ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

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COURSE OUTLINE

▸ ESSENTIALS OF BONE PHYSIOLOGY
  ▸ Resorption
  ▸ Ridge classification
▸ BONY REQUIREMENTS FOR SUCCESSFUL IMPLANTS
  ▸ Bone volume
  ▸ Spacing
▸ BASICS OF BONE GRAFT HEALING
  ▸ Normal physiology
▸ BONE GRAFT OPTIONS
  ▸ Synthetic
  ▸ “Real Bone”
▸ MEMBRANES

ESSENTIALS OF BONE PHYSIOLOGY

▸ RIDGE RESORPTION
  ▸ Bony atrophy at site of tooth loss/removal
  ▸ “Use it or Lose it”
▸ RIDGE CLASSIFICATION
  ▸ Density
  ▸ Ridge volume/height

ESSENTIALS OF BONE PHYSIOLOGY

PATTERNS OF BONE LOSS

▸ MAXILLA: UPWARD AND INWARD
  ▸ Ridge becomes narrower
▸ MANDIBLE: DOWNWARD AND OUTWARD
  ▸ Ridge becomes wider and flatter

**RIDGE RESORPTION**

- REVIEW OF ALL ENGLISH LANGUAGE DENTAL LITERATURE
- 3954 TITLES / 238 ABSTRACTS —> 104 FULL TEXT ARTICLE ANALYSIS
- 6 MONTHS AFTER EXTRACTION
  - 3.79mm (29–63%) horizontal
  - 1.24mm (B)/ 0.84mm (L) vertical avg. bone loss (11–22%)


**MAJOR CHANGES TO EXTRACTION SITE OCCUR IN FIRST 12 MONTHS AFTER EXTRACTION.**
**2/3 OF THE RESORPTION OCCURS WITHIN THE FEW MONTHS**

- SCHROPP L ET AL. BONE HEALING AND SOFT TISSUE CONTOUR CHANGES FOLLOWING SINGLE-TOOTH EXTRACTION. A CLINICAL AND RADIOGRAPHIC 12-MONTH PROSPECTIVE STUDY. INT J PERIODONTICS RESTORATIVE DENT 23(4); 313-23, 2003

**RIDGE CLASSIFICATION**

- BRANEMARK’S (1985) CLASSIFICATION OF RIDGE SHAPE BASED ON AMOUNT OF RESORPTION
- LINE—DEMARCATES ALVEOLAR/ BASAL BONE

- SCHROPP L ET AL. BONE HEALING AND SOFT TISSUE CONTOUR CHANGES FOLLOWING SINGLE-TOOTH EXTRACTION. A CLINICAL AND RADIOGRAPHIC 12-MONTH PROSPECTIVE STUDY. INT J PERIODONTICS RESTORATIVE DENT 23(4); 313-23, 2003

**BONE QUALITY CLASSIFICATION**

BRANEMARK’S CLASSIFICATION, BASED ON RATIO OF CORTICAL AND CANCELLOUS BONE AND MEDULLARY DENSITY

- VASCULARITY DENSITY

- SCHROPP L ET AL. BONE HEALING AND SOFT TISSUE CONTOUR CHANGES FOLLOWING SINGLE-TOOTH EXTRACTION. A CLINICAL AND RADIOGRAPHIC 12-MONTH PROSPECTIVE STUDY. INT J PERIODONTICS RESTORATIVE DENT 23(4); 313-23, 2003
ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

BONY REQUIREMENTS FOR SUCCESSFUL IMPLANT OUTCOMES

▸ BONE VOLUME
  ▸ Buccal/ Lingual thickness

▸ SPACING
  ▸ Implant-Tooth
  ▸ Implant-Implant

IN ADDITION TO GOOD QUALITY BONE, WE ALSO NEED

Sufficient bone volume

INSUFFICIENT BONE VOLUME

INADEQUATE BONE WIDTH
INSUFFICIENT BONE VOLUME

INADEQUATE BONE HEIGHT
INADEQUATE BONE WIDTH

HOW MUCH BONE DO WE NEED SURROUNDING AN IMPLANT FIXTURE?

