1. Changes in neuronal surface area may be monitored by measuring the plasma membrane capacitance [8]. Membrane time constant (tao m) is given by the product of the membrane resistance (rm) and membrane capacitance (Cm), tao m = rm Cm.

Brain Res Brain Res Protoc. 1997 May;1(2):114-6.

Membrane time constant as a tool to assess cell degeneration.

1. The passive properties in the soma and dendrites must also be changed. Subthalamic nucleus projection neurons in rat have a membrane time constant of 6msec. As we assume all cells have approximately the same membrane capacitance (1 µF/cm2), by using the assumption of an RC circuit we can calculate the subthalamic nucleus projection neuron membrane resistance from:

time constant = Resistance \* Capacitance

This yields a membrane resistance of 6000 ohms cm2. Remember, NEURON requires this as a conductance g\_pas (which is the reciprocal of the resistance, i.e. 0.0001667 S/cm2). Subthalamic nucleus cells also have a very high resting membrane potential, so our leakage equilibrium potential (e\_pas) is set to -60mV. The dendrite definition then becomes (for dendrite 0):

<http://web.mit.edu/neuron_v7.4/nrntuthtml/tutorial/tutB.html>

 In human sensory-motor cortex, the total neuronal arbor volume of Betz cells is on average about 20 times higher than that of TTL5 neurons in motor cortex (Rivara et al., [2003](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4481152/#B262); Sherwood et al., [2003](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4481152/#B284)). I

. Inward rectification, as shown by steady-state I–V relationships in the tuft indicates a selective increase in the dendritic Ih conductance (Zhu, [2000](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4481152/#B359)).

Interestingly in another study by Lazarov et al. ([2018](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6759653/#B114)), APs were initiated in the AIS, even when axonal Nav channel density was reduced to about 10% in a beta IV spectrin mutant mouse. This experimental finding indicates to a great extent that AP initiation in the AIS does not require such a high local channel density. However in that study, the precision of AP timing was substantially compromised when axonal channel density was reduced. Likewise, the temporal accuracy of AP generation from MNTB cells decreases in a beta IV spectrin mutant mouse (Kopp-Scheinpflug and Tempel, [2015](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6759653/#B108)).

Inactivating voltage-gated K+ (Kv) currents were first characterized in neurons from the marine gastropod *Onichidium verruculatum* and were subsequently described as “A-type”