

## ANATOMY

**Joints:** site where two or more bones come together, whether or not movement occurs between them

- Structural Classifications
  - *Fibrous joint*
    - Joined by fibrous tissue
    - Very little movement
    - Degree of movement depends on the length of the collagen fibers uniting the bones
  - *Cartilaginous joint*
    - **Primary**
      - Bones are United by a plate or a bar of hyaline cartilage
      - No movement is possible
      - Union between epiphysis and the diaphysis
    - **Secondary**
      - Bones are united by a plate of fibrocartilage
      - Small movement is possible
      - Articular surfaces are covered by a thin layer of hyaline cartilage

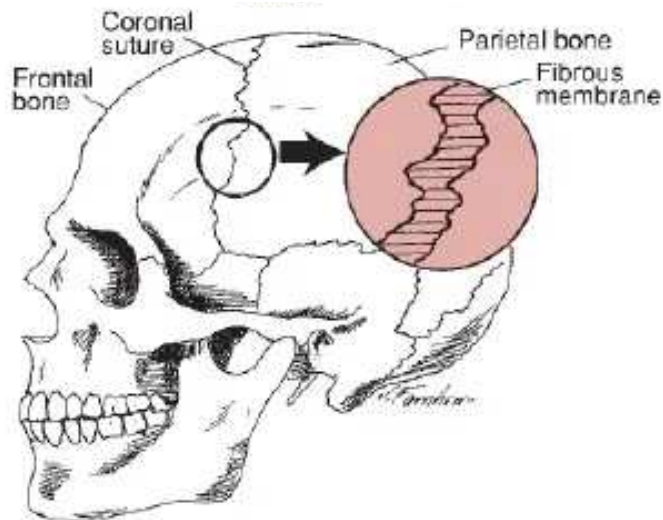


Figure 2-16. The Coronal Suture, Joint structure and function, 4<sup>th</sup> ed. FA Davis Company©2007

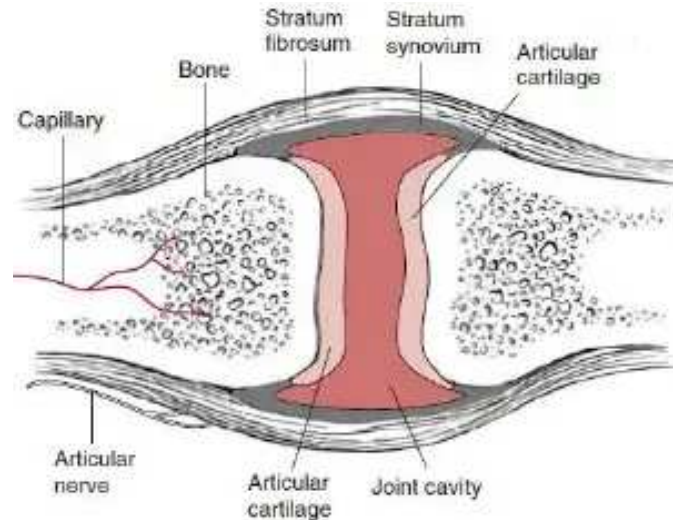


Figure 2-19. A typical diarthrodial joint, Joint structure and function, 4<sup>th</sup> ed. FA Davis Company©2007

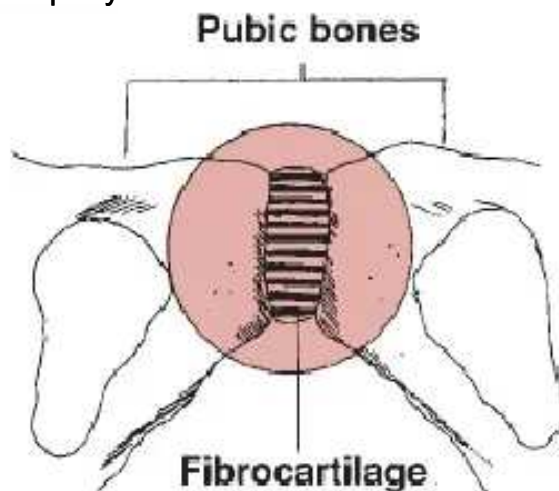


Figure 2-18. Cartilaginous Joint, Joint structure and function, 4<sup>th</sup> ed. FA Davis Company©2007

- *Synovial joint*

- Classification according to the arrangement of the articular surfaces and the type of movement possible

JOINTS	DEFINITION	MOVEMENT	EXAMPLE
Plane	Apposed articular structures are flat or almost flat; permits bone to slide upon each other	–	Sternoclavicular joint; acromioclavicular
Hinge	Resembles hinge in a door	Flexion-extension	Elbow, knee, ankle joint
Pivot	Central bony pivot surrounded by a bony ligamentous ring	Rotation	Atlanto-axial joint, radioulnar joint

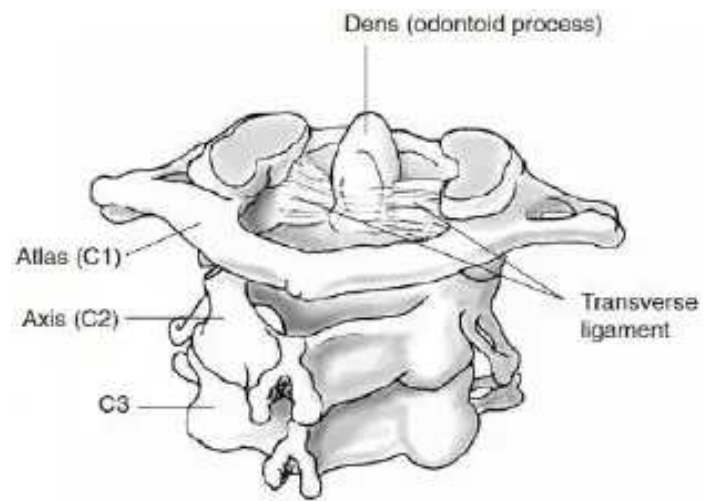
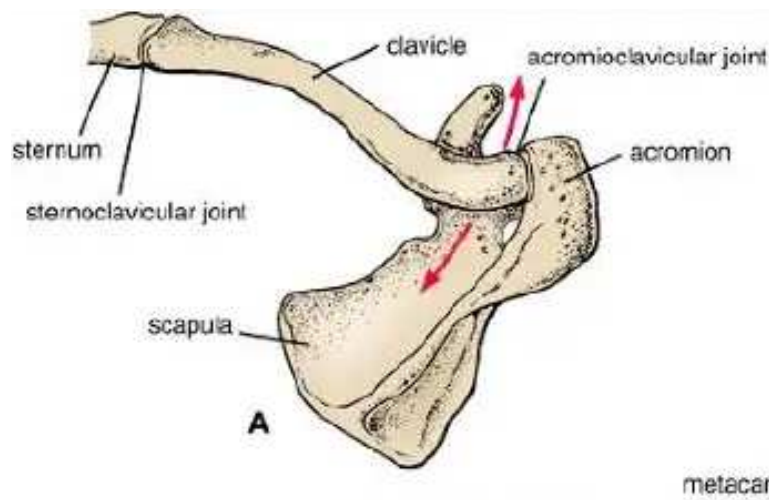


