Ten million Americans over the age of 50 have osteoporosis, while 34 million are at risk for developing the disease, according to the 2004 US Public Health Service’s “Bone Health and Osteoporosis: A Report of the Surgeon General.”

According to the report, osteoporosis accounts for more than 1.5 million bone fractures annually, a number that is increasing as the population ages. Moreover, healthcare expenses related to osteoporosis are estimated at $18 billion per year.

Fortunately, technology companies have responded to the need for more precise and accurate bone density screening with innovative high-tech improvements in scanning modalities.

Hologic’s vertebral fracture assessment

Hologic, for example, has introduced the high definition instant vertebral assessment (IVA-HD) spinal imaging modality on its Discovery series of dual-energy X-ray absorptiometry (DXA) densitometers. Used to identify fractures, the instant vertebral assessment (IVA) is a lateral thoracic and lumbar spine vertebral fracture assessment (VFA) performed at the time of a bone mineral density (BMD) study. The IVA-HD doubles the resolution of previous IVA techniques, which improves diagnostic sensitivity and helps physicians more accurately detect vertebral fractures.

Almost two out of three vertebral fractures are asymptomatic, yet approximately one-third of women over the age of 65 have vertebral fractures, says Raymond Cole DO, CCD. Dr Cole is a clinical assistant professor in the Department of Internal Medicine at Michigan State University College of Osteopathic Medicine and Director of the Osteoporosis Testing Center of Michigan. By World Health Organization (WHO) standards, women with vertebral fragility fractures have osteoporosis, regardless of their BMD on densitometry.

For reimbursement, the IVA-HD is coded in the American Medical Association’s Current Procedural Terminology (CPT) system as a vertebral fracture assessment (VFA) using the DXA densitometer code 76077. Medicare began paying for the VFA as of Jan 1, 2005.

Usually performed at the time of a DXA BMD exam, the VFA may be billed as a separate test for eligible Medicare recipients age 65 and older. For example, if a DO performs the standard DXA BMD measurement of the hip and spine as well as the VFA, the BMD can be billed as 76075, while the VFA can be billed as a separate procedure using code 76077. Other insurance companies are slowly getting on board for reimbursement of the VFA exam.

The International Society for Clinical Densitometry (ISCD) supports use of the VFA, noting that the vertebral fracture assessment enhances fracture risk stratification and helps improve physicians’ selection of therapeutic options. The US Surgeon General also supports the use of VFA, citing vertebral fracture as a major risk for future fractures, disability and morbidity. “Fractures due to bone disease are
common, costly, and often become a chronic burden on individuals and society,” the Surgeon General has written. “They often occur silently and have warning signs that are too often dismissed by individuals and health professionals.”

Warning signs of osteoporosis

Technology continues to help physicians uncover the warning signs of osteoporosis. Building on the foundation set by Lunar Prodigy, General Electric (GE) Healthcare has recently unveiled the technologically advanced iDXA. This scanner performs six-point calibration with normal, pre-osteoporotic and osteoporotic BMD values as well as lean, normal and obese values.

With a CZ-HDT™ detector that delivers images of high detail and resolution, the iDXA provides measurements of bone mineral density, body composition and fat distribution. It also is capable of BMD measurement in patients weighing up to 400 pounds.

“The new iDXA provides both excellent image quality and precise bone density measurements to help clinicians diagnose osteoporosis,” says Kenneth G. Faulkner, PhD, vice president of business development at Synarc. “The system can also determine regional body fat composition, which is an important indicator of risk for diabetes and cardiovascular disease.”

The concept of fat distribution is becoming increasingly important as researchers have recently associated cardiovascular disease with excessive fat in the waist or android region, as compared to the hip or gynecoid region.

Writing in the Nov 5, 2005, issue of *Lancet*, investigators from the Population Health Research Institute at Hamilton, Ontario’s McMaster University, report that a patient’s waist-to-hip ratio (WHR) is a better predictor of heart attack risk than their body-mass index (BMI).

