In this study, we investigated type I collagen fibrillogenesis through the sol-gel transition using simultaneous confocal reflectance microscopy, confocal fluorescence microscopy, and rheology. The multi-modal approach allows direct correlation of the evolving microstructure and the evolving viscoelastic properties on the fibril and network length scales. Such measurements also allow a rheological gel-point to be determined. For the 1.0 mg/mL collagen gels assembled at 25°C studied, a frequency-independent rheological gel-point was found to occur at 12.3 min, where storage and loss moduli both displayed power-law scaling with a scaling exponent of $\Delta = 0.78$. These findings are consistent with results for chemical gels despite the more heterogeneous structure and absence of chemical cross-links in the investigated collagen gels. Importantly, simultaneous imaging revealed a network spanning structure at the rheological gel-point, indicating that collagen I gelation could be successfully described structurally and mechanically within the percolation model. Quantitative assessment of collagen structural diameter showed that collagen was present primarily as single fibrils of ~40 nm at the sol-gel transition and became thicker as gelation continued. This study clarifies how structure sets viscoelasticity during collagen fibrillogenesis and more broadly highlights the utility of multi-modal approaches in studying how structure determines mechanical properties in evolving networks.

Plenty of pizza will be provided.