Figure 1-14. Examples of different types of synovial joint. Clinical Anatomy by Region, 8<sup>th</sup> ed. Lippincott Williams & Wilkins

Figure 2-22. A pivot joint. Joint structure and function, 4<sup>th</sup> ed. FA Davis Company ©2007

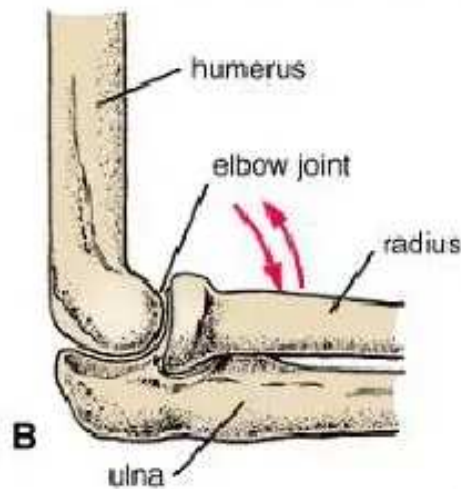
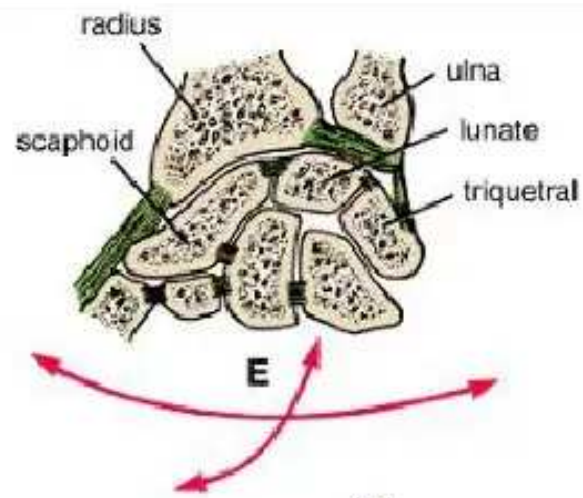


Figure 1-14. Examples of different types of synovial joint. Clinical Anatomy by Region, 8<sup>th</sup> ed. Lippincott Williams & Wilkins

Ellipsoid	Elliptical convex surfaces that fits into an elliptical concave articular surface	Flexion-extension, abduction-adduction	Wrist joint
Condylod	Have two distinct convex surfaces that articulates with two concave surfaces	Flexion-extension, abduction-adduction, small amount of rotation	MCP joints



*Ellipsoid*

Figure 1-14. Examples of different types of synovial joint. Clinical Anatomy by Region, 8<sup>th</sup> ed. Lippincott Williams & Wilkins

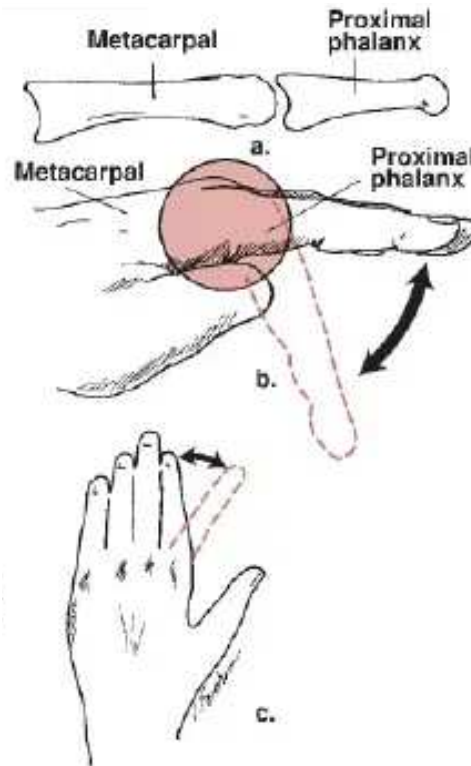
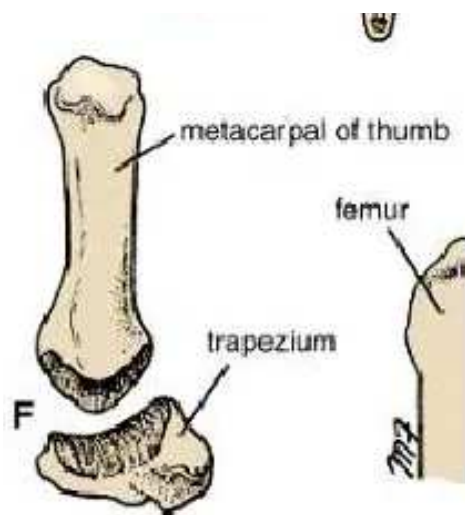


Figure 2-23. A condyloid joint. Joint structure and function, 4<sup>th</sup> ed. FA Davis Company©2007

Saddle	Articular surfaces are reciprocally concavoconvex and resembles a saddle on a horses back	Flexion-extension, abduction-adduction, and rotation	CMC Joint
Ball and socket	A ball-shaped head of one bone fits into a socket like concavity of another	Flexion-extension, abduction-adduction, lateral-medial rotation, circumduction	Shoulder and hip joint



*Saddle*

Figure 1-14. Examples of different types of synovial joint. Clinical Anatomy by Region, 8<sup>th</sup> ed. Lippincott Williams & Wilkins

