PIPADOR REVISION

MRCOG Part 1 Revision Notes

DEXA

MEDICAL PHYSICS • LECTURE 510

VISUAL EXAMINATION REVISION NOTES

2026 Edition

510

MRCOG PART 1 REVISION NOTES | MEDICAL PHYSICS

DEXA

Physics, interpretation, indications and limitations of dual-energy X-ray absorptiometry

T ≤ −2.5	−1 to −2.5	Z ≤ −2	≈ 0.001– 0.01 mSv
Osteoporosis	Osteopenia	Below expected for age	Radiation dose

■ KEY FACTS: Learning objectives

- Define DXA, bone mineral density (BMD), T-score and Z-score and the WHO diagnostic categories.
- Explain the physics of dual-energy X-ray absorptiometry and its limitations.
- Describe indications in women's health, interpretation, fracture risk assessment (FRAX, NOGG) and monitoring.

510.1 Key definitions

Term	Definition
DXA (DEXA)	Dual-energy X-ray absorptiometry — measures bone mineral density using two X-ray energies
Bone mineral density (BMD)	Bone mineral content divided by projected area (g/cm²) — 'areal' density
T-score	Number of standard deviations the BMD differs from the mean of young healthy adults (peak bone mass)
Z-score	Number of standard deviations from the mean of age-, sex- (and ethnicity-) matched people
Osteoporosis (WHO)	T-score ≤ −2.5 at spine, total hip or femoral neck
Osteopenia (low bone mass)	T-score between −1.0 and −2.5
Least significant change (LSC)	Smallest change in BMD between scans that exceeds measurement error (≈ 2.8 × precision error)
FRAX	Tool estimating 10-year probability of major osteoporotic and hip fracture

■ IN PLAIN ENGLISH: DXA

DXA sends two X-ray beams of different energy through the hip and spine. Because bone and soft tissue absorb them differently, the machine can **subtract soft tissue and measure the mineral in bone**. The result is compared with young adults (T-score) or people of the same age (Z-score).

