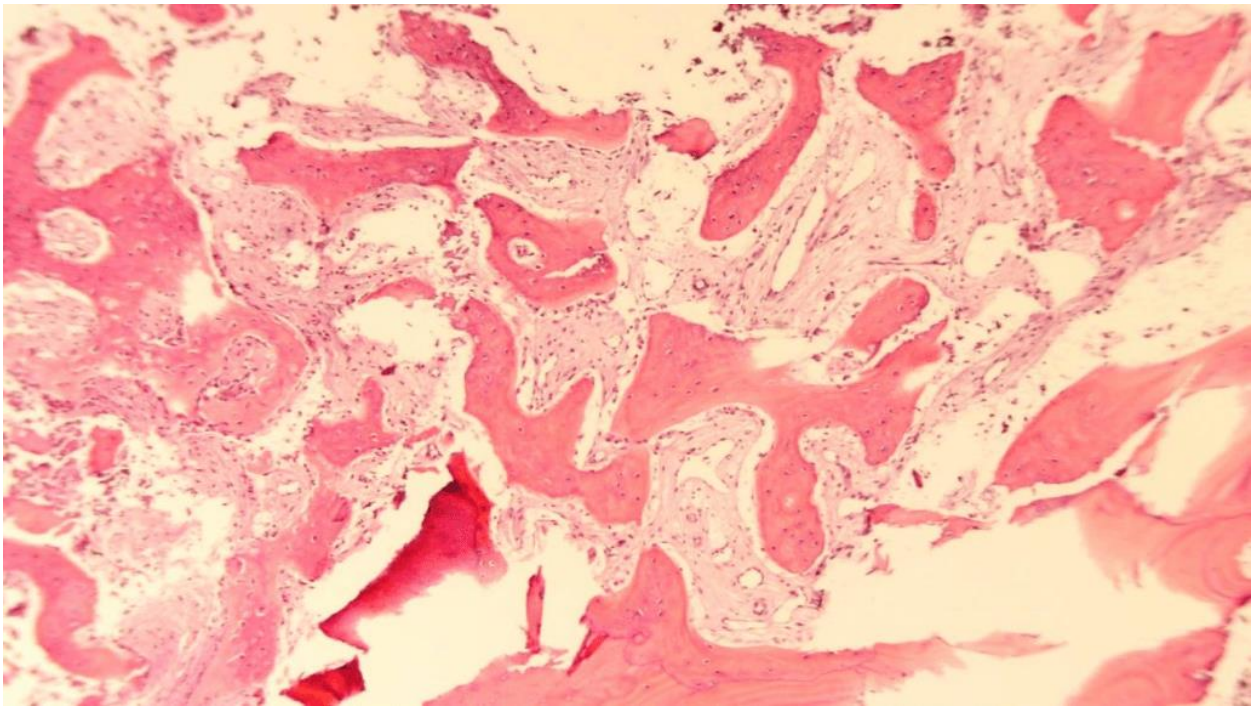
Biocompatible and Non-Biocompatible Bone Grafts–Don't Mix!

