

# Experimental Investigations on the Effect of a Pressure Wave Massage Apparatus (Lympha-press) in Lymphedema\*

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The introduction of instruments for pressure wave massage of the limbs (5, 6) has brought considerable progress to the treatment of various forms of chronic peripheral edema generally and lymphedema in particular. This paper deals with preliminary quantitative results which shed light on the mechanism of the action of pressure wave therapy.

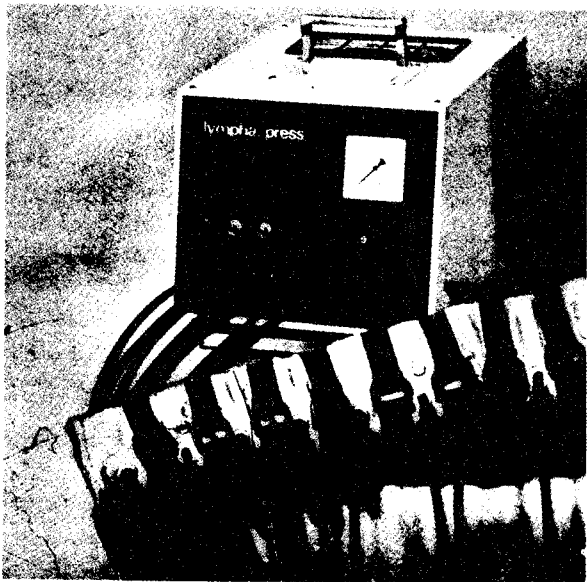


Figure 1. Lympha-press apparatus after Zelikovsky

## PATIENTS AND METHODS

The study was conducted on a number of patients treated with the Lympha-press apparatus (after Zelikovsky (6)) against lymphedema of the upper or lower limbs (Fig. 1). According to this method of pressure wave massage, overlapping sleeves are inflated in rhythmic cycles from the distal end proximally, causing an intermittent ascending compression of the limb under pressure waves of variable intensity (up to 200 mm Hg).

The following procedures were used :

### 1. VOLUME MEASUREMENT

The volume of the treated limb was measured according to the method described by Kuhnke (1) (disk model) by double measurements of the limb periphery at 4 cm intervals, with the assistance of a desk computer, before and after the massage.

\* Translation from an article in German, in "Phlebologie und Proktologie", 2/80, May 1980, pp. 124-128.

### 2. ISOTOPE LYMPHOGRAPHY

99 m of TC sulfur microcolloid (Lymphoscint<sup>(R)</sup>) was injected subcutaneously in three small depots of 0.1 ml each into the back of the foot or hand. In the case of digital measurement with collimated probes over the regional inguinal or axillar lymph nodes, the dose was about 100 mCi and with gamma camera readings 0.5-1.0 mCi ; a semiquantitative result in dose percentage terms was obtained by a preliminary measurement of injected activity and a decay correction (4).

### 3. MEASUREMENT OF ALBUMIN CONTENT

Three days after the intravenous injection of <sup>131</sup>I-albumin (100 mCi) and thyroid gland block by means of potassium iodide, the injected tracer is fairly homogeneously mixed in the distribution space. The albumin distribution space constitutes a parameter for the extracellular (volume vascular and interstitial). Treatment-induced changes of the externally measured radioactivity reflect at this stage changes of the albumin volume (3). Simultaneous volume measurements yield data on the concentration of albumin in the tissue ("specific activity").

