MUNI
PHARM

LOCOMOTIVE SYSTEM DISEASES FALLS

M. Chalupová

Lecture from Geriatric Pharmacotherapy 5.5. 2023

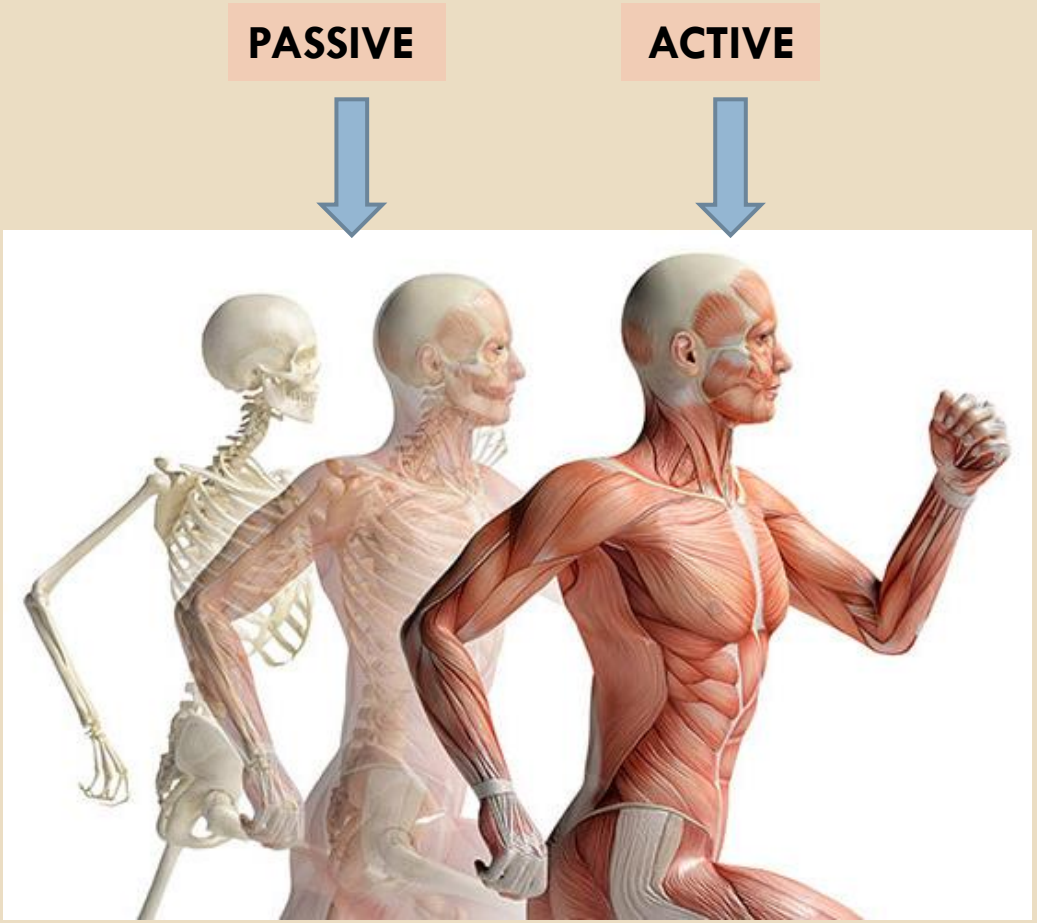
Locomotive system

Passive

- bones
- joints

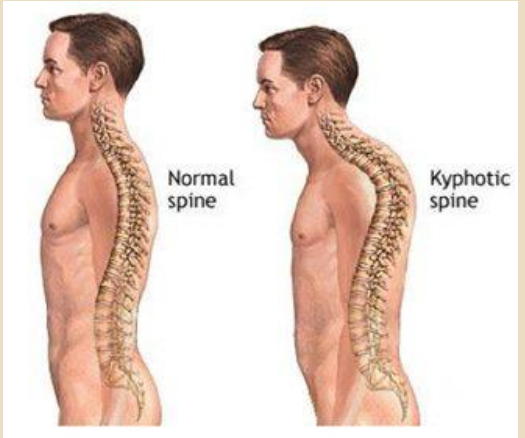
Active

- muscles



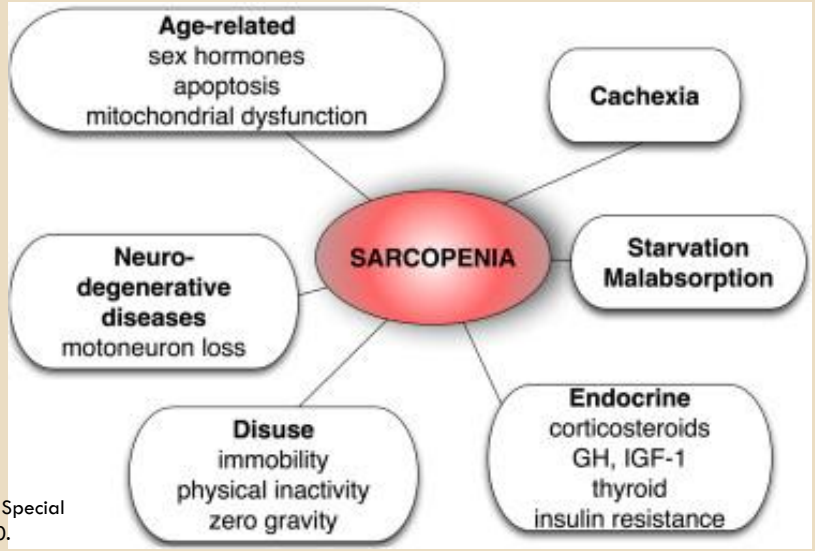
Posture

- **age-related hyperkyphosis**
  - 20–40% of older adults
  - **exaggerated anterior curvature** of the thoracic spine
  - stooped posture, loss of height, and other distortions owing to atrophy and effect of weakness in skeleton and major muscle groups
  - altered biomechanics, muscle imbalance
  - slowly **decreasing range in joints**



