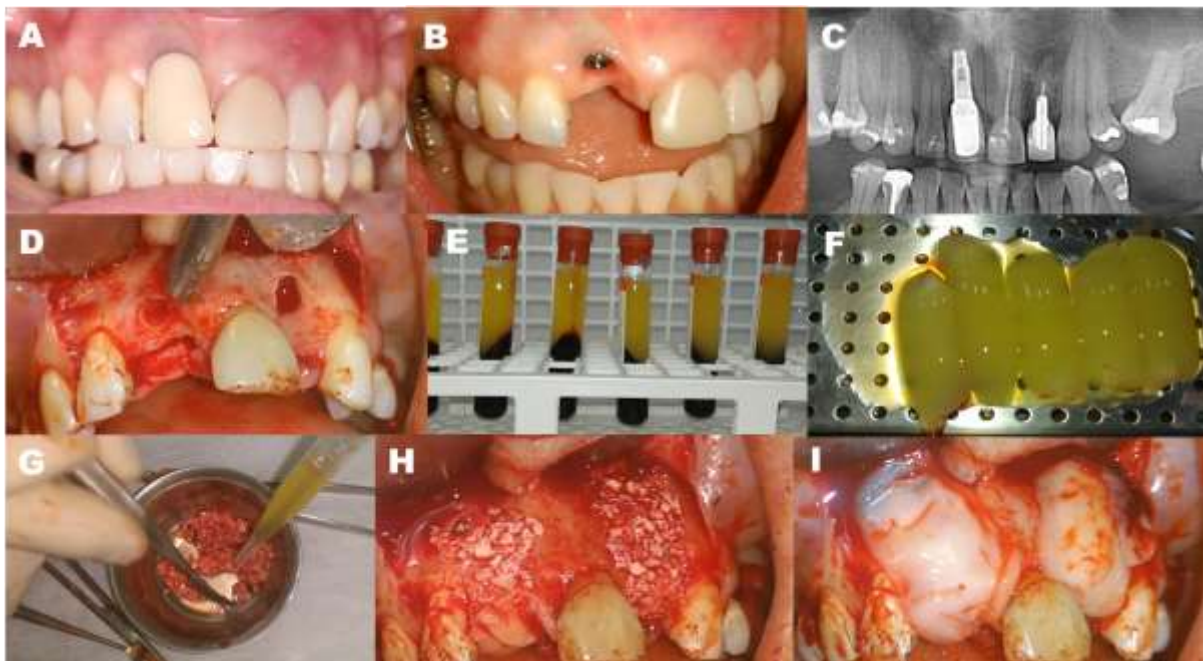
There was obedience to the bioethical principles of non-maleficence, beneficence, autonomy, justice and equity recommended by Brazilian National Health Council through Normative Resolution n. 466/2012 and Circular Letter n. 166/2018. The patient signed the Free and Informed Consent for participation in this study, with approval by the local Ethics Committee of the State University of Vale do Acaraú in the Plataforma Brasil (CAAE n.: 91602218.0.0000.5053, opinion n.: 2.806.761).

3. Case Report

Female patient, 45 years old, normosystemic, reported an aesthetic complaint in the anterior maxillary region. Upon clinical and radiographic examination, a single implant-supported dental prosthesis was diagnosed in the region of tooth #11 with aesthetic and functional inadequacy, unfavorable dimensions and position with regard to mobility, as well as altered limits of the gingival mucosa. In tooth #22, gingival inflammation, suppuration and periapical bone resorption were verified,

resulting from a trace of root fracture of the tooth already endodontically treated and with indirect coronary restoration supported by an intraradicular retainer. The proposed surgical treatment under local anesthesia consisted of removing the implant and the tooth #22, with immediate GBR using a mixed graft (sticky bone) composed of Bio-Oss® and leukocyte- and platelet-rich fibrin (L-PRF) and L-PRF membranes, being the autologous blood compounds collected by venipuncture in liquid form in the dental office. (Figure 1).

Figure 1 – Initial clinical-radiographic diagnosis (A-C) and first surgical stage, for removal of implant and tooth #22 (D), autologous fibrin harvesting (E-F), mixture of xenogeneic bone and L-PRF (G) and insertion of mixed graft (H) and L-PRF membranes (I).



Source: Authors (2021).

The L-PRF membranes were obtained after the centrifugation process for 10 minutes at 1500 rpm while the liquid fibrin was obtained after 3 minutes at 2700 rpm (Ponte, 2020).

