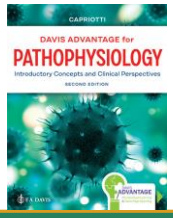

Chapter 38

Degenerative Disorders of the Musculoskeletal System

1

Overview

- Osteoporosis
  - Most common degenerative disease of bone
  - Occurs with aging
    - Osteoclast activity greater than osteoblast activity
- Osteoarthritis (OA)
  - Degeneration of joints with aging
- Degenerative disc disease (DDD)
  - Discs between vertebrae become compressed or misaligned

2

Basic Concepts

- Hydroxyapatite
  - Ca++ and phosphate crystals
- Two types of bone
  - Cortical
    - Dense
  - Trabecular
    - Cancellous, spongy
    - Found in high amounts in the upper femur, vertebrae, and wrist
    - Osteoporosis of trabecular bone displays degeneration first

3

Bone Health

- Constant remodeling
- Dependent on calcium
- Hormones
  - Vitamin D: calcium absorption
  - Calcitonin
  - Parathyroid hormone
  - Testosterone and estrogen
- Mechanical stimulation

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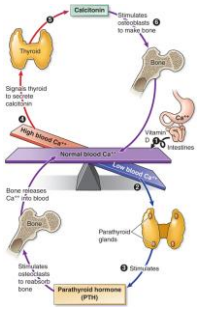
Bone Health (continued)



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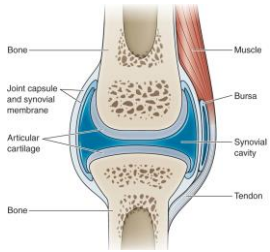
Joint Health

- Types of joints
  - Synarthrosis
    - No mobility
  - Diarthrosis
    - Most movement
    - Synovial joint
  - Amphiarthrosis
    - Moderately movable
- Arthropathy
  - Joint disorder
- Arthritis
  - Inflammation of joint



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Degeneration of Bone

- Bone remodeling
  - Destruction and reconstruction of bone
- Involves osteoclasts and osteoblasts
- Stimulated by stresses upon bone
- Osteoporosis is elevated osteoclast activity without adequate bone replacement
- Recommended calcium intake to maintain bone health: 1,000–1,200 mg/day

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Degeneration of Joints

- OA affects certain joints and not others
- OA targets
  - Cervical and lumbosacral spine
  - Hip
  - Knee
  - 1st metatarsal phalangeal joint
  - Wrist, elbow, and ankle are often spared

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Articular Cartilage Deterioration

- Chondrocytes produce cartilage
  - Cartilage loss in with age
  - Cartilage, along with synovial fluid, provides cushioning
- Excessive force causes cartilage to breakdown
- Subchondral bone deterioration

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Articular Cartilage Deterioration (continued)

- Osteophytes
  - Form at margin of cartilage loss
  - Hallmark of OA
- In OA, synovial membrane often becomes inflamed
  - Concentration of lubricin (glycoprotein that acts as lubricant) declines

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Assessment

- Pain
  - When did it begin
  - Location
- Swelling
- Subsequent course
- Impact on life
  - Activities of daily living (ADLs)
- Management strategies
- Current medications
- Surgeries, injuries
- Assess the joint
  - Swelling
  - Tenderness
  - Muscle strength
  - ROM

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Diagnosis and Treatment

- Diagnosis
  - X-ray
  - CT scan
  - MRI
  - Bone scan
  - DEXA
    - Bone mineral density (BMD)
    - T score
- Treatment
  - NSAIDs
  - Corticosteroids
    - Oral or injected into joint
  - Osteoporosis
    - Bisphosphonates
    - Selective estrogen receptor modulators (SERMs)
    - Parathyroid hormone
    - Biologic agents

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Osteoporosis

- Osteoporosis: "porous bone"
  - Low bone density
  - Structural deterioration of bone
  - Breaks in trabecular matrix
- Osteopenia
  - Thinning of trabecular matrix (occurs before osteoporosis)
- Silent disease
  - May present with pathological fracture or height loss

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Risk Factors of Osteoporosis

- Female gender
- Postmenopausal age in female
- Lack of estrogen in female
- Lack of testosterone in male
- Family history
- Asian and Caucasian women
- Thin and small-framed women
- Lack of recommended daily intake of calcium and vitamin D
- Lack of weight-bearing exercise
- Excess alcohol consumption
- Excess caffeine consumption
- Smoking
- Long-term use of corticosteroids
- Excess carbonated soft drink consumption
- Gastric bariatric surgery
- Eating disorders such as anorexia
- Hyperthyroidism or excessive intake of thyroid medication
- Hyperparathyroidism
- Anticonvulsant medications

