Alternative Ways to Exercise After SCI: Case Studies of Stimulation-Driven Overground Cycling without Motor Assistance

Lisa M. Lombardo MPT1, Kevin M. Foglyano BSE1, Stephanie Nogan Bailey BSE1, Ronald J. Triolo PhD1,2, John McDaniel PhD1,3

1 Advanced Platform Technology Center, Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland OH, 2 Department of Biomedical Engineering, Case Western Reserve University, Cleveland OH, 3 Kent State University, Kent, OH

BACKGROUND

Immobility following paralysis compromises physical activity and can lead to long-term health complications including cardiovascular disease, pulmonary disease and diabetes. Adapted exercise equipment for persons with spinal cord injuries (SCI) is often restricted to specialized gyms, requires assistance, and may not provide the intensity needed for the global health benefits of exercising the lower extremity muscles. The purpose of this study was to begin to examine the effectiveness of stimulation-driven overground cycling as a new, engaging modality for exercise and recreation after SCI.

CASE PRESENTATION

Two male recipients and well-conditioned regular users of an implanted neuroprosthesis (NP) targeting muscles necessary for standing/stepping.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Injury Level</th>
<th>NP User Duration</th>
<th>Able to Stand after 30 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject 1</td>
<td>57 years old</td>
<td>T11 AIS B</td>
<td>6 years</td>
<td>Able to stand &gt; 30 minutes</td>
</tr>
<tr>
<td>Subject 2</td>
<td>60 years old</td>
<td>T4 AIS B</td>
<td>5 years</td>
<td>Able to stand &gt; 30 minutes</td>
</tr>
</tbody>
</table>

DATA COLLECTION

Max and mean power and speed were collected pre- and post-training. Steady state power after initial peak power surge was collected to document endurance and ability to maintain power output over time.

RESULTS

Mean, peak, and steady state power output increased for both subjects with training, indicating positive impact on strength and endurance. Max and mean speeds showed modest increases.

CONCLUSION

Even well-conditioned, regular users of stimulation for exercise can improve peak cycling power by 68% and increased fatigue resistance (steady state power) by 72% after 16 weeks of training. This gain was sufficient to enable outdoor cycling over level ground for more than an hour without motor assistance. Future work is concentrating on replicating and generalizing these findings on more subjects with surface stimulation, investigating methods to maximize the physiological effects of stimulation-driven overground cycling exercise, and quantifying its impact on overall health, well-being, quality of life, community engagement and societal participation.

REFERENCES


Support

The research described here was supported by the Advanced Platform Technology Center of the Rehabilitation Research and Development Service of the US Department of Veterans Affairs Veterans Health Administration.