Allograft Skeletal Reconstruction: Applications and Challenges

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Disclosures

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Allografts

- Types
- Safety
- Utility
- Complications
- Solutions
- Future applications
- Case study
History of Bone/Tissue Transplantation

Osteoarticular elbow transplant
First successful bone allograft transplant

Glasgow, 1878. Dr Macewen, age 32, had a 3 yr old emaciated boy with osteomyelitis, necrosis, right humerus mid-shaft, chronic pus draining. Humerus shaft removed, healed. 15 mo later: no bone regrowth, limb useless and parents request amputation.

Sir William Macewen (1848 - 1924), Regius Professor of Surgery at the University of Glasgow. Macewen W. Observations concerning transplantation of bone, illustrated by a case of interhuman osseous transplantation, whereby two-thirds of the shaft of a humerus was restored. Proc Roy Soc Lond 1881; 32: 232-47
30 YR LATER
Limb functions,
Allografts

- Traditional
  - Cancellous
  - Cortical
- DBM

- Sports
  - Ligaments
  - Tendons
- Osteoarticular
  - Cryopreserved
  - Fresh
Allografts in the United States

- 2012 – 1 Million allografts
- Less than 50% use of autografts
  Morbidity..Cost
- **Why structural?**
  Strongest material for it’s size and weight
  Used to replace bone loss for trauma, tumor, infection and osteolysis where the only other alternative may be limb loss.
Case Presentations
7 yo female w/ sarcoma left femur
History

- 13 yo female w/ hx Juvenile OCD
- Cheerleader
- OCD lesion R knee ’07- improved w/ rest x 3 mos
- Developed L knee pain 10/08 and rested as she did w/ R knee
- Returned to cheerleading gradually and developed signif pain
- L knee scope at Children’s Hosp → large OCD lesion L MFC 8/24/09
- Did well w/ PT and resumed high level tumbling/cheerleading
MRI 9/2/09
18 yo OCD Femoral condyle 6mos PO
18 yo college tennis player
osteosarcoma tibia
Back playing competitive tennis
17 you female championship basketball player low grade OGS
Returned to competition
Clinical Cases

• 22 yo... 150,000 volt injury...bilateral UE and LE amputations. Right AE with only humeral head present....
18 yo male lacrosse player
ogs ulna
30 yo female small cell OGS femur
Post-op  6/17/09
Thank you

• Questions?

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So...that’s the good news..

Allograft Complications

- 1990
- Combined – MGH – 50% (80%)
- Infection – 4-30%
- Non-union – 8-14%
- Fracture – 5-18%

How do we justify doing an operation that has a 50%+ complication rate?

- Have we improved?
- New techniques   DETAILS, DETAILS DETAILS
Infection

• Why?
  Compromised local bed
  Compromised immune system

Poor soft tissue coverage
  Nutrition
  Multiple operations
  Hematoma
  Dead tissue
Clinical Infection Prevention

- Antibiotics
- Meticulous technique
- Avoid hematoma
- Use local/free flaps
- ANC (>500)
- Toe nail hygiene
Non-unions

• WHY?
  Nutrition
  Chemotherapy/radiation
  NSAIDS
  Smoking
  Lack of RIGID fixation
  Poor local blood supply
  Poor graft fit
  Infection
Non-union Prevention

• Nutrition
• Avoid NSAIDS/smoking
• Graft junction sites initially
• Graft delayed unions early
• RIGID fixation
• Perfect fit
• Ultrasonic stimulation (?)
Fracture

• WHY?
  Bone dissolution

• Lack of mechanical support along entire graft

• Granulation tissue/cortical perforations

• Non-unions/loss of fixation
Fracture Prevention

• Bridge entire graft with hardware
• Graft initially and early if delayed union
• Avoid cortical perforations (holes for sutures)
• Avoid excessive activities
Prevention of Allograft Complications

• **Antibiotic cement loaded allografts**
  - Removes marrow/blood elements
  - Serves as reservoir for antibiotic
  - Strengthens graft overall
  - Allows for more rigid fixation
Cemented Allografts

