Bilateral reduction of sternocleidomastoid motor unit discharge rate during acute unilateral noxious stimulation

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1. OBJECTIVE

• A decrease of single motor unit discharge rates have been observed following experimentally induced muscle pain (1,2). This has been attributed to either a reduction in the descending drive to the muscle during pain or a reflex inhibition mediated by small diameter muscle afferents.

• In order to further investigate the potential mechanisms underlying a pain-induced decrease of motor unit discharge rate, this study evaluated the effect of acute unilateral painful stimulation of the sternocleidomastoid muscle on the discharge rate of sternocleidomastoid motor units bilaterally during isometric neck flexion and rotation

2. METHODS

• **12** healthy **volunteers**

• intramuscular EMG signals (**iEMG)** detected from the sternocleidomastoid (SCM) muscle bilaterally; surface EMG signals (**sEMG)** SCM muscle bilaterally

• Visual feedback of force produced during isometric cervical flexion and rotation

• 3 Contractions: **Flexion, Rotation Left** and **Rotation Right** (@10% and 20% MVC)

• 4 Conditions: **Baseline**, **Isotonic saline** solution (0.5 cc; 0.9%) on left side, **Hypertonic saline** solution (0.5 cc; 5.8%) (Experimental Pain) on left side, **Recovery** after 15 min.

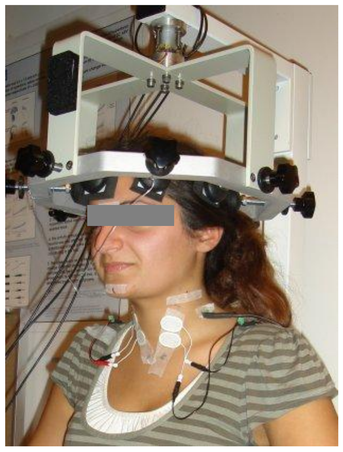


Figure 1. Experimental set-up

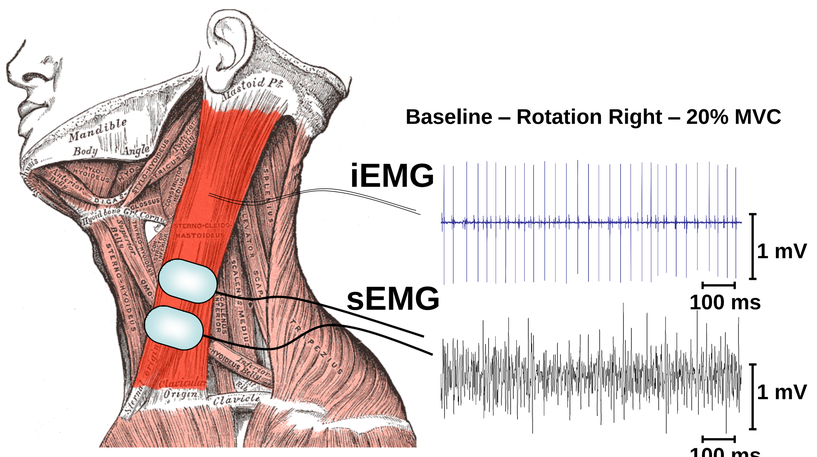


Figure 2. Representation of electrode placement

Baseline – Rotation Right – 20% MVC

Data analysis:

•**RMS of sEMG** signals detected on SCM muscle bilaterally

•**Discharge rate** of MUs identified after decomposition of iEMG signals detected from the SCM muscle bilaterally