The immediate postoperative period of 1 week showed no significant morbidity, without any areas of contamination, unusual inflammation, wound dehiscence or loss of graft material. After 7 months, the alveolar ridge maintained its dimensional stability in the grafted regions. In the second surgical approach, 2 implants were placed together with another GBR of mixed graft or sticky bone, as in the first surgical approach (Figure 2).

Figure 2 – Clinical-radiographic diagnosis after 7 months (A-C) and second surgical stage, with test of the surgical guide for implants (D), complementary mixed bone graft (E) and insertion of fibrin membranes (F).



Source: Authors (2021).

Six months after the implants, healing caps were placed for tissue conditioning, which remained for 20 days until the complementary dental preparation of tooth #21 and #12, endodontically treated in parallel to the proposed GBR, to allow for the adaptation of the provisional unitary dentures. There was a good gain in thickness, limit and contour of the gingival mucosa, as well as improvement in bone dimensions in terms of height and thickness, and the case continues to be monitored until the final prosthesis is completed. (Figure 3).

Figure 3 – Final clinical-radiographic diagnosis after 6 months of implants. Tissue conditioning with healing caps (A), complementary dental preparation of tooth #21 (B-C) for the prosthetic laboratory step (D) and intraoral appearance (E-F).



Source: Authors (2021).

3. Discussion

Although autogenous grafts are still considered the gold standard for bone regeneration, Bio-Oss® represents the second option for vertical bone augmentation in Dentistry, due to its promising clinical results with minimal risk of infection or immune response and slower resorption of than alloplastic ceramics such as beta-tricalcium phosphate, giving greater predictability to bone remodeling and implant placement and lesser postoperative morbidity (Shamsoddin, Houshmand & Golabgiran, 2019).

Bio-Oss® xenograft provides good surgical bed filling, biocompatibility and osteoconduction, while reducing operative time and surgical morbidity (Hass Junior *et al.*, 2016). Meloni *et al.* (2018) demonstrated that the use of Bio-Oss® can be quite versatile, being able to be combined with other filling materials, such as particulate autologous bone and covered

by a resorbable collagen membrane for GBR in horizontal bone defects. Canellas *et al.* (2021) conducted a systematic review and network meta-analysis to compare different grafts used in the preservation of the dental socket in height and width after extraction and observed in 31 clinical studies distributed worldwide that there was less variation in results with the use of Bio-Oss® or Bio-Oss Collagen® than with other therapeutic modalities including PRF, reinforcing that the aforementioned xenografts would be more predictable bone substitute biomaterials for this application.

Despite stimulating cell proliferation, differentiation, mineralization and gene expression related to osteogenesis, L-PRF alone may be limited to the maintenance of the alveolar ridge during GBR, according to preclinical studies and short-term randomized clinical trials to date (Liu *et al.*, 2019; Ponte *et al.*, 2019). The addition of mineralized and rigid materials, such as Bio-Oss®, could favor the osteoconductive effect in a balanced way with the rate of resorption of the filling material (Castro-Silva, 2018). Csöngé, Bozsik, Tóth-Bagi, Gyuris and Kónya (2021) discussed the issue of multiplicity of preparations and an optimal graft-PRF ratio, which could contribute to heterogeneous results, testing the use of sticky bone by associating lyophilized human cortical bone matrix with L-PRF and suggesting a proportion of 0.125g/1ml of plasma (or 1g/8ml) due to its greater strength or binding capacity.

L-PRF therapy could be negatively affected by the patient's systemic conditions, including: older age, pre-existing conditions (such as thrombocytopenia, hemorrhagic disease, and diabetes), nutritional deficiency, environmental or ethnic differences, autoimmunity, and genetic susceptibility (Liu *et al.*, 2019). A Brazilian study found that, in healthy young adult patients between 20 and 40 years old who underwent different forms of GBR after maxillary premolar extraction and before the dental implants, the use of L-PRF without or with association with Boneceramic®, an alloplastic graft compound by hydroxyapatite and beta-TCP, exhibited greater bone gain than biphasic ceramic alone through histomorphometric analysis, exceeding expectations in the GBR purpose (Ponte, 2020). The growing clinical evidence with L-PRF may indicate the gradual technical-scientific evolution of biomaterials for GBR in Dentistry (Castro-Silva *et al.*, 2021).

