COMPARISON OF DXL OF CALCANEUS, DXA OF SPINE AND HIP AND FRAX IN PATIENTS WITH VERTEBRAL FRACTURES AND FRAGILITY FRACTURES

Christian Muschitz[1], Roland Kocijan[1], Robert Fertl[1], Martin Laimer[1], Judith Haschka[1], Friederike Kühne[1], Miriam Putz[1], Vasilis Evdokimidis[2], Reinhart Waneck[2] and Heinrich Resch[1]

[1] St. Vincent Hospital, Medical Department II - The VINFORCE Study Group, Vienna, Austria
[2] St. Vincent Hospital, Department of Radiology, Vienna, Austria

KRANKENHAUS BARMHERZIGE SCHWESTERN Wien
EIN UNTERNEHMEN DER VINZENZ GRUPPE WIEN

Objectives:

Presently DXA measurements of spine and hip are diagnostic standard to identify patients who are at substatial risk for osteoporotic fracture. A T-score ≤ -2.5 at these measured sites is regarded as the diagnostic threshold for osteoporosis but BMD of the spine is often distorted by conditions such as scoliosis, osteoarthritis, degenerative conditions or compression fractures.

Calcaneal BMD obtained by DXL provides further information of BMD by a combination of DXA with a laser measurement of heel thickness. This technique allows separation of bone mineral, lean tissue and adipose tissue in a three component model instead of a two component model (BMD and soft tissue). The FRAX tool estimates the 10 year risk for major osteoporotic or hip fracture based on clinical risk factors with or without hip BMD.

Material & Methods:

This population-based study is comprised of 530 Caucasian patients (448 women, 82 men, age 66.2 ± 14.8 years). In 129 patients X-ray analysis of the spine revealed vertebral fractures, in 169 patients fragility fractures were reported by protocol and partly by X-ray. BMD (g/cm^2, T-score) of the calcaneus was obtained by DXL Calscan (Demetech AB) BMD of the spine and hip was measured by an iDXA device (GE Lunar). Fractures or degenerative vertebrae with a T-score deviation of ≥ 1SD of mean were excluded from the BMD calculation (Table 1).

The patient database was identical for both scanners.

The area under the receiver-operating curve (AUC) was calculated for each measurement site and scanner to show the ability of each scanner and measurement site to discriminate between fracture patients and the control group of 341 patients. The Austrian database was used for FRAX calculations.

101 patients were randomly assigned into a comparable subgroup to investigate the influence of the individual FRAX score in the prediction of fracture risk. Within this subgroup 32 patients had verified vertebral compression fractures. BMD data were implemented into the FRAX calculation tool as T-score of femoral neck and scanner specific producer's database (option: other manufacturer). To find an approach for DXL in the FRAX system we used the T-score of the heel instead of the T-score femoral neck.

Values	Vertebral fracture *n=131 (109 ♀/22♂)*	No vertebral fracture *n=399 (339♀/60♂)*
Population (years)	73.1 ± 12.2	66.2 ± 14.8*
Females (years)	74.2 ± 11.5	67.0 ± 14.7*
Males (years)	67.6 ± 14.3	61.6 ± 15.1*
DXL Heel	-2.67 ± 0.33	-1.92 ± 0.24**
L1 – L4 T-score	-2.04 ± 0.27	-1.51 ± 0.26**
Fem Neck T-score	-2.00 ± 0.23	-1.33 ± 0.24*
Total Hip T-score	-1.80 ± 0.22	-1.16 ± 0.23*
		*P <0.05 **P < 0.0001

Table 1: Patient specific data - Demographics

Results:

In the whole group of 530 patients the strongest correlation coefficient of the two measuring methods was found between DXL of the calcaneus and DXA of femoral neck (Table 2).

In identifying vertebral fracture patients the AUC results (T-score) of the calcaneus (0.70) were equal to the femoral neck (0.70), but the calcaneus and hip results were clearly superior to the vertebral results in the analysis of the female stratum (Table 3, Fig. 1).