• Dog studies
  Did not interfere with healing/strength
  Reduces complications 50%

• Human studies (Toronto/Denver)
  Reduced complications 30% (Primarily infection and non-union)
10 yo male OGS proximal humerus
• Now a professional guitar player

15 years post op
History

• 50 yo male dx w/ osteosarcoma of L distal femur 1990
• Chemo-4 rounds of Adriamycin and cisplatin pre-op and 4 rounds post-op
• Resection w/fem allograft in Michigan 4/91
• L TKA 4/06
• Met lung CA w/ more chemo → renal insuff
• Mult thoracotomies ‘92-’97 – CTs neg now
• Developed hip and knee pain 11/09
History 20 year follow up

• 46 yo female s/p rad resect L tibia w/allograft recon w/intercalary allograft and gastroc flap for osteosarcoma – 1992
• Back to normal activities
• Now needs knee replacement on other knee
Post-op screw removal
20 years post op
Allografts for Skeletal Reconstruction: Summary

• Anatomically replaces resected tissue
• Best grafts are cortical/intercalary
• Allograft prosthetic composites for periarticular areas
• Safe in regards to disease transmission
• Complications can be avoided
• Successful grafts will last the lifetime of the patient
Allograft Safety: What about Infection: Viral and Bacterial

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Allografts: Safety

• AATB Inspected and accredited
• Serology Hepatitis/HIV (PCR)
• Medical Director Review
• Pre-processing cultures
• Post processing destructive cultures
• Extraction

When in doubt, throw it out!
Recent Publicity Re: Bacterial Infection

- Fresh graft
- No pre-processing cultures
- Put into cell culture media w/o culture
- Pt developed acute knee infection post op
  Clost. Sordelli
Magnitude of Problem?

- CDC – 41 cases of post op infection involving allograft cases
- 750,000 aliquots/pieces of allograft used 2001

Still not clear.....
Where do these bugs come from?

- Donor
  Time of death
  Post mortem bacterial growth
- Procurement
  Skin contamination
  Break in sterile technique
  Bowel contamination
- Processing
  Environmental
  Break in technique
  Cross contamination
- OR 1% of all procedures
Culturing…..

• Traditional swabbing
  Used for years – tissue banking and clinical medicine, ? False negatives?
  May not be sensitive enough!

• Extraction method – immersion/agitation
  May be more sensitive, less false negatives
Current Practice

• Highest risk graft – Fresh Procured, wrapped, iced, shipped. Upon arrival processing commences. Grafts cultured, companion tissue used for destruction/culture, grafts re-cultured just before insertion into cell culture media. Extraction

MINIMUM FIVE CULTURES PER GRAFT
Know where your grafts come from, what they are tested for, how they are treated and who screens the donor.
History

• 42 yo female diagnosed w/ osteosarcoma of L distal femur at age 19 in 1988
• Underwent resection, placement of allograft bone, and fusion w/ a rod 11/15/88 in Tampa, FL
• Doing well until Jan ’11 when she stopped abruptly to avoid running into someone
• Noted a loud pop followed by L distal femur pain
Procedure

- To OR 7/21/11 for bridging compression plate, a vascularized free fibular flap, and stem cell allograft
Special Case....
Special Person!!
17 yo female osteosarcoma proximal tibia
30 yo Traumatic loss distal tibia
Post-op 9/30/09
Osteochondral Allograft to MFC
Human Allograft Skin
Traditional Indications for Use

Excised burn wounds

- Excised burn wounds
- Coverage of widely expanded autograft
- Extensive skin disorders
- Testing the wound bed for autografting
- Dermal template for cultured skin
- Necrotizing wound infections, degloving injuries, and chronic wounds
24 yo osteonecrosis humeral head due to high dose steroids for a closed head injury
22 yo female, shot in leg while watching television

- Entrance medially
- Exit anteriorly
- No N/V damage!
- Initial I & D