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Traction force and tension fluctuations in growing axons JEFFREY URBACH, JAMIE POLACKWICH, DANIEL KOCH, RYAN MCALLISTER, Georgetown University, HERBERT GELLER, NHLBI, NIH — Actively generated mechanical forces play a central role in axon growth and guidance during nervous system development. We describe the dynamics of traction stresses from growth cones of actively advancing axons from postnatal rat DRG neurons. By tracking the movement of the growth cone and analyzing the traction stresses in a co-moving reference frame, we show that there is a clear and consistent average stress field underlying the complex spatial stresses present at any one time. The average stress field has strong maxima on the sides of the growth cone, directed inward toward the growth cone neck. This pattern represents a contractile stress contained within the growth cone, and a net force that is balanced by the axon tension. In addition, using high time-resolution measurements, we show that the stress field is composed of fluctuating local stress peaks, with a population of peaks whose lifetime distribution follows an exponential decay, and a small number of very long-lived peaks. We also find that the tension appears to vary randomly over short time scales, roughly consistent with the lifetime of the stress peaks, suggesting that the tension fluctuations originate from stochastic adhesion dynamics.

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