

DXA Course Review

Lecture 14



Learning Objectives

Patient Care

Patient
Safety

DXA
Production
and Results

DXA
Procedures

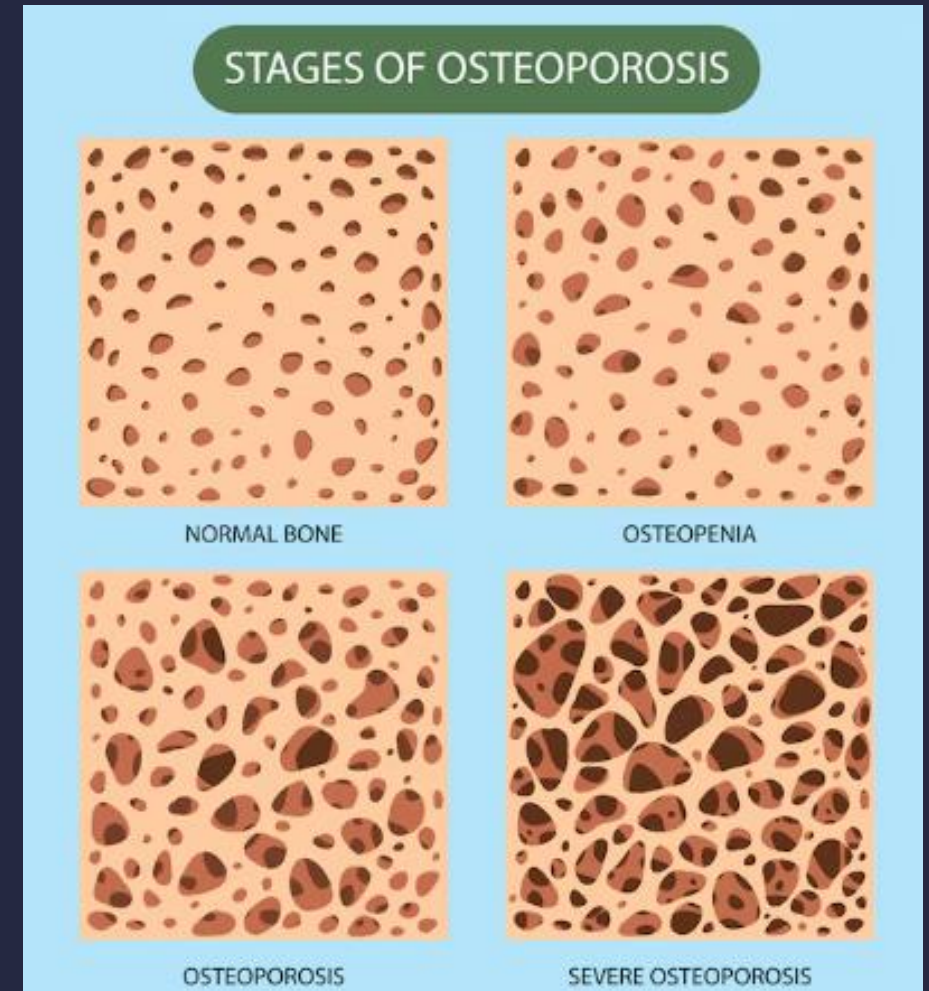
Anatomy
Review

Patient Care



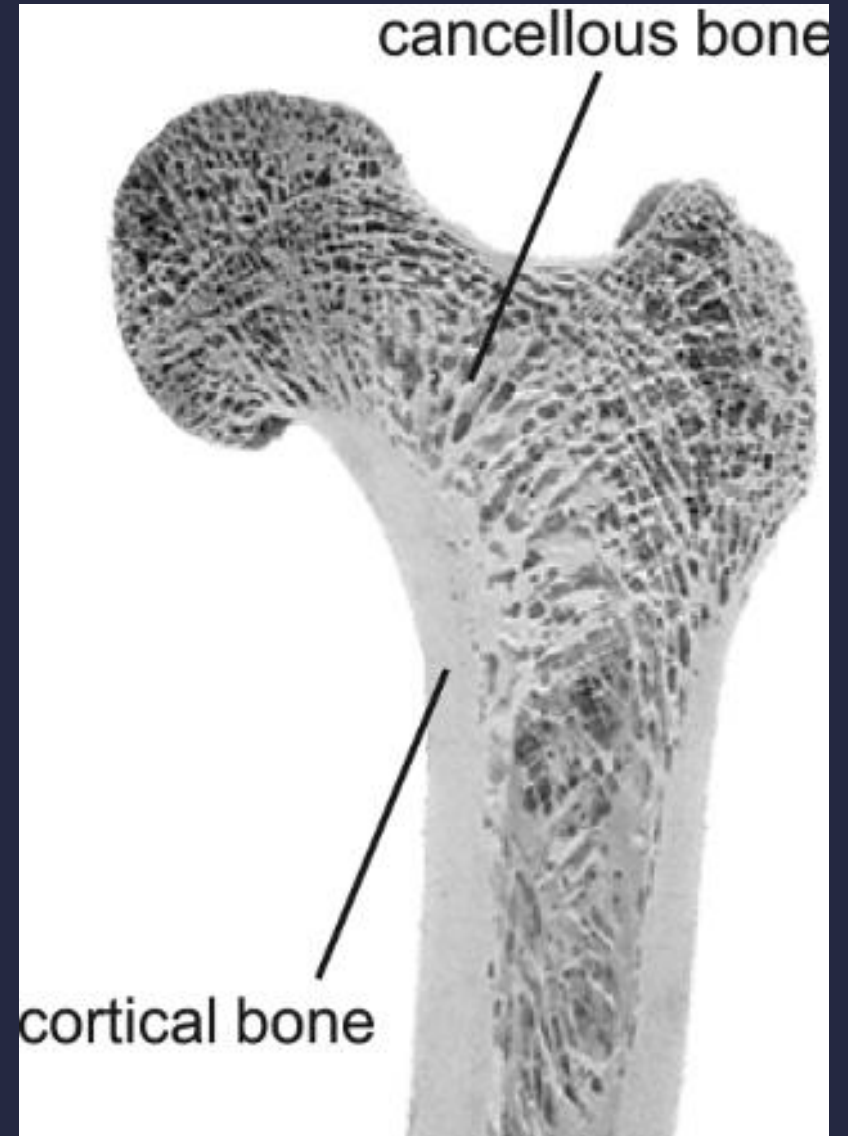
Osteoporosis

- World Health Organization Definition
- Primary Osteoporosis
 - Type 1
 - Type 2
- Secondary Osteoporosis



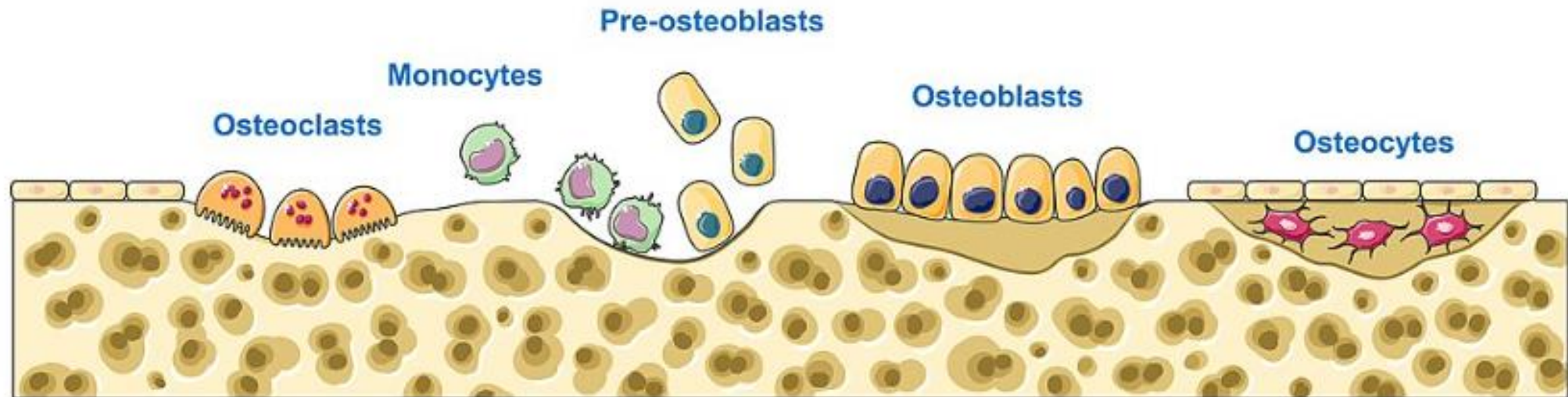
Bone Physiology

- Functions of Bone
 - Structural support and protection
 - Storage of essential minerals
- Structural Anatomy
- Types of Bone
 - Cortical bone
 - Trabecular bone



Bone Physiology Continued

- Bone Remodeling Cycle
 - Resorption/formation
 - Osteoblasts/Osteoclasts
 - Factors affecting remodeling



Bone Health and Patient Education

- Prevention and Treatment
 - Exercise
 - Nutrition
 - Smoking cessation
 - Fall Prevention





Bone Health and Patient Education Continued

- Risk Factors
 - Controllable
 - Smoking, alcohol, calcium, Vitamin D, Hormone therapy medications.
 - Uncontrollable
 - Genetics, race, gender, age, medical conditions

