USING DIGITAL IMAGE CORRELATION TO DETERMINE MECHANO-TRANSDUCTION BEHAVIOUR OF THE VISCEROFUGAL NEURON IN THE GUT

Gwen Palmer1, Tiina Roose1, Timothy Hibberd2, Simon Brookes2, Mark Taylor2
1University of Southampton, UK; 2Flinders University, South Australia

Introduction
Mechanical force is encoded by action potential discharge in sensory neurons, such as the viscerofugal neuron; this is known as mechano-transduction. Most studies of mechano-transduction compare neural firing responses to global strain or the applied load. This allows discrimination of an appropriate stimulus for sensory neuron activation, but does not reveal how mechanical states are related to sensory neuron firing. This level of understanding can only be achieved if local mechanical states, such as local strain, are known.

Viscerofugal neurons are mechanosensory neurons in gastrointestinal wall. A method to record firing and cell body location of viscerofugal neurons was recently developed [Hibberd,2012]. Digital image correlation method can be used to calculate the local strains in samples of soft tissue. The relative simplicity of in vitro gut preparations used to record viscerofugal neurons is highly amenable to digital image correlation. This presents an ideal opportunity to study both global and local strain within the tissue and its relationship to mechanosensory neural firing responses.

Methodology
Paralysed flat-sheets of guinea-pig colon were loaded uni- and bi-axially while video recording. Viscerofugal neurons were localized and recorded extracellularly from colonic nerves [Hibberd,2012]. Numerous graphite markers were applied to the tissue surface, adjacent identified viscerofugal cell bodies for subsequent image analysis.

Results
As expected, local strains surrounding cell bodies differed from global strains. In general, local strains are lower than global strain; likely due to the location of cell bodies which are typically near the fixed edge of the sample. There is a stronger correlation between the local circumferential strain and neural response than longitudinal strain.

Local strains can be compared with neural response. Fig. 2 shows circumferential strains versus the neural response.

Discussion
The results shown in Fig. 2 suggest that the viscerofugal neuron has a lower threshold for firing as a function of strain. Digital Image Correlation techniques may prove valuable in the research of mechano-transduction in sensory neurons in the gut.

References

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