COREBONE
Bioactive Coral Bone Graft

Scientific Background and Case Reports

May 2019
Since their development in the eighties, coral (coralline) implants have been successfully used worldwide to treat a variety of orthopedic, craniofacial, oral bony defects and augmentation procedures. With the introduction of osseointegrated dental implants, increasing bone volume and improving bony contours has become an issue of utmost importance in dental medicine. Furthermore, the introduction of immediate implant placement, especially at sites in which post-extraction bone resorption is prominent, has made bone augmentation procedures an integral part of most treatment plans and implant procedures. (1,2)

Natural coral skeleton is morphologically and chemically close to that of native bone, (1) making it a potential "bone replacement" biomaterial. Using it may, among other qualities, enable to bypass some of the inherent complications associated with the use of autogenous grafts and allografts. In dental/oral surgery autogenous grafts are most commonly harvested from the posterior mandible, iliac crest, femur or parietal bone. Thus increasing operative time, donor-site morbidity and cost. Handling contour to a proper size and individual variations in resorption, are additional factors which may complicate the procedure. (2) In Europe, the use of allografts is limited due to legal issues as well as donor-site morbidity. (3,4) Bovine/porcine grafts are commonly used, however, due immunogenicity and disease transmission potential risks (5) they pass viral/prion elimination process and lose essential bone like and resorptions qualities.

The main characteristics that make Coral Bone suitable and desirable for bone augmentations are osteoconduction and resorption. Moreover, coral has the potential to enhance bone regeneration, does not evoke inflammatory infiltrate or fibrous encapsulation. (6,9)

Numerous clinical and pre-clinical studies and longitudinal follow-ups have shown successful augmentation claiming that natural coral and coralline hydroxyapatite are biocompatible and resistant to infection. (6,7)

Due to their morphological and biological properties, coralline xenografts have been used in dentistry for over 30 years. Previous studies showed that calcium carbonate rich grafts (Bio Coral, France) encouraged new bone formation after maxillary sinus augmentation procedures with 19.59%-37.32% and 21.17%-54.65% mean new bone growth for tissue-engineered bone and calcium phosphate, respectively. (8,9,10)

A clinical follow-up of socket preservation procedures using Bio Coral in the posterior maxilla and mandible claimed that 93.5% of the augmentation sites were successful, being suitable to support the placement of endosseous dental implant with no further need for additional augmentation procedures. Hence, in successful sites, coral granules can spare residual ridge atrophy and resorption, obviating the need for autogenous bone graft, reducing patient morbidity, treatment and costs.

Histological analyses of core specimens harvested during implant placement in sites which were previously treated with coral grafts, revealed no foreign body reaction to coral grafted particles. (6) Histochemical analysis showed that no osteoblasts positive for alkaline phosphatase were present and mineralized tissue analysis (von Kossa) suggested that the bone around the grafted particles was mature and highly mineralized. (12) Additionally, the fact that almost all grafted particles (Bio Coral) were surrounded by mature bone supports the claim that this bio material is highly osteoconductive. Unlike many other materials no fibrous tissue encapsulation was seen. (12,13)

Additional observations with similar coralline product, however, HA coated (Pro Osteon, Biomet-Zimmer) have shown vascular ingrowth, differentiation of osteoprogenitor cells, bone remodeling and graft resorption occurring together with host bone ingrowth into and onto the porous coralline microstructure. (12,13)


5. R.A Kenley, K. Yim; Biotechnology and bone graft substitutes; Pharmaceutical research 1993; Vol 10.


CoreBone - The ideal alternative to bovine and human derived products

Corals have been used as bone grafting material for 30 years. Their bone-like qualities, composition, structure, strength and resorption, have led to their use in dental and orthopedics procedures in hundreds of thousands reported cases. However, in the last decade, corals have been declared as endangered species and their quality decreased due to the rising sea pollution.

CoreBone unlike previous products, is made of corals are grown in a closed, controlled aquatic (aquarium) system. Using laboratory-made sea water and proprietary technology enriching the growth environment and the corals with bioactive nutrients, CoreBone leverages the coral natural bone-like properties and prevent sea pollution related risks.

Different types of corals, varies in the porosity, strength and shape are cultured for various dental and orthopedic indications. CoreBone’s graft material is comprised of the pure mineral part of the coral. It consists of calcium carbonate crystals (>95%) in the form of aragonite enriched with silicium, strontium, and other non-organic substances. The three main elements - calcium, silicium and strontium - are known to play an important role in the bone mineralization process and in the activation of enzymatic reactions with osteogenic cells.

Biomimetic - Bone replacement materials made from corals cultured in closed and monitored system enriched with silicium and strontium for bioactivity and strength
Bioactive - Attractive to bone cells and stimulates new bone growth and connectivity
Strong - Up to 5 times than cancellous bone/synthetics
Porous - Optimal porous structure enables vascularity ingrowth and new bone formation
Biodegradable - Remodels by osteoclastic activity
Cortico - Cancellous coral types mix - for optimal bone formation and remodeling
Low risk - No human/bovine biological risks, no marine pollution

Histology of a core trephined from an edentulous upper posterior ridge 6 months following a sinus lift. The upper zone reveals graft particles (CB) partly surrounded by New Bone (NB) indicating high graft conductivity. Graft to bone contact is about 60%.

