Alterations in the Musculoskeletal System

NURS 142
ADN Program

Musculoskeletal System

Normal structure

- Tissues
  - Cartilage
  - Ligaments/tendons
  - Fascia: A flat band of tissue below the skin that covers underlying tissues and separates different layers of tissue. Fascia encloses muscles.
  - Bursa: A closed fluid-filled sac that functions to provide a gliding surface to reduce friction between tissues of the body.
- Bones
- Muscles
- Joints

Function

- Support
- Protection
- Movement
- Mineral storage
- Hematopoiesis: The production of all types of blood cells.

Bone Structure & Development

Continuous process of bone remodeling

Osteoblasts = builders = deposition of new bone

Osteoclasts = removal of old bone = resorption

Growth zone for longitudinal growth in children - Epiphyseal plate
Disruption plate can result in threat to growth
Longitudinal growth continues to approx. age 20
Ligaments attach bone to bone – joint stability
Tendons attach muscle to bone – joint movement
Fibrous tissue – low blood supply
Cartilage - avascular

Factors Influencing MS Health
- Age
  - High growth rate Infant
  - Toddler – lordosis up to age 5-6 high risk for injury due to falls, MVA – Infant & child car seats
  - Infant and children's bones are porous and less dense than adult’s. Until puberty bones are soft and more easily bent and fractured.
- School age – 10-13 – growth spurt
- Seniors – decreased activity
- Environment
  - Job
  - Sun exposure
  - Activity

Normal Diarthrodial Joint (Freely movable)
Risk Factors for Alterations in Musculoskeletal Health

- History
  - Injuries
  - Family history
  - Medical conditions
    - Metabolic alterations
    - Gastrectomy
    - Renal tubular necrosis condition involving the death of tubular cells that form the tubule that transports urine to the ureters
    - Hypoparathyroidism
  - Surgery
  - Gender: postmenopausal female – osteoporosis, men - gout

- Age

- Medications
  - Musculoskeletal drugs - relaxants, NSAIDS, narcotics
  - Antiepileptic meds - osteomalacia
  - Phenothiazines - gait disturbances
  - Corticosteroids - abnormal fat distribution, avascular necrosis, decreased bone and muscle mass
  - K-depleting diuretics - muscle weakness

- Diet
- Obesity

Posture

Assessment

- History & interview
  - Chief complaint
  - Movement behaviors
  - Functional assessment
  - Self-care behaviors
  - Questions

- General
  - Posture
  - Gait steady? Unsteady? – disturbed?
  - Muscle strength – Movement against gravity? Resistance
  - Assistive devices

- Vital signs
  - Inspection & palpation provides data regarding symmetry and configuration of muscles, atrophy?

- Neurovascular assessment - CSM - circulation, sensation and movement. 5P’s - paralysis, paresthesia, pain, pulselessness, pallor
**Diagnostic Tests**

- **Blood chemistry**
  - Calcium: decreased in hypoparathyroidism, osteomalacia, renal disease, increased in hyperparathyroidism, immobility, osteoporosis (release of calcium into blood stream – increase in resorption)
  - Alkaline phosphatase: enzyme produced by osteoblasts for mineralization of bone – elevated with healing fractures, osteoporosis, osteomalacia
  - Creatine kinase (CK): muscle enzyme – increased in muscular dystrophy, muscle injuries
  - ESR: elevated with inflammation as well as C-reactive protein
  - RF: non-specific found in connective tissue disease
  - ANA: Anti-nuclear antibodies. Positive in 95% of patients with rheumatoid arthritis

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**Diagnostics - Visualizations**

- **X-ray**
- **CT**: soft tissue & bony abnormalities
- **MRI**: helpful in identifying abnormalities of cartilage and soft tissue surrounding joints
- **Bone scan**: injection of radioisotope taken up by bones – degree of uptake related to blood flow.
- **Biopsy**
- **Arthrogram**: injection of contrast medium into joint cavity
- **Arthroscopy**: direct visualization
- **Arthrocentesis**: like arthrogram – synovial fluid
- **Electromyogram (EMG)**: primary muscle disease
- **Bone Mass Measurements - Dual-energy x-ray absorptiometry (DEXA)**: fast, precise, low-dose of radiation measures bone density for osteoporosis
**Etiology of Injuries**

- Be alert and be aware of the environment.
- The causes of musculoskeletal injuries are variable.