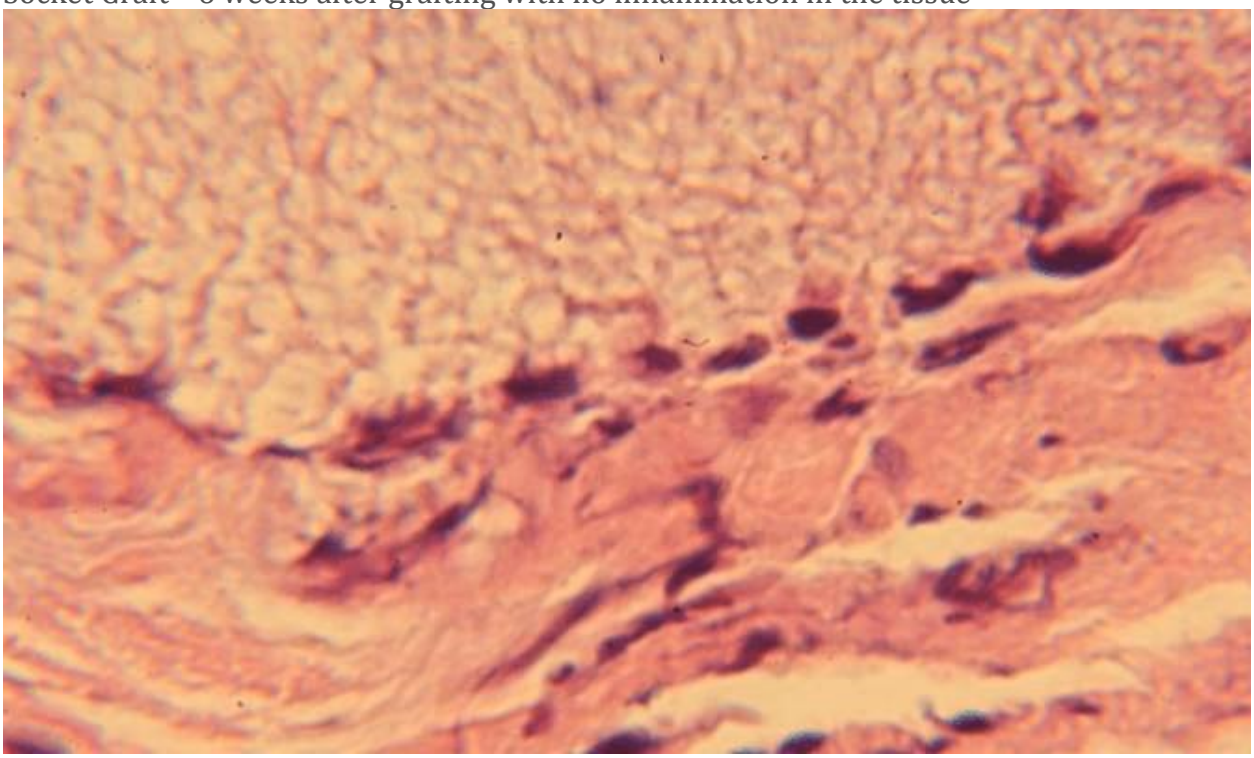
It is common practice to mix various bone graft materials. Using different bone graft materials in order to take advantage of their individual properties is obviously appealing. However, knowledge of the mechanism of producing mineralization is critical for success of the bone graft cocktail so that competing processes do not interfere with bone formation. There are two basic methods of mineralization produced by bone graft materials. One method produces mineralization via the same mechanism that formed our bones in the first place which results in normal bone formation. The other method produces mineralization via an inflammatory process producing sclerotic bone.

- Synthograft 1st generation βTCP
- Cerasorb 2nd generation βTCP
- OsseoConduct™ 3rd generation βTCP
- Autografts, PRF, etc.
- Perioglass, Uniglass
- Calcium Sulfate
- Socket Graft™
- Sinus Graft™
- Ridge Graft™

Autografts do not produce an inflammatory immune response. All autografts such as bone and blood derived products such as PRF and PRP produce normal bone without inflammation. Most synthetics produce bone via osteoconduction and those that are fully resorbed result in normal bone. The βTCP synthetic bone grafts have performed equally to autografts and superior to allografts in clinical trials. The bioglasses are resorbed and produce normal bone but they have been eclipsed by the more effective βTCP synthetics. The following are histologic samples from biocompatible bone grafts that don not produce an inflammatory response and produce normal bone.



