

Integrated Trabecular Bone Score: Introducing TBS 3.1

Osteoporosis is the most common chronic metabolic bone disease, characterized by low bone density. It is estimated that more than 200 million people are at higher risk of fracture due to this disease.¹

Integrated TBS 3.1 provides:

- New clinical decision tools, especially helpful for patients with borderline BMD T-scores
- Visual assessment tools, including a new “Bone Resilience Index”
- Faster reporting workflow, with automated (and editable) conclusions

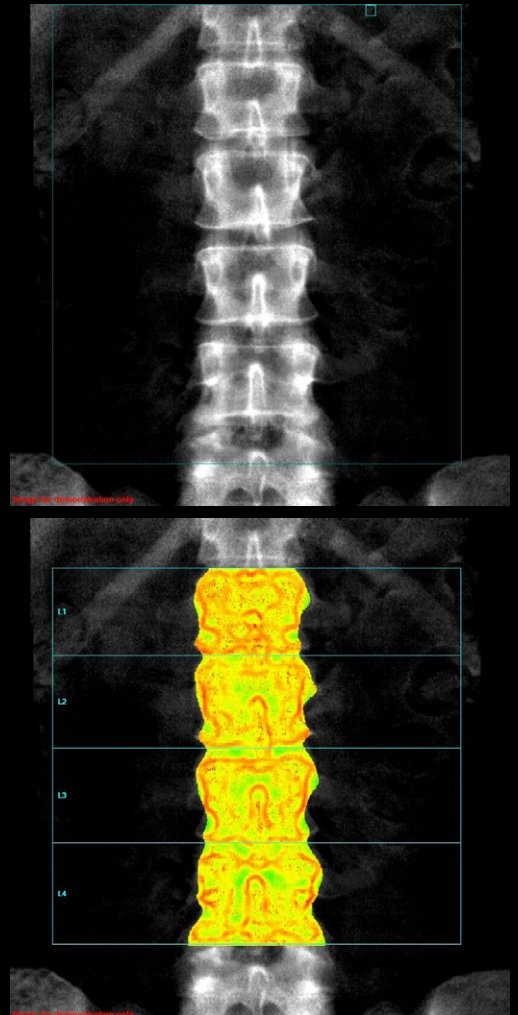
The value of TBS in evaluating fracture risk

An FDA cleared software with TBS functionality, Integrated TBS uses DXA scans to estimate bone texture and assess bone micro-architecture, providing additive information to bone mineral density (BMD). TBS is a separate risk factor from bone density that measures bone quality and research suggests that it adds to DXA in predicting patients whose bones are at risk of fracture due to diseases or medications they are taking.

Introducing Integrated TBS 3.1

TBS 3.1 has been updated with new tools and reporting added including:

- A skeletal status assessment table was added, providing a “Bone Resilience Index” that visually shows the combined BMD T-score and TBS categories.
- New therapeutic decision tools have been introduced, including TBS adjusted FRAX[®] and TBS adjusted BMD T-score. These tools can be helpful since different drugs may impact bone density and bone micro-architecture differently.
- For quicker workflow, automated conclusions are now included in the report, providing conclusions based on medical society guidelines. These have been developed by clinicians and key opinion leaders in the field and are easily editable.



NEW Bone Health Report

1 TBS Mapping:

Visualizes local TBS values using a color scale; well-structured cancellous bone is in green and poorly structured is in red

3 Skeletal Status Assessment:

Overall fracture risk for patient is displayed on a color-coded grid

2 TBS Results for Selected Region:

Graph comparing patient results to a normal population

4 Therapeutic Decision Tools:

Combining TBS with BMD for an adjusted T-score, and with FRAX² for an adjusted risk of fracture

GE HealthCare
3030 Ohmeda Drive, Madison, WI 53718
Phone: () - - -

Patient: BMD_Med_TBS_Low,		Referring Physician:	
Birth Date: 2/4/1951	Age: 66.1 years	Patient ID:	
Height: 62.2 in.	Weight: 112.9 lbs.	Measured: 3/13/2017 3:21:31 PM (16)	
Sex: Female	Ethnicity: White	Analyzed: 1/8/2023 9:11:05 PM (18 (SP 5))	

BONE HEALTH REPORT

1 TBS Mapping

2 TBS Spine Results

TBS L1-L4 = 1.165 - Degraded microarchitecture
Note: Not Calibrated

3 Skeletal Status Assessment

Osteoporosis is a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture.¹

The TBS is derived from the texture of the DXA image and has been shown to be related to bone microarchitecture and fracture risk. It provides information independent of BMD.

