Objectives

- Describe the epidemiology, incidence, the staging and grading of tumors and types of common bone tumors in children, adolescents, and young adults.
- Identify the medical, surgical, and physical therapy diagnostic and age-appropriate interventions used to treat patients diagnosed with bone tumors.
- Recognize common integumentary, musculoskeletal, neurovascular, and cardiopulmonary impairments seen in these patients due to the complex medical, surgical, and therapeutic management.
- Discuss tools to measure functional outcomes and quality of life appropriate for patient's age and surgical intervention.

Pediatric Oncology

- 10,000 children diagnosed with cancer each year
- 2% of all cancer cases in the United States
- Leading cause of death from disease in children
- 80% survival rate
- Rate of cancer in age 15-29 3x higher than below 15

Why should physical therapists be involved?

Health status of adult survivors compared to siblings

- General Health: OR 2.5
- Mental Health: OR 1.6
- Activity Limitations: OR 0.7

Hudson et al. 2003
Role of PT in Pediatric Oncology

- Disease and treatment occur during a critical point of development in pediatric cancer
  - Have not yet acquired mature posture, gait, motor skills, cognitive skills, social skills, etc
  - The process can alter the course of development
- Cancer and the treatment can have an affect on an immature musculoskeletal system causing impairments and activity limitations into adulthood

Common Orthopedic Impairments

- Osteosarcoma complications
- Osteonecrosis
- Scoliosis
- Osteopenia/Osteoporosis
- Fracture risk

<table>
<thead>
<tr>
<th>Types</th>
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<tbody>
<tr>
<td>Pediatric/Adolescent</td>
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<tr>
<td>• Ewing’s Sarcoma</td>
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<tr>
<td>• Osteosarcoma</td>
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<tr>
<td>Adult</td>
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<tr>
<td>• Multiple myeloma</td>
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<td>• Chondrosarcoma</td>
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Epidemiology

- 900 total cases per year
- 400 new cases a year under the age of 20 years old in the US
- 3.4% all childhood cancers
- 56% of malignant bone tumors in children
- 5-year overall survival about 70%
- Decreased prognosis with involvement of pelvis

Pathogenesis

- Radiation
  - Ionizing radiation → secondary malignancy
    - Within 2 decades of treatment
  - External beam radiation (latency)

Second most common secondary malignancy

- Paget’s disease (osteitis deformans)
  - Malignancy 1%, poor outcome
- Familiar retinoblastoma

---


Pathogenesis - Osteosarcoma

Genetic
• p53 mutation
  – Tumor suppressor gene on chromosome 17p

Location
Osteosarcoma
• Distal femur
• Proximal tibia
• Proximal humerus

Ewing’s Sarcoma
• Long bones of arms and legs
• Pelvis, chest
• Flat bones: skull and trunk

Pathogenesis – Ewing’s Sarcoma

Genetic
• Translocation between chromosomes 11 and 22
  – 85%
  – EWS-FLI1

Long-term Outcomes
• 733 osteosarcoma survivors (1970-1986)
  – 1,077 eligible
• Age of diagnosis: 13.7 years (2 to 20 years)
• Age of last contact: 35.3 years (13 to 51 years)
• Length of follow-up: 21.6 years (5.1 to 33.8 years)
• Sibling cohort average age 31.3 at last contact
  (3 to 58 years)

Limitations
• Self-report
• 72% amputation

After 5+ year Survivorship

Subsequent survival
• 10 years: 93.5% (95% CI: 92.1-95.0%)
• 15 years: 90.4% (95% CI: 88.7-92.2%)
• 20 years: 88.6% (95% CI: 86.6-90.5%)

• Females favorable survival (p=0.04)
Health Conditions

• Coronary Heart Disease
  – 11 of 733 (1.5%) baseline (5 years from diagnosis)
  – 19 congestive heart failure more than 5 years
    • No statistical significance to anthracycline
    • Although more events occurred in patients who were exposed to higher doses of anthracycline

Chronic Medical Conditions

Osteosarcoma survivors
• 87% at least one medical condition
• 50% two or more medical conditions
• 76.1% grade-3 or grade-4 conditions
• Similar prevalence compared to other childhood cancer but
• Higher grade conditions more likely
  – Compared to other childhood cancer survivors
  – RR=1.4, 95% CI 1.2-1.6, p<0.001
  – Even adjusting for amputation status, gender, age

