

Bone Quality: From Bench to Bedside

Opening Editorial Comment

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The term “bone quality” is frequently used by clinicians, basic scientists, and engineers. However, do they mean the same thing? In this symposium, we asked the authors what they meant by “bone quality,” and as the reader will discover, there are many aspects of bone quality that vary in importance and scope with the person providing the definition. In recent years, numerous reviews have explored and described bone quality (eg, [2–25, 29]) and some have discussed therapies for fragility fractures [13], but none has emphasized the transition from the bench to the bedside (and the operating room). In fact, the majority of these reviews of bone quality are either engineering or basic bone biology articles [3–6, 10, 11, 16], including imaging techniques [3, 8, 12, 17, 20, 25], or papers on how to treat osteoporosis [5, 7, 9, 15, 18, 19, 21, 23, 24]. Here too we review those topics, providing recent research data from leaders in the field. This symposium reviews and makes suggestions for appropriate management of individuals with impaired bone quality because the orthopaedic surgeon sees cases where the quality of the bone is abnormal, whether in patients with osteoporosis, osteopetrosis, cancer [14], or a metabolic problem, such as diabetes [22], kidney disease [29], or rheumatoid arthritis, and because little guidance is available on pre- and postsurgical management of these cases.



Fig. 1 Adele L. Boskey, PhD, is shown.



Fig. 2 Eve L. Donnelly, PhD, is shown.

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We, the guest editors for this symposium, hope the material we provide will serve as a convenient and long-lasting reference for what bone quality is, how it can be measured, how it can be manipulated, and how the orthopaedic clinician should think about it when planning surgery and postoperative care or clinical research studies.



Fig. 3 J. Gregory Kinnett, MD, is shown.

The symposium starts with an overview of the different methods used to measure bone quality. This is followed by papers elaborating on the information that can be learned by selected examples of these techniques. The first paper by Dr. Donnelly should thus be used as a guide for selecting which methodology-based papers need to be read in more depth. After describing methods, papers are presented on diseases, including but not limited to osteoporosis, in which bone quality is altered, reviewing diagnostic methods and therapeutic management of patients with “altered bone quality.” Finally, we conclude with papers on the posttreatment management of these patients. Unfortunately, it was not possible to provide papers on all the new methods for characterizing bone quality, such as phosphorus-31 nuclear magnetic resonance [1, 27, 28] nor was it possible to provide descriptions of all of the newer therapies in preclinical and clinical trials aimed at preventing fracture reduction. Nonetheless, we hope the symposium will provide guidance for surgeons dealing with patients with altered bone quality and also will identify areas where additional investigations are needed. It is also hoped the clinician reader will appreciate how techniques such as Raman imaging of bone might soon be extended to clinical practice, bridging the gap between the laboratory and the clinic.

The invited contributors were asked to define bone quality from their perspective and review the field, including, where applicable, providing examples from their own unpublished data. Because of this model, there is some redundancy in the papers, but we have done our best to ensure this does not happen too frequently.

The guest editors would like to thank all the authors who contributed to this symposium and all the reviewers who provided input on these articles. We hope the readers will find this both useful and informative and they will consider the many qualities of bone when they are treating their patients and trying to explain unexpected bone properties.

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