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Dual energy X-ray absorptiometry

This article forms part of our 'Tests and results' series for 2011 which aims to provide information about common tests that general practitioners order regularly. It considers areas such as indications, what to tell the patient, what the test can and cannot tell you, and interpretation of results.

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Dual energy X-ray absorptiometry (DXA) is the gold standard for diagnosing osteoporosis (OP). It uses X-rays at two energy levels and works on the principle that, as X-rays pass through body tissues they are attenuated to a different extent in different tissue types. The result – the bone mineral density (BMD) – can be reported at a number of sites. The most clinically useful are the lumbar spine, femoral neck and total hip (also termed the 'proximal femur').

Indications

Dual energy X-ray absorptiometry is indicated to investigate individuals at risk of bone loss or OP, or who have sustained a minimal trauma fracture (due to the force equivalent of a fall from standing height or less).¹ It may have a role in monitoring response to OP treatment, although there is insufficient evidence to support its routine use.

Medicare Benefits Schedule (MBS) indications for which bone densitometry is reimbursed are listed in *Table 1*. For situations outside these indications costs to the patient vary (the current MBS fee for DXA is \$98.55).

Precautions

Most DXA machines cannot accommodate patients who weigh more than 130 kg.

Information for patients

Dual energy X-ray absorptiometry is a safe, simple, painless procedure which takes

approximately 20 minutes. It involves a very small amount of radiation exposure – much less than that of a chest X-ray.

Interpretation

Interpretation of DXA involves two results: the 'T-score' and 'Z-score'. The T-score is the number of standard deviations a patient's BMD differs from

that of a healthy young adult of the same gender and ethnicity. The Z-score is the number of standard deviations a patient's BMD differs from an average person of the same age, gender, and ethnicity. Lower scores indicate lower bone density.

Osteoporosis is defined by reference to the T-score. According to World Health Organization criteria:

- a T-score more than -1 is normal
- a T-score between -1 and -2.5 indicates osteopenia
- a T-score less than -2.5 diagnoses OP
- established (severe) OP is defined as a T-score less than -2.5 in the presence of a minimal trauma fracture.

The Z-score indicates whether additional reasons for bone loss (besides aging) are likely. If the Z-score is less than -2.0 , laboratory examinations for secondary causes of OP are indicated. However, a Z-score more than -2.0 does not exclude secondary OP. Further assessment should be guided by the medical history and clinical examination.

Common interpretation issues

- Osteoarthritis in the lumbar spine can inflate BMD measures at this site. Hip BMD is more accurate if there is a discrepancy between hip and spine
- Serial femoral neck BMD measures can vary widely if patient positioning during the scan is not exactly duplicated. Total hip BMD is better used if this occurs
- If monitoring a patient's BMD, use the same machine wherever possible to reduce measurement error
- DXA reports may note other factors such as body composition, bone mineral content, bone area and BMD at additional sites, but these do not usually assist clinical decision making.

Next steps

Actions needed following DXA depend on the results, the patient's OP risk profile and whether

Table 1. MBS indications for DXA

- Confirmation of a presumptive diagnosis of low bone mineral density made on the basis of one or more fractures occurring after minimal trauma
- Measurement of bone mineral density, for a person aged 70 years or over
- Diagnosis and monitoring of bone loss associated with one or more of:
 - prolonged glucocorticoid therapy
 - conditions associated with excess glucocorticoid secretion
 - male hypogonadism
 - female hypogonadism lasting more than 6 months before the age of 45 years
 - primary hyperparathyroidism
 - chronic liver disease
 - chronic renal disease
 - proven malabsorptive disorders
 - rheumatoid arthritis
 - conditions associated with thyroxine excess
- Monitoring of low bone mineral density proven by bone densitometry at least 12 months previously
- Measurement of bone density 12 months after a significant change in therapy

they have a history of minimal trauma fracture. For detailed information see the *Clinical guidelines for the prevention and treatment of osteoporosis in postmenopausal women and older men* and its accompanying algorithm (see *Resources*).¹

Consider additional laboratory investigations to exclude secondary causes of OP and other bone diseases if there was a minimal trauma fracture, if the history or examination suggests there may be a cause of secondary OP, or if the Z-score is less than -2.0 .

General lifestyle advice for the prevention of OP is important for all patients. No additional treatment is needed for patients with T-score more than -1.0 without fracture. If the T-score is less than -1.0 and the patient has sustained a minimal trauma fracture, specific anti-osteoporotic treatment is indicated, even if the T-score is not less than -2.5 . For T-scores between -1.0 and -2.5 without fracture, specific therapy may be considered depending on individual risk (although this treatment may not be covered by the PBS unless specific criteria are met, see *Resources*).

If OP is not present, DXA should be repeated after an interval of at least 2 years, at a time when the T-score is likely to be approaching -2.5 . Typically the T-score drops by about 0.1 per year, so for example, with a T-score of -2.0 a repeat BMD in 5 years is warranted.

Case study

DXA results for a Caucasian woman 78 years of age (Figure 1). The images of the lumbar spine (A) and hip (B) show the regions of interest scanned by a Hologic DXA scanner. In this instance, lumbar vertebra L1 through L4 were included in the total lumbar spine measurement which is the most useful clinical measure for the lumbar spine. For the hip, the sites of clinical importance are the femoral neck (marked 1) and the total hip (=1+2+3).

The important sites to look for are circled in green: the total lumbar spine (LS) measures and the femoral neck and total hip measures. In particular note the T-scores (green circle) and Z-scores (red circle). In this instance, the total hip and the lumbar spine T-scores are both less than -2.5

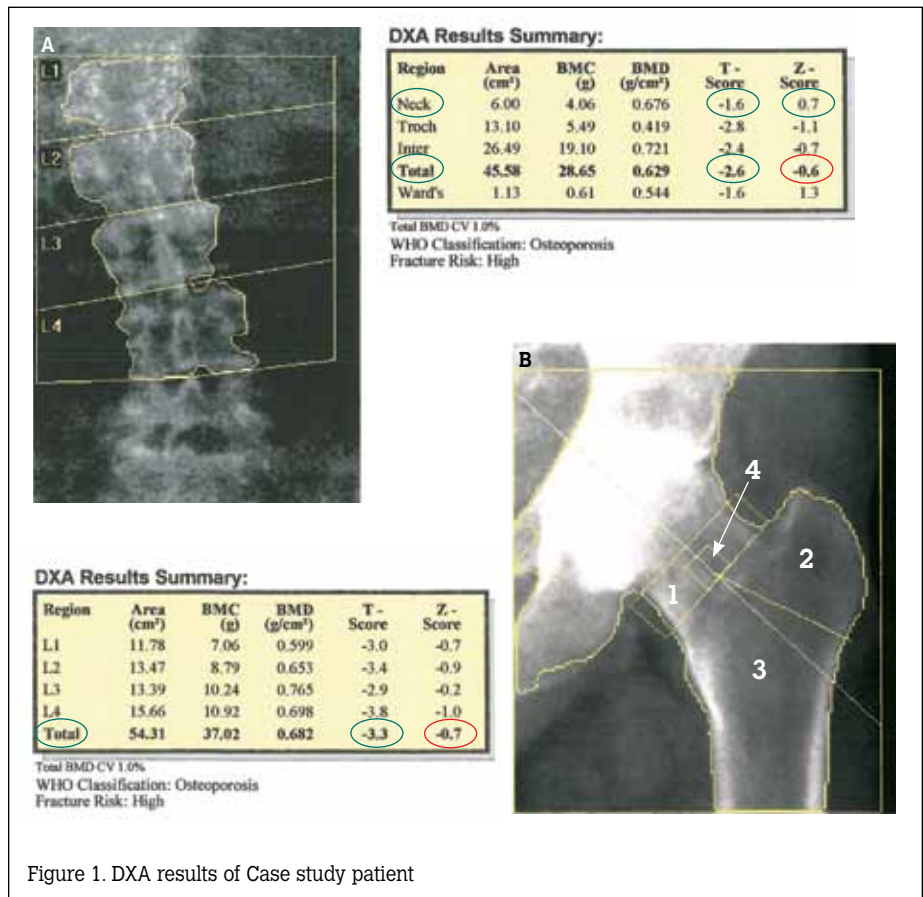


Figure 1. DXA results of Case study patient

which is diagnostic of osteoporosis. The Z-scores are more than -2.0 so unless there are other clinical indicators, secondary causes of OP are unlikely. As this patient is over 70 years of age and has a T-score of less than -3.0 , she is eligible under the PBS for specific OP treatment, regardless of her fracture history.

Note: In this example the image of the lumbar spine demonstrates both a scoliosis and changes of osteoarthritis (OA). The OA changes are likely to result in an overestimate of lumbar spine BMD so this may be even lower than the reported T-score of -3.3 .

Commonly, although not seen in this example, when lumbar spine OA changes are present on the image the hip T-score may be markedly lower than that of the spine. In this situation, the hip T-score is the most important result to use in the clinical interpretation of the scan.

Resources

- *Clinical guidelines for the prevention and treatment of osteoporosis in postmenopausal women and older men*: www.racgp.org.au/guidelines/musculoskeletal diseases/osteoporosis
- MBS Online: www.health.gov.au/internet/mbsonline/publishing.nsf/Content/Medicare-Benefits-Schedule-MBS-1.

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Reference

1. The RACGP Osteoporosis Working Group. Clinical guideline for the prevention and treatment of osteoporosis in postmenopausal women and older men. Melbourne: The RACGP, 2010.

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