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Mono- and polysynaptic propriospinal connections in the lateral part of the spinal dorsal horn: a correlative physiological and morphological study

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While it is widely accepted that nociceptive information processing in the spinal dorsal horn involves local segmental neuronal networks, there are controversial theories about the propriospinal connectivity of spinal neurons. Former results obtained from neuronal tracing experiments and recent demonstration of long axon collaterals running in the dorsolateral funiculus and arising from local-circuit and projection neurons of the superficial spinal laminae provide anatomical evidences for the existence of rostro-caudally oriented intersegmental propriospinal pathways. By using the IR-LED imaging technique we performed paired recordings from neurons in lamina I of the spinal dorsal horn and the adjacent lateral spinal nucleus with preserved intra- and inter-segmental connections. While a neuron was recorded in whole-cell patch-clamp mode, other cells in adjacent caudal spinal segments were stimulated in cell-attached configuration. The stimulation of distant (up to several hundreds of micrometers) neurons evoked both mono- and polysynaptic responses in the recorded cells. Both the stimulated and the recorded neurons were labelled, and 3-dimensionally reconstructed in a consecutive morphological analysis. Although the somato-dendritic morphology of the recovered cells showed a remarkable variability, distinct cell groups can be identified on the basis of their axonal trajectories. The results provide data for a better understanding of the organization of spinal neural networks.