# Osteobiologics

LXWebbMD

## AUTOGRAFT

- Bone graft transferred from one body site to another in the same patient
- Indications
  - Gold standard
- Properties
  - Osteogenic, osteoinductive and osteoconductive
  - Least immunogenic
  - Cortical, cancellous or corticocancellous
  - Vascular or nonvascular

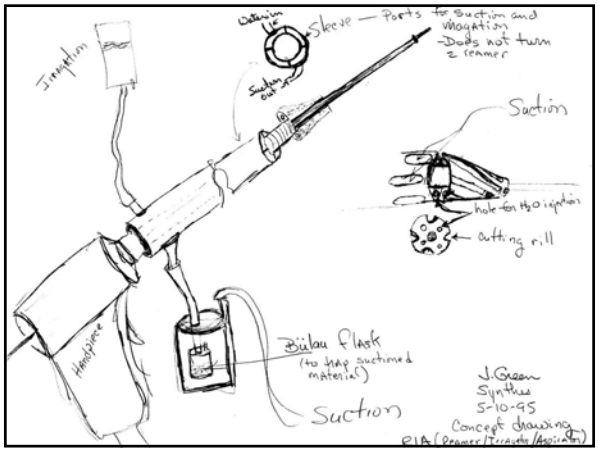
## AUTOGRAFT

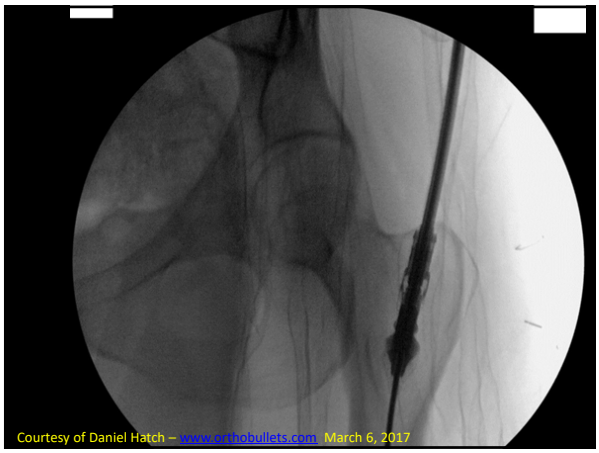
- Donor sites
  - Iliac crest is the most common site for autograft
    - Provides both cancellous and cortical graft
    - Higher complication rate with anterior versus posterior harvesting
    - 2-36% complication rate
      - Blood loss and hematoma
      - Injury to lateral femoral cutaneous nerve or cluneal nerves
      - Hernia formation
      - Infection
      - Fracture
      - Cosmetic defect
      - Chronic pain
    - Tibial metaphysis, Distal Radius, Calcaneus

Jim Green

## Reamer Irrigator Aspirator

- Provides large volume of bone graft from intramedullary source
- Femur (most common)
- Tibia





Courtesy of Daniel Hatch – www.orthobullets.com March 6, 2017

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## Video

Ben Taylor 2-28-2013

## Allograft

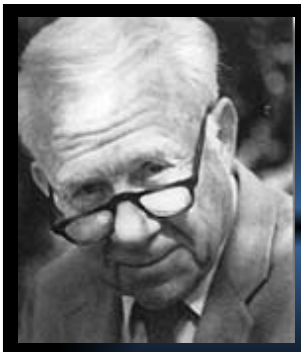
- Bone graft obtained from a cadaver and inserted after processing
- Processing methods
  - Debridement of soft tissue, wash with ethanol (remove live cells), gamma irradiation (sterilization)
    - Dose dependent higher doses of irradiation kills bacteria and viruses but may impair biomechanical properties
  - Fresh allograft
    - Cleansing and processing removes cells and decreases the immune response improving incorporation
    - Indications
      - Rarely used due to disease transmission and immune response of recipient
  - Frozen or freeze dried
    - Reduces immunogenicity while maintaining osteoconductive properties
    - Reduces osteoinductive properties
    - Shelf life
      - One year for fresh frozen stored at -20 degrees C
      - Five years for fresh frozen stored at -70 degrees C
      - Indefinite for freeze dried

## Risks and Complications

- Disease transmission
  - Risk of Hepatitis B disease transmission in musculoskeletal fresh frozen allograft transplantation is 1 in 63,000
  - Risk of Hepatitis C disease transmission in musculoskeletal fresh frozen allograft transplantation is 1 in 100,000
  - Risk of transmission of HIV in fresh frozen allograft bone is 1 in 1,000,000
  - Allografts are tested for HIV,HBV, HCV, HTLV and syphilis

## Demineralized Bone Matrix (DBM)

- Acidic extraction of bone matrix from allograft
  - Removes the minerals and leaves the collagenous and noncollagenous structure and proteins
- Properties
  - osteoconductive without structural support
  - minimally osteoinductive despite preservation of osteoinductive molecules
  - interproduct and interlot variability is common



