dental
bone & tissue
regeneration

botiss
biomaterials

cerabone®

Natural bovine bone grafting material

Scientific and clinical evidence

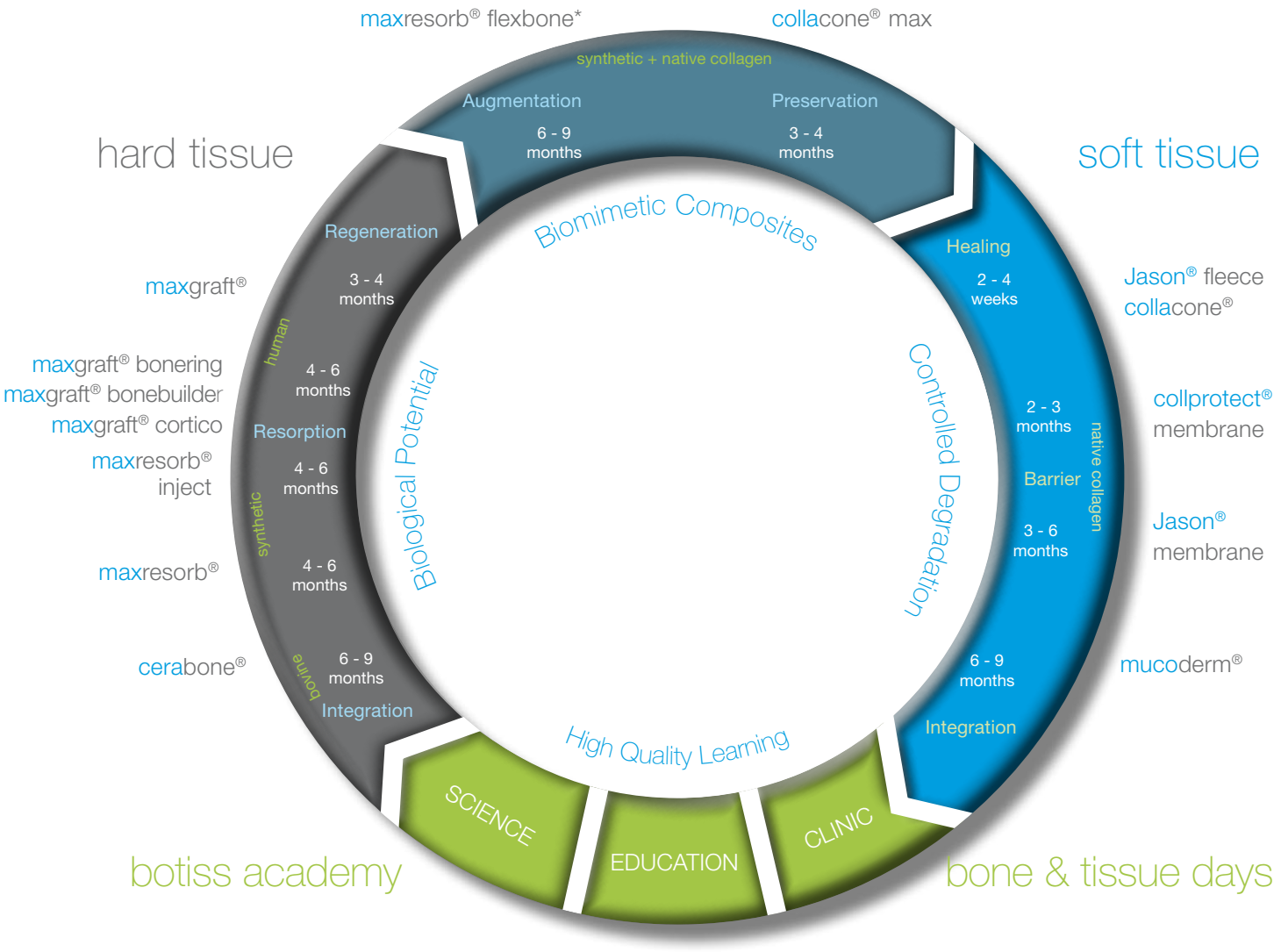
natural

safe

pure

hard tissue

botiss regeneration system



cerabone®

Natural bovine bone graft

maxresorb®

Synthetic biphasic calcium phosphate

maxresorb® inject

Synthetic injectable bone paste

maxgraft® bonebuilder

Patient matched allogenic bone implant

maxgraft® bonering / maxgraft® cortico

Processed allogenic bone ring / Processed allogenic bone plate

maxgraft®

Processed allogenic bone graft

collacone® max

Cone
(CaP / Collagen composite)

maxresorb® flexbone*

Flexible blocks
(CaP / Collagen composite)

Jason® fleece / collacone®

Collagenic hemostypt
(Sponge / Cone)

collprotect® membrane

Native collagen membrane

Jason® membrane

Native pericardium
GBR / GTR membrane

mucoderm®

3D-stable soft tissue
(Collagen) graft

* Coming soon

Bone and regeneration techniques

cerabone® 0.5 - 1.0 mm

cerabone® 1.0 - 2.0 mm

The use of bone graft materials

Bone graft materials are applied to replace and regenerate bone matrix lost by various reasons such as tooth extraction, cystectomy or bone atrophy following loss of teeth or inflammatory processes. For the filling of bone defects, the patient‘s own (autologous) bone is considered the „gold standard“, because of its biological activity due to vital cells and growth factors. Nevertheless, the harvesting of autologous bone requires a second surgical site associated with an additional bony defect and potential donor site morbidity.

In addition, the quantity of autologous bone is limited. Today, due to a constant development, bone graft materials provide a reliable and safe alternative to autologous bone grafts.
Clinicians can choose between a variety of different bone graft materials and augmentation techniques. Bone graft materials are classified by their origin into four groups.

