

MRI, CT Compete to Evaluate Bone Quality

BY SHERRY BOSCHERT

SAN FRANCISCO — Advances in imaging techniques are providing new insights into trabecular and cortical bone structure and may help assess bone quality, a key component of bone strength identified by a 2001 National Institutes of Health consensus panel.

Recent studies suggest that high-resolution MRI (hrMRI), multidetector CT, and high-resolution peripheral quantitative CT (hr-pQCT) each may be useful in assessing bone quality. But each brings different advantages and disadvantages, and it's unclear which imaging modality will be best for identifying osteoporotic fractures and monitoring treatment-related changes in bone structure.

The three imaging modalities can produce significantly different absolute numbers compared with each other when assessing trabecular or cortical bone structure, yet all correlate reasonably well with micro-CT as a standard of reference, Dr. Thomas M. Link said at a conference sponsored by the International Society for Magnetic Resonance in Medicine. Because of differences in acquisition and analysis of the images, bone structure data from the three imaging modalities are not directly comparable.

Trabecular and cortical bone structure are key components of bone quality, which was deemed to be an important component of bone strength, according to the NIH (JAMA 2001;285:785-95).

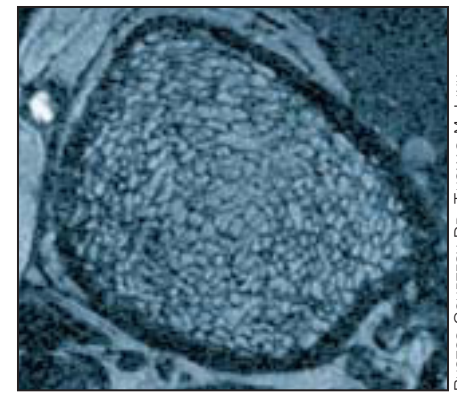
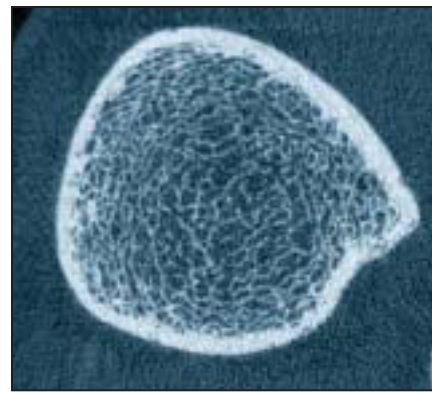
In one randomized, double-blind

study, for example, 51 postmenopausal women with osteopenia were treated with alendronate or placebo and followed over a 2-year period by 3-T MRI of the radius, tibia, and femur; hr-pQCT of the radius and tibia; and dual x-ray absorptiometry measures of bone mineral density. Both hrMRI and hr-pQCT results for trabecular bone showed moderate but significant correlation with bone density as a reference, even though there was a two- to fourfold difference between hrMRI and hr-pQCT in parameter values such as trabecular number, thickness, or separation (J. Bone Miner. Res. 2008;23:463-74).

Earlier studies of hrMRI showed that calcitonin-salmon nasal spray helped maintain trabecular microarchitecture vs. placebo (J. Bone Miner. Res. 2005;20:1548-61) and that testosterone replacement may improve trabecular microarchitecture in hypogonadal men (J. Clin. Endocrinol. Metab. 2003;88:1497-502).

Another study of 106 postmenopausal women found no difference in conventional bone mineral density measurements between the 35 women with a history of fractures and the fracture-free women in the rest of the cohort, but hr-pQCT imaging showed significant differences in trabecular structure (J. Clin. Endocrinol. Metab. 2005;90:6508-15).

Multidetector CT was used in a separate study showing significant increases in trabecular microstructure in 65 postmenopausal women treated for 12 months with teriparatide for osteoporosis (J. Bone Miner. Res. 2007;22:1426-33).



High-resolution peripheral quantitative CT (left) and high-resolution 3-T MRI (right) each have characteristic advantages and disadvantages for imaging bone.

PHOTOS COURTESY DR. THOMAS M. LINK



All three imaging modalities correlate reasonably well with micro-CT as a standard of reference.

DR. LINK

For cortical bone imaging, a newer area of research, two 2008 studies using hr-pQCT showed substantial differences between postmenopausal women with hip or wrist fractures, compared with fracture-free women, said Dr. Link, professor of radiology at the University of California, San Francisco.

Both hrMRI and hr-pQCT are being used experimentally to assess cortical bone porosity, which affects bone stability. One recent study using hr-pQCT found significant differences between normal premenopausal women, normal postmenopausal women, and postmenopausal women with renal osteodystrophy. "This is quite exciting to see these changes in cortical bone porosity. We don't really know what they mean yet, but they're clearly associated with fracture risk," Dr. Link said.

