The effect of spinal manipulation on sensorimotor integration and cortical effects of motor training in a cohort of participants with subclinical neck pain

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INTRODUCTION

- Spinal manipulation leads to neural plastic changes in subjects with spinal dysfunction and subclinical neck pain (SCNP), which is defined as recurring neck dysfunction such as stiffness and pain for which the sufferers have not yet sought treatment [1-5].
- A limitation of previous studies is that they applied simple repetitive movement sequences, measuring the effects of repetitive motor movements rather than motor skill acquisition [1-4]. .
- If the presence of SCNP affects the way the central nervous system (CNS) responds when learning upper limb motor tasks it could have important implications for the relationship between SCNP and the development of overuse injuries.
- Short latency somatosensory evoked potentials (SEPs) provide a means of investigating changes in sensorimotor integration (SMI) following both interventions such as chiropractic manipulation and motor learning

PURPOSE OF STUDY

- This study sought to investigate the immediate effects of spinal manipulation on CNS processing in a group with SCNP following a motor skill acquisition task.

METHODOLOGY

- Eleven subjects (mean age 22.2) in the Passive Head Movement (PHM) group and twelve (mean age 22.4) in the Spinal manipulation (Man) group gave informed consent (approval by UOIT's Research Ethics Board).
- Peripheral (N9), spinal (N13), brainstem (P14, N18) and cortical (N20 and N30) somatosensory evoked potentials (SEP) were recorded following median nerve stimulation before and after PHM or Man, and following a complex motor task in a between group design. 1500 SEP sweeps were averaged for each condition.
- PHM intervention involved neck palpation and movement but no manipulation. Man included high velocity, low amplitude, cervical manipulation to dysfunctional regions. Either PHM or Man was delivered prior to a motor learning task which consisted of 15 sequences of 7,8, and 9 in randomized order and appearing twice in each block Ex.7,9,8,9,7,8;8,9,7,8,7,9 etc...performed with the middle 3 digits of the dominant hand
- Data was analyzed in SPSS as a mixed design split-plot repeated measures ANOVA with three levels; pre-intervention, post-intervention and post-motor training, and two groups; PHM and Man. Post hoc comparisons were done with paired two samples t-tests were also performed as needed.

