Calcium concentration changes in spider mechanoreceptors during sensory transduction

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Introduction
Little is known about the roles of Ca\(^{2+}\) in transduction and action potential encoding by most mechanoreceptors. Intracellular recordings can be performed from sensory neurons in the lyriform organ VS-3 of the spider Cupiennius salei. Using mechanical stimulation, changes in intracellular calcium levels were observed.

Calcium estimation
Neurons received repetitive mechanical pulses, causing one action potential per stimulus. Calcium estimation was performed from sensory neurons in the lyriform organ VS-3 of Cupiennius salei. Neurons received repetitive mechanical pulses, causing one action potential per stimulus.

Resting and stimulated calcium levels
Resting calcium concentration in VS-3 neurons was ~400 nM and increased to a maximum level of ~2 \text{\textmu}M at high firing rates.

Regional distribution of calcium levels
There were no significant differences between the values of [Ca\(^{2+}\)] or [Ca\(^{2+}\)] in the four regions, but values of [Ca\(^{2+}\)] were significantly different from each other (p<0.05, asterisks), except between the mid-dendrite and axon regions.

Action potentials cause calcium entry through voltage-activated calcium channels
Action potentials cause calcium entry through voltage-activated calcium channels. The receptor potential is too small to open voltage-activated calcium channels.

Conclusions
- Resting calcium concentration in VS-3 neurons was ~400 nM and increased to a maximum level of ~2 \text{\textmu}M at high firing rates.
- Calcium enters through voltage-activated calcium channels opened by action potentials. Nickel blocks the channels and prevents the calcium rise.
- Calcium entry is abolished by TTX. No evidence was seen for calcium entry through mechanically-activated channels.

References
- Thippayagiri (50 \text{\textmu}M) had an effect on calcium levels (data not shown), indicating that calcium release from internal stores is not significant.