Health Status

• 50% osteosarcoma survivors 18 years and older
  – 33% in other cancer other cancer survivors
  – 17.7% sibling
  • Physical limitation 29.1%
  • Pain from osteosarcoma or treatment 22.1%
  • Adverse mental health 15.8%
  • Impaired functional status 15.6%
  • Anxiety/fear 12.2%
  • Adverse general health 10.3%
  • Greater than peers across the board
  • Functional limitation, activity limitations and pain > all cancers

Rehabilitation Considerations

Surgical procedure
Health/wellness/fitness
Motivation
Age & growth
Education
Knowledge
Surgeon bias
Skill of prosthetist
Lack of evidence based practice
Patient and family expectations
Location and size of the tumor
Technology-past present future
Funding/resources
Distance from center
Patient and family bias
Psychosocial issues of the patient and family

Points of Entry for Physical Therapy

• Pre-diagnosis
  • Outpatient evaluation and/or treatment
  • Inpatient general medical or orthopedic floors
  • Rheumatology, orthopedic, and/or chronic pain clinics
• Diagnosis
  • Inpatient admission
  • Outpatient solid tumor clinic
• Pre-operative
  • Chemotherapy admissions
• Post-operative
  • Post-surgical acute stay
  • Acute rehabilitation stay
  • Chemotherapy admissions
  • Outpatient evaluation and/or treatment
  • Post-lengthening
• Bone marrow transplantation admission (Ewing's Sarcoma)
• Long-term follow-up
**My Experience**

- Multidisciplinary Sarcoma Clinic
  - Physical Therapist
  - Orthopedic Oncologists
  - Pediatric Oncologists
  - Cell Biologists
  - Radiologists
  - NPs, PAs, Residents, Fellows, Medical Students, Nurses
- Social Workers
- Psychologists
- Child Life Specialists
- Consult: General Surgeons, Wound care, Nutritionists
- External Consult: Radiation Oncologists, Prosthetics and Orthotics
- Acute inpatient
- Outpatient

**Diagnosis**

- Pain (sharp or dull) at the site of the tumor
- Reproducible with palpation
- Pain: activity related → rest → night pain
- “Growing pains” weeks to months
- Mild trauma (?)
- Swelling (mass) and/or redness at the site of the tumor
- Increased pain with activity or lifting
- Limping
- Decreased movement of the affected limb

**X-ray**

- Poorly defined, irregular region of metaphyseal demineralization

**MRI**

- Contrast
- T1-weighted

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**References**


CT Scan

- Chest CT

PET-CT

- Shows metabolic activity
- Standard uptake values (SUV)

Bone Scan

- Metabolic activity

Biopsy

- Needle, core
- CT guided
- Open biopsy

Performed by:
- Orthopedic Oncologist
- Interventional Radiologist

Grading

- Grading:
  - Low-grade:
    - looks like normal cells
    - usually slow-growing and are less likely to spread
  - High-grade:
    - look very abnormal
    - likely to grow quickly and spread.
  - Most osteosarcomas are high-grade

Biopsy

- Ewing's Sarcoma
  - Small, round, blue cell
- Osteosarcoma
  - Atypical cells
  - Immature osteoid
Staging

Stage 1A
• The cancer is low-grade and is contained within the hard coating of the bone.

Stage 1B
• The cancer is low-grade and extends outside the bone into the soft tissue spaces, which contain nerves and blood vessels.

Stage 2A
• The cancer is high-grade and is completely contained within the hard coating of the bone.

Stage 2B
• The cancer is high-grade and extends outside the bone into the soft tissue spaces, which contain nerves and blood vessels. Most osteosarcomas are stage 2B.

Stage 3
• The cancer can be low-grade or high-grade and it’s found either within the bone or extending outside the bone and has spread to other parts of the body or to other bones not directly connected to the bone where the tumor started. Often to the lungs.

