Bio217: Pathophysiology Notes  
Professor Linda Falkow

Unit X: Musculoskeletal System & Integumentary System

Chapter 36: Musculoskeletal System
Chapter 37: Alterations of Musculoskeletal Function
Chapter 39: Structure, Function & Disorders of the Integumentary System

Skeletal System
- Forms the body
- Supports tissues
- Permits movement
  - by providing attachment points for muscles
- Hemopoiesis (blood cell formation)
- Mineral storage

Elements of Bone Tissue
- Rigid connective tissue
- Constituents
  - Cells
  - Fibers
  - Ground substance
  - Calcium

Bone Cells
- Enable bone to grow, repair, synthesize new bone tissue and resorb old tissue
  - Osteoblast
    - Bone forming cell
  - Osteoclast
    - Reabsorptive bone cell
  - Osteocyte
    - Transformed osteoblast, maintains matrix

Bone Matrix
- extracellular components

- Collagen fibers – tensile strength
- Proteoglycans – strengthen bone, transport Ca++
- Glycoproteins – regulate collagen interactions → fibril formation
- Bone mineralization – crystals of HAP (hydroxyapatite) \((\text{Ca}_x \text{PO}_y\text{OH}_z)\)

Bone Tissue
- Compact (cortical) bone
  - 85% of the skeleton
  - Haversian system (osteon)
    - Haversian (central) canal, lamellae, lacunae, osteocyte, and canaliculi
- Spongy (cancellous) bone
  - Lack haversian systems
  - Trabeculae
- Periosteum
Bone Tissue
Structure of compact bone & cancellous bone

Bone
• 206 bones
• Axial skeleton
  – 80 bones
    • Skull, vertebral column, thorax
• Appendicular skeleton
  – 126 bones
    • Upper and lower extremities, pectoral and pelvic girdle

Bones
• Long bones
  – Upper and lower extremities
• Flat bones
  – Ribs and scapulae
• Short bones (cuboidal bones)
  – Wrist and ankles
• Irregular bones
  – Vertebrae, mandibles, facial bones

Long Bone
Longitudinal section of long bone

Bone Remodeling and Repair
• Bone remodeling
  – Maintains internal structure
  – Repair microscopic injuries
• Bone Repair
  – Fractures and gross injuries
  – Inflammation/hematoma formation
  – Procallus formation
  – Callus formation
  – Callus replacement
  – Remodeling

Joints
• Joint classifications based on movement
  – Synarthrosis
    • Immovable
  – Amphiarthrosis
    • Slightly movable
  – Diarthrosis
    • Freely movable
Joints

- Joint classifications based on **structure**
  - Fibrous
    - Joins bone to bone
    - Suture, syndesmosis, gomphosis
  - Cartilaginous
    - Symphysis and synchondrosis
  - Synovial
    - Uniaxial, biaxial, or multiaxial
    - Joint capsule, synovial membrane, joint cavity, synovial fluid, articular cartilage

---

**Knee Joint (synovial)**

---

**Synovial Joint Movements**

---

**Skeletal Muscles**

- Millions of individual muscle fibers (= muscle cells) contract and relax to facilitate movement
  - More than 600 in body
  - 2 to 60 cm long
Skeletal Muscles

- Whole muscle
  - Fascia (3 part CT framework)
  - Epimysium
    - Entire belly of muscle
  - Perimysium
    - Fascicles
      - Bundles of muscle fibers
  - Endomysium
    - Individual muscle fiber

Muscle

- Skeletal muscle
  - Voluntary
  - Striated
  - Motor units

  ![Muscle fibers](image)

Muscle Fibers

- Sarcotubular system
  - Transverse tubules
  - Sarcoplasmic reticulum (SR)

- Sarcomere (myofibrils)
  - Muscle proteins
    - Actin
    - Myosin
    - Troponin-tropomyosin complex

- Nonprotein components:
  - Creatine and creatinine
  - Phosphate, chloride, calcium, magnesium, sodium, potassium

