Bone quality, as measured by Trabecular Bone Score (TBS), in patients with primary hyperparathyroidism (PHPT).

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INTRODUCTION PHPT leads to bone loss and increased fracture risk, particularly pronounced at sites rich in cortical bone. However, although trabecular bone mass at spine seems relatively preserved, the risk of vertebral fractures (VFx) is increased. Therefore, the reduction of bone mineral density (BMD) at spine does not completely explain the increased fractures risk, and the deterioration of bone quality has been advocated as a contributor.

The **Trabecular Bone Score** (**TBS**) is a grey-level texture measurement based on the use of experimental variograms of 2D projection images acquired during a DXA lumbar spine scan. It may be used for the routine evaluation bone micro-architecture, as it is strongly correlated with bone micro-architecture, regardless of BMD

AIM OF THE STUDY evaluate the usefulness of TBS alone or in combination with BMD for predicting VFx in PHPT patients before and after surgery or a conservative follow up.

PATIENTS **92 PHPT patients** (18 eugonadal F and 74 post-menopausal F, aged 62.7±10.1 years, BMI 26.2±4.5 kg/m2) consecutively referred to our Centre between Jan-2010 and Dec-2012, and 98 age-, gender- and BMI matched controls referred for multinodular goiter with normal thyroid function.

METHODS In all subjects: TBS and BMD (at lumbar spine, LS and femoral neck, FN) were measured and reported as Z-scores; asymptomatic vertebral fractures (VFx) were assessed by radiograph and the spinal deformity index (SDI) was calculated. Among the 92 PHPT patients, we also report the available longitudinal BMD, TBS and VFx data after 24 months of follow-up for 20 subjects operated on and for 10 conservatively treated.

RESULTS *Cross-sectional arm*

- The **bivariate correlation analysis** showed that **TBS was associated with LS-BMD (R=0.27, P=0.011) and SDI (R= -0.31, P=0.003)** and not with any parameter of calcium metabolism, BMI or years since menopause.
- the **logistic regression analysis** showed that the **presence of a VFx was associated with TBS (OR 1.4, 95%CI 1.1-1.9, P=0.02),** regardless of LS-BMD (OR 1.2, 95%CI 0.7-1.9, P=0.52), age (OR 1.0, 95%CI 0.9-1.1, P=0.11), BMI (OR 1.0, 95%CI 0.9-1.2, P=0.6) and gender (OR 2.9, 95%CI 0.8-11.1, P=0.12).

Diagnostic accuracy of low-TBS and low-BMD (alone or in combination) for detecting PHPT patients with prevalent VFx

Parameters of HPA axis activity	Sensitivity	Specificity	Accuracy	p
Low TBS	75	61.5	67.4	<0.0001
Low LS-BMD	75	30.8	50	0.542
Low FT-BMD	72.5	44.2	56.5	0.099
Low FN-BMD	70	50	58.7	0.05
Low TBS *plus* low LS-BMD	60	67.3	64	0.009
Low TBS *plus* low FT-BMD	47.5	80.8	66.3	0.004
Low TBS *plus* low FN-BMD	52.5	86.5	71,7	<0.0001
Low TBS *plus* low BMD at any site	62.5	65.4	64	0.008
Low TBS or low LS-BMD	90	25	53.3	0.103
Low TBS or low FT-BMD	95	23.1	54.3	0.02
Low TBS or low FN BMD	95	28.8	57.6	0.006

38 out of the 40 fractured PHPT patients had at least low TBS and/or low FT- or FN-BMD

** Low TBS=≤ -2.0, low BMD=≤-0.3 (LS), -0.2 (FT), -0.6 (FN) (defined on the basis of the cut-offs with the best compromise between SE and SP obtained by ROC analysis).*

Clinical characteristics PHPT and controls

	Controls (n=98)	PHPT (n=92)	P
Age (yrs)	62.1±9.7 (45.6 – 80.0)	62.7±10.1 (40.0 – 82.0)	0.670
BMI (kg/m²)	27.0±3.8 (20.5 – 36.4)	26.2±4.5 (19.0 – 35.0)	0.253
Females/Males	81/17 (82.7/17.3)	74/18 (80.4/19.6)	0.712
YSM (years)	13.6±9.2 (1.0 – 33.0)	13.5±8.6 (1.0 – 31.5)	0.99
25-hydroxyvitamin D (ng/mL)	27.6±9.2 (16.5 – 65.8)	28.4±11.7 (4.8 - 63.0)	0.631
PTH (pg/ml)	48.4±14.4 (16.1 – 79)	151.5±105.9 (42 – 638)	<0.0001
Serum Calcium (mg/dL)	9.2±0.4 (8.5 – 10.2)	11.2±0.8 (10.4 – 15.4)	<0.0001
Urinary Calcium 24 h (mg/day)	169.2±70.6 (70 – 318.5)	323.6±176.1 (100 – 1118)	<0.0001
Urinary Calcium 24 h/kg (mg/day)	2.5±1.0 (1 – 4)	4.8±2.5 (1.2 – 16.00)	<0.0001
Creatinine Clearance (ml/min)	–	88.2±22.3 (50 – 144)	–
LS-BMD (Z-score)	0.51±1.46 (-2.00 – 4.10)	-0.73±1.14 (-3.80 – 2.80)	<0.0001
FT-BMD (Z-score)	0.22±0.83 (-1.50 – 2.10)	-0.48±0.93 (-2.50 – 1.40)	<0.0001
FN-BMD (Z-score)	0.05±0.85 (-2.60 – 2.70)	-0.69±0.84 (-2.50 – 1.90)	<0.0001
TBS (Z-score)	-0.98±1.07 (-2.51 – 1.99)	-2.39±1.79 (-6.55 – 1.97)	<0.0001
No. of patients with VFx	8 (8.2)	40 (43.5)	<0.0001
Spinal Deformity Index	0.09±0.32 (0 – 2)	1.03±1.79 (0 – 9)	<0.0001

