

# Functional and Gait Training using a Wearable Hip-assist Robot Improves Gait and Physical Function in the Elderly

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**Abstract**— The purpose of this study was to investigate the effect of the functional and gait training with Gait Enhancing and Motivating System (GEMS) on gait and physical function in elderly persons. Thirty-three elderly adults received 40-minute functional and gait training session with the GEMS in various environments, total 24 sessions for consecutive 8 weeks.

**Clinical Relevance**— After 24-sessions of robot-assisted functional and gait training with GEMS, significant functional improvements were demonstrated in the 10MWT, FRT, FSST, TUG, BBS, 6MWT, and muscle strength (hip/knee/ankle). A newly developed wearable hip assist robot, the GEMS, is a potentially useful training device for improving gait and physical function in elderly persons.

## I. INTRODUCTION

Decline of physical function with age ultimately leads to sedentary lifestyles, which are strongly correlated with various cardiovascular and metabolic morbidities and reduced life expectancies [1]. Regular physical activity is recommended as a countermeasure to mitigate the natural decline of physical function with age. However, the limited mobility of older adults constitutes a formidable barrier to regular practice of standard exercise programs. The purpose of this study was to investigate the effect of the functional and gait training with a wearable hip-assist robot on physical function in elderly persons.

## II. METHODS

Thirty-three elderly adults (mean aged  $79.78 \pm 3.29$ ) living in residential care facilities for the elderly participated in this study. The Gait Enhancing and Motivating System (GEMS, Samsung Electronics Co., Ltd., Korea), which functions as a wearable hip-assist robot, was used for training. All participants received 40-minute training session with GEMS in various environments; 20-minute functional training including sit-to-stand and balance training and 20-minute gait training including incline, over-ground and stair walking, 24 sessions for consecutive 8 weeks. For the first 4 weeks,

training was conducted using an assist mode and then a resistance mode of GEMS for the next 4 weeks. Assessments were performed at baseline, 4 weeks after assist mode training, and 8 weeks after training with resistance mode. Physical functions were measured by the 10-meter walking test (10MWT), four square step test (FSST), timed up and go test (TUG), 6-minute walking test (6MWT), functional reach test (FRT), Berg balance scale (BBS), and muscle strength (hip flexion/extension/abduction/adduction, knee flexion/extension, and ankle dorsi/plantar flexion) tests. All outcome measures were performed without wearing the GEMS.

## III. RESULTS

After 24-sessions of robot-assisted functional and gait training with GEMS, significant functional improvements were demonstrated in the 10MWT, FRT, FSST, TUG, BBS, 6MWT, and muscle strength (hip/knee/ankle) from baseline ( $p < .05$ ). Especially, 10MWT, TUG, BBS, and muscle strength (hip adduction, knee flexion/extension, ankle dorsi/plantar flexion) showed significant changes between the baseline to 4 weeks and between 4 to 8 weeks ( $p < .05$ ).

## IV. DISCUSSION & CONCLUSION

The elderly exhibit slower walking speeds, and commonly suffer from lower-limb pain and balance disorders, thus exposing them to increased risk of falling [2]. Regular physical activity is associated with decreased mortality and age-related morbidity in older adults [3]. Hence, specific training paradigms accounting for age-related frailty and disabilities must be designed for the elderly. This study demonstrated that functional and gait training with GEMS in elderly persons improved physical performance including gait, balance, and muscle strength. A newly developed wearable hip assist robot, the GEMS, is a potentially useful training device for improving gait and physical function in elderly persons.

## REFERENCES

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