Investigators studied the rate of heart attack in more than 27,000 patients, comparing the incidence of heart attack to BMI and WHR. They found that BMI is a relatively weak predictor of heart attack risk when accounting for other risk factors, such as diabetes, smoking, cholesterol, diet, activity and hypertension.

“What we know is that fat in the abdomen, which is associated with a larger waist, is metabolically active and produces various hormones that can cause harmful effects such as diabetes and adversely affect blood pressure and lipid levels,” says Salim Yusuf, MD, director of the Population Health Research Institute at McMaster.

“iDXA’s ability to provide a highly precise measurement of abdominal fat at the time of a bone density test may help assist physicians to better identify patients who may be at risk for chronic diseases, such as coronary artery disease, hypertension, myocardial infarction, hyperlipidemia and diabetes,” says Michigan State’s Dr Cole.

He believes that the iDXA’s advanced measurement technology offers physicians the opportunity for earlier detection, and treatment of osteoporosis. Physicians can obtain highly precise and timely feedback on minor, difficult-to-detect changes in bone and provide patients with information that may motivate them to stick with treatment plans.

To assess for vertebral fractures, GE/Lunar offers advanced technology on its Prodigy series, which allows its densitometers to perform a VFA examination of the lateral thoracic and lumbar spine at the time of the DXA. Lunar calls its version of the VFA the dual-energy vertebral assessment (DVA).

GE’s prodigy series also offers parameters to aid physicians in assessing bone strength and fracture risk. These include hip axis length, upper neck region of interest measurement, a dual-femur assessment in one measurement sequence, orthopedic customized region of interest analysis, and femur-strength index, which combines both geometry and the density of the femur to assess for fracture risk.

CompuMed (www.compumed.net) now offers the OsteoGram, a stand-alone, software-based medical image processing system. It uses conventional film-based hand X-ray of the phalanges to screen for osteoporosis. A hand X-ray is taken using either digital or standard X-ray equipment and is then analyzed using the OsteoGram software.

Linking OsteoGram to digital mammography equipment allows providers to use the system as an accessory tool or to integrate it into a digital workstation. This, in turn, allows physicians to screen women for osteoporosis at the same time they perform an annual mammogram.

New role for MRI

Some researchers believe that although technologies such as bone densitometry and quantitative computed tomography (QCT) can evaluate the results of osteoporosis, they provide no insight into the pathophysiology of the disease. Writing in the September 2005 issue of *Radiology*, James Griffith, MD, of the Prince of Wales Hospital in Hong Kong, reports that magnetic resonance imaging (MRI) has demonstrated that “decreasing marrow perfusion and increasing marrow fat content accompany a reduction in bone density.”

While Dr Griffith predicts that MRI and MRS (magnetic resonance spectroscopy) may never evolve into bone screening tools, he believes that studies of the physiology of aging bone could be useful in tailoring treatment plans for osteoporosis patients or for preventing the onset of the disease.

Other technologies

Peripheral testing of the heel, fingers, shin, or kneecap can be performed by peripheral DXA (pDXA), quantitative ultrasound (QUS), or peripheral QCT scanning (pQCT) technology. However, while physicians may use these technologies to estimate fracture risk, they cannot use the tests to diagnose osteoporosis or monitor the impact of therapy.

According to its official position, the International Society for Clinical Densitometry (ISCD) states, “The World Health Organization [WHO] criteria for diagnosis of
osteoarthritis and osteopenia should not be used with peripheral BMD measurements other than the 33% radius [forearm].”

“Central [hip and spine] DXA is considered to be the ‘gold standard’ method of measuring BMD, diagnosing osteoporosis, and monitoring the effects of osteoporosis therapy,” says Dr Cole.

Susan Ott, MD, associate professor in the Department of Medicine at the University of Washington, agrees, calling DXA “the method used to determine treatment efficacy in recent large clinical trials, and to characterize fracture risk in large epidemiological studies.”

While Dr Ott reports that ultrasound may be a more cost-effective method of screening bone mass, she believes the technology is unable to measure sites of osteoporotic fracture such as the hip or spine. Moreover, adding ultrasound to DXA fails to improve prediction of fractures.

