

# RESTORATION AFTER SINUS LIFT USING BONECERAMIC OR BIO-OSS

## Histological observations in a split-mouth study without autologous bone graft



Gabriele Caruso MD, DDS  
Private practice  
Cagliari, Italy

CORRESPONDENCE  
Dr. Gabriele Caruso

Corso Vittorio Emanuele 16  
09124 Cagliari, Italia  
tel 070 682222  
tel and fax 070 663545  
mail: gabrcaru@tin.it

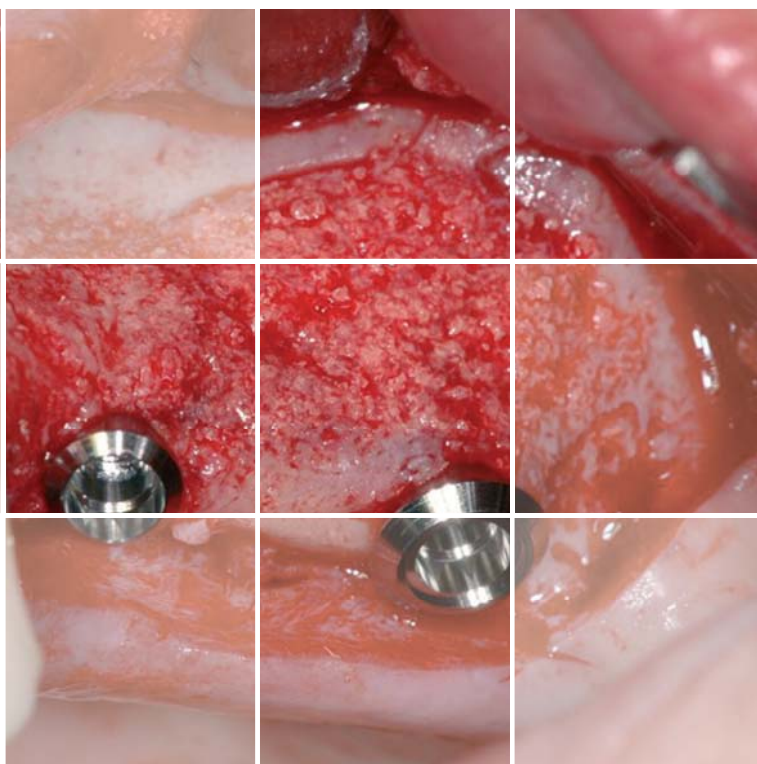
### Introduction

Sinus elevation procedures using bone graft materials are commonly used to elevate the floor of the expanded sinus cavity in the edentulous posterior maxilla in order to increase bone height to allow the placement of dental implants.

The patient's own (autologous) bone harvested from the jaw or elsewhere is the preferred material for this procedure. However, limited quantities are available and the procedure may result in pain and complications at the donor site. Calcium phosphates are commonly used as bone substitute materials. They often consist either of hydroxyapatite (HA) or of tricalcium phosphate (TCP). Both of these materials are known to be osteoconductive. HA is generally considered as non-reabsorbable material, whereas TCP is known to be substituted by newly formed bone. By combining HA and TCP in a so called biphasic calcium phosphate, it became possible to modulate the degradation rate by varying the HA/TCP ratio (Le Geros et al. 2003).

The aim of the documentation of these clinical cases was to evaluate implant-based restoration in the posterior maxilla previously augmented randomly using a synthetic biphasic calcium phosphate on one side or an anorganic bovine bone mineral (apatite) on the other. We also evaluated histology, residual bone height, type of bone and primary stability of implants.

patient AF 8 months of healing after sinus augmentation



### Materials

The biphasic calcium phosphate (BCP, Straumann BoneCeramic, Institut Straumann AG, Switzerland) applied is a fully synthetic bone graft substitute in particulate form composed of biphasic 60% hydroxyapatite (HA), and of 40% of the beta form of tricalcium phosphate (beta-TCP). The anorganic bone mineral (ABM, Bio-Oss, Geistlich Pharma AG, Switzerland) applied is a natural bone mineral (apatite) of bovine origin, in the form of granules.

## METHODS & RESULTS

### Patients

All patients referred to our practice for implants placement between 2004 and 2007 were screened. The four patients enrolled in this case documentation were in need of bilateral sinus elevation before the implant based restoration of the posterior maxilla. Mean age was 59.5 (range 54-67 years). Two of the four patients were smokers. All patients had adult chronic periodontitis. No acute infection (PPD  $\geq$  4 mm) was observed at the time of treatment. The patients enrolled did not present any condition or symptom that was contrary to implant therapy.

### Augmentation procedure

Bilateral sinus lift was performed following a trap-door technique using a synthetic biphasic calcium phosphate (BCP) on one side and an anorganic bovine bone mineral (ABM) on the other. No autologous bone was applied to reduce the number of variables. The allocation of the substitute material was randomized by flipping a coin. Before augmentation, the residual bone height (RBH) was measured by CT scan examination at the intended implant site. The mean height was 1.87 mm (range 0.5-3 mm) for the BCP group and 2.4 mm (range 0.6-4 mm) for the ABM group. All patients healed uneventfully. Details of the patient status and the sinus elevation procedure performed are summarized in table 1.