RESULTS

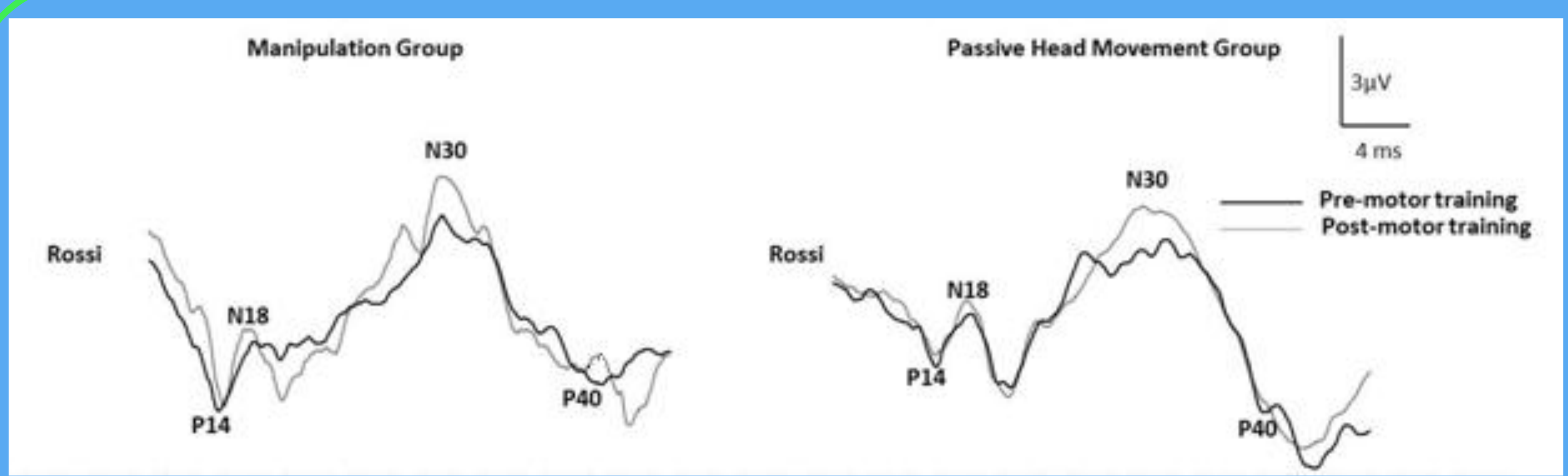

Fig 1. Raw traces from representative participants from both groups showing the N30 SEP peak complex pre and post-motor training (recorded from previously described frontal site [2]). Note the significant increase in the P22-N30 complex following motor training for both groups.

- There was a significant main effect of the repeated measures ANOVA [F (2,38) = 12.87, p<.0.0001] as well as an interaction between group and repeated measure [F (2,38) = 4.38, p <0.02] for the N30 SEP peak. Post hoc analysis revealed a significant 