

# Calcium balance

In bones: 99%

1% Mainly intracellular

0.1%–0.2% ECF

# Serum calcium

Serum calcium exists in three forms:

- (1) protein bound,
- (2) complexed, and
- (3) ionized.

# Regulation of Serum Calcium

- Absorbed from the intestine under the influence of vitamin D,
- Stored in bone, and is excreted by the kidney

# Control of excretion in the kidney

Distal convoluted

Vit. D and parath. hormone

# Calcitonin

A hormone produced by C cells in the thyroid, is thought to act on the kidney and bone to remove calcium from the circulation

# Function of PTH

Maintain the calcium concentration of the ECF:

- Promoting the release of calcium from bone,
- Increasing the activation of vitamin D

# Vitamin D

Vitamin D3, the precursor of the active form of vitamin D

# Calcium and phosphate

- Normal serum levels of calcium (8.5 to 10.5 mg/dL in adults) and
- Phosphate (2.5 to 4.5 mg/dL in adults)
- Regulated so that the product of the two concentrations ( $[\text{Ca}] \times [\text{PO}_4]$ ) is normally maintained at less than 70

# Hypocalcemia

- (1) Impaired ability to mobilize calcium bone stores,
- (2) Abnormal losses of calcium from the kidney,
- (3) Increased protein binding or chelation such that greater proportions of calcium are in the nonionized form

pseudohypocalcemia

Asymptomatic?

# Magnesium deficiency

- Inhibits PTH release and
- Impairs the action of PTH on bone resorption

# Renal failure

Po<sub>4</sub> ↗

Ca ↘

# Respiratory alkalosis can produce tetany?

Because of increased protein binding of  
calcium

Hypocalcemia is a common finding  
in a patient with acute pancreatitis?

Soap

# Manifestations of Hypocalcemia

- Serum calcium  $<8.5$  mg/dL
- Paresthesias, especially numbness and tingling
- Skeletal muscle cramps
- Abdominal muscle spasms and cramps
- Hyperactive reflexes
- Carpopedal spasm
- Tetany
- Laryngeal spasm

# Cardiovascular signs

- Hypotension
- Signs of cardiac insufficiency
- Decreased response to drugs that act by calcium-mediated mechanisms
- Prolongation of the QT interval predisposes to ventricular dysrhythmias

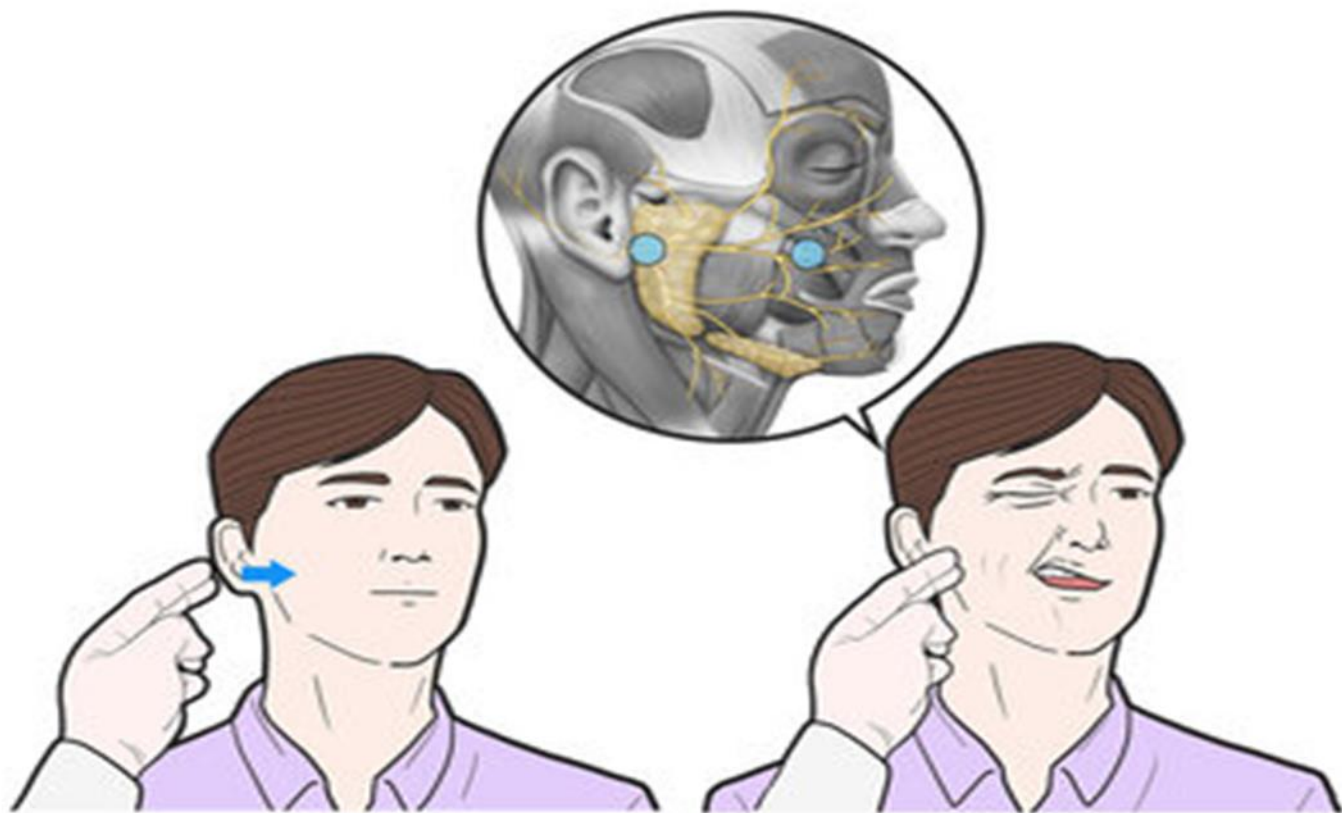
# Skeletal Effects (Chronic Deficiency)

