بسم الله الرحمن الرحيم

السلام عليكم ورحمة الله وبركاته


Welcome
Criações Mitau

Musculoskeletal system

By

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Objectives

At the end of the lecture the student will be able to:

1-Identify structure of musculoskeletal system

2-List functions of musculoskeletal system

3-Explain factors affecting bone maintenance

4-Identify age related changes that affect musculoskeletal system

5-Explain musculoskeletal problems associated with aging

6-Discus common musculoskeletal disorders in older adult

Outlines:

1-Introduction

2-Structure of musculoskeletal system

3-Functions of musculoskeletal system

4-Factors affecting bone maintenance

5-Age related changes that affect musculoskeletal system

6-Problems associated with musculoskeletal system changes

7-Toward better musculoskeletal health

*Common Musculoskeletal disorders in older adults Osteoporosis Osteoarthritis and Rheumatoid arthritis

* Nutritional recommendations for musculoskeletal disorders


Introduction

INTRODUCTION

The musculoskeletal system the largest system in the body. Bony structures and connective tissue accounts for approximately ٢٥% of the body weight, and muscle accounts for approximately ٥٠% of the body weight. Bone is composed of cells, protein matrix, and mineral deposits. The bone cells are allow growth, repair, and remodeling. The changes in musculoskeletal system cause many problems to the elderly persons such as pain, impaired mobility, increased risk of fall, osteoporosis, osteoarthritis and rheumatoid .

Structurs

Bones, joints, muscles, tendons, ligaments and bursa of the body.

bones*:* It is the hardest tissues in the body and when fully developed it is composed of:

Water: (20%)

Organic material as bone cells (30-40)

Inorganic material as mineral salts, mainly calcium, and phosphorus: (40-50%)

The matrix, which consists of collagen and ground substances (glycoprotein and proteoglycans), provides a framework in which inorganic mineral salts are deposited.

Osteocytes are mature bone cells involved in bone-maintenance functions; they are located in bone matrix.

Osteoclasts, are multinuclear cells involved in destroying, resorbing, and remolding bone.

Structurs cont.

2- Joints: The bones of the body are joined together at joints that allow for a variety of movements. The junction of two or more bones is called a joint (e.g. knee joint the junction between femur and tibia bones).

3*-Ligament*: Is a small band of dense, white, fibrous elastic tissue. Ligaments connect the ends of bones together in order to form a joint. Most ligaments limit dislocation, or prevent certain movements that may cause breaks**.**

Structurs cont.

4- Tendons is a flexible band of fibrous connective tissues that connects muscles to bones.

5- Cartilage : Is a rigid connective tissue that serves as a support for soft tissue and provides the artiacular surface for joint movement.

6-Muscles: **Three types of muscle tissue are:**

Cardiac: is found in the heart, spontaneous contraction.

Smooth muscle: in the wall of hollow structures (airways, arteries, GIT, urinary bladder and uterus).

Skeletal which requires neuronal stimulation for contraction.

Functions

Protection: bony structure provides protection for .(vital organs as (heart, brain, and lung

Support: bony skeleton body structure by .providing a strong and solid frame

Movement: the muscles attached to skeleton allow .the body to move

Mineral storage: calcium, phosphorus and magnesium are minerals deposited and stored in .the bone matrix

Factors affecting

1- Local stress: (weight bearing) acts to simulate bone formation and remodeling. Weight-bearing bones are thick and strong. Without weight-bearing or stress.

2- Biologically active vitamin D: functions to increase the amount of calcium in the blood by promoting absorption of calcium from the gastrointestinal tract.