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**Health Alterations – Soft Tissue Injuries**

**Sprains/sprains**
- Sprain – ligament injury due to wrenching or twisting movement
- Strain – stretching of muscle/fascia – acute may involve partial or complete rupture of muscle
- Causes
- Healing time – 3-6 weeks esp sprains – decreased blood supply.
- RICE (Rest, Ice, Compression, Elevation) plus NSAIDs (nonsteroidal anti-inflammatory drugs) program, which may include a knee brace for compression and added stability, or a physical therapy regimen

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**Dislocation/subluxation-partial dislocation**

First Assess - Inspect
- due to ligament injury – displacement of articular surface of joints
- may be congenital – check infant for symmetrical gluteal folds
- Inspection – asymmetry of musculoskeletal contour, local pain, tenderness, loss of function, shortening of affected extremity
- Developmental dysplasia of hip – disloc or sublux 1:21000 births girls> boys. Asymmetry of gluteal folds
- Cultural - > incidence with use of cradle boards or traditional swaddled – Native American
- Carrying infants on hip or back with legs abducted - Korean, Chinese, and some African groups - seldom affected
- Infants to 3 months- Pavlik harness worn for hip reduction
- Slipped Capital Femoral Epiphysis during adolescent growth spurt. Limp, pain, loss of joint motion traction or surgery most follow-up until epiphyseal plates closed
Soft Tissue Injuries

- Rotator cuff tears - muscles and tendons in shoulder
- Ligament injuries
- Meniscus injuries - Injuries to the crescent-shaped cartilage pads between the two joints formed by the femur (the thigh bone) and the tibia (the shin bone). 2 menisci are easily injured by the force of rotating the knee while bearing weight
- Repetitive motion injuries

Herniated Nucleus pulposus

Common cause of acute & chronic low back pain.

Degenerative disk disease leads to intervertebral narrowing & decreased efficiency of the "shock absorbing" affects of the disks

Risk factors for low back pain - undue strain, osteoarthritis, obesity, smoking, stress, prolonged periods of sitting

Osteomyelitis

- Direct or indirect invasion of microorganisms (Staph A)
- Bacteria lodge & grow - increase pressure - ischemia and vascular compromise - sequestration = infected island of bone
- Chronic if persists for more than 4 weeks
- Vigorous i.v. antibiotic treatment - surgical debridement - immobilization - prone to pathologic fractures - handle with care
- Discharge teaching - Extremely important complete course of antibiotics
Osteoporosis

- "Silent disease"
- Resorption > deposition (formation)
  - Porous & brittle bones
- Risk factors
  - Postmenopausal women
  - Thin, small frame
  - Family history
  - Long-term steroid use
  - Inactivity
  - Caucasian/Asian-American

Management goal – prevent or stop process
- Adequate calcium intake & Vitamin D 1000mg/day – premenopausal and postmenopausal women taking estrogen, 1500mg/day – postmenopausal not taking estrogen
- Exercise program
- Medications
  - HRT hormone replacement therapy = Estrogen – inhibits osteoclast activity
  - SERM - selective estrogen receptor modulators – mimics effect of estrogen
  - Bisphosphonates inhibits osteoclastic bone resorption, increases bone density – must be taken before meals
  - Calcitonin secreted by thyroid gland – effect same as estrogen I.M or inhalant must be taken with calcium supplement to prevent hyperparathyroidism

