

Literature cerabone®

Background and physico-chemical studies on bovine bone substitutes

Comparison of different methods for the preparation of porous bone substitution materials and structural investigations by synchrotron μ -computer tomography

D. Tadic, F. Beckmann, T. Donath, M. Epple, *Materialwissenschaft und Werkstofftechnik*, Volume 35, Issue 4, pages 240–244, April 2004

Abstract

The preparation of porous biomaterials for bone substitution is an important clinical issue in current biomedical technology because the ingrowth of bone can only occur if a suitable number of sufficiently large pores is available. Different procedures are compared here: The combined chemical-thermal treatment of bovine and human cancellous bone, the calcination of bovine cancellous bone, mechanical hole-drilling, and the extraction of porogens (in this case: salt crystals). The inner structure and the porosity of all samples were studied using high-resolution synchrotron μ -computer tomography.

A thorough physicochemical characterisation of 14 calcium phosphate-based bone substitution materials in comparison to natural bone.

D Tadic, M Epple, *Biomaterials* (2004), Volume: 25, Issue: 6, Pages: 987-994

Abstract

Fourteen different synthetic or biological bone substitution materials were characterised by high-resolution X-ray diffractometry, infrared spectroscopy, thermogravimetry, and scanning electron microscopy. Thus, the main parameters chemical composition, crystallinity, and morphology were determined. The results are compared with natural bone samples. The materials fall into different classes: Chemically treated bone, calcined bovine bone, algae-derived hydroxyapatite, synthetic hydroxyapatite, peptide-loaded hydroxyapatite, and synthetic beta-TCP ceramics.

Mediation of bone ingrowth in porous hydroxyapatite bone graft substitutes.

Hing KA, Best SM, Tanner KE, Bonfield W, Revell PA. *J Biomed Mater Res A*. 2004 Jan 1;68(1):187-200.

Abstract

Previous investigations have shown that both the early biological response and the mechanical properties of a porous hydroxyapatite bone graft substitute are highly sensitive to its pore structure. The objective of this study was to evaluate whether the pore structure continued to influence bone integration in the medium to long term. Two screened batches of porous hydroxyapatite (PHA) designated as batch A and batch B, with porosities of approximately 60 and 80%, respectively, were

selected for this study and implanted for periods of 5, 13, and 26 weeks into the lower femur of New Zealand White rabbits. Histomorphometric analysis of the absolute volume of bone ingrowth within batch A and B implants from 5 to 26 weeks showed that the absolute volume of bone ingrowth was consistently lower in batch A (10-21%), compared to batch B implants (24-31%). However, when the volume of bone ingrowth was normalised for the available pore space, this difference was reduced (23-47% and 32-42% for batches A and B, respectively). These observations suggest that differences in the volume of bone ingrowth initially depended on pore interconnectivity rather than pore size, whereas the volume or morphology of the PHA influenced the volume and morphology of bone ingrowth at later time points. Compression testing showed that bone ingrowth had a strong reinforcing effect on PHA bone graft substitutes, and a strong correlation was identified between mechanical properties and the absolute volume of ingrowth for both batches A and B. Furthermore, at 13 and 26 weeks, there was no significant variation in the ultimate compressive strength of integrated batch A and B implants. This similarity in ultimate mechanical properties indicated that the absolute volume of ingrowth may be mediated by the PHA structure through its impact on the dynamics of the local biomechanical environment. The results of push-out testing showed that fixation of PHA bone graft substitutes was independent of density within the range studied, with no significant difference in the interfacial shear stress between batches A and B at each time point throughout the study.

Reviews

Guided Tissue Regeneration: Kieferorthopädie nach parodontalregenerativen Maßnahmen

Prof. Dr. med. dent. Nezar Watted, Prof. Dr. med. Dr. med. dent. Josip S. Bil/ Bad Mergentheim, DENTALZEITUNG, Jahr: 2008 Ausgabe: 03

Bei der Behandlung erwachsener Patienten sieht sich der Kieferorthopäde häufig nicht nur der Problematik eines konservierend und prothetisch versorgten Gebisses, sondern in manchen Fällen lokalisierten bzw. generalisierten parodontalen Destruktionen und/oder marginalen Parodontitiden ausgesetzt. Über die Notwendigkeit eines gesunden Parodontiums als Voraussetzung für orthodontische Zahnbewegungen besteht in der kieferorthopädischen Fachwelt keinerlei Zweifel, sodass eine sorgfältige parodontale Vorbehandlung bei entsprechenden Patienten zur "conditio sine qua non" geworden ist.