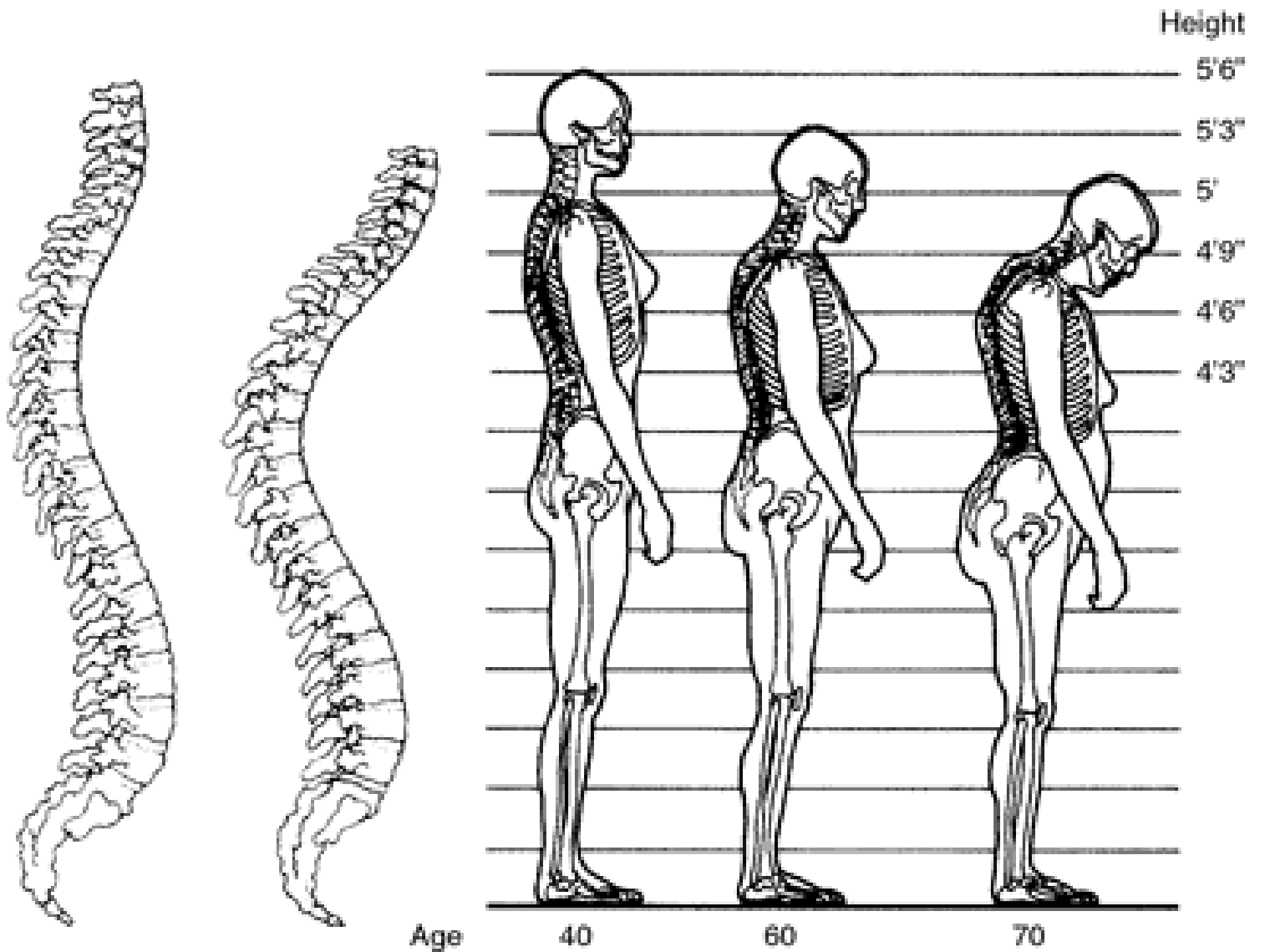
3- Parathyroid hormone and calcitonin: are the major hormonal regulators of calcium homeostasis.

Age-related changes

Changes in the skeleton:

Height decreases with age by approximately 1-6 inches this can explained by: The fibrocartillage of the intervertebral disks lose water and becomes drier, thinner. This causes the vertebrae to compress and height to diminish.

Shortening of the spinal column results in kyphosis of the upper thoracic spine (exaggerated spinal curvature) and shorting of the trunk makes the arms appear relatively long.


Height
5'6"
5'3"
5'
4'9"
4'6"
4'3"
Age
40
60
70

Age-related changes

Changes in Bone:

Bone mass and minerals are decreased leads to the bones become brittle and easy to fracture especially in older women, more liable to osteoporosis.