(H&E Original Mag. X100)
3D Through Porous Structure
Bioactive surface and interconnected pores in optimal dimensions for ingrowth of blood vessels and bone deposition.

Bone Deposition into Pores
Mineralized matrix of cortical bone is deposited on the surface of coral mineral. Ingrown blood vessel inside a pore of CoreBone graft.

Bone Cells Attracted by CoreBone Graft
Layers of strained active osteoprogenitor cells attached to bioactive coral mineral surface (48 hours after grafting in vivo).

Strength CoreBone Vs Human Bone*
resistance to deformation E-Module (Mpa)
* Human cancellous bone

CoreBone 500
300-450 μm

CoreBone 1000
600-1000 μm

CoreBone 2000
1600-2000 μm
**Case Report: Prof. Haim Tal, DMD PhD, Israel**

Socket preservation before implantation using CoreBone 1000

**Granules size:** 600-1000 μm

**Site:** Tooth #25

**Patient:** 65 years of age, female

**Follow up:** 4 months after augmentation

Tooth #25 - extraction socket filled with CoreBone 1000, three months post extraction and grafting. Radio-opaque area shows new bone and graft particles.

Two implants we placed at #25 and #26 following 18 weeks from extraction. #25 CoreBone grafting site.

Histological Presentation of decalcified hard tissue harvested from the grafted extraction socket 18 weeks after socket preservation procedure using CoreBone (500). Histological observation reveals New bone surrounding and in contact with CoreBone particles. Bone to graft contact is present around most of the particles. A few ossification centers showing osteoblastic activity around woven bone are visible.

Upper: H&E stain; Lower: Trichrome stain. Original Magnification X100
Case Report: Dr. Oliver Scheiter, DDS, Mallorca

Buccal defect correction CoreBone 1000
Granules size: 600-1000 μm
Site: Anterior right Maxilla
Follow up: 10 months after augmentation

Initial site, teeth 12-13 are missing, a large bony defect is seen at the buccal aspect of the area.

Digital planning of the implantation (the implants will be placed at the position of teeth no 12-13, with the final restoration in mind) The large buccal defect is seen on the x-ray.
Two implants were paced at the augmentation site the same day.

CT scan after final restoration confirms an optimal position of the implant.

Final restoration, 10 months after augmentation, sufficient bone volume and keratinized tissue are seen.
Case Report: Prof. Gerrard Scortecci, DDS PhD, France

Bone augmentation after periapical cyst extraction, using CoreBone 1000

Granules size: 600-1000 μm

Site: Anterior maxilla, tooth no 12

Primary Pan-X, a large periapical cyst is seen surrounding the apex of tooth no 12

Initial site: the buccal aspect of the root is revealed, showing the periapical cyst at the site

Cyst after extraction

Initial site: periapical cyst clinical view before extraction

The defect is filled with CoreBone 1000 granules

Cyst extraction leaving a large bony defect

Pan-X after 12 months for augmentation – the bonny defect is fully filled with graft, no residual lesion is seen.
Open sinus lift procedure, augmentation using CoreBone 1000

**Granules size:** 600-1000 μm

**Site:** Posterior right Maxilla

**Follow up:** 6 months after augmentation

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Initial site Pan-X and PA Xray, teeth 14-15 are missing, bone height is not sufficient for implant placement due to proximity of the maxillary sinus.

An open sinus lift procedure was performed, using a lateral minimal invasive technique. A collagen membrane was placed to secure the thin mucosa lining of the sinus.

Augmentation using CoreBone 1000 combined with autogenous growth factors and fibrin.

PRF membrane placed over the sinus window.

Coreflon PTFE sutures are used for tissue approximation.

PA X-ray after the augmentation. Graft filling the floor of the sinus creating sufficient height for future implant placement.
Final restoration – clinical view.

Implantation 6 months after augmentation. Sufficient bone width and height was clinically observed. Primary implant stability achieved upon implantation.

PA X-ray, after implant placement, 6 months after augmentation.

PA X-ray after final loading. Normal granulation and sufficient bone level seen.

Final restoration – clinical view.
Histologic section of a core trephined from an edentulous upper posterior ridge 6 months following a sinus lift procedure. The sinus was augmented with CoreBone particles 600-1000 u. The ridge zone (bottom) presents mainly pristine cancellous bone (PB) and Bone Marrow (BM). The upper zone reveals a few graft particles (CB) partly surrounded by New Bone (NB) indicating high graft conductivity. Graft to bone contact is about 60%.

(H&E Original Mag. X100)

PB – Pristine Bone
NB – New Bone
BM- Bone Marrow
CB – CoreBone Particle
Case Report: Prof. Haim Tal, DMD PhD, Israel

Socket preservation using CoreBone 1000
Granules size: 600-1000 μm
Site: Anterior Maxilla

PA X-ray, teeth no 11-21 showing periapical and periodontal lesions.