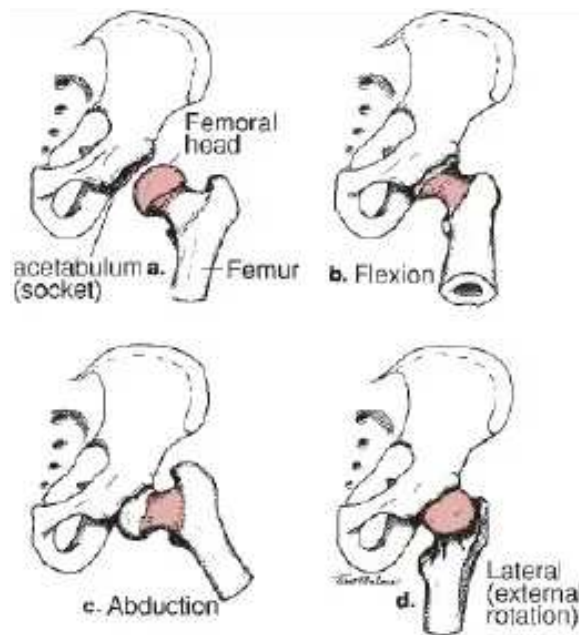


Figure 2-24. A ball-and-socket joint. Joint structure and function, 4<sup>th</sup> ed. FA Davis Company©2007

*Why synovial joint?*

1. stratum fibrosum (fibrous capsule) – outer layer
2. stratum synovium (stratum synovium) – inner layer

- a. intima
  - i. synoviocytes
    - 1. type a
    - 2. type b
- b. subsynovial tissue

The joint capsule is composed of two layers: stratum fibrosum and stratum synovium.

The stratum synovium also consists of two layers: the intima and subsynovial tissue.

1. **intima:** lines the joint space; composed of a layer of specialized fibroblasts known as **synoviocytes**
  - a. **Type A synoviocytes:** macrophage like cells, responsible for removal of debris from the joint cavity. During phagocytosis, type A cells synthesize and release lytic enzymes that have the potential for damaging joint tissues.
  - b. **Type B synoviocytes:** synthesize and release enzyme inhibitors that inhibit the lytic enzymes and are responsible for initiating an immune response through the secretion of antigens.

As part of their function in joint maintenance, both types of cells synthesize the hyaluronic acid component of the synovial fluid, as well as constituents of the matrix in which the cells are embedded.

Type A and B cells also secrete a wide range of cytokines, including multiple growth factors. The interplay of the cytokines acting as stimulators or inhibitors of synoviocytes results in structural repair of synovium, response to foreign or autologous antigens, and tissue destruction.

- Joint Stability
  - Articular surface shape, size, and arrangement
  - Ligaments
  - Muscle tone



Figure 27-13c. Multiple Rheumatoid nodules of the digits with typical ulnar deviation deformity from long-standing rheumatoid arthritis. Pathology Implications for the Physical Therapist, 3<sup>rd</sup> ed.

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Figure 10.47. Knee joints in rheumatoid arthritis. Colour Atlas of Anatomical Pathology, 3<sup>rd</sup> ed. Elsevier©2004



Figure 25.20 Radiological features of rheumatoid arthritis. General and Systemic Pathology, 4<sup>th</sup> ed. Elsevier©2007

## DEFINITION

- O'Sullivan (2007)
  - Systemic inflammatory dse
  - Major subclassification within the category of diffuse connective tissue dse
- Braddom
  - 100 diverse d/o affecting the musculoskeletal system
  - Characterized by aberrant autoimmune responses leading to sustained inflammation & 2° change to tissues in & around the joints
- Kisner
  - Autoimmune, chronic, inflammatory, systemic dse, primarily affecting synovial lining of joints as well as other connective tissue

## EPIDEMIOLOGY

- 10 cases /1000 people ≈ 2.1 million persons
- Women are affected 3x more often than men (20 – 60 y/o)
- Women = men (>65 y/o)
- Dse onset and course
  - c/o of generalized joint stiffness lasting wks. – mos.
  - High titers – more severe dse course
  - Many pts improve spontaneously
  - Long course marked by exacerbations and remissions are frequently seen
  - Elderly onset RA – Large joint involvement; *polymyalgia rheumatica*

## ETIOLOGY

- Etiology is unknown
- Hypothesis
  - Autoimmune disorder
    - Rheumatoid Factor
      - IgG
      - IgM
  - Bacterial Microorganisms
    - Streptococcus
    - Clostridia
    - Diptheroids
    - Mycoplasmas
  - Genetic predisposition
    - HLA-D
    - HLA-DRB1

## PATHOLOGY

- Grossly edematous appearance of the synovium with hair-like projections into the joint cavity
- Distinctive vascular changes
  - Venous distension
  - Capillary obstruction
  - Neutrophilic infiltration of arterial walls and areas of thrombosis and hemorrhage
- Pannus formation

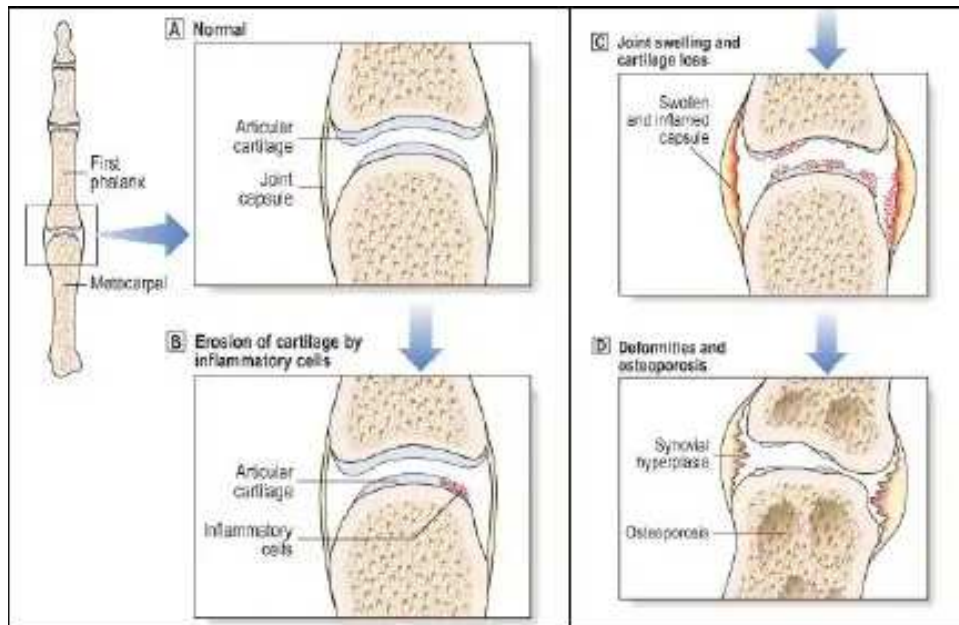


Figure 25.18. The progression of rheumatoid disease. General and Systemic Pathology, 4<sup>th</sup> ed. Elsevier©2007