For purpose of clarity, "bone resilience index" is defined as the combination of BMD T-score and TBS categories. The zones of Bone Resilience are established based upon level of fracture risk.²

		BMD T-score*		
		Normal	Osteopenia	Osteoporosis
TBS**	Normal	Normal	Moderate	Low
	Partially Degraded	Normal	Moderate	Low
	Degraded	Normal	Moderate	Low

* BMD T-score is the min value of spine, total hip, and femoral neck.
** Spine TBS L1-L4 Normal microarchitecture > 1.310; Degraded <= 1.230

Normal
Moderate
Low
Severely Low

Color coded Bone Resilience Zones based on Fracture Risk³

4 Therapeutic Decision Tools

The FRAX 10-year probability of fracture:

Type of Fracture	Risk	Risk Adjusted for TBS*
Major Osteoporotic	16.7 %	19.3 %
Hip	3.6 %	4.5 %

* Validated only for Caucasian and Asian women and men.⁴ Refer to local guidelines before using these values.
Reported Risk Factors besides BMD: Family Hist. (Parent hip fracture), History of Fracture (Adult)
⁴ Calcif Tissue Int. 96, 500-509 (2015)

The BMD T-score:

Bone Site	BMD T-score	BMD T-score adjusted for TBS ⁵
AP Spine: L1-L4	-2.2	-3.2
Left Femur: Neck	-2.3	-2.7
Left Femur: Total	-2.2	-2.6

⁵ Validated for Caucasian women only.
The grayed cell is the minimum value.

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5 Detailed Spine Results:

Combining BMD and TBS for all ROI

6 Conclusion:

Automatically populates patients results together with recommendations, which can be edited as needed

GE HealthCare
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Patient: BMD_Med_TBS_Low,		Referring Physician: (not specified)	
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BONE HEALTH REPORT

5 Detailed Spine Results

Region	TBS		BMD	
	TBS	Z-score	BMD (g/cm2)	T-score
L1	1.084	-	0.876	-2.1
L2	1.083	-	0.915	-2.4
L3	1.259	-	0.940	-2.2
L4	1.236	-	0.927	-2.3
L1-L2	1.083	-1.4	0.895	-2.2
L1-L3	1.142	-1.1	0.912	-2.1
L1-L4	1.165	-1.2	0.917	-2.2
L2-L3	1.171	-1.4	0.929	-2.3
L2-L4	1.193	-1.1	0.928	-2.3
L3-L4	1.248	-0.8	0.934	-2.2
L1-L3 (L2)	1.171	-0.7	0.911	-2.1
L1-L4 (L2)	1.193	-0.8	0.917	-2.1
L1-L4 (L2,L3)	1.160	-0.8	0.905	-2.2
L1-L4 (L3)	1.134	-1.3	0.908	-2.2
L2-L4 (L3)	1.159	-1.3	0.922	-2.3

6 Conclusion

The Lumbar spine TBS is 1.165 which suggests a degraded microarchitecture compared to reference population.

The patient's associated BMD and TBS values suggest a Low resilience to fracture.

Furthermore, the minimum BMD T-Score (either adjusted or not for TBS), positions the patient in the Osteoporosis category equivalent.

The patient's FRAX results should be interpreted in regard to the intervention thresholds provided by national medical guidelines.

Final decision regarding diagnostic or therapeutic recommendations should include BMD, TBS, additional clinical risk factors as well as the clinical context of the patient.

7 Notes & References

TBS Version: 3.1.0

¹ Consensus Development Conference. Am J Med 94, 646-650 (1994)
² Adapted from J Bone Miner. Res. 26, 2762-2769 (2011)
³ Adapted from Osteoporosis Int. 29, 751-758 (2018)

Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm2) for AP Spine L1-L4 BMD; T-score USA (Combined NHANES ages 20-30) / Lunar (ages 20-40) AP Spine; Female, White Reference Population (±1SD); T-score USA (Combined NHANES ages 20-30) / Lunar (ages 20-40) Femur; Female, White Reference Population (±1SD); World Health Organization - Definition of Osteoporosis and Osteopenia for Caucasian Women: Normal = T-score at or above -1.0 SD; Osteopenia = T-score between -1.0 and -2.5 SD; Osteoporosis = T-score at or below -2.5 SD; BMDs additional only apply when a young healthy Caucasian Women reference database is used to determine T-scores; FRAX Version 4.1; The 10 year probability of fracture may be lower than reported if the patient has received treatment; Major Osteoporotic Fracture: Clinical Spine, Forearm, Hip or Shoulder; The TBS is derived from the texture of the DXA image and has been shown to be related to bone microarchitecture and fracture risk; This data provides information independent of BMD value; it is used as a complement to the data obtained from the DXA analysis and the clinical examination; TBS Z-score Reference Population: European (Medmaps) - White; The TBS score can assist the health care professional in the assessment of fracture risk and in monitoring the effect of treatments on patients across time; Overall fracture risk will depend on many additional factors that should be considered before making diagnostic or therapeutic recommendations; The software does not diagnose disease or recommend treatment regimens. Only the health care professional can make these judgments; TBS version 3.1.0. Before accepting this report, the user is held accountable for ensuring that the DXA examination has been carried out: 1) by the osteoradiologist; GE Lunar iDXA (BMD >1046); 2) after the latest TBS calibration; Not Calibrated. Since the system has not been calibrated using TBS Phantoms, the results must not be used for diagnostic purpose.

