Selective Motor Control and Focal Dystonia

The ability to make fine movements, such as control of individual digits, is an important skill. The physiology of the ability is not well known, and its dysfunction is a prominent component of several movement disorders such as focal dystonia. The properties of individual corticospinal neurons include innervation of many spinal alpha-motoneurons, making the task particularly difficult. Additionally, the motor system appears to have a wide spread activation with even a focal movement. Hence, whatever capability there is for fine control must include some inhibition as well as excitation. The hypothesis has been suggested and largely proven that the motor system has a center-surround organization; so that unwanted movements are inhibited as the desired movement is commanded (Hallett, 2010, Sohn and Hallett, 2004). This appears to be a cortical process aided by the basal ganglia. The precise physiological mechanisms of the surround inhibition have been investigated, but are not yet completely established. Patients with focal hand dystonia have difficulties with fine motor control and there is a concomitant dysfunction of the surround inhibition mechanism. Several intracortical circuits have been identified that are malfunctioning and can contribute to the abnormality of surround inhibition (Beck *et al.*, 2008). A feature of these circuits are that they are all inhibitory with short latencies. A correlative abnormality has been seen in sensory systems in patients with focal dystonia. Behaviorally, there is a mild abnormality of spatial and temporal discrimination. The physiology underlying the temporal discrimination abnormality is a failure of a short latency inhibitory mechanism (Tamura *et al.*, 2008). Hence there might be a similar abnormality of short latency inhibition in both motor and sensory function, suggesting a malfunction of a class of inhibitory interneurons. Proof of principle studies have demonstrated that training to improve surround inhibition and sensory discrimination can ameliorate dystonia.