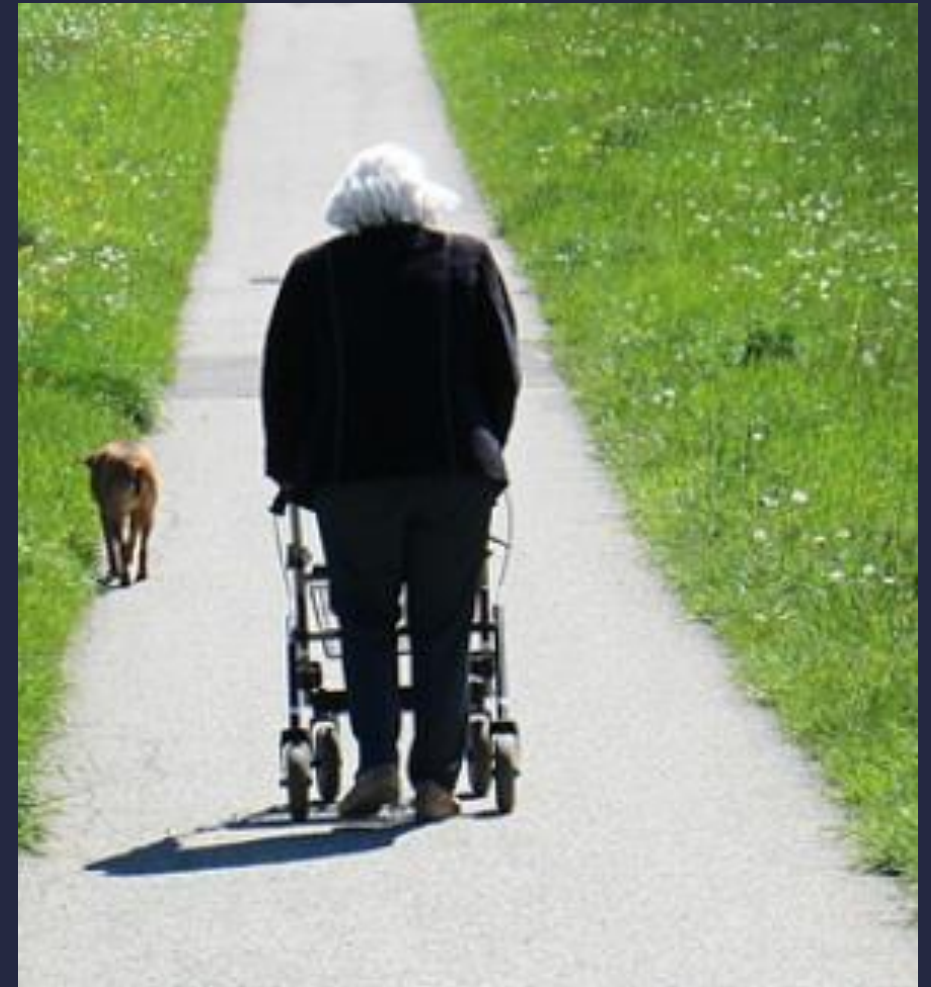
Patient Preparation

- Patient instructions and explanation of procedure
- Patient History
 - Medical History
 - Medication Use
 - Current height and weight
 - Contraindications
 - Possible pregnancy
 - Clinical indication and guidelines



Patient Preparation

- Patient Factors
 - Limited mobility or mental impairment
 - Unusual Anatomy, pathology or body habitus
 - Removeable artifacts
 - Pediatric patients



Patient Preparation

- Operator Ergonomics
 - Body Mechanics
 - Balance, alignment, movement
 - Patient transfer techniques
- Infection Control
 - Disinfect work area
 - Disinfect equipment

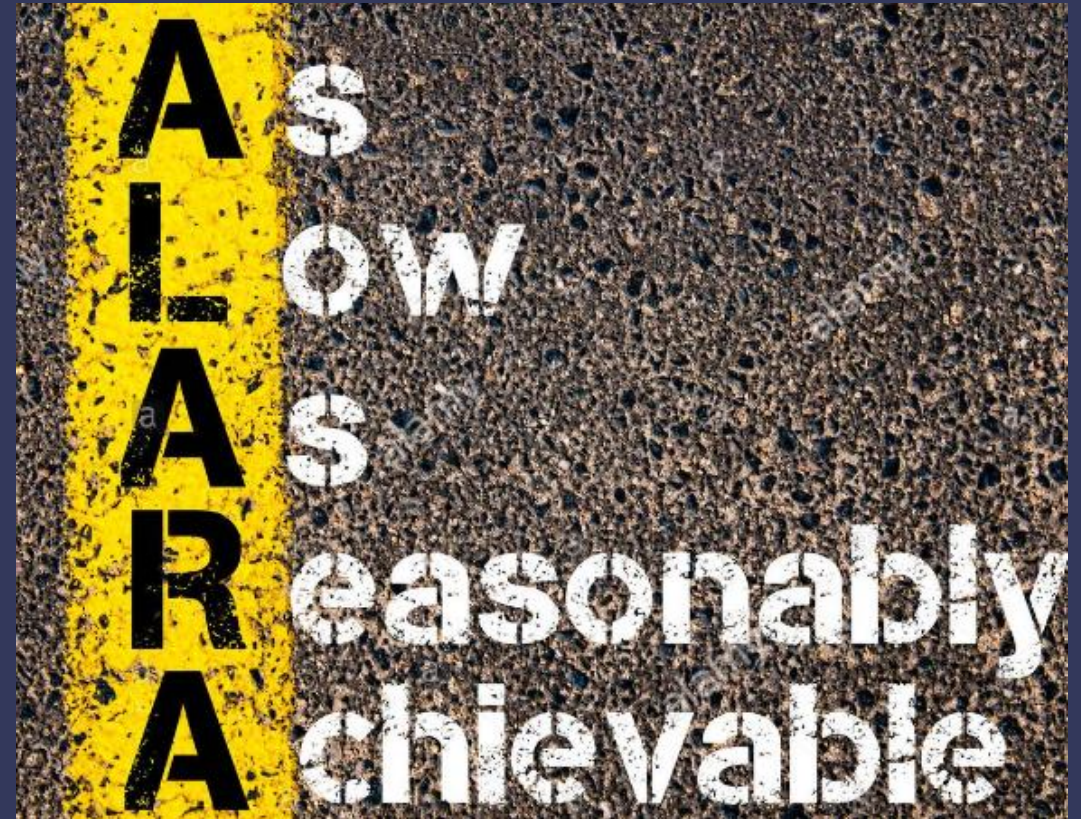


Safety



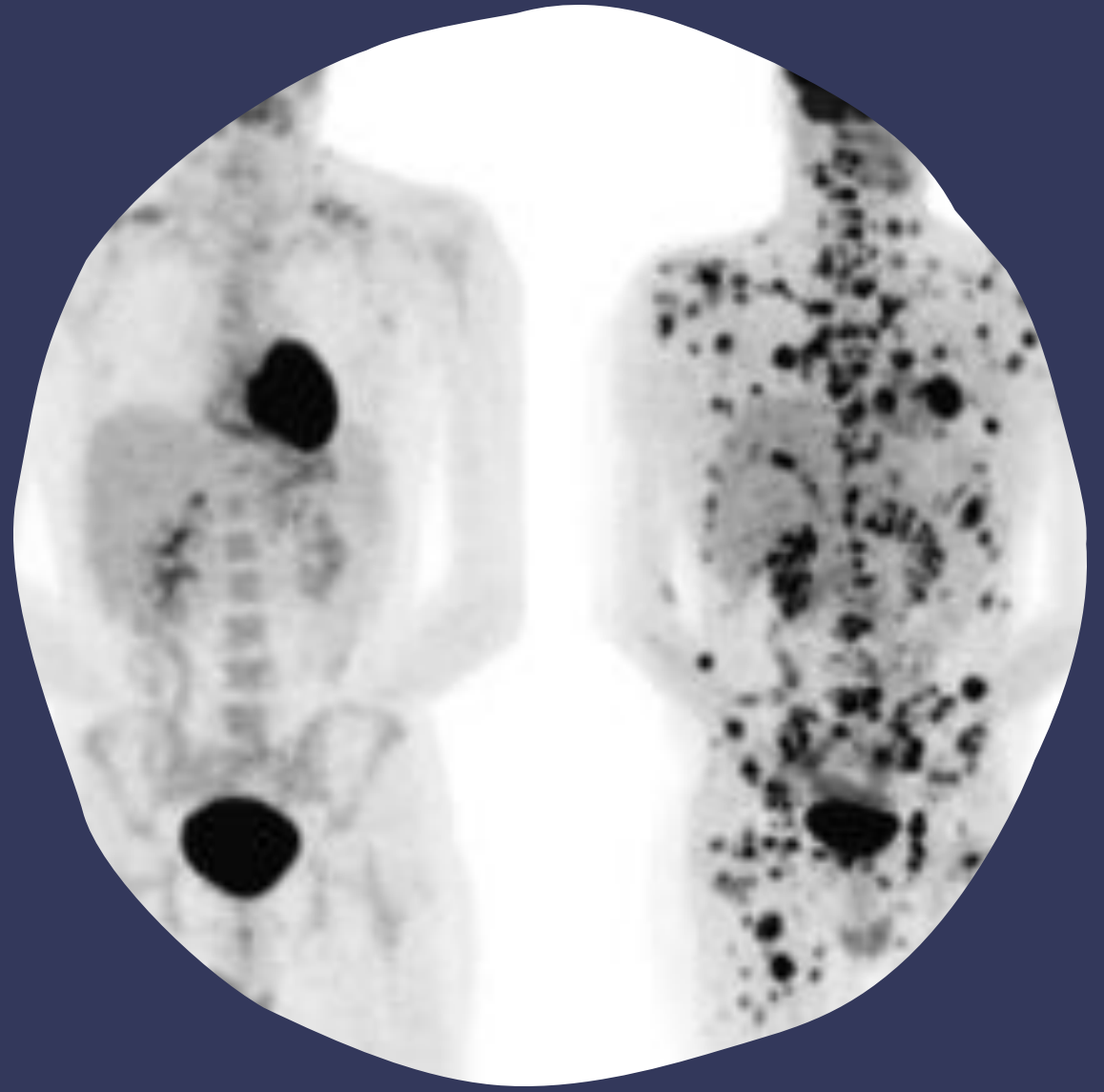
Fundamental Principles

- ALARA
- Basic Methods of Protection
 - Time
 - Distance
 - Shielding

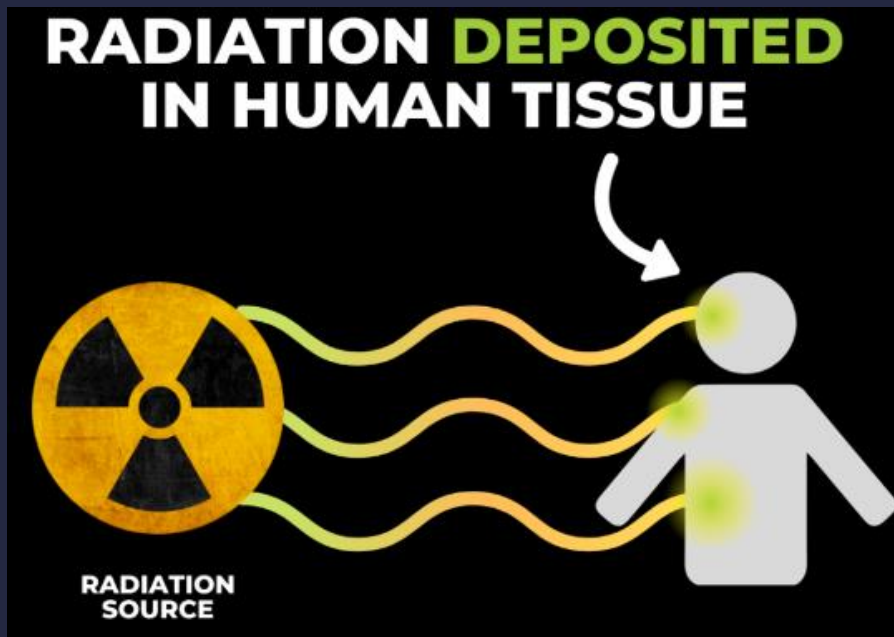


Biological Effects of Radiation

- Long-Term effects of radiation
- Chronic effects of radiation
- Acute effects of radiation
- Radiosensitive Tissues/Organs



