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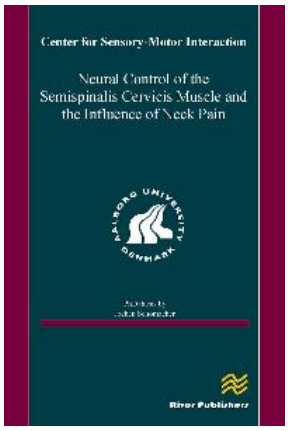


# Neural Control of the Semispinalis Cervicis Muscle and the Influence of Neck Pain

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## Description:

The objective of this thesis was to investigate the activation of the deep cervical extensor, the semispinalis cervicis, in asymptomatic individuals and patients with neck pain. Together with the deep flexor muscles the deep cervical extensors contribute to support and stabilization of the cervical spine. Impaired activation of these muscles may contribute to the recurrence and maintenance of neck pain and consequently assessing and restoring the function of the deep muscles is considered to be important in the rehabilitation of patients with neck pain. Preliminary evidence for lower activation of the deep cervical extensors in patients with neck pain was shown in only one study which utilized functional magnetic resonance imaging (MRI) to evaluate the activation of the deep muscles. This thesis directly examined the neural control of the semispinalis cervicis using ultrasound guided intramuscular electromyography (EMG) and compared the activation of the semispinalis cervicis in patients with chronic neck pain and in healthy controls. Finally, the possibility of emphasizing the activation of this muscle by specific exercise was evaluated.

Four studies were performed. First, the neural drive to fascicles of the semispinalis cervicis at two different spinal levels was investigated in healthy subjects in order to examine whether all fascicles of the muscle receive common or independent neural drive. In a second study, the activity of semispinalis cervicis was examined in patients with neck pain and compared to healthy controls to examine whether this muscle is activated differently in patients. In the third study the tenderness to pressure of the tissues over the cervical zygapophyseal joints was measured using the pressure pain threshold (PPT) at two spinal levels. Furthermore, the activity of the semispinalis cervicis was measured at the same levels and a correlation analysis was performed between PPT and EMG measures. In the fourth and final study the activation of semispinalis cervicis in relation to the superficial extensor splenius capitis was investigated during three different exercises.

The results showed a lower recruitment threshold and a higher number of active motor units in the fascicle of the semispinalis cervicis at the spinal level C5 compared to C2 reflecting a partially independent neural drive to fascicles of semispinalis cervicis. The independent drive to different fascicles of the muscle may be determined by mechanical needs and advantages of different fascicles for the task performed. The second study of the thesis showed that patients with chronic neck pain display lower activity of the semispinalis cervicis compared to healthy controls. Furthermore, the directional specificity of semispinalis cervicis was lower in patients, i.e. the ability to contract in well-defined preferred directions according to the muscle's anatomical position relative to the spine. In the second study the activation of the semispinalis cervicis muscles was measured at C3. In the third study the activation of semispinalis cervicis muscle was monitored at both C2 and C5 and the results showed that patients with neck pain also display lower and less defined activation of the semispinalis cervicis at these levels suggesting that altered activation of this muscle is generalized to all levels of the cervical spine and is not unique to one spinal level. PPT measured over C2 and C5 correlated significantly, albeit only weakly with EMG amplitude and the directional specificity of semispinalis cervicis when the control and patient data was pooled together, suggesting that other factors like general psychological distress, fear avoidance behavior and disuse may contribute this finding. Finally, the activity of the semispinalis cervicis increased relative to the splenius capitis when the patient pushed dorsally against the therapist's manual resistance at the vertebral arch of C2. This did not occur when pushing backwards against resistance applied at either the occiput or at C5.

Taken together, these findings indicate that the neural control of the semispinalis cervicis muscle is altered in patients with chronic neck pain. Furthermore, patients with the highest pressure pain sensitivity displayed the greatest impairment in activation of the semispinalis cervicis. Given the role of the deep cervical extensors in the provision of support to the cervical spine, impaired control of this muscle may have relevance for the perpetuation or maintenance of neck pain.. A specific exercise was shown to increase the activity of semispinalis cervicis relative to the superficial splenius capitis, suggesting that this exercise would be useful to include an exercise program for patients with neck pain. Further research is necessary to investigate the efficacy of such an exercise in patients with neck pain.

**Keywords:** magnetic resonance imaging