The Bone Graft Experts

Literature References related to

Fusion Xpress Bone Putty

Fusion Xpress is a combination of biphasic calcium phosphate and equine demineralized bone powder in a putty carrier.

Farina, N. M., F. M. Guzon, M. L. Pena, and A. G. Cantalapiedra. "In Vivo Behaviour of Two Different Biphasic Ceramic Implanted in Mandibular Bone of Dogs." *J Mater Sci Mater Med*. 19(4):1565-1573, 2008.

FINDINGS:

1. **Osteoid at 4 wks, new bone by 12 wks; mature bone (haversian canals) by 24 wks;**
2. **15%HA/85%TCP is more osteoinductive than ceramic with higher proportion of HA/TCP (i.e., 85:15);**
3. **Higher local calcium phosphate concentrations from dissolution of the TCP has a stimulatory effect on bone matrix mineralization;**
4. **TCP provides a capacity to undergo early and intense bone substitution early in implantation period;**
5. **Biphasic ceramics (TCP & HA) are biocompatible in dogs.**

Di Stefano, D. A., L. Artese, G. Iezzi, A. Piattelli, S. Pagnutti, M. Piccirilli, and V. Perrotti. "Alveolar Ridge Regeneration with Equine Spongy Bone: A Clinical, Histological, and Immunohistochemical Case Series." *Clin Implant Dent Relat Res.* 11(2): 90-100, 2009.

FINDINGS:

1. **Equine bone protein extract shows an ability to induce osteoblastic differentiation of human bone marrow derived MSCs or to induce ectopic bone formation in a rat model.**
2. **Newly formed bone was found in all specimens and macroscopically similar to the surrounding bone.**
3. **No inflammatory cell infiltrate for foreign body giant cells were observed.**
4. **Deantigenated equine bone is biocompatible, and its usage is associated with new blood vessel ingrowth during healing.**

Barbieri, D., H. Yuan, F. de Groot, W. R. Walsh, and J. D. de Bruijn. "Influence of Different Polymeric Gels on the Ectopic Bone Forming Ability of an Osteoinductive Biphasic Calcium Phosphate Ceramic." *Acta Biomater.* 7(5):2007-2014, 2011.

FINDINGS:

1. **In vivo, the gels dissolve and are cleared away.**
2. **Available space increases between the BCP granules allowing for soft tissues – including blood vessels- to gradually enter the implants, followed by MSCs finally resulting in bone formation.**
3. **A correlation between bone formation and dissolution of the considered gels is likely.**
4. **Biocompatible gels with fast dissolution rates allow inductive bone formation to occur.**

Bongio, M., van den Beucken, J. J., Leeuwenburgh, C. G., Jansen, J. A. "Development of Bone Substitute Materials: From 'Biocompatible' to 'Instructive'." *J Mater Chem.* 20:8747-8759, 2010.

REVIEW ARTICLE FINDINGS:

1. **Defines evolution of biomaterials**
   a. **1st generation 'tolerant, inert': *e.g.*, titanium**
   b. **2nd generation 'responsive': *e.g.*, bioglass**
   c. **3rd generation 'instructive': *e.g.*, engineered Biphasic Calcium Phosphate biomaterials that possess inherent biological cues for bone regeneration.**
2. **Biomaterials endowed with high porosity and interconnectivity encourage and instruct attachment of bone-forming cells, nutrient/oxygen infiltration, and vascularization.**
3. **The induction of bone formation at non-osseous sites in animals without the addition of any osteoinductive biomolecules is feasible with 3rd generation calcium phosphate ceramics."**

Spivak, J. M., and A. Hasharoni. "Use of Hydroxyapatite in Spine Surgery." *Eur Spine J.* 10 Suppl 2: S197-204, 2001.

FINDINGS:

1. **Animals implanted with the TCP/HA composite and DBM showed significant earlier fusion consolidation than the animals implanted with DBM alone, TCP/HA composite alone, or autograft.**
2. **Combining an osteoconductive ceramic material such as a TCP/HA composite with an osteoinductive agent such as rhBMP2, DBM,….and others seems to be the most promising combination for achieving a reliably successful spinal fusion without the use of autogenous bone graft.**
3. **The HA/TCP ceramic composite, can serve as a scaffold onto which mesenchymal cells grow and differentiate into bone-producing osteoblasts, form creeping cones of bone in the scaffold, replace and degrade the scaffold.**

additional references over >>>

Hashimoto-Uoshima, M., I. Ishikawa, A. Kinoshita, H. T. Weng, and S. Oda. "Clinical and Histologic Observation of Replacement of Biphasic Calcium Phosphate by Bone Tissue in Monkeys." *Int J Periodontics Restorative Dent.* 15(2): 205-13, 1995.