Chemotherapy

• Methotrexate
• Cyclophosphamide
• Doxorubicin (anthracycline)
• Ifosfamide

Neuropathy

• Vincristine
• Cisplatin (plantinum)
• Etoposide

***Wound Healing***

Peripheral Neuropathy

Cramping
• Pain
Weakness
Numbness
Paralysis

Radiation

• Local
• Chest
  – Therapeutic
  – Preventative

Complications:
• Fibrosis
  – Musculoskeletal asymmetry
• Coronary artery disease
• Decreased wound healing
• Osteonecrosis

Wound Healing
**Surgical Intervention**

- Limb sparing
  - Wedge resection
  - Endoprosthesis
- Amputation
- Rotationplasty
- Resection of lung metastasis

**Surgical Goals**

- Negative margins
- Assessment of chemotherapy effectiveness
  - Biopsy
  - Percent necrosis (%)
- Optimize function of limb/body part
  - Avoiding compromise of neurovascular bundles
- No risk at increased mortality

**Surgical Complications**

- Disruption of neurovascular bundle
  - Decreased sensation
  - Decreased motor
  - Decreased vascularity
- Infection
- Joint instability
- Delayed wound healing
- Delayed bone healing
- Fracture
  - Bone
  - Hardware
  - Endoprosthesis

**PT/OT Clinical Points Specific to Management of Patients with Bone Tumors:**

- Wound Healing: Delayed wound healing with chemotherapy. Care must be taken with progressive range of motion opposing incisions.
- Muscles/structures spared, resected, or re-routed: Know what you are and are not strengthening or ranging.
- Secondary effects of chemotherapy on overall cardiopulmonary function: Incorporate cardiopulmonary training as appropriate.
- Secondary effects of chemotherapy/surgery on neurological system: Screen for neuropathies. Educate on proper supportive shoes or devices.
- Secondary effects of chemotherapy/surgery on bone health: Care must be taken with progressive range of motion, weight bearing, and shearing/contact activities.
- Patient/family goals and expectations need to be addressed and re-addressed frequently throughout management.
- Communication is essential for success: Open communication between oncologists, orthopaedic oncologists, social workers, other physical and occupational therapists.
- Be realistic with goal setting.
- When in doubt, do no harm. Then seek guidance/knowledge.

**Limb Sparing**

- Surgical procedure of choice for local control in 90% of patients
- 67-90% endoprosthesis survival in the lower extremity at 5-years post-op
  - Patient survival 60-70% overall

Limb Sparing

- Pelvic resection
- Wedge resection
- Endoprosthesis
  - Proximal and total femur replacement
  - Distal femur replacement
  - Proximal tibia replacement
  - Proximal humerus replacement
- Allograft
- Autograft

Pelvic Resection

- Post-op goals:
  - Healing of abdominopelvic muscles repair under minimal tension.
  - Normal knee and ankle function, and minimal decrease hip function
- Types:
  - Type I Pelvic resection (of the iliac bone)
  - Type II Pelvic resection (resection of the acetabulum with endoprosthetic reconstruction) (and type II/III resections)
  - Type III Pelvic resection (resection of the pubic bone)

Type I Pelvic Resection

- Partial
- Complete

Type II

Type I and Type II (with abductor muscle reconstruction)

Post-op management:
- Immediately post-op:
  - Balanced traction/suspension in 30 degrees hip flexion and abduction
  - Custom abduction brace with pelvic band
  - 30 degrees hip flexion and abduction
  - WBAT (Type I), TTWB (Type II abductor mm. reconstruction)
  - First 6 weeks: Knee and ankle exercises and functional mobility
  - After 6 weeks and discontinuation of brace: Start active hip abdution strengthening
  - Use assistive device until hip abduction muscle strength is regained.

Type II (with acetabular reconstruction prosthesis and abductors are intact)

Post-op management:
- Immediately post-op:
  - Balanced traction/suspension in 30 degrees hip flexion and abduction
  - PWB
  - 6 weeks
  - First 6 weeks: Knee, ankle, and hip active ROM (without external resistance) and progressive mobility
  - After 6 weeks: Start active hip abductor and flexor strengthening
  - Use assistive device until hip abduction muscle strength is regained.

[Image of pelvic resection types]

Complete Internal Hemipelvectomy

Type I/II/III (complete internal hemipelvectomy)

Post-op management:
- Immediately post-op:
  - Balanced traction/suspension in 30 hip degrees flexion and abduction
  - TTWB with assistive device
  - Progress gait to WBAT
  - Fit for custom shoe lift for leg length discrepancy

Wedge Resection

- Remaining bone filled with graft

Pros
- Bone intact
- Full function depending upon amount of bone resected, soft tissue involvement, and bone healing

Cons
- Non-weight bearing until full bone healing
- Activity limitations
- Weakness

