Characterization of premature axon branching in the developing mammalian peripheral Nervous system

Abstract

During postnatal mammalian development, the pattern of motor axon branching within a muscle is refined through synapse elimination. While a small number of motor axons branch within the nerve fascicle before reaching the target muscle, the nature of this extramuscular premature branching and its role in neuromuscular system development is not currently understood. To characterize the phenomenon of premature axon branching in postnatal development, I used transgenic mice that express fluorescent protein in neurons in order to image motor nerves at high resolution. By examining motor nerves in cross section at numerous age points, I found that premature branching is more prevalent at early developmental ages with respect to adulthood, as demonstrated by the increased number of premature branches within the nerve and thus the number of axons entering the muscle. Rather than being clustered close to the target muscle, premature branches are distributed roughly evenly along the length of the nerve. The existence of retraction bulbs within the nerve suggests that the reduction of premature branching during development is due to refinement along the length of the nerve. These results demonstrate that the process of competitive synapse elimination results in larger scale refinement than previously thought. The non-optimal wiring diagram conferred by premature branching may be a byproduct of mammalian nervous system development.