The Foot, Aging, and Exercise

ATLANTIC ORTHOPAEDIC S P E C I A L I S T S

Leaders in Orthopaedic Health

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Changes in the Aging Foot



"When our feet hurt, we hurt all over."

Socrates

The Foot is composed of

26 bones

- 25% of all the bones in the body!
- 33 joints
- 120 intertwining web of muscles, ligaments and bone

Function of the feet



- Support the body's weight
- 2. Act as a shock absorber
- Serves as a lever for propulsion forward
- Maintains balance adjusting to uneven surfaces

As one ages the ability to ambulate is directly related to foot health Sustained mobility often enables older adults to maximize their independence and ability to socialize



Think About It...

Average person takes

- 10,000 steps/day
- Or x> 3,000,000 steps/year
- With each step force of impact is 2-3x body weight
- 18,000 individuals die each year from injuries sustained by a fall

FOOT PROBLEMS

- According to the US National Center for Health Statistics (NCHS), impairment of the lower extremities can cause activity limitations in the elderly.
- Studies show that care for a bedridden patient costs much more than care for an ambulatory patient.
- To maintain and preserve quality of life one must be able to move about to get from point to point.
- Mobility is a vital ingredient to independence and a higher quality of life.
- Foot problems can make it difficult or next to impossible for seniors to perform activities of daily living and social activities.

Mirror of Health

- Normal aging leads to deficits in the vascular, skeletomuscular, and nervous systems
- The feet are often the first to see signs of systemic conditions.
- There are more than 300 different foot ailments. Some can be traced to heredity, the aging process, or may stem from the effect of years of neglect and/or abuse
- 90% of the population over the age of 65 have evidence of foot pain that alters independent activity

General Changes in Feet During Aging

- With age, feet tend to spread, and lose the fat pads that cushion the bottom of the feet
- Increase in weight affects the bone and ligament structure.
- Skin has decrease hair growth, oil secretion, and nail growth is thickened with longitudinal ridges.



– Ingrown toenails

Common Foot Problems Associated with Aging

Toenails

- Degenerative changes (onychopathy)
- Thickening (onychochauxis & onychogryphosis)
- Longitudinal ridging (onychorrhexis)
 - Microtrauma
 - Disease
 - Nutritional impairment
- Fungal infection (onychomycosis)



Common Foot Problems Associated with Aging

Skeletal-muscular pain

- There is progressive muscle mass loss and soft tissue atrophy that leads to:
- Structural abnormalities
 - Bunions
 - Hammertoes
 - Metatarsalgia
 - Heel pain
 - Fat pad atrophy
- Arthritis

Common Foot Problems Associated with Aging

Nerve disorders

- Morton Neuroma
- Neuropathies
- Paresthesias
 - Abnormal skin sensations
- Reduced deep tendon reflexes
- Autonomic Nervous system changes
 - Decreased sweating and oil production

Systemic Diseases That Manifest On The Lower Extremity

Diabetes

 Neuropathy, Ischemia, Muscle weakness, Skin changes

Arthrosclerosis

- Skin changes, edema, pain
- Reynaud's Disease
- Thromboembolic diseases
 - Blood clots i.e. strokes, DVT
- Hypothyroidism
- Congestive Heart Failure

Systemic Diseases That Manifest On The Lower Extremity

- Renal Failure
- Lymphedema
- Arthritis
 - Osteoarthritis, Rheumatoid, Gouty
- Anemias
 - Iron deficiency
 - B Vitamin deficiency
 - K Vitamin deficiency

Systemic Diseases That Manifest On The Lower Extremity

- Active Chemotherapy
- Chronic Steroid Therapy
- Immunosuppression
- Alzheimer's Disease
- Parkinson's Disease

AGING



Between 40 and 50

- Bone density begins to decrease more rapidly in women
- Articular cartilage becomes more brittle
- Connective tissue losses tensile strength, elasticity and regenerative properties
- Muscle mass decreases even with continued activity
- Body weight increases
- Skin becomes drier, with decreased hair growth and thickening of the nails



Skin

- Dry skin
- Corns and calluses
- Fungal and Bacterial Conditions
- Warts
- Loss of plantar fat pad
- Decreased small vessels
- Decreased small fibers



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refraining from smoking and adherence to heart medicines.