12.1% increase (p < 0.05) in the N30 SEP peak amplitude post SM and an 18.01% increase (p < 0.02) for the same peak following the subsequent motor training. There was a 47.63% increase in the N30 peak following motor training in the PHM group (p = 0.04). See Figure 2. There were no other significant findings for any of the other SEP peaks.
- There was a significant improvement in reaction time to key press for both groups following motor training (p<0.001) but no difference between PHM and Man.

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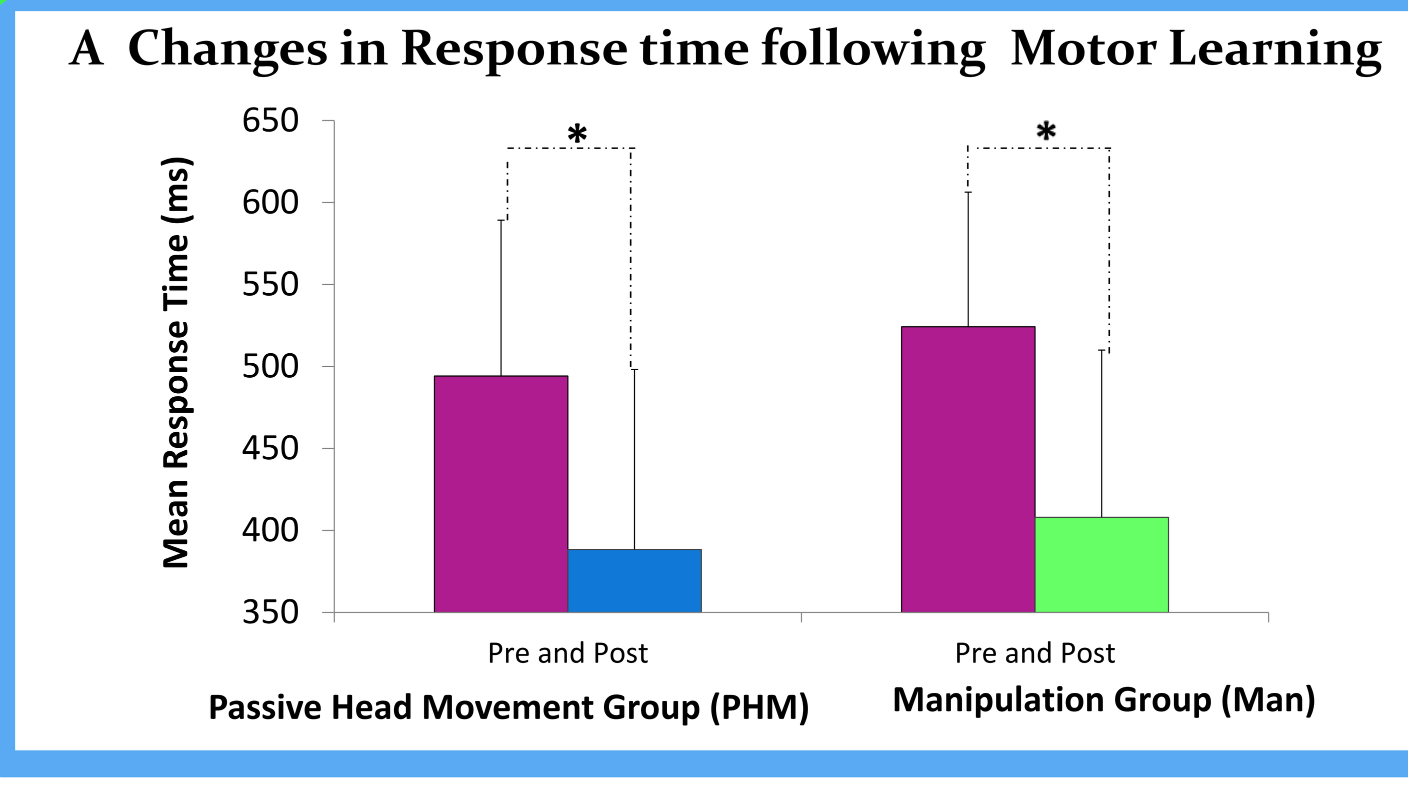