Clinical view after atraumatic extractions od the teeth.

Augmentation using CoreBone 1000 to achieve sufficient volume and soft tissue support in the aesthetic area.

Clinical view of the initial site before implant placement, showing sufficient keratinized tissue as well as preserving the interdental papilla.

Clinical view of the implants at the augmentation site
Radiographic follow-up after extraction and socket preservation procedures. Normal trabeculation and bone height suggest satisfactory remodeling.

At 8m PA x-ray showing implants placed at the augmented site.

Case Report: Prof. Ziv Mazor, DMD PhD, Israel

Socket preservation before implantation, using CoreBone 1000

Granules size: 600-1000 μm
Site: Posterior right mandible, teeth no 46-47
Extraction cause: Endodontic lesion involving furcation
Follow up: 4 months

Initial Site – lower mandible teeth 46-7
Socket after extraction
Immediate augmentation using CoreBone 1000

Final Sutures

Initial Site CT – Bone and Defect Evaluation
Upon augmentation

4 months follow-up shows normal trabeculation

Clinical follow-up regenerated bone seen at the site 4 months after extraction

Clinical view of the Implant placement 4 months after extraction

Panoramic X-ray after implant placement, 4 months after augmentation
Case Report: Dr. Yaacov Levy, DMD, Israel

Socket preservation after extraction, using CoreBone 1000

Granules size: 600-1000 μm, using - rt

Site: Right mandible mandible, tooth no 46

Extraction Site, shows a large intramonth bony defects due to tooth extraction, leaving bone contours/volume unsuitable for implant placement.

CT cross sections shows the defect before augmentation.
A Six month after augmentation with Corebone, before implant placement, presents graft material integrated with the host bone, eliminating the defect and providing suitable site for implantation.

Successful implant placement, allows proper rehabilitation by implant supported prostheses. Separating radiographic borders between CoreBone graft and newly formed bone can be observed.

Periapical X ray view 10 months after performing a two-unit implant supported restoration. Radiographic Peri-implant bone level and density, as well as other clinical measures are very pleasing.
Case Report: Prof. Haim Tal, DMD PhD, Israel

Augmentation of large bony defect following an endodontic lesion and a sinus lift procedure using CoreBone 1000
Granules size: 600-1000 μm
Site: Posterior right Maxilla
Follow up:

Augmentation of the defects and a sinus lift procedure were performed using CoreBone 1000, followed by 4 implants placement 8 months later.
Case Report: Dr. Jaroslaw Pospiech, DDS, Poland

Lateral bone defect repair, using CoreBone 1000

**Granules size:** 600-1000 μm

**Site:** Posterior left mandible

**Follow up:** 10 months

Initial Site: posterior left mandible

A large bony defect in the residual ridge is seen, buccal aspect of posterior mandible

Upon augmentation using CoreBone 1000

Follow up and imaging before implant placement. The 3D imaging shows stable bone volume achieved only 10 months after augmentation using CoreBone granules. Cross section shows no encapsulation at the augmentation site, bone and CoreBone scaffold are well incorporated at the site

Upon implantation, sufficient bone volume of the ridge

Successful implantation and core installation
Case Report: Dr. Yaacov Levy, DMD, Israel

Sinus lift augmentation before implantation, using CoreBone 1000

Granules size: 600-1000 μm, using CoreBone

Site: Right maxillary sinus

Pa X-RAY after augmentation, using CoreBone 1000

Pa X-RAY after implant placement, 6 months after augmentation. Sufficient bone volume and good stability were observed. No signs of granulation or encapsulation of the graft.

Pa X-RAY after final corona restoration, 3 months after implantation at the initial site.

The implants are fully osseo-integrated, no periapical signs of graft separation or encapsulation, normal trabeculation is seen on the X-RAY.
Case Report: Dr. Ziemowit, DDS, Poland

Socket preservation before implantation, using CoreBone 1000
Granules size: 600-1000 μm
Site: Posterior left mandible, tooth no 36
Extraction cause: Endodontic lesion, Susp. Vertical Root Fracture
Follow up: 4 months

Initial site, an Endo-Perio lesion is seen originating at the M root of tooth no 36. Partial insufficient endodontic treatment

Socket after extraction, a B defect is seen on site

CoreBone 600-1000 μm granules are used for socket preservation before future implantation

Sutures are made to approximate soft tissue edges after extraction

X-Ray after extraction and augmentation

PA X-Ray, 4 months after augmentation. No encapsulation is seen, regular trabeculation and graft particles are seen on site.
Implantation day, 6 months after extraction. Clinical bone is seen on site, hard bone tissue filling the socket providing sufficient bone volume for implant placement.

Implant placement, the showing initial stability, additional CoreBONE graft at the cervical area is added to provide ridge width and ensure further osseo-integration.

PA X-ray on implantation day

4 months follow up after implantation, no encapsulation is seen, normal trabeculation surrounding the implant.