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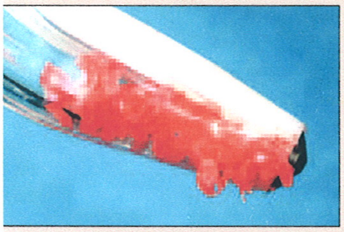
Grafting Autologous Cortical Bone in Regenerative Therapy:

Preliminary Histological Evidence

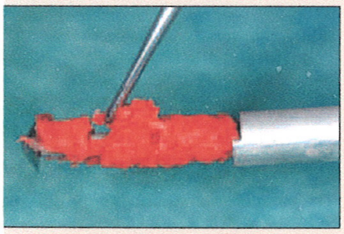
Ugo Consolo, Vittorio Ferri**, Ferdinando D'Avenia***, Davide Zaffe*****

Introduction

Autologous bone is still held to be the best grafting material in regenerative therapy. Recent intraoral harvesting devices (Micross and Safescraper® curve) allow a fair quantity of cortical bone to be taken with minimal postoperative morbidity.



The characteristic curly form of cortical bone harvested using the Safescraper® curve device.



The cortical bone harvested using the Micross device, ideal for limited donor sites.

Objectives: The authors present preliminary histological evidence of ridge augmentation with pre-implant GBR, Sinus Grafting (SG) and bone preservation techniques in post-extraction sites (PES) without membranes, using only 100% autologous cortical bone grafts harvested intraorally.

Materials and methods

14 patients: 6 male, 8 female (aged between 27 and 63 years) received an autologous cortical bone graft. These were 4 SGs, 5 GBRs with non-resorbable membranes in e-PTFE and 5 PES.

Special manual bone scalpels (Micross and Safescraper® curve – META – Reggio Emilia, Italy), equipped with an internal collection chamber, were used to harvest autologous cortical bone from surgically convenient intraoral sites: the oblique external ridge, the cortical palatal vault and the zygomatic process of the maxilla. The donor site was selected so as to minimise post-operative discomfort for the patient.

During the second stage surgery a biopsy was taken of the regenerated tissues using a trephine bur of a diameter suitable for implant placement. The samples were bored after 3 months for PES, after 9 months for GBR cases, and after 5 months for SG. The biopsies, fixed using 4 % paraformaldehyde in a pH 7.2 phosphate buffer, were embedded in PMMA. Thick sections (150 µm), obtained with a diamond-blade microtome, were microradiographed using Italstructures equipment, whilst thin sections (5 µm), obtained using a Autocut Jung bone microtome, were coloured with toluidine blue, Gomori trichrome or treated histochemically to evaluate alkaline phosphatase (ALP) and tartrate-resistant acid phosphatase (TRAP).

Results and observations

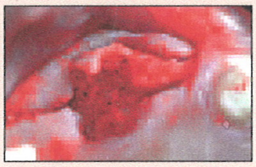
At 3 months, in the PES biopsies, almost all the grafted autologous cortical bone was surrounded by newly-formed bone on which lines of osteoblasts were depositing. Osteoclasts, positive to TRAP, were scarce or absent. The grafted cortical bone could be easily distinguished from the recently-formed bone and generally appeared osteocytes, although in more than one patient live osteocytes were found within fragments of grafted autologous bone.

In the 5-month SG biopsies and in the 9-month GBR biopsies the appearance of the grafted cortical bone was clearly distinguishable from the newly-formed bone, from which it was separated by reversal lines. Even after 9 months from implantation, in some of the biopsies, the grafted bone contained live bone cells populating many of its lacunae. At 9 months after the inevitable resorption of the grafted bone, no erosive activity of the newly-formed bone and of the grafted tissue was visible. All treated sites were perfectly healed and the implant therapy was completed successfully according to Albrektsson's criteria.

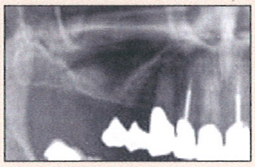
Conclusions

Autologous cortical bone harvested using manual instrumentation has an ideal structure for grafting, given ist characteristic curly form, preserving cellular vitality. The cortical bone used in ridge augmentation procedures shows excellent integration and limited resorption activity: at 9 months initial remodelling activity was present. In the treatment of large post-extraction sites (PES), in GBR and in Sinus Grafting (SG), the fragments of cortical bone harvested using Micross and Safescraper® curve curve devices appear to be an excellent filling material, unlike cancellous bone which, when grafted, is resorbed very rapidly and thus requires further intervention or the addition of slow-absorption support material.