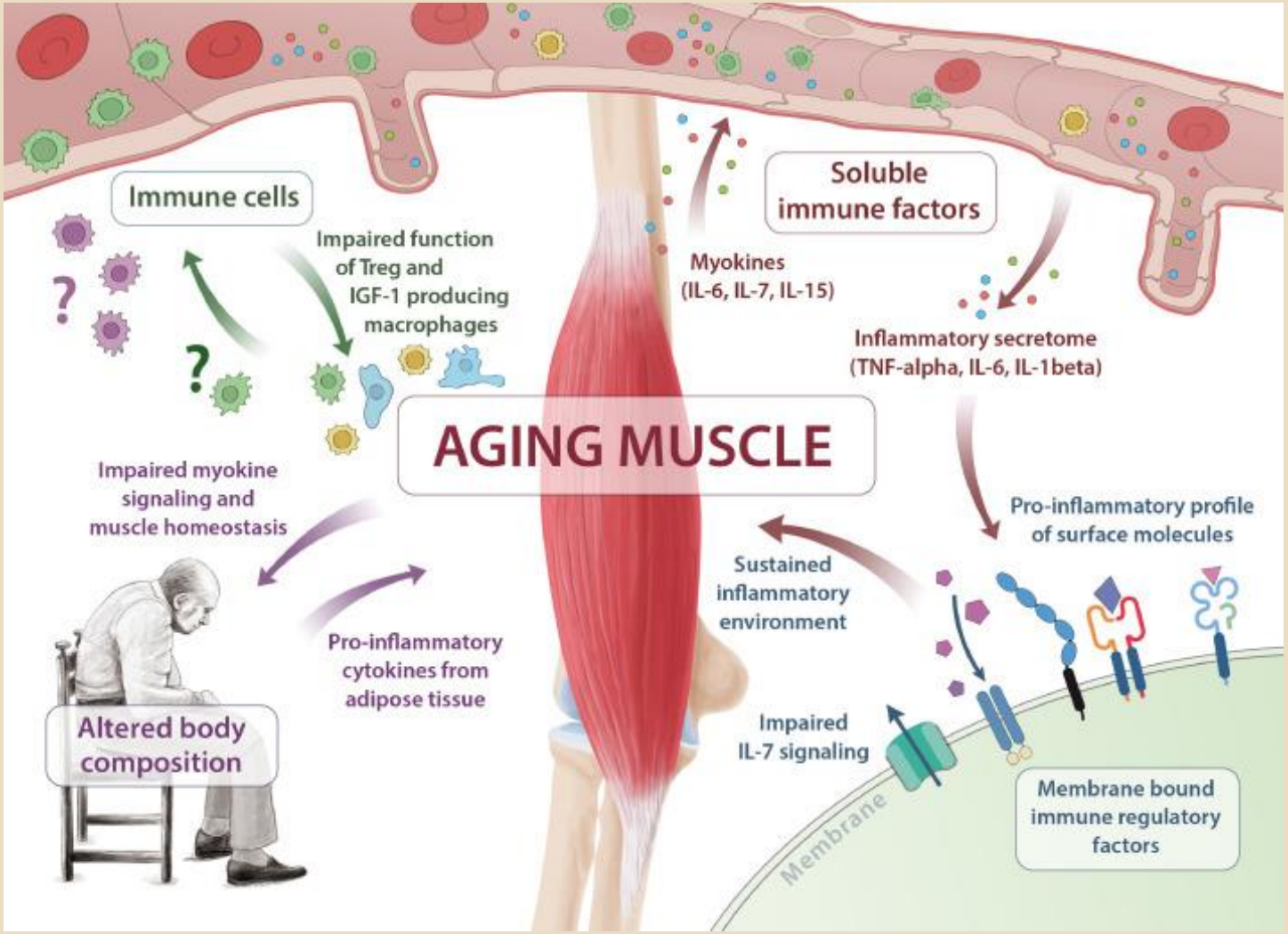
Muscle system changes

- **sarcopenia**
  - decline in muscle function associated with loss of muscle mass
  - elderly patients with comorbidities affecting the musculoskeletal system or impairing physical activity
  - poor dietary proten intake
  - leads to disability, falls and increased mortality
  - linked to an increased prevalence of osteoporosis, thus further increasing its propensity to fractures



Muscaritoli M., Anker S.D. et al. Consensus definition of sarcopenia, cachexia and pre-cachexia: Joint document elaborated by Special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics". Clinical Nutrition 29/2, 2010.

