Hybrid Assistive Limb

The Hybrid Assistive Limb is a powered exoskeleton suit developed by Japan's Tsukuba University and the robotics company Cyberdyne. It is designed to support and expand the physical capabilities of its users, particularly people with physical disabilities.

Watanabe et al. investigated the long-term effects of a lumbar-type hybrid assistive limb for patients with chronic heart failure. [Participants and Methods] A total of 28 hospitalized patients with chronic heart failure (mean age, 73.1 ± 13.8 years) were randomly assigned to two groups: the hybrid assistive limb group or the control group, in which they performed a sit-to-stand exercise with or without the hybrid assistive limb, respectively. The cardiac rehabilitation therapy included this intervention, which was performed as many times as possible for 5-30 minutes per day for 6-10 days. Clinical assessments like lower-limb muscle strength, walking ability, etc., were measured before and after the intervention. Cardiac events were followed up for up to a year after discharge. [Results] No adverse events occurred during the study period in either group. In terms of long-term effects, the incidence of cardiac events was 23% and 45% in the hybrid assistive limb and the control groups, respectively. [Conclusion] Hybrid assistive limb-assisted exercise therapy may be a safe and feasible cardiac rehabilitation tool in patients with chronic heart failure. The lumbar-type wearable cyborg

hybrid assistive limb may have a positive effect on heart failure prognosis by adding long-term exercise therapy [1)].

A robotic arm (not robotic hand) is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement.

The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand.

To determine how differences in frequency of the single-joint hybrid assistive limb (HAL-SJ) use affect the improvement of upper limb motor function and activities of daily living (ADL) in stroke patients.

Subacute stroke patients were divided into the high or low frequency of HAL-SJ use groups. The two groups were matched by propensity score, and the degree of changes 30 days after initiating HAL-SJ use was compared. A logistic regression analysis was performed to examine whether frequent use would increase the number of subjects experiencing the efficacy of more than the minimal clinically important difference (MCID) of Fugl-Meyer assessment (FMA).

Twenty-five stroke patients were matched by propensity score, and nine pairs were matched. The high-frequency group showed a significantly superior increase to total FMA shoulder, elbow, forearm, and Barthel index compared with the low-frequency group. Logistic regression analysis revealed no significant associations between frequent use and MCID.

The frequency of HAL-SJ use may affect the improvement of motor function and ADL ability of the upper limb with exception of the fingers and wrist. However, the frequency of intervention was not effective enough to further increase the number of subjects with clinically meaningful changes in upper limb motor function.IMPLICATIONS FOR REHABILITATIONThe current study aimed to clarify how differences in the frequency of single-joint hybrid assistive limb (HAL-SJ) use can affect the improvement of upper-limb motor functions and ADL in subacute stroke patients.Our results implied that the frequency of HAL-SJ use may influence the recovery of upper limb function.However, even if HAL-SJ is used frequently, it does not mean that more patients will achieve clinically meaningful recovery [2)].

The Hybrid Assistive Limb (HAL) was developed as an exoskeleton robot that supports gait training. The purpose of a study of Setoguchi et al. was to assess the usefulness of training using the HAL after total hip arthroplasty (THA). They targeted 16 consecutive patients who underwent THA via the posterior approach. They randomized patients to the HAL group (8 hips), in which the HAL was used as part of physical therapy, or the control group (8 hips), in which only typical physical therapy was performed. Gait analysis was performed before and after surgery, and comparisons were made between the two groups. They evaluated the single support time (%), double support time (%), cadence (steps/min), velocity (cm/s), stride length (cm), and anteroposterior and lateral variability, and assessed the hip and knee joint range of motion in the sagittal plane. The results showed improvements in the hip extension angle and other gait parameters in the HAL group. Among gait-related problems after THA, a decreased peak hip extension angle is reported to be a significant

factor that affects gait disability. This study revealed that HAL usage after THA seems to be a useful method to obtain sufficient extension angle [3)].

Use of the Hybrid Assistive Limb (HAL) that is effective for improvement of gait ability in chronic stroke patients has been reported. However, how long the effects are maintained remains unknown. The purpose of the present study was to investigate whether the effect of gait training using the HAL on gait ability was maintained for 3 months after the intervention.

A longitudinal, observational study with an intervention for a single group that adhered to the STROBE guidelines was performed. Nine chronic stroke patients were enrolled in this study. The patients performed gait training sessions using the HAL, 2-5 sessions/week for 3 weeks. Gait speed, stride length, cadence, and 2-minute walk distance (2MWD) were measured before and after intervention and at 3-month follow-up. The clinical trial registration number of this study is UMIN000012764 R000014756. Results: Compared to the initial status, gait speed ($p = .02$), stride length ($p = .03$), cadence ($p = .01$), and 2MWD ($p < .05$) were significantly increased immediately after the intervention. Moreover, gait speed ($p < .01$), cadence ($p = .03$), and 2MWD ($p = .02$) remained significantly higher 3 months after the intervention. There were no significant changes in all outcome measures between after intervention and at 3-month follow-up. Conclusions: This study showed that gait training using the HAL resulted in significant improvement of gait ability after the intervention and the effect was maintained for 3 months after the training [4)].

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