

BONE HARVESTING FROM THE CORTICAL OF THE ZYGOMATIC PROCESS OF THE MAXILLA. A CASE REPORT

Introduction

Implant-prosthetic reconstruction of atrophic maxillae often requires resorting to bone grafts, which are at present considered the gold standard in this type of reconstruction. (4,15).

The volume of bone graft required for the reconstruction of the maxillary defect determines the choice of the donor site. (3,4).

For implant-prosthetic three-dimensional reconstructions of bone volume loss (classes IV, V and VI of the Cawood and Howell classification) (2) it is necessary to resort to bone harvesting which can supply an adequate quantity of bone. In oral surgery the most adequate sources which can supply large amounts of bone are normally extraoral and at present mainly include the iliac crest, the calvarium and the tibia (3, 5).

Intraoral bone harvesting instead, is indicated when the reconstructions concern small to medium maxillary defects or the augmentation of the maxillary sinus floor, even in bilateral cases. The most common intraoral donor sites for maxillary defect reconstructions are: the mandibular symphysis (6, 11), the mandibular ramus(1, 8, 9), the maxillary tuber (3, 4), the anterior nasal spine area (3, 4) and also the alveolar crest (4). This type of bone harvesting can be performed under local anaesthesia or day surgery, generally have uneventful postoperative courses and presents a very low morbidity incidence (10).

Intraoral harvesting

Bone harvesting from the **mandibular symphysis** is generally the most common intraoral harvesting technique, even if in recent years harvesting from the mandibular retromolar area has become more favoured due to less postoperative complications. Up to 10 ml of cortical membranous bone can be collected from the mandibular symphysis, with a favourable postoperative course which may present mild local oedema, moderate pain at the harvesting site which is easily controllable pharmacologically, possible mild haematoma on the chin, very rarely

slight paresthesia of the chin and lips and possible paresthesia of the teeth between the cuspids (3, 4, 6, 11).

Bone harvesting from the **mandibular ramus**, is progressively replacing that from the mandibular symphysis due to technological advances and the post operative course which is marked by a significantly lower morbidity. With this type of harvesting up to 15 ml of cortical bone can be taken bordering the mandibular channel and harvesting spongy bone is also possible. The favourable postoperative course, which is generally very satisfactory presenting only a very mild oedema, slight pain and a rather insignificant haematoma, has made this type of harvesting well accepted by the patients, even if, from a surgical point of view, the technique is slightly more complicated to perform compared to harvesting from the mandibular symphysis (1, 3, 4, 8, 9).

Bone harvesting from the **maxillary tuber**, which is, from the maxillary molar area, finds limited application principally because the quantity of bone which can be collected is scarce as well as the quality of the bone itself; it has a small concentration of cortical bone and low spongy bone density. It is possible to remove 2-3 ml of bone using bone trephines, bone scrapers and mills and the techniques are relatively simple to perform. Nevertheless, the altered morphology of the tuber which derives from this operation may compromise future stability of the prosthesis. The postoperative course is very favourable, often assimilated to that of the contiguous grafting site, presenting very mild pain and local oedema. Unlike mandibular symphysis and ramus grafts, those removed from the maxillary tuber are particulate grafts and require also the employment of membranes for the guided bone regeneration (3, 4).

Bone harvesting from the region of the **nasal spine** supplies a rather modest quantity of bone and the choice of this donor site is justified when the surgery to be performed provides for the anterior maxillary bone, which is the alveolar process in correspondence of the nasal floor, to be exposed. The insignificant quantity of bone that can be taken from this donor site does not in any way alter the bone morphology of the maxilla, the postoperative course does not present any type of complication and normally is perfectly assimilated to that of the contiguous grafting site (3, 4).

Bone harvesting from the **alveolar crest** is performed in the area contiguous to that of the grafting site. Sometimes, but actually very rarely, there is an existing

exostosis, but more likely the crest can offer the small amount of particulate bone necessary during the osteointegrated implant treatment and/or the augmentation of the maxillary sinus floor. The amount of bone removed from this donor site only provides for small augmentations, the optimisation of the morphology of the implant site, correcting eventual dehiscences and fenestrations, the augmentation of the maxillary sinus floor during the implant surgery. Furthermore, the particulate bone removed either from the tuber or the other possible sites, is an excellent space filler for guided bone regeneration, which is the regeneration of bone within sites that present a lack of bone due to defects and atrophies, and more precisely bone grafts are used to fill post extraction loss of bone either immediate, delayed and precocious; dehiscences and/or fenestrations; slight two-dimensional augmentations of the alveolar crest and augmentations of the maxillary sinus floor (4).

