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Title:
The effect of motor imagery, action observation and neck muscle vibration on cervical joint position sense and pressure pain threshold in chronic neck pain patients

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Abstract:
Introduction:
Impaired cervical joint position sense is a feature of chronic neck pain (Armstrong, McNair, & Taylor, 2008). Whether impaired joint position sense displays a proprioceptive deficit (Jull, Falla, Treleaven, Hodges, & Vicenzino, 2007) or a more central information processing bias (Beinert & Taube, 2013; Goble, 2010) is under debate. Therefore, we compared 3 different treatments with respect to their effect on joint position sense and pressure pain threshold: First, neck muscle vibration that was previously been shown to improve sensorimotor function of the cervical spine as well as postural control in neck pain patients (Beinert et al. 2013). This intervention is thought to stimulate afferent signal processing (Roll & Vedel, 1982). Second, two further interventions were chosen that are unlikely to influence afferent processing at all but act specifically at the motor side: motor imagery and action observation.

Methods:
We conducted a double blinded, three armed, randomized controlled trial with 45 chronic neck pain patients. Cervical joint position sense was assessed for the neutral head position and pressure pain threshold was evaluated at the zygapophyseal joint of C2 and the trigger point of the levator scapulae. All parameters were measured before and directly after the intervention. Targeted neck muscle vibration was applied at the painful region about C2 side with 100 Hz. The motor imagery group imagined cervical joint reposition exercises by following instructions from a voice recorded tape. The action observation group watched a video with a person performing joint reposition exercises. Each group received a treatment of 5 *45 seconds of action (vibration or motor imagery or movement observation) with 15 seconds break in-between.

Results:
Before intervention, there was no difference between groups regarding sex, age, pain intensity, cervical joint position sense and pressure pain thresholds. Joint position sense improved immediately after the intervention, displaying a time effect (p < 0.001). Further, a time * group (motor imagery/action observation/vibration) interaction was observed (F[2,42] = 3.546; p = 0.038). Post hoc analysis revealed no difference between motor imagery and action observation (p= 0.762), but motor imagery as well as action observation were superior to neck muscle vibration (p=0.001).

Pressure pain threshold displayed a time effect for neck muscle vibration (F[1,14] = 7.792; p = 0.014) but not for motor imagery (F[1,14] = 0.00; p = 0.984) and action observation (F[1,14] = 0.298; p = 0.594).

Discussion/Conclusion:
Motor imagery and action observation are interventions that are unlikely to alter afferent information processing. Nevertheless, both interventions improved cervical joint position sense after a single treatment session. Therefore, these results question the assumption that impaired joint position sense is solely due to a proprioceptive deficit (Jull et al., 2007; Treleaven, 2008). Neck muscle vibration on the other hand had a smaller but also significant positive effect on joint position sense. Furthermore, in contrast to the other two interventions, vibration also significantly reduced pressure pain threshold indicating that afferent stimulation is closely related to the perception of pain. Future studies have to evaluate potential long term benefits of these different treatment strategies.

References: