

Force Sensing Resistor Testing of Hand Forces and Grasps during Daily Functional Activities in the Covid-19 Pandemic

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Abstract : Introduction Scientific evidence on the hand forces and the types of grasps measurement during daily tasks are lacking, leaving a gap in the field of hand rehabilitation and robotics. Measuring the grasp forces and types produced by the individual fingers during daily functional tasks is valuable to inform and grade rehabilitation practices for second to fifth metacarpal fractures with robust scientific evidence. Feix et al, 2016 identified the most extensive and complete grasp study that resulted in the GRASP taxonomy. Covid-19 virus changed data collection across the globe and safety precautions in research are essential to ensure the health of participants and researchers. Methodology A cross-sectional study investigated six healthy adults aged 20 to 59 years, pilot participants' hand forces during 105 tasks. The tasks were categorized into five sections namely, personal care, transport and moving around, home environment and inside, gardening and outside, and office. The predominant grasp of each task was identified guided by the GRASP Taxonomy. Grasp forces were measured with 13mm force-sensing resistors glued onto a glove attached to each of the dominant and non-dominant hand's individual fingers. Testing equipment included Flexiforce 13millimetres FSR .5" circle, calibrated prior to testing, 10k 1/4w resistors, Arduino pro mini 5.0v - compatible, Esp-01-kit, Arduino uno r3 - compatible board, USB ab cable - 1m, Ftdi ft232 mini USB to serial, Sil 40 inline connectors, ribbon cable combo male header pins, female to female, male to female, two gloves, glue to attach the FSR to glove, Arduino software programme downloaded on a laptop. Grip strength measurements with Jamar dynamometer prior to testing and after every 25 daily tasks were taken to will avoid fatigue and ensure reliability in testing. Covid-19 precautions included wearing face masks at all times, screening questionnaires, temperatures taken, wearing surgical gloves before putting on the testing gloves 1.5 metres long wires attaching the FSR to the Arduino to maintain social distance. Findings Predominant grasps observed during 105 tasks included, adducted thumb (17), lateral tripod (10), prismatic three fingers (12), small diameter (9), prismatic two fingers (9), medium wrap (7), fixed hook (5), sphere four fingers (4), palmar (4), parallel extension (4), index finger extension (3), distal (3), power sphere (2), tripod (2), quadpod (2), prismatic four fingers (2), lateral (2), large-diameter (2), ventral (2), precision sphere (1), palmar pinch (1), light tool (1), inferior pincher (1), and writing tripod (1). Range of forces applied per category, personal care (1-25N), transport and moving around (1-9 N), home environment and inside (1-41N), gardening and outside (1-26.5N), and office (1-20N). Conclusion Scientifically measurements of finger forces with careful consideration to types of grasps used in daily tasks should guide rehabilitation practices and robotic design to ensure a return to the full participation of the individual into the community.

Keywords : activities of daily living (ADL), Covid-19, force-sensing resistors, grasps, hand forces

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