Sources: Carl J. Pepine, University of Florida: WSJ reporting Illustration: Erik Brynildsen/The Wall Street Journal

Vascular system Venous





Muscles contracted, valve above muscle opens







Connective Tissue

- Calcium pyrophoshate crystals tend to deposit around chondrocytes as we age leading to brittle articular cartilage
- Decreased thickness
- Collagen becomes stiffer
 - Glycation end products increase and this increases cross linkages
- Arthritis



Muscle

- Number and size of muscle fibers decreases
 - Fast contracting >slow contracting
 - Decrease is due to
 - Decrease in activity
 - Loss of motor units
 - Decrease in anabolic hormones
 - Growth hormone
 - Insulin like growth factor testosterone and DHEA

Balance and Strength Issues

• Pelvic, Posterior Calf, and Intrinsic



Bone Density

- Cortices become thinner from the inside and there is a decrease in cancellous bone
 - Senescent bone loss
 - aging impaired ability to absorb calcium from intestines – Vitamin D levels important
 - Sex hormones inhibit cytokines IL-1, IL-6 and TNF (males linear, females exponential)

Summary of the effects of Aging

Structure	Age related Change	Creates
Skin	Thinner and Drier	Less complaint and resilient Prone to cracking, calluses and ulcers
Nail	Thicker and Brittle	Difficult to cut, ingrown and mycosis
Arterial System	↑ resistance ↓ elasticity	↑ Blood Pressure, ↓ blood supply, loss of hair, dystrophic nails, pain, impaired healing, ulceration
Venous System	↓ elasticity, Incompetent valves	Varicosities, edema, hemosiderin deposition, ulceration
Bone and Joints	Osteopenia Osteoarthritis	↑ risk of fracture, pain, restricted motion, deformity

Summary of the effects of Aging

	Structure	Age related Change	Creates
	Fat Pad	Decreased bottom of the foot Fat depositions about ankle	Pain in ball and heel of foot Reduced motion of the ankle
	Muscle	\downarrow muscle mass	↓ muscle strength, ↓ circulation Altered gait mechanics
	Ligaments	↓ elasticity, stiffness	Restricted motion Altered gait mechanics
	Tendons	↓ elasticity	Decreased strength Increased risk of disease
	Overall	Wider, longer, weaker foot ↓ circulation ↓ sensation	Gait abnormalities Abnormal structure

These changes lead to

Cold Feet

- Muscle mass decrease with age
 - Females>males
- Skin thins
 - Starts at about age 40
 - Females>males
- Raynauld's Phenomena / Disease
- Anemia
 - Iron deficiency
 - Vitamin B deficiency
- Blood Coagulation Abnormalities
 - Vitamin K deficiency

Edema

Edema

- Medication side effect or
- Non-pitting edema will spring back quickly suggesting hepatic or renal disease or malnutrition.
- Pitting edema retains the pit for more than a minute suggesting cardiac disease, CHF or inflammation.

Edema can also suggest:

- Diffuse edema with redness and warmth suggests DVT, superficial thrombophlebitis, or cellulitis
- Brawny hyperpigmented skin suggests chronic venous insufficiency.
- Purpuric chevron over the lateral malleolus suggests a ruptured Baker's cyst.

Treatment

Support hose 15- 25 mmHg



Skin changes

- Dry Skin
- Corns and Calluses
- Fungal and Bacterial Conditions
- Warts
- Loss of plantar fat pad
- Decreased sensation

Painful Forefoot

- Digital deformities: Bunions, hammertoes
- Tenderness of the great toe plantar suggests sesamoiditis.
- Tenderness over the dorsal aspect of the metatarsal heads suggests stress fracture.
- Discrete tenderness over the dorsal aspect of the second metatarsal head is Freiberg's infarction (AVN).
- Tenderness to palpation over the plantar aspect of the metatarsal heads is metatarsalgia.
- Burning pain between the 3rd and 4th toes at the MTPJ suggests Morton's neuroma
- Pain on flexing the toes suggests an inflammatory lesion of the arch of the foot (Strunsky's sign).

Medial Foot Pain

- Tenderness and swelling at the base of the second metatarsal after injury indicates Lisfranc's fracture.
 - Swelling and tenderness of medial ankle suggests medial ankle sprain or posterior tibialis tendonitis
 - Navicular tenderness suggests bursitis.
 - Pain and tingling over the medial and plantar aspects of the foot suggests the tarsal tunnel syndrome.

Increased pain on squeezing the malleoli together or pain on rotation of the foot at the ankle suggests a syndesmotic sprain.

