

# Bone Densitometry for Technologists

## Chapter 1

1. What is the most sensitive weight-bearing bone?
  - a. Talus
  - b. Calcaneus
  - c. Navicular
  - d. Cuboid
2. What does the central skeletal site include?
  - a. Thoracic and lumbar spine
  - b. Pelvis
  - c. Proximal femur
  - d. A & C
3. X-ray densitometry reports which of the following quantities during the scan?
  - a. Bone mineral density (BMD)
  - b. Bone mineral content (BMC)
  - c. Area
  - d. All the above
4. BMD with quantitative computed tomography (QCT) are 3-dimensional or volumetric.
  - a. True
  - b. False
5. How are bone density measurements of a PA lumbar spine reported?
  - a. L1 - L4 BMD
  - b. L2 - L4 BMD
  - c. L1, L2, L3, L4 BMD
  - d. A & B
6. Quantitative ultrasound (QUS) measures what parameters?
  - a. Bone mineral density
  - b. Speed of sound
  - c. Broadband ultrasound attenuation
  - d. B & C
7. The expression of a patient's densitometry value as a percentage of average peak for a young adult of the same sex is called what?
  - a. % young adult
  - b. % young reference
  - c. % your range
  - d. A & B
8. What year did the International Committee for Standards in Bone Measurement approve the standardized BMD for the total femur?
  - a. 1996
  - b. 1997
  - c. 1998
  - d. 1999

## Chapter 2

9. What percentage of bone density loss must occur before it can be visualized on a radiograph?
  - a. 20%
  - b. 30%
  - c. 40%
  - d. 50%
10. What method of radiogrammetry has been used for almost 50 years?
  - a. Metatarsal
  - b. Calcaneus
  - c. Metacarpal
  - d. Carpal
11. A radiologic osteoporosis score of \_\_\_\_\_ or less indicates peripheral osteoporosis.
  - a. 58
  - b. 68
  - c. 78
  - d. 88
12. Who performed studies on the effects of weightlessness on the skeleton of astronauts in the Gemini and Apollo missions?
  - a. George Voss
  - b. Pauline Beery Mack
  - c. Barneet and Nordin
  - d. KG Faulkner
13. What is referred to as a reduction in the number and energy of photons in the x-ray beam?
  - a. Absorption
  - b. Refraction
  - c. Attenuation
  - d. Scatter
14. The difference in the patterns of transmitted or attenuate photons create the \_\_\_\_\_ necessary to discern images on an x-ray.
  - a. Contrast
  - b. Sharpness
  - c. Detail
  - d. Level
15. Accuracy of single-photon absorptiometry (SPA) measurements of the mid-radius range from \_\_\_\_\_ to \_\_\_\_\_ percent.
  - a. 1, 2
  - b. 3, 5
  - c. 4, 6
  - d. 5, 7
16. In the United States, what was the most utilized isotope for dual-photon absorptiometry?
  - a. Cesium – 131
  - b. Cobalt 60
  - c. Chromium – 51
  - d. Gadolinium – 153

17. What is the advantage of an x-ray tube over the use of a radioactive isotope for dual-energy x-ray absorptiometry (DXA)?
- No source decay
  - Less dose overlap
  - Faster scans
  - All the above

### Chapter 3

18. The pedicles, lamina, spinous process, transverse process and the inferior and superior articulating surfaces are considered what part of a vertebrae?
- Body
  - Posterior elements
  - Foramen
  - None of the above
19. The posterior elements of L1, L2, and L3 have what shaped appearance?
- U
  - Y
  - H
  - A and B
20. What area is extensively used in densitometry, but also is the most affected by structural change and artifact?
- Metacarpals
  - Femur
  - Lumbar spine
  - Forearm
21. Vertebral fractures in osteoporosis frequently occur at what level?
- T7 – T9
  - T12 – L2
  - L3 – L5
  - A & B
22. What is the likelihood of degenerative changes in a 55-year-old woman?
- 10%
  - 30%
  - 40%
  - 50%
23. Unlike aortic calcification, what can have a profound effect on measured BMD in the AP and PA lumbar spine?
- Facet sclerosis
  - Osteophytes
  - Scoliosis
  - Fracture
24. Which of the following is an artifact that can occur in a PA lumbar spine study?
- Renal stones
  - Gallstones
  - Contrast agents
  - All the above