Therapeutic Intervention

- Trunk/core strengthening
- Gait training
  - Assistive device
  - Weightbearing
  - Symmetry
  - Efficiency
  - Shoe lift for LLD
- Myofascial/Postural intervention
- Scar mobilization
- Kinesiotaping
- Isolated strengthening
- Functional Strengthening
  - Prevention of compensation and disuse atrophy

Type III

Post-op management:
- Immediately post-op:
  - Ankle and knee exercises
  - WBAT with assistive device
  - First 6 weeks: Knee, ankle, and hip active ROM
  - After 6 weeks: Start active hip abductor and flexor strengthening
  - Use assistive device until hip abduction muscle strength is regained.
Limb Sparing

• Pros
  – Readily available tissue
  – Intact limb with full sensation and motor function
  – Joint proprioception
  – End bearing sensation
  – Cosmetic function
  – Expandable option

• Cons
  – Length-length discrepancies, instability of joints, joint/bone degeneration
  – Risk of infection/fracture
  – Scarring/scar mobility
  – Loosening of prosthesis with activity/growth, infection
  – Post-operative weight bearing limitations
  – Limited physical activity – no contact sports
  – Prolonged use of assistive devices
  – Surgical neurovascular compromise
  – May require bracing

Proximal and Total Femur Replacement

• Bipolar
  • Goal: regaining of abductor strength, and prevention of hip dislocation

• Reconstruction of the abductor mechanism
  • Dacron tape sutures and a cable grip system to attach the remaining abductor mechanism directly to the prosthesis.

Post-op management:

• Immediately post-op:
  • Balanced traction/suspension in 30 degrees flexion and abduction
  • Knee and ankle exercises
  • For total femur: knee is immobilized x 2 weeks
  • Custom abduction brace with pelvic band
    • 30 degrees abduction and 0-60 degrees flexion
    • TTWB
    • Hip abduction strengthening

• After 6-8 weeks:
  • Remove brace after active hip abduction achieved
  • FWB

• Proximal Femur Replacement with acetabular replacement (THR): Total hip precautions x 3 months
  • No flexion > 90 degrees, no crossing legs, no hip adduction past midline

Distal Femur Replacement

Goal: Knee 0-90 degrees flexion and FWB

An anteromedial trans-adductor approach: preserve the quadriceps muscles (and especially rectus femoris).

Modular endoprosthetic system
- rotating hinge knee mechanism
- limb length and quadriceps tension
- anatomic joint line

Post-op management:
- Immediately post-op:
  - Rigid knee immobilizer
  - NO knee flexion
  - Start isometric knee exercise
  - Hip and ankle exercises
- First 2 weeks:
  - Cemented prosthesis (always with knee immobilizer): WBAT with assistive device
  - Cementless prosthesis (always with knee immobilizer): PWB
- 2 to 6 weeks (after surgical wound clearance):
  - Begin AAROM
  - Discontinue knee immobilizer with independent SLR without extension lag
  - Focused strengthening on knee extensors and begin hamstring strengthening
- After 6 weeks:
  - Start aggressive knee flexion strengthening
  - Increase knee extensor strength
  - Consider CPM or Low-load prolonged-duration stretch brace
- Manipulation under anesthesia is contraindicated
- Surgical release indicated if knee flexion < 60 degrees at six months post-op

Low-load prolonged-duration stretch brace

- Dynasplint ©, Ultraflex ©
- Wear >8 hours/day

Endoprosthesis

Expandable
- Surgical lengthening
- Heat-modulated lengthening
- Magnetic lengthening

"Adult", non-expandable

Outcomes – Knee ROM

- 20 patients
- Wide resection and endoprosthesis placement
- Age: 21.7 +/- 7.3 years
- Post surgery: 3.0 +/- 1.6 years
- Knee ROM
  - Surgical: 106.6 degrees +/- 13.0 degrees
  - Non-surgical: 134.1 degrees +/- 7.5 degrees
  - Matched: 137.7 degrees +/- 7.0 degrees
  - p<0.05

Proximal Tibia Replacement

Goal: Full knee extension without extension lag

Proximal Tibia Replacement

- Reconstruction of the extensor mechanism:
  - bone graft
  - woven Dacron tape
  - rotational medial gastrocnemius muscle flap coverage
  - preservation of the tibialis anterior and peroneal function (as able)