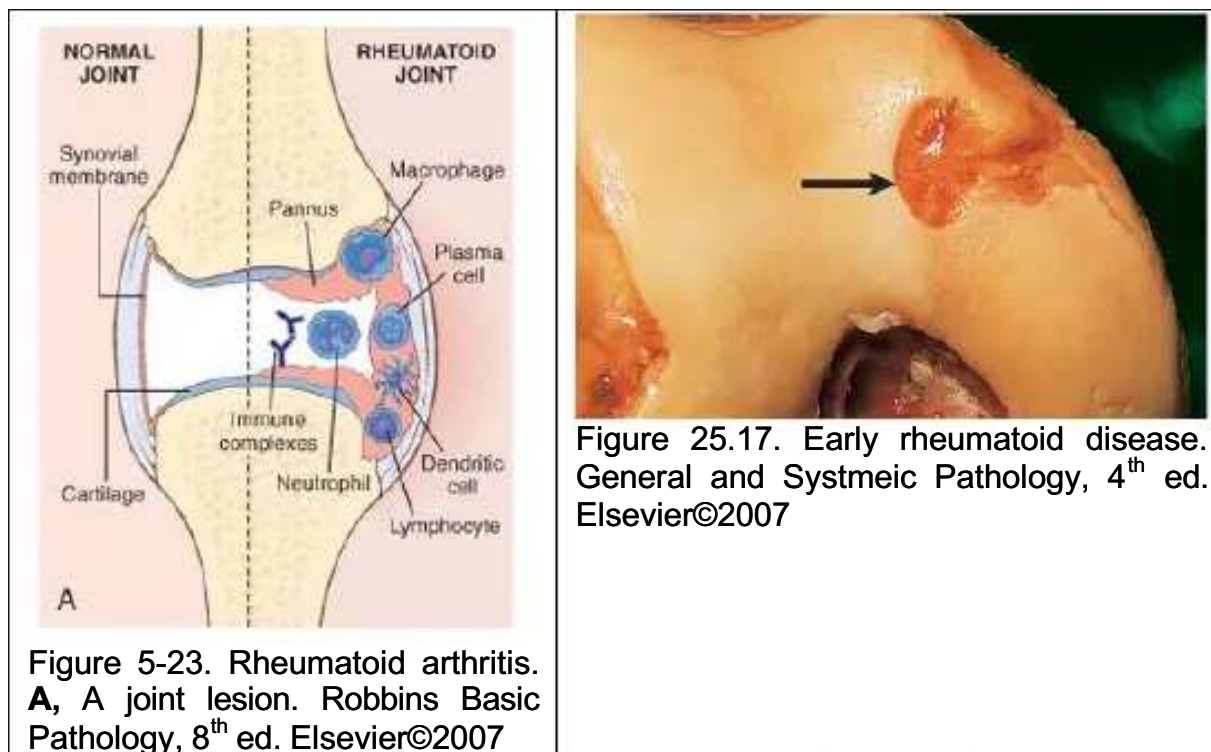
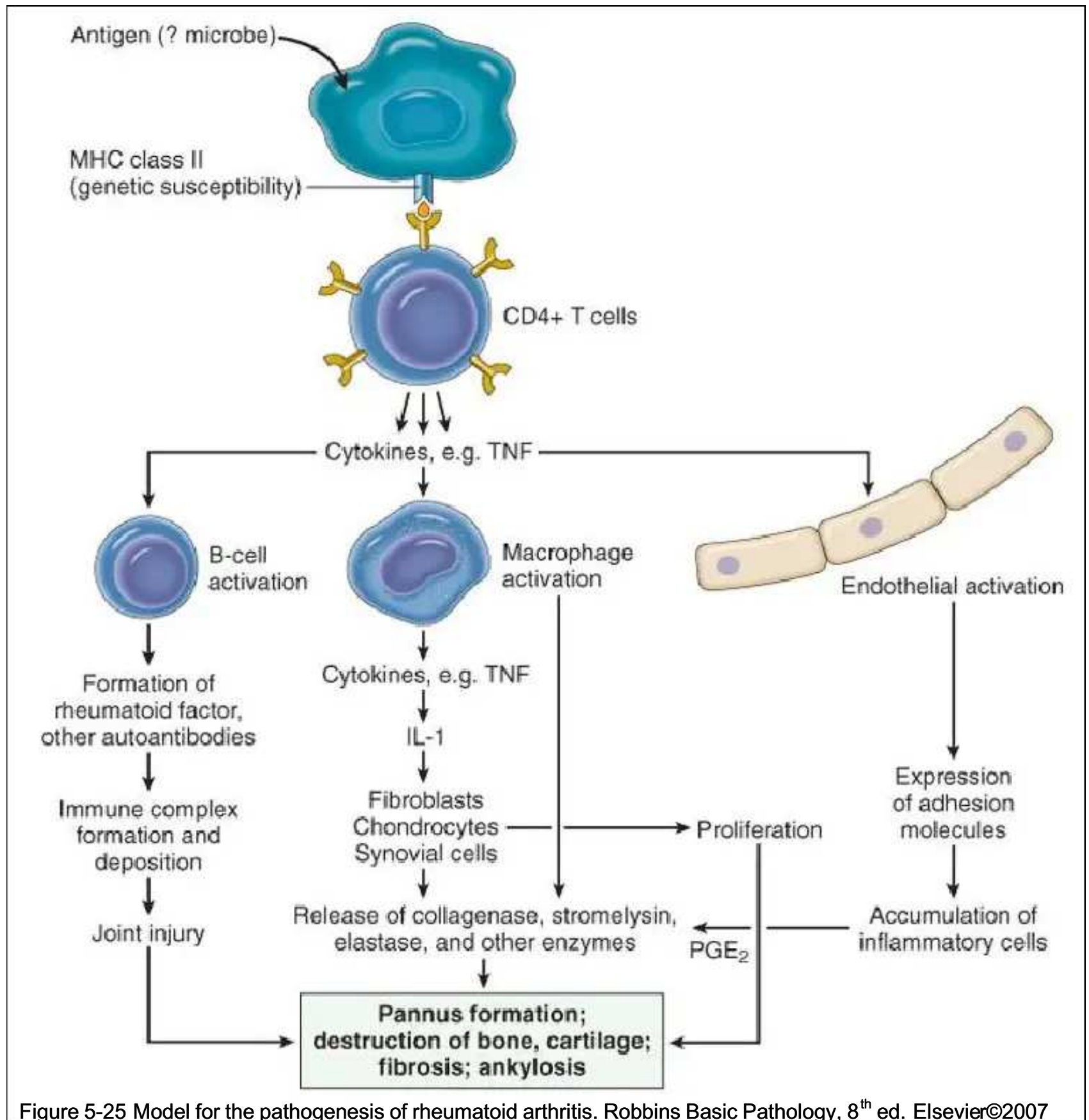