- Osteomalacia
- Bone pain

# Diagnosis and Treatment

Chvostek's and Trousseau's tests

## Chvostek's test





# Hypercalcemia

# Causes

- Increased bone resorption caused by neoplasms or hyperparathyroidism.
- Tumor
- Prolonged immobilization,
- Increased intestinal absorption of calcium, and
- Excessive doses of vitamin D

# Manifestations

- Serum calcium  $>10.5$  mg/dL
- Polyuria
- Increased thirst
- Flank pain
- Signs of acute renal insufficiency
- Signs of kidney stones

- Muscle weakness
- Ataxia, loss of muscle tone
- Lethargy
- Personality and behavioral changes
- Stupor and coma

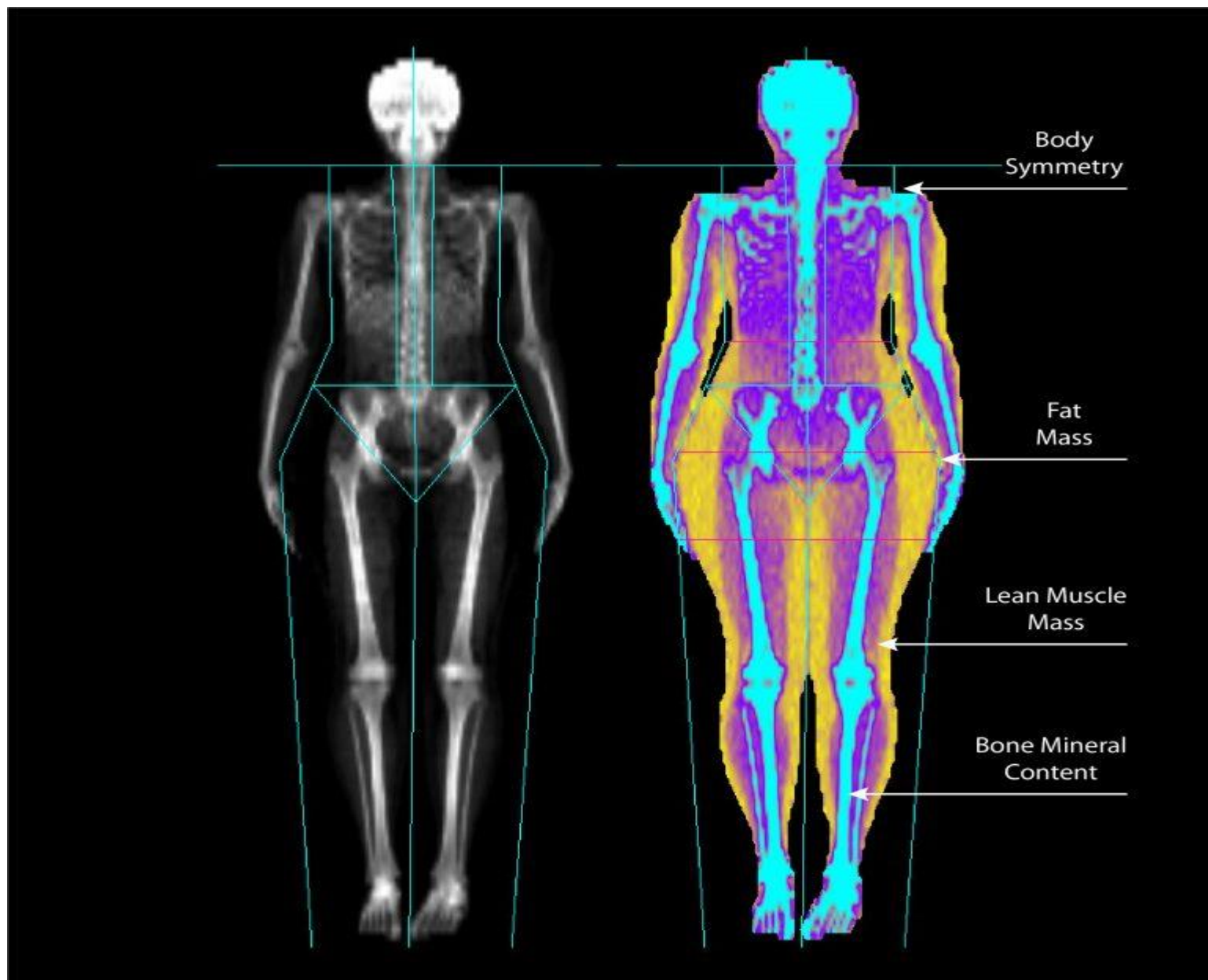
- Hypertension
- Shortening of the QT interval
- Atrioventricular block

