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Liquid-like bundles of crosslinked actin filaments contract without motors

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The actin cytoskeleton is a dynamic, structural material that drives cellular-scale deformations during processes such as cell migration and division. Motor proteins are responsible for actively driving many deformations by buckling and translocating actin filaments. However, there is evidence that deformations, such as the constriction of the actin bundle that drives the separation of cells during division, can occur without motors, mediated instead by crosslinker proteins. How might crosslinkers, independent of motors, drive contraction of a bundle? Using a model system of purified proteins, we show that crosslinkers, analogous to molecular cohesion, create an effective surface tension that induces bundle contraction. Crosslinked short actin filaments form micron-sized spindle-shaped bundles. Similar to tactoid granules found at the isotropic-nematic phase transition in liquid crystals, these bundles coarsen and coalesce like liquid droplets. In contrast, crosslinked long filaments coarsen into a steady state of bundles that are frozen in a solid-like network. Near the liquid-solid boundary, filaments of intermediate length initially form bundles that spontaneously contract into tactoid droplets. Our results, that crosslinked actin bundles are liquid-like with an effective surface tension, provide evidence for a mechanism of motor-independent contractility in biological materials.