Figure 5-23. Rheumatoid arthritis. A, A joint lesion. Robbins Basic Pathology, 8<sup>th</sup> ed. Elsevier©2007



### CLASSIFICATION CRITERIA

- *The 1987 Revised Criteria for the Classification of RA*
  - Presentation of four out of seven listed criteria
  - criteria must last at least 6 weeks
    - Morning stiffness
    - Arthritis of 3 or more joints involved
    - Arthritis of Hand joints
    - 
    - Rheumatoid nodules

- Serum rheumatoid factor
- Radiographic changes

## CLINICAL MANIFESTATIONS

- Systemic manifestations
  - morning stiffness lasting > 3 mins – hallmark of RA
  - anorexia
  - weight loss
  - fatigue
- Joint involvement
  - Bilateral and symmetrical joint involvement
  - Immobility and cardinal signs of inflammation
  - Examination may reveal crepitus
  - Cervical spine
    - Atlantoaxial joint & midcervical region – most common sites of inflammation
    - decreased ROM
    - C1 – C2: 50%
  - TMJ
    - Inability to open mouth fully ≈ 2 in.
    - Normal approximation of upper and lower teeth may be altered
  - Shoulders
    - Seen in GH, SC, AC joints
    - Degeneration, pain and LOM
  - Elbows
    - Flexion contractures frequently develop
  - Wrists
    - Flexion contracture due to early synovitis between eight carpal bone and ulna
    - Volar subluxation of the carpals on the radius as a result of erosive synovitis of the radiocarpal joint
    - *Piano key sign*
  - Hand Joints
    - MCP
      - Volar subluxation and ulnar drift
      - *Bowstring effect*
      - *zigzag effect*
    - PIP
      - Fusiform or sausage-like appearance in the fingers
      - *Swan-neck deformity*
      - *Boutonniere deformity*
      - *Bouchard's nodes*
    - DIP
      - Most often uninvolved
    - Thumb
      - Synovial swelling
      - Classification of thumb deformities' by Nalebuff
        - › type 1: MCP flexion c IP hyperextension s CMC involvement



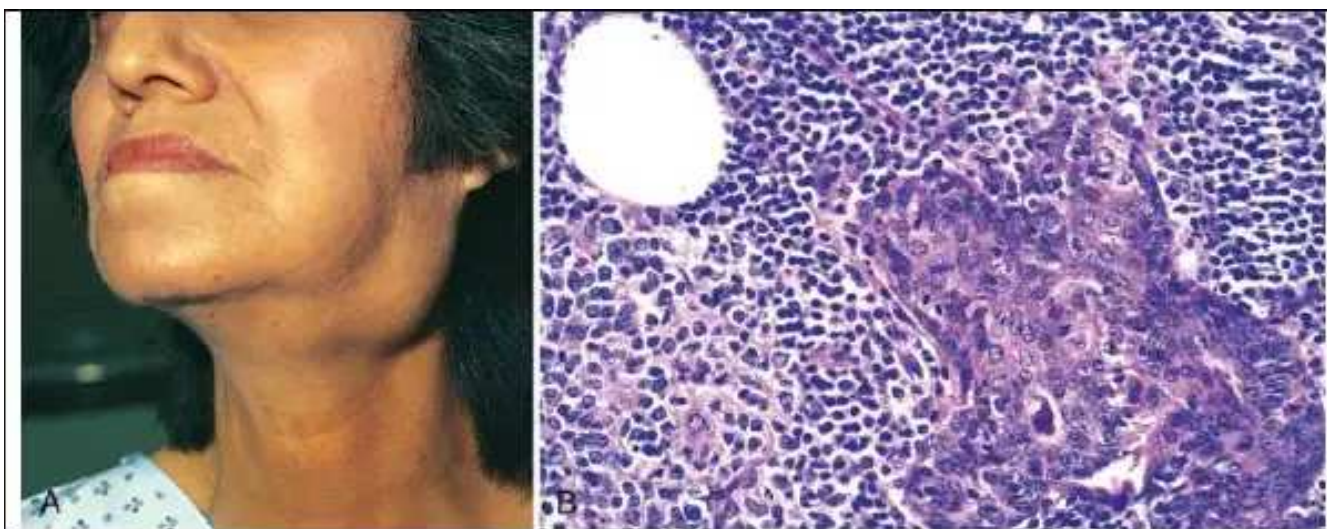


Figure 5-26 Sjögren syndrome. **A**, Enlargement of the salivary gland. **B**, The histologic view shows intense lymphocytic and plasma cell infiltration with ductal epithelial hyperplasia. Robbins Basic Pathology, 8<sup>th</sup> ed. Elsevier©2007



Figure 25.21 Scleritis in rheumatoid arthritis. General and Systemic Pathology, 4<sup>th</sup> ed. Elsevier©2007

## LABORATORY TESTS

- Elevated erythrocyte sedimentation rate (ESR) or C Reactive Protein (CRP)
  - Indicate presence of active inflammation
  - Presence/absence of Rheumatoid Factor (RF) neither confirms nor rule out RA
- Complete Blood Count
  - Decreased RBCs – 20% of people c RA
  - WBCs normal
- Synovial fluid analysis
  - Culture
    - If joint is inflamed – increase WBCs
    - *Gout or pseudogout*: presence of crystals
    - Inflammatory arthritis, such as RA, produces fair mucin clotting

