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We understand bone health

A practical guide to Trabecular Bone Score (TBS) in clinical routine

Statements & workflow example from the 2023
ESCEO & IOF expert working group publication

Clinical guide to TBS: from scan acquisition to treatment decisions

This document provides a guide on the use and interpretation of TBS in the clinical workflow, from scan acquisition and fracture risk assessment to treatment decision-making. Step-by-step, it also summarizes Appendix 1 of the article by the International Expert Working Group of the ESCEO-IOF, under the auspices of WHO Collaborating Centre for Epidemiology of Musculoskeletal Health and Aging, published in *Osteoporosis International*.



22 statements strongly recommended per GRADE* methodology

The article, authored by the International Expert Working Group recommends that TBS enhances fracture risk assessment and treatment decision-making and should be used alongside FRAX and/or bone mineral density (BMD).

The following individual statements, all of which were strongly supported by the members of the Working Group, cover primary osteoporosis, secondary osteoporosis, treatment initiation and treatment monitoring.

*Grades of Recommendation, Assessment, Development and Evaluation approach.

Statements related to bone health and fracture risk assessment

Topic 1: Use of TBS in fracture risk prediction in postmenopausal and male osteoporosis

- TBS is predictive of fragility fractures in postmenopausal women and men above the age of 50 years.
- TBS is predictive of fragility fractures independent of BMD and of clinical risk factors (including those in FRAX).
- TBS adds predictive value when used in association with FRAX and BMD to adjust FRAX-probability of fracture in postmenopausal women and in men above the age of 50 years.
- BMD adjusted for TBS is an alternative solution, when FRAX is not available.
- The greatest utility of TBS is for those individuals who lie close to a FRAX or BMD T-score intervention threshold.
- TBS continues to add value to FRAX in patients previously receiving antiresorptive treatments.

Topic 2: Use of TBS in the prediction of fracture risk associated with secondary osteoporosis

- Reductions in TBS are observed in most secondary osteoporosis-related diseases.
- TBS predicts fracture risk in type 2 diabetes, independently of BMD and FRAX probability.
- TBS predicts fracture risk in chronic kidney disease, independently of BMD.
- TBS predicts fracture risk in patients treated with glucocorticoid, independently of BMD.
- TBS predicts fracture risk in rheumatological diseases, for example, rheumatoid arthritis, independently of BMD.
- TBS is relatively unaffected by spinal changes such as osteophytes and syndesmophytes.

Statements related to treatment initiation, decision-making and monitoring

Topic 3: Use of TBS for the initiation of treatment and monitoring of treatment effect in postmenopausal osteoporosis

- Patients with low TBS who lie below but near the treatment threshold should be considered for an earlier assessment and lifestyle advice.
- TBS with BMD and FRAX probability contributes to the stratification of antiosteoporosis therapy according to fracture risk, directing very high risk patients to anabolic-first approaches.
- TBS in conjunction with BMD, is useful for monitoring individual response to long-term denosumab treatment (5 years or more).
- TBS in conjunction with BMD is useful for monitoring individual response to PTH/PTHrP-analogue treatments such as teriparatide and abaloparatide.
- TBS in conjunction with BMD is useful for monitoring individual response to romosozumab.
- A decrease in TBS more than LSC during treatment should prompt further clinical review.
- TBS contributes useful information in the assessment of treatment response for patients receiving bone forming agents or long-term denosumab.

