Use of Allogeneic Bone Graft in Maxillary Reconstruction for Installation of Dental Implants

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The aim of this study is to evaluate the efficacy of the application of allogeneous bone at the maxillo-mandibular reconstructions for future rehabilitation with dental implants. The patients were submitted to reconstruction of maxilla, using allogeneic bone grafts, in 3 different techniques: onlay grafts for lateral ridge augmentation, onlay and particulate bone for sinus lift grafting, and particulate alone for sinus lift grafts. Clinical and radiographic control was done at the postoperative phase for at least 8 months, until the patient could be submitted to the installation of dental implants. The results showed success in the majority of the cases, and dental implants could be installed. This can be considered an excellent alternative when compared with the use of autogenous grafts; because handling is easier, there is a great amount of material available and a possibility of using local anesthesia, and consequently there is a reduction of patient morbidity.

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It is estimated that in the United States 40,000 persons receive allogeneic grafts in the maxillomandibular region annually. Because of the development of specialized centers in the manipulation and processing of skeletal tissues, the use of allogeneic grafts became an alternative for the treatment of the atrophic maxilla and mandible.1

Osteogenesis is the most important basic principle for total integration of bone grafts. The new bone from the patient is produced by the osteoinduction process, whereby mesenchymal cells differentiate into osteoblast cells that produce new bone. This differentiation process is coordinated by glycoproteins, such as bone morphogenetic protein (BMP). BMPs are present in both autogenous and allogeneic bone. The process of osteoinduction determines the 3-dimensional growth of capillary vessels, perivascular tissues, and osteoprogenitor cells from the patient to the graft.2

The incorporation process of the graft happens through the gradual replacement of bone until the formation of new bone occurs, and this comprises 5 stages, beginning with the acute inflammatory process, with gradual substitution by granulation tissue and an increase in osteoclast activity.2,3

The second and third stages are the incorporation phase, which lasts several weeks and includes vascul-
larity and osteoinduction. During this phase, the immunologic system of the patient becomes sensitive to the donor antigenicity, going through remodeling and ending with an efficient structure. At this phase, the medullary bone is totally reabsorbed and substituted, and the cortical bone may remain even if partially integrated. 2,3

The incorporation phase, characterized by osteoinduction and osteoconduction of allogeneic graft, is slower than the same process when autogenous graft is used, because of the immunologic response of the patient. After 4 or 6 weeks, osteogenesis begins. After 1 year, the differences between allogeneic and autogenous grafts decrease. 2-4

The purpose of this study is to evaluate the application of allogeneic bone for maxillary reconstruction for future rehabilitation with dental implants.

Patients and Methods

We evaluated 28 patients who underwent allograft surgery for maxillary reconstruction. The allogeneic bones used were obtained from the Bank of Tissues and Bone of the Clinical Hospital of the Federal University of Paraná, Brazil. The postoperative follow-up ranged from 1 year to 6 years, with implants and prostheses being functional throughout the follow-up period.

The patients underwent reconstruction of maxilla, by use of allogeneic bone grafts, via 3 different techniques: onlay grafts for lateral ridge augmentation, onlay and particulate bone for sinus lift grafting, and particulate bone alone for sinus lift grafting (Fig 1).

GRAFT PREPARATION

Onlay Grafts

For onlay grafts, after the allogeneic bone had been received from the Bank of Tissues and Bone, it was manipulated with sterilized instruments. This phase consists of preparation of the bone graft, usually harvested from a human femur, so that it fits the alveolar defect. With the use of a reciprocating saw, the bone was cut into block pieces (Fig 2); then it was safely stored until it could be placed in the patient.

Particulate Grafts

For particulate bone grafts, the allogeneic bone was cut into block pieces. Then, with the use of a specific grinder instrument, the bone blocks were made into particulate bone, and this was safely stored until it could be used in the patient.

TECHNIQUES

Onlay Grafts for Lateral Ridge Augmentation

The first technique was used when there was sufficient bone height to receive a dental implant but the alveolar ridge was not wide enough.

The patient underwent local anesthesia in the area of the procedure; then, with the use of a scalpel, an incision was made so that a mucoperiosteal flap could be released from the bone below. The recipient area was prepared, and by use of round burs, perforations were made to improve blood supply to the graft. The block bone grafts, which had been prepared previously, were then adjusted to the recipient area and fixated with 2 titanium screws, 1.5 mm in diameter, in each block bone. Sharp areas from the grafts were removed with round burs. Sutures were made with
Nylon No. 4 (Ethicon; Johnson & Johnson, Somerville, NJ) and were kept in place for at least 14 days (Fig 3).

