QCT versus DXA

What the Experts Say

Excerpts from Leading Journals in the Field
Bone density measurements

Cancellous bone mineral density in vertebral crests from the 12th to the 4th lumbar spinal segments was measured by single-energy quantitative computed tomography (QCT) as previously reported. In our hands, QCT has a coefficient of variation (CV) of 0.8% from repeated measurements of normal bone. Women who had been scanned at all sites as measured by DXA compared with QCT, however, the total spine segment for the whole body also showed a significant loss of -4.0 ± 4.6% (p = 0.001). Again, the loss in the CEE group was less than in the MA group 1.5 ± 4.2% vs. -4.1% ± 3.7% respectively, p = 0.001. Figure 2 shows that the CEE group experienced mean DXA bone losses in the femoral neck and whole body density; however, no region showed statistically significant loss. At 12 months, the MA group experienced significant loss in all hip sites in the whole body, and in the spine region of the whole body bone density by DXA. These losses averaged -2.8% in whole body, -5.2% in the femoral neck, and -8.1% in WJ area.

This trial was planned to be both larger (25 women per arm) and longer. However, the results showing nearly universal QCT bone loss became apparent (Fig. 1), we felt unobliged to continue a randomized blinded trial. We discontinued further enrolment and ended the study after 1 year of observation.

Advanced Hospital Technology: Vol. 1: 1992

Bone density measurements

Changes in bone density and morphometrics over time

QCT cancellous spine bone density decreased over time in women treated by therapy in both groups and averaged 12% in the entire cohort of 29 women at 1 year from whom QCT was performed. Women who received CEE treated women experienced a significantly higher annual (0.7%± 0.8%) vs. 0.4% (p=0.0007), while MPA treated women experienced a loss of 0.9% ±19%. The greater loss during MPA treatment just reached significance (p = 0.039).

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OSTEOPOROSIS: Diagnosis with Lateral and Posteroanterior Dual X-Ray Absorptiometry Compared with Quantitative CT

S. Guglielmi, S.K. Grimston, K. C. Fischer, B. Pagni

Quantitative CT has the ability to measure selectively the trabecular compartment of the vertebrae and has therefore been recognized as a sensitive method with which to assess BMD in patients with osteoporosis.

Quantitative CT has been shown to help discriminate between healthy women and those with osteoporosis better than PA-DXA.

The better diagnostic sensitivity of quantitative CT compared with PA-DXA may be a result of the fact that PA-DXA quantifies not only the trabecular compartment of the vertebral body but also the posterior compact bone of the vertebrae. In the additive, any hypotrophic and degenerative change and/or vascular calcification, which commonly occur concurrently with PA-DXA, may not be included in the final result from PA-DXA.

Moreover, findings at quantitative CT (p = .01) and L-DXA (p = .05) correlated better with age than finding at PA-DXA (p = .05). The best-fitting curve was linear, and the correlation was independent of years in menopause. In the healthy women, a more significant linear decrease in BMD with age was found with quantitative CT and L-DXA than with PA-DXA.

Results of logistic regression analysis indicated both quantitative CT and L-DXA but not PA-DXA to be the significant predictors of osteoporotic fractures (p < .01). In contrast, quantitative CT was the best predictor of vertebral fractures, whereas PA-DXA and L-DXA were not significant predictors of osteoporotic fracture.

A similar finding was derived from analysis of receiver-operating-characteristic curves. The curves for fracture prediction (measured areas under curve) for both quantitative CT (AUC = 0.918, 95% CI: 0.822, L-DXA = 0.847, p < 0.001, PA-DXA = 0.793; 95% CI: 0.644) showed L-DXA to have a sensitivity and specificity higher than those of PA-DXA (p < .05) but lower than those of quantitative CT (p < .05).

In general, results indicated that scans obtained with quantitative CT were more discriminative between healthy subjects and those with osteoporosis as well as quantitative CT does.