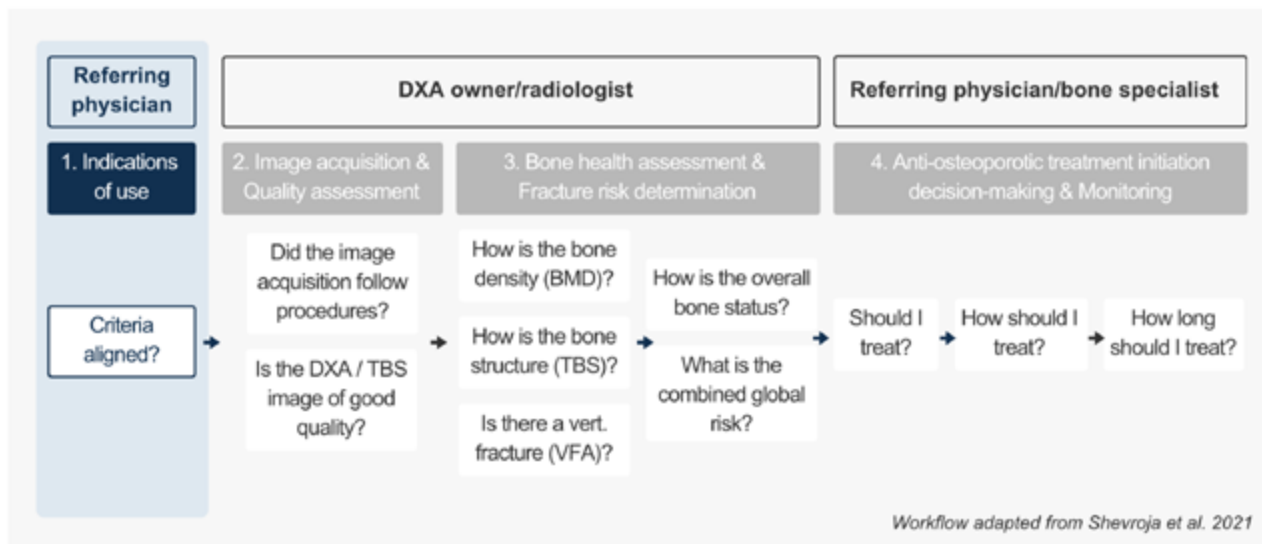
Topic 4: Use of TBS for treatment monitoring in secondary osteoporosis

- TBS adds value when used with BMD in monitoring skeletal effects of aromatase inhibitors.
- TBS adds value when used with BMD in monitoring skeletal effects of glucocorticoids.
- Evidence supporting the use of TBS in monitoring response to antiosteoporosis therapy is applicable across both primary and secondary osteoporosis.

TBS in the clinical workflow and indications for use

The following workflow example can be used to facilitate the integration of TBS in clinical practice in alignment with your clinical workflow.

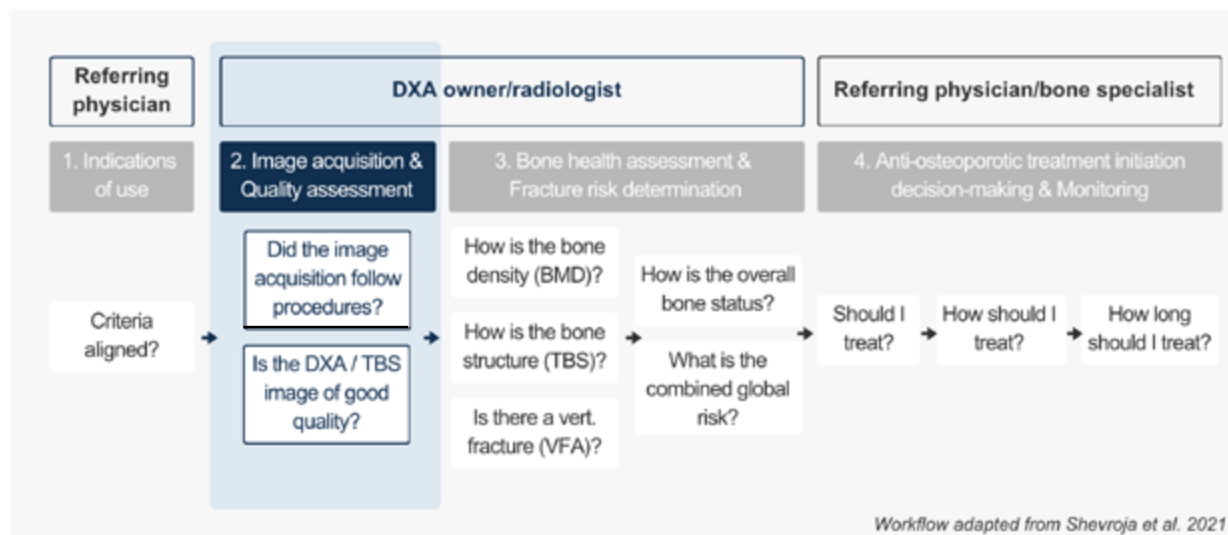
Trabecular bone score (TBS) is a grey scale texture measure that correlates with bone microarchitecture, which can be used alongside FRAX and BMD to enhance the assessment of fracture risk and to inform treatment initiation and monitoring.