BLOOD SUPPLY TO ALVEOLAR BONE COMES FROM:
- Periosteum
- Periodontal ligament
- Endosteal blood supply

INADEQUATE BONE THICKNESS LEADS TO RESORPTION DUE TO COMPROMISED BLOOD SUPPLY
- 2 mm buccal (facial)
- 2 mm lingual (palatal)

SALAMA 1998

<table>
<thead>
<tr>
<th>Class</th>
<th>Restoration Environment</th>
<th>Proximity Limitations</th>
<th>Vertical soft Tissue Limitations</th>
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<tr>
<td>1</td>
<td>Tooth-Tooth</td>
<td>1.0 mm</td>
<td>5.0 mm</td>
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<tr>
<td>2</td>
<td>Tooth-Pontic</td>
<td>N/A</td>
<td>3.5 mm</td>
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<tr>
<td>3</td>
<td>Pontic-Pontic</td>
<td>N/A</td>
<td>3.0 mm</td>
</tr>
<tr>
<td>4</td>
<td>Tooth-Implant</td>
<td>1.5 mm</td>
<td>4.5 mm</td>
</tr>
<tr>
<td>5</td>
<td>Implant-Pontic</td>
<td>N/A</td>
<td>5.5 mm</td>
</tr>
<tr>
<td>6</td>
<td>Implant-Implant</td>
<td>N/A</td>
<td>3.5 mm</td>
</tr>
</tbody>
</table>

NOT BASED ON “PLATFORM-SWITCHED” IMPLANTS
**IMPLANT SPACING GUIDELINES**


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**ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST**

**REQUIREMENTS FOR NEW BONE FORMATION**

- **Cells**
  - Stem cells, marrow stromal cells, osteoblasts, chondrocytes, fibroblasts
- Scaffold provided by bone graft
- **Signalling molecules**
- **Structural Properties**
  - Porosity, pore size, pore interconnection
  - Mechanical properties
- **Biological Properties**
  - Osteoconductive, osteoinductive, or both
  - Cytokines, growth factors and molecules involved in cell adhesion

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**ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST**

**BASICS OF BONE GRAFT HEALING**

- Bone heals by cellular regeneration vs scar formation
- This makes healing of nonvascular grafts possible
- Nonvascular graft initially survives by plasmatic circulation
- The hematoma induces inflammation and formation of granulation tissue

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**ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST**

**BASICS OF BONE GRAFT HEALING**

- Hypoxia and lactic acid build-up induces angiogenesis by about 2 weeks
- Cancellous bone grafts revascularize at about 1 mm/day (about 2 weeks)
- Cortical bone grafts revascularize take 2 months or longer
- Mesenchymal stem cells in bone marrow, endosteum and periosteum differentiate in to osteoblasts
- "Creeping substitution" osteoclastic resorption followed by osteoblastic bone deposition
ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

BASICS OF BONE GRAFT HEALING

▸ THE SURVIVING PROGENITOR CELLS FORM UNORGANIZED WOVEN BONE AT ABOUT 6-8 WEEKS
▸ REMODELING (OSTEOCLASTIC ACTIVITY) OCCURS OVER THE NEXT FEW MONTHS TO FORM AN ORGANIZED LAMELLAR STRUCTURE
▸ BMPs ARE RELEASED DUE TO OSTEOCLASTIC ACTIVITY, RESULTING IN ATTRACTION, DIFFERENTIATION, AND PROLIFERATION OF OSTEOBLASTS

Bone Morphogenetic Protein (BMP)

▸ BMPs are growth factors also known as cytokines and as metabologens.
▸ Marshall Urist 1965 (Science) - demineralized, lyophilized segments of bone induced new bone formation when implanted in muscle pouches in rabbits.
▸ BMPs interact with specific receptors on the cell surface
▸ BMP3: Induces bone formation.
▸ BMP4: Regulates the formation of teeth, limbs and bone from mesoderm. It also plays a role in fracture repair, epidermis formation, dorsal-ventral axis formation, and ovarian folliculal development.
▸ BMP7: Plays a key role in osteoblast differentiation.
▸ BMP8a: Involved in bone and cartilage development.
▸ Proposed the name “Bone Morphogenetic Protein” - Journal of Dental Research (1971)

