A. GATTO, S. CAREY, S. SUNDARRAO. Design and development of a wrist-hand orthosis for individuals with a spinal cord injury. Gerontechnology 2018;17(Suppl):104s; https://doi.org/10.4017/gt.2018.17.s.101.00 **Purpose** Between 45%-60% of all reported spinal cord injury (SCI) cases (in the US) are classified as incomplete quadriplegia, ranking it the most common SCI[1]. The majority of cervical SCIs occur in the C5-C7 segments causing patients to lose upper & lower limb functionality[2]. Among quadriplegic SCI patients, studies have shown that restoring arm/hand function is their highest priority. Providing them the ability to grasp objects will allow for independent completion of activities of daily living (ADLs) that would otherwise need assistance[2,3,4,5]. Patients with an incomplete C5-C7 SCI, lose prehension abilities, but wrist function is almost universally retained[2,6,7], thus most prehension rehabilitation techniques apply the tenodesis effect (wrist extension for grasping, wrist flexion for releasing[6,7]. Current tenodesis wrist-hand orthoses (WHOs) engage only the thumb and index finger for gripping, not allowing for whole-handed gripping[7], meaning, only 20% of ADLs can be completed. **Method** The powered WHO used in this project began as a student project and utilizes a modified version of the tenodesis effect (wrist flexion for grasping, wrist extension for releasing) to help individuals with an incomplete C6-C7 SCI to independently complete ADLs. Further, a variable assistance motor can be installed providing individuals the ability to control the level of assistance. This variable assistance feature also means other patient types, such as stroke patients or elderly individuals, who have lost grip strength, can use this device. This orthosis design is customizable, lighter, and easier to use than currently available WHOs. This WHO was initially tested on 2 able-bodied (AB) individuals. Following this, the orthosis was shown to a potential user (it could not be used since the fit was not customized for the user) for initial feedback on design. **Results & Discussion** For both AB individuals the orthosis was successful in whole handed gripping, but was unsuccessful in acute digital manipulation, as expected. The individual with a SCI, who was shown the orthosis, did like the design and believed that it would allow him to complete more ADLs than he currently can complete, but mentioned that, like other WHOs, this one could not be donned/doffed independently. From this feedback we have begun to develop a don/doff stand for the orthosis that will allow users to independently don/doff the orthosis, giving each a complete sense of independence. In order for this orthosis/stand set to work, the original orthosis had to be redesigned to accommodate the stand. We are currently in this process of redesigning to combine the freedom for wrist motion with the stability needed for donning/doffing. Once we complete the orthosis and stand we will begin testing on patients that will benefit from the device. During this phase of testing we plan to use motion capture data and a modeling software to (1) optimize key features and parameters of the orthosis during the on-going prototyping phase, (2) determine the effects the prototyped orthosis has on the human body, and (3) define adjustments required for individually customized orthoses.

References

1. Kalsi-Ryan S, Beaton D, Curt A, Duff S, Popovic MR, Rudhe C, Fehlings MG, Verrier MC. Journal of Neurotrauma. 2012 March;29(5):905-914
2. Thorsen R, Dalla CD, Chiaramonte S, Binda L, Beghi E, Redaelli T, Occhi EF, Ferrarin M. The Scientific World Journal. 2013
3. Simpson LA, Eng JJ, Hsieh JT, Wolfe DL. Journal of neurotrauma. 2012 May 20;29(8):1548-1555
4. Harvey LA, Dunlop SA, Churilov L, Galea MP. Journal of physiotherapy. 2016 April;62(2): 88-95
5. Mateo S, Di Rienzo F, Bergeron V, Guillot A, Collet C, Rode G. Frontiers in behavioral neuroscience. 2015 September 11;9:234
6. Di Rienzo F, Guillot A, Mateo S, Daligault S, Delpuech C, Rode G, Collet C. Experimental brain research. 2015 January; 233(1):291-302
7. Mateo S, Roby-Brami A, Reilly KT., Rossetti Y, Collet C, Rode G (2015). Journal of neuroengineering and rehabilitation. 2015 January 30;12(1):1

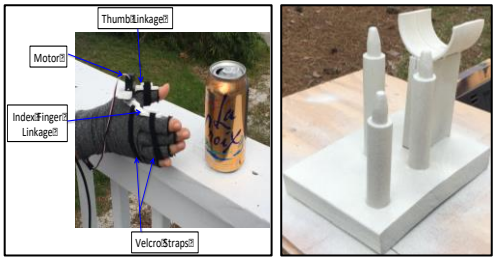

Figure 1. Othosis (Left) and Don/Doff Stand (right)

Keywords: SCI, wrist orthosis, ADLs
Address: University of South Florida, USF;
E: ambergatto@mail.usf.edu