25. Ward's triangle is a calculated region of high density in the femoral neck.
- True
  - False
26. Which of the following **is not** a commonly measured site of the forearm?
- 10% site
  - 33% site
  - 50% site
  - 75% site

#### Chapter 4

27. What is the purpose of elevating a patient's legs for a scan?
- Flatten the lumbar spine against the table
  - Increase the separation between the lumbar vertebrae
  - Decrease movement
  - A & B
28. The term rotoscoliosis is rotation of the vertebrae accompanying scoliosis.
- True
  - False
29. Which of the following is an anatomic positioning limitation that a technologist cannot overcome?
- Disc space collapse
  - Severe thoracic kyphosis
  - Arthritic changes
  - All the above
30. What is the goal when positioning a patient for a proximal femur study?
- Reduced movement
  - Properly rotated proximal femur
  - Straight femoral shaft
  - B & C
31. Precision is not improved when the mean of the right and left region of interest (ROI) is used instead of the BMD for either single ROI.
- True
  - False
32. When positioning a forearm, the scan should include the radial styloid and the \_\_\_\_\_ region of interest.
- 10%
  - 33%
  - 50%
  - 75%
33. What is the major obstacle to correct positioning for a forearm on a central DXA device?
- Patient size
  - Rotation of the arm
  - Design of the scan table
  - Patient movement
34. A forearm scan should contain the lower 2/3 of which bone?
- Capitate
  - Hamate
  - Trapezoid
  - Scaphoid

## Chapter 5

35. When energy is released and then transmitted through a substance, it is called \_\_\_\_\_.
- Infrared
  - Radiation
  - Microwave
  - Radio waves
36. What is used to describe a quantity of radiation exposure?
- Curie
  - Millicurie
  - Microcurie
  - Roentgen
37. Radon is a gas formed by the decay of \_\_\_\_\_.
- Uranium
  - Cesium
  - Cobalt
  - Helium
38. GI death occurs as a result of what level of radiation dose?
- 100 – 150 rads
  - 200 – 1,000 rads
  - 1,000 – 5,000 rads
  - > 5000 rads
39. Reddening of the skin can occur with what size dose?
- <300 rads
  - 300 -1,000 rads
  - 2,000 – 5,000 rads
  - >5,000 rads
40. What dose to the ovaries can cause permanent sterility?
- 100 rads
  - 200 rads
  - 500 rads
  - 600 rads
41. Which is the most sensitive to irradiation?
- Red blood cells
  - White blood cells
  - Platelets
  - Plasma
42. What is the amount of natural background radiation exposure each year?
- 120 mrem/year
  - 180 mrem/year
  - 210 mrem/year
  - 240 mrem/year
43. What is the annual dose limit for a radiation worker?
- 4 rem/year
  - 5 rem/year
  - 6 rem/year
  - 7 rem/year

