Biocompatible and Nonbiocompatible bone grafts- don't mix!

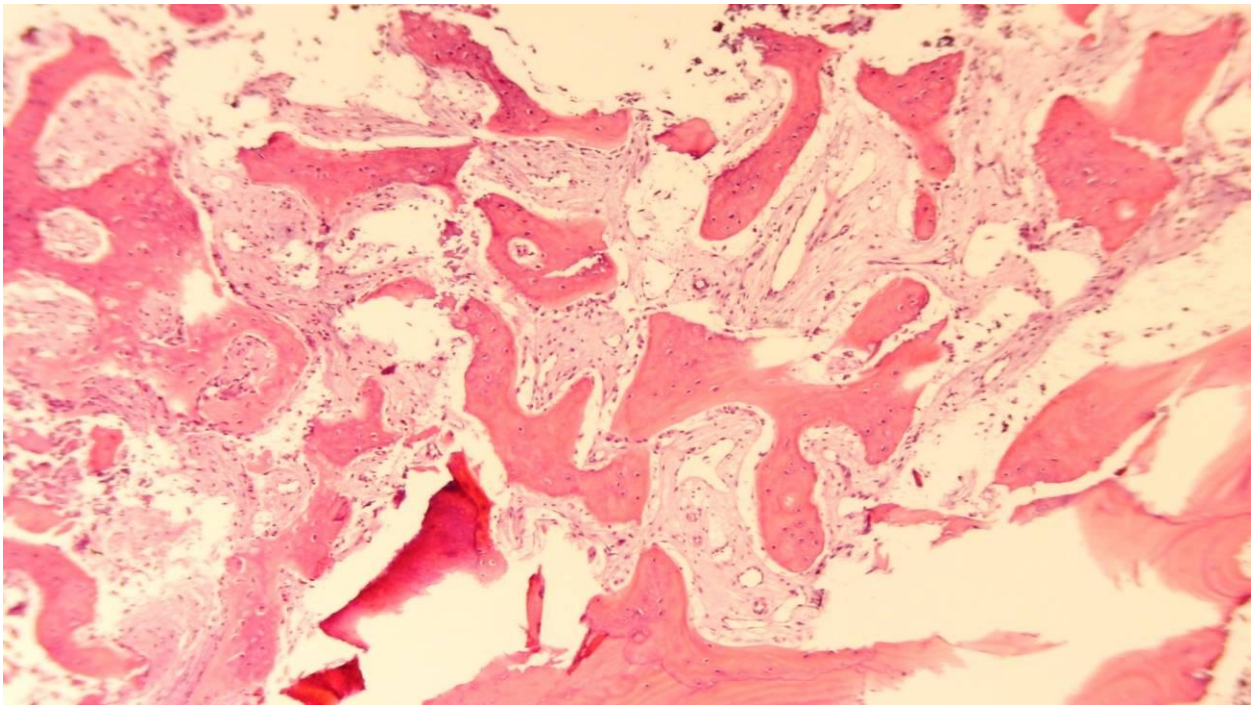
It is common practice to mix various bone graft components. Using different bone graft materials in order to take advantage of their individual properties is obviously appealing. However, knowledge of the mechanism of producing mineralization is critical for success of the bone graft cocktail so that 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 and results in normal bone formation. The other method produces mineralization via an inflammatory process.

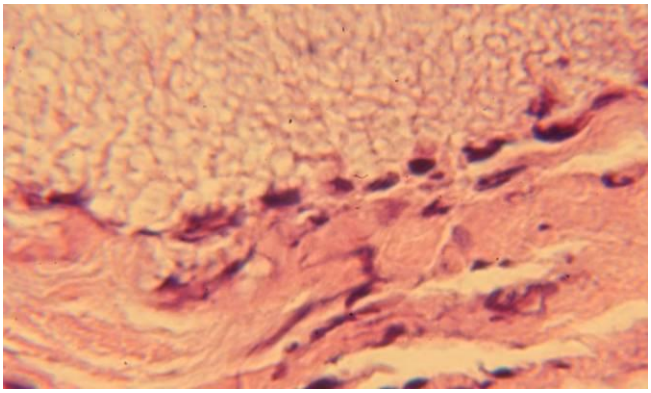
The graft materials that produce mineralization resulting in normal bone formation do so by either allowing bone to grow into and around the graft material via osteoconduction or they stimulate mineralization via osteogenesis. Here are some biocompatible bone grafts-