Myofibrils

- Cross-section of myofibril
- Actin and myosin filaments
- T-tubules and sarcoplasmic reticulum
- Cross-strriations
- Mitochondria
- Transverse tubules (T-tubules)
- Sarcoplasmic reticulum
- Myofibrils
Muscle Contraction

- Excitation
  - Muscle fiber action potential
- Coupling
- Contraction
  - Cross-bridge theory
- Relaxation

Muscle Metabolism

- Requires constant supply of ATP and phosphocreatine (CP creatine phosphate)
- Strenuous activity requires oxygen
- Type I fibers can resist fatigue longer than type II fibers

Concept Check

1. The skeletal system:
   - A. Supports tissues
   - B. Binds organs together
   - C. Protects CNS structures
   - D. Involved in blood cell production
   - E. Lines body cavities

2. A function of the epiphyseal plate that is not a function of articular cartilage:
   - A. Enable articulation of bones
   - B. Enable bones to increase in length
   - C. Repair damaged bone
   - D. Provide sensory nerves to bone

3. Joints are classified functionally & structurally. Which is a correct functional/structural relationship?
   - A. Amphiarthrosis/fibrous
   - B. Diarthrosis/ synovial
   - C. Synarthrosis/ synchondrosis
   - D. Diarthrosis/ fibrous
   - E. Synarthrosis/ cartilaginous

4. Which is not included in a motor unit?
   - A. Muscle fibers
   - B. Motor nerve axons
   - C. Anterior horn cell
   - D. Upper motor neuron

5. Which are correctly matched?
   - A. Sarcomere – unit of contraction
   - B. Sarcolemma – membrane covering the muscle cell
   - C. Sarcoplasmic reticulum – Ca storage and transport
   - D. All of the above are correct

Musculoskeletal Injuries

- Alterations of Musculoskeletal Function

- Chapter 37

- Fractures
  - Break in a bone

  - Classifications
    - Complete or incomplete (broken completely through or not)
      - Closed or open (compound) (skin intact or skin is broken)
    - Comminuted - fragmented
    - Linear – break is parallel to long axis of bone
    - Oblique – break at an oblique angle
    - Spiral – encircles bone
    - Transverse – at right angles to long axis
Fracture Classifications

• Greenstick – incomplete break
• Torus - buckling of bone
• Bowing – bending of bone
• Pathologic – due to disease (osteoarthritis)
• Stress – microfracture often due to repeated stress, common in athletes

Bone Fractures

Pathophysiology

1. Bleeding at ends of bone → Hematoma formation
2. Bone tissue destruction → inflammatory response
   - Procallus formation
   - Callus formation
   - Callus reabsorption
   - Remodeling

Callus Formation

A. Hematoma
B. Fibrous network
C. Ca deposition
D. Callus formation
E. Remodeling

Callus Formation

Excessive callus formation

Bone Fractures

Dislocation
- Temporary displacement of two bones
- Loss of contact between articular cartilage

Subluxation
- Contact between articular surfaces is only partially lost

Both caused by trauma
Support Structure Injuries

- **Strain**
  - Tear or injury to a tendon

- **Sprain**
  - Tear or injury to a ligament

- **Avulsion**
  - Complete separation of a tendon or ligament from its bony attachment site

Tendinopathy and Bursitis

- **Tendinitis**
  - Inflammation of a tendon

- **Bursitis**
  - Inflammation of a bursa

- **Epicondyritis**
  - Inflammation of a tendon where it attaches to bone
    - Tennis elbow (lateral epicondyritis)
    - Golfer's elbow (medial epicondyritis)

Tendinopathy and Bursitis

Rhabdomyolysis

- **Rhabdomyolysis** (myoglobinuria) is a life-threatening complication of severe muscle trauma with muscle cell loss
  - Excess myoglobin in urine due to muscle damage

- Pathophysiology
  - Wt. of limp extremity → ischemia → edema → necrosis (cell loss)

Osteoporosis

- **Metabolic bone disorder** → decreased bone mass
  - (Bone resorption >> bone deposition)

- **Porous bone**
- **Poorly mineralized bone**
- **Bone density**
  - Normal bone: 833 mg/cm²
  - Osteopenic bone: 833 to 648 mg/cm²
  - Osteoporosis: <648 mg/cm²