Socket Graft™ 6 weeks after grafting with no inflammation in the tissue



OsseoConduct™ βTCP 5 weeks after grafting with no inflammation in the tissue

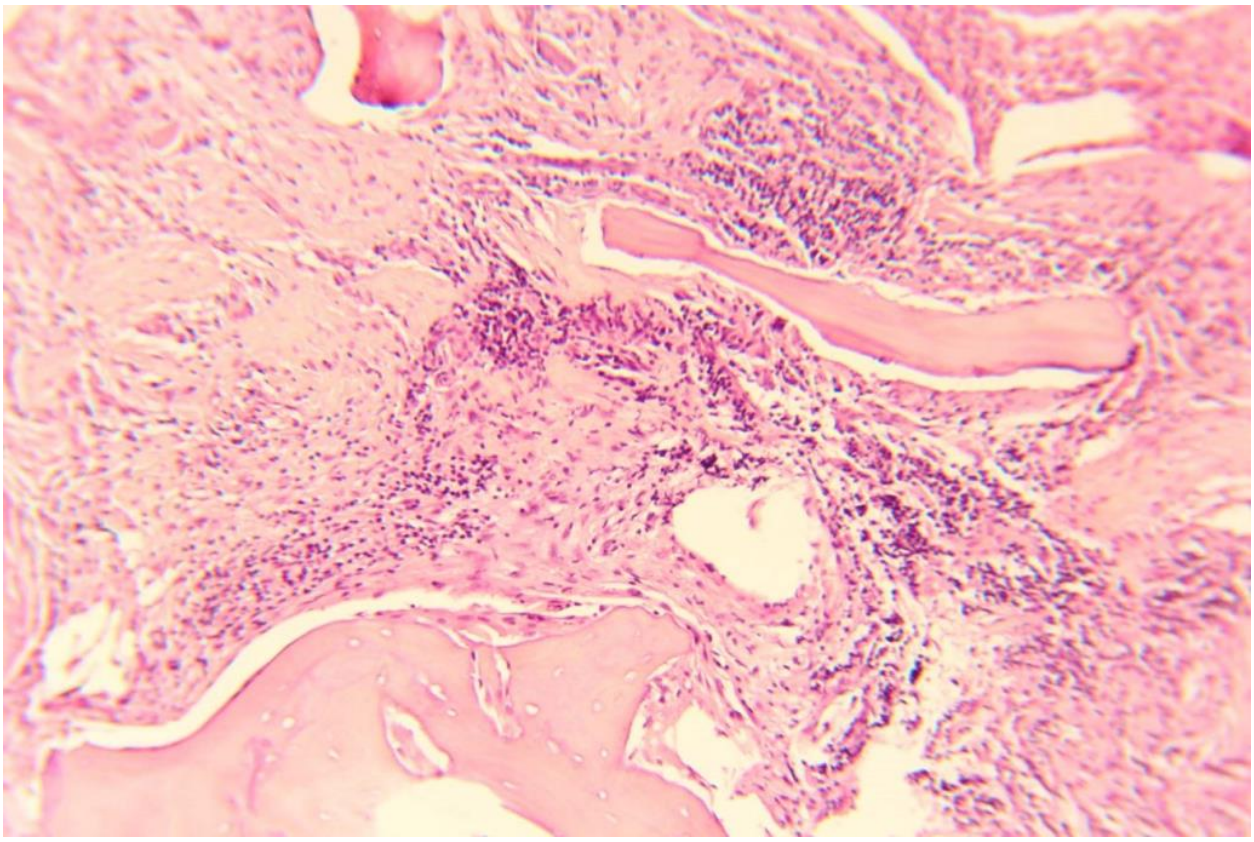
The bone grafts that produce mineralization via inflammation are primarily bone grafts that contain foreign proteins.

- Allografts: Human proteins
- BioOss: Cow proteins
- Infuse: Allograft in a xenograft foundation
- BioPlant: Resorbable membranes made from foreign proteins

