



## **Use of a biphasic bone substitute dispersed within a collagen matrix as a filling material in sinus floor elevations. A retrospective monocentric study**

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USE OF A BIPHASIC BONE SUBSTITUTE DISPERSED WITHIN A COLLAGEN MATRIX AS A  
FILLING  
MATERIAL IN SINUS FLOOR ELEVATIONS. A RETROSPECTIVE MONOCENTRIC STUDY

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## INTRODUCTION

Sinus floor elevation (SFE) is a surgical procedure commonly used prior to dental implant placement in edentulous posterior maxilla when bone height is insufficient (1–3). In a systematic review, Tan *et al*, found a mean of 90,1% implant survival rate after SFE at 3 years follow-up(4). Several grafting materials can be used. Autogeneous bone has been for years the gold standard material but it harvest increases morbidity. Biomaterials allow for reduced operating time, less morbidity, and make the procedure realizable under local anesthesia even in bilateral cases (5–7).

Matri™ Bone (Biom'up, Saint-Priest, France) is an original synthetic biphasic bone graft made of hydroxyapatite (HA) and beta tri-calcium phosphate ( $\beta$  TCP) porous granules embedded in a type I or III porcine collagen matrix. It presents in adjustable and malleable blocks that can be folded during introduction into the recipient site. The great advantage of this material is its cohesivity, facilitating its handling and limiting the spreading of particules, especially in the sinus cavity when sinus membrane is accidentally perforated.

The goal of our study was to evaluate the efficiency of Matri™ Bone as a filling biomaterial in SFE.

## MATERIAL AND METHODS

We carried out a retrospective monocentric study covering the period between January 2014 and December 2017. Inclusion criteria were all patients, male or female, over 21 years of age at the time of surgery, in whom dental implants were expected in the lateral edentulous maxilla but who had a residual bone height of less than 6mm measured at the mid-point of the edentulous space, patients for whom a cone beam CT or a CT scan 6 months after the SFE was available and, when implanted, patients that could be followed at least 12 months after implant insertion. When bilateral SFE was required, both sides were included. Exclusion criteria for the procedure were patients presenting with unbalanced systemic diseases, chronic sinusitis, smokers (over 10 cigarettes per day), pregnant women during first consultation, history of head and neck radiotherapy, bisphosphonates use, maxillary tumors (benign or malignant) and severe bruxism. Exclusion criteria for the study were patients with incomplete files or lost to follow-up. All patients signed an informed consent about the procedure and the biomaterial. Evaluation criteria were gain in height and implant survival rate at the last follow-up after loading.

The biomaterial we used was made from 90% of synthetic biphasic bone substitute particles (60% HA and 40%  $\beta$ -TCP) embedded within a 10% porcine type I or III collagen matrix (Matri™ Bone, Biom'up, Saint-Priest, France). Two particle sizes were available (80-200 $\mu$  and 0.5-1mm). The biomaterial presented in the form of malleable blocks of four different sizes: 12x12x12mm, 24x12x12mm, 30x30x6mm, 35x60x6mm.

Preoperative investigation was classical: orthopantomogram and Cone Beam Computed Tomography (CBCT) centered on the maxillary (Figure 1). Local anesthesia (articaine and epinephrine) was mostly performed except for patients who expressly claimed general anesthesia. A vestibular incision was used to expose the lateral sinus wall and a rectangular window (12-15mm length over 6-8mm height) was made with a piezotome or a diamond burr over the residual alveolar ridge. The sinus membrane

