Alteration in musculoskeletal function

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October 2007
Pediatric Differences
Bones

• Ossification
  – Fontanels are still open at birth
    • Posterior closes at 2-3 months
    • Anterior closes at 12-18 months
• Long bone epiphyses remain cartilaginous; growth continues until approximately age 20
• Calcium intake during childhood and adolescence is essential for adequate bone density to prevent osteopenia or osteoporosis and fractures in adulthood
• Injuries to the epiphyseal plate are of particular concern in young children
• Long bones of children are porous and less dense than those of adults
  – Children’s bones can bend, buckle, or break after a simple fall.
Pediatric Variations
Muscles, tendons, ligaments

• Muscular system is almost completely formed at birth. Muscles do not increase in number, but do increase in length and circumference

• Until puberty ligaments and tendons are stronger than bones

• Sprain: tearing of ligaments, which connect bones

• Tendons connect bones to muscles
Pediatric Variations in Bones

- Thicker periosteum surrounding the bones. As a result, fractures in children tend to be more stable and less displaced than those seen in adults.
- Faster bone healing due to greater bone-forming potential of the pediatric periosteum.
- Increased porosity, decreased density which makes children’s bones more prone to buckling when compressed, or bowing when bent.
- Remodeling is more rapid in children.
Assessment: Musculoskeletal System

• Gross motor function
  – Muscle size
  – Muscle tone
  – Strength
  – Abnormal movements

• Fine motor function:
  – Manipulation of toys
  – Drawing
ASSESSMENT

- Gait: arm and leg swing, heel to toe gait
- Posture
  - maintenance of upright position
  - presence of ataxia
  - presence of swaying
- Joints
  - range of motion
  - contractures
  - redness, edema, pain
  - abnormal prominences
VARUS
ABDUCTION
EVERSION
SUPPINATION
PRONATION
FIGURE 35–2  The parts of long bones.
Pediatric differences
Growth plate
Physes

• Composed of cartilage.
• The “weakest link” in the pediatric bone. It may separate before an adjacent joint ligament tears.
• Injuries to the growth plate may result in deformities
DISORDERS OF THE FEET AND LEGS

METATARSUS ADDUCTUS

The most common congenital foot deformity
Metatarsus Adductus

• Turning in of the forefoot
• Caused by both intrauterine positioning and genetic factors
• Most cases resolve without therapy by 3 months
• If it persists beyond 1 year, begin passive stretching exercises.
• Wear shoes on the wrong foot
• Dennis-Browne splint
• Casting for curvature angles > 15 degrees or cases that do not respond to other therapies
Clubfoot

- Congenital abnormality in which the foot is twisted out of its normal position.
  - Boys 2x more than girls
  - Bilateral in 50% of affected infants
- Caused by abnormal intrauterine positioning or neuromuscular or vascular problems or genetics
Clubfoot includes 3 areas of deformity

1. Equinus: The midfoot is directed downward

2. Varus: The hindfoot turns inward

3. Adduction The forefoot curls toward the heel and turns upward in partial supination.
Clubfoot

• Involves muscles, tendons and bones
• Cannot be corrected by exercise
• Can also include other deformities
  – Small foot
  – Shortened achilles tendon
  – Muscles in the lower leg are atrophied
  – Leg lengths are normal
Clubfoot prior to treatment
Clubfoot
Treatment of clubfoot

• Early treatment is key to success
  – Begin as soon as possible after birth
• Serial casting is treatment of choice
  – Long leg cast
  – Changed every 2 weeks
  – Continues for 8-12 weeks
• Splinting after correction: Denis-Brown Splint
• Surgery at 3-12 months if unsuccessful by then
Dennis-Brown Splint
Nursing care
cast care

- Skin care
- Cast care
- Possible complications
  - Toes/ fingers should be pink
  - Skin warm, cap refill < 2 sec
  - Raise the casted extremity above heart and rest on pillows to prevent swelling
Hip spica cast

Short Leg Hip Spica Cast
Nursing Care

cast care

• Notify the physician
  – Unusual odor beneath the cast
  – Drainage
  – Tingling
  – Burning or numbness in the casted arm or leg
  – Swelling or inability to move the fingers or toes
  – Slippage of the cast
  – Cast cracked, soft or loose
  – Sudden, unexplained fever
  – Unusual fussiness or irritability in an infant or child
  – Finger or toes that are blue or white
  – Pain that is not relieved by any comfort measures
Cast Care

- Plaster, fiberglass, or new plastics (Gore Procel) that are waterproof.
- Teaching Points
  - Keep cast dry
  - Don’t stick anything into the cast
  - Trim rough edges
  - Relieve itching with cool hairdryer and benadryl
  - Exercise the extremity
  - Apply an ice bag to the cast (only if dry)
- Call MD if problems
Cast care complications
compartment syndrome

- Pulselessness
- Pale
- Pain
- Paresthesia
- Paralysis
Genu Varum 
Bowlegs

• Deformity in which the knees are widely separated while the ankles are close together and the lower legs are turned inward.