Muscle system changes



Nelke Ch., Dziewas R. et al. Skeletal muscle as potential central link between sarcopenia and immune senescence. Lancet, 49, 2019.

Muscle system changes

- loss of muscle strength and aerobic muscle functioning are two of the hallmarks of

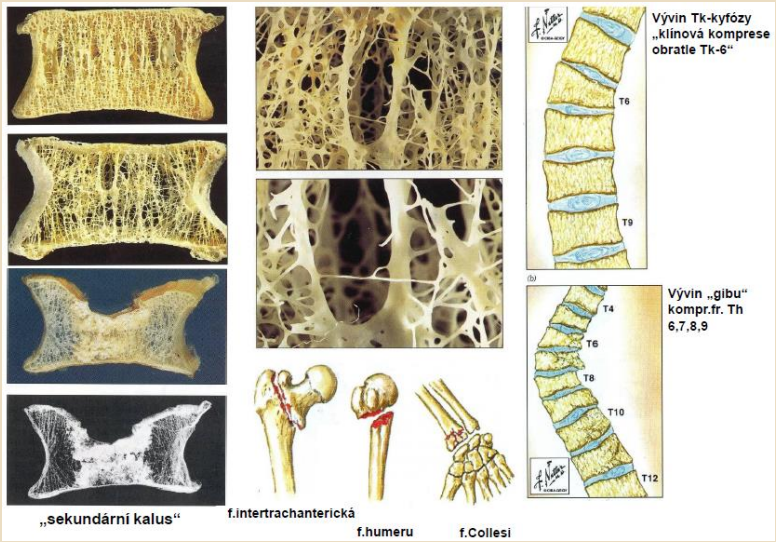
FRAILTY

- *„clinical state in which there is an increase in an individual's vulnerability for developing increased dependency and/or mortality when exposed to a stressor"* Morley et al. (2013)
- estimated that 25 % to 50 % of individuals aged over 85 years are frail
- **multi-system dysregulation** leading to a **loss of physiological reserve**
- more likely to suffer **adverse effects** from treatment, diseases or infections

Bone ageing

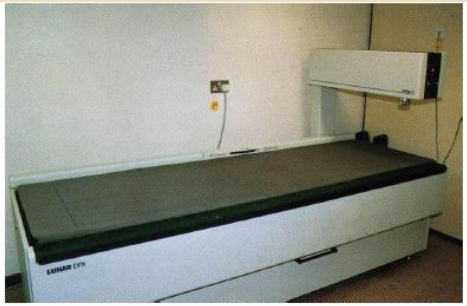
OSTEOPOROSIS

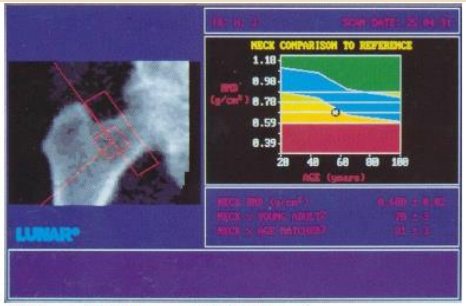
- progressive metabolic bone disease that **decreases bone density** with deterioration of inner bone architecture
- skeletal weakness leads to **fractures** with minor or inapparent trauma
  - thoracic and lumbar spine
  - wrist, femur neck



Diagnosis of osteporosis (DXA)

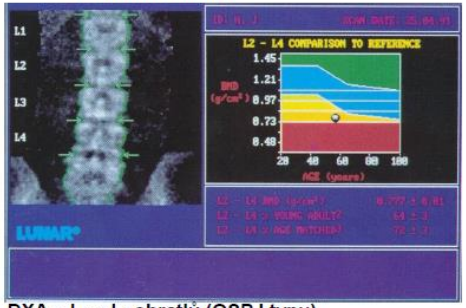
- **dual-energy x-ray absorptiometry** (**DXA** scan)