Classification

Autologous:
- Patient‘s own bone, mostly harvested intraorally or from the iliac crest
- Intrinsic biological activity

Allogenic:
- Bone from human donors (multi-organ donors or femoral heads of living donors)
- Natural bone composition and structure

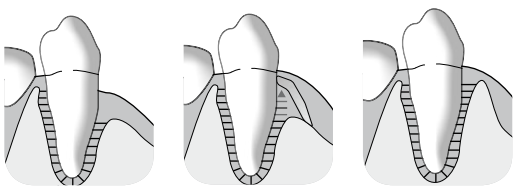
Xenogenic:
- From other organisms, mainly bovine origin
- Long-term volume stability

Alloplastic:
- Synthetically produced, preferably calcium phosphate ceramics
- No risk of disease transmission

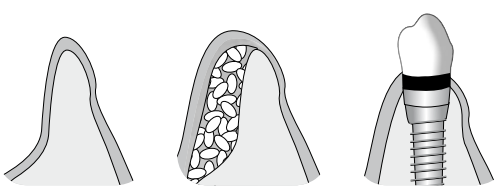
The GBR/GTR technique

The principle of Guided Bone Regeneration (GBR) or Guided Tissue Regeneration (GTR) is based on the separation of the grafted site from the surrounding soft tissue by application of a barrier. Collagen membranes act as a resorbable matrix to avoid the ingrowth of the faster proliferating fibroblasts and/or epithelium into the defect, and to maintain the space for controlled regeneration of bone.
The application of a bone graft material into the defect prevents a collapse of the collagen membrane, acting as a place holder for the regenerating bone and as an osteoconductive scaffold for the ingrowth of blood vessels and bone forming cells.

Guided Tissue Regeneration (GTR)



Guided Bone Regeneration (GBR)



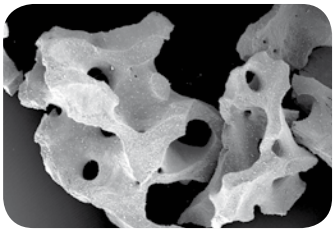
For large defects a mixture of autologous or allogenic bone, which has excellent biological potential, and a bone graft material for volume stability of the grafting site, is recommended.

Histology of cerabone® six months after sinus lift; optimal integration and bone healing

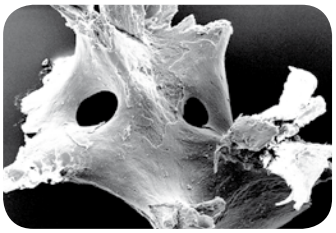
Xenogenic bone graft materials

Xenogenic bone grafts are derived from animals, preferably of bovine origin. Bovine bone materials are deproteinized by heating (sintering) to exclude the risk of allergic reactions and disease transmission[1].

Bovine bone materials have a long tradition, are very well documented, and their clinical application has found wide-ranging acceptance. The removal of all proteins transforms them into biologically derived hydroxyapatite ceramics. They are characterized by their preserved three-dimensional natural bone structure with interconnecting pores, strongly resembling the human bone structure. Their guided osseous integration rather than rapid resorption leads to excellent volume stability of the graft, with the formation of new bone on the highly structured bovine bone surface.



SEM: cerabone® macro- and micropores resembling human bone



SEM picture of human bone

cerabone® – natural bovine bone grafting material

cerabone® is derived from bovine bone in an established high-temperature heating process (sintering) guaranteeing its safety.
Beside safety and reliablity of the product and the production process, the material fulfills all other important requirements for the clinical success of a bovine bone graft material:

cerabone® excellent biofunctionality; superior hydrophilicity and blood uptake

- Phase pure hydroxyapatite without organic components
- Rough and open porous structure comparable to native human bone
- Excellent hydrophilicity enabling a rapid uptake of blood
- Optimal biocompatibility proved in various *in vitro* and *in vivo* tests
- Rapid and controlled osseous integration

These characteristics are the base for the excellent clinical results of cerabone® demonstrated by high volume stability at the graft site, complete integration into newly formed bone matrix with high bone density[2].

[1] Murugan et al. (2003). Heat-deproteinated xenogeneic bone from slaughterhouse waste: Physico-chemical properties. *Bull Mater Sci* 26:523–528.

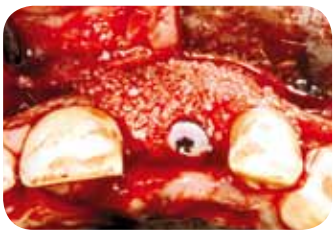
[2] Rothamel et al. (2011). Sinus floor Elevation using a sintered, natural bone mineral. *zzi* 27(1).

Indications for cerabone®

cerabone® product family

Periodontology

Intraosseous defects (1 - 3 walls)
Furcation defects (class I - II)



Implantology and Oral and CMF Surgery

- Sinus floor elevation
- Horizontal augmentation
- Vertical augmentation
- Ridge preservation
- Peri-implant defects
- Socket preservation
- Bone defect augmentation

Product Specifications

cerabone® packaging

cerabone® granules

Article No.	Particle Size	Content
1510	0.5 - 1.0 mm	1 x 0.5 ml
1511	0.5 - 1.0 mm	1 x 1.0 ml
1512	0.5 - 1.0 mm	1 x 2.0 ml
1515	0.5 - 1.0 mm	1 x 5.0 ml
1520	1.0 - 2.0 mm	1 x 0.5 ml
1521	1.0 - 2.0 mm	1 x 1.0 ml
1522	1.0 - 2.0 mm	1 x 2.0 ml
1525	1.0 - 2.0 mm	1 x 5.0 ml

cerabone® block

Article No.	Dimension	Content
1720	20 x 20 x 10 mm	1 x block

cerabone®: Safety and reliability facts made in Germany

Sintering

Heating up to 1250°C

BSE free

cerabone® is gained from the cancellous bone of femur condyles of domestic cattle. All cattle have been tested for BSE with negative results. Because of the choice of the raw material (food industry) and the special processing, cerabone® is BSE free.