Gout

- Metabolic disorder
  - Genetic/familial tendency
  - 90% middle-aged men
- Risk factors
  - Diabetes
  - Obesity
  - HTN
- Hyperuricemia
  - Purine synthesis &/or renal excretion

Signs & symptoms
- Swollen, tender, painful joints, "great toe" – reddened to dusky
- Deposit of Na urate crystals in joint fluid = tophi

Treatment
- Fluids & low-purine diet (organ meats, venison, anchovies, wine/beer), fluids prevent precipitation of uric acid in the renal tubules
- Colchicine - specific analgesic for gouty arthritis – expect pain relief
- Probenecid (Benemid) – increases urinary uric acid excretion – inhibits renal reabsorption of urates
- Allopurinol (Zyloprim) – slows body rate of uric acid production
- Acetaminophen – antiinflammatory & pain control
- No Aspirin – inactivates effects of uricosurics – results in urate retention
Videos on Arthritis: Osteoarthritis, Rheumatoid Arthritis and Juvenile RA

- Osteoarthritis and Rheumatoid Arthritis 7" (7"
  http://www.youtube.com/watch?v=6lx_774GuTw&feature=related

- Osteoarthritis, Rheumatoid Arthritis, 3D 6" Animation, www.anytimework.com
  http://www.youtube.com/watch?v=xLcQMEnVnYo

- Osteoarthritis DoctorsArthritisRelief.com 3"
  http://www.youtube.com/watch?v=26zGQoaCV8&feature=related

- Osteoarthritis: Elaine’s story 3"
  http://www.youtube.com/watch?v=W4zrvWD6jw

Arthritis Videos (continued)

- Rheumatoid Arthritis 3"
  http://www.youtube.com/watch?v=3yeOZ0FXiuc

- What Does Rheumatoid Arthritis Do? 4"
  http://www.youtube.com/watch?v=ae4ZGRIzR3I

- Living with Juvenile Arthritis - Frankie’s Story 4"
  http://www.youtube.com/watch?v=6q8EBAcDAw&NR=1

- Living with Juvenile Arthritis 3"
  http://www.youtube.com/watch?v=EVeN3NjQQms&feature=related

Arthritis

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<th>Rheumatoid Arthritis (RA)</th>
<th>Juvenile RA</th>
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<td>Process</td>
<td>Degeneration of joint cartilage</td>
<td>Inflammation Granulation tissue</td>
<td>Inflammation of joints</td>
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<td>Rough surfaces</td>
<td>Fibrous connective tissue</td>
<td>May have extraarticular manifestations</td>
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<td>Malacia</td>
<td>Ankylosis</td>
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<td></td>
<td>Cartilage fragmentation</td>
<td>Extraarticular manifestations</td>
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<td>Bone spurs</td>
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<tr>
<td>Response</td>
<td>Local Noninflammatory</td>
<td>Systemic Inflammatory</td>
<td>Local /systemic Inflammatory</td>
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<td>Incidence</td>
<td>1/3 of adults</td>
<td>&gt;women 75%</td>
<td>&gt;girls</td>
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<td>Age 60 – 60-80%</td>
<td>Young adult – Child-bearing age</td>
<td>Age 2-5 or 9-12 &amp; adolescence</td>
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<td>&gt;men</td>
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<td>&gt;Native-Americans</td>
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<td>Joints affected</td>
<td>Small &amp;/or large</td>
<td>Small &amp;/or large</td>
<td>Pauciarticular</td>
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<td>Systemic Polyarticular</td>
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<td>Symmetrical Chronic</td>
<td>Variable</td>
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<td>Etiology</td>
<td>Age, Fractures Infection</td>
<td>Autoimmune response</td>
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<td>Congenital deformity</td>
<td>Genetic Viral</td>
<td>Autoimmune response</td>
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<td>Course</td>
<td>Usually self-limiting</td>
<td>Remissions &amp; Exacerbation</td>
<td>Resolution</td>
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<td>Mild to progressive</td>
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<td>Rheumatoid Arthritis (RA)</td>
<td>Juvenile RA</td>
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<td><strong>Mobility</strong></td>
<td>Stiffness after rest and inactivity</td>
<td>Impaired mobility due to pain and swelling</td>
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<td><strong>Nodules</strong></td>
<td>Heberden's</td>
<td>Painful Interphalangeal joints</td>
<td>Rheumatoid</td>
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<tr>
<td><strong>Goals</strong></td>
<td>Control pain &amp; fatigue</td>
<td>Joint protection</td>
<td>Maintain ROM</td>
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<tr>
<th>Curvature of the Spine</th>
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<td>Normal</td>
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<tr>
<th>Scoliosis Video</th>
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<tr>
<td>Rebecca Living with Scoliosis 5”</td>
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<td>Scoliosis 2”</td>
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</table>
Important! Protect your bones