Proximal Tibia Replacement

Post-op management:
- Immediately post-op:
  - Rigid knee immobilizer
  - No knee flexion
  - Hip and ankle exercises
- First 6 weeks:
  - WBAT (always with knee immobilizer)
  - No active or passive knee flexion
  - Use knee immobilizer to allow healing of patellar tendon
  - Start isometric quad exercises

After 6 weeks (and after surgical wound clearance):
- Begin gentle AAROM of knee (target knee flexion 0-90 degrees)
- Discontinue knee immobilizer with independent SLR without extension lag
- Increase knee extensor strength
- Manipulation under anesthesia is contraindicated
- Do not aim for a full range of knee flexion at the expense of extension lag


Proximal Humerus Replacement and Shoulder Girdle Resection

• After:
  - Proximal humerus (for both intra and extra articular resection)
  - Tikhoff-Linberg procedure
  - Scapular prosthesis replacement
• Goal: Normal hand, wrist and elbow function. Shoulder joint stability.
• Limitations: usually above shoulder hand exercises are lost


Therapeutic Intervention

• Core strengthening
• Gait training
  - Assistive device
  - Weightbearing
  - Symmetry
  - Efficiency
  - Hinged knee brace
  - Shoe lift – contralateral limb LLD
• Myofascial/flexibility
• Isolated strengthening
  - Especially of quads, hip extensors, functional hip abduction
• Functional Strengthening
  - Prevention of compensation and disuse atrophy
• GENTLE, progressive knee flexion

Outcomes

• 25 patients
• Age: 25 years
• 4 years post limb sparing surgery with medial gastrocnemius flap
• Knee flexion: 60 degrees mean (30-100 degrees)

Suspensions

Proximal Humerus Replacement and Shoulder Girdle Resections

Post-op management:
• Immediately post-op:
  • Arm sling or immobilizer
  • Hand exercises
  • AAROM elbow
  • Avoid full elbow extension: protect flexor muscles (coracobrachialis, short head biceps)
  • Initiate adaptive techniques

After post-op follow-up with surgeon:
• Start Codman II shoulder exercises
• Active hand/elbow strengthening
• After 4 weeks: start full elbow extension exercises
• Scapular replacement: start scapulothoracic movement after 4 weeks.
• After 6 weeks:
  • Discontinue sling
  • AAROM shoulder exercises
  • Goal: Full elbow and hand function (feeding, and hygiene preserved)

Allograft and Autografts

• Allograft:
  – Cadaver replacement, intercalary or osteoarticular

• Autograft:
  – Replacement of a bone from another part of the patient’s body
180 Degree Twist and Turn to Function

Surgical, Physical Therapy and Prosthetic Interventions

Colleen P. Coulter PT, DPT, PhD, PCS
Children’s Healthcare of Atlanta
Orthotics and Prosthetics

Objectives

• Describe the amputation levels and surgical procedures for rotationplasty
• Discuss the advantages and disadvantages of amputations and rotationplasty
• Define the physical therapy treatments
• Discuss prosthetic management
• Overview of current research

Considerations for Surgery

Limb sparing including rotationplasty should provide function equal to amputation

Surgical procedures of amputation and rotationplasty

Determine

• Physical therapy prescription
• Weight bearing status
• Range of motion indications
• Type of post-op exercises
• Return to activity
• Outcome

Amputations

• Definitive procedure, “loss”
• Less complicated surgical procedure
• Fewer complications
• Phantom sensations
• Return to function faster
• Possibly better function than limb sparing
  – Failed limb sparing
  – Patients electing amputation
  – Only option
• Advances in prosthetic technology
• Greater societal awareness and acceptance

Rotationplasty, the “Combo”

• Amputation
  • Definitive procedure, “loss”
  • Trans tibia amputation level function
  • Weight-bearing through foot
  • Propriception of “knee”
  • Full function- high impact
  • Prosthetic accommodates length
• Limb Sparing
  • Complicated surgical procedure
  • Common vascular, neurological and skin complications
  • Foot and ankle are intact
  • Restricted activities- low impact

“Whopper” incisions
Delayed healing
Weight bearing precautions

DiCaprio M. J.BJS 2003
Gebhardt M. J.BJS 2002
Gupta S. JAAOS 2012
Levels of Amputation

Hemipelvectomy

- Internal- limb sparing
- External- amputation

Levels of Amputation, Trans Femoral

- Varied length of residual limb
- Distal femoral growth plate ablated
- Residual limb will shorten in proportion to the sound limb with growth
- Advances in prosthetic technology- microprocessor knees