Osteoporosis

- **Potential causes**
  - Decreased levels of estrogens and testosterone
  - Decreased activity level
  - Inadequate levels of vitamins D, C, or Mg²⁺
    (diet or absorption problems)
Osteoporosis

- Iatrogenic osteoporosis
  - Patients on heparin (→ bone resorption)

- Regional osteoporosis
  - Disuse of body region, or weightlessness → uniform dist. of bone loss

- Postmenopausal osteoporosis
  - Decreased level of estrogens, or hyperparathyroidism

- Glucocorticoid-induced osteoporosis (cortisone → incr. bone resorption, decr. formation)

- Age-related bone loss → begins in 4th decade
Osteomalacia

- Metabolic disorder → inadequate mineralization (aka adult rickets)
- Deficiency of vitamin D lowers the absorption of Ca from the intestines
- Bone formation progresses to osteoid formation but calcification does not occur → soft bones
  - Pain, bone fractures, vertebral collapse, bone malformation

Paget Disease

- Abnormal remodeling - irregular resorption and deposition of bone
  - (aka osteitis deformans)
- Disorganized, thickened, but soft bones
- Most often affects the axial skeleton
  - Skull thickens → compresses brain tissue
  - → cranial nerves impacted
  - → hearing loss
- Idiopathic, viral?

Osteomyelitis

- Infectious bone disorder
  Caused by a staphylococcal infection
- Most common cause is open wound (exogenous); also can be from blood-borne (endogenous) infection

Osteomyelitis

- Pathophysiology:
  - Bone infection → inflammatory response
    · (vascular engorgement, edema incr. WBCs, abscess formation
  - Exudate can seal canaliculi, extend into metaphysis and marrow
- Manifestations
  - Acute and chronic inflammation, fever, pain, necrotic bone
- Treatment
  - Antibiotics, débridement, surgery, hyperbaric oxygen therapy

Osteomyelitis showing sequestration and involucrum
Osteoarthritis

• **aka** Inflammatory Joint Disease
• Characterized by inflammatory damage or destruction in the synovial membrane or articular cartilage and by systemic signs of inflammation
  – Fever, leukocytosis, malaise, anorexia, and hyperfibrinogenemia

Osteoarthritis (OA)

- Most common form of arthritis
- Erosion of articular cartilage → bone spurs (osteophytes)
- Age related
- Affects mostly hips and knees, can affect any joint
- Primary disease is idiopathic (metabolic factors, genetics, chemical & mechanical factors)

Osteoarthritis

- OA characterized by local areas of damage and loss of articular cartilage, new bone formation of joint margins, subchondral bone changes, mild synovitis and thickening of the joint capsule
- Manifestations
  – Pain, stiffness, enlargement of the joint, tenderness, limited motion, and deformity

Degeneration of cartilage of hip joint

Rheumatoid Arthritis (RA)

- Chronic, progressive, systemic, inflammatory disorder of joints
- Systemic autoimmune damage to CT, primarily in the joints (synovial membrane)
- Affects symmetrical joints
- Similar symptoms to osteoarthritis

Nodes form in proximal and distal joints of fingers
**Rheumatoid Arthritis**

- Presence of rheumatoid factors (RA or RF test)
  - Antibodies (IgG and IgM) against antibodies
- Synovitis → edema and inflamed synovial membrane

**Rheumatoid Arthritis**

- Pathogenesis
  - CD4 T helper cells and other cells in the synovial fluid become activated and release cytokines
  - Recruitment and retention of inflammatory cells in the joint sublining region
  - Cycle of altered cytokine and signal transduction pathways

**Rheumatoid Arthritis**

- Evaluation
  - Four or more of the following:
    - Morning joint stiffness lasting at least 1 hour
    - Arthritis of three or more joint areas
    - Arthritis of the hand joints
    - Symmetric arthritis
    - Rheumatoid nodules
    - Abnormal amounts of serum rheumatoid factor
    - Radiographic changes