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Hip Fracture and Mortality

- Increased mortality risk with osteoporotic hip fractures
- Risk of mortality is 2.8 to 4 times greater among hip fracture patients during the first 3 months after the fracture
- Nearly 1 in 4 fracture patients will die within 12 months after fracture

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Osteoporosis (continued_1)

- Primary
  - Prolonged negative calcium balance
  - Poor dietary habits, lack of weight-bearing exercise, lack of daily exposure to sunlight
- Secondary
  - Disorders that affect bone tissue
  - i.e., hyperparathyroidism, corticosteroids

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Osteoporosis (continued_2)

- Hormones play a role in BMD
  - Estrogen slows osteoclast activity
    - Postmenopausal women
    - Female triad
      - Amenorrhea, decreased body weight, excessive exercise

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Osteoporosis Diagnosis

- Dual energy x-ray absorptiometry (DEXA)
  - Measures BMD
    - Compared with reference population of healthy adults, age 30 years
  - Reported at T score
- X-rays do not show osteoporosis until bone loss more than 40%
- Blood tests
  - PTH, estradiol, osteocalcin (protein in bone, high level indicates bone breakdown)

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Osteoporosis Diagnosis (continued)

- Urine
  - Telopeptides, bone breakdown product
- FRAX risk assessment
  - Self-assessment tool to predict a person's risk of fracture
  - Gives a 10-year probability of a fracture in the spine, hip, shoulder, or wrist
  - Ages 40–90 years

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Osteoporosis Treatment

- Lifestyle changes
  - Diet
    - 1,000 mg of calcium and 400 IU vitamin D
  - UV light, appropriate weight-bearing exercise
- Anti-resorption
  - Bisphosphonates
    - Have been associated with atypical fractures
  - SERMs (selective estrogen receptor modulators)
  - Denosumab

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Osteoporosis Treatment (continued)

- Calcitonin
  - Increases bone formation (effective vertebral compression)
- Teriparatide
  - Stimulates osteoblasts
- Vertebroplasty
  - Injecting bone cement into the fractured area of the vertebrae

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Osteoarthritis (OA)

- Individuals older than age 40 years
- Associated with trauma to joints over course of life
  - Slowly progressive, degenerative, and inflammatory condition
  - Changes in cartilage lead to inflammation and changes in joint surfaces
- Excess weight increases risk for OA in weight-bearing joints

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Risk Factors of OA

- Aging
- Obesity
- History of participation in team sports
- History of trauma or overuse of a joint
- Heavy occupational work
- Misalignment of the pelvis, hip, knee, ankle, or foot

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Osteoarthritis (OA) (continued_1)

- Patient presents with following:
  - Deep, aching joint pain
  - Pain relieved with rest
  - Joint pain during cold weather
  - Stiffness when arising in the morning
  - Crepitus of the joint during motion
  - Joint swelling
  - Altered gait
  - Limited range of motion

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OA Physical Examination

- Joint deformity
- Joint tenderness
- Decreased range of motion
- Fingers are often involved in OA
  - Swellings
    - Heberden's nodes
      - Distal interphalangeal joint (DIP)
    - Bouchard's nodes
      - Proximal interphalangeal joint (PIP)

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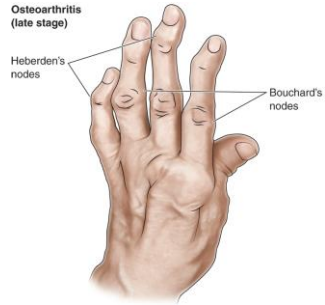
Osteoarthritis (OA) (continued_2)



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OA Diagnosis

- Diagnosis
  - No specific laboratory test
  - Serum markers
    - Osteocalcin and hyaluronic acid
  - Physical examination
  - X-rays confirm diagnosis
    - Joint space narrowing
    - Osteophytes

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OA Treatment

- Treatment
- NSAIDs
- Oral steroids not recommended
  - Intra-articular injections or topical may help
- Maintain mobility
  - Moderate exercise
- Dietary supplements
  - Chondroitin sulfate
- Reduce stress on joints

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OA Surgical Options

- Osteotomy
  - Excision of bone spurs
- Osteoplasty
  - Scraping and removal of deteriorated tissue from the joint
- Arthrodesis
  - Surgical fusion of bone (spine)
- Partial or total joint arthroplasty
  - Deteriorated bone replaced with a prosthetic device

