

Autograft bone harvested from the iliac crest is the standard in bone grafts, it satisfies all the criteria of successful grafts: osteoconductivity, osteogenicity and osteoinductivity. However, it has its own limitations such as a limited supply of donor bone, and it is associated with donor-site morbidity. The other alternative is to take tissues from donors or cadavers, which addresses the limited supply and donor-site morbidity issues. Since allografts require sterilization, much of the osteoinductivity and osteogenicity are removed. However, they have their own drawbacks: reduced functional capacity, non-unions and poor bone allograft incorporation.

Currently existing commercial bone graft products can be classified into five major categories

Allograft-based: demineralized bone matrix (DBM) is prepared using a demineralizing agent leaving the bone matrix with desired osteoinductive growth factors. DBM could be combined with bone chips, glycerol or collagen in an osteoconductive and osteoinductive scaffold.

Factor-based substitutes: growth factors residing in the ECM of the bone involved in bone regeneration; TGF-beta, IGF, PDGF, FG, VEGF and BMPs, are mixed with an autograft. In conjunction of growth factors, small molecules like statin; which increases not only bone density, but also expression of VEGF and BMP-2; or cAMP; which enhances the collagen matrix; can also be injected.

Cell-based substitutes: in vitro mesenchymal stem cells (MSC) are differentiated toward the osteoblast lineage. Also, interaction between MSCs and scaffold is still actively investigated.

Ceramic-based substitutes: the primary component of bone is calcium phosphate making it desirable to use for graft substitutes. Likewise bioactive glass is another group of ceramics which has high modulus, is brittle and used as a composite with polymethylmethacrylate to form bone cement or due to its mineralizing capabilities, combined with polysulfone to form a porous cartilage-bone interface.

Natural/synthetic, degradable/nondegradable polymer-based substitutes: degradable synthetic polymers include polylactic acid and poly(lactic-co-glycolic acid) (PLGA).

By combining polymer (PLGA) and ceramic (CaP), investigators obtain a biodegradable, formable, osteoconductive, osteointegrative material.

A sintered polymeric microspheres scaffold with calcium phosphate synthesized within the microspheres, provides a surface for osteoblast attachment, proliferation, differentiation and migration. Addition of a nanofiber increases production of osteoblast proteins. Preseeded osteoblasts within the scaffold contribute to overall bone repair.