**Ankylosing Spondylitis**

- Inflammatory joint disease of spine or sacroiliac joints causing stiffening and fusion of joints
- Systemic, immune inflammatory disease
Ankylosing Spondylitis

- Primary proposed site is the enthesis — Site where ligaments, tendons, and joint capsule are inserted into bone
- Cause unknown, but strong association with HLA-B27 antigen

- Begins with inflammation of fibrocartilage of vertebrae and sacroiliac joint
- Inflammatory cells infiltrate and erode fibrocartilage
- As repair begins, scar tissue ossifies & calcifies; joint eventually fuses

Ankylosing Spondylitis

- Early symptoms
  - Low back pain, stiffness, pain, and restricted motion
- Patient demonstrates loss of normal lumbar curvature

Gout

- Metabolic disorder
  - Disrupts the body’s control of uric acid production or excretion
- High levels of uric acid in blood and other body fluids
- Uric acid crystals are deposited in CT
- When these crystals occur in the synovial fluid, inflammation is known as “gouty arthritis”

- Mechanisms for crystal deposition
  - Lower body temperatures, decreased albumin or glycosaminoglycan levels, changes in ion concentration and pH, and trauma
- Clinical stages
  - Asymptomatic hyperuricemia
  - Acute gouty arthritis
  - Tophaceous gout
**Gout**

- Dietary purine → Body purine nucleotides → Purines → Tissue nucleic acids → Uric acid → Intestinal excretion → Renal excretion

**Fibromyalgia**

- Chronic widespread joint and muscle pain
- Vague symptoms
  - Increased sensitivity to touch, absence of inflammation, fatigue, and sleep disturbances

**Fibromyalgia**

- Possible factors
  - Flulike viral illness, chronic fatigue syndrome, HIV infection, Lyme disease, medications, physical or emotional trauma
- Scientific studies are unclear

**Bone Tumors**

- Osteosarcoma
  - 38% of bone tumors
  - Predominant in adolescents and young adults; occurs in seniors if history of radiation therapy
  - Contain masses of osteoid
    - "Streamers": noncalcified bone matrix and callus
  - Located in the metaphyses of long bones
    - 50% occur around the knees

**Osteosarcoma**
Concept Check

1. In a complete fracture:
   A. Fracture crosses the entire width of bone
   B. more than 2 bone fragments present
   C. separation of ligament exits
   D. the surface opposite break is intact.

2. Which is a definite sign of fracture?
   A. abrasion
   B. Shock
   C. Muscle spasm
   D. unnatural alignment

Matching:

3. subluxation  a. Compound fracture
4. tennis elbow  b. Common in elderly & children
5. open fracture  c. Lateral epicondylitis
6. greenstick fracture  d. Partial loss of contact between bone surfaces

Matching:

7. OA        e. Buildup of uric acid
8. RA        f. Staph infection in bone
9. Osteomyelitis  g. Affects wt-bearing joints, bone spurs form
10. Gout  h. Inflam., autoimmune, affects hands

Matching:

11. ankylosing spondylitis
12. fibromyalgia
13. osteosarcoma
14. rhabdomyolysis
   a. Muscle damage → myoglobinuria
   b. Malignant bone tumor
   c. Fatigue and muscle pain, sensitive to touch
   d. Ossification & fusion of vertebral column

Structure, Function, and Disorders of the Integument

Chapter 39

Regions of the Skin

- Epidermis
- Dermis
- Hypodermis - lies deep to skin

Regions

- Dermal appendages
  - Nails
  - Hair
  - Sebaceous glands
  - Eccrine and apocrine sweat glands
- Blood supply
  - Papillary capillaries
Nails

Aging and Skin Integrity

- Integumentary system reflects numerous changes from genetic and environmental factors
  - Skin becomes thinner, drier, wrinkled, and demonstrates changes in pigmentation
  - Shortening and decrease in number of capillary loops
  - Fewer melanocytes and Langerhans cells
  - Atrophy of the sebaceous, eccrine, and apocrine glands
  - Changes in hair color
  - Fewer hair follicles and growth of thinner hair