• If not improved by age 2, refer to orthopedist

• BLOOUT’S DISEASE abnormal growth on the medial side of the proximal tibia which causes an increasing varus deformity

• RICKETS result of inadequate bone mineralization caused by deficiency of calcium and or vit D.
Genu varum
Genu valgum
knocknees

• Usually a normal part of a child’s growth and development and often resolve on their own
• Braces for correction should be worn both day and night
Structural Deformities

Hip

- Developmental Dysplasia of the hip (DDH)
- Leggs-Calve-Perthes disease
- Slipped capital femoral epiphysis (SCFE)
Developmental Dysplasia of Hip

The femoral head and the acetabulum are improperly aligned.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
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<tbody>
<tr>
<td>Dislocated</td>
<td>Displacement of the bone from its normal articulation with the joint</td>
</tr>
<tr>
<td>Subluxation</td>
<td>A partial dislocation</td>
</tr>
<tr>
<td>Dysplasia</td>
<td>Abnormal cellular or structural development</td>
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</table>
Developmental Dysplasia of the Hip

• Five signs that indicate hip instability or dislocation in an infant:
  – Galeazzi’s sign: infant is supine and hips flexed @ 90 degrees while knees bent, the level of the knees on the affected side will be lower (BOOK CALLS IT ALLIS’ SIGN)
  – Lack of flexion of the hip/ Limited abduction
  – Asymmetric gluteal folds
  – Telescoping or pistoning of the thigh
Galeazzi Test
Difference in knee height

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Assessment of congenital hip dysplasia

– Ortolani’s click and Barlow’s Test: baby relaxed, flex hip and knees @90 degrees. Grasp the baby’s thigh with the middle finger over the greater trochantur, lift the thigh to bring the femoral head from its dislocated position to opposite the acetabulum. At the same time, abduct the thigh reducing femoral head into the acetabulum. If you hear a click, that is a positive (abnormal) sign.
DDH clinical therapy

• XRAYS NOT RELIABLE UNTIL AFTER 3 MONTHS

• Pavlik harness us the most commonly used method for hip reduction.
  – Keeps the hip in flexion and abduction, but does not allow extension or adduction

• Older than 3 months, use skin traction

• Surgery with hip spica cast may be needed
Pavlik harness nursing care

- Worn 24/7 DO NOT REMOVE
- Usually worn for at least 6 weeks
- Only sponge baths
- DO NOT PLACE ON SIDE
- DO NOT LIFT FROM FEET
- Keep legs apart
- All straps are marked at the first fitting with indelible ink
Nursing Care

- Maintain traction
- Provide cast care
- Control pain
- Prevent complications from immobility
- Promote normal growth and development
- Discharge planning and home care teaching
Guidelines for Pavlik Harness Application

1. Position the chest halter at nipple line and fasten with Velcro.
2. Position the legs and feet in the stirrups, being sure the hips are flexed and abducted. Fasten with Velcro.
3. Connect the chest halter and leg straps in front.
4. Connect the chest halter and leg straps in back.

All the straps are marked at the first fitting with indelible ink so they can be reattached easily after the harness is rinsed and dried.
Hewson brace
Legg-Calve-Perthes Disease

- Avascular necrosis of the proximal femoral epiphysis
- More boys than girls affected. Higher in families with history (?genetic component)
- More common w/ low birth weight, increased parental age and exposure to tobacco smoke
- Presents with pain in the hip joint accompanied by spasm and limited motion.
Legg-Calve-Perthes Disease

- Passes through 5 stages
  - Prenecrosis an insult or coagulation disorder causes loss of blood supply to the femoral head
  - STAGE I - necrotic stage (3-6 months) asymptomatic, head of femur is structurally intact, but avascular
  - STAGE II revascularization (1-4 years) pain and limitation of movement. X-rays show new bone deposition and dead bone resorption fractions can occur
  - STAGE III Bone healing Reoosification takes place and pain decreases
  - STAGE IV Remodeling Disease process is over, no pain and improved joint function
Treated with rest (Toronto brace) and abducted and internally rotated positioning.
Legg-Calve-Perthes Disease
Nursing Diagnoses

