Xenogenous bone blocks for maxillary reconstruction - histologic and microtomographic split-mouth clinical trial

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Abstract

Background: Atrophic ridges are a challenge in the oral rehabilitation with osseointegrated implants. Autogenous bone graft is the gold standard in ridge augmentation. However, the resorption rates and donor site morbidity limit its use. The deproteinized bovine bone (DPBB) are a viable alternative. DPBB can be particulate or compacted in a block, like the autogenous bone block. There are few clinical studies evaluating the DPBB graft incorporation to the receptor site and its remodeling properties. Aim/hypothesis: This study hypothesis is deproteinized bovine bone blocks (DPBB) sintered in low temperatures, present similar characteristics of mineralization and bone neof ormation than autogenous graft from mandibular ramus. Material and methods: Six patients with edentulous atrophic maxillary ridges were randomized selected in a list of patients whose sought for oral rehabilitation with implants. The inclusion criteria were absence of systemic health issues, age between 20 and 70 years old, with hormonal stability, and consent. Irradiated patients, patients with systemic diseases and post menopause women were excluded. The patients were submitted to reconstruction surgery under general anesthesia. Each side of anterior maxilla received one type of graft, according to randomization process, xenogenous block (test) or Mandibular ramus block graft (control). After 9 months of healing, at implant placement, a biopsy was performed with a 2mm trephine bur, in horizontal direction. Specimens were first processed in 10% formaldehyde for 48h, washed for 24h and stored in 70% alcohol, after they were processed in a digital microCT scan, and then submitted to paraffin inclusion and histomorphometry analysis. Results: The analyzed parameters were tissue volume, bone volume, bone volume percent, tissue surface, bone surface, bone density and porosity, soft tissue and mineralized tissue. The trabecular number, thickness, and separation were also evaluated. All the evaluated parameters respect the normal distribution (Shapiro-Wilk: p = 0.060 – 0.975) and homoscedastic (Levene: p= 0.250 – 0.972). There was statistical difference between groups only for the trabecular thickness. Autogenous bone graft presented larger trabeculae (0.45mm) than DPBB (0.29mm) (p<0.05). Conclusions and Clinical Implications: Results suggest that the DPBB block tested presented similar micro structural and bone formation characteristics to the autologous bone graft from mandibular ramus, furthermore, Deproteinized Bovine Block grafts could be a suitable clinical alternative to autogenous bone when this is contraindicated, for example in compromised health patients or in cases with no sufficient autologous bone donation site.

Methods and Materials

Early teeth loss; Atrophic ridges; Implant rehabilitation; Autogenous bone as gold standard; Alternatives to autogenous bone grafting

Aim

To evaluate the mineralization and new bone formation of a bovine deproteinized bone block in comparison to autogenous graft from mandibular ramus.

Figure 1. Volume comparison between initial (A) and after 9 months (B) for autogenous bone graft.

Figure 2. Study design. (A) Patient selection with total edentulism and maxillary resorption with at least 10mm of ridge height and 2mm of thickness. (B) Split mouth graft placement. (C) Reappraisal of grafts after 9 months, biopsy and (D) implant placement. (E) and (F) core biopsies of autogenous and bovine bone blocks for microCT and Histology.

Figure 3. Histomicrographs of entire biopsies removed from (A) Autogenous graft from mandibular ramus and (B and D) Bovine deproteinized bone block (green arrows indicate the interface between host bone and graft). Hematoxylin-eosin stain (100μm)

Figure 4. Microtomographs of entire biopsies removed from (A) Autogenous graft from mandibular ramus and (B) Bovine deproteinized bone block (green arrows indicate the interface between host bone and graft).

Table 1. Distribution of evaluated parameters on microtomographic analysis. Mean (SD) for autogenous bone and Deproteinized bovine bone block grafts (DPBB)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean (SD)</th>
<th>DPBB (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone vol.</td>
<td>23.01(8.29)</td>
<td>32.94(6.57)</td>
</tr>
<tr>
<td>Bone vol. (%)</td>
<td>6.66(4.44)</td>
<td>9.15(3.36)</td>
</tr>
<tr>
<td>Bone surface vol.</td>
<td>11.45(2.06)</td>
<td>13.28(2.43)</td>
</tr>
<tr>
<td>Bone surface</td>
<td>96.15(40.74)</td>
<td>116.9(39.54)</td>
</tr>
<tr>
<td>Tissue surface</td>
<td>51.94(15.47)</td>
<td>67.17(10.33)</td>
</tr>
<tr>
<td>Trabecular number</td>
<td>0.87(0.03)</td>
<td>0.95(0.02)</td>
</tr>
<tr>
<td>Trabecular separation</td>
<td>0.46(0.05)</td>
<td>0.49(0.17)</td>
</tr>
<tr>
<td>Trabecular thickness</td>
<td>0.60(0.15)*</td>
<td>0.29(0.04)*</td>
</tr>
<tr>
<td>Bone density</td>
<td>4.20(1.04)</td>
<td>3.59(0.98)</td>
</tr>
<tr>
<td>Porosity</td>
<td>32.16(10.53)</td>
<td>71.06(9.84)</td>
</tr>
</tbody>
</table>

Conclusion

DPBB block tested presented similar micro structural and bone formation characteristics to the autologous bone graft from mandibular ramus.