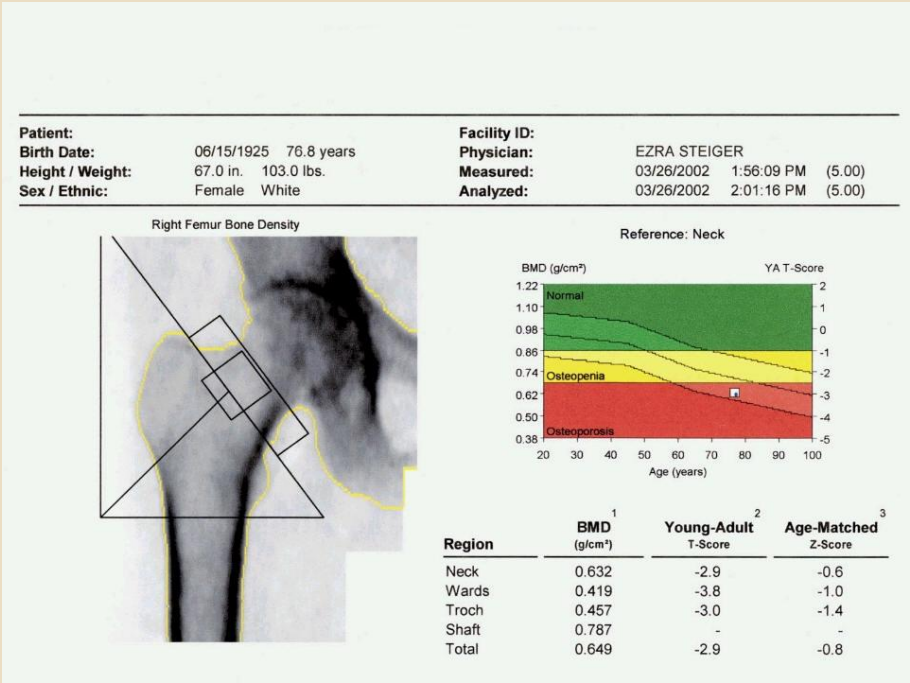


DXA – krček femoru (OSP I.typu)
– Wardův trojúhelník

USDM



DXA – L_1 – L_4 obratlů (OSP I.typu)