Threefold sterility

Patented manufacturing process

Both product and production process are fulfilling the German and EU-regulatory and security requirements for bovine bone grafts including EN ISO 22442-1 and EN ISO 22442-2.
The proprietary manufacturing process of cerabone® is based on high-temperature heating (sintering) and special surface treatment that result in:

- Cell-friendly, biomimetically structured, rough surface
- Complete removal of organic components and albuminous impurities
- No risk of allergic reactions or rejection

CE certification

- CE certification of cerabone® was issued in 2002
- The product is on the market since January 2002
- No single adverse event reported in association with the product

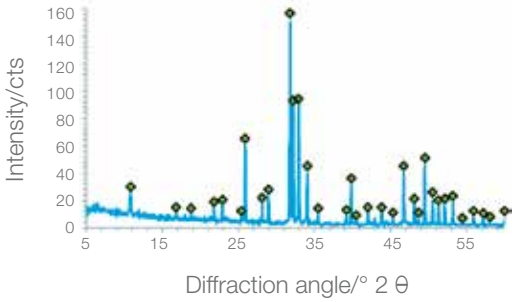
Sterile and storable

cerabone® is available as granules and in block form. The product is packed in sterile vials, sealed in primary and secondary blister packaging and sterilized with gamma irradiation. cerabone® can be stored at room temperature for up to three years.

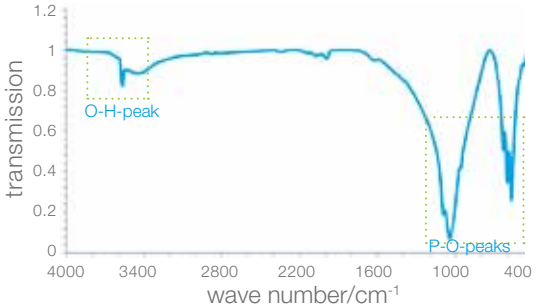
cerabone®: 100% pure mineral bone phase

cerabone® consists of the pure mineral phase of bovine bone. No other phases besides hydroxyapatite are detectable. The high phase purity leads to maximal volume stability. In addition, the absence of organic components warrants for the high safety of cerabone®.

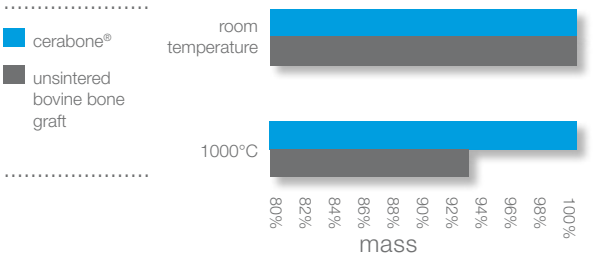
Results from Prof. Dr. C. Vogt, University of Hanover



X-ray diffractometry: mineral phases and crystallinity. Narrow peaks and low baseline[3]. cerabone® shows high crystallinity and 100% purity.



Infrared spectroscopy: molecular fingerprint. Characteristic peaks of phosphate and hydroxy groups of the hydroxyapatite[3]. No other organic phases detectable.

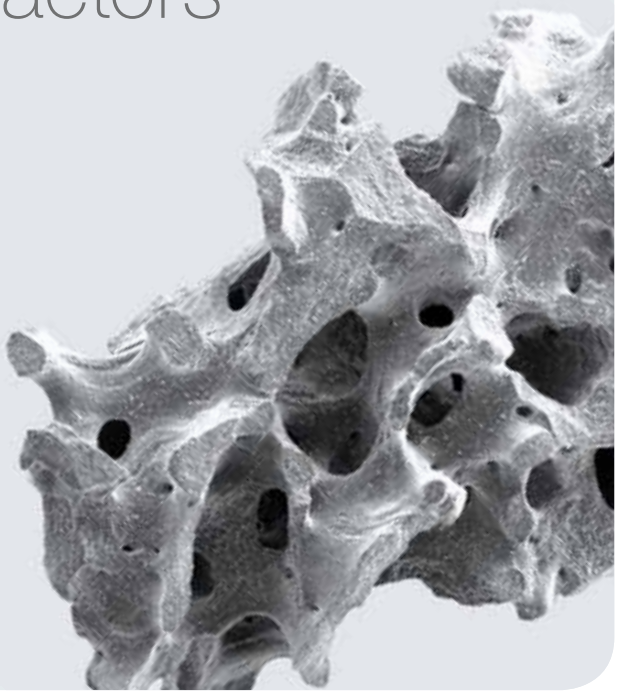


Thermogravimetric analysis showing combustion of organic components. No mass loss by heating cerabone® up to 1000°C[4]. Complete removal of organic components (cells, collagen) by sintering process.

Particle size 1.0 - 2.0 mm 0.5 - 1.0 mm

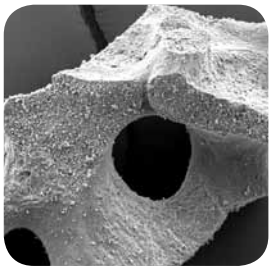
[3] Prof. C. Vogt, Leibniz University Hanover, Protocol on the analysis of bone graft material, 2012.
[4] Tadic et al. (2004). A thorough physicochemical characterisation of 14 calcium phosphate-based bone substitution materials in comparison to natural bone. *Biomaterials* 25:987–994.

Topography and hydrophilicity as key success factors

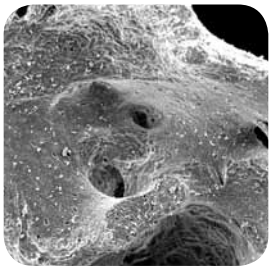


Optimal adhesion and ingrowth of cells, proteins and blood vessels

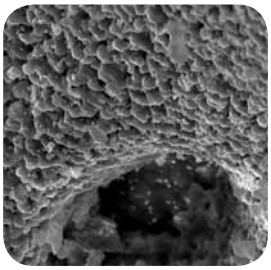
Scanning electron microscope (SEM) pictures show the highly structured surface of cerabone® as well as the macro and micropores.



The macroporous structure enables migration of cells, penetration of blood vessels and integration of the particles

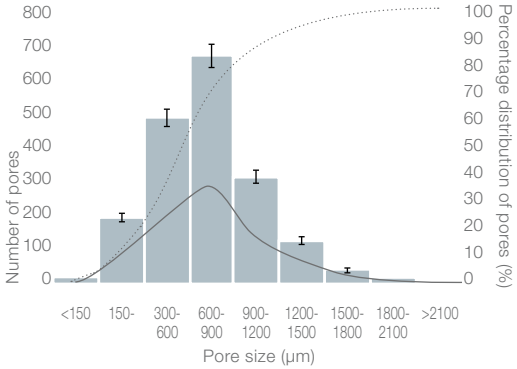


The capillary effect of the micropores leads to a quick blood uptake of the material



The rough surface ensures an excellent and homogenous surface adhesion of cells and proteins

Pore distribution of cerabone®[5]



Excellent hydrophilicity of cerabone®

cerabone®´s rapid and complete hydration with blood or saline solution is crucial for superior handling characteristics, new bone formation and for the final clinical success.

