Children Musculoskeletal Disorders
Nursing 231

Objectives
• Describe various acute musculoskeletal injuries that may occur in children, including sprains, strains, contusions, dislocations, and fractures
• List and identify different types of fractures. Explain the use of casts and types of fractures
• Discuss the importance of identifying an injury of the epiphyseal growth plate
• Describe nursing management associated with various MS disorders
  Identify the education needs of the families of children with MS alterations

BONES
• Bones have a hard outer surface and a somewhat soft inter core.
• Bones provide protection for organs and a framework for movement and support for body structures.
• The bone matrix stores calcium (98% of total calcium is in bone), phosphorus, magnesium, and fluoride.
• The red bone marrow located within the bone cavities produces red and white blood cells (hematopoiesis)

Bone cont...
• The muscles attached to the bone allow for movement and heat production through contraction.
• The shape and construction of a bone is determined by it’s function and the force exerted on it.

Bone cont...
• Bone is composed of cells, protein matrix, and mineral deposits
• The three types of cells are osteoblasts, osteocytes, and osteoclasts.
• The osteoblasts secrete bone matrix.
• The matrix is a framework in which inorganic mineral salts are deposited.
• Matrix is composed of collagen and ground substances, glycoproteins and proteoglycans.

Bone cont...
• Osteocytes are mature bone cells involved in bone maintenance functions.
• They are located in lacunae, the bone matrix units.
• Osteoclasts are multinuclear cells involved in destroying, resorbing, and remodeling bone.
• Osteoclasts are located in shallow Howship’s lacunae, small pits in bone.

Bones cont...
• Haversian system are microscopic functioning units of cortical bone.
• The center of the haversian canal contains a capillary, around the capillary are circles of lamelae (mineralized bone matrix)
• Lamelae are lacunae containing osteocytes which are nourished by canaliculi (canals)
• The Canaliculi communicate with adjacent blood vessels within the haversian system.

Bone cont...
• Lacunae is cancellous bone are layered in an irregular lattice network (trabeculae).
• Red bone marrow fills the lattice network.
• Capillaries nourish the osteocytes located in the lacunae.

12 Bone cont...
• The structure of the long bone consist of:
  • The diaphysis the shaft of the bone (primarily cortical bone)
  • The epiphyses the ends of the bone (primarily cancellous bone)
  • The epiphyseal plate which separates the diaphysis and the epiphyses and is the center for longitudinal growth in children.

13

14 Epiphyseal Growth Plate
• Controls long bone growth and is vascular area of active cell division
• New cartilage is laid down on the epiphyseal end of the plate.
• Growing cells of the epiphysis are sensitive to nutrition and hormonal changes
• Growth hormone secreted by the anterior lobe of the pituitary gland is responsible for increasing bone length
• Maturation and bone shaping continues until age 21.

15 Bone cont...
• Cartilage a tough, elastic bonelike tissue covers the end of long bones at the joints.
• The long bones are constructed for weight bearing and movement.

16 Bone cont...
• Periosteum is dense, fibrous membrane covering the bone.
• It contains nerves, blood vessels and lymphatics
• The periosteum nourishes bone and allows for growth
• It provides for attachment of the tendons and ligaments.
• It is the layer closest to the bone containing osteoblasts (bone-forming cells)

17 Bone formation
• Ossification is the process by which the bone matrix is formed and hardening minerals (calcium salts) are deposited on the collagen fibers in an electronegative environment.
• The collagen fibers give tensile strength to the bone.
• Calcium provides compressional strength.

18 Bone formation cont...
• There are two basic models to ossification, intramembranous and endochondral.
• Intramembranous ossification of bone develops within the membrane.
• Examples are the face and skull which heal by fibrous union.

19 Bone formation cont...
• Endochondral ossification, osteoid tissue, which is cartilage-like tissue is formed, reabsorbed, and replaced by bone.

20 Bone healing
• Most bones in the body are formed and heal by endochondral ossification.
• Bone regenerates itself by undergoing several stages in healing a fracture.
• Fracture hematoma

21 Bone healing cont...
• Inflammation and neovascularization
• Reparative phase with formation and ossification.
• Remodeling into mature bone.

22 Bone healing cont...
• Fracture hematoma
• The highly vascularized internal bone when injured, bleeds forming a hematoma.

23 Bone healing cont...
• Inflammatory and revascularization
• The injured area is invaded by macrophages which clean-up the area and clear out bone fragments.
• The hematoma undergoes organization into fibrin strand forming.
• Creating a network for revascularization and the invasion of fibroblasts and osteoblasts.

24 Bone healing cont...
• Fibroblasts invade the damaged area between the edges of broken bone and lay down fibrocartilage (callus formation) plug.
• The callus shape and volume of tissue required to bridge the defect are proportional to the amount of bone damage and displacement.