510.2 Physics

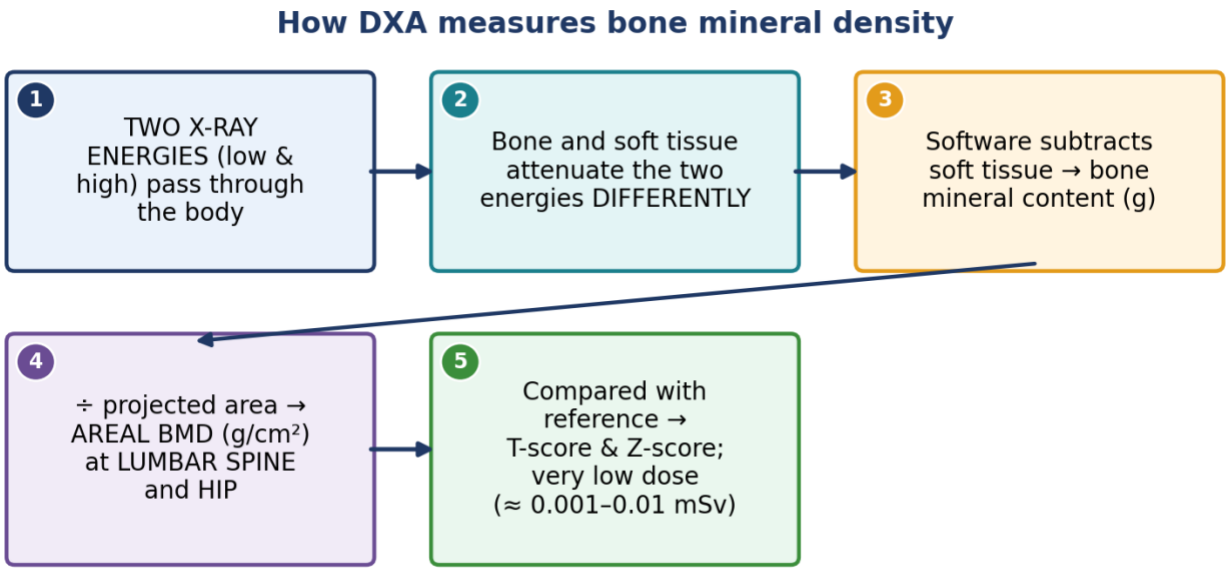


Figure 510.1 — How DXA works

- Two photon energies (e.g. ≈ 40 and 70 keV) produced by K-edge filtering or switching kV
  - Differential attenuation solved for bone and soft-tissue components.
- Measures **areal** BMD (g/cm²) — not true volumetric density, so larger bones appear denser; quantitative CT gives volumetric BMD (higher dose).
- Very low dose (≈ 0.001–0.01 mSv — less than a day of background); avoided in pregnancy (not because of dose but because BMD changes and positioning).

