Minute negative superhelicity is sufficient to induce the B-Z transition in the presence of low tension

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Left-handed Z-DNA has fascinated biological scientists for decades by its extraordinary structure and potential involvement in biological phenomena. Despite its instability relative to B-DNA, Z-DNA is stabilized *in vivo* by negative supercoiling. A detailed understanding of Z-DNA formation is, however, still lacking. In this study, we have examined the B-Z transition in a short GC repeat in the presence of controlled tension and superhelicity via a hybrid technique of single-molecule FRET and magnetic tweezers. The hybrid scheme enabled us to identify the states of the specific GC region under mechanical control and trace conformational changes synchronously at local and global scales. Surprisingly, minute negative superhelicity can facilitate the B-Z transition at low tension, indicating that tension, as well as torsion, plays a pivotal role in the transition. Dynamic interconversions between the states at elevated temperatures yielded thermodynamic and kinetic constants of the transition. Our single-molecule studies shed light on the understanding of Z-DNA formation by highlighting the highly cooperative and dynamic nature of the B-Z transition.