Dentistry

Clinical Sheet

APPOSITION SURGERY USING EQUINE-DERIVED BLOCK GRAFTS

Combined use of bone grafts, bone marrow concentrate and hyperbaric oxygen therapy for the recovery of ridge thickness.

From the Bioteck Academy Editorial Staff.

Following tooth loss, it is common to observe morphological alterations that over time lead to atrophy of the alveolar process. In the event that the bone volume is insufficient for inserting dental implants, it must be increased before carrying out implant surgery. One option for the recovery of crestal thickness is offered by apposition surgery which is usually performed using a resorbable osteoconductive and possibly osteoinductive graft that stimulates osteogenesis. In this study, an equine-derived graft is used, made biocompatible through an enzymatic process for antigen removal.

In the case of crestal defects, the apposition of the graft can benefit from vascular and cellular supply from a single bone wall. Therefore, when this type of surgery is performed, a strategy aimed at further promoting regeneration is the use of bone marrow aspirate concentrate (BMAC). The process of concentrating the aspirate makes it possible to integrate the graft – which acts as scaffold – with a significant amount of mesenchymal cells and growth factors that may promote regenerative events.

A further strategy to try and maximize the biological and clinical result is hyperbaric oxygen therapy, whose mechanism of action is based on physical laws and biochemical processes according to which collagen synthesis seems to increase under conditions of increased oxygen availability.

Materials

The procedures entailed the use of block substitutes (20 x 10 x 5 mm) of equine-derived cancellous bone (Bioteck). As Heart pericardium membranes (Bioteck) – deemed most suitable for this type of procedure due to the long protection time – were not available in Brazil at the time of the study, the grafts were protected with Biocollagen equine collagen membranes (Bioteck).
The cancellous block is obtained through the Zymo-Teck enzymatic process, which assures selective elimination of antigens without applying high temperatures or using organic solvents. This process of elimination of the antigen component preserves the bone collagen in its native conformation within the graft and does not alter the mineral bone structure, thus preserving the typical mechanical strength of natural bone tissue.
The Biocollagen membrane is a resorbable membrane obtained from equine tendon collagen. Its composition makes it particularly easy to handle, whether used dry or following hydration, and since it is only composed of collagen, it easily adheres to the graft site and exerts significant haemostasis.

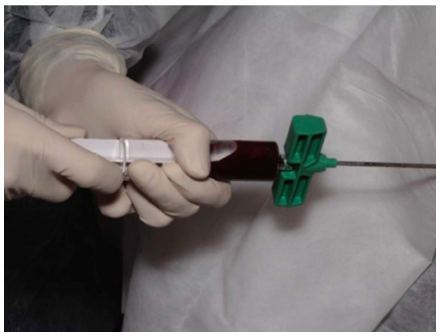

Fig. 1 *– Harvesting of bone marrow aspirate from the iliac crest.*

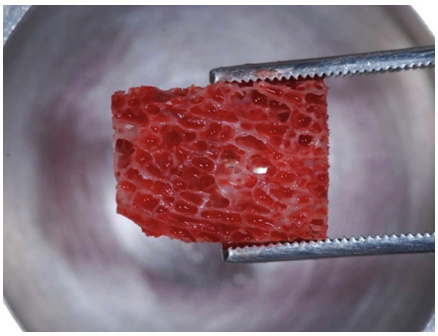

Fig. 2 *– The block graft, appropriately shaped to better adhere to the graft site, is soaked in the bone marrow aspirate concentrate.*

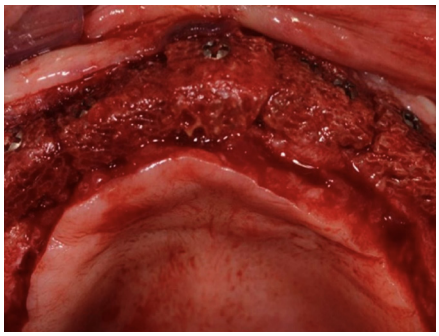

Fig. 3 *– The blocks are positioned and securely fixed with appropriate osteosynthesis screws, in order to increase the volume of the entire crestal profile.*

