



## Biobone Symposium

13-15 October 2015 - Santiago de Compostela, Spain

---



### Dr. Sandra Shefelbine

Principal Investigator

Department of Mechanical and Industrial Engineering, Northeastern University, Boston, MA, USA

[www.shefelbine.org](http://www.shefelbine.org)

---

### What makes bone tough?

**Abstract:** Structural and compositional properties of bone throughout its hierarchy (from the whole bone to the molecule) are responsible for its unique mechanical properties, particularly its strength and toughness and its ability to adapt to mechanical load. Disruptions within the hierarchy or alterations in the mechanical load on the bone can result in changes in its mechanical and structural properties. We have examined multi-scale mechanics, structure, and composition of the genetic bone disease, osteogenesis imperfecta, which is caused by mutations of the collagen and results in extremely brittle bones. At the whole bone level we measured fracture resistance; at the tissue level we examined porosity, mineral density, collagen structure, and tissue modulus; at the mineralized fibril level we measured fibril strain and stiffness, mineral structure, and composition. We have used molecular modeling to understand the effects of altered amino acid composition on protein mechanics. By understanding how a molecular defect results in an organ level pathology, we can determine the critical components of the hierarchy. We are now using the multi-scale pipeline to investigate other mouse models of skeletal pathologies in order to determine relationships between structure, composition, and mechanics at different length-scales. We also use computational and in vivo models to examine how bone adapts to mechanical loading. Harnessing bone's mechanosensitivity could provide novel paradigms for therapies addressing bone deficits or deformities and in optimizing tissue engineering of mineralized constructs.

**Bio:** Dr. Sandra J. Shefelbine is currently on the faculty in the Department of Mechanical and Industrial Engineering at Northeastern. She received her BSE from Princeton University in Mechanical and Aerospace Engineering, an MPhil in Engineering Design from Cambridge University, and a PhD from Stanford University in Mechanical Engineering. She was recipient of the National Science Foundation International Post-Doctoral Fellowship for work at the Institute for Orthopedic Research (Ulm, Germany) and subsequently had a post-doctoral fellowship in the Department of Radiology at UCSF. She was a Reader in the Department of Bioengineering at Imperial College in London before moving to Boston in 2013. She currently lectures mechanics and musculoskeletal biomechanics and is the recipient of numerous teaching awards.