EARLY IMPLANT PLACEMENT IN BILATERAL SINUS FLOOR AUGMENTATION USING ILIAC BONE BLOCK GRAFTS IN SEVERE MAXILLARY ATROPHY: A CLINICAL, HISTOLOGICAL, AND RADIOGRAPHIC CASE REPORT

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Effectively restoring a grossly atrophic maxilla can be difficult for the implant surgeon. The placement of dental implants in patients who are edentulous in the posterior maxilla can present difficulties because of deficient posterior alveolar ridge and increased pneumatization of the maxillary sinus, resulting in a minimal hard tissue bed. Implant placement requires adequate quality and quantity of bone, especially in the posterior maxilla. Insufficient bone height and width in this area of the maxilla, because of expansion of the maxillary sinus and atrophic reduction of the alveolar ridge, represents a contraindication for conventional insertion of dental implants. The reconstruction of edentulous patients with adequate bone volume and density by the use of bone graft and, subsequently, the placement of dental implants has become a viable treatment option with high predictability. It is commonly shared that autologous bone graft is the gold standard grafting method in the augmentation of Higromor antrum and in any kinds of guided bone regeneration. In this article, the authors report a case of severe maxillary atrophy that is augmented by block bone graft harvested from iliac crest. An early placement of implants is possible due to the quick healing of the site, as proven by histologic examinations.

Key Words: maxillary alveolar ridge atrophy, autologous bone graft, iliac crest donor site

INTRODUCTION

Pathological situations with relevant loss of bone support have been observed in relation to bone jaws and may cause functional and esthetic handicaps to the patient. Patients with severe maxillary atrophies are clear examples of alterations of the masticatory, deglutory, and phonatory abilities with subsequent psychological implications and constitute an important group candidate for reconstructive treatments. Insufficient bone height and width in the posterior

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maxilla, due to the expansion of the maxillary sinus, and atrophic reduction of the alveolar ridge represent contraindications for the conventional placement of dental implants.

Since the initial applications of sinus lift augmentation and implant placement in the mid 1970s, both surgical techniques and graft materials used have evolved.5

The first clinical and experimental studies about implants in bone grafts were made in the 1980s. The first authors used tibia-trabecular bone grafts in combination with titanium fixtures in the augmentation of severe maxillary defects.6

Still in 1980s, a successful procedure was described: maxillary sinus lift augmentation was performed with the interposition of bone grafts between the floor of the sinus and the alveolar ridge. This methodology had the purpose of increasing the available height in the posterior maxilla for implant placement.7

In 1983, and later in 1987, some authors developed and extended techniques combining iliac crest bone grafts fixed with implants to the atrophic alveolar bone.2–8

Currently, the augmentation of the maxillary sinus floor with autogenous bone grafts represents a common surgical procedure to solve clinical situations characterized by severe atrophies of the posterior maxillary alveolar ridge.

Many low-invasive procedures, such as the transalveolar osteotomy, have been developed to fill the antrum, and they guarantee less morbidity to the patient. These surgical techniques can use different types of bone, yet they are mainly employed for the treatment of small defects when the residual ridge is of 3 to 5 mm, which is the minimum required for the implant placement.9

In severe atrophy cases, invasive-type lateral wall approaches, such as the modified Caldwell-Luc, are preferred instead, as they use the iliac crest bone block graft, which offers high quality and quantity of bone.5

The sinus floor elevation procedure with autogenous, cancellous bone graft appears to be a valuable and reliable preimplantological technique with a high success rate.10,11

The purpose of this analysis is to evaluate, from clinical, radiological, and histological points of view, preprosthetic surgical solutions using iliac crest bone block.

As described in the following case, iliac crest bone block allows a rapid revascularization and has the capacity to integrate easily to the recipient site, allowing the implants to be placed early.

CASE REPORT

A partially edentulous 47-year-old woman was referred to our division for preprosthetic surgery with implant placement.

