DENTAL IMPLANTS

Does Graft Particle Type and Size Affect Ridge Dimensional Changes After Alveolar Ridge Split Procedure?

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Purpose: The absence of an adequate volume of bone at implant sites requires augmentation procedures before the placement of implants. The aim of the present study was to assess the ridge width gain with the use of allografts and biphasic β-tricalcium phosphate with hydroxyapatite (alloplast) in ridge split procedures, when each were used in small (0.25 to 1 mm) and large (1 to 2 mm) particle sizes.

Patients and Methods: A randomized controlled trial of 23 subjects with severe atrophy of the mandible in the horizontal dimension was conducted in a private institute. The patients underwent placement of 49 dental implants after a staged ridge split procedure. The patients were randomly allocated to alloplast and allograft groups (predictor variable). In each group, the patients were randomly assigned to either small graft particle or large graft particle size (predictor variable). The gain in ridge width (outcome variable) was assessed before implant placement. A 2-way analysis of variance test and the Student unpaired *t* test were used for evaluation of the ridge width gain between the allograft and alloplast groups (predictor variable). Differences were considered significant if *P* values were < .05.

Results: The sample included 23 patients (14 men and 9 women). The patients were randomly allocated to the alloplast (n = 11) or allograft (n = 12) group before the ridge split procedure. In each group, they were assigned to a small graft particle or large graft particle size (alloplast group, small particle in 5 and large particle size in 6 patients; allograft group, small particle in 6 and large particle size in 6). A statistically significant difference was observed between the 2 graft types. The average ridge width gain was significantly greater in the alloplast group (large, 4.40 $\pm$ 0.24 mm; small, 3.52 $\pm$ 0.59 mm) than in the allograft group (large, 3.82 $\pm$ 0.19 mm; small, 2.57 $\pm$ 0.16 mm). For both graft types (alloplast and allograft), the large particle size graft resulted in a greater ridge width gain compared with the small particle size graft ($P < .05$).

Conclusions: Within the limitations of the present study, we suggest the use of large particle alloplast as the graft material of choice for staged ridge split procedures in the posterior mandible.

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The extraction of teeth can result in ≤ 50% of alveolar ridge width loss within the first 1 to 3 years. This loss has been reported to be 3.8 to 6.1 mm during a period of 3 to 12 months.[1-3] This bone resorption can lead to compromised positioning of the implant and jeopardize its esthetic integrity. In addition, the lack of an adequate bone thickness on the labial surface of an implant can risk the long-term survival of the implant. Surgical procedures such as block onlay grafting, guided bone regeneration, distraction osteogenesis, and the split ridge technique have been documented to augment the bone volume for implant site development.[4-6] This technique has also been described as a bone spreading or ridge expansion technique and was introduced by Tatum[7] and modified by Summers.[8] Q2

The lateral ridge expansion technique involves longitudinal splitting of the alveolar ridge into 2 parts, provoking a greenstick fracture of the buccal cortex. This segment is then repositioned bucally using osteotomes to create a space between the buccal and lingual cortical plates. This space can be filled with autologous bone or allogenic or alloplastic biomaterials.[9] Depending on the timing of implant placement, this technique can be performed using an immediate or a delayed or staged approach.[6,10-12]

In narrow ridges, it will be necessary to place a graft material order to maintain the desired ridge width after ridge expansion.[13] The type of graft material and its particle size might influence bone regeneration. The use of bone substitutes and biomaterials for intraoral grafting has become increasingly popular.[14-17] Synthetic materials, such calcium phosphate and hydroxyapatite (HA), are used frequently owing to their similarity in chemical composition to the bone mineral matrix, superior biocompatibility, and osteoconductive properties.[15] From a histologic viewpoint, it has been observed that the use of alloplast in the form of β-tricalcium phosphate (β-TCP) leads to bone formation similar to that formed with an autogenous graft.[16,17] Allografts have also been of special interest for ridge augmentation procedures, because it has been observed that they are highly biocompatible and lead to fewer complications.[18] In addition, they can be either osteoinductive or osteoconductive, depending on the processing method.[19] These grafts mainly include freeze-dried and demineralized freeze-dried bones. Freeze-dried allografts are often used, because they are less likely to induce any sensitization reactions in the host.[20,21]

The published data have highlighted the importance of the graft size and its effect on bone augmentation. It has been observed that the size of the particle plays a crucial role in bone regeneration.[22,23] Petrungaro and Amar[24] analyzed the effect of small (150 to 400 μm) and large particles (1 to 2 mm) on total bone volume Q3 and concluded that large particle bone grafts are superior in terms of bone volume and resorption rate compared with small particle grafts. However, contradictory results were reported by Zhou et al[23] and Pallesen et al,[25] who showed that augmentation of bone can be effectively achieved with the use of small particle-size bone grafts. Thus, the published data are inconclusive on the type of graft material and particle size that should be used to achieve the optimal ridge width for placement of dental implants in the staged ridge split technique.

The purpose of the present study was to assess the ridge width gain using alloplast and allografts with biphasic β-TCP with hydroxyapatite, with each of these used with small (0.25 to 1 mm) and large (1 to 2 mm) particle sizes. We hypothesized that type of graft and the particle size of graft would not have significant effects on the ridge width gain. The specific aims of the present study were to compare the 2 different types of grafts and the 2 different particle sizes for each graft type on the ridge width gain in the atrophic mandible.

Patients and Methods

The study outline shown as a flowchart in Figure 1, according to the consolidated standards of reporting trials (CONSORT).

STUDY DESIGN

To address the research question, we designed and implemented a prospective randomized clinical trial that included patients with a reduced bone width in the posterior mandible and requiring implant placement. The institutional review board approved the present study (approval no. 6193-A/2014). The patients underwent placement of 49 dental implants after the staged ridge split procedure from January 2011 to May 2012.

To be included in the study, the following inclusion criteria had to have been met: 7 mm of bone height above the mandibular canal, an inadequate buccolingual width to allow placement of dental implants (ridge width less than 5 mm), and the presence of cancellous bone between the buccal and lingual cortical plates. Patients were excluded as study subjects if vertical bone loss was present, if they were heavy smokers (more than 10 cigarettes daily), or if they had immunodeficiency or a known metabolic bone disease contraindicating implant surgery.

The patients were randomized using a computer-generated randomization list and were allocated to either the allograft or alloplast group. In the allograft group, 6 patients each were randomly allocated to the small particle and large particle groups. Similarly, in the alloplast group, 5 patients were in the small