Note: In presence of osteopenia and fragility fracture(s), patients should be treated, irrespective of TBS and BMD.

Indications for the use of TBS (adapted from ISCD, 2019; Kanis et al., 2019)

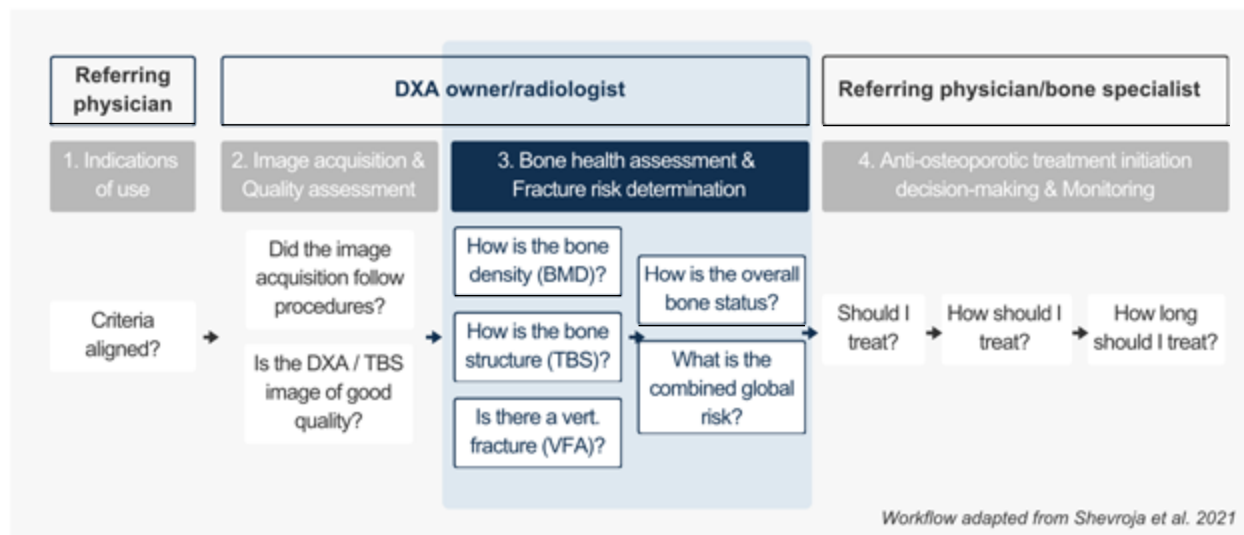
- If FRAX (without BMD) indicates intermediate risk of fracture;
- In women aged 65 years or over, and men aged 70 years or over, for routine bone health monitoring;
- In women and men aged under 65 and 70 years respectively, TBS is recommended alongside BMD, if they have a risk factor for low bone mass such as low body weight, prior fracture, high-risk medication use, or a disease or condition associated with bone loss;
- Adults with a fragility fracture;
- Adults with a disease or condition associated with secondary osteoporosis;
- Adults taking a medication associated with secondary osteoporosis;
- Adults who are being considered for pharmacological treatment;
- Adults receiving treatment, to monitor treatment effectiveness;
- Adults not receiving osteoporosis treatment, when evidence of bone fragility would lead to treatment.



Note: In presence of osteopenia and fragility fracture(s), patients should be treated, irrespective of TBS and BMD.