- Promote normal growth and development
- Elimination of pain and discomfort
- Normal proximal femur without joint deformity
Slipped Femoral Epiphysis

- Occurs when the femoral head is displaced from the femoral neck. Commonly seen during the adolescent growth spurt, between ages 11 and 14 in girls and ages 13 and 16 in boys.
- Limp
- Pain
- Limited movement in the hip
- Surgical Correction is usually necessary
Right Hip
Slipped Capital Femoral Epiphysis
Slipped epiphysis

Slipped epiphysis

Normal hip
Structural Deformities

• Spine
  – Scoliosis
  – Kyphosis
  – Lordosis
Structural Deformities

– Scoliosis  Lateral S or C-shaped curvature of the spine that is often associated with a rotational deformity of the spine and ribs.
– Curves greater than 10 degrees are considered abnormal
Scoliosis

• Most common spinal deformity, is a lateral curvature of the spine usually associated with a rotary deformity
  – Functional: temporary curvature caused by posture or position change
  – Structural: occurs from changes in the bony structure of the spine, the soft tissue surrounding the spine, or both.
  – Curve of >10 degrees is considered abnormal
scoliosis
Idiopathic Scoliosis

- No recognizable cause: 1:10
- Late onset (after age 10)
- Most often right thoracic curve
- Girls affected more than boys
- Screening:
  - when bending forward the thoracic cavity becomes asymmetrical
- Diagnosis:
  - x-ray
Thoraco-lumbar Scoliosis
Scoliosis before surgery
Idiopathic Scoliosis

• X-ray findings
  – location
  – direction
  – angle
  – degree
  – direction of vertebral rotation
## Idiopathic Scoliosis

<table>
<thead>
<tr>
<th>Degree Range</th>
<th>Treatment Options</th>
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<tbody>
<tr>
<td>&lt;20 degrees</td>
<td>Observe, exercise to strengthen toward outside of curve</td>
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| 20-40 degrees  | Bracing with boston or Milwaukee brace  
|                | Worn 23 hours/day |
| >40 degrees    | Spinal Fusion  
|                | – Harrington rod  
|                | – Dwyer instrumentation  
|                | – Luque wires  
|                | – Cotrel-Dubousset instrumentation |
Bracing for scoliosis

• Purpose of bracing is to keep the curve from progressing as a child grows. The curve will demonstrate improvement during the time the child is braced, it will typically revert to its original degree of severity when the brace is discontinued after growth stops.

• Several studies demonstrate the importance of the mother’s attitude on the child’s perception of her won condition and acceptance of treatment.

• Wear brace 22-23 hours a day/ 7 days a week.
• **Living With Scoliosis - First Clip of “Going Straight” Video Released**
Concerns of patients undergoing treatment for scoliosis

- Almost all of the participant reported having to deal with stress, denial, fear, anger, and shame
- Risk of neurological and muscle damage
- Risk of bone destruction as metal rods are inserted into the spine
- Altered body image
OSTEOMYELITIS

Infection of the bone that can occur in any bone in the body.
  – femur
  – tibia
  – skull in infant

Any organism is capable of causing osteomyelitis:
  – exogenous route
  – hematogenous route
Infectious Musculoskeletal Disorders

- Osteomyelitis
  - Infection of the bone (usually bacterial)
  - Trauma to the bone or surgery to the bone are common causes
Osteomyelitis
Osteomyelitis

• EXOGENOUS ROUTE: direct
  – Penetrating wounds
  – Open fractures
  – Contamination during surgery

• HEMATOGENOUS ROUTE: through the bloodstream from an infection elsewhere
  – Abscess
  – Burn
  – Abrasions
  - URI
  - otitis media
  - abscessed teeth
Osteomyelitis:
Risk Factors

• Trauma
• Bacteremia
• Illness
• Malnutrition
• Immune system deficiency

Infection begins in metaphyseal venous sinusoid (sluggish blood flow, poorly developed reticuloendothelial system)
Osteomyelitis: History

• History of recent or concurrent infection in 1/3 to 1/2 of cases

• Unexplained bone pain and fever=OSTEOMYELITIS until proven otherwise
Lab Tests: Osteomyelitis

