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ORIGINAL ARTICLE

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# The effect of an arm sling used for shoulder support on gait efficiency in hemiplegic patients with stroke using walking aids

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## ABSTRACT

**BACKGROUND:** The effects of an arm sling on the physiological costs of walking are not known. Even though a previous study reported that an arm sling can improve gait efficiency, its entrance criteria was only hemiparetic patients able to walk without walking aids independently.

**AIM:** The aim of this study was to investigate the effect of shoulder support by an arm sling on gait efficiency in hemiplegic stroke patients using walking aids.

**DESIGN:** Randomized crossover design.

**SETTING:** Rehabilitation department of a university hospital.

**POPULATION:** A total of 57 hemiplegic patients with shoulder subluxation dependent on canes were grouped into single cane (N.=30) and quad cane groups (N.=27) as walking aids.

**METHODS:** All patients performed a walk with their own walking aid with and without an arm sling in randomized order, on the same day. We measured the energy cost and energy expenditure using a portable gas analyzer and heart rate during a 6-minutes Walk Test and a 10-m Walk Test. We analyzed all outcomes measures with and without an arm sling between the patients who were grouped according to their walking aids using 2-way repeated ANOVA.

**RESULTS:** The energy cost ( $0.068 \pm 0.023$  mL/kg/m) and oxygen expenditure ( $8.609 \pm 2.155$  mL/kg/minutes) were lower with the arm sling ( $P < 0.05$ ) than without the arm sling ( $0.074 \pm 0.029$  mL/kg/m, and  $9.109 \pm 2.406$  mL/kg/minutes, respectively), and the walking endurance ( $138.942 \pm 47.043$  m) were longer ( $P < 0.05$ ) with the arm sling among the hemiplegic patients with single cane.

**CONCLUSIONS:** Among the hemiplegic patients with a single cane, the walking endurance achieved with an arm sling significantly improved than those achieved without an arm sling, and the energy expenditure and energy cost was significantly lower.

**CLINICAL REHABILITATION IMPACT:** The hemiplegic arm support with an arm sling may be beneficial for gait efficiency in hemiplegic patients using a single cane, which lead to decreased oxygen use at a given speed.

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**Key words:** Stroke - Gait - Hemiplegia.

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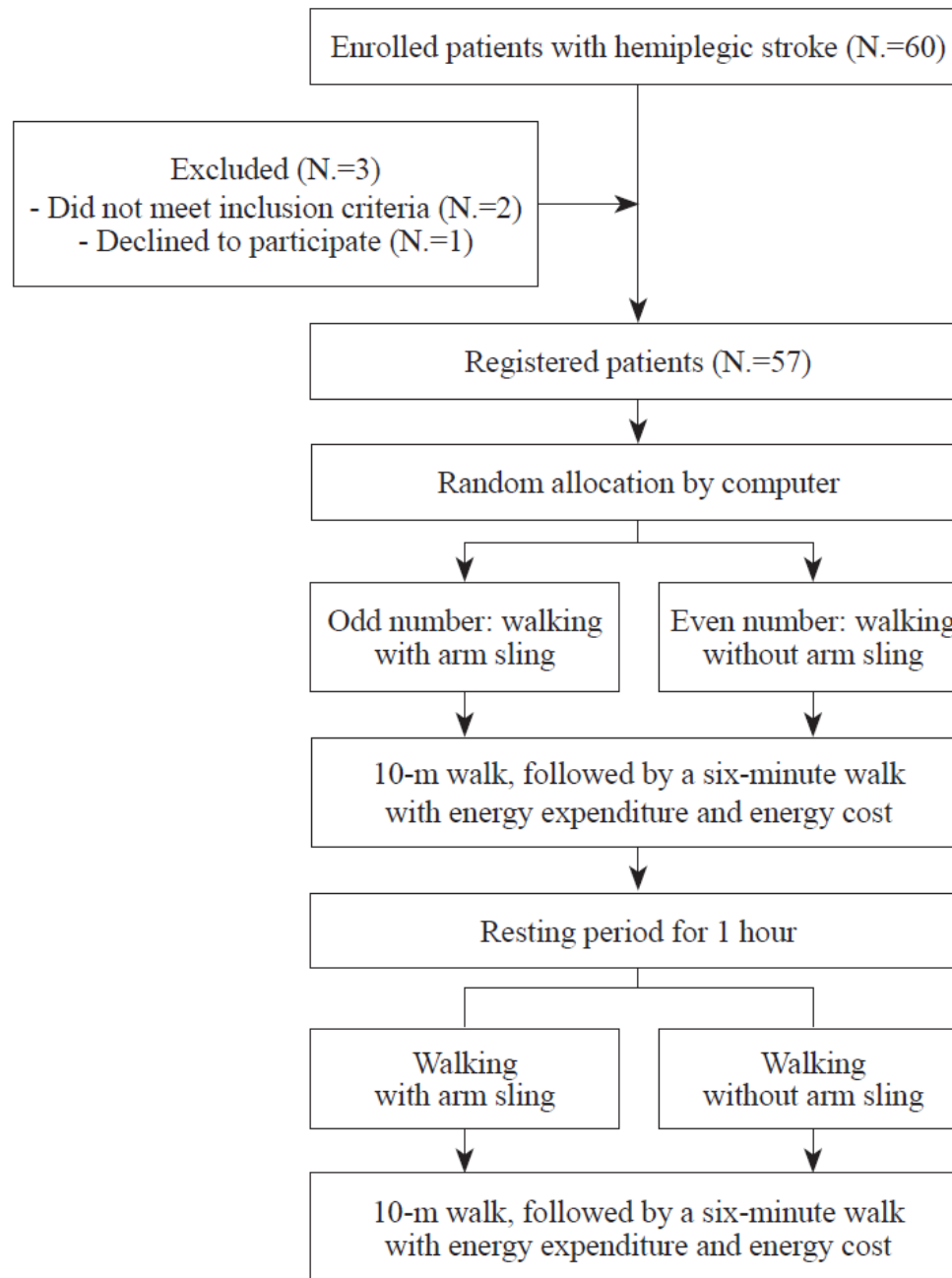