In recent years oral surgeons have been provided with a technically advanced instrument that allows them to collect chips of cortical bone by scraping the bony surface. Up to now the main application of this instrument was to remove chips of cortical bone from the vestibular surface of the mandible. It is rather simple to handle and offers the possibility to enclose the graft in a reservoir until subsequently required by the implant treatment. As this instrument has only recently been introduced, the precise indications for its use and employment are still to be discovered.

The authors of this articles have devised a procedure to harvest bone from the cortical of the **zygomatic process** of the maxilla by using this grafting instrument, which depending on the patient's morphology, enables the surgeon to collect a few ml of cortical particulate.

The surgery technique of the case report presented is explained step by step in the review of the surgery technique on page 33.

Case report

Francesco, a healthy 57 year old patient. The OPG (Fig. 1) shows sever loss of alveolar bone at tooth #17, the presence of apical lesions at tooth #16, with 12mm periodontal pockets and a three-wall defect, apical lesions at #15 presenting grade III tooth mobility. We proceed to endodontic retreatment of tooth #14 which is

then restored with carbon fibre posts and prepare the upper teeth to receive a temporary fixed prosthesis from #14 to #24. Teeth #15,#16 and #17 are then extracted and the alveolar sockets are filled with heterologous bone grafts from equine bone and collagen (Fig. 2).

A Computed Axial Tomography of the maxilla performed after three months reveals an insufficient bone thickness for an implant to be positioned and the augmentation of the maxilla sinus floor to be performed in one session (Fig.3). Therefore, we decide to perform the augmentation of the right maxilla, resorting to an intraoral donor site contiguous to that of the receiving site, for the harvesting of the required quantity of bone without having recourse to a second donor site and only later, after four months, install the implant.

Due to the prominence of the patient's zygomatic process of the maxillary (Fig. 4), it is considered a favourable donor site from which remove particulate cortical bone by means of the easy-to-handle and safe grafting instrument. The technique to harvesting bone for the zygomatic process of the maxillary by means of the said instrument is fully described on page 33. The particulate cortical bone removed from the zygomatic process of the maxillary and enclosed in the reservoir of the trephine is then set in a bowl (Fig. 5). The particulate cortical bone is mixed with the same amount of heterologous bone of equine origin. Figure 6 shows the bone which is ready to be used for the augmentation of the maxillary sinus with a lamina of deantigenated cortical bone tissue rehydrated with normal saline and rifampicin and a syringe of polylactic acid and polyglycolic acid gel which will be used during the surgery. The bone fenestration of the anterior side of the maxillary sinus is prepared by means of a trephine mounted on a straight handle (Fig. 7). After having carefully detached the membrane of the maxillary sinus by means of appropriate tools and positioned the cortical bone fenestration as the ceiling of the newly formed cavity we proceed to filling the maxillary sinus with the autologous bone tissue mixed with the heterologous bone tissue and set a layer of polylactic acid and polyglycolic acid gel (Fig. 8).

The lamina of deantigenated integral cortical heterologous bone of equine origin, flexible and totally absorbable is positioned to form the anterior wall of the lifted maxillary sinus, then immobilised by means of titanium micro screws (Fig. 9). The flap is readjusted without creating tensions using polytetrafluoroethylene thread paying great attention to passing the thread from the corner between the

crestal incision and the release incision (Fig. 10). The postoperative course is characterised by normal morbidity at the surgical site. The patient is treated with antibiotics and anti-inflammatory drugs for ten days considering the grafting procedure of the integral heterologous bone lamina. The sutures are removed after 10 days. The orthopantomography performed four months after the surgery and just before placing the prosthesis clearly shows the result obtained by this type of procedure. (Fig. 11).

Discussion

In spite of what has been reported recently (12), harvesting bone from the zygomatic bone had already been performed in maxillo-facial surgery. Already in 1985 Wolford et al. (14) describe a technique to harvest bone from the zygomatic bone during a Le Fort I procedure. The authors removed a 1 x 1,5 cm chip of cortical bone from the zygomatic arch without having any complication at the operation site.

In these last years, thanks to the oral surgeons' ever improving surgical skills as well as the availability of new technologies and advanced grafting instruments, the zygomatic area has become a possible intraoral bone harvesting donor site for the reconstruction of bone defects of the maxillary which allows oral implantations to be performed. In 2002 Kainulainen et al. (12, 13) delineated a technique to harvest bone from the zygomatic bone after making an incision of the alveolar mucosa between the first / second molar and the first premolar, 5 mm above the mucogingival junction by means of a trephine mounted on a straight handle, and after having lifted the flap to expose the zygomatic arch, perform coring of cortical bone grafts and if possible also of spongy bone grafts from the zygomatic bone. The trephine, having a diameter of 4-6 mm, is used at an angle of 45° with respect to the occlusal plane, and goes deep into the zygomatic bone not more than 12-14 mm to obtain between two and five bone cores. By using a bone coring trephine with reservoir and filter dispersal of bone chips is avoided. The cortical bone, ground into particulate by means of a bone miller, mixed to the bone chips contained in the filter become a putty-like mouldable material which can be immediately placed in the maxillary bone defect to be reconstructed, such as post-implant fenestrations, one or two post-extractive alveolar filling or it can

be used added to the grafts collected from the symphysis when the latter results insufficient. The postoperative course is acceptable characterised by local oedema and moderate pain. Nevertheless the authors have stated the perforation of the maxillary sinus in two of the three cases presented, which were successfully treated with an antibiotic therapy and presented no further complications.