Properties of the Ideal Bone Graft Material

▸ BIOMCOMPATIBLE
▸ SERVING AS A SCAFFOLDING FOR NEW BONE FORMATION (OSTEOCONDUCTIVE)
▸ Should be resorbable and replaced by host bone
▸ OSTEOINDUCTIVE
▸ Dependent on BMPs present in organic matrix
▸ OSTEOGENIC
▸ Requires living cells transplanted with graft
▸ NON-ANTIGENIC
▸ EASY TO MANIPULATE

Graft Materials
**BONE GRAFTS**

- SYNTHETIC (ALLOPLAST)
  - Hydroxyapatite
- “REAL BONE”
  - Xenograft
  - Allograft
  - Autograft
- MEMBRANES
  - Resorbable
  - Non-Resorbable

**ALLOPLASTIC (SYNTHETIC)**

- Density, porosity and crystallinity are all controlled
- Biocompatible, no disease risk
- Osteoconductive only
- Used mostly as volume expanders
- Degrade in 6 - 24 months

**DENSE HYDROXYAPATITE**

- DS PRODUCT/ BRAND
  - Symbios OsseoGraf D-300 (250-420µ particle range)
  - Symbios OsseoGraf D-700 (420-1000µ particle range)
- PROPERTIES
  - Non-porous, high density, high crystallinity, low resorbability
  - Can bond directly to bone
- INDICATIONS
  - Ridge maintenance and soft tissue support
  - Not used where an implant will be placed
- BENEFITS
  - Inexpensive, biocompatible
  - 5 year shelf life
ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

DENSE HYDROXYAPATITE

DISADVANTAGES
- No significant resorption or ossification

LIMITATIONS
- First few millimeters can be surrounded by bone
- Fibrous CT encapsulation beyond a few millimeters

TECHNIQUE
- Hydrate with saline for 10-15 minutes before use

ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

LOW-DENSITY HYDROXYAPATITE

PRODUCT/BRAND
- Symbios OsseoGraft LD-300 (250-420µ particle range)

PROPERTIES
- Readily resorbable (solution mediated- dissolves into Ca++ and PO4)
- Granules - 300µ
- Hydrophilic- cohesive

INDICATIONS
- Volume expander - combined with demineralized bone allograft
- Extraction sites or periodontal defects

ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

LOW-DENSITY HYDROXYAPATITE

BENEFITS
- For patients who will not accept allograft of xenograft

DISADVANTAGES
- If used alone, wait 12-15 months before implant can be placed

TECHNIQUE
- Hydrate with saline for 10-15 min before use

ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

BONE GRAFTS

“REAL BONE”
- Xenograft
  - Symbios Xenograft Granules
- Allograft
  - DBX Putty
  - Symbios Mineralized Cancellous/Cortical Powder
  - Symbios Demineralized Cortical Powder
  - Symbios Mineralized Corticocancellous Granules
  - Symbios Demineralized Corticocancellous Granules
- Autograft
**XENOGRAFT – SYMBIOS XENOGRAFT GRANULES**

**SOURCE**
- Porcine (carbonate apatite)

**PREPARATION**
- Low temperature chemical extraction of organic and cellular components
- High temperature (>1500°C) to remove residual organic components

**PROPERTIES**
- Interconnecting macro- and microscopic pore structure
- Highly porous - 88 to 95% empty space
- Supports vascularization and nutrition
- Rough surface texture - facilitates cell adhesion and bone ingrowth
- Hydrophilic - granules cohesive when wet
- Osteoconductive

**INDICATIONS**
- Ridge augmentation around implants
- When patient refuses allograft
- Benefits
  - Ridge augmentation maintained longer than other bone grafts

