

Proprioception and Unilateral Neglect after Stroke

by

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This is to certify that the thesis entitled “**Proprioception in Unilateral Neglect after Stroke**” submitted by **Georgia Fisher** in fulfilment of the requirements for the degree of Doctor of Philosophy (Physiotherapy) is in a form ready for examination.

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This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

Unilateral neglect and proprioceptive impairment are two common sequelae of stroke with negative impacts on functional recovery. Unilateral neglect and proprioception impairment are linked through their shared involvement in sensorimotor integration, particularly of the upper limb, which has received little attention previously resulting in significant gaps between evidence-based best practice and usual clinical practice (evidence-practice gap). These are exacerbated by similar, and separate evidence-practice gaps in clinical assessment of unilateral neglect and proprioception impairment. Hence, addressing the current issues with assessment of unilateral neglect and proprioception impairment is a critical first step in this area and is the overall aim of this thesis.

Although there are systematic reviews specific to assessment and treatment of unilateral neglect and proprioception impairment separately, previous to this thesis none had examined the link between the two. Thus, the first study (Chapter 3) of this thesis is a systematic review, which found that people with unilateral neglect after stroke have more frequent and severe proprioception impairment than those without. Furthermore, the studies included in the review used various outcome measures of both unilateral neglect and proprioception that were often not comprehensive. Previous research had indicated a large evidence-practice gap for the assessment of proprioception, however, proprioception assessment in clinical stroke rehabilitation had not been described in detail.

To address this, the second study (Chapter 4) was a survey of clinicians in stroke rehabilitation about their knowledge and practical application of proprioception impairment assessments. These results showed significant clinician knowledge gaps, and mixed ability to identify signs of proprioception impairment in clinical practice. The study also showed that most clinicians use an unstandardised position matching task to assess proprioception impairment, which was likely due to the limited functional relevance and poor ability to detect change of current clinical assessments. Given that clinical position matching assessment was unstandardised, proprioceptive impairment was not quantified and, subsequently, not correlated to

other upper limb impairments or to the presence of unilateral neglect. Therefore, the next study of this thesis (Chapter 5) was a cross-sectional investigation of proprioception and other upper limb impairments in people with stroke that aimed to quantify clinical position matching assessment and correlate it with upper limb function. Chapter 5 found no significant relationship between quantified clinical position-matching assessment and upper limb impairments in people with stroke, along with a high inter-person and intra-person variability in position matching ability after stroke.

In line with the findings about unilateral neglect assessment in Chapter 3, there were previously reported inconsistencies in the type and comprehensiveness of unilateral neglect assessment used in clinical stroke rehabilitation. However, the reasons for this were unknown. Therefore, the aim of the final study of this thesis (Chapter 6) was to identify determinants of clinician's selection and use of unilateral neglect assessment, and to explore the reasons for the current evidence-practice gap. Chapter 6 had a mixed-methods design including clinician focus groups and clinical notes audit, and found different barriers and facilitators to the use of clinical assessments of neglect between the hospital and community settings. Additionally, implementation of unilateral neglect assessment was influenced by specific behavioural determinants, including clinician knowledge, healthcare system role delineation, and implementation setting.

Collectively, the findings of this thesis provided preliminary evidence on the relationship between unilateral neglect and proprioceptive impairment, and the importance of its consideration in clinical assessment. Furthermore, this thesis' findings provided insights on the factors that explain the evidence-practice gap separate to the clinical assessment of unilateral neglect and proprioceptive impairment. These included a lack of clinician knowledge of both impairments, multiple barriers to implementation of unilateral neglect assessment in clinical practice, and a poor clinical utility of current proprioception assessment tools in practice. Each of these are important areas for further research to facilitate the translation of evidence-based clinical assessment of unilateral neglect and proprioception impairment into practice. Once research of this nature is completed, clinical assessment of the relationship of unilateral neglect and proprioception

impairment can commence, which would further improve the rehabilitation outcomes of people with these impairments after stroke.

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List of Abbreviations

AHPRA: Australian Health Practitioners Regulation Agency

AXIS: Appraisal Tool for Cross-Sectional Studies

CBS: Catherine Bergego Scale

CT: Computed Tomography

DENA: Dublin Extrapersonal Neglect Assessment

EmNSA: Erasmus modifications to the Nottingham Sensory Assessment

IMU: Inertial Measurement Unit

GCS: Glasgow Coma Scale

HREC: Human Research Ethics Committee

JPR: Joint Position Reproduction

KF-NAP: Kessler Foundation Neglect Assessment Process

MED: Movement Extent Determination

MoCA: Montreal Cognitive Assessment

MRI: Magnetic Resonance Imaging

NIHSS: National Institute of Health Stroke Scale

RASP: Rivermead Assessment of Somatosensory Performance

SSA: Site Specific Assessment

TDF: Theoretical Domains Framework

TIA: Transient Ischaemic Attack

TPD: Threshold of passive motion detection

UL-PPA: Upper Limb Physiological Profile Assessment

VAS: Visual Analogue Scale

Publications

Fisher, G., Quel de Oliveira, C., Verhagen, A., Gandevia, S., & Kennedy, D. (2020). Proprioceptive impairment in unilateral neglect after stroke: A systematic review. *SAGE Open Medicine*, 8, 2050312120951073. doi:10.1177/2050312120951073

Scholarships

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Prizes

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Statement of contribution of authors

In addition to Ms Fisher and her supervisory team, the chapters below were also contributed to by the following individuals:

Chapter 3

Professor Arianne Verhagen (data analysis, manuscript review)

Chapter 4

Professor Annie Rochette (protocol development, manuscript review)

Chapter 5

Mr Sam Gilbert (data analysis, manuscript composition)

Ms Muneeba Chaudry (data collection)

Ms Katja Valente (data collection)

Chapter 6

Associate Professor Emma Power (protocol development, manuscript review)

Ms Annaleise Getley (protocol development, data collection)

Appendix 1

Ms Victoria Keogh (data collection, data analysis)

Thesis Limitations

The final year of this thesis was conducted in the era of the SARS-COV19 pandemic. For approximately ten of these months, Australia was in varying degrees of lockdown and restrictions, which impacted significantly on the data collection of the studies herein reported, with the targeted sample sizes for studies in Chapters 4, 5, and 6 not achieved. First, recruitment for Chapter 5 was completely ceased due to policies preventing external professionals from conducting research in the public healthcare system. At the time of writing, this policy was still in place and thus data collection for this study was halted in March 2020 and unable to continue. Therefore, the planned sample size of 45 participants was not achieved, and was reduced to 10 participants. Second, healthcare clinicians in both inpatient and community settings faced enormous disruption to their practice in the form of continually changing restrictions and the necessity of moving as much of their work as possible to the telehealth medium. Disruptions related to SARS-COV19 significantly limited ancillary time in clinical loads, including time to participate in research studies, which may justify the high level of survey attrition, and small sample sizes for the survey-based study described in Chapter 4.

Finally, the priority of SARS-COV19 trials in the human research ethics application system meant that approvals for new or amendments to non-COVID related projects were significantly delayed. Chapter 6 was in the development phase in the beginning of 2020, and thus its timeline was extended by six months from completion in August 2020 to January 2021. Additionally, approval for the planned third study site in another state could not be obtained on time because of higher regulations and requirements from that state. Everything possible was done to overcome these barriers, including modifying studies to be delivered remotely, incentivising the survey, and attempting to find another in-state site for Chapter 6. However, the magnitude of the pandemic effects on society and healthcare systems had a significant and unavoidable impact on the sample sizes presented in the following chapters.

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