- Synthograft 1st generation bTCP
- Cerasorb 2nd generation bTCP
- Osseoconduct 3rd generation bTCP
- Autografts, PRF etc.
- Perioglass, Uniglass
- Calcium Sulfate
- Socket Graft Putty
- Sinus Graft
- Ridge Graft

Autografts of course 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 bTCP synthetic bone grafts have performed equally to autografts and allografts in clinical trials. The bioglasses are resorbed and produce normal bone but they have been eclipsed by the more effective bTCP synthetics. The following are histologic samples from biocompatible bone grafts that do not produce an inflammatory response and produce normal bone.



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

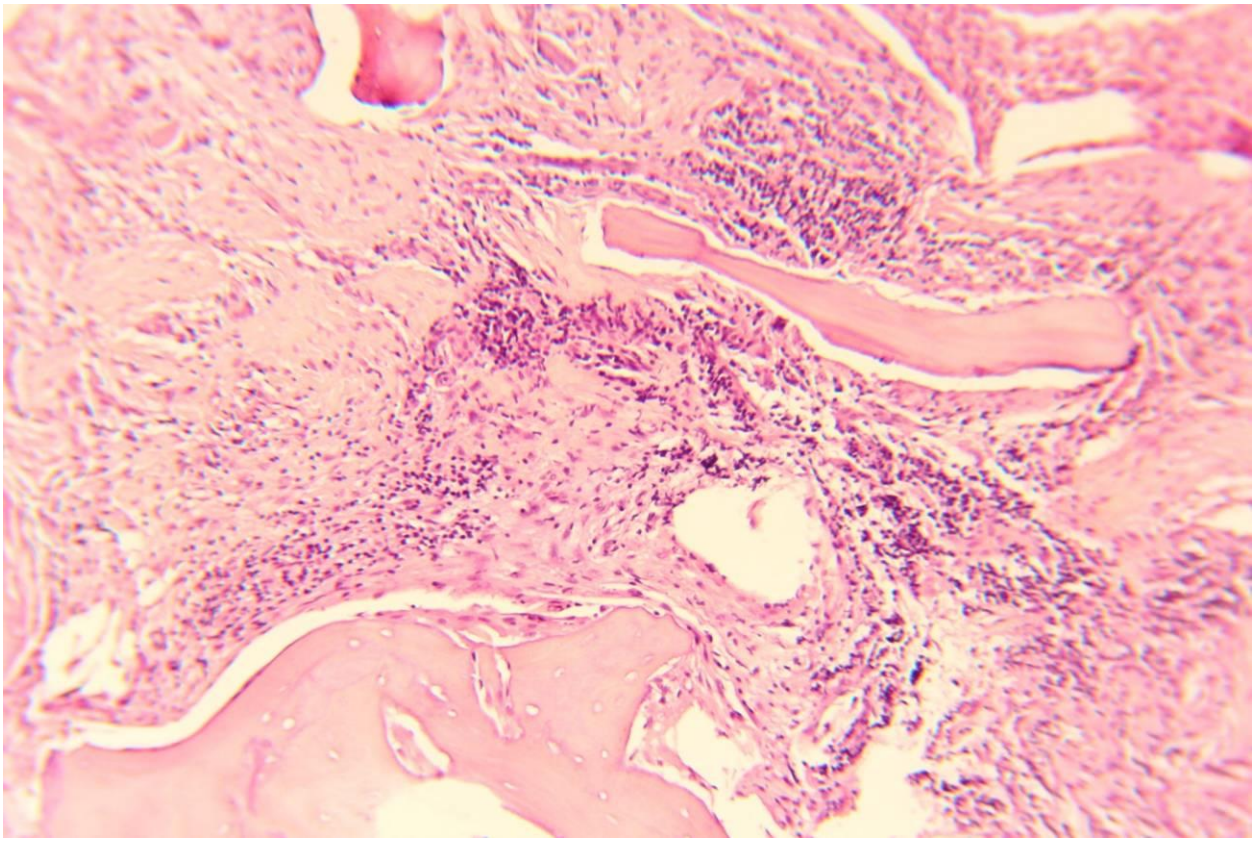


OsseoConduct bTCP 5 weeks after placement with no inflammation is the tissue

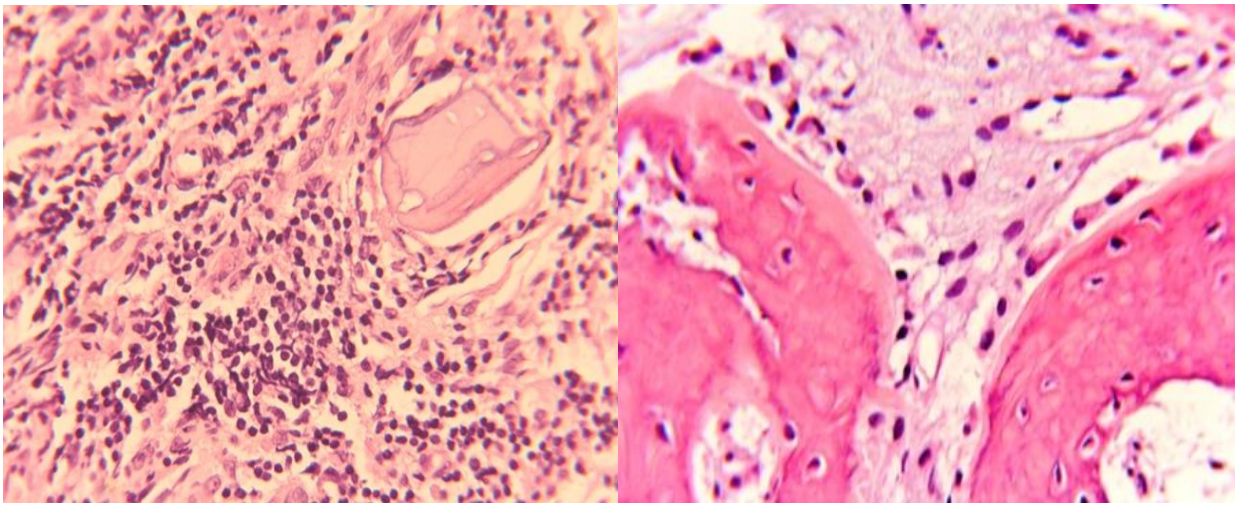
The bone grafts that produce mineralization via inflammation are primarily bone grafts that contain foreign proteins.

- Allografts - human proteins
- BioOss - cow proteins
- Infuse an allograft in a xenograft
- Foundation
- Resorbable membranes made from foreign proteins
- BioPlant

Allografts and BioOss are the most common bone grafts that produce mineralization via inflammation. 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 and these products are resorbed via attack by the host immune system. 