Units of Measurements



- Absorbed Dose
 - mGy
- Dose Equivalent
 - mSv

Radiation Protection

- General Protection Issues
 - Radiation signs posted
 - Door Closed
 - Limit unnecessary people in room
- Occupational Protection
 - Scanner-operator distance
 - Personnel monitoring
 - Exposure records

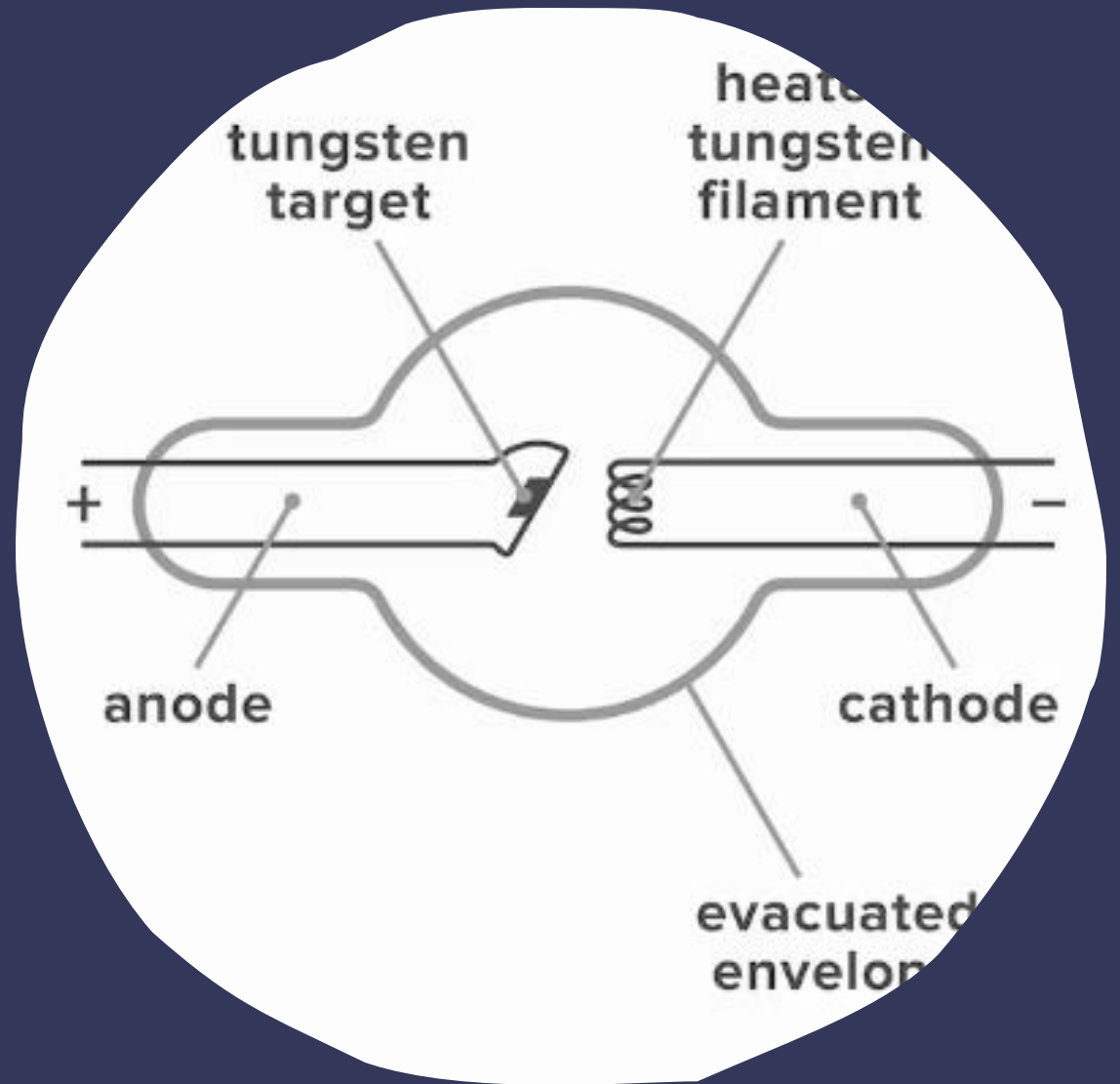


Radiation Protection



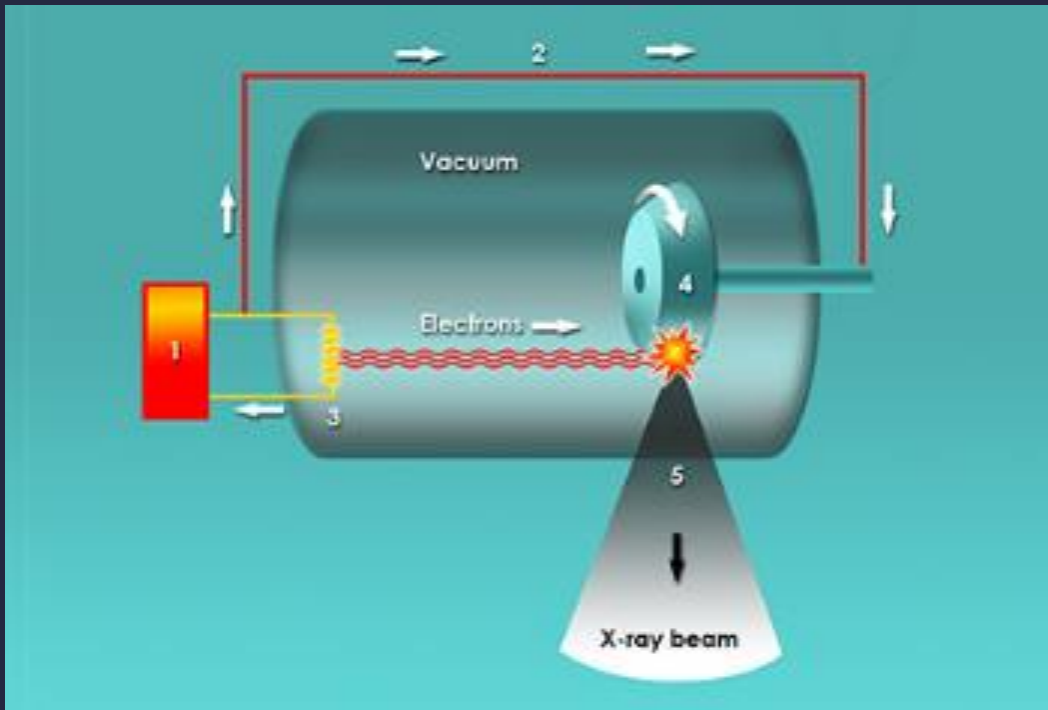
- Patient Protection
 - Comparison levels of radiation
 - Peripheral DXA
 - Axial DXA
 - Natural background radiation
- Strategies to minimize patient exposure
 - Patient instructions
 - Correct exam performance

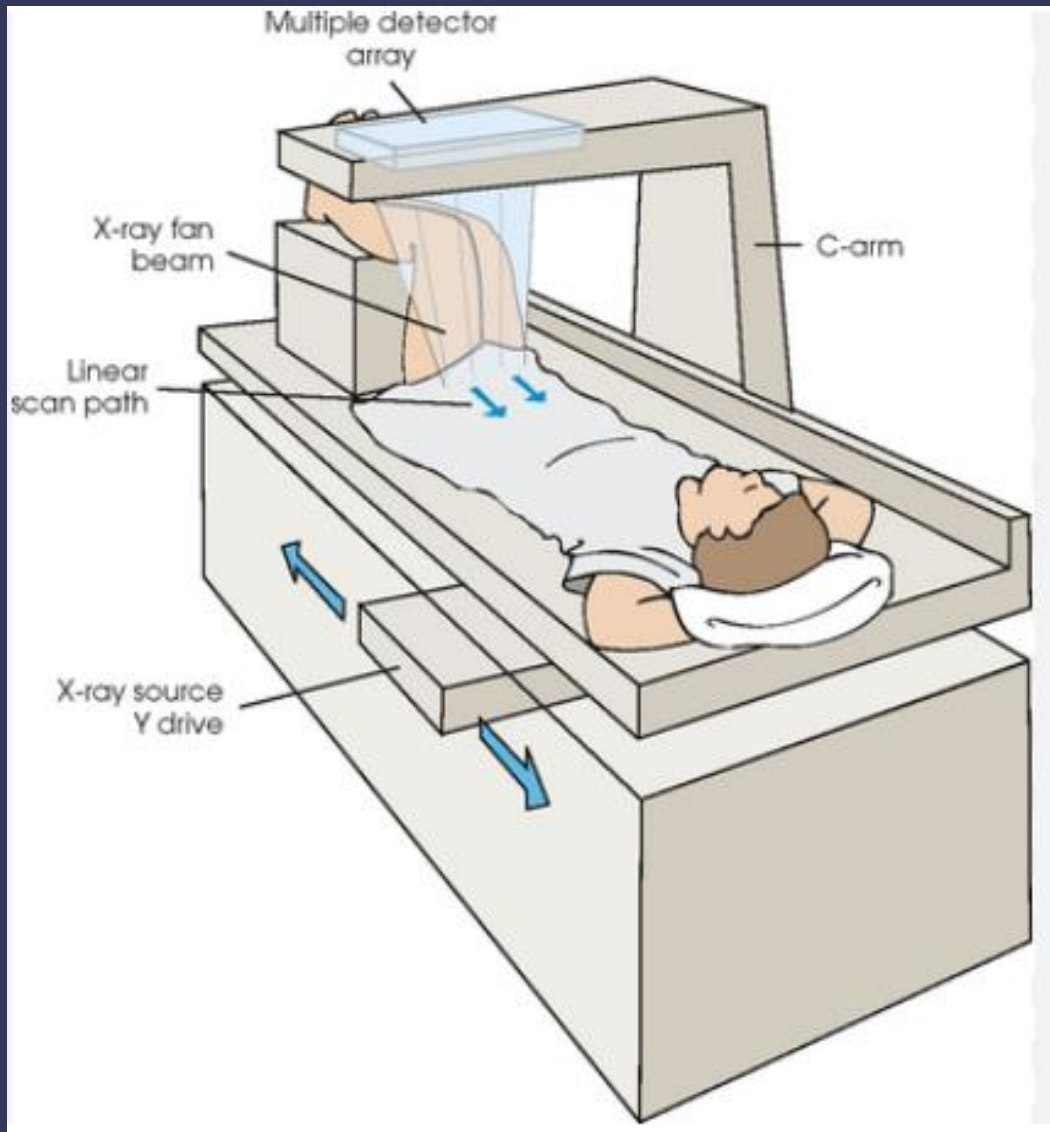
Image Production



Fundamentals of X-ray Production

- Properties of X-ray Beam
 - Scatter
 - Mass
 - Wavelength
 - Frequency
- X-ray Energy Production