The choice of treatment modalities for osteoporosis often depends on the diagnostic sensitivity of screening procedures. In the present study, receiver-operating-characteristic curves were generated for each BMD measurement and were compared in terms of diagnostic sensitivity. With this procedure, L-DXA was shown to be superior to quantitative CT in terms of accurate differentiation between fracture and nonfracture.

In conclusion, findings in this study demonstrate that the diagnostic sensitivity of L-DXA is between that of PA-DXA and quantitative CT. Moreover, L-DXA is potentially more sensitive than quantitative CT to identify abnormal or degenerative processes of the spine.


Trabecular bone is approximately eight times more metabolically active than cortical bone. Quantitative computed tomography (QCT) is an effective measure of trabecular bone but is also highly sensitive to changes in skeletal density.

Discrimination of osteoporotic women

Of equal interest to the comparisons of the two healthy groups (reflecting age and menopause-related changes) are the comparisons of the measurements in their ability to discriminate the osteoporotic postmenopausal and osteoprotective postmenopausal women. We used the Student’s t-test, odds ratios, and receiver operating curves under the ROC (receiver operating curves) statistical approaches to quantify the ability of the measurements to discriminate the osteoporotic postmenopausal group from the healthy postmenopausal group.

Since most of the age-related changes are influenced by age, we adjusted for age in the logistic regression and ROC analysis. The results of odds ratios analysis reflected clearly the trends shown by the Student’s t-test. In our study, QCT TRAB BMD and QCT INTG BMD gave the best results based on age-adjusted odds ratios, followed by DXA LAT BMD and DXA PA BMD.

The trend of spine measurements showing better discrimination for vertebral fractures has been reported in many cross-sectional studies comparing the abilities of measurement of the spine with those of peripheral sites. In contrast, it has been reported in both cross-sectional and longitudinal studies that peripheral measurements may be equal to spinal measurements when the latter are obtained by projection techniques such as DXA. Cumings et al. and Davis et al. found that calculated DXA measurements were better than the DXA PA BMD for assessing hip fracture risk and age-related bone loss.

Table 1

Use of DXA and QCT bone mineral density to discriminate between 55 women with at least one spinal fracture and 56 non-fracture controls. Shown are the t-scores derived from a t-test between the two groups (with corresponding p-values), area under the receiver operating characteristic (ROC) curve, and age-adjusted odds ratio per standard deviation decrease in BMD.

<table>
<thead>
<tr>
<th>Technique</th>
<th>t-score</th>
<th>n(55)</th>
<th>n(56)</th>
<th>p-value</th>
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<tr>
<td>AP spine DXA</td>
<td>3.36</td>
<td>0.001</td>
<td>0.650</td>
<td>1.47</td>
</tr>
<tr>
<td>Lateral spine DXA</td>
<td>5.22</td>
<td>0.001</td>
<td>0.714</td>
<td>1.08</td>
</tr>
<tr>
<td>QCT</td>
<td>8.45</td>
<td>0.001</td>
<td>0.797</td>
<td>3.17</td>
</tr>
</tbody>
</table>

Mild versus Definite Osteoporosis: Comparison of Bone Densitometry Techniques Using Different Statistical Models

A. Haertl, J. Block, C.-G. Giss, P. Steiger, and H.K. Genant

In conclusion, we found that direct measurement of spinal trabecular bone by QCT is the most powerful approach for discriminating postmenopausal women with osteoporotic fractures from those with definite fractures. These conclusions are consistent with all statistical tests undertaken with our BMD data.

Measurement of Axial and Peripheral Bone Mass by QCT

K. Faulkner

QCT provides a three-dimensional measurement of bone mineral density (BMD) as opposed to most other techniques, such as single and dual x-ray absorptiometry (DXA and DPA).

Since DXA and DPA are projectional, they are limited to reporting area density (mass per unit area). In contrast, the units of QCT are mass per unit volume as derived from the three-dimensional QCT image. The cross-sectional QCT images also allow the isolation of the trabecular bone, which is a more sensitive site for bone mineral changes than cortical or integral sites.