FINDINGS:

1. **Bone replacement of implanted material is greater at higher ratios of TCP to HA minimizing the volume of remaining implant materials in the healing defect and allowing for more bone formation within the implants.**
2. **Biphasic combined with Guided Tissue Regeneration maintain the shape of the ridge whereas both GTR alone or no graft showed resorprtion of the ridges.**

Reynolds, M. A., M. E. Aichelmann-Reidy, G. L. Branch-Mays, and J. C. Gunsolley. "The Efficacy of Bone Replacement Grafts in the Treatment of Periodontal Osseous Defects. A Systematic Review." *Ann Periodontol.* 8(1): 227-265, 2003. (Humans; retrospective meta-analysis)

REVIEW ARTICLE FINDINGS:

1. **This systematic review shows that bone replacement grafts provide demonstrable clinical improvements in periodontal defects compared to debridement alone.**
2. **There is consistent support for formation of new attachments with both autogenous and allogeneic demineralized bone grafts.**
3. **Xenogenic bone grafts can support the formation a new attachment apparatus.**
4. **Bone grafts increase bone level, reduce crestal bone loss, increase clinical attachment level and reduce probing depth compared to open flap debridement.**

Stein, J. M., S. Fickl, S. S. Yekta, U. Hoischen, C. Ocklenburg, and R. Smeets. "Clinical Evaluation of a Biphasic Calcium Composite Grafting Material in the Treatment of Human Periodontal Intrabony Defects: A 12-Month Randomized Controlled Clinical Trial." *J Periodontol.* 80(11): 1774-1782, 2009. (Human; controlled prospective clinical trial)

FINDINGS:

1. **The clinical benefit of biphasic was equivalent to autograft cancellous and superior to open flap debridement alone.**
2. **No significant differences for probing depth and clinical attachment level between biphasic and autologous cancellous, showing significantly lower probing depth and higher attachment levels than open flap alone.**

Friedmann, A., M. Dard, B. M. Kleber, J. P. Bernimoulin, and D. D. Bosshardt. "Ridge Augmentation and Maxillary Sinus Grafting with a Biphasic Calcium Phosphate: Histologic and Histomorphometric Observations." *Clin Oral Implants Res.* 20(7): 708-14, 2009. (Humans)

FINDINGS:

1. **Groups treated with Biphasic had a significantly higher gain of attachment level than patients with open flap debridement alone (difference was +1.6 ± .4mm).**
2. **Intrabony defect scores improved significantly with Biphasic vs. Open Flap Debridement at 6 months ($p<0.045$).**

Arts, J. J., L. H. Walschot, N. Verdonschot, B. W. Schreurs, and P. Buma. "Biological Activity of Tri-Calcium phosphate/Hydroxyl-Apatite Granules Mixed with Impacted Morsellized Bone Graft. A Study in Rabbits." *J Biomed Mater Res B Appl Biomater*. 81(2): 476-485, 2007.

Daculsi, G., N. Passuti, S. Martin, C. Deudon, R. Z. Legeros, and S. Raher. "Macroporous Calcium Phosphate Ceramic for Long Bone Surgery in Humans and Dogs. Clinical and Histological Study." *J Biomed Mater Res.* 24(3): 379-96, 1990.

Gaasbeek, R. D., H. G. Toonen, R. J. van Heerwaarden, and P. Buma. "Mechanism of Bone Incorporation of Beta-TCP Bone Substitute in Open Wedge Tibial Osteotomy in Patients." *Biomaterials.* 26(33): 6713-6719, 2005.

Kaushick, B. T., N. D. Jayakumar, O. Padmalatha, and S. Varghese. "Treatment of Human Periodontal Infrabony Defects with Hydroxyapatite + Beta Tricalcium Phosphate Bone Graft Alone and in Combination with Platelet Rich Plasma: A Randomized Clinical Trial." *Indian J Dent Res.* 22(4): 505-510, 2011.

Lee, M. J., B. O. Kim, and S. J. Yu. "Clinical Evaluation of a Biphasic Calcium Phosphate Grafting Material in the Treatment of Human Periodontal Intrabony Defects." *J Periodontal Implant Sci.* 42(4): 127-135, 2012 .

Pratt, J. N., D. J. Griffon, D. G. Dunlop, N. Smith, and C. R. Howie. "Impaction Grafting with Morsellised Allograft and Tricalcium Phosphate-Hydroxyapatite: Incorporation within Ovine Metaphyseal Bone Defects." *Biomaterials.* 23(16): 3309-3317, 2002.

Ridgway, H. K., J. T. Mellonig, and D. L. Cochran. "Human Histologic and Clinical Evaluation of Recombinant Human Platelet-Derived Growth Factor and Beta-Tricalcium Phosphate for the Treatment of Periodontal Intraosseous Defects." *Int J Periodontics Restorative Dent.* 28(2):171-179, 2008.