“PRESERVATION OF BONE TECHNIQUE AND MATERIALS”

Wolff's Law:

Bone in a healthy person will adapt to the loads it is placed under. If loading on a particular bone increases, the bone will remodel itself over time to become stronger to resist that sort of loading. The external cortical portion of the bone becomes thicker as a result

If loading on a bone decreases, the bone will become weaker due to turnover as it is less metabolically costly to maintain and there is no stimulus for continued remodeling that is required to maintain bone mass.

Management of certain dental deficiencies mandate the use of bone graft materials.

Ideal bone graft incorporates three main elements:

- Osteogenic precursor cells
- An osteoinductive signal
- An osteoconductive scaffold

- **OSTEOGENIC ELEMENT: Osteogenic precursor cells participate in the early stages of the healing process to unite the graft with the host bone. Autogenous bone, bone marrow aspirate and platelet rich plasma contain these cells.**

- OSTEOINDUCTIVE ELEMENT: stimulates the proliferation and differentiation of mesenchymal stem cells into mature bone cells. Naturally occurring bone morphogenetic proteins or genetically engineered recombinant BMPs are the principle materials.

- OSTEOCONDUCTIVE ELEMENT: A scaffold enables the attachment, migration and distribution of vascular and osteogenic cells.
  - Physical characteristics affecting osteoconduction:

    Porosity, pore size, interconnectivity, 3 dimensional architecture

Type of material selected depends on which 3 elements are most crucial

AUTOGRAFT: Bone harvested from the patient

All 3 elements are present: osteogenic cells, osteoinductive signal and osteoconductive scaffold.

Disadvantages:

- Increased surgical time
- Limited availability
- Variable quality
- Increased incidence of donor site morbidity and pain

COMPOSITE GRAFTS:

- Need the same 3 elements for an ideal bone graft substitute

BONE FORMATION:

- **Bone is a dynamic biological tissue that constantly undergoes deposition, resorption and remodeling.**

CELLULAR COMPONENTS OF BONE:

- The cellular component of bone consist of mesenchymal stem cells, osteogenic precursor cells, osteoblasts, osteocytes and hemapoietic stem cells.

- MESENCHYMAL STEM CELLS are undifferentiated cells which can undergo unlimited division and give rise to one or several different cell types (blood, bone, skin)

- OSTEOGENIC PRECURSOR cells are stem cells derived from mesenchyme that have the potential to undergo mitosis and differentiation into osteoblasts. They make up the deep layer of the periosteum and endosteum.

- OSTEOBLASTS are mature, metabolically active, bone forming cells.

They secrete OSTEOID which is the unmineralized organic matrix that undergoes mineralization, giving bone its strength and rigidity.

- OSTEOCYTES are created when mature osteoblasts become entrapped within the bone matrix. They are involved in the control of the extracellular concentration of calcium and phosphorus as well as in adaptive remodeling behavior.

- OSTEOCLASTS are multi nucleated, bone resorbing cells that secrete hydrolytic enzymes.

- HEMAPOIETIC STEM CELLS are the cells that all red blood cells, white blood cells and osteoclasts are derived.

- BONE consists of both organic and inorganic constituents.

- ORGANIC MATRIX (osteoid) is secreted by osteoblasts. Mostly collagen.

- INORGANIC MATRIX is the mineralized content of bone and consists primarily of a carbonated calcium phosphate. The mineral crystals for hydroxyapatite

STAGES OF BONE HEALING:

- Inflammatory Stage: formation of granulation tissue, ingrowth of vascular tissue and migration of mesenchymal cells
- Repair Stage: Collagen matrix laid down and osteoid secreted and mineralized
- Remodeling Stage: Healed bone restored to its original shape Typically achieved in 3-6 months.