Good hydrophilicity and fast blood uptake of cerabone®[3]

Its strong capillary action facilitates fast and efficient penetration of the material particles with fluids, nutrients and blood through the three-dimensional, porous trabecular bone network, resulting in excellent handling, reliability and predictability in the daily clinical use.

Hydrophobicity of a non sintered bovine bone graft material[3]

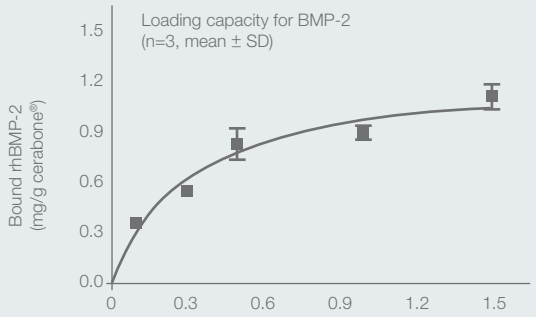
[5] Seidel and Dingeldein (2004). Cerabone® - Bovine Based Spongiosa Ceramic. *Mat.-wiss. u. Werkstofftech.* 35:208–212.

cerabone® serves as an excellent matrix for bone regeneration

cerabone® and growth factors

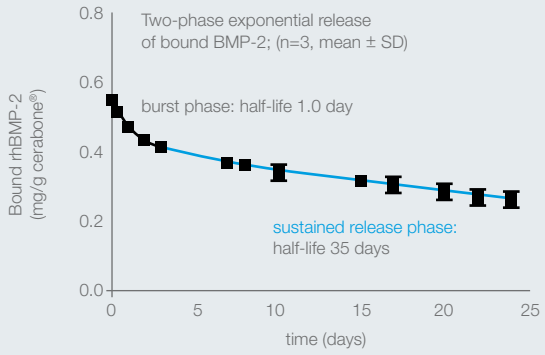
In vitro experiments from Prof. Dr. H. Jennissen und Dr. M. Laub
University of Duisburg-Essen/Morphoplant GmbH

A



In vitro experiments show that cerabone® can be loaded with up to 1 mg BMP-2/g.

B



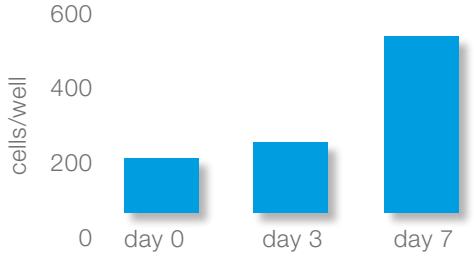
Two-phase controlled exponential release of BMP-2 may provide cerabone® with enhanced osseointegration (Morphoplant GmbH; patent application WO 2009/056567).

Growth of osteoblasts and osteoclasts on cerabone®

In vitro results from PD Dr. Dr. D. Rothamel, University of Collogne and Dr. C. Reichert, University of Bonn

The rough surface also promotes the adhesion of serum proteins and cells onto the surface. Osteoblast-like cells quickly adhere to the cerabone® particles. Only attached osteoblasts can start to produce new bone matrix leading to the osseous integration of the cerabone® particles. In another study, good adherence of osteoclasts promoted the superficial remodeling of the particles.

Proliferation of osteoblasts on cerabone®



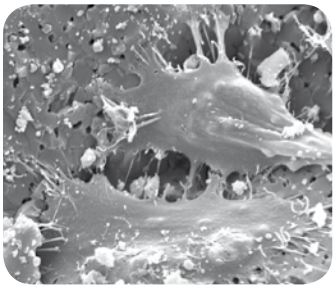
[6] Konermann et al. (2014). Bone substitute material composition and morphology differentially modulate calcium and phosphate release through osteoclast-like cells. *International journal of oral and maxillofacial surgery* 43:514–521.

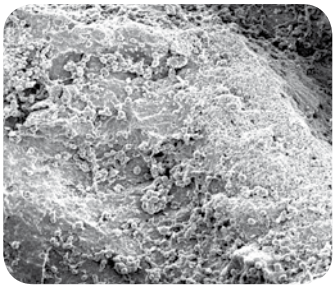
Bone biology:

Scientific results from *in vitro* experiments

BMP-2 structure

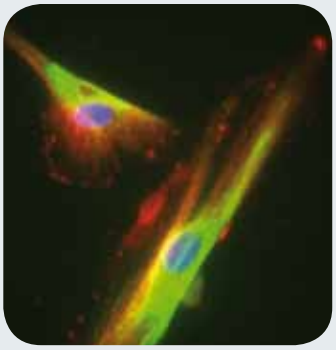
Colonialization of cerabone® by osteoblasts
PD Dr. Dr. Daniel Rothamel





Osteoclastic resorption of cerabone®
Dr. C. Reichert, University of Bonn[6]

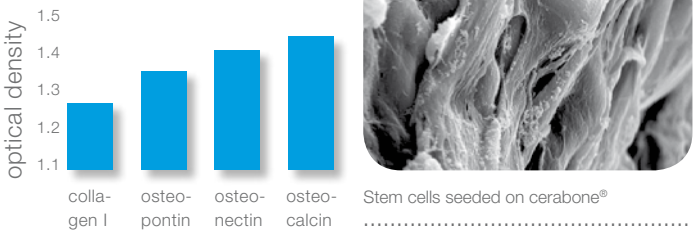
Stem cell research



Immunofluorescence staining of stem cells

Interaction of cerabone® with stem cells
In vitro results from Prof. Dr. B. Zavan, University of Padova