Osteokonduktive und -induktive Knochenersatzmaterialien – Teil 1

Dr. Dr. Ralf Smeets, Dr. Dr. Andreas Kolk, ZMK, Jg. 26; Ausgabe 6, Juni 2010

Autologer Knochen ist aufgrund seiner speziellen Eigenschaften als Transplantationsmaterial unbestritten. Dennoch hat sich im Kopf-Hals-Bereich die Alternative „Knochenersatzmaterial“ mit ihren bestimmten Vorzügen in so großem Maße etabliert, dass der Überblick angesichts der Fülle der auf dem Markt erhältlichen Knochenersatzmaterialien beinahe verloren geht. Mit der Erläuterung der Einteilung wichtiger Materialien nach den 3 Hauptgruppen schafft PD Dr. Dr. Ralf Smeets nachfolgend eine Übersicht, erläutert Vor- und Nachteile der einzelnen Gruppen und stellt gängige Produkte vor.

Gleichzeitig werden die Anforderungen an die modernen Knochenersatzmaterialien beschrieben, ohne deren Wissen der Einsatz als Füllstoff bzw. Gerüstmaterial für die Knochenheilung nicht gelingen kann.

Die Grenzen der Implantation mit simultaner gesteuerter Knochenregeneration

Marius Steigmann, ZMK, Jga. 25, Ausgabe 11, November 2009

Die gesteuerte Knochenregeneration (Guided Bone Regeneration [GBR]) ist eine erfolgreiche Methode der Augmentation in Fällen, in denen das Knochenangebot für eine Implantation nicht ausreicht. Bei der Behandlung sind zwei unterschiedliche Vorgehensweisen möglich: Die Implantate können mit simultaner GBR oder verzögert gesetzt werden. Beide Methoden können in der täglichen Praxis angewendet werden und haben spezifische Vor- und Nachteile. Dieser Beitrag gibt Kriterien an die Hand, welche Behandlungsmethode sich im konkreten Patientenfall anbietet. Der Autor hat die Grenzen des simultanen Vorgehens anhand einer Untersuchung in der eigenen Praxis bei Fällen mit horizontalen Knochendefekten ausgelotet und beschreibt seine Beobachtungen im Folgenden.

Marketing and Other Types of “Mad Cow Disease”

PD Dr Jörg Neugebauer, PD Dr Daniel Rothamel and Prof Joachim E. Zöller, EDI Journal, Ausgabe 2/2010, Vol. 6

For patients to be treated with implants and implant-supported restorations, a number of different medical devices are required such that adequate treatment can be performed in line with current scientific evidence. Many products and suppliers have become established in recent years. As a result, highly specific surgical techniques and materials are available today to deal with a variety of different indications.

Studies on cerabone® (and endobone, the precursor of cerabone)

Background studies

Cerabone® – eine Spongiosa-Keramik bovinen Ursprungs

P. Seidel, E. Dingeldein, Materialwissenschaft und Werkstofftechnik, Volume 35, Issue 4, pages 208–212, April 2004

Abstract

Bei dem Implantatmaterial Cerabone® handelt es sich um eine Hydroxylapatitkeramik mit dem Hauptbestandteil Pentacalcium-hydroxid-[tris]phosphat. Die Gewinnung des Implantates erfolgt durch die Präparation tierischer Knochen, die durch Temperaturprozesse in ihre keramische Form transformiert werden. Aufgrund des spongiösen Ausgangsmaterials besitzt Cerabone® ein interkonnektierendes makro- und mikroporöses Porensystem. Dieses liefert dem neuzubildenden Knochen eine strukturierte Leitschiene, in und um die ausgehend vom Lagerknochen neuer Knochen angelagert wird. Der durch die Herstellungsprozesse beibehaltene Aufbau der natürlichen Spongiosa wirkt sich besonders gut auf die

mechanischen Eigenschaften des Implantates und das Einwachsverhalten des neuen Knochens nach der Implantation aus.

Cerabone® – Bovine Based Spongiosa Ceramic

Cerabone® is a hydroxy apatite ceramic based on pentacalcium-hydroxy-[tri]phosphate. The aquirement of the implant takes place by preparing bovine bones, which are transformed in their ceramic forms by using high temperature processes. Due to the spongy raw material the implant Cerabone® has a natural interconnecting macro- and micropore system. Within a cancellar structure the trabeculae form an osteoconductive guide for the new bone. Based on the production processes the natural constitution of the spongiosa is preserved, which affects positively the mechanical properties and bone ingrowth.

Comparison of six bone-graft substitutes regarding to cell seeding efficiency, metabolism and growth behaviour of human mesenchymal stem cells (MSC) in vitro.

Seebach C, Schultheiss J, Wilhelm K, Frank J, Henrich D. Injury. 2010 Jul;41(7):731-8. Epub 2010 Mar 15.