25 Bone healing cont...
• Ossification of the callus begins within 2 to 3 weeks
• Chondrocytes die and osteoblasts invade replacing the cartilaginous callus with bony callus.

26 Bone healing cont...
• Remodeling is the final stage of fracture repair.
• It consists of moving any remaining devitalized tissue and reorganizing the new bone into its former structural arrangement.
• The final touches to bony callus are made by the osteoclasts and the osteoblasts, Remodeling may take months to years depending on the extend of injury.

27 Bone healing cont...
• Adequate immobilization is essential until there is evidence of callus formation with ossification on x-ray.

28 Soft Tissue Injuries
• Sprain: Stretching or tearing of a ligament from injury to a joint
• Strain: Stretching or tearing of either muscle or a tendon from overuse, overstretching, or misuse
• Contusion: Occurs when there is damage to soft tissue, small vessels, and muscles

30 Patho and Clinical Manifestations
• Sprains and strains are graded according to severity of the injury
• Mild sprain there is microscopic tearing of the ligament with local tenderness and minimal swelling
• Moderate sprain is partial tearing of the ligament, partial joint instability, immediate pain, swelling and ecchymosis

31 Treatment
• Rest: Staying off the injury for several hours to several days depending on severity
• Ice: On for 30 minutes, off for 15 minutes
• Compression: Use of an elastic wrap
• Elevation: Elevation of the injured part level with or above the level of the heart

32 Dislocations
• Dislocation: Displacement of two bone ends or of a bone from its articulation with a
• Joint
  - Subluxation: An incomplete or partial dislocation of the articular surfaces of a joint

**Nursemaid’s Elbow**
- Dislocation of elbow or subluxation of radial head, typically occurs in children younger than 5 years of age.
- Child’s hand is jerked by an adult to prevent a fall or when child is forcibly lifted by a hand.

**Types of fractures**
- Greenstick fracture. This is an incomplete break, only on one side of the bone.

**Types of fractures cont...**
- Transverse fracture. A break in a cross-sectional plane

**Types of fractures cont...**
- Oblique fracture. A break at an angle to the long axis of the bone.

**Types of fractures cont...**
- Spiral fracture. This is more about how it occurred than how it looks. Twisting has other clinical implications.

**Types of fractures cont...**
- Comminuted fracture. This is the worst kind of fracture because it is shattering of the bone into many pieces.

**Types of fractures cont...**
- Closed or simple fracture. The bone is broken, but the skin is not lacerated by the force or the bone fragments.
- Open or compound fracture. The skin is pierced by the bone or by the blow that breaks the skin at the time of the fracture.
- The bone may or may not be visible in the wound.

**Clinical signs and symptoms**
- Pain caused by swelling at the site, muscle spasm, and damage to the periosteum.
- Pain is immediate and severe
- Pain is aggravated by pressure at the site of injury.
- Pain is aggravated by attempted motion

**Clinical S & S cont...**
- Obvious deformity resulting from loss of bone continuity.
- Crepitus or grating sound if the extremity is moved.

**Clinical S & S cont...**
- Soft tissue edema in area of injury resulting from extravasation of blood and tissue
Warmth over injured area resulting from increased blood flow to the area
- Ecchymosis of the skin surrounding injured area. May not be apparent for several days.

**Clinical S & S cont...**
- Impairment or loss of sensation or paralysis distal to the injury resulting from nerve entrapment or damage.
- Signs of shock related to severe tissue injury, blood loss, or intense pain.
- Evidence of fracture on x-ray film.

**Clinical S & S cont...**
- No attempt should be made to elicit sign when fracture is suspected because it may cause farther damage and increase pain.

**Treatment**
- The treatment for a bone fracture depends upon the type and location of the fracture and the patient’s age and medical history.
- When a fracture is suspected the affected area should be immobilized to prevent any further damage.
- Moving a broken or dislocated bone can cause additional damage to the bone, nearby blood vessels, and nerves or other tissue surrounding the bone.

**Treatment cont...**
- First aid or emergency treatment may be splints, braces, or covering an open wound with a clean cloth until the injury is treated professionally.

**Treatment cont...**
- There are three principles of fracture treatment.
  - Reduction or realignment of bone fragments
  - Maintenance of realignment by immobilization.
  - Restoration of function

**Treatment cont...**
- Reduction is accomplished by
  - Closed manipulation. Cast or sling
  - Internal fixation. Surgery (open reduction and internal fixation).
  - Internal fixation various types of holding devices are used such as nails, screws, pins, wires, and rods.

**Treatment cont...**
- External fixation involves surgery where pins are insert above and below the fracture and held in place by clamping device.
- Traction, realignment and immobilization
- The single most important element of obtaining union of fracture fragments is immobilization.

