WOLBERT VAN DEN HOORN

POSTDOCTORAL FELLOW | PROGRAM 4
ARC TRAINING CENTRE FOR JOINT BIOMECHANICS

Appointment duration: September 2021 - March 2025

PhD (UQ) **MSc** (Vrije Universiteit Amsterdam) BSc (Physiotherapy, Hoge School van Utrecht)

Research Interests: I am interested in the neural control of shoulder movements during daily life behaviours to optimise recovery after surgery. I aim to identify modifiable factors to improve rehabilitation to enhance patients' quality of life and improve long term outcomes, bridging the gap between lab findings and the real world.

Collaborators: Zimmer Biomet, Greenslopes Private Hospital

RESEARCH SUMMARY

The goal of any surgery is to ensure optimal functional recovery for each individual patient, but current measures lack objective assessment of movement behaviour in the clinic or the real-world. To address this, we are creating a comprehensive functional movement database that measures joint and segmental motion, muscle activation, and other key factors. This data base aims to inform the design of joint implants, new surgical techniques, post-surgical rehabilitations, as well as serving as reference for treatment success. Administering the optimal "movement dose" at different stages of the patient's recovery is key. To assess the "movement dose" in real life, we are developing techniques utilising mobile devices that allow characterisation of movement behaviours in the real world which will ultimately inform rehabilitation trajectory.

PROJECT LIST

Central nervous system control of shoulder muscles during a bench press task with different postural demands.

- Aim: Determine whether or not the central nervous system sends the same command to muscles that are activated together during a bench press task, and whether the control of multiple muscles is altered depending on the postural demand for which more co-activation is required to maintain joint posture/stability.
- Hypothesis: Considering the flexibility of the shoulder girdle in young individuals without shoulder issues, we hypothesize that the central nervous system sends individual commands to shoulder muscles that are activated together to achieve the task independent of postural demand.
- Research Impact: Understanding how our shoulder muscles are controlled in normal pain-free activities will provide a basis upon which we can develop new studies that will test the control of shoulder muscles in people with shoulder pain and injury.

The neurophysiological drivers of shoulder muscle activation, and functional recovery, after total reverse shoulder replacement.

- The total reverse shoulder replacement was designed to overcome joint osteoarthritis with insufficient rotator cuff function and to enhance the function of deltoid muscle to compensate. Although satisfactory outcomes have been reported, functional outcome remain variable between patients. The deltoid is a large muscle with different biomechanical functions where a less efficient (co-activation) strategy of the different deltoid muscles could limit the ability to achieve normal range of motion.
- Hypothesis: We hypothesize that lesser efficient deltoid control in individuals after total reverse shoulder replacement (i.e., co-activation of the different deltoid parts) is underpinned by a common command from the central nervous system. The level of common command to the deltoid muscles is negatively associated with functional range of motion. More common drive represents a neural constraint, making it challenging to efficiently control shoulder movements via deltoid activation.
- Research Impact: If our hypotheses are supported, this work will provide a paradigm shift in what we consider to be the drivers of successful rehabilitation after shoulder surgery.

GRANTS

- 2022 Early career research scheme: Driving the deltoid: The neurophysiological drivers of shoulder muscle activation, and functional recovery after total reverse shoulder replacement. (25K)
- 2022 Metro South Health co-funded collaboration grant: The neurophysiological drivers of shoulder muscle activation, and functional recovery after total reverse shoulder replacement. (50K)
- 2022 ARC-ITTC Seed grant: Biomechanical characteristics of the human supraspinatus tendon under physiological loading

SELECTED CONFERENCES/PUBLICATIONS

- The 13th Australasian Biomechanics Conference (ABC13, 2022): Mapping magnetic field disturbances in motion capture lab, Wolbert van den Hoorn, Graham Kerr.
- ARC-ITTC 2022 Research symposium: Validity of post-surgical shoulder mobility assessment tool (mymobility© App), Wolbert van den Hoorn, Maxence Lavaill, Ashish Gupta, Roberto Pareyon Valero, Freek Hollman, Graham Kerr

SUPERVISION

- Miss Amy Ma, Mr Giacomo Nardese & Mr Arthur Fabre (PhD candidates)

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