TOMOGRAPHIC EVALUATION OF ATROPHIC MAXILLA REHABILITATED WITH AUTOGENOUS AND XENOGENEIC BLOCK GRAFTS

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ABSTRACT

Aim: The aim of this study was to evaluate the dimensional stability of autogenous and xenogenous bone blocks after grafting procedures using cone beam computed tomography.

Material and Methods: Autogenous (n=6) and xenogeneic (n=7) bone graft blocks were evaluated after 8 (T1) and 16 (T2) months. A dimensional analysis was carried using linear measurements of the height and thickness of the blocks in the tomographic exam.

Results: For the autogenous bone blocks, there was a reduction in height of 1.42mm (10.06%) and a reduction in mean thickness of 1.24mm (29.60%). For the xenogeneic bone blocks, the mean height reduction was 1.38mm (10.02%) and the mean thickness reduction was 0.97mm (18.81%) with remodeling (26.62%). However, there were no significant differences between the xenogeneic and autogenous bone blocks (p=0.366).

Conclusions: The results showed no differences in the dimensional stability of autogenous or xenogenous bone graft blocks. However, clinical and experimental studies with longer follow up periods are needed to elucidate the mechanisms involved in the remodeling process of bone grafts.

KEYWORDS: maxilla, bone transplantation, autologous transplantation, heterologous transplantation

http://dx.doi.org/10.19177/jrd.v4i12-117

INTRODUCTION

The success of implant-supported rehabilitation is associated with the availability of enough bone for the installation of the implant. Sufficient bone availability is important for the correct positioning of the implants and the osseointegration process. In cases of inadequate bone availability, bone grafting procedures are often required. In cases where there is an insufficient amount of bone, grafting procedures with different techniques and materials have been proposed for the rehabilitation of severely resorbed alveolar ridges. Autogenous bone is considered the gold standard grafting material due to its osteoconductive, osteoinductive and osteogenic properties. The occurrence of bone remodeling and revascularization in grafted autologous bone, providing an ideal site to support occlusal forces of implant-supported prosthesis.
Different biomaterials have been used for bone grafting in order to optimize aesthetic and functional results\(^4\).\(^7\).\(^11\). Autogenous bone can be obtained from intra oral sources such as the mandibular branch and symphysis\(^4\). Additional surgical procedures, resulting in increased morbidity. Thus, the development of biomaterials as substitutes for autogenous bone graft has become a subject of strong interest for researchers\(^4\).

Xenogenous grafts are a new alternative to replace autogenous bone. This type of bone is widely available and there is no need for a donor site. The advantage is the reduction in morbidity and the fact that there are none of the biological risks inherent to homologous grafts\(^4\). Indeed, xenogenous bone blocks are highly biocompatible and easy to remodel; they maintain a constant volume for an extended period of time\(^4\). However, the resorption potential and dimensional stability of autogenous and xenogenous bone grafts remains only partially elucidated\(^4\).\(^17\)-\(^20\). Therefore, the objective of this study was to evaluate the dimensional stability of autogenous and xenogenous bone blocks after grafting procedures, cone Morse implant placement and prosthetic rehabilitation, using the cone beam computed tomography (CBCT) method.

**MATERIAL AND METHODS**

This observational and retrospective study used CT scans of patients undergoing autologous block bone grafts (obtained from the mandibular branch) and xenogenous block bone grafts, followed by the installation of cone Morse taper implants and prosthetic rehabilitation. The scans were used to assess the stability of the bone block in terms of height and thickness of the grafted regions. The study was approved by the Research Ethics Committee (COEP) of the State University of Ponta Grossa (Paraná, Brazil), protocol number 14558/11, number 114/2011, on October 27, 2011.

The study selected 16 computed cone beam tomographies of partially edentulous patients who received autogenous bone grafts in block (obtained from the mandibular branch) and xenogenous bone grafts in block, followed by implant-prosthetic rehabilitation. Male and female patients aged over 18 years and with no systemic diseases were included in the sample according to the following criteria: loss of bone thickness in need of reconstruction with block graft for later implant placement, dissatisfaction with removable prosthetic rehabilitation, totally or partially edentulous maxilla, rehabilitated antagonist arch, with aligned occlusal pattern and absence of any kind of odontogenic infectious focus. Exclusion criteria were: absence of CT in the evaluation periods, the presence of systemic diseases and use of drugs, tobacco or alcohol.