Upon clinical inspection, only a few teeth were left, and they were compromised by a periodontal disease, whereas the alveolar residual ridge was reabsorbed (Figure 1).

The patient carried a removable partial prosthesis for years, and it contributed to the worsening of her severe maxillary atrophy.

Radiographic examination showed a high pneumatization of the maxillary sinus associated with an extreme resorption of the postextractive alveolar ridge (Figure 2).

Under general anesthesia, a mucoperiosteal flap was elevated to expose the lateral surface of the maxilla, and a rectangular window was outlined bilaterally; then, using curettes, the window was reflected superiorly, and the sinus membrane was elevated. A perforation produced during membrane elevation on the right side was covered with a collagen membrane. Two corticocancellous blocks were harvested from the anterior iliac crest and placed onto the 2 sinuses and then fixed bilaterally with 2 screws together with the inlay graft.

The above-described procedure allowed the restoration of bone volume for implant insertion, but implants were not placed immediately. In the end, the soft-tissue flap was closed without tension with an absorbable 4–0 suture (Vicryl, Ethicon) to prevent any dehiscence.

Postoperatively, the patient was prescribed a 10-day antibiotic therapy.

After 20 days, 2 little flaps were elevated bilaterally and 2 bone biopsies were undertaken to study both the healing and vitality levels; after the biopsies, a computerized tomography scan (CT) was taken (Figures 3, 5, and 7) to check if the grafted site had changed and to compare it with the outcome of the histological examination.

A soft-lined partial denture was placed in the third postoperative week. The healing period was uneventful.

After approximately 3 months, another CT was performed (Figures 4, 6, and 8) to evaluate if the bone graft had undergone any modifications, and the screws were removed under local anesthesia. Furthermore, a new bone biopsy was taken, 8 implants were inserted with a torque superior to 45 Ncm (Figure 9), and, in the end, the flap was closed.

After 6 months, all implants were osseointegrated according to radiographic and clinical examinations (Figure 10). Therefore, abutment connection was
performed, and the patient received a totally implant-anchored full-arch restoration (Figures 11 and 12).

Upon 12-month assessment, no bone resorption was noticed.

**HISTOLOGIC AND RADIOGRAPHIC FINDINGS**

After 20 days from the graft, the harvested bone sample was analyzed (Figure 13), and it was noticed that it maintained its vitality; in fact, some osteocyte lacunae full of osteocytes were found. Osteocytes were survived to the harvesting and represented a visible sign of a rapid revascularization of the graft; between the bone surfaces of the harvest and recipient sites, an osseous neoformation was evident that bonded the graft and the recipient sites due to the active deposition of osteoblasts. The aspect of the osseous neoformation's trabecular was peculiar when compared with either that of the grafted iliac crest or that of the original maxilla. In detail, it appeared full of new vessels, typical signs of a neovascularization generated between the maxillary and the grafted bones; moreover, a high rate of osteoprogenitor cells that were attracted by chemotactic factors and would evolve in osteogenic cells was noticed.

After 20 days, radiographic examination showed a concentration of blood in the sinusal mucosa as well as a good integration of the grafts in the recipient site.
After 3 months, CT examination revealed an excellent stability of the graft’s dimension and only a slight bony resorption. The sagittal view of the cortical iliac crest showed it disappeared due to the reshape of the previous months. The axial view, on the other hand, exhibited that the grafts seemed well integrated with the Higmoro antrum walls, while, according to the radiographic test, there were no signs of sinusal flogosis, even if a perforation of the membrane occurred during the operation. In the end, the bone density was high because of the mineralization.

The histological harvest revealed the graft maintained its vitality and the bone reshaped due to its depositing activity. The osteocyte lacunae were full of osteocytes, and the cancellous bone became more fibrous.

In addition, a complete integration was evident between the grafted bone and the recipient site with a complete fusion of their surfaces after 3 months (Figure 14).