Collagen synthesis changes with age, leading to decreased flexibility in tendons, and ligaments.

Cartilage, on the other hand, continues to grow, evidenced by the lengthening and broadening of the ears and nose.

Age-related changes

Muscle mass and tone:

*Muscles becomes shrink, calcify, muscle cells undergoes atrophy, replaced by fibrous connective tissue and fatty tissues.

*Loss of muscle strength and mass is referred to as sarcopenia and can adversely affect the older adult's balance , gait, and falls.

*Increased muscle rigidity contributes to limited movement in areas such as the neck, hips, and knees.

*Reduction in blood supply to the muscles can lead to changes in muscle function.

Joints and supporting structures:

*The synovial membrane lines the joints cavity and secretes a lubricating fluid called synovial fluid. With age, there is a decrease in cynovial fluids, and the cartilage in joints become thinner.

* Decrease collagen formation, which causes loss of resilience (flexability) and elasticity in joints and supporting structures (ligaments, tendons) this lead to decreased range of motion.

* The bursae are fluid-filled synovial sacs located at various points around the joints. With age, changes in the bursae increase the risk of inflammation causing bursitis.

*Increase viscosity of synovial fluid and the synovial membrane become more fibrotic.

Factors increase age-associated bone loss:

- Imbalance between osteoplast (bone forming) and osteoclast (bearing down activity.
- Reduced absorption of calcium and vitamin D from the GIT.
- Reduced weight-bearing exercise
- Imbalance between calcitonin and parathyroid hormone levels.
- Decreased sunlight exposure.
- Decreased dietary intake of foods rich in calcium and
- vitamin D.
- Changes in estrogen levels in women

Common physiological changes affecting musculoskeletal System with aging:

Physiological changes	Results
Decreased Bone mass and minerals.	Increase risk of osteoporosis
Decreased fluid in intervertebral disks	Decreased height and increased curvature of the spine (kyphosis)
Decreased blood supply to muscles	Decreased muscle strength
Decreased tissue elasticity	Decreased mobility and flexibility
Decreased muscle mass	Decreased strength Increased risk of falls
Decrease collagen formation and elasticity in joints	Decreased range of motion

The problems associated with musculoskeletal system changes are:

- Pain
- Impaired mobility
- Self-care deficit
- Increased risk of fall
- Increased risk of infection
- Increased risk of fracture.

- Toward better musculoskeletal health:

- Individualized activity considering patient abilities and limitations
- Ideally 20-30 minutes of moderate-intensity exercises three days weekly
- Passive exercise to maintain joint mobility for patients with limited movement.
- Regular exercise (range of motion and walking).
- Provide assistance as needed
- Provide safety environment to prevent fall
- Nutrition (calcium), improving lifestyle
- Exposure to the sun (vitamin D)

- Common musculoskeletal system disorders associated with aging:

1-Osteoporosis:

Osteoporosis is considered the most common metabolic bone disorder for elderly. It is estimated that there are 1.5 million bone fractures every year secondary to osteoporosis. The disease primarily affects women but also occurs in one out of six men.

Definition of Osteoporosis :

Osteoporosis is a disease characterized by structural deterioration of bone tissue, leading to fragile bones and low bone mass.

Etiology of Osteoporosis :

The actual causes of osteoporosis are unknown. Certain risk factors increase the developing of osteoporosis.

Age; with advanced age and Post-menopause there is a decrease in estrogen hormone for female and testosterone in men in addition low calcitonin for both (these hormones inhibit bone loss)

female - women are four times more likely to develop osteoporosis than men.

Natural menopause before age 40. (The withdrawal of estrogens at menopause causes an accelerated bone resorption that continues during the postmenopausal years.