MRI or hr-pQCT provide high spatial resolution and produce no or relatively little radiation, compared with high-radiation exposure from multidetector CT. Multidetector CT has the advantage of allowing imaging of more central

skeletal sites such as the spine or proximal femur, he said. The hr-pQCT scanners image only peripheral sites such as small areas of the radius and tibia and possibly the calcaneus, while hrMRI covers larger areas of the radius, tibia, and possibly the femur.

The CT techniques provide measures of bone densitometry. Although hrMRI gives no densitometric data, some studies suggest it may be used to analyze bone marrow composition through spectroscopy in order to assess bone stability. The three techniques appear to have similar rates of reproducibility.

MRI is expensive, and the time needed for imaging results in motion artifacts. In comparison, hr-pQCT requires a dedicated scanner. Although exam time is shorter with hr-pQCT, motion artifacts remain a problem. Multidetector CT is widely available and requires less time for a scan. Postimage processing requires sophisticated techniques with MRI, but also is technically challenging with hr-pQCT.

Dr. Link has received research funding and support from Merck, which markets medication to treat osteoporosis. ■

New Program Helps Simplify Prediction of Fracture Risk

BY MICHAEL VLESSIDES

KANANASKIS, ALTA. — Physicians looking for a quick and easy way to predict fracture risk may need to look no further than a new computer program that considers more than just bone mineral density in making such determinations and summarizes its findings in a vivid, color-coded representation of the patient.

Developed by rheumatologist William Bensen, the Bone DESTINY software program predicts fractures more reliably than do bone mineral density (BMD) assessments alone. Use of the Bone DESTINY program achieves prediction accuracy comparable to that attained by following the guidelines developed by Osteoporosis Canada (Can. Assoc. Radiol. J. 2005;56:178-88).

Bone DESTINY is free to

physicians and is currently being used in the Hamilton, Ont., area. It has not been released for general use yet, but there are plans to make it available throughout Canada, the United States, and Europe. It has been funded by Dr. Bensen and the division of rheumatology at McMaster University, Hamilton.

"Bone DESTINY begins with bone density, then adds a number of other important risk factors," said Dr. Maggie Larché, a rheumatologist at McMaster University. "These include age, steroid use, propensity to fall, history of previous falls, body mass index, and previous fragility fractures."

"These data are plugged into a handheld computer, which then generates a neat graphic with a color-coded representation of the patient's risk." The program's five color codes represent fracture risk; patients at

high (red) or very high (purple) risk for fracture are recommended for treatment. The program also produces an accompanying text report.

In the first of two studies presented at the annual meeting of the Canadian Rheumatology Association, Dr. Larché and her colleagues at McMaster studied the predictive value of the Bone DESTINY program in 14,812 postmenopausal women at least 60 years old. For each patient, a set of treatment recommendations was produced based on BMD alone, on Osteoporosis Canada guidelines, or on Bone DESTINY results.

Among 7,049 patients aged 60-69 years, BMD analysis alone recommended treatment in 19%. By comparison, 20% were recommended for treatment according to OC guidelines, and 28% according to Bone DESTINY. In 5,252 patients aged 70-

79 years, 29% were recommended for treatment based on BMD alone, 43% according to Bone DESTINY, and 51% according to OC guidelines. In 2,511 patients at least 80 years old, 47%, 72%, and 77% would be recommended for treatment according to BMD, OC guidelines, and Bone DESTINY results, respectively.

A second study compared predictive values of the three methods in 572 men and 3,914 women (50 years and older) who had suffered at least one previous fragility fracture.

For all age groups, both Bone DESTINY and OC guidelines recommended treatment in 80% of the women to prevent another fracture; 35% of the women would have received treatment based on BMD alone, Dr. Larché reported.

The most significant difference, however, was observed in

men, in whom Bone DESTINY recommended treatment in 73%, compared with 26% by BMD alone and 41% by OC guidelines.

In an interview, Dr. Larché said these differences may be explained by the weighting of such risk factors as history of falls and propensity to fall, which the OC guidelines do not consider. "We feel they are underestimating rather than we are overestimating the fracture risk, but that's still to be determined."

"In the end, Bone DESTINY has a very similar outcome to OC guidelines, but has the advantage of being very user-friendly," she added. "The primary care physicians absolutely adore it, as do we."

Dr. Larché reported receiving honoraria and/or speakers fees from Amgen, Abbott, BMS, Pfizer, Schering, and GSK. ■