**Discussion**

In the treatment of atrophic maxillae, some principles have to be taken into consideration, such as the elimination of minimal volume of the residual bone and the conservation of the maxillary topography.

The augmentation of the maxillary sinus floor with bone grafts for the insertion of endosseous implants is a promising solution for patients with highly atrophic maxilla and functional problems with their partial or full dentures.12,13

The use of autologous bone graft represents the gold standard for any kind of augmentation of alveolar defects. In fact, the use of this method in maxillary sinus lift augmentation with subsequent implant placement provides a great predictability to solve complex problems in the case of maxillary atrophies.11–14

Considering our experience and that of other authors, the iliac crest is the most suitable bone to graft in the reconstruction of maxillary atrophies with a residual ridge less than 3 mm.15 In particular, the anterior iliac crest is the harvest site preferred by many authors because of the good quantity and quality of bone obtainable and the simplicity of harvesting techniques.

Recently, some authors have suggested that the iliac crest site produces an unacceptably high degree of postoperative morbidity.16,17 Because of this morbidity, the use of other donor areas, such as the cranium and mandible, is advocated.18,19 The use of the iliac crest as a donor site for alveolar bone grafting has been routinely performed in our division for many years, with little or no significant postoperative morbidity.20
FIGURES 3–8. FIGURE 3. Right sinus at 20 days. FIGURE 4. Right sinus at 3 months. FIGURE 5. Left sinus at 20 days. FIGURE 6. Left sinus at 3 months. FIGURE 7. Computerized tomography scan (CT) in axial view at 20 days. FIGURE 8. CT in axial view at 3 months.
The most evident benefit offered by cortico-trabecular bone block grafts is the great anatomical correspondence and adaptability to alveolar ridges; besides this, as shown in our case, if a perforation occurs accidentally during membrane elevation, we encounter no infections, and the correct healing process of the graft is not compromised. On the other hand, many authors have stated that the best harvesting sites are the intraoral and the calvarium sites; to ground their argument, they claim these sites show more rapid revascularization, good incorporation, and less resorption with shorter healing times (3–6 months) than iliac crest bone grafts (5–8 months). In our article, we show that the healing time of the iliac crest is inferior to that described in the literature. We believe that research should be more detailed on the healing times of the different grafting techniques, using histology as the main research tool.

In the end, according to our experience and to other authors’ analyses, the insertion of implants should be postponed to have a better bone-implant contact and bone filling in autogenous bone grafts.

CONCLUSION

With the illustrated case, we want to highlight how rapidly bone block iliac crest grafts revascularize (after only 20 days) and integrate (only after 3 months) with the recipient site, contrary to what is stated in literature.

For this reason, in our opinion, the use of the cortico-cancellous bone block graft has to be the preferred method in order to restore an adequate quality of the superior maxillary bone; this method is recommended when facing severe bone atrophies that require sinus floor or bilateral lifts and a delayed implant placement.

Regarding the correct timing of implant insertion,
FIGURE 13. Biopsy at 20 days after surgery: the histological aspect of the iliac bone graft reveals osteocyte lacunae full of vital osteocytes, which represent a sign of the grafted bone’s rapid revascularization. (A) Lamellar-type cortical bone of the ilium that faces to maxillary antrum. (B) Cancellous part of the block graft with bone trabeculae and medullary spaces. (C) Bone grafted/maxillary alveolar ridge interface (original magnification ×100). At a higher magnification (×200), a newly formed trabeculae bone bond with ordinal trabeculae of the original maxillary bone due to osteoconduction is clearly noted.

FIGURE 14. Bone biopsy at 3 months after the bone augmentation procedure: histological aspect of the original bone residual alveolar crest (A), which, after healing, appears completely fused to the iliac bone block graft (B). (Original magnification ×25, hematoxylin and eosin).
we find that implants can be placed no more than 3 or 4 months after grafting; as shown by our histological report, a short healing time allows an earlier placement of implants.

**REFERENCES**