Cervical Spine Sensorimotor Control in Individuals with Chronic Idiopathic Neck Pain

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Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy (Physiotherapy)

July 2018

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This is to certify that the thesis entitled *Cervical Spine Sensorimotor Control in Individuals with Chronic Idiopathic Neck Pain*, submitted in fulfilment of the requirements for the degree Doctor of Philosophy (Physiotherapy), is in a form ready for examination.

12 July 2018

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DECLARATION

I hereby certify that the work embodied in this thesis is my own work, conducted under normal supervision.

This thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository**, subject to the provisions of the Copyright Act 1968. **Unless an Embargo has been approved for a determined period.

I hereby certify that this thesis is in the form of a series of published papers of which I am a joint author. For each such work a written statement, endorsed by the other authors and the Faculty Assistant Dean (Research Teaching), attesting to my contribution to the joint work has been included.

12 July 2018

Rutger de Zoete ________________ __________

Signature Date

ACKNOWLEDGEMENTS

This thesis is the result of a three-year adventure that I have enjoyed every day. I am very grateful for the opportunity I was given to complete my PhD at The University of Newcastle and would like to thank a number of people in particular.

Firstly, my principal supervisor Associate Professor Snodgrass, Suzanne, thank you for your exceptional guidance throughout my PhD candidature. Your ambition and resilience are inspiring, and I could not have wished for a better mentor. To my other supervisors, Doctor Osmotherly, Peter, and Professor Rivett, Darren, your input and feedback have been invaluable for my project. To the three of you, thank you for providing me with so many research and teaching opportunities and for supporting me during my project.

During my candidature I was awarded a PhD top-up scholarship through the Hunter Medical Research Institute (HMRI). Felicity and Michael Thomson, I am grateful for the support you have given me and would like to express my sincere gratitude for supporting early career researchers such as myself. To The University of Newcastle's Centre for Brain and Mental Health Research, thank you for supporting my project with two travel grants, allowing me to visit national and international conferences and further build my network.

This project gained strength from collaborating with researchers at different institutions. I would like to acknowledge the support of Doctor Julia Treleaven (The University of Queensland, Australia), Doctor Eythor Kristjansson (The University of Iceland, Iceland), and Professor Enrique Ferreira (Universidad Católica del Uruguay, Uruguay). Thank you for sharing your methodologies and making testing and analysis software available for my studies, it has been a pleasure working with you. I am grateful to Jason Harris for his technical support in setting up our movement laboratory.

This project would not have been possible without the one-hundred participants who volunteered their time to visit our laboratory for assessments. I am so thankful for their help and it has been a pleasure meeting each of them. I would like to thank Mark Rothfield and the HMRI Research Register team for assistance in the recruitment of participants.

My time in Australia would not have been the same without three people by my side. To Nienke and Damian, thank you for your kindness and support, for listening to all my neck pain stories, and for all those hours on the tennis court. To Sophie, I am profoundly grateful for the support and love you have given me while completing my PhD. I am humbled by your ever-positive energy while encouraging me to work hard.

Lastly, there are only three people the final words of this section could be devoted to. To my sister, Marieke, thank you for the support and humour you have offered over the past three years. To my wonderful parents, Annemiek and Marco, thank you for believing in me, for your endless love and support, and for the many early-morning and late-night calls. Your words are always comforting and I envy your combined wisdom.

SUPERVISOR STATEMENT

I, Associate Professor Suzanne J. Snodgrass, attest that Research Higher Degree candidate Rutger M. J. de Zoete was the lead author of the following publications:

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2018). *Cervical Sensorimotor* Control Does Not Change over Time and is Not Related to Chronic Idiopathic Neck Pain Characteristics: A Six-Month Longitudinal Observational Study. *Under Review*.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2018). No Differences between Individuals with Chronic Idiopathic Neck Pain and Healthy Individuals on Seven Cervical Sensorimotor Control Tests: A Case-Control Study. *Under Review*.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (in press). Seven Cervical Sensorimotor Control Tests Measure Different Skills in Individuals with Chronic Idiopathic Neck Pain. *Brazilian Journal of Physical Therapy*.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Farrell S.F., Snodgrass S.J. (2016). Sensorimotor control in individuals with idiopathic neck pain and healthy individuals: A systematic review and meta-analysis. *Archives of Physical Medicine and Rehabilitation*, 98:1257-71. doi: 10.1016/j.apmr.2016.09.121

12 July 2018

Suzanne Snodgrass ________________ ___________

Signature Date

PUBLICATIONS AND PRESENTATIONS INCLUDED AS PART OF THE THESIS

Papers Published and Submitted for Publication in Peer-Reviewed Scientific Journals

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2018). *Cervical Sensorimotor* Control Does Not Change over Time and is Not Related to Chronic Idiopathic Neck Pain Characteristics: A Six-Month Longitudinal Observational Study. *Under Review*.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2018). No Differences between Individuals with Chronic Idiopathic Neck Pain and Healthy Individuals on Seven Cervical Sensorimotor Control Tests: A Case-Control Study. *Under Review*.

