How to rehabilitate the posterior parts of the jaw? What is the interest of the use of a bone substitute and a collagen membrane in the management of posterior maxillary bone deficits? A longitudinal study of a clinical case.

Translated by Biom’Up from the original article

Dr Jean Lionel Clamadieu
DU Implantologie Paris VI
DU Réhabilitation chirurgicale maxillo-faciale Paris VII
DU Esthétique du Sourire Strasbourg
Post Graduate Implantology NYU

The management of posterior maxillary bone deficits in height and thickness is very often necessary to rehabilitate these areas with implants in improved mechanical and aesthetic conditions. Through the longitudinal study of a clinical case, the interest of the use of MATRI™BONE a filling material and the resorbable membrane COVA™ will be exposed in this type of bone regeneration.

Maxillary edentulous premolar-molar regions present quite frequently, with their sinus proximity, a reduced bone volume requiring management of these deficits, prior to implants placement. The lack of bone height and / or thickness is precisely evaluated using a 3D clinical and radiological study (CBCT). The implant-prosthetic rehabilitation will then integrate a bone reconstruction phase prior or simultaneous to implants placement. Sinus filling techniques are now well described and codified and are part of the procedures performed by the implantologist. The different Summers derived techniques will be considered with vertical residual bone between 6 and 10 mm. The side edges will be systematically performed when the vertical residual bone will be less than 6 mm.

NEW BONE FORMATION
Autologous grafts, “Gold Standard” ten years ago, are now replaced for sinus filling, by using allogenic resorbable substitutes. Indeed, the purpose of the sinus lift is no longer to provide an autologous bone creating an additional bone volume, but the establishment of a resorbable space maintainer capable of inducing at the end a new bone formation in a well-irrigated and non-infected site. There are many bone substitutes of various particle sizes and of different origins (organic or mineral). The main technical difficulty of the “sinus lift” is the respect of the integrity of the sinus membrane during its detachment. The piercing of the sinus membrane is quite common and complicates the implementation of the bone substitute material. The risk of leakage of allergenic particles into sinus is real, reducing the homogeneity of our filling and capable of inducing ENT infectious phenomena.

FILLING HOMOGENEITY
The main advantage of the use of MATRI™ BONE (Biom’Up, France) is its matrix nature with elastic consistency, shape memory, enabling implementation without risk of intrasinus particles leakage and ensures prefect homogeneity of the filling; (Fig 1A). It is an osteoconductive and resorbable bone substitute matrix based on hydroxyapatite, calcium

phosphate (60/40) and porcine acellular collagen. The mineralized portion of the material presents an ideal porosity to osteoconduction needed for any bone filling. Collagen provides its haemostatic properties and provides a growth matrix for osteoblasts. MATRI™ BONE is a resorbable bone substitution matrix, hemostatic and osteoconductive hydroxyapatite (60%), calcium phosphate (40%) and porcine acellular collagen.

COVA™ is a cross-linked acellular porcine collagen membrane, allowing guided regeneration, resorbable and suturable; (Fig.1B). This mineralized matrix must be hydrated with the patient's blood by immersion of thirty seconds to get certain mechanical qualities. We therefore chose to systematically use PRF exudate rich in BMP. It can be easily cut to the size of the bone window formed. We turn to the preparation of MATRI™ BONE. It is advisable to soak the matrix in the patient’s blood during at least 30 seconds. In the clinical case, the matrix is hydrated in patient’s PRF.

Fig.2: Preparation of MATRI™ BONE. It is advisable to soak the matrix in the patient's blood during at least 30 seconds. In the clinical case, the matrix is hydrated in patient’s PRF.

Fig.3a and 3b: Preoperative examinations. Observation of a broken 13-18 tooth-supported bridge at the inter 15 and pillar 16, this bridge presenting three pillars 13, 16 and 18. Radiological examination reveals an interradicular fracture of the tooth 16.

salivary contamination. The elastic property of shape memory allows performing bone window with a reduced diameter without risk of heterogeneity or gapped area. COVA™ is a cross-linked acellular porcine collagen membrane. It has a mechanical strength while being flexible and can be sutured or fixed with pins. It will maintain the bone substitution matrix in the lateral apposition side when a bone augmentation in thickness will be required. This membrane, easily handled is cut for a perfect fit to the grafted site. In this case, it is hydrated in PRF exudates rich in BMP. In fact, these two materials allow us to manage the vast majority of maxillary posterior volumetric deficits.

Fig. 4: Additional examinations and treatment planning. Fig. 5a: The first surgery is performed under local anesthesia. A full-thickness flap, extended from 13 to 18, allows obtaining a good visibility of the operative site. The distal papilla of 13 is preserved. The avulsion of the 16 is performed without bone trauma using periotomes and then the socket is thoroughly curetted. Fig. 5b: A low volume of the lateral bone window is made to access the sinus cavity.

**CLINICAL CASE**

A female patient of 56 years, non-smoker, comes with a broken 13-18 tooth-supported bridge at the inter 15 and pillar 16, this bridge presenting three pillars 13, 16 and 18. The radiological examination reveals an interradicular fracture of the tooth 16 probably due to an excessive burden compared to the low number of prosthetic abutments; (Fig.3). An implant-supported rehabilitation is practiced for teeth 14 to 17 and tooth-supported for teeth 13 and 18; (Fig. 4). The initial radiological analysis has shown a healthy sinus and an important bone defect in height and thickness, two surgical steps are planned:

- **1st surgery:** Avulsion of broken tooth 16. Sinus and alveolar filling. Apposition graft to increase the bone thickness at 14 and 15.
- **2nd surgery:** placement of three implants. Antibiotic treatment (Amoxicillin, clavulanic acid) is initiated two days before surgery and continued for ten days. Corticosteroids (Prednisolone 60 mg) is introduced one hour before surgery and continued the next two days.