The Bone Induction Principle

Large amounts of Bone

Recombinant gene techniques

TGF Beta superfamily

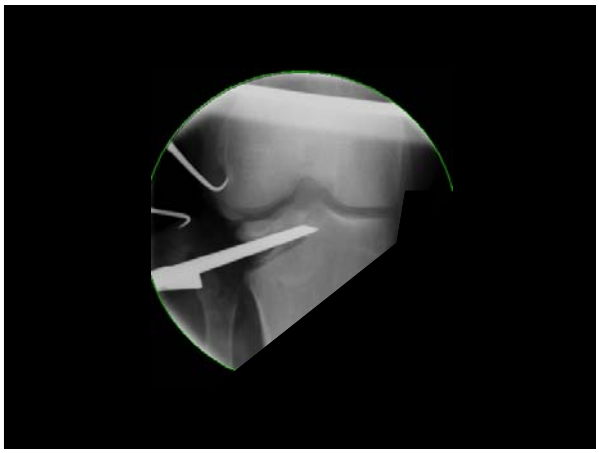
Marshall Urist
Bone: Formation by Autoinduction
*Science* 12 November 1965:
Vol. 150. no. 3698, pp. 893 - 899

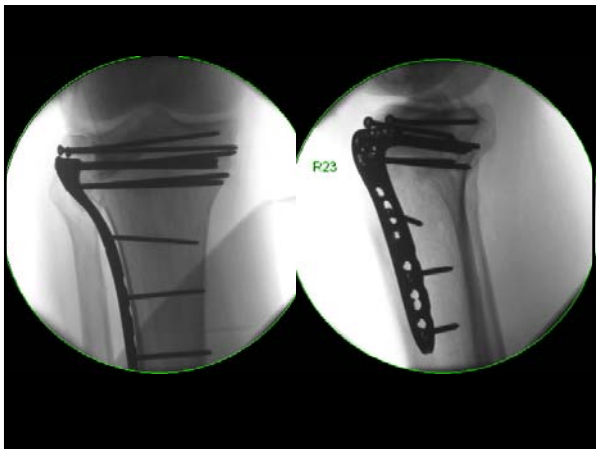
## BMP

- Osteoinductive properties
  - Stimulates undifferentiated perivascular mesenchymal cells to differentiate into osteoblasts through serine-threonine kinase receptors
  - rhBMP-2 and rh-BMP-7 are FDA approved for application in anterior lumbar fusion or tibial nonunion
- Complications
  - Under or overproduction of bone
  - Inflammatory responses (complications in spine)
  - Early bone resorption

## Synthetics

- Alternative to autografts and allografts
- Various compositions available
- Powder, pellet or putty form
- Properties
  - Osteoconductive only
- Compressive strength
  - Calcium phosphate > $CaSO_4$
  - Level I evidence shows that calcium phosphate bone substitutes allow for bone filling, early rehabilitation and prevention of articular subsidence in distal radius and tibial plateau fxs






## Relative Resorption Rates

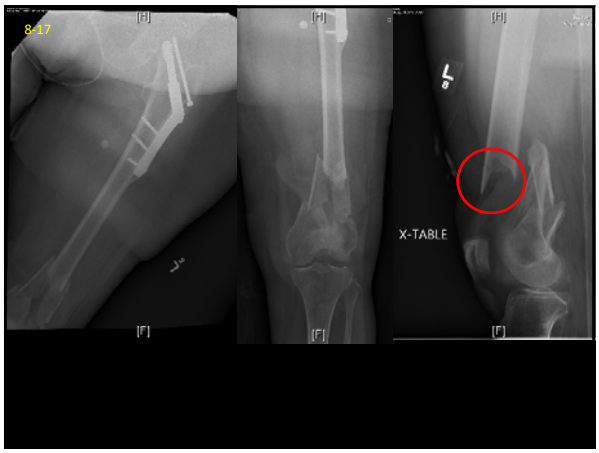
- $CaSO_4$ > Calcium phosphate > hydroxyapatite

**A prospective, randomized clinical trial comparing an antibiotic-impregnated bioabsorbable bone substitute with standard antibiotic-impregnated cement beads in the treatment of chronic osteomyelitis and infected nonunion**

- BBS vs PMMA for osteomyelitis and infected nonunion
- …in the treatment of chronic osteomyelitis and infected nonunion, the use of an antibiotic-impregnated Bioabsorbable Bonegraft Substitute (BBS) is equivalent to standard surgical therapy in eradicating infection and it may reduce the number of subsequent surgical procedures.