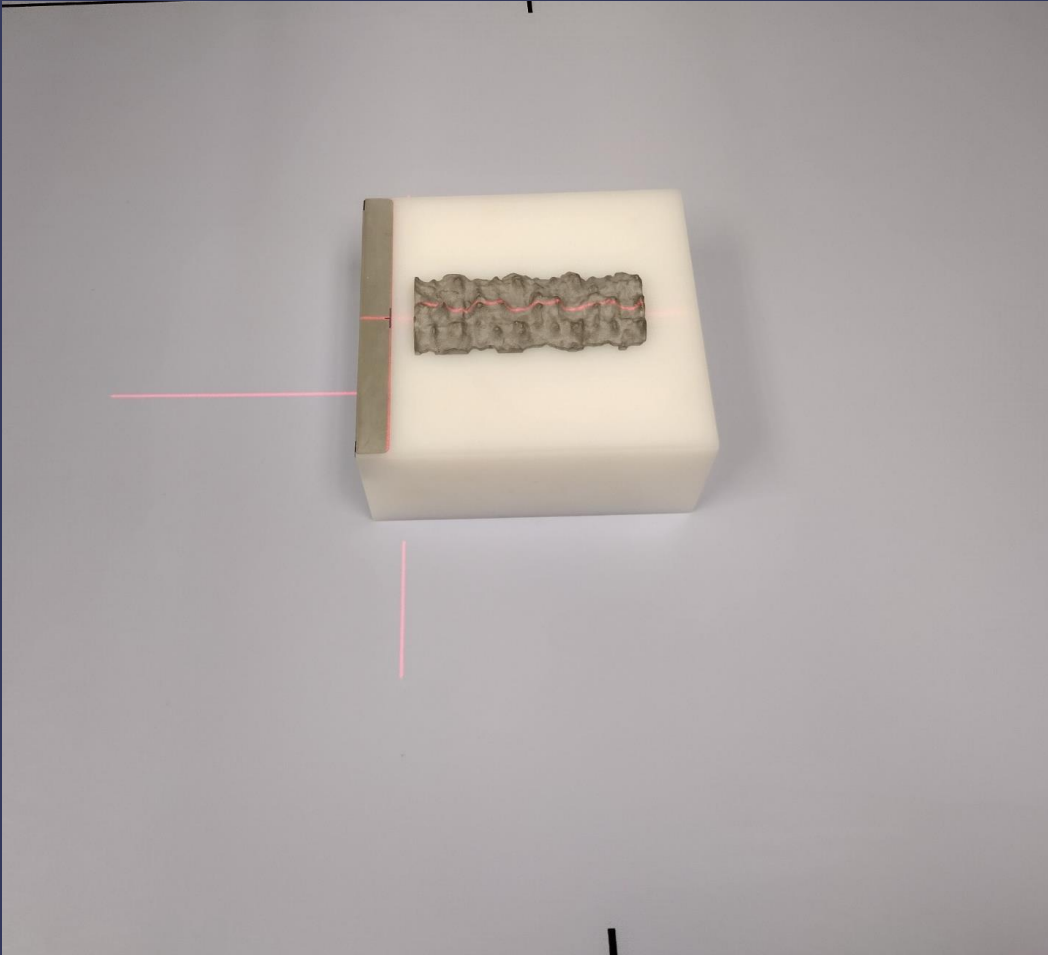


DXA Systems

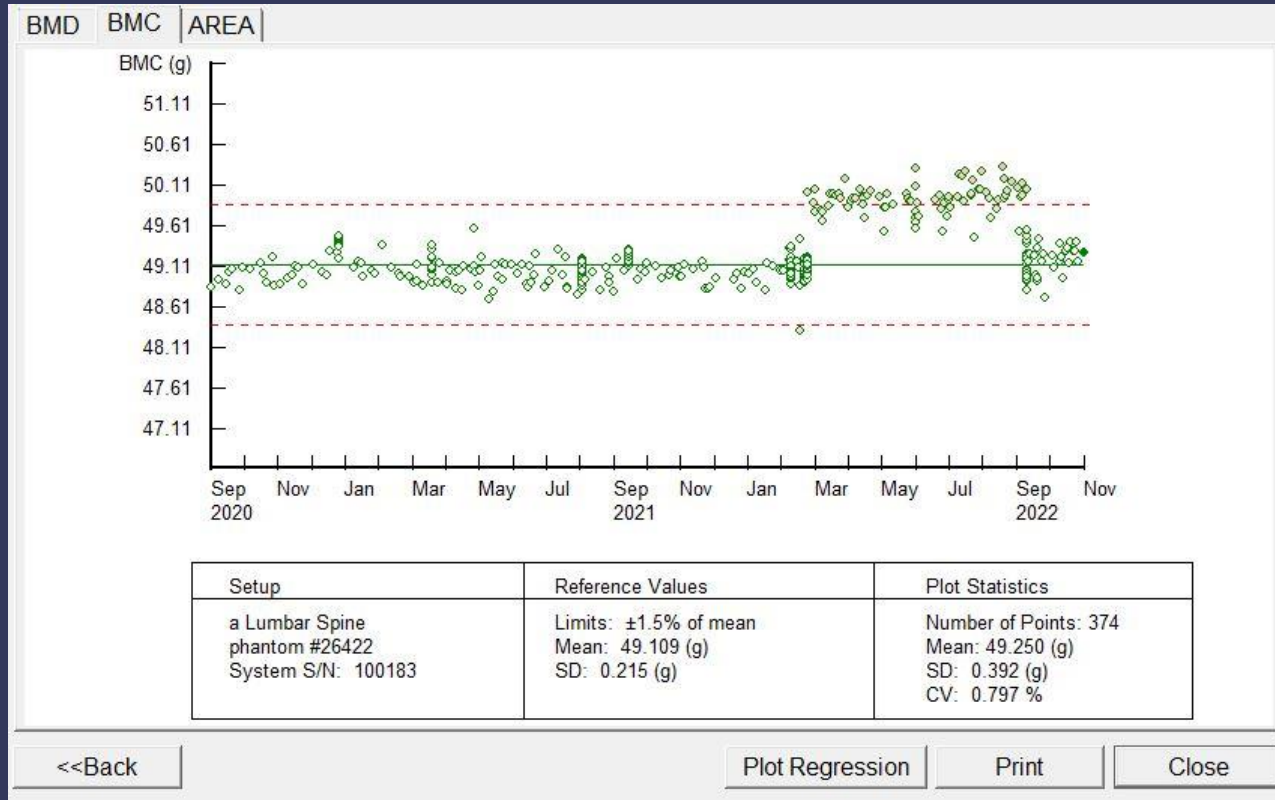
- Dual Photon Energies
- DXA components
 - X-ray Production
 - K-edge filtration
 - Energy Switching
 - Radiation detector system
- Fan Beam
 - Mechanics of fan beam
 - Geometry of fan beam

Quality Control

- Equipment Safety
 - Electrical
 - Pinch points
 - Emergency stop
- Use of Phantoms
 - Frequency
 - Types



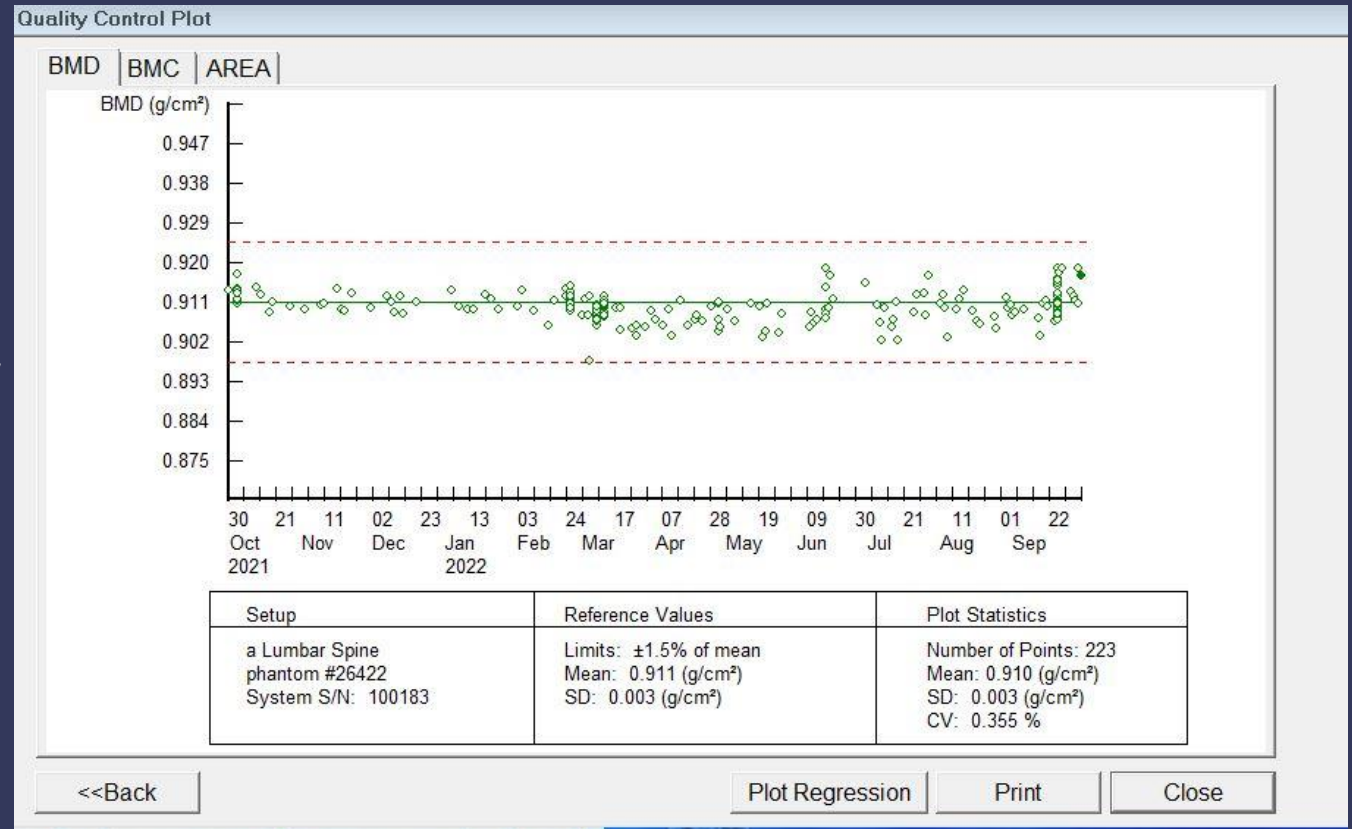
Quality Control



- Calibration
 - Recalibration
 - Cross calibration
- Troubleshooting and Actions
 - Shift or Drift
 - Pass/Fail criteria
 - Need for service
- Record Maintenance