Precision error is very small (1 to 2%) in experienced hands and with specialized analysis software.

When appropriately expressed in the correct units, the radiation dose due to a QCT examination is much less than a lateral x-ray of the spine routinely used to diagnose vertebral fractures. Thus the perception that QCT is a high radiation dose technique is not true.

While prospective data relating QCT to fracture risk are not available, cross-sectional data indicate the superior predictive capability for a vertebral QCT measurement compared to both anterior (AP) and lateral DXA of the spine (see Table 2). This is likely due to the ability of QCT to measure purely trabecular bone of the vertebral body, which is thought to be the first to respond to menopausal changes.

QCT demonstrates both a stronger correlation with age than DXA and a greater degree of age-related loss than seen with DXA.

In conclusion, we found that direct measurement of spinal trabecular bone by QCT is the most powerful approach for discriminating postmenopausal women with osteoporotic fractures from those with definite fractures. These conclusions are consistent with all statistical tests undertaken with our BMD data.


Assessing Osteoporotic CT’s Quantitative Advantage

H.K. Genant

Clinical results indicate that quantitative computed tomography can reliably evaluate and monitor the many forms of osteoporosis and its various treatments. The greatest advantages of QCT for osteoporotic bone mineral density (BMD) include high precision of the technique, the high sensitivity of the vertebral spinoous processes, and the potential for widespread use.

Diagnostic Imaging, August 1985

"We believe that consideration should be given to the use of QCT as the "gold standard" against which other measurements of spinal BMD are judged."
“Solving the equations for the time to reach meaningful change revealed a mean time of 2.86 months for DXA and 1.54 months for QCT. DXA taking an average of 73% longer than QCT.”

Effect of Osteoarthritis on Lumbar Spine and Hip on Bone Mineral Density and Diagnosis of Osteoporosis

G. Lai, M. Peacock, E. Sah, G. Donula, E. Brauerston, C.C. Johnston

ABSTRACT

In order to assess the elderly the ability of osteoarthritis on bone mineral density (BMD) and on diagnostic osteoporosis, lumbar spine and hip were radiographical evaluated. The ability of bone mineral density (BMD) and osteophytes, sclerosis and joint space narrowing on hip BMD and not on anteroposterior lumbar spine. Prevalence and severity of osteoarthritis were scored on osteophytes, joint space narrowing and bone sclerosis. Ultrasound measurements were also made at the hip to examine whether osteoporosis at hip or lumbar spine influence bone at this remote site. Osteoporosis were the common feature, men having a higher prevalence than women, and lumbar spine having more disease than hip. Hip osteoarthritis explained 16.6% of hip BMD variation and 6% of variation in severity of osteoarthritis on bone structure and 10% of men had osteoporosis. We conclude severe and moderate osteoarthritis were scored on osteoarthritis and not on anteroposterior lumbar spine.

Lumbar Spinal Bone Densitometry May Result in Inaccuracy in the Measurement of Vertebral Morphology

C. Ferreira, M.L. Len, Y. Elsaye, and E. Sauvan

When bone mineral content (BMC) is used by dual-energy x-ray absorptiometry (DXA), the bone is essentially scored as the component of the attenuation caused by the soft tissue overlying bone cannot be measured, the attenuation caused by the soft tissue adjacent to the bone is measured and is used in the calculation of BMC. Similar to the observations in aging, disease, therapy.


Effect of Spinal Degenerative Disease on Longitudinal Measurements of Bone Density

G. James, P.H. Sambrook, T. Nguyen, P.J. Keyh, J.A. Elman

DXA: Spinal BMD measurement and its subsequent follow-up may be erroneous in the elderly due to substantial variation and diagnostic inaccuracy.

Abstract/Park International Congress: 20/95

Anomalies in the Measurement of Changes in Vertebral-Bone Mineral by Dual-Energy X-Ray Absorptiometry During Weight Bearing

P. Tehill, W.J. Harman, S. Dowen, and P.C. Freeman

ABSTRACT

For an eating disorder study over a period of 1 year, we measured total-bone mineral density using a peripheral dual-energy x-ray absorptiometry (PQDR-1000W) or is switched to FB mode.

