

Bone Biopsy and DXA for Decision-Making in Cancer Patient Management

Endocrinologists are collaborating with radiologists and oncologists at Penn Medicine to perform metabolic bone biopsy and dual-energy x-ray absorptiometry (DXA) to assist in decision-making for the management of cancer patients.

As many as 70% of persons with advanced breast cancer or prostate cancer will have bone metastases as a complication of malignancy, as will between 15% and 30% of individuals with cancers of the lung, colon, stomach, bladder, uterus, rectum, thyroid or kidney.

Metabolic bone biopsies are available only at very specialized medical centers, because their use requires extensive clinical training on the part of endocrinologists, as well as the presence of trained oncologic orthopedists to obtain bone specimens, and pathologists with the expertise to interpret them.

At the Penn Bone Center, as elsewhere, metabolic bone biopsies are used to guide therapy by determining bone turnover rate and qualitative defects in bone cells. It should be noted that metabolic bone biopsies are not used to interpret metastatic lesions.

A second investigative tool, DXA plays an instrumental role in the management of cancer patients as an assessment of bone mineral density, which can be depleted by both chemotherapy and radiotherapy. In these populations, DXA assessment can be used to alter these therapies. DXA is available at most Penn Radiology sites.

CASE STUDY

In March 2015, Mr. Z, a 26-year-old man with no significant prior medical problems presented to a local emergency department complaining of severe back pain that began, he reported, after shoveling snow a few months before.

Mr. Z denied falls or accidents. His discomfort had worsened over time to the extent that he developed shortness of breath and was starting to hunch over in pain. He also reported a height loss of ~4 inches over the previous months. Imaging at this time reported a 15cm tumor in the liver and multiple fractures in the thoracic and lumbar spine (Figure 1).

A biopsy of the tumor yielded a diagnosis of hepatocellular carcinoma. Subsequently, Mr. Z underwent resection of the liver tumor, chemotherapy and extensive testing, including a comprehensive genetic profile assessment.

Mr. Z was then referred to Penn Endocrinology, where he was evaluated by Dr. Amna Khan in January 2016 for his spontaneous spinal fractures. Following a DXA, which found low bone mineral density and a very low trabecular score consistent with osteoporosis, Mr. Z received a metabolic bone biopsy, which reported a low turnover state (see APPENDIX, pgs. 2-3).

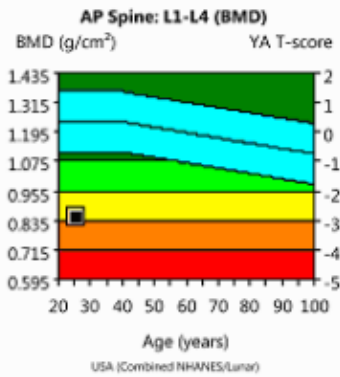
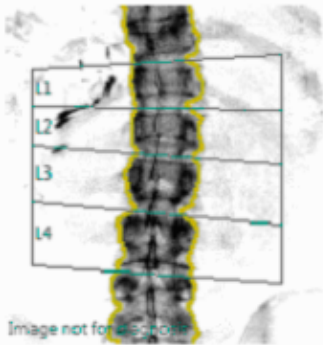
Mr. Z's regimen was then altered to include a medication that would increase bone turnover. He completed 2 years of this therapy with robust gains in bone density and skeletal quality, as demonstrated by improved trabecular bone score (see APPENDIX pgs 4-5) and without additional fractures. Today, more than five years after his original diagnosis, Mr. Z remains in the community and continues to pursue follow-up care.



