Augmentation materials

IMPLANTOLOGY YEAR COURSE
Module 3

STUART ELLIS BDS MFGDP(UK) DPDS MSc
Course Director
Cavendish House Implant Centre
Cambridge

Bone augmentation materials

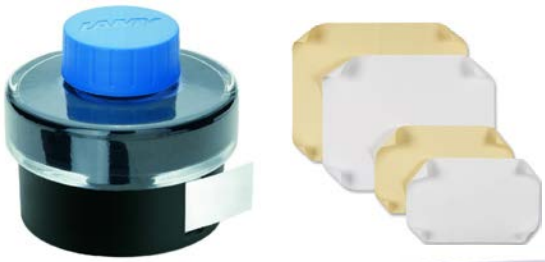
Essential function 1: support the membrane

Bone augmentation materials

Essential function 2: provide a scaffold for new bone

Bone augmentation materials

Essential function 2: provide a scaffold for new bone



Bone augmentation materials

Essential function 2: provide a scaffold for new bone

OsteoCONDUCTION

Bone augmentation materials

Desirable function 1: induce bone growth

Bone augmentation materials

Desirable function 1: induce bone growth

Bone augmentation materials

OsteoINDUCTION

Bone augmentation materials

Desirable function 1: induce bone growth

- Bone Morphological Proteins (BMPs)
- RANK, OPG etc
- Growth factors - TGF, IGFs, PDGF, FBGs etc
- Surface electrical charge

Bone augmentation materials

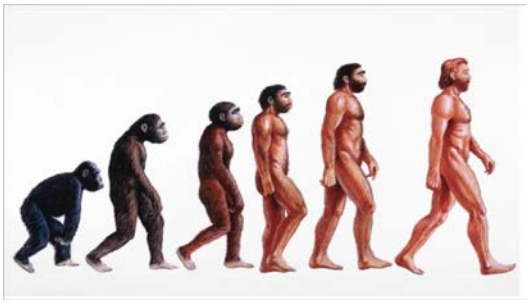
BMP containing graft materials…

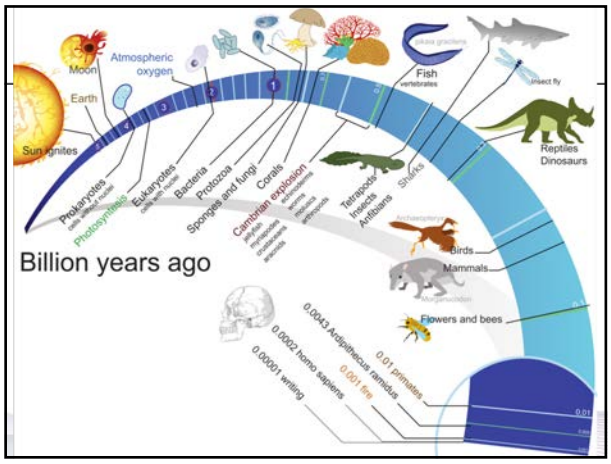
Bone augmentation materials

BMP containing graft materials…

Bone augmentation materials

Bone augmentation materials

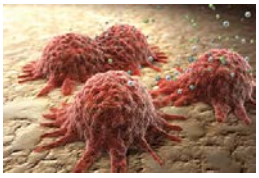




Bone augmentation materials

Desirable function 2: live cells

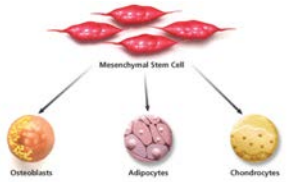
OsteoGENIC



Bone augmentation materials

Desirable function 2: live cells

OsteoGENIC



Bone augmentation materials

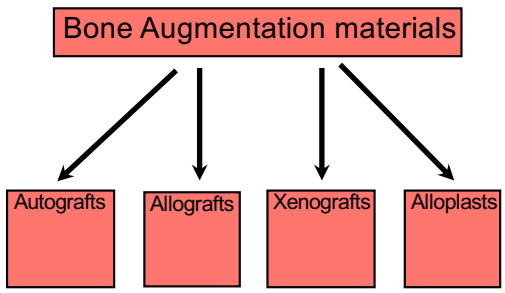
Essential functions :

- Osteoconductive
- Support GBR membrane
- Not resorb too fast

Desirable functions :

- Osteoinductive
- Osteogenic

Bone augmentation materials



Autografts

Bone Augmentation materials

Autografts | Allografts | Xenografts | Alloplasts

Autografts

Autogenous bone:

- Bone taken from the same individual
- Can be harvested intra or extra orally

Autografts

Advantages :

- Osteoconductive
- Osteoinductive
- Osteogenic
- No immune response
- No cross infection issues
- No material costs