Fractures by Communication

Open fracture

Closed fracture

Diagram:

- Anterior
- Convergent
- Oblique
- Oblique
- Lateral
- Longitudinal
- Oblique
- Flexion
- Lateral
**Fracture Classification by Location**

- Tibial plateau
- Tibial shaft
- Fibular head
- Fibular shaft
- Distal fibula

**Fracture Management**

- **First** assess neurovascular status distal to the injury
- **Reduction** (alignment)
  - Open - surgical
  - Closed – manipulation or traction
- **Immobilization**
  - Skeletal or skin traction
  - External fixator
  - Cast
  - Splint
  - Brace

**Healing Process of Fractures**

1. Hematoma formation
2. Fibrous network
3. Osteoblasts – collagen – calcium deposition
4. Callus formation
5. Ossification – consolidation - remodeling
Know how to set up & evaluate Equipment

Immobilization With Traction

**Skeletal**
- Weight – 5 – 45# 
- Pins 
- Skin care

**General**
- Ropes & pulleys in straight alignment 
- Extremity in straight alignment 
- Knots not touching pulleys 
- Weights hang freely

Immobilization with Casts

- Drying - Use palm of hands, heat production
- Assess - CSM: skin at cast edges
- Teach - Elevation, ice @ fracture site for 24 hrs., keep cast dry, no foreign objects, exercise joints above & below the cast, elevate extremity
- Casts early ambulation; X-rays without removing
- After 48 hours – walking heel added to plaster cast – immediately after synthetic types
- Body jacket & hip spica – cast syndrome due to compression of duodenum against the mesenteric artery– abd pain, N&V, check BS turn q2h – do not use bar on double hip spica to turn
- Hip spica – commonly used for femur fractures in children
- Frequent recasting required for infants due to rapid growth
**Hip Fracture – Internal Fixation**

**ORIF (open reduction internal fixation)**

- Femoral head endoprosthesis
  - Intracapsular fractures
- Compression screw with side plate
  - Extracapsular fractures

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**Hip Surgery Video**

- Hip Surgery 3
- [http://www.youtube.com/watch?v=DosqbEy8tecY&feature=fvw](http://www.youtube.com/watch?v=DosqbEy8tecY&feature=fvw)

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**Fracture Complications**

- **Union**
  - Delayed
  - Non-union
  - Malunion
- **Compartment syndrome**
  - Nerve & arterial & venous compression – irreversible muscle & nerve ischemia
  - Compression - edema
    - Fascia
    - Circumferential device
  - Consequences
  - CSM
  - Action
- **Avascular necrosis**
- **Osteomyelitis**
- **Venous thrombosis**
- **Fat embolism**
  - Long bones & pelvis
  - Bone marrow or catecholamine action
  - S & S
    - 48 hours post fracture
    - Respiratory/Cardiac signs
    - Petechiae – neck, anterior chest wall, conjunctiva
Muscular Dystrophy