Tomographic images were obtained using a cone beam computerized tomograph (Sirona, Bensheim, Germany), obtained eight (T1) and 16 (T2) months after the bone grafting procedure. The CT scans were carried out in a standardized manner on the same device and by the same operator, respecting the manufacturer's instructions: the patient's head was positioned with the occlusal plane parallel to the ground and the median sagittal plane, perpendicular to the ground, with constant cephalostat settings. The image acquisition factors were constant: high-contrast, 42mAs, 85kV and section thickness 0.16mm.

Autogenous (n=6) and xenogenous (n=7) bone graft blocks were evaluated. Tomographic variables evaluated in these blocks were: height (H), mean thickness and mean area. To obtain the graft height measurement (A), a line that was parallel to the long axis of the implant was drawn between the uppermost and lowermost point of the block, and the distance between these points recorded (Figure 1). Graft thickness was measured in three regions parallel to the line of the cervical portion of the implant: at the level of the cervical portion of the implant (E1), 3 mm above (E2) and 6 mm above the cervical portion of the implant (E3). Measurements were obtained from the buccal region of the implant to the surface of the graft (Figure 2). E1, E2 and E3 were used to obtain the mean thickness.

Based on the values of height and thickness E1, E2 and E3, the following variables were defined: Area 1 (height x E1), Area 2 (height x E2) and Area 3 (height x E3). A1, A2 and A3 were used to calculate the mean area. All measurements were carried out after 8 (T1) and 16 (T2) months. The measurements were obtained using Galaxis software version 1.7 (Sirona, Bensheim, Germany) in the sagittal view window (Figures 3 and 4) and were evaluated by the same calibrated examiner.

The comparison between T1 and T2 within each group was carried out using the non-parametric Wilcoxon test. For both groups (autogenous and xenogenous blocks), the dimensional variation of the blocks at the moments T1 and T2 was assessed using non-parametric Mann-Whitney. A single calibrated examiner obtained all measurements at T1 and T2.
examiner (JCS) was previously calibrated by an experienced radiologist (FNGKF). After 60 days, eight tomographies were reanalyzed and the data were compared with the previous measurements. Intra-examiner reproducibility was evaluated by paired t-test (95% confidence interval) and revealed no significant differences between measurements. P values <0.05 were considered statistically significant. Data were analyzed using the computer software IBM SPSS v.20.0.

Figure 1. Height (A) and thickness (B) of the bone graft on sagittal slice of CBCT.

Figure 2. Schematic representation of thickness measurement of autogenous bone blocks after 8 (A) and 16 (B) months.

RESULTS

This study evaluated 16 CT samples, 6 autogenous bone blocks and 7 xenogenous blocks. Three xenogenous blocks were excluded due to poor positioning of implants, which made it impossible to measure the thickness (Et) at T1. Regarding the height of the blocks, both groups decreased between T1 and T2. In the autogenous bone blocks, this reduction was 1.42mm corresponding to a reduction of 10.06% while in the xenogeneic bone blocks the reduction was 1.38mm (10.02%) (Figure 5).

The autogenous bone blocks had a significant reduction (p=0.028) in mean thickness at T2 when compared to those at T1, 1.24mm (29.60%). There was also a significant reduction of the mean area (p=0.028), which was 22.24mm² (36.46%) (Figure 6).

Similarly, the mean thickness of the xenogenous blocks had a significant reduction of 0.97mm (p=0.018), which corresponds to 18.81%. Regarding the mean area of the xenogenous blocks,
there was also a significant reduction (p=0.018) corresponding to 19.85% (26.62%) (Figure 6). There were no significant dimensional change difference of autologous and xenogenous bone blocks between T1 and T2.

Figure 3. Schematic representation of thickness measurement of xenogenous bone blocks after 8 (A) and 16 (B) months.