**Onlay and Particulate Bone for Sinus Lift Grafting**

The second technique was used in the maxilla when there was not enough height and width in the area suggested to receive dental implants.

The patient received the same preparation with local anesthesia. A mucoperiosteal flap was made, and by use of a round bur, access to the maxillary sinus was established. A specific instrument was used to undermine and detach the sinus membrane so that it could be lifted and allowed for loading with particulate bone, which had been prepared previously. This procedure would recover the height of the area that would receive the dental implants.

To promote the augmentation of the alveolar ridge, especially at the anterior portion of the maxilla, the bone blocks were used, in the same manner as described previously.

The mucoperiosteal flap was released to cover the surgical area without tension, by making relaxing incisions and scoring the periosteum.

**Particulate Bone Alone for Sinus Lift Grafting**

The third technique was used every time there was an intention to recover only the bone height at the area that would receive the dental implants.

After preparation of the patient and allogeneic bone as described previously, the maxillary sinuses were filled with particulate bone at the area that needed to recover its height.

A period of at least 8 months was planned before the patient could be submitted to the installation of dental implants.

Clinical and radiographic examination was done during the postoperative phase.

### Results

Eight cases of maxillary reconstruction, for lateral ridge augmentation, were performed by use of onlay grafts only. All cases were successful, and the dental implants were installed (Table 1). In 7 cases, sinus lifting with bone grafting was done, but dental implants could only be installed in 5 patients. The other 2 patients underwent new reconstruction surgery. In another 13 patients sinus lift bone grafting with allogeneic onlay and particulate bone grafts was done. It was not possible to install dental implants in 2 cases.

### Discussion

Some authors believe that the principal concern regarding, and disadvantage of, allografts is risk of infectious disease transmission, such as acquired immunodeficiency syndrome. On the other hand, it is

<table>
<thead>
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<th>Graft</th>
<th>No. of Cases</th>
<th>Male</th>
<th>Female</th>
<th>Success (Installation of Dental Implants)</th>
<th>Shortest Time of Follow-up</th>
<th>Longest Time of Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral ridge augmentation with allogeneic onlay grafts</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>1 yr</td>
<td>4 yr</td>
</tr>
<tr>
<td>Sinus lift bone grafts with allogeneic particulate bone grafts only</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1 yr</td>
<td>6 yr</td>
</tr>
<tr>
<td>Sinus lift bone grafts with allogeneic onlay grafts and particulate bone grafts</td>
<td>13</td>
<td>3</td>
<td>10</td>
<td>11</td>
<td>1 yr</td>
<td>5 yr</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>6</td>
<td>19</td>
<td>24</td>
<td>—</td>
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</tbody>
</table>

also stated that adequate material processing, including freezing, demineralization, and lyophilization, can decrease the risk of infection transmission.4,5

Allograft has some advantages, such as easy manipulation, great amount of material available, possibility of local anesthesia for the procedure, cost reduction, and morbidity reduction, because the use of another donor site is not necessary.2,6,7 When allograft is compared with autogenous grafts, differences cannot be observed at the final stage of incorporation with regard to histology.8,9

Research to evaluate the immunologic response, performed in patients undergoing allograft surgery, has shown no presence of antibodies in blood samples. Use of local anesthesia, the great amount of material available, no need for a donor site, and cost reduction are pointed to as the advantages of allogeneic grafts. However, the potential for infectious disease transmission is a disadvantage.5 However, the possibility of disease transmission with lyophilized allograft and frozen cartilage was evaluated. Three forms of virus were considered—human immunodeficiency virus, the viruses associated with Creutzfeldt-Jakob disease, and the viruses associated with hepatitis B and C; up to 1993, no case had been found.5

When allogeneic bone grafts are used for reconstruction, the amount of time required for revascularization is longer than that with reconstruction with autogenous bone.4 This is likely due in part to the immunologic response. Fresh bone presents a better immunologic response. Freezing and lyophilization preserve properties to improve the chance of graft incorporation.4,10,11

On the basis of an analysis of the literature, as described previously, many advantages of the use of allogeneic grafts for maxillomandibular reconstruction can be listed, especially when it is compared with the use of autogenous grafts. Handling is easier, there is a great amount of material available, and there is a possibility of using local anesthesia; consequently, there is a reduction of patient morbidity. After all, it was found in this study that in most of the patients, dental implants could be installed, so the use of allogeneic bone graft can be considered a good alternative in this type of treatment.

References