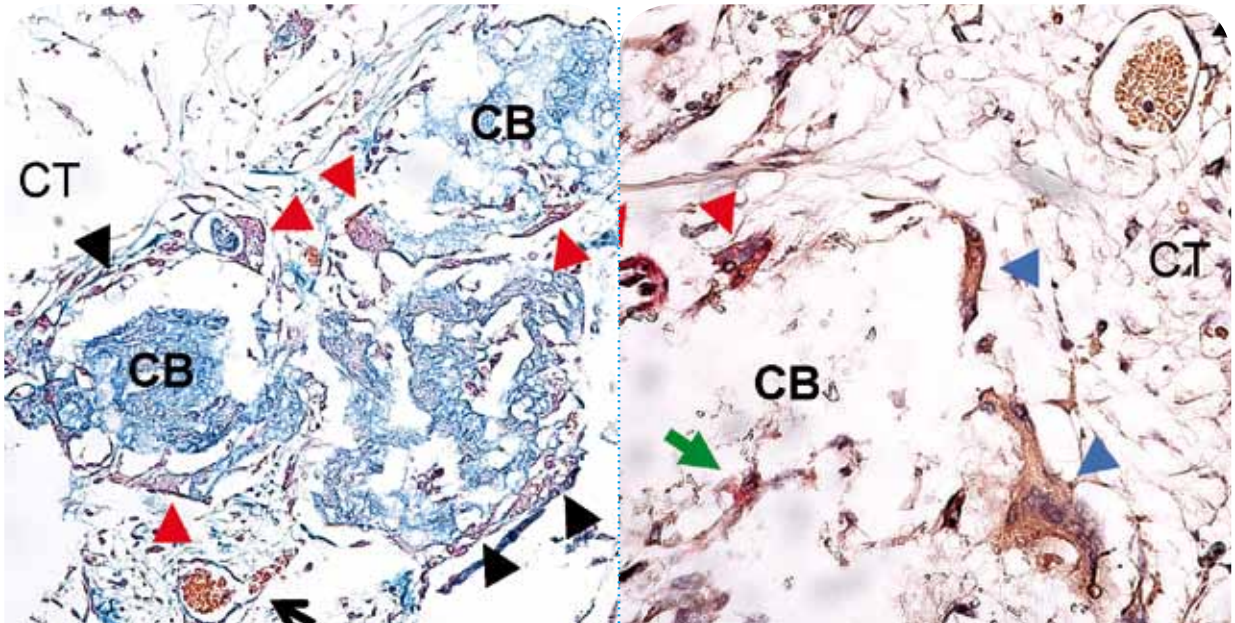
cerabone® supports the differentiation of attached stem cells into osteoblasts that produce new bone matrix.
Collagen, osteopontin, osteonectin and osteocalcin are proteins of the extracellular bone matrix that can be used as markers for bone formation. Their detection 14 days after seeding stem cells on cerabone® indicate the correct differentiation of the cells.



Stem cells seeded on cerabone®

Tissue integration and cellular degradation
In vivo data from a mouse model by Dr. Dr. S. Ghanaati, University of Mainz and University of Frankfurt a. M.

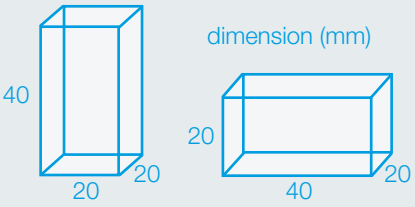
15 days after implantation into the subcutaneous tissue (CT) of mice, cerabone® (CB) is embedded within a well vascularized granulation tissue (blood vessels marked by arrows). No fibrous encapsulation or inflammatory reactions are observed. Mononuclear and multinuclear cells (arrow heads) indicate the onset of cellular degradation of the cerabone® particles.



Maximal stability and good osseous integration of cerabone®

Histological studies on cerabone®

Compressive force (N)	1670±120	4510±770
Compressive resistance (N/cm²)	420±32	564±96
Shear force (N/cm²)	124±35	338±200



Endodontics

cerabone® – osteoconduction and bony regeneration

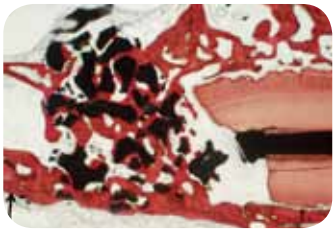
Optimal bone regeneration after bone defect treatment with cerabone® was demonstrated in an animal study.

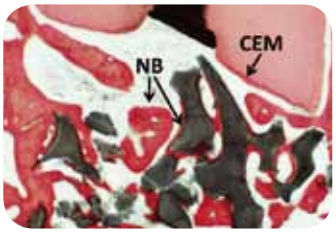
Bony defects following apicoectomy, were filled with cerabone®.

The histological examination showed a complete bridging of the osteotomy orifice after three months and a well established new bone (NB) and cementum formation (CEM) around the cerabone® particles.

In vivo

Results from Prof. Dr. Z. Artzi, University of Tel Aviv [7]





Section of maxillary block stained with Stevenels blue and Van Gieson's picro fuchsin

Implantology

cerabone® – osseous integration and optimal stability

Sinus lift study from PD Dr. Dr. D. Rothamel, University of Cologne [8]

Biopsy taken six months after sinus floor elevation. cerabone® particles are covered by a layer of newly formed bone matrix

A study on 12 patients showed that cerabone® acts as an osteoconductive material that supports the regeneration of bone after sinus floor elevation surgery. After six months the particles of all biopsies were completely integrated into the newly formed bone matrix, while the grafted area showed excellent volume stability.

[7] Artzi et al. (2012). Effect of Guided Tissue Regeneration on Newly Formed Bone and Cementum in Periapical Tissue Healing after Endodontic Surgery: An In Vivo Study in the Cat. *Journal of Endodontics* 38:163–169.

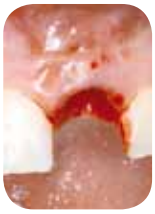
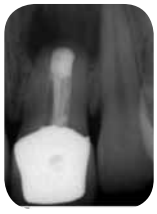
[8] Rothamel et al. (2011). Sinus floor elevation using a sintered, natural bone mineral - A histological case report study. *zzi* 27(1): 60.