We found that the present level of reimbursement is too low to cover costs for DXA scanning. In the conventional antero-posterior (AP) plane but the disadvantage in including spinal DXA measurements and DXA has been developed to overcome this limitation and is under development to assess the application of lumbar DXA in clinical practice.

Conclusion: The study confirms the greater use of lumbar DXA over spine AP-QCT, but the reimbursement of lumbar DXA remains too low.

American Journal of Gastroenterology 113: 139-146, 2008

Scanning-Induced Variability and Quality Assurance in Longitudinal Dual-Energy X-Ray Absorptiometry Measurements

H. Sievonen, P. Oja, V. Vuori

Characteristics of typical malfunctions and scanner-induced variability observed in dual-energy x-ray absorptiometry (DXA), and their potential side effects on longitudinal radial reduction of DXA were evaluated. According to extensive, cumulative quality assurance (QA), data obtained from two successive x-ray scans during a 2.5-year period, the scanner-induced variability may vary from long-term drift (~0.5%/year), short-term drift (~0.2–2.2%/day), inhomogeneity of the x-ray beam over the tabletop (~0.5%), and changes in internal filtration (~0.5%). The scanner-induced variability of their effects may be considerable with respect to expected small changes in bone density. Furthermore, these effects may not be discriminated from each other. Therefore it may not be possible to correct their cumulative effect using long-term QA data only.

Medical Physics 21(11), November 1994

Dual-Energy X-Ray Absorptiometry: The Effects of Beam Hardening on Bone Density Measurements

G. Maiba, B. de McKinney, S. C. Dhiau, P. R. J. Ryan, and I. Fogleman

The effect of scan size on the results of longitudinal studies was examined. For a spine scan in 20-cm body thickness, the effect of scan size on the true change and implied an error of 0.15%/year for a measurement of a change of loss of 0.5%/year in a postmenopausal woman.

Medical Physics; 11(2), 1982

Coding and Reimbursement Issues for Dual-Energy X-Ray Absorptiometry

D. J. Sartoris

We believe that the present level of reimbursement is too low to cover costs for DXA scanning, but the ability of DXA to discriminate fracture and to monitor skeletal uniformity of the soft tissue in the lateral projection.

Lateral DEXA avoids PA DXA’s problems

The Superiority of Spinal S imperfect for the AP projection for the diagnosis and follow-up of osteoporotic patients.

K. Borrmann, C. Reinsager, C. Christensen

We conclude that: 1) Two to ten years after menopause the lumbar spine is susceptible to changes in bone density due to age and sex; 2) At least one of the projections of the QDR-1000W seems to have an accuracy problem. 3) The exclusion of the posterior elements in the longitudinal studies may not sufficiently correct for the expected value of osteoporosis.


Assessment of Spinal Bone Mass Loss by Lateral Versus Antero-Posterior View Revisited

A. Nalb, D.O. Snellman, B. Rizzoli, A. Donath, F. Tjernberg, B. B. Ramph

Conclusions: In the context of a clinical setting, detecting and monitoring of mean differences in lateral DEXA is not inferior to follow lateral densitometry in the AP view. However, the view is an indication that the relatively small difference in postmenopausal skeletal age is consistent with the somewhat lower precision of the lateral projections.

American Journal of Roentgenology 193: 1393-1398, 2004

Bone 36: 200-205, 1981

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Lateral DEXA avoids PDA's problems

The Superiority of Spiral Saturated-Light-QDR and QCT over Dual-Energy AP-DX in Detecting Vertebral Compression Fractures

M. Lafferty and D. J. Dawber

But neither the QCT (the r = 0.36) nor the QDR (the r = 0.36) had high enough correlation to...for the follow-up bone loss. 2) At least one of the projections of the QDR-1000W to have an accuracy problem. 3) The exclusion of the posterior elements in the lumbar spine. There is a large difference in the value of spinal density.