Longitudinal arm

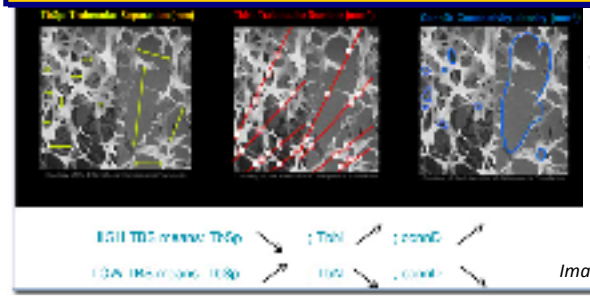
	Conservative Group (n=10)		Surgical Group (n=20)	
	Baseline	End of Follow up	Baseline	End of Follow up
Age (yrs)	72.3±7.7 (61 – 82)	74.3±7.7 (63 – 64)	58.8±8.4 (48 – 75)	60.9±8.4 (50 – 77)
BMI (kg/m²)	27.4±2.8 (22.3 – 30.9)	27.6±3.2 (20.6 – 30.7)	24.3±4.3 (19.6 –35)	24.6±4 (21 – 35)
25-hydroxyvitamin D (ng/mL)	34.2±14.3 (19 – 55)	34.4±15.7 (19 – 56)	26±5.8 (18 – 35)	35.8±10.1** (21 – 58)
PTH (pg/mL)	135.5±50.5 (86 – 202)	114.9±50.9 (78 – 218)	159±122 (59 – 620)	38±15.9*** (15 – 64)
Serum calcium (mg/dL)	10.6±0.1 (10.4 – 10.8)	10.5±0.2 (10.4 – 10.9)	11.1±0.6 (10.4 – 12.1)	9.1±0.3 (8.6 – 9.8)***
Urinary Calcium 24 h (mg)	296.7±104.6 (150 – 430)	237.1 ± 48.3 (200 – 350)	327.7±95 (206 – 497)	193.5±95.9 (100 – 472)***
Urinary Calcium 24 h/kg (mg/day)	4.3±1.15 (3 – 6.7)	3.6±1.25 (2.8 – 6.9)	4.7±6.2 (3.2 – 9)	2.5±3.*** (1.5 – 5.8)
Creatinine Clearance (ml/min)	4.3±1.2 (58 – 105)	3.6±1.1 (59 – 105)	86.6±15.8 (64 – 106)	92.8±17.9 (65 – 119)
LS-BMD (Z-score)	0.36±1.15 (-0.9 – 2.1)	0.38±1.18 (-0.9 – 2.4)	-1.12±1.29 (-3.8 – 2.1)	-0.69±1.12* (-2.6 – 2.6)
FT-BMD (Z-score)	-0.23±0.83 (-1.1 – 1.2)	-0.27±0.85 (-1.3 – 1.15)	-0.92±0.7 (-1.8 – 1.1)	-0.6±0.78*** (-1.6 – 1.4)
FN BMD (Z-score)	-0.19±0.85 (-1.0 – 1.2)	-0.1±0.87 (-1.0 – 1.5)	-1.19±0.71 (-2.1 – 0.5)	-0.78±0.71*** (-1.9 – 0.8)
TBS (Z-score)	-1.32±1.63 (-3.31 – 0.63)	-1.71±1.5 (-4.11 – 0.61)	-3.03±1.17 (-5.75 – -1.282)	-1.63±0.37*** (-3.68 – 1.6)
No. of patients with vertebral fractures (%)	3 (33.3)	6 (66.7) *	7 (65)	7 (65)
Spinal Deformity Index	0.3±0.5 (0 – 1)	0.6±0.5 (0 – 1)	1.25±1.37 (0 – 5)	1.25±1.37 (0 – 5)

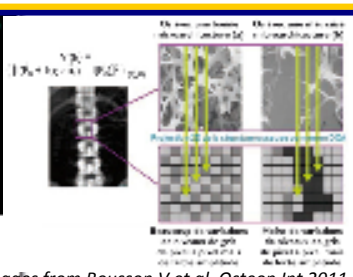
*** Conservative Group**

The 3 patients experiencing a VFx during the follow up had no VFx at baseline. These subjects were younger (64.3±2.4 years) than the 7 patients without new VFx (78.6±4 years, P<0.0001). Interestingly, in these patients, TBS decreased more than in the 7 patients without new fractures (TBS mean change -441.6±217.9% vs -9.3±39.4%, P=0.01), while the BMD changes were comparable.

CONCLUSIONS

1. TBS is reduced and associated with VFx regardless of BMD, age, BMI and gender;
2. TBS has higher diagnostic accuracy than BMD for detecting patients with VFx and may be used together with BMD to reach a better SN and SP;
3. after recovery TBS increases, while it decreases after a conservative follow up in patients experiencing new VFx.





Images from Bousson V et al. Osteop Int 2011