* Dental Clinic Director – University of Modena and Reggio Emilia
** Private practice, Modena – Italy
*** Private practice, Parma – Italy
**** Department of Anatomy and Histology University of Modena and Reggio Emilia

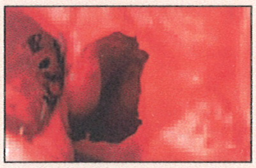


PES. Following the extraction, the bone tissue collected from nearby using the Micross device is put in place.



SG. The OPT shows sinus atrophy.

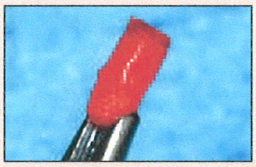
PES. Completely healed bone tissue, after 3 months of healing.



SG. The access window after elevating the sinus membrane.

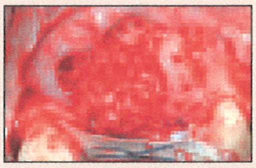
GBR. The presence of a horizontal and vertical bone loss is clearly visible.

Palatal stabilisation of the membrane in e-PTFE and cortical perforation of the grafting site.



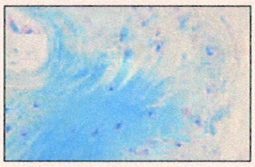
PES. The biopsy taken from the PES using a trephine bur of a suitable diameter for implant placement.

SG. A large quantity of cortical bone tissue harvested with Safescraper® curve device from the zygomatic process.

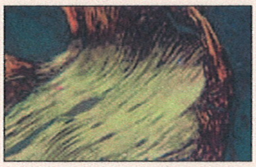


GBR. The bone tissue harvested using the Safescraper® curve device is put in place to fill the defect.

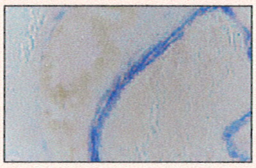
GBR. Second stage surgery 9 months later. The newly-formed bone tissue before biopsy.



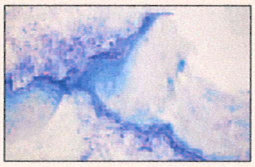
3-month PES biopsy. Live bone cells (black arrow) present not only in the newly-formed bone but also in the grafted autologous bone. Coloured using toluidine blue.



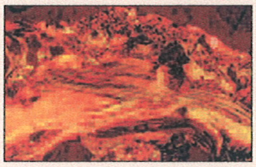
3-month PES Biopsy. Grafted cortical bone (OA) surrounded by newly-formed bone (N). The polarised light image enables us to distinguish more easily the central laminary area (grafted bone) from the peripheral area with its interwoven fibres (newly-deposited bone).



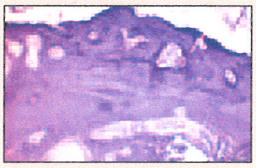
3-month PES Biopsy. Alkaline phosphatase shown by the active osteoblasts (black arrow) on the cortical graft.



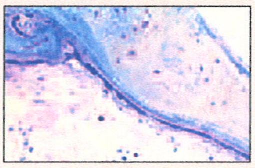
9-month GBR biopsy. Colouring with toluidine blue shows the grafted cortical bone (OA), containing live osteocytes, on which active osteoblasts (arrow) are laying new bone.



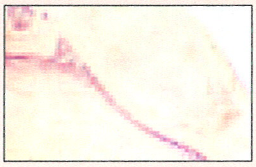
9-month GBR biopsy. Grafted cortical bone (OA) surrounded by newly-formed bone (N). The polarised light image enables us to distinguish more easily the central laminary area (grafted bone) from the peripheral area with its interwoven fibres (newly-deposited bone.)



9-month GBR biopsy. The lack of TRAP-positivity underlines the absence of erosion of the newly formed bone (N) and of the grafted tissue (OA).



9-month GBR biopsy. 9 months after grafting, neo-formative activities are still present, even if not widespread. Coloured using toluidine blue.



9-month GBR biopsy. Alkaline phosphatase-positive osteoblasts are apposing new bone onto the preexisting tissue.