44. What is the maximum permissible dose to a fetus?
- a. 100 mrem
  - b. 250 mrem
  - c. 500 mrem
  - d. 700 mrem

## Chapter 6

45. What are quality control anthropomorphic phantoms made of?
- a. Hydroxyapatite
  - b. Aluminum
  - c. Plexiglass
  - d. A & B
46. Which phantom is intended to replicate the lower half of T12 to the upper half of L5?
- a. European spine phantom
  - b. Bona Fida Spine phantom
  - c. Hologic spine phantom
  - d. Lunar spine phantom
47. Manufacturers generally recommend scanning the phantom how many times on the same day without repositioning it?
- a. 6
  - b. 8
  - c. 10
  - d. 12
48. Two of the most commonly used methods for tracking machine performance are the Shewhart rules and the CUSUM chart.
- a. True
  - b. False
49. Shewart rules have been used in analytical chemistry since \_\_\_\_\_.
- a. 1940's
  - b. 1950's
  - c. 1960's
  - d. 1970's
50. A machine failure has occurred if which of the following Shewhart rules have been violated?
- a. A phantom BMD value exceeding the average  $\pm 3SD$
  - b. Two consecutive phantom BMD values on the same side of the average exceeding the average by  $\pm 2SD$
  - c. Two consecutive phantom BMD values differing by more than  $4SD$
  - d. All the above
51. Which of the following **is not** an International Society for Clinical Densitometry quality control requirement for DXA facilities?
- a. Follow manufacture's guidelines for system maintenance
  - b. Perform monthly phantom scans
  - c. Maintain all service logs
  - d. Comply with government inspection, radiation surveys and regulation requirements

## Chapter 7

52. What is it called when quantitative measurement techniques can reproduce the same numerical results in the same setting?
- Explicit
  - Precision
  - Accuracy
  - Definition
53. The only way to know that a biologic change has occurred is to know if the \_\_\_\_\_ of the technique has been exceeded.
- Reproducibility
  - Integrity
  - Precision
  - Standard deviation
54. Precision is expressed by which of the following?
- Root-mean-square standard (RMS-SD)
  - Root-mean-square % coefficient (RMS-%CV)
  - Least significant change (LSC)
  - A & B

## Chapter 8

55. What is one of the most important uses of the bone density measurement?
- Determine medication to reduce bone loss
  - Outline exercises to build bone
  - Predict patient fracture risk
  - A & B
56. How should a patient's fracture risk be expressed in clinical practice?
- Relative risk
  - Clinical risk
  - Baseline risk
  - Absolute risk
57. Absolute risk predictions usually cover a period of how many years?
- 3 years
  - 5 years
  - 7 years
  - 10 years
58. Which of the following **is not** an absolute fracture risk prediction tool?
- FRAX
  - FORE FRC
  - CAROC
  - Primary Fracture Risk Prediction Tool
59. Where was the FRAX risk algorithm developed?
- World Health Organization
  - National Academy of Science
  - National Institute of Health
  - Association of Science and Technology

60. What tool is the predominant method for the prediction of fracture risk?
- FORE FRC
  - Garvan Fracture Risk Prediction Tool
  - CAROC
  - FRAX
61. FRAX is intended to be used with BMD or T-scores obtained at skeletal sites other than the femoral neck or with other technologies.
- True
  - False
62. What is the acceptable age for FORE-FRC to begin?
- 40
  - 45
  - 50
  - 55
63. The original CAROC assessment tool was found to \_\_\_\_\_ fracture risk in Canadian men and women.
- Overestimate
  - Accurately predict
  - Underestimate
  - Miscalculate
64. The Garvan fracture risk calculator is widely used in what country?
- United States
  - Spain
  - Australia
  - Germany

## Chapter 9

65. Prior to 1991, osteoporosis was described as what kind of disorder?
- Systemic skeletal disorder
  - Microarchitectural deterioration of bone
  - Age-related
  - Bone fragility
66. What year was the World Health Organization (WHO) criteria for the diagnosis of osteoporosis based on bone density published?
- 1992
  - 1994
  - 1996
  - 1998
67. The WHO stated a bone density that was \_\_\_\_\_ standard deviations or more below the average peak of the young adult was sufficiently low to be called osteoporosis.
- 1.5
  - 2.0
  - 2.5
  - 3.0