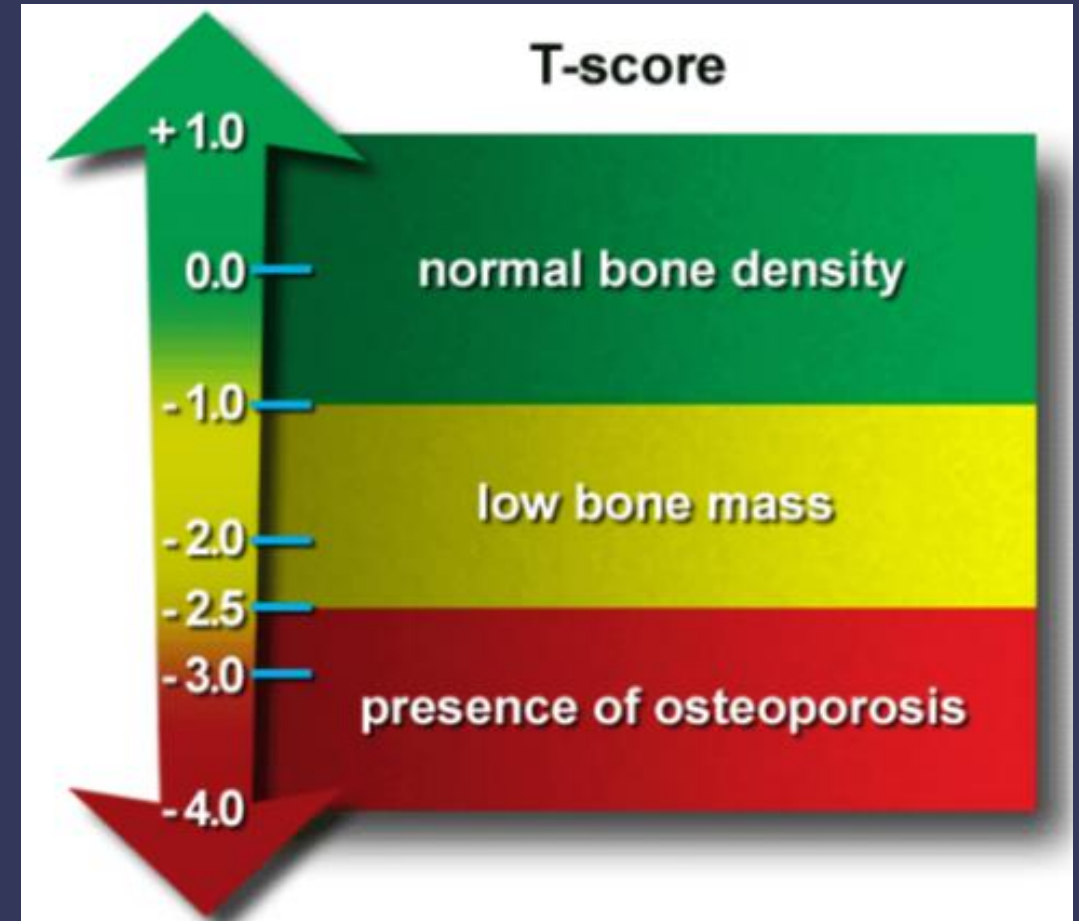
Measuring BMD

- Scan Analysis Algorithm
 - Bone edge detection
 - Definition and calculation of BMC, area, and BMD
- Basic Statistical Concepts
 - Mean
 - Standard deviation
 - Coefficient of variation



Measuring BMD

- Reporting Patient results
 - Z-score
 - T-score
 - WHO diagnostic criteria



Other DXA Accessories and Scanning

- FRAX
- Vertebral Fracture Assessment
- Pediatric Adolescent Scanning



FRAX® WHO Fracture Risk Assessment Tool

Home Calculation Tool Paper Charts FAQ

Calculation Tool

Please answer the questions below to calculate the ten year probability of fracture with BMD.

Country: **UK** Name/ID: About the risk factors ⓘ

Questionnaire:

1. Age (between 40-90 years) or Date of birth
Age: 65 Y: M: D:

2. Sex ☐ Male ☒ Female

3. Weight (kg) 65

4. Height (cm) 165

5. Previous fracture ☐ No ☒ Yes

6. Parent fractured hip ☒ No ☐ Yes

7. Current smoking ☒ No ☐ Yes

8. Glucocorticoids ☒ No ☐ Yes

9. Rheumatoid arthritis ☒ No ☐ Yes

10. Secondary osteoporosis ☒ No ☐ Yes

11. Alcohol 3 or more units per day ☒ No ☐ Yes

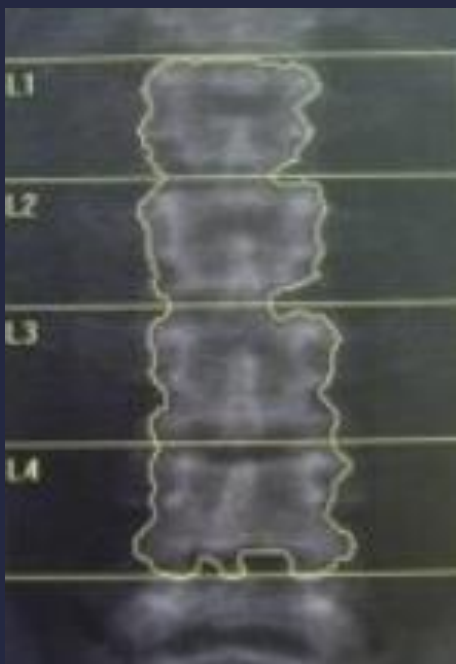
12. Femoral neck BMD (g/cm²)
T-Score -2.5

BMI 23.9
The ten year probability of fracture (%)

Major osteoporotic	19
Hip fracture	4.9

[View NOGG Guidance](#)

Determining Quality in BMD



- Precision
- Accuracy
- Factors related to accuracy and Precision
 - Scanner (Speed/Mode)
 - Operator
 - In-vivo precision study
 - Positioning
 - Patient variables (Body habitus, variant anatomy)

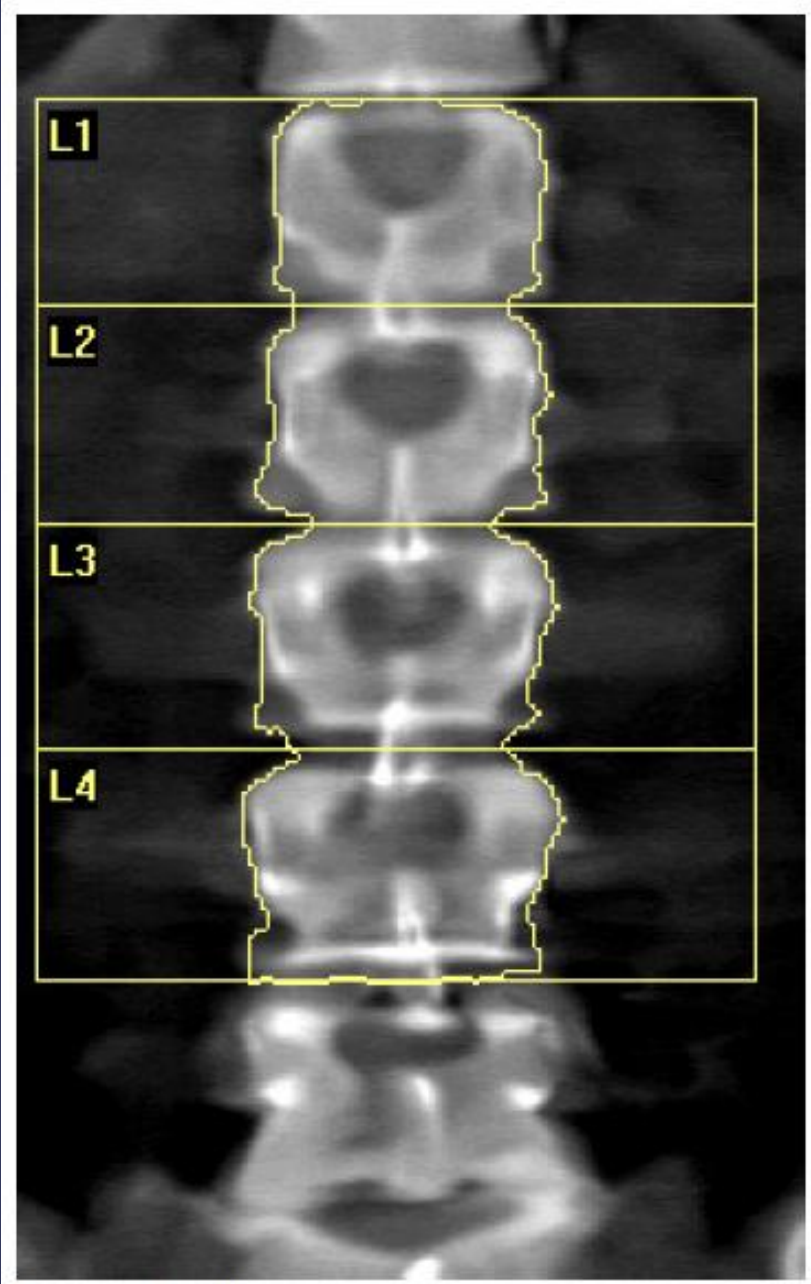


File and Database Management

- Storage and Retrieval of Data
- Back-up and Archiving



DXA Procedures



Scanning the Lumbar Spine

- Anatomy
 - Regions of interest
 - Bony landmarks
 - Radiographic appearance
 - Significant structures
 - Pelvis
 - Ribs
 - T-12

