Case Report

Ten-year follow-up in a maxillary sinus augmentation using anorganic bovine bone (Bio-Oss). A case report with histomorphometric evaluation

Key words: anorganic bovine bone; Bio-oss; maxillary sinus augmentation

Abstract: Several bone grafting materials have been used in sinus augmentation procedures. Bio-Oss (deproteinized and sterilized bovine bone) has shown to have osteoconductive properties and no inflammatory or adverse responses have been published. In spite of these successful results, histologic data regarding bone augmentation using Bio-Oss in humans is scarce. The purpose of this study was to analyse the amount of Bio-Oss ossification in a case of maxillary sinus augmentation, recording and comparing histomorphometric data 8 months, 2 and 10 years after surgery. This long-term histologic evaluation of retrieved specimens has been performed, comparing histomorphic measures at different times. Eight months after surgery we observed in 20 different thin sections of the specimen a mean amount of bone tissue (including medullar spaces) of 29.8% and 70.2% of Bio-Oss. At 2 years the bone tissue increased to 69.7% and 10 years after surgery it was 86.7%. The comparison of the means for each time has shown a highly significant increasing trend in bone formation associated with Bio-oss resorption: at 8 months, 2 and 10 years.

Several bone grafting materials have been used in sinus augmentation procedures (Pi-attelli et al. 1999). Bio-Oss (deproteinized and sterilized bovine bone) has shown to have osteoconductive properties and no inflammatory (Wheeler et al. 1996; Valentini et al. 2000) or adverse responses have been published. In spite of these successful results, histologic data regarding bone augmentation using Bio-Oss in humans is scarce.

Material and methods

Surgical procedure
A 60-year-old man [Fig. 1] was treated with a left maxillary sinus augmentation technique as suggested by Kent & Block (1989). After local anaesthesia, an incision was made palatal to the edentulous crest and then continued buccally, at least 3 mm from the grafting area. A mucoperiosteal flap was elevated, exposing the lateral wall of the left maxillary sinus. The antrum was outlined on the lateral wall of the maxilla with a round bur under copious irrigation. An elevator was used to push the sinus membrane inward and to elevate the lateral wall of the sinus. The membrane was dissected from the floor, the lateral walls and the medial wall of the antrum. The graft material (anorganic bovine bone)
was placed against the medial wall of the antrum. Three plasma sprayed implants IMZ™ were inserted, taking care to achieve the primary stability (Fig. 2). Bio-Oss was then applied to completely fill the compartment (Figs 3 and 4) and an e-PTFE membrane was fixed on the lateral wall of the maxilla, covering the grafting material. The soft tissues were sutured obtaining a primary closure (Fig. 5). Three biopsy specimens were taken at 8 months, 2 and 10 years after surgery using a trephine bur and copious irrigation. Cores were taken in the most apical space between the mesial and the middle implant to a depth (in a bucco-palatal direction) of about 4 mm after 8 months, a depth of 8 mm at 2 years and 12 mm at 10 years. The deepest component of the specimens (4 mm) was considered at 2 years and 10 years.

**Hystomorphometric evaluation**

The samples were immediately fixed in 4% paraformaldehyde phosphate buffer, pH 7.4 for 24 h. The specimens were then dehydrated through graded ethanols, cleared in xylene, embedded in paraffin, cut into slices of about 10µm thick and stained with ematoxylin and eosin.

Using a high geometric linearity TV camera, directly applied on a light microscope (obj. magn. 6.3 ×), a morphometric-computerized analysis was performed by means of an interactive computerized image analysis system (Kontron-Zeiss/IBAS 2).

The image of the half specimen corresponding was displayed on a TV colour monitor with a resolution of 512 × 512 square pixels; this image was the specimen for interactive editing in the image analyzer.

A suitable computer program for morphometric analysis was defined and then performed.

**Results**

The error due to the automatic process of hystomorphometric evaluation of each section has been controlled analysing 20 sections for each specimen (8 months, 2 and 10 years).

Eight months after surgery we observed a mean amount of bone tissue (including medullar spaces) of 29.8% [Fig. 6] and 70.3% of Bio-Oss ± 2.6. At 2 years [Fig. 7] the bone tissue increased to 69.7% ± 2.7 and 10 years after surgery [Fig. 8] it was 86.7% ± 2.8.

**Discussion**

In the present study, sinus floor augmentation with anorganic bovine bone was evaluated. Many authors [Lundgren et al. 1996; Piattelli et al. 1999; Valentini et al. 2000] have concluded that the sinus-lift augmentation technique is a safe and effective method to increase bone volume in the maxilla. The histologic data on bone formation and clinical success rates confirm that the ideal graft material for sinus-lift augmentation is autogenous bone [Valentini et al. 2000].

In spite of this, Bio-Oss has been shown to be highly biocompatible with oral hard tissues in animals and humans and to have
the properties of an osteoconductive material [Pinholt et al. 1991; Berglundh & Lindhe 1997]. New bone has been detected over exposed implants using Bio-Oss in association with membranes [Zitzman et al. 1997]. The amount of newly formed bone after 6 months in cases treated with maxillary sinus augmentation using Bio-oss varied from 14.7% ± 5.0% to 33.1% ± 12.4% [Wheel er et al. 1996; Yildirim et al. 2000, 2001].

In our case report, all three specimens (8 months, 2 and 10 years after surgery) the Bio-Oss particles were surrounded by newly formed lamellar bone (Figs 6, 7 and 8), showing processes of slow resorption. The potential metabolism of Bio-Oss by osteoclasts could be confirmed by the progressive increase in relative bone volume (Table 1, Fig. 9) until the biopsy at the tenth year after surgery. After 8 months the bone tissue represented the 29.8% of the total new volume (and Bio-Oss 100% – 29.8% = 70.2%). In the next 16 months (until the second year) 56.8% of the residual Bio-Oss was substituted by bone and, from the second year until the tenth, similarly the 56.1% of the grafting material was replaced by lamellar bone, showing a markedly faster process of resorption in the first period after surgery. In fact, until the second year a speed of resorption (SR) of 3.55% per month was observed. This value decreased consistently in the following 8 years with a mean value of 0.58% per month, which is 6.12 times slower than the initial SR.

Zusammenfassung


Material und Methode: Diese histologische Langzeituntersuchung erfolgte mit Hilfe von verschiedenen Zeitpunkten entnommenen Biopsien, welche dann histomorphometrisch vermessen und verglichen wurden.

Resultate: 8 Monate nach der Chirurgie entdeckten wir auf den 20 dünnen Schnitten die Biopsie einen mittleren Knochengewebesanteil [Markräume eingeschlossen] von 29.8% ± 2.6% (und 70.2% Bio-Oss). Nach 2 Jahren wuchs der Knochengewebesanteil auf 67.9% ± 2.7% und nach 10 Jahren waren es 86.7% ± 2.8.

Zusammenfassung: Der Vergleich der Mittelwerte während 10 Jahren zeigt einen signifikanten Trend zur Knochenbildung einhergehend mit der Bio-Oss Resorption.

References