# Treatment

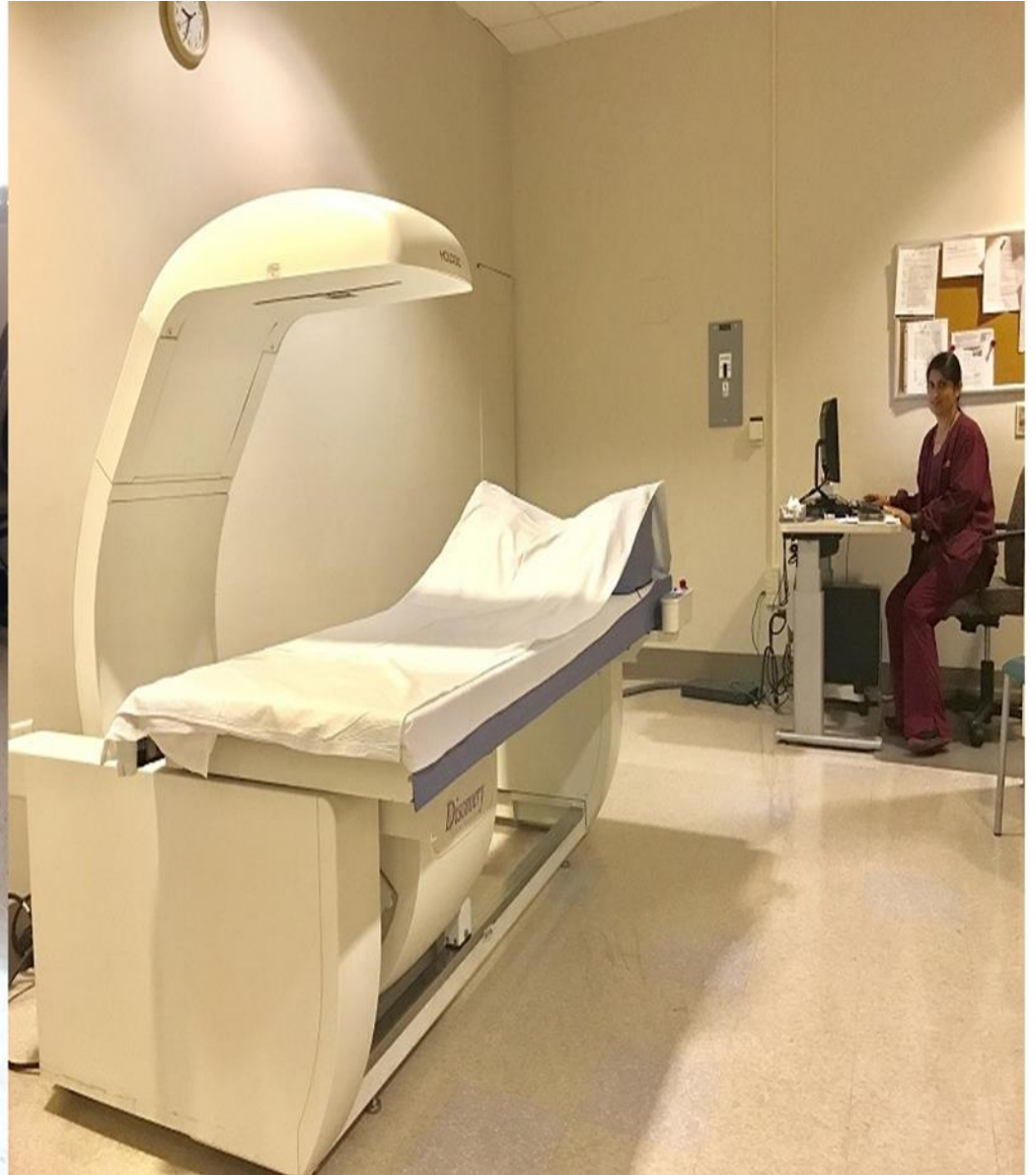
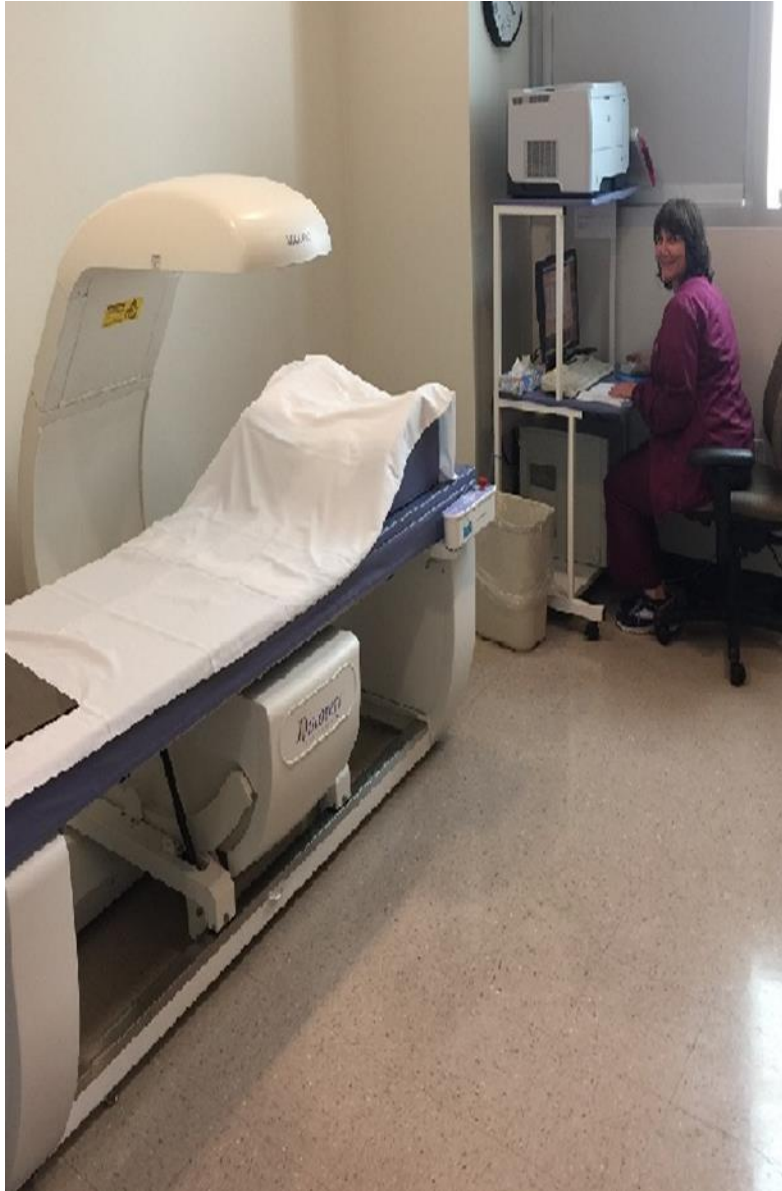
N.S. and lasix