Clinical Manifestations of Skin Dysfunction

Flat Lesions
- 1. Macule – flat, circumscribed, discolored lesion, <1 cm;
  - freckle, nevus, petechia, measles
- 2. Patch – flat, irregular lesion, >1 cm;
  - vitiligo, port wine stains
- 3. Petechiae – circumscribed area of blood < 0.5 cm;
  - thrombocytopenia
- 4. Purpura – circumscribed area of blood > 0.5 cm;
  - bruises
- 5. Telangiectasia – fine, irregular red lines due to dilated superficial blood vessels; RA, rosacea

Elevated Lesions
- 6. Papule – elevated, firm area, < 1 cm;
  - wart, elevated moles, lichen planus
- 7. Plaque – elevated, firm, rough lesion with flat top > 1 cm;
  - psoriasis, eczema
- 8. Nodule – elevated, firm lesion, deeper in dermis than papule, 1-2 cm;
  - lipoma, Ca deposits
- 9. Wheal – transient, well defined and often changing borders;
  - hives, insect bites, allergic reaction
- 10. Vesicle and bulla – fluid-filled, thin walled lesion, bulla >1 cm;
  - blisters, herpes zoster, 2° burns
- 11. Pustule – lesion containing WBC exudates;
  - acne, impetigo

More Elevated Lesions
- 12. Comedo – plugged hair follicle, blackhead, whitehead
- 13. Scale – accumulation of stratum corneum, psoriasis
- 14. Crust – accumulation of dried blood or serum;
  - eczema, impetigo
- 15. Lichenification – thick, tough skin due to rubbing or itching;
  - chronic dermatitis
- 16. Cyst – encapsulated mass of dermis, solid or fluid filled;
  - sebaceous cyst
- 17. Tumor – solid lesion > 2 cm;
  - fibroma, lipoma, melanoma
- 18. Scar – thin or thick fibrous tissue;
  - healed laceration, burn or incision

Depressed Lesions
- 19. Atrophy – thinning of epidermis or dermis due to decreased CT;
  - thin skin of elderly
- 20. Ulcer – loss of epidermis and dermis;
  - pressure sores, basal cell carcinoma
- 21. Excoriation – loss of epidermis w/ exposed dermis;
  - scratches
- 22. Fissure – crack or break exposing dermis;
  - Athlete's foot, crack in corner of mouth
- 22. Erosion – moist, red break in epidermis after rupture of vesicle or bulla, larger than fissure;
  - Chickenpox, diaper dermatitis
Pressure Ulcers

- Result from any unrelieved pressure on skin, causing underlying tissue damage
  - Pressure
  - Shearing forces
  - Friction
  - Moisture

Pressure Ulcers

- Progression of decubitis ulcer: Compressed tissue over bony prominence → ischemia → necrosis

Pressure Ulcers

- Stages
  - Nonblanchable erythema of intact skin
  - Partial-thickness skin loss involving epidermis or dermis
  - Full-thickness skin loss involving damage or loss of subcutaneous tissue
  - Full-thickness skin loss with damage to muscle, bone, or supporting structures

Keloids

- Elevated, rounded, and firm
- Clawlike margins extend beyond original injury site
- Excessive collagen formation during dermal CT repair
- Common in darkly pigmented skin types and burn scars
- Type III collagen is increased

Pruritus

- Itching
- Most common symptom of primary skin disorders
- Itch is carried by specific unmyelinated C-nerve fibers and is triggered by a number of itch mediators
- The CNS can modulate the itch response
  - Pain stimuli at lower intensities can induce itching
  - Chronic itching can result in infections and scarring due to persistent scratching

Disorders of the Skin

- Inflammatory disorders
  - Most common inflammatory disorder of skin is dermatitis or eczema
  - Various types of dermatitis exist
  - Disorders are generally characterized by pruritus, lesions with indistinct borders, and epidermal changes
Inflammatory Disorders

- Allergic contact dermatitis
  - Caused by a hypersensitivity type IV reaction
  - Allergen comes in contact with skin, binds to a carrier protein to form sensitizing antigen; Langerhans cells process antigen and carry it to T cells, which become sensitized to the antigen