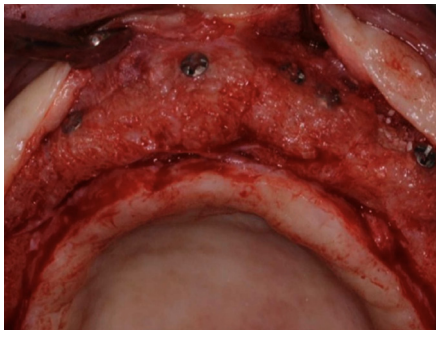

Fig. 4 *– Appearance of the regenerated site 6 months after grafting. Note the bleeding of the blocks, indicating successful vascularization.*

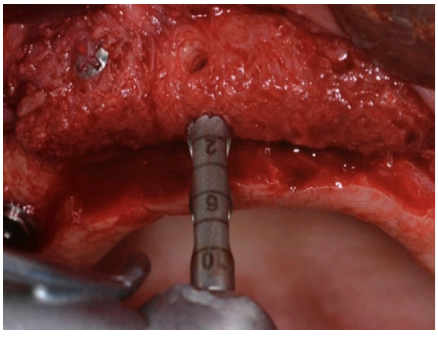

Fig. 5 *– When the osteosynthesis screws are removed the blocks are stable and well integrated. A biopsy sample is taken at the level of the implant tunnel.*

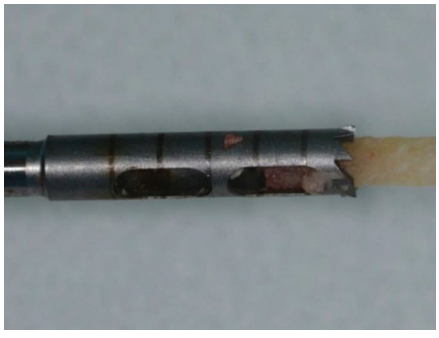

Fig. 6 *– Appearance of the biopsy following collection.*

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Results

The sheet summarizes a study published in 2018[1] in which 24 patients with edentulous maxilla and with an anterior alveolar crestal bone thickness of 2-3 mm underwent bone reconstruction surgery. The patients were divided into 3 groups: a control group (GC) which entailed treatment with block grafts; a Group 1 (G1) in which the graft was first combined with BMAC and a Group 2 (G2) where, in addition to the use of BMAC, the patients underwent oxygen therapy. 24 hours after the first procedure, the patients of group G2 began oxygen therapy, repeated daily for 20 days.

6 months after placement of the graft, in conjunction with insertion of the implants, biopsies were collected from each patient to perform a histomorphometric analysis. In addition, Cone Beam Computed Tomography (CBCT) was performed before the procedure (T0), 4 months (T4) and 8 months after surgery (T8). All patients recovered without complications and prosthetic rehabilitation was successful for every patient.

CBCT did not highlight significant differences between the groups, either at T4 or at T8, in terms of bone tissue increase. The histomorphometric analyses with CBCT showed that the samples collected from group GC showed the smallest amount of vital mineralized tissue (VMTGC=36.58±9.56%), whereas both G1 and G2 samples showed higher levels of vital tissue (VMTG1=55.64±2.83% and VMTG2=55.30±1.41%). The analyses of the amounts of non mineralized vital tissue (NMT) and of non vital mineralized tissue (NVMT) were found to be lower in groups G1 and G2, compared to GC (NMTG1 = 39.76±11.48%, NMTG2 = 40.3 ± 11.48 %, NMTGC = 51.21 ± 11.54 %, NVMTG1= 3.65 ± 0.87 %, NVMTG2 = 4.1 ± 0.87 %, NVMTGC =11.16±2.37%).

The use of bone marrow concentrate made it possible to obtain a significant increase in newly formed bone tissue compared to the control group. Oxygen therapy did not provide additional benefits compared to treatment with BMAC alone.