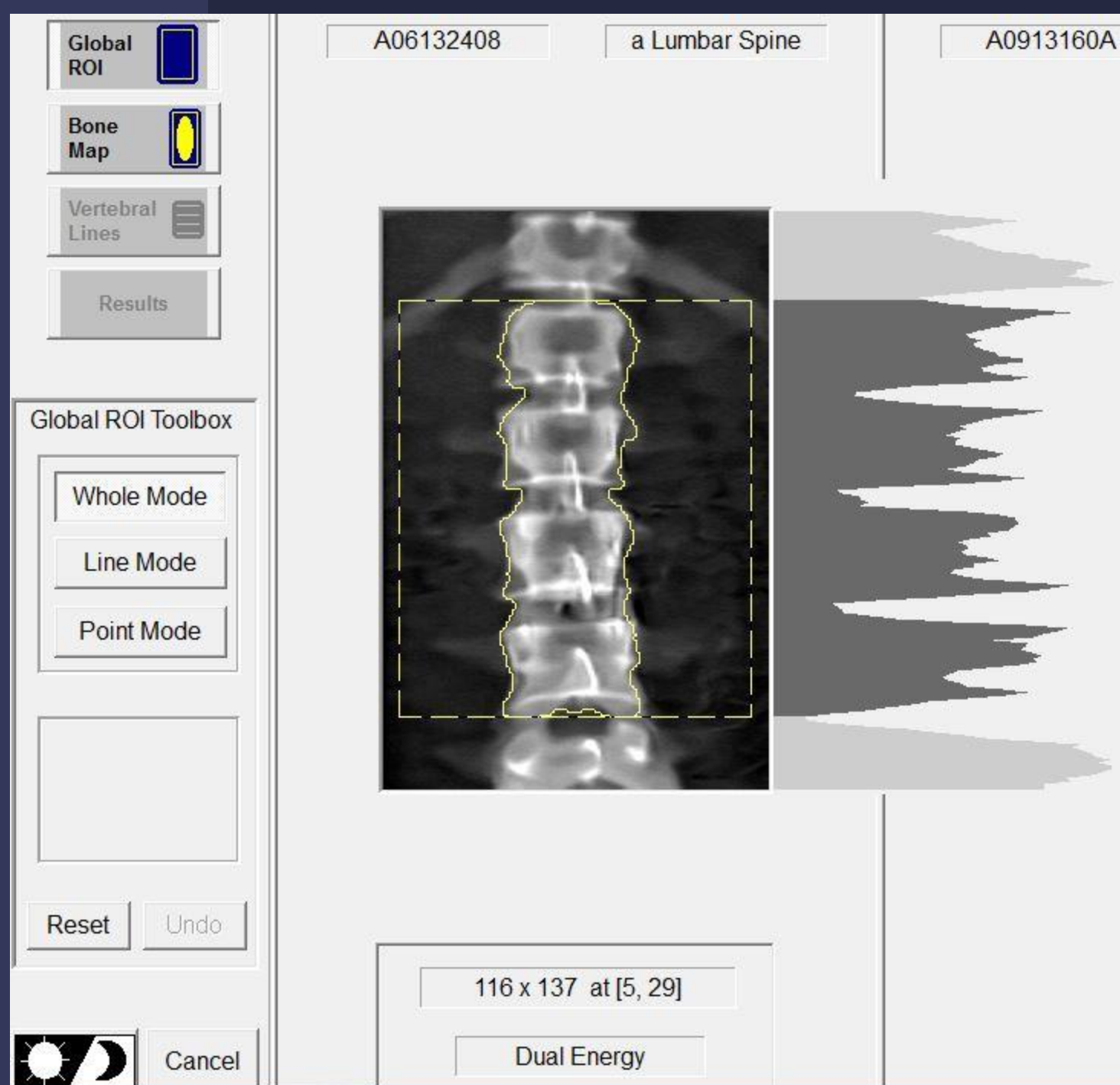
Lumbar Spine

- Scan Acquisition
 - Patient instruction
 - Patient positioning
 - Compensation for variations in:
 - Anatomy
 - Body Habitus
 - Pathology
 - Low bone density



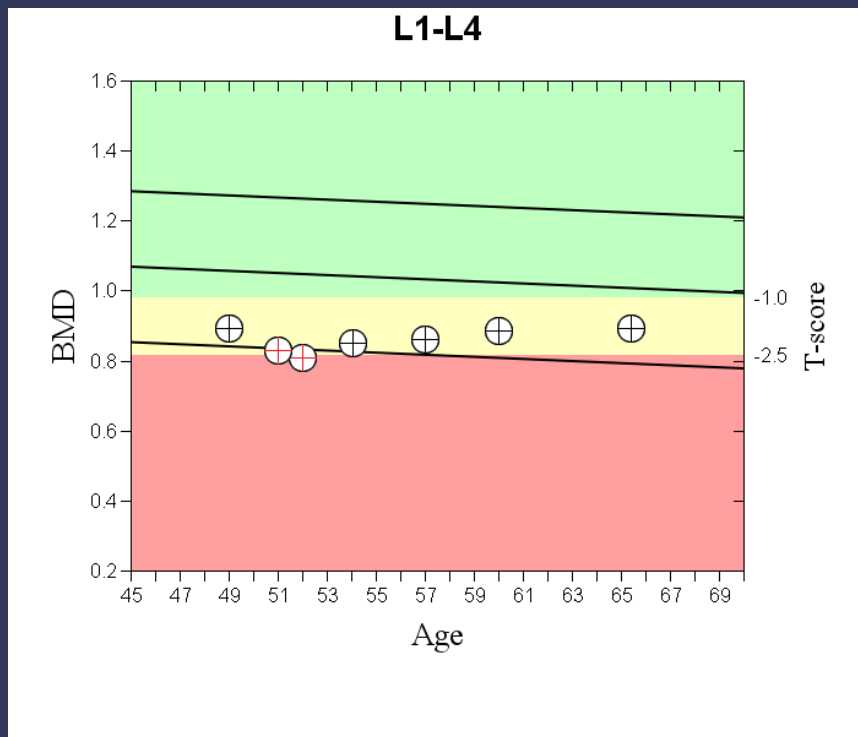
Lumbar Spine

- Scan Analysis
 - Accurate ROI Placement
 - Bone Mapping
 - Vertebral line placement
 - Graphical display
 - Exclusion of vertebrae



L- Spine DXA Results

- BMC, Area, BMD
- T-score, Z-score

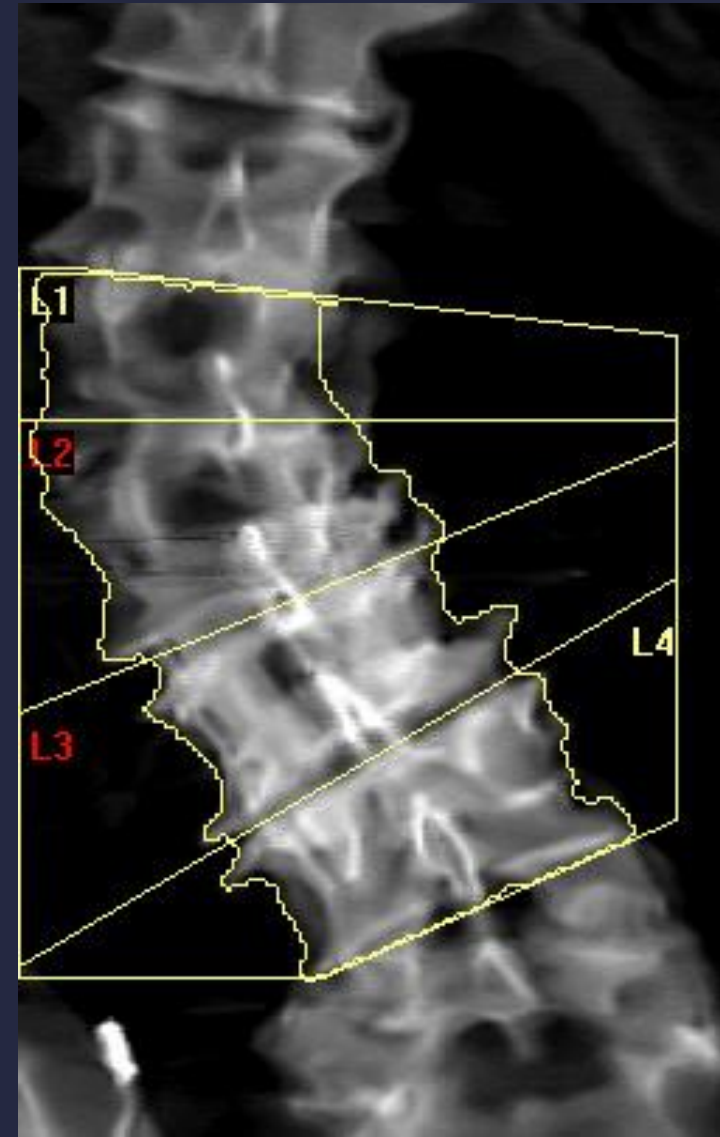


DXA Results Summary:

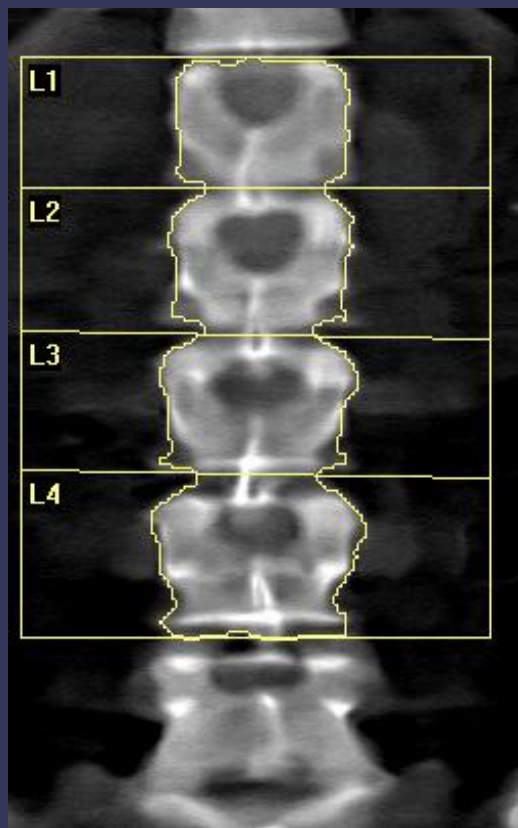
Region	Area (cm ²)	BMC (g)	BMD (g/cm ²)	T - score	Z - score
L1	13.96	13.06	0.935	-1.3	-1.3
L2	15.66	14.83	0.947	-1.3	-1.3
L3	17.56	16.63	0.947	-1.4	-1.4
L4	18.51	16.84	0.910	-1.6	-1.6
Total	65.68	61.35	0.934	-1.4	-1.4

Lumbar Spine

- Common Problems of potential Causes
 - Poor bone edge detection
 - Nonremovable artifacts
 - Variant anatomy
 - Fractures and pathology
 - Aortic and other calcifications