- MD Video: http://www.youtube.com/watch?v=ZrPnmsq4HM
- Genetic - males
- Muscle fiber degeneration and muscle wasting
- Progressive weakness & muscle deformity
- Signs & symptoms
  - Generalized muscle weakness
  - Gower’s maneuver indicates weakness of the lower limb. Use hands and arms to “walk” up his own body from a squatting position due to lack of hip and thigh muscle strength.
  - Deficiency of dystrophin – muscle protein (muscle biopsy)
- Management - supportive, ROM, PT

Medical Management

- Medications
- Nutrition
- Immobilization
- Rest
- Exercise
  - Active/passive
  - Isometric
  - Isotonic

EXERCISE

I decided to take an aerobics class. I bent, twisted, gyrated and jumped up and down for an hour. But, by the time I got my leotard on, the class was over.
Medical Management

- Medications
- Nutrition
- Immobilization
- Rest
- Exercise
  - Active/passive
  - Isometric
  - Isotonic
- Cold
  - Vasoconstriction → edema
- Heat
  - Edema
  - Comfort
- Heat and cold: Never continuous – 20-30 minutes with 10-15 minute breaks

Closed Reduction

Assistive devices

Special beds & frames

Surgical Management

- Osteotomy
- Arthrodesis
- ORIF
- Total hip, knee replacements
  - Special restrictions
    - Special goals knee exercises to achieve and maintain 90 degree flexion
- Total hip ROM restrictions – adduction, flexion >60 degree, internal rotation. Remember ROM to uninvolved extremities. Promote muscle strength – quadriceps-setting exercises – ie. Push knee down into mattress
**Surgical Management**

- Osteotomy
- Arthrodesis
- ORIF
- Total hip, knee replacements
  - Special restrictions
  - Special goals
- Amputations
  - Assessment
  - Support measures
  - Psychosocial implications
  - Amputations – loss/grief process – encourage to talk about concerns

**Fluid & Electrolytes**

- Fluid intake
- Electrolyte effects
  - ↓ K⁺
  - ↓ Ca⁺
- Acid-base imbalances

**Pharmacological Therapy**

- Analgesics
  - Acetaminophen (Tylenol)
  - Propoxyphene hydrochloride (Darvon)
  - Salicylates
    - Aspirin (acetylated)
    - Anthropan (nonacetylated)
- NSAIDs
  - Ibuprofen (Advil, Nuprin, Motrin)
  - Indomethacin (Indocin)
  - Diclofenac (Cataflam, Voltaren)

- NSAIDs - don’t take with Cox-2 inhibitors such as Celebrex, Vioxx
- Muscle relaxants
- Calcium supplements with Vitamin D
Pharmacological Therapy

- Estrogen
- Antibiotics
- Corticosteroids
- Disease-modifying antirheumatic drugs (DMARDs)
  - Immunosuppressives/Cytotoxics
    - Methotrexate
    - Immuran
    - Cyclosporin
    - Arava

Nutrition

- Protein
- Fluids
- Vitamins
- Fiber
- Calcium
- Weight control

Nursing Diagnosis

- Altered nutrition: < or > than body requirements
- Alteration in comfort
- Risk for infection
- Impaired physical mobility
- Altered health maintenance
- Social isolation
- Body image disturbance
- Risk for injury
**Outcomes**

- Adequate nutrition
- Vital signs WNL
- CSM WNL
- Mobility/ROM
- Decreased pain
- Normal elimination pattern
- Understanding of disease process

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**Nursing Interventions & Discharge Planning**

**Assess**

**Support**

**Teach**

- Diet
- Medications
- Assistive devices can relieve pressure on joints and promote mobility
- Safety - follow strenuous exercise with a cool-down period before relaxing. Stretching and warm-up exercises are an important part of the exercise routine
- Pain management

- Community resources
- Teach & evaluate activities (return demo)
- Coordinate home care
- S & S to report
- Medication usage

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**Legal & Ethical Issues**

- Pain control management
- Use of cadaver bones, ligaments
- Autonomy
- Confidentiality
- Beneficence
1. A 23-year-old college student has an open fracture of the left leg from a motor vehicle accident (MVA). Following reduction of the fracture and suturing of the laceration, the physician applied a long leg cast and admitted her to the nursing unit. During a routine assessment of her cast, she complains that her foot is cool and numb. What would you do?