Autografts

Autogenous bone:

Harvesting methods - block graft

Autografts

Issues:

- Donor site morbidity
- Highly invasive
- Highly skilled surgery
- Must be corticocancellous
- Can resorb 60% in 6 months
- Eventually replaced by *creeping substitution*

Autografts

Autogenous bone:

Harvesting methods - bone mill

Autografts

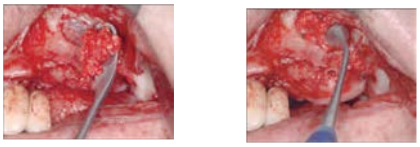
Autogenous bone:

Harvesting methods - bone mill

Autografts

Autogenous bone:

Harvesting methods - bone mill



Autografts - bone mill

Advantages :

- Large surface area
- Greater osteoinductivity and osteoconductivity than block grafts

Disadvantages :

- Mechanical manipulation can destroy cell viability

Autografts

Autogenous bone:

Harvesting methods - bone scraper

Autografts

Autogenous bone:

Harvesting methods - bone scraper

Autografts - bone scraper

Advantages :

- Easy and relatively non invasive
- Low morbidity of donor site

Disadvantages :

- Mainly cortical bone
- Few osteogenic cells present
- Few bone stimulating proteins
- Resorbs quickly

Autografts

Autogenous bone:

Harvesting methods - bone trap

Autografts - bone mill

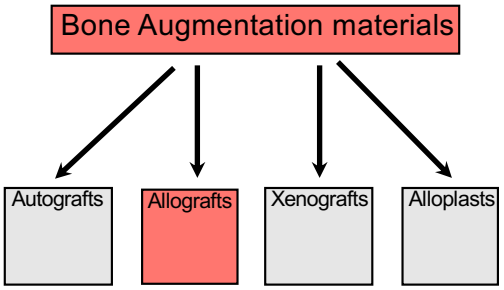
Advantages :

- No donor site

Disadvantages :

- Limited quantity
- Bacteria and saliva contamination
- 'Dust-like' particle size
- Resorbs fast

Allografts



Allografts

Allogenous bone:

Bone taken from different individual of same species

Allografts

Allogenous bone:

Bone stored in human tissue banks

Allografts

Allografts:

- Used in orthopedic surgery >120 years
- Fresh frozen bone (FFB)
- Freeze-dried bone (FDB)
- Demineralised freeze-dried bone (DFDB)

Allografts

Fresh frozen bone (FFB):

- High risk disease transmission
- High risk immunological reactions
- Rarely used

Allografts

Freeze dried bone (FDB)

- Freeze drying process reduces immunogenicity
- Good biocompatability
- Contains BMPs etc
- Wide variabilty between batches
- ? BMPs in active form
- ? concentration BMPs enough for osteoinduction

Allografts

Demineralised freeze dried bone (FDB)

- Process intended to expose BMPs
- Reduces mechanical stability
- Can resorb fast

Allografts

Allografts on the market:

- Rocky Mountain (USA)
- Allosource DFDB(USA)
- Pacific Coast (USA)
- Grafton (Biohorizons, USA)
- MinerOss (Biohorizons, USA)
- BioSet (RTI Biologics, USA)
- Dynagraft (Isotis, USA)

Allografts – Alastair Cooke KBE

Allografts – Biomedical Tissue Services


SHOCKING DETAILS AS PROBE INTO THEFT OF CORPSE PARTS EXPANDS

BODY COUNT NEAR 1,000

DAILY NEWS

BODY SNATCHERS!

Allografts – Biomedical Tissue Services

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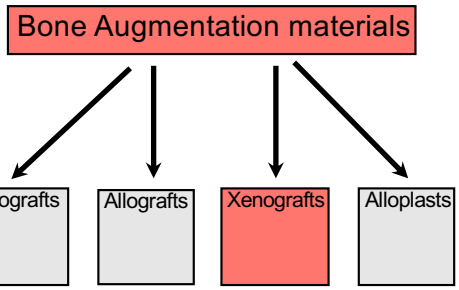
Xenografts



Xenografts

Xenografts:

Materials derived from other animals

Xenografts

Coralline HA & calcified algae exoskeletons:

- Poor osteoconductivity
- High rate complications
- Seldom used today

Xenografts

Animal derived bone:

- Mainly bovine cancellous bone
- Very similar architecture to human bone
- Organic component removed
- Reduces risk disease transmission
- Reduces risk of immunological reactions
- Termed 'Deproteinized Bovine Bone Materials' (DBBMs)