3. RESULTS

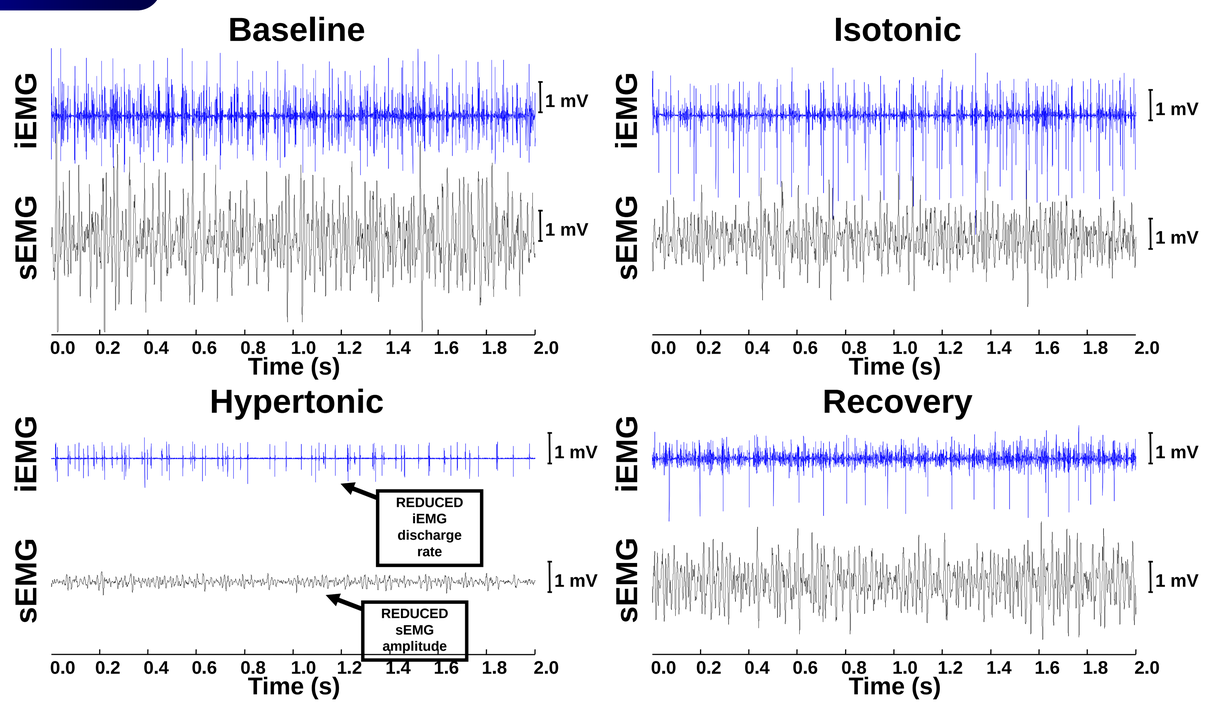
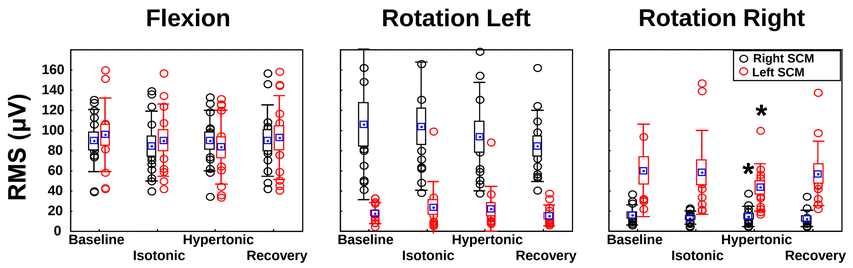


Figure 3. Representative EMG data detected from the left SCM muscle during isometric right rotation of the head at 20% MVC in each of the four conditions (**Baseline**, **Isotonic saline**, **Hypertonic saline**, and **Recovery**). Reduced sEMG amplitude and reduced discharge rate of single motor units can be observed during the painful condition.

Surface EMG



Intramuscular EMG

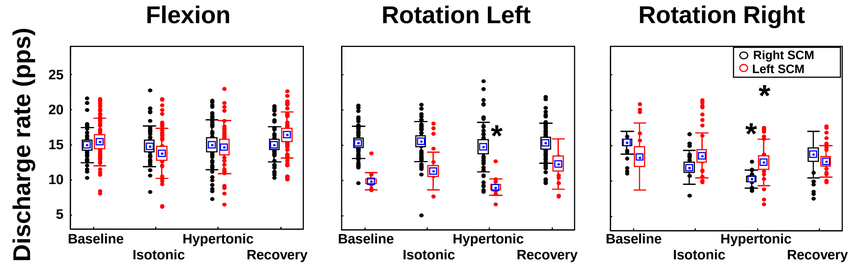


Figure 4. Mean and SD of the surface EMG amplitude and discharge rate of single motor units recorded from the sternocleidomastoid muscle bilaterally during isometric cervical flexion, right and left rotation recorded at baseline, following injection of isotonic saline (control), hypertonic saline (painful) and during recovery (15 min post pain). * indicates significant difference between hypertonic saline and baseline condition; $P < 0.05$.

4. CONCLUSIONS

• Stimulation of nociceptive afferents by injection of hypertonic saline into the left sternocleidomastoid muscle resulted in reduced discharge rate of left sternocleidomastoid motor units during ipsilateral and contralateral cervical rotation.

• Although the inhibitory effect of pain-inducing substances on motor unit discharges has been proven in previous work (1,2), this is the first study to show that this inhibitory effect is dependent on the direction of force.

• In addition, the discharge rate of motor units in the contralateral, non-painful sternocleidomastoid muscle was reduced during ipsilateral cervical rotation.

• Taken together, these findings suggest that the decreased discharge rate of single motor units observed following experimentally induced muscle pain reflects a pain-induced reduction in the descending drive to the muscle rather than a reflex inhibition mediated by small diameter muscle afferents.

5. REFERENCES

1.Farina D, Arendt-Nielsen L, Merletti R, Graven-Nielsen T. Effect of experimental muscle pain on motor unit firing rate and conduction velocity. J Neurophysiol 2004;91:1250-1259.

2. Sohn MK, Graven-Nielsen T, Arendt-Nielsen L, Svensson P. Inhibition of motor unit firing during experimental muscle pain in humans. Muscle Nerve 2000;23:1219-1226.

ACKNOWLEDGEMENTS

This work was supported by the Danish Technical Research Council and by the European Community (CyberManS project contract nr. 016712)