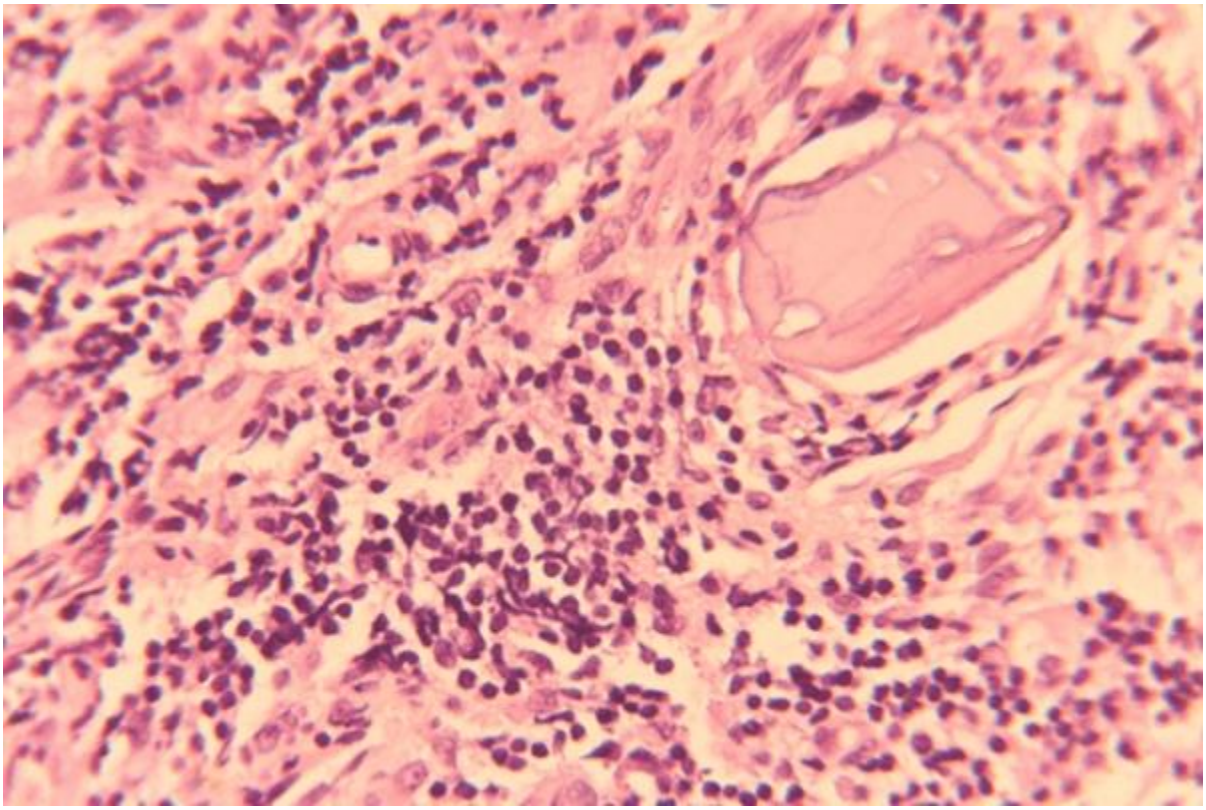
Allografts and BioOss are the most common bone grafts that produce mineralization via inflammation resulting in sclerotic bone. BioPlant produces considerable inflammation, but it is not clear what the mechanism is for mineralization. All growth factors on the market are actually allografts. Growth factors are large complex proteins that were originally derived from an individual and then copied to produce a recombinant growth factor. Everyone's growth factors are different and recognized by the host immune system therefore recombinant growth factors produce an immune response by the host.

Recombinant growth factors are known to produce significant swelling and inflammation as a result of host recognition of the foreign protein. Collagen is either an allograft or a xenograft. In order for collagen products to be resorbed, the immune system of the host has to attack it. Bone grafts that contain foreign proteins will elicit an inflammatory response depending on how the donor and host tissue match immunologically. The concept that foreign proteins from the donor stimulates bone formation has been proven false.

