The Impact of Glucocorticoid Therapy on Trabecular Bone Score in Older Women

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RESEARCH QUESTION

Is TBS a useful tool for identifying older women at risk of glucocorticoid-induced osteoporosis as well as those with prevalent fractures?

BACKGROUND

Glucocorticoid therapy is associated with increased fracture risk that cannot be fully explained by decreased bone mineral density (BMD); this may be a consequence of alterations in the micro-architectural properties of bone. [1]

Trabecular Bone Score (TBS) has been developed as a tool with which to examine bone micro-architecture using 2D dual energy x-ray absorptiometry (DXA) images of the lumbar spine (Fig 1.). [2]

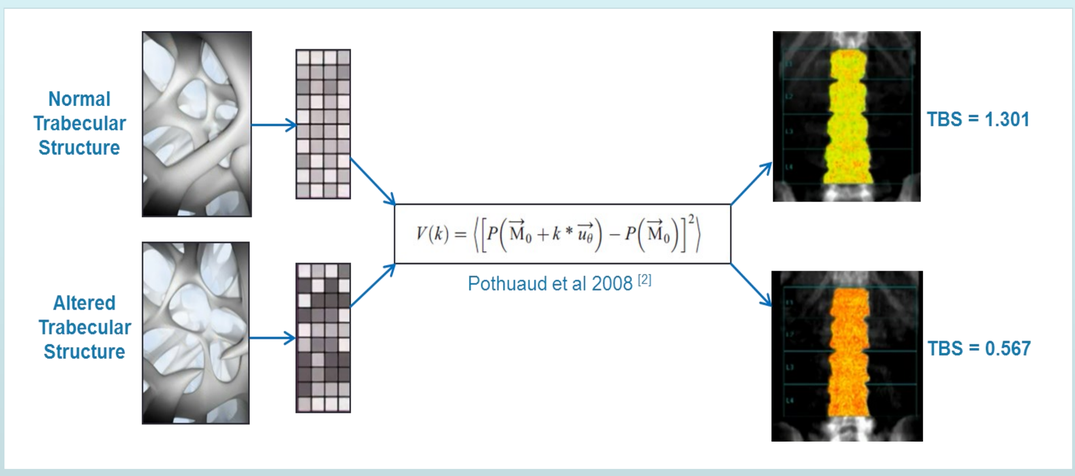

Fig 1. Calculation of TBS from 2D DXA images of the lumbar spine [2]

The aim of our study was to assess the ability of TBS to discriminate between glucocorticoid-treated women; women with prevalent fractures and healthy individuals.

METHODS

Study design:
We conducted a cross-sectional, observational study.

Participants:
Older women (n = 484, ages 55 to 79 years) were recruited from the local population.
Women had either:

(i) Taken prednisolone >5 mg/day (or equivalent) for >3 months (n = 64)
(ii) Sustained a recent fracture of the distal forearm (n = 46), proximal humerus (n = 37), vertebra (n = 30) or proximal femur (n = 28)

Or were:

(iii) Healthy population-based individuals without prevalent fractures (n = 279), not taking medications known to affect bone metabolism and without diseases known to cause osteoporosis

Densitometry:
Lumbar spine BMD (LS-BMD) was measured by DXA (Hologic QDR 4500A). TBS was calculated by examining pixel variations within the DXA images to produce grey -level texture measurements (TBS - Clinical Data Analysis software v1.6, Med-Imaps) (Fig.1.)

Statistical analysis:
Age-adjusted Z-scores (mean (95%CI)) for LS-BMD and TBS for (i) the glucocorticoid-treated women; (ii) the women in each fracture study sub-group; and (iii) healthy individuals, were calculated.

Differences between the study sub-groups was examined using ANOVA with post hoc Student-Newman-Kuels tests for pairwise comparisons.

The discriminatory ability, area under the curve (AUC) was determined using receiver operator characteristic (ROC) analysis for (i) BMD alone; (ii) TBS alone; and (iii) BMD + TBS (calculated using logistic regression). The AUCs were then compared using pairwise comparisons of ROC curves.
A $p<0.05$ indicated statistical significance.

OUTCOME MEASURES

- Lumbar spine BMD (in $g \cdot cm^{-2}$)
- TBS (in mm^{-1})

RESULTS

Table 1. Characteristics of (i) the healthy, population-based women, (ii) glucocorticoid-treated women, and (iii) those women who had sustained a recent fracture. All data are shown as mean ± SD.

