Atrophic maxillary floor augmentation by mineralized human bone allograft in sinuses of different size: an histologic and histomorphometric analysis

Resorption and pneumatization of bone, following tooth extraction, are common occurrences in the posterior maxilla. They may cause both a quantitative reduction and a qualitative deterioration of bone that leads to inadequate bone dimension for proper size/length implant placement. About 30 years ago, Boyne & James (1980) introduced maxillary sinus augmentation with lateral access approach, to allow proper implant insertion in an atrophic maxillary posterior ridge. The sinus augmentation with lateral access has been widely studied afterwards, depicting this technique as a safe and highly predictable treatment (Smiler et al. 1992; Zinner & Small 1996; Block et al. 1998; Wallace & Froum 2003; Del Fabbro et al. 2004; Aghaloo & Moy 2007; Petursson et al. 2008).

Autogenous bone, from both intraoral and extraoral sources, was the graft used in the early sinus augmentation techniques (Boyne & James 1980; Smiler et al. 1992; Block et al. 1998). Nevertheless, autogenous bone suffers from several drawbacks such as the need of a second surgical site, donor site morbidity and longer surgical times (Davis et al. 1984; Chiapasco et al. 2009). Interestingly, 17% (out of 47 sinus augmentation) infected sinus complications occurred when autogenous bone, obtained form iliac crest, ramus or chin, was used as the graft (Kahnberg & Vannas-Lofqvist 2008). Furthermore, a rapid and unpredictable resorption of grafted autogenous bone can invalidate long-term results, particularly in sizeable bone regenerations (Davis et al. 1984). Autogenous bone resorption (up to 50%) was also recorded in sinus augmentation procedures performed in both beagle dogs (Schlegel et al. 2003) and humans (Browaeys et al. 2007; Sbordone et al. 2009). Systematic literature reviews (Wallace & Froum 2003; Del Fabbro et al. 2004; Aghaloo & Moy 2011; Smiler et al. 2001, 2002; Block et al. 2003). The used 80/20 MHBA mixture appears to promote, in the severe atrophic maxilla, a satisfactory bone formation. Our results prove that the larger the sinus, the longer the maturation time needed to achieve a suitable amount of new bone formation.

Key words: allografts, bone grafts, bone regeneration, guided bone regeneration, histology, maxillary sinus, sinus augmentation

Abstract

Objective: The aims of this work were to histologically examine the healing of mineralized human bone allograft (MHBA) in sinus augmentation for elevating a severe maxillary atrophy ridge (≤2 mm residual ridge height) and to correlate the results to the sinus cavity size.

Material and methods: A two-stage protocol was conducted in 23 patients, all having crestal bone ≤2 mm. A mixture of 80/20 cortical/cancellous of MHBA particles was used to augment sinus using the lateral window approach in narrow (NS; <15 mm bucco-palatal distance) and wide (WS; ≥15 mm bucco-palatal distance) sinuses, based upon computerized tomography (CT) assessment. A bone core biopsy was taken at implant placement, 6 and 9 months after surgery. Microradiography, histology and histochemistry of methacrylate-embedded sections were performed to analyze and to evaluate the bone and graft amount.

Results: Newly formed bone around MBHA particles was found in all 28 biopsies. Bone showed a woven structure at 6 months after surgery and a lamellar structure 9 months after surgery. At 6 months after surgery, the 13 NS and 15 WS had 30.5 ± 8.8% and 20.7 ± 4.9% mean ± SD bone formation, respectively. At 9 months after surgery, it was 38.8 ± 7% (NS) and 30.7 ± 3% (WS). Residual graft was about 16% (6 months) and 6% (9 months), in both NS and WS. The Mann–Whitney test showed a greater bone formation in NS than in WS (P < 0.005).

Conclusions: The used 80/20 MHBA mixture appears to promote, in the severe atrophic maxilla, a satisfactory bone formation. Our results prove that the larger the sinus, the longer the maturation time needed to achieve a suitable amount of new bone formation.