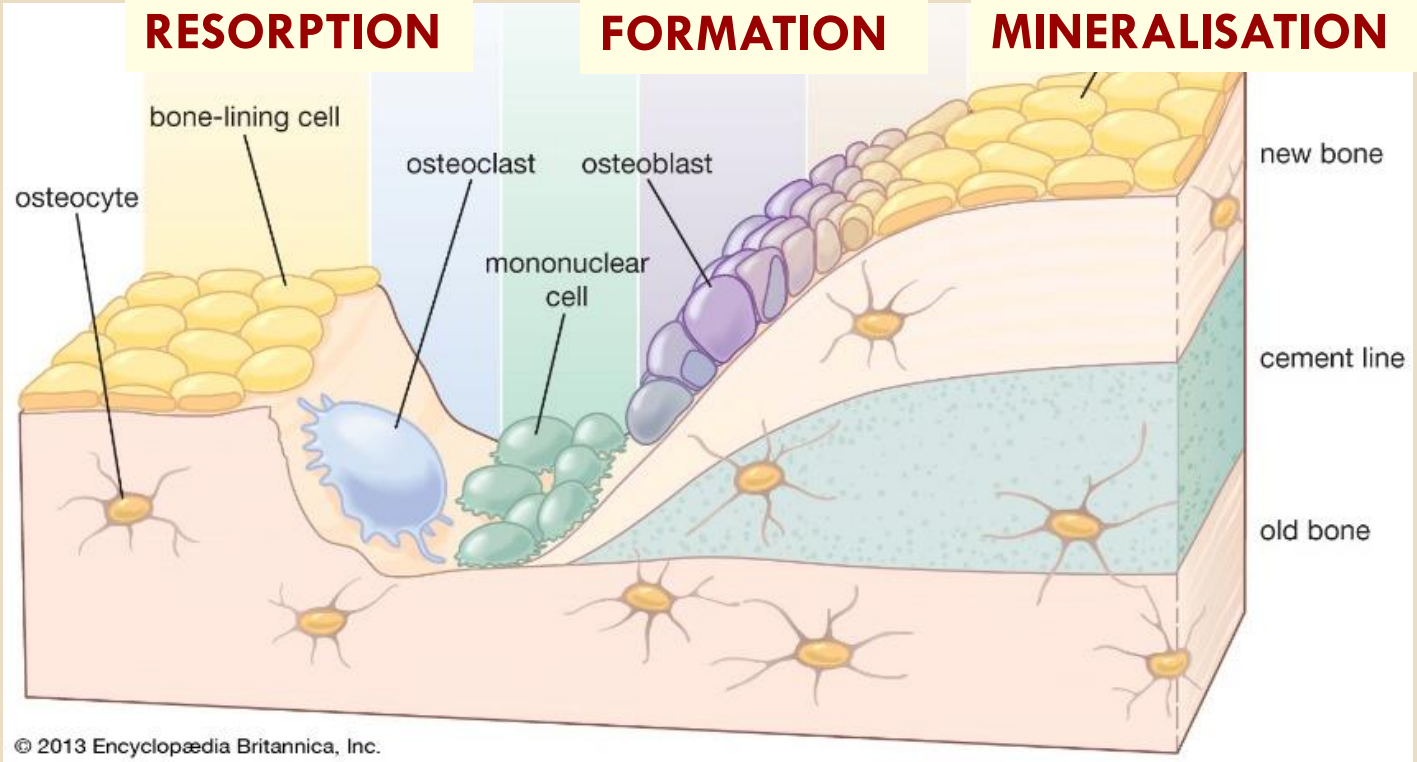
Osteoporosis therapy approaches

BISPHOSPHONATES
HRT/SERMs
DENOSUMAB
STRONTIUM RANELATE
CALCITONIN

PTH ANALOGUES

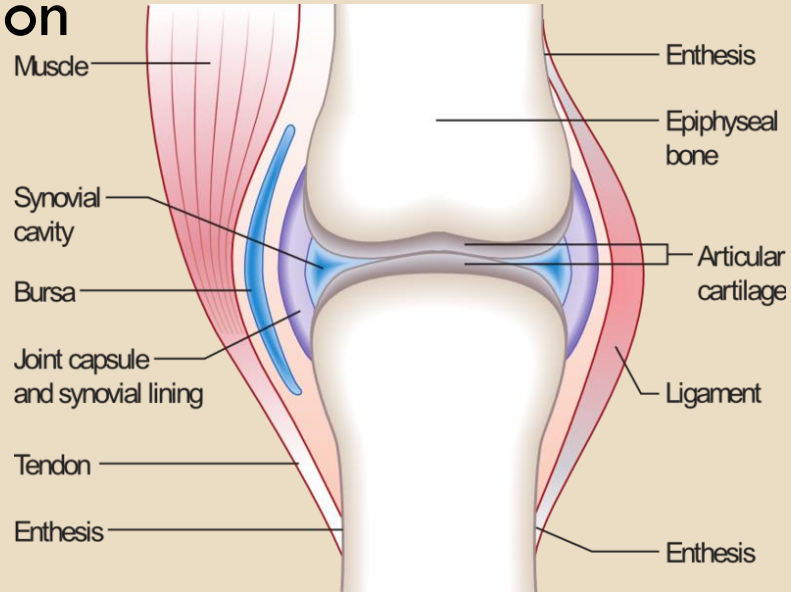
CALCIUM
VITAMIN D

RESORPTION | **FORMATION** | **MINERALISATION**



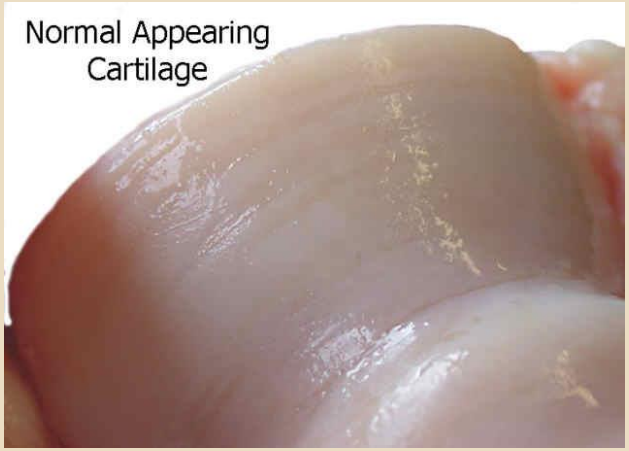
Joint ageing

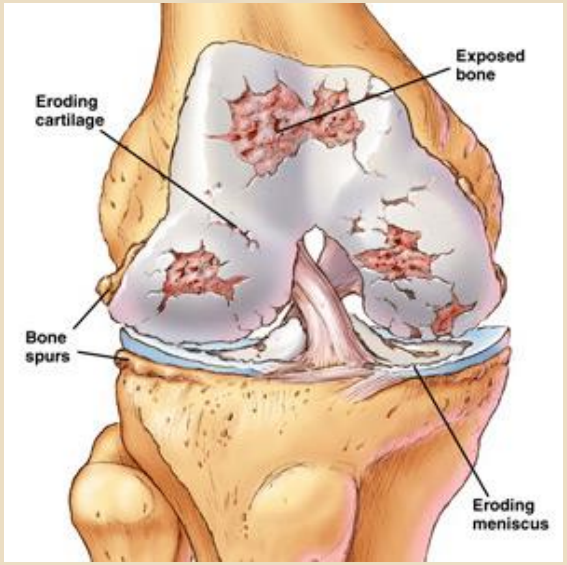
- **loss of resilience and elasticity** in ligaments, cartilage and periarticular tissues
- **degeneration** with erosion and calcification of cartilage and capsule, gradual reduction in collagen
- **bunions** and **subluxation** of small joints in hands and feet are common



