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TBS in clinical DXA practice

Assessing fracture risk adjusted with TBS in DXA scanning services

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Osteoporosis is classed as a silent disease often only being diagnosed after a fracture¹. The most common visible signs of an osteoporotic spinal fracture are a loss of height, curvature of the spine, possibly with unexplained back or muscle spasms, with this becoming more evident with subsequent incidence of vertebral fractures². Therefore, it is important that existing and newly developing assessments are considered to identify and reduce the risks from these fractures, because an early diagnosis of osteoporosis before a fracture arises and effective treatment strategies can prevent the effects of the condition and fragility fracture³ or progression where osteoporosis is already diagnosed and fractures have occurred.

Dual Energy X-Ray Absorptiometry (DXA) is the recognised bone mineral density measurement (BMD) tool and a DXA scanner upgrade at North Devon District Hospital in 2022 to a GE Lunar iDXA (GE Healthcare, Bedford, UK), included access to additional features not available on the previous equipment. One specific software additional to the standard features is Trabecular Bone Score (TBS).

Using this article for CPD

Reflect on the article and the points below and add to your personal learning record.

Key points:

TBS assess the 'texture' of bone and assigns a value in order to describe bone quality

TBS can be used to enhance fracture risk assessment in patients who have reliable lumbar spine DXA measurements.

What effect does excluding vertebrae from the DXA measurements have on TBS and FRAX[®] scores?

What limitations are there in using TBS and FRAX[®]?

How might TBS enhance reporting of fracture risk in your service?

allows the scan results and subsequent fracture risk to be refined further for the individual⁴ and supplement BMD measurement from the neck of femur, used in fracture risk assessment, with TBS assessed at the lumbar spine. TBS is also independent of BMD.⁵

A known limitation of BMD assessments is that only the density is measured⁶ without capability of assessing the bone microarchitecture. TBS provides skeletal information that is not captured on a standard BMD measurement. The commonly used fracture risk assessment tool FRAX^{®7} uses a computer-based algorithm that calculates major osteoporotic and hip fracture probability over the next ten years⁸.

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TBS utilises the acquired lumbar spine scan and a texture parameter to assign a 'value' to the distribution of the bone mineral as a TBS.

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This may be inputted into FRAX[®] to refine fracture risk independent of and supplementary to femoral neck BMD also input into the tool. TBS can be used to enhance fracture prediction through modifying FRAX[®] percentage risk factors.

For clinical practice in North Devon, after the DXA scan is acquired, the standard analysis is performed including, assessment of anomalous vertebrae that might need excluding, including if a T-score differs by greater than one standard deviation from the adjacent vertebrae, and the presence of a visible abnormality⁹. Once this is concluded, the TBS assessment is accessed which gives a result as a TBS, a TBS T-score and TBS Z-score. The output on the GE Lunar iDXA is similar layout to the densitometry page with a reference chart showing TBS values, T-score and age. If a vertebra has been excluded at the analysis stage this is automatically transferred across to the TBS reference chart. TBS scores currently cannot be automatically populated into the iDXA version of FRAX[®], therefore the online version of FRAX[®] is used to make TBS enhanced fracture risk assessments.

Following input of the standard FRAX[®] data, including the femoral neck BMD and selection of the scanner manufacturer that the BMD was originated, the usual process for calculation occurs and fracture risks demonstrated. Below the 10yr fracture risk results is an option to 'Adjust with TBS'. Activating this opens FRAX[®] adjusted for TBS- the operator subsequently inputs the TBS and selects the 'compute FRAX[®] adjusted for TBS' option. This opens a further page, and the operator is

people with a BMI between 15 – 37 kg/m².

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Calculating this score produces a TBS adjusted ten-year probability for major osteoporotic fracture and for hip fracture.

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This revised scoring can be inputted into the National Osteoporosis Guideline Group (NOGG)¹⁰, accessible via the link on the original FRAX[®] clinical risk page. The manual data entry section enables the user to input age, gender, use of glucocorticoids and the TBS revised major osteoporotic fracture score and hip fracture score. By selecting the 'you have already measured BMD' option the revised NOGG treatment threshold graphs and corresponding recommendations are displayed adjusted for TBS. One area that is important to note is that when selecting the manual entry for NOGG if the 10-year probability for fracture percentage is greater than 12, it will not allow you to use TBS adjusted FRAX[®] to refine the result, as it has a maximum range of 12. To help users to understand how to use TBS there is free eLearning and certificated programme available to access through the TBS link from the FRAX[®] website which is very helpful.

BMD can be falsely elevated through degenerative changes¹¹. When vertebrae are excluded in accordance with best practice recommendations, this reduces the number of vertebra available for analysis and therefore precision. One study found that in most cases for their research, excluding vertebra can potentially lower TBS results, although this was not always the case. They further recorded that the effects of fracture risk prediction following vertebral exclusion requires validation but suggest in the meantime it would be reasonable to use the similar approach for TBS as is used to define exclusions of vertebra for BMD. For some this could adversely affect the fracture risk scores, by introducing variabilities on the FRAX[®] values. When writing DXA reports the vertebrae excluded from the measurements should recorded on the report beside the TBS Score, to ensure it is understood that the values may be less reliable due to the exclusions.

There is a potential negative correlation with TBS for people of advancing age, because of the changes in bone microarchitecture associated with this process¹². A further study found TBS for African Americans fracture risk to be less discriminatory when compared with Caucasians¹³. On the GE scanner TBS software, the lowest age range starts at 45 years with the upper age being 85 years, so there is a lesser latitude for which patient meets the criteria for its use. There is the ability to trend on the TBS results from

their official position that TBS's role is unclear with monitoring anti-resorptive therapy, but that with anabolic therapy TBS could be potentially useful¹⁴. Also, for post-menopausal women with type II diabetes, TBS is associated with major osteoporosis fracture risk.

The main results where TBS is useful is refining the data for the individual, as with a good quality scan and clearly recorded clinical details inputted into FRAX® allows the reporter to get accurate NOGG recommendations, with the TBS used correctly this will further refine the data. Although it is important to use this with caution as the Scanner does not give a warning when trying to review patients outside the parameters for age. Equally the online TBS tool does not appear to alert the reporter that they are inputting a BMI that is outside the parameters for TBS, so it relies on good analytical skills for the reporter.

It is important to understand there are lots of aspects for effectively using the TBS tool to refine fracture risk, in addition to the standard FRAX® and NOGG guidance. Through understanding all the different aspects with correctly using TBS will allow the operator and reporter to be able to accurately refine the results for the patient, to enhance the report.

The authors declare that there is no conflict of interest.

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