**Cast**
- Cast drying takes a few minutes but 48 hours to harden
- Support the cast with palm of your hands when moving. Finger can cause indentation and a pressure area
- Support the cast and adjacent joints with pillows.

**Cast cont...**
- Dry the cast by natural evaporation. Don’t use a dryer. This will dry the outside only.
Fans can be used to facilitate drying.

- **Cast cont...**
  - Damp cast should never be placed on a hard surface and should be turned frequently
  - A dry cast is white, shiny, resonant (sounds hollow), feels cool, odorless, and feels firm
  - A wet cast is gray, dull in appearance, dull to percussion, feels damp and has a musty odor.

- **Cast cont...**
  - Hip Spica cast should be turned after several hours.
  - Hip Spica cast should never be lifted by the ankle, foot, or the cross bar.

- **Nursing care of cast**
  - Check circulation.
  - The cast extremity should be the same color and temperature as the other extremity.
  - White and/or cold indicates arterial decrease circulation

- **Nursing care of cast cont...**
  - Check blanching (nails white to pink should be less than 3 seconds) and check pulses
  - Check for sensation and pain.
  - Check for movement. Possible nerve impairment.

- **Nursing care of cast cont...**
  - Touch. Check for warm or hot areas. Compare injured extremities with the other.
  - Report any unusual smell or odors from the cast.
  - Hearing. Listen to the patient’s complains of pain, numbness, tingling, these could be indications of nerve damage or lack of circulation

- **Nursing care of cast cont...**
  - Edema generally peaks in 24 to 48 hours.
  - Decrease edema by:
    - Apply ice bag to the cast area.
    - Elevating the extremity increasing venous return
    - Movement of the digits of the extremities. Movement stimulates circulation

- **Nursing care of cast cont...**
  - Protect the cast.
  - When bathing or showering be sure to cover the cast with plastic to keep dry.
  - Advice the patient not to put anything inside the cast.
  - Report any slippage, cracking, softness, or looseness of cast to the health care provider

- **Nursing care of cast cont...**
  - When the cast is removed, the skin will be dry and flaky.
  - Wash with warm water and mild soap
  - The extremity will be stiff for a while. It may need to be supported with a sling.
  - Normal movement will correct the stiffness.

- **Complications**
  - Volkmann’s ischemic contracture
  - When the arm is flexed and put into a cast.
  - The radial artery and nerve maybe compressed at the elbow causing nerve injury and circulatory impairment.
Complications cont...
- Volkmann’s contracture must be detected and treated within 6 hours or permanent damage will result.
- The elbow will flexed, wrist will be hyperextended, and fingers will be flexed (claw-like).
- To prevent. Check the patient’s hand hourly for radial pulses, coldness, blanching, and color for 48 hours.
- After edema subsides there is less chance of injury.

Complications cont...
- Fat embolism. Fat globules are released from the marrow following fractures.
- They enter the bloodstream and obstruct the pulmonary circulation.
- Onset of symptoms is usually in 1 to 4 hours after injury

Complications cont...
- Signs and symptoms of fat embolism:
  - Altered mental status
  - Dyspnea
  - Tachypnea and tachycardia
  - Petechial rash
  - Fever
  - Restlessness and agitation

Complications cont...
- Risk factors of fat embolism are:
  - Hypovolemia
  - Shock
  - Delayed immobilization of fracture
  - Multiple fractures.

Complications cont...
- Pulmonary embolism result when deep vein thrombosis dislodges and obstructs pulmonary circulation
- This usually results 4 to 10 days after trauma or after the development thrombophlebitis which can occur much later.

Complications cont...
- Signs and symptoms of pulmonary embolism
  - Chest pain and/or dyspnea
  - Anxiety and/or apprehension
  - Cough and/or hemoptysis
  - Tachypnea and tachycardia
  - Fever

Complications cont...
- Risk factors of pulmonary embolism
  - History of deep vein thrombosis, pulmonary embolism
  - Venous stasis, immobility
  - Trauma, major surgery
  - History of heart disease, obesity
Over 40 years

Compartment syndrome
- Compartment syndrome is the increased pressure within one or more compartments causing massive compromise of circulation of an area.
- This leads to decreased perfusion and tissue anoxia
- Irreversible neuromuscular damage can result in 4 to 6 hours after the onset of compartment syndrome.

Osteomyelitis
- An infection can cause interruption of the integrity of the skin.
- Bacteria can invade the bone tissue and set up an infection.
- Assess the patient for pain, fever, erythema in the area surrounding the fracture
- Tachycardia and elevation of WBCs

Osteomyelitis calls for aggressive antibiotic IV therapy, 3-8 weeks or more.

Avascular necrosis is an interruption in the blood supply to the bony tissue, which results in the death of the bone.
- The death of bony tissue can serve as a focus of infection.
- Indication of lack of circulation are pain and decreased sensation
- Notify the physician if patient exhibits pain and decreased sensation.