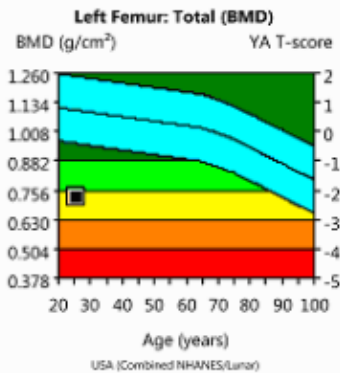
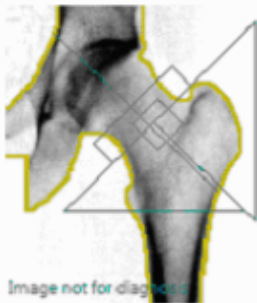
Figure 1: Sagittal T2-weighted images demonstrating multilevel vertebral compression fractures most severe at T6 and T11 with ~50% loss of vertebral body height. No bony retropulsion or evidence of cord compression. No marrow signal abnormality to suggest an acute fracture.

APPENDIX

	Measured: 11/09/2017 11:59:18 AM (16 [SP 2]) Analyzed: 11/09/2017 12:02:11 PM (16 [SP 2])
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Region	BMD (g/cm ²)	YA T-score	AM Z-score
L1	0.756	-3.1	-3.4
L2	0.770	-3.6	-4.0
L3	0.877	-2.7	-3.1
L4	0.954	-2.1	-2.4
L1-L4	0.851	-2.8	-3.1



Region	BMD (g/cm ²)	YA T-score	AM Z-score
Neck	0.791	-1.8	-2.3
Total	0.726	-2.2	-2.6

Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm² for AP Spine L1-L4); (± 0.012 g/cm² for Left Femur Total); T-score: USA (Combined NHANES (ages 20-30) / Lunar (ages 20-40)) AP Spine, Female, White Reference Population (y113); T-score: USA (Combined NHANES (ages 20-30) / Lunar (ages 20-40)) Femur, Female, White Reference Population (y113); Z-score: AP Spine Matched for Age, Sex, Ethnic; Z-score: Left Femur Matched for Age, Sex, Ethnic; World Health Organization - Definition of Osteoporosis and Low Bone Mass for Caucasian Women: Normal = T-score at or above -1.0 SD; Low Bone Mass = T-score between -1.0 and -2.5 SD; Osteoporosis = T-score at or below -2.5 SD; (WHO definitions only apply when a young healthy Caucasian Women reference database is used to determine T-scores)
 Date created: 11/09/2017 12:06:19 PM 16 [SP 2]; Filename: cst5zo4j7.mxc; AP Spine: 100:2.50:50.00:6.0 0.008.52 0.30x0.25 18.3%Fat=5.6%; 0.00:0.00 0.00:0.00; Scan Mode: Standard;OneScan: 146.0 µGy; Left Femur: 100:0.63:50.00:6.0 0.00:10.38 0.30x0.25 14.1%Fat=18.7%; 0.00:0.00 0.00:0.00; Neck Angle (deg)= 45; Scan Mode: Thin: 37.0 µGy

APPENDIX



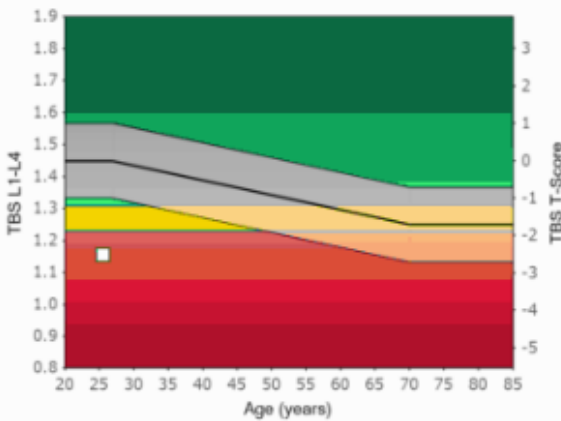
Patient ID: 8330651175
 Acquisition date: 11/09/2017
 Prescribing doctor: AMNA KHAN

