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HAL Identified as the Only Device to Induce Neuroplasticity and Provide Comprehensive Therapeutic Benefits—Findings Published in an International Medical Journal

CYBERDYNE Inc. (headquartered in Tsukuba, Ibaraki, Japan; President and CEO: Yoshiyuki Sankai, hereinafter "the Company") announced that its HAL, the world's first wearable cyborg, has been identified as the only exoskeleton device that induces neuroplasticity and provides comprehensive therapeutic benefits across multiple health outcomes associated with spinal cord injury (SCI). These findings were derived from a systematic review published in a leading international medical journal.

The systematic review, titled "Actively Controlled Exoskeletons Show Improved Function and Neuroplasticity Compared to Passive Control: A Systematic Review", was published in the June 2025 issue of the Global Spine Journal. It was led by Mr. Darren Lui of St George's Hospital, one of the largest teaching hospitals in the United Kingdom. The review analyzed 27 clinical studies, carefully selected from an initial pool of 555 publications from 2011 to 2023, involving a total of 591 patients with SCI, to compare the clinical outcomes of actively controlled versus passively controlled exoskeletons.

HAL, developed by CYBERDYNE, is characterized by its unique principle of interactive biofeedback (iBF), whereby it detects bioelectrical signals generated from the user's central nervous system in real time and enables voluntary motion through synchronized robotic assistance. This establishes a neural feedback loop in which somatosensory information from the body is transmitted back to the central nervous system (brain), thereby facilitating functional improvement through interactive engagement between the user and HAL.

Based on extensive comparative analysis, the systematic review revealed that among HAL and nine other passively controlled exoskeletons (e.g., ReWalk, Ekso, Lokomat), HAL was the only device shown to consistently induce neuroplasticity and yield therapeutic effects across all evaluated health domains.

The review cited findings from functional magnetic resonance imaging (fMRI) studies, which show that active movement induces greater neural responses in the central nervous system than passive movement. Furthermore, it described how the repetitive neuromuscular process realized by HAL's active control mechanism—wherein bioelectrical signals are amplified to produce intentional movement—feeds successful movement back to the CNS. This loop facilitates motor learning and synaptic strengthening, enabling reconstruction and reactivation of spinal circuits even below the level of injury, and ultimately contributing to partial reinnervation.

Through this mechanism, HAL demonstrated not only significant improvements in primary mobility outcomes such as walking distance and speed, but also consistent and clinically meaningful improvements in secondary outcomes including continence, pain, and quality of life (QoL). These findings substantiate HAL as a unique therapeutic device capable of restoring functions across the entire neuromuscular system.

The Company believes that HAL represents the only medical device capable of rebuilding functions across the brain–nervous–muscular system, and is the core technology of its Cybernics Treatment for SCI—a highly complex and multifaceted condition. Going forward, CYBERDYNE remains committed to promoting evidence-based medicine and collaborating with domestic and international medical institutions to expand and advance innovative rehabilitation paradigms.

Note: A systematic review is a rigorous and reproducible research method used to collect, evaluate, and synthesize multiple studies from around the world on a specific topic. It is widely regarded as one of the highest levels of scientific evidence, especially in the medical field, where it plays a critical role in supporting clinical practice and policy decision-making.

Reference:

Chiu KIA, Taylor C, Saha P, Geddes J, Bishop T, Bernard J, Lui D. Actively Controlled Exoskeletons Show Improved Function and Neuroplasticity Compared to Passive Control: A Systematic Review. Global Spine Journal. 2025.