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Feasibility of Using Higher Energy Beam Pairs to Improve DXA Accuracy

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In standard DXA the fat content of the soft tissue containing the bone is assumed to be the same as the soft tissue in the baseline region of the scan adjacent to the bone. Unfortunately, this assumption is rarely correct and inaccuracies in BMD can exceed 20 % in clinically realistic cases. Moreover, changes in fat content resulting from weight loss or gain makes interpretation of changes seen in BMD problematic. The cause of the inaccuracy is the large difference in the attenuation characteristics of fat and lean tissues at the effective energy of the low energy beam used in standard DXA. A mathematical simulation of DXA using monoenergetic photon beams was performed using beam energy pairs higher than used for standard DXA. In the simulation the low energy beam was varied from 80 to 110 keV with the high energy beam held constant at 140 keV. The entrance doses of the simulations were varied to maintain a measurement precision equivalent to that of standard DXA. For simulated DXA using higher beam energy pairs the BMD error due to inhomogeneities in the fat content of soft tissue was eliminated. The entrance skin dose for the higher energy beam pairs needed to be increased to achieve the same measurement precision as standard DXA.
Thus, the accuracy of BMD measurements can be improved by using higher energy beam pairs with a modest increase in entrance dose. This improvement in accuracy allows the accurate assessment of BMD changes in patients experiencing weight change.