Femoral Trabecular Patterns and Bone Mineral Content^{*‡}

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Introduction

We were intrigued by a recent article published by Singh and co-workers⁷. This article described a method of diagnosis and grading of the degree of osteoporosis in the proximal femur on the basis of trabecular pattern. The purpose of our study was to determine the relationship between the femoral rating system of Singh and the measured bone mineral content (BMC) of the radial midshaft in a series of women.

Cameron and co-workers at the University of Wisconsin have developed an accurate method of determining BMC by means of ^{125}I photon absorptiometry^{3,9}. This method is consistently reproducible at the 2% level^{2,6}. The ^{125}I photon absorptiometric method of measuring bone mineral content has demonstrated agreement with ash measurements of cadaver bones at the 3% level^{2,6}. In addition, the usefulness of the radial midshaft BMC determination in assessing the degree of generalized osteoporosis has been established in our laboratory and in other laboratories using the same measurement site and technique^{4,5,8}. Measurements of BMC made at the radial midshaft correlate well with measurements made at other sites on the appendicular skeleton including the humeral midshaft, ulnar midshaft, distal ulna and radius, distal femur, and tibial and

fibular midshaft. In addition, the radial BMC measurement correlates well with the grade of spinal osteoporosis as determined radiographically and with the vertebral and whole skeleton ash content as measured on cadavers. Detailed descriptions of the technique are available in the literature.

Methods

Nineteen subjects were included in the study. They were females at least forty-eight years old who had no evidence of rheumatoid arthritis. These women had never received corticosteroid therapy. The group contained nine presumably nonosteoporotic controls and ten patients known to have symptomatic osteoporosis. We defined symptomatic osteoporosis to be the presence of vertebral collapse or femoral neck fractures associated with minimal trauma.

Anteroposterior radiographs of the proximal femora of these subjects were taken while their hips were internally rotated 20° . Three hips were not included in the study because of the presence of a femoral nail, an Austin-Moore prosthesis, and an ununited femoral neck fracture. Two orthopedic residents and three orthopedic staff members rated the hip films according to Singh's system.

Results

Femoral trabecular patterns can be consistently scored by different individuals. The root-mean-square deviation about the mean score for each femur was 0.86 points on a scale of one to six. Over 90% of the scores were within 1.2 points of the mean for each femur. For the sixteen subjects in which bilateral hip films were used, there was good agreement between the scores for left and right femora (Fig. 1).

There was no significant correlation between the femoral trabecular score and the radial bone mineral content. In fact, there was a slight negative correlation ($r = -0.130$) between these two parameters (Fig. 2). As osteoporosis develops, resorption of fine trabeculae makes a coarse trabecular pattern more apparent. This factor may be responsible for the negative correlation. An illustration of the negative correlation between the femoral score and BMC is provided by a forty-eight year old woman (M.S.) with known symptomatic osteoporosis. She had the second lowest BMC in our series (0.58 g/cm). The mean bone mineral content for women referred to our laboratory with spontaneous hip or vertebral fractures is 0.62 ± 0.12 (standard deviation) g/cm. The upper limit of BMC for women with spontaneous fractures⁸ is about

0.80 g/cm. The average bone mineral content for normal forty to forty-nine year old women¹ is 0.98 ± 0.10 g/cm. Yet, the trabecular ratings for this woman averaged 5.6--the highest in our series (Fig. 3).

We then tested the relationship between the femoral score and the bone mineral content corrected for age. For this test, the difference (Δ BMC) between the BMC of each patient and the mean BMC of clinically normal women of the same age range was expressed as a function of femoral score. A statistically insignificant negative correlation ($r = -0.242$) was obtained (Fig. 4). The normal values of BMC were obtained from a previously published report¹.

It is our impression that the tensile trabeculae are relatively less prominent and often nearly absent in valgus hips (Fig. 5). We have also noted a poor association between femoral cortical thickness and scores based on trabecular patterns.

Conclusion

On the basis of these observations, we conclude that the trabecular patterns of the proximal femur as described by Singh and co-workers are not correlated with bone mass. Thus, these trabecular patterns are of little or no help in establishing the

diagnosis or severity of osteoporosis.

Summary

Radiographs of thirty-five hips internally rotated by 20° in nineteen women at least forty-eight years old without rheumatoid arthritis were scored for the relative degree of osteoporosis according to criteria published by Singh and co-workers. Bone mineral content of the radial midshaft was measured in these women by the ^{125}I photon absorptiometric method developed by Cameron and co-workers.

No significant correlation was found between these two parameters either directly or after correction of the bone mineral data for the ages of the subjects.

We conclude that the trabecular scoring method described by Singh and co-workers is of little or no help in establishing the diagnosis for severity of osteoporosis.

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Fig. 1: Mean trabecular score of right femur versus mean score of left femur in sixteen women. Note that thirteen of the sixteen pairs of scores agree within one point.

Fig. 2: Radial midshaft bone mineral content (BMC) versus mean femoral score. Note the lack of significant correlation between these two parameters.

Gilbert Bond
25% COTTON

Fig. 3: Left femur with a mean score of 5.8. The score of the right femur of this patient was 5.4. The bilateral average score of 5.6 was the highest in our series although the BMC of 0.58 g/cm was the second lowest in our series.

Fig. 4: Radial midshaft BMC corrected for age versus mean femoral score. Negative values signify below normal BMC. There is no significant correlation.

Fig. 5: Valgus hip. Note the relative absence of the principal tensile trabeculae. The absence of these trabeculae was a common finding in valgus hips. The mean score for this femur was 3.0, yet the BMC of this patient was 0.86 g/cm²--a normal value. In fact, this woman had the third highest BMC in our series. Note that the femoral cortex is relatively thick even though the trabecular score of 3.0 was the second lowest in our series.