Osteoarthritis (OA)

- **chronic arthropathy** characterized by disruption and potential **loss of joint hyaline cartilage** along with other joint changes, including bone hypertrophy
  - osteophyte formation
- becomes symptomatic in the 40s and 50s





Classification of osteoarthritis

Primary (idiopathic) OA

- exact cause is unknown (complex etiology)

Secondary OA

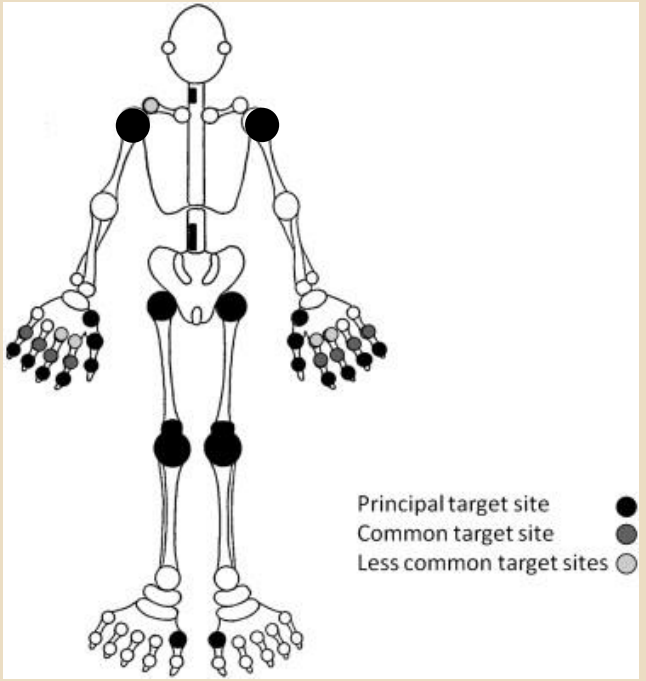
- results from conditions that change the microenvironment of the cartilage
  - trauma
  - metabolic disorders (diabetes, hemochromatosis, Wilson disease)
  - congenital joint abnormalities

Osteoarthritis symptoms

- onset is most often gradual, usually beginning with one or a few joints
- **pain** is the earliest symptom
  - sometimes described as a deep ache on initial movement
  - pain usually worsened by severe load bearing and relieved by rest but can eventually become constant
- **stiffness** follows awakening or inactivity but lasts less than 30 min. and lessens with movement
- as OA progresses, joint motion becomes restricted, and tenderness and **crepitus** or grating sensations develop

Affected joints in OA

- **hip (coxarthrosis)**
- **knee (gonarthrosis)**
- **arm (shoulder joint)**
- **vertebral column**
  - intervertebral disks and joints in the cervical and lumbar vertebrae
- **hand**
  - distal interphalangeal (DIP) and proximal interphalangeal (PIP) joints
  - thumb carpometacarpal joint (rhizarthrosis)
- **foot**
  - first metatarsophalangeal joint



Osteoarthritis diagnosis

- **X-rays**
  - cartilage deformation and reduction
  - new bone outgrowths (**osteophytes**)

OA prevention and therapy

- **weight reduction**
- **exercising**
  - relaxing exercising, breathing gymnastics
- **supporting devices**
  - sticks, crutches, walkers
- **physical therapy**
  - hydrotherapy, magnetotherapy, electrotherapy, ultrasound
- **chondroprotective agents (DMOADs)**
  - glucosamine, chondroitin sulphate
- **analgesics** (non-opioid and opioid)
- **surgery**
  - total joint replacement (arthroplasty)

