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Single-molecule studies of collagen mechanics NANCY FORDE, NAGHMEH REZAEI, Department of Physics, Simon Fraser University, MICHAEL KIRKNESS, Department of Molecular Biology and Biochemistry, Simon Fraser University — Collagen is the fundamental structural protein in vertebrates. Its triple helical structure at the molecular level is believed to be strongly related to its mechanical role in connective tissues. However, the mechanics of collagen at the single-molecule level remain contentious. Estimates of its persistence length span an order of magnitude, from 15-180 nm for this biopolymer of 300 nm contour length. How collagen responds to applied force is also controversial, with different single-molecule studies suggesting one of three different responses: extending entropically, overwinding, or unwinding, all at forces below 10 pN. Using atomic force microscopy to image collagens deposited from solution, we find that their flexibility depends strongly on ionic strength and pH. To study force-dependent structural changes, we are performing highly parallelized enzymatic cleavage assays of triple helical collagen in our new compact centrifuge force microscope. Because proteolytic cleavage requires a locally unwound triple helix, these experiments are revealing how local collagen structure changes in response to applied force. Our results can help to resolve long-standing debates about collagen mechanics and structure at the molecular level.

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