Impact of Telerehabilitation on Subjects with Locomotive Syndrome: The Bibai Study

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INTRODUCTION: Locomotive syndrome (LS) is characterized by diminished mobility due to impaired locomotive organs, which increases the risk of disability [1]. LS is a leading cause of nursing care in elderly, often resulting in significant personal and societal burden. With the rapid aging of the population, effective interventions are urgently needed to address these challenges. Conventional rehabilitation programs face barriers such as limited accessibility and the difficulty of maintaining consistent participation. Telerehabilitation (TR) expands access to rehabilitation by reducing the need for travel, making it a potentially effective intervention for subjects with LS. This study aimed to investigate the effects of TR on physical function in subjects with LS.

METHODS: Eleven subjects with LS (average age: 1 male and 10 females, 63.4±6.3 years old) participated in this study. The study protocol was approved by our institutional review board, and written informed consent was obtained from all subjects. Intervention sessions were delivered via TR technology using a large-screen monitor at local health centers. Weekly 40-minute sessions over 8 weeks were conducted by physical therapists. Participants were instructed to replicate them at home at least once a week. The intervention consisted of locomotion training (e.g., one-leg stands, squats, heel raises, lunges) and resistance exercises using Therabands. Exercises included knee extensions and clamshell exercises, with band resistance progressively increased. All participants underwent the LS risk test (stand-up test, two-step test, 25-question risk assessment [GLFS-25]), physical function assessments, and body composition assessments using a bioelectrical impedance analyzer (MC-780A-N, TANITA Inc.) both before and after the intervention. In the stand-up test, the ability to stand on one or both legs from stools at heights of 40, 30, 20, and 10 cm was assessed. In the two-step test, the length of two consecutive strides from a starting line was measured, with scores normalized by participants' height. The GLFS-25 is a self-reported questionnaire assessing activities over the past month, scored 0–100, with higher scores indicating greater LS severity. Participants were classified into Non-LS, LS Stage 1, 2, or 3 based on their LS risk test results, with higher stages reflecting more severe conditions [2]. Physical function assessments included the isometric knee and hip extension strength, grip strength, 10-meter walk time, timed up and go test (TUG), and six-minute walk test (6MWT). Body composition assessments included weight, body fat mass, and appendicular skeletal muscle mass (ASM). Statistical analyses comparing pre- and post-intervention data were conducted using paired t-tests and chi-square tests. The significance level was set at 0.05.

RESULTS: The interventions via TR technology significantly reduced LS severity ($p = 0.046$) (Fig. 1). Specifically, the intervention significantly increased two-step test scores ($p = 0.018$) and decreased GLFS-25 scores ($p = 0.008$) (Fig. 2), although no significant change was observed in stand-up test scores. Regarding physical function, the intervention significantly increased 6MWT ($p < 0.001$), but there were no significant changes in knee or hip extension muscle strength, grip strength, 10-meter walk time, or TUG (Table 1). As for body composition, there were no changes in weight, body fat mass, and ASM.

DISCUSSION: This study demonstrated that interventions via TR technology significantly reduced LS severity and improved six-minute walk test scores. Despite no observed changes in muscle strength or muscle mass, the improved six-minute walk and two-step test results suggest enhanced walking ability. The GLFS-25 score effectively assesses mobility in relation to pain, daily activities, and mental health. As exercise habits are known to improve this score [3], interventions via TR technology may enhance these habits, leading to improved outcomes. Interventions via TR technology, widely accessible across regions, offers an effective strategy for preventing the progression of LS.

SIGNIFICANCE: This study is the first to demonstrate that interventions via TR technology can significantly improve severity of LS. Interventions via TR technology holds strong potential as a scalable and effective solution to prevent LS progression.

REFERENCES: [1] Nakamura K, J Orthop Sci. 2008;13(1):1-2. [2] Yoshimura N et al., J Bone Miner Metab. 2022;40(4):623-35 [3] Yamada T et al., Prog Rehabil Med. 2021;30(6):20210006.

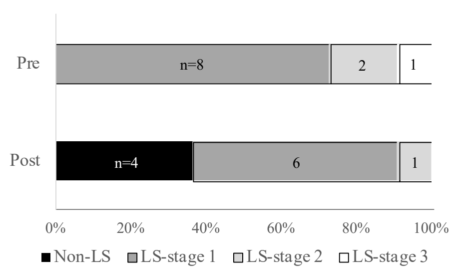

Figure 1. The number of subjects diagnosed with Non-LS and LS-stage 1, 2, or 3 in pre- and post-intervention.

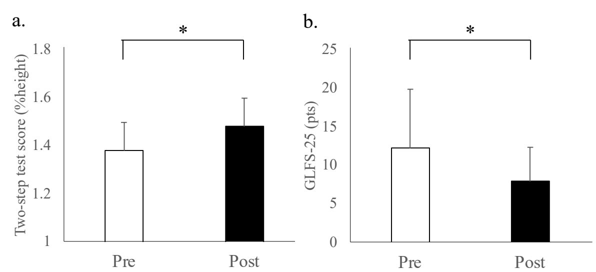

Figure 2. The score of two-step test and GLF-25 in pre- and post-intervention. *$p<0.05$

Table 1. Physical function pre- and post-intervention

	Pre	Post
Knee extension strength (kgf/kg)	20.7±9.2	23.3±11.1
Hip extension strength (kgf/kg)	11.1±2.3	11.3±3.2
Grip Strength (kg)	24.5±5.3	20.6±8.6
10-m walking tine (s)	4.5±0.5	4.4±0.8
TUG (s)	5.8±1.1	5.4±0.6
6MWT (m)	563±50	593±44*

Mean+/-SD, *$p<0.05$