Conclusion: The study confirms the greater use of QDR for routine DXA, but the reproducibility of lateral DEXA is still less compared to spiral QCT.

Abstract: Minimisation of Radiation Dose in Dual-Energy X-Ray Absorptiometry

K. Biermanns, C. Heiniger, C. Christian

We conclude that: 1) Five to ten years after menopause the lateral projection is not superior to the anterior-posterior view in determining bone mass. In the AP plane, the accuracy was significantly inferior compared to spiral QCT.

TABLE 1: Breakdown of Typical Costs of Dual-Energy X-ray Absorptiometry

K. Nishimoto, P. J. McIlroy, S. C. Dohle, P. A. Rogers, B. J. McCall, and J. Ellinger

The effect of scanning conditions on the results of long-term studies was examined. For a spine scan at 20 cm body thickness, spiral QCT showed a significantly better correlation and true change and implied an error of 0.15%/year for a measurement of a true loss of 0.7%/year in a postmenopausal woman.

Physical Medical 21 (11), November 1994

The correlation between the measured and true changes in the bone mass should be less than 1%.

Medicare RSUs

The phantom measurements offer an explanation for the vertebrae in vivo and demonstrate that, under different circumstances, changes in bone mass in BMC and BMD can be wrongly recorded. We believe that the exclusion of the posterior elements in the lumbar spine is necessary in elderly patients.

H. Skiavén, G. Dorulla, J. M. Weigert, C. E. Cann

The elevated BMD, as measured by DXA, in obese patients (body mass index [BMI] > 27 kg/m²) was underestimated by 3%, but femoral neck and pelvic BMC was overestimated by 2.2 and 3.2%, respectively, both compared with the same technique for this evaluation, and QCT may be superior. We suggest that, in the evaluation of a patient who has a BMI in the range 25 kg/m² to 45 kg/m², either DXA or QCT should be used. For diagnostic purposes or the interpretation, it may be necessary that the result of the DXA scan be confirmed by QCT, or vice versa.


Since the slope of the relationship was a strong correlation between BMC and the bone mass, it is used in the primary diagnostic algorithm. All values are correct since the evaluation of femur BMD by DXA is the primary measure if DXA of the spine is apparently too high, and osteoporosis, from osteoarthritis or aortic calcification, our results suggest that even the femur BMD is artificially elevated in the obese patient and may not be used for diagnosis of osteoporosis or osteopenia.

Our results suggest that, for the patient who is clinically osteoporotic, the combined analyses of the different techniques for this evaluation, and QCT may be superior.

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OSTEOPOROSIS: Diagnosis with Lateral and Posteroanterior Dual X-Ray Absorptiometry Compared with Quantitative CT


Quantitative CT has the ability to measure selectively the trabecular compartment of the vertebra and has therefore been recognized as a sensitive method with which to assess BMD in patients with osteoporosis. Quantitative CT has been shown to help discriminate between healthy women and those with osteoporosis better than PA-DXA.

The better diagnostic sensitivity of quantitative CT compared with PA-DXA may be a result of the fact that PA-DXA quantifies not only the trabecular compartment of the vertebral body but also the posterior compact bone elements of the vertebra. In addition, any hypertrophic and degenerative change and/or vascular calcification, which commonly occur with PA-DXA but do not help during the final result from PA-DXA.

Moreover, findings at quantitative CT (P < .01) and L-DXA (P < .05) correlated better with age than finding at PA-DXA (P = .368). The best-fitting curve was linear, and the correlation index was independent of years since menopause.

In the healthy women, a more significant linear decrease in BMD with age was found at L-DXA than at PA-DXA (P < .01).

Results of logistic regression analysis indicated both quantitative CT and L-DXA but not PA-DXA to be the significant predictors of osteoporotic fractures (P < .01). In contrast, bone mass at lumbar spine L-DXA but not at lumbar L-DXA were not significant predictors of osteoporotic fracture. A similar finding was found from analyses of receiver-operating-characteristic curves. The curves for fracture prediction (area under curve) were 0.740 at lumbar spine L-DXA and 0.720 at lumbar L-DXA. The area under the curve at lumbar L-DXA was larger and significantly higher than those of PA-DXA (P < .05) but lower than those of quantitative CT (P < .05).