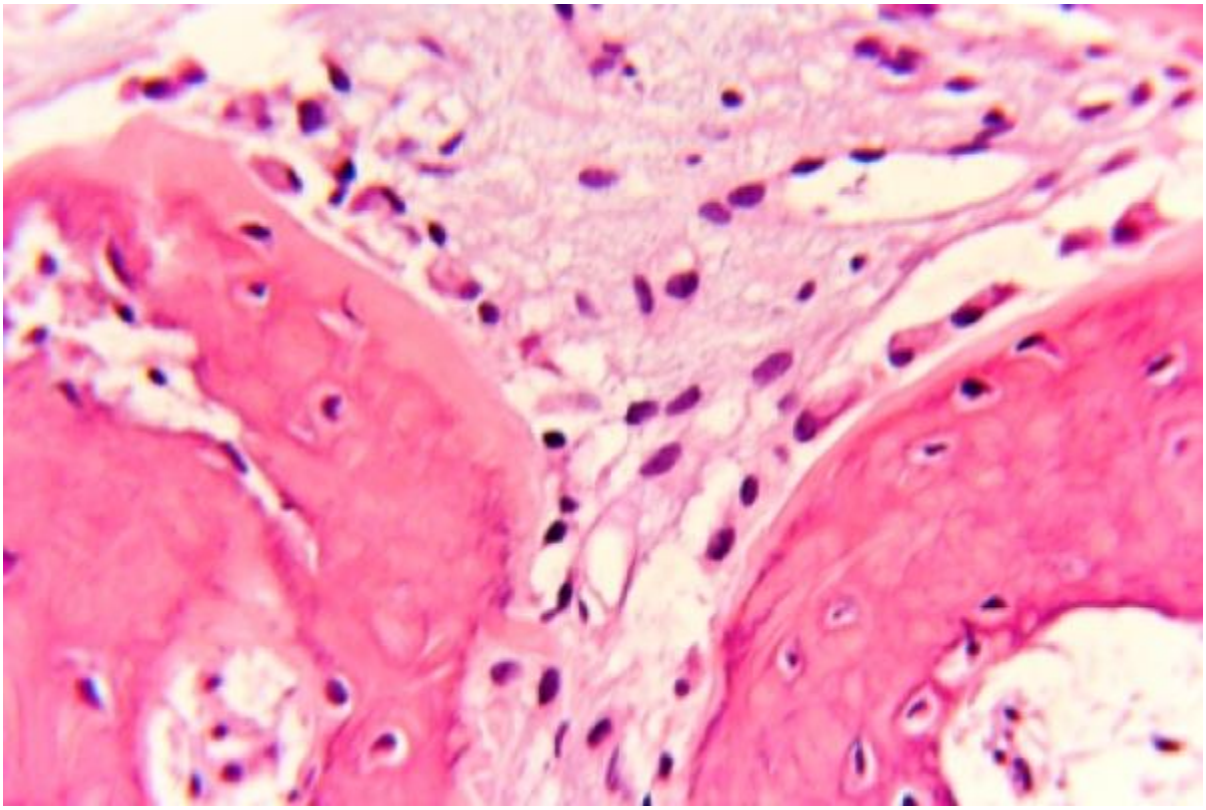
At this time, proponents of allografts and xenografts contend that these grafts form bone through the process of osteoconduction. However, our study at SteinerBio paints a different picture. The following photomicrograph shows the tissue taken from a socket 7 weeks post extraction that had been grafted with an allograft. This photo shows small areas of mineralization forming on the allograft particles. Since osteoconduction is a process of bone growing in from the periphery, isolated areas of mineralization do not fit that model and disproves osteoconduction as a method of mineralization for allografts. You can see in the following photograph there is intense inflammation that appears to be associated with the graft particles. The inflammatory cells (stained blue) were identified as cytotoxic T cells, which are involved in the process of organ rejection. This inflammatory infiltrate makes it very unlikely that osteoblasts are involved in this mineralization process.



Histology from an extraction socket 7 weeks after grafting with cadaver bone showing widespread inflammatory infiltrate



High power of non-biocompatible bone graft (allograft) with intense inflammation at 7 weeks



High power of a biocompatible bone graft (Socket Graft™) at 6 weeks showing no inflammation, only normal bone formation (osteogenesis)

So Why Does It Matter?

Mineralization formed in the presence of intense inflammation produces sclerotic bone which cannot remodel or adapt to changing loads. It is estimated that approximately 25% of all implant failures are the result of placing implants in areas that have been grafted with non-biocompatible bone grafts that produce sclerotic bone. When mixing non-biocompatible bone graft materials with biocompatible bone graft materials, a battle begins. As soon as the body recognizes the foreign proteins of the non-biocompatible bone graft material, the inflammatory immune system responds to the non-biocompatible bone graft material and overwhelms normal bone formation promoted by the biocompatible bone graft material, resulting in poor bone formation or sclerotic bone formation.

Common mistakes in bone grafting is using blood derived products, such as PRP, and mixing with cadaver bone or BioOss. Any beneficial effect of the blood derived material will

be wiped out by the inflammatory response to the proteins in the human or animal bone. Another common mistake is to cover a synthetic graft material such as βTCP with a resorbable collagen membrane. The intense inflammatory response that attacks and resorbs the collagen membrane can completely stop bone formation in the βTCP. Growth factors are commonly mixed with a variety of graft materials. None of the growth factors on the market stimulate bone formation (**osteogenesis**). Infuse (BMP2) is the only growth factor that is osteoinductive. What most dentists don't know is that osteoinduction is a pathologic process and the last thing you want in a bone graft is for it to be forming bone outside of bone. Regarding SteinerBio bone graft products, we advise covering our products with inert nonresorbable membranes and blood derived autograft products, such as PRP. We do not advise mixing non-biocompatible bone graft products with SteinerBio bone graft products.