Ability of peripheral QCT at the radius in comparison to DEXA of the spine to diagnose vertebral fractures in postmenopausal women

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INTRODUCTION

Numerous studies concerning comparative measurements between peripheral and axial sites have been done. Due to a low sensitivity, single photon absorptiometry at the distal radius is generally claimed to be the least useful diagnostic means for bone mass measurements. We now demonstrate the capability of quantitative computed tomography at the distal radius (pQCT) in comparison to dual-energy X-ray absorptiometry (DEXA) measurements at the lumbar spine in normals and patients with established osteoporosis. We believe osteoporosis to be a generalized disease which can be assessed by bone mass mea-

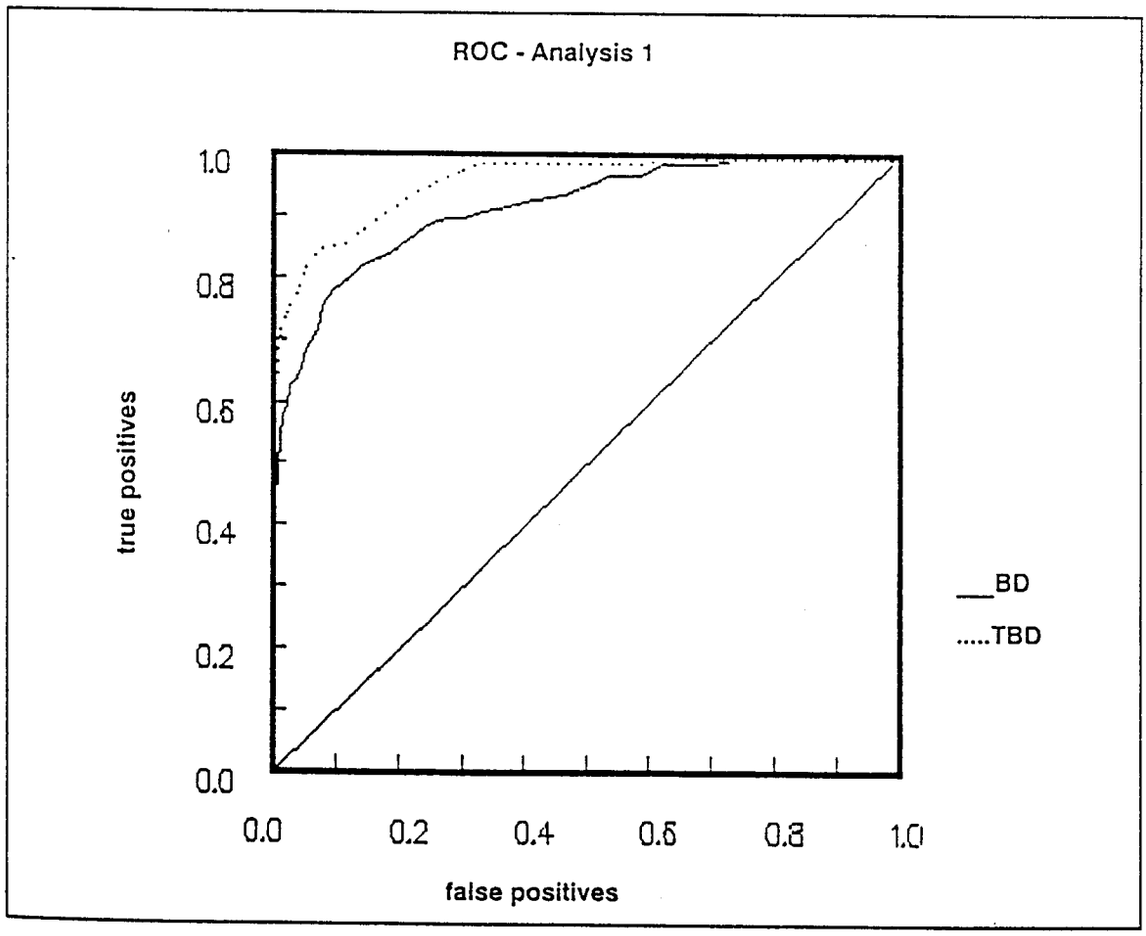

Figure 1.