Abstract

INTRODUCTION:

Various synthetic bone-graft substitutes are used commercially as osteoconductive scaffolds in the treatment of bone defects and fractures. The role of bone-graft substitutes is changing from osteoconductive conduits for growth to an delivery system for biologic fracture treatments. Achieving optimal bone regeneration requires biologics (e.g. MSC) and using the correct scaffold incorporated into a local environment for bone regeneration. The need for an unlimited supply with high quality bone-graft substitutes continue to find alternatives for bone replacement surgery.

MATERIALS AND METHODS:

This in vitro study investigates cell seeding efficiency, metabolism, gene expression and growth behaviour of MSC sown on six commercially clinical available bone-graft substitutes in order to define their biological properties: synthetic silicate-substituted porous hydroxyapatite (Actifuse ABX), synthetic alpha-TCP (Biobase), synthetic beta-TCP (Vitoss), synthetic beta-TCP (Chronos), processed human cancellous allograft (Tutoplast) and processed bovines hydroxyapatite ceramic (Cerabone). 250,000 MSC derived from human bone marrow (n=4) were seeded onto the scaffolds, respectively. On days 2, 6 and 10 the adherence of MSC (fluorescence microscopy) and cellular activity (MTT assay) were analysed. Osteogenic gene expression (cbfa-1) was analysed by RT-PCR and scanning electron microscopy was performed.

RESULTS:

The highest number of adhering cells was found on Tutoplast (e.g. day 6: 110.0+/-24.0 cells/microscopic field; p<0.05) followed by Chronos (47.5+/-19.5, p<0.05), Actifuse ABX (19.1+/-4.4), Biobase (15.7+/-9.9), Vitoss (8.8+/-8.7) and Cerabone (8.1+/-2.2). MSC seeded onto Tutoplast showed highest metabolic activity and gene expression of cbfa-1. These data are confirmed by scanning electron microscopy. The cell shapes varied from round-shaped cells to wide spread cells and cell clusters, depending on the bone-

graft substitutes. Processed human cancellous allograft is a well-structured and biocompatible scaffold for ingrowing MSC in vitro. Of all other synthetical scaffolds, beta-tricalcium phosphate (Chronos) have shown the best growth behaviour for MSC.

DISCUSSION:

Our results indicate that various bone-graft substitutes influence cell seeding efficiency, metabolic activity and growth behaviour of MSC in different manners. We detected a high variety of cellular integration of MSC in vitro, which may be important for bony integration in the clinical setting.

Optimierung der Proliferation mesenchymaler Progenitorzellen auf Knochenersatzmaterial durch Thrombozytenkonzentrat

M. Herten, M. Vogel, J. Kircher, M. Jäger, R. Krauspe, Poster Jahrestagung der Deutschen Gesellschaft für Biomaterialien 2011

Endobone: Biomechanical assessment of bone ingrowth in porous hydroxyapatite.

Hing KA, Best SM, Tanner KE, Bonfield W, Revell PA. J Mater Sci Mater Med. 1997 Dec;8(12):731-6.

Abstract

Porous hydroxyapatite (Endobon) specimens were implanted into the femoral condyle of New Zealand White rabbits for up to 6 months. After sacrifice, specimens were sectioned for histology and mechanical testing, where the extent of reinforcement by bony ingrowth was assessed by compression testing and fixation was assessed by push-out testing. From histological observations, it was established that the majority of bone ingrowth occurred between 10 day and 5 weeks after implantation and proceeded predominantly from the deep end of the trephined defect, with some integration from the circumferential sides. At 3 months, the implants were fully integrated, exhibiting bony ingrowth, vascularization and bone marrow stroma within the internal macropores. After 5 weeks, the mean ultimate compressive strength of retrieved implants (6.9 MPa) was found to be greater than that of the original implant (2.2 MPa), and by 3 months the fully integrated implants attained a compressive strength of approximately 20 MPa. Push-out testing demonstrated that after 5 weeks in vivo, the interfacial shear strength reached 3.2 MPa, increasing to 7.3 MPa at 3 and 6 months.

Endobone: Characterization of porous hydroxyapatite.

Hing KA, Best SM, Bonfield W., J Mater Sci Mater Med. 1999 Mar;10(3):135-45.