Lack of physical activity (Bones need stress for bone maintenance)

Nutrition (Low calcium intake or lack of its absorption, Low vitamin D intake, High phosphate, Inadequate calories, low protein) Reduces nutrients needed for bone remodeling and associated with low bone density

- Heredity factors: The risk increases if there is a history of osteoporosis and/or bone fractures in the family.
- Lifestyle (Cigarette smoking, Alcohol-regularly consuming, Caffeine, Lack of exposure to sunlight) Reduces osteogenesis in bone remodeling.
- Taking certain medications such as (corticosteroids, Antiseizure medications, and thyroid hormone) affects calcium absorption and metabolism.
- Other pathological disorders such as hyperthyroidism, hyperparathyroidism, anorexia nervosa, and gastrointestinal disease can also increase the risk

Manifestations:

- Osteoporosis typically is asymptomatic until a fracture occur. Typical symptoms of osteoporosis are back pain, loss of height, dorsal kyphosis, and cervical lordosis. Hip fractures can occur spontaneously or following mild to moderate trauma.

- **Symptoms include:**
- Gradual loss of height.
- Rounding of the shoulders.
- Gum inflammation and loosening of the teeth.
- Acute lower backache.
- Swelling of a wrist after a minor fall or injury

Diagnosis:

- The history and the presence of secondary causes should be an indicator to suspect osteoporosis in the older adults. The secondary causes include; hyperparathyroidism, diminished physical activity, paralysis, alcoholism, nutritional deficiencies, renal tubular acidosis that causes excretion of ca by the kidneys).
- Laboratory biochemical markers, including calcium, phosphorus, and alkaline phosphate levels.
- Radiographic studies may reveal vertebral compression fractures and a decrease in bone density. When a significant loss of bone mass is apparent on the radiograph the condition is known as osteopenia.

Treatment:

- Osteoporosis isn’t curable but is controllable and preventable. Treatment aimed at slowing the rate of bone resorption. The most common therapeutic medications used for treatment of osteoporosis (calcium salts, vitamin D, estrogen, bisphosphonates).

- **Medications:** Most drug therapies work by decreasing bone desorption.One of the most common therapies is the use of **Biphosphonates** such as alendronate or risedronate that act an inhibitor of osteoclastic activity and helps in the prevention and treatment of osteoporosis.
- **Calcium salts;** essential compobent for bone formation
- **Vitamin D** (increases intestinal absorption of calcium and pgosphrus)
- **Calcitonin** which is a hormone that decreases bone resorption, involved in calcium regulation and metabolism.
- **Estrogen Replacement Therapy (ERT**): (0.625 mg/day) are useful for 3 to 5 years after menopause, reduced risk of vertebral and hip fracture.

Prevention of osteoporosis:

- Choose high calcium foods daily such as skim and low-fat milks, yogurts, cheeses, salmon, sardines, vegetables especially broccoli, kale, collards, calcium-fortified foods such as some orange juices, apple juices.
- Get adequate vitamin D, you can get vitamin D from exposure to sunlight and from foods such as vitamin D-fortified milks; salmon, tuna and shrimp. The RDA for vitamin D form 400 to 800 IU (International Units) per day.
- Check with your doctor about taking calcium and vitamin D supplements.
- Follow a program of regular, weight-bearing exercise at least three or four times a week. Do not smoke. Smoking makes osteoporosis worse and may negate the beneficial effects of estrogen replacement therapy (ERT).
- Pay attention to your posture. Keep your back straight when you sit, stand and walk.
- Take measures to prevent falls and injury to your bones.

Management

- Assessment of the elderly with a diagnosis of osteoporosis requires obtaining the height and weight and determining the presence of pain, particularly in the upper and lower back or hip.
- Dietary assessment provides information about dietary intake of calcium rich foods.
- Analgesics are given for pain as prescribed.
- If the elderly must stay in bed, the nurse gently assists the patient with position changes, passive exercise, relaxation techniques and emotional support.

- Encourage the elderly to eat a well balanced diet and expose to sunlight.
- Encourage activities that involve mild exercise such as walking and range of motion exercise.
- Move the affected elderly gently as possible using correct body mechanism to avoid refracture.
- Encourage adequate fluids intake to help maintain adequate urine output and avoid renal calculi, hypercalcemia and urinary tract infection.
- Advice the elderly to sleep on a firm mattress.
- Teach the elderly women about breast self-examination every month especially if she is taking estrogen therapy.
- Encourage the elderly to use assistive devices such as cans or a walker if needed to maintain the proper postural balance and correction of body mechanism.