was progressively lifted and the space created above the sinus floor was filled with the biomaterial (Figure 2) previously folded on itself and moistened with physiological serum or with blood ponctioned locally. Filling could be completed with additional biomaterial blocs in order to obtain a complete filling of the space until outcropping (Figure 3). Once the material in place, it gorged itself with blood allowing for a perfect fitting of the space and the possible remaining gaps. We did not use any additional membrane, neither to cover the bony window nor to plug a possible tear of the membrane. Closure was performed with non-resorbable thread. A control orthopantomogram at least was performed directly after surgery. Antibiotherapy was prescribed (amoxicilline 1g / clavulanic acid 125mg 3x/day or clindamycine 600mg 3x/day in case of allergies to  $\beta$ -lactamines for seven days. Analgesics (paracetamol and codeine or tramadol) and chlorhexidine mouth rinses for 10 days were given. Nose blowing was forbidden for three weeks. Lukewarm soft diet was recommended for one week. Sutures were removed the 15th day. A CBCT or a CT scan was realized around the 5th postoperative month to assess the gain in height and to evaluate the length of implants. Implants (Biomet 3i or Straumann – 4 in diameter and 8mm in length at least) were inserted under local anesthesia around the 6<sup>th</sup> month.

## RESULTS

Nineteen patients (21 SFE) could be included in the study. Characteristics of patients are summed up in table 1. Average bone height was 3,8mm [1.5 - 5.8] before SFE and 12.7mm [3.5 - 20.6] after SFE, representing a mean gain in height of 8,9mm [0 – 16.8]. Mean biomaterial volume used by SFE was 7,6mm<sup>3</sup> [1.7 - 12.6]. Average number of implants placed after SFE was 2.1 by side [0 - 3]. Mean Implant survival rate was of 86,4% with a mean follow-up of 19 months after functional loading and 31months [12 - 59] after insertion of implants. The implant survival rate was calculated with functional implants loaded over implants placed in SFE.

Two failures occurred. In one case, SFE failed because of infection and the patient could not be implanted. In the second case, integration of the implants into the augmented sinus could not be achieved and the implants were lost six months after insertion.

Two perforations of the sinus membrane were identified during the SFE procedure without any consequences on the success of the SFE or on implant placement.

## DISCUSSION

Matri<sup>TM</sup> Bone is a safe, efficient and easy to use filling biomaterial for SFE. It allows for reliable and predictable results. The technique is simple, repeatable and leads to a low rate of complications, even in case of peroperative sinus membrane perforation.

According to recent studies, implant survival rates after SFE with lateral approach varies from 75.57% to 100%, 3 to 7 years after functional loading, that matches our 86.4% implant survival rate. No differences in implant survival rates exist when it comes to biomaterials (4,8).

Average gain in height was 8.9mm at six months follow-up in our study, that corresponds to usual results when autogenous or xenogenous bone grafts are used (9,10).

We had two recognized per-operative sinus membrane perforations in our series. These perforations had no consequences neither on the SFE success nor on the implant success. According to studies, sinus membrane perforations occur in about 20% of the cases (4) and expose to the risk of intra-sinusal migration of graft material particles of sinusitis and thus of SFE failures (11). Matri™ Bone is in the form of cohesive blocks thanks to the collagen matrix and this drastically reduces the risk of particle migration even in case of sinus membrane perforation (12). We had 9.5% evident membrane perforations in our study and, despite no use of additional collagen or any other kind of membrane, we didn't notice any particle migration in our patients. The use of biomaterials instead of autologous bone allows for less morbidity as no donor site is needed, for a diminution of the operative time and for less resorption (13,14). Allografts or xenografts may lead to infectious disease transmission even if the risk is said to be very low and so far unknown bacterial or viruses contamination cannot be excluded (15). Allografts constitute a natural bone scaffold submitted to a high resorption rate when compared to other graft material and more likely to be used in cortico-cancellous bone blocks for alveolar bone grafting (16). Xenografts have the same limitations and present in addition a risk of immunological problems and of specific disease transmission (porcine endogenous retrovirus, bovine spongiform encephalopathy) (17,18). On the other hand, bone graft materials have a cost and there might exist some cultural or religious limitations to their use. Concerning resorption, allo- and xenografts seem to be more resorbed when compared to synthetic biomaterials even if level of confidence is low (16). Among synthetic biomaterials,  $\beta$ -TCP gave good results in some studies, but it seems to be resorbed as much as autologous bone. Its association with HA seems to lead to greater new bone formation compared to xenografts (16,19). The association with a collagen matrix allows for cohesivity, provides a better ease of use and hemostatic properties when used dry (12). Our implant success rate was comparable to the actual literature but comparative, randomized (if possible) studies dealing with a greater number of patients and showing histomorphological data must be performed in order to confirm these good results.

