

Home-based robotic glove therapy improves hand function in chronic cervical SCI

Loss of hand function following a high-level spinal cord injury (SCI) is one of the main factors limiting independence in activities of daily living (ADL), yet after discharge many patients have little ongoing access to intensive hand rehabilitation. A 2020 pilot study by Osuagwu et al. explored whether a simple, home-based program using a Soft Robotic Assistive Glove could improve hand function in people with chronic cervical SCI.

Study population and setting

Fifteen adults with chronic (more than 12 months post-injury), motor-incomplete cervical SCI (AIS C or D, C2–C8) were recruited from the National Spinal Injuries Centre in the UK. All had residual hand function but continued difficulty with grasp, manipulation, and performing activities of daily living (ADLs) independently in the chronic phase.

Intervention:

Practical home-based use

Participants were trained to use the Robotic Glove at home for at least 4 hours per day over 12 weeks, either continuously or in shorter sessions. Each day they performed a short, structured set of tasks with the glove (repetitive grasp-and-release of a softball, simulated drinking from a can, eating with cutlery, and writing name and address) and then used the glove during usual ADL such as feeding and grooming, recording usage in a diary. The glove itself is lightweight and uses soft “tendon” actuators and fingertip/palm sensors to detect grip intent and provide proportional flexion support to the thumb, middle and ring fingers, thereby augmenting grasp while encouraging active movement.

Outcome measures

Participants were assessed at baseline, Week 6, Week 12, and Week 18 (6-week follow-up). The primary outcome was the Toronto Rehabilitation Institute Hand Function Test (TRI-HFT), which measures object manipulation and grasp tasks including palmar grip of a weighted wooden bar and instrumented measures of cylinder (palmar) and credit-card (lateral) grip forces. Secondary measures included pinch strength with a pinchmeter, muscle tone with the Modified Ashworth Scale (MAS), satisfaction with assistive technology (QUEST), and health status (SF-36).

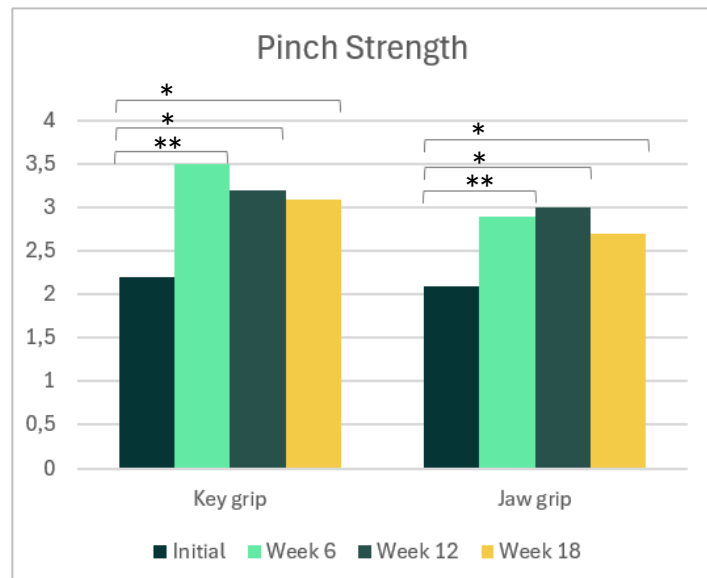


Figure 1: Pinch Strength (kg), * $p < 0.016$, ** $p < 0.003$

Key clinical results

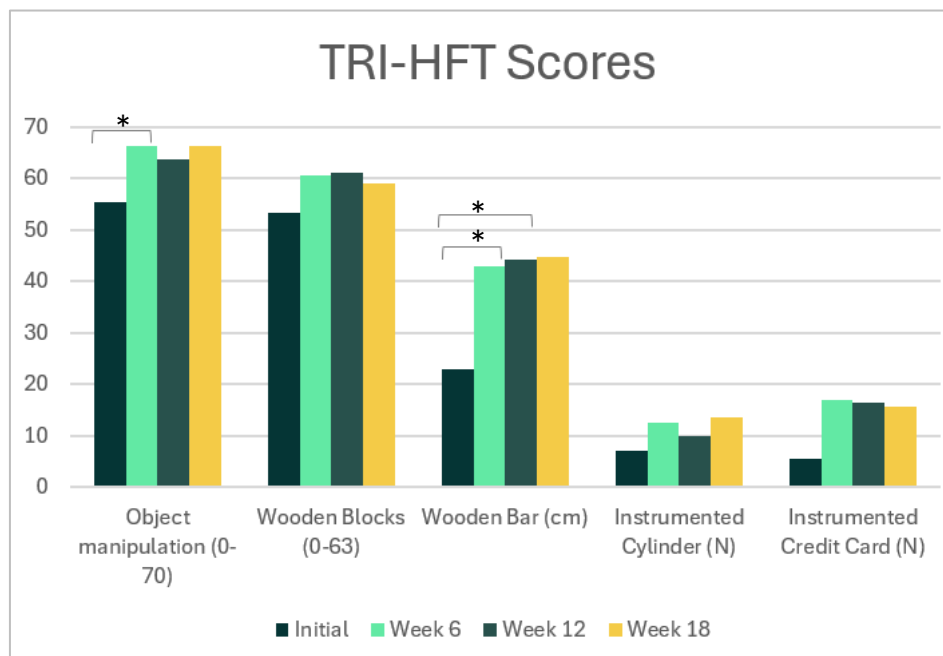


Figure 2: Results of TRI-HFT (Scales within the brackets), * $p < 0,016$

By Week 6, Significant improvements were observed in several TRI-HFT components (figure 2), including object manipulation and wooden bar performance. The length of a wooden bar that could be held with a pronated palmar grip increased substantially and this gain was maintained at Week 12 and follow-up. Instrumented cylinder and credit-card components also showed increased grasp and pinch force, indicating stronger palmar and lateral grip useful for everyday tasks such as holding a pan, toothbrush or hairbrush. Pinchmeter dynamometry (figure 1) revealed significant, maintained increases in key and jaw grip strength starting at Week 6, while thumb muscle tone on the MAS improved, suggesting reduced hypertonia during the period of glove use. Participants reported improvements in grip function, hand use, and object manipulation, and functional gains in ADL such as eating, grooming, driving, stair climbing (holding a handrail), and other bimanual tasks.

Implications for therapy and acceptance

The authors conclude that an intensive, activity-based, self-administered program using the Robotic Glove can improve and help retain both gross and fine hand function in chronic cervical SCI, supporting the idea that home-based, technology-supported practice can drive meaningful functional change even years after injury.

For therapists, this suggests the Robotic Glove may be a practical tool to extend high-intensity, task-specific hand training into the home environment, complementing centre-based rehabilitation and potentially increasing independence in ADL for suitable patients.

Most participants rated the Robotic Glove as effective, comfortable and easy to use, and overall were “quite satisfied” on the QUEST satisfaction scale, with some wishing to keep the device after the study.

Osuagwu BAC, Timms S, Peachment R, Dowie S, Thrussell H, Cross S, Shirley R, Segura-Fragoso A, Taylor J. Home-based rehabilitation using a soft robotic hand glove device leads to improvement in hand function in people with chronic spinal cord injury: a pilot study. J Neuroeng Rehabil. 2020 Mar 5;17(1):40. doi: 10.1186/s12984-020-00660-y. PMID: 32138780; PMCID: PMC7057671.