Traction
- Traction is the application of a pulling force applied in two directions to reduce and immobilize a fracture.
- Traction provides proper bone alignment and reduces muscle spasm.

Nursing implication for traction are:
- Maintain proper alignment
- Check to sure weights are hanging freely and not touching the floor.
- Check the skin for breakdown and apply preventive measures
- Do not remove or lift the weights without a physician order.

Skeletal traction
- Skeletal traction is mechanically force applied to the bone with the use of pins, wires, or tongs.
- Note counter traction and vector forces
- Monitor skin color, pulses, sensation, of the affected extremity.
- Monitor insertion site for inflammation (redness), edema, and drainage.

Types of Skeletal Traction
- Crutchfield Tong
- Balanced Suspension
- 90/90 Femoral Traction
- Dunlop or Sidearm Traction
Crutchfield Tong used to stabilize fractures or displaced vertebrae in the cervical and high thoracic areas of the spine.

Tongs are inserted into either side of the scalp through burr holes in the skull.

Head must be in proper alignment.

Balanced Suspension may be used with skeletal or skin traction for fractures of the femur, hip, tibia.

Thomas ring splint fits around the upper leg and provides support of the hip. The Pearson attachment is connected with the ring at the knee and supports and provides flexion of the lower leg. Bed should be maintained in a flat position to reduce flexion contracture of the hip.

90/90 Femoral Traction is the most commonly used traction for complicated fractures of the femur.

The lower part of the leg is in a boot cast, and a skeletal pin is placed in the distal fragment of the femur. Traction ropes are applied on the boot cast and at the pin site to maintain a 90 degree flexion of the hip and knee.

Dunlop or Sidearm traction: Can use either skeletal or skin traction for humerus fx.

The upper arm is abducted and the forearm is placed in a 90 degree angle from the plane of the child.

Pull is obtained in two directions, one in line with the upper part of the arm and one in line with the lower part.

Skin traction

Skin traction is the application of traction by the use of elastic bandages, boots, or adhesive.

Types of skin traction are:

- Buck’s traction.
- Cervical traction
- Bryant’s traction

Skin traction cont...

Buck’s traction is commonly used preoperatively on patients with fractured hips.

It is used to alleviate muscle spasms, pain, and to immobilize a the lower extremity.

An appliance boot or Fast Tract is applied, attached to a rope, a pulley, and a weight.

The apparatus is allowed to hang free over the edge of the bed which applies traction.

The patient’s weight applies counter traction.

Skin traction cont...

Cervical skin traction is the application of a head halter and a chin pad which is attached to a traction device.

Cervical skin traction relieves muscle spasms and compression in the upper extremities and neck.

Position the patient with the head of the bed elevated and attach the weights to a pulley system over the head of the bed.
Skin traction cont...
• In cervical traction the vector pull should be from the occipital area and not the chin or over the ears.
• Check for pressure on the chin by slipping your fingers under the chin straps.

Skin traction cont...
• Pelvic skin traction is the application of a traction to the pelvis, and iliac crest and attached to weights over the end of the bed.
• Pelvic skin traction is applied to relieve low back pain, hip pain, or leg pain and muscle spasm.
• Check for proper placement of apparatus and counter traction (slipping down in bed)

Bryant’s traction
• Bryant’s traction is a form of skin traction used with children.
• The traction is used to stabilize a fracture of the femur, correct a congenital hip dislocation.
• Position the child flat with a 90 degree hip flexion with the bottom slightly off the bed.
• The child’s bottom should be off the bed

Balanced suspension traction
• Balanced suspension traction is used with skin or skeleton traction.
• Mostly used to approximate fractures of the femur, tibia, or fibula.
• Victor force measures produce counter traction force to create a balance.

Clubfoot
• Can be unilateral or bilateral
• Could be caused by arrested fetal development in utero during the first trimester when foot is formed or by neuromuscular abnormalities
• Has three components of deformities
  – Foot points downward (equinos)
  – Forefoot turns inward (adductus)
  – Sole of the foot turns inward (in version, supination)

Treatment
• Soon as possible after birth
• Casting, major on surgical treatment, consists of manipulation of the foot into the correct anatomic position and application of casts
• Casts changed every two weeks until complete correction has occurred, takes 3 months

Scoliosis

Kyphosis

Lordosis
• **Legg-Calve-Perthes Disease**

• **Muscular Dystrophy**

• **Juvenile Rheumatoid Arthritis**
  • Inflammation of connective tissue
  • Include Systemic Lupus, Scleroderma, and Polyarthritis
  • JRA has three distinct modes of onset: arthritis in fewer than five joints (oligoarthritis) arthritis in more than five joints (polyarthritis) and systemic disease