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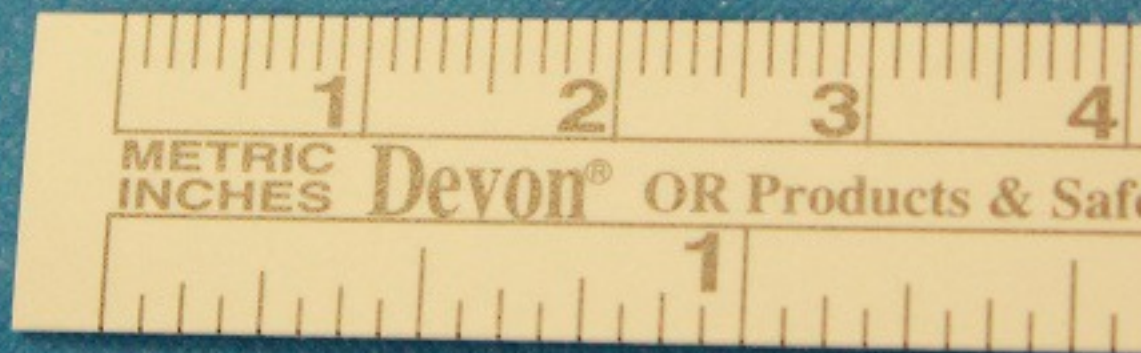
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Age	Gender	Side	Bone height before SFE (in mm)	Bone height after SFE (the 6th month) (in mm)	Gain of height (in mm)	Volume of grafting material (cm³)	Membrane perforation	Number of implants placed after SFE	Follow-up after insertion of implants (months)
60	W	L	3,8	20,6	16,8	5,2	No	2	53
52	W	R	3,2	16,5	13,3	12,6	No	2	28
61	M	R	3,5	14,2	10,7	12,6	No	2	26
65	M	R	4,0	13,2	9,2	5,2	No	2	59
47	W	R	1,5	9,1	7,6	5,2	No	2	49
63	M	L	5,2	12,5	7,3	12,6	No	2	49
64	W	L	4,8	17,9	13,1	3,7	No	2	32
62	W	R L	2,6 3,5	12,5 13,3	9,9 9,8	6,5	No	3 3	28
						5,9	No		
59	W	R	2,1	14,9	12,8	6,9	No	2	30
35	M	R	4,3	9,1	4,8	12,6	Yes	1	26
62	M	R	1,6	13,0	11,4	5,2	No	3	39
69	M	L	5,8	15,2	9,4	3,5	No	3	25
66	M	L	3,3	11,7	8,4	12,6	No	1	22
63	W	L	3,5	3,5	0	12,6	No	0	32
66	W	L	5,1	10,5	5,4	1,7	No	2	24
58	W	L	4,4	11,9	7,5	5,2	Yes	2	18
64	W	R L	3,6 4,0	12,9 8,9	9,3 4,9	7,0	No	3 3	12
						5,6	No		
59	W	L	5,7	10,7	5,0	5,2	No	1	18
73	M	L	4,5	13,8	9,3	12,6	No	3	18
60,3[35;73]			3,8[1,5;5,8]	12,7[3,5;20,6]	8,9[0;16,8]	7,6[1,7 ;12,6]	9,5%	2,1[0 ;3]	31[12;59]

TABLE 1 : CHARACTERISTICS OF THE SURVEYED POPULATION (L:LEFT R: RIGHT W: WOMAN M: MAN)