

Difference between immediate effects of active exercise with compression therapy on lower-limb lymphedema while seated and supine

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Introduction

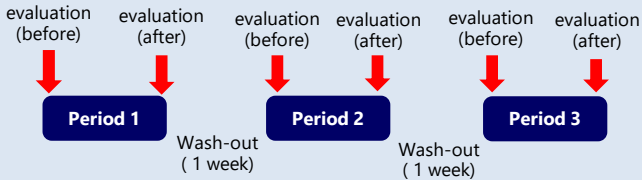
Lymphedema is a chronic, progressive condition characterized by accumulation of fluid in the tissue spaces due to lymphatic system insufficiency and damaged lymph transport¹⁾. The treatment for lymphedema - complete decongestive physical therapy (CDP) - consists of four main components: skin care, manual lymph drainage (MLD), multi-layered compression bandaging therapy (CT), and active exercise with compression therapy (AECT)²⁾. There is little evidence to indicate which types, intensities, and frequencies of exercise may be safely used in the management of lymphedema.

Aim:
We focused on the immediate effects of AECT on lower limb lymphedema (LLL) and tried to determine whether the outcomes of seated or supine AECT using a bicycle ergometer differed in patients with LLL associated with gynecological cancers.

Objectives and Methods

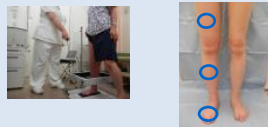
PARTICIPANTS:
Cancer survivors with a known diagnosis of lower limb lymphedema (N=18) were directly referred to our study by clinicians at Keio University Hospital.

DESIGN:
This was a randomized cross-over trial (3 periods, 3 interventions, 6 groups).



Evaluation Lower limb volume:
• assessed using a Perometer (Pero-system, Germany)
• measured before and after each intervention

Skin symptoms Pitting sign: palpation
• evaluated from 0 to 2 in severity.



Stiffness: pinching
• evaluated from 0 to 3 in severity.
*The total score for the three measurement sites was used for the analysis.

INTERVENTIONS
Compression therapy: multilayer bandaging
Exercise: lower limb ergometer
Exercise device: Terasu-ergo II (Syowa, Japan)
Exercise intensity: low load (Karvonen k=0.3)
Duration: 15 min



AECT (seated position)



AECT (supine position)



CT (both legs elevated)

Analysis
Analysis of variance using linear mixed-effects modeling was used to compare the effects of the three interventions (seated position, supine position, and CT). Least square means (LSM) were used to determine the percentage changes in lower limb volume. Spearman's rank correlation was used to compare the severity of pre-intervention skin symptoms (skin stiffness and pitting edema) with decrements in lower limb volume.

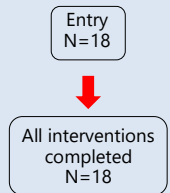
Results

Table 1. Baseline Characteristics of the 18 Study Participants with LLL

Age - yrs	64.1±10.8
BMI - kg/m ²	23.2±4.0
Cervical cancer	4 (22.2%)
Endometrial cancer	5 (27.8%)
Ovarian cancer	9 (50.0%)
Cancer stage I	8 (44.4%)
II	2 (11.1%)
III	1 (5.6%)
IV	1 (5.6%)
Date not available	6 (33.3%)
Lymphedema severity	
ISL II	9 (50%)
ISL late II	9 (50%)
Time since onset of LLL (months)	90.8±81.5

* Values are expressed as means ±SD or no. (%)

Fig 1. Enrolment/ follow-up of the study participants



Lower limb volume

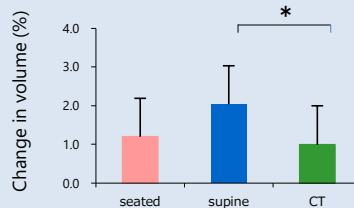


Fig 2. LSM %changes in lower limb volume were significantly greater after supine AECT than CT (p=0.014)
* : p <0.05

* : %change = (pre-volume - post-volume) / pre-volume × 100

Correlations between severity of pre-intervention skin symptoms and changes in lower limb volume

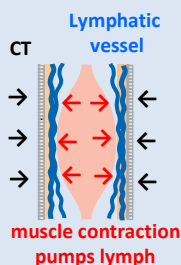
Pitting sign:
The severity of pre-intervention skin pitting was significantly correlated with the change in lower limb volume for seated AECT (r=0.616, p=0.006), supine AECT (r=0.549, p=0.018), and CT (r=0.490, p=0.039).

Stiffness:
The severity of pre-intervention skin stiffness was significantly correlated with the change in lower limb volume for supine AECT (r=0.520, p=0.027), but not for seated AECT or CT.

Conclusions

- 1) Our findings demonstrated that AECT using a bicycle ergometer decreased fluid volume in the lower extremities in patients with LLL associated with gynecological cancer.
- 2) Supine AECT resulted in more reduction in lower limb volume than seated AECT.
- 3) Supine AECT had marked effects on severe LLL.

AECT = CT + muscle pumping



- i) Restraint of excessive leakage out of blood vessels
- ii) Improvement of lymph propulsion and lymphatic vessel recruitment
- iii) Increase of lymphatic drainage

Supine AECT might avoid the negative effects of gravity on the lower limb and increases lymphatic drainage.

Severe LLL

- i) Narrowing of the lumen of lymphatic vessels
- ii) Decreased flexibility of lymphatic vessels
- iii) Impaired ability to transport lymph
- iv) Reduced effect of muscle pumping

Supine AECT for severe LLL might promote lymph flow while using gravity advantageously.

References

- 1) International Society of Lymphology "The diagnosis and treatment of peripheral lymphedema: 2013 Consensus Document of the International Society of Lymphology" *Lymphology* 46 (1) (2013) : 1-11
- 2) Lymphedema Framework "Best Practice for the Management of Lymphedema: International Consensus" London: MEP Ltd (2006)