- Manifestations
  - Erythema, swelling, pruritus, vesicular lesions

A. Poison ivy on knee
B. Poison ivy dermatitis

- Irritant contact dermatitis
  - Nonimmunologic inflammation of the skin
  - Chemical irritation from acids or prolonged exposure to irritating substances (soaps, detergents, industrial agents)
  - Symptoms similar to allergic contact dermatitis
  - Treatment—remove stimulus

- Stasis dermatitis
  - Occurs in legs as a result of venous stasis, edema, and vascular trauma
  - Sequence of events: erythema, pruritus, scaling, petechiae, ulcerations

- Seborrheic dermatitis
  - Inflammation of the skin involving scalp, eyebrows, eyelids, nasolabial folds, and ear canals
  - Scaly, white, or yellowish plaques

Papulosquamous Disorders

- Psoriasis
  - Chronic, relapsing, proliferative skin disorder
  - T cell immune-mediated skin disease
  - Scaly, thick, silvery, elevated lesions, usually on scalp, elbows, or knees caused by a high mitotic rate in basal layer
  - Shows evidence of dermal and epidermal thickening
  - Epidermal turnover goes from 26-30 days to 3-4 days
  - Cells do not have time to mature or adequately keratinize

Stasis and Seborrheic Dermatitis

Psoriasis
Guttate Psoriasis after Strep infection
Papulosquamous Disorders

- **Pityriasis rosea**
  - Benign, self-limiting inflammatory disorder
  - Usually occurs during the winter months
  - Herald patch
    - Circular, demarcated, salmon-pink, 3- to 4-cm lesion

Papulosquamous Disorders

- **Lichen planus**
  - Benign, inflammatory disorder of the skin and mucous membranes
  - Unknown origin, but T cells, adhesion molecules, inflammatory cytokines, and antigen presenting cells are involved
  - Nonscaling, violet-colored, 2- to 4-mm lesions
  - Wrists, ankles, lower legs, genitalia

Papulosquamous Disorders

- **Acne vulgaris**
  - Inflammatory disease of the pilosebaceous follicles
  - **Acne rosacea**
    - Inflammation of the skin that develops in adulthood
    - Lesions
      - Erythematotelangiectatic, papulopustular, phymatous, and ocular
    - Associated with chronic, inappropriate VD resulting in flushing and sensitivity to sun

Papulosquamous Disorders

- **Lupus erythematosus**
  - Inflammatory, autoimmune disease with cutaneous manifestations
  - Discoid lupus erythematosus
    - Restricted to the skin
    - Photosensitivity
    - Butterfly pattern over the nose and cheeks
  - Systemic lupus erythematosus

Vesiculobullous Disorders

- **Pemphigus**
  - Rare, chronic, blister-forming disease of skin and oral mucous membranes
  - Blisters form in deep or superficial epidermis
  - Autoimmune disease caused by circulating IgG autoantibodies
Vesiculobullous Disorders

- **Pemphigus**
  - Tissue biopsies demonstrate autoantibody presence
  - Types
    - Pemphigus vulgaris (severe)
    - Pemphigus foliaceous
    - Pemphigus erythematosus

- **Bullous pemphigoid**
  - More benign disease than pemphigus vulgaris
  - Bound IgG and blistering of the subepidermal skin layer
  - Subepidermal blistering and eosinophils distinguish pemphigoid from pemphigus

- **Erythema multiforme**
  - Acute, recurring disorder of the skin and mucous membranes
  - Associated with allergic or toxic reactions to drugs or microorganisms
  - Caused by immune complexes formed and deposited around dermal blood vessels, basement membranes, and keratinocytes

Infections

- **Bacterial infections**
  - Folliculitis
  - Furuncles
  - Carbuncles
  - Cellulitis
  - Erysipelas
  - Impetigo

- **Viral infections**
  - Herpes zoster and varicella
Warts
- Benign lesions caused by the human papillomavirus (HPV)
- Diagnosed by visualization
- Condylomata acuminata – Venereal warts