Clinical application of cerabone®

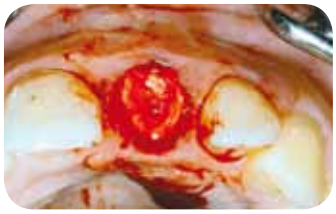
Clinical case by

Dr. Marius Steigmann, Neckargemünd, Germany

cerabone® for coverage of implant dehiscence and ridge augmentation

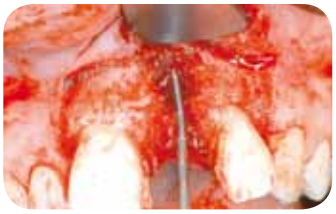



Extraction of tooth 21 after endodontic treatment



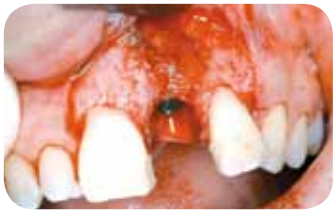
Application of collacone® for stabilization of the blood clot

Buccal bone defect after eight weeks healing time

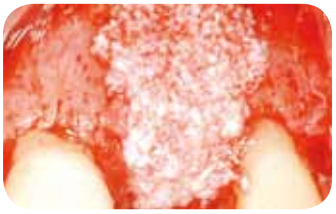


A periodontal probe demonstrates the vertical extension of the defect

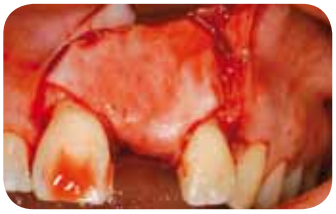
Implant placed into the former extraction socket



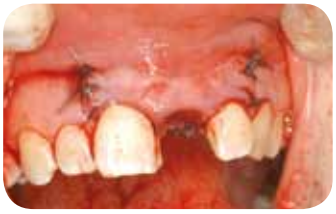
Surface of the implant is covered with autologous bone



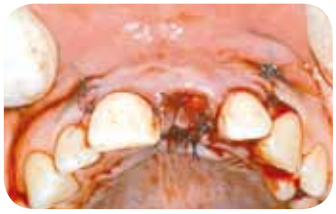
Coverage of the autologous bone with cerabone® (0.5 - 1.0 mm)



Covering of the bone substitute with Jason® membrane



Closure of the site using single sutures after periosteum slitting



Tension-free suturing maintains undisturbed healing

Abutment installation after implant uncovering, six months after implantation

Final prosthetic restoration with a full-ceramic crown

Contour maintenance

For augmentations in the aesthetic region cerabone® provides long-term dimensional stability and therefore a good bone bed to support an optimal contour of the soft tissue and sustained aesthetic result.

Clinical application of cerabone®

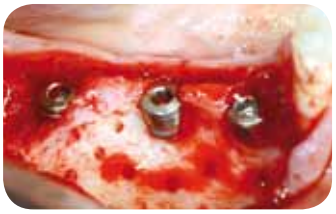
Clinical case by

Dr. Viktor Kalenchuk, Chernivtsi, Ukraine

Ridge augmentation with cerabone® and collprotect® membrane

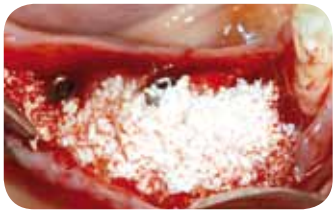
Clinical situation with narrow alveolar ridge in the lower jaw

3.5 mm dental implants inserted with inefficient immersion of dental implant platforms

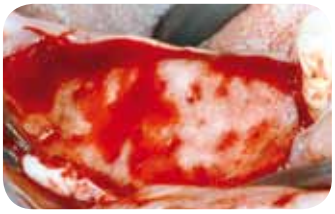


Implants inserted and cortical bone perforated, vestibular view

Alveolar ridge form and size renewal around implants with cerabone®



cerabone® particles size 0.5 - 1.0 mm in place



Covering augmentation site with collprotect® membrane

Situation at re-entry six months post-operative, implants partly covered by new bone matrix

Implants uncovered, good integration of cerabone® particles

Rehydration

Due to its excellent hydrophilicity, cerabone® particles adhere to each other after mixing with blood or sterile saline solution, allowing optimal handling and good adaptation to surface contours.

Particle Size

Small cerabone® particles (0.5 - 1.0 mm) allow a good adaptation to surface contours; they are especially useful for lateral augmentations or to fill voids when working with autologous bone blocks.

For sinus lift and extensive augmentations the use of cerabone® particle size 1.0 - 2.0 mm is recommended. The increased space between the large particles enables a better vascularization and improves the regeneration of larger defects.

Clinical application of cerabone®

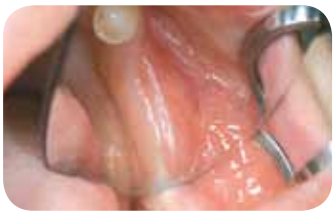
Clinical case by

Dr. Marius Steigmann, Neckargemünd, Germany

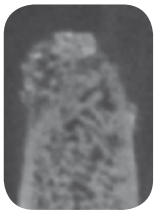
cerabone® for horizontal augmentation

Atrophic alveolar ridge in the left mandible

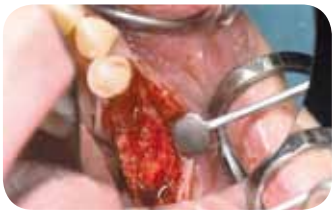
After mucoperiosteal flap elevation, the extensive bone resorption is visible



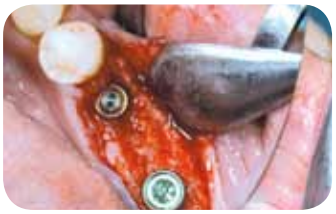
Clinical view six months after augmentation reveals healthy soft tissue situation



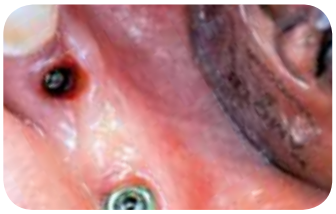
Pre-operative cone beam scan revealing good osseous formation of the augmented site



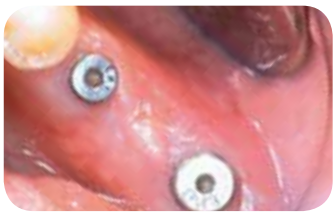
Excellent bone regeneration six months after application of cerabone® particles and Jason® membrane



The wide ridge allows for stable insertion of the two implants



Situation after healing of the soft tissue



Insertion of gingiva formers allow for soft tissue maturation

Final prosthetic restoration with ceramic bridge

Antibiotic prophylaxis

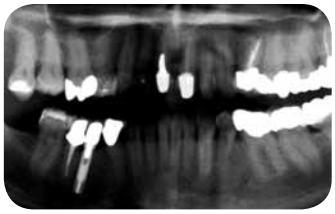
Make sure that the patient's blood contains a sufficient concentration of antibiotics before starting the augmentation (especially for larger augmentation volumes), e.g. by starting the antibiosis one day prior to surgery or at least one hour before by ingestion of a full daily dose.