M McKee et al J Ortho Trauma 2010 Aug;24(8):483-90

8-17

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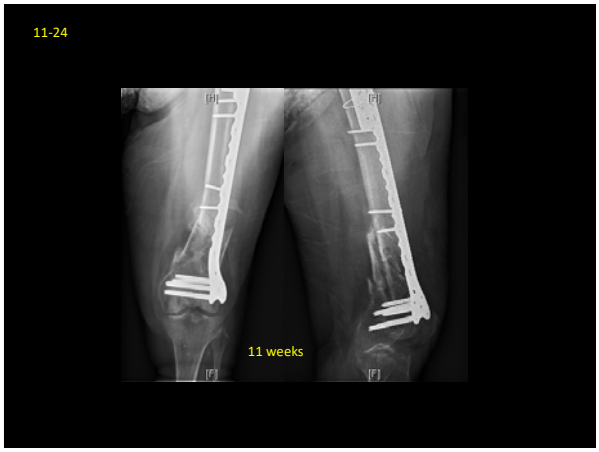
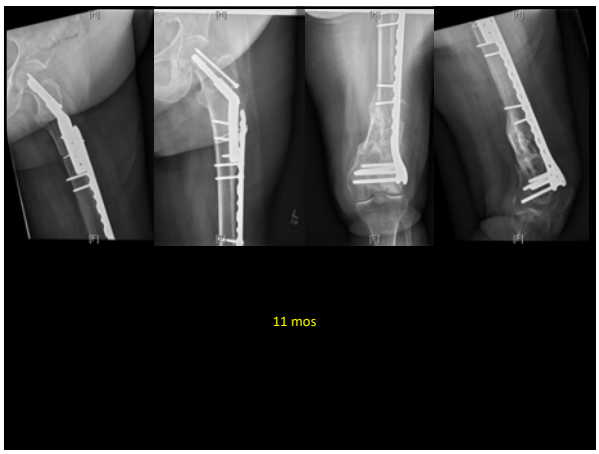
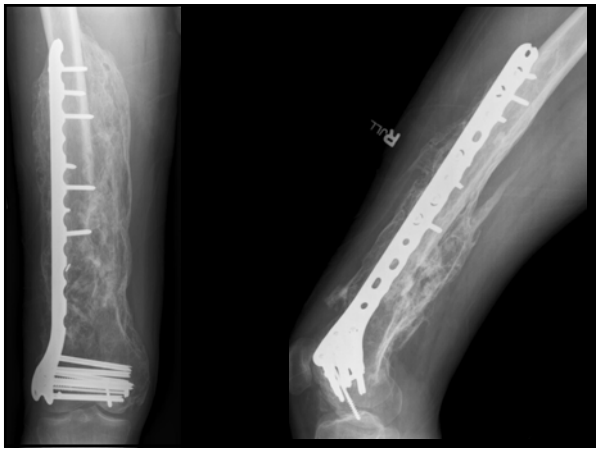
- Enterobacter cloacae complex 9-3
- Light growth clostridium histolyticum 9-6


9-3


11-24
11 weeks


11 mos

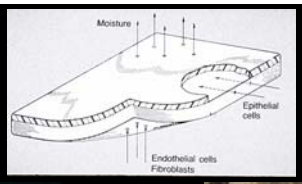



Alain Masquelet

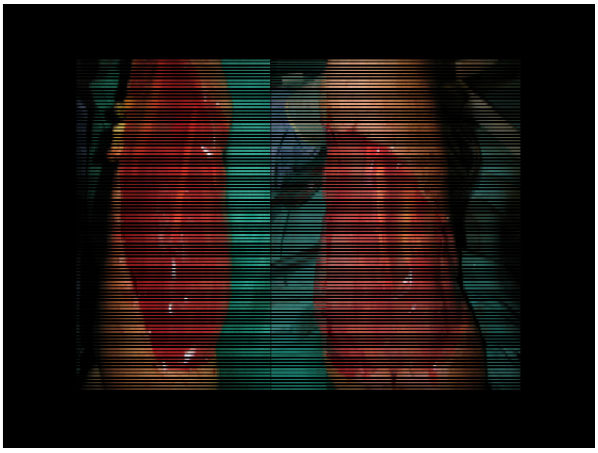
## PMMA Induced Membrane

- production of growth factors (VEGF, TGFbeta1) and osteoinductive factors (BMP-2) were maximum at 4 weeks  At this time, induced membranes favored human bone marrow stromal cell differentiation to the osteoblastic lineage.

J Orthop Res 2004 Jan;22(1):73-9.
**Induced membranes secrete growth factors including vascular and osteoinductive factors and could stimulate bone regeneration.**
**Pelissier,P, Mesquelet,AC, Bareille,R, Pelissier, SM and Amedee, J**




John F. Burke MD and Ioannas Yannas PhD



Thank you

For your attention