Project REHAB RHYTHM

Newcastle University

STRENGTHENING SURVIVING CONNECTIONS TO IMPROVE UPPER LIMB FUNCTION AFTER SPINAL CORD INJURY

Some 60,000 people in the UK live with spinal cord injuries (SCI). Being confined to a wheelchair because of paralysis or weakness of the legs is the most obvious sign of this life-changing condition, but people with SCI also often have problems with arm and hand movements. We use our hands for a wide variety of everyday tasks, from cooking to typing. Hand function is critical for self-care such as in dressing or washing. Our hands are also important for social communication: gestures, a caress or a hug. It is no wonder then that improving hand function consistently ranks among the top priorities for SCI individuals – typically higher than regaining the ability to walk. Yet there are few treatments to enhance upper limb function beyond physiotherapy, which yields variable benefits. In this project, we take a different approach, based on understanding the underlying neuroscience governing how connections are naturally strengthened in the nervous system. We will exploit these processes to create a portable device which SCI survivors can use at home to produce lasting improvements in hand function.

IN OUTLINE: The INSPIRE foundation is funding project **REHAB RHYTHM** or **'Strengthening Residual Motor Pathways by Pairing Repetitive Movements with Nerve Stimulation'.**

In the new rehab protocol which we have developed, we ask people to tap along in time to a beat played on a metronome while we give electrical nerve stimuli in time with the movements. This strengthens connections from the brain to the spinal cord. We think this works so well because the movements locked to a beat are highly regular, allowing us to time the nerve stimulus at just the right moment to have the best effect. In this project, we will optimise this protocol, and then test it on people with SCI to demonstrate a meaningful improvement in hand function.

WHY ARE WE APPROACHING YOU? There is no NHS or public funding for SCI research and we are appealing to you to help raise funds for this important project.

HOW MUCH, HOW LONG & WHERE? The total cost of the project is £239,610. Lasting 36 months, most of the work will be conducted at Newcastle University, which is a world class research centre for the control of movement in health and disease. For the final trial in SCI survivors, the Newcastle team will work with their long-term collaborators at the Institute of Neurosciences, Kolkata, India (INK). INK is the leading specialist neuroscience hospital in India, and serves a very wide catchment area over East India and further afield; this provides rapid access to large cohorts of patients. In this project, we will recruit 30 SCI survivors for the final at-home trial of the new device.

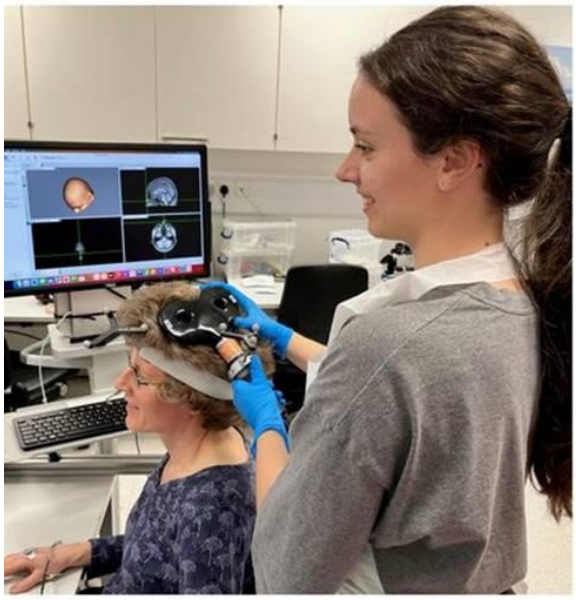
OUR DEDICATED RESEARCH TEAM

Prof. Stuart Baker MA PhD Principal Investigator (PI). Professor of Movement Neuroscience at Newcastle University.

To be appointed, Research Assistant (RA) on project REHAB RHYTHM at Newcastle University.

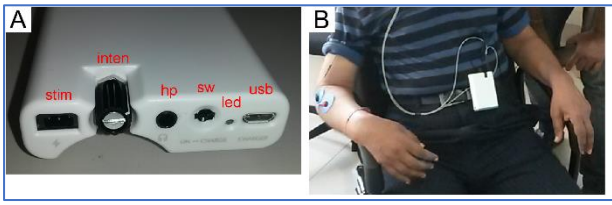
Dr Hrishikesh Kumar MD DM. Head of Department of Neurology and Director of Research at Institute of Neurosciences, Kolkata.

Dr Supriyo Choudhury MBBS MD. Assistant Director of Research at Institute of Neurosciences, Kolkata.



PREVIOUS RESEARCH. In previous research, we tested the new protocol of rhythmic movement combined with nerve stimulation in uninjured people. We showed that this strengthens connections from brain to spinal cord, measured using transcranial magnetic brain stimulation (LEFT).

We have extensive experience of developing portable and wearable devices to induce plasticity, exemplified by the device shown BELOW which was used in a previous successful clinical trial at INK.



Previous wearable device developed in Newcastle. A, photo: stim, stimulus port; inten, intensity control; hp, headphone jack; sw, on/charge switch; led, charge indicator; usb, charge port. B, device worn by a patient in a clinical trial at INK.

PROPOSAL. We now plan to develop this promising approach in uninjured participants, optimising things like the number of beats and the interval. We will then work with a small number of SCI participants to optimise the protocol further, making sure that it is suited to people with impaired movement. Finally, we will develop a portable device to deliver the protocol at home, and use this to demonstrate meaningful improvements in hand function for individuals with SCI.

WHO WILL BENEFIT? Most SCI sufferers with injuries to the cervical cord experience some impairment of hand function. Our research will offer a principled way in which surviving connections can be strengthened to recover better. This will be achieved using a cheap portable device usable at home, making the new therapy highly accessible to all.

HOW THE EXPECTED OUTCOME WILL BENEFIT THE SPINAL CORD INJURED

'There is an urgent need for new approaches to rehabilitation of hand and arm movements. These are a priority for people with SCI, but current approaches are not very effective. This project will develop and test a simple treatment involving home-based rhythmic movement paired with nerve stimulation. We developed this procedure from the bottom up, based on detailed understanding of the neuroscience of how connections in the spinal cord naturally strengthen during learning. I think it has enormous potential to enhance the quality of everyday life after SCI, in a low cost and available technology'.

Prof. Stuart Baker
Principal Investigator
Project REHAB RHYTHM