**DISADVANTAGES**
- Slow resorption through osteoclastic activity

**LIMITATIONS**
- May take >24 months to resorb
- Particles adjacent to soft tissue become encapsulated

**TECHNIQUE**
- Hydrate with sterile saline
- Used alone or mixed with autogenous bone (1:1)

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**ALLOGRAFT - DEMINERALIZED FREEZE-DRIED BONE (DFDBA)**

**SOURCE**
- Human bone - healthy organ donors
- Licensed tissue banks (MTF - Musculoskeletal Transplant Foundation)

**PREPARATION**
- Harvested in operating room
- Cut into blocks, strips, or ground to a specific particle size (200-500µ)
- Steam —> ethanol soak to remove cells and organic material
- 0.6N HCl 6-16 hours to remove mineral component
- Freeze-dried, packaged and sterilized (gamma irradiation or ethylene oxide gas)

**PRODUCT/ BRAND**
- Symbios demineralized cortical powder
- Symbios demineralized cortical and cancellous granules

**PROPERTIES**
- Osteoinductive due to presence of BMPs
- Demineralization releases BMPs from organic bone matrix
- BMP causes differentiation of mesenchymal cells into osteoblasts

**INDICATIONS**
- Ridge preservation after extraction
- Ridge augmentation (including sinus lift)
- Periodontal defects
ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

ALLOGRAFT - DEMINERALIZED FREEZE-DRIED BONE (DFDBA)

- **BENEFITS**
  - Predictable bone formation
  - Relatively inexpensive, readily available
  - No harvest site morbidity

- **DISADVANTAGES**
  - 6-12 months required for complete resorption and replacement with vital bone
  - Risk of HIV transmission - 1 in 2.8 billion (no confirmed cases in >40 years)
  - BMP activity varies with donor age, sterilization method

- **TECHNIQUE**
  - Mix with sterile saline or blood

ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

SYMBIOS DBX PUTTY

- **SOURCE**
  - Human bone - healthy organ donors

- **PREPARATION**
  - Demineralized Bone Matrix Putty
  - Starts as Cortical Bone (212 – 850 μ)
  - Demineralization exposes natural BMP in bone
  - Demineralized bone mixed with biologic carrier
  - Sodium Hyaluronate – synthetic material: Chemically identical to the sodium hyaluronate produced by the human body
  - Integrades in approximately 3-4 months

- **INDICATIONS**
  - Ridge augmentation (including sinus lift)
  - Extraction sites
  - Bony defects

- **FEATURES**

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>BENEFITS</th>
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<tbody>
<tr>
<td>Proven osteoinductivity in Urist intramuscular model</td>
<td>Predictable bone formation</td>
</tr>
<tr>
<td>Thy bone content by volume</td>
<td>Highest demineralized bone content available</td>
</tr>
<tr>
<td>pH balanced and compatible with surrounding blood cells</td>
<td>Biocompatible</td>
</tr>
<tr>
<td>MTF: Largest tissue bank in the world</td>
<td>Unsurpassed safety</td>
</tr>
<tr>
<td>Resists movement under irrigation</td>
<td>Ease of use</td>
</tr>
<tr>
<td>Maintains physical integrity</td>
<td></td>
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<tr>
<td>Simple delivery system / ready to use off-the-shelf</td>
<td></td>
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<tr>
<td>No mixing, heating, thawing or refrigeration required</td>
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</tbody>
</table>

ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

ALLOGRAFT - MINERALIZED FREEZE-DRIED BONE (MFDBA)

- **SOURCE**
  - Human bone - healthy organ donors

- **PREPARATION**
  - Similar to DFDBA but without the acid demineralization step
  - Cortical or cancellous granules of various sizes
  - Block form

- **PRODUCT/BRAND**
  - Symbios mineralized cancellous powder
  - Symbios mineralized cortical and cancellous granules

- **PROPERTIES**
  - Osteoinductive and osteoconductive

- **INDICATIONS**
  - Ridge preservation grafting
  - Ridge augmentation (including sinus lift)
  - Intrabony defects
ESSSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST

ALLOGRAFT – MINERALIZED FREEZE-DRIED BONE (MFDBA)

- **LIMITATIONS**
  - BMPs are not bioavailable until mineral component is resorbed
  - Clinical relevance of this is unclear presently

- **TECHNICAL ISSUES**
  - Due to mineral content, it takes longer for resorption and replacement with vital bone compared with DFDBA
  - Mineral content can give the clinical and radiographic appearance of successful integration before it is complete

- **TECHNIQUE**
  - Granules can be mixed with sterile saline or blood

COMBINING DFDBA AND MFDBA

- **SOURCE**
  - Human bone - healthy organ donors

- **PREPARATION**
  - Mix of mineralized and demineralized allograft

- **BENEFITS**
  - More rapid osteoinduction due to more BMPs
  - Retains better structural integrity, higher density

CORTICAL VS. CANCELLOUS BONE GRAFT

- **CORTICAL BONE**
  - Slower incorporation due to need to remodel Haversian systems
  - Provides more structural support

- **CANCELLOUS BONE**
  - Less structural support
  - Greater osteoconduction
  - More rapid incorporation

- **CORTICOCANCELLOUS MIX (SYMBIOS CORTICAL/CANCELLOUS GRANULES)**
  - Blends properties of both - dimensional stability with shorter integration time
  - 80% cortical/ 20% cancellous
  - Mineralized: 1.0 - 2.0mm / Demineralized: 0.5 - 3.0mm particle size
  - 4 - 5 month integration time

POWDER VS. GRANULES

- **SYMBIOS MINERALIZED CANCELLOUS POWDER**
  - 250 - 850µ particle size
  - Allows for faster revascularization, remodels faster than cortical
  - Integrates in 3 - 4 months

- **SYMBIOS MINERALIZED CORTICAL POWDER**
  - 250 - 850µ particle size
  - Denser than cancellous, slower revascularization, greater stability
  - Integrates in 4 - 5 months

- **SYMBIOS DEMINERALIZED CORTICAL POWDER**
  - 250 - 850µ particle size
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POWDER VS. GRANULES

-SYMBIOS MINERALIZED CORTICAL AND CANCELLOUS GRANULES
- 80% cortical/ 20% cancellous
- 1.0 - 2.0 mm particle range
- Integrates in 4 - 5 months

-SYMBIOS DEMINERALIZED CORTICAL AND CANCELLOUS GRANULES
- 80% cortical/ 20% cancellous
- 0.5 - 3.0 mm particle range
- Integrates in 4 - 5 months

OSSIX BONE

-Sponge-like block of hydroxyapatite and sugar cross-linked collagen matrix (Glymatrix)
- Provides an ideal environment for vascularization, cell proliferation and bone maturation

-NO MIGRATION OF PARTICLES

-INDICATIONS
  - Ridge preservation (can be used w/o membrane)
  - Bone augmentation (including sinus lift)
  - Intrabony defects
  - Peri-implantitis defects

AUTOGRAFT (AUTOGENOUS)

-SOURCE
  - Patient ("Gold Standard")
  - Maxillary tuberosity, mandibular symphysis, mandibular ramus

-PREPARATION
  - As needed - granules, shavings or blocks

-PROPERTIES
  - Osteoconductive and osteoinductive
  - Limited living cell transplant - osteogenic
  - Cancellous - more cells, more osteogenic potential
  - Cortical - more BMPs, more structural support

-INDICATIONS
  - Any bone defect
**AUTOGRAPH (AUTOGENOUS)**

**BENEFITS**
- Presence of viable osteogenic cells
- No risk of disease transmission
- No antigenic properties

**DISADVANTAGES**
- Requires donor site and associated morbidity

**LIMITATIONS**
- Only a small percentage of osteogenic cells survive transplantation (within 300µ of a blood supply first 1-2 weeks)
- Remaining serves as osseoconductive scaffold (“creeping substitution”)
- In larger defects, may need to be mixed with allograft, xenograft, or alloplast to give structural support