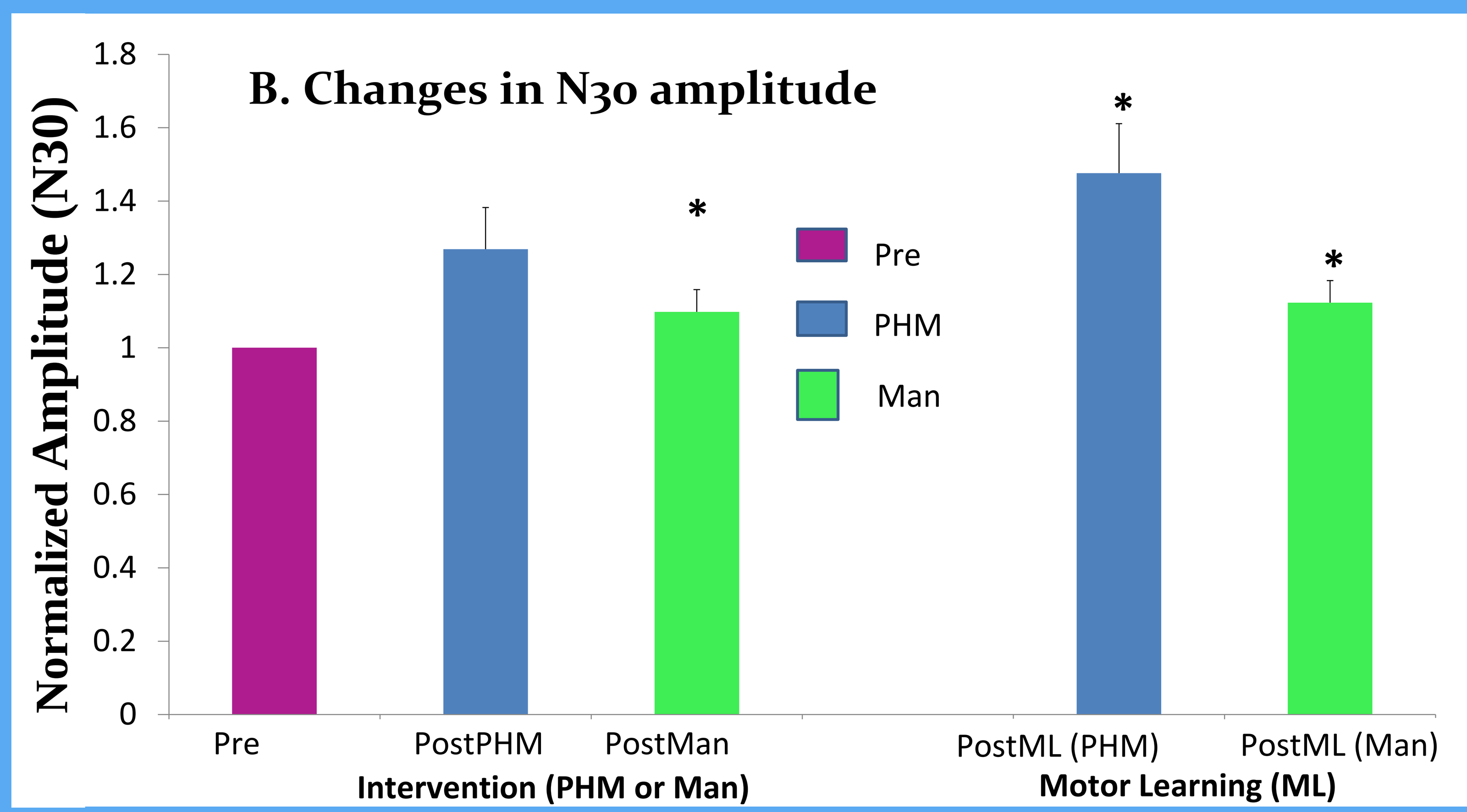

Fig 2A. Changes in Response Time following Motor Learning: Both the PHM and the Manipulation group showed significant improvements in response time to key press (p<0.001)
Fig 2B: Normalized mean amplitude changes in N30 following the passive head movement and manipulation (Error bars depict SE; Pre-values were normalized to 1.)* indicates significant changes compare to pre-intervention N30 SEP peak amplitude for both intervention (PHM or Man) and following motor learning.)

DISCUSSION

- This work has shown an increase in cortical SEP amplitudes following a cervical spine manipulation intervention in SCNP participants.
- The changes occurred for a SEP peak known to be involved in early sensorimotor integration [6].
- The results also suggest that a complex motor training task induces changes in neural processing, supporting and extending previous work, which looked at simple motor tasks.
- The fact that the N30 SEP peak amplitude increase was attenuated following motor learning when preceded by Man (compared to what occurred after PHM) provides evidence that Man has the potential to normalize the afferent processing that takes place during early motor learning in a SCNP population.
- This work may be relevant to identifying neural markers that indicate those individuals at risk of developing overuse injuries

CONCLUSION

- This work is unique in that it shows that cervical spine manipulation in a SCNP group can change the way the brain responds to a subsequent complex motor learning task.
- Changes in the N30 SEP peak may be a potential neural marker of disordered sensorimotor integration which can potentially be normalized by appropriate treatment.

REFERENCES

1. Haavik, H., & Murphy, B. (2012). The role of spinal manipulation in addressing disordered sensorimotor integration and altered motor control. Journal of Electromyography and Kinesiology; 22(5), 768-776. doi: 10.1016/j.jelekin.2012.02.012
2. Haavik Taylor, H., & Murphy, B. (2008). Altered sensorimotor integration with cervical spine manipulation. Journal of Manipulative and Physiological Therapeutics, 31(2), 115-126.
3. Haavik Taylor, H., & Murphy, B. (2010a). Altered central integration of dual somatosensory input after cervical spine manipulation. Journal of manipulative and physiological therapeutics, 33(3), 178-188.
4. Haavik Taylor, H., & Murphy, B. (2010b). The effects of spinal manipulation on central integration of dual somatosensory input observed after motor training: a crossover study. Journal of manipulative and physiological therapeutics, 33(4), 261-272.
5. Haavik Taylor H and Murphy B. (2011). Subclinical neck pain and the effects of cervical manipulation on elbow joint position sense. Journal of Manipulative and Physiological Therapeutics. 34:88-97.
6. Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.