	Study sub-group					
	Healthy population-based (*n*=371)	Glucocorticoid-treated (*n*=64)	Forearm Fracture (*n*=46)	Humerus Fracture (*n*=37)	Vertebral Fracture (*n*=30)	Hip Fracture (*n*=28)
Age (years)	67.7 ± 7.3	67.4 ± 7.5	68.3 ± 7.2	69.4 ± 6.1	70.6 ± 6.6	73.0 ± 6.0 *
Height (cm)	160.6 ± 6.5	159.3 ± 6.2	158.6 ± 6.4	158.7 ± 6.6	156.8 ± 6.8	159.4 ± 6.8
Weight (kg)	70.3 ± 12.3	72.9 ± 15.6	70.9 ± 15.2	71.0 ± 11.4	62.1 ± 16.1 †	66.0 ± 13.1
LS-BMD (g/cm^2)	0.927 ± 0.164	0.906 ± 0.182	0.872 ± 0.180	0.836 ± 0.142	0.704 ± 0.136	0.802 ± 0.150
TBS (mm^{-1})	1.122 ± 0.138	1.011 ± 0.152	1.071 ±0.141	1.014 ± 0.123	0.983 ± 0.130	1.036 ± 0.140

* = significantly older than those in the forearm fracture, steroid treated and healthy postmenopausal groups
† = significantly lower weight than those in the forearm and humerus fracture groups, the steroid treated group and the healthy postmenopausal groups.
Abbreviations: SD; standard deviation, *n*; number, LS-BMD; bone mineral density, TBS; trabecular bone score

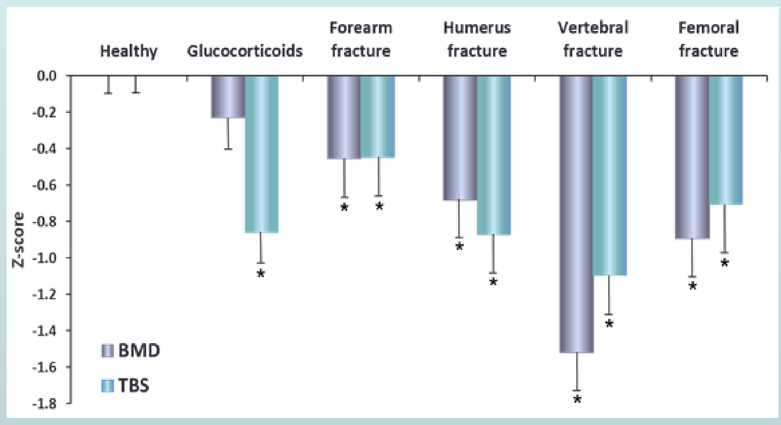

Fig 2. Z-scores (mean (95%CI)) for BMD and TBS for (i) healthy individuals; (ii) glucocorticoid- treated women; and (iii) women with prevalent fractures

Table 2. Discriminatory ability of BMD, TBS and BMD+TBS for prevalent fracture or glucocorticoid use

Study group	BMD		TBS		BMD + TBS	
	AUC	95%CI	AUC	95%CI	AUC	95%CI
Glucocorticoids	0.572	0.491 to 0.653	0.721*[a]	0.654 to 0.788	0.721*[b]	0.654 to 0.788
Forearm Fracture	0.641*	0.547 to 0.735	0.621*	0.535 to 0.707	0.622*	0.575 to 0.749
Humerus Fracture	0.689*	0.602 to 0.776	0.757*	0.679 to 0.834	0.753*	0.676 to 0.830
Vertebral Fracture	0.876*	0.818 to 0.935	0.802*	0.725 to 0.879	0.892*[c]	0.834 to 0.950
Hip Fractures	0.739*	0.643 to 0.834	0.696*	0.594 to 0.798	0.763*	0.675 to 0.852

*AUC different from 0.5 ($p<0.05$),
[a] AUC differs between BMD and TBS ($p=0.002$),
[b] AUC differs between BMD and BMD+TBS ($p=0.002$),
[c] AUC differs between TBS and BMD+TBS ($p=0.002$)

CONCLUSIONS

- BMD and TBS demonstrate similar discriminatory ability for recent fracture
- However, TBS appears to provide additional information regarding alterations in bone quality resulting from treatment with glucocorticoids
- BMD alone does not reveal such qualitative information

KEY STUDY FINDINGS

TBS, when used in conjunction with BMD, may be a useful tool for identifying women with glucocorticoid-induced osteoporosis and those with prevalent fractures.

REFERENCES

[1] Lekamwasam S et al. Osteoporos Int 2012, 23; 9: 2257-2276.
[2] Pothuaud L et al. Bone 2008, 42: 775-787.

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