# DEXA scan

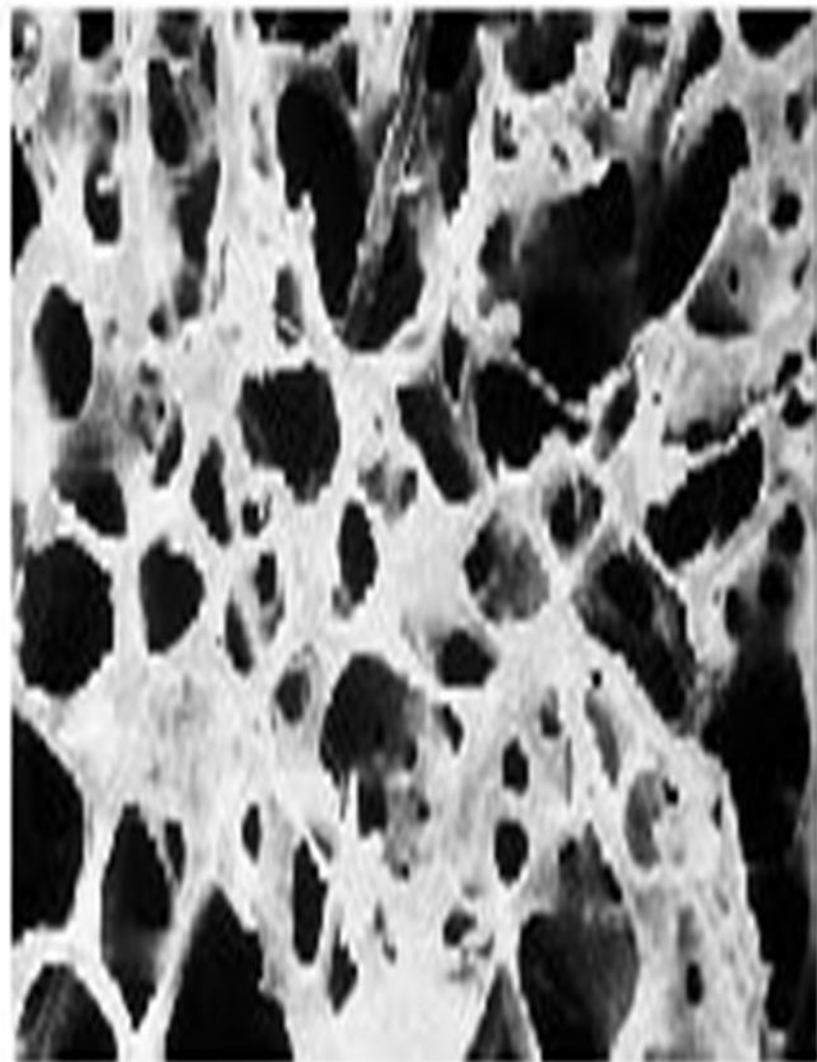
Dual-energy x-ray absorptiometry (DEXA)