2-Arthritis:

- Arthritis is a general term referring to multiple different diseases affect joints. Generally these diseases fall into two main categories:
- **A) <u>Osteoarthritis or degenerative arthritis</u>,** resulting when cartilage is damaged and bones undergo abnormal changes.
- **B) <u>Inflammatory arthritis</u>** resulting from inflammation in the joints (eg.rheumatoid arthritis). The three main symptoms of arthritis are joint pain, stiffness, and joint swelling that lasts more than 2 weeks.

Osteoarthritis:

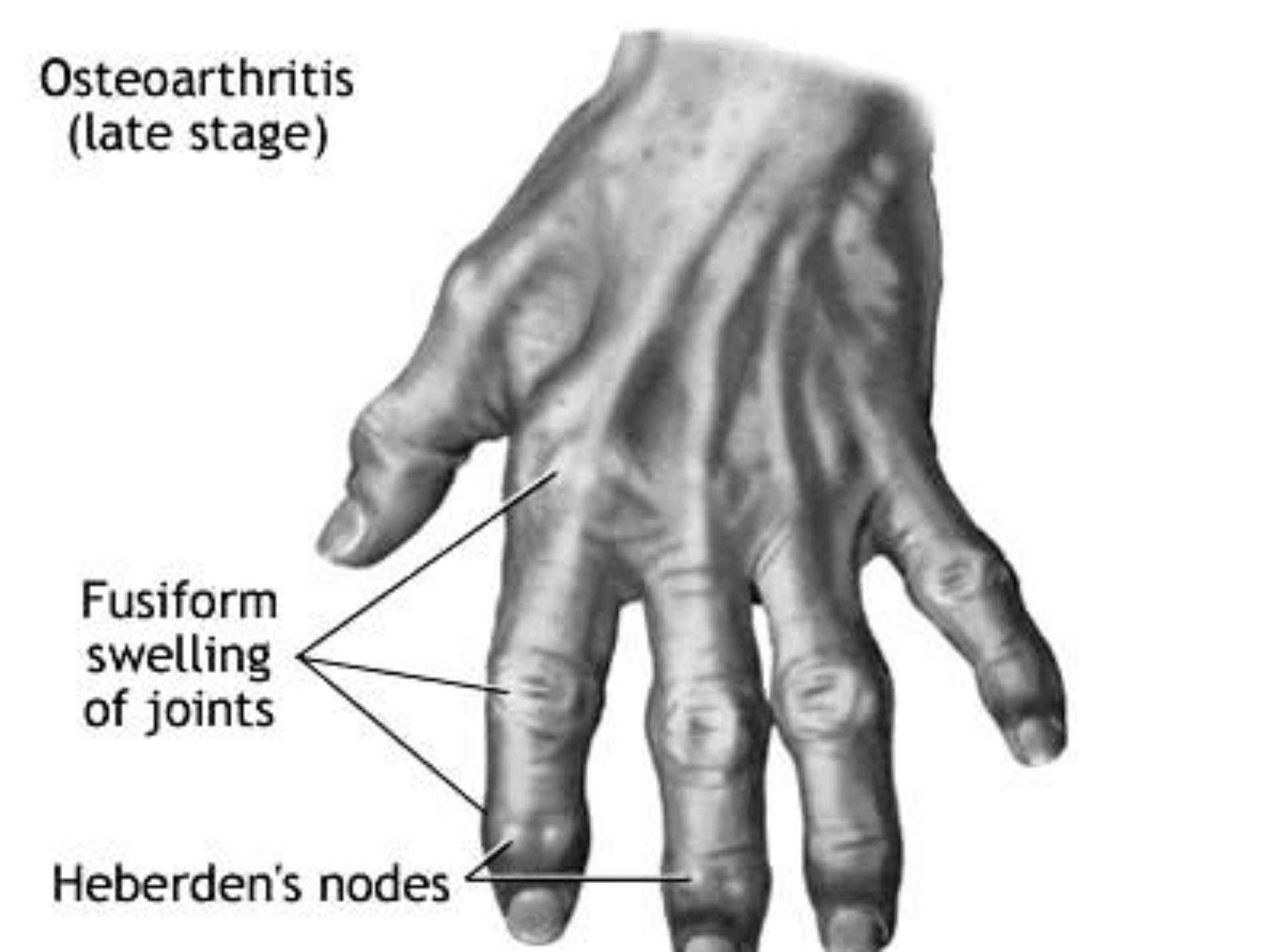
- Also called degenerative joint disease, is a non-inflammatory disorder of movable joints and it is the most common type of arthritis in older adults. The incidence of osteoarthritis rises significantly with age. Before age 45, osteoarthritis occurs more frequently in males. After age 55 years, it occurs more frequently in females.
- Osteoarthritis is characterized by progressive particular cartilage deterioration with the formation of new bone in the joint space. The degeneration of the joint is not caused by aging alone. Age, trauma, lifestyle, obesity, and genetics have been cited as predisposing factors in the development of osteoarthritis.
- Osteoarthritis most often affects the large weight-bearing joints such as the hips, and the knees, but joints of the hands, feet, and spine can also be affected.