**STEPS OF THE TREATMENT**

The first surgery is performed under local anesthesia; (Fig. 5). A full-thickness flap, extended from 13 to 18, allows obtaining a good visibility of the operative site. The distal papilla of 13 is preserved. The avulsion of the 16 is performed without bone trauma using periodontal curettes; (Fig. 5A). A low volume of the lateral bone window is made to access the sinus cavity; (Fig. 5B), then the sinus membrane is gently peeled off; (Fig. 5C and D). The volume of the window is reduced as the mineralized matrix is compressed during the insertion. Its shape memory will allow its expansion into the sinus cavity. MATRI™ BONE - dimensions 30 x 30 x 6 mm and particle size 0.5-1 mm - is cut into two pieces to allow easy handling (Fig. 5E), then inserted and pressed into the inferior part of the sinus; (Fig. 5F). From the start, the collagen part provides a density of the filling allowing optimal blood colonization. The empty socket of the 16 is also filled; (Fig. 5G), and an apposition graft is achieved by using the same substitution material for increasing the thickness of the bone ridge at the teeth 14 and 15; (Fig. 5H). The membrane COVA™ is then easily positioned on the site and fixed with titanium pins to stabilize the apposition and close the sinus window; (Fig. 5I and J). It is important to ensure a perfect immobilization of the membrane. Finally, the flap is repositioned without tension thanks to a periosteal incision; (Fig. 5K). 2D radiological and immediate 3D controls allow us to assess the size and homogeneity of bone reconstruction; (Fig. 6).

**Fig. 5c and 5d:** The membrane is gently peeled off. **Fig. 5e:** Its shape memory will allow expansion into the sinus cavity. "Matri™ BONE" is cut into two pieces to allow easy handling... **Fig. 5f**... then is inserted and pressed into the inferior part of the sinus. **Fig. 5g:** The empty socket of the 16 is also filled.

The provisional prosthesis is emptied. All vestibular part is removed to avoid charges. Local treatments with chlorexidine are prescribed. The sutures are removed 15 days after surgery; (Fig.7). Healing is satisfactory without any sign of inflammation or pain. The second surgery is performed under local anesthesia four months after the first surgical phase. The crestal thickness obtained is suitable for our prosthetic corridor. Three implants "Clinic Serf" are introduced in 14, 16 and 17; (Fig. 8).

Fig. 5h: An apposition graft is achieved by using the same substitution material for increasing the thickness of the bone ridge at the teeth 14 and 15.

Fig. 5i and 5j: A COVA™ membrane is then easily positioned on the site and secured with titanium pins to stabilize the apposition and close the sinus window.

Fig. 5k: It is important to ensure a perfect immobilization of the membrane. Finally, the flap is repositioned without tension thanks to a periosteal incision.

Fig. 6a and 6b: 2D and 3D immediate postoperative radiological controls.
Bone remodeling is already usable at four months and the area filled with the bone substitution matrix is compact and without adhesion to the periosteum of the flap. A sub-drilling and the use of osteotomes at the teeth 16 and 17 allow obtaining a satisfactory primary retention, evaluated at 25 N/cm on the distal implants and 40 N/cm on the mesial implant. A healing screw is placed on the latter implant only. When preparing implant sockets, a sample is taken using a trephine with an internal diameter of 3.3 mm; (Fig. 9). Histological analysis of the bone biopsy; (Fig. 10, Lab. Novotec, Lyon, France) shows that under the residual cortical bone appears an area consisting of a mixture of fragments of bone substitute in light gray (-olds) and mineralized and cellular bone areas in green (*), all maintained by the interstitial tissue (ti). At higher magnification, in area (b), areas of mineralized and cellular bone (osteocytes in red) clearly appear contiguous to different fragments of bone substitutes. Small areas of bone tissue in formation (osteoid tissue) are visualized in different sites of the area (↩), indicating a phenomenon of bone remodeling. The bone marrow is well developed and vascularized around fragments of material with some dense matrix areas (∆). Osteoblasts (ob) were observed in the form of the lining cells along the material, or cubical cells nearby areas of bone formation. The laboratory concluded to a perfect osseointegration of fragments material in connection with a bone remodeling phenomenon in progress; (Fig. 10).

Fig. 9: During the setting up of implants, a sample is taken in the filled area using a trephine. Fig.10a and 10b: Results of histological analysis of sample taken 4 months after filling. 🌟: bone substitute (light gray) *: residual cortical bone (green): a mixture of bone and cement debris, Mo: bone marrow, ti: interstitial tissue ->: osteoid tissue, Δ: Dense matrix area , ob: osteoblast. Fig. 11a and 11b: Performing of the prosthesis nine months after filling (five months after the placement).

**FINAL RESULT**
The prosthesis is made five months after implant placement; (Fig. 11). It perfectly integrates the prosthetic corridor and provides aesthetic and functional recovery. The use of a bone substitute matrix loaded in β-TCP and a resorbable membrane both rigid and elastic has allowed a low morbidity bone reconstruction, predictable in volume, stable at four months, allowing an implant positioning of quality for perfect prosthetic integration. The reproducibility of this type of result, the ease of implementation of volume augmentation, the homogeneity of bone regeneration obtained make MATRI™ BONE and COVA™, two materials of choice in the management of maxillary areas in implantology if surgical and prosthetic procedures are properly followed.

**TO DEEPEN**