68. In 2002, the National Osteoporosis Foundation estimated how many men and women in the United States over the age of 50 had osteoporosis and osteopenia?
- 20 million
  - 27 million
  - 38 million
  - 44 million
69. What is the lifetime risk of hip fracture for a 50-year-old Caucasian woman?
- 15.2%
  - 17.5%
  - 23.2%
  - 26.5%
70. How many fractures are attributed to osteoporosis each year?
- 1 million
  - 2 million
  - 3 million
  - 4 million
71. Kyphosis is commonly known as what?
- Morbidity
  - Widow's hump
  - Dowager's hump
  - B & C
72. What percentage of women who fracture their hip cannot walk independently one year later?
- 30%
  - 40%
  - 50%
  - 60%
73. What refers to the maximum bone mass or density that is attained in life?
- Peak bone measurement
  - Peak bone level
  - Peak bone density
  - Peak bone equivalent
74. Peak bone density is reached by what age?
- 20
  - 25
  - 30
  - 35
75. Which of the following is a factor in the failure to achieve an average peak bone density?
- Calcium deficiency
  - Lack of exercise
  - Genetics
  - A & B
76. What forms new bone to replace removed old bone?
- Osteoblast
  - Osteoclast
  - Osteocytes
  - Cartilage

77. The diagnosis of osteoporosis should be based on bone measurement from what site?
- PA lumbar spine
  - Forearm
  - Proximal femur
  - A & C
78. How often will Medicare pay for a bone density test?
- 12 months
  - 18 months
  - 23 months
  - 36 months
79. Pharmacologic intervention should be considered when a patient has a T-score equal to or poorer than \_\_\_\_\_ at the lumbar spine or femoral neck.
- 1.0
  - 1.5
  - 2.0
  - 2.5
80. How much calcium does the National Osteoporosis Foundation recommend per day?
- 800 mg
  - 1,000 mg
  - 1,200 mg
  - 1,400 mg

## Chapter 10

81. The results from bone densitometry can be categorized into which of the following?
- The skeletal image
  - Age-regression graph
  - patient orientation
  - A & B
82. When calculating bone density parameters, what is the default region of interest in the PA lumbar spine?
- T11 – L4
  - T11 – L5
  - T12 – L5
  - L1 – L4
83. What is the preferred site of the forearm to scan for a patient being evaluated for hyperparathyroidism?
- 10% site
  - 33% site
  - 50% site
  - 5 mm site
84. In clinical practice the standard score comparisons have been given more importance than the % comparison in diagnosis of fracture risk.
- True
  - False

85. Which of the following should never be used in the interpretation of serial bone mass?
- T-score
  - Z-score
  - % comparisons
  - All the above

## Chapter 11

86. Even with perfect positioning study results may not be ideal due to which factors?
- Artifacts
  - Structured changes in patient anatomy
  - Patient movement
  - A & B

## Chapter 12

87. Which of the following **is not** true of the pediatric skeleton?
- Ossification centers fuse in different bones at different ages
  - Chronological age does reflect their bone age
  - Puberty has a profound effect on the development of the skeleton
  - Radiation safety issues are not the same as adults
88. As low as reasonably achievable (ALARA) is the guiding principle in pediatric densitometry radiation safety.
- True
  - False
89. What are secondary ossifications centers at the end of the long bone that are responsible for longitudinal growth?
- Epiphyses
  - Osteoblasts
  - Osteocytes
  - Osteoclasts
90. Ring like epiphysis on the upper and low surfaces of the vertebral bone do not fuse with the rest of the vertebral body until what age?
- 16
  - 18
  - 20
  - 25
91. What technique is used to determine bone age in the hand?
- Greulich and Pyle method
  - Jensen method
  - Tanner and Whitehouse method
  - A & C
92. What is used to determine the level of sexual development of a child?
- Hobart Stage
  - Jensen Stage
  - Tanner Stage
  - Miller Stage

