Why Use Interface Bioactive Bone Graft?

The Interface Bioactive Bone Graft is a bioactive glass material that bonds to bone through a rapid sequence of chemical reactions at the interface of the glass in the presence of living bone tissue. Unlike calcium phosphates for which bone bonding is dependent on resorption rate and boney ingrowth, bioactive glass undergoes a unique surface modification within the physiological environment that allows for direct bonding with surrounding bone. Following implantation, an exchange of a critical concentration of biologically active ions between the glass surface and surrounding physiological fluid produces a bioactive hydroxy carbonate apatite (HCA) layer to which bone can readily bond to. These chemical surface reactions are followed by cellular responses as part of the normal healing process that include the proliferation and differentiation of bone related cells on the HCA matrix, with mineralization of the matrix by 12 days in vivo. Further osseous development at the defect site is dependent on the continued release of biologically active ions from the bioactive glass at the rates needed for cellular proliferation and differentiation.[1-3]

In addition to the bone bonding advantages realized through rapid formation of the HCA layer, more recent studies have demonstrated that the dissolution of ions from bioactive glass up-regulates the expression of genes that control osteogenesis, which explains the higher rate of bone formation in comparison to other bioceramics such as hydroxyapatite.[1,2,5] Further studies have shown potential angiogenic effects, with increased secretion of vascular endothelial growth factors (VEGF) *in vitro*, and enhancement of vascularization *in vivo*.[1,2] Bioactive glasses have also been reported to minimize the persistence of macrophage and inflammatory responses, potentially allowing for faster cellular proliferation, matrix mineralization and bone bonding.[3]

Particle size and distribution range are also critical factors to the bone bonding performance of bioactive glasses. The patented 210 µm – 420 µm particle size range of BioStructures' Interface Bioactive Bone Graft has demonstrated advantages over typical 90 µm – 710 µm ranges including higher rates of bone formation within a defect site and within the individual glass particles.[6] In general, a specific and narrow particle distribution can result in better controlled ion dissolution and surface reactivity, resulting in a more consistent biologic response and rate of bone formation throughout the grafting site. Smaller particles (below 210 µm) can degrade quickly and cause a transient inflammatory response that may impede the up-regulation of osteoprogenitor cells. The smaller particles can also become compacted between larger particles, causing a reduction of space that can potentially interfere with osteoconduction. On the higher end, larger particles (above 420 µm) may not fully degrade, leaving unreacted glass remaining in the bone defect that can potentially impede glass remodeling.[4]

In summary, the Interface Bioactive Bone Graft is a bioactive glass that has bone bonding properties that are advantageous over other grafting materials. Interface participates in the repair process and allows for direct bonding of the graft material to bone through a sequence of chemical reactions involving biologically active ions that produce a favorable biologic response. Further, Interface is advantageous when compared to other bioactive glass products due to its specific and narrow particle size distribution that results in enhanced bone bonding at the grafting site.

1. Hench, LL. The story of Bioglass®. *J Mater Sci: Mater Med* 2006, 17:967-978.
2. Gerhardt LC, Boccaccini AR. Bioactive Glass and Glass-Ceramic Scaffolds for Bone Tissue Engineering. *Materials* 2010; 3:3867-3910.
3. Greenspan DC. Bioactive glass: mechanisms of bone bonding. *Scandanavian Society of Periodontology Annual Meeting* 1999.
4. Schepers EJG, Ducheyne P. Bioactive glass particles of narrow size range for the treatment of oral bone defects: a 1-24 month experiment with several materials and particle sizes and size ranges. *J Oral Rehab* 1997; 24:171-181.
5. Xynos ID, Edgar AJ, Buttery LDK, Hench LL, Polak JM. Gene-expression profiling of human osteoblasts following treatment with the ionic products of Bioglass® 45S5 dissolution. *J Biomed Mater Res* 2001; 55:151-157.
6. Yang SS. Compositions and Methods to Repair Osseous Defects. US Patent 6,228,386 (2001).