Factors contributing to osteoarthritis:

- **A-Primary osteoarthritis:**
- **Mostly related to aging, and (genetic) basis.**
- **Obesity: puts added weight on the joints and causes osteoarthritis by increasing the mechanical stress on the cartilage especially the knees.**
- **Abnormal joints at birth (congenital abnormalities)**
- **Hormonal disorders. Such as diabetes, are also associated with early cartilage wear and secondary osteoarthritis.**
- **Inflammatory diseases (such as gout, and rheumatoid arthritis).**
- **A joint infection, e.g. from an injury.**

Manifestation of osteoarthritis:

- The symptoms of osteoarthritis include pain, stiffness, and joint hypertrophy.
- **Pain in the affected joint**: "Pain" is generally described as a sharp ache, or a burning sensation in the associate **muscles and tendons**., Joint pain is usually worse later in the day, it can also occur after long periods of inactivity, for example, sitting in a theater.
- **Tenderness, swelling around the affected joint**
- **Early morning stiffness**. In severe osteoarthritis, complete loss of cartilage causes friction between bones, causing limited motion lasts 20-30 minutes.
- **Crackling noise** (**called "crepitus") when** the affected joint is moved or touched


Osteoarthritis
(late stage)
Fusiform
swelling
of joints
Heberden's nodes

Osteoarthritis

Healthy knee joint

Hypertrophy and spurring
of bone and erosion of cartilage

Diagnosis

- There is no blood test for the diagnosis of osteoarthritis. Blood tests well as to exclude other arthritis conditions that can mimic osteoarthritis.
- Plain radiographs may demonstrate narrowing of the joint space and presence of osteophytes at the joint margin and loss of joint cartilage.
- MRI is greater sensitive to detect changes in cartilage.

Management for osteoarthritis

- There is no specific treatment to halt cartilage degeneration or to repair damaged cartilage in osteoarthritis. The goal of treatment in osteoarthritis is aimed to
- - Reduce joint pain and stiffness and prevention of further damage
- - Maintaining joint mobility and function.
- Therapeutic measures include physical therapy, exercise programs, rest, reduced joint load, weight reduction, drug therapy and surgery

Physical therapy, exercise programs

- Exercise usually does not aggravate osteoarthritis when performed at levels that do not cause joint pain. Exercise is helpful in osteoarthritis in several ways. First, it strengthens the muscular support around the joints, prevents muscle atrophy, It also improves and maintains joint mobility. Finally, it helps with weight reduction and promotes endurance
- Other physical measures that can relieve symptoms are heat and cold application and transcutaneous nerve stimulation.
- **Heat and Ice Treatments:** Ice, when a joint is inflamed (particularly in the knee) applying ice for 20 to 30 minutes can be effective. Heat treatments can relieve pain with hot soaks and warm paraffin application.

