Original article

# Evaluation of lymph drainage using bioelectrical impedance of the body

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## Abstract

***Aim*:** The aim of this study was to investigate the effects of manual and mechanical lymph drainage on the bioelectrical composition of body tissues of patients with lymphoedema of the lower limbs.

***Method*:** Twenty-one patients with lymphoedema of one leg were evaluated using single frequency bioelectrical impedance with four electrodes (SF-BIA4) immediately before and after a combination of manual and mechanical lymph drainage. Statistical analysis used the two-tailed paired *t*-test with an alpha error of 5% being considered acceptable.

***Results*:** On comparing the results before and after lymph drainage, statistically significant differences were identified for both lymphoedematous and apparently healthy legs, but there were no significant differences in the alterations caused by the treatment between the healthy and lymphoedematous limbs of the same patient.

***Conclusion*:** It was concluded that the association of manual and mechanical lymph drainage both modified the body composition as identified by bioelectrical impedance, and reduced the oedema.

**Keywords:** lymph drainage; lymphoedema; bioelectrical impedance

## Introduction

Lymphoedema is characterized by significant and cumulative oedema of the tissue, with functional, aesthetical and psychosocial repercussions.[1] A precise diagnosis is fundamental before deciding on treatment, which aims to re-establish the balance between the protein load and the transport capacity of the lymphatic system.[2,3]

Manual and mechanical (RAGodoy)[4] lymph drainage is part of a series of measures used in the conservative treatment of lymphoedema. The objective of these techniques is to produce pressure gradients in order to transfer the lymph and interstitial fluid back into the bloodstream.[5]

The use of flexible rods in manual lymph drainage has proven to be an easy method to employ, that is efficacious to reduce the size of lymphoedematous limbs.[5–7] The results of this therapy have been confirmed by lymphoscintigraphy.[6] Positive results were also confirmed by lymphoscintigraphy after mechanical lymph drainage, where plantar flexion and dorsiflexion movements are passively produced using a mechanical device.[8]

It is essential, however, to use techniques that objectively measure the size of the limb and its composition, both to assess the severity of the lymphoedema and its response to treatment.[9–15]

Bioelectrical impedance analysis, although not providing a quantitative volume measurement of lymphoedema, provides a measurement index that is highly correlated with quantitative measurements of the increase in limb volume seen in lymphoedema.

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The speed and ease of the impedance technique renders it a suitable alternative to perometry in the assessment of lymphoedema.[15–17]

The objective of this study was to investigate the effects of manual and mechanical lymph drainage on the body composition of patients with leg lymphoedema using bioelectrical impedance.

## Methods

Twenty-one volunteers with one lymphoedematous and one apparently healthy leg were included in this study. The study was carried out in the Godoy Clinic in São José do Rio Preto from 2006 to 2008. The project was approved by the Research Ethics Committee of the Medicine School in São José do Rio Preto (FAMERP – # 2829/2004). All patients with clinical and volumetric diagnoses of lower limb lymphoedema were invited to participate in this study. Enrolment was by order of arrival in the clinic when the objectives of the study were explained and patients who accepted to participate signed written consent forms. Both the lower extremities were evaluated as treatment involved both limbs and thus changes in the apparently healthy leg were possible.

The body composition, before and after treatment by lymph drainage, was measured by bioelectrical impedance. For this, a single frequency (50 kHz) device with four electrodes (Bodystat 1500) was employed. The lymph drainage sessions lasted one hour and involved simultaneous application of manual (Godoy and Godoy method)[5–7] and mechanical (RAGodoy)[4,8] lymph drainage.

The parameter measured was total body water (L).

The values obtained in the bioimpedance tests were analysed using the paired two-tailed Student's *t*-test with an alpha error of 5% ($P < 0.05$) considered acceptable. Measurements of both the lymphedoematous and apparently healthy limbs were compared as were the measurements before and after the treatment sessions.

## Results

Analyses of the results obtained before and after treatment are presented in relation to body fat (Table 1), lean mass (Table 2), total body water (Table 3) and impedance (Table 4).

**Table 1** Mean and *P* value of body fat before and after lymph drainage

| | Mean | | |
|---|---|---|---|
| Fat (kg) | Before | After | *P* value |
| Healthy limb | 23.23 (Std11.07) | 24.10 (Std 12.38) | <0.001 |
| Lymphoedematous limb | 20.79 (Std12.5) | 21.46 (Std 12.89) | <0.001 |

**Table 2** Mean and *P* value of lean mass before and after lymph drainage

| | Mean | | |
|---|---|---|---|
| Lean mass (kg) | Before | After | *P* value |
| Healthy limb | 52.00 (Std 12.46) | 51.13 (Std 12.21) | <0.001 |
| Lymphoedematous limbs | 54.44 (Std 13.04) | 53.77 (Std 12.46) | <0.001 |

**Table 3** Mean and *P* value of total body water before and after lymph drainage

| | Mean | | |
|---|---|---|---|
| Total water (L) | Before | After | *P* value |
| Healthy limb | 39.13 (Std 8.27) | 38.31 (Std 8.10) | <0.001 |
| Lymphoedematous limbs | 41.50 (Std 9.00) | 40.87 (Std 9.12) | <0.001 |

**Table 4** Mean and *P* value of impedance before and after lymph drainage

| | Mean | | |
|---|---|---|---|
| Impedance | Before | After | *P* value |
| Healthy limb | 484.57 (Std 86.41) | 502.90 (Std 87.15) | <0.001 |
| Lymphoedematous limbs | 441.76 (Std 87.28) | 453.52 (Std 90.03) | <0.001 |

## Discussion

The current study shows that the association of mechanical and manual lymph drainage modified the pattern of bioelectrical impedance identifying a reduction in the oedema.

The efficacy of bioelectrical impedance has been proven in the measurement and monitoring of lymphoedema[8,9] and as an early diagnostic method of both single or bilateral lymphoedema.[9,13] Among its advantages, compared with the traditional techniques of evaluation including perimetry and volumetry, is the capacity to distinguish if the changes in volume are due to muscle atrophy or to increases in lean body mass or body fat available to the fibrosclerotic tissue or to improvements due to lymph drainage. Thus, this is a more sensitive method to identify small changes in the interstitial fluid and lymph.[11]

The results of this study, as presented in Tables 1–4, highlight a statically significant difference in the body

composition after the use of manual and mechanical lymph drainage. This difference showed similar patterns for both lymphoedematous and apparently healthy limbs with an increase in the impedance and the amount of fat and a reduction in the lean mass and water content. This suggests that lymph drainage reduces the volume of protein-rich fluids of not only the affected limb, thereby improving the lymphoedema, but also of the healthy limb.

When assessing changes in affected limbs compared with apparently healthy limbs no statistically significant differences were observed. With this result we can affirm that drainage provides benefits in the treatment of lymphoedema and in respect to the re-absorption of interstitial fluids even in normal limbs.

## Conclusion

In conclusion, the association of mechanical and manual lymph drainage modified patterns as assessed by bioelectrical impedance and showed a reduction in the post-treatment oedema.

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