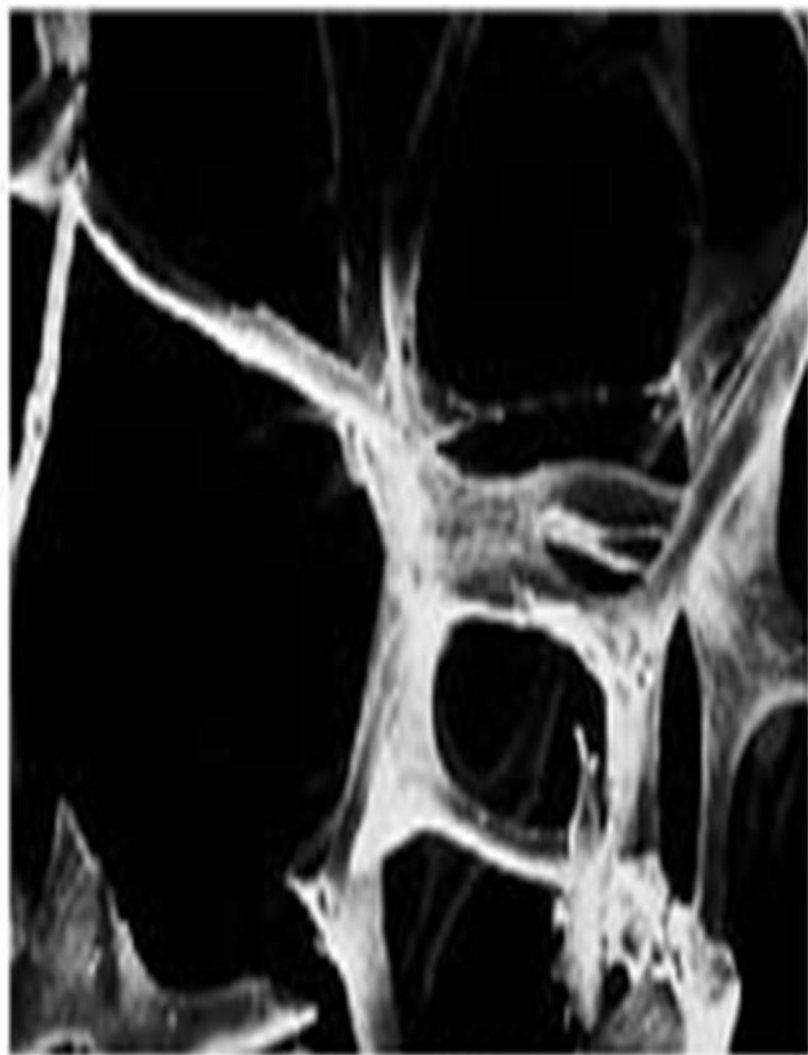
## DEXA Scan Results







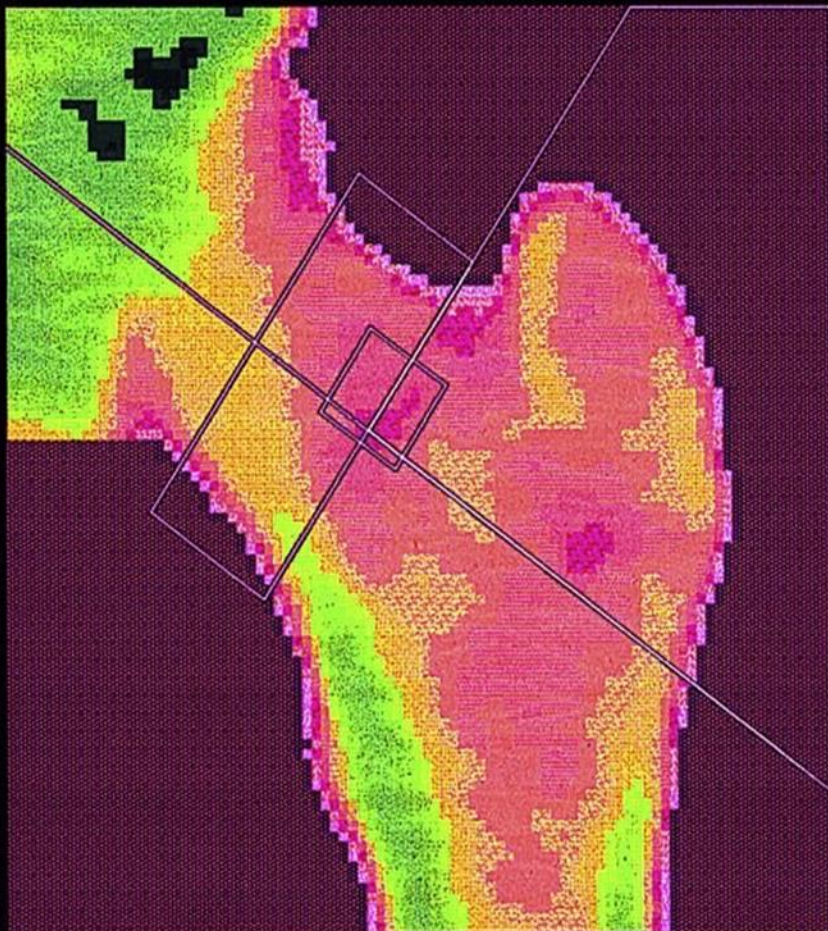
**Normal Bone**



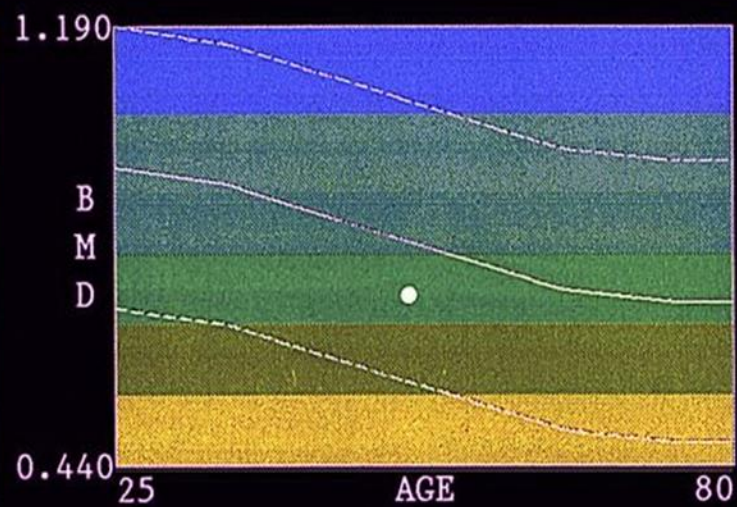
**Osteoporotic Bone**

L  H

