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Assessment of Trabecular Bone Status

A.M. Parfitt, MBB Chir*

Ed. Note - This overview was originally presented at the International Symposium on Clinical Disorders of Bone and Mineral Metabolism, May 9-13, 1983. The following list indicates the presentations given in this session at the Symposium and the contents of the corresponding chapter in the Proceedings of the Symposium published by Excerpta Medica. The numbers in parentheses refer to pages in this volume. Complete information about the contents of the Proceedings can be found at the back of this issue.

Problems in measurement of trabecular bone. R.B. Mazess (30)
Clinical application of peripheral computed tomography. P. Ruegsegger and M. Dambacher (48)
Comparison of trabecular bone density at axial and peripheral sites using computed tomography. T.N. Hangartner, T.R. Overton, and W.M. Rigal (54)
Comparison of dual photon absorptiometry and quantitative computed tomography of the lumbar spine in the same subjects. M.R. Powell, F.O. Kolb, H.K. Genant, C.E. Cann, and B.G. Stebler (58)

At our last clinical symposium in 1972 (1), the assessment of cortical bone by radiogrammetry and by single energy photon absorptiometry was discussed in detail. The uses and limitations of these methods are now well established and have provided an extensive body of data on age-related loss of cortical bone. We now need similar data for trabecular bone because of many differences between these two types (see Table).

The study of trabecular bone is attended by many more technical problems than the study of cortical bone. Some of the methods for measuring trabecular bone are given below:

- Histomorphometry (ilium, vertebra)
- Photodensitometry (phalanges, vertebrae)
- Compton scatter (calcaneum)
- Single energy photon absorptiometry:
  - single path (radius)
- Single energy photon absorptiometry:
  - multi-path (radius)
- Partial body neutron activation (trunk)

Although histomorphometry of trabecular bone is useful in population studies, it is a cumbersome, inaccurate method for determining trabecular bone mass in individual subjects. Photodensitometry using an aluminum or potassium phosphate stepwedge is subject to several sources of error, but it needs no capital investment and could be used more widely (4). The description of the Compton scatter technique at the last meeting aroused much excitement, but a decade later a clinically useful procedure has still not been perfected (5). Single energy photon absorptiometry at the distal measurement site in

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the radius is frequently, but erroneously, believed to
found is metabolically inert and contributes little to the
than is commonly supposed, and the trabecular bone
provide information on trabecular bone (6). However,
restriction of multiple levels that
instruments capable of scanning at multiple levels that
can get closer to the active trabecular bone in the meta-
instruments suitable for monitoring the short-
native study of trabecular bone in the last ten years. There is
be made an excuse for curtailing the duration of thera-
in both precision and accuracy is likely, but this must not
be an excuse for curtailing the duration of thera-
A great deal of progress has been made in the noninva-
the radius is frequently, but erroneously, believed to
with cross-sectional data. This may reflect in part the
with and without vertebral compression fracture much better than single
energy PA of the radius.
Genant, et al (pp. 40 ff.) reviewed the advantages of QCT
for selective examination of trabecular bone and de-
scribed how recent technical advances have reduced the
error due to variable marrow fat. In contrast to DPA, a
postmenopausal acceleration of trabecular bone loss is observed with QCT. Discrimination between persons
with and without compression fracture appeared less
satisfactory than with DPA, but this may have been the
result of including some patients with wedging but with-
out compression of a vertebra. However, as with DPA,
discrimination is much better than with measurements of peripheral cortical bone.
Ruegsegger and Dambacher (pp. 48 ff.) described the
application of QCT to trabecular bone of the extremities,
particularly the distal radius and distal tibia. This tech-
nique has the highest precision of all the methods dis-
cussed, allowing the demonstration for the first time that
bone loss in some patients occurs in abrupt steps rather than
continuously. Because of its high precision, the
technique is also ideally suited for monitoring the short-
term response to a large number of potential therapeutic
agents that could be used in accordance with the
Activation-Depress-Free-Repeat (ADFT) concept of Frost.
Using a similar method, Hangartner (pp. 54 ff.) observed
a significant correlation between trabecular bone den-
sity measured by QCT in the distal radius and in the spine
but with a prediction error of about 20%. The implication
of this new approach remains to be explored in detail.
Finally, Powell, et al (pp. 58 ff.) reported a rather low
correlation between QCT and DPA measurements in the
same subjects, although QCT correlated somewhat bet-
ter than DPA with a semi-quantitative fracture index.
A great deal of progress has been made in the noninva-
sive study of trabecular bone in the last ten years. There is
still controversy about the size of the error due to vari-
ble marrow fat and about the success of different tech-
niques in coping with this error. More studies are
needed directly comparing the two major techniques of
DPA and QCT in the same subjects, particularly serial
measurements by both methods. Further improvement
in both precision and accuracy is likely, but this must not
be made an excuse for curtailing the duration of thera-
peutic studies, which is dictated by the biological charac-

### TABLE

<table>
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<th>Comparison of Cortical and Trabecular Bone</th>
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<tr>
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</table>

*In humans, a temporary physiologic need for bone mineral during
growth, pregnancy, and lactation is met by increased cortical porosity
(2), and the most important long-term response to increased parathy-
roid hormone secretion is cortical thinning (3).
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teristics of the remodeling system and not by technical factors in the methods of measurement (9).

Also, much more is involved in the study of trabecular bone than simply measuring its amount. The complex three-dimensional structure of this tissue, which is clinically important for several reasons, is accessible to high resolution CT applied to iliac bone samples (10). Perhaps in another decade instrumental resolution will increase to the extent that similar information can be obtained from the intact patient, but this will probably require the application to bone of even newer methods such as nuclear magnetic resonance.

References