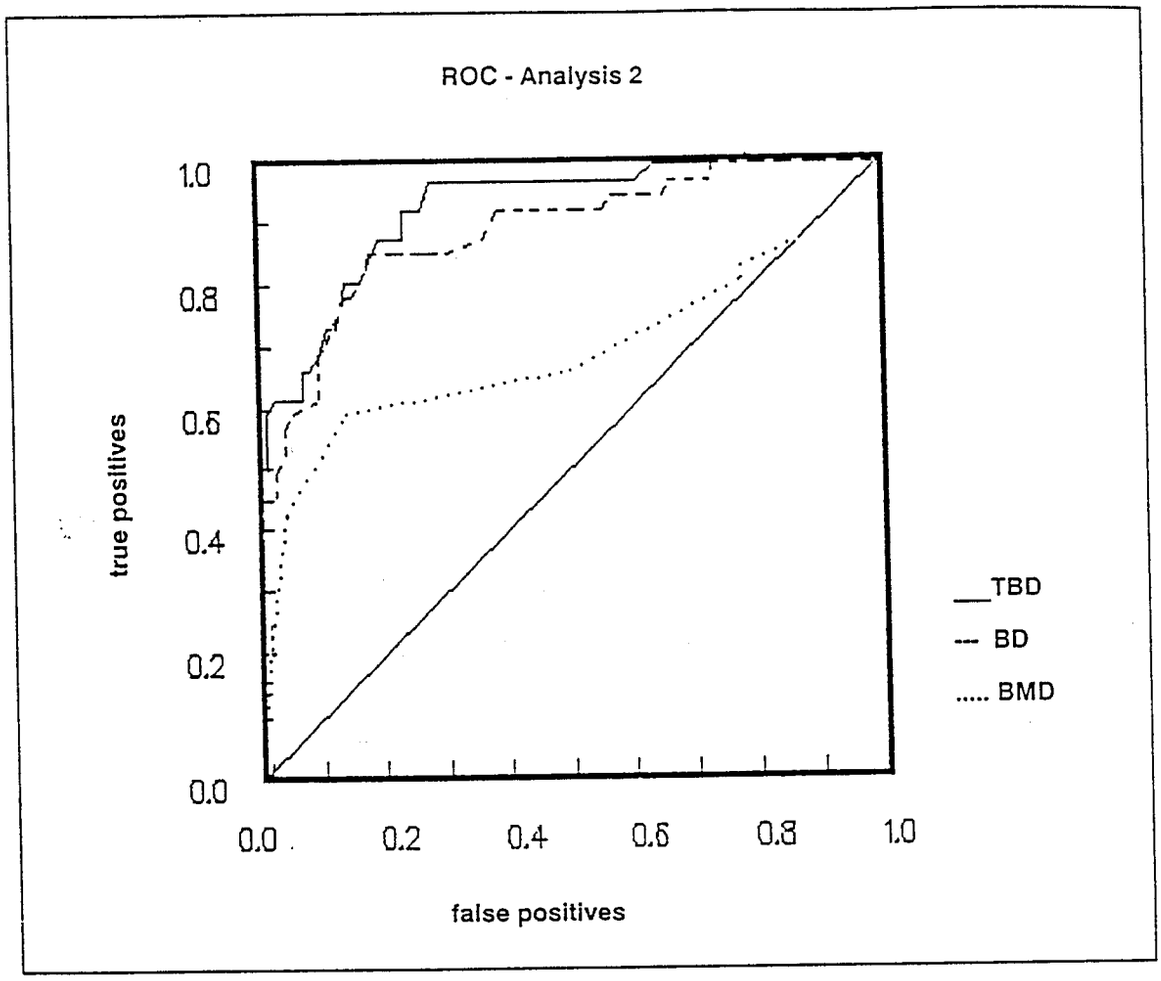

Figure 2.

surements successfully also at peripheral sites with an appropriate technique. Although pQCT was introduced more than a decade ago, it was widely ignored in comparative studies.

MATERIALS AND METHODS

244 postmenopausal women without chronic diseases, without drug intake affecting bone turnover, without hormone replacement, and without oophorectomy, and 154 postmenopausal women with spinal crush fractures in X-rays but no evidence for other metabolic bone diseases had bone density measurements. All subjects were measured with pQCT, 46 of the normals and 42 of the osteoporotic patients had also DEXA measurements of the lumbar spine. Mean age and ranges for both groups are shown in Table I. Peripheral QCT was performed at the distal radius ("5%-site") with a Stratec SCT 900 ^{125}I fan beam scanner. Bone density (BD) of the radius cross-section and its trabecular portion (TBD) were calculated as linear attenuation coefficient (1/cm). DEXA was performed at the lumbar spine (L1-L4) with a Lunar DPX scanner. The results were expressed as bone mineral density (BMD) in g/cm^2. Fractured vertebrae were excluded from evaluation. The ROC analyses were performed

with the set of pQCT data and with a separate set of data from patients additionally measured with DEXA.

RESULTS

The sensitivity and specificity of the methods for BD and TBD are displayed as ROC curve 1 (Fig. 1), whereas ROC curve 2 shows the parameters BD, TBD and BMD (Fig. 2). The results of the group comparisons are demonstrated in Table I. At 80% sensitivity, the specificity level for TBD was ≥ 87%, for BD ≥84% and for BMD 28%. At 80% specificity, the sensitivity for TBD was ≥87%, for BD ≥84% and for BMD 60%. The correlation between TBD and BMD resulted in r=0.46 ($p<0.0001$).

Table I. Differences between patients and normals ± standard deviation.

ROC-Analysis 1	244 normals	154 osteoporotics	t	p
BD (1/cm)	0.884±0.091	0.695±0.102	21.9	<0.001
TBD (1/cm)	0.730±0.069	0.558±0.075	27.5	<0.001
age (range)	60.8±8.6 (44-91)	66.5±8.9 (46-87)	NS	

ROC-Analysis 2	46 normals	42 osteoporotics	t	p
BD (1/cm)	0.901±0.099	0.731±0.109	7.6	<0.001
TBD (1/cm)	0.745±0.079	0.583±0.089	8.9	<0.001
BMD (g/cm^2)	1.095±0.117	0.929±0.215	4.5	<0.001
age (range)	56.0±7.1 (44-70)	67.6±9.8 (46-84)	NS	

CONCLUSIONS

In contrast to QCT-measurements there are various errors inherent to absorptiometry affecting considerably the individually measured results. Thus mismatching results between the known diagnosis and the measured values may be found. These errors are e.g. the fat error in soft tissue of up to 30% (1-3), the error due to different vertebral size of up to 16% (4), and other errors. The medullary fat error, inherent to both methods is of minor importance. Although the classification of our normals and patients may be different from other authors (5-9), we did not find a substantial difference in the ROC curve for DEXA of the lumbar spine in our measurements. Yet, we received the highest sensitivity and specificity in our peripheral QCT measurements, compared to data reported of other measurement sites and different techniques. In contrast to a previous investigation (10) measurement of purely trabecular bone gave best results.

We conclude that it is not necessary to have a high correlation between single peripheral and axial measurement results. More important is a high diagnostic sensitivity and a low false positive rate for the prediction of axial fracture risk. This can be achieved very effectively with pQCT measurements at the distal radius as our data suggest.

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