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**MEMBRANES FOR GUIDED TISSUE REGENERATION**

**WHEN A WOUND IS CREATED, BOTH SOFT TISSUE AND BONE FORMING CELLS MIGRATE TO THE AREA**

**SOFT TISSUE CELLS DIVIDE AND MIGRATE FASTER THAN BONE CELLS**

**LARGER DEFECTS TEND TO HEAL WITH MORE SOFT TISSUE THAN BONE**

**MEMBRANES ARE USED TO EXCLUDE SOFT TISSUE FORMING CELLS AND ALLOW BONE FORMING CELLS TO POPULATE THE WOUND/ DEFECT**

**A MEMBRANE ALSO PROTECTS THE WOUND AND CONTAINS THE GRAFT PARTICLES**

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**MEMBRANES FOR GUIDED TISSUE REGENERATION**

**PROPERTIES OF THE IDEAL BARRIER MEMBRANE**
- Biocompatible
- Easy to manipulate and contour
- Flexible
- Stiff enough to resist collapse
- Resist passage of bacteria and cells
- Allow passage of oxygen and nutrients
- Should not interfere with osteogenesis
- Easily removed

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**PRIMARY CLOSURE OVER GRAFT SITE**

**FLAP MANIPULATION MAY BE DIFFICULT, TIME-CONSUMING**

**FLAP MOBILIZATION REQUIRES PERIOSTEAL ELEVATION**

**FLAP DEVELOPMENT CAN AFFECT SOFT TISSUE ARCHITECTURE**

**MAY REQUIRE SECOND SURGERY TO REMOVE MEMBRANE**

**HIGH-DENSITY PTFE (d-PTFE) MEMBRANES DEVELOPED LATE 1994 TO MINIMIZE THESE PROBLEMS**
**MEMBRANES**

- **Resorbable**
  - Used when primary closure is desired
- **Non-Resorbable**
  - Used when primary closure is not possible
  - Used when longer graft protection is wanted
  - Requires removal

**EARLY GTR MEMBRANES - 1990s**

- **Highly Porous Expanded PTFE (GoreTex)**
- **Highly Porous Resorbable Polymer (GUIDOR)**
- **Porous Polylactide Mesh (Vicryl)**
- **Gelatin Sponge (Gelfoam)**
- **Collagen Sponge (Collaplug)**
  - Primary closure required due to porous nature of barrier
  - Pores 30 - 100μm (Bacteria generally <10μm)
  - Exposure of membrane necessitated removal due to bacterial contamination
  - High rate of graft failure

**BONE GRAFTS**

- **MEMBRANES**
  - Resorbable
    - Collagen-Based
      - Rapid Resorption
      - Slow Resorption
  - Non-Resorbable
    - Titanium
    - PTFE
    - Porous
    - Non-Porous (Dense)

**RESORBABLE MEMBRANES**

- Indicated for coverage of
  - Onlay grafts
  - Coverage of apical defects
  - Coverage of sinus lift access windows
- Not ideal for extraction site coverage
- Made from bovine or porcine collagen
- Cross-linking delays resorption time
SYMBIOS™ OSTEOSHIELD® COLLAGEN

**RESORBABLE**
- Resorbable tissue matrix derived from highly-purified type-I bovine Achilles tendon for safety and predictability
- GBR barrier function
- Dual-sided
- Resorbs in approximately 26 – 38 weeks
- 3-Year shelf life

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<tr>
<td>15 mm x 20 mm</td>
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<tr>
<td>20 mm x 30 mm</td>
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<tr>
<td>30 mm x 40 mm</td>
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**Features**

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-layer construction</td>
<td>Guides healing of bone and tissue – inner layers help prevent cellular and bacterial down growth</td>
</tr>
<tr>
<td>Unique fiber orientation</td>
<td>Provides tensile strength to accommodate sutures or tacks</td>
</tr>
<tr>
<td>Excellent wet handling characteristics and</td>
<td>Ease of use</td>
</tr>
<tr>
<td>either side may be placed on site</td>
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**ESSENTIALS OF BONE GRAFTING FOR THE NON-SPECIALIST**