Our findings corroborate the satisfactory clinical results in the literature, with the use of L-PRF and grafts in different applications and techniques for bone gain. Sezgin, Uraz, Taner and Çulhaoğlu (2017) observed in intraosseous defects that L-PRF and bovine mineral bone reduced clinical periodontal indexes after 6 months. Carvalho *et al.* (2020) used L-PRF and allogeneic demineralized bone matrix in fenestration extended to 2 implants and achieved regeneration of the compromised buccal bone wall after 6 months. Kerhwald *et al.* (2021) observed that liquid L-PRF, lyophilized bovine bone and L-PRF membranes together with implant placement favored significant bone gain, implant stability and prosthetic rehabilitation in a patient with atrophic maxilla. Moraes Júnior and Carvalho (2020) verified the viability of vertical and horizontal GBR in the anterior region of the mandible using tent screws, particulate xenogeneic and autogenous biomaterial (1:1) agglutinated with i-PRF and PTFE membrane covered with L-PRF matrix, for implant installation in the region of teeth #32 and #41.

In fresh dental sockets, Mattos *et al.* (2016) grafted hydroxyapatite with collagen and L-PRF membrane in the region of tooth #24 with buccal bone wall presenting dehiscence and installed a dental implant, promoting satisfactory osseointegration and rehabilitation in the aesthetic area in 18 months. Silva *et al.* (2020) after remotion of the teeth #21, #22 and #23 used i-PRF to bind synthetic hydroxyapatite and covered the sticky bone with L-PRF membrane, generating an excellent postoperative period and after 6 months, satisfactory bone thickness for implants. Huang, Tan and Kuang (2020) investigated the effect of Bio-Oss® granules with or without PRF in 106 patients with anterior unit tooth loss and alveolar defects and observed that, 12 months after implants and simultaneous GBR, in the group with PRF the thickness of the buccal bone wall and around of implants was higher, the rates of gingival bleeding, probing depth and attachment loss were lower, and the height of bone graft and osteogenesis were greater than xenograft alone.

The use of GBR in two approaches to severe bone loss is reported, as noted by Massuda *et al.* (2020) who treated severe maxillary resorption in esthetic area between teeth #12 and #22 with homologous block corticomedullary graft and after

7 months installed implants together with a complementary graft of inorganic bovine bone associated with liquid-phase L-PRF and L-PRF membrane, obtaining good final results with the stabilization of a metal-ceramic fixed prosthesis. Interestingly, the protocol used for two GBR using a sticky bone and L-PRF membrane is still unexplored in the literature, which makes this clinical case unprecedented.

According to Ponte *et al.* (2019), the L-PRF barrier membrane could represent an unmanufactured and customized dental office alternative for osteopromotion in GBR. In the current Brazilian market, commercial osteopromoting membranes have imported origin and natural origin, with bovine collagen more prevalent than porcine, equine and synthetic sources (titanium, polytetrafluoroethylene, alumina, polypropylene and polylactic and polyglycolic acid), with great heterogeneity of formats and rates of resorption, from 4 to 63 weeks (Araújo *et al.*, 2021). Thus, biocompatibility, bioreabsorption and bioactivity of the PRF membrane are favorable in the interaction with the biological environment (Araújo *et al.*, 2020), such as GBR collagen membranes, not negatively affecting tissue healing or generating waste products (Quesada, Brenner & Feltraco, 2011).

In addition to the good aesthetic-functional relationship of single implants in the anterior region of the maxilla, for a clinical case to be successful, it must also provide good comfort and hygiene conditions (Souza *et al.*, 2015). The patient's satisfaction with appearance and chewing can, finally, affirm that the proposed surgical-prosthetic treatment was effective and successful, as observed by other authors in the use of L-PRF during GBR (Ponte, 2020; Moraes Júnior & Carvalho, 2020; Mattos *et al.*, 2016). Regarding the efficiency of the technique, the total treatment time with GBR using sticky bone, L-PRF membrane and implants, from surgery to the prosthetic phase, converges with that found in the literature, with an average duration of one and a half years in the region maxillary anterior (Massuda *et al.*, 2020; Moraes Júnior & Carvalho, 2020).

4. Conclusion

This case report suggests that sticky bone and L-PRF membrane synergistically contributes to multiple GBR in the anterior maxillary region, both in fresh dental socket and in implantodontic retreatment, favoring bone gain and osseointegration.

Possible limitations of this study are the limited follow-up of the patient, who continues her routine dental monitoring, and the absence of other serial cases. However, the positive results achieved encourage the achievement of similar surgical protocols with sticky bone and L-PRF membrane for GBR in the anterior maxilla region.

Acknowledgments

To the Sandro Ponte Clinic and Federal University of Ceara, Campus Sobral (Faculty of Dentistry, Postgraduate Program in Biotechnology and Biomaterials Laboratory) which jointly enabled the realization and follow-up of this clinical case. To the financial support of the Ceara State Foundation of Support for Scientific and Technological Development (CAPES/FUNCAP-AUXPE process n. 88881.166822/2018-01).

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