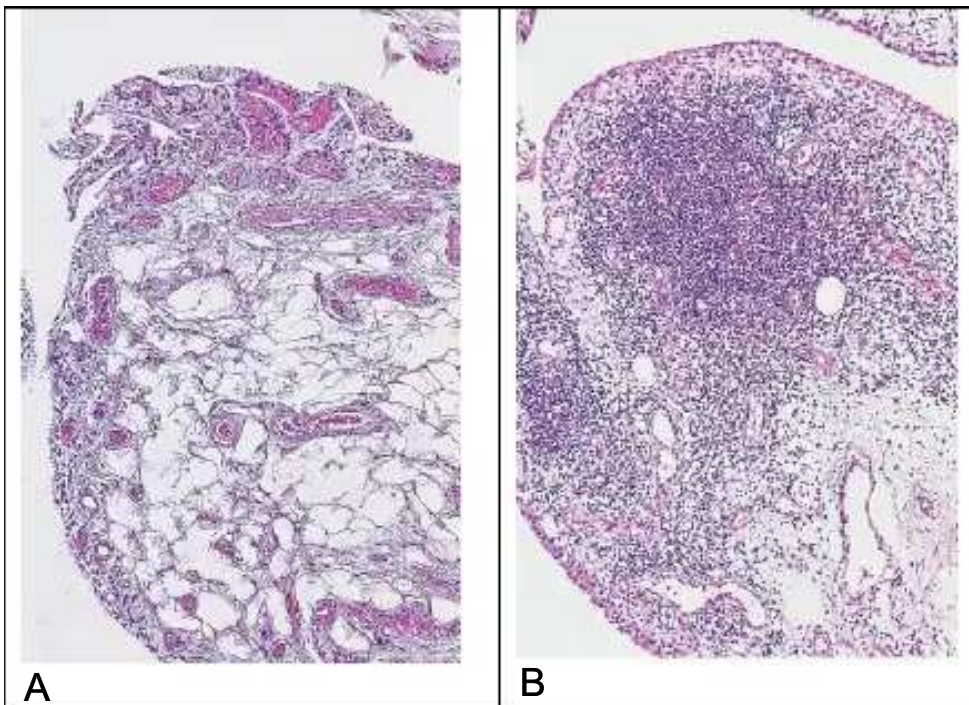


Figure 25.19 Rheumatoid Arthritis. **A** Normal synovium. **B** Note the dense lymphocytic infiltrates in the synovial biopsy from a patient with active rheumatoid arthritis. General and Systemic Pathology, 4<sup>th</sup> ed. Elsevier©2007

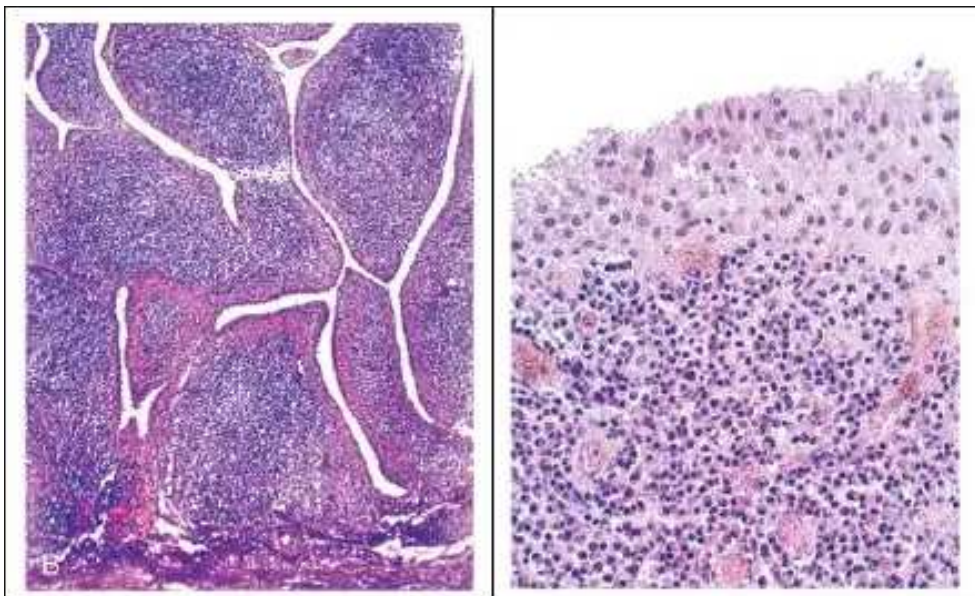


Figure 5-23 Rheumatoid arthritis. **B**, Low magnification reveals marked synovial hypertrophy with formation of villi. **C**, At higher magnification, dense lymphoid aggregates are seen in the synovium. Robbins Basic Pathology, 8<sup>th</sup> ed. Elsevier©2007

### ANCILLARY PROCEDURE

- Radiography
  - Alignment
  - Bone density & surface
  - Cartilaginous spacing

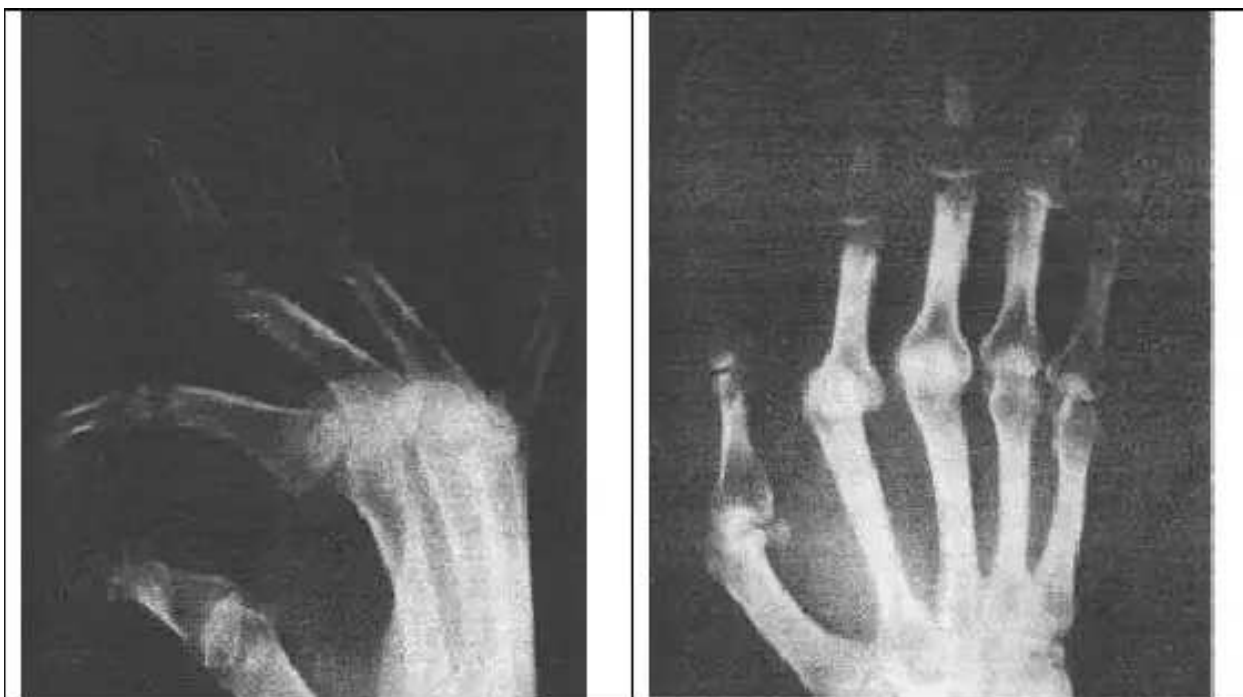


Figure 37-9. Typical deformities and x-ray findings in rheumatoid arthritis of the hands and feet. Physical Medicine and Rehabilitation, 3<sup>rd</sup> ed. ©Elsevier

