A Multidisciplinary Approach to Limb Preservation

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Course Objectives
• Describe complex orthopedic injuries, infections and tumors with supporting case discussions as well as brief care of the multidisciplinary team setting.
• Discuss when to refer to an ILP specialist and methods in which primary care and other specialists can be a key member of the multi-disciplinary team to prevent limb loss.
• Describe new amputation surgical procedures, methods and therapies with supporting case discussions.

Mission Statement
To foster a patient-centered, team-based, innovative approach to the diagnosis and treatment of complex limb and life-threatening conditions.

Disclosures
Filet mignon at a Stryker dinner
Otherwise - nothing

ILP – Who Are We?
Institute for Limb Preservation (ILP) is a team of medical professionals specializing in management of complex extremity problems and treatment of conditions and diseases that place people at risk for losing an extremity and potentially their life.

Program Overview
• Founding principles of Drs. Ross Wilkins, Tom Arganese and Bill Brown since 1986:
  – Patient Centered Care
  – Seamless teamwork amongst specialists to improve patient outcomes
  – Clinic without walls
• Based at Presbyterian/St Luke’s Medical Center in Denver, Colorado
• Community based tertiary care program with both hospital employed and private practice physicians
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Multidisciplinary Approach

The Patient

- Ortho
- Plastic Surgery
- PM&R
- Pathology
- Oncology
- Rad Onc
- Vascular Surgery
- Neurosurgery
- Physical Therapy
- Radiology
- Infectious Disease

- Multidisciplinary Team

- Weekly interdisciplinary patient conference
- Sub-specialty expertise including oncology, adult and pediatric orthopedics, microvascular surgery, infectious disease, amputations and physical medicine and rehabilitation
- The latest treatments with proven success based on the on-going ILP clinical research
- Active involvement in outcome studies, publications, and presentations at world-wide medical conferences

What We Do - ILP Service Lines

- Tumors – Sarcoma, limb threatening carcinoma, benign aggressive bone and soft tissue tumors
- AVN/Osteonecrosis
- Non-Union/Bone Healing
- Amputations
- Replant (mangled extremities)
- Complex Joint Reconstruction
- Extremity and joint infections
- Research

What We Don’t Do

- Diabetic ulcers/ infections – some exceptions in young active patients
- Paraplegic/ quadriplegic pressure related ulcers
- Necrotizing fasciitis – some exceptions to this as well

Tumor Service Line

- Sarcoma makes up the bulk of limb threatening tumors
  - Bone origin (eg osteosarcoma and Ewing’s Sarcoma, chondrosarcoma, metastatic dx)
  - Soft tissue origin (eg liposarcoma, synovial sarcoma, myxofibrosarcoma, pleomorphic sarcoma)
- Limb threatening carcinoma less common

Tumor Service Line

- 2 orthopedic oncologists
- 3 plastic surgeons that do reconstruction as well as hand tumors
- 1 oncologist that specializes in sarcoma
- MSK radiologists and interventional radiologist
- 2 radiation oncologists
- Fellowship trained MSK/peds pathologist
HISTORY

- Thorough history is very important
- ROS, constitutional symptoms
- Incidental finding
- Night pain
- Activity related
- Cyclical pain
- Relieving measures

- 90% of patients with tumors relate the onset of symptoms to a traumatic event.

PHYSICAL EXAM

- Focused exam on affected extremity, including lymph nodes
- What’s the lesion doing to the limb
- Limb length discrepancy
- ROM
- Skin changes
- Increased tactile temperature
- Angular deformity
- Palpable masses

Tumor Service Line - Case

- 36 year-old male mass growing in his left thigh for about 6 months
- Thought it was a result of trauma
- Finally sought medical care and had it biopsied – in office biopsy with Tru-cut needle positive for sarcoma
- Staging studies scheduled and oncology consultation

Tumor Service Line - Case

- Had preop radiation
- Underwent resection with orthopedics
- Reconstruction with plastics utilizing an anteriolateral thigh flap
- Donor site skin grafted
37 yr old male presents with a two year history of an enlarging mass on his medial right ankle.
TREATMENT OPTIONS