In general, results indicated that scans obtained with quantitative CT and L-DXA did not help discriminate between healthy subjects and those with osteoporosis as well as quantitative CT does.

The choice of treatment modalities for osteoporosis often depends on the diagnostic sensitivity of screening procedures. In the present study, receiver-operating-characteristic curves were generated for each BMD measurement technique and were compared in terms of diagnostic sensitivity. With this procedure, L-DXA was shown to be superior in L-DXA but inferior to quantitative CT in terms of accurate differentiation between fracture and nonfracture.

In conclusion, findings in this study demonstrate that the diagnostic sensitivity of L-DXA is between that of PA-DXA and quantitative CT. Moreover, L-DXA is potentially more sensitive than quantitative CT to healthy vertebrae due to the presence of anatomical abnormalities or degenerative processes of the spine.

Comparison of Noninvasive Bone Mineral Measurements in Assessing Age-Related Fracture, Discrimination, and Diagnostic Classification

S. Grampp, H. K. Genant, A. Mathur, P. Lang, M. Jurges, M. Tabak, C.-C. Gluer, Y. L. M. Davido

Detection of age- and menopause-related bone loss is of great importance. Even when significant differences, except for QCT RAD TRAB BMD readily differentiated between healthy premenopausal and osteoporotic postmenopausal subjects and reflect age- and menopause-related bone loss. In differentiating between healthy premenopausal and healthy postmenopausal women, the test abilities (based on percentage decrease and Student's values) were shown by QCT, followed by L-DXA at L-DXA. Similar results were also obtained by Siegert et al. who found a decrement of 42% in the comparison of healthy premenopausal and healthy postmenopausal women for QCT BMD 28% and 28% for QCT INTG BMD. L-DXA of the spine showed better abilities in the lateral (L-DXA L-BMD) measurements compared with the PA (PA BMD) measurements. This agrees with the results obtained by Guglielmi et al. who found the highest sensitivity and specificity for the detection of age- and osteoporosis-related changes in trabecular bone followed by L-DXA L-BMD and by L-DXA PA BMD.

Discrimination of osteoporotic women Of equal interest to the comparisons of the two healthy groups (reflecting age and menopause-related changes) are the comparisons of the measurements in their ability to discriminate postmenopausal and osteoporotopic postmenopausal women. We used the Student's t test, odds ratio, and age under the ROC curve as statistical approaches to quantify the ability of the measurements to discriminate the postmenopausal osteoporotic group from the healthy postmenopausal group. Since most of the measurements were influenced by age, we adjusted for age in the logistic regression and ROC analysis. The results of odds ratio analysis reflected clearly the trends shown by the Student's t test. In our study, QCT TRAB BMD and QCT INTG BMD gave the best results based on age-adjusted odds ratio, followed by L-DXA L-BMD and L-DXA PA BMD. The same trend, with L-DXA demonstrating the highest sensitivity for distinction between normal and osteoporotic women, was found in studies by Guglielmi et al. and by Legros et al. who compared QCT with DXA L-BMD and DXA PA BMD. PA-Ct al. and Van Berkum et al. found that L-DXA was the better predictor of vertebral fracture.

The trend of spine measurements showing better discrimination for vertebral fractures has been reported in many cross-sectional studies comparing the abilities of different measurements of the spine with those of peripheral sites. In contrast, it has been reported in both cross-sectional and longitudinal studies that peripheral measurements may be equal to spinal measurements when the latter are obtained by projectional techniques such as DXA. Gummings et al. and Davis et al. found that spinal DXA measurements were better than the DXA PA BMD for assessing hip fracture risk and related bone loss.