Table 1: Details on patient population and sinus elevation procedure

Patient initials	Age	Smoking habit ( $\geq$ 10 cigarettes a day)	Material	Volume applied	RBH	Healing time before dental implant placement
AF	67	Yes	BCP	1 g	2 mm	8 mo
			ABM	1 g	4 mm	11 mo
PS	57	Yes	BCP	1 g	3 mm	10 mo
			ABM	1 g	4 mm	10 mo
PA	54	No	BCP	1,5 g	2 mm	10 mo
			ABM	2 g	0,6 mm	10 mo
CS	60	No	BCP	2 g	0,5 mm	10 mo
			ABM	1 g	1 mm	10 mo

g: grams, ml: millimetres, mo: months

### Dental Implant placement

Implants were placed following a staged approach. The mean healing time after augmentation was 9 months (range 8-10 months) for BCP and 10,5 months (range 10-11 months) for ABM. In addition, the density of the native bone at the time of implant placement was qualified according to Misch et al. 1990. Good primary stability was achieved for 5 out of 8 implants. In particular 3 implants, inserted in sites previously augmented with BCP, achieved a limited primary stability and they were screwed in manually. Details on the placement of implants are summarized in table 2.

### Dental Implant restoration

All 8 dental implants in the 4 patients enrolled were successfully loaded. The loading time indicated above is defined as the time during which the dental implant was in occlusion. The mean loading time of the 8 dental implants observed was 17.625 months (range 3 months - 2 years 6 months). Details on the placement of dental implants are also summarized in table 2.

Table 2: Summary of dental implant placement and restoration

Patient initials	Material	No. of dental implants	Site	Density of bone	Primary stability	Healing time before loading	Implant survival after loading
AF	BCP	1	26	Type 4	limited	15 mo	2 y 6 mo
	ABM	1	16	Type 3	good	16 mo	2y 5 mo
PS	BCP	1	16	Type 3	good	15 mo	2 y 2 mo
	ABM	1	26	Type 3	good	12 mo	2 y 2 mo
PA	BCP	1	16	Type 4	limited	12 mo	1 y
	ABM	1	26	Type 3	good	12 mo	1 y
CS	BCP	1	26	Type 4	limited	5 mo	3 mo
	ABM	1	16	Type 3	good	5 mo	3 mo

mo: months, y: years

### Qualitative and quantitative histological evaluation

All patients agreed for biopsies to be harvested at the augmented site during dental implant placement. Cores retrieved during dental implant bed preparation were histologically evaluated from all sites except one in patient, PS, who refused the second biopsy.

In all sections analyzed, both bone substitute materials were well osseointegrated, if loosely packed at the site. This became evident in patient CS who showed an unusual high density of granules ( $>$  35 %) at the site augmented with BCP, where bone formation was only observed in areas where granules were less abundant. Due to this variance within the same specimen, this site was excluded from the quantitative histological evaluation.

In the remaining sites, the mean amount of newly formed bone was 35.8 % (range 28.0 - 43.4 %) - mean 37.7 % (range 29.5 - 43.4 %) for BCP and mean 33.9 % (range 28.0 - 40.6 %) for ABM. The quantitative results from the histological evaluation are summarized in table 3.

Table 3: Qualitative results from histological evaluation

Patient initials	Material	RBH	Density of bone	Substitute density	Newly formed bone density	Non mineralized tissue density
AF	BCP	2 mm	Type 4	18.0%	40.3%	41.7%
	ABM	4 mm	Type 3	19.0%	33.0%	48.0%
PS	BCP	3 mm	Type 3	11.5%	43.4%	45.0%
	ABM	4 mm	Type 3	-/-	-/-	-/-
PA	BCP	2 mm	Type 4	19.1%	29.5%	51.4%
	ABM	0,6 mm	Type 3	19.3%	40.6%	40.1%
CS	BCP	0,5 mm	Type 4	-/-	-/-	-/-
	ABM	1 mm	Type 3	21.4%	28.0%	5.7%

### Conclusions

Due to the limited number of patients enrolled, only preliminary conclusions can be made on the bone substitute materials investigated and the success of dental implants placed at the augmented sites.

Bone in-growth was observed at all sites either augmented with biphasic calcium phosphate (BCP) or anorganic bovine bone mineral (ABM), even though the bone height and quality was limited.

Comparable amounts of newly formed bone were observed for both substitute materials as long as the bone substitute was loosely packed.

All 8 dental implants placed at the augmented site were successfully osseointegrated, although 3 dental implants, inserted in sites previously augmented with BCP, showed limited primary stability which is known to be a critical factor for early dental implant survival.

Due to the comparable amount of newly formed bone observed in the histological evaluation, height and quality of native bone at the augmentation site are assumed to be the main factor for the limited primary stability achieved.

Further investigations are needed to confirm the observations made within the four patients enrolled in this case documentation.

### Take home message

BCP and ABM are both suitable materials for sinus elevation enabling successful implant-based restoration of the posterior maxilla.

patient AF 8 months histology lens eclipse E 600 2x

