

Analysis of the healing process in sinus bone grafting using the various grafting materials

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Statement of Purpose: Various bone grafting materials have been studied for use in maxillary sinus grafts in order to accelerate the bone healing process and prevent re-pneumonization of the maxillary sinus after grafting. However, most of these reports are from in vitro studies or animals experiments. To fully assess the healing process, bone grafting materials transplanted in humans must be examined histologically. Such studies are obviously limited for ethical reasons, and research studies demonstrating the superiority of a specific material are hard to find. The purpose of this study was to compare differences in the healing process in the sinus bone grafting using the various grafting materials.

Methods: The maxillary sinus membrane was lifted carefully, and a bone graft was performed. The maxillary sinus bone grafts were divided into four groups according to the graft material used: Group I, a mixture of autogenous bone and BioOss (Osteohealth Co., USA); Group II, a mixture of BioOss and Orthoblast II (Greencross, ISOTIS, USA); Group III, BioOss only; and Group IV, synthetic bone, OSTEON (GENOSS, Korea), only. For Group I, particulate autogenous bone, harvested from the ramus or mandibular symphysis, was mixed with BioOss at a volume ratio of approximately 26-50% using a tissue adhesive (Greenplast; Korea). For Group II, BioOss and Orthoblast II were mixed at a ratio of 1:2. Groups 2, 3, and 4 were transplanted also using a small amount of autogenous bone harvested from the maxillary sinus bony window and the maxillary tuberosity. The number of each specimen in Group 1, 2, 3, 4 was selected randomly. The number of participants varied per group since not all of the patients agreed to take part in this study. BioOss with a particle size of 1-2 mm was used. For OSTEON hydrated in sterile saline, 50% of the particles were 0.5-1 mm and 50% were 1-2 mm. The graft materials were stabilized with Greenplast and placed in the sinus cavity. Where the residual alveolar bone quantity was sufficient for primary stabilization, immediate placement was performed; otherwise, placement was delayed for 4 months. In all cases, the lateral sinus window was covered by a resorbable collagen membrane (Ossix; ColBar R&D Ltd., Ramat Hasharon, Israel) before the primary suture. Patients were placed on antibiotics and analgesics. Oral gargling with 0.12% chlorhexidine was prescribed. To evaluate the healing status of the graft surgery, bone specimens were collected from the lateral sinus using a 2.0-mm trephine bur at 4 and 6 months after surgery.

In the delayed placement cases, samples were collected 4 months after maxillary sinus bone grafting, immediately prior to implant placement. In the cases of immediate implant placement at the time of maxillary sinus bone grafting, samples were collected 6 months after surgery. To evaluate the healing status of the graft surgery, bone specimens were collected from the lateral sinus using a 2.0-mm trephine bur at 4 and 6 months after surgery. Histology of the bone specimens was prepared and the percentage of newly-formed bone fraction, lamellar bone/woven bone ratio (LB/WB) and newly-formed bone/graft material ratio (NB/GM) were measured in order to indicate the suitability of the materials and the successful healing of the graft. Differences in these measurements between Groups 1 and 2 and between the 4- and 6-month samples were analyzed. The histomorphometric analysis of each group according to time point was performed by the Kruskal-Wallis validation method. The *p* values <0.05 were deemed to be statistically significant. Statistical analyses were performed using statistical software package (SPSS 15.0).

Results: LB/WB ratio and NB/GM ratio were markedly increased at 6 months compared with the values in the group at 4 months. It was observed that good bone healing was achieved even for grafts of xenogeneic bone only or synthetic only. Cases grafted with a mixture of allogeneic and xenogeneic bone showed no great advantage with regard to bone healing.

Conclusions: The results indicated that grafts of xenogeneic or synthetic bone can be used for use in sinus bone grafting.

References: Liljensten E, Larsson C, Thomsen P, Blomqvist G, Hirsch JM, Wedenberg C. J Mater Sci Mater Med. 1998;9:535-541.