QCT of the spine is limited by the requirement of having to follow protocols used in testing laboratories rather than in community settings. Moreover, because QCT measurements decrease with aging, “T scores” of older individuals are lower than those made with DXA measurements.

**Next generation of osteoporosis assessment tools**

Hologic has announced a strategic research collaboration with The Johns Hopkins University for the development of tomographic 3-D image reconstruction of the hip using Hologic’s Discovery line of bone densitometers.

Because microarchitecture bone structure is an integral component of bone strength, a three-dimensional volumetric density model should provide a more accurate assessment of complex femur bone structure, according to Dr Cole.

“Clinicians have sought the next generation of osteoporosis assessment tools to better predict femur fracture risk,” says Brad Herrington, vice president of Hologic’s Skeletal Health Imaging. “Virtually all imaging modalities have turned to 3-D. Low-dose tomographic assessment of bone density and geometry may provide the ultimate clinical tool to discern bone structure and strength.”

Existing higher-end scanners have the ability to calculate a 10-year absolute risk for any osteoporotic fracture using the patient’s gender, age and BMD. Experts predict that broadened diagnostic and treatment parameters for osteoporosis and fracture risk may be on the horizon. This means that densitometers may be able to calculate a patient’s fracture risk using more inclusive parameters, including clinical risk factors, bone turnover rates, architecture and mineralization.

“There are a number of clinical risk factors that provide information on fracture risk over and above that given by BMD,” says John Kanis, MD, director of the WHO Collaborating Centre for Metabolic Bone Diseases at the University of Sheffield Medical School, Sheffield, England. Writing in Osteoporosis International 2005, Dr Kanis says that “assessment of fracture risk... needs to be distinguished from diagnosis to take account of the independent value of the clinical risk factors.”

Such factors include age, a prior fragility fracture, a parental history of hip fracture, smoking, use of systemic steroids, excess alcohol intake and rheumatoid arthritis. These factors “can be integrated by the calculation of fracture probability with or without the use of BMD,” with treatment “offered to those who have a fracture risk greater than the intervention threshold,” says Dr Kanis.

In the years ahead, healthcare professionals may weigh a patient’s clinical risk factors in terms of their risk for causing fracture and then combine these numbers with the fracture risk determined by a DXA BMD. By programming these parameters into the densitometer’s computer software, healthcare professionals will be able to determine fracture probability or the patient’s 10-year absolute risk for osteoporotic fracture.

Driving the focus on quality assurance are several factors, including the need for unified standards of BMD interpretation, accurate and precise bone density measurement, and the growing complexity of densitometers. Quality assurance programs prefer the certification of physicians who read BMD scans and the technologists who perform scans.

Upon completion of ISCD certification, physicians are awarded the certified clinical densitometrist (CCD) designation. Technicians receive the certified densitometry technician (CDT) designation once they demonstrate proficiency in densitometry.

The American Registry of Radiologic Technologists (ARRT) also awards bone densitometry certification (BD) to technologists upon completion of training and certification testing. Certification requirements vary from state-to-state with some states requiring certification. Individual state requirements for certification are available on the ISCD’s Web site. [www.ISCD.org](http://www.ISCD.org)

**Resources**

- EndocrineWeb.com: The Osteoporosis Center [www.endocrineweb.com/osteo](http://www.endocrineweb.com/osteo)
- GE Medical [www.gemedical.com](http://www.gemedical.com)
- Hologic [www.hologic.com](http://www.hologic.com)
- International Osteoporosis Foundation [www.osteofound.org](http://www.osteofound.org)
- International Society for Clinical Densitometry [www.ISCD.org](http://www.ISCD.org)
- OBGYN.net: Osteoporosis [www.obgyn.net/osteo](http://www.obgyn.net/osteo)
- Osteoporosis & Related Bone Diseases National Institutes of Health—National Resource Center [www.osteo.org](http://www.osteo.org)