**OSSIX MEMBRANES – OSSIX PLUS**

**Properties**
- Porcine collagen
- GLYMATIX cross-linking
- 4 - 6 month resorption time
- Breaks down in 3 - 5 weeks if exposed
- Dual-sided, very conformable
- Does not need to be tacked down or sutured

**OSSIX MEMBRANES – OSSIX VOLUMAX**

**Properties**
- Porcine collagen
- GLYMATIX cross-linking
- 4 - 6 month resorption time
- Dual-sided
- Thicker (1-2mm), less dense than OSSIX PLUS
- Expands when wet
- Resistant to degradation if exposed
- Forms scaffold for ossification (osteodegradable)
NON-RESORBABLE MEMBRANES

- HIGH DENSITY PTFE (d-PTFE)
- POLYFLUOROTETRAETHYLENE (TEFLON)

PREPARATION
- PTFE paste compressed to desired thickness, density and porosity
- Textured, then die-cut to desired size

PROPERTIES
- Bio-inert
- Non-inflammatory
- Lack of tissue ingrowth
- Textured surface increases surface area - increased stability

2 SIDES
- Shiny - toward graft
- Dimpled - toward oral cavity

- PORE SIZE (0.3µm) BLOCKS BACTERIA, BUT ALLOWS DIFFUSION OF OXYGEN AND SMALL MOLECULES
- IMMEDIATELY COATED WITH PLASMA PROTEINS
- Forms a seal that blocks migration of bacteria and epithelial cells
- EXPOSURE OF MEMBRANE IS OK - PRIMARY CLOSURE NOT REQUIRED
- EASILY REMOVED - NON SURGICALLY OR WITH MINIMAL INCISION
- AVAILABLE WITH TITANIUM REINFORCEMENT
- Increases stiffness for tenting
- Flexible, without memory
- Provides additional stability for large defects
- MAY BE USED WITH FIXATION SCREWS FOR LARGE MEMBRANES

SYMBIOS™ OSTEOSHIELD® PTFE

- PROPRIETARY 100% POLYTETRAFLUOROETHYLENE SHEET
- BIOLOGICALLY INERT AND TISSUE COMPATIBLE
- MESH APPEARANCE IS “DIMPLES”, NOT HOLES – MAKES MEMBRANE VIRTUALLY IMPERVIOUS TO BACTERIAL AND SOFT TISSUE PENETRATION (SMOOTH SIDE IS PLACED ON BONE)
- 4-YEAR SHELF LIFE

Multi-pack configuration
12 mm x 24 mm (10 pack)
25 mm x 30 mm (4 pack)

Features | Benefits
--- | ---
Primary closure is not required | By avoiding releasing incisions the membrane maintains soft tissue architecture and preserves keratinized muccosa Easily, non-surgical removal after 21-28 days
Medical grade PTFE | Biocompatible and non-reactive Can be trimmed with sharp sterile scissors for easier handling
Micro-machined surface texture | Facilitates cell adhesion Enhances membrane stability Reduces flap retraction Increases pull-out strength
WHEN TO USE WHAT???

- Powder is easier to condense than larger granules
- Smaller particle size integrates faster
- Cortical bone is more structurally stable than cancellous
- Cancellous grafts integrate faster
- Mineralized grafts are more stable, denser
- Demineralized grafts have more BMP
- Xenografts most dimensionally stable, are not completely replaced by bone

I use xenograft only for augmenting around the top of an implant

For ridge preservation, sinus lift, ridge augmentation, I use Symbios mineralized cortical powder

Symbios Osteoshield PTFE membrane most of the time

When I want primary closure - Symbios Osteoshield resorbable collagen membrane

I wait 4 months after ridge preservation
I wait 4-6 months after a sinus lift
I wait 6 months after a larger ridge augmentation

Thank You!