Results of logistic regression analysis indicated both quantitative CT and L-DXA but not PA-DXA to be the significant predictors of osteoporotic fracture (P < .01). In contrast, bone mass at lumbar spine L-DXA but not at lumbar L-DXA were not significant predictors of osteoporotic fracture. A similar finding was found from analyses of receiver-operating-characteristic curves. The curves for fracture prediction (area under curve) were 0.740 at lumbar spine L-DXA and 0.720 at lumbar L-DXA. The area under the curve at lumbar L-DXA was larger and significantly higher than those of PA-DXA (P < .05) but lower than those of quantitative CT (P < .05).

In general, results indicated that scans obtained with quantitative CT and L-DXA did not help discriminate between healthy subjects and those with osteoporosis as well as quantitative CT does.

Age and Bone Mass in Premenopausal Women


Trabecular bone is approximately eight times more metabolically active than cortical bone. Quantitative computed tomography (QCT) of the spine measures trabecular bone and therefore highly sensitive changes in skeletal density.

Development in QCT & Comparisons with DXA

J.E. Adams

QCT scans of the hip and/or spine were obtained in adults (age 60 ± 12; 26–84 years, SD 18 ± 5) using a Metabolic Bone Clinic using a Philips SA4000 CT Unit in conjunction with QCT Pro1 (Medwad Software Inc., San Francisco). All patients had hip and spine DXA measurements using either a pencil beam (Lunar DPX-L) and a fan beam (Hologic 4500 Acclimation) system. A comparison was made between the precision (%CV) of the two techniques. The ability of QCT to identify patients with osteoporosis and mild versus definite osteoporosis (<2.5 Z-score) was determined. Vertebral fracture discrimination by QCT was also assessed.

The precision of 2D QCT (1.31%) in the lumbar spine is comparable to DXA (1.90% - fan beam; 1.50% - pencil beam). Using a two-sided Student's t-test, the lowest CV% was a Z-score <2.5 (WHO) that was determined. Vertebral fracture discrimination by QCT was also assessed.

A QCT T score of -1.87 identified the same number of individuals with spinal osteoporosis as defined by DXA. ROC precision analysis showed that OSTEOPOROSIS: Diagnosis with Lateral and Posteroanterior Dual X-Ray Absorptiometry Compared with Quantitative CT was the better predictor of vertebral fracture.

CONCLUSIONS

QCT-T2 has greater discrimination for vertebral fractures than DXA and can be applied to multiple anatomic sites (cervical and lumbar).

Mild versus Definite Osteoporosis: Comparison of Bone Density Techniques Using Different Statistical Models

A.F. Heuck, J. Block, C.-C. Gluer, P. Steiger and H.K. Genant

In conclusion, we found that direct measurement of spinal trabecular bone by QCT is the most powerful approach for discriminating postmenopausal women and for differentiating women with mild osteoporosis from those with definite fractures. The techniques were extensively compared in all statistical tests undertaken with our BMD data.

Table 3

<table>
<thead>
<tr>
<th>Technique</th>
<th>Lumbar spine</th>
<th>Lateral spine</th>
<th>AP spine DXA</th>
<th>QCT</th>
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<tr>
<td>Score</td>
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<td>0.74</td>
<td>0.33 (p&lt;0.001)</td>
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<td>Odds Ratio</td>
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<tr>
<td>ROC Area</td>
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<td>0.89</td>
<td>0.85 (p&lt;0.001)</td>
<td>0.90</td>
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</tbody>
</table>


Assessing Osteoporosis: CT’s Quantitative Advantage

H.K. Genant

Clinical results indicate that quantitative computed tomography can reliably evaluate and monitor the many forms of osteoporosis and its various treatments. The greatest advantages of spinal QCT for bone mineral density assessment are the high precision of the technique, the high sensitivity of the vertebral spongiosa measurement, and the potential for widespread use.