Rest, reduced joint load

- Resting sore joints decreases stress on the joints, and relieve pain and swelling. Patients are asked to simply decrease the intensity and/or frequency of the activities that consistently cause joint pain.
- Physical therapists can provide support devices, such as splints, canes, walkers, and braces. These devices can be helpful in reducing stress on the joints.
- Occupational therapists can assess daily activities and determine additional devices that may help patients at work or home. Finger splints can support individual joints of the fingers. Paraffin wax dips, warm water soaks, and nighttime cotton gloves can help ease hand symptoms. Spine symptoms can improve with a neck collar, lumbar corset, or a firm mattress, depending on what areas are involved.

Weight reduction:

- **Obesity** is a known risk factor for osteoarthritis, therefore it is important to advice older adults that weight reduction can reduce both risk and symptoms of osteoarthritis of the knee.
- **Drug therapy**
- A combination of nonpharmacological and pharmacological measures is recommended in management of osteoarthritis. Medication may be used topically, taken orally, or injected into the joints to decrease joint inflammation and pain.
- The most commonly used drugs are; A- acetaminophen (the 1st analgesic prescribed for elderly for relieving pain of osteoarthritis, because it has fewer adverse reactions than NSAIDs
- B- Non-steroidal anti-inflammatory drugs
- Fish oil supplements have been shown to have some anti-inflammation properties and increasing the dietary fish intake and/or fish oil capsules (omega 3 capsules) can sometimes reduce inflammation of arthritis.

Surgery:

- When pain is persistent and disabling despite physical and pharmacological intervention, and severe structural damage is evident radiographically, surgery is
- **Osteotomy**is a bone removal procedure that can help realign some of the deformity in selected patients, usually those with knee disease. In some cases, severely degenerated joints are best treated by replacement with an artificial joint (**arthroplasty).**

Rheumatoid arthritis (RA)

- Is the major cause of disability in older adults. It is a chronic, systematic, progressive inflammatory disease of unknown etiology, characterized by an inflammatory reaction in the synovial membrane that results in destruction of the joint cartilage and supporting structures. This chronic erosion and destructions can cause joint deformities.
- Rheumatoid arthritis like osteoporosis that primarily affects women. The onset of the disease can occur at any age, but it usually begins after age 35ys in women and after 45 yrs in men.
- Although the definite cause is unknown, there are contributing factors such as; genetic factors, autoimmunity and microbial infection.

- Small peripheral joints usually are affected symmetrically. The hands are affected first, followed by the feet. Other joints may be affected are the wrists, knees, ankles, elbows, neck and shoulders.
- Unlike osteoarthritis, RA usually affects proximal rather than distal joints of the hands and feet.

Manifestation of RA:

- Patient present with an acute or gradual onset of pain, swelling, and stiffness of multiple joints.
- Associated manifestations such as; fatigue, malaise, low grade fever, anorexia, and weight loss may be developed.
- Specific to the joint, pain, warmth, edema and limitation of movement. Prolonged morning joint stiffness is a positive indicator. Over time the articular cartilage, fibrous joint capsule, surrounding ligaments, and tendons become inflamed, eventually causing joint deformity and loss of function
- Systemic involvement of RA is related to the formation of rheumatoid nodules that can invade the skin, heart valves, pleural and the spleen.

Management of RA:

- The goals of treatment are maintenance of joint function
- **Rest and exercise:**
- A healthy balance between rest and therapeutic exercise is very necessary in management of RA. Pt should be educated to maintain periodical rest during the day and to participate in activities. Isotonic and isometric exercises are helpful to prevent further damage to the joint, promote muscle strength. Periodically bed rest decreases systemic inflammation and it may be necessary during the acute phase. With bed rest, range of motion (ROM) exercises are needed to maintain function

- **Non pharmacological pain relief measures:** Should be utililized to decrease pain and maintain function as; heat and cold modalities, transcutaneous electrical nerve.
- Surgeries may include synovecto my (removal of tue inflamed synovial lining.

Nutritional recommendations for musculoskeletal disorders

- Nutrition and bone, muscle and joint health are closely related. A healthy diet can help you prevent and manage musculoskeletal disorders such as
- Vitamin B6 and B12
- Vitamin A
- Magneseium
- Vitamin K
- Zinc


Tanko