Date created: 1/11/2023 12:40:14 PM (SP 5); Filename: bmd_med_tbs_low.mcx; AP Spine: 1002.50:50.00:0.00:7.62:0.30x25:18.6%Fat+13.7%; 0.00:0.00:0.00:0.00; Scan Mode: Standard; 146.0 µJy; 4.57 cGy/cm2; Left Femur: 1002.30:50.00:6.0:0.00:11.82:0.30x25:16.6%Fat+24.1%; 0.00:0.00:0.00:0.00; Neck Angle (deg)= 50; Scan Mode: Standard; 146.0 µJy; 4.50 cGy/cm2.

GE HealthCare Page: 2 of 2 Lunar iDXA

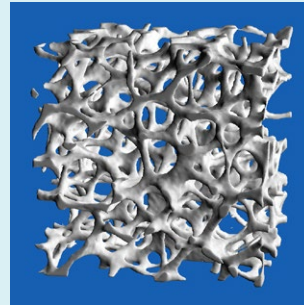
Studies have shown that the addition of TBS can help clinicians predict major osteoporotic fractures (MOF) of the hip, spine, upper arm and wrist, better than using DXA alone.^{3,4}

“We have one osteoporotic fracture every three seconds.⁵ And more than 50 percent of major osteoporotic fractures occur in a non-osteoporotic zone.⁶ That’s why knowing both the bone density and structure—the quantity and the quality of the bone is important. Combining these, we more accurately predict fracture risk and can have the best outcomes for our patients.”

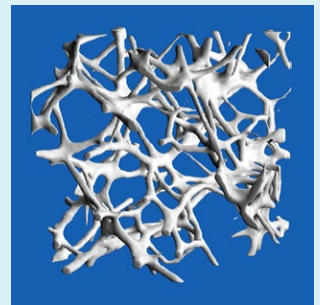
– **Didier Hans**, Professor and Co-Director of the Center of Bone Diseases, Bone and Joint Department at Lausanne University Hospital and University of Lausanne, Switzerland



Systemic skeletal disease characterized by low bone mass and a micro-architectural deterioration of bone tissue...leading to fracture



Normal



Osteoporotic

TBS is a clinical tool to help understand bone architecture

To access online learning about Integrated TBS and how to use it, [click here](#).

To learn more about GE HealthCare’s bone and metabolic health solutions, [click here](#).

1. Sözen T, Özışık L, Başaran NÇ. An overview and management of osteoporosis. Eur J Rheumatol. 2017;4(1):46-56. doi:10.5152/eurjrheum.2016.048. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5335887/>.

2. <https://www.sheffield.ac.uk/FRAX/>.

3. Hans D, Goertzen AL, Krieg MA, Leslie WD. Bone microarchitecture assessed by TBS predicts osteoporotic fractures independent of bone density: the Manitoba study. J Bone Miner Res. 2011 Nov;26(11):2762-9. doi: 10.1002/jbmr.499. PMID: 21887701. <https://pubmed.ncbi.nlm.nih.gov/21887701/>.

4. Shevroja E, Lamy O, Kohlmeier L, Koromani F, Rivadeneira F, Hans D. Use of Trabecular Bone Score (TBS) as a Complementary Approach to Dual-energy X-ray Absorptiometry (DXA) for Fracture Risk Assessment in Clinical Practice. J Clin Densitom. 2017 Jul-Sep;20(3):334-345. doi: 10.1016/j.jocd.2017.06.019. Epub 2017 Jul 19. PMID: 28734710.

5. Tomasevic-Todorovic S, Vazic A, Issaka A, Hanna F. Comparative assessment of fracture risk among osteoporosis and osteopenia patients: a cross-sectional study. Open Access Rheumatol. 2018;10:61-66. Published 2018 May 30. doi:10.2147/OARRR.S151307. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5985792/>.

6. Warriner AH, Patkar NM, Curtis JR, et al. Which fractures are most attributable to osteoporosis? J Clin Epidemiol. 2011;64(1):46-53. doi:10.1016/j.jclinepi.2010.07.007. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5030717/>.



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