Left Hip



Fem Neck version 2.3

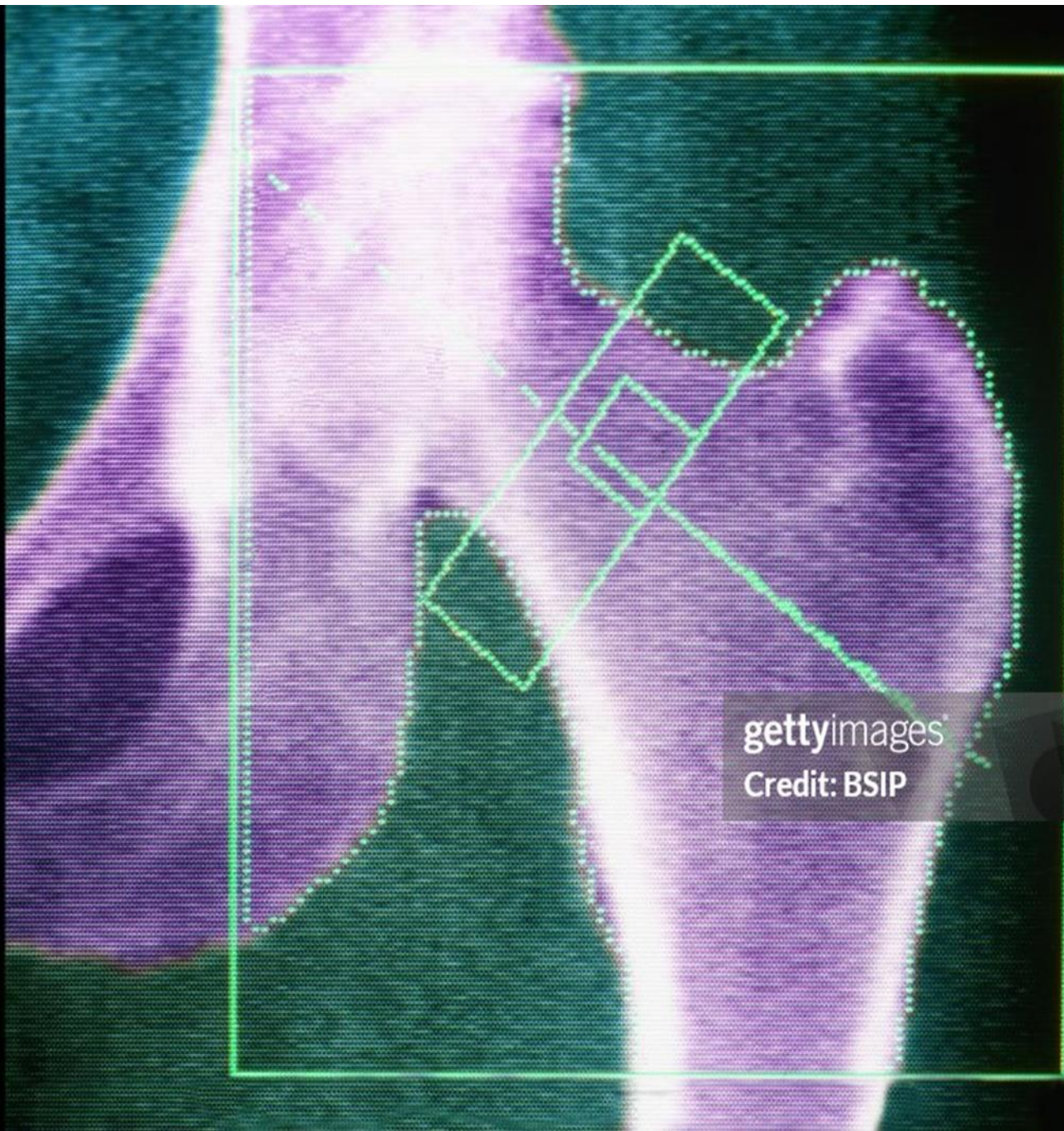


0.730

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Credit: BSIP

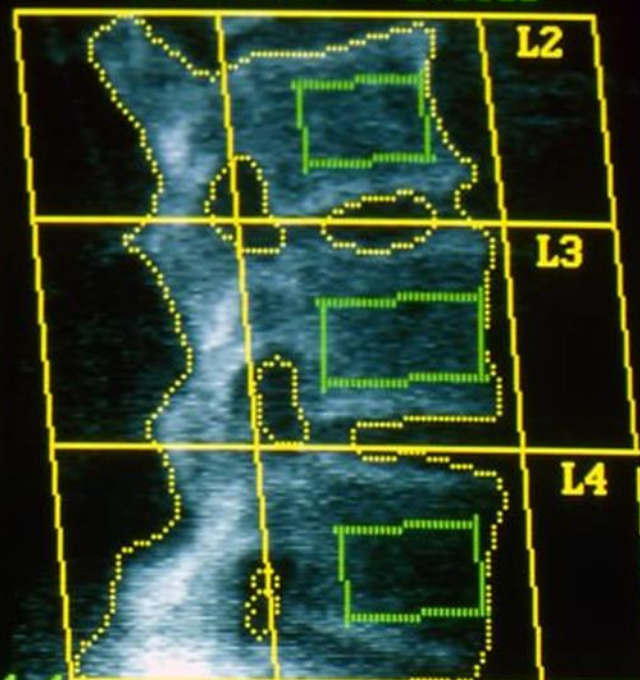
