Posterior Root Muscle Reflexes (PRMRs)

Although much of the literature surrounding tSCS is focused on its use as a therapeutic tool to modify altered motor control after spinal cord injury, the underlying physiology of its effects has been under investigation using low frequency stimulation paradigms. Like all of the neurophysiological techniques that we have or will examine, PRMRs have been seen in animal models and even some human work prior to their gaining popularity around 2007. We can start with the **Minassian paper (2007)** that describes the method, relates some of the history and begins the process of proving that they are reflex events evoked by efferent fiber activation and not direct activation of the afferent fibers leaving the spinal cord. Their work was a continuation of the Houston work done by M.R. Dimitrijevic who used epidurally-located electrodes to examine spinal cord circuitry. He was able to evoke these reflex events at varying frequencies under differing conditions, a classical stimulus-response paradigm, that has yielded a considerable body of work that describes spinal cord processing. One key part of this story is found in Minassian et al., 2004, page 410, figure 5.

A good place to start is with the biophysics and computer modeling of current flow from this form of stimulation. I included the **Holsheimer (2002)** paper that focuses on implanted epidural stimulation and the **Danner paper (2011)** that focuses on tSCS to emphasize the similarities in what structures are depolarized. It is a lot to take in but you will read that the lowest threshold is found in the larger diameter fibers of the dorsal root. The high impedance of the dura matter surrounding the cord itself makes it likely that the anterior root fibers would be lower threshold and more accessible than the long-tract systems within the spinal cord.

**Knikou and coworkers (2013)** used a different location for the indifferent electrode. Their placement is like that of Sayenko and others from the Harkema group who put the cathode(s) over the iliac crests bilaterally with the anode over the T01-L1 spine. Although that allows for some lateralization, it also makes more likely the activation of peripheral nerves in the region of the cauda equina. Thus, from my viewpoint, they are not achieving pure root stimulation.