

## Sensory control of central pattern generation.

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The mammalian lumbar spinal cord has the capability to generate fictive locomotion, i.e. alternating and rhythmic flexion and extension in the absence of oscillating input from either the brain or the periphery, when stimulated pharmacologically or electrically with a tonic stimulation pattern to either the dorsum of the spinal cord or dorsal roots. This lecture focused on the interaction of central pattern generation with the dynamic, proprioceptive and cutaneous sensory information during actual locomotion, in the absence of any supraspinal input. The fact that the circuitry within the lumbosacral spinal cord which undoubtedly includes those neurons responsible for central pattern generation can interpret such complex proprioceptive input, points toward a capability of central pattern generators that is not generally recognized as one of his outstanding features. This capability is highly significant from the standpoint of understanding the basic neural control of locomotion, but also providing new potential rehabilitative strategies. Basically this capability permits the translation of a very general and nonspecific signal that may be routinely provided from supraspinal descending input to the lumbosacral spinal cord. When this general control is combined with the detailed control that can be derived from ongoing proprioceptive information from the lower limbs, there are means of initiating, sustaining and controlling effective weightbearing locomotion. For example, we have used epidural and/or pharmacologically (predominantly with serotonergic agonists) stimulation as a general signal that can facilitate locomotion in complete spinal rats. The results suggest that the spinal circuitry that generates locomotion can readily interpret the sensory information derived from the kinetic and kinematic events associated with stepping. These experiments show that the spinal circuitry can accurately perceive the levels of load on the hindlimbs, the speed of a treadmill belt, and the direction of the movement. In performing these different tasks, different combinations of motor pools are activated and the level of activation among these motor pools is modulated to accommodate the dynamics of the peripheral input. These data demonstrate that the proprioceptive input to the lumbosacral spinal cord can serve as the source of control of locomotion in the absence of any input from the brain. The conclusion is that the potential opportunity for regaining load bearing locomotion after a severe spinal cord injury is becoming more apparent. At this stage it even seems feasible to develop means of delivering to humans these combined interventions of epidural stimulation, pharmacological stimulation and proprioceptive information associated with load bearing interacting simultaneously to the lumbosacral spinal cord circuitry that controls locomotion . Presenting these combined interventions repetitively over a period of weeks and even months will then provide the opportunity for the spinal circuitry to relearn how to step.

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