- OSTEOGENIC MATERIALS: Autografts, Platelet Rich Plasma, Bone Marrow Aspirate

- OSTEOINDUCTIVE MATERIALS: Autografts, recombinant bone morphogenetic proteins, Demineralized bone matrix

- OSTEOCONDUCTIVE MATERIALS: Autografts, Allografts, Synthetic bone substitutes

COMMERCIAL DEMINERALIZED BONE MATRIX (DBM)

- Derived from human cortical bone, prepared by grinding and removing the minerals with hydrochloric acid.

- Many formulations are less than 40% DBM by weight with the rest an inert carrier.

- Want the carrier to be biocompatible

Disease transmission is a concern with any allograft.

- **Stringent donor screening and tissue testing makes risk very low.**

DYNABLAST

- **Mineralize-osteoinductive material**

  -Naturally occurring BMP signals mesynchemal stem cells in the blood to form bone cells

- **Demineralized-ostoeconductive material**

  -Provides a scaffold which is the structural support to maintain space.

- 90% bone by volume in the carrier material
- Demineralization is a controlled process in house that limits variability.
- Inductive signalling is assayed
- 15% of the material is rejected and not used

Allografts in the past were mineralized

OR

demineralized particulates.

If you wanted both you needed to mix them yourself.

Bone Morphogenetic Proteins

- Osteoinduction stimulated by BMPs found in blood and bones.
- BMPs interact with specific receptors on the cell surface.
- They have the ability to induce the formation of bone.

Platelet Rich Plasma

- By-product of blood plasma that is rich in platelets
- Allows the body to take advantage of the normal healing pathways at a greatly accelerated rate.

- During healing, the body rushes cells and cell types to the wound in order to initiate the healing process.

- Platelets function in the formation of clots and release of growth factors. Stimulate stem cells to regenerate new tissue.

- By adding PRP and BMP to the implant site with bone substitute particles, we can now GROW bone more predictably and faster than ever before.

Graft Material types

Autogenous: Patients own bone

- Block
- Particulate

Alloplastic: Artificial graft materials

Allograft: Donor Bone

Autogenous Block Grafts

- Advantages
  - Can augment large areas
  - Patients own bone (known source)
  - Can add to bone height predictably
  - Maintain greater volume of bone
  - Osteogenesis within 1 week
  - BMP’s
  - Cortical bone acts as a membrane

Autogenous Block Grafts

- Disadvantages
  - Requires second surgical site (possibly extraoral)
  - Increased morbidity
  - Difficulty with soft tissue coverage
  - Compromised blood supply
  - Trauma from opposing teeth—incision opening
  - Difficulty with transitional prosthesis

Autogenous Particulate Grafts

- Advantages
  - Readily available at time of surgery
  - Known source
  - Cost effective
  - May supply BMP’s

Autogenous Particulate Grafts

- Disadvantages
  - Only for small sites
  - Can’t hold ridge form
  - May require membrane

Osseous Collection Trap

Salvin Dental Specialties

www.salvin.com

Alloplastic Graft Materials

- Definition: Synthetic, biocompatible products developed to deal with a broad range of indications. May be various textures, particle sizes and shapes. May be ceramic, polymer, or composite materials.

Allograft Materials

- Frozen
- Freeze Dried Bone
- Demineralized Freeze Dried Bone
- Often used with autogenous bone
- Concern with donor source?

Puros (Zimmer)

Block Allograft: Used where space maintenance and volume enhancement are desired, including sinus elevations, extraction sockets and ridge augmentations.

Cortical and cancellous bone.

Advantages:

- Provides sufficient bone volume
- No autogenous harvesting
- Saves time
- Reduction of pain and morbidity

Pericardium

- A biological three layered membrane, which encases and protects the heart and can be used when Guided Tissue Regeneration.
  - Flexible and adaptable
  - Remodels/Resorbable
  - Tough and resilient
  - Suturable
  - Space creating

Exactech Dental Biologics

866-284-9690

PepGen P-15 Flow bone grafting material

THANK YOU

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