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Short-Latency Crossed Spinal Responses in the Human Soleus Muscle during Sitting and Walking

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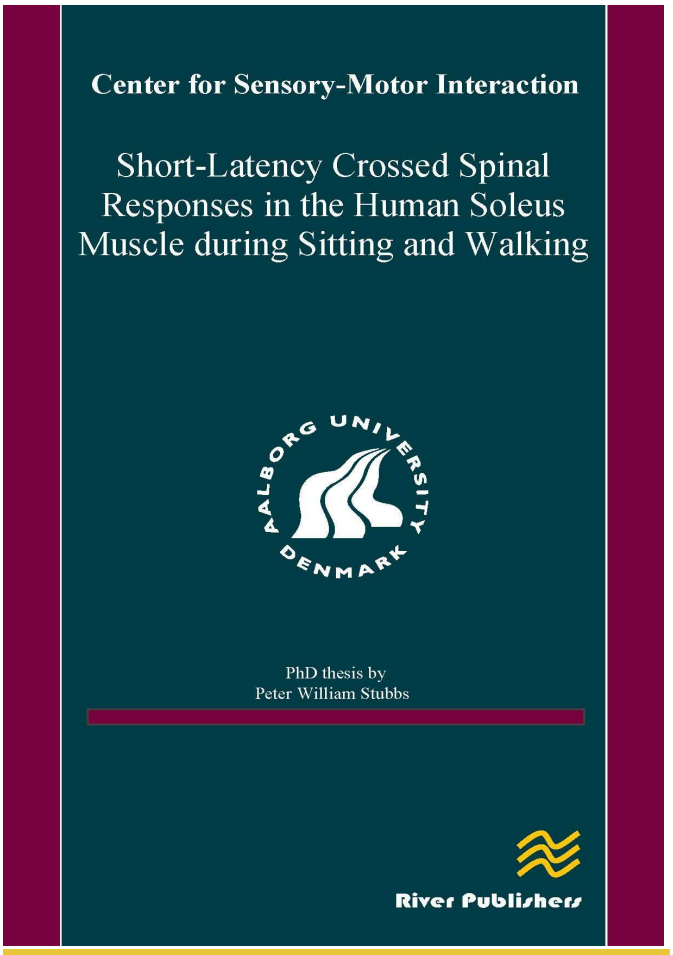
Interlimb reflex pathways were initially investigated by Sherrington (1910), who demonstrated that the crossed extensor reflex was evident in the cat and suggested that it may have a functional role. This work formed the basis for future (interlimb) reflex research on the human and the cat. Due to the inability to perform invasive studies in the human, the cat is often used as a model for understanding neural pathways. However, the cat and the human have many differences (for example: quadrupedal vs. bipedal). In the human there is an increased reliance on the ankle extensors compared to the cat during walking. Therefore, although research in the cat shows limited responses in contralateral ankle extensor efferents following stimulation of the ipsilateral ankle extensor nerve afferents, there are possibly differences in the reliance of interlimb feedback from the ankle extensors in the human.

The aims of this research, discussed in this book, was to investigate (i) if crossed reflexes are present in sitting and a functional task as human walking following electrical stimulation (Study I and III) (ii) how they are modulated (Study IIIV) and (iii) the likely pathways and nerve fibres involved (Study IIII). From the current thesis it can be concluded that short latency interlimb reflexes are observed from the ipsilateral tibial nerve to the contralateral soleus and are: (i) inhibitory and observed in sitting and walking (ii) modulated by supraspinal areas due to the phase dependence and alterations in patients with stroke (iii) likely mediated by large diameter ipsilateral muscle/tendon afferents.

The current thesis suggests that commissural interneurons are present in the human with input from ipsilateral ankle extensor muscle or tendon afferents to the contralateral soleus. It is proposed that the stimulus to the ipsilateral tibial nerve may indicate a mechanical disturbance to the ipsilateral ankle extensors with the inhibition initially halting the contralateral soleus EMG activity until supraspinal areas can act voluntarily to appropriately modify the EMG activity. Although it is difficult to propose the exact supraspinal areas involved and the functional role of the response, this thesis provides the basis for future studies.



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