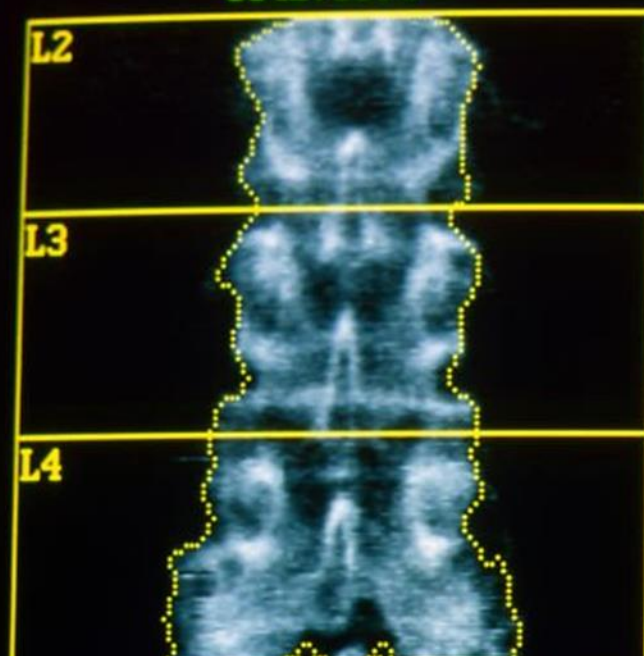
|               |       |
|---------------|-------|
| % Young Ref.  | 79.4  |
| T - Score     | -1.58 |
| % Age Matched | 88.7  |
| Z - Score     | -0.77 |



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S0427000G

S0427000H 1.000B

DMO  
gm/cm<sup>3</sup>

AP 0.1  
Lat 0.1  
Méd 0.1

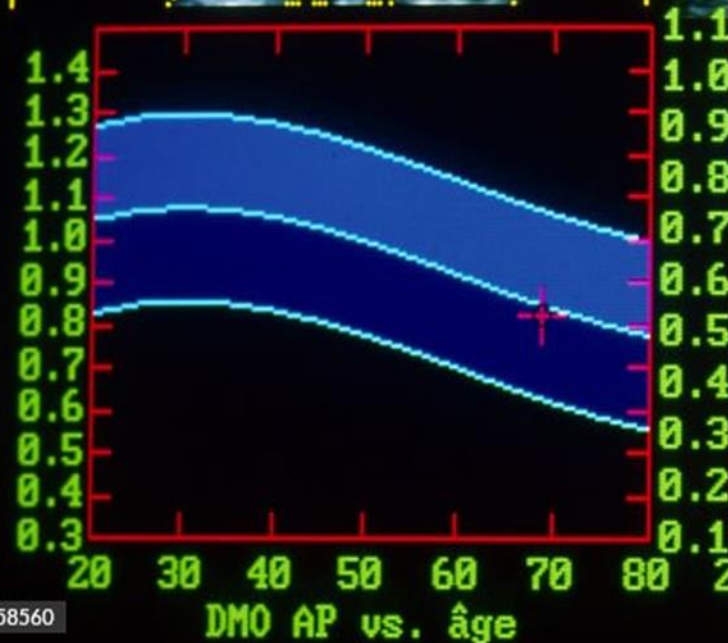
po

AP -2  
LAT -2

CV DM

Hologic  
(S/N)

Ana  
Versio



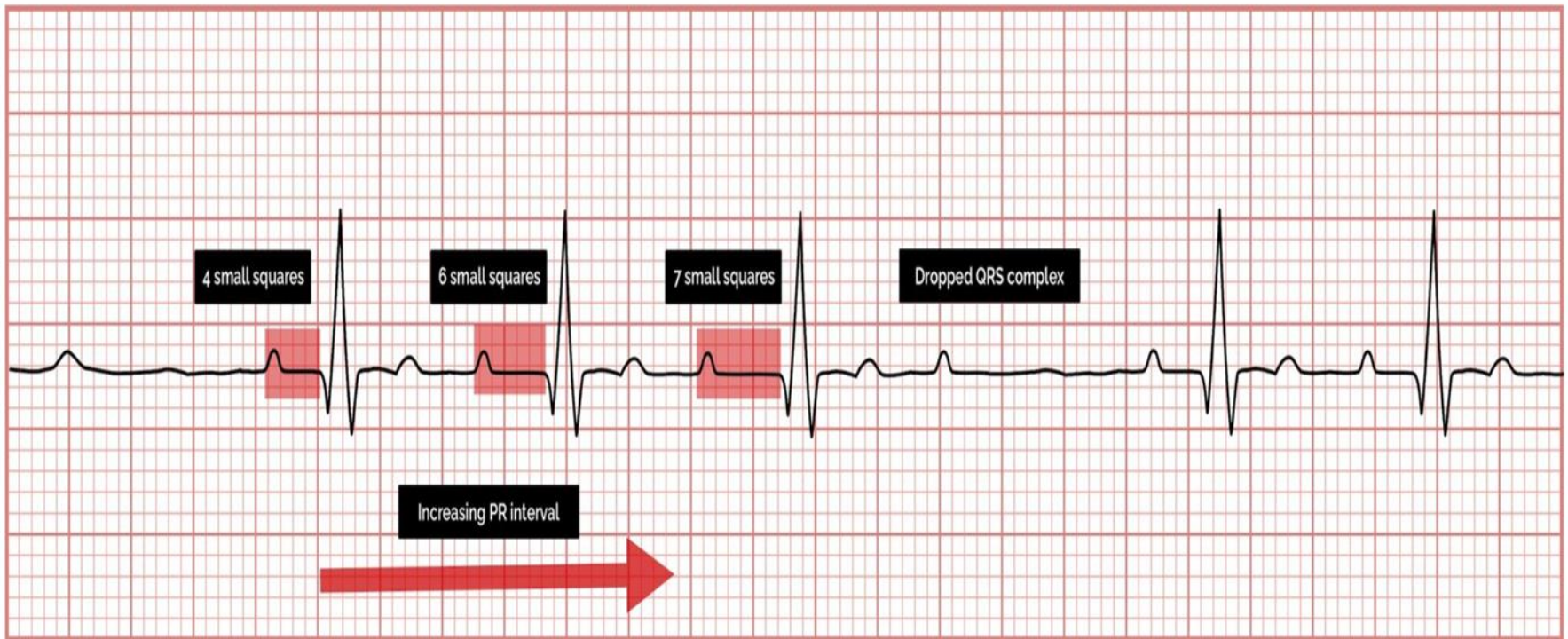
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# First degree AV block



# Second Degree Heart Block

Mobitz type 1 (Wenckebach)



Thank you