2018

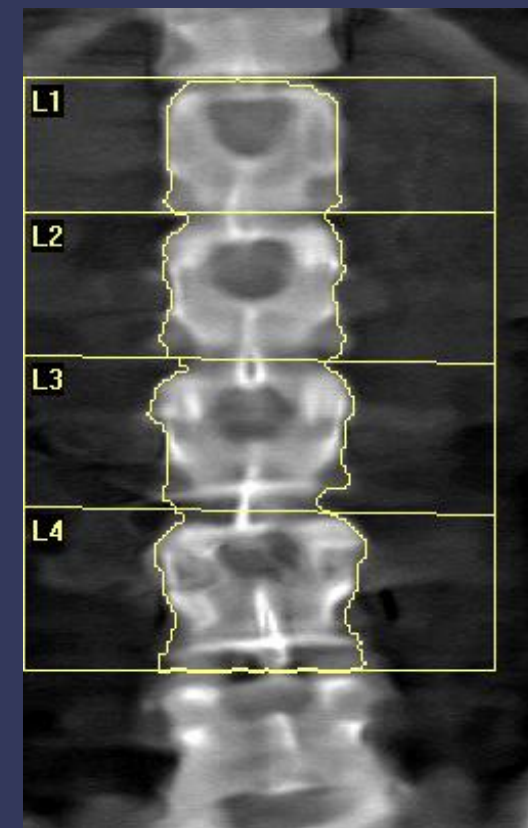


Baseline

2019



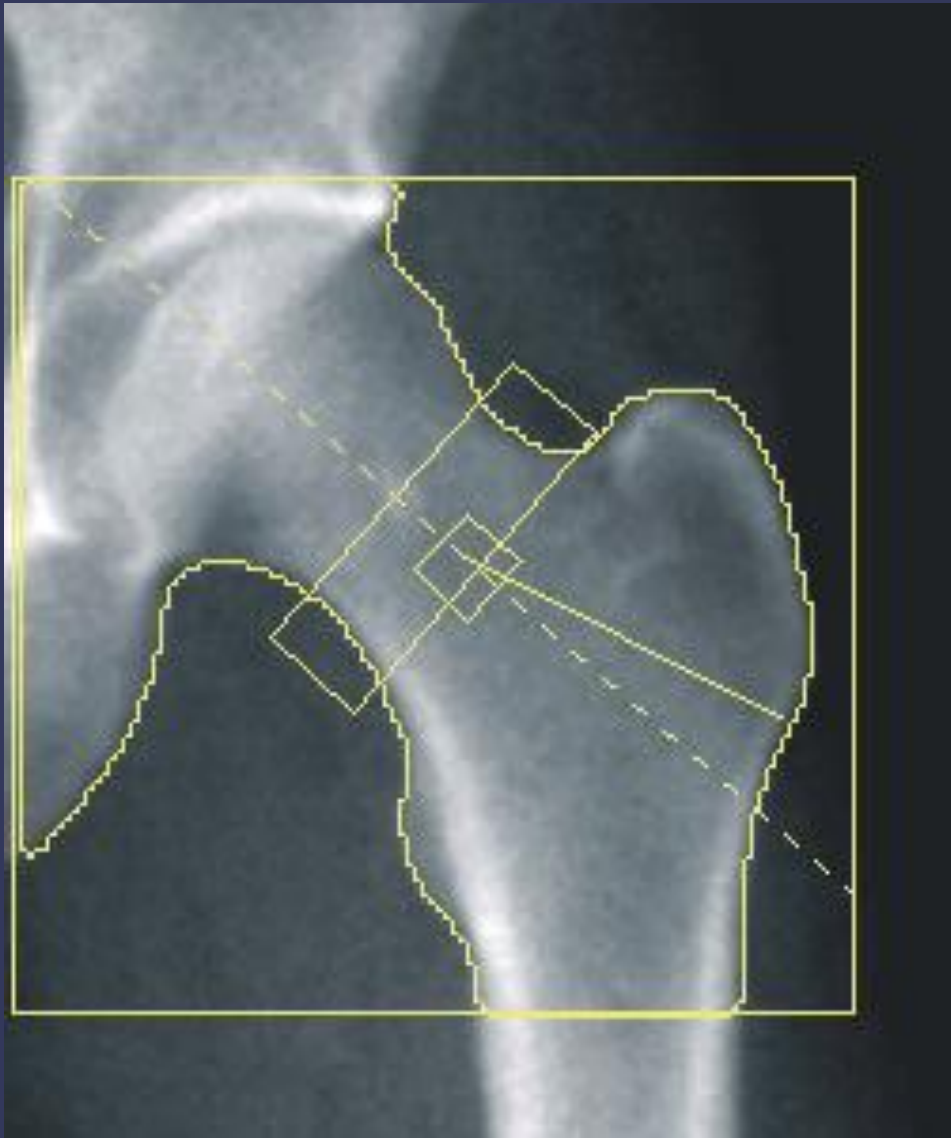
2022



Follow-Up Scans

Lumbar Spine

Are the changes significant? and why?



Proximal Femur

- Anatomy
 - Regions of interest
 - Bony landmarks
 - Radiographic appearance
 - Significant structures
 - Pelvis

Proximal Femurs

Scan Acquisition

- Patient instruction

- Femur Selection (Right vs Left or Dual)

- Patient Positioning

 - Femoral neck rotation

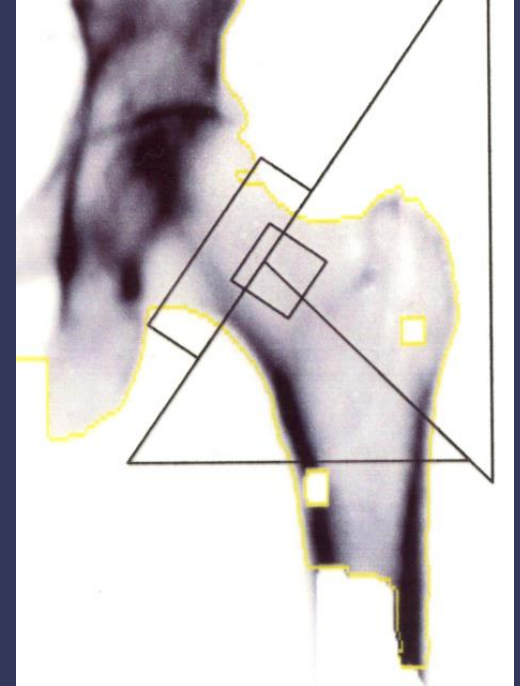
 - Femoral shaft placement

- Compensation for variations in anatomy, body habitus, pathology, or low bone density



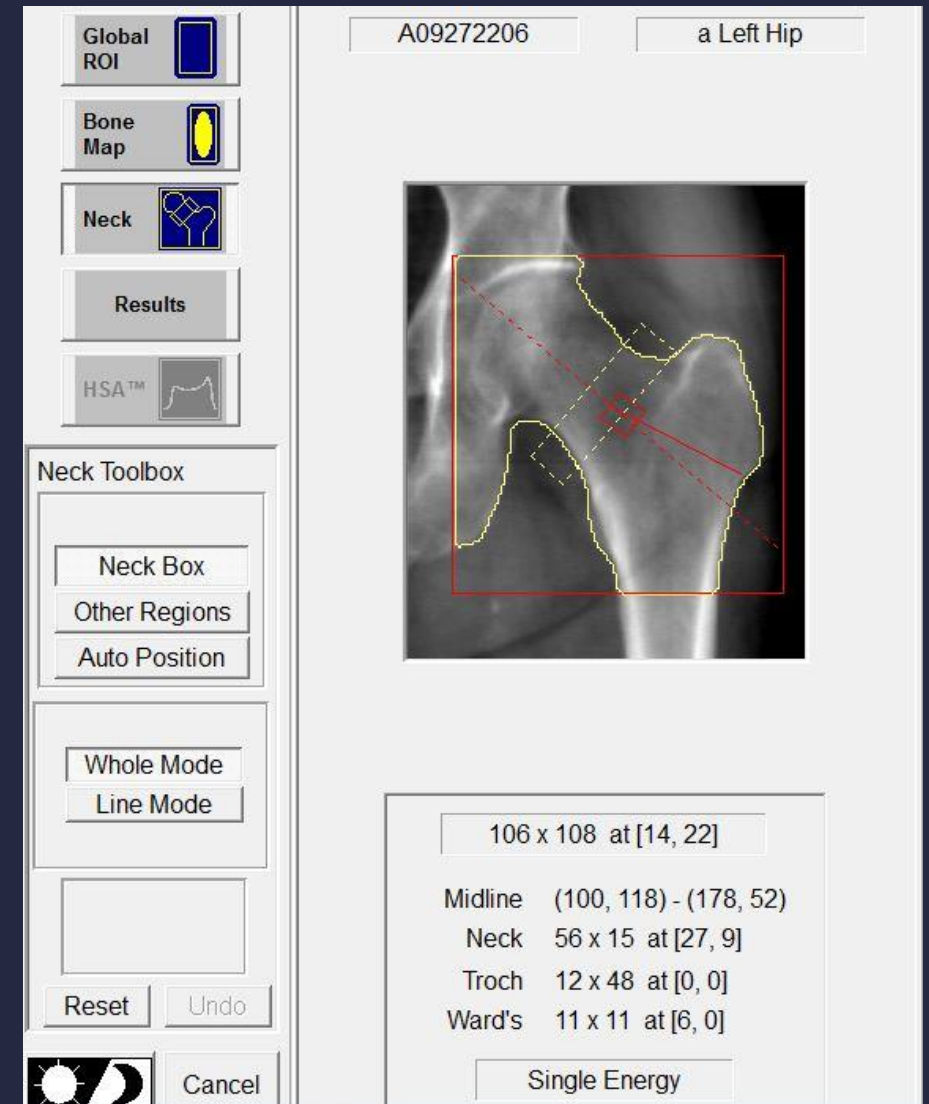
Proximal Femurs

- Common Problems of potential Causes
 - Poor bone edge detection
 - Nonremovable artifacts
 - Variant anatomy (Short femoral neck, inadequate space between ischium and femur)
 - Fractures and pathology



Proximal Femurs

- Scan Analysis
 - Accurate ROI Placement
 - Bone Mapping
 - Neck Box Placement
 - Graphical display



Proximal Femur Results

- BMC, Area, BMD
- T-score, Z-score
- Neck and Total hip

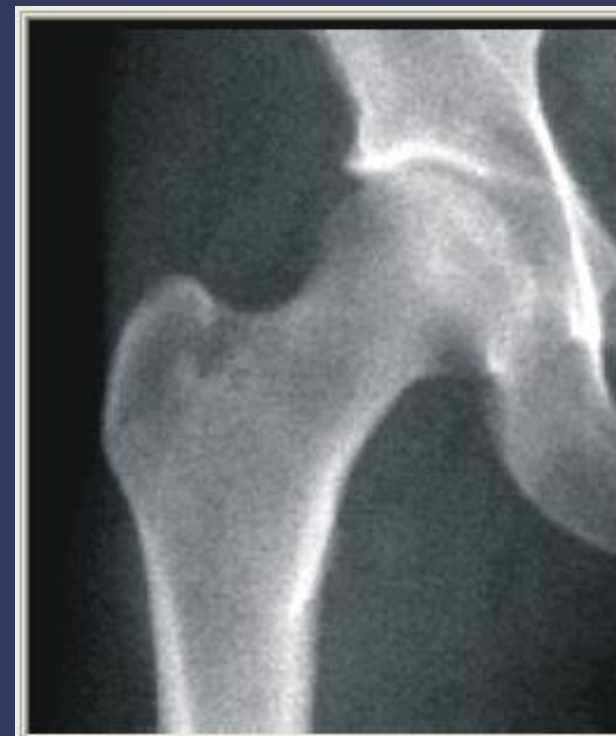
DXA Results Summary:

Region	Area (cm ²)	BMC (g)	BMD (g/cm ²)	T - score	Z - score
Neck	6.72	4.86	0.723	-1.5	-0.5
Troch	14.32	8.16	0.570	-1.6	-1.3
Inter	28.41	29.55	1.040	-0.9	-0.4
Total	49.46	42.57	0.861	-1.1	-0.6
Ward's	1.20	0.60	0.498	-2.0	-0.3

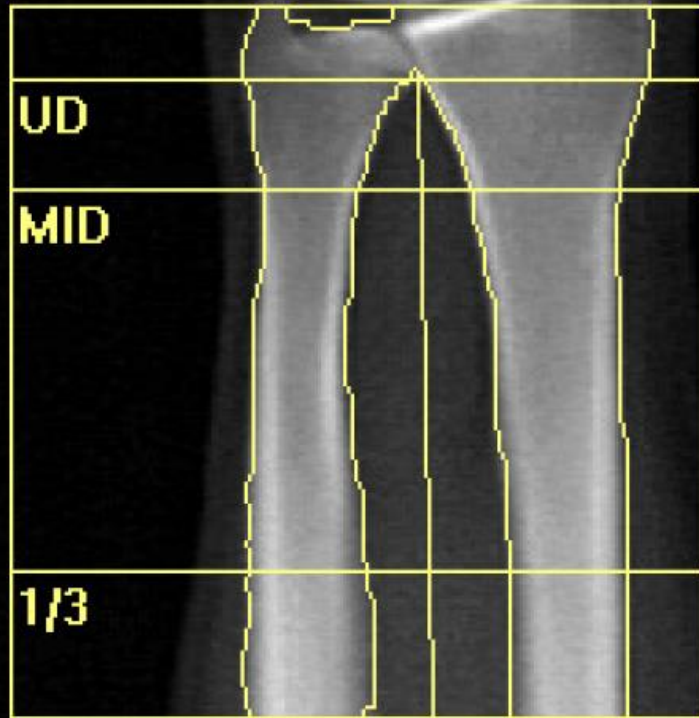
Total BMD CV 1.0% ACE = 1.034 PCE = 1.007 TH = 5.817

Proximal Femurs

- Follow-Up Scans
 - Unit of comparison
 - BMD and T-score
 - Are the changes significant and why
 - Reproduce baseline study



Scanning the Forearm



- Anatomy
 - Regions of interest
 - Bony landmarks
 - Radiographic appearance
 - Significant structures
 - Carpal bones
 - Soft tissue



Forearm

- Scan Acquisition
 - Patient instruction
 - Selection (right vs left)
 - Forearm Length
 - Patient positioning
 - Compensation for variations in:
 - Anatomy
 - Body Habitus
 - Pathology
 - Low bone density

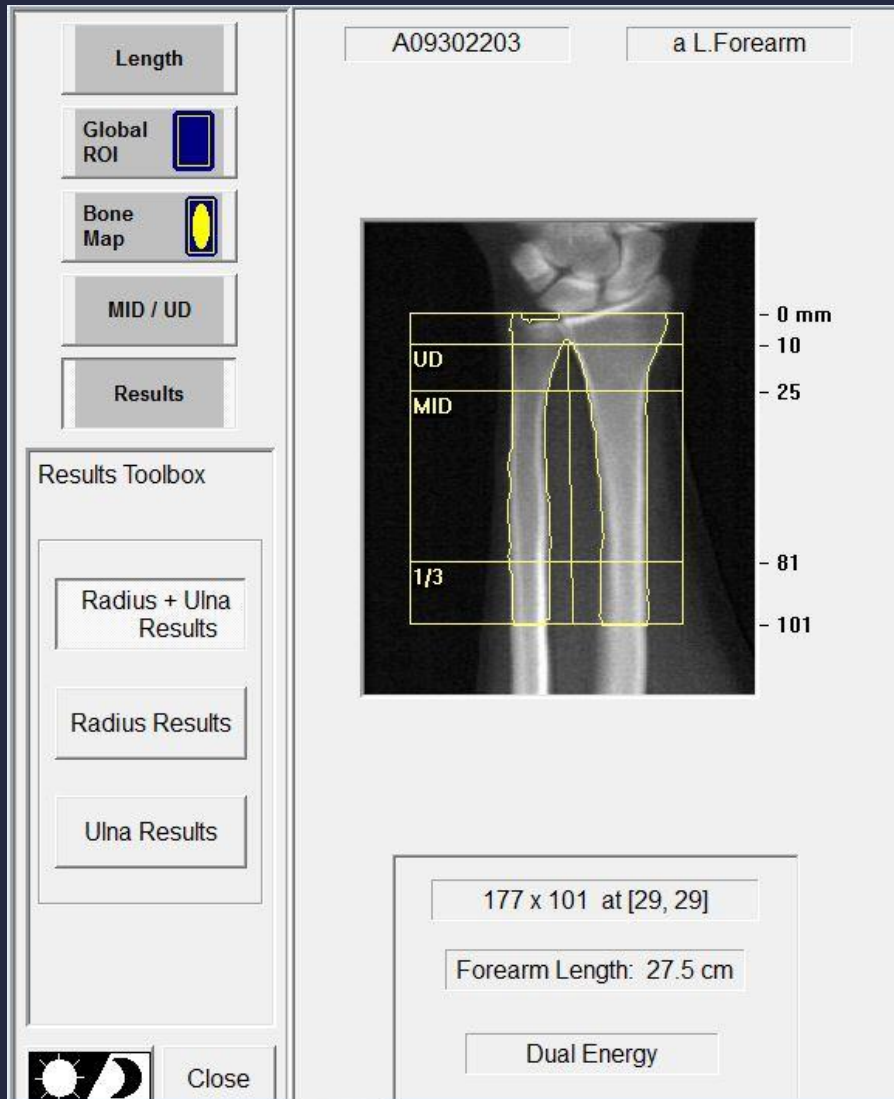
Forearm



- Common Problems of potential Causes
 - Poor bone edge detection
 - Nonremovable artifacts
 - Variant anatomy
 - Fractures and pathology

Forearm

- Scan Analysis
 - Accurate ROI Placement
 - Bone Mapping
 - Mid-line
 - Graphical display



Forearm Results

- BMC, Area, BMD
- T-score, Z-score
- 1/3 or 33% radius

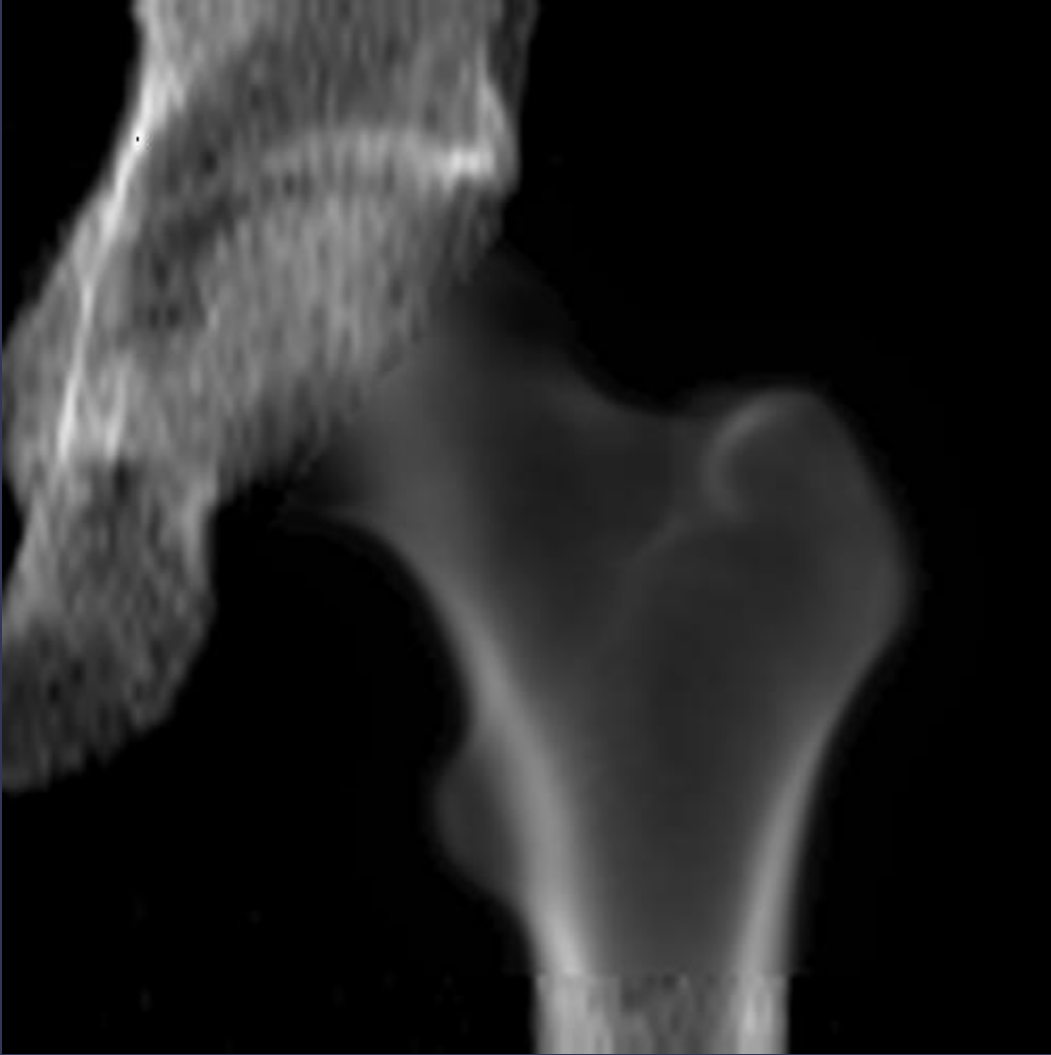
DXA Results Summary:

Radius	Area (cm ²)	BMC (g)	BMD (g/cm ²)	T - score	Z - score
UD	3.44	2.08	0.604	0.9	2.5
MID	7.83	6.06	0.774	1.2	2.4
1/3	2.99	2.53	0.846	0.5	2.3
Total	14.27	10.68	0.748	1.2	2.8

Forearm

- Follow-Up Scans
 - Unit of comparison
 - BMD
 - T-score
 - Reproduce baseline study
 - Is forearm considered reproducible?





Anatomy Review