Lateral Foot Pain

- Swelling and tenderness of the lateral malleolus to palpation suggests sprain or distal fibular fracture.
 - Consider a peroneal retinaculum sprain if the tenderness is at the posterior lateral malleolus.
- Tenderness at the base of the fifth metatarsal bone suggests avulsion fracture, bursitis, Jones' fracture



Painful Heel

- Tenderness and swelling deep to the Achilles tendon between the tendon and the calcaneus suggests retrocalcaneal bursitis.
- Tenderness of the overlying skin over the distal third of the Achilles tendon suggests tendo-Achilles tendonitis.
- Diffuse tenderness of the Achilles tendon suggests Achilles tendonitis.
- Tenderness plantar medial heel suggests plantar fasciitis.

What can we do

- Eat Right
- Lose Weight
- Stay Active
- Take Care of Problems
 - Ignoring them doesn't make them go away, but increases the potential of complications!



Better Diets



oread, cereal, rice & pasta 6-11 servings

Remember the food pyramid!
 Watch you caloric intake!



Better Diets

- Iron deficiency
 - Pumpkin seeds, nuts, fish and watermelon
- B Vitamin deficiency
 - B complex supplement
- K Vitamin deficiency
 - Ginger, fish, parsley, salads, spring onion, apricots, and celery



Lose weight

- Pounds per square inch
 - Weight loss reduces hip, knee, ankle and foot pain!!
- "I can't lose weight because my feet hurt!"
 - REALLY???!!!!!



Warm Up and Cool Down

Drink 16 to 32 ounces of fluid 1 to 2 hours before exercise

Break into a light sweat.

- Do some light calisthenics and marching in place to get the blood flowing
- Once you have loosened up by getting your body warm, you then begin to stretch.
- By sweating, you are getting the blood pumping to your legs and arms

Stretching is of paramount importance.

- It should not hurt. If it does, you are probably being too aggressive or doing it improperly
- Stretching should be done before and after exercise

Benefits of Exercise

In the Cardiovascular System, exercise

- Improves blood pressure and lipid profiles
- Decreases risk of CAD
- Improves CHF symptoms and decreases hospitalization rate

In Diabetes Mellitus, type 2, exercise

- Decreases incidence
- Improves glycemic control, and insulin sensitivity
- In Osteoporosis, exercise
 - Increases bone density
 - Decreases hip and vertebral fractures
 - Decreases risk of falling

Benefits of Exercise

In Osteoarthritis, exercise

- Keeps joints, tendons and ligaments flexible
- Improves function, and decreases pain

For Neuropsychologic health, exercise

- Improves quality of sleep, improves quality of life and decreases fatigue
- Improves cognitive function and short-term memory
- Decreases rates of depression

Benefits of Exercise

In Addition, exercise

- Decreases all-cause mortality and morbidity
- Decreases risk of obesity
- Improves symptoms in peripheral vascular occlusive disease
- Increases your energy and endurance
- Increases gastrointestinal motility

Strength Training

- Although the positive benefits of aerobic exercise are widely accepted, the importance of resistance training is becoming increasingly apparent.
- Muscle strength declines by:
 - 15 % per decade after age 50
 - 30 % per decade after age 70
 - The loss of muscle mass occurs in women > men
 - Resistance training can result in 25 to 100% strength gain in adults through muscle hypertrophy (growth) and, increased motor unit recruitment (use).



Active foot exercises

- Increase muscle bulk
- Increases circulation
- Decreases stiffness
- Increases balance
- Decreases gait disturbances

Most common foot exercises



Additional exercises







Marble Pick ups

- Intrinsic muscles
 - Metatarsal pain
- Arch strengthener
 - Longitudinal arch
- Arch strengthener
 Posterior tibial tendon



Skin changesDry Skin

- Moisturize!
- Skin specific, but any good lotion or cream
 - Eucalyptus oil
 - Antimicrobial and antifungal
 - Stimulates circulation
 - Facilitates the production of ceramides in cells that increases skin softness and suppleness



Skin changes....Dry Skin

Moisturize!

- Menthol
 - 50% of essential oil in peppermint
 - Inhibits pain receptors
 - Dilates blood vessels
- Squalenes
 - Precursors to cholesterol
 - 15% of total fat content of skin which declines with age
 - Olive oil is 0.2-0.7% squalenes



Skin changes....Dry Skin

Moisturize!

- Cocoa butter
 - Contains antioxidants called flavonoids
 - appears to cause relaxation of veins
- Shea Butter
 - Contains Vitamin E an antioxidant
- Coconut oil
 - High numbers of medium chain triglycerides



Skin changes....Dry Skin

Moisturize!