Clinical application of cerabone®

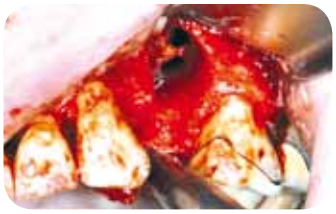
Clinical case by

Dr. Derk Siebers, Berlin, Germany

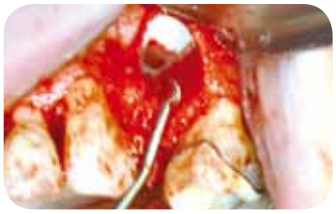
Socket management/ridge preservation with cerabone® and Jason® membrane



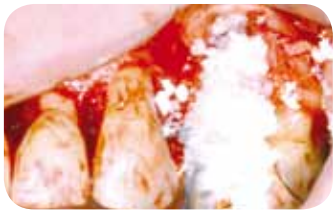
Pre-operative OPG, tooth 25 planned for extraction



Large defect of the buccal wall visible after tooth extraction



Jason® membrane placed to close the mouth-antrum connection

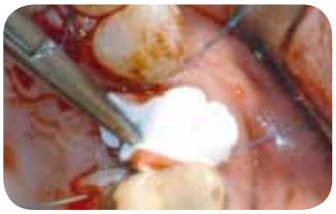


Socket filled with cerabone® and augmentation of the buccal wall

Covering of augmentation site with Jason® membrane

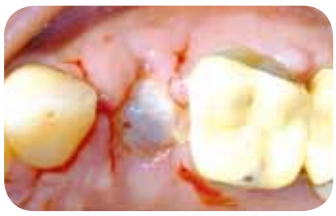
Augmentation site covered with Jason® membrane in double layer

Jason® membrane protecting the socket

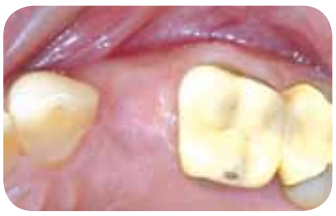


Jason® fleece placed over membrane

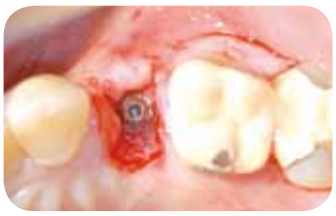
Jason® fleece left exposed for open healing



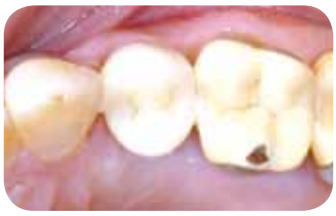
Situation two weeks after healing



Soft tissue situation after four months healing time



Implant insertion 12 months after augmentation



Final prosthetic restoration, occlusal view

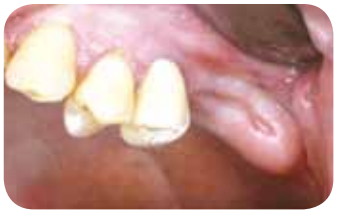
Final prosthetic restoration, vestibular view

Clinical application of cerabone®

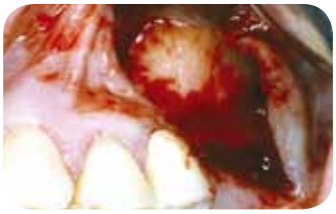
Clinical case by

PD Dr. Dr. Daniel Rothamel, Cologne, Germany

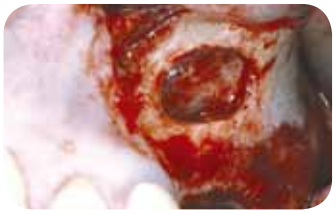
Two-stage sinus lift with cerabone® and Jason® membrane



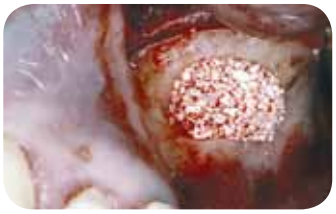
Clinical situation before surgery



Surgical presentation of the atrophic alveolar ridge

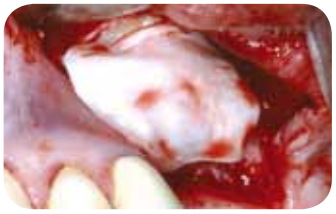


Preparation of lateral sinus window



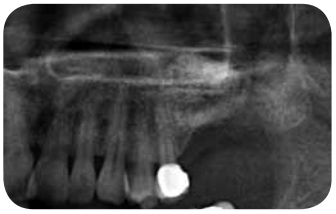
Filling of the sinus cavity with cerabone®

Additional lateral augmentation with cerabone®

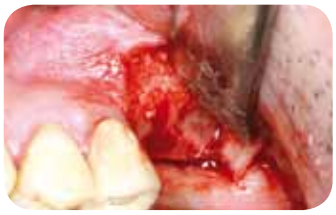


Covering of the augmentation site with the slowly resorbing Jason® membrane

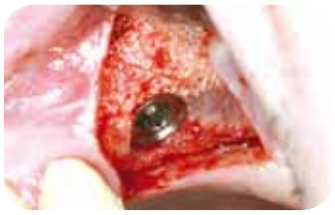
Tension-free wound closure



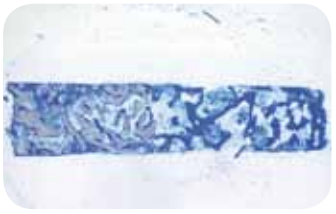
Detail of OPG showing radio-pacity of cerabone®