93. In girls, the peak rate of linear growth is seen in which Tanner Stage?
- Stage 1
  - Stage 2
  - Stage 3
  - Stage 4
94. The \_\_\_\_\_ is the standard score comparison to bone density that is predicted for the patient's age.
- T-score
  - Z-score
  - C-score
  - L-score
95. Using the T-score in children is always appropriate.
- True
  - False
96. In the study from Gafni and Baron, the second most common error in interpretation of pediatric densitometry results was the use of a reference database that did not reflect what?
- Patient's sex
  - Patient's height
  - Patient's ethnicity
  - A & C
97. In the study from Bachrach, how much greater was the BMD for black females?
- 3%
  - 5%
  - 7%
  - 10%
98. What is osteogenesis imperfecta often called?
- "failure to thrive disease"
  - "long bone disease"
  - "brittle bone disease"
  - "malabsorption disease"
99. Which of the following is not a secondary cause of low bone mass in childhood?
- Cushing's syndrome
  - Rotavirus
  - Hyperthyroidism
  - Rheumatoid arthritis
100. What is the greatest problem faced in pediatric densitometry?
- Underutilization
  - Misinterpretation
  - Machine design
  - Inconsistent results

### Chapter 13

101. What percentage of vertebral fractures are symptomatic?
- 17%
  - 26%
  - 33%
  - 40%

102. Quantitative techniques rely heavily on the accuracy of what?
- Computer techniques
  - Point placement
  - Comparison to reference databases
  - B & C
103. Fan-array DXA imaging largely avoids the problem created by \_\_\_\_\_.
- Scan time
  - Patient positioning
  - Parallax
  - Patient movement
104. In Rea's evaluation of post-menopausal women using VFA imaging, what percentage of unfractured vertebrae were identified?
- 96.4%
  - 97.4%
  - 98.4%
  - 99.4%
105. What is the most common location for vertebral fractures?
- T4 – T6
  - T7 – T8
  - T9 – T12
  - T11 – L1,
106. In a study by Schousboe, what percentage of women over 60 with osteopenic bone density had a vertebral fracture?
- 27.4%
  - 29.2%
  - 31.4%
  - 33.6%
107. Which of the following **is not** a clinical guideline for VFA?
- Postmenopausal women with osteopenia
  - Age  $\geq$  to 50 years
  - Height loss  $>2$  cm
  - Self-reported vertebral fracture
108. Due to abdominal aortic calcification, what location is better to diagnosis osteoporosis in older women using BMD?
- Forearm
  - Proximal femur
  - PA lumbar spine
  - A & C
109. On the AAC-8 scale, what score is a calcification length of  $> 3$  vertebrae?
- 1
  - 2
  - 3
  - 4

## Chapter 14

110. The assessment of body composition is concerned with the percentage and distribution of \_\_\_\_ and \_\_\_\_ in the body.
- Fat, muscle
  - Fat, lean tissue
  - Lean tissue, muscle
  - Height, weight
111. What is the measurement that relates to a patient's weight to their height?
- Body composition
  - Muscle mass index
  - Body mass index
  - Lean tissue index
112. A body mass index of 30.00 – 34.99 is what obesity class?
- Preobese
  - Obese class 1
  - Obese class 2
  - Obese class 3
113. The fat-free compartment of the body is divided into which of the following?
- Water
  - Protein
  - Mineral
  - All the above
114. What is the "gold standard" for measuring body composition?
- Measurement of skin fold thickness
  - Bioelectric impedance
  - Air displacement plethysmography
  - Underwater weighing
115. Fat mass has a density of \_\_\_\_\_.
- 0.9/gcm<sup>3</sup>
  - 1.1/gcm<sup>3</sup>
  - 1.2/gcm<sup>3</sup>
  - 1.3/gcm<sup>3</sup>
116. Skin fold measurements is considered a \_\_\_\_\_ compartment method to determine body fat.
- One
  - Two
  - Three
  - Four
117. Bioelectric impedance analysis is often found in health clubs.
- True
  - False
118. What is one technique using air displacement called?
- BOD POD
  - POD BOD
  - AIR POD
  - BOD CAP

119. According to the American Heart Association, what waist circumference for men is criteria for metabolic syndrome?
- a.  $\geq 30''$
  - b.  $\geq 35''$
  - c.  $\geq 40''$
  - d.  $\geq 45''$
120. Increased visceral or adipose tissue is strongly associated with metabolic and cardiovascular disease risk.
- a. True
  - b. False