Materials and Methods

Thanks to the recent introduction on the market of bone scrapers, the authors of the present work have devised a procedure to harvest particulate cortical bone from the zygomatic process of the maxilla. Using this easy-to-handle safe grafting instrument it is possible to harvest the few ml of cortical bone which may be necessary for: the coverage of post-implant dehiscences and fenestrations, usually vestibular defects; the filling of larger bone defects in post-extractive immediate implants; reconstruction of small defects due to lack of bone of the edentulous crest; the filling of the sinusal cavities obtained after the lifting of the maxillary sinus floor with placement, in one or two stages, of osteointegrated implants, mixing them with heterologous bone; employment as space filler together with a membrane for guided bone regeneration; an emergency donor site, for example when the quantity of bone graft from other donor sites such as the mandibular symphysis or the mandibular retromolar area result insufficient.

Precautions

As clearly pointed out in the technical report, this type of bone harvest is simple and does not entail any complication: even when used rather aggressively the bone scraper penetrates the maxillary sinus without risk of lacerating the membrane.

Nevertheless, some precautions are to be taken during the procedure: the gum flaps are to be kept wide open and protected from the action of the instrument by means of a spatula-retractor, the skeletal surface must be big enough to allow scraping, the lower margin of the infraorbital foramen with the relative vascular-nervous bundle must be located and protected to avoid that an incorrect handling to cause a lesion; the inferior orbital fissure is only to be interested by palpation

above the mobilised flap; there is no need to expose the zygomatic bone on the upper and lateral sides where the zygomatic foramen together with the homonymous nerve are located; the muscles involved in elevating the upper lip such as the zygomatic minor are retracted with the flap and do not interfere with the operation.

Postoperative course

Following the surgical procedure and paying attention to the anatomy of the donor site, which is proceeding with bipolar hemostasis of even the tiniest vessels encountered as well as carefully displacing the flap to preserve its integrity, avoids giving rise to complications and therefore the postoperative course results integrated with that of the receiving site, which in this type of operation is normally contiguous.

When bone is harvested from the zygomatic process of the maxillary of an edentulous patient and grafted in a site which is not contiguous, postoperative morbidity presents slight local pain and a moderate local oedema: in no case will there be considerable morphological changes in the facial morphology of the patient.

As in all case of bone harvesting it is necessary to first examine the receiving site in order to determine the quantity of bone required to reconstruct the maxillary bone defect as well as the suitability of the donor site.

Conclusions

The zygomatic process of the maxillary bone is suitable to offer a few ml of cortical bone thanks to its morphology which can be predetermined by CAT scan. Collection of bone tissue is carried out by means of a easy-to-handle instrument which can be used not only by the most experienced surgeons without incurring in complications.

This simple operation is carried out in day surgery. This type of bone harvesting can be bilateral without any aesthetical outcome because the surrounding soft tissues are well supported.

For all the described reasons, the authors believe that this method of bone harvesting can become part of the basic technical skills required from all oral surgeons.

Fig. 1 - The OPG shows the clinical situation of the patients before the extractions are performed.

Fig. 2 - Teeth #15,#16 and #17 have been extracted and the alveolar sockets are filled with heterologous bone grafts from equine bone and collagen. The flaps have been sutured.

Fig. 3 - A Computed Axial Tomography of the maxilla performed after three months reveals an insufficient bone thickness for an implant to be positioned.

Fig. 4 - The zygomatic process of the maxillary is exposed.

Fig. 5 - The particulate cortical bone is removed by means of a grafting instrument.

Fig. 6 - Autologous bone and heterologous bone, polylactic acid and polyglycolic acid gel a lamina of deantigenated cortical bone tissue are ready to be used for the augmentation of the maxillary sinus surgery.

Fig. 7 - Bone fenestration of the anterior side of the maxillary sinus.

Fig. 8 - Newly formed sinus cavity filled with the autologous bone tissue mixed with the eterologous bone tissue with a layer of polylactic acid and polyglycolic acid gel.

Fig. 9 - The lamina of deantigenated integral cortical heterologous bone is positioned to form le anterior wall of the maxillary sinus.

Fig. 10 - The flap is sutured, without creating tensions, PTFE thred.

Fig. 11 - The orthopantomography performed after four months shows the result obtained by this type of procedure.