Abstract

Hydroxyapatite has been considered for use in the repair of osseous defects for the last 20 years. Recent developments have led to interest in the potential of porous hydroxyapatite as a synthetic bone graft. However, despite considerable activity in this field, regarding assessment of the biological response to such materials, the basic materials characterization is often inadequate. This paper documents the characterization of the chemical composition, mechanical integrity, macro- and microstructure of a

porous hydroxyapatite, Endobon (E. Merck GmbH), intended for the bone-graft market. Specimens possessed a range of apparent densities from 0.35 to 1.44 g cm⁻³. Chemical analysis demonstrated that the natural apatite precursor of Endobon was not converted to pure hydroxyapatite, but retained many of the ionic substituents found in bone mineral, notably carbonate, sodium and magnesium ions. Investigation of the microstructure illustrated that the struts of the material were not fully dense, but had retained some traces of the network of osteocyte lacunae. Macrostructural analysis demonstrated the complex inter-relationship between the structural features of an open pore structure. Both pore size and connectivity were found to be inversely dependent on apparent density. Furthermore, measurement of pore aspect ratio and orientation demonstrated a relationship between apparent density and the degree of macrostructural anisotropy within the specimens, while, it was also noted that pore connectivity was sensitive to anisotropy. Compression testing demonstrated the effect of apparent density and macrostructural anisotropy on the mechanical properties. An increase in apparent density from 0.38 to 1.25 g cm⁻³ resulted in increases in ultimate compressive stress and compressive modulus of 1 to 11 MPa and 0.2 to 3.1 GPa, respectively. Furthermore, anisotropic high density (> 0.9 g cm⁻³) specimens were found to possess lower compressive moduli than isotropic specimens with equivalent apparent densities. These results underline the importance of full structural and mechanical characterization of porous ceramic implant materials.

Endobone: Bone substitutes as carriers for transforming growth factor-beta(1) (TGF-beta(1)).

Gille J, Dorn B, Kekow J, Bruns J, Behrens P. *Int Orthop.* 2002;26(4):203-6. Epub 2002 Apr 23.

Abstract

We studied the suitability of three different hydroxyapatite materials (Endobone, Bio-Oss and Algipore) as carriers for the bone growth promoting factor TGF-beta(1). The hydroxyapatite materials either were incubated for 24 h or directly loaded with hrTGF-beta(1) (Diagnostic Products Corporation, DPC) at a concentration of 10 ng hrTGF-beta(1)/mg. For the release experiment the hydroxyapatite materials covered with hrTGF-beta(1) were either suspended in pure phosphate buffered saline (PBS) or human serum albumin (HSA). The concentration of hrTGF-beta(1) was measured every 6 h the first day and then daily at the 2nd, 7th, 14th and 28th day. With Bio-Oss and Endobone the release of growth factor in HSA showed a two-phase kinetics. TGF-beta(1) reached a maximum concentration within the first 24 h and decreased almost linearly until day 28. With Algipore the concentration of growth factor reached a maximum after 12 h and showed a rapid decline until day 2. From day 2 the TGF-beta(1) concentrations remained low. Significantly, more TGF-beta(1) was released into HSA than into PBS. Our study suggests that the hydroxyapatite materials are suitable as TGF-beta(1) carriers.

Endobone: Biocompatibility testing of different sterilised or disinfected allogeneous bone grafts in comparison to the gold standard of autologous bone grafts--an "in vitro" analysis of immunomodulation.

Endres S, Kratz M, Heinz M, Herzberger C, Reichel S, von Garrel T, Gotzen L, Wilke A. Z Orthop Ihre Grenzgeb. 2005 Nov-Dec;143(6):660-8.

Abstract

INTRODUCTION:

Repair of large skeletal defects using bone allografts has become a routine procedure in orthopaedic and trauma surgery. Different procedures of sterilisation (82.5 degrees C disinfection; 121 degrees C autoclaving; PES; Tutoplast; 25 kGy gamma irradiation) are available to inactivate bacteria and fungi, including their spores, as well as viruses in human bone allografts. The efficiency of these procedures has been proven. However, the effects on the cellular response are rarely investigated. This present in vitro study investigates the immunological answer of human bone marrow cells to human allogeneous and autologous bone platelets which were sterilised by different methods.

MATERIALS AND METHODS:

Human bone marrow cells and the bone platelets were harvested from patients undergoing a total hip replacement. All patients provided informed consent. Human bone platelets, 10 mm in diameter, 3 mm in height, were produced from femoral heads which were removed within the scope of total hip replacements. They were sterilised by different procedures or were disinfected (gamma radiotherapy, PES/ethanol treatment, Tutoplast procedure, 121 degrees C autoclaving, > 82.5 degrees C thermoisinfection). In addition, an autologous in vitro bone donation was simulated and compared with the allogeneous bone grafts. Endobon was evaluated as a bovine hydroxyapatite ceramic. As control a human bone marrow cell culture without bone platelets was used. Over a period of four weeks the changes of the immunogenic cell populations were analysed in vitro (FACS analysis). Light and scanning microscopy were done to reveal morphological differences. As a vitality test the trypan-blue staining was performed.