- Amputation
- Resection of mass with free flap and skin graft

FREE MUSCLE FLAP

Specialties Involved

- Orthopedics
- Plastics
- Oncology
- Radiation oncology
- Radiology
- PT/OT
- Pathology

X-RAY - CODMAN'S TRIANGLE

X-RAY : SUNBURST PATTERN
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27 yo MALE OSTEOSARCOMA

DISTAL FEMORAL OSTEOSARCOMA

PROXIMAL TIBIAL OSTEOSARCOMA

IA CHEMO RESPONSE
EWING’S SARCOMA

- Third most common malignant tumor
- Flat bones and diaphysis of long bones
- Lytic, ‘onion-skinning’
- Soft tissue masses

INTERCALLARY ALLOGRAFT

33 y.o. male with 3 months of activity related thigh pain
INTERCALLARY RECONSTRUCTION

- ALLOGRAFT
- ENDOPROSTHESIS
- INTERCALLARY CUSTOM CAGE

4. Remove the ARM. Use an up to 1.8 mm saw blade to perform the resection. Once the resection is done, remove the cutting guides holding the k-wires in place. Use the same k-wires to land the proximal and distal drill guides through them. Use 1.6/1.9 drill bit to drill through the drill hole on the proximal and distal drill guides.

Osteonecrosis

- Interchangeable terms
  - Avascular necrosis
  - Aseptic necrosis
  - Ischemic necrosis
AVN/ Osteonecrosis

- A condition in which poor blood supply to an area of bone leads to bone death
- Multiple sites
  - Femur – proximal and distal
  - Humerus
  - Tibia – proximal and distal
  - Talus
  - Vertebrae

Osteonecrosis

- Treatment of ON continues to be one of the more frustrating and controversial issues in orthopaedic surgery.

Osteonecrosis

- Can be life altering for younger patients
- Goal to preserve joints and avoid an arthroplasty or delay ‘the inevitable’
- Co-morbidities

Osteonecrosis

- 25,000 – 30,000 new cases per year US
- True prevalence difficult to define
- Underlying diagnosis in 10% of the 500,000 THR in US & Western Europe

Osteonecrosis

- Early diagnosis is important for initiating early treatment, leading to a more favorable outcome.
- Prognosis & success of treatment are related to stage of disease
- High index of suspicion
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Osteonecrosis

CLASSIFICATION
- Ficat and Arlet
  - Stage 0 – no abnormalities
  - Stage I – +
  - x-ray changes lucent and sclerotic
    - Il B – crescent sign
  - Stage II A – plain
  - Stage III – femoral head flattening
  - Stage IV - OA, joint space narrowing

DIAGNOSTIC IMAGING
- MRI – the most accurate imaging modality for ON diagnosis
  - Signal alterations in the anterosuperior femoral head surrounded by a band of low signal intensity on T-1 sequences
  - Extent and location femoral head involvement
  - X-ray – may be normal in early stages
  - Transient osteoporosis

TREATMENT GOALS
- Maintain patient function
- Prevent joint destruction

TREATMENT
- Several surgical and non-surgical approaches have been proposed to manage ON.
- All biologic techniques have been intended to delay or avoid joint arthroplasty in young adult patients.
  - Non-operative treatment leads to uniformly poor results
  - 80% rate of progression
  - Pain consistently precedes collapse

SURGICAL OPTIONS
- Femoral head preserving – pre-collapse
- Core decompression+stem cell injection, vascularized free fibula, osteochondral allografts
- Rotational osteotomies
- Arthroplasty
Core Decompression

STEM CELLS
- Bone marrow aspiration
- Consolidation
- Injection into necrotic segment
- May supplement with BMP product

STEM CELLS
- Sources
  - Bone marrow
  - Adipose tissue
  - Peripheral blood - pheresis
- Bone marrow aspiration
- Consolidation
- Injection into necrotic segment
- May supplement with BMP product

Free Vascularized Fibula Graft
Results

39.Y.O. FEMORAL NECK FRACTURE NONUNION AND AVN
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DISTAL FEMORAL OSTEONECROSIS

AVN Case

- 25 year-old male
- Presented with right scaphoid non-union
- CT scan showed signs of AVN of the proximal pole

