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SHORT COMMUNICATION

Bone crestal height and bone density after third-molar extraction and grafting: a long-term follow-up study

Etiene Andrade Munhoz · Augusto Bodanezi · Osny Ferreira Junior · José Mauro Granjeiro

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Abstract The objective of this study was to evaluate the long-term influence of xenogenic grafts on bone crestal height and radiographic density following extraction of teeth. The right and left third lower molars of 22 patients were surgically extracted, and one randomly chosen socket was filled with a xenogenic graft (Gent-Tech). The contralateral molar was left to heal naturally, serving as a paired control. Digital intraoral radiographies were taken at surgery and 2, 6, and 24 months after, to evaluate bone density (BD) and alveolar bone crest to cementoenamel junction distance. The data obtained were subjected to two-way analysis of variance and Tukey's test (α=0.05). The significant decrease in cementoenamel junction distance observed for both groups was limited to the first 6 months. BD values increased significantly in the first 6 months, with no alterations observed up to 24 months for both groups. BD was higher for the experimental group at all time points (p<0.05). Socket grafting with the xenogenic materials tested did not changed bone crestal height and bone radiographic density in the long term.

E. Andrade Munhoz (✉) · O. Ferreira Junior
Department of Stomatology and Oral Surgery,
School of Dentistry, University of São Paulo,
Al. Dr. Otávio Pinheiro Brisolla 9-75,
17012-901 Bauru, São Paulo, Brazil
e-mail: etiamfob@yahoo.com

A. Bodanezi
Department of Dentistry, Endodontics and Dental Materials,
School of Dentistry, University of São Paulo,
Bauru, Brazil

J. Mauro Granjeiro
Department of Cell and Molecular Biology, Institute of Biology,
Fluminense Federal University,
Niterói-RJ, Brazil

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Introduction

Recent follow-up researches show that the placement of a biomaterial in an extraction socket is able to modify bone modeling and counteract marginal ridge contraction that happens after tooth removal [1, 2].

Bone regeneration techniques with nonresorbable xenogenic grafts or bioabsorbable membranes were demonstrated, in a few short-term studies, to be a viable and stable treatment to prevent vertical and horizontal ridge losses often associated with impacted mandibular third-molar extractions [3–5].

Since a previous 6-month study showed an increase in radiographic density and bone height maintenance after third-molar removal and grafting [6], this study was designed to evaluate the long-term influence that a bovine xenogenic graft combined with a resorbable membrane has on vertical bone height and radiographic density following surgical tooth extraction.

Materials and methods

Study design

The authors designed a split-mouth clinical trial, which was approved by the local ethics committee. Volunteers aged between 15 and 25 years were included in the study according to the following criteria: impacted bilateral lower third molars present in symmetrical position and agreement to sign an informed consent form. The sample was composed of 10 men and 12 women. From the initial sample of 39 patients, a total of 17 did not attend all the

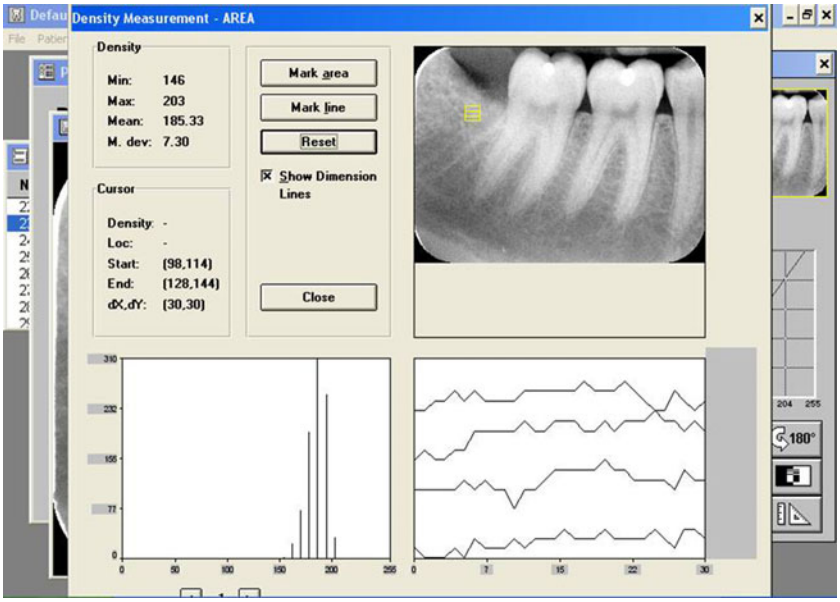

Fig. 1 Measurement on Digora Digital System

follow-up examinations due to emigration (9 subjects), change of address and telephone number (5 subjects), or refusal to participate (3 subjects).

Before surgical procedures, one mandibular third-molar socket of each patient was chosen at random to receive xenogenic graft material (Gen-Tech; Baumer, Mogi Mirim, SP, Brazil), composed of bovine bone morphogenetic proteins (BMPs) and organic and inorganic bone and collagen. After the socket was filled, the biomaterial was covered with a resorbable collagen membrane (Gen-Derm; Baumer, Mogi Mirim, SP, Brazil). The remaining contralateral socket for each patient did not receive any biomaterial and served as a paired control. The surgical sites were then sutured, and each patient received written immediate postsurgical recommendations and pain medication.