1. Aloise, A.C., et al. Use of bone marrow aspirate concentrate (BMAC) associated with hyperbaric oxygenation therapy in maxillary appositional bone reconstruction. A randomized clinical trial. Symmetry, 10(533), doi:10.3390/sym10100533 (2018).

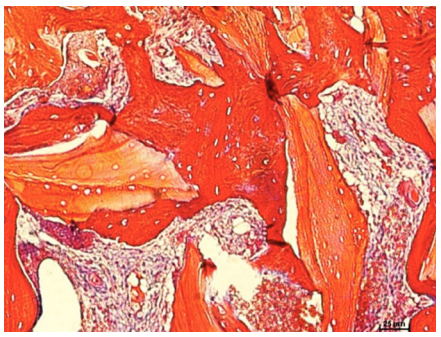

Fig. 7 *– Histological image of non vital mineralized tissue (NVMT) (light red), vital mineralized tissue (VMT) (dark red) and non mineralized tissue (NMT) (sparse tissue) from a sample of the control group (CG), 100x magnification (Masson's trichrome).*

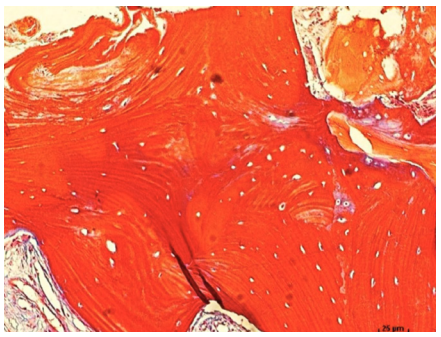

Fig. 8 *– Histological image of NVMT (light red), VMT (dark red) and NMT (sparse tissue) from a sample of group 1 (G1), 100x magnification (Masson's trichrome).*

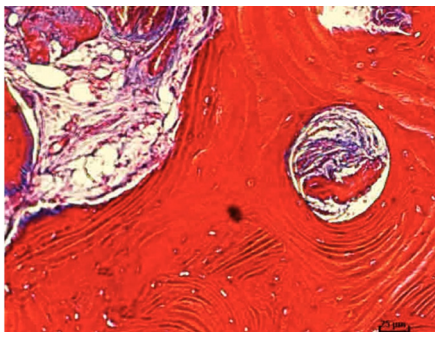

Fig. 9 *– Histological image of NVMT (light red), VMT (dark red) and NMT (sparse tissue) from a sample of group 2 (G2), 100x magnification (Masson's trichrome).*

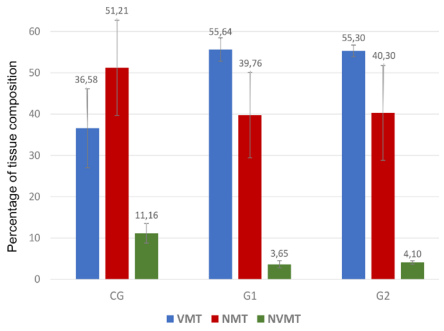

Fig. 10 *– Histomorphometric results: percentage of vital mineralized tissue (VMT), vital non-mineralized tissue (NMT) and non vital mineralized tissue (NVMT) in the samples taken from the control group (CG), group 1 (G1) and group 2 (G2).*

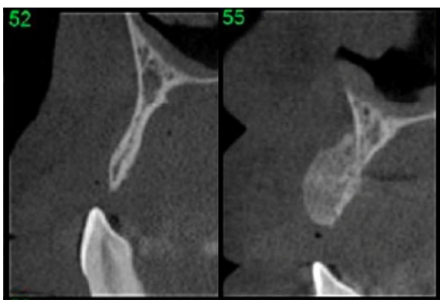

Fig. 11 *– Pre- and post-operative CBCT. The extent of the regeneration is noteworthy.*

	4 months	8 months
CG	4,17 ± 0,37	4,01 ± 0.86
G1	3,85 ± 0,50	3,83 ± 0,27
G2	3,83 ± 0,73	3,57 ± 0,49

Fig. 12 *– Average values of bone tissue augmentation, measured in millimeters by CBCT 4 months and 8 months after surgery.*

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