References


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Xenogenous bone blocks for maxillary reconstruction: clinic and tomographic split-mouth trial

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³ São Paulo State University, Dental School at Araçatuba, Department of Basic Sciences

Abstract

Background: Autogenous bone graft still the gold standard in ridge augmentation. However, the resorption rates and donor site morbidity limit its use. Many bone substitutes, as the deproteinized bovine bone (DPBB), are an alternative for ridge reconstruction. DPBB can be particulate or compacted in a block, with autogenous block like structure. There are few clinical studies evaluating the block of DPBB graft clinical behavior, resorption, implantation and implant stability in xenogenous bone block area. Aim/hypothesis: This study hypothesizes deproteinized bovine bone blocks (DPBB) sintered in low temperatures, present similar clinical behavior, similar implant initial stability and less resorption rates than autogenous graft from mandibular ramus.

Material and methods: Ten patients with edentulous atrophic maxillary ridges were randomized selected in a list of patients for oral rehabilitation with implants. The inclusion criteria were: absence of systemic health issues, age between 20 and 70 years old. Irradiated patients, with general diseases and post menopause women were excluded. The patients were submitted to reconstruction surgery under general anesthesia. Each side of anterior maxilla received one type of graft, according to randomization, xenogenous block (test) or Mandibular ramus block graft (control). The alveolar ridges were scanned by CBCT at two times: pre-graft surgery (T0), immediate post-operative (T1) and pre-implants (T2). At the moment of graft surgery the alveolar ridges were measured with surgical caliper in three standardized position. Nine months after an all-on-four protocol was installed, and the clinical measurements were repeated, and it was measured implant torque and implant stability quotient (ISQ).

Results: All the 20 grafted areas were able to implant placement, at post operative period of grafting, 5 patients presented one or more complications, 2 related with xenogenous bone and 3 in the autogenous group. The main complications were wound dehiscence and graft exposure, with a mean of 74.2 days after surgery, ranging from 20 to 120 days. Membrane exposures were kept 99% with chlorhexidine 0.12% gel and follow-up, in 3 cases the membrane needs removal due soft tissue impairment. Three patients presented complications of donor site, like seroma, infection, swelling and hemorrhage, treated with local procedures. The volumetric changes had not statistic difference between the test and control group, graft volume, was initial volume 81.5 (SD 20.27) in autogenous group and 89.75 (SD 8.34) in the bovine block, mean resorption percentages were 10.53 (7.08) and 9.33 (10.41) respectively. Installation torque (control: 41; test: 30.5) and ISQ (control: 62; test: 53.37) presented no statistic difference.

Conclusions and Clinical Implications: The tested xenogenous block presented similar clinical behavior of mandibular ramus autogenous block, for maxillary horizontal reconstruction. The complication rates, resorption and implant torque and stability presented no statistical difference in this clinical trial.

Background and Aim

Early teeth loss; Atrophic ridges; Implant rehabilitation; Autogenous bone as gold standard; Alternatives to autogenous bone grafting

AIM

To evaluate the graft incorporation, the volume changes and the implant stability of a bovine deproteinized bone block in comparison to autogenous graft from mandibular ramus.

Methods and Materials

Clinical resorption 9 months after graft placement.

Figure 3. Comparison between percentage of clinical resorption (result from difference between T1 and T2 measures), for autogenous and Deroteinized bovine block graft (DPBB).

CT volume changes

Figure 4. 95% CI for the Bone volume in mm² prior grafting, immediately after grafting and 9 months earlier. There was no difference for autogenous bone and DPBB in all evaluated periods, and both grafts have achieved feasible volumetric gain in CT.

Figure 5. 95% CI for the insertion torque (N), for straight and inclined implants. Inclined implants presented lower insertion torque in both autogenous and DPBB.

Figure 6. 95% CI for the Initial Stability Quotient (ISQ), for straight and inclined implants. No difference was observed for both autogenous and DPBB.

Results

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Methods and Materials

Figure 2. Study design. (A) Patient selection with total edentulism and maxillary resorption with at least 10mm of ridge height and 2mm of thickness. (B) Split mouth graft placement. (C) Reopening of grafts after 9 months, biopsy and (D) implant placement. (E) Initial stability measurement with Osstell Q.
Avaliação clínica, tomográfica e histológica da reconstrução alveolar horizontal por meio de enxerto autógeno e heterógeno em bloco: estudo clínico prospectivo de boca-dividida
Defeito inicial
Área doadora no ramo mandibular

Blocos ósseos [Autógeno e xenógenos] posicionado
Bonefill Bloco [Cod 16498 Lote ]

Situacao clinica
Follow Up = 09 meses

Reentrada após 09 meses, revelando regeneração óssea ideal
Follow Up = 09 meses
Situação na reabertura revelando osso maduro e contorno reconstruído do rebordo

Implantes BioDIRECT SWE instalados
Pedro Henrique de Azambuja Carvalho


Valfrido Antonio Pereira Filho