BONE MASS MEASUREMENT TECHNIQUES

ABSTRACT:

Osteoporosis is a disease that lowers bone density causing brittle bones. It affects 24 million of Americans. Therefore, physicians request a bone density scan to determinate your actual bone density; to reveal early signs of bone loss and to diagnose low bone mass that may signal the need for treatment. Most of the bone mass measurement techniques currently being used are based on the fact that bone absorbs radiation. For example, the higher the bone density, the more radiation is absorbed. This leaves a correspondingly decreased amount of radiation to reach the radiation detector that is an integral part of these devices. There are several techniques for estimating bone mass, for example, Single Photon Absorptiometry (SPA); Dual Photon Absorptiometry (DPA); Dual Energy X-ray Absorptiometry (DEXA); and Quantitative Computed Tomography (QCT).

SINGLE PHOTON ABSORPTIOMETRY:

Single Photon Absorptiometry (SPA) involves the passing of a collimated bean of low energy photons from a 125I source through a limb and measuring the transmitted radiation using a sodium iodide scintillation detector. In clinical practice, the radius or calcaneous are measured. SPA has been used for more than 20 years. The technique takes only 15 minutes and the cost is very low.

DUAL PHOTON ABSORPTIOMETRY:

Dual Photon Absorptiometry (DPA) is a direct extension of SPA. However, it uses a 153Gd as a source, and measures bone density by determining the absorption of two beans of photons at two different energies. In clinical practices, the lumbar spine and the femoral neck are measured. The technique takes about 20 minutes for each site.

DUAL ENERGY X-RAY ABSORPTIOMETRY:

Dual Energy X-ray Absorptiometry (DEXA) is similar to the Dual Photon Absorpmentry (DPA) although the radioisotope source is replaced by an X-ray source. The two X-ray energies allow the machine to differentiate between bone and soft tissue, giving a very accurate estimation of bone density. This change reduces the problem of decay of isotope sources; as well as increase the speed scan time. The great photon flux permits scan time to be speeded up considerably without loss of precision. Moreover, the beam collimation is also tighter with a higher spartial resolution as a result.

QUANTITATIVE COMPUTED TOMOGRAPHY:

Quantitative Computed Tomography (QCT) is an extension of the computed tomography imaging approach that quantifies the absorption of ionizing radiation by calcified tissue. Advantages of QCT are that trabecular bone can be distinguished from cortical bone, and extraosseous calcium, which will elevate the BDM, by DEXA. However, this technique gives a high radiation dose and a poorer accuracy and reproducibility compared with DEXA and DPA. The scan takes about 15 minutes. In addition is more expensive.

PROCEDURES AND METHODS:

In my visit to Clifton Medical Imaging Center, I had the opportunity to see how a DEXA scan test was done. The test is very simple. It is a noninvasive procedure. First, you will lie without moving on the scan table. Second, the scanner will pass over one area of the skeleton such as the hip or lower spine. Third, a dual energy beam of very low dose x-ray will pass through that area of your body and is measurement by a detector. The radiologist will produce a report for your physician based on the bone density measurements and your medical history. The examination will last approximately 15 minutes. The amount of radiation for a DEXA scan is only a fraction (1/20) of that received from a standard chest X-ray.

INTERPRETATION GUIDELINES:

There are four guidelines for the interpretation of DEXA bone density scan:

1. The colored picture will identify the local areas of grossly altered bone density.
2. The colored graph with T and Z scores will show the relationship between osteopenia /osteoporosis and the patients.
   . The T score is used to predict fracture risk and to diagnose osteoporosis.
   b. The Z score helps to detect whether conditions other than aging and osteoporosis are causing bone loss.
1. The numerical data will give the numerical values of bone mineral density BMD and bone mineral content BMC.
2. The technical data will be the information related to the machine performance.

Your bone mineral density BMD is compared to the average BMD found at peak bone mass achieved between ages 20-30.

CONCLUSION:

In summary, the ideal technique for measurement of bone mass should be reliable, fast, inexpensive and cause only a low radiation exposure. Moreover, it should have a higher level of precision, so that the effects of treatment can be monitored. DEXA scanning has been proven to be the most accurate method of measuring bone mineral density (BMD) because it uses the least amount of radiation and it is lower in cost if we compared with other methods.

COMPARISON OF BONE MASS MEASUREMENT TECHNIQUES

		BODY SITE	ACCURACY	PRECISION	TECHNIQUE TIME	RADIATION DOSE
SINGLE PHOTON ABSORPTIOMETRY	**SPA**	HEEL FOREARM	2-5%	1-2%	15 MINUTES	< STANDARD CHEST X-RAY
DUAL PHOTON ABSORPTIOMETRY	**DPA**	HIP SPINE FOREARM	1-10%	2-4%	20 MINUTES FOR EACH SITE	< STANDARD CHEST X-RAY
DUAL ENERGY X-RAY ABSORPTIOMETRY	**DEXA**	HIP SPINE FOREARM HEEL	4-10%	1-2%	5 MINUTES FOR EACH SITE	< STANDARD CHEST X-RAY
QUANTITATIVE COMPUTED TOMOGRAPHY	**QCT**	SPINE FOREARM	2-15%	0.5-6%	15 MINUTES	50 TO 100 GREATER THAN DPA

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