SPINE TBS REPORT

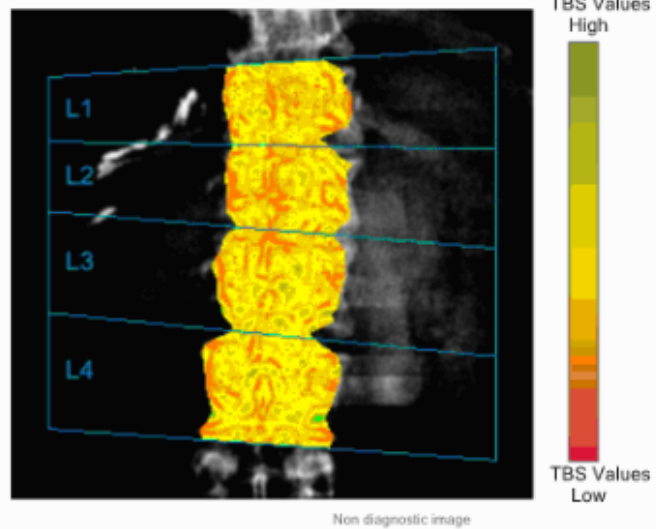
TBS reference graph

Reference population: USA (NHANES / Medmaps)

TBS L1-L4: 1.156



TBS Mapping



Non diagnostic image

Additional results

Region	TBS	TBS T-Score	TBS Z-Score	BMD	BMD T-Score
L1	1.093	---	---	0.756	-3.1
L2	1.087	---	---	0.770	-3.6
L3	1.205	---	---	0.877	-2.7
L4	1.239	---	---	0.954	-2.1
L1-L4	1.156	-2.5	-2.5	0.851	-2.8
L1-L3	1.129	-2.8	-2.8	0.806	-3.1
L1-L2	1.090	-2.9	-2.9	0.763	-3.4
L2-L3	1.146	-2.9	-2.9	0.828	-3.1
L2-L4	1.177	-2.5	-2.5	0.877	-2.7
L3-L4	1.222	-2.1	-2.1	0.918	-2.4

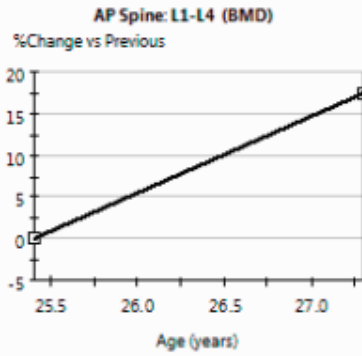
FRAX

Comments

 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.
 The TBS score can assist the health care professional in 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.
 Date of analysis: 11/14/2017 - TBS version : 3.0.2.0 - DXA : GE-Lunar iDXA #212011 - DXA file: "cst5zo4j7.mex"
 Before accepting this report, the user is held accountable for ensuring that the DXA examination has been carried out:
 - by the osteodensitometer GE-Lunar iDXA (# 212011)
 - after the latest TBS INsight calibration, the 11/10/2017 2:47:55 PM.

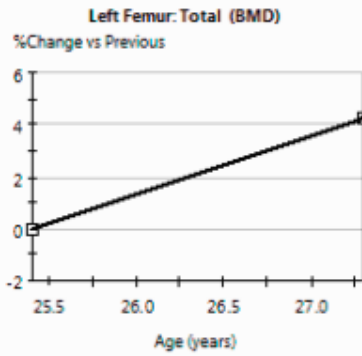
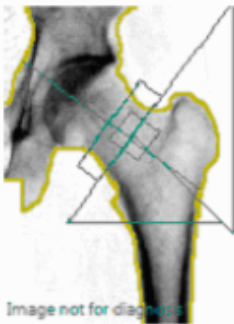
APPENDIX

	Measured: 09/11/2019 1:56:30 PM (17 [SP 1]) Analyzed: 09/11/2019 1:58:16 PM (17 [SP 1])
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Trend: L1-L4

Measured Date	Measured Age	BMD (g/cm ³)	Change vs Previous (g/cm ³)	Change vs Previous (%)
09/11/2019	27.3	0.999	0.148*	17.4*
11/09/2017	25.4	0.851	-	-



Trend: Total

Measured Date	Measured Age	BMD (g/cm ³)	Change vs Previous (g/cm ³)	Change vs Previous (%)
09/11/2019	27.3	0.757	0.031	4.3
11/09/2017	25.4	0.726	-	-