Levels of Amputation, knee disarticulation

- End bearing
- Long residual limb
- Femoral growth plates spared
- May require growth plate arrest for equal knee centers at skeletal maturity
- Advances in prosthetic knee technology affording space for equal knee centers
Levels of Amputation, Trans-Tibia and Symes

- Varied length of residual limb
  - Proximal growth plate spared
  - Symes distal growth plate spared. May require distal tibia growth plate arrest to shorted limb for optimal prosthetic fit and function
- Potential excellent functional outcome with prosthesis

Rotationplasty

Classification of Rotationplasty Procedures

- A I lesion
- All lesion
- B I lesion
- B II lesion
- B III a lesion
- B III b lesion

Limb Sparing, rotationplasty

Surgical outcome for Rotationplasty

Dependent on location of the tumor and surgical level

- Proximal femur B I, B II, B III a
  - Ilio femoral fusion, anatomical knee functions as the hip (limited degrees of freedom) and the ankle the knee
- Mid to Distal Femur A I
  - Proximal Tibia A II
  - Full anatomical hip degrees of freedom
  - Knee excised
  - Foot and ankle complex function as the knee

Challenges of Rotationplasty

Growth

- Growing child
- Considerations for knee centers by end of skeletal maturity
Challenges of Rotationplasty

Muscle function and strength dependent on the surgical level. Determines the primary muscles for mobility and stability/ flexibility and strength. Effects quality of gait.

- Proximal surgical levels
  - hip weakness
  - Rely on ankle and foot muscles
- Distal surgical levels
  - ankle and foot weakness
  - Rely on hip and thigh muscles

Challenges of Rotationplasty

- Condition of the limb
  - Wound healing: “whopper” incisions
  - Edema thigh and foot/ankle
  - Skin pressures
  - Breakdown
  - In grown toe nails
  - Delay bone healing
- Sensation
  - Peripheral nerve damage
  - Inconsistent sensation
  - Chemotherapy induced peripheral neuropathy
  - Proprioception

Benefits of Rotationplasty, “FUNCTION”

Motor control, coordination and balance

Upper extremity tumors

Preserve hand functions

Limb sparing
Amputation

Length is not as important as FUNCTION

Treatment- Rehabilitation Team

Patient and family

- Oncology Orthopedics
- Physical Therapist
- Occupational Therapist
- Prosthetist
- Orthotist
- Physical Medicine

Established Oncology team

- Oncologist
- Nursing
- Social worker
- Psychologist
- Child Life
- Subspecialty consultants
**International Classification of Function**

*Jette A, Physical Therapy May 2006*

**ICF Model**

**Health Condition**

(disorder/disease)

- Body functions and structure
- Activity
- Participation

- Environmental Factors
- Personal Factors

---

**Pre-operative: Evaluation**

- History
- Past surgical history, "old injuries"
- Motivation and understanding
- Functional and activity level
- Condition of the extremity
- Generalized mobility/ROM
- Strength
- Gait
- Assistive devices
- Environment

---

**Pre-operative: Plan**

- Photos, dolls, skeleton, videos
- Meet other patients and families with similar surgical procedure
- Notify inpatient PT of patient and provide treatment guidelines to treating therapists
- Set up outpatient PT before surgery and provide treatment guidelines
- Gait training, weight bearing as prescribed
- Order equipment: wheelchair, CPM, bedside commode

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**Treatment Priority, The Guide to PT Practice**

**Domains**

- Integumentry
- Cardiovascular
- Pulmonary
- Neurological
- Musculoskeletal

---

**Patient/family Education**

**Functional Advantages and Disadvantage of Surgical Options in the Management of Lower Extremity Bone Tumors in Children**

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**Amputation: acute post operative**

Prepare for prosthetic fit and function

- Wound care
- Edema control
- Shaping
Acute Post operative Care

- Scar/soft tissue management
- Desensitization
- Pain management

Amputation: acute post operative

- Mobility/Gait training - crutches, wheelchair
- Transfers
- ADL’s
- ROM - contracture management
- Strengthening isometric
- Education to patient and family

Amputation: immediate postoperative - IPOP

- Immediate post-op prosthesis, IPOP. Appropriate candidate selection
- Weight bearing as soon as tolerated
- Edema control
- Pain management
- Precaution - sensation