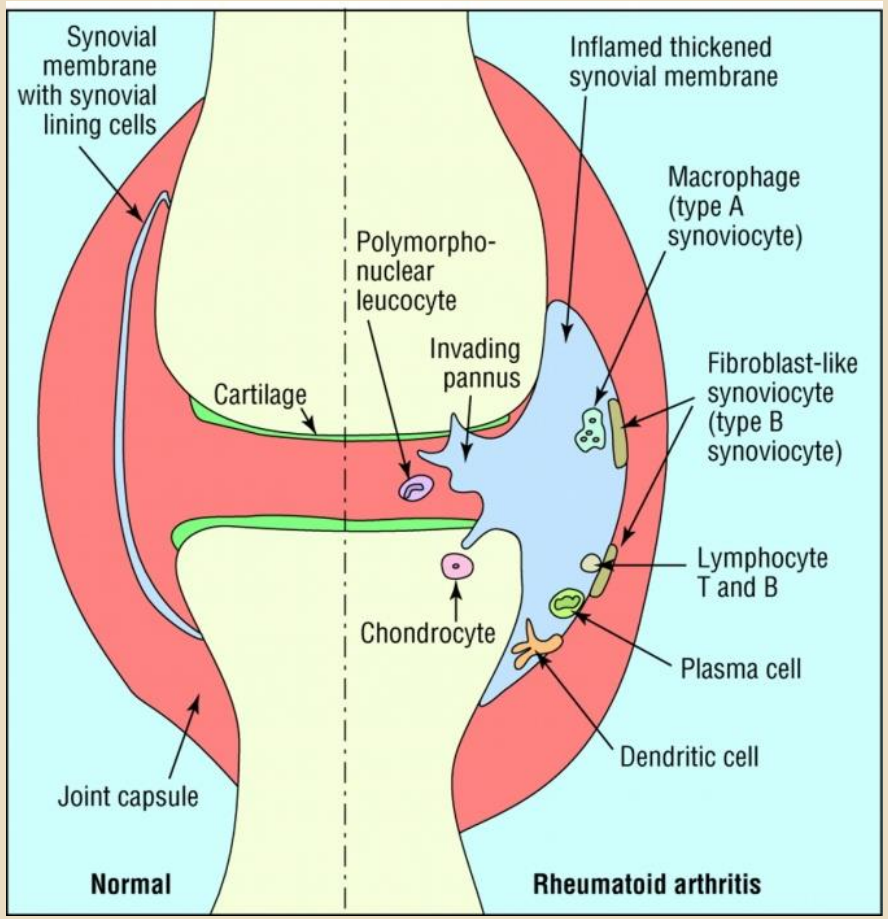
Rheumatoid arthritis (RA)

- **chronic systemic inflammatory autoimmune** disease that primarily involves the joints
- the precise **cause is unknown**
- causes **damage mediated by cytokines, chemokines, and metalloproteases** (TNF-α, INF-γ)
- **peripheral joints** (wrists, metacarpophalangeal joints) are symmetrically inflamed, leading to progressive destruction of articular structures, usually accompanied by **systemic symptoms**

- **Elderly Onset Rheumatoid Arthritis (EORA)**
  - starting at >60 years of age
  - higher risk than younger RA patients for falls and decline in functional status

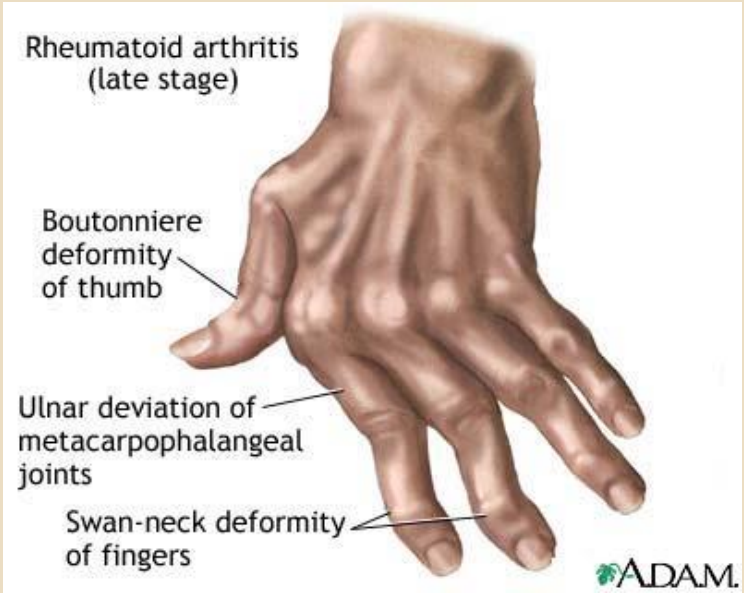
RA pathophysiology

- **antibodies (immune complexes)** produced by synovial lining cells and plasma cells
  - **rheumatoid factor**
- normally thin **synovial membrane** proliferates, thickens and develops villous folds
- secondary cartilage destruction



RA symptoms and signs

- onset often beginning with systemic and joint symptoms
- **systemic symptoms** include generalized fatigue, anorexia, weakness, and occasionally low-grade fever
- **joint symptoms** are **symetric** and include pain, swelling, stiffness
  - **proximal interphalangeal joints**
  - **metacarpophalangeal joints**
  - shoulders
  - elbows
  - hips
  - knees
  - ankles



RA symptoms and signs

- **extraarticular symptoms** are usually at sites of pressure and chronic irritation (the extensor surface of the forearm, metacarpophalangeal joints)
  - vasculitis causing leg ulcers
  - pleural or pericardial effusions, pulmonary infiltrates or fibrosis
  - pericarditis, myocarditis
  - lymphadenopathy

- **older adults with RA tend to be underdiagnosed and undertreated**

RA therapy

Non-pharmacological

- **stretching and weight-bearing exercise**
  - maintaining ranges of motion in the joint, preventing muscle atrophy
- **supportive devices**
- **adjustment in daily regime**
- **surgery**
  - synovectomy
  - joint replacement
  - arthrodesis