- Aloe Vera
 - astringent causes contraction of the skin, blood vessels, and other tissues stopping the fluid discharge
 - Emollient helps to soften and smooth the skin
 - Antifungal, antibacterial and antiviral
 - cell proliferation



Skin changes

- Nail Changes
- Onychomycosis
 - Fungal infections of the nail plate causing deformed and white or yellow discoloration of the nails
 - X>10% of population has onychomycosis
 - Risk factors include:
 - Male, PVD, Diabetes, aging immunocompromised
 - Treatment has a high failure rate
 - Systemic is associated with hepatotoxicity
 - Terbinafine and itraconazole
 - Topical
 - Herbal
 - Ciclopirox 8%

Skin changes

Calluses

- Are due to keratin dysfunction and persistent shear forces
- Treatment
 - Should be smoothed lightly with an emery board or pumice stone
- If the dry skin does not resolve than its more than just dry skin
 - Fungal Infection
 - Athletes foot
 - Bacterial Infection
 - erythrasma
 - Systemic Disease
 - Dermatitis
 - Psoriasis

The four "V's" of skin care

- Vinegar
- Vicks Vapor Rub
- Vaseline
- Vegetable shortening



Shoes

- We change shoe size with aging
- Best to buy after 4:00pm to have maximal swelling
- Note tight shoes decrease circulation
- Heels
 - greater than 3" load the forefoot 7X that of body weight
 - Lead to contracture of posterior calf musculature

Foot Health Tips

- Properly fitted shoes are essential
- Shop for shoes in the afternoon; feet tend to swell during the day.
- Never cut corns and calluses with a razor, pocket knife, or other such instrument
- Bathe your feet daily in lukewarm (not hot) water, using a mild soap, preferably one containing moisturizers, or use a moisturizer separately.
- Trim or file your toenails straight across.
- Inspect your feet every day or have someone do this for you.
- FOOT PAIN IS NOT NORMAL HAVE IT CHECKED



Thank you





References

- Nursing care of the aging feet. Mitty E Geriatric Nursing Vol 30:5p350
- American Journal of Epidemiology Vol148No7p657
- Foot care for the Aging Edelstein PhysTher 1988Vol68p1882



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Table 1. Selected Age-Related and Disease-Related Changes of the Foot

AGE-RELATED CHANGES

Skin

- · Loss of hair below knee, on dorsum of the foot, and on the toes
- · Atrophy with parchment-like and xerotic appearance
- Brownish pigmentations
- Hyperkeratotic lesions (hypertrophy and hyperplasia) referred to as corns and calluses

Toenails

- Degenerative trophic changes (onychopathy)
- Thickening (onychauxis and onychogryphosis)
- Longitudinal ridging (onychorrhexis) secondary to repeated microtrauma, disease, or nutritional impairment
- Hyperkeratosis (onychophosis)
- Tinea unguium (onychomycosis)

Muscle Mass and Soft Tissue

Progressive loss of muscle mass and soft-tissue atrophy cause decreased function and lack of activity; susceptibility to foot injury increases so that microtrauma may result in fracture and marked limitation of activity.

Interossei (between bones) Atrophy precipitating development of:

- Digital contractures (hammer toe)
- Metatarsal prolapse; pain in the ball of the foot (metatarsalgia)
- Displacement of the plantar (sole of the foot) fat pad; heel pain

DISEASE-RELATED CHANGES

Peripheral Vascular Disease and Arterial Insufficiency

Pain on rest

Coldness

· Color variations (rubor and cyanosis)

- Intermittent claudication
- Trophic changes
- Marked Vascular Disease
- · Subungual (under the nail) hemorrhage
- Subhyperkeratotic hemorrhage

Neuropathy

- Loss of sensation (reduced sensitivity to pain and heat or cold)
- Paresthesia (abnormal skin sensations such as burning, tingling, and itching)
- Reduced Achilles tendon reflex
- Other changes such as skin color and hydration changes, loss of proprioception (the awareness of body/parts position, location, orientation, and movement of the body and its parts), reduced ambulatory capacity, lessened sense of vibration

Gout

Toe, foot, or ankle pain with warmth and redness

Raynaud's Disease

Bilateral episodic digital discomfort, pallor, and cyanosis

Thromboembolic Disease

Due to aortic-iliac stenosis, arrhythmia, cholesterol embolization (after coronary artery bypass or catheterization), or warfarin therapy, cyanosis of a single toe (blue toe syndrome) may occur

Note: Refer to Reference 3 for a comprehensive list of foot and ankle disorders and foot manifestations of systemic disorders.

Source: References 2, 3, 9, 13, 14.