AVN Case

- Taken to OR
- Vascularized bone flap taken from volar distal radius
- Humpback deformity corrected
- Screw placed
- Healed and entire bone looks vascular

Nonunion/ Bone Healing

- Commonly seen in tibia
- Less common in femur and upper extremity
- Often after open fractures
- Commonly associated with infection but can be associated with many conditions
- Bone loss after trauma
Nonunion/ Bone Healing - Case

- 65 year-old female
- Suffered femur fracture in car accident 2 years earlier
- Femur was rodded
- Went on to nonunion

Nonunion/ Bone Healing - Case

- Rod removed and bone resected back to good bleeding bone
- 2 plates placed at 90 degrees to each other
- Vascularized fibula bone transferred from ipsilateral leg with peroneal vessels anastomosed to the femoral vessels

Amputation Service Line

- Amputations are a very important part of limb preservation
- We do not consider it a “failure” of limb preservation
- Consider if a well done amputation and well fitted prosthesis will function better than a limb salvage surgery
- We use many techniques to preserve both length and function
Amputation - Case

- 32 year-old male lost both legs in MVA
- Right side above knee and left side through the knee
- Transferred to ILP in the subacute period
- Underwent transfer of rectus abdominus muscle to left leg to preserve length

MANGLED EXTREMITY WITH SKIN LOSS AND AKA

RECTUS ABDOMINIS FLAP

BILATERAL LOWER EXTREMITY AMPUTEE

- Had significant problems with the right above knee amputation
- Multiple revisions without success
- Underwent osseous integration
- Significantly improved prosthetic wear

OSSEOUS INTEGRATION
Replant/ Mangled Extremity

• 24/7 call
• Treat both upper extremity amputations and upper extremity mangled injuries
• Hand/plastic/microvascular surgeons
• Orthopedic surgeons
• Adult and pediatric

Replant/ Mangled Extremity

• 35 year-old cowboy/ rancher
• Team roping competition
• Roped his thumb off
• Transferred from Nebraska to the Institute for Limb Preservation

Replant/ Mangled Extremity

• Taken to the OR emergently
• Thumb replanted
• Doing very well and returned to team roping
Complex Joint Reconstruction

- 1 million total joints performed in the US each year (4 million in 10 years)
- Can have any number of issues or complications
  - Infection, aseptic loosening, pain, metal allergy, periprosthetic fracture
  - Specialize in treating these difficult to treat problems

Complex Joint Reconstruction

- 79 year-old female
- Total knee arthroplasty in Florida
- Fell in the post operative period and had drainage
- Unable to straighten knee
- Moved to Colorado
- Knee infected and extensor mechanism disrupted

Complex Joint Reconstruction

- Taken to the operating room for explant of joint and gastrocnemius flap
- Allowed to heal and 6 weeks of antibiotics
- At 3 months return to OR for replant of knee with hinged prosthesis and repair of extensor mechanism
Extremity/ Joint Infection

- Infection is a major problem that can threaten an extremity
- Native tissue (soft tissue or osteomyelitis)
- Associated with hardware (fracture treatment or total joint replacement)
- “Cancer like” approach to infection
  - Ability to reconstruct allows this

Extremity/ Joint Infection

- 34 year-old male
- Tibia fracture
- Underwent ORIF with subsequent infection
- Presented to ILP
- Hardware removed and bone debrided
- Had rectus free flap, skin graft
- Bone transport done – eventually healed
**Research**

- Research is an essential part of our program
- Full time research assistant
- Forefront of evidence based medicine

**ILP Success**

- Developing a world-class sarcoma and extremity salvage program in a community-based location with "academic" values
- Advantages
  - Excellent collaboration between physicians
  - Ease of access for patients
  - Able to work with physicians closer to patient's home
  - More "nimble" than an academic program
  - Limb Preservation Foundation

**Limb Preservation Foundation**

- The foundation was started by Dr Ross Wilkins in 1986 to support:
  - Research to advance the science of limb preservation
  - Help our patients through the economic stress of living through a limb threatening illness
- Strong relationship between ILP and the foundation.

**THANK YOU**

"Not all of us can do great things. But we can do small things with great love."