RESULTS:

Light and scanning microscopy demonstrated large differences between the various sterilisation and disinfection methods. After 4 weeks the autologous bone platelets were completely covered with homogeneously distributed human osteoblast like cells. The heat-sterilised/disinfected transplants demonstrated similar effects compared to the autologous bone grafts while the irradiated bone platelets demonstrated less cell coverage. 2/3 of the cells were vital on average after four weeks, with the exception of the irradiated bone platelets. The FACS analysis revealed in comparison to the control group provable differences in the immunological answer for the autologous bone donation as well as for the differently sterilised or disinfected allogeneous bone grafts. The heat sterilisation or, respectively, disinfection methods compared to the autologous bone donation demonstrated almost similar in vitro effects. By far the worst results, characterised by an excessively increased portion of cytotoxic T-cells and a decreased amount of viable cells, were seen in the 25 kGy gamma irradiation samples.

CONCLUSIONS:

The results demonstrate the influence of the different sterilisation and disinfection procedures on the differentiation of human marrow cells (host). Similar in vitro effects were seen for the autologous and heat-treated bone platelets. The treatment of allogeneous bone grafts with PES/ethanol and the Tutoplast

procedures showed, just as Endobon, only low differences in comparison with the control cultures. The worse results in the case of the irradiated bone platelets may be explained by the production of free radicals which led to an excessive cell death.

Animal Studies

Bone ingrowth in bFGF-coated hydroxyapatite ceramic implants.

Schnettler R, Alt V, Dingeldein E, Pfefferle HJ, Kilian O, Meyer C, Heiss C, Wenisch S. *Biomaterials*. 2003 Nov;24(25):4603-8.

Abstract

This experimental study was performed to evaluate angiogenesis, bone formation, and bone ingrowth in response to osteoinductive implants of bovine-derived hydroxyapatite (HA) ceramics either uncoated or coated with basic fibroblast growth factor (bFGF) in miniature pigs. A cylindrical bone defect was created in both femur condyles of 24 miniature pigs using a saline coated trephine. Sixteen of the 48 defects were filled with HA cylinders coated with 50 microg rhbFG, uncoated HA cylinders, and with autogenous transplants, respectively. Fluorochrome labelled histological analysis, histomorphometry, and scanning electron microscopy were performed to study angiogenesis, bone formation and bone ingrowth. Complete bone ingrowth into bFGF-coated HA implants and autografts was seen after 34 days compared to 80 days in the uncoated HA group. Active ring-shaped areas of fluorochrome labelled bone deposition with dynamic bone remodelling were found in all cylinders. New vessels could be found in all cylinders. Histomorphometric analysis showed no difference in bone ingrowth over time between autogenous transplants and bFGF-coated HA implants. The current experimental study revealed comparable results of bFGF-coated HA implants and autogenous grafts regarding angiogenesis, bone synthesis and bone ingrowth.

Evaluation of a novel nanocrystalline hydroxyapatite paste and a solid hydroxyapatite ceramic for the treatment of critical size bone defects (CSD) in rabbits.

Huber FX, Berger I, McArthur N, Huber C, Kock HP, Hillmeier J, Meeder PJ. *J Mater Sci Mater Med*. 2008 Jan;19(1):33-8. Epub 2007 Jun 14.

Abstract

The purpose of our study was to test the effectiveness of Ostim nanocrystalline hydroxyapatite paste and Cerabone ceramic by treating a critical size bone defect (CSD) on the right foreleg of a white New Zealand rabbit. Evaluation was carried out by comparing four groups each with a different CSD filling: an only OSTIM bone filling, an only Cerabone filling, an OSTIM-Cerabone combination, and a control group with no filling of the CSD. The results of this study display a rapid and uniform bone ingrowth following the CSD filling with Ostim. The histological and histomorphometrical data have shown similarly excellent results for both the Ostim and Cerabone-Ostim groups. The control group faired poorly in comparison, as three cases of non-union were observed and none of the defects were totally refilled with fresh bone

within 60 days. The successful bone healing with osseous consolidation verifies the importance of the nanocrystalline hydroxyapatite in the treatment of metaphyseal osseous volume defects in the metaphyseal spongiosa.

Injectable nanocrystalline hydroxyapatite paste for bone substitution: in vivo analysis of biocompatibility and vascularization.

Laschke MW, Witt K, Pohlemann T, Menger MD. *J Biomed Mater Res B Appl Biomater.* 2007 Aug;82(2):494-505.