Figure 1.—The study flowchart.

TABLE I.—Patients' demographic and clinical characteristics according to the walking aids at baselines.

	Single cane (N.=30)	Quad cane (N.=27)	P
Age (years)	59.57±8.57	56.85±11.73	0.32
Sex (male/female, N.)	16/14	16/11	0.79
Height (cm)	163.63±9.41	164.93±7.51	0.32
Weight (kg)	63.65±13.61	68.96±9.37	0.10
Post-stroke duration (month)	15.50±11.52	15.74±11.05	0.94
Type of stroke (ischemic/ hemorrhage, N.)	20/10	19/8	0.78
Side of lesion (right/left, N.)	14/16	9/18	0.42
MMSE (score)	27.20±1.69	26.50±1.47	0.28
FAC (4/5 score, N.)	11/19	16/11	0.11
Shoulder pain (yes/no, N.)	12/8	9/18	0.78
Spasticity (mild (G0~G1) / severe (G2~G3), N.)	16/14	13/14	0.79
Manual Function Test (8~16/17~32 score, N.)	17/13	20/7	0.14
Breath of subluxation (1/2 finger, N.)	18/12	16/11	1.00

Values are presented as mean±SD or number (N.) of patients (%). The P values within the table refer to differences in group means or proportion of patients. MMSE: mini-mental state examination; FAC: functional ambulation classification.

TABLE II.—Metabolic demand and gait parameters without and with an arm sling, according to walking aid.

	Group	Without arm sling	With arm sling	P value
Energy cost (mL/kg/m)	Single cane	0.074±0.029	0.068±0.023	0.008
	Quad-cane	0.167±0.138	0.161±0.119	0.633
Energy expenditure (mL/kg/min)	Single cane	9.109±2.406	8.609±2.155	0.030
	Quad-cane	8.364±2.580	8.182±2.639	0.617
6MWT (m)	Single cane	135.103±45.990	138.942±47.043	0.020
	Quad-cane	65.442±26.157	68.112±26.339	0.366
10MWT (m/sec)	Single cane	0.420±0.151	0.430±0.161	0.284
	Quad-cane	0.189±0.069	0.251±0.194	0.306
HR (beats/min)	Single cane	95.326±13.456	95.043±13.550	0.339
	Quad-cane	103.273±33.693	105.910±31.294	0.346

Values are presented as mean±SD for each type of cane. P values within the table refer to differences between each of outcome measures without and with an arm sling.

6MWT: 6-Minute Walk Test is a test of walking endurance; 10MWT: 10-Meter Walk Test assesses walking speed; HR: heart rate.

- ◆ **T-caneのように、上肢の動きを伴いやすい状況で上肢スリングを用いると歩行のエネルギー効率を改善することができる。**
- ◆ **一方、四点杖を使用するような、バランスを保つような戦略を用いている場合は、歩行のエネルギー効率という観点からは、上肢装具の使用効果は乏しい。**