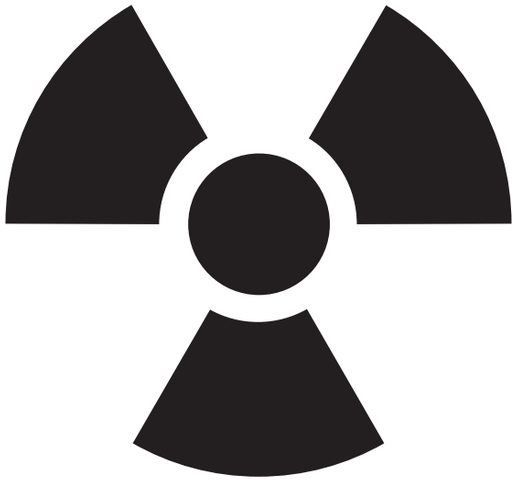
BONE DENSITOMETRY & RADIATION DOSE



Mindways Software, Inc.

Bone density measurements are considered to be a safe and effective means to help the physician evaluate a person's risk for osteoporosis or to monitor changes in bone to assess therapy. "Central" bone density measurements of the spine or hip have been shown to be more useful in diagnosing osteoporosis than are "peripheral" measurements of the hands, wrist or heel. In addition, central bone density measurements are widely considered the preferred means for measuring bone changes with therapy, while health risks associated with these measurements are believed to be very small compared to the clinical benefit obtained from these exams.

QCT and DXA are the two techniques used for central bone density measurements. Both techniques use low doses of x-rays to sample bone in the hip or spine. A common misconception is that QCT x-ray doses are much larger than DXA x-ray doses, and consequently more likely to result in adverse health conditions. In reality, x-ray doses from QCT and DXA are comparable—especially when considering that a DXA study is often accompanied by a lateral spine x-ray. And in all cases, the typical x-ray doses received from DXA or QCT examinations are small in comparison to other common radiation sources and are believed to represent no significant health risk.

The actual health risks from exposure to low x-ray doses are difficult to determine. They are estimated from known hazards from high doses, like those experienced by atomic bomb survivors. No risk of adverse health conditions have been established for lower exposures of 5000 mrem or less. Conservatively, health experts assume radiation health risks are proportional to exposure. This leads to pessimistic estimates of a 0.01% chance of developing cancer due to a 1000 mrem x-ray dose, compared to a normal lifetime risk of cancer for women in the US of 33%[1]. All doses from bone density measurements are less than 10 mrem. By comparison, natural background radiation is about 300 mrem/year, an x-ray of the spine is 70 mrem, a mammogram is 45 mrem, and a round trip transcontinental plane flight is 6 mrem.

IN ACCORDANCE WITH current knowledge of radiation health risks, the Health Physics Society recommends against quantitative estimation of health risk below an individual dose of 5 rem in one year or a lifetime dose of 10 rem in addition to background radiation. Risk estimation in this dose range should be strictly qualitative accentuating a range of hypothetical health outcomes with an emphasis on the likely possibility of zero adverse health effects. The current philosophy of radiation protection is based on the assumption that any radiation dose, no matter how small, may result in human health effects, such as cancer and hereditary genetic damage. There is substantial and convincing scientific evidence for health risks at high dose. Below 10 rem (which includes occupational and environmental exposures), risks of health effects are either too small to be observed or are non-existent.

… the Society has concluded that estimates of risk should be limited to individuals receiving a dose of at least 5 rem in one year or a lifetime dose of at least 10 rem in addition to natural background. Below these doses, risk estimates should not be used: expressions of risk should only be qualitative emphasizing the inability to detect any increased health detriment (i.e., zero health effects is the most likely outcome).

RADIATION RISK IN PERSPECTIVE
Health Physics Society Position Statement on Risk from Ionizing Radiation

Typical Effective X-Ray Doses[2] (ICRP 60)

for Common X-Ray Procedures and Various Natural Sources

Source	Dose (mrem)
Annual natural background exposure	300
Lateral lumbar spine x-ray	70
Mammogram	45
Dental x-ray	10
Transcontinental flight, round trip	6
QCT with localizer	3–10
Chest x-ray	5
DXA, hip or spine	1–6
One week ski vacation	1–2
DXA, wrist or heel	<1

*1 mrem = 0.01 μSieverts

References

Kalender WA. Effective dose values in bone mineral measurements by photon absorptiometry and computed tomography. Osteoporosis Int 2: 82-87, 1992.

Lewis MK, Blake GM, Fogelman I. Patient dose in dual x-ray absorptiometry. Osteoporosis Int 4: 11-15, 1994.

Steel SA, Baker AJ, Saunderson JR. An assessment of the radiation dose to patients and staff from a Lunar Expert-XL fan beam densitometer. Physiol Meas 19: 17-26, 1998.

ICRP Publication 60. 1990 Recommendations of the International Commission on Radiation Protection, Annals of the ICRP 21: no. 1-3, 1991.

Cameron J. Radiation dosimetry. Environmental Health Perspectives 91: 45-48, 1991.

[1]The American Cancer Society "Cancer Statistics for 1998" estimates that 1 in 3 women and 1 in 2 men in the US have a risk of getting cancer or dying from it during their lifetime.

[2]X-ray doses are expressed as "effective dose" according to guidelines used by the American Association of Physicists in Medicine. Effective doses are based on the amount of radiation exposure for a procedure and the amount of the body exposed to the radiation, and are used to compare relative health risks from the exposure. Effective doses are given in units of millirem (mrem). Sometimes they are also given in microSieverts (1 mrem = 10 μSv).

Mindways Software, Inc.
282 Second St., 4th Floor
San Francisco, CA 94105
Tel: 415 247 9930
Internet: www.qct.com

©1998 Mindways Software, Inc.

Typical X-Ray Doses (ICRP 60) for Common X-Ray Procedures and Various Natural Sources

DXA, wrist or heel
<1 mrem

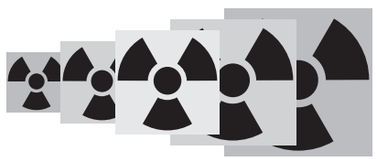
Transcontinental flight, round trip
6 mrem

One week ski vacation
1–2 mrem

Dental x-ray
10 mrem

Chest x-ray
5 mrem

Mammogram
45 mrem



DXA, hip or spine
1–6 mrem

QCT with localizer
3–10 mrem

Lateral lumbar spine x-ray
70 mrem

Annual natural background exposure
300 mrem