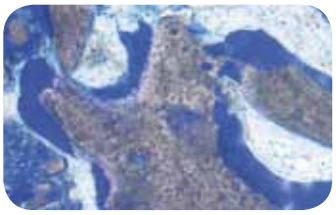
Very good integration of cerabone® particles without soft tissue encapsulation



Implant placed in sufficient bone matrix



Trephine biopsy taken at implant insertion



Detail of the histology showing cerabone® particles covered by newly formed bone matrix

Schneiderian membrane perforation

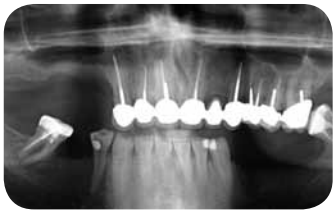
In case of a small perforation (< 5 mm) of the Schneiderian membrane during sinus floor elevation, the application of a collagen membrane (e.g. Jason® membrane or collprotect® membrane) is a useful tool for perforation coverage. Make sure that the patient doesn´t sneeze for two weeks and prescribe antibiotics and swelling prophylaxis (e.g. xylomethazoline). Never continue if you find an acute sinusitis with presence of pus.

Clinical application of cerabone®

Clinical case by

Dr. Damir Jelušić, Opatija, Croatia

Sinus floor elevation with cerabone® and Jason® membrane



Pre-operative OPG

Preparation of a lateral window for sinus floor elevation

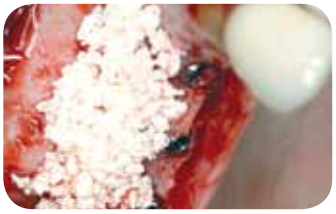
Perforation of the Schneiderian membrane visible after preparation of the lateral window

Jason® fleece introduced into the sinus cavity to cover the Schneiderian membrane

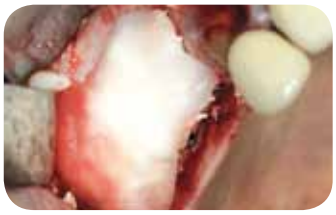
Filling of the sinus cavity with cerabone® (particle size 1.0 - 2.0 mm)

Simultaneous placement of three implants

Jason® fleece covering the lateral sinus window



Additional horizontal augmentation with cerabone® (particle size 1.0 - 2.0 mm)



Covering of the augmentation site with Jason® membrane

Re-opening six months after implantation, stable integration of the cerabone® particles

Placement of gingiva formers

Good situation after removal of ginigva formers, six weeks after re-opening

Membrane coverage

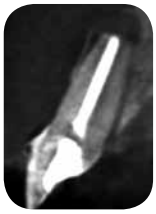
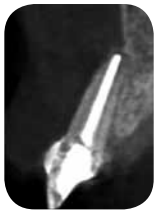
For better and more predictable results we always recommend to cover the augmentation area (and the lateral sinus window after sinus floor elevation) with a collagen membrane (e.g. collprotect® membrane or Jason® membrane).

Clinical application of cerabone®

Clinical case by

Dr. Damir Jelušić, Opatija, Croatia

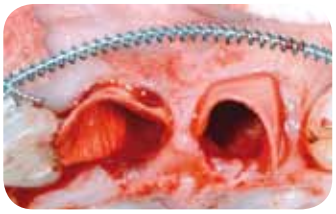
Socket preservation with cerabone®

Pre-operative CT of teeth eleven and 21 after endodontic treatment

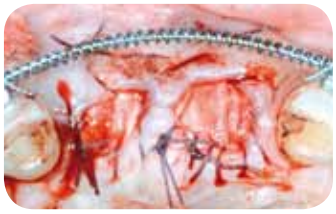
Teeth eleven and 21 not worth saving and planned for extraction

Situation after extraction of the front teeth

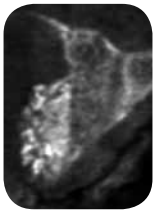
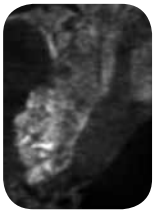


Jason® membranes placed within in the extraction sockets, covering the vestibular wall

Filling of the sockets with cerabone®



Jason® membrane turned down over the socket and sutured

Post-operative CT four months after extraction, good preservation of the ridge

Flapless implant placement (punch technique) four months after socket preparation; complete integration of cerabone® particles

Placement of gingiva formers

Final prosthetic situation with individual emergence profile created with provisional crowns (Four months post implantation)

Individualized zirconium abutments

Final prostethic restoration with ceramic crowns

Density

Avoid to compress the cerabone® particles excessively at the defect site. Open space between the particles permits blood vessel ingrowth and the formation of new bone matrix.

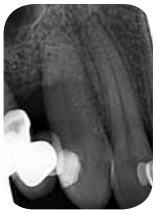
Clinical application of cerabone®

Clinical case by

Dr. Raluca Cosgarea and Prof. Dr. Dr. Anton Sculean, Cluj-Napoca, Romania and Bern, Switzerland

Regeneration of intrabony defects with cerabone® and collprotect® membrane

Pre-operative defect measurement

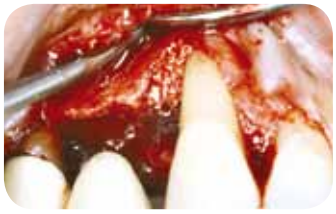


Pre-operative x-ray showing intrabony defect

Defect presentation after preparation of mucoperiosteal flap

Rehydration of cerabone® particles

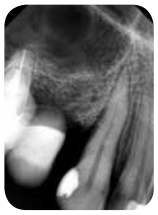
collprotect® membrane cut to shape



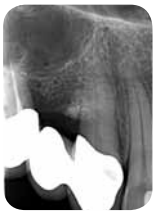
Filling of intrabony defect with cerabone®

collprotect® membrane in place

Wound closure



X-ray control at 12 months post-operative



X-ray at 24 months post-operative

Final prosthetic restoration

Sterile application

Pay attention to sterile application of the substitute, e.g. by using new instruments for granule insertion (and trimming of membranes). Prior contact to saliva may contaminate your graft.

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