

Summary

## Bone quality: Summary of NIH/ASBMR meeting

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The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) and the American Society for Bone and Mineral Research (ASBMR) hosted "Bone Quality: What Is It and Can We Measure It?" on May 2-3, 2005. The meeting was co-sponsored by the Institut National de la Santé et de la Recherche Médicale (the French National Institute of Medical Research, or INSERM) and the National Institute for Biomedical Imaging and Bioengineering (NIBIB). Since the NIH sponsored the "Workshop on Aging and Bone Quality" more than 10 years ago, experts have continued to debate the significance of bone quantity vs. bone quality in the diagnosis and treatment of osteoporosis. Despite important scientific advances in the last decade, including new osteoporosis treatments and increased knowledge of the factors that contribute to skeletal fragility, bone fractures are still common today. The recently published *Bone Health and Osteoporosis: A Report of the Surgeon General* notes that more than 1.5 million Americans suffer an osteoporosis-related fracture each year. It also cites a prediction that as our population ages, the number and cost of osteoporotic fractures will double over the next 50 years.

Reducing the incidence of fractures will require further improvements in diagnosis and treatment based on a deeper understanding of bone strength. Understanding osteoporosis and fracture risk requires studying both the amount of bone and its quality. The meaning of the term *bone quality* is a subject of confusion, and a review of the medical literature in the field will give you many different definitions. The term *bone quality* has been used ambiguously to describe various factors that influence bone strength; however, its precise definition and the practical implications of measuring it remain obscure. Some of the factors associated with bone quality include the macrostructural and microstructural architecture, the tissue

material properties, the lamellar properties, the remodeling dynamics, microporosity, the mineralization profile, the accumulation of microdamage, and the chemical constituency of the extracellular matrix. All of these factors come into play under the strong influence of genetic modulation and regulation. These components are interdependent: a primary abnormality in one aspect usually will be associated with alterations in other aspects. Ideally, it would be beneficial to take all the factors that might contribute to fracture, including mineralization, the rate of remodeling, extracellular matrix properties, microdamage, bone mineral density, and so on, and put them in an equation to enable the calculation of fracture risk. Because that is unlikely, the research community must try to determine which of these factors are highly correlated with fracture risk, and whether they or their surrogates can be measured.

The purpose of this meeting was to examine these implications and to look at bone quality from the perspectives of basic and clinical scientists. The meeting brought together young investigators and senior scientists from diverse fields, including engineering, physics, biology, and clinical medicine, to share cutting-edge research, debate current paradigms, and foster innovative collaborations. Meeting participants discussed topics such as the effect of osteoporosis therapies on the architecture of bone, factors that contribute to bone fracture, the mechanics of fracture, novel techniques for addressing skeletal fragility, the best methods for conducting clinical trials in osteoporosis, and the most promising techniques for widespread clinical evaluation. A video transcript from this meeting can be viewed at the American Society for Bone and Mineral Research web site at [www.asbmr.org/bonequality.cfm#WebCast](http://www.asbmr.org/bonequality.cfm#WebCast). A summary of the findings from this meeting and future directions for the field will be discussed during this session.

The author has no conflict of interest.

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