Prosthetic training

- Weight shifts
  - side to side
  - diagonals
- Gait training - progress per MD
  - Walker > Crutches > no devices
- Ramps
- Curbs
- Transfers into cars
- Uneven surfaces

Advanced training - “nothing stopping us now”

Rotationplasty: Prosthetic competency
**Upper limb salvage**

Immediate post-op
- Immobilization
- Care of the orthosis
- Mobility and transfers
- Pain management
- Gentle active ROM to the neck, hand and elbow
- Isometric strengthening of the scapula, shoulder, forearm and hand
- ADL’s dressing, bathing
- Out-patient PT or OT

**Upper limb salvage, out patient rehabilitation**

- Soft tissue and scar management
- Posture- standing and sitting
- Initiate active ROM to the hand and elbow
- Scapula stabilization exercises
- Progress strengthening exercises when appropriate
- ADL’s dressing, bathing, driving
- Bi-manual activities

**Upper Limb Salvage, out patient rehabilitation**

- Driving
- ADL- grooming
- Reaching overhead
- Backpack loads and posture
- Fun age appropriate activities
  - WII fit
  - Super soakers
  - Bow and arrow target shooting
  - Texting

**Upper Extremity Tumors**

Distal radial recurring Osteosarcoma

**“Rehabilitation” outside the clinic**

Activity and Participation

**“Rehabilitation” outside the clinic, The next step- Activity and Participation**
“Rehabilitation” outside the clinic: Activity and Participation

PARTICIPATION

Children’s Oncology Group- COG, Late Effects Task Force

Challenges of Evidence Based Practice

- Study periods span many years, retrospective
- Advances in prosthetic technology
- Advances in surgical interventions
- Advances in chemotherapy
- ↑ AWARENESS of physical impairments in our society
- ↑ Sports and recreation programs for the “disabled”

Malignant Bone Tumors: Limb Sparing versus Amputation

Comparing limb sparing to amputation, considerations for limb sparing:

1. Survival rates should be no worse
2. The reconstructed limb must provide satisfactory outcome.
3. Functional outcome studies comparing two procedures have limitations:
   - inability to randomize treatments
   - subjectivity in measurements

Outcome measures used for cancer research

- MSTS - Musculoskeletal Tumor Society
- TESS - Toronto Extremity Salvage Score
- SF-36 - Short Form-36
- FMA - Functional Movement Assessment
- RNL - Reintegration to Normal Living


- Apply disease specific measures, TESS and MSTS
- Intra-articular replacements
- 20 patients, average 16 yrs, 7.5 yrs from dx
- Structural and treatment variables
  - > loss of knee extension, > difficulty of task
  - > muscle loss < in function
  - Knee extension strength and knee ROM are associated with impairment and disability.
  - Focus for post recovery


Function and Upright Time Following Limb Salvage, Amputation, and Rotationplasty for Pediatric Sarcoma of the Bone

- 123, > 5 year disease free survivors w/o complications
- Grouped- LS, AKA, rotationplasty and BKA
- Retrospective study, survey phone and interview
- TESS, MSTS, % upright time
- LS advantage over AKA
- Greater upright time in rotationplasty and BKA
- Outcome dependent on measurement tool used
- Limitations of this study


Functional Outcomes Following Amputation and Limb Salvage Surgery at Different Levels in the Lower Extremity

- 408 subjects- 65 amputation, 343 limb salvage
- Mean age 49.3 +/- 19.2
- Mean length of follow up 8.9 +/- 5.2 years
- Amputees classified as BK, AK, hip and pelvic levels
- Study specific self report questionnaire regarding function and quality of life
- BK and limb salvage outcomes were similar
- ↑ loss of function at higher levels of amputation, limb salvage had a functional advantage
- Clinical importance: Informed pre-operative decision making and estimate long-term functional prognosis for the patient


Malignant Tumor of the Distal Part of the Femur or the Proximal Part of the Tibia: Endoprosthetic Replacement or Rotationplasty. Functional Outcome and Quality-of-Life Measures

- 67 patients- 11 to 24 years
- 33 rotationplasty
- 34 endoprosthetic replacement
- ↓ Assistive devices with rotationplasty
- ↑ Sports and recreation with rotationplasty
- ↓ Pain with rotationplasty
- Cosmetic appearance may be a disadvantage

THANK YOU
“The Cup Song”