(*) Indicates significant change based on 95% confidence interval. (LSC= 0.028 g/cm³ for AP Spine L1-L4); (LSC= 0.033 g/cm³ for Left Femur Total); Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm³ for AP Spine L1-L4); (± 0.012 g/cm³ for Left Femur Total)
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APPENDIX

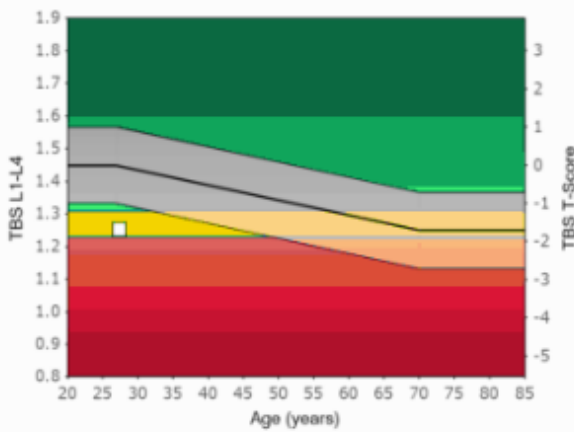
Patient ID: 8330651175
 Acquisition date: 09/11/2019
 Prescribing doctor: AMNA KHAN

SPINE TBS REPORT

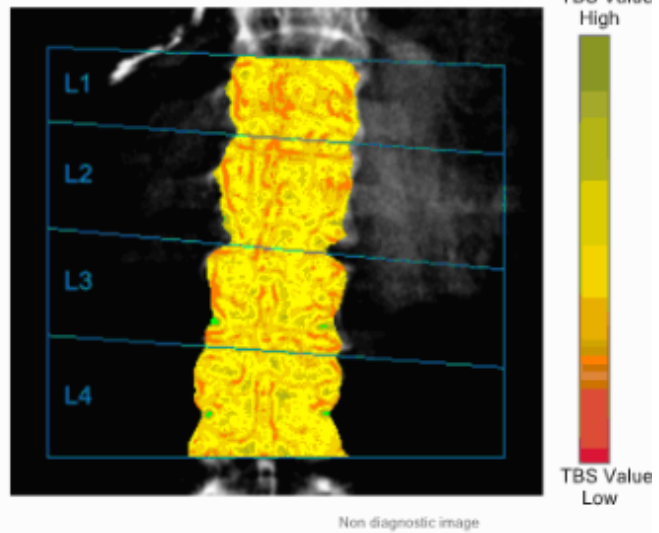
TBS reference graph

Reference population: USA (NHANES / Medmaps)

TBS L1-L4: 1.254



TBS Mapping



Additional results

Region	TBS	TBS T-Score	TBS Z-Score	BMD	BMD T-Score
L1	1.121	---	---	0.885	-2.1
L2	1.235	---	---	0.992	-1.8
L3	1.282	---	---	1.121	-0.8
L4	1.378	---	---	0.974	-1.9
L1-L4	1.254	-1.7	-1.7	0.999	-1.6
L1-L3	1.212	-2.1	-2.1	1.009	-1.4
L1-L2	1.178	-2.2	-2.2	0.946	-1.9
L2-L3	1.258	-2.0	-2.0	1.056	-1.3
L2-L4	1.298	-1.5	-1.5	1.026	-1.5
L3-L4	1.330	-1.2	-1.1	1.042	-1.4

FRAX

Comments

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. The TBS score can assist the health care professional in 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. Date of analysis: 09/11/2019 - TBS version : 3.0.2.0 - DXA : GE-Lunar iDXA #212011 - DXA file: "zrhoxp4j7.mex" Before accepting this report, the user is held accountable for ensuring that the DXA examination has been carried out: - by the osteodensitometer GE-Lunar iDXA (# 212011) - after the latest TBS iNsign calibration, the 11/10/2017 2:47:55 PM



FACULTY TEAM

The endocrinologists at Penn Bone Center are committed to assessment and treatment of patients with osteoporosis and metabolic bone disorders.

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