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- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Farrell S.F., Snodgrass S.J. (2016). Sensorimotor control in individuals with idiopathic neck pain and healthy individuals: A systematic review and meta-analysis. *Archives of Physical Medicine and Rehabilitation*, 98:1257-71. doi: 10.1016/j.apmr.2016.09.121

Abstracts Presented at Peer-Reviewed Scientific Conferences

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2018, April). Cervical Sensorimotor Control is Not Correlated with Neck Pain or Neck Disability in Individuals with Chronic Idiopathic Neck Pain. Poster presentation at the Australian Pain Society/New Zealand Pain Society Conference, Sydney, Australia.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2017, December). No differences in cervical sensorimotor control between individuals with chronic idiopathic neck pain and healthy individuals. Platform presentation presented at the Sensorimotor Control Satellite Meeting of the Australasian Neuroscience Society, Sydney, Australia.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2017, November). Cervical spine sensorimotor control in individuals with chronic idiopathic neck pain. Platform presentation presented at The University of Newcastle Centre for Brain and Mental Health Research conference, Newcastle, Australia.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Snodgrass S.J. (2017, October). Head Tilt Response: A Novel Method to Test Spatial Orientation in Individuals with Idiopathic Neck Pain. Platform presentation presented at the conference of the Australian Physiotherapy Association, Sydney, Australia.

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Farrell S.F., Snodgrass S.J. (2016, July). Sensorimotor control in individuals with idiopathic neck pain and healthy individuals: A systematic review and meta-analysis. Platform presentation presented at the quadrennial conference of the International Federation of Orthopaedic Manipulative Physical Therapists, Glasgow, Scotland. doi:10.1016/j.math.2016.05.041

- de Zoete R.M.J., Osmotherly P.G., Rivett D.A., Farrell S.F., Snodgrass S.J. (2015, October). Sensorimotor control in people with insidious onset neck pain and healthy individuals: a systematic review. Platform presentation presented at the biannual conference of the Australian Physiotherapy Association, Gold Coast, Australia. doi: 10.13140/RG.2.1.1810.8883

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ABSTRACT

The aim of this thesis was to investigate the clinical relevance of cervical sensorimotor control in individuals with chronic idiopathic neck pain. Sensorimotor control has been defined as all the afferent and efferent information streams, as well as the central integration components contributing to joint stability, and recent research has suggested that cervical sensorimotor control might be disturbed in individuals with neck pain. However, current evidence is ambiguous and different studies with varying study designs and source populations report inconsistent findings. This body of work, reporting the findings of four studies, addresses this issue by investigating cervical sensorimotor control in a homogenous sample of individuals with chronic idiopathic neck pain.

Chapter 1 provides a brief introduction to neck pain and sensorimotor control and presents the research question for this thesis: (1) what is the most useful test or combination of tests for assessing cervical sensorimotor control in individuals with idiopathic neck pain, and (2) is chronic idiopathic neck pain associated with cervical sensorimotor control? Chapter 2 discusses literature on cervical sensorimotor control in individuals with neck pain in more detail, and further discusses what tests measurements have been used to assess cervical sensorimotor control.

Chapter 3 reports the findings of Study 1; a systematic review of the literature with meta-analysis that identified six tests that have been used to assess cervical sensorimotor control in individuals with idiopathic neck pain. These tests included measurements of joint position error, postural balance,

subjective visual vertical, smooth pursuit neck torsion, head steadiness, and The Fly®. One other outcome measure, head tilt response, although not described in this population, was deemed relevant for individuals with idiopathic neck pain. Meta-analysis demonstrated a statistically significant difference between pooled means for joint position error, however the actual magnitude of the difference was not considered clinically meaningful. In further meta-analyses for postural balance, no differences were found between individuals with chronic idiopathic neck pain and healthy individuals.

Chapter 4 reports the findings of Study 2, which tested whether seven cervical sensorimotor control tests measure the same, or different, skills. The study found that different tests did not cluster together in factor analysis, indicating that all tests measure distinct skills and potentially unique characteristics of cervical sensorimotor control. Two tests, postural balance and head steadiness, were found to explain a large proportion of the variance across the variables. This study suggests that clinically not one test or test battery can be recommended, and arguably clinicians have to perform all tests to adequately assess cervical sensorimotor control or nominate which aspect of cervical sensorimotor control they are examining.

Chapter 5 presents Study 3 and reports a case-control study comparing outcomes of seven cervical sensorimotor control tests in 50 individuals with chronic idiopathic neck pain and 50 sex and age matched healthy individuals. With groups being similar in terms of sex, age, BMI and physical activity levels, no differences were found for any of the cervical sensorimotor control tests. This suggests that these tests may not be clinically useful to discriminate between individuals with chronic idiopathic neck pain and healthy individuals. Additionally, correlations between cervical sensorimotor control outcomes and neck pain intensity and neck disability were weak at best, further questioning the clinical meaningfulness of these tests.

Chapter 6 reports the findings of Study 4, which investigated whether changes in cervical sensorimotor control occur over time in individuals with chronic idiopathic neck pain, and what factors are associated with changes in cervical sensorimotor control. Only half of the sensorimotor control outcomes significantly changed over a six-month period. It was further found that changes in cervical sensorimotor control outcomes were not associated with characteristics of neck pain, including neck pain intensity, neck pain duration, and neck disability. Other factors, such as sex, age, BMI, and physical activity level, were not associated with changes in cervical sensorimotor control. This suggests that clinically, cervical sensorimotor control might not be a relevant assessment for individuals with chronic idiopathic neck pain.

This thesis contributes to the understanding of the relevance of cervical sensorimotor control in individuals with chronic idiopathic neck pain. Based on inconsistent findings in recent literature, the clinical meaningfulness of cervical sensorimotor control has been questioned. From the current studies demonstrating that (1) seven tests appear to measure unique aspects that may address different characteristics of cervical sensorimotor control, (2) none of these tests discriminate between individuals with chronic idiopathic neck pain and healthy individuals, and (3) cervical sensorimotor control outcomes are not associated with characteristics of neck pain, it is suggested that cervical sensorimotor control may not be useful in the clinical assessment of individuals with chronic idiopathic neck pain.