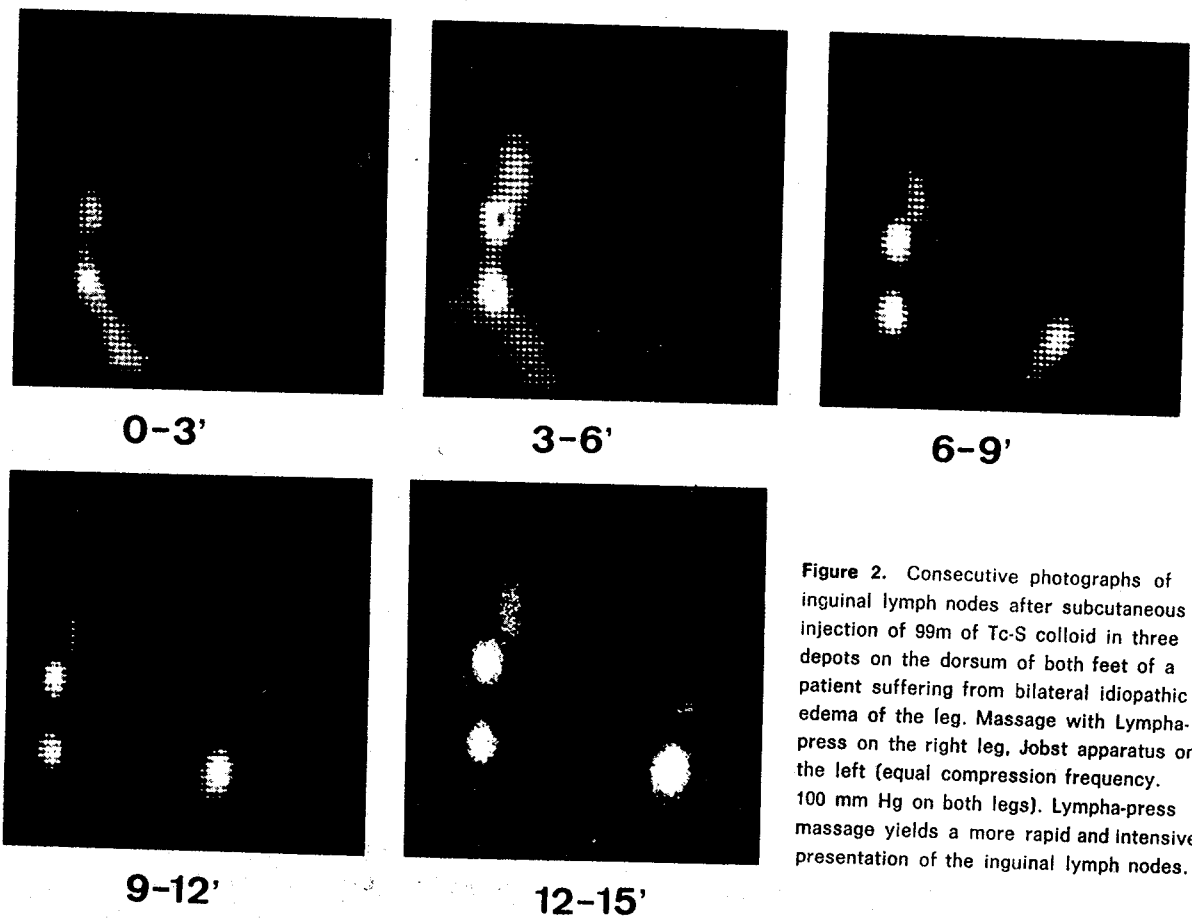
## RESULTS

### Limb Volume

After a three-hour Lympha-press massage the total blood volume of the extremity decreased significantly, in average terms, from  $7,890 \pm 383.2$  ml to  $7,526.8 \pm 367.7$  ml ( $n=63$  ;  $p < 0.001$ ).

The average volume decrease per session amounted to 4.6% of the initial volume. The volume-reducing effect of the pressure massage was usually more pronounced in the lower leg than the thigh. In some cases there was even an increase of the volume of the most proximal thigh areas, especially at the inguinal flexure, which was outside the compression range. The limb volume reduction is invariably associated with an increased urine excretion.

Compression bandages between sessions help maintain the achieved volume reduction in the majority of patients. This approach finally produces a highly satisfactory clinical condition (Fig. 6) which can be maintained by using medical compression stockings (compression class 2-3).