Image acquisition and quality assessment

- A DXA scanner calibration with a dedicated fractal phantom is required for TBS software installations and when there is a change in the DXA system, in order to clinically interpret the data;
- When a DXA system is upgraded or replaced, it is strongly recommended that a new baseline TBS measurement is set for patients under treatment monitoring;
- Change in scan mode may impact TBS outcomes. This can be mitigated by ensuring correct measurement and data entry of height and weight, and avoidance of change in scan mode for longitudinal monitoring, unless indicated by the DXA manufacturer;
- Vertebrae affected by structural anomalies should be excluded from BMD analysis in accordance with ISCD protocol. Vertebrae excluded for BMD analysis are also excluded for TBS, e.g. sclerotic lesions, osteophytes, syndesmophytes, laminectomy and fracture;
- Spinal degenerative changes minimally impact TBS, unlike BMD. As such, it is not unusual to observe discordance between spine TBS (lower) and BMD (higher);
- If two or more vertebrae are excluded, neither BMD nor TBS can be used for diagnosis;
- When a combination of vertebrae other than L1-L4 is used, combination-specific threshold adjustments are automatically applied in the current TBS iNsight version (3.1 and higher).
- The currently available TBS software is valid for use in individuals within the BMI range of 15 to 37 kg.m⁻². Interpretation of TBS results outside of this range should be made with caution.



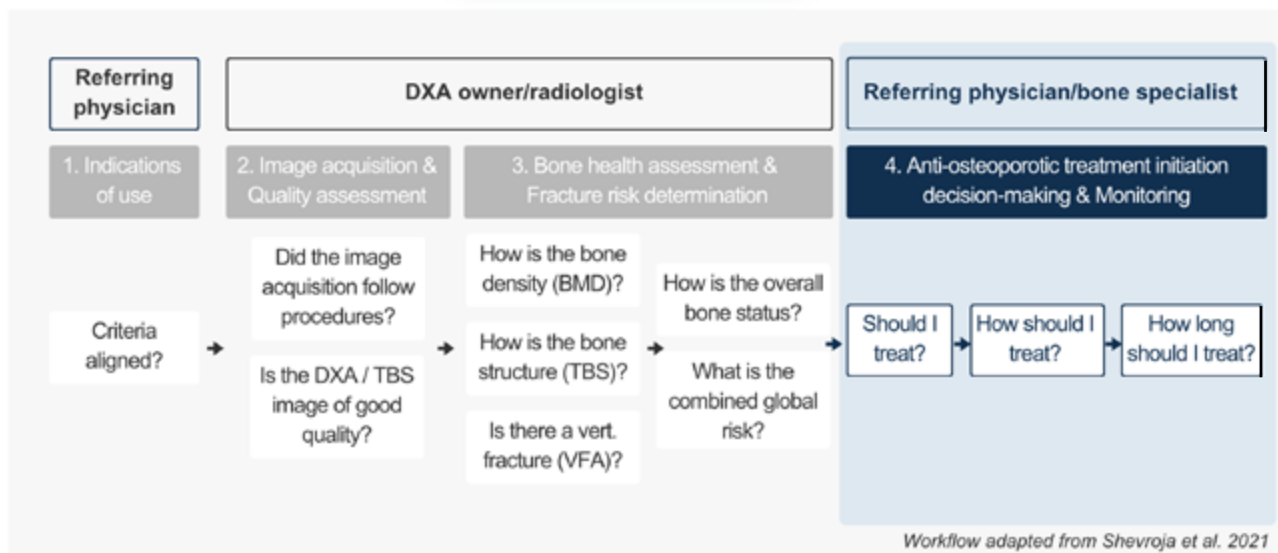
Note: In presence of osteopenia and fragility fracture(s), patients should be treated, irrespective of TBS and BMD.

Bone health assessment

- In the assessment of bone health, TBS can be used alongside BMD to provide additional information relating to bone microarchitecture;
- The 'Bone Resilience Index' is an interpretive tool provided by the manufacturer, comprising combinations of categories of BMD (normal, osteopenic or osteoporosis) and TBS (normal, partially degraded or degraded);
- Discordance between BMD and TBS (for example, normal BMD and degraded TBS), should prompt consideration of further clinical evaluation for possible causes of secondary osteoporosis;
- Vertebral fracture assessment (VFA) should be considered for osteopenic patients with degraded TBS.

