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Perspective Article

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Osteoporosis and fracture risk: bone matrix quality

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Increased fracture risk is generally associated with the reduced bone mineral density (BMD) found in osteoporotic and osteopenic individuals, but the relationship between bone mass and fracture risk is an imperfect one. The results of anti-resorptive treatment on BMD and fracture risk provide the best example of this. The maximal fracture reduction with treatment occurs in the first year of treatment, whereas BMD continues to increase for at least several more years[1-4]. Black et al. in a meta-analysis of 13 randomized trials which used alendronate, raloxifene, calcitonin, estradiol, etidronate, risedronate or tiludronate found that the observed fracture risk reduction from anti-resorptive therapies was at least twice as large as would be expected from the changes in BMD alone[5]. Moreover, despite differences in the extent to which the different compounds increase BMD, reductions in spine fracture after three years are all similar[6] (Table 1).

Compound	Increased BMD	Reduction in fracture incidence
Alendronate[1, 2]	6.2%	50%
Risedronate[3]	5.4%	41%
Raloxifene[7]	2.6-2.7%	34-47%
Calcitonin[8]	1-2%	30-35%

Table 1. Increased vertebral BMD and reduced fracture incidence after three years' treatment with four anti-resorptive compounds.

The disconnect between BMD and fracture risk is often attributed to the quality of the bone matrix. "Bone quality" is used and defined in a variety of ways. In this session, three aspects of bone matrix quality will be considered: (1) collagen effects (**Dr. Bailey**); (2) mineral effects (**Dr. Boskey**); (3) architectural effects independent of bone mineral, including those induced by changes in bone turnover rate (**Dr. Weinans**). The role that anti-resorptive therapies play in altering the mineral fraction itself and how these might be responsible for the greater than expected reduction in fracture incidence will be addressed by **Dr. Boivin**.

A biomechanical understanding of the potential effects of variations in collagen, mineral and architecture is a necessary prerequisite to an understanding of how such changes might affect the amount of energy required to fracture a bone. **Dr. Turner** will set the stage for a discussion of variations in bone matrix and architecture by examining the biomechanical implications of changes in tissue quality.

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