- CBC  \textit{leukocytosis}
- ESR  \textit{elevated (not reliable in neonates)}
- \textit{C-reactive protein elevated}
- Blood cultures $+$ in 40-50\% of cases
Osteomyelitis: Radiologic findings

<table>
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<th>X-RAYS</th>
<th>Not positive until 10 days</th>
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<tr>
<td>EARLY X-RAYS</td>
<td>Only shows tissue swelling</td>
</tr>
<tr>
<td>BONE SCAN</td>
<td>Positive early</td>
</tr>
<tr>
<td>MRI</td>
<td>Sensative and specific</td>
</tr>
<tr>
<td>NEEDLE BIOPSY</td>
<td>Diagnostic culture is most valuable test</td>
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- **STAPHYLOCOCCUS AUREUS** (INFANTS & CHILDREN)
- **E COLI**
- **GROUP B STREP (NEONATES)**
- **STREPTOCOCCUS PYOGENES**
- **HAEMOPHILUS INFLUENZAE** (6 MONTHS - 4 YRS)
Osteomyelitis: Treatment

• Antibiotics for 6 weeks
• Antibiotic of choice depends on age of child and probable organism (remember MRSA)
  – Cefotaxime
  – Oxacillin and gentamycin
  – Clindamycin
  – Cefazolin
• Switch from IV to oral antibiotic once clinical response is seen (7 -10 days)
Evaluation/ outcomes of nursing care of child with osteomyelitis

• Absence of signs of infection or sepsis
• Completion of prescribed course of antibiotics
• Prevention of infection in contacts
• Adequate intake of fluids and nutrients
• Absence of pain
• Return to normal activities of daily living
Other M/S disorders

- Osgood-schlatter disease (tender tibial tuberosity)
- Achondroplasia (dwarfism)
- Skeletal tuberculosis
- Septic arthritis
- Marfan syndrome (Abe Lincoln)
- Osteogenesis imperfecta (brittle bones)
Osteogenesis Imperfecta

- The skin is thin and translucent. Twenty to 30% have dentin dysplasia and abnormal teeth. **Blue sclera** are present due to the vascular bed showing through the thin sclera. Twenty percent have deafness due to otosclerosis. Also have joint laxity and hypermobility, short stature and congenital hernias. Usually presents in infancy or childhood. Twenty percent have fractures at or near birth.

- Pamidronate is a bone resorption inhibitor that reduces bone fractures and pain
Muscular dystrophy
Muscular Dystrophy

- Group of inherited diseases characterized by muscle fiber degeneration and muscle wasting.
- X-linked (Duchenne Muscular dystrophy) is the most common. Also known as pseudohypertrophic MD
- Caused by an absence of dystrophin, a protein that helps keep muscle cells intact
- Onset: Ages 2-6
- Symptoms: generalized weakness and muscle wasting first affecting the muscles of the hips, pelvic area, thighs, and shoulders. **Calves are enlarged**
- Diagnostic tests: creatine kinase (CK)
Muscular dystrophy

- Progression: DMD eventually affects all voluntary muscles, and the heart and breathing muscles. Survival is rare beyond the early 30s. A less severe variant is Becker muscular dystrophy.
- Treatment: Corticosteroids slows the course of DMD in doses of 0.75 mg/kg/day.
  - Significant side effects, including osteoporosis.
- Treatment, nonpharmacologic: braces, standing frames and wheelchairs (full time by age 12)
Video re: DMD

- www.parentprojectmd.org
FIGURE 35–17 Because the leg muscles of children with muscular dystrophy are weak, they must perform the Gower’s maneuver to raise to a standing position. A and B, The child first maneuvers to a position supported by arms and legs. C, The child next pushes off the floor and rests one hand on the knee. D and E, The child then pushes himself upright.
FIGURE 35–17 (continued)  Because the leg muscles of children with muscular dystrophy are weak, they must perform the Gower’s maneuver to raise to a standing position.  

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C, The child next pushes off the floor and rests one hand on the knee. 

D and E, The child then pushes himself upright.
Remember:

- Brain function is unaffected.
- Normal intelligence
Traumatic Injuries to MS system

- **Greenstick fracture** occurs because the bone is not as brittle as it would be in an adult, and thus does not completely fracture, but rather exhibits bowing without complete disruption of the bone’s cortex.

- **Growth plate injuries**, as in Salter-Harris fractures, require careful treatment and accurate reduction to make sure that the bone continues to grow normally.

- **Plastic deformation** of the bone, in which the bone permanently bends but does not break, is also possible in children. These injuries may require an osteotomy to realign the bone if it is fixed and cannot be realigned by closed methods.
GREENSTICK FRACTURE

Bone is angulated beyond the limits. Not a complete break, but a fracture on the tension side and plastic deformity with an intact cortex on the compression side.
Pediatric Fractures
Clinical Manifestations

- PAIN
- Tenderness and Swelling
- Impaired function, limping
- Limited movement
- Ecchymosis surrounding site
- Crepitus at site of fracture
- Decreased neurovascular status distal to site of fracture
- Distal atrophy
FIGURE 35–19   The Salter-Harris classification system is based on the angle of the fracture in relation to the epiphysis.
What significant complication results from epiphyseal plate injuries?

Premature closure of the growth plate and deformity
• Two-year old boy was running and fell. He refuses to bear weight. There is no swelling, but tenderness over the distal tibia. X-rays are normal.

• What type of fracture is this?
Toddler’s fracture

• Non-displaced oblique tibial fracture as the result of a rotational injury sustained while running or playing.
Sites of fractures in children

- **Clavicle** is the most frequently fractured bone in children as a result of birth injury or a fall on an outstretched arm.
- **Distal radius fracture** is common in childhood.
- Injuries to the **growth plate** occur in one third of skeletal trauma.
- **Pelvic** fractures occur infrequently.
- **Skull fractures** have the highest morbidity.
Pediatric emergency fractures

- **Supracondylar fracture** with neurovascular compromise
- **Compartment syndrome 5 P’s**
  - Pain
  - Paralysis
  - Paresthesia
  - Pulselessness
  - Pallor
Fractured Femur
Pediatric Fractures
Nursing Assessment

- Assess for pain, swelling, skin color, neurovascular status
- Assess for cause of injury
- Assess need for pain relief
- Assess for signs and symptoms of infection
- Assess for wound healing
- Assess for skin irritation
- Assess for hydration status
- Assess for signs and symptoms of complications such as fat emboli, compartment syndrome
Pediatric Fractures
Nursing Diagnosis

• High risk for injury
• Impaired mobility
• Impaired tissue integrity
• High risk for infection
• Pain
• Self-care deficit
• High risk for diversional activity deficit
• Knowledge deficit
Pediatric Fractures Nursing Intervention

- Assess breathing patterns and lung sounds
- Perform skin and neurovascular assessments q 2 hrs
- Use adequate padding and skin wrapping to avoid placing pressure on the popliteal space
- Change position q 2-3 hrs (for child in cast)
- Increase fluids and fiber in child’s diet as change in mobility increases constipation
Pediatric Fractures Complications

• Deformity of the limb
• Limb length discrepancy
• Joint incongruity
• Limitation of movement
• Nerve injury resulting in numbness
• Circulatory compromise
• Volkmann’s ischemic contracture
• Gangrene
• Compartment Syndrome
Traction: Skeletal Pull is applied directly to the bone

- 90-90 Traction
- External Fixation
- Crutchfield Tongs
Traction: Skin
Pull is applied to skin surface

- **Dunlop traction** (can be either skin or skeletal traction)
- **Bryant Traction**
- **Buck Traction**: Used for knee immobilization to correct contractures or deformities, or for short term immobilization of a fracture
- **Russell Traction**: Used for fractures of the femur and lower leg. Traction is placed on the lower leg while the knee is suspended in a padded sling
If child is older than 3 months, skin traction (Bryant Traction) is indicated.
Figure 59.—Skeletal traction by 90-90-90 suspension method for fracture of left femur. A. Traction applied. B. Same as view A. Note ease of access to high posterior wound of thigh. This position, because of its possible adverse effect on the knee, should not be maintained for more than 2 or 3 weeks.
Nursing Care Plan: Traction
Child will remain free of signs and symptoms of neurovascular compromise

• Evaluation: Child’s extremities pink, warm, dry with palpable pedal pulses and capillary refill of <2 sec. Bilaterally. Child denies any numbness or tingling in extremity.
  – Assess neurovascular status of left lower extremity, including temperature, color, pedal pulse, edema, and capillary refill at least every 4 hours or more.
  – Monitor child’s ability to move his toes and detect sensation
  – Maintain traction
Outcomes for Patients with M/S disorders

- Child states he or she feels no pain or numbness in extremity
- Child demonstrates allowable weight bearing activities with cased lower extremity
- Parents accurately state child’s care needs to be met both in and out of the hospital
- Child states positive aspects of self participation in activities