Radiographic assessment

The intervening areas were individually x-rayed with digital radiographs (Digora; Soredex Orion Corporation, Helsinki, Finland) for 0.2 seconds using a paralleling technique and a dental x-ray unit (Yoshida Kaykor X-707, Tokyo, Japan) operating at 7 mA and 70 kVp, immediately after extraction and at 2, 6, and 24 months after surgical procedures. For standardization, a RINN-XCP positioner (Dentsply; Elgin, IL) was individualized and adapted to each patient through occlusal molds made of resin (Duralay; Polidental, Cotia, SP, Brazil).

To determine the distal vertical bone heights of second lower molars, the distance from the cementoenamel junction (CEJ) to the alveolar bone crest was determined; for bone density (BD), pixel intensity values were measured in squares of 30×30 pixels in eight distinct regions (Fig. 1). Evaluations were conducted in a blinded fashion by one examiner and were repeated after 4 weeks.

Statistical analysis

The data obtained were evaluated by two-way analysis of variance (ANOVA) and Tukey's test, used for individual comparisons (α=0.05). Intraexaminer agreement was

Table 1 Mean bone alveolar crest to CEJ distance values (mm) and standard deviation in each interval studied

Interval	Control group	Experimental group
0 mo	1.98 ± 1.57^{ab}	1.96 ± 0.97^{cd}
2 mo	2.12 ± 1.61^{ab}	1.82 ± 1.09^{cd}
6 mo	1.27 ± 0.60^{ab}	0.93 ± 0.47^{cd}
24 mo	0.73 ± 0.44^{a}	0.62 ± 0.31^{c}
Gain/Loss	−1.25±1.60	−1.34±0.84

Values with the same letters indicate statistical difference.

Table 2 Mean values and standard deviation of BD (pixels values) in each interval studied

Interval	Control group	Experimental group
0 mo	126.80 ± 32.08^{bc}	135.29 ± 35.83^{de}
2 mo	143.18 ± 32.36^{bc}	169.26 ± 20.05^{de}
6 mo	149.73 ± 20.89^{bc}	167.33 ± 22.91^{de}
24 mo	139.64 ± 34.24^{b}	152.75 ± 32.48^{d}
Gain/Loss	12.84±46.15	17.45±37.27

Values with the same letters indicate statistical difference.

calculated by Dahlberg's error. All statistical tests were conducted using SPSS software (v. 16.0 for Windows; SPSS, Chicago, IL).

Results

There was a significant decrease in bone crestal distance for both groups at the 2- and 6-month intervals that remained unaltered until the end of the experiment ($p<0.05$; Table 1). The differences in radiographic BD between the time of surgery and 2 and 6 months later were statistically significant in both the experimental and control groups ($p<0.05$). A decrease in pixel value after 24 months, with no difference between initial and 24-month values, was observed in both groups (Table 2). The measures were significantly higher in experimental group in all periods evaluated ($p<0.05$).

Regarding intraexaminer agreement, Dalberg's error was found to be 0.36 mm for distance from alveolar bone crest to CEJ ($p=0.093$) and 5.198 pixels for BD ($p=0.285$).

Discussion

The decrease in CEJ-to-alveolar bone crest distance noticed for both groups 6 months after third-molar extraction was already reported in a preceding evaluation and also in researches conducted by other authors [3, 4, 7]. Thus, from 6 months on, development of intrabony defects exceeding 4 mm was expected to occur in the control group, as previously described by Kugelberg et al. [7]. Conversely, in this study, no periodontal losses were observed for both control and experimental groups. Thus, it should not be assumed that the use of a xenogenic graft was responsible for maintaining the alveolar bone crest level from 6 to 24 months. Although differences were not observed with this experimental model, xenogenic inorganic materials have been shown to better preserve the dimension of the alveolar ridge elsewhere in the mandible and maxilla [2].

Since inorganic particles need a significant amount of time to be resorbed [9, 10], the longer experimental intervals tested in this study were expected to produce radiographic similarities between the grafted and non-grafted areas, but the reduction in radiographic BD perceived from 6 to 24 months for the experimental group was not enough to eliminate the statistical difference between groups. This finding may therefore evidence an incomplete resorption of the graft material during the period, although Oltramari et al. [8] described the break-down of this same inorganic xenogenic particles graft into the sockets of minipigs from 3 months onward [8]. The compaction of the xenogenic material into internal bone, combined with the inorganic nature of the graft, was pointed as probable causes for a delay in the resorption process. Furthermore, the removal of xenogenic particles by osteoclasts could be present, but the radiographic method may have not been sensitive to properly detect the biomaterial's resorbed amount.

Differently from evidenced in other short-term studies [3–5], the results of this research suggest that xenogenic bovine graft provides no benefits for the patient after mandibular third-molar extraction. Undoubtedly, the significant differences concerning biomaterials' formulae may explain this dissonance, but the bone crest measurement method applied (probing or radiographic) should also be considered.

From a clinical point of view, the reported absence of bone crestal height changes 2 years after third-molar sockets grafting, if extendable to other mandibular and maxillary sites, shows that the tested material could be useful to conserve ridge's dimension for implant insertion and esthetic rehabilitation, although some increase in radiographic density of the area may happen.

As a final advice, Gen-Tech and Gen-Derm were approved for commercialization only by the Brazilian National Health Surveillance Agency, and thus, their international use still requires further researching.

Conclusion

In conclusion, socket grafting with the xenogenic materials tested did not change bone crestal height and bone radiographic density in the long term.

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Conflict of interest The authors declare that they have no conflict of interest.

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