510.3 Interpretation

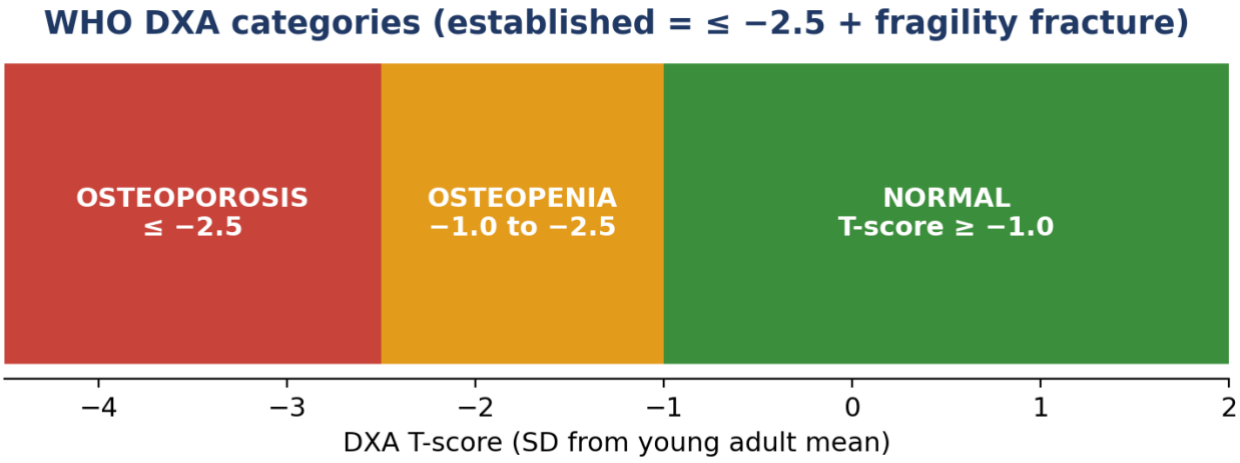


Figure 510.2 — WHO DXA categories

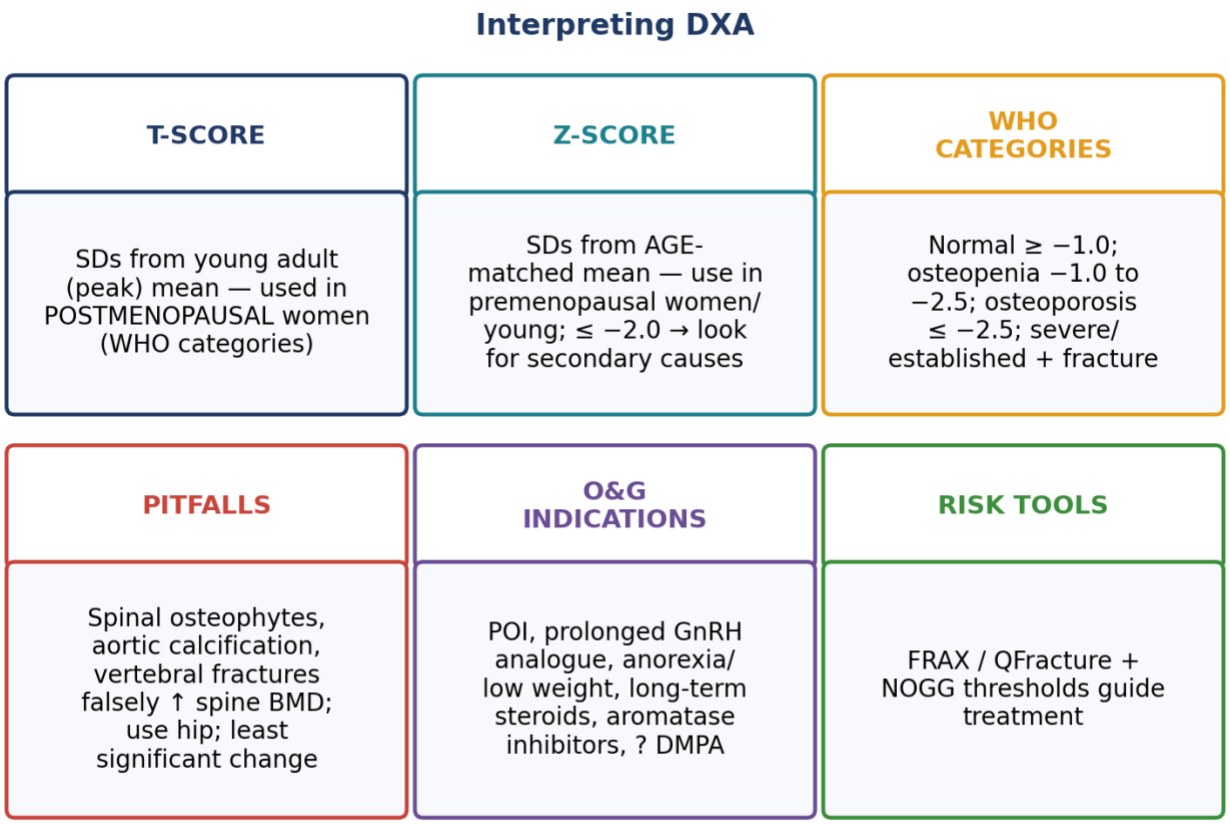


Figure 510.3 — Interpreting DXA

Topic	Details
Sites	• Lumbar spine (L1–L4) and hip (total hip, femoral neck) • Forearm if spine/hip unusable or hyperparathyroidism
Which score	• T-score for postmenopausal women (and men ≥ 50) • Z-score for premenopausal women and children — 'below expected range for age' if ≤ −2.0
Errors	• Degenerative change (osteophytes), aortic calcification, vertebral fractures, scoliosis, metal → falsely high spine BMD • Positioning differences between scans
Monitoring	• Same machine, ≥ 2 years apart (or as per treatment) • Compare against LSC
Fracture risk	• FRAX ± BMD → NOGG intervention thresholds • Vertebral fracture assessment (VFA) on DXA

510.4 Indications in women's health

- **Premature ovarian insufficiency** (baseline at diagnosis; monitor on HRT), early surgical menopause.
- Long-term **GnRH analogues** (> 6 months, or with add-back)
  - **Aromatase inhibitors** (breast cancer)
  - Long-term **glucocorticoids** (≥ 7.5 mg prednisolone ≥ 3 months)
  - Anorexia nervosa/low BMI, hypogonadism, malabsorption
  - Hyperthyroidism/hyperparathyroidism.
- Postmenopausal women with fragility fracture or FRAX near the intervention threshold

  - DMPA users with additional risk factors (FSRH — DXA not routinely required).
- Pregnancy/lactation-associated osteoporosis (scan postpartum).

■ **COMMON PITFALLS**

Using T-scores in premenopausal women (use Z-scores).

Relying on spine BMD in older women with degenerative disease.

Comparing scans from different machines without cross-calibration.

510.5 Must-know summary

■ **EXAM TIP**

- DXA uses two X-ray energies to subtract soft tissue → areal BMD (g/cm²) at spine and hip; very low dose.
- T-score (vs young adults): ≥ −1 normal, −1 to −2.5 osteopenia, ≤ −2.5 osteoporosis (+ fracture = severe).
- Z-score (vs age-matched) for premenopausal women; ≤ −2 → secondary causes.
- O&G indications: POI, GnRH analogues, aromatase inhibitors, steroids, anorexia; use FRAX/NOGG for treatment decisions.

■ **MNEMONIC / MEMORY AID**

'T for Thirty-year-olds (young adult), Z for Zame age'.