ACUITY OF GOAL-DIRECTED REACHING MOVEMENTS TO VISIBLE TARGETS IN CHRONIC NECK DISORDERS

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Aims
Pain in the neck-shoulder area is very common in the working population. Lately, research has pointed out deficits in sensorimotor control – for instance cervical proprioceptive acuity – as a possible source of both signs and symptoms as well as an underlying factor in the pathogenesis of chronic neck pain. We recently demonstrated that also proprioception of the upper extremity is reduced in neck disorder of both non-traumatic (Djupsjöbacka et al., in preparation) and traumatic origin (Sandlund et al., 2006). The results were obtained in a single-joint ipsilateral repositioning task under blindfolded conditions. However, working situations and everyday tasks generally require interaction with the environment and involve control of multi-joint movements in 3D-space. The aim of the present study was to extend previous research on reduced upper extremity proprioception in neck-shoulder pain disorders by studying the acuity of goal directed reaching movements. Therefore, we tested three-dimensional end-point variability in arm movements to a visible target in 24 patients with chronic non-specific neck-shoulder pain and 22 healthy age- and gender-matched controls.

Methods
In this single-blinded comparative group study subjects performed arm-reaching movements to a visible target sitting with the shoulders strapped to the back of a rigid chair and a pointer firmly fixed to right palm in a plastic plate preventing movements distally to the wrist. The target was a soft foam-rubber stick, one cm in diameter, placed at eye level 20 cm to the left of the subjects left acromion, pointing medially to the right. Fifteen trials were performed and the subjects were instructed to bring the pointer tip as close as possible to the target “as fast and accurate as possible without corrections”. Kinematics was measured with an electromagnetic tracking system (FASTRACK, Polhemus Inc., USA) with a sensor placed on the hand. End-point variability (VE) in the X, Y and Z-plane was calculated and used as outcome measure together with 3D peak velocity of the reaching movement. The patients also performed pain ratings and answered questionnaires addressing functioning, status and activity limitations. Multivariate regression using Partial Least Squares (PLS) modeling was conducted to assess associations between VE (controlled for peak velocity) and the ratings of functional limitation and symptom characteristics that were considered relevant for task performance.

Results
Univariate ANOVA of peak velocity showed no differences between the groups (p = 0.317). A mixed model ANCOVA was performed to analyse group differences in VE, submitting Group (neck pain and control) as between-subject factor, Coordinate axis (X, Y and Z) as within-subject factor and, to account for speed accuracy trade-off, Peak velocity as covariate. The analysis showed significantly higher end-point variability for the patients compared to controls (Group, p = 0.006). Peak velocity was highly significant as covariate (p < 0.001). Multivariate analysis, using PLS, found distinct associations between end-point variability (controlled for Peak velocity), and self-rated limitations in neck movements (rotating, flexing and bending) and deficits in the ability to put a shirt of and on.

Conclusions
The findings show that people with non-traumatic neck pain disorders have reduced end-point accuracy in the upper extremity compared to people without neck pain when performing goal directed reaching movements. The association to deficits in neck movements and activity limitations supports a functional relevance of acuity in goal directed reaching: an ability that might be important for optimal performance in many work tasks as well as to the development of musculoskeletal pain. The results may also be of importance in future attempts to develop objective measures for sub-classification of patients with neck-shoulder disorders and in the design of rehabilitation interventions.

References