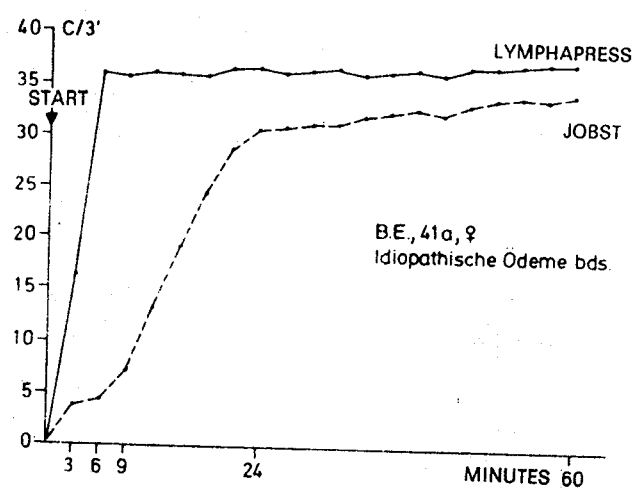


**Figure 2.** Consecutive photographs of inguinal lymph nodes after subcutaneous injection of 99m of Tc-S colloid in three depots on the dorsum of both feet of a patient suffering from bilateral idiopathic edema of the leg. Massage with Lympha-press on the right leg, Jobst apparatus on the left (equal compression frequency, 100 mm Hg on both legs). Lympha-press massage yields a more rapid and intensive presentation of the inguinal lymph nodes.

**LYMPH TRANSPORT**  
**In the idiopathic form**

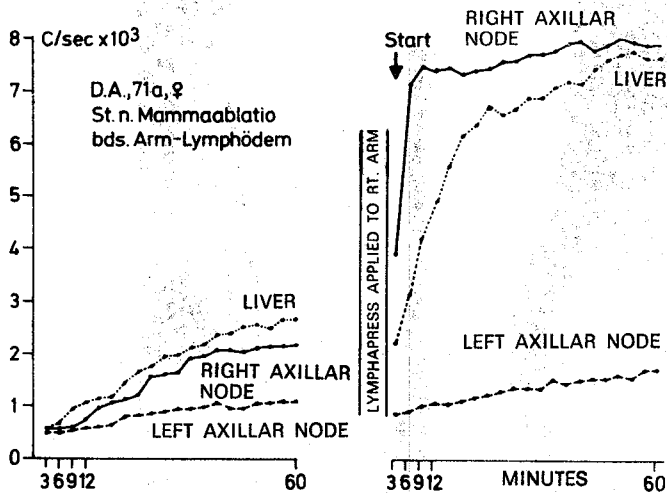
A study of lymph kinetics in the course of massage with Lympha-press on one leg and the Jobst apparatus on the other was carried out on a patient suffering from bilateral idiopathic peripheral edema with normal isotope lymphography data. (The Jobst apparatus causes an intermittent compression of the entire extremity without an ascending pressure wave). Consecutive pictures of the inguinal lymph nodes (Fig. 2) and time activity curves (Fig. 3) show that the pressure wave massage performed with the Lympha-press apparatus causes a much more rapid and intensive transport of the lymph-linked tracer than does the continuous-intermittent compression effect of the Jobst apparatus.

**In arm lymphedema following ablation mammae**  
Lymphedema following a resection of axillary lymph nodes with subsequent irradiation, results from a central block and cannot be regarded as the outcome of a disturbance of peripheral lymph transport. Isotope lymphography in the indurated forms and especially in those complicated by erysipelas does not reveal any lymph nodes. On the other hand, isolated axillary or clavicular lymph nodes are usually visible in arm lymphedemata that are still in the soft stage.



**Figure 3.** Time activity curves of lymph kinetics under Lympha-press and Jobst massage (Fig. 2).

As shown in Fig. 4, a Lympha-press treatment for one hour (righthand part of the graph) brought about a marked acceleration of the initially very sluggish lymph transport. The lymph-linked tracer passes along the thoracic duct into the blood stream and reaches the liver, as shown by the rise of hepatic activity following the accumulation of tracer in the axillar region.



**Figure 4.** Time activity curves over both axillar regions and liver after the injection of 99m Tc sulfur colloid into a number of subcutaneous depots on the dorsum of both hands. After one hour of rest (lefthand part) the Lympha-press sleeves were applied to the right arm. This manipulation alone increases the activity in the regional axillar lymph nodes. A subsequent Lympha-press massage causes an abrupt increase of activity in the axillar region followed shortly afterwards by a similar effect in the liver.

### In indurated lymphedemata

Neither an intensive single treatment nor a series of sessions brought about a clear-cut improvement of lymph transport in cases of indurated lymphedema of the legs, especially after recurring erysipelas, where isotope lymphography revealed no lymph nodes on the affected side.

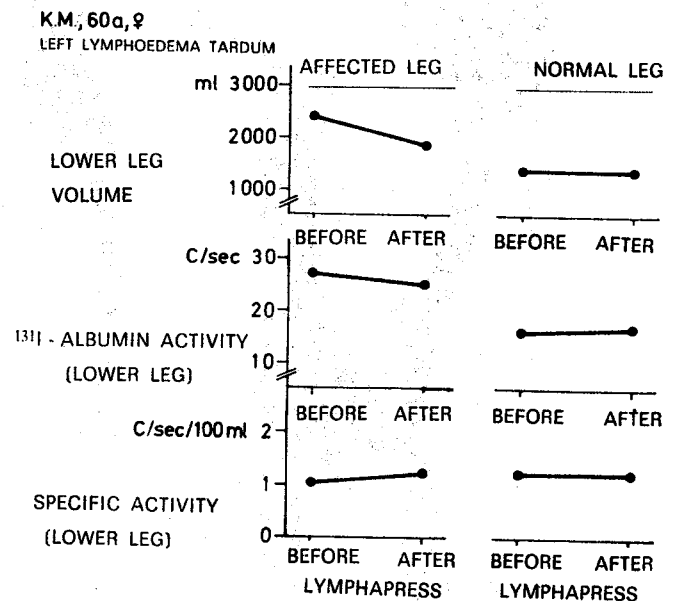
### TISSUE ALBUMIN CONTENT

In three patients with severe unilateral leg lymphedema in terms of both the isotope lymphography and the clinical picture, Lympha-press massage of **both** lower legs caused a volume reduction which was much more pronounced on the sick leg. Albumin activity in the affected leg invariably showed a greater decrease in comparison with the normal leg. However, this reduction was not as pronounced as that of the total extremity volume, so that all three patients showed an increase of the specific albumin content of the lymphedematous leg. Fig. 5 illustrates this condition in a female patient of this group.

### DISCUSSION

The impressive clinical results (Fig. 6) of Lympha-press treatment, as determined by accurate volume measurements, raise the question of the mode of action of this therapy.

The increased urine excretion suggests that the pressure wave massage causes mainly a mobilization



**Figure 5.** Lympha-press massage of both lower legs in unilateral lymphedema three days after intravenous injection of <sup>131</sup>I albumin. Reduction of the volume of the lower leg (above) and to a lesser extent, of albumin activity (middle) of the affected lower leg. As a result there is an increase of specific albumin activity following the Lympha-press massage (bottom). On the normal leg, Lympha-press treatment causes no significant changes of volume or activity.

of water. A limb volume reduction by an average of 364 ml within three hours can only be attributed to water loss. As shown in Fig. 5 there is a simultaneous increase of local albumin concentration in the tissue. Only an additional high pressure from outside in the form of a compression bandage can keep the leg volume constant despite the increased oncotic pressure exerted by the tissue.

As for the increase of tissue albumin content, it can be explained in terms of a greater elimination of water than of albumin by the Lympha-press massage. At any rate there is some lowering of albumin activity, which indicates that the massage reduces the lymph load. Our results with isotope lymphography indicate that the Lympha-press massage also improves the lymph transport. This applies in particular to the soft forms of lymphedema. For this reason the Lympha-press massage treatment should be started as soon as possible after the occurrence of lymphedema in order to prevent the disease from reaching the indurated stage, which is refractory to treatment.

A combination with a manual lymph drainage is especially indicated in such cases. Such treatment can also bring about a decongestion of the proximal parts of the extremity, where the Lympha-press treatment often causes a tissue congestion.



**Figure 6.** Female patient, 18 years old, with congenital lymphedema three months after the institution of Lympha-press treatment for three hours once a week with compression bandages between treatments. The young girl was able to wear readymade shoes for the first time in her life.

### SUMMARY

The following effects of a massage by the Lympha-press apparatus could be demonstrated by girth measurements and nuclearmedical investigations on the treated extremity :

1. Volume reduction (in lymphedema in average 4.6% of the basic extremity volume after 3 h).
2. Improvement of the lymph kinetics in cases with intact or decreased lymph transport. If isotopic lymphography failed to show any lymphatic transport as in cases with severe, indurated lymphedemas no effect on the lymph kinetics could be demonstrated.
3. Decrease of albumin content in the tissues.

However there is an increase of local albumin concentration in lymphedema by overproportional water reduction.. Therefore compression bandages should be applied between the Lympha-press massages for maintenance of the effect.

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