T-Score	DXL Heel	L1-L4	L Tot Hip	L Fem Neck
DXL Heel		0.585*	0.689*	0.667*
L1- L4	0.585*		0.651*	0.617*
Left Total Hip	0.689*	0.651*		0.910*
Left Fem Neck	0.667*	0.617*	0.910*	
				*P < 0.0001 for all sites

Table 2: Scanning sites - correlation coefficients

T-Score	Females & Males AUC	Females & Males SD	Females AUC	Females SD
DXL calcaneus	0.70	0.026	0.72	0.028
DXA -total hip	0.69	0.027	0.70	0.029
DXA - fem neck	0.70	0.027	0.71	0.029
DXA - L1-L4	0.62	0.029	0.62	0.032
				AUC calculated with 95% CI

Table 3: Identification of vert FX patients (n=530)

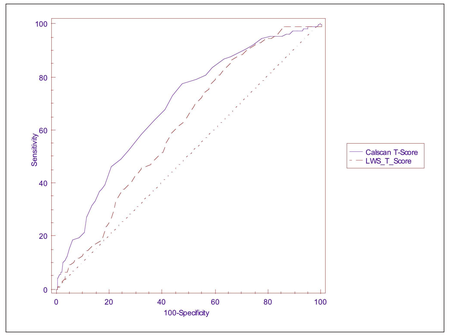

Fig 1: AUC – T-Score -2.5

In the male population the number of patients was too small to find any evidence.

The implementation of the FRAX score in the subgroup of 101 patients for DXL and DXA the AUC results showed highly significant values ranging from 0.763 – 0.894 for the prediction of any major osteoporotic fracture or hip fracture in patients with prevalent vertebral fractures or in patients with prevalent vertebral and fragility fractures. For all these patients there were no statistically significant differences between DXL and DXA for the prediction of any major osteoporotic fracture risk. For the evaluation of osteoporotic hip fracture risk in our patients with prevalent fractures DXA results reached statistical significance compared to DXL. (Table 4).

	AUC	95% CI	P-value
DXA – major FX risk	0.859	0.775 – 0.920	n.s.
DXL – major FX risk (Pts with vert Fx only)	0.805	0.713 – 0.877	
DXA – Hip FX risk	0.807	0.717 – 0.879	<.001
DXL – Hip FX risk (Pts with vert FX only)	0.763	0.667 – 0.842	
DXA – major FX risk	0.894	0.817 – 0.946	n.s.
DXL – major FX risk (Pts with vert & fragility FX)	0.845	0.759 – 0.910	
DXA – hip FX risk	0.832	0.745 – 0.899	<.05
DXL – hip FX risk (Pts with vert & fragility FX)	0.791	0.698 – 0.866	

Table 4: FRAX analysis (n=101)

The T-score of the hip (DXA) and also the T-score of the calcaneus (DXL) in combination with the FRAX score were significantly better in the identification of patients with spine fractures than the DXA spine T-score despite a relatively small number of patients (32 of 101) in the FRAX sub-set. There was no statistical significance between DXL and DXA (Table 5, Figure 2).

	AUC	95% CI	P-value
DXL T-score & major FX	0.797	0.701 – 0.873	n.s.
DXA T-score Hip & FRAX	0.858	0.770 – 0.922	<0.020
DXA T-score lumbar spine	0.663	0.527 – 0.731	<0.001

Table 5: Comparison of AUC in pts with vert FX

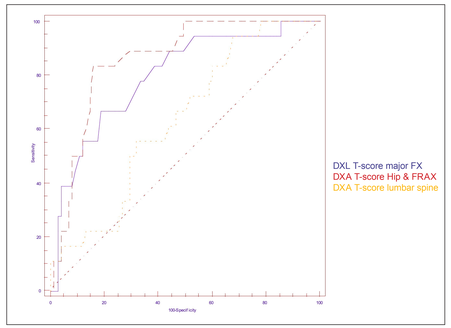

Fig 2: Comparison of AUC in pts with vert FX

Conclusion:

Our results clearly show that DXL of calcaneus is comparably effective than DXA of the femoral neck to identify patients with vertebral or fragility fractures and both measuring sites are superior to BMD measurements of lumbar spine by DXA.

For the evaluation of osteoporotic fracture risk FRAX is a calculation tool to estimate a 10 year probability of the individual patient. In our randomized subgroup DXL of the calcaneus and DXA of the femoral neck are equal in the prediction of any major osteoporotic fracture in patients with or without prevalent fractures. DXA of the femoral neck seems superior in the prediction of hip fracture risk, but the limitation of our method is on the one hand the approach to calculate the FRAX score with BMD results of the calcaneus and on the other hand the relatively small number of 101 patients in the subgroup. None of these patients had prevalent osteoporotic hip fractures.

We conclude that calcaneus scans by DXL can be used as an effective diagnostic alternative in clinical practice where hip and/or spine BMD results are suspect or not readily available or possible. The implementation of the FRAX tool generally improves the sensitivity and specificity of DXL and DXA indicating the necessity of evaluating clinical risk factors and BMD measurements.

Keywords: Vertebral fractures, DXL calcaneus, DXA spine, hip, FRAX