DISCUSSION

Bone grafts are widely used to enable the installation of osseointegrated implants in regions with insufficient bone availability. The autogenous bone graft is considered the gold standard. However, due to the need for a second surgical site, it presents greater morbidity. Therefore, different biomaterials have been developed for use in grafting procedures, including xenogenous bone source. However, despite its widespread use, the potential for resorption of autogenous and xenogenous bone grafts remains controversial. Thus, this study compared the remodeling of xenogenous and autogenous bone block grafts through their linear measurements after installation of osseointegrated implants (T1) and after prosthetic rehabilitation (T2) using CT scans.

CBCT is widely used to evaluate the donor and the recipient sites in grafting procedures, and is a fundamental requirement for proper planning. Based on CT sections and predetermined reference lines, it was possible to obtain standardized measurements at the observation periods. Thus, the tomographic analysis used in this study proved to be reproducible and enabled us to map the dimensional changes of the grafts as previously described. However, three cases in our sample in the xenogenous graft group were excluded due to poor positioning of the implants, which made it impossible to evaluate the thickness E1 at T1.

Our data revealed slightly lower dimensional changes in xenogenous blocks compared to autogenous bone blocks, however with no statistical difference. In addition, treatment with xenogeneic bone showed greater bone volume at the time of installation of the implants. Corroborating these data, other authors have reported that the use of xenogenous blocks resulted in greater gains in volume compared to autogenous bone due to higher resorption rate of autogenous bone. Furthermore, patients who received xenogeneic bone blocks presented greater bone volume at the time of installation of the osseointegrated implants, due to the greater availability of material. In fact, such availability is considered an important advantage of xenogeneic bone when compared with the limited availability of autogenous bone, especially of intra-oral origin.

In our study, there was a 1.42mm (10.06%) reduction in height and a reduction in mean thickness of 1.24mm (29.60%) for autogenous bone blocks. Regarding the mean area, this reduction was 36.46%. In xenogenous blocks, the reduction in height was 1.38mm (10.02%) and in thickness it was 0.97mm (18.81%) with 26.62% reduction in the mean area. Despite the tendency of a reduction in resorption for xenogenous blocks, this
difference was not statistically significant, corroborating data previously reported by other authors. In this study, a histological analysis was carried out in rats, which revealed that xenogenous grafts were absorbed to a lesser extent by multinucleated cells compared with autogenous grafts. Other authors have evaluated the histological behavior of autogenous and xenogenous bone blocks in mandibular defects in dogs. Bone resorption was detected in both autogenous and xenogenous blocks. The xenogenous bone blocks presented regions coated with soft tissue and the presence of multinucleated giant cells. Furthermore, xenogeneic bone blocks presented osteoconductive properties similar to autogenous bone, corroborating the data obtained in our study.

Figure 4. Dimensional alteration in height of autogenous and xenogenous bone blocks after 8 (T1) and 16 (T2) months.

Other authors have reported no differences between the resorption process of autogenous bone blocks and cortical fresh-frozen block bone allografts. However, the bone resorption profile of corticocancellous fresh-frozen block bone allografts was significantly greater when compared with cortical bone block autografts and autogenous bone blocks. This difference is possibly associated with the bone's structure, due to the presence of trabecular bone.

Other authors have observed more pronounced volumetric reduction in particulate autogenous bone grafts when compared with particulate xenogenous deproteinized bovine bone (Bio-Oss) in maxillary sinus lift procedures. This study also evaluated the resorption of different combinations of autogenous particulate bone and Bio-Oss. The results revealed that the graft volume is better preserved after addition of Bio-Oss, and this volumetric shrinkage is significantly influenced by the relationship between Bio-Oss and autogenous bone.

Figure 5. Dimensional alteration in thickness (average) of autogenous and xenogenous bone blocks after 8 (T1) and 16 (T2) months.

CONCLUSIONS

Based on our results, the xenogenous block presented volumetric stability similar to autogenous block after 8 and 16 months. Thus, in cases where the autogenous graft is not recommended or when this treatment is not well accepted by the patient, the use of xenogenous bone can be considered as a highly relevant alternative. However, it is important that other clinical studies with a larger sample and follow-up period are carried out. The data from these studies will certainly contribute to elucidating the mechanisms of bone remodeling in the presence of different biomaterials.

REFERENCES

8. Misch CM. Comparison of intraoral donor sites for onlay grafting prior to implant