2. 24 hours later, the same college student complains of pain unrelieved with analgesics that had been effective earlier. Her foot is cold, capillary refill is >3 seconds, pain on passive movement of her toes, and there is marked increase in swelling. What would you do? Why?

3. What would you teach a patient about cast care in preparation for discharge?

4. Mrs. K has had a right total hip replacement. She asks you to review the positions and movements she should avoid. What will you tell her? Are there any exercises she should perform?
5. Mrs. Heberden has been diagnosed with osteoarthritis of the hip. Oh! That’s terrible! she exclaims. My neighbor had arthritis and her blood vessels got inflamed as well as her joints. She died from a heart problem caused by her arthritis. What does she need to know?

6. Mrs. Norman has rheumatoid arthritis and is so stiff in the morning that she cannot prepare her husband’s breakfast before he leaves for work. She feels worthless because she is unable to fix his breakfast. Can you help her?

7. Eighteen hours after a compound fracture of the femur, a patient who had been lucid and stable suddenly becomes restless and confused with rapid respirations, tachycardia, and has petechiae on the anterior chest & neck. What is this patient’s predominant physiological need? What do you believe is happening? What is this patient’s primary physiological need? Why?

8. What are the five P’s that remind us of the necessary assessment for a patient who has a cast?

9. Avascular necrosis of bone most commonly occurs at the _______ of the _______.

10. The process of fitting a fracture together is called ________.

11. Immediate application of cold to an injury may minimize _______, while immediate application of heat may promote _______.

12. An elastic bandage used to immobilize a strained ankle should be re-wrapped every ___ hours to check the condition of the skin; the bandage must be tight enough to provide ________ but not so tight as to impair ________.

13. Casts are applied to immobilize the joints _______ and _______ the fractured bone; this prevents _______ at the site of the fracture.

14. Systemic manifestations of adult and juvenile _____________ may include vasculitis, renal, and cardiac dysfunction.

15. A man who has gout needs to know that the medications _______ and _______ may cause _______ which will worsen the gout. In addition he should drink at least _______ ml fluids daily to protect his kidneys.

16. List three positions/movements of the operative hip joint to avoid after hip replacement.

17. Brian, a 14 year-old-boy, has been treated for a slipped capital femoral epiphysis. He asks when he will be finished with follow-up care. What will you tell him and why?

18. A taxi driver has been unable to work for weeks because he fractured his right ankle. He is behind in his rent. When the cast was removed today, delayed union was diagnosed. He is frowning and biting his lip. One of your nursing diagnosis might be:

Evaluate your care: For each of the nursing diagnosis below, list at least two outcome criteria for use in evaluation of your nursing care.

- Diagnosis: Pain related to inflammation and muscle spasm
  Outcome:
  Outcome:

- Diagnosis: Impaired mobility related to joint stiffness
  Outcome:
  Outcome:

- Diagnosis: Risk for injury related to improper use of crutches, unsteady gait.
  Outcome:
  Outcome:
Use the clues provided to complete this exercise. One letter goes in each blank

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1. Long term use of this common group of medications is a frequent cause of osteoporosis.
2. A decrease in this hormone after menopause is considered to be an important etiological factor in postmenopausal osteoporosis.
3. Measures to promote are very important in both hospitalized and non-hospitalized persons with osteoporosis.
4. Osteoporosis occurs when bone ______________ occurs faster than bone formation.
5. __________ promotes osteoporosis by reducing the stimuli to bone formation.
6. A person suspected of having osteoporosis may manifest which spinal alteration?
7. and 8. Handle a person with osteoporosis carefully when turning to prevent __________
9. Dietary intake of __________ is essential for prevention and treatment of osteoporosis.
10. Demineralization of the bones is decreased by __________

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