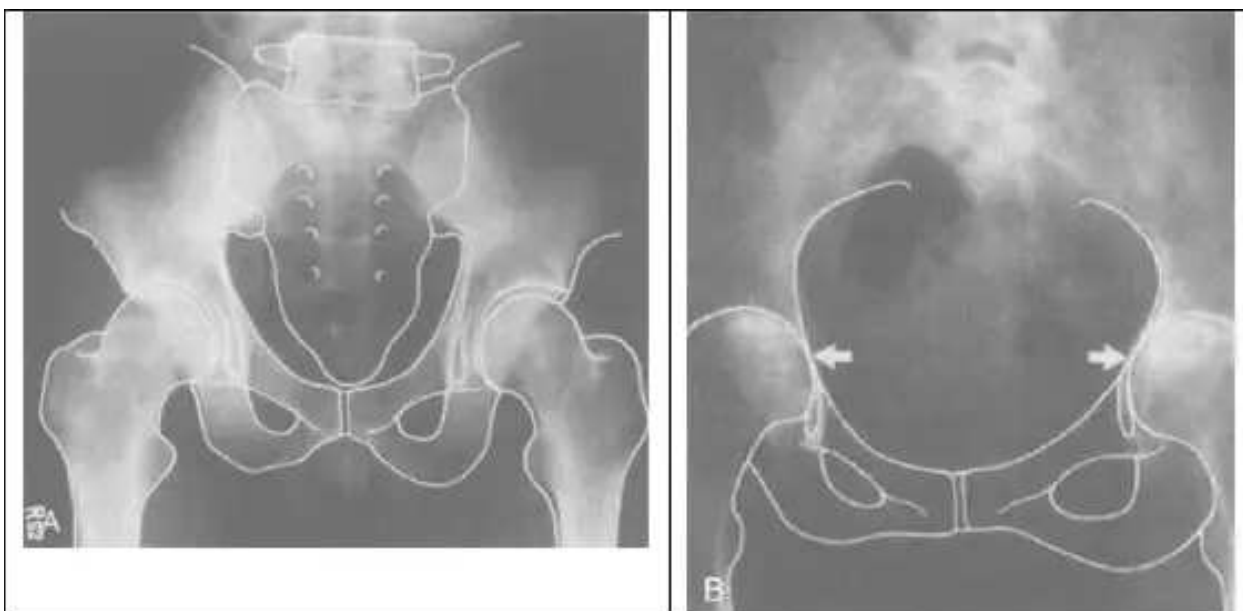


Figure 27-15. A, Radiograph of normal hips and pelvis. B, Radiograph of rheumatoid arthritis of the hips. Pathology Implications for the Physical Therapist, 3<sup>rd</sup> ed. Elsevier©2009

### DIFFERENTIAL DIAGNOSIS

DISEASE	DESCRIPTION	ONSET	DIFFERENCE
Osteoarthritis	Chronic degenerative d/o primarily affecting articular cartilage of synovial joints, with eventual bony remodeling & overgrowth at the margins of the joints	>40 y/o	Develops slowly over many years due to mechanical stress  Osteophyte formation, cartilage destruction, altered joint alignment  Few joints involved
Spondyloarthropathy: <i>ankylosing spondilitis</i>	Chronic, progressive inflammatory disorder of undetermined cause	middle and low back pain & stiffness > 3 months usually males  < 40 y/o	Inflammation of fibrous tissue affecting entheses, or insertions of ligament, tendons, and capsules into bone than of synovium  Joints involved: SI joints, spine, large peripheral joints
Polymyalgia	Systemic rheumatic inflammatory	>55 y/o	Muscles more affected than joints

Rheumatism (PMR)	disorder with an unknown cause	Affects twice as many women as men  > 80 y/o 10x more prevalent  Between 50 – 59 affects caucasian population	Closely linked with Gentle cell arteritis  Most common symptom is severe headache  Self limiting 2 – 3 years
Systemic Lupus Erythematosus	Belongs to the family of autoimmune rheumatic diseases. Known to be chronic, systemic, inflammatory disease characterized by injury to the skin, joints, kidneys, heart and blood-forming organs, nervous system, and mucous membrane	Between ages 15 & 40 y/o  Women 10-15x more affected than men  More common in African-American, African-Caribbean, Hispanic-American, and Asians  African-American women include early tobacco use	No known gene association  Acute migratory or persistent nonerosive arthritis may involve any joint  Approx. 30% of people with SLE have coexistent fibromyalgia, independent of race  Skin rashes, kidney involvement, photosensitivity
Scleroderma (Progressive Systemic Sclerosis)	Lesser-known chronic multisystem diseases characterized by inflammation and fibrosis of many parts of the body, including the skin, blood vessels, synovium, skeletal muscle, and certain internal organs such as kidneys, lungs, heart, and GI tract	Genetic and environmental factors  Can occur in individuals of any age, race, or sex, but it occurs most commonly in young or middle-age women (ages 25 – 55)	Skin Raynaud's Phenomenon  Articular complaints may begin at any time during the course of the disease  Involvement of GI tract esophageal hypomotility  Sclerodactyly (chronic hardening and shrinking of fingers and toes)

Differential Diagnosis for Physical Therapy Screening for Referral, 4<sup>th</sup> ed. Elsevier©2007