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 somehow stimulates bone formation has been proven false. At this time proponents of allografts and xenografts contend that these grafts form bone via osteoconduction. However our study at Steiner Biotechnology paints a different picture. The following photomicrograph is of cadaver bone taken from a socket 7 weeks after extraction and grafting. Some small areas of mineralization have begun to form on the allograft particles. Because 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 as (stained blue) were identified as cytotoxic T cells which are involved in organ rejection. This inflammatory infiltrate makes it very unlikely that osteoblasts are involved in this mineralization process.



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



High power of nonbiocompatible bone graft (allograft) on the left with intense inflammation at 7 weeks. On the right a high power of a biocompatible bone graft (socket Graft Putty) at 6 weeks with no inflammation and normal bone formation.

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 nonbiocompatible bone grafts that produce sclerotic bone. When mixing biocompatible with nonbiocompatible bone graft materials the inflammatory immune response to the nonbiocompatible bone graft material overwhelms normal bone formation promoted by the biocompatible bone graft material and poor bone formation occurs or sclerotic bone is formed. The success of any bone graft cocktail is mixing materials that produce mineralization via the same pathways. The only materials approved for mixing with or covering Steiner Biotechnology bone grafts are blood derived autografts such as PRP, PRF etc. or inert nonresorbable membranes.

Steiner Biotechnology