Diagnostic Imaging, August 1995
Changes in bone density and morphometrics over time

Bone density measurements

Cancellous bone mineral density in vertebral cortices from the 12th thoracic to the 4th lumbar spinal segments was measured by single-energy quantitative computed tomography (QCT) as previously reported. In our hands, QCT has a coefficient of variation (CV) of 0.8% from repeated measurements. Cancellous bone mineral density determined by QCT was more reproducible than DXA, particularly when repeated measurements of the same patient were conducted using the same equipment at all sites as measured by DXA compared with QCT; however, the total spine segment bone density of the whole body also showed a significant loss of -4.0 ± 4.6% (t = -4.97, p < 0.001). Again, the loss in the CEE group was less than in the MPA group (-1.5 ± 0.2%; t = 3.08, p = 0.002). Figure 2 shows that the CEE group experienced mean DXA bone losses in the femoral neck and whole body density; however, no group showed statistically significant loss. At 12 months, the MPA group experienced significant loss in all hip sites, in the whole body, and in the spine region bone density by DXA. These losses averaged -2.8% in whole body, -5.2% in the femoral neck, and -8.1% in the Ward’s area.

Our DXA measurements over the 4000 centers worldwide. Generally, spinal DXA is performed over 4000 centers worldwide. Generally, spinal DXA is performed on standard clinical CT scanners using lateral DXA or DPA. The postmenopausal trabecular bone loss by DXA is osteoporosis (T score <-2.5) is applied to both men and women over 15 years postmenopause. On the basis of this information, the use of QCT as the “gold standard” against which other measurements of spinal BMD are judged. For postmenopausal women, the use of QCT to detect changes in spinal density (DEN) over time, as compared with QCT, 179 osteoporotic patients with vertebral fractures and 53 women without had densitometry by both DXA and QCT and a mean follow-up of 2.5 years. Patients were included only if they were experiencing or maintaining DEN.

QCT is a digital imaging technique that generates computerized volumetric measurements of bone density. It is based on the assumption that bone is homogeneous and isotropic. QCT is used to assess the density of bone at specific locations, such as the lumbar spine, hip, and proximal femur. It is particularly useful for assessing bone density in the spine, where it can provide more accurate measurements than other methods.

QCT bone loss became apparent (Fig. 1), we demonstrated that QCT bone loss quantification is generally superior to DXA. In our hands, QCT shows a highly significant loss in bone mass relative to the age-related reference values. This loss was greater in the CEE group than in the MPA group.

QCT diagnosis of osteoporosis the agreement is better (<0.42). Between patients with and without fracture

Bone Density Measurement in Osteoporosis and Other Bone Diseases

M.R. McClung

Only quantitative CT techniques of measuring bone are currently the gold standard for assessing trabecular bone. Such techniques measure trabecular bone thickness, trabecular number, and trabecular separation. These are all important determinants of bone strength and can be used to detect osteoporosis at an early stage.

QCT is a technique that is used to assess bone mineral density in the axial and appendicular skeleton. With its cross-sectional scanning plane, QCT is one of the principal techniques used to provide detailed information about the structure and density of bone. It is particularly useful for assessing bone density in the spine, where it can provide more accurate measurements than other methods.

QCT has the advantage of being able to detect changes in bone mineral density over time, which is important for monitoring the effectiveness of treatments for osteoporosis. It is also useful for assessing bone density in patients with vertebral fractures, where it can provide more accurate measurements than other methods.

QCT has been used to detect changes in bone density over time, which is important for monitoring the effectiveness of treatments for osteoporosis. It is also useful for assessing bone density in patients with vertebral fractures, where it can provide more accurate measurements than other methods.

QCT measurements of the spine by DXA, lateral DXA or DPA. The postmenopausal trabecular bone loss by DXA is osteoporosis (T score <-2.5) is applied to both men and women over 15 years postmenopause. On the basis of this information, the use of QCT as the “gold standard” against which other measurements of spinal BMD are judged. For postmenopausal women, the use of QCT to detect changes in spinal density (DEN) over time, as compared with QCT, 179 osteoporotic patients with vertebral fractures and 53 women without had densitometry by both DXA and QCT and a mean follow-up of 2.5 years. Patients were included only if they were experiencing or maintaining DEN.

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