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Rickets

- Children (infants 4 to 12 months of age)
- Lack of vitamin D, calcium, phosphorus
  - Food supplementation with vitamin D has reduced development of rickets
  - Reduced vitamin D decreases calcium absorption
  - If serum calcium levels fall, PTH secreted, stimulating bone breakdown
- Risk factors
  - Lactose intolerance, malabsorption, malnutrition

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Rickets (continued)

- Malformation of bones develop
- Protrusion of sternum
- Varus deformity (bowing) of the legs
- Costochondral swellings
- Delay in fontanelle closure, tooth development

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Rickets Diagnosis and Treatment

- Diagnosis
  - Serum levels of calcium PTH, alkaline phosphate
  - X-rays showing bone deformity
- Treatment
  - 400 to 1,000 IU of vitamin D daily are needed with adequate calcium intake
  - Daily UV exposure of 10 to 30 minutes for vitamin D metabolism

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Osteomalacia

- Adult vitamin D deficiency
- Similar to rickets
- In adults, vitamin D deficiency is not necessarily caused by malnutrition
- Common causes
  - Lack of sufficient exposure to sunlight
  - Renal disorders
  - Cancer
  - Gastrointestinal malabsorption

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Osteomalacia (continued)

- Vitamin D deficiency reduces calcium absorption
  - PTH released leading to bone breakdown
- Bone weakens, intense pain
- Lumbar back pain, particularly walking up and down stairs

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Osteomalacia Diagnosis

- Diagnosis
  - Blood test for vitamin D, PTH, alkaline phosphatase (Ca++ may be normal)
- DEXA
- X-ray
  - Pseudofracture (Looser's zones)
    - Along the surfaces and shafts of long bones
  - Subperiosteal resorption, increased cortical thinning, and bone porosity

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Treatment of Osteomalacia

- 50,000 IU of ergocalciferol (vitamin D_2) until normalized
- Maintenance doses: 1,000 IU vitamin D_3 daily
- Patient should get adequate sunlight and increase calcium in the diet

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Degenerative Disc Disease (DDD)

- Common cause of pain, motor weakness, and neuropathy
- Nervous system affected as vertebral disc distortions compromise spinal nerves
- Cervical and lumbar regions
  - L4, L5, and S1 most commonly affected

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Signs and Symptoms of DDD

- Signs and symptoms of ***lumbar*** DDD
  - Pain in the lower back that radiates down the back of the leg (also called "sciatica")
  - Pain in the buttocks or thighs
  - Pain that worsens when sitting, bending, lifting, or twisting
  - Pain that is minimized when walking, changing positions, or lying down
  - Numbness, tingling, or weakness in the legs
  - Foot drop

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Signs and Symptoms of DDD (continued)

- Signs and symptoms of ***cervical*** DDD
  - Chronic neck pain that can radiate to the shoulders and down the arms
  - Numbness or tingling in the arm or hand
  - Weakness of the arm or hand

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Spinal Nerve Impingement

- Herniated disc
- Bulging disc
- Degenerated disc
- Osteophyte formation
  - Bony formations can narrow the spinal canal
  - Spinal stenosis
- Slippage of disc and vertebrae
  - Spondylolisthesis: forward
  - Retrolisthesis: backward

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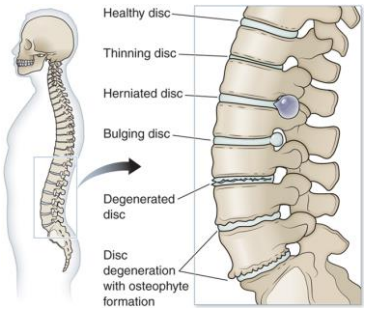
Spinal Nerve Impingement (continued)



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DDD Physical Examination

- The clinician should test:
  - Muscle strength
  - Deep tendon reflexes
  - Sensory dermatomes
    - Give information about which spinal nerve is affected

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DDD Diagnosis and Treatment

- Diagnosis
  - Physical examination tests
  - X-ray
  - MRI
  - EMG
- Treatment
  - Physical therapy
  - Pain management
  - Epidural steroid injection
  - Chiropractic care
  - Surgery

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Spinal Stenosis

- Anatomic narrowing of spinal canal, nerve root canal, and intervertebral foramina
- Develops over time
- Symptoms similar to disc herniation
- Diagnosis
  - X-ray
  - MRI
- Treatment
  - Pain management

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Cauda Equina Syndrome

- Compressed lumbosacral nerves in DDD
- Compromised bowel or bladder function
- Medical emergency

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