Xenografts

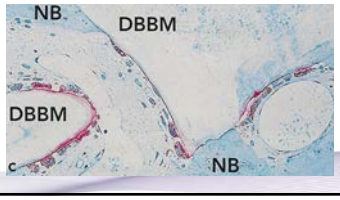
Deproteinized Bovine Bone Materials (DBBMs):

- Slow resorption rate
- ? never fully resorb
- Studies shown still present after 10 years
- Good osteoconduction
- 'Osteoclasts' colonise surfaces

Xenografts

Deproteinized Bovine Bone Materials (DBBMs):

- Osteoclast-like cells
- Stained for TRAP (indicates osteoclast-like activity)
- Shows fewer cells than normal bone
- Resorption lacunae smaller than normal bone



Xenografts

Deproteinized Bovine Bone Materials (DBBMs):

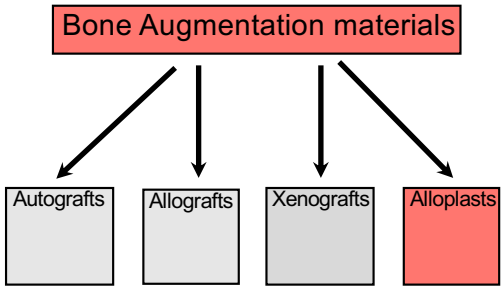
- Can be produced in cancellous block or particulate forms
- Massive supply
- Many on market
- Many long term studies with good results

Xenografts

Deproteinized Bovine Bone Materials (DBBMs):

- Bio-Oss (Geistlich)

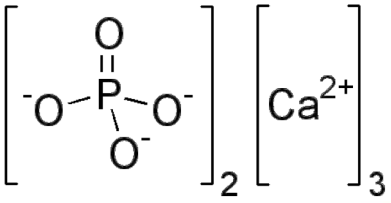
Xenografts



Alloplasts

Alloplastic bone:

Completely synthetic bone augmentation material



Alloplasts

Alloplastic bone:

Tricalcium phosphate - $Ca_3(PO_4)_2$

Alloplasts

Alloplastic bone:

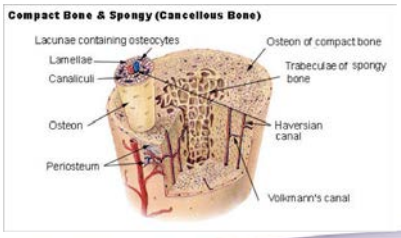
Tricalcium phosphate - $Ca_3(PO_4)_2$

- Closely resembles inorganic phase of bone
- Macropore size can be controlled and engineered
- Can vary phase distributions (amorphous and crystalline)

Alloplasts

Alloplastic bone:

Hydroxyapatite - $Ca_5(PO_4)_3OH$



Alloplasts

Alloplastic bone:

Hydroxyapatite - $Ca_5(PO_4)_3OH$

- Osteoconductive
- Non resorbable

Alloplasts

Alloplastic bone:

β–tricalcium phosphate

- Osteoconductive
- Resorbable
- Needs a membrane

Alloplasts

Alloplastic bone:

β–tricalcium phosphate

Alloplasts

Alloplastic bone:

β–tricalcium phosphate

Alloplasts

Alloplastic bone:

β–tricalcium phosphate

+

Alloplasts

Alloplastic bone:

β–tricalcium phosphate

- Negative charged surface
- Termed 'zeta potential'
- Proteins are charged colloidal particles
- Proteins attracted to –ve charged surfaces
- Enhances protein deposition
- Required before bone cell migration/adhesion

Alloplasts

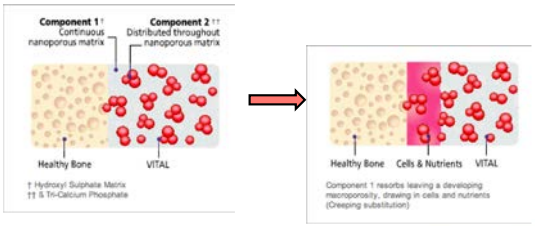
Alloplastic bone:

β–tricalcium phosphate in hydroxyl sulphate matrix

Alloplasts

Alloplastic bone:

β–tricalcium phosphate in hydroxyl sulphate matrix



Alloplasts

Alloplastic bone:

Other alloplasts:-

- Mixtures of TCP and HA
- Bioactive glasses (silica based ceramics)
- Composites of silica and HA

Alloplasts

Advantages of alloplasts:

- No animal products (religious and ethical issues)
- No issues of cross infection
- Can engineer to molecular level
- ? Osteoinductive (zeta potential)

Conclusion

Conclusion

- Autografts only material well documented to be osteo*inductive*
- Problems with resorption and donor site morbidity
- Most alternatives are effective
- No one product clinically better than another
- Not one size fits all!
- Test, try and see what suits you in your hands.

THE END