Abstract

The nanocrystalline hydroxyapatite paste Ostim represents a fully degradable synthetic bone substitute for the filling of bone defects. Herein, we investigated in vivo the inflammatory and angiogenic host tissue response to this biomaterial after implantation. For this purpose, Ostim was implanted into the dorsal skinfold chambers of Syrian golden hamsters. The hydroxyapatite ceramic Cerabone and isogenic transplanted cancellous bone served as controls. Angiogenesis, microhemodynamics, microvascular permeability, and leukocyte-endothelial cell interaction of the host tissue were analyzed over 2 weeks using intravital fluorescence microscopy. Ostim exhibited good biocompatibility comparable to that of Cerabone and cancellous bone, as indicated by a lack of venular leukocyte activation after implantation. Cancellous bone induced a more pronounced angiogenic response and an increased microvessel density when compared with the synthetic bone substitutes. In contrast to Cerabone, however, Ostim showed a guided neovascularization directed toward areas of degradation. Histology confirmed the ingrowth of proliferating vascularized tissue into the hydroxyapatite paste at sites of degradation, while the hydroxyapatite ceramic was not pierced by new microvessels. Thus, Ostim represents an injectable synthetic bone substitute, which may optimize the conditions for the formation of new bone at sites of bone defects by supporting a guided vascularization during biodegradation.

Endobone: Tissue reaction and material characteristics of four bone substitutes.

Jensen SS, Aaboe M, Pinholt EM, Hjørting-Hansen E, Melsen F, Ruyter IE. *Int J Oral Maxillofac Implants.* 1996 Jan-Feb;11(1):55-66.

Abstract

The aim of the present study was to qualitatively and quantitatively compare the tissue reactions around four different bone substitutes used in orthopedic and craniofacial surgery. Cylinders of two bovine bone substitutes (Endobon and Bio-Oss) and two coral-derived bone substitutes (Pro Osteon 500 and Interpore 500 HA/CC) were implanted into 5-mm bur holes in rabbit tibiae. There was no difference in the amount of newly formed bone around the four biomaterials. Interpore 500 HA/CC resorbed completely, whereas the other three biomaterials did not undergo any detectable biodegradation. Bio-Oss was osseointegrated to a higher degree than the other biomaterials. Material characteristics

obtained by diffuse reflectance infrared Fourier transform spectrometry analysis and energy-dispersive spectrometry did not explain the differences in biologic behavior.

Endobone: Defect reconstruction using demineralized bone matrix. Experimental studies on piglets.

Schnettler R, Dingeldein E, Herr G. Orthopade. 1998 Feb;27(2):80-8.

Abstract

The aim of this study was to evaluate the bone stimulation forced by Demineralized Bone Matrix (DBM)-Chips and-Gel in comparison to the bone-ingrowth into a porous hydroxylapatite ceramic (Endobon) in mini pigs. The following results were obtained: 1. DBM-Chips and DBM-Gel did not stimulate bone healing when filled into cancellous bone defects. The defect did not heal within 12 weeks. 2. Up to 35 days the least amount of new bone formation was observed within porous hydroxylapatite ceramic. Up to 12 weeks complete bone ingrowth in to the ceramic has been seen with close bonding between new formed bone and the ceramic trabeculae. 3. By continuous labelling with fluorochromes the new bone formation could be analysed by fluorescence microscopy and the dynamics could be related to time after implantation.

Clinical Studies

A Clinical Comparison of Cerabone (A Decalcified Freeze-dried Bone Allograft) with Autogenous Bone Graft in the Treatment of Two- and Three-wall Intrabony Periodontal Defects: A Human Study with Six-month Reentry

Author: Nader Abolfazli, Fariba Saleh Saber, Ardeshir Lafzi, Amir Eskandari, Sarah Mehrasbi , Journal: Journal of Dental Research, Dental Clinics, Dental Prospects Year: 2008 Vol: 2 Issue: 1

Background and aims. Complete and predictable regeneration of tissue lost as a result of infection or trauma is the ultimate goal of periodontal therapy. Various graft materials have been successfully used in the treatment of intrabony defects. The purpose of this study was to evaluate the use of a decalcified freeze-dried bone allograft (Cerabone) with the autogenous bone graft as a gold standard in the treatment of human two- or three-wall intrabony periodontal defects.

Materials and methods. This split-mouth study was done on 10 pairs of matched two- or three-wall intrabony periodontal defects with 5 mm or more probing depth and 3 mm or more depth of intrabony component following phase I therapy. In the control sites autogenous bone graft and in the test sites decalcified freeze-dried bone allograft were used.

Results. At baseline, no significant differences were found in terms of oral hygiene and defect characteristics. At six months, analysis showed a significant improvement in soft and hard tissue parameters for both treatment groups as compared to preoperative measurements. There were no

statistical differences in clinically-measured parameters between treatment groups after 6 months except for crestal resorption that increased significantly in control group ($P = 0.25$). Defect resolution and bone fill in the test and control groups were 2.5 ± 0.46 mm versus 2.7 ± 0.73 mm and 2 ± 0.62 mm versus 2.20 ± 0.52 mm, respectively.