## PROGNOSIS

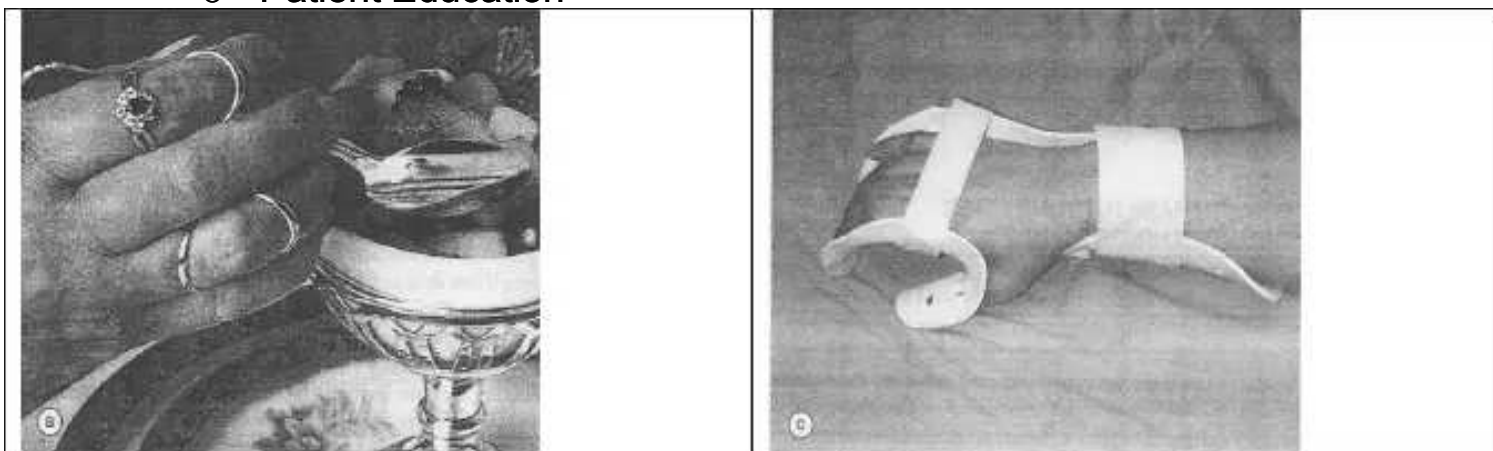
- Poor prognosis
  - Early age of onset
  - High levels of RF in serum
  - Presence of rheumatoid nodules
  - Persistent sustained disease >1 yr
- *Classification of Functional Status in RA*

CLASS	DEFINITION
Class I	Completely able to perform usual activities of daily living (self care, vocational, & avocational)
Class II	Able to perform usual self-care & vocational activities, but ltd in avocational activities
Class III	Able to perform usual self-care activities, but ltd in vocational and avocational activities
Class IV	Ltd. In ability to perform usual self care, vocational, and avocational activities

## MEDICAL MANAGEMENT

- Pharmacological Therapy
  - Nonsteroidal anti-inflammatory Drugs (NSAIDs)
    - Acetylsalicylic acid (ASA)
    - indomethacin
  - Disease-Modifying Antirheumatic Drugs (DMARD)
    - Sulfasalazine
    - Hydroxychloroquine
    - Gold Compounds
    - D-penicillamine
  - Corticosteroid
- Surgical Management

- Soft tissue
  - Synovectomy
  - Soft tissue release
  - Tendon transfers
- Bone & Joint
  - Tenosynovectomy
  - Arthrodesis
  - Osteotomies
- Common joint replacement
  - Hip
  - Knee
  - MCP
- PT Management
  - Modalities
    - Superficial heat
      - HMP
      - Dry heating pads and lamps
      - Paraffin
      - Hydrotherapy
    - Cryotherapy
    - TENS
  - Joint mobilization
    - Grade I & Grade II Oscillations
    - ROM exercises
  - Strengthening
    - Isometric exercises in pain free positions
    - Dynamic exercises (Concentric & eccentric)
  - Joint Protection & assistive devices
    - Orthoses
    - Splints
  - Endurance training
    - Cycle ergometry
    - Aquatic exercises
  - Functional Training
    - Energy conservation techniques
    - Home modifications
  - Gait Training
  - Patient Education



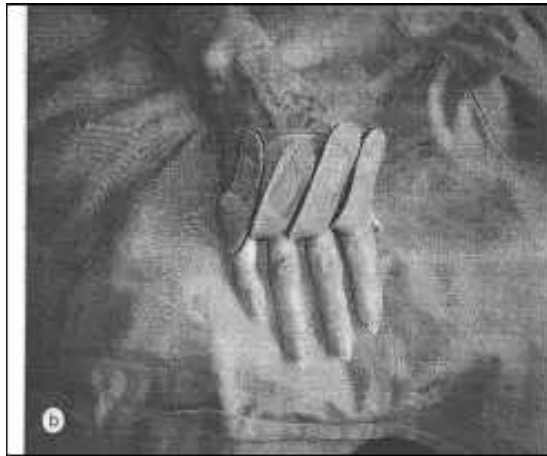


Figure 37.5 Upper limb orthoses and manipulation aids commonly used by patients with rheumatic diseases. *Physical Medicine and Rehabilitation*, 3<sup>rd</sup> ed. ©Elsevier

#### References:

O'Sullivan, S.B., & Schmitz T.J. (2007). *Physical Rehabilitation* (5<sup>th</sup> ed.). Philadelphia, Pennsylvania: FA Davis Company

Snell, R.S. *Clinical Anatomy by Region* (8<sup>th</sup> ed.). Lippincott Williams & Wilkins

Levangie, P.K., & Norkin, C.C. (2005). *Joint Structure and Function* (4<sup>th</sup> ed.). Philadelphia, Pennsylvania: FA Davis Company

Kumar, Abbas, Fausto, & Mitchell. (2007). *Robbins Basic Pathology* (8<sup>th</sup> ed.) Saunders

Underwood, J.C.E. (Ed.). (2007). *General and Systemic Pathology* (4<sup>th</sup> ed.). Churchill Livingstone

McPhee, S.J., & Hammer, G.D. (Eds.). (2010). *Pathophysiology of Disease: An Introduction to Clinical Medicine* (6<sup>th</sup> ed.). The McGraw-Hill Companies, Inc.

Cooke, R., & Stewart, B. (2004) *Colour Atlas of Anatomical Pathology*. Churchill Livingstone

Goodman, C.C., & Fuller, K.S. (2009). *Pathology Implications for the Physical Therapy* (3<sup>rd</sup> ed.). St. Louis, Missouri: Saunders

Braddom, R.L. *Physical Medicine & Rehabilitation* (3<sup>rd</sup> ed.). Saunders

Kisner, C., & Colby, L.A. (2007). *Therapeutic Exercise Foundations and Techniques* (5<sup>th</sup> ed.). Philadelphia, PA: FA Davis Company

Goodman, C.C., & Snyder T.E.K. (2007) *Differential Diagnosis for the Physical Therapist: Screening for Referral* (4<sup>th</sup> ed.). St. Louis, Missouri: Saunders