RA therapy

Pharmacological

- **Disease Modifying Anti-Rheumatic Drugs (DMARDs)**
  - **methotrexate**, hydroxychloroquine, leflunomide, sulfasalazine
- **biologics**
  - **TNF-α inhibitors**
    - etanercept, infliximab, adalimumab, golimumab, certolizumab
  - **anti-CD20 monoclonal antibody**
    - rituximab
  - **T-lymphocyte activation inhibitors**
    - abatacept
  - **IL-6 receptor antibody**
    - tocilizumab
  - **IL-1 receptor antagonist**
    - anakinra

RA therapy

- **NSAIDs and analgesics**
  - ibuprofen, diclofenac, indomethacin, naproxen, coxibs
  - **AEs:** GIT bleeding, kidney impairment
- **corticosteroids**
  - p.o. or intraarticular forms
  - **AEs:** osteoporosis, cataract, glucose metabolism impairment, immune system changes

General changes in movement

- disability ensues as a combined effect of **muscular weakness, joint stiffness and impaired central processing** mechanism leading to:
  - **limitation of range and speed of movement**
  - **less precision in fine movements** and in rapid alternating movements
  - **irregular timing of action**, loss of smooth flow of one form of action into another
  - **reduction of confidence and reliability** of action
  - the individual may experience **difficulty with intricate tasks**
    - worse if uncompensated visual defect is present

Balance

DECREASED BALANCE due to:

- decreased muscle flexibility and strength
- reduced central processing of sensory information in the spinal cord and brain
- motor responses are slowed down

- increased risk of **FALLS**
- limit in activities of daily living and leisure-time activities
- **balance excercises** recommended for elderly at risk of falls

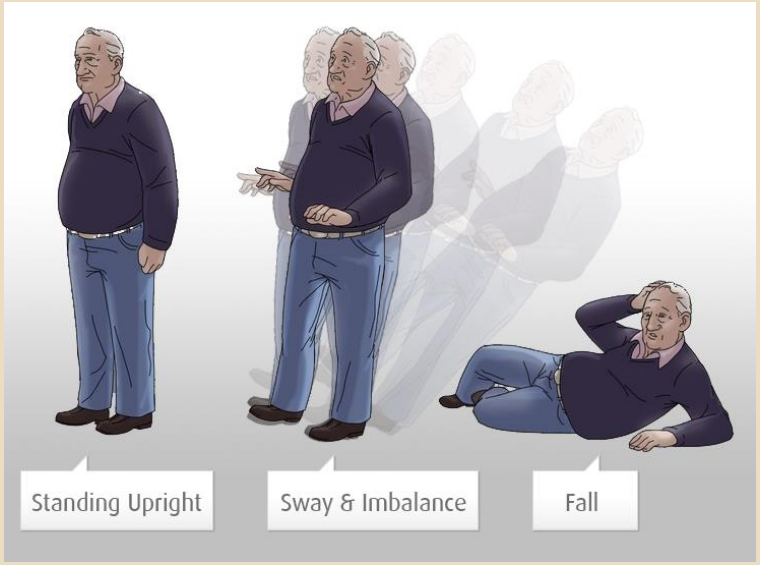
Physical activity

- **resistance training**
  - improves strength and can reverse or delay the decline in muscle mass and strength
- **aerobic exercise**
  - helps to improve endurance by increasing the capillary density, mitochondrial and enzyme levels in the skeletal muscles
  - maintains patient independence

- many possible **forms** maintaining or increasing aerobic fittness and flexibility
  - **walking, nordic walking, swimming, stretching, dancing, gardening, hiking, cycling or organised exercise sessions**

Falls

- **walking and stability impairment**
  - impairment in sensory receptors, CNS analysers and PNS nerve pathways
  - impairment in perception and maintaining of balance and equilibrium in space
  - slow shuffling walking, mild flexion in hips and knees
- **polypragmasia**
- **dementia, depression, anxiety**



Causes of falls

- **neurological cerebrovascular diseases**
  - brain strokes
- **cardiovascular diseases**
  - hypotension, arrhytmias
- **locomotory system diseases**
  - rheumatoid arthritis, osteoporosis, osteoarthritis, myopathies
- **eye disorders**
- **vestibular system disorders**
- **psychiatric conditions**
  - dementia, anxiety, depression

Falls prevention

- appropriate **shoes**
- **devices**
  - walkers, crutches, sticks
- **adaptation in living environment**
  - holders, handles and rests in bathroom
  - elevated WC seats
  - anti-slide carpets into the bathtub
  - sufficient lighting

Falls consequences

- **fractures**
  - compressive fractures of pelvis and vertebrae
  - femoral neck fractures
- **increased mortality**
- **consumption of special devices**
- **changes in overall health condition**
  - thromboembolies, pneumonias, osteoporosis

Long-term imobility complications

Decubitus ulcers

- **I. stage** – painful red skin
- **II. stage** – inflammation, blisters
- **III. stage** – tissue necrosis, but skin layers only
- **IV. stage** – uncovering of fatty tissue, muscles, bones