Conclusion. The results of this study demonstrated that both graft materials improved clinical parameters. The comparison of the two treatment groups did not show any significant differences in clinical parameters after six months. However, because of the limited amount of intra-oral donor bone, it is preferable to use decalcified freeze-dried bone allograft.

Sinusbodenelevation mit einem gesinterten, natürlichen Knochenmineral - Eine humanhistologische Fallstudie. Sinus floor elevation using a sintered, natural bone mineral - A histological case report study

Rothamel, D., Smeets, R., Happe, A., Fienitz, T., Mazor, Z., Schwarz, F., Zöller, J., Zeitschrift für zahnärztliche Implantologie, 2011;27(1):60

Background: Implantological rehabilitation of the posterior maxilla often requires cranialization of the sinus floor to allow for long-term stability and permit the placement of sufficiently long implants. Well known as sinus floor elevation or sinus lift, this operation is one of the most common therapies for vertical deficits of the upper jaw.

Aim: The aim of the present study was the histological and clinical evaluation of the xenogenic bone substitute material (BEGO OSS, Bego Implant Systems, Bremen) for the indications one-stage and two-stage sinus floor elevation.

Materials and method: Twelve patients were included in the study, undergoing 15 simultaneous or staged sinuslift operations. Data were evaluated clinically and, for two-stage approaches, histologically and histomorphometrically after trephine harvesting during implant bed preparation.

Results: Healing was uneventful in all cases. All patients showed good hard tissue regeneration of the lateral window of the sinus. Neither resorption nor dislocation of the granular bone substitute material was observed. Radiologically, good volume stability of the graft was observed. Histologically, bone substitute particles displayed complete osseous integration in newly formed bone matrix. The proportion of newly formed bone within the graft was 25.8-49.6 %, whereas the proportion of remaining bone substitute material varied from 28.6-38.5 %.

Conclusion: It was concluded that BEGO055 acts as an osteoconductive material to support hard tissue regeneration after sinus floor elevation. Showing excellent volume stability, it is integrated into newly formed bone matrix within a six-month healing period.

Implantologie. Kieferkammerhaltende Maßnahmen im Rahmen von Extraktionen vor Implantatversorgung

Daniel Rothamel, Mauricio Herrera, Thea Lingohr, Viktor E. Karapetian, Tim Fienitz, Robert Mischkowski, Dirk Duddeck, Joachim E. Zöller, Die Quintessenz; 2010;61(11):1379

Zusammenfassung

Im Rahmen der natürlichen Wundheilungsvorgänge nach Zahnextraktion werden regelhaft Volumenverluste des Alveolarkammes beobachtet. Diese können das Hart- und Weichgewebslager für Implantationen kompromittieren, aber auch Einfluss auf das ästhetische Ergebnis bei Brückenversorgungen nehmen. Zur Verhinderung dieser resorptiven Vorgänge wurden in den vergangenen Jahren verschiedene Verfahren entwickelt, die den Erhalt des Kieferknochens zum Ziel haben. Neben der Auffüllung der Alveole mit Knochenersatzmaterialien sowie der Abdeckung mit Membranen und Schleimhauttransplantaten wurde eine Vielzahl weiterer Techniken untersucht, um das Hart- und Weichgewebslager für nachfolgende Versorgungen zu optimieren. Jedoch stellt jedes Verfahren einen Eingriff in die natürlichen Wundheilungsvorgänge des Organismus dar, was bei der Planung und Durchführung alveolenerhaltender Maßnahmen stets berücksichtigt werden muss.

Klinische Anwendung des bovinen, gesinterten Knochenersatzmaterials Cerabone Implantologische Fallbeobachtungen

Dr. Dr. Daniel Rothamel, Dr. Jörg Neugebauer, Dr. Dr. Martin Scheer, Dr. Lutz Ritter und Univ.-Prof. Dr. Dr. Joachim E. Zöller, Köln; Z Oral Implant, 4. Jahrgang 4/2008

Bei augmentativen Eingriffen in der dentalen Implantologie ist neben der Verwendung von autogenem Knochen die Anwendung verschiedener Knochenersatzmaterialien etabliert. Diese haben bei der Sinusboden elevation, aber auch bei prä- und periimplantären lateralen Kieferkamm augmentationen gute Ergebnisse gezeigt. Ziel der vorliegenden Arbeit ist die klinische Bewertung eines neuartigen gesinterten natürlichen Knochenminerals (Cerabone, AMC.Oraltec GmbH, Tuttlingen), welches aus bovinem Knochengewebe hergestellt wird und in granulärer Form erhältlich ist.

Sinus Floor Elevation From a Maxillary Molar Tooth Extraction Socket in a Patient With Chronic Inflammation

Tözüm T.F., Dursun E., Tulunoglu I., J Periodontol, March 2009, Vol 80, Number 3

Background: The compromised nature of the residual interradicular bone after extraction of periodontally hopeless maxillary molars often requires a sinus elevation procedure to ideally place the implants to accept future prosthesis. Maxillary sinus elevation surgery is a procedure used to increase the volume of bone mass so that dental implants can be placed. This article documents a sinus floor elevation technique through an extraction socket in a 65-year-old white male with chronic inflammation to increase the bone mass after the extraction of a periodontally involved maxillary molar tooth. Methods: Computerized tomography revealed an increased thickness of the sinus membrane, which was attributed to possible chronic sinus inflammation and periodontal inflammation. After consultation with the Department of Otolaryngology, it was diagnosed as chronic inflammation without any contraindication for sinus elevation surgery or implant placement. One month after the extraction, the

sinus floor elevation surgery was performed through the extraction socket, and implants were placed 4 months later.

Results: An uneventful healing was noted after 6 months of osseointegration; two porcelain-fused-to-metal crowns were fabricated. Clinical follow-up took place every 3 months for 3 years, and successful healing was achieved. The patient was satisfied with the esthetic and functional results of the oral rehabilitation.

Conclusion: Sinus floor elevation through an extraction socket without any residual bone, followed by dental implant placement, provided successful functional results and acceptable stability

Kieferorthopädie nach parodontalregenerativen Maßnahmen

(Orthodontics following periodontal regenerative procedures)

Watted N, Bill J.S., Dentalzeitung, Volume 3, Jahr 2008

Zusammenfassung

Bei der Behandlung erwachsener Patienten sieht sich der Kieferorthopäde häufig nicht nur der Problematik eines konservierend und prothetisch versorgten Gebisses, sondern in manchen Fällen lokalisierten bzw. generalisierten parodontalen Destruktionen und/oder marginalen Parodontitiden ausgesetzt. Über die Notwendigkeit eines gesunden Parodontiums als Voraussetzung für orthodontische Zahnbewegungen besteht in der kieferorthopädischen Fachwelt keinerlei Zweifel, sodass eine sorgfältige parodontale Vorbehandlung bei entsprechenden Patienten zur „conditio sine qua non“ geworden ist.

Orthopedic Studies

Void filling of tibia compression fracture zones using a novel resorbable nanocrystalline hydroxyapatite paste in combination with a hydroxyapatite ceramic core: first clinical results.

Huber FX, McArthur N, Hillmeier J, Kock HJ, Baier M, Diwo M, Berger I, Meeder PJ. Arch Orthop Trauma Surg. 2006 Oct;126(8):533-40. Epub 2006 Jul 12.

Abstract

INTRODUCTION:

It is a generally accepted standard surgical practice to fill-in the metaphyseal defect zones resulting from the reduction of tibia compression fractures. The development of various innovative bone substitutes is also currently on the increase.

MATERIALS AND METHODS:

In our prospective study, we used Ostim, a novel resorbable nanocrystalline hydroxyapatite paste, together with Cerabone, a solid hydroxyapatite ceramic, in combination with angularly stable osteosynthesis to treat 24 tibia compression fractures. Types B2 and B3, as well as types C2 and C3 fractures, according to the AO classification, were included in the study.

RESULTS:

The mean total range of joint motion in terms of flexion and extension was improved from the

immediate postoperative value of 79 +/- 14 degrees to 97 +/- 13 degrees at 6 weeks after surgery, to 109 +/- 16 degrees at 3 months, and finally to 118 +/- 17 degrees at 1 year. In three patients, a delayed wound healing was observed as a local complication.

CONCLUSION:

The use of the Ostim and Cerabone combination is an effective method in treating tibia compression fractures with large defect zones left after reduction.

Endobone: Osseous integration of bovine hydroxyapatite ceramic in metaphyseal bone defects of the distal radius.

Werber KD, Brauer RB, Weiss W, Becker K. J Hand Surg Am. 2000 Sep;25(5):833-41.

Abstract

Hydroxyapatite ceramic made of bovine spongiosa was used as structural support material in a prospective study to correct bone defects experienced after reduction in distal radius fractures. The study took place over a 3-year period (1992-1999) and comprised 14 patients. Osseous integration was analyzed via biopsies and magnetic resonance imaging. Long-term follow-up monitoring involving magnetic resonance imaging in 13 of the 14 patients showed fibrovascular growth within incorporated hydroxyapatite material. Osseous integration was demonstrated in magnetic resonance images by gadolinium uptake and by the presence of osteoid layers and endothelialized vessels. Hydroxyapatite ceramic offers a biologically acceptable alternative to autologous bone when augmenting distal radius fracture fixation.