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## Efficacy of anti-gravity treadmill after a hip fracture in patients with sarcopenia

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Abstract

**Objective**
To compare the effects of antigravity treadmill (AGT) with conventional rehabilitation and conventional rehabilitation among patients who had surgery for the elderly hip fracture with sarcopenia.

**Design**
A prospective double-blind randomized controlled trial.

Setting and participants
Acute hip fracture patients with sarcopenia, aged 65 or older, after hip fracture surgery, admitted to rehabilitation center.

**Methods**
Participants were randomly assigned to experimental group (n=19) or control group (n=19). All patients received 50 minutes of individualized therapy time on each of 10 consecutive working days. Patients in the experimental group received AGT for 20 minutes and other individualized physical therapy for 30 minutes. Patients in the control group received 50 minutes of individualized physical therapy every day.

**Main Outcome Measures**
Participants were evaluated prior to the treatment, 3 weeks, 3 months, and 6 months after treatment. As the primary outcome measure, Koval walking ability scores (KOVAL) and functional ambulatory category (FAC) were used. Secondary outcome measures included Berg Balance Scale (BBS), Korean version of the Mini-Mental Status Examination (K-MMSE), Euro Quality of Life Questionnaire Five-Dimensional Classification (EQ-5D), Korean version of the modified Barthel index (K-MBI), and hand grip strength.

**Results**

There were no significant differences between the two groups for any demographic or baseline measures except for hip operation type. There were significant differences between the two groups for primary and secondary outcomes except for grip strength (right and left) and K-MMSE at the all follow-ups (Table 1). In both groups, obvious changes were noted for the KOVAL, FAC, BBS, EQ-5D, and K-MBI scores at 3 weeks, 3 months. The degree of improvement was higher in the experimental group and the therapeutic effect also lasted longer in that group. However, in both groups, from 3 months to 6 months, the KOVAL, FAC, BBS, EQ-5D, and K-MBI scores were slightly improved or showed plateau (Table 2). We also examined the changes of primary and secondary outcomes over time between the groups. During the study, KOVAL scores were lower in the experimental group compared to the control group ($\beta$=0.368). FAC and BBS scores were higher in the experimental group compared to the control group ($\beta$=0.242 and $\beta$=3.053 respectively) (Table 3).

**Conclusions**

Our results suggest that conventional rehabilitation with antigravity treadmill was more effective for long-term functional recovery in elderly hip fracture with sarcopenia. Future studies with larger number of subjects are necessary.

Acknowledgment :Abstract Objective To compare the effects of antigravity treadmill (AGT) with conventional rehabilitation and conventional rehabilitation among patients who had surgery for the elderly hip fracture with sarcopenia. Design A prospective double-blind randomized controlled trial. Setting and participants Acute hip fracture patients with sarcopenia, aged 65 or older, after hip fracture surgery, admitted to rehabilitation center. Methods Participants were randomly assigned to experimental group (n=19) or control group (n=19). All patients received 50 minutes of individualized therapy time on each of 10 consecutive working days. Patients in the experimental group received AGT for 20 minutes and other individualized physical therapy for 30 minutes. Patients in the control group received 50 minutes of individualized physical therapy every day. Main Outcome Measures Participants were evaluated prior to the treatment, 3 weeks, 3 months, and 6 months after treatment. As the primary outcome measure, Koval walking ability scores (KOVAL) and functional ambulatory category (FAC) were used. Secondary outcome measures included Berg Balance Scale (BBS), Korean version of the Mini-Mental Status Examination (K-MMSE), Euro Quality of Life Questionnaire Five-Dimensional Classification (EQ-5D), Korean version of the modified Barthel index (K-MBI), and hand grip strength. Results There were no significant differences between the two groups for any demographic or baseline measures except for hip operation type. There were significant differences between the two groups for primary and secondary outcomes except for grip strength (right and left) and K-MMSE at the all follow-ups (Table 1). In both groups, obvious changes were noted for the KOVAL, FAC, BBS, EQ-5D, and K-MBI scores at 3 weeks, 3 months. The degree of improvement was higher in the experimental group and the therapeutic effect also lasted longer in that group. However, in both groups, from 3 months to 6 months, the KOVAL, FAC, BBS, EQ-5D, and K-MBI scores were slightly improved or showed plateau (Table 2). We also examined the changes of primary and secondary outcomes over time between the groups. During the study, KOVAL scores were lower in the experimental group compared to the control

group (β=0.368). FAC and BBS scores were higher in the experimental group compared to the control group (β=0.242 and β=3.053 respectively) (Table 3). Conclusions Our results suggest that conventional rehabilitation with antigravity treadmill was more effective for long-term functional recovery in elderly hip fracture with sarcopenia. Future studies with larger number of subjects are necessary.

Table 1. The outcome measures for the experimental and control groups at 4 evaluation times

| Measures | Evaluation time | | | | Between-group difference | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 3-wk | | 3-mon | | 6-mon | |
| | Baseline | 3-wk | 3-mon | 6-mon | Difference* | P† | Difference* | P† | Difference* | P† |
| **KOVAL** | | | | | | | | | | |
| Experimental | 6.58±0.51 | 4.78±0.78 | 2.47±1.12 | 2.36±0.89 | | | | | | |
| Control | 6.89±0.31 | 5.94±0.40 | 4.00±1.49 | 3.79±1.54 | -1.15 (-1.56, -0.74) | < .001 | -1.52 (-2.39, -0.65) | .002 | -1.42(-2.25, -0.58) | .003 |
| **FAC** | | | | | | | | | | |
| Experimental | 0.68±0.82 | 2.26±0.87 | 3.42±1.01 | 3.58±1.07 | | | | | | |
| Control | 0.63±0.59 | 1.47±0.77 | 2.57±1.07 | 2.73±0.99 | 0.78 (0.24, 1.33) | .009 | 0.84 (0.15, 1.52) | .016 | 0.84 (0.16, 1.52) | .009 |
| **BBS** | | | | | | | | | | |
| Experimental | 9.26±5.11 | 30.47±14.63 | 37.89±10.58 | 38.62±10.00 | | | | | | |
| Control | 8.90±5.12 | 18.47±7.54 | 28.52±11.18 | 27.10±12.54 | 12.00 (4.33, 19.66) | .006 | 9.36 (2.20, 16.53) | .017 | 11.42 (3.95, 18.88) | .007 |
| **EQ-5D** | | | | | | | | | | |
| Experimental | 0.18±0.26 | 0.67±0.09 | 0.76±0.08 | 0.77±0.83 | | | | | | |
| Control | 0.15±0.22 | 0.38±0.22 | 0.54±0.24 | 0.57±0.20 | 0.28 (0.16, 0.39) | < .001 | 0.21 (0.09, 0.33) | .001 | 0.19 (0.08, 0.29) | .008 |
| **K-MBI** | | | | | | | | | | |
| Experimental | 32.00±23.22 | 64.63±14.34 | 76.15±14.33 | 75.73±14.22 | | | | | | |
| Control | 29.37±12.84 | 45.36±14.23 | 60.94±15.31 | 62.57±15.34 | 19.26 (9.85, 28.67) | .001 | 15.21 (5.45, 24.96) | .006 | 13.15 (3.42, 22.89) | .014 |

NOTE. Values are mean ± SD or as otherwise indicated.
*Values are mean difference (95% confidence interval)
†Between-group comparisons were performed using the Mann-Whitney U test

Table 2. Changes of each outcome measures from baseline to the 3-week, the 3-month and 6-month follow-up evaluations

| Measures | Within-group change score from baseline | | Between-group difference in change score | |
|---|---|---|---|---|
| | Experimental | Control | Difference | *P** |
| **KOVAL** | | | | |
| 3-wk follow-up | -1.78 (-2.09, -1.48) † | -0.94 (-1.14, -0.75) † | -0.84 (-1.19, -0.49) | < .001 |
| 3-mon follow-up | -4.10 (-4.61, -3.59) † | -2.89 (-3.61, -2.17) † | -1.21 (-2.05, -0.36) | .006 |
| 6-mon follow-up | -4.21 (-4.62, -3.79)† | -3.10 (-3.85, -2.35) † | -1.11 (-1.93, -0.27) | .020 |
| **FAC** | | | | |
| 3-wk follow-up | 1.57 (1.24, 1.91) † | 0.84 (0.51, 1.17) † | 0.73 (0.28, 1.19) | .003 |
| 3-mon follow-up | 2.73 (2.28, 3.18) † | 1.94 (1.42, 2.46) † | 0.79 (0.12, 1.45) | .032 |
| 6-mon follow-up | 2.89 (2.36, 3.42) † | 2.10 (1.52, 2.68) † | 0.79 (0.03, 1.54) | .030 |
| **BBS** | | | | |
| 3-wk follow-up | 21.21 (15.71, 26.70) † | 9.57 (7.22, 11.93) † | 11.63 (5.85, 17.40) | .001 |
| 3-mon follow-up | 28.63 (23.88, 33.38)† | 19.63 (14.55, 24.71) † | 9.00 (2.28, 15.71) | .006 |
| 6-mon follow-up | 29.26 (24.78, 33.74)† | 18.21 (11.95, 24.46) † | 11.05 (3.62, 18.48) | .006 |
| **EQ-5D** | | | | |
| 3-wk follow-up | 0.49 (0.37, 0.62)† | 0.23 (0.14, 0.33) † | 0.25 (0.10, 0.41) | .005 |
| 3-mon follow-up | 0.58 (0.46, 0.71)† | 0.39 (0.24, 0.54) † | 0.19 (0.00, 0.37) | .056 |
| 6-mon follow-up | 0.59 (0.47, 0.71)† | 0.42 (0.28, 0.56) † | 0.17 (-0.01, 0.34) | .085 |
| **K-MBI** | | | | |
| 3-wk follow-up | 32.63 (22.38, 42.88)† | 16.00 (9.30, 22.69) † | 16.63 (4.80, 28.45) | .009 |
| 3-mon follow-up | 44.15 (32.43, 55.88)† | 31.57 (24.36, 38.79) † | 12.57 (-0.71, 25.86) | .136 |
| 6-mon follow-up | 43.73 (32.33, 55.13)† | 33.21 (24.87, 41.54) † | 10.52 (-3.10, 24.16) | .165 |

NOTE. Values are mean difference (95% confidence interval) or as otherwise indicated.
*Between-group comparisons were performed using the Mann-Whitney U test
† *P*<.05 compared with baseline using the Wilcoxon signed-rank test.

Table 3. Changes of primary and secondary outcomes over time between the groups

| Measures | β coefficient | 95% CI | *P* |
|---|---|---|---|
| KOVAL | | | |
| Experimental | -0.368 | -0.608 to -0.129 | .003 |
| Control | | | |
| FAC | | | |
| Experimental | 0.242 | 0.021 to 0.463 | .032 |
| Control | | | |
| BBS | | | |
| Experimental | 3.053 | 0.730 to 5.375 | .010 |
| Control | | | |
| K-MMSE | | | |
| Experimental | -0.195 | -1.118 to 0.729 | .679 |
| Control | | | |
| EQ 5D | | | |
| Experimental | 0.044 | -0.011 to 0.098 | .118 |
| Control | | | |
| K-MBI | | | |
| Experimental | 2.753 | -1.439 to 6.944 | .198 |
| Control | | | |
| Grip strength (Rt) | | | |
| Experimental | 0.524 | -0.263 to 1.310 | .192 |
| Control | | | |
| Grip strength (Lt) | | | |
| Experimental | 0.253 | -0.518 to 1.024 | .521 |
| Control | | | |

GEE analysis with adjustment for age, sex, BMI, ASM, total admission period, day to surgery, days to rehabilitation, type of hip fracture, hip operation type, and cognitive dysfunction at baseline.

CI confidence interval GEE generalized estimation equations