Fracture risk determination

- TBS can be used in the assessment of fracture risk using FRAX-adjusted for TBS directly OR indirectly by using the femoral neck BMD T-score-adjusted for TBS, but not both, to avoid over-adjustment for TBS;
- FRAX-adjusted for TBS can be used to adjust the probability of MOF or hip fracture, for bone microarchitecture, in men and women aged 40 to 90 years. The adjusted FRAX probabilities can then be compared to local or national intervention thresholds;
- In countries and regions where BMD T-score is the primary measure for assessment and reimbursement, BMD T-score-adjusted for TBS can be used;
- BMD T-score-adjusted for TBS can be used in fracture prediction models other than FRAX;
- The lowest adjusted T-score (lumbar spine, total hip or femoral neck) is used for diagnosis;
- Other approaches might include BMD Z-score (age 20 to 49 years) and the risk threshold adjustment (or treatment threshold shift) referring to the lowest BMD T-score adjusted for TBS Z-score;
- The selected approach should reflect patient age and country or region-specific guidelines.



Note: In presence of osteopenia and fragility fracture(s), patients should be treated, irrespective of TBS and BMD.

Treatment initiation, decision-making and monitoring

- FRAX-adjusted for TBS or BMD T-score adjusted for TBS can be used to inform treatment initiation, in conjunction with country or region-specific treatment intervention thresholds;
- The greatest utility of either TBS adjustment is for individuals who are close to a FRAX or BMD T-score treatment intervention threshold;
- Patients with low TBS who lie below but near the treatment threshold should be considered for an earlier assessment and lifestyle advice;
- FRAX-adjusted for TBS can be used to guide the choice of anti-osteoporosis treatment in the framework of ESCEO-IOF recommendations on categorization to low, high or very high fracture risk (with the latter category directed to anabolic first regimens);
- Since TBS captures elements of bone microarchitecture, conceptually, a low (degraded or partially degraded) TBS might support the use of treatments that impact both BMD and bone microarchitecture, for example, long-term denosumab or bone anabolic agents;
- Conversely, bisphosphonates, SERMs and MHT might be considered if the treatment goal is preservation of TBS;
- Least significant change (LSC) should be used to interpret treatment effect at the individual level, based on the center-specific precision error;
- The average of published TBS precision errors and corresponding LSCs (Hologic and GE systems) are 1.37%CV and 3.79% respectively.
- If a patient has a significant reduction (exceeding LSC) in TBS during treatment, consider causes of secondary osteoporosis and if an alternative treatment is required;
- If a patient has a significant increase (exceeding LSC) in TBS and/or BMD during treatment while not expected given the given drugs and their associated mechanism of action, check for possible technical inaccuracies.

References

The content of this document is adapted from the article by the International Expert Working Group of the ESCEO-IOF, under the auspices of WHO Collaborating Centre for Epidemiology of Musculoskeletal Health and Aging, published in Osteoporosis International.

The cited article (Shevroja et al., 2023. Osteoporosis International) is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License. The full reference of the original article, including author(s) is:

Shevroja E, Reginster JY, Lamy O, et al. Update on the clinical use of trabecular bone score (TBS) in the management of osteoporosis: results of an expert group meeting organized by the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases (ESCEO), and the International Osteoporosis Foundation (IOF) under the auspices of WHO Collaborating Center for Epidemiology of Musculoskeletal Health and Aging. *Osteoporos Int.* 2023;34:1501-1529. <https://doi.org/10.1007/s00198-023-06817-4>.



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We understand bone health

Founded by medical practitioners and clinical researchers, Medimaps combines Swiss innovation with a global presence to lead in bone health management. We provide healthcare professionals worldwide with advanced AI-driven software that enables comprehensive bone microarchitecture assessment.

Our passion for musculoskeletal health is underpinned by scientific knowledge, collaborations with world-class academics, clinicians, industry partners, and direct patient engagement. The science behind our cutting-edge imaging applications and clinical evidence forms the core of our company's DNA.



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