Fungal Infections
- Fungi causing superficial skin lesions are called dermatophytes
- Fungal disorders are called mycoses; mycoses caused by dermatophytes are termed tinea
  - Tinea capitis (scalp)
  - Tinea pedis (athlete’s foot)
  - Tinea corporis (ringworm)
  - Tinea cruris (groin, jock itch)
  - Tinea unguium (nails) or onychomycosis

Fungal Infections
- Candidiasis
  - Caused by Candida albicans
  - Normally found on the skin, in the GI tract, and in the vagina
  - C. albicans can change from a commensal organism to a pathogen
    - Local environment of moisture and warmth, systemic administration of antibiotics, pregnancy, diabetes mellitus, Cushing’s disease, debilitated states, age < 6 months, immunosuppression, and neoplastic diseases

Vascular Disorders
- Cutaneous vasculitis
  - Results from immune complexes in the small blood vessels
    - Develops from drugs, bacterial infections, viral infections, or allergens
  - Lesions
    - Palpable purpura progressing to hemorrhagic bullae with necrosis and ulceration

Vascular Disorders
- Urticaria
  - Caused by type I hypersensitivity reactions to allergens
  - Histamine release causes endothelial cells of skin to contract
    - Causes leakage of fluid from the vessels
  - Treatment
    - Antihistamines and steroids

Vascular Disorders
- Scleroderma
  - Sclerosis of the skin that can progress to internal organs
  - The disease is associated with several antibodies
  - Lesions exhibit massive deposits of collagen with inflammation, vascular changes, and capillary dilation
  - Skin is hard, hypopigmented, taut, and tightly connected to underlying tissue
Vascular Disorders

- Scleroderma
  - Facial skin becomes very tight
  - Fingers become tapered and flexed; nails and fingertips can be lost from atrophy
  - Mouth may not open completely
  - 50% of patients die within 5 years

Insect Bites

- Bees
- Mosquitoes
- Flies

Benign Tumors

- Seborrheic keratosis
- Keratoacanthoma
- Actinic keratosis
- Nevi (moles)

Cancer

- Basal cell carcinoma
- Squamous cell carcinoma
- Malignant melanoma
- Kaposi sarcoma
Burns

- Partial-thickness burns
  - First degree
- Superficial and deep partial
  - Second degree
- Full-thickness burns
  - Third degree
- “Rule of nines”

Rule of Nines

Burns

- Skin injury caused by exposure to extreme cold
- Usually affects fingers, toes, ears, nose, and cheeks
- The “burning reaction” is caused by alternating cycles of vasoconstriction and vasodilation
- Inflammation and reperfusion are both part of the pathophysiology

Frostbite

Disorders of the Hair

- Male-pattern alopecia
  - Genetically predisposed response to androgens
  - Androgen-sensitive and androgen-insensitive follicles
- Female-pattern alopecia
  - Associated with elevated levels of the serum adrenal androgen dehydroepiandrosterone sulfate
  - No loss of hair along the frontal hairline

Disorders of the Hair

- Alopecia areata
  - Autoimmune T cell–mediated inflammatory disease against hair follicles that results in baldness
- Hirsutism
  - Androgen-sensitive areas
    - Abnormal growth and distribution of hair on the face, body, and pubic area in a male pattern that occurs in women
Concept Check:

1. Which layer of the epidermis contains dead keratinocytes?
   - A. Corneum
   - B. Lucidum
   - C. Granulosum
   - D. Spinosum
   - E. Germinativum (Basale)

2. The dermis is composed of all of the following except:
   - A. Melanocytes
   - B. Collagen
   - C. Elastin
   - D. Apocrine sweat glands
   - E. Sebaceous glands

Match the lesion with the example:
3. Macule
   - A. hives
4. Nodule
   - B. psoriasis
5. Scale
   - C. lipoma
6. Wheal
   - D. freckle

7. Which are most likely to undergo malignant transformation?
   - A. Seborrheic keratosis
   - B. Nevi
   - C. Actinic keratosis
   - D. B and C are correct

8. A burn that destroys the epidermis and